ÄKTA go™

User Manual

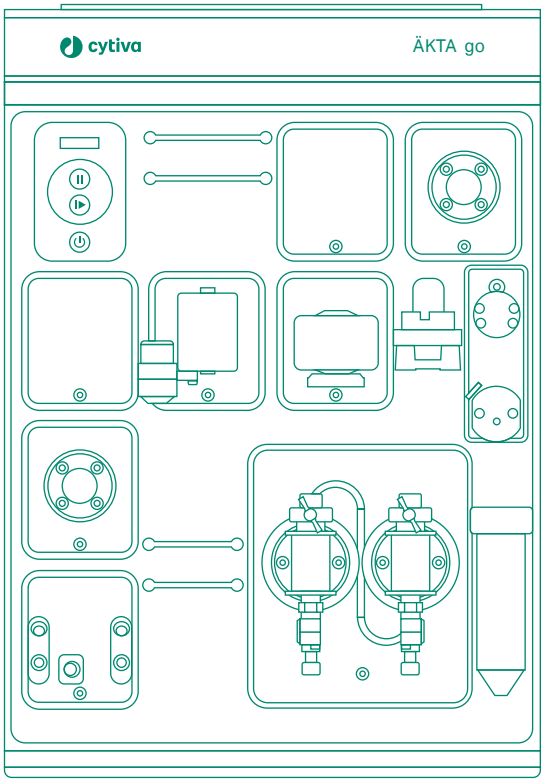

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Table of Contents

1 Introduction

About this chapter

This chapter contains important user information, the intended use of the ÄKTA go™ instrument, and lists the available user documentation.

In this chapter

1.1 Important user information

Read the *Operating Instructions* before operating the product

All users must read the entire *ÄKTA go Operating Instructions* before installing, operating, or maintaining the product.

Always keep the *Operating Instructions* at hand when operating the product.

Do not operate the product in any other way than described in the user documentation. If you do, you may be exposed to hazards that can lead to personal injury and you may cause damage to the equipment.

Intended use of the product

The ÄKTA go system is intended for the purification of bio-molecules, in particular proteins, for research purposes. It is intended to be used by trained laboratory staff members in research laboratories within academia and industry.

The ÄKTA go system must not be used in any clinical procedures, or for diagnostic purposes.

System definition

In this manual, the combination of the ÄKTA go instrument and the UNICORN™ software is referred to as the system.

The ÄKTA go instrument without the software is referred to as the instrument.

Prerequisites

In order to operate the system according to the intended purpose, it is important that the following prerequisites are followed:

- you have a general understanding of how the computer and the Windows operating system work.
- you understand the concepts of liquid chromatography.
- you have read and understood the Safety instructions chapter in *ÄKTA go Operating Instructions*.
- a user account has been created according to *UNICORN Administration and Technical Manual*.

1.2 About this manual

Introduction

This section contains information about the purpose and scope of this manual, safety definitions, notes and tips, and typographical conventions.

Purpose of this manual

The *User Manual* provides you with a detailed description of the ÄKTA go system, the function of the different parts, and how to maintain and replace them. The *User Manual* also provides tips on how to get the most out of your system when running it. Basic instructions, including important safety information, are given in *ÄKTA go Operating Instructions (29360951)*. For information about chromatography techniques and columns, refer to the respective handbook or instruction.

The instrument is controlled by a PC running UNICORN system control software.

Definitions

This user documentation contains safety notices (WARNING, CAUTION, and NOTICE) concerning the safe use of the product. See definitions below.

WARNING

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury. It is important not to proceed until all stated conditions are met and clearly understood.

CAUTION

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. It is important not to proceed until all stated conditions are met and clearly understood.

NOTICE

NOTICE indicates instructions that must be followed to avoid damage to the product or other equipment.

Notes and tips

Note: *A note is used to indicate information that is important for trouble-free and optimal use of the product.*

Tip: *A tip contains useful information that can improve or optimize your procedures.*

Typographical conventions

Software items are identified in the text by ***bold italic*** text.

Hardware items are identified in the text by **bold** text.

Tip: *The text can include clickable hyperlinks to reference information.*

1.3 Associated documentation

Introduction

This section describes the user documentation that is delivered with the product, and how to find related literature that can be downloaded or ordered from Cytiva.

ÄKTA go user documentation

The user documentation listed in the table below is available in printed format or as PDF file at *cytiva.com/aktago* under ***Related Documents***.

Translations of the *Operating Instructions* are given in several languages and are contained in the CD, or can be found online at *cytiva.com/aktago*.

Documentation	Main contents
ÄKTA go Unpacking Instructions (29383543)	Information needed to handle the delivery package and unpack the ÄKTA go instrument.
ÄKTA go Operating Instructions (29360951)	Information needed to install, operate, and maintain the ÄKTA go system in a safe way. Translations of the original instructions are given in several languages.
ÄKTA go Cue Cards (29383545)	Essential information to be kept near the ÄKTA go system.
ÄKTA go User Manual (This document)	Additional detailed information on the system, component functions, and maintenance. Tips on how to get the most out of the system when running it.
ÄKTA go Product Documentation (29434983)	General specifications and list of materials in the flow path.
ÄKTA avant, ÄKTA pure ÄKTA go, and ÄKTA pcc Privacy and Security Manual (29488174)	Describes the privacy and security considerations of the use of the system. The manual describes the expected intended use of the system, the privacy and security capabilities included, and how these capabilities are configured.
ÄKTA avant, ÄKTA go, ÄKTA pcc, and ÄKTA pure Site Preparation Guide (29117084)	Instructions on how to prepare the installation site for the ÄKTA go system.
Install I/O-box E9 Installation Instructions (29021463)	Instructions needed to install and connect I/O-box on ÄKTA™ systems.

UNICORN user documentation

The user documentation listed in the following table is available from the ***Help*** menu in UNICORN or from the UNICORN ***Contextual Help*** software accessed by pressing the **F1** key in any UNICORN module. It also can be downloaded from *cytiva.com/UNICORN* under ***Related Documents***.

Documentation	Main contents
UNICORN Quick Installation Guide [1]	Detailed instructions on how to install UNICORN.
UNICORN Administration and Technical Manual[2]	• Overview and detailed description of network setup and complete software installation. • Administration of UNICORN and the UNICORN database.
UNICORN Method Manual[2]	• Overview and detailed descriptions of the method creation features in UNICORN. • Workflow descriptions for common operations.
UNICORN System Control Manual[2]	• Overview and detailed description of the system control features in UNICORN. • Includes general operation, system settings and instructions on how to perform a run.
UNICORN Evaluation Manual[2]	• Overview and detailed descriptions of the Evaluation Classic [3] module in UNICORN. • Description of the evaluation algorithms used in UNICORN.
Getting started with Evaluation (accessed through help in the UNICORN Evaluation module)	• Video clips showing common workflows in the Evaluation module. • Overview of features of the Evaluation module.
UNICORN Help	By pressing **F1**, descriptions are displayed for the currently active pane or dialog box.

[1] The UNICORN Quick Installation Guide can be downloaded from *cytiva.com/aktago*.
[2] The current UNICORN version is added to the title of the manual.
[3] Evaluation Classic is an advanced evaluation module that requires an extra license to run.

Online help

Online help in UNICORN software may be accessed in three ways:

- Use the ***Help*** menu to access help on the current module and contextual help (help on the current context).

- Press the ***F1*** key on the keyboard to open the contextual help for the current context.
- Click on the help symbol if one is displayed. In general, help symbols are shown in dialog boxes.

All of these approaches open the online help in a help browser that supports access to UNICORN documentation and navigation among help topics using browse, search and index functions.

Additional literature

For practical tips on chromatography, refer to the handbooks available at *cytiva.com/handbooks*.

Data files, application notes and user documentation on the web

To order or download data files, application notes or user documentation, see the instruction below.

Step	Action
1	Go to cytiva.com.
2	Search for ÄKTA go in the search bar.
3	In the search results, click on ***ÄKTA go*** to go to the product page.
4	Navigate to ***Related Documents***.
5	Select the type of document and download the chosen literature.
6	Alternatively, go to *cytiva.com/instructions*.
7	Enter the product code of the chosen literature, and click the search button. ***Tip:*** *For example, enter 29360951 to search for this Operating Instructions. See ÄKTA go user documentation, on page 10 for product codes of other relevant documentation.*
8	Select to download the chosen literature.

1.4 Abbreviations

Introduction

This section explains abbreviations that appear in the user documentation for the ÄKTA go instrument.

Abbreviations

Abbreviation	Definition
CIP	Cleaning In Place
I/O box	Input/Output box
RTU	Real-Time Unit
SEC	Size exclusion chromatography
UPS	Uninterruptible power supply

2 System description

About this chapter

This chapter provides an overview of the ÄKTA go system and describes the instrument modules and components.

In this chapter

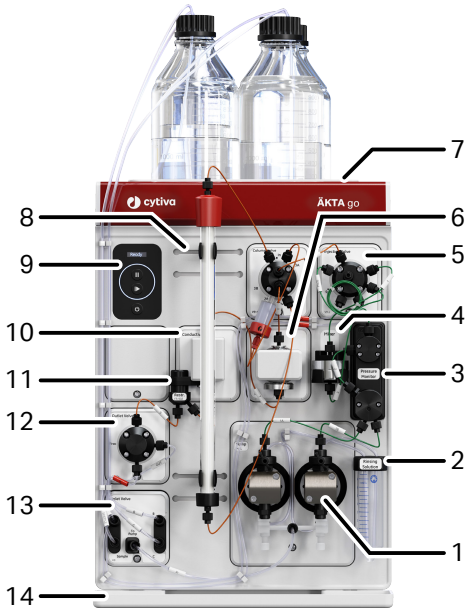
2.1 System overview

Introduction

This section provides an overview of the system and its available modules and components.

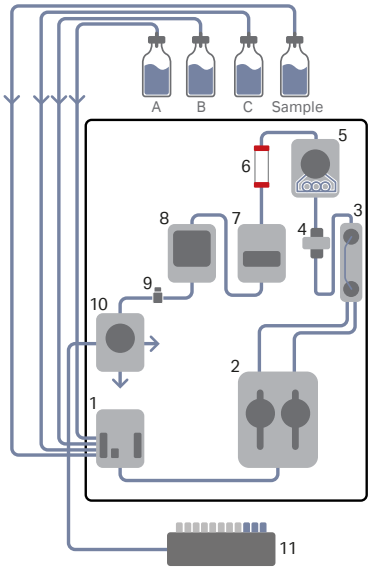
Illustration of the ÄKTA go instrument

The illustration below shows ÄKTA go with all standard components denoted. The instrument in the illustration also has an optional column valve and two columns connected.



Part	Function
1	Pump
2	Pump rinsing solution tube
3	Pressure monitor
4	Mixer
5	Injection valve
6	UV monitor
7	Top tray
8	Holder rails
9	Instrument control panel
10	Conductivity monitor
11	Flow restrictor
12	Outlet valve
13	Inlet valve
14	Bottom tray

Illustration of the flow path



Part	Description
1	Inlet valve
2	Pump
3	Pressure monitor
4	Mixer
5	Injection valve
6	Column
7	UV monitor
8	Conductivity monitor
9	Flow restrictor
10	Outlet valve
11	Fraction collector

2.2 Standard modules and components

In this section

2.2.1 Inlet valve

Introduction

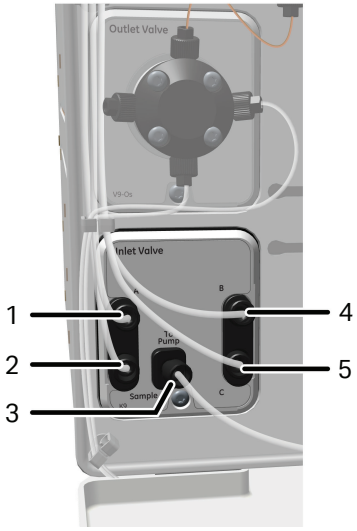
Inlet valves are used to select which buffers or samples to use in a run. The inlet valve **K9** is a membrane valve with four inlet ports: two buffer inlets, one sample inlet, and one inlet for cleaning solutions. By default, the inlet valve is closed. Once a flow is started, the software automatically opens the **A** inlet. Another inlet can be specified before the flow is started.

The inlet valve can be used to create step or linear gradients, by mixing the suitable proportions of buffers from the **A** and **B** inlets. When used for gradient formation the valve opens one inlet at a time, and the buffers are mixed in the inlet, pump, and mixer.

The number of inlets to the system can be increased by installing extra optional inlet valves. For information on optional inlet valves, refer to *Section 2.3.3 Optional inlet valves, on page 38*.

Location and illustration

The inlet valve **K9** is the first module in the flow path of the instrument. The following illustration shows the location and parts of inlet valve **K9**.



Part	Description
1	Inlet port **A**, with tubing to buffer A
2	Inlet port **Sample**, with tubing to sample
3	Outlet port **To Pump**, with tubing to the pump
4	Inlet port **B**, with tubing to buffer B
5	Inlet port **C**, with tubing to cleaning solution

2.2.2 Pump and pump rinsing system

Introduction

This section describes the design and main functions of the pump and the pump rinsing system.

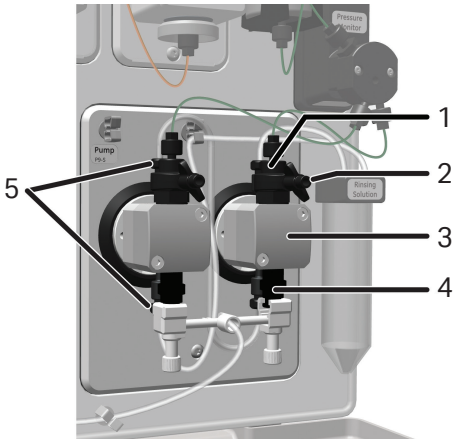
Function of the pump

The ÄKTA go system is fitted with one high precision pump. The pump consists of two pump heads that work alternately to give a continuous, low pulsation liquid delivery.

To make sure that the correct liquid volume is delivered, the pump must be free from air. Each pump head is equipped with a purge valve that is used for this purpose. For instructions on how to purge the pump heads, refer to *ÄKTA go Operating Instructions (29360951)*.

Location and illustration of the pump

The pump is installed after the inlet valve and before the pressure monitor in the flow path. The illustration below shows the location and parts of the pump.



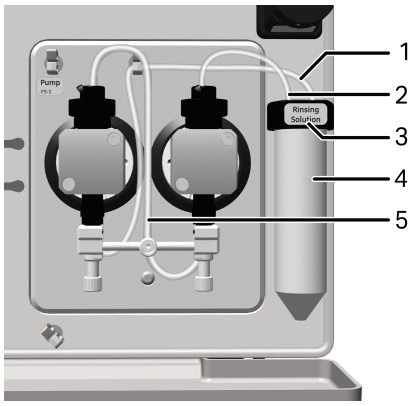
Part	Description
1	Outlet port with check valve
2	Purge valve
3	Pump head
4	Inlet port with check valve
5	Connections to pump rinsing system

Function of the pump rinsing system

The pump rinsing system flushes the low pressure chambers behind the pistons with a low flow of 20% ethanol or aqueous buffer to rinse the pistons and lubricate the piston seals. This prolongs the lifetime of the pump by preventing the deposition of salts from buffers on the pistons and leakage at the seals between the pump chamber and the drive mechanism.

For instructions on how to fill the pump rinsing system, refer to *ÄKTA go Operating Instructions (29360951)*.

Illustration of the pump rinsing system



Part	Description
1	Inlet tubing
2	Outlet tubing
3	Rinsing solution tube holder
4	Rinsing solution tube
5	Tubing connecting pump heads

2.2.3 Pressure monitor

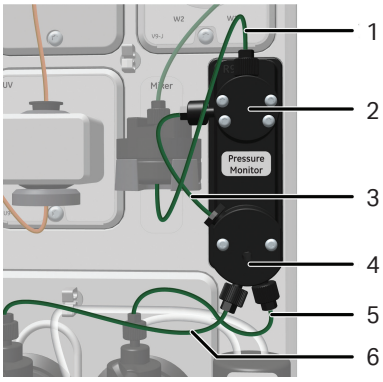
Introduction

The pressure monitor measures the pressure in the system. To measure the highest pressure in the system, the pressure monitor is placed after the pump. A pump flow restrictor is incorporated in the pressure monitor module, to make sure that the liquid delivery is accurate at low flow rates.

Additional pressure sensors can be included in the system by installing the advanced column valve **V9-C**.

Location and illustration

The pressure monitor is installed after the pump and before the mixer in the flow path. The illustration shows the pressure monitor and the connected tubing in the ÄKTA go instrument.



Part	Description
1	Outlet tubing, to the mixer
2	Pressure monitor
3	Tubing connecting the pump flow restrictor to the pressure monitor
4	Pump flow restrictor
5	Inlet tubing, from right pump head
6	Inlet tubing, from left pump head

2.2.4 Mixer

Introduction

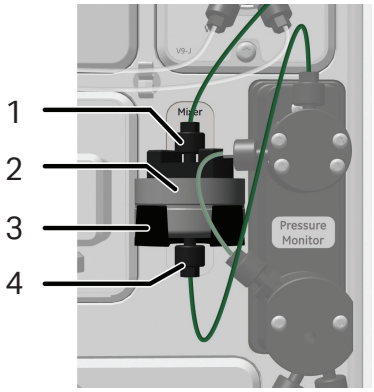
The ÄKTA go mixer is a static mixer with a volume of 1 mL. The mixer uses a titanium membrane to mix buffers and does not contain a filter inside.

Tip: *Add an online filter to prevent particles from entering the flow path and clogging the column.*

Depending on sample constituents, the membrane can become clogged. The membrane can be cleaned manually or using a system Cleaning-In-Place (CIP) method. See *Section 5.3.2 Maintenance of the mixer, on page 142* for instructions.

Location and illustration of the mixer

The mixer is installed after the pressure monitor and before the injection valve. The illustration shows the location and parts of the mixer.



Part	Description
1	Outlet, with tubing to the injection valve
2	Mixer
3	Mixer holder
4	Inlet, with tubing from the pressure monitor

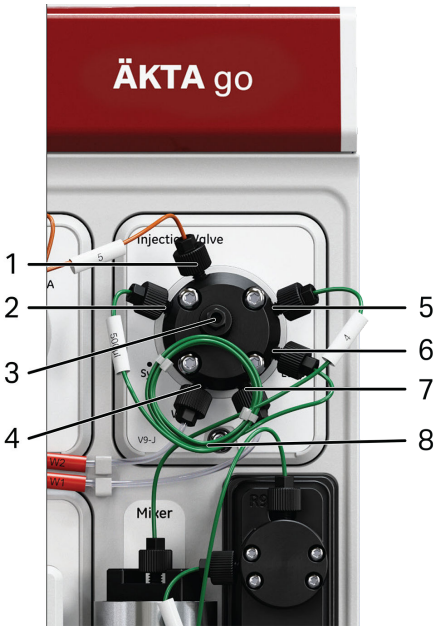
2.2.5 Injection valve

Introduction

The injection valve is used to direct sample onto the column and enables a number of different sample application techniques.

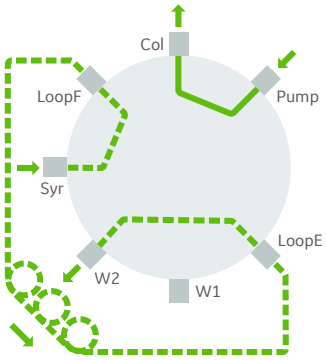
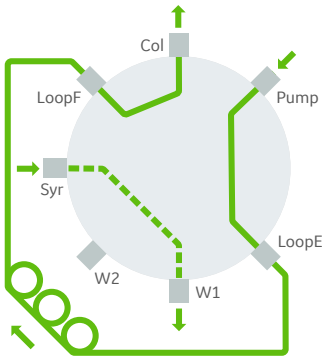
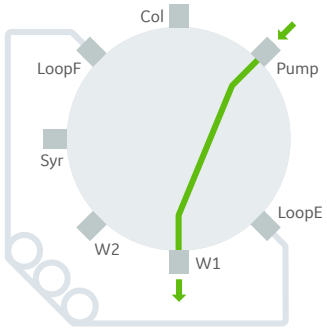
Location and illustration

The injection valve is installed after the mixer in the flow path, and before a column or column valve. The illustration below shows the location and parts of the injection valve.



Part	Description
1	Column port **Col**, for connection to a column or column valve.
2	Loop port **LoopF**, for connection and filling of a loop.
3	Syringe port **Syr**, for connection of a syringe to fill a loop.
4	Waste port **W2**, for loop waste.
5	Pump port **Pump**, for connection with the mixer.
6	Loop port **LoopE**, for connection and emptying of a loop.
7	Waste port **W1**, for pump waste.
8	Loop

Flow paths

Position	Flow path illustration	Description
Load		The flow is directed onto the column or column valve. Sample can be loaded manually into the loop through the syringe port **Syr**. Excess sample leaves through the waste port **W2**.
Inject		The flow is directed through the loop and onto the column or column valve. The syringe port can be washed manually in this position.
Waste		The flow is directed to waste through the **W1** port. This flow path is used for performing a pump wash.

Note: *Make sure all ports in the injection valve are plugged with either tubing or stop plugs, to avoid liquid to flow out during valve turns.*

2.2.6 UV monitor

Introduction

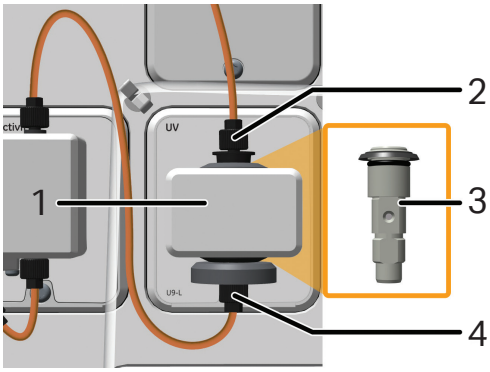
The UV monitor measures the UV absorbance, of buffers and eluted proteins, at the fixed wavelength of 280 nm. The UV monitor includes a monitor unit with a UV flow cell. The standard UV flow cell path length is 2 mm, but a 5 mm UV flow cell is also available. The 5 mm UV flow cell is better suited for high resolution size exclusion chromatography (SEC) runs due to its lower internal volume of 20 µL, compared to 30 µL internal volume of the 2 mm UV flow cell. For instructions on how to replace the UV flow cell, see *Section 5.3.3 Maintenance of the UV flow cell, on page 145*.

The UV lamp is a LED lamp that does not need warming up before use and does not heat the sample. The lamp is automatically turned on when a run starts, and turned off when the run ends. It also turns off during a run when in state ***Pause*** or ***Errors, alarms and warnings*** for more than 30 min and automatically turns on after changing these states.

Note: *If running long runs, where the UV lamp is not required, the lamp can be turned off using a manual instruction. See Section 7.6.5 Manual instructions - Monitors, on page 261.*

Location and illustration

The UV monitor is installed after the column or column valve and before the conductivity monitor in the flow path. The illustration below shows the UV monitor and the UV flow cell.



Part	Description
1	UV monitor
2	Inlet, with tubing from a column or column valve
3	UV flow cell
4	Outlet, with tubing to the conductivity monitor

2.2.7 Conductivity monitor

Introduction

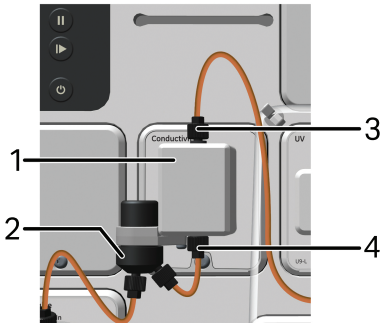
The conductivity monitor measures the conductivity of buffers and eluted proteins. The conductivity monitor is factory-calibrated on delivery but can be re-calibrated if needed, see *Section 5.4.3 Calibrate the conductivity monitor, on page 165*.

As the conductivity of a liquid is dependent on temperature, the conductivity flow cell is fitted with a temperature sensor. To adjust for changes in temperature, the temperature sensor is used in UNICORN together with a temperature compensation factor. Always keep the conductivity temperature compensation on. Turning it off may result in fluctuating conductivity signals, especially if the run is done in a refrigerator where the temperature changes.

Location and illustration

The conductivity monitor is installed after the UV monitor. A flow restrictor is included in the flow path after the conductivity monitor. If a pH valve is installed in the system, move the flow restrictor to the pH valve. See *Section 2.2.8 Flow restrictor, on page 27*.

The illustration below shows the conductivity monitor with the flow restrictor.



Part	Description
1	Conductivity monitor
2	Flow restrictor
3	Inlet, with tubing from the UV monitor
4	Outlet, with tubing to the flow restrictor or pH valve

2.2.8 Flow restrictor

Introduction

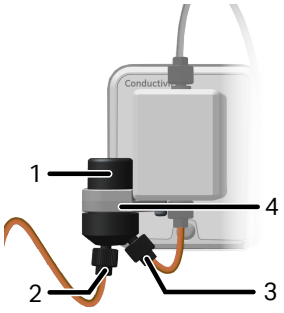
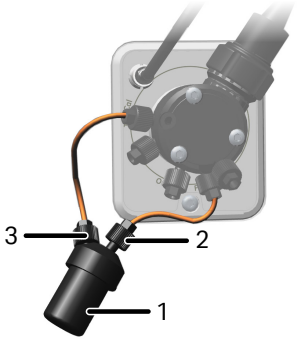
The flow restrictor generates a steady back pressure in the flow path of approximately 0.2 MPa. This prevents formation of air bubbles in the UV flow cell.

Note: *There is a risk that air bubbles cause large disturbances in the UV signal. Use the automatic pressure control function to avoid pressure alarms, instead of removing the flow restrictor. See* *Section 3.8 Pressure control, on page 100**.*

Location and illustration

The flow restrictor is included in the flow path after the conductivity monitor. The conductivity monitor is equipped with a holder for the flow restrictor. If the instrument is fitted with a pH valve, the flow restrictor should be moved from the conductivity monitor to the pH valve.

The illustrations below show the flow restrictor fitted on the conductivity monitor and on the pH valve.

Conductivity monitor with flow restrictor	pH valve with flow restrictor	Part	Description
		1	Flow restrictor
		2	Outlet
		3	Inlet
		4	Holder

2.2.9 Outlet valve V9-Os

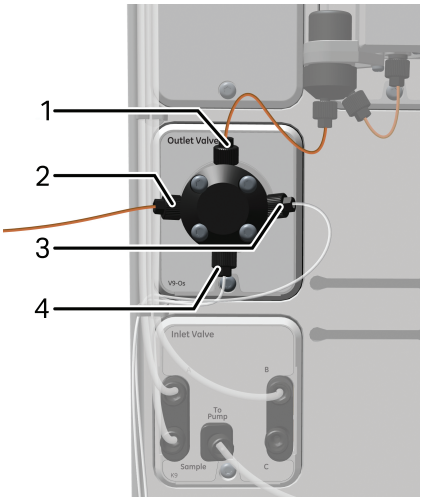
Introduction

The outlet valve **V9-Os** is used to direct the flow from the instrument to the fraction collector, to an outlet port, or to waste.

Note: *The outlet valve* **V9-Os** *can be replaced with the outlet valve* **V9-O**, *see Section 2.3.7 Outlet valve V9-O, on page 46*.

Location and illustration

The outlet valve is installed last in the flow path on the instrument. The illustration below shows the location and parts of the outlet valve.



Part	Description
1	Inlet port **In**, with tubing from the flow restrictor or pH valve
2	Fractionation port **Frac**, with tubing to the Fraction collector
3	Outlet port **Out1**, with tubing to a collection bottle
4	Waste port **W**, with tubing to the waste

2.2.10 Module panel

Introduction

All positions in the chassis of the instrument must be occupied. Positions not used for standard or optional modules must be fitted with a module panel.

Module panels are installed in the same way as other modules, and must be connected to the cable inside the instrument. See *Install optional modules, on page 31*.

When a module is replaced by a module panel, the removed module has to be deselected in ***System Properties*** in UNICORN.

Location and illustration

The illustration shows a module panel (indicated in orange) installed on an ÄKTA go instrument equipped with an optional column valve.

2.3 Optional modules and components

In this section

2.3.1 Installation of optional modules

Introduction

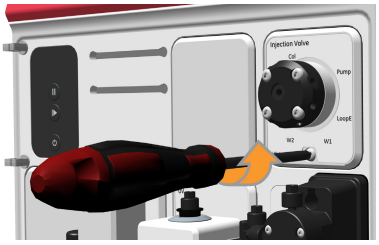
The modules compatible with the ÄKTA go instrument are easy to install in the instrument. The installation procedures are similar for most modules. Up to four external modules can also be connected to the instrument via UniNet-9 cables at the back of the system.

Install optional modules

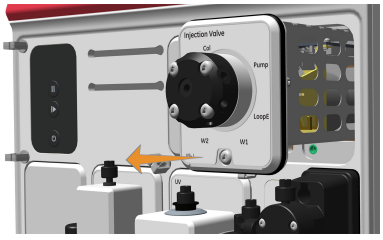
Follow the steps below to install or replace a module or module panel. Module panels must be used in positions not occupied by modules.

Note: *The illustrations show the principle of how to replace and install a module. The position of the module on the instrument depends on the module being installed.*

Step	Action
1	Disconnect power from the instrument by using the instrument power button.
2	If a module is to be replaced, loosen the tubing connectors and remove the tubing from the existing module.
3	Loosen the screw in the module or module panel with a Torx T20 screwdriver.

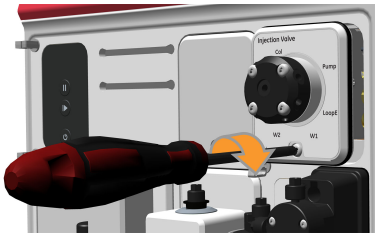


4	Remove the module or module panel and disconnect the cable at the back.



Step	Action
5	Connect the cable to the new module or module panel.

6	Insert the module or module panel and fasten it with a Torx T20 screwdriver.



Note: *When an optional module is removed or a new module is installed, the system configuration must be updated in UNICORN. To update a module in System configuration, see System configuration, on page 33.*

Install external modules

External modules such as a Fraction collector, an air sensor and an I/O box are not installed in the instrument chassis, but are connected via a UniNet-9 cable at the back of the system. It is possible to install up to four external modules with F-type connectors. Optional inlet valves, if not installed in the instrument chassis, can also be connected via UniNet-9 cables at the back of the system.

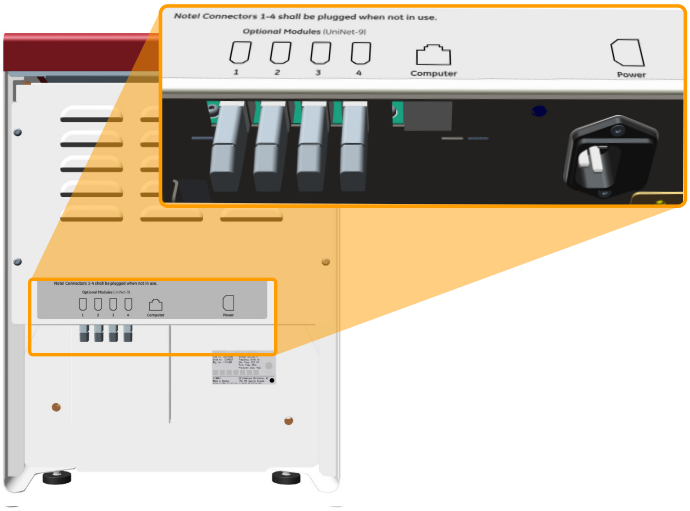
Follow the steps below to install or replace an external module.

NOTICE
UniNet-9 cable.

Only use UniNet-9 cables delivered or approved by Cytiva.

Step	Action
1	Disconnect the ÄKTA instrument in the UNICORN system control software, and turn off the ÄKTA instrument.

Step	Action
2	On the back of the ÄKTA instrument, remove the jumper from the UniNet-9 port to be used. ***Note:*** *Keep the removed jumper safely. All contacts must have a connected module or jumper.*



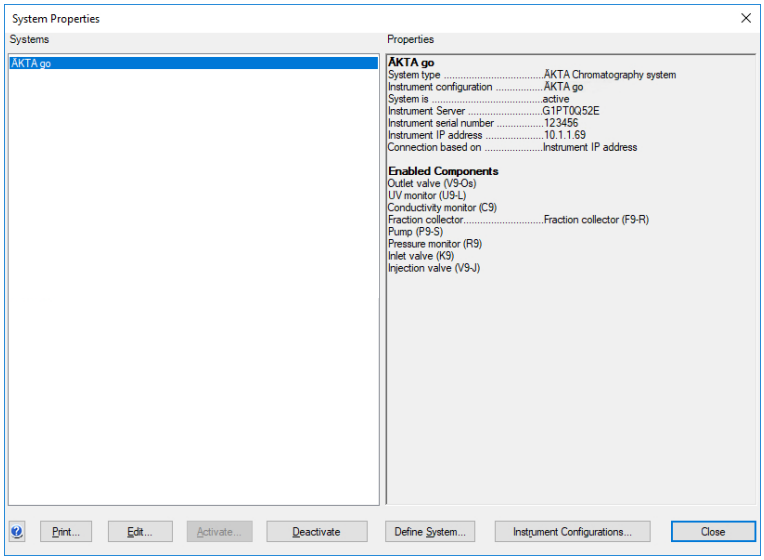
3	Connect the UniNet-9 cable between the UniNet-9 port on the external module and on the back of the ÄKTA instrument. ***Tip:*** *The rounded side of the connector is facing the ÄKTA instrument.*
4	Make sure that all unused UniNet-9 ports on the ÄKTA instrument are plugged with jumpers.

System configuration

When an optional module is removed or a new module is installed, the system configuration must be updated in UNICORN. Follow the steps below to update the system configuration in UNICORN.

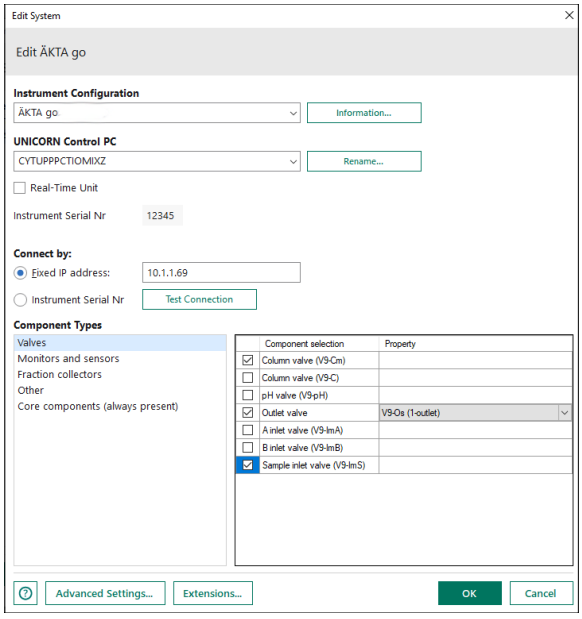
Step	Action
1	In the ***Tools*** menu in the ***Administration*** module, click ***System Properties*** or click the ***System Properties*** icon to open the dialog. *Result:* The ***System Properties*** dialog is displayed.

Step	Action



2 Select the system of interest in the ***System Properties*** dialog and click ***Edit***.

Result:
The ***Edit*** dialog is displayed.



Step	Action
3	Select the installed modules from the ***Component types*** list. ***Note:*** *Instrument modules are referred to as* ***Components*** *in UNICORN.* ***Note:*** *If applicable, choose the appropriate option in the* ***Property*** *column.*
4	Click ***OK*** to apply the changes.

2.3.2 Air sensor

Introduction

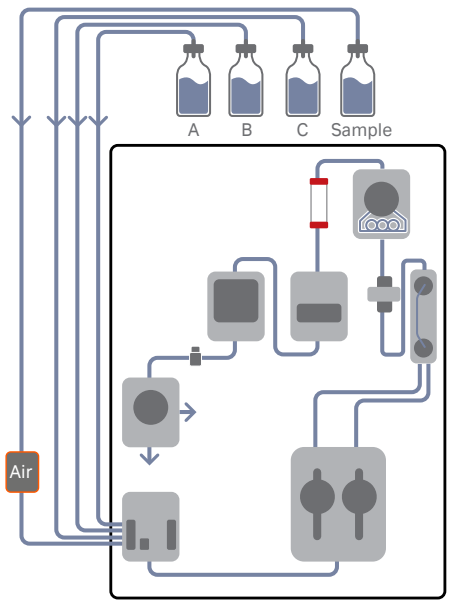
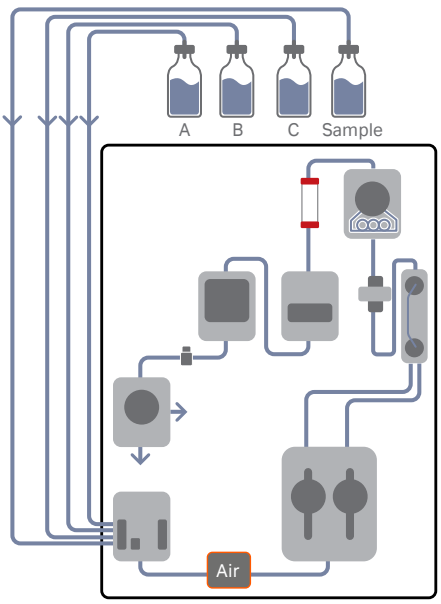
An air sensor is used to prevent air from entering the liquid flow path of the system. By detecting the presence of air, the air sensor can be used for complete sample loading or to detect if running out of buffer.

Location and illustration

One of two different air sensors, **L9-1.5** or **L9-1.2**, can be installed in the ÄKTA go instrument. The communication cable in the air sensor connects to a UniNet-9 port at the back of the instrument. The air sensor can be installed in the following positions:

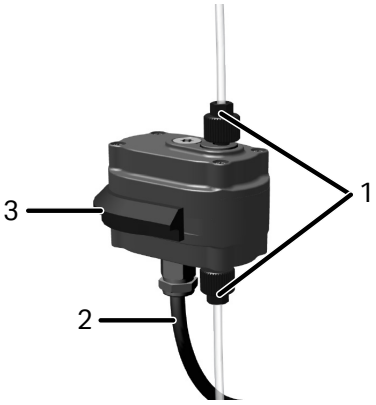
- **L9-1.5** or **L9-1.2** before inlet valve on the sample inlet tubing,

  or
- **L9-1.5** air sensor between inlet valve and pump.

Air sensor before inlet valve on the sample inlet tubing	Air sensor between inlet valve and pump
	

When installed before the inlet valve, the air sensor can be used to load sample onto a column until air is detected. In this location, the air sensor can be attached to the rails on the instrument using a bottle holder and adapter, see *Adapter for air sensor, on page 65*.

When installed after the inlet valve, the air sensor **L9-1.5** can detect if a buffer is running out. The illustration below shows the components of the external air sensor.



Part	Description
1	Tubing connectors
2	Communication cable
3	Holder adapter

2.3.3 Optional inlet valves

Introduction

Three optional inlet valves can be installed on the ÄKTA go instrument. The optional inlet valves available for the instrument and their functions are described in the table below.

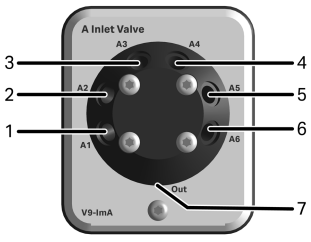
Inlet valve	Label	Function
A inlet valve	**V9-ImA**	Enables automatic change between six buffer inlets. Connects to port **A** of inlet valve **K9**.
B inlet valve	**V9-ImB**	Enables automatic change between six buffer inlets. Connects to port **B** of inlet valve **K9.**
Sample inlet valve	**V9-ImS**	Enables automatic loading from five sample inlets and one buffer inlet. Connects to port **Sample** of inlet valve **K9**.

Location

Optional inlet valves must be installed before the inlet valve **K9** in the flow path. The optional inlet valves can either be installed in the instrument chassis or in an extension box. Extension boxes can be installed on the instrument rails or placed on the bench, to the left of the instrument.

Illustration of V9-ImA and V9-ImB inlet valves

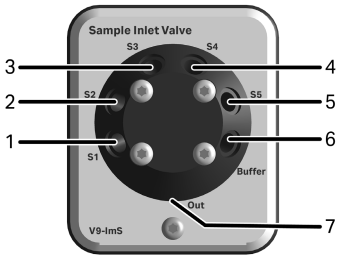
The illustration below shows the ports of **V9-ImA** and **V9-ImB** inlet valves, in this example with label **V9-ImA**. The **V9-ImB** inlet valve has corresponding **B** inlet ports.



Part	Description
1 to 6	Buffer inlet ports **A1** to **A6**, with tubing to buffer
7	Outlet port **Out**, with tubing to inlet valve **K9**

Illustration of inlet valve V9-ImS

The illustration below shows the ports of the **V9-ImS** sample inlet valve.



Part	Description
1 to 5	Sample inlet ports **S1** to **S5**, with tubing to sample
6	Buffer inlet port **Buffer**, with tubing to buffer
7	Outlet port **Out**, with tubing to inlet valve **K9**

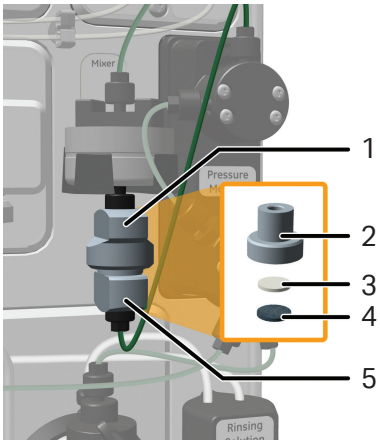
2.3.4 Online filter

Introduction

The online filter prevents particles from entering the flow path and clogging the column.

Location and illustration

The online filter can be installed before the mixer in the flow path. Use the male-male union connector with inner diameter of 0.75 mm (union 1/16"M / 1/16"M) supplied in the accessories box, to screw the online filter directly onto the bottom of the mixer. The illustration shows the location and parts of the online filter.



Part	Description
1	Top nut
2	Holder
3	Support net
4	Filter
5	Bottom nut

2.3.5 Column valves

Introduction

Column valves can be used to connect several columns to the system. The optional column valves **V9-Cm** and **V9-C** allow the user to choose the column, the flow direction through the column, or to bypass the columns.

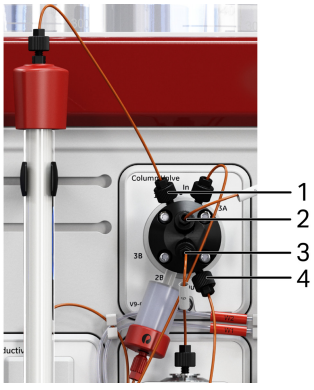
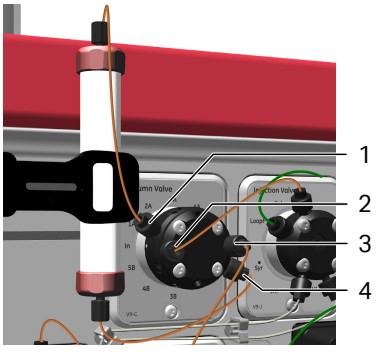
The column valves available for the ÄKTA go instrument and their functions are described in the table below.

Label	Description
V9-Cm	Up to three columns can be connected to the valve.
V9-C	Up to five columns can be connected to the valve. Contains two pressure sensors, one before the column and one after the column. These measure the pre- and post-column pressure, which are used to calculate the delta-column pressure.

Note: *If the column valve* **V9-C** *is installed together with a column that can withstand a pressure higher than 2 MPa, the* ***Alarm pressure*** *in* ***System Settings*** *needs to be set to 5 MPa.*

Location and illustration

The column valve is installed after the injection valve and before the UV monitor. The illustration below shows the location and parts of the column valves **V9-Cm** and **V9-C**.

Column valve V9-Cm	Column valve V9-C
	

Part	Description
1	Column port **1A**, with tubing to the top of a column.
2	Inlet port **In**, with tubing from the injection valve.
3	**Out** port, with tubing to the UV monitor.
4	Column port **1B**, with tubing to the bottom of a column.

Note: *If the system is running in **Down flow** mode, the liquid flow path is directed from the column valve onto the column through the **A** ports, and from the column onto the column valve through the **B** ports.*

*If the system is running in **Up flow** mode, the liquid flow path runs in the opposite direction.*

2.3.6 pH valve

Introduction

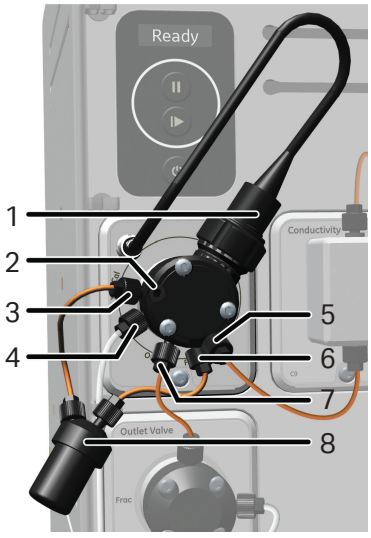
The pH valve is used to direct the flow to a pH electrode when in-line monitoring of pH is relevant during a run. For instructions on how to install the pH electrode, see *Replace the pH electrode, on page 152*.

When using a pH valve, move the flow restrictor from the conductivity monitor to the pH valve. The flow restrictor generates back pressure to prevent the formation of air bubbles. The pH valve directs the flow to the pH electrode and to the flow restrictor, or by-passes one or both.

Location and illustration

The pH valve should be installed last in the flow path, right before the outlet valve. This prevents the pH electrode in the valve from being exposed to high pressure. During a normal run, the electrode should not be exposed to more than 0.5 MPa but can withstand transient pressure pulses of 0.8 MPa.

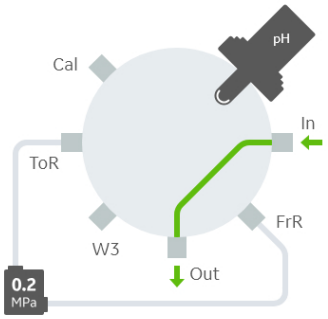
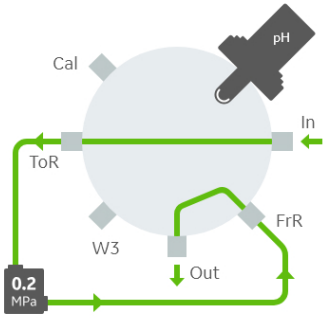
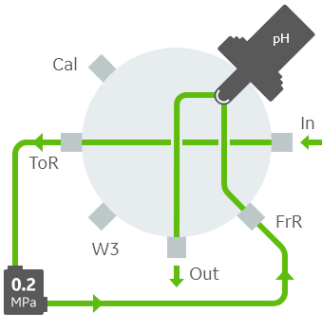
The illustration below shows the location and parts of the pH valve with the flow restrictor.

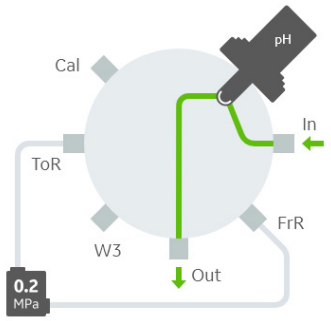
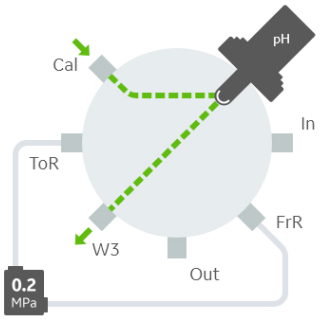


Part	Description
1	pH electrode
2	Calibration port **Cal**, for connecting a syringe during calibration
3	Port **ToR**, with tubing to the flow restrictor
4	Waste port **W3**, with tubing to waste
5	Inlet port **In**, with tubing from the conductivity monitor
6	Port **FrR**, with tubing from the flow restrictor
7	Outlet port **Out**, with tubing to the outlet valve
8	Flow restrictor

Flow paths

The table below describes the different flow paths through the pH valve.

Position	Flow path illustration	Description
By-pass Both		Both the pH electrode and flow restrictor are by-passed.
Restrictor Only		The flow restrictor is in use and the pH electrode is by-passed.
Restrictor and pH		Both the pH electrode and flow restrictor are in use.

Position	Flow path illustration	Description
pH Only		The pH electrode is in use and the flow restrictor is by-passed.
Calibration		The calibration port **Cal** is used to inject solution into the pH flow cell using a syringe. Excess solution leaves the valve through waste port **W3**. This flow path is used when calibrating the pH monitor and when filling the pH flow cell with storage solution.

2.3.7 Outlet valve V9-O

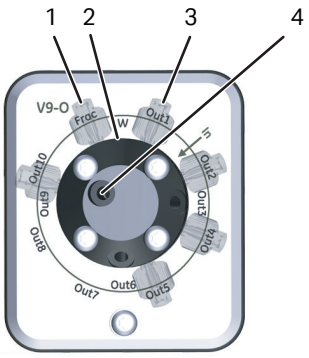
Introduction

An optional outlet valve can be installed on the ÄKTA go instrument replacing the standard outlet valve. Outlet valve **V9-O** allows the flow to be directed to the Fraction collector, any of the ten outlet ports, or to waste.

Location and illustration

The optional outlet valve must be installed last in the flow path on the instrument. Replace the outlet valve **V9-Os** with outlet valve **V9-O** by installing it in the designated outlet valve position.

The illustration below shows the parts of outlet valve **V9-O**.



Part	Description
1	Fractionation port **Frac**, with tubing to the Fraction collector
2	Waste port **W**, with tubing to waste
3	Outlet ports **Out1** to **Out10**, with tubing to collection bottles
4	Inlet port **In**, with tubing from the flow restrictor or the pH valve

2.3.8 Fraction collector F9-T

Introduction

A Fraction collector is used for the collection of fractions from purification runs. The Fraction F9-T collector can be used for the following functions:

- Fixed volume fractionation
- Peak fractionation
- Combined fixed volume fractionation and peak fractionation.

For a more detailed description of the fractionation functions, see *Section 3.3 Fractionation overview, on page 86*.

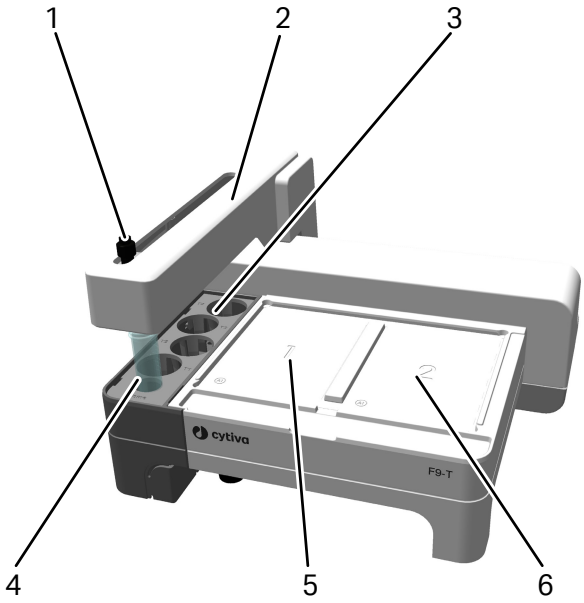
The fractions can be collected in plates or tubes, see the table in *Tubes, on page 53* for supported plates and tubes.

The Fraction collector can be placed in a tunnel below or beside the instrument.

The Fraction collector F9-T can use the ***DropSync*** function to reduce risk of spillage during movement between fractions. Technical details are found in *Section 3.3 Fractionation overview, on page 86*.

Illustration of front view

The illustration below shows the main parts of Fraction collector F9-T.



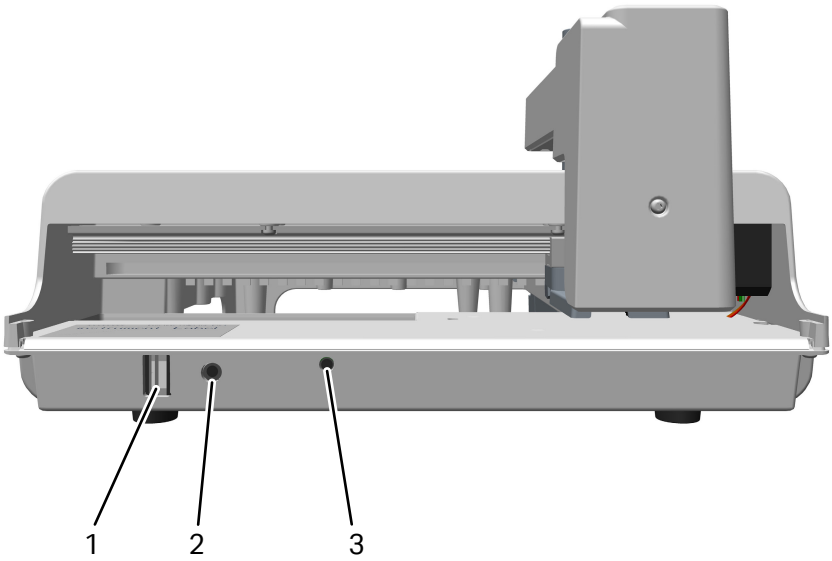
Part	Description
1	Nozzle

Part	Description
2	Fractionation arm
3	Tube rack for 50 mL tubes
4	Home position
5	Plate position 1
6	Plate position 2

Illustrations of back view

The illustration below shows the back view of Fraction collector F9-T.

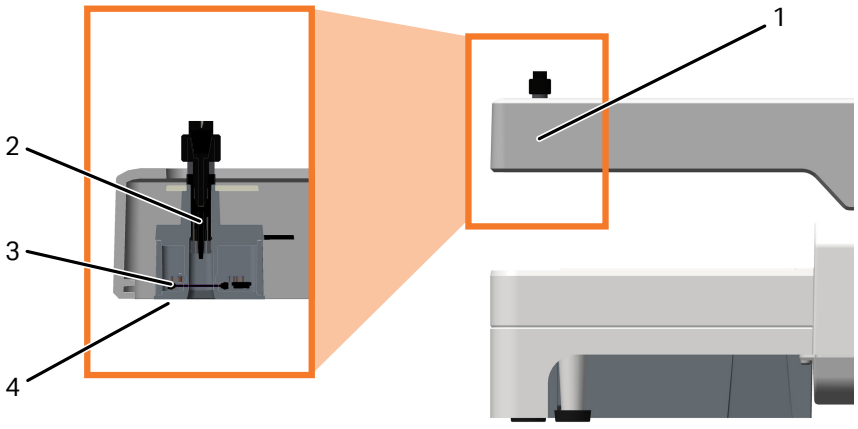
The Fraction collector is connected to the instrument via the UniNet-9 F-type connector port, both for communication and power supply.



Part	Description
1	UniNet-9 F-type connector port
2	Node ID
3	Status LED

Illustrations of dispenser head

The illustration below shows the dispenser head of Fraction collector F9-T.



Part	Description
1	Dispenser head
2	Nozzle
3	Drop sync sensor
4	LED light

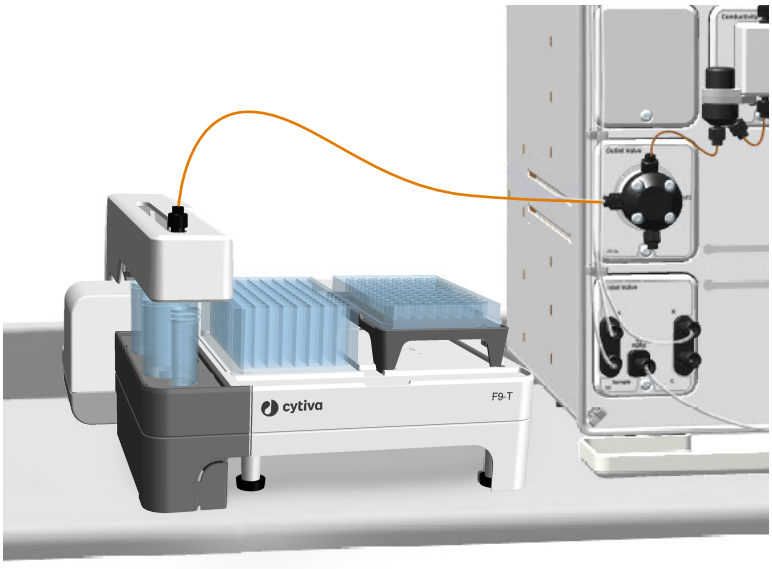
Connect Fraction collector without tunnel

The Fraction collector can be placed beside the ÄKTA go instrument. The recommended tubing length for such a setup is 40 cm.

Note: *Longer tubing increases back pressure and peak broadening in the chromatographic process.*

Follow the steps below to connect the tubing from the instrument to the Fraction collector F9-T.

Step	Action
1	Connect one end of the tubing to the **Frac** port on the outlet valve on the ÄKTA go instrument using a fingertight connector.
2	Connect the other end to the selected nozzle.

Step	Action
3	Insert the nozzle into the fractionation arm. 
4	Adjust the delay volume setting in the UNICORN software, see *Section 7.9 Delay volumes, on page 275*. ***Note:*** *The default delay volume setting in UNICORN is defined for the 40 cm tubing with inner diameter 0.5 mm (orange tubing).*

Connect Fraction collector using a tunnel

To reduce the footprint, the Fraction collector F9-T can be positioned under the instrument by using a tunnel.

Follow the steps below to place the instrument on top of the tunnel and install the fraction collector F9-T inside the tunnel.

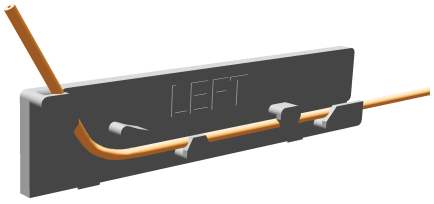
Step	Action
1	Place the tunnel at the intended location.

Step	Action
2	Use two persons to lift the instrument onto the tunnel in a safe manner.

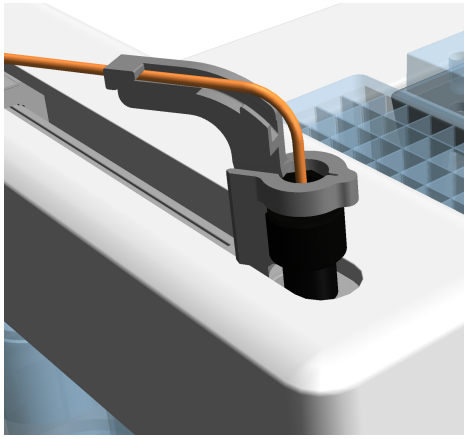
CAUTION

Heavy object. Use proper lifting equipment, or use two or more persons when moving the instrument. All lifting and moving must be performed in accordance with local regulations.

3	Make sure that the front feet of the ÄKTA go instrument are placed on top of the pins at the front of the tunnel.
4	Connect the UniNet-9 cable to the back of instrument and pull the cable into the tunnel from the back.
5	Connect the other end of the UniNet-9 cable to the fraction collector and put the fraction collector securely on the tunnel tray.
6	Connect 80 cm tubing to the **Frac** port on the outlet valve of instrument.
7	Guide the tubing inside the tunnel using the tubing guide on the left-hand side inside the tunnel.



8	Attach the tubing to the nozzle and attach the nozzle guide to it.

Step	Action
9	Insert the tubing with the nozzle guide into the fractionation arm. 
10	Adjust the delay volume in UNICORN according to the table in *Section 7.9 Delay volumes, on page 275*.

DropSync function

To reduce sample spillage during fractionation, the fraction collector can use the ***DropSync*** function. Technical details are found in *Section 3.3 Fractionation overview, on page 86*.

LED light

A LED light in the dispenser head indicate ongoing fractionation and illuminate the fractionation area. The LED light can be turned on or off in ***System settings*** in UNICORN.

Plates

The tables below list available plate types and recommended plate manufacturers. Plates from other manufacturers can work if they are of the same quality and dimensions.

Plates	Maximum volume	Default fractionation volume
96 well microplate[1], [2]	0.3 mL	0.1 mL
96 deep well plate[3]	2 mL	2 mL
48 deep well plate[4]	4.5 mL	4 mL
24 deep well plate[4]	9 mL	8 mL

[1] Microplate holder F9-T and micro nozzle are required.

[2] If microplates with maximum volume less than 0.3 mL is used, change to blue (i.d. 0.25 mm) tubing between the UV monitor and Fraction collector F9-T. Adjust delay volume accordingly.
[3] Only standard height 44 mm with square wells.
[4] Only standard height 44 mm with rectangular wells **A1** to **H6**.

Plates from the following manufacturers are recommended:

- Whatman™
- Corning
- Greiner
- Nunc

Tubes

The table below lists tubes and suitable holders.

For tube sizes 0.5 mL, 1.5 mL, and 2 mL, the manufacturer Eppendorf® is recommended. For 15 mL and 50 mL tube sizes, the manufacturer Falcon is recommended.

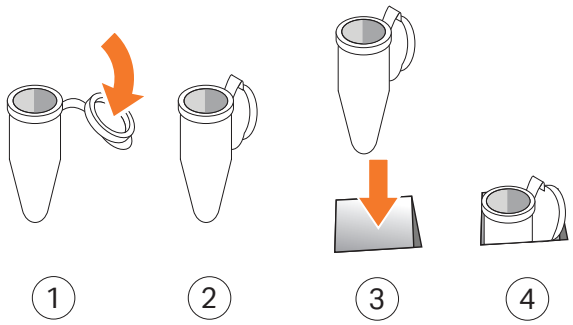
Tubes from other manufacturers can be used if they are of the same quality and dimensions.

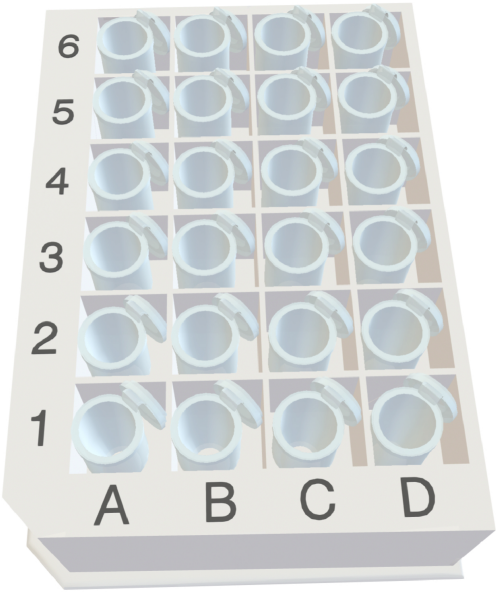
Tube size	Suitable holder
0.5 mL tubes	48 position rack
1.5 mL tubes	24 deep well plate[1]
2 mL tubes	24 deep well plate[1]
15 mL tubes[2]	Tube rack for 50 mL tubes
50 mL tubes	Tube rack for 50 mL tubes

[1] Only for tubes with an attached lid.
[2] Only for the **Home** position, not for fractionation.

Correct tube position in a 24 deep well plate

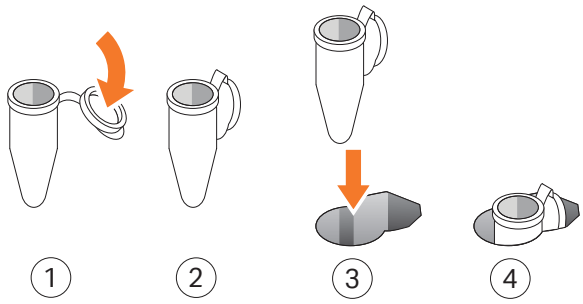
1.5 mL and 2.0 mL tubes are placed in a 24 deep well plate with their lids bent backward, and inserted in 45 degrees from the well structure with the lids in the upper right corners. For example, a tube in the **A1** position have the tube facing the outer corner, and the lid facing the opposite corner.





Correct tube position in a rack

0.5 mL tubes are placed in a rack with 48 positions with their lids bent backward. The tube is positioned in the round part of the hole, and the lid is positioned in the lid shaped part of the hole.

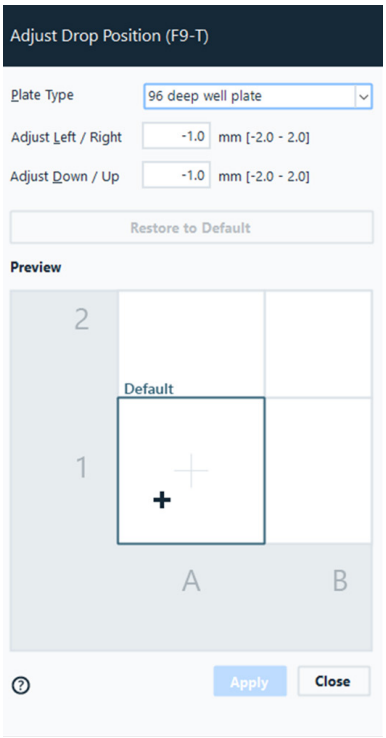


Dispensing position and adjustment

For all plates and tubes, except for the 0.5 mL tubes, the default positioning of the nozzle is not at the center of the well/tube.

Depending on the running conditions, or if non-standard plates are used, the default position might need to be adjusted. There is an adjustment setting available in the ***System Control →System →Adjust drop position (F9-T)***.

As shown in the illustration below.



Default drop position

The default drop position is chosen for optimal liquid behavior in the wells/tubes. The values in the table below represent the nozzle distance (in mm) from the center of wells/tubes in left/right and down/up direction, respectively.

Plate type	Default offset from center of well Left/Right (mm)	Default offset from center of well Down/Up (mm)
96 deep well plate	-1.0	-1.0
96 microplate	-0.5	-0.5
48 deep well plate	-0.8	-5.3
24 deep well plate	-5.5	-5.5
0.5 mL tubes	0.0	0.0
1.5 mL tubes	-0.8	-0.8
2 mL tubes	-0.8	-0.8
50 mL tubes	0.0	8.0

2.3.9 Fraction collector F9-R

Introduction

A Fraction collector is used for the collection of fractions from purification runs. The Fraction collector **F9-R** can be used for the following functions:

- Fixed volume fractionation
- Peak fractionation

For a more detailed description of the fractionation functions, see *Section 3.3 Fractionation overview, on page 86*.

In Fraction collector **F9-R**, fractions can be collected in tubes of the following sizes:

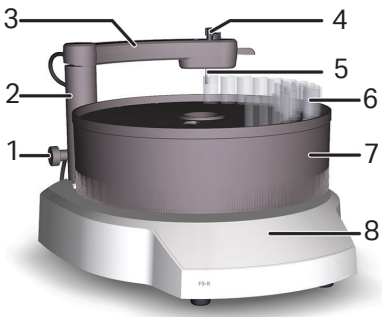
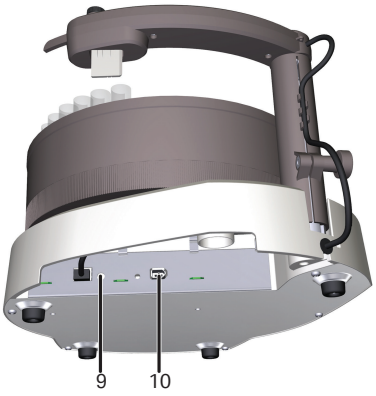
Tube rack	Inserts	Tube diameter	Maximum number of tubes	Tube length
Tube rack 40 × 30 mm	12 mm Tube holder 12 mm Tube guide	30 mm	40	50 to 180 mm
Tube rack 95 × 10-18 mm[1]	18 mm Tube holder 18 mm Tube guide	• 10 mm • 12 mm • 18 mm	95	50 to 180 mm
Tube rack 175 × 12 mm	30 mm Tube holder 30 mm Tube guide	12 mm	175	50 to 180 mm

[1] This tube rack is supplied with the Fraction collector **F9-T**

To reduce sample spillage during fractionation, the Fraction collector **F9-R** can use the ***DropSync*** function, for a system flow up to 2 mL/min. Technical details are found in *Fraction collector F9-R Operating instructions (29656880)*.

Illustration

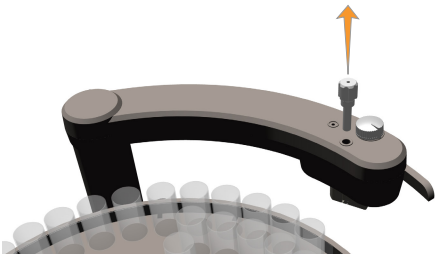
The illustrations below shows the main parts of the F9-R Fraction collector.

Front view	Back view
	

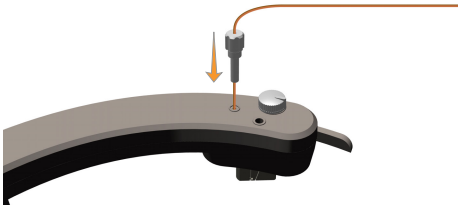
Part	Description
1	Lock knob
2	Stationary part of delivery arm
3	Delivery arm
4	Tubing connector
5	Tube sensor
6	Collection tubes
7	Tube rack
8	Base unit
9	Node ID switch
10	UniNet-9 F-type connector (for communication and power supply)

Connect tubing

Step	Action
1	Remove the tubing connector from the delivery arm and insert the 40 cm precut tubing through the tubing connector.



2	Use the tube adjustment cavity on the delivery arm to expose the correct length of tubing from the tubing connector. Insert the tubing into the tube adjustment cavity and slide the connector down towards the delivery arm. Tighten the tubing connector when correct tubing length is exposed.



3	Re-install the tubing connector on the delivery arm.
4	Adjust the position and height of the delivery arm. Use the adjustment knob to place the tube sensor in the correct position for the used tubes. Refer to *Fraction collector F9-R Operating instructions (29656880)* for detailed instructions.

5	Connect the 40 cm precut tubing from the Fraction collector to the **Frac** port on the outlet valve.

Step	Action
6	Adjust the delay volume setting in UNICORN to the volume of the tubing. See *Section 7.9 Delay volumes, on page 275* for more details. ***Note:*** *The default delay volume is correct and does not need to be set if standard tubing (40 cm) is used.*

2.3.10 I/O-box

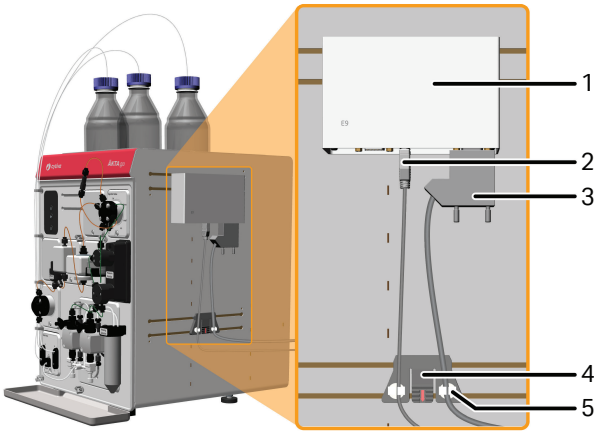
Introduction

The I/O-box is used to interface other equipment in order to measure parameters such as refractive index, light scattering, and fluorescence as analog signals. The I/O-box can control external equipment by a digital output signal, and also detect the equipment state by digital input. It is also possible to send out internal detector signals to external equipment.

For information on requirements of the equipment that can be connected to the I/O-box, refer to the *Install I/O-box E9, Installation Instructions*.

Location and illustration

One I/O-box can be installed on the ÄKTA go instrument. The illustration below shows the I/O-box and its recommended location.



Part	Description
1	I/O-box
2	UniNet-9 F-type cable
3	D-sub cable
4	Multi-purpose holder
5	Clip

2.3.11 Accessories

Introduction

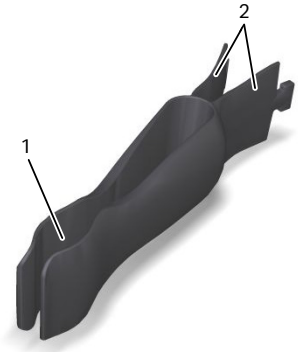
This section describes the available accessories for the ÄKTA go instrument. Holders and clamps are used to attach or organize columns, tubing and bottles to the instrument. These can be attached to the rails of the instrument.

Two column clamps and one multi-directional column clamp are delivered with the standard system. The remaining accessories listed in this section can be ordered separately. For ordering information, see *Chapter 8 Ordering information, on page 289*.

Column clamp

The column clamp can be used to attach small sized columns. Use two clamps to attach long columns.

The illustration below shows the column clamp.

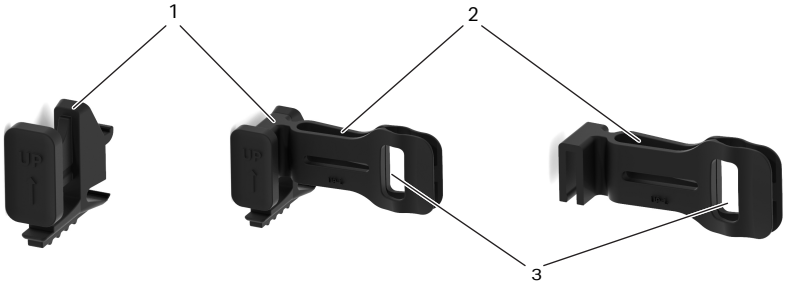


Part	Description
1	Position for a column
2	Inner end tabs

Multi-directional column clamp

The multi-directional column clamp can be used to attach small sized columns with an outer diameter of 12 to 18 mm to the instrument.

The illustration below shows the multi-directional column clamp.



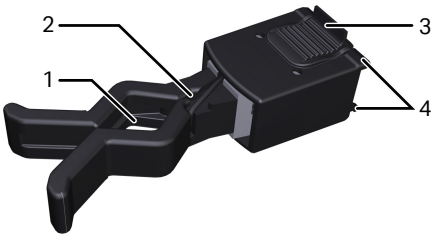
Part	Description
1	Base unit with snap-in to holder rails
2	Clamp unit
3	Position for column

One base unit and one clamp unit of the multi-directional column clamp are used to mount a column vertically on a rail.

Column holder

The column holder has one position for medium sized columns and one position for small sized columns. The column holder can also be used for bottles. Use two holders to attach long columns.

The illustration below shows the column holder.

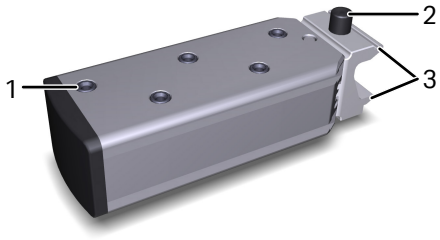


Part	Description
1	Position for a medium sized column or bottle
2	Position for a small sized column
3	Tab for holder attachment/ detachment
4	Snap-in to holder rails

Column holder rod

The column holder rod is used to attach several HiTrap™ columns. The holder has threaded ports for HiTrap columns and tubing connectors. Push the button of the holder to attach the holder to a holder rail.

The illustration below shows the column holder rod.

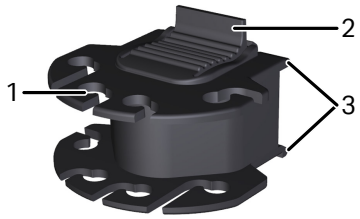


Part	Description
1	Positions for columns
2	Button for holder attachment/ detachment
3	Snap-in to holder rails

Tubing holder spool

The tubing holder spool is used to hold and arrange tubing. It can be useful when using additional inlet valves in the instrument.

The illustration below shows the tubing holder spool.

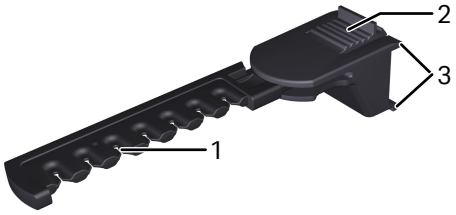


Part	Description
1	Positions for tubing
2	Tab for holder attachment/ detachment
3	Snap-in to holder rails

Tubing holder comb

The tubing holder comb is used to hold and arrange tubing.

The illustration below shows the tubing holder comb.

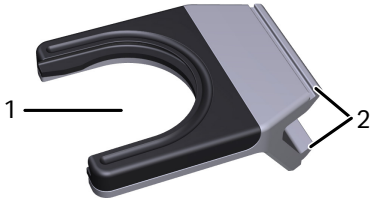


Part	Description
1	Positions for tubing
2	Tab for holder attachment/ detachment
3	Snap-in to holder rails

Bottle holder

The bottle holder can be used for holding bottles when attached to the holder rails. For example, to hold a sample bottle. It can also be used to hold an air sensor fitted with an adapter.

The illustration below shows the bottle holder.

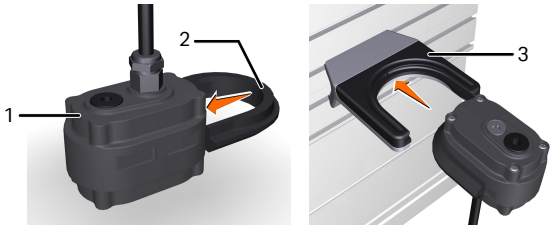


Part	Description
1	Position for bottle/air sensor
2	Snap-in to holder rails

Adapter for air sensor

The adapter for air sensor is used to fit an external air sensor into the bottle holder.

The illustrations below show how to install the adapter onto the air sensor, and bottle holder.

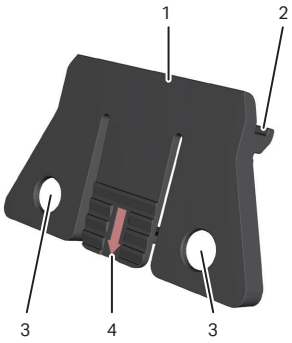


Part	Description
1	Air sensor
2	Air sensor adapter
3	Bottle holder

Multi-purpose holder

The multi-purpose holder can be used for different functions. Secure the I/O-box cable to the multi-purpose holder when the unit is attached to the ÄKTA go instrument; or hold the holder for flat 10 mL sample loops. The multi-purpose holder can be attached to a holder rail on the instrument.

The illustration below shows the multi-purpose holder.

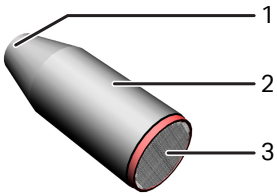


Part	Description
1	Attachment point for accessories
2	Snap-in to holder rails
3	Attachment points for tubing holders
4	Tab for holder attachment/ detachment

Inlet filters

Inlet filters can be attached to inlet tubing for the filtering of buffers. Attach inlet filters to inlet tubing, by inserting the tubing into the inlet filter holder and rotating it until securely attached. The inlet filters are also useful to keep the tubing at the bottom of buffer bottles.

The illustration below shows an inlet filter.

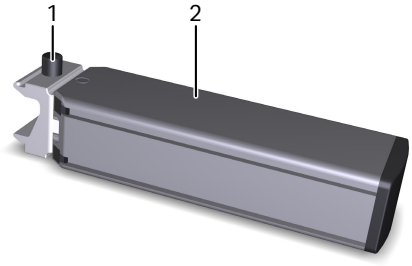


Part	Description
1	Inlet, for inlet tubing
2	Inlet filter holder
3	Inlet filter

Rail extension

The rail extension rod can be used to attach accessories, such as column holders or a multi-purpose holder. The rod has extra rails on both sides. Push the button of the rod to attach it to a holder rail.

The illustration below shows the rail extension rod.

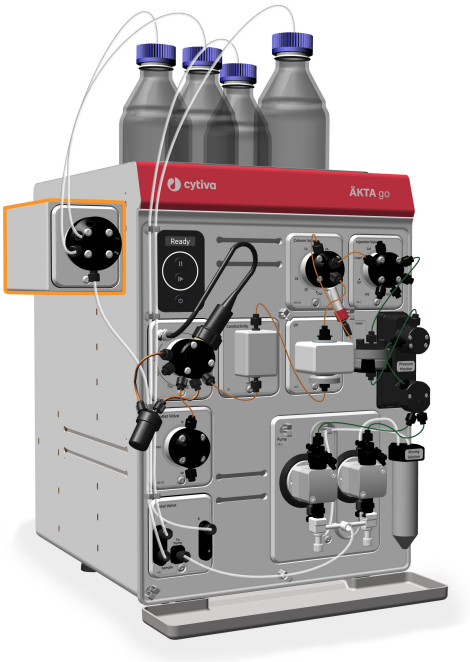


Part	Description
1	Button for holder attachment/ detachment
2	Extension rod

Extension box

The extension box can be used to install extra valves on the ÄKTA go instrument outside the system chassis, if all positions in the chassis are filled.

The illustration below shows an extension box with an optional inlet valve mounted on the side of the instrument.



The extension box can be mounted in two ways.

- On the side of the ÄKTA go instrument.
- Standing next to the ÄKTA go instrument.

2.4 General system settings

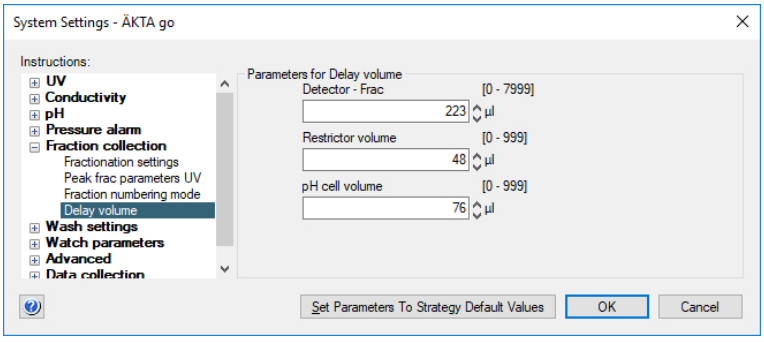
Introduction

System settings can be accessed through the ***System Control*** module in UNICORN, by selecting ***System*** →***Settings***.

This section describes the system settings related to delay volume, instrument control panel, power-save mode, and wash settings. For more system settings information, see *Section 7.5 System settings, on page 237*.

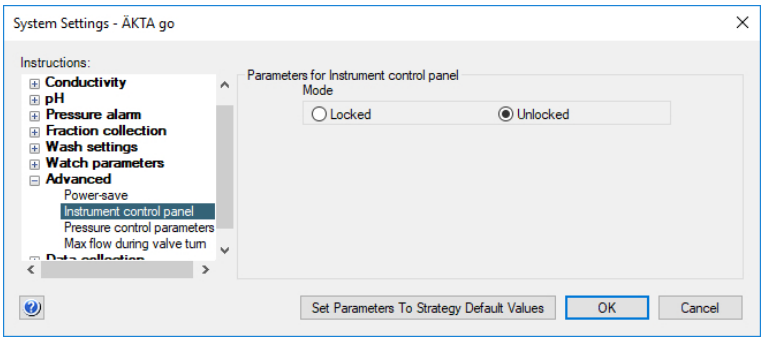
Delay volume

The delay volume is the retention volume that has to be dispensed before collecting the fractions indicated in the chromatogram. It corresponds to the volume in the flow path from the UV monitor to the Fraction collector. There is a default value set for the delay volume, if no changes are done in the flow path after the UV monitor this value is correct. If a module has been installed after the UV monitor in the flow path or if the tubing dimensions have been changed, the delay volume has to be adjusted to make sure that the fractions are dispensed in the correct tubes. See *Section 7.9 Delay volumes, on page 275*, for information on standard delay volumes and instructions to determine delay volumes.



Instrument control panel

The **Pause** and **Continue** buttons of the **Instrument control panel** can be locked or unlocked. To do this in UNICORN, select ***Advanced*** →***Instrument control panel*** in the ***System Settings*** dialog, in ***System control***.

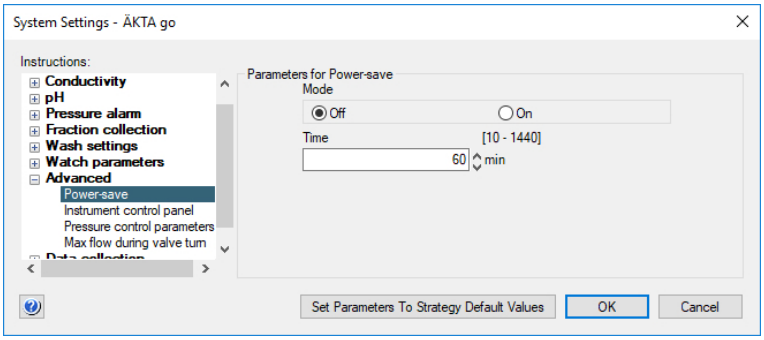


Power-save

ÄKTA go has a power-save mode. The instrument enters ***Power-save*** after having been in ***Ready*** state for a set period of time. The system enters the ***Ready*** state when a method run, a method queue, or a manual run ends.

To enable ***Power-save*** in UNICORN, select ***Advanced*** →***Power-save*** in the ***System Settings*** dialog.

Note: *To activate **Power-save**, a system must be connected and in **Ready** state.*



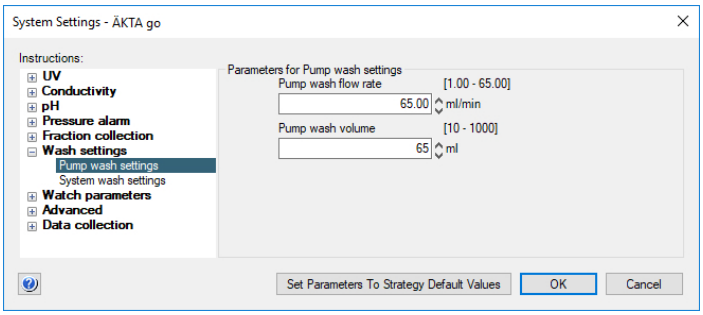
Note: ***Power-save*** *lowers the power consumption of the instrument to < 20 W when the instrument is not in use, by turning off power to all modules except the instrument control panel.*

Wash settings

Wash settings, including wash volumes and flow rates, are defined by default and optimized for the system. See *Section 3.6 System wash and pump wash, on page 95*, for reasons to change the default settings for system wash and pump wash.

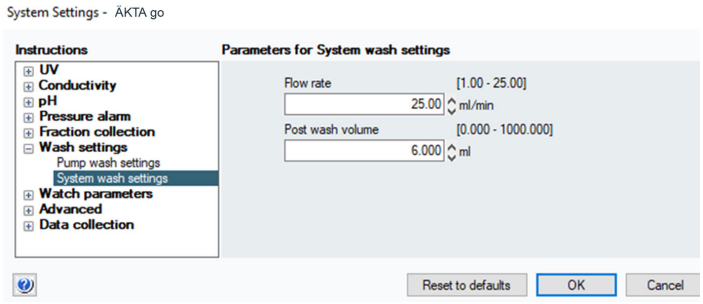
Pump wash

To change the volume and the flow rate for pump wash and system wash in UNICORN, select ***Wash settings*** in the ***System Settings*** dialog.



System wash

To change the flow rate and post wash volume for system wash in UNICORN, select ***Wash settings*** in the ***System Settings*** dialog.



Post wash volume sets the volume to wash the system with after System wash has been performed. It includes a 6 mL post wash volume by default with the flow rate used when System wash was executed. The post wash volume can be changed. If the most recently used flow rate was 0 mL/min before System wash was issued, the ***Flow rate*** set in ***System wash settings*** will be used for Post wash volume.

3 Considerations when running the system

About this chapter

Basic instructions on how to prepare and perform a run are given in *ÄKTA go Operating Instructions*. This chapter contains additional information along with tips related to operation of the system.

In this chapter

3.1 Sample application

About this section

This section gives an overview of the different sample application techniques available for the ÄKTA go instrument, and includes considerations to make when choosing sample application technique.

In this section

3.1.1 Sample application techniques

There are three techniques for sample application on ÄKTA go: using a sample loop, a Superloop™, or the pump. Several factors should be considered in order to choose the most appropriate sample application technique.

The table below shows the suitable sample volumes for the different sample application techniques.

Sample application technique	Volume
Sample loop injection	25 µL to 10 mL
Superloop injection	1 to 150 mL
Pump injection	> 5 mL

The table below shows additional considerations regarding the different sample application techniques.

Sample application technique	Advantages	Disadvantages
Sample loop injection	• Only option for small sample volumes (25 µL to 5 mL) • No sample in the pump or mixer • All sample is loaded onto the column • The ***Reinject counted volume*** instruction can be used [1]	• Manual loading of sample loop from syringe • Need to empty the loop 3 to 5 times the loop volume to load all sample • Sample is diluted
Superloop injection	• Suits repeated application of the same sample • No sample dilution • Little sample loss for medium volumes • No sample in the pump or mixer • Transparent graded sample container, possible to check quality and monitor injected volume • The ***Reinject counted volume*** instruction can be used [1]	• Manual loading of the Superloop • Needs to be cleaned after use

Sample application technique	Advantages	Disadvantages
Pump injection	• Loading of large amount of sample • Easy (only requires priming of the sample inlet with correct sample) • Possibility to use air sensor to load all sample • No extra equipment needed	• Not possible to load small sample volumes due to the flow path volume • Sample in the flow path from inlet valve to column needs to be pushed onto the column • Not possible to load the sample left in the inlet tubing without an air sensor • Sample has to travel through the entire flow path up to the column, which has to be cleaned after use

[1] The collected peak from a previous run, that included the ***Peak to Loop*** functionality, is re-injected from selected sample loop or Superloop. For more information about the ***Peak to Loop*** functionality, refer to the UNICORN Help text for the Elution phase.

3.1.2 Sample application using a sample loop

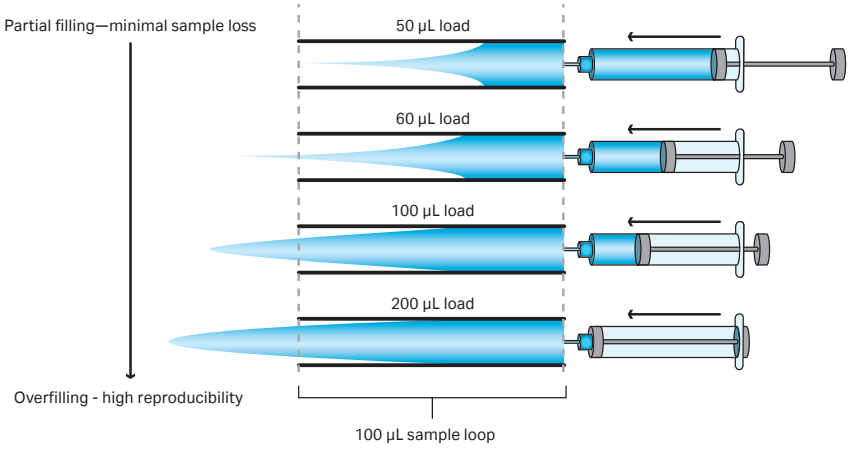
Introduction

A sample loop is recommended for injection of small sample volumes onto a column.

Filling a sample loop

There are two ways to fill a sample loop: partial filling and overfilling. With partial filling, there is no sample loss but reproducibility is lower if the same procedure is repeated. With overfilling, a better volume accuracy is obtained. For a complete fill, load three to five times the loop volume to obtain high accuracy. The needed volume depends on the loop dimensions (length and i.d.). Generally, the larger the loop volume the less overfill is needed.

The image below illustrates these concepts, in this example using a 100 µL loop with an inner diameter of 0.5 mm.



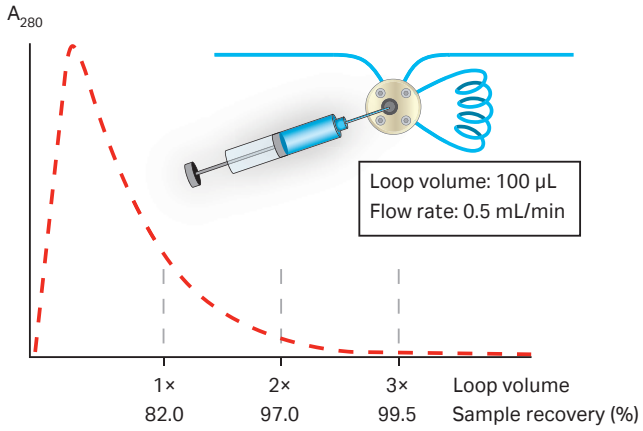
Note: *For partially filled sample loop, do not fill more than half of the total loop volume. If more is applied, a portion of the sample might pass through and out of the loop.*

Emptying a sample loop

To avoid dilution when emptying a sample loop, empty it in the opposite direction from which it was filled. This is done by design in ÄKTA systems.

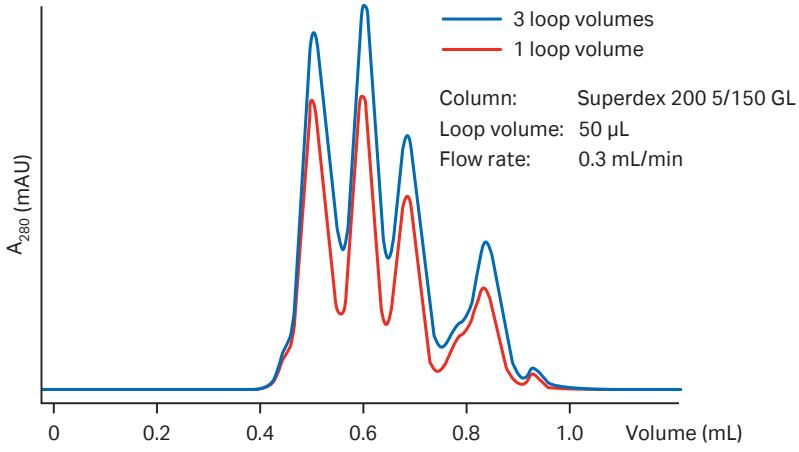
The volume needed to achieve complete recovery will vary with the flow rate, loop dimensions, and the properties of the sample, but usually three to five times the loop volume is sufficient.

The image below shows an example of the recovery achieved at different volumes when emptying a 100 µL loop at 0.5 mL/min. To empty the loop completely, in this example a buffer volume corresponding to three times the loop volume was needed.



To achieve high sample recovery, use a large volume to empty the loop. For non-binding techniques, such as desalting and SEC, consider the sample volume limitations due to the size of the column used.

The chromatogram below shows how the separation in an SEC column is affected by different volumes used to empty the loop during sample injection. Here resolution is increased by using a lower volume to apply the sample onto the column.



3.1.3 Sample application using a Superloop

Introduction

A Superloop can be used to load medium to large volumes of sample onto a column. The Superloop is connected to the injection valve and filled with a syringe.

A Superloop can also be used for multiple injections, for example in a scouting experiment when the same application conditions are required.

When a Superloop is used in-line, its pressure limit should be considered. Set a pressure alarm to the Superloop that corresponds to the specification of the Superloop in use. Refer to *Measured pressure, on page 97* for more information.

Note: *If using a predefined method, a suitable pressure limit for the Superloop is automatically set.*

Note: *If the Superloop is used together with the column valve* **V9-C***, the* ***Alarm pressure*** *in System Settings needs to be set to 5 MPa.*

Prepare the Superloop

To avoid injecting air into the flow path of the instrument, the Superloop should be prefilled with buffer manually before attaching the Superloop to the system. See the corresponding Superloop instructions for information on how to assemble and prefill a Superloop with buffer.

Connect the Superloop

Follow the steps below to connect the Superloop to the injection valve:

Step	Action
1	Attach the Superloop to the instrument using a column holder.
2	Connect the top tubing from the Superloop to the **LoopE** port on the injection valve.
3	Connect the bottom tubing from the Superloop to the **LoopF** port on the injection valve.

Fill the Superloop

Follow the steps below to fill the Superloop using a syringe:

Step	Action
1	In the ***Process Picture***, make sure that the injection valve is in position ***Load***. ***Note:*** ***Load*** *is the default position for the valve.*

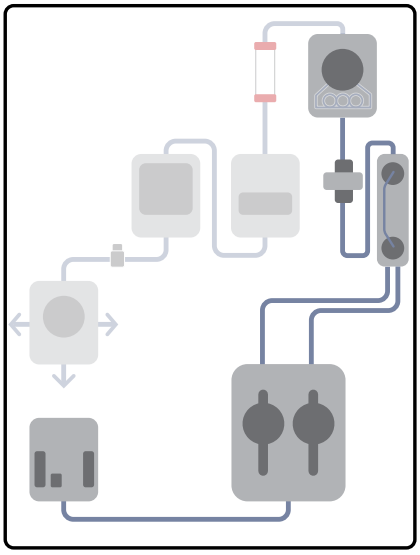
Step	Action
2	Fill a syringe with sample.
3	Connect the syringe to the **Syr** port in the injection valve. ***Note:*** *Make sure that there is no air in the syringe before connecting the syringe to the injection valve.*
4	Load the sample by emptying the syringe into the injection valve.
5	Disconnect the syringe and plug the **Syr** port with a stop plug. ***Note:*** *Prevent air to enter the Superloop. After loading the Superloop, always plug the* **Syr** *port on the injection valve with a stop plug.*

3.1.4 Sample application using pump injection

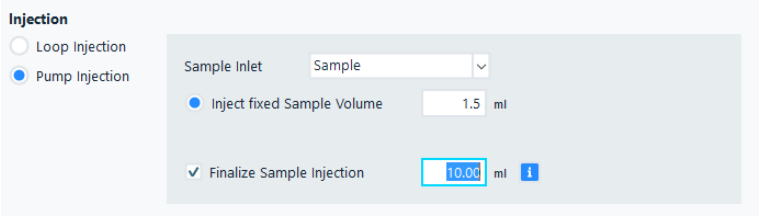
Introduction

Use the pump to load large volumes of sample onto the column. Sample is loaded using the **Sample** inlet on inlet valve **K9**.

The smallest recommended volume to load using the pump is 5 mL. This is because the instrument has a dead volume between the inlet valve and the injection valve of approximately 4 mL. The dead volume is illustrated below.



Make sure to load the sample remaining in the flow path between the inlet valve and the injection valve onto the column, especially when loading small sample volumes. This is done by pumping buffer from the **A** inlet onto the column after loading sample, and before continuing the run. When using predefined methods, this is done by clicking the ***Finalize Sample Injection*** tick box.



To prepare for pump injection, prime the sample manually to the inlet valve. For instructions, refer to *ÄKTA go Operating Instructions*.

Multiple sample injections using the pump

It is possible to use the pump to inject up to five samples after each other, for instance in a scouting run. For this you have to install the optional sample inlet valve **V9-ImS** and connect it to the **Sample** inlet port of the inlet valve **K9**. Load all sample in the flow path, from the optional sample inlet valve to the injection valve, with buffer from the optional sample inlet valve. This is done by selecting the ***Finalize Sample Injection*** option in the predefined methods.

3.2 Air sensor

About this section

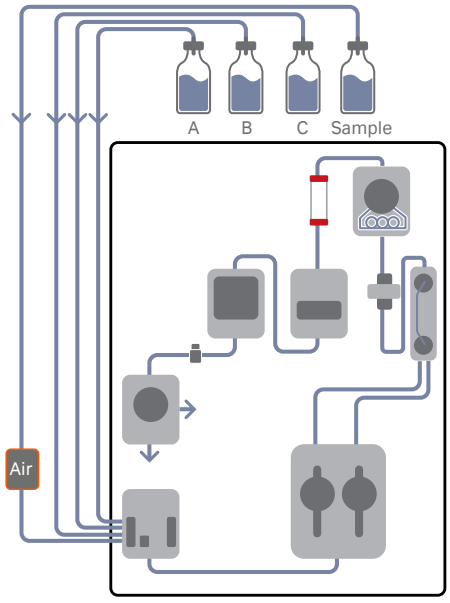
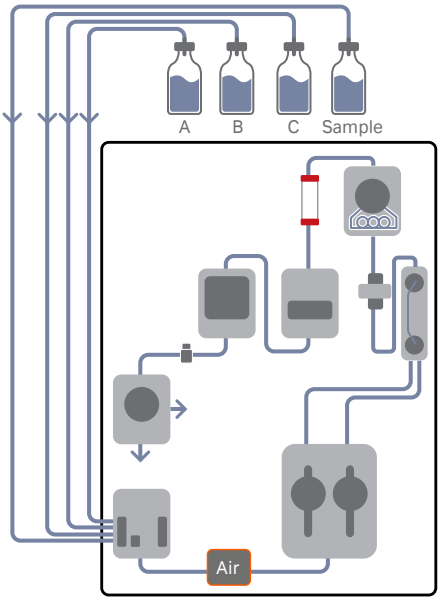
This section describes how the air sensors can be used on ÄKTA go.

In this section

3.2.1 Introduction

ÄKTA go can be equipped with one of two different air sensors, **L9-1.5** or **L9-1.2**. Air sensor **L9-1.5** can be used either for complete sample loading or to detect when a buffer is finished. **L9-1.5** is placed before the inlet valve for complete sample loading and between the inlet valve and the pump to detect when a buffer is finished. The two location options are illustrated below.

Air sensor **L9-1.2** can only be placed before the inlet valve for complete sample loading. It is not recommended to place the air sensor **L9-1.2** between the inlet valve and the pump.

Air sensor before inlet valve	Air sensor between inlet valve and pump
	

Note: *The location of the air sensor must be set in UNICORN during system configuration.*

3.2.2 Air sensor for complete sample loading

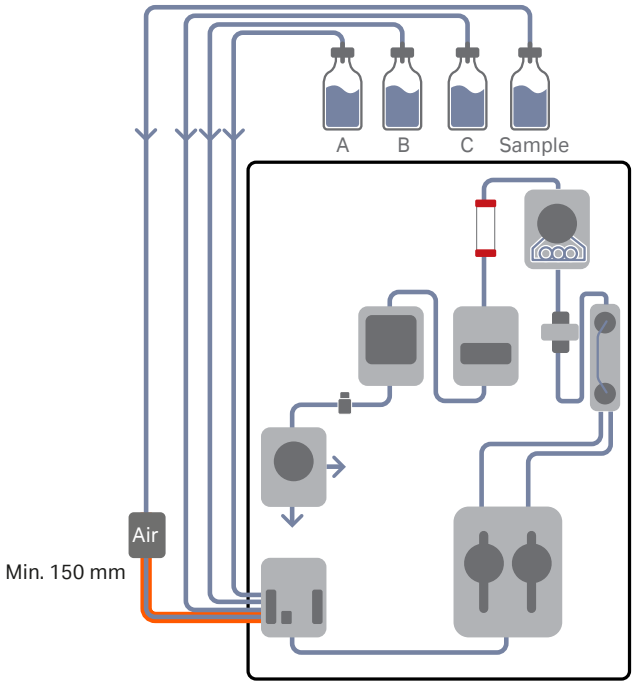
Introduction

For complete sample loading, place the air sensor **L9-1.5** or **L9-1.2** on the sample tubing connected to the **Sample** inlet on inlet valve **K9**. Disable the air sensor alarm in the method and program the method so that when air is detected in the flow path, sample loading stops and the sample remaining between the inlet valve and the column is loaded onto the column with the buffer from the **A** inlet. This is done by selecting ***Inject all sample using air sensor*** and then ***Finalize Sample Injection*** in the predefined method.

Note: *Do not connect the* **L9-1.2** *air sensor with narrow tubing o.d. 1/16" since the high flow rate during a pump wash might cause cavitation. Use connectors Union 1/16" Male, 5/16" Female fitting tubing connector, 5/16" + Ferrule (yellow), 1/8".*

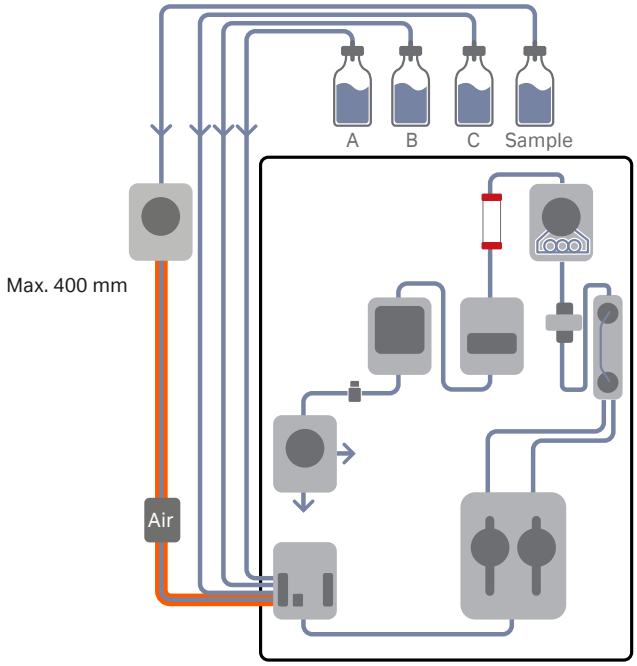
It is recommended to install the air sensor at a minimum distance of 150 mm from the inlet valve (the tubing is highlighted in the image below), when working at the maximum flow rate. This provides sufficient time for the system to stop the liquid flow before air enters the inlet valve.

Note: *If using a low flow rate, of 5 mL/min or less, a distance of 100 mm is enough.*



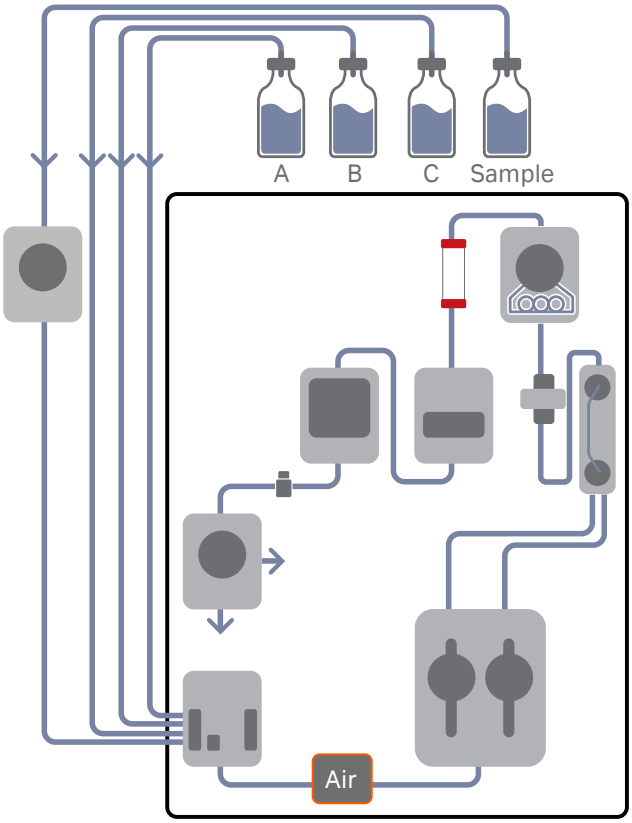
Air sensor for complete sample loading with optional sample inlet valve

It is possible to use the air sensor for complete sample loading with an additional sample inlet valve as well. This is useful when up to five different samples are loaded in a scouting run. When this function is used, the air between the additional sample inlet valve and inlet valve **K9** needs to be removed before the next sample is loaded. This is done using two pump washes, which are included in the predefined methods. One pump wash from the **Buffer** inlet in the sample inlet valve, followed by another pump wash from the **A** inlet. It is important that the distance from the sample inlet valve to inlet valve **K9** is not more than 400 mm (the tubing is highlighted in the image below), to make sure that the pump can remove the air in this flow path.



3.2.3 Air sensor to detect empty buffer bottles

To detect when a buffer bottle is empty, place the air sensor **L9-1.5** between the inlet valve and the pump.



To use the air sensor **L9-1.5** to detect when a buffer bottle is empty, the air sensor alarm needs to be activated. If using a predefined method, the air sensor alarm is activated by default. If performing a manual run, the ***Air sensor alarm*** is activated by the user in ***System Settings***. See *Section 7.5.5 System settings - Air sensor, on page 243* for details.

After replacing the empty bottle of buffer, prime the inlet tubing and perform a pump wash to remove the air from the flow path before continuing the run.

Note: *It is not recommended to place the air sensor between inlet valve* **K9** *and the pump for complete sample loading. This is because all sample in the flow path between the air sensor and the injection valve (up to 4 mL) is lost when the air is removed using a pump wash. If the air sensor is placed before inlet valve* **K9***, only the amount of sample present between the air sensor and inlet valve* **K9** *will be lost (approximately 0.3 mL).*

3.3 Fractionation overview

Introduction

ÄKTA go can be equipped with a Fraction collector, to collect fractions of the chromatographic separation.

If a Fraction collector is installed, the system can perform the following types of fractionation:

- Fixed volume fractionation
- Peak fractionation
- Combined fixed volume fractionation and peak fractionation

During fractionation there is a delay in retention between when the fractionation mark is seen in the UV to when the same liquid is dispensed in the Fraction collector. This is called the delay volume. The delay volume corresponds to the volume of the flow path from the UV monitor to the Fraction collector and must be dispensed before what is detected in the UV reaches the Fraction collector. The volume present in the flow path from the UV monitor to the Fraction collector when the first fractionation mark is shown in the chromatogram is called the pre-fractionation volume. The pre-fractionation volume has the same size as the delay volume. A default delay volume is set for the standard system. If anything is changed in the flow path from the UV monitor to the Fraction collector, the delay volume must be adjusted in ***System Settings***.

The Fraction collectors have a ***DropSync*** (drop synchronization) function that is used during low flow rates to synchronize movement after drop release. The ***DropSync*** settings differ between the two Fraction collectors.

DropSync in Fraction collector F9-T

The available settings are ***On***, ***Off***, and ***Auto*** for ***DropSync*** in Fraction collector **F9-T**. The flow rate limit for when drop synchronization works depends on the properties (for example viscosity) of the liquid, of the plate type used (distances between wells), and type of nozzle used (size of the drops). The ***Auto*** setting turns the drop synchronization on for flows below 3 mL/min, and turns it off for flows above 3 mL/min. This is done for all plate types except 96 deep well, where the limit is 5 mL/min.

Note: *These flow rates are optimized for water-based buffers and the standard nozzle. Do not use the* ***Auto*** *setting together with a micro nozzle because the micro nozzle only forms drops up to 1.5 mL/min.*

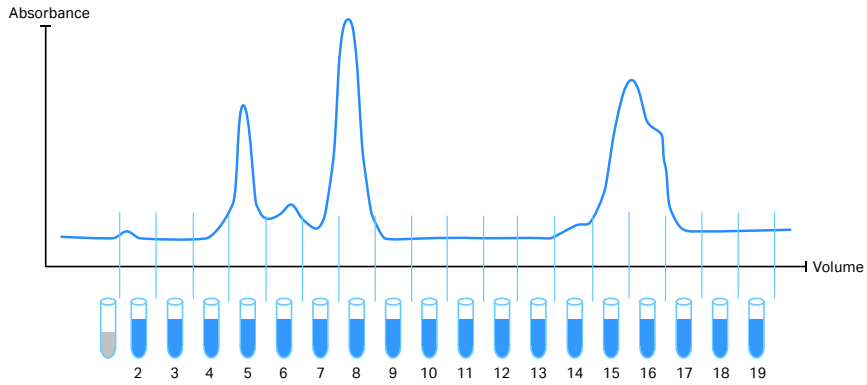
DropSync in Fraction collector F9-R

The available settings are, ***On*** and ***Off*** for ***DropSync*** in Fraction collector **F9-R**. It is recommended to use ***DropSync*** for flow rates below 2 mL/min. Higher flow rates can however be used, depending on the properties (for example viscosity) of the liquid.

Fixed volume fractionation

In fixed volume fractionation, the Fraction collector collects the set liquid volume and moves to the next tube.

The illustration below shows an example chromatogram from fixed volume fractionation. The fractions collected and the numerical marking of fractions are indicated.



Note: *The pre-fractionation volume is collected in the first tube of the Fraction collector F9-R. This is not indicated with a numerical fraction mark on the chromatogram.*

Note: *In Fraction collector* **F9-T** *the collection of pre-fractionation volume can be set in system settings. See* *Section 7.5.6 System settings - Fraction collection F9-T, on page 244* *for more information.*

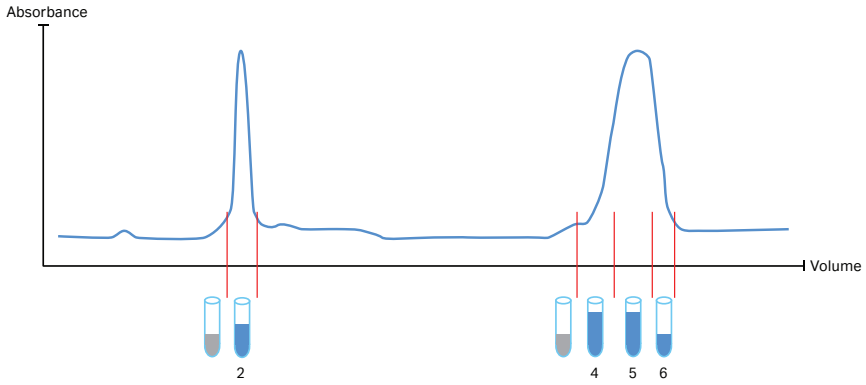
Peak fractionation

In peak fractionation, a peak detection algorithm uses the UV signal to determine when to start and stop fractionation. To allow for different parts of the peaks to be analyzed, the fraction size during elution can be set to a value smaller than the expected peak volume.

There are three different modes to perform peak fractionation – at level, at slope, or in a combination of the two. When separating a number of peaks that do not have a baseline separation, it is often useful to perform peak fractionation at slope. Use the default values for the first run. Adjust the method by examining the chromatogram from the run in the ***Evaluation*** module, refer to *UNICORN Evaluation manual*. In the ***Evaluation Classic*** module, it is possible to differentiate a curve to get the values of the slope.

Note: *When peak fractionation is used in Fraction collector* **F9-T***, the fraction collector moves to start position and waits for the peak in position. Collection of pre-fractionation volume is done using the settings chosen.*

The illustration below shows an example chromatogram of peak fractionation. The fractions collected and the numerical marking of fractions are indicated.



Combined fixed volume fractionation and peak fractionation

In combined fractionation, Fraction collector **F9-T** moves to the next position when a peak in the UV signal is detected, independently of the volume set in fixed volume fractionation. After the peak, fixed volume fractionation continues.

To allow for different parts of the peaks to be analyzed, the fraction size during elution can be set to a value smaller than the expected peak volume.

Collection of flow-through

To collect the liquid flow-through of a run, direct the liquid flow to one of the outlet ports of the outlet valve.

Note: *Predefined methods do not support collection of a peak or fixed volume fraction through outlet ports* **Out1-10**. *However, this can be done using a watch parameter in text programming.*

Collection of pre-fractionation volume

The pre-fractionation volume is the liquid volume present in the flow path from the UV detector to the Fraction collector when a fractionation command is issued. There is no waste vessel available in either Fraction collector **F9-T** or **F9-R**.

- In Fraction collector **F9-R**, the pre-fractionation volume is collected in the first tube in the Fraction collector.
- In Fraction collector **F9-T**, the pre-fractionation volume can be collected either together with the first fraction or in the tube/well before the first fraction.

For available settings for Fraction collector **F9-T**, see *Section 7.5.6 System settings - Fraction collection F9-T, on page 244*. The pre-fractionation volume equals the delay volume. See *Section 7.9 Delay volumes, on page 275* for examples of delay volumes and how to calculate the delay volume.

3.4 Performance optimization

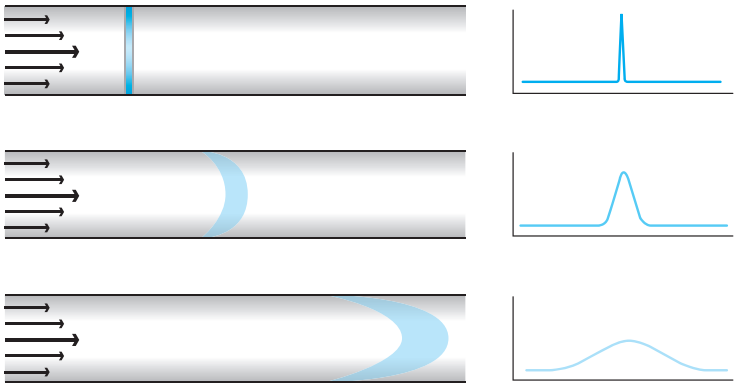
Introduction

This section gives a short description of how the internal volume of the system affects liquid transportation and protein purification results. For a more detailed description, see *Additional literature, on page 12*.

All components in the system must in some way be connected to each other with tubing. Excess internal volume will give unnecessary peak broadening, which results in dilution of the separated proteins, and decreased resolution (purity obtained). Peak broadening is due to the flow rate in the tubing being higher towards the middle, compared with the flow rate close to the walls of the tubing. The result is that a protein peak passing through the system will become broader as it moves through the tubing, as illustrated in the picture below. When using a narrow tubing, the run cannot be performed at the same flow rate as when using a wide tubing. Pressure generated by the liquid flow is increased when the tubing dimension is decreased.

This means that the tubing connecting the components of the system must always be as short as possible, and the dimensions of the tubing need to be appropriate for the dimensions of the column used.

The illustration below shows peak broadening. Liquid flows faster in the middle of a tube as compared to closer to the walls. The farther a protein peak passes through a tube, the broader it becomes, as depicted in the chromatograms shown on the right.

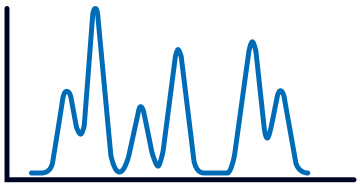
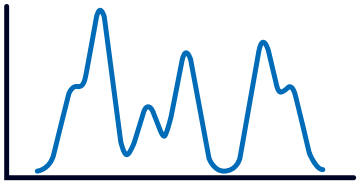


High resolution columns – low flow rate

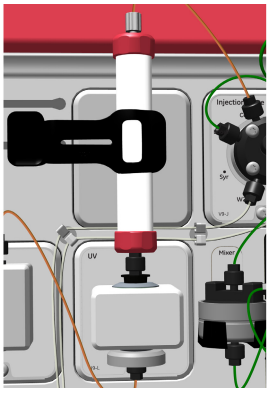
The relative system contribution to peak broadening will depend on both the bead size of the chromatography resin and the column dimensions. Small beads and narrow columns result in narrow peaks (a high-resolution column), whereas large beads and wide columns result in wide peaks. The system volume can contribute significantly to the peak broadening of a narrow peak, but will contribute almost nothing to a wide peak.

For high resolution columns, the tubing inner diameter after the column should be decreased to make sure the resolution obtained in the column is kept until the Fraction collector. This is true both for the tubing from the column to the UV monitor and for the tubing from the UV monitor to the Fraction collector. The volume inside the modules in this part of the flow path also matters. Therefore, all modules that are not in use should be removed from the flow path and the UV flow cell should be exchanged to that with the smallest inner volume, which is the 5 mm flow cell.

The illustration below shows the effect of peak broadening from the UV monitor to the Fraction collector of a high resolution column where the tubing is too long and too wide. Changing to thinner and shorter tubing will reduce this effect and keep the peaks separated in the Fraction collector.

Separation at UV monitor	Separation at Fraction collector
	

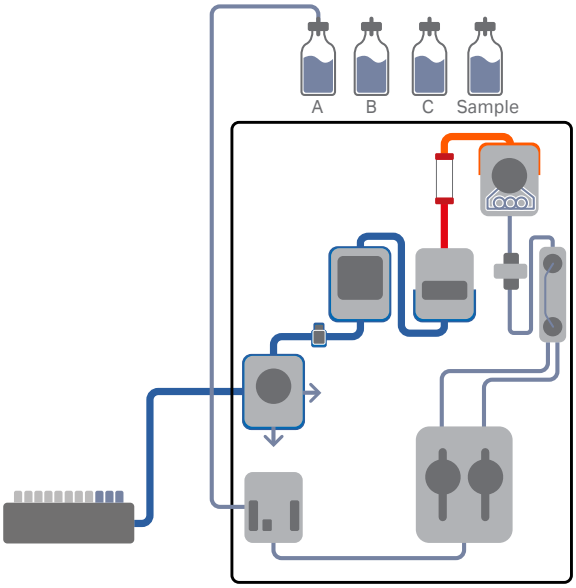
One way to minimize the volume between the column and UV monitor is to attach the column directly to the UV flow cell using a male/male fingertight connector (union 1/16"M / 1/16"M). When using this connection, use the multi-directional column clamp to hold the column.



Sample volume does not affect resolution in chromatography techniques involving adsorption of the target protein onto the column. Examples of such binding techniques are affinity chromatography (AC), ion exchange chromatography (IEX), and hydrophobic interaction chromatography (HIC). Size exclusion chromatography (SEC), however, is a non-binding chromatography technique, and a sample zone is therefore broadened during passage through the SEC column. As a result, the sample gets diluted, and the resolution will decrease with an increasing sample volume.

For high resolution SEC columns, the tubing inner diameter and length from the injection valve to the column should be decreased to minimize sample dilution due to band broadening before entering the column.

The illustration below shows the different parts of the flow path that are important to consider during high resolution chromatography. The volume from the injection valve to the column (orange) is only important in non-binding techniques, such as SEC. Whereas the volume from the column to the UV detector (red) and the volume from the UV to the Fraction collector (blue) is important in all high resolution chromatography techniques.



The table below shows the recommended tubing inner diameters (i.d.) for the tubing from the injection valve to the Fraction collector for certain column sizes.

Column diameter	Recommended tubing i.d.
≥ 7 mm	0.5 mm (standard in ÄKTA go)
4 or 5 mm	0.25 mm
3.2 mm	0.15 mm

It is important to remember that the generated back pressure increases dramatically when the tubing inner diameter decreases. Therefore, it is important to set an appropriate pressure alarm. Moreover, high resolution columns with narrow tubing must be run at lower flow rates not to exceed the pressure limits.

Large columns – high flow rate

To be able to run large columns at high flow rates, the tubing from injection valve to Fraction collector needs to be changed to tubing with wider inner diameter.

Column diameter	Recommended tubing i.d.
16 mm	0.5 mm (standard in ÄKTA go)
26 mm	0.75 mm or decreased flow rate
50 mm	Not recommended for ÄKTA go

3.5 UV monitor

Introduction

UV monitor **U9-L** measures the UV absorbance at the fixed wavelength of 280 nm. The signal measured by the UV monitor can be used to calculate the protein concentration of a sample, when working within its linear range (up to 2000 mAU). UV absorbance signals outside the linear range are not proportional to protein concentration.

The relationship between absorbance and concentration is described by Lambert-Beer's law:

$A = \varepsilon \times b \times c$

where,

A = absorbance, ε = extinction coefficient, b = cell path length, and c = concentration.

UV flow cells

The UV signal measured can be optimized according to the protein concentration of the sample used. If, for example, the protein concentration of the sample is low, the UV signal can be amplified by replacing the standard 2 mm UV flow cell with the optional 5 mm UV flow cell. See *Section 5.6.4 Replace the UV flow cell, on page 187* for instructions.

UV monitor **U9-L** can be installed with one of two available UV flow cells.

Flow cell path length	Internal flow cell volume	Description
2 mm	30 µL	Standard UV flow cell.
5 mm	20 µL	Optional UV flow cell. Can be used to amplify the UV signal measured.

If the UV flow cell is changed, the cell path length must be adjusted. For detailed instructions, see *Section 5.4.2 Calibrate the UV monitor U9-L, on page 160*.

3.6 System wash and pump wash

Introduction

Contrary to the similarity in names the system wash and the pump wash are designed for different uses. The system wash is used to fill the system with a chosen solution. The pump wash is used to wash the pump and the flow path between the pump and the injection valve.

System wash

The system wash fills the system with the chosen buffer. This can be used for example to change buffer concentration prior to an elution step.

Due to the design of ÄKTA go, the system wash consists of two parts. In the first part, the system is washed with 15 mL of buffer at the default flow rate of 25 mL/min. The flow rate can be changed in ***System Settings***. In the second part, the system is washed with a Post wash volume of buffer at the same flow rate as that used prior to the system wash. The default volume is 6 mL but can be changed in ***System Settings***. If running at a low flow rate, the system wash can take a long time to be completed.

During system wash, the system state is changed to ***Wash*** in the **Instrument Control Panel** and in UNICORN. Any method running during a system wash is set to ***Hold*** until the wash is completed. After the system wash is completed, the valves return to their previous positions.

The table below shows the system wash options available for different system configurations.

System configuration	Flow path
Standard	The liquid flow path is directed to waste on the injection valve.
Column valve installed	The liquid flow path can be directed to waste on the injection valve or outlet valve.[1] The column valve is by-passed.
Column valve and pH valve installed	The liquid flow path can be directed to waste on the injection valve or outlet valve.[1] The column valve and the pH valve are by-passed.

[1] This can be set in ***Manual instruction*** →***Pump*** →***System wash***.

Note: *An instruction issued during system wash is not performed until the wash is completed.*

Note: *A system wash cannot be performed when the system is in* ***Hold*** *state.*

Note: *Pressing* ***Continue*** *during a system wash terminates the wash and continues the run.*

Pump wash

The pump wash is used to wash the pump together with the flow path between the inlet valve and the injection valve. By default, the pump wash uses 65 mL of buffer at a flow rate of 65 mL/min, which is enough to remove sample from this section of the flow path.

For instructions on how to change the wash volume and flow rate, see *Wash settings, on page 69*.

3.7 Pressure alarms

Introduction

Pressure alarms can protect the instrument and the columns used from the pressure generated by the liquid flow. If the defined pressure limit is reached, pressure alarms stop the flow.

The pressure alarm is automatically set to 2 MPa, to provide basic column protection. However, to protect a column properly, it is recommended to set a pressure alarm adequate for the column used in each run.

To make sure the pressure is not too high, use pressure flow control. Pressure flow control regulates the flow rate to avoid overpressure and continue the run. See *Section 3.8 Pressure control, on page 100* for more information.

Measured pressure

The standard configuration of ÄKTA go has one pressure monitor. To measure the highest pressure in the system, the pressure monitor is placed after the pump.

When a column is selected in systems with only one pressure sensor, the pressure alarm is automatically set according to the table below. Recommended flow rates and pressure limits are found in the column list in UNICORN.

If pre-column pressure limit	Pressure alarm setting
≥ 1 MPa	The delta-column pressure limit is used.
< 1 MPa	The pre-column pressure limit is used.

When using a Superloop, a Superloop pressure alarm can be set to protect it. The Superloop pressure alarm uses the pressure signal, when the Superloop is in-line. This means that there can be two alarms set on the same pressure signal – one to protect the column and one to protect the Superloop. The lowest alarm limit will trigger the alarm. To set the alarm, see *Section 7.5.4 System settings - Pressure alarms, on page 241*.

WARNING
Cutting risk. Use the protective jacket and do not exceed the pressure specifications of the Superloop. Overpressure can cause the glass in the Superloop to break.

The Superloop pressure alarm is automatically set when using a Superloop in a predefined method. The pressure limits for each Superloop are indicated below.

Superloop volume (mL)	Pressure limit (MPa)
10	4

Superloop volume (mL)	Pressure limit (MPa)
50	4
150	2

Pre-column and delta-column pressure alarm

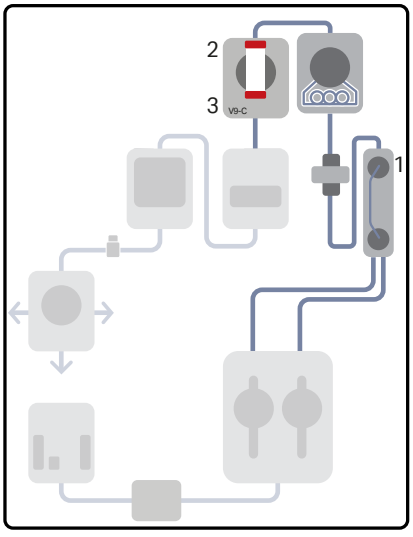
If the advanced column valve **V9-C** is installed, two additional pressure sensors are present: one before the column, and one after the column. In this case, pre-column and delta-column pressure alarms can be set. The pre-column pressure alarm protects the column hardware. The delta-column pressure alarm protects the resin and packed bed.

Pressure limits for each column are found in the column list in UNICORN. By default, pre-column and delta-column pressure alarms are automatically set when a column is selected in a method or manual run. To change these pressure alarms, see *Section 7.5.4 System settings - Pressure alarms, on page 241*.

Post-column pressure alarm

The post-column pressure alarm can protect the UV flow cell and the pH electrode from high pressure. If column valve **V9-C** is installed in the instrument, the default post-column pressure alarm is defined at 2 MPa. If pH valve **V9-pH** is also installed and the pH electrode is in-line, the default post-column pressure alarm is set to 0.8 MPa.

The location and description of the different types of measured pressure is presented below.



Part	Pressure type	Description
1	***Pressure***	Pressure measured after the pump.
2	***Pre Column Pressure*** (PreC)[1]	Pressure measured before the column. This is the pressure on the column hardware.
3	***Post Column Pressure*** (PostC)[1]	Pressure measured after the column.
N/A	***Delta Column Pressure*** (ΔP)[1]	The pressure difference between the pre-column pressure and post-column pressure. This is the pressure on the resin and packed bed.

[1] Pressure measured only when column valve **V9-C** is installed.

Note: *Since the tubing between the pressure monitor and the column is short, the difference between the pressure and the pre-column pressure is small.*

3.8 Pressure control

Introduction

Pressure control regulates the flow rate if the pressure reaches close to the defined limit. Pressure control can be used to avoid method stops due to pressure alarms, which can happen during sample application if the viscosity of the sample is higher than the buffer.

To enable pressure control when creating a method in the ***Method Editor***, select ***Control to avoid Overpressure*** in the ***Method Settings*** phase. To enable pressure control when performing a manual run, select ***Manual instructions*** →***Pump*** →***Flow*** in ***System Control***.

Pressure control parameters

Pressure control uses PI (proportional-integral) regulation. The PI parameters have default values but can be optimized for the chromatography method in use.

To optimize the PI parameters for pressure control, change the settings manually and test the new settings with a manual run. After optimization, set the PI parameters in ***System Settings*** →***Advanced*** →***Pressure control parameters***.

The table below describes the parameters used for pressure control.

Parameter	Description
P factor	Proportional component in PI pressure regulation. Reduces the error between the actual and the requested target pressure but may leave a permanent error.
I factor	Integrating component in PI pressure regulation. Eliminates the stationary error from the P factor but can introduce instability that may lead to oscillations in pressure and flow rate. To disable the I factor, set I = 0. ***Note:*** *As a general guide, use a small I factor for high-pressure columns and a large I factor for low-pressure columns.*
Target value for pressure control	Sets the target value for PI pressure regulation as a percentage of the pressure limit. The pressure limit is set in the ***Alarm pressure*** instruction. The ***Alarm pressure*** used for pressure control depends on the settings in the ***Flow*** instruction. ***Note:*** *If the target value is close to the pressure limit, a transient pressure pulse might trigger a pressure alarm.*

Parameter	Description
Min allowed flow rate	If the flow rate is reduced below the value set in ***Min allowed flow rate***, the method is paused and the system is set to state ***Alarms and errors***. ***Min allowed flow rate*** can be set as volumetric or as linear flow. A column type must be selected before using linear flow.

Recommended pressure control parameters

The table below contains the recommended values for P and I parameters for different resin types.

Resin type	P factor	I factor	Additional information
Default	8	40	N/A
Small soft resin columns (i.d. < 10 mm)	8	40	N/A
Large soft resin columns (i.d. > 10 mm)	8	300 to 600	Increase the I factor to decrease pressure ramp-up time.
Small rigid resin columns (e.g., SEC columns)	8	15	Decrease the I factor to avoid large fluctuations in pressure and flow rate. Alternatively, increase the P factor.
	20	40	

3.9 Performing a run in cold environment

When performing a run in a cold environment, pressure can increase up to 60%, compared to room temperature, due to increased liquid viscosity at low temperature.

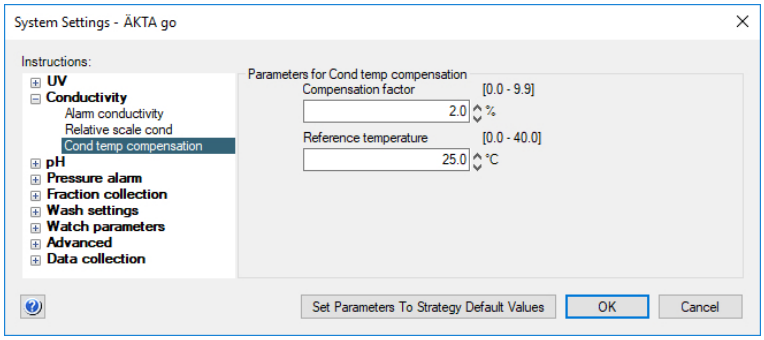
To protect a column when performing a run in a cold environment, decrease the flow rate and set appropriate pressure limits. To decreased the flow rate automatically, select ***Reduce for Cold Room*** in the ***Method Settings*** phase, in ***Method Editor***. This option reduces the flow rate to 50% of the flow rate previously set. Refer to *ÄKTA go Operating Instructions (29360951)* for more information and follow the precautions listed.

3.10 Conductivity temperature compensation

The conductivity of liquids is dependent on temperature. To compensate the temperature at which conductivity is measured, a ***Compensation factor*** can be set in ***System Settings***. The ***Compensation factor*** has two main uses. It allows you to get a comparable conductivity signal from two similar runs at different temperatures, and makes sure that the conductivity signal does not fluctuate due to temperature changes, such as in a refrigerator.

The compensation factor is expressed as the percentage of conductivity change per degree Celsius. The user can adjust the ***Compensation factor*** according to the composition of the buffer used. By default, ***Compensation factor*** is set to 2.0%, which can be used for common salt buffers.

Follow the steps below to set the compensation factor.

Step	Action
1	Open the ***System Settings*** dialog, by selecting ***System*** →***Settings*** in the ***System control*** module.
2	Select ***Conductivity*** →***Cond temp compensation***. 
3	Set ***Compensation factor*** to the relevant value.

Note: *Do not set the conductivity temperature compensation to zero. Especially when using the instrument in refrigerators, setting the temperature compensation to zero generates a fluctuating conductivity signal.*

Note: *For performance tests, use a compensation factor of 2.1%.*

4 Performance tests

About this chapter

Performance tests are used to test the function of ÄKTA go after installation or replacement of individual modules. Performance tests can also be used to check the condition of the system if unexpected results are obtained or after a prolonged stop.

This chapter describes the available performance tests for ÄKTA go. It contains information about when to run performance tests, detailed descriptions of the tests, and how to troubleshoot failed performance tests.

For instructions on how to run performance tests, refer to *ÄKTA go Operating Instructions (29360951)*. Detailed instructions for each test are provided in the performance test method notes in UNICORN.

In this chapter

4.1 When to run performance tests

Schedule

Performance tests can be run at any time, as required. The following table provides recommendations for when to run performance tests.

Occasion	Test
After system installation	Run the ***System test*** and ***Mixer test***. If you have installed additional modules that have performance tests, run the corresponding tests as well.
After module installation	Run the performance test applicable to the installed module.[1]
If a problem is suspected	Run the performance test applicable to the module or modules causing the problem.
After a prolonged stop	Run the ***System test*** and ***Mixer test***. If you have installed additional modules that have performance tests, run the corresponding tests as well.
If the ***System test*** fails due to the pump.	Run the ***System test*** or the ***Pump test*** after troubleshooting.

[1] Not all modules have an applicable performance test.

Considerations before running performance tests

Before running a performance test, the following aspects should be considered:

- Disconnect all columns from the flow path. Columns should not be used when running a performance test.
- Make sure that the correct path length is set for the UV flow cell. The correct path length is set by default, but has to be set if the UV flow cell is changed to a 5 mm UV flow cell. See *Section 5.4.2 Calibrate the UV monitor U9-L, on page 160*.
- Set the temperature compensation factor to 2.1%, which is suitable for a solution of 1 M NaCl 1% acetone. See *Section 3.10 Conductivity temperature compensation, on page 103* for instructions.

4.2 Description of performance tests

Introduction

This section provides a detailed description of performance tests.

All performance tests generate a chromatogram. The ***System test***, ***Mixer test***, ***Pump test***, and ***Column valve V9-C test*** generate a test report. The ***Fraction collector F9-R*** and ***Fraction collector F9-T test*** is evaluated visually.

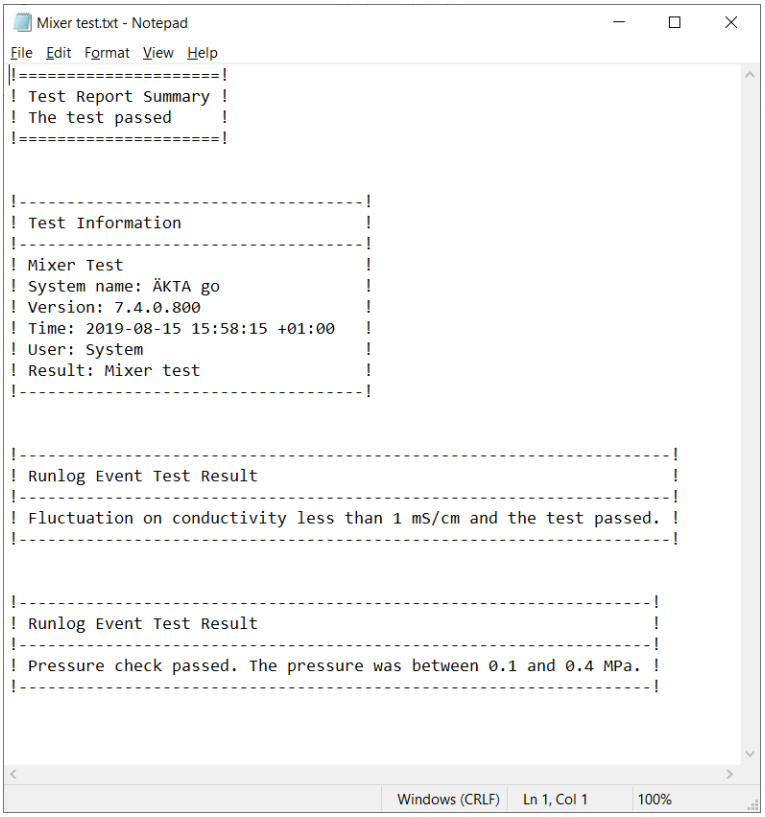
In this section

4.2.1 Test result and report

The performance test data are displayed in ***System Control*** as the test progresses. When completed, the result can be found in the ***Evaluation*** module. Test results are saved in the user home folder. A different destination folder can be set in ***Start Protocol***.

A test report is also generated specifying whether a performance test has passed or failed. This report file can be found in `C:\Program Files (x86)\Cytiva \UNICORN\UNICORN <version no>\Temp`. If printing is selected, the test report will be printed. By default the file name is the name of the test. A different name can be entered in ***Start Protocol***. The test result is stated at the top of the report. If the test was failed refer to respective test in *Section 4.3 Failed performance tests, on page 115*.

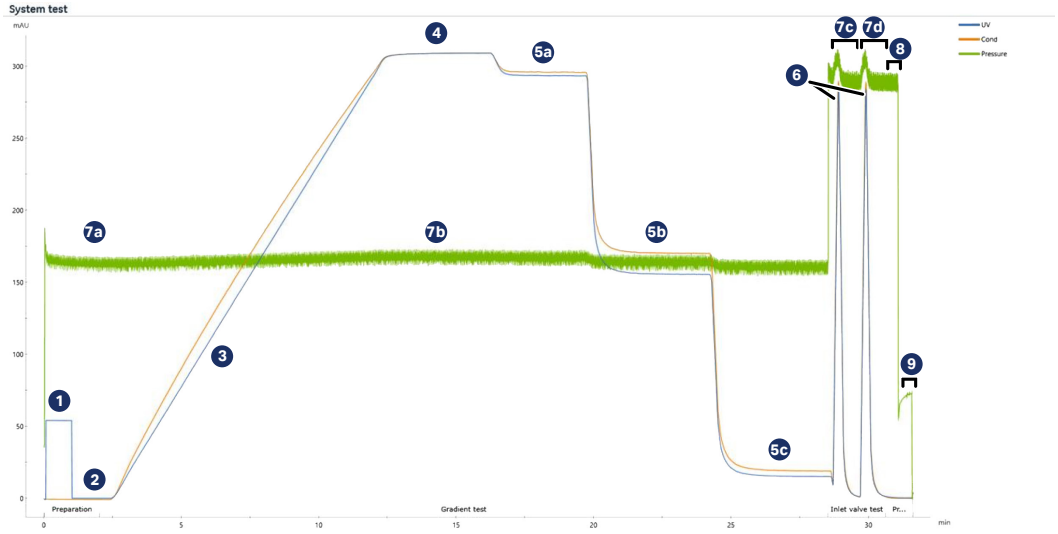
The example below shows the report from a ***Mixer test***.



4.2.2 System test

The ***System test*** is used to verify the functionality of the inlet valve, pump, pressure monitor, UV monitor, conductivity monitor, and flow restrictor.

The following chromatogram shows an example of a ***System test*** that has passed.

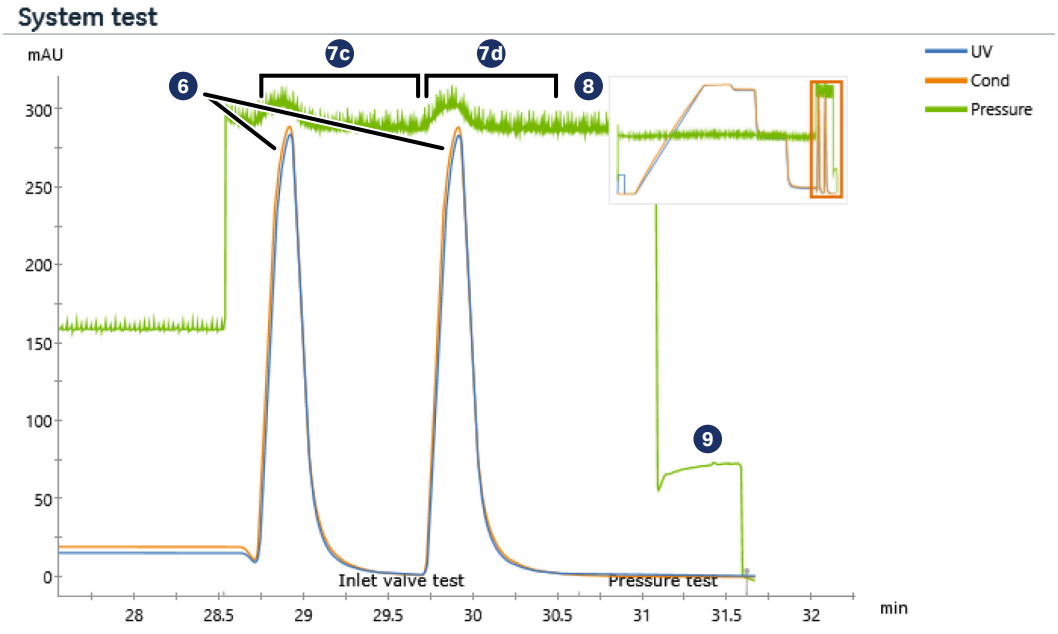


The main stages of the ***System test*** indicated in the chromatogram are described below.

Stage	Test	Description
1	UV signal before auto zero	Determines correct mounting of the UV flow cell
2	UV noise test and absolute deviation from zero	Tests the function of the UV monitor
3	Gradient test	Tests the pump, UV monitor, and inlet valve, by measuring the UV signal during linear gradient formation.
4	UV absorbance test and Conductivity test at 100% B	• Tests that the correct path length is set for the UV flow cell and tests the function of inlet valve port **B**, by comparing the UV signal with a theoretical value. • Tests the calibration and function of the conductivity monitor, by comparing the conductivity signal with a theoretical value.

Stage	Test	Description
5a-5c	Step response test and Conductivity test at 50%	• Tests the pump, UV monitor, and inlet valve port **B** at the 95% (5a), 50% (5b), and 5% (5c) steps, by measuring the UV signal. • Tests the conductivity monitor and inlet valve at the 50% step (5b), by measuring the conductivity signal.
6	Peak test	Tests the inlet valve by comparing the conductivity curves from inlet valve ports **C** and **Sample**.
7a-7d	Pump pulsation test	Checks whether air has entered the flow path, by measuring the pressure signal when different inlets are in use: **A** inlet (7a), **B** inlet (7b), **C** inlet (7c), and **Sample** inlet (7d).
8	Pressure check at 25 mL/min	Tests flow restrictor function, pressure monitor calibration, and system tubing, by applying a 25 mL/min flow rate throughout the system.
9	Pressure check at 1 mL/min	Tests flow restrictor function.

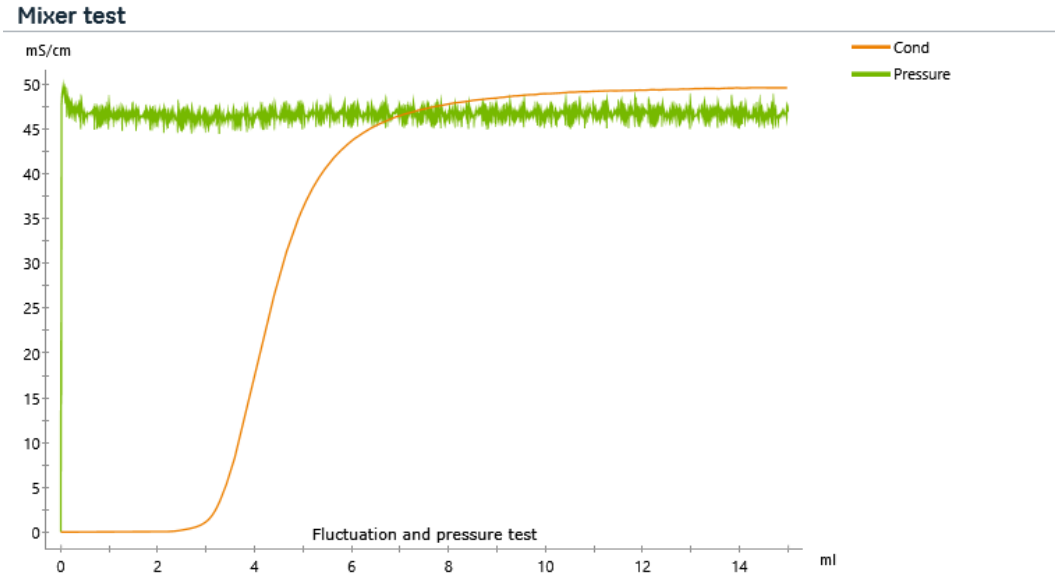
The following image shows an amplified view of the last section of the chromatogram above.



4.2.3 Mixer test

The ***Mixer test*** is used to verify the functionality of the mixer in combination with the inlet valve and the pump. The mixer performance test checks pressure and conductivity fluctuations, during gradient formation. A functional mixer maintains a stable conductivity signal.

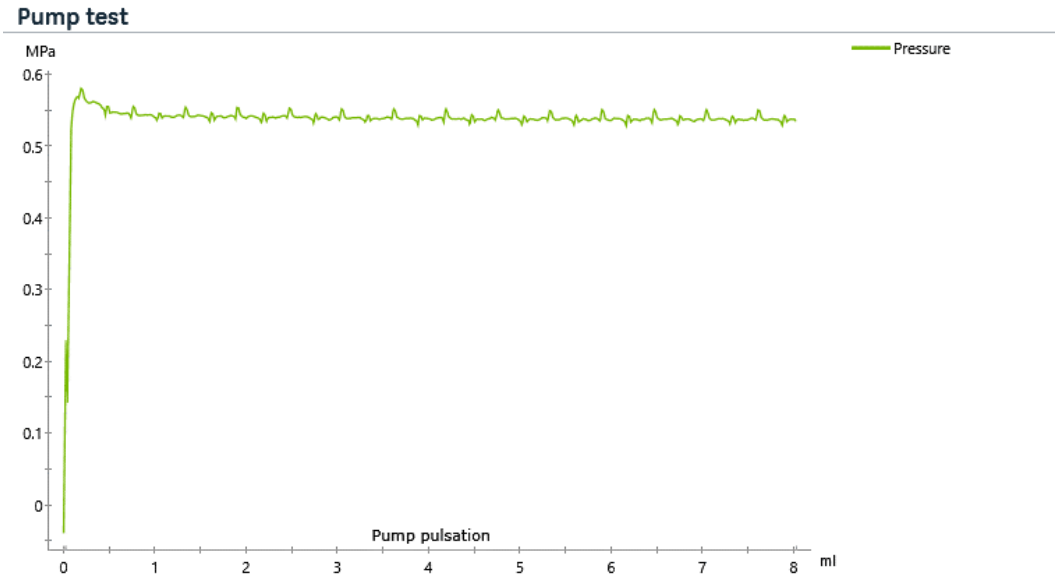
The illustration below shows a chromatogram from a ***Mixer test*** that has passed.



4.2.4 Pump test

The ***Pump test*** verifies the functionality of the pump by checking pressure stability. This test can be run after troubleshooting of the pump.

The illustration below shows a chromatogram of a passed ***Pump test***.

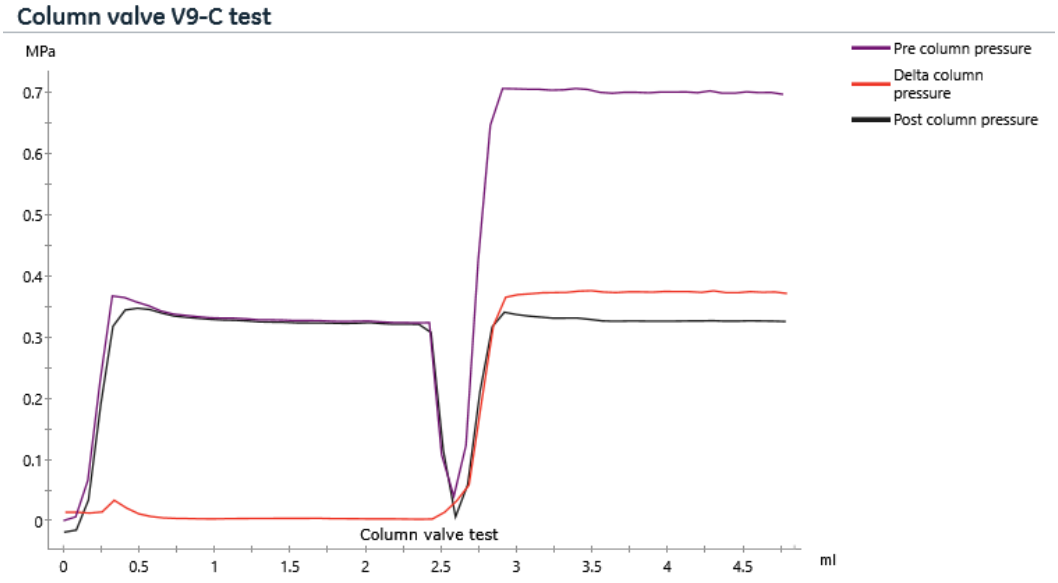


4.2.5 Column valve V9-C test

The ***Column valve V9-C test*** checks the pressure sensors in column valve **V9-C**. Functional pressure sensors detect pressure changes when the column valve rotates and the liquid flow passes through the **Ref 1** tubing mounted on the column valve.

Note: *The* **Ref 1** *tubing is supplied with column valve* **V9-C**.

The illustration below shows a chromatogram of a passed ***Column valve V9-C test***.



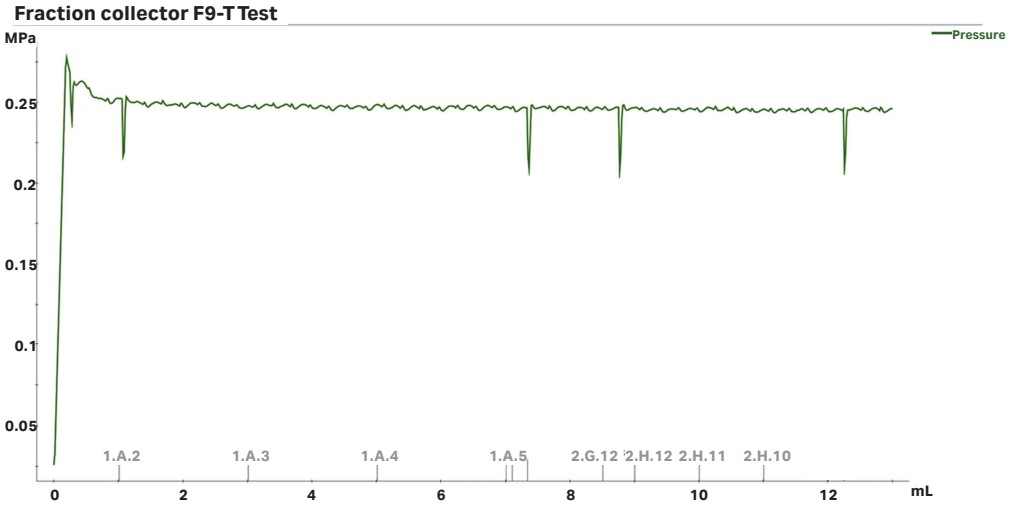
4.2.6 Fraction collector F9-T test

The ***Fraction collector F9-T test*** checks that the fraction collector works as required, by testing correct liquid dispensing into wells and liquid spillage.

The table below shows the volumes dispensed in the corresponding wells. Two 96 deep well plates are used in the ***Fraction collector F9-T test***.

Well	Volume
1.A.1	Pre-fractionation volume
1.A.2, 1A.3, 1.A.4	2 mL
2.H.12, 2.H.11, 2.H.10	1 mL
1.A.5, 2.G.11, 2.G.12, 2.H.9	Small volume, no need to check

The illustration below shows a chromatogram of a passed ***Fraction collector F9-T test***. The fractionation marks at the bottom of the chromatogram correspond to the filled wells.

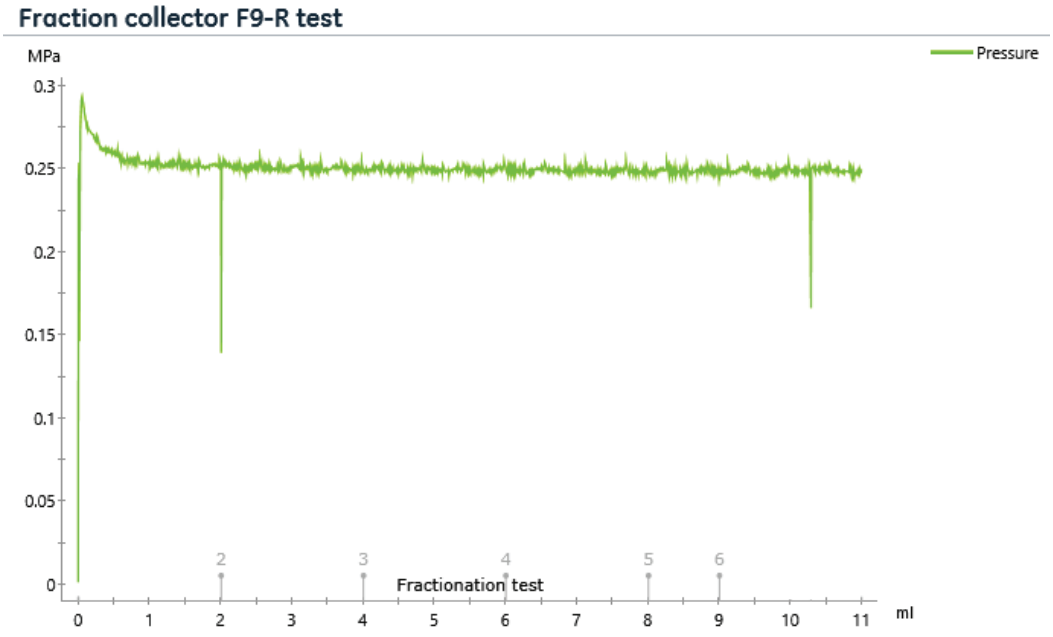


4.2.7 Fraction collector F9-R test

The ***Fraction collector F9-R test*** checks that the Fraction collector works as required, by testing correct liquid dispensing into collection tubes and liquid spillage. The table below shows the volumes dispensed and the corresponding tubes.

Tube number	Volume
1	Pre-fractionation volume
2–4	2 mL
5–6	1 mL

The illustration below shows a chromatogram of a passed ***Fraction collector F9-R test***. The fractionation marks at the bottom of the chromatogram correspond to the filled tubes.



4.3 Failed performance tests

Introduction

If a performance test fails, see the corresponding section to check and correct the possible causes of the failure. If a failed performance test cannot be corrected by performing the suggested actions or the test indicates a type of malfunction not listed below, the module might have to be repaired or replaced. Contact your local Cytiva representative regarding this.

In this section

4.3.1 System test failure

Introduction

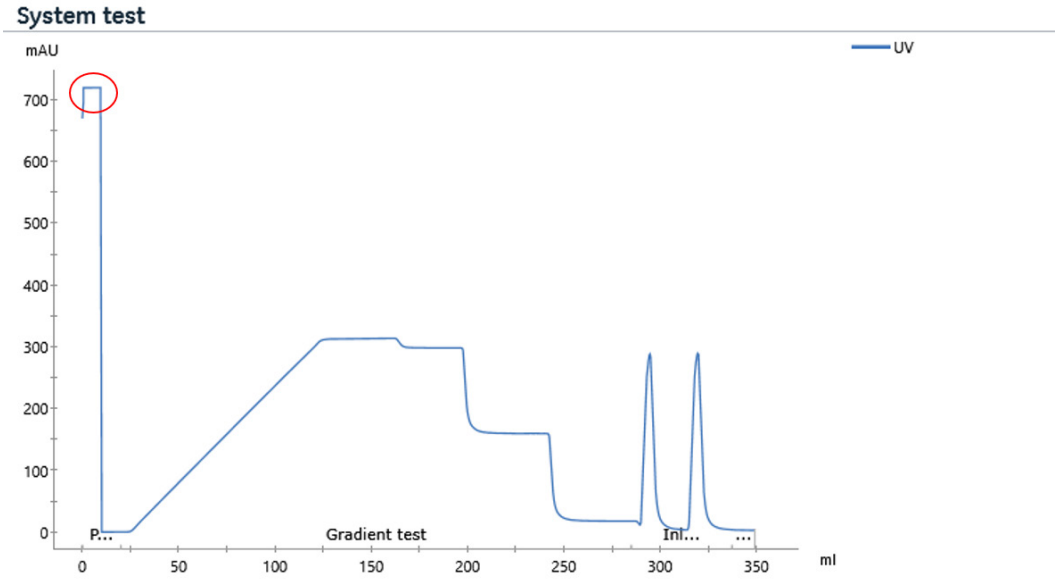
A failed ***System test*** indicates a malfunction of ÄKTA go. Review the test report to check which part of the test failed and check the corresponding section below for possible causes of the failure. After performing the suggested corrective actions, verify that the issue is fixed by running the ***System test*** again.

Note: *It is important that the correct solution concentrations (1.0% (v/v) acetone and 1.0 M NaCl) are used in the* ***System test*** *and that the solutions are thoroughly mixed.*

UV signal before auto zero failed

Test outcome	Possible cause	Action
High UV signal	UV flow cell not properly attached to the UV monitor	Make sure that the UV flow cell is properly attached to the UV monitor.
	Incorrect UV cell path length set in UNICORN	See *Section 5.4.2 Calibrate the UV monitor U9-L, on page 160*.

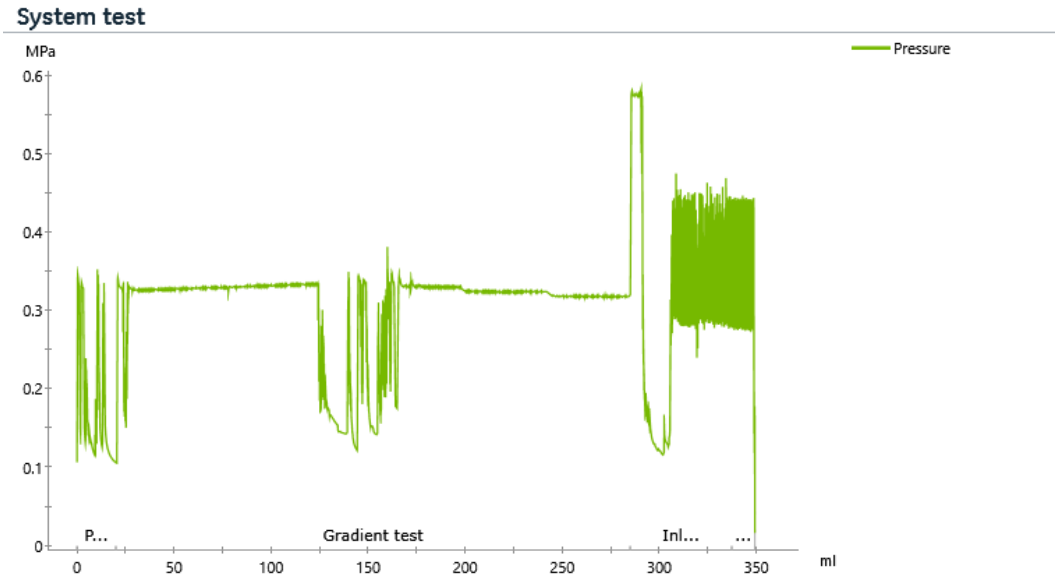
The chromatogram below shows an example of a failed system performance test caused by a UV flow cell not properly attached to the UV monitor.



Pump pulsation test failed

Test outcome	Possible cause	Action
Unstable pressure	Air in the pump or faulty pump	Make sure that the tubing is correctly connected to the inlet valve and connectors are tightened. Prime and purge the pump, according to the *Operating Instructions*, before starting the test. If air persists in the pump, run the system with 100% methanol to remove the air in the pump. If the problem persists, change the pump piston seals. See *Replace piston, piston seal, and rinse membrane, on page 178*.

The chromatogram below shows an example of a failed ***System test*** due to air in the pump.



UV noise test failed

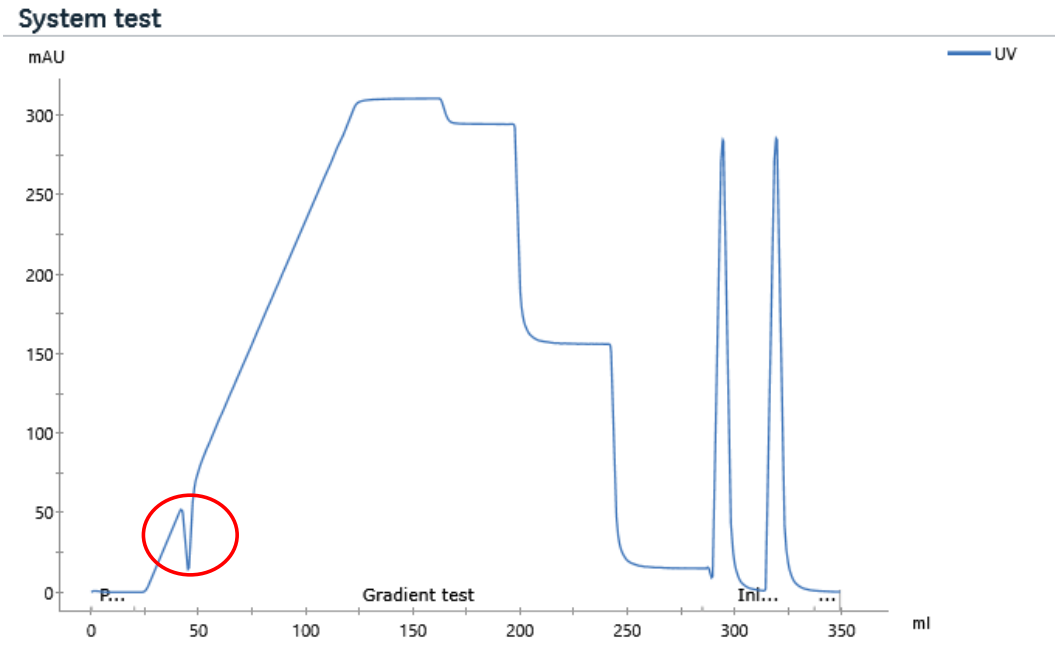
Test outcome	Possible cause	Action
High UV signal noise	Air in the UV flow cell or clogged UV flow cell	Clean the UV flow cell. See *Clean the UV flow cell, on page 145*.

Test outcome	Possible cause	Action
	Air in the UV flow cell due to uninstalled or faulty flow restrictor	Add or replace the flow restrictor. See *Instruction, on page 189*.
	Contaminated buffers	Check the buffers.
	Faulty electronics in the UV monitor	Replace the UV monitor.

Gradient test failed

Test outcome	Possible cause	Action
Non-linear UV signal	Air in the pump or faulty pump	Make sure that the tubing is correctly connected to the inlet valve and connectors are tightened. Prime and purge the pump, according to the *Operating Instructions*, before starting the test. If air persists in the pump, run the system with 100% methanol, to remove the air in the pump. If the problem persists, change the pump piston seals. See *Replace piston, piston seal, and rinse membrane, on page 178*.
	Air in the UV flow cell due to uninstalled or faulty flow restrictor	Add or replace the flow restrictor. See *Instruction, on page 189*.
	Damaged pump piston seals	Replace pump piston seals. See *Replace piston, piston seal, and rinse membrane, on page 178*.
	Faulty UV monitor	Clean the UV flow cell following the instructions in *Clean the UV flow cell, on page 145*. If the problem persists contact service to repair or replace the UV monitor.

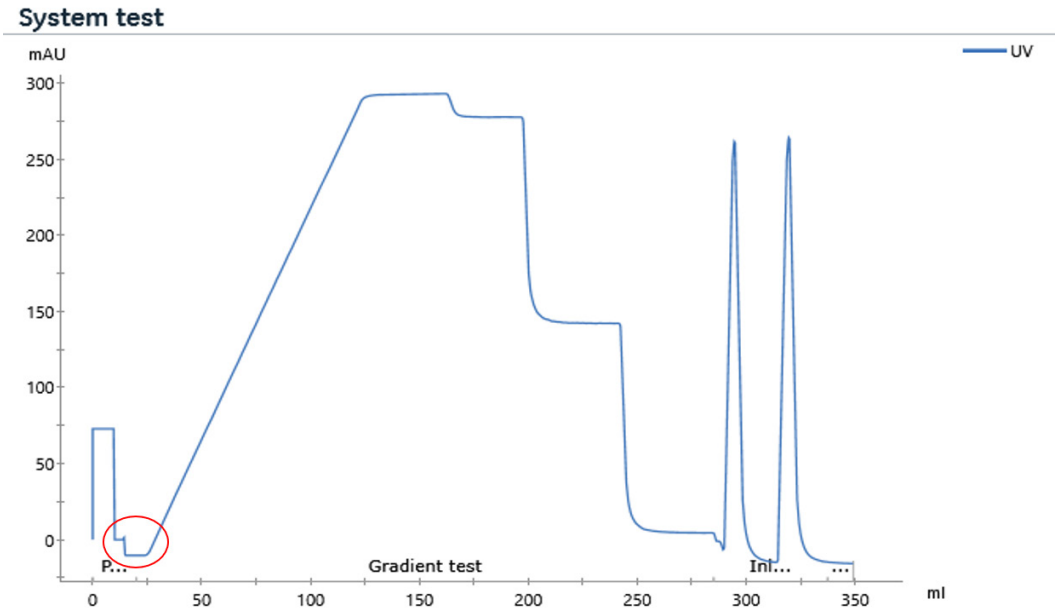
The chromatogram below shows an example of a failed ***System test*** caused by air in tubing **B**.



Absolute deviation from zero failed

Test outcome	Possible cause	Action
Drifting UV signal baseline.	Air in the UV flow cell or clogged UV flow cell	Clean the UV flow cell. See *Clean the UV flow cell, on page 145*. If the problem persists, contact service.
Spikes or steep decreases in the UV signal.	Air in the system	Prime buffer inlets and purge the pump according to the *Operating Instructions*.
	Air in the UV flow cell due to uninstalled or faulty flow restrictor	Add or replace the flow restrictor. See *Instruction, on page 189*.

The chromatogram below shows an example of a ***System test*** failed due to UV signal deviating from zero.



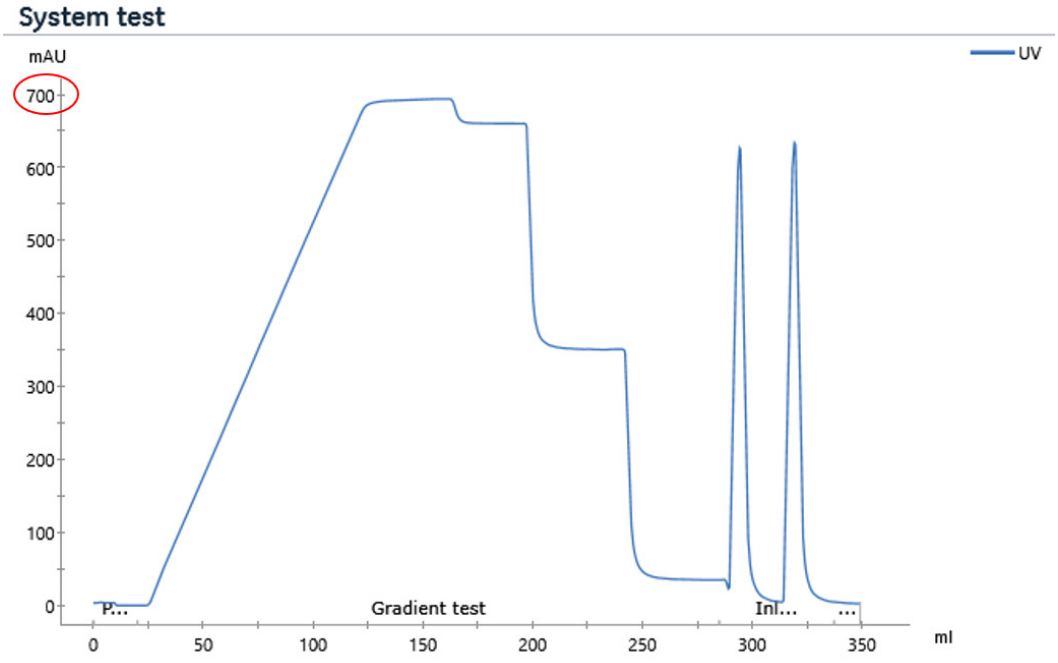
Step response test failed

Test outcome	Possible cause	Action
All values failed	Air in the pump or faulty pump	Prime buffer inlets and purge the pump, according to the *Operating Instructions*, before starting the test. Clean the UV flow cell. See *Clean the UV flow cell, on page 145*. If air persists in the pump, run the system with 100% methanol, to remove the air in the pump. If the pump is faulty, see *Instruction, on page 184*.
Failed values at 5%	Damaged inlet valve **K9** or loose connector in the **B** inlet	Check tubing connections to the inlet valve or replace the inlet valve. See *Section 5.6.1 Replace ÄKTA go modules, on page 183*.
Failed values at 50%	Damaged inlet valve **K9** or loose connector in the **A** or **B** inlets	
Failed values at 95%	Damaged inlet valve **K9** or loose connector in the **A** inlet	

UV absorbance test failed

Test outcome	Possible cause	Action
High UV signal amplitude deviation.	Incorrectly prepared acetone solution	Make sure that the used acetone solution is 1.0% (v/v) and that no liquid has evaporated.
	Incorrect UV cell path length set in UNICORN	Set the UV cell path length in UNICORN. See *Section 5.4.2 Calibrate the UV monitor U9-L, on page 160* for instructions.

The chromatogram below shows an example of a failed ***System test*** due to incorrectly set UV cell path length. In this example, the cell path length has been set to 2 mm in the software, but a 5 mm UV cell is in use on the system.

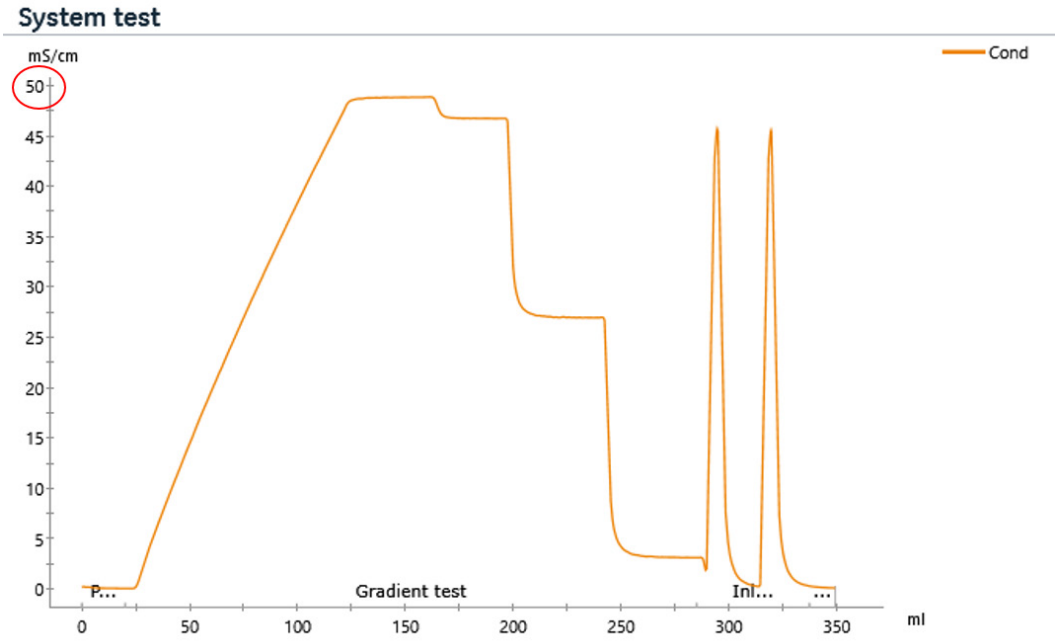


Conductivity test at 100% failed or conductivity test at 50% failed

Test outcome	Possible cause	Action
High conductivity signal amplitude deviation.	Incorrectly prepared NaCl solution	Make sure that the concentration of the NaCl solution is 1.0 M.

Test outcome	Possible cause	Action
	Incorrect calibration of the conductivity monitor	See *Section 5.4.3 Calibrate the conductivity monitor, on page 165*.
	Faulty or dirty conductivity monitor	Clean the conductivity flow cell following the instructions in *Section 5.3.4 Maintenance of the conductivity flow cell, on page 147*. If the problem persists contact service to repair or replace the conductivity monitor.
	Incorrect ***Cond temp compensation factor*** value	Make sure the conductivity temperature compensation factor is turned on. Use 2.1% when running performance tests.
	Damaged inlet valve **K9** or loose connector in the **B** inlet	Check tubing connections to the inlet valve or replace the inlet valve. See *Section 5.6.1 Replace ÄKTA go modules, on page 183*

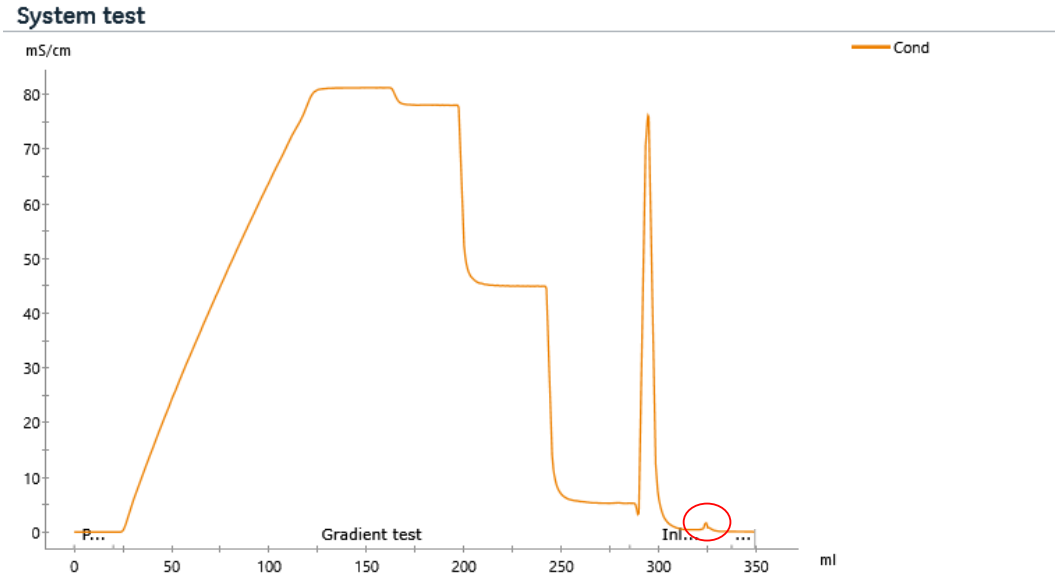
The chromatogram below shows an example of a failed ***System test*** due to incorrect calibration of the conductivity monitor.



Peak test failed

Test outcome	Possible cause	Action
Conductivity peaks not proportional	Air in the pump or faulty pump	Prime buffer inlets and purge the pump, according to the *Operating Instructions*, before starting the test. Clean the UV flow cell. See *Clean the UV flow cell, on page 145*. If air persists in the pump, run the system with 100% methanol, to remove air in the pump. If the pump is faulty, see *Instruction, on page 184*.
	Damaged inlet valve **K9** or loose connectors on the **C** inlet or **Sample** inlet	Check tubing connections to the inlet valve or replace the inlet valve. See *Section 5.6.1 Replace ÄKTA go modules, on page 183*.

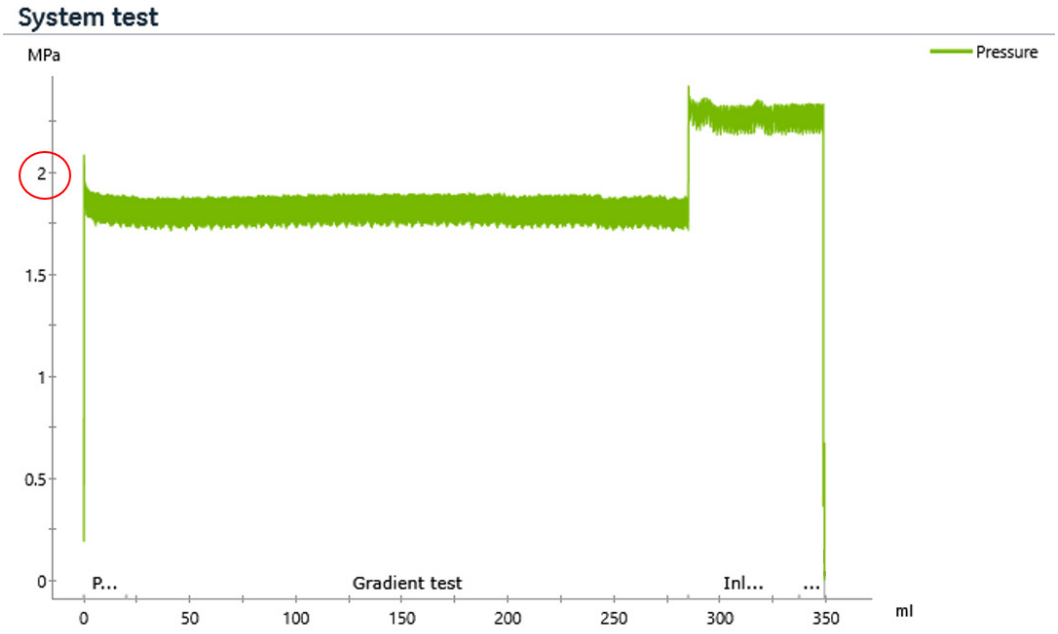
The chromatogram below shows an example of a failed ***System test*** due to a loose sample tubing connector.



Pressure check at 25 mL/min flow rate failed

Test outcome	Possible cause	Action
High pressure	Folded, twisted, or blocked tubing	Check the tubing.
	Incorrect calibration of the pressure sensors	Calibrate the pressure sensors. See *Section 5.4.1 Calibrate the pressure sensors, on page 158*.
	High back pressure from the flow restrictor	Clean or adjust the flow restrictor. If the problem persists, replace the flow restrictor. See *Section 5.3.5 Maintenance of the flow restrictor, on page 149*.

The chromatogram below shows an example of a failed ***System test*** due to high back pressure from the flow restrictor.



Pressure check at 1 mL/min flow rate failed

Test outcome	Possible cause	Action
Pressure outside of range	Low back pressure from the flow restrictor	Clean or adjust the flow restrictor. If the problem persists, replace the flow restrictor. See *Section 5.3.5 Maintenance of the flow restrictor, on page 149*.
	Leakage in the flow path	Make sure that all tubing are properly attached.

4.3.2 Mixer test failure

Introduction

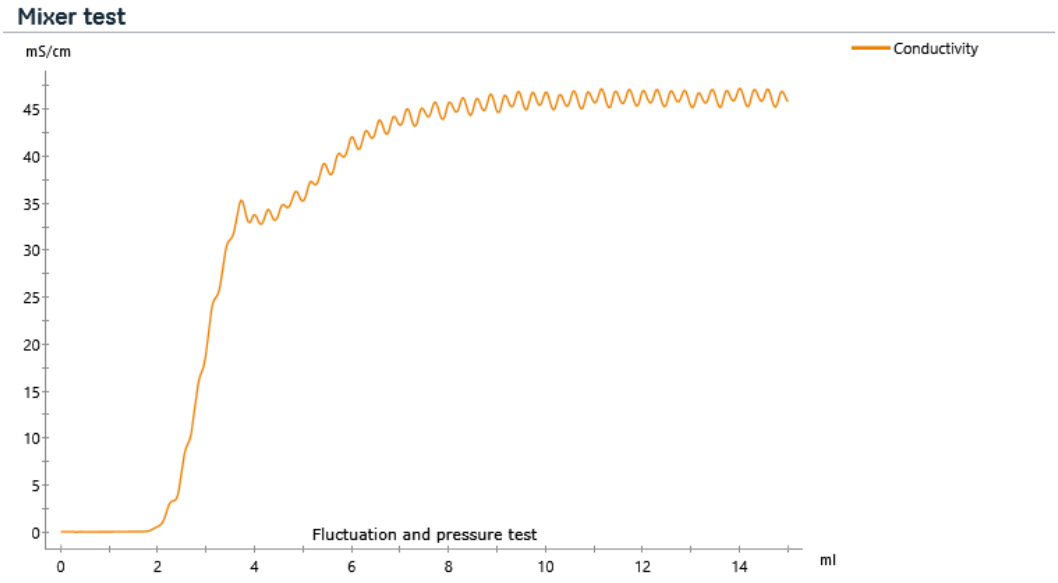
A failed ***Mixer test*** indicates a malfunction of the mixer. Review the test report to check which part of the test failed and check the corresponding section for possible causes of the failure. After performing the suggested corrective actions, verify that the issue is fixed by running the ***Mixer test*** again.

Note: *It is important that the correct solution concentrations (1.0% (v/v) acetone and 1.0 M NaCl) are used in the* ***Mixer test*** *and that the solutions are thoroughly mixed.*

Conductivity fluctuation test failed

Test outcome	Possible cause	Action
High conductivity signal fluctuation	Clogged mixer	Clean the mixer and install the online filter. If the online filter is already installed, replace the filter. See *Section 5.3.2 Maintenance of the mixer, on page 142* and *Section 5.6.8 Replace the online filter, on page 193*.
	No membrane in the mixer	Make sure that a membrane is mounted in the mixer. See *Section 5.3.2 Maintenance of the mixer, on page 142*.

The chromatogram below shows an example of a failed ***Mixer test*** due to absence of membrane in the mixer.



Pressure check failed

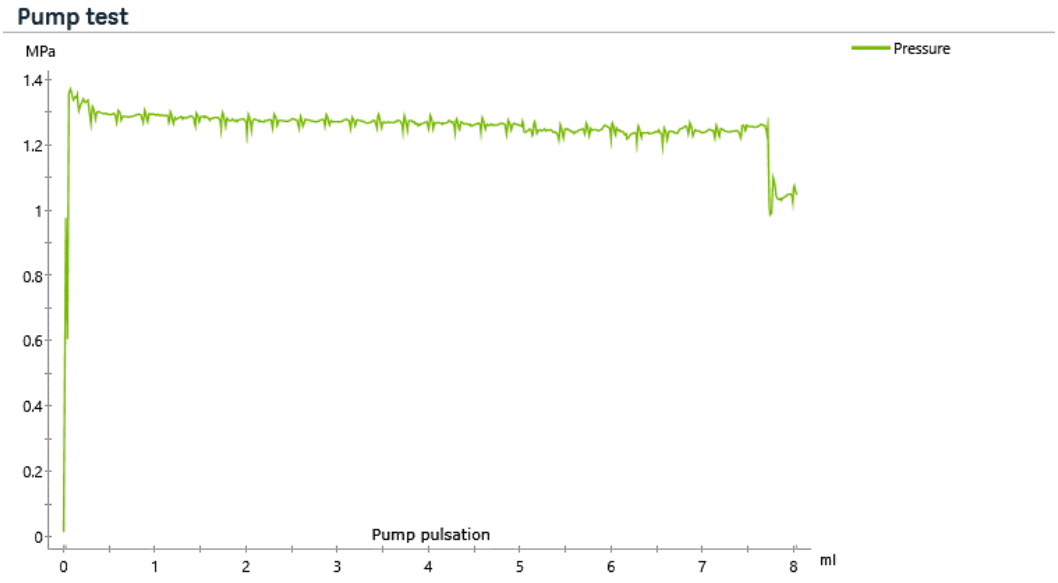
Test outcome	Possible cause	Action
High pressure	Incorrect calibration of the pressure sensors	Calibrate the pressure sensors. See *Section 5.4.1 Calibrate the pressure sensors, on page 158*.
	Folded, twisted, or blocked tubing	Check the tubing and replace if necessary.
	Clogged mixer	Clean the mixer and install the online filter. If the online filter is already installed, replace the filter. See *Section 5.3.2 Maintenance of the mixer, on page 142* and *Section 5.6.8 Replace the online filter, on page 193*.
	Clogged online filter	Replace the online filter. See *Section 5.6.8 Replace the online filter, on page 193*.

4.3.3 Pump test failure

A failed ***Pump test*** indicates a malfunction of the pump. Check the table below for possible causes of the failure. After performing the suggested corrective actions, verify that the issue is fixed by running the ***Pump test*** again.

Test outcome	Possible cause	Action
High pressure and/or increased pressure fluctuation	Erratic pump pressure	Refer to *Section 5.5.1 Maintenance of the pump head check valves, on page 172* for cleaning or replacing the pump head check valves. If the problem persists, refer to *Instruction, on page 184* for pump replacement instructions.
	Folded, twisted, or blocked tubing	Check the tubing and replace if necessary.
	Incorrect calibration of the pressure sensors	Calibrate the pressure sensors. See *Section 5.4.1 Calibrate the pressure sensors, on page 158*.
	High back pressure from the flow restrictor	Clean or adjust the flow restrictor. If the problem persists, replace the flow restrictor. See *Section 5.3.5 Maintenance of the flow restrictor, on page 149*.
Unstable pressure	Air in the pump or faulty pump	Make sure that the tubing is correctly connected to the inlet valve and connectors are tightened. Prime and purge the pump, according to the *Operating Instructions*, before starting the test. If air persists in the pump, run the system with 100% methanol, to remove air in the pump. If the problem persists, change the pump piston seals. See *Replace piston, piston seal, and rinse membrane, on page 178*.

The chromatogram below shows an example of a failed ***Pump test*** due to high back pressure from the flow restrictor.



4.3.4 Column valve V9-C test failure

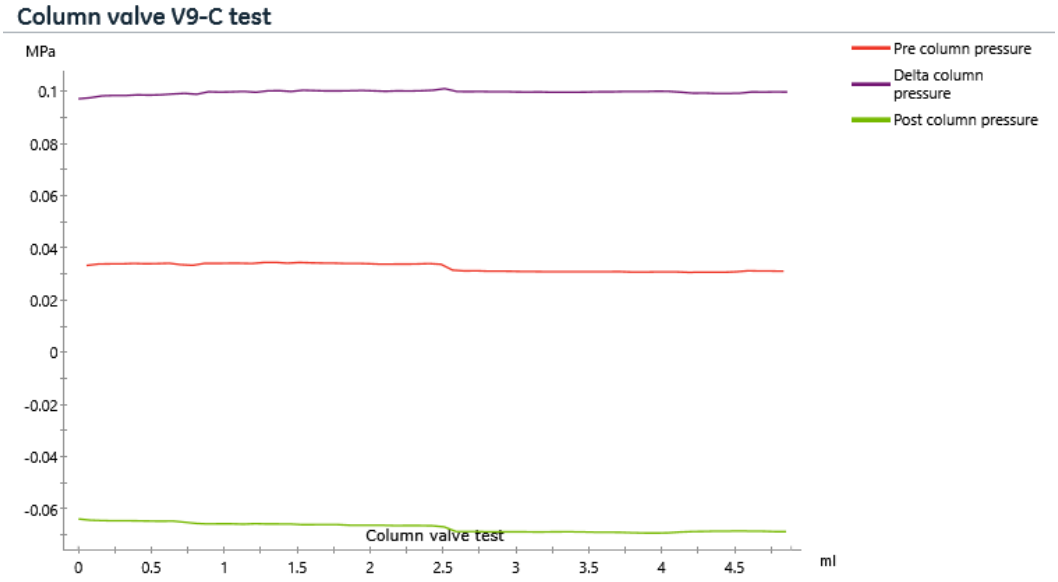
Introduction

A failed ***Column valve V9-C test*** indicates a malfunction of column valve **V9-C**. Review the test report to check which part of the test failed and check the corresponding section for possible causes of the failure. After performing the suggested corrective actions, verify that the issue is fixed by running the ***Column valve V9-C test*** again.

Failed pre-, post-, and delta-column pressure tests

Test outcome	Possible cause	Action
Below minimum or no pressure change	Incorrect calibration of the integrated pressure sensors	Calibrate the integrated pressure sensors. See *Section 5.4.1 Calibrate the pressure sensors, on page 158*.
	Incorrect system preparation for the performance test	Make sure that the **Ref1** reference tubing is connected between the column valve ports **1A** and **1B**. ***Note:*** *If a pH monitor is connected, make sure the flow restrictor is in-line.*
	Faulty column valve	Replace the column valve following the instructions in *Section 5.6.1 Replace ÄKTA go modules, on page 183*. For repair of the column valve contact service.

If a faulty column valve cannot rotate to the correct positions, no pressure is generated. The chromatogram below shows an example of a failed ***Column valve V9-C test*** due to a faulty column valve.

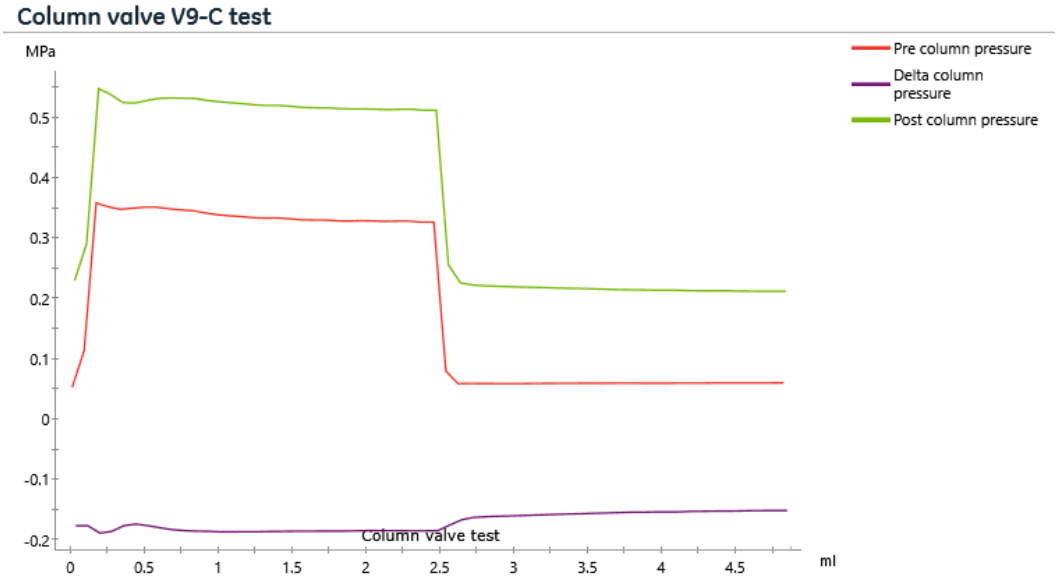


Note: *Damaged pressure sensors can give similar results.*

Failed delta-column pressure test

Test outcome	Possible cause	Action
Below minimum or no pressure change	Incorrect calibration of the integrated pressure sensors	Calibrate the integrated pressure sensors. See *Section 5.4.1 Calibrate the pressure sensors, on page 158*.
	Incorrect system preparation for the performance test	Make sure that the reference tubing **Ref 1** is connected between the column valve ports **1A** and **1B**. ***Note:*** *If a pH monitor is connected, make sure the flow restrictor in-line.*

The chromatogram below shows an example of a failed ***Column valve V9-C test*** due to wrong **Ref 1** tubing connection in port **1B**.



4.3.5 Fraction collector F9-T test failure

A failed ***Fraction collector F9-T test*** indicates a malfunction of the Fraction collector. Visually inspect the system and the resulting chromatogram to understand the causes for test failure. Check the table below for possible causes of the failure. After performing the suggested corrective actions, verify that the issue is fixed by running the ***Fraction collector F9-T test*** again.

Test outcome	Possible cause	Action
Unstable pressure and incorrect volumes dispensed in the wells	Air in the pump or faulty pump	Make sure that the tubing is correctly connected to the inlet valve and connectors are tightened. Prime and purge the pump, according to the *ÄKTA go Operating Instructions (29360951)*, before starting the test. If air persists in the pump, run the system with 100% methanol, to remove air in the pump. If the problem persists, change the pump piston seals. See *Replace piston, piston seal, and rinse membrane, on page 178*.
Incorrect volume dispensed in 1.A.1	***Delay volume*** incorrectly set	Set correct ***Delay volume*** in ***System settings***.
Liquid dispersed in the wrong well/outside of well	Calibrate Fraction collector	Contact Service personnel for help with calibration.
	Deep well plate incorrectly positioned in the fraction collector	Repeat the test with a properly positioned deep well plate.
Spillage between wells	***DropSync*** function is inactive	Set the ***DropSync*** function to ***Auto*** or ***On*** in ***System Settings***.

4.3.6 Fraction collector F9-R test failure

A failed ***Fraction collector F9-R test*** indicates a malfunction of the Fraction collector. Visually inspect the system and the resulting chromatogram to understand the causes for test failure. Check the table below for possible causes of the failure. After performing the suggested corrective actions, verify that the issue is fixed by running the ***Fraction collector F9-R test*** again.

Test outcome	Possible cause	Action
Unstable pressure and incorrect volumes dispensed in the collection tubes.	Air in the pump or faulty pump	Make sure that the tubing is correctly connected to the inlet valve and connectors are tightened. Prime and purge the pump, according to the *ÄKTA go Operating Instructions (29360951)*, before starting the test. If air persists in the pump, run the system with 100% methanol, to remove air in the pump. If the problem persists, change the pump piston seals. See *Replace piston, piston seal, and rinse membrane, on page 178*.
Liquid dispensed in the wrong collection tubes.	Incorrect positioning of the fractionation arm	Make sure that the fractionation arm is positioned above tube number one before starting the test.
Spillage between tubes.	***DropSync*** function inactive	Enable ***DropSync*** in ***System Settings***. See *Section 7.5.7 System settings - Fraction collection F9-R, on page 247*.

5 Maintenance and service

About this chapter

This chapter describes the maintenance program for ÄKTA go and provides instructions for maintenance, calibration, basic service, and replacement of modules and components.

In this chapter

5.1 Maintenance Manager

Introduction

Maintenance Manager in UNICORN allows the user to display general information about the system and its modules, as well as operational statistics of the modules. There are predefined maintenance notifications of the system and its modules based on calendar periods of system use and on operational statistics of the modules. To enable predefined maintenance notifications refer to *UNICORN help*.

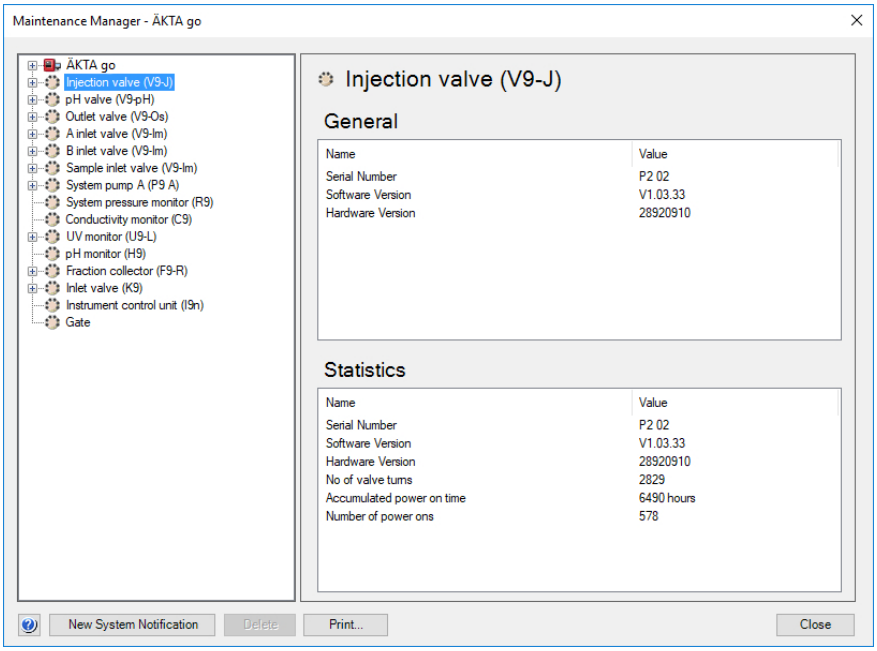
Additional maintenance notifications can also be added for the system. See *Add a new system notification, on page 137*, for instructions.

Open Maintenance Manager

Access ***Maintenance Manager*** from the ***System Control*** module, in UNICORN. Go to the ***System*** menu and select ***Maintenance Manager*** to open the ***Maintenance Manager*** dialog.

View general information and statistics

In the left pane of the ***Maintenance Manager*** dialog box, select the system of interest to view general system information and information for a module of interest. When modules are selected, operational statistics are also displayed.

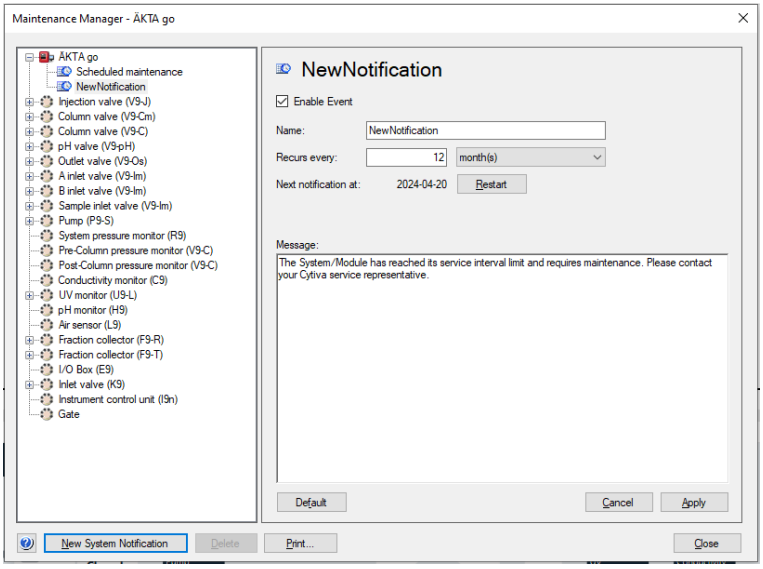


Add a new system notification

The user can add new system notifications to the list of system events.

Follow the steps below to add a new system notification.

Step	Action
1	In the ***Maintenance Manager*** dialog box, click ***New System Notification***.



2	In the ***NewNotification*** pane: **a.** Enter a name for the new notification. **b.** Select a time interval after which the new notification is issued. **c.** If applicable, write a message to be shown in the maintenance notification.
3	Click ***Apply*** to save the changes and apply the notification settings.

5.2 Maintenance schedule

Introduction

This section covers the maintenance procedures to be performed by the user of ÄKTA go, as outlined below.

Periodic maintenance

The user should perform the following periodic maintenance.

Interval	Maintenance action	Instructions
Daily or before each run	Calibrate the pH monitor	See *Section 5.4.5 Calibrate the pH monitor, on page 169*.
Weekly	Change pump rinsing solution	Change the pump rinsing solution daily if aqueous buffers are used, or weekly if 20% ethanol is used. For instructions refer to *ÄKTA go Operating Instructions (29360951)*.
	Calibrate the pressure sensors	See *Section 5.4.1 Calibrate the pressure sensors, on page 158*.
	Clean the Fraction collector drop sync sensor	See *Section 5.3.7 Maintenance and cleaning of Fraction collector F9-T, on page 154* and *Section 5.3.8 Maintenance and cleaning of Fraction collector F9-R, on page 156*.
	Replace the online filter	See *Section 5.6.8 Replace the online filter, on page 193*.
Monthly	Check the flow restrictor	See *Section 5.3.5 Maintenance of the flow restrictor, on page 149*.
Every 6 months	Clean the UV flow cell	See *Section 5.3.3 Maintenance of the UV flow cell, on page 145*.
	Replace the pH electrode	See *Replace the pH electrode, on page 152*.

Maintenance when required

The following maintenance should be performed when required.

Maintenance action	Instructions
Clean the instrument surfaces	Refer to *ÄKTA go Operating Instructions (29360951)*

Maintenance action	Instructions
Run ***System CIP*** (System cleaning-in-place)	Refer to *ÄKTA go Operating Instructions (29360951)*
Clean and store the pH electrode	See *Section 5.3.6 Maintenance of the pH valve and electrode, on page 150*.
Clean the conductivity flow cell	See *Section 5.3.4 Maintenance of the conductivity flow cell, on page 147*
Clean or replace the mixer membrane and O-ring	See *Section 5.3.2 Maintenance of the mixer, on page 142*
Calibrate the conductivity monitor	See *Section 5.4.3 Calibrate the conductivity monitor, on page 165*
Calibrate the temperature sensor	See *Section 5.4.4 Calibrate the temperature sensor, on page 168*
Reset the pressure sensors	See *Section 5.4.1 Calibrate the pressure sensors, on page 158*
Replace tubing and connectors	See *Section 5.6.6 Replace tubing and connectors, on page 190*
Replace the UV flow cell	See *Section 5.6.4 Replace the UV flow cell, on page 187*
Replace pump rinsing system tubing	Refer to *ÄKTA go Operating Instructions (29360951)*
Replace main fuses	Refer to *ÄKTA go Operating Instructions (29360951)*

5.3 Maintenance procedures

About this section

This section gives instructions for maintenance of the modules and components in the ÄKTA go instrument.

In this section

5.3.1 Maintenance of the pump

Maintenance interval

Clean the pump when required. During the first months of use it is normal that excess oil leaks out of the drain hole below the pump. The function of the pump is not in any way affected by this.

Required material

- Cloth
- Mild cleaning agent or 20% ethanol

Clean the pump

Follow the steps below to clean the pump externally.

Step	Action
1	Switch off the instrument.
2	Wipe off the excess oil from the pump head with a damp cloth. Wipe off stains using a mild cleaning agent or 20% ethanol.
3	Let the pump dry completely before using the instrument.

5.3.2 Maintenance of the mixer

Maintenance interval

Clean the mixer membrane when the mixer performance test fails or if the pressure in the system is higher than expected. Replace the mixer membrane if the problem persists.

Replace the O-rings inside the mixer if they are damaged.

Required material

- Mixer O-rings and membrane
- 20% ethanol
- Distilled water
- Ultrasonic bath

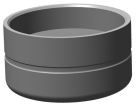
Clean or replace the mixer membrane and O-ring

Follow the steps below to replace the O-rings and membrane inside the mixer.

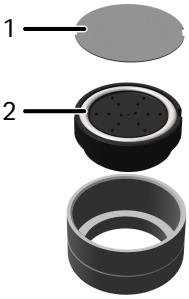
Tip: *Use gloves during the replacement procedure to avoid contaminating the mixer components.*

Step	Action
1	Disconnect all tubing to the mixer.
2	Unscrew the top section of the mixer.

Step	Action
3	Remove the O-ring from the top section.

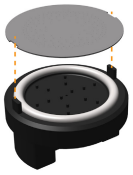


4	Remove the mixer membrane (1).

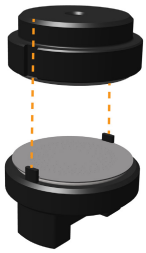


5	Clean the membrane according to the solutions used: • If using biological agents, immerse the membrane completely in 20% ethanol and place it in an ultrasonic bath for a few minutes. Repeat the ultrasonic bath with distilled water. • If using only salt buffers, rinse the membrane with distilled water.
6	Remove the O-ring (2) from the bottom section.
7	Wet the new O-rings with 20% ethanol and fit them into position.

Step	Action
8	To reassemble the mixer components, hold the top section of the mixer upside-down and place the membrane on top of the section. Fit the membrane indentations to the protrusions on the top section.



9	Place the bottom section of the mixer on top of the membrane. Make sure that the top and bottom sections are aligned.



10	Screw the metal section onto the inner components of the mixer and connect the tubing.

Note: *Make sure to assemble the mixer correctly, following the instructions above. Incorrect assembly of the mixer can cause leakage.*

5.3.3 Maintenance of the UV flow cell

Maintenance interval

Clean the UV flow cell every six months, or when required.

NOTICE

Keep UV flow cell clean. Do not allow solutions containing dissolved salts, proteins or other solid solutes to dry out in the flow cell. Do not allow particles to enter the flow cell, as damage to the flow cell may occur.

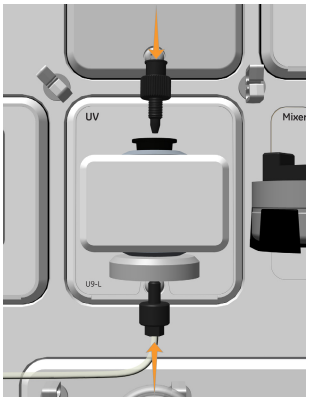
Required material

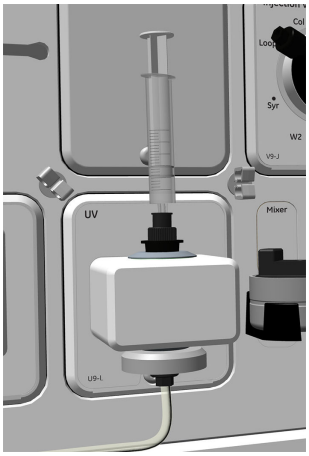
- Luer connector
- Syringe, 25 to 30 mL
- 10% surfactant detergent solution (e.g., Decon 90, Deconex 11, or RBS 25)
- Distilled water

Clean the UV flow cell

Follow the steps below to clean the UV flow cell.

Step	Action
1	Disconnect all tubing from the UV monitor.
2	Replace the top fingertight connector with a Luer connector, and connect a piece of waste tubing to the bottom of the UV monitor. Insert the waste tubing into a waste container.



Step	Action
3	Fill a syringe with distilled water, and connect the syringe to the Luer connector. 
4	Inject the distilled water through the UV flow cell carefully. Disconnect the syringe.
5	Fill a syringe with a 10% surfactant detergent solution. ***Tip:*** *Heat the 10% surfactant detergent solution to 40°C to increase the cleaning effect.*
6	Connect the syringe to the Luer connector and inject the detergent solution through the UV flow cell. Repeat steps 5 and 6 about five times.
7	Disconnect the syringe and leave the detergent solution in the UV flow cell for at least 20 minutes.
8	Fill a syringe with distilled water. Connect the syringe to the Luer connector.
9	Inject the distilled water into the UV flow cell to rinse the UV flow cell. Disconnect the syringe.
10	Disconnect the Luer connector from the top of the UV monitor and the waste tubing from the bottom of the UV monitor. Reconnect the tubing to the UV monitor.

5.3.4 Maintenance of the conductivity flow cell

Maintenance interval

Clean the conductivity flow cell when required.

Required material

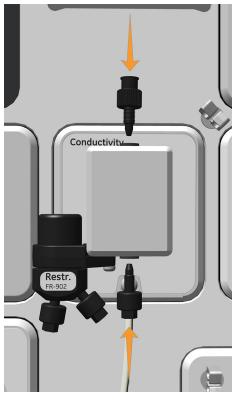
- Luer connector
- Waste container
- Syringe, 25 to 30 mL
- 1 M NaOH
- Distilled water

Note: *Use protective gloves when handling 1 M NaOH.*

Clean the conductivity flow cell

Follow the steps below to clean the conductivity flow cell of the conductivity monitor.

Step	Action
1	Disconnect all tubing from the conductivity monitor.
2	Replace the top fingertight connector with a Luer connector, and connect a piece of waste tubing to the bottom of the conductivity monitor. Insert the waste tubing into a waste container.



Step	Action
3	Fill a syringe with distilled water, and connect the syringe to the Luer connector. 
4	Inject distilled water through the conductivity flow cell carefully. Disconnect the syringe.
5	Fill a syringe with 1 M NaOH, connect the syringe to the Luer connector, and inject the solution through the conductivity flow cell.
6	Repeat step 5 about five times.
7	Leave the liquid in the conductivity flow cell for at least 15 minutes.
8	Fill a syringe with distilled water. Connect the syringe to the Luer connector.
9	Inject the distilled water into the conductivity flow cell to rinse the conductivity flow cell. Disconnect the syringe.
10	Disconnect the Luer connector from the top of the conductivity monitor and the waste tubing from the bottom. Reconnect the fingertight connectors with the respective tubing.

5.3.5 Maintenance of the flow restrictor

Maintenance interval

Check the back pressure of the flow restrictor every month.

Clean the flow restrictor when required, for example if there is high back pressure from the flow restrictor, the pressure is unstable, or the pressure is close to zero.

Location of the flow restrictor

The recommended positions for the flow restrictor are the following:

- Connected to the conductivity monitor

  or

- If a pH valve is installed, connected to the pH valve.

Check the flow restrictor

Follow the steps below to check the back pressure of the flow restrictor:

Step	Action
1	Set the flow restrictor in-line and start a flow of 2.5 mL/min. Take note of the pressure reading.
2	If the flow restrictor is connected to the conductivity monitor, remove the restrictor and connect the tubing using the 1/16"F / 1/16"F union connector. If a pH valve is installed, change the position to by-pass the flow restrictor.
3	Start a flow of 2.5 mL/min and take note of the pressure reading.
4	Check that the pressure difference is within 0.2 ± 0.05 MPa. If this is not the case, replace the flow restrictor.

Clean the flow restrictor

The flow restrictor is cleaned during a System CIP. If the flow restrictor is installed in a pH valve, select ***pH valve*** in the System CIP phase properties dialog, and perform a System CIP according to the instructions. Refer to the *Operating Instructions* for more information.

Note: *If required, remove the flow restrictor from the instrument and use an ultrasonic bath for cleaning.*

5.3.6 Maintenance of the pH valve and electrode

Maintenance interval

Clean the pH electrode and the pH valve when required. The pH electrode has a limited longevity and should be replaced every six months or when the response time is slow. After cleaning or replacement, recalibrate the pH monitor, see *Section 5.4.5 Calibrate the pH monitor, on page 169*.

Store the pH electrode when pH monitoring is not used.

Note: *The pH electrode and part of the valve, including the injection port, are not cleaned during a System CIP. These parts have to be cleaned manually as described below.*

Required material

- pH electrode
- Distilled water
- Standard buffer, pH 4
- Syringe, 25 to 30 mL
- 0.1 M HCl and 0.1 M NaOH (for cleaning of salt deposits)
- Liquid detergent (for cleaning of oil and grease)
- 1% pepsin solution in 0.1 M HCl and 1 M KNO_3 (for cleaning protein deposits)
- 1M NaOH (for cleaning the pH valve)

pH electrode cleaning procedures

The pH electrode can be cleaned installed in the pH valve or removed from the pH valve. Instructions are provided in the following sections.

Clean the pH electrode following the procedures below. If these methods fail to improve the electrode, replace the electrode. See *Replace the pH electrode, on page 152*.

Required cleaning	Procedure
Salt deposits	Wash the electrode sequentially with 0.1 M HCl, 0.1 M NaOH, and 0.1 M HCl. Leave the electrode immersed for 5 minutes in each solution and rinse with distilled water between each solution.
Oil and grease films	Wash the electrode tip in liquid detergent and water. Use organic solvents if known to dissolve the specific films, and rinse with distilled water.
Protein deposits	Wash the electrode with a solution of 1% pepsin in 0.1 M HCl for five minutes, followed by thorough rinsing with distilled water.

Clean the pH electrode installed in the pH valve

Follow the steps below to clean the pH electrode installed in the pH valve. The calibration function is used to switch the position of the pH valve. However, no calibration is performed.

Step	Action
1	Use the calibration function to switch the position of the pH valve: **a.** Open the ***Calibration*** dialog from the ***System Control*** module. **b.** Select ***pH*** in ***Monitor to calibrate***. **c.** Click ***Prepare for calibration***.
2	Fill a syringe with approximately 10 mL of the chosen cleaning solution. Connect the syringe to the pH valve port **Cal**. Inject the liquid and wait for 5 minutes. Disconnect the syringe. 
3	If several cleaning solutions are to be used, repeat step 4 with distilled water and then with the next solution.
4	As the last step in the cleaning procedure, rinse the pH electrode with distilled water. Connect a syringe with distilled water to port **Cal**, inject the water, and disconnect the syringe.
5	In the ***Calibration*** dialog, press the ***Close*** button. *Result:* The pH valve switches back to the default position and the ***Calibration*** dialog closes. No calibration is performed.

Clean the pH electrode removed from the pH valve

If the pH electrode has been removed from the pH valve, wash the electrode tip by immersion in the solutions recommended for the required cleaning.

If the removal of protein deposits has failed following the procedure in *pH electrode cleaning procedures, on page 150*, clean the pH electrode with a 1 M KNO_3 solution. Heat the solution to 60°C to 80°C and immerse the electrode tip in the solution. Allow the electrode to cool while immersed in the KNO_3 solution before use.

Note: *This procedure can only be performed when the pH electrode is not installed in the pH valve.*

Clean the pH valve

To clean the pH valve, follow the procedure used to clean the pH electrode installed in the valve. Use a 1 M NaOH solution for cleaning the pH valve.

Note: *Replace the pH electrode with the dummy electrode before cleaning the pH valve.*

Replace the pH electrode

CAUTION

pH-electrode. Handle the pH-electrode with care. The glass tip may break and cause injury.

Follow the steps below to replace the pH electrode.

Step	Action
1	Disconnect the pH electrode cable of the used pH electrode from the connection on the front of the pH valve.
2	Unscrew the nut of the pH electrode by hand, and pull the used electrode away.
3	Unpack the new pH electrode. Remove the cover from the tip of the new pH electrode. Make sure that the electrode is not broken or dry.
4	Prior to first use of the electrode, immerse the glass tip in distilled water for 30 minutes and then in a standard buffer, pH 4, for 30 minutes.
5	Carefully insert the new pH electrode into the pH flow cell. Tighten the nut by hand to secure the electrode.
6	Connect the pH electrode cable of the new electrode to the connection on the front of the pH valve.
7	Calibrate the new pH electrode, see *Section 5.4.5 Calibrate the pH monitor, on page 169*.

Storage of the pH electrode

The pH electrode can be stored in storage solution inside the pH flow cell. If pH monitoring is not used for a week or longer, inject new storage solution into the pH flow cell or replace the pH electrode with the dummy electrode that was installed in the pH valve on delivery.

Follow the steps below to store the pH electrode in the pH flow cell.

Step	Action
1	Use the calibration function to switch the position of the pH valve: **a.** Open the ***Calibration*** dialog from the ***System Control*** module. **b.** Select ***pH*** in ***Monitor to calibrate***. **c.** Click ***Prepare for calibration***.
2	Fill a syringe with approximately 10 mL of the storage solution. Connect the syringe to the pH valve port **Cal**, and inject the storage solution. 
3	Click ***Close***.

5.3.7 Maintenance and cleaning of Fraction collector F9-T

Maintenance interval

Clean the Fraction collector externally when necessary. Do not allow spilled liquid to dry on the Fraction collector.

Required material

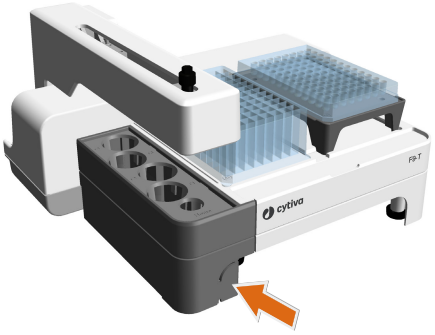
The following materials are required:

- Cloth
- Water, mild cleaning agent or 20% ethanol.

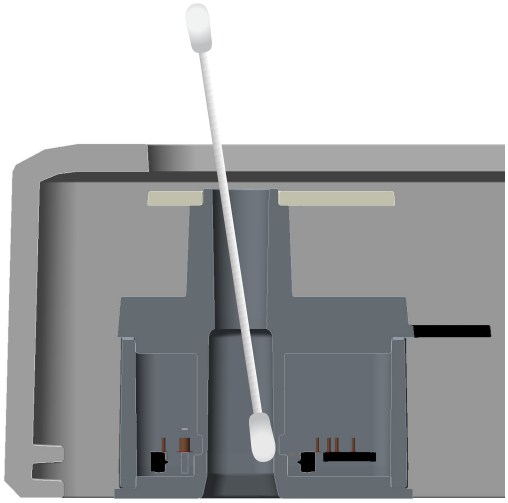
Instruction

Follow the steps below to clean the fraction collector externally.

Step	Action
1	Check that no run is in progress.
2	Turn off the ÄKTA go instrument.
3	Remove the tube rack by pressing the wedge and pulling the rack out, discard any remaining tubes and wash the tube rack with mild cleaning agent or 20% ethanol.
4	Wipe the surface of the Fraction collector with a damp cloth. Wipe off stains using a mild cleaning agent or 20% ethanol. Remember to wipe all sides, including the underside of the fractionation arm. Wipe off any excess of liquid.



Step	Action
5	Lift out the nozzle, wet a cotton swab lightly with water and clean the hole through the fractionation arm. Make sure to clean the area around the drop sync sensor thoroughly.



6	Insert the nozzle into the fractionation arm.
7	When the tube rack is dry, add a 15 mL tube and put it back into position.
8	Let the Fraction collector dry completely before restart.

5.3.8 Maintenance and cleaning of Fraction collector F9-R

Maintenance interval

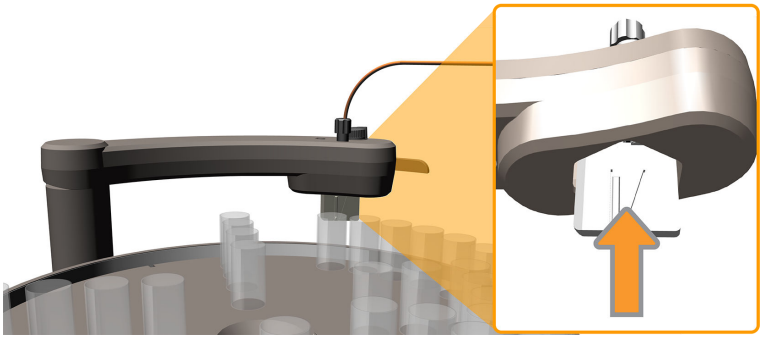
Clean the Fraction collector when required, for example in case of liquid spill.

Required material

- Water or 20% ethanol
- Cloth

Clean the Fraction collector externally

Follow the steps below to clean the Fraction collector F9-R externally and the drop sync sensor.

Step	Action
1	Switch off the instrument.
2	Wipe the surface with a damp cloth. Remove stains using a mild cleaning agent or 20% ethanol. Wipe off any excess.
3	Clean the drop sync sensor located under the delivery arm with a damp cloth. 
4	Let the Fraction collector dry completely before restart.

5.4 Calibration of monitors and sensors

Introduction

This section provides instructions for calibration of the instrument monitors and sensors. The calibration is performed using the ***Calibration*** dialog in the ***System Control*** module in UNICORN.

In this section

5.4.1 Calibrate the pressure sensors

Introduction

ÄKTA go can have up to three pressure sensors:

- One pressure sensor in the pressure monitor, that measures the pressure of the system.
- Two column pressure sensors in column valve **V9-C**, that measure pre-column pressure and post-column pressure.

Maintenance interval

Check the pressure sensors every week, or when the ambient temperature has changed by more than ± 5°C.

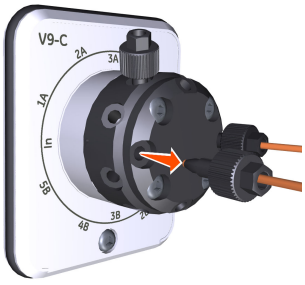
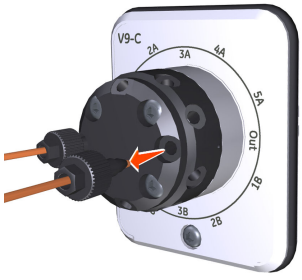
Instruction

Follow the steps below to check and calibrate the pressure sensors. The procedure is the same for each sensor.

Step	Action
1	Disconnect the relevant tubing to the pressure sensor being checked. See *Pressure sensor tubing, on page 159*.
2	In the ***System Control*** module, select ***System*** →***Calibrate*** to open the ***Calibration*** dialog.
3	Select the pressure sensor to calibrate from the ***Monitor to calibrate*** drop-down list and check the pressure value(s) displayed in ***Current value***.
4	If the pressure reading is outside the range ± 0.02 MPa, press ***Reset Pressure***.

Pressure sensor tubing

The table below shows the tubing to disconnect when checking and calibrating the pressure sensors.

Pressure sensor	Tubing to disconnect
System pressure sensor	Tubing between the pressure monitor and the mixer. 
Pre-column pressure sensor	Tubing in column valve **V9-C** port **In** 
Post-column pressure sensor	Tubing in column valve **V9-C** port **Out** 

5.4.2 Calibrate the UV monitor U9-L

Introduction

The path length in the UV flow cell might differ from the nominal length, which leads to incorrect results in the calculation of protein concentration in the eluate. To achieve normalized absorbance, the path length in the UV flow cell must be calibrated. The calibration procedure is described below.

Note: *The flow cell path length must be registered or updated, when the flow cell is replaced.*

Maintenance interval

Calibrate the UV monitor when a new UV flow cell is installed, to obtain the real UV cell path length.

Required material

- UV Test accessories (29293950)
- Waste beaker
- UV Test Kit, 1 and 2 mm (29276997) or UV Test Kit, 5 and 10 mm (29276998)
- UV Test Calculation protocol (29032336)
- UV Test Kit Instructions (29304919)

Calibration test kit and calculation protocol

To calibrate the UV monitor, a calibration kit and a calculation protocol are required.

The calibration kit contains test solutions which should be used according to the flow cell path length.

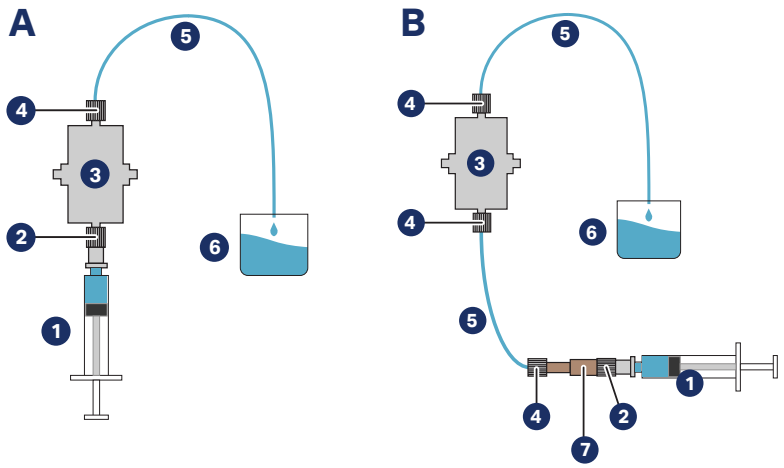
UV flow cell path length	Calibration kit
2 mm	UV Test Kit, 1 and 2 mm (product code 29276997)
5 mm	UV Test Kit, 5 and 10 mm (product code 29276998)

The *UV Test Kit Calculation Protocol (29032336)* and *UV test kit instructions (29304919)* can be downloaded from cytiva.com. Search for the product code of the suitable calibration kit as indicated above, and click on ***Related documents*** to access the documents.

UV calibration setup

For convenience, use the tubing and fittings included in the UV test accessories. The illustration below shows the UV calibration setup. If possible, fit the syringe directly to the UV flow cell as shown in illustration A. Alternatively, connect the syringe as shown in illustration B.

Tip: *Adapt tubing length to minimize the use of test solution.*



Part	Function	Note
1	Syringe, 3 mL	Part of UV Test Kit
2	Female Luer-Male Luer connector	Part of UV test accessories
3	UV flow cell	N/A
4	Fingertight HPLC	Part of UV test accessories
5	EFTE tubing, i.d. 1 mm, o.d. 1/16	Part of UV test accessories
6	Waste beaker	Supplied locally
7	Union 1/16"F / 1/16"F	Part of UV test accessories

The UV test kit is used to calibrate many different UV monitors. The table below shows the concentration of iron(III)-sulphate that must be used for the respective UV flow cells available for ÄKTA go.

Concentration of iron(III)-sulphate in 0.1 M sulphuric acid (mg/L) UV flow cell with 2 mm path length	Concentration of iron(III)-sulphate in 0.1 M sulphuric acid (mg/L) UV flow cell with 5 mm path length
0	0

Concentration of iron(III)-sulphate in 0.1 M sulphuric acid (mg/L) UV flow cell with 2 mm path length	Concentration of iron(III)-sulphate in 0.1 M sulphuric acid (mg/L) UV flow cell with 5 mm path length
117	55
234	117
570	234
1420	570

Preparing for calibration

Follow the steps below to prepare for the calibration of the UV monitor **U9-L**.

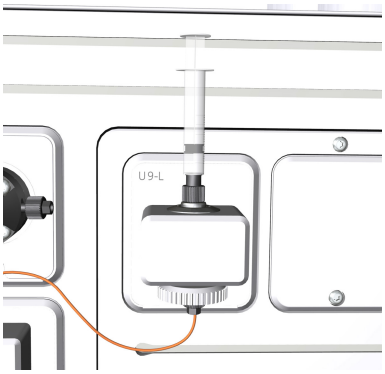
Step	Action
1	Make sure that the flow restrictor is inline in the flow path after the UV flow cell.
2	Mount the union Luer female/1/16" male, included in the test kit, in the upper inlet of the UV flow cell.
3	Open the *UV Test Kit Calculation Protocol (29032336)* file.
4	Type the concentrations of the solutions in ascending order into the column ***UV Test Kit, Concentration Fe(III)SULF (mg/L)*** in the *UV Test Kit Calculation Protocol*. ***Tip:*** *The solution bottles are labeled with the concentration value and the reference absorbance value for each solution. Alternatively, the Certificate of Analysis (CoA) in the calibration kit describes the concentration of Fe(III)-SULF (mg/L) and the reference absorbance values (AU/cm). The values for the test solutions stated in the CoA are only valid at room temperature.*
5	Type the reference absorbance values into the column ***UV Test Kit, Certificate Absorbance (AU/cm)*** in the *UV Test Kit Calculation Protocol*.

Performing the calibration

Follow the steps below to calibrate UV monitor **U9-L**.

Step	Action
1	In ***Process Picture***, select the pump and set the ***Flow rate*** to 0.0 mL/min.
2	Fill one of the supplied syringes with 1.5 to 2 mL of the first solution (0 mg/L). Make sure that there are no air bubbles in the syringe.

Step	Action
3	Fit the syringe in the union Luer connector and inject the solution. Do not remove the syringe.



Note:

Air trapped in the UV flow cell causes inaccurate measurements. To avoid introducing air into the UV flow cell, gently fill the union Luer up to the edge with test solution that is to be introduced, using the syringe. Then insert the syringe into the union Luer.

4	Wait until the monitored absorbance value has stabilized.
5	In ***Process Picture***, select the UV monitor and click ***Auto Zero UV*** for the first solution (0 mg/L). *Result:* The UV absorbance is set to zero.
6	Remove the syringe.
7	Repeat steps 3 and 4 with the remaining four test solutions in increasing concentration order according to UV test solution tables. Use a new syringe for each solution.
8	Type the values into the column ***UV Monitor, Measured Absorbance (AU)*** in the *UV Test Kit Calculation Protocol*. ***Note:*** *The values must be converted from mAU to AU.*

Step	Action
9	In the *UV Test Kit Calculation Protocol*, read the ***Real cell length in mm*** and ***Linearity Deviation*** when all absorbance values have been entered in the table. The values are shown at the bottom of the table. ***Note:*** *The* ***Coefficient of regression (R^2)*** *must be larger than 0.999. If this is not the case, one or more measured values are faulty.*

Adjust the UV cell path length

Follow the steps below to define the ***UV cell path length*** in UNICORN. The path length of the UV flow cell must be adjusted when the UV flow cell has been replaced or calibrated.

Step	Action
1	In the ***System Control*** module, select ***System*** →***Calibration***.
2	Select ***UV cell path length*** from the ***Monitor to calibrate*** drop-down list.
3	Type the nominal path length of the UV flow cell in the ***Nominal length*** input field and click ***Set***.
4	<table><tr><th>Calibration performed?</th><th>Action</th></tr><tr><td>Yes</td><td>Type the calculated flow path length of the UV flow cell, obtained in the calibration procedure, in the ***Real length*** input field and click ***Set***.</td></tr><tr><td>No</td><td>Type the nominal flow path length of the UV flow cell in the ***Real length*** input field and click ***Set***.</td></tr></table> *Result:* The path length of the UV flow cell is updated.

5.4.3 Calibrate the conductivity monitor

Introduction

Two types of calibration of the conductivity monitor can be performed:

- ***Conductivity monitor - factory calibration***: Restores the conductivity flow cell constant to the factory default value. Perform this calibration to override an incorrect user calibration.
- ***Conductivity monitor - user calibration***: The user calibrates the conductivity flow cell constant. Perform calibration after cleaning, when the signal is unstable, or when you suspect that the calibration is incorrect.

Required material

- Distilled water
- 1.00 M NaCl

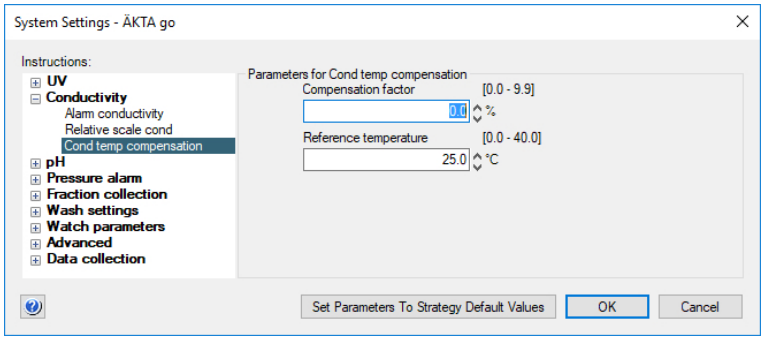
  or
- Certified conductivity standard solution

Instruction

To perform a factory calibration of the conductivity monitor, select ***Conductivity monitor - factory calibration*** in the ***Calibration*** dialog and click ***Restore***.

Follow the steps below to perform a user calibration of the conductivity flow cell constant.

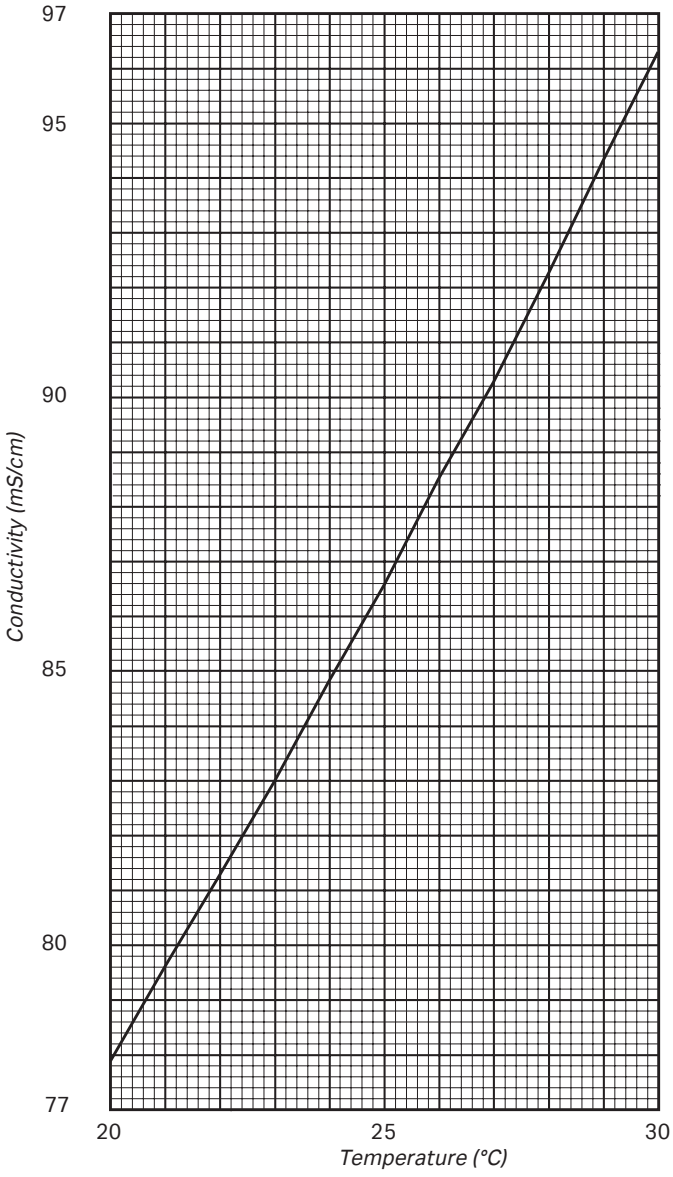
Step	Action
1	Make sure that the instrument has been switched on for at least one hour.
2	Open the ***System Settings*** dialog by selecting ***System*** →***Settings*** from the ***System Control*** module.
3	Set the ***Compensation factor*** to 0%.



Step	Action
4	Wash the whole flow path and fill it with distilled water using a suitable inlet and the pump, until the conductivity value reaches 0.00 mS/cm.
5	Prime and purge the inlet used in step 4 with the 1.00 M NaCl calibration solution. Fill the conductivity cell with the calibration solution at a 1 mL/min flow rate. Pump in at least 15 mL of the calibration solution and wait until the conductivity signal and the temperature have stabilized before continuing the calibration.
6	Open the ***Calibration*** dialog from the ***System Control*** module, by selecting ***System*** →***Calibrate***.
7	Select ***Conductivity monitor - user calibration*** from the ***Monitor to calibrate*** drop-down list.
8	Enter the theoretical conductivity value at the current conductivity temperature in the ***Enter theoretical conductivity value*** input field. **a.** If a certified conductivity standard solution is used, use the supplied theoretical conductivity value. **b.** If a manually prepared 1.00 M NaCl calibration solution is used, see *Graph for conductivity value, on page 167*. ***Tip:*** *The temperature is available in the **Run Data** field.*
9	Click ***Calibrate***. *Result:* The new conductivity cell constant is displayed in the ***Conductivity cell 1 constant/cm*** box. The new constant should normally be 40 ± 10 cm^{-1}. The date and time for the calibration are also displayed.
10	In the ***System Control*** toolbar, click the ***End*** icon to end the run.
11	In the ***System Settings*** dialog, select ***Conductivity*** →***Cond temp compensation*** and set the ***Compensation factor*** back to the relevant value. Click ***OK***.

Graph for conductivity value

The graph below shows the conductivity value at the current temperature when 1.00 M NaCl calibration solution is used.



5.4.4 Calibrate the temperature sensor

Introduction

The temperature sensor is located in the conductivity monitor, and monitors the temperature to give accurate conductivity measurements.

Maintenance interval

Calibrate the temperature sensor when required.

Required material

- External temperature sensor
- Distilled water

  or
- Buffer

Instruction

Follow the steps below to calibrate the temperature sensor.

Step	Action
1	Open the ***Calibration*** dialog by selecting ***System*** →***Calibrate***, in the ***System Control*** module.
2	Select ***Temperature calibration*** and follow the instructions in the ***Calibration*** dialog.

5.4.5 Calibrate the pH monitor

Maintenance interval

Calibrate the pH monitor once a day, when the pH electrode has been replaced, or if the ambient temperature has changed by more than ± 5°C.

Required material

- Syringe
- Luer connector
- pH calibration buffers

Note: *Use two pH calibration buffers with a difference of at least one pH unit. Preferably use a pH standard buffer, pH 4 or pH 7, as the first calibration point, and a pH standard buffer close to the lowest or highest pH needed to measure as the second point. Allow the buffers to reach to ambient temperature before use.*

Instruction

CAUTION

pH-electrode. Handle the pH-electrode with care. The glass tip may break and cause injury.

Follow the steps below to calibrate the pH monitor.

Step	Action
1	Attach a Luer connector to the pH valve port **Cal**.
2	Open the ***Calibration*** dialog from the ***System Control*** module, by selecting ***System*** →***Calibrate***.
3	Select ***pH*** from the ***Monitor to calibrate*** drop-down list and click the ***Prepare for calibration*** button. *Result:* The pH valve switches to the calibration position.
4	Enter the pH of the first pH standard buffer in the ***pH for buffer 1*** field.

Step	Action
5	Fill a syringe with approximately 10 mL of the first pH standard buffer. Connect the syringe to the Luer connector in port **Cal** and inject the buffer. 
6	When the ***Current value*** is stable, click the ***Calibrate*** button.
7	Using a new syringe, wash the pH flow cell by injecting water into port **Cal**.
8	Enter the pH of the second pH standard buffer in the ***pH for buffer 2*** field.
9	Repeat steps 5-7 using the second pH standard buffer. *Result:* The calibration date and time are displayed in the dialog, along with values for ***Calibrated electrode slope*** and ***Asymmetry potential at pH 7***.
10	Check that ***Calibrated electrode slope*** ≥ 80% and ***Asymmetry potential at pH 7*** is within the ± 60 mV range. ***Note:*** *If the values are not within the specified range, repeat the calibration procedure. If the problem persists, replace the electrode as indicated in Replace the pH electrode, on page 152.*
11	Click the ***Close*** button to switch the pH valve back to the default position and to close the ***Calibration*** dialog.

5.5 Service

Introduction

This section describes basic service procedures that can be performed by an experienced user. It contains instructions on how to repair modules or replace parts of modules to repair them.

In this section

5.5.1 Maintenance of the pump head check valves

Maintenance interval

Replace or clean a check valve when required, for example if the check valve is clogged or damaged.

Required material

- Adjustable wrench
- 20% ethanol
- Distilled water
- Ultrasonic bath
- Check valve kit

Clean the pump head check valves

Follow the steps below to remove and clean the pump head check valves.

WARNING

Hazardous substances. When using hazardous chemical and biological agents, take all suitable protective measures, such as wearing protective glasses and gloves resistant to the substances used. Follow local and/or national regulations for safe operation and maintenance of the system.

Step	Action
1	Switch off the instrument and disconnect all tubing from the pump head.
2	Remove the upper and lower check valves from the pump head, following the instructions in *Replace the pump head check valves, on page 173*.
3	Clean the check valves according to the solutions used: • If using biological agents, immerse the check valves completely in methanol and place them in an ultrasonic bath for a few minutes. Repeat the ultrasonic bath with distilled water. • If using only salt buffers, rinse the valves with distilled water.
4	Refit the check valves in the pump head.
5	Refit the inlet manifold and reconnect the tubing to the pump head.

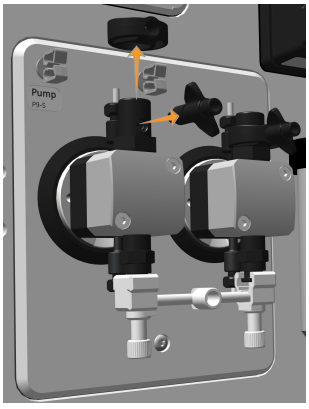
Replace the pump head check valves

NOTICE

To prevent loss or damage to internal component, check valves must be handled with care.

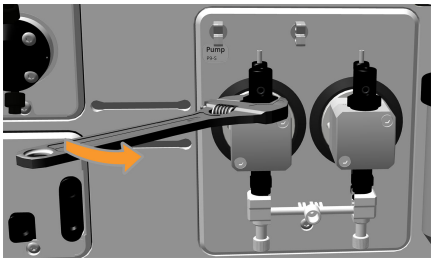
Follow the steps to replace the check valves of a pump.

Step	Action
1	Switch off the instrument.
2	Disconnect the tubing from the check valves, the pump inlet tubing, and the tubing of the pump rinsing system.
3	Unscrew the purge valve by turning it counter-clockwise, and lift off the ring.

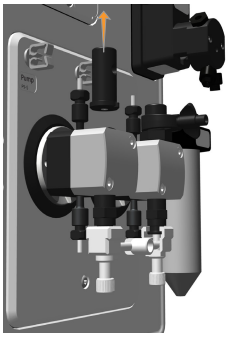


Step	Action
4	Unscrew the plastic nut of the upper check valve using an adjustable wrench (1), and lift off the upper check valve (2).

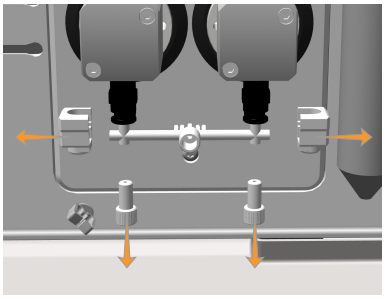
1



2



5	Replace the upper check valve with a new one.
6	Tighten the nut until fully finger-tight. Use an adjustable wrench to further tighten it. ***Note:*** *Do not over tighten the nut, as doing so might cause it to break.*
7	Place the ring onto the new upper check valve, and screw the purge valve.
8	Unscrew the two white plastic screws located below each pump head. Pull the plastic connectors to the sides to release the inlet manifold.



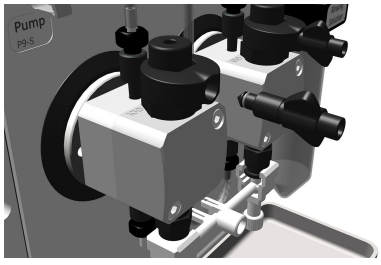
Step	Action
9	Unscrew the lower check valve using an adjustable wrench, and remove it from the pump head.

10	Replace the lower check valve with a new one.
11	Tighten the nut until fully finger-tight. Use an adjustable wrench to further tighten it. ***Note:*** *Do not over tighten the nut, as doing so might cause it to break.*
12	Refit the inlet manifold and reconnect the tubing to the pump.

Replace O-ring

Follow the steps below to the replace the O-ring located in the purge valve.

Step	Action
1	Unscrew the purge valve of the pump head and remove the O-ring from the purge valve.
2	Wet a new O-ring with lubricant and fit it to the purge valve.



Step	Action
	Note: *Always use Lubricant 56686700 when exchanging the O-ring 3 × 1 mm.*
3	Screw the purge valve back into the pump head.

5.5.2 Maintenance of the pump pistons and piston seals

Maintenance interval

Replace or clean the pistons, piston seals, rinse membranes, or O-rings of the pump if they are damaged. After replacement, perform a run to break in the new piston seals.

Note: *Always replace the O-rings, piston seals, and pump membrane housing of both pump heads at the same time.*

NOTICE

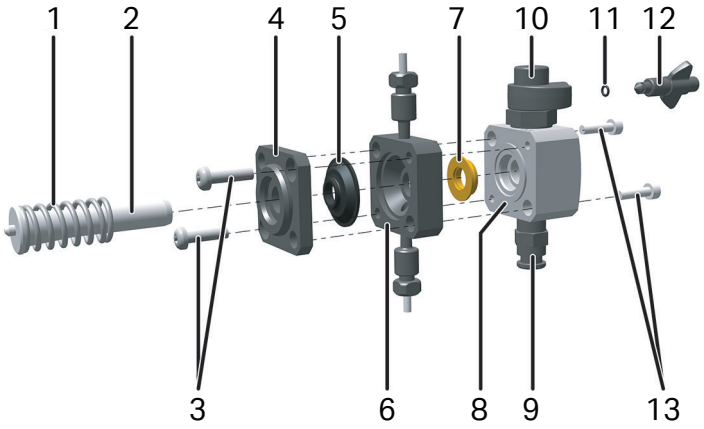
Advanced maintenance. Read the instruction carefully before disassembly of the pump head.

Required material

- Torx T20 screwdriver
- Allen key
- Ultrasonic bath
- Ethanol, 20%
- Tubing giving a back pressure of 2 to 4 MPa
- P9-S Seal kit, 65 mL

Illustration

The illustration below shows the parts of the pump head in pump **P9-S**.

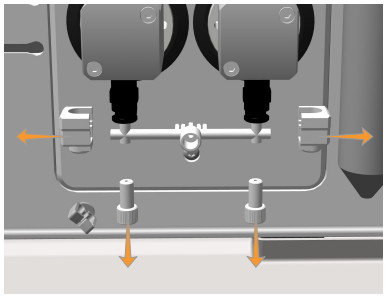


Part	Description	Part	Description
1	Return spring	8	Pump head
2	Piston	9	Lower check valve
3	Star screws	10	Upper check valve
4	Drain plate	11	O-ring
5	Rinse membrane	12	Purge valve
6	Rinse chamber	13	Allen screws
7	Piston seal		

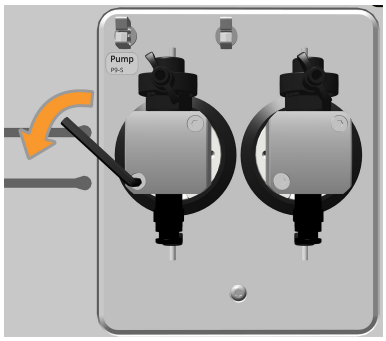
Replace piston, piston seal, and rinse membrane

Step	Action
1	Disconnect all tubing from the pump.

Step	Action
2	Unscrew the two white plastic screws located below each pump head by hand. Pull the plastic connectors to the sides to release the inlet manifold.



3	Unscrew one of the Allen screws from the front section of the pump head, using an Allen key. Unscrew the second screw, while pushing firmly on the front section of the pump head to compensate for the pressure of the piston return spring.

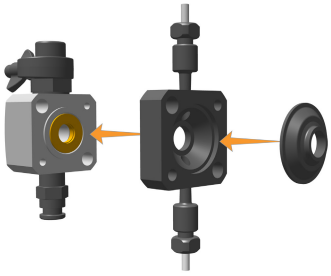


4	Place the front section of the pump head face down on the bench. Pull out the piston together with the return spring.
5	Inspect the piston and return spring for signs of damage. If damaged, discard the piston and return spring and use a new piston and return spring when assembling the pump head.

Step	Action
6	Unscrew the two screws of the drain plate using a Torx T20 screwdriver. Remove the drain plate.

7	Remove the rinse membrane using the piston.

8	Remove the rinse chamber and discard the piston seal.
9	Clean the pump head, rinse chamber, and drain plate in an ultrasonic bath. If there are particles on any surfaces, the check valves should be removed and cleaned separately. See *Clean the pump head check valves, on page 172*
10	Wet a new piston seal with 20% ethanol. Place the new piston seal in the hole in the front section of the pump head and press it into position.
11	Place the rinse chamber onto the pump head, with the conical depression in the rinse chamber facing outwards. Fit the new rinse membrane with the conical depression inwards.



12	Place the drain plate on top of the assembly. Tighten the screws with a Torx T20 screwdriver.

Step	Action
13	Wet the new piston with 20% ethanol and insert it into the return spring. Insert the piston into the pump head gently and press it firmly downwards into the piston seal. ***Note:*** *Do not push the piston at an angle to the pump head. Once inserted into the pump head, do not twist the piston.*
14	Mount the pump head onto the instrument. Push firmly on the front section of the pump head and tighten the screws with an Allen key.

Break in the new pump piston seal

Follow the steps below to break in the new pump piston seal in the pump.

Step	Action
1	Fill a buffer bottle with at least 50 mL of 20% ethanol in water. Immerse the inlet tubing in the buffer vessel. Place the buffer vessel on the top tray.
2	Prime the inlets and purge the pump heads. Refer to the *ÄKTA go Operating Instructions (29360951)* for instructions.
3	Connect tubing that gives a back pressure of 2 to 4 MPa at 25 mL/min, between the injection valve and the UV monitor.
4	Immerse the waste tubing in the buffer vessel to recirculate the liquid.
5	Set the system flow rate to 25 mL/min.
6	Run the flow for 2 hours.
7	Discard the used ethanol.

5.6 Replacement of modules and components

About this section

This section gives instructions for replacing the modules and components in the ÄKTA go instrument.

In this section

5.6.1 Replace ÄKTA go modules

The procedure to replace or install a module is similar for most modules. To replace modules in the ÄKTA go instrument, refer to *Install optional modules, on page 31* for detailed instructions.

5.6.2 Replace the pump

Maintenance interval

Replace the pump if damaged or if replacement of the pump head check valves and the pump piston seals is not sufficient to fix the pump.

Required material

- Pump **P9-S**
- Torx T20 screwdriver

Instruction

Follow the steps below to replace pump **P9-S**.

Step	Action
1	Disconnect power from the instrument by using the instrument power button.
2	Disconnect the tubing from the check valves, the pump inlet tubing, and the tubing of the pump rinsing system.
3	Loosen the screw with a Torx T20 screwdriver.
4	Remove the pump module and disconnect the cable from the back of the module.
5	Connect the cable to the new pump, insert the pump into the chassis, and fasten the screw with a Torx T20 screwdriver.
6	Connect the tubing to the pump.

5.6.3 Replace the pressure monitor

Maintenance interval

Replace the pressure monitor when required.

Required material

- Pressure monitor **R9-1n**
- Torx T20 screwdriver

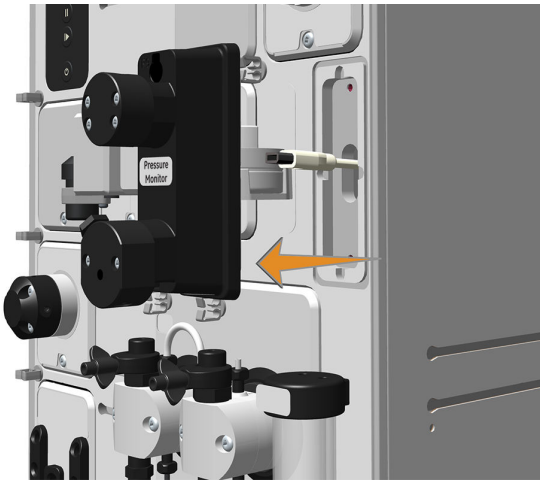
Instruction

Follow the steps below to replace the pressure monitor.

Note: *A pressure monitor must always be installed in ÄKTA systems to protect the instrument from damage caused by high pressure.*

Step	Action
1	Disconnect power from the instrument by using the instrument power button.
2	Loosen the tubing connectors and remove the tubing from the pressure monitor.
3	Loosen the top and bottom screws in the pressure monitor with a Torx T20 screwdriver.

Step	Action
4	Remove the pressure monitor and disconnect the cable at the back.



5	Connect the cable to the new pressure monitor and fasten both screws with a Torx T20 screwdriver.

Note: *When the pressure monitor is replaced, the pressure monitor should be calibrated in UNICORN. See* *Section 5.4.1 Calibrate the pressure sensors, on page 158* *for instructions.*

5.6.4 Replace the UV flow cell

Maintenance interval

Replace the UV flow cell to use a UV flow cell with a different path length, or if the current UV flow cell is damaged.

Required material

- UV flow cell

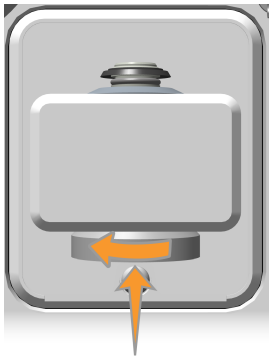
Instruction

CAUTION

Hazardous chemicals or biological agents in UV flow cell.
Make sure that the entire UV flow cell has been flushed thoroughly with bacteriostatic solution (e.g., NaOH) and distilled water, before service and maintenance.

Follow the steps below to replace the UV flow cell.

Step	Action
1	Switch off the instrument.
2	Disconnect the tubing from the UV flow cell.
3	Unscrew the wheel at the bottom of the UV monitor and press the wheel upwards to release the UV flow cell.



Step	Action
4	Pull the UV flow cell upwards out of the monitor. Hold the UV flow cell by the top part with the O-ring. Do not touch the optical surfaces of the UV flow cell.

Note:

Make sure that the UV flow cell does not come into contact with any liquid, and that no liquid enters the monitor.

5	Insert a new UV flow cell into the monitor.
6	Tighten the wheel firmly.
7	Connect the tubing to the new flow cell.
8	Switch on the instrument.
9	If a cell with a different path length is used, adjust the UV flow cell path length in the ***Calibrate*** dialog, in ***System Control***.

Note:
If a real cell path length is needed, calibrate the new UV flow cell path length instead of using the nominal value.

After replacing the UV flow cell, run a system performance test to make sure that the UV flow cell is working properly. Refer to *ÄKTA go Operating Instructions (29360951)* for instructions.

5.6.5 Replace the flow restrictor

Maintenance interval

Replace the flow restrictor when required, for example if there is high back pressure from the flow restrictor, the pressure is unstable, or the pressure is close to zero.

Required material

- Flow restrictor **FR-902**

Instruction

Follow the steps below to replace the flow restrictor.

Step	Action
1	Disconnect the tubing from the used flow restrictor, and discard the flow restrictor.
2	Connect the tubing to the new flow restrictor: **a.** If connecting the flow restrictor to the conductivity monitor, connect the flow restrictor port **IN** to the outlet of the conductivity monitor, and connect the flow restrictor port **OUT** to the outlet valve port **In**. **b.** If connecting the flow restrictor to the pH valve, connect the flow restrictor port **IN** to the pH valve port **ToR** (To Restrictor), and connect the flow restrictor port **OUT** to the pH valve port **FrR** (From Restrictor).
3	Check the back pressure of the new flow restrictor, following the instructions above.

After replacing the flow restrictor, run a system performance test to check that the flow restrictor is working properly. Refer to the *Operating Instructions* for instructions.

5.6.6 Replace tubing and connectors

Maintenance interval

Replace tubing and connectors when required, for example if a tubing is clogged or has been bent so that the flow is stopped.

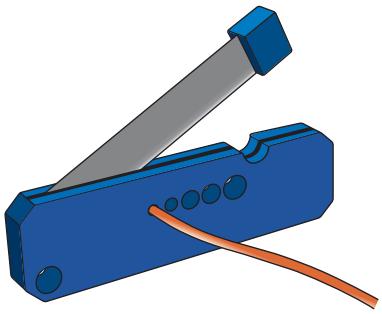
Required material

- Tubing and connectors
- Tubing cutter
- Fingertight wrench

Instruction

Follow the steps below to replace tubing and connectors.

Step	Action
1	Unscrew the connectors, and disconnect the tubing.
2	If the tubing has labels, remove the labels to be used with the new tubing later.
3	Cut the new tubing to the same length as the old tubing. Use a tubing cutter to get a straight angle cut.



CAUTION

Cut injuries. The tubing cutter is very sharp and must be handled with care to avoid injuries.

Step	Action
	Note: *When replacing system tubing, use the original inner diameter and length to make sure that the correct internal volumes are maintained. Inlet and outlet tubing may be shortened if required.*
4	Put the old labels on the new tubing.
5	Mount the new connectors on the tubing. • For fingertight connectors, slide the connector onto the tubing. • For tubing connectors 1/8", slide the connector onto the tubing. Slide the ferrule onto the tubing with the thick end towards the end of the tubing.
6	Insert the tubing with connector into the port. Make sure to insert the tubing all the way into the bottom of the port.
7	Tighten the connector fully. For areas difficult to access, use the fingertight wrench included in the accessory kit.

5.6.7 Replace the inlet filters

Maintenance interval

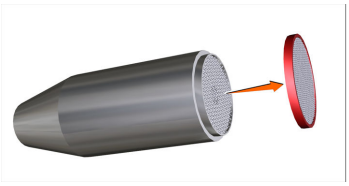
Replace the inlet filters when required, for example when the filters are clogged.

Required material

Inlet filter set

Instruction

Follow the steps below to replace the inlet filter and support net from inlet tubing.

Step	Action
1	Pull off the inlet filter and the support net from the inlet filter holder. 
2	Fit the new support net and inlet filter, and press the filter into position.

5.6.8 Replace the online filter

Maintenance interval

Replace the online filter every week, or when required, for example when the filter becomes clogged.

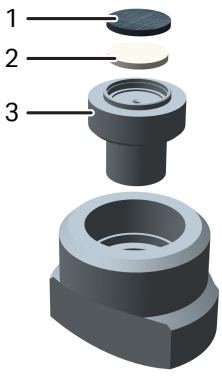
Required material

- Filter 10PP
- Forceps
- Gloves

Instruction

Follow the steps below to replace the online filter.

Tip: *Use forceps and gloves during the replacement procedure to avoid contamination.*

Step	Action
1	Unscrew the nut from the online filter. 
2	Remove the old filter (1) using forceps. Replace the support net (2) if damaged. 

Step	Action
3	Mount the new filter. Carefully push the filter onto the holder (3).
4	Refit the nut and tighten the online filter by hand.

6 Troubleshooting

About this chapter

This chapter describes how to troubleshoot the ÄKTA go instrument in the case of a system malfunction. Possible causes and corrective actions are described in the following sections.

In this chapter

6.1 Hardware issues

Introduction

If malfunction of a module is suspected, check the following sections for possible causes and corrective actions for the issue. If there is a malfunction of the system but the issue or module affected is unknown, run a suitable performance test as the first step in troubleshooting the system. For instructions on how to run performance tests refer to *ÄKTA go Operating Instructions (29360951)*. For a detailed description of the performance tests, see *Chapter 4 Performance tests, on page 104*.

Power supply

Problem	Possible cause	Action
Instrument does not turn on	Power cord not connected	Connect the power cord to the wall outlet and to the electrical inlet on the instrument.
	No electric current in the wall outlet	Make sure that there is electric current in the wall outlet.
	Broken fuse in the instrument	Replace the fuse. Refer to *ÄKTA go Operating Instructions (29360951)*.
	Overheated instrument	Switch off the instrument and wait until the temperature has decreased before restarting it. If the problem persists, generate a System error report and contact Service.

High internal temperature

Problem	Possible cause	Action
High internal temperature	Insufficient instrument ventilation	Make sure that the air ventilation on the back of the instrument is not covered. There should be at least 10 cm clearance at the back of the instrument to allow adequate air circulation.
	Hot surroundings	Decrease the room temperature. Maximum operating temperature is 35°C.
	Faulty fan	Contact Service.

Instrument communication

Problem	Possible cause	Action
The instrument is not detected by UNICORN	Disconnected network cable between the instrument and the control computer	Connect the cable.
The system could not be connected to UNICORN	UNICORN instrument server has shut down	Restart the control computer.
The UNICORN client has lost connection to the instrument server	Temporary overload of the processor	Restart the UNICORN client to regain control.
Multiple error messages in UNICORN: ***One or more module(s) is not found by the instrument***	A cable between a module and the instrument is not connected	Check all modules and connections.
	A UniNet-9 connector is not plugged	Check that all UniNet-9 connectors that are not in use are plugged with gray jumpers.
	Incorrect Node ID for one module	Change the Node ID. See *Section 7.12 Node ID, on page 287*.
Module not found by the instrument or warning message in UNICORN: ***(Warning) Two instrument modules have the same Node ID***	Two or several modules have the same Node ID	Change the Node ID. See *Section 7.12 Node ID, on page 287*.
Warning message in UNICORN: ***Instrument module is missing***	The module is not functioning properly	In the displayed dialog in UNICORN, select the option ***Restart the system only*** and click ***OK***. If the problem persists, contact Service.
Warning messages in UNICORN: ***(Warning) Gate (12): Internal instrument error***	Incorrect Node ID for one module	Change the Node ID. See *Section 7.12 Node ID, on page 287*.
Error message from a module: ***Internal instrument error***	Various causes	Restart the instrument. If the problem persists, generate a System error report, and contact Service.

Leakage

Problem	Possible cause	Action
Leakage around a connector	Connector not tightened	Tighten the connector. If necessary, replace the connector.
	Worn connector	Unscrew the connector to check it. If necessary, replace the connector.
	Crystallized material around the connector	Unscrew to clean the connector. If necessary, replace the connector.

High pressure

Problem	Possible cause	Action
Pressure alarm or higher pressure than expected	Pressure increase due to viscosity (e.g. samples or run in a cold environment)	Lower the flow rate or activate ***Pressure Control***. See *Section 3.8 Pressure control, on page 100*.
	Pressure alarm incorrectly set	Check the pressure alarm setting in ***System Settings***.
	Clogged online filter	Replace the online filter. See *Section 5.6.8 Replace the online filter, on page 193*.
	Tubing i.d. changed	The back pressure for a 0.25 mm i.d. tubing is 16 times higher than that for a 0.50 mm i.d. tubing used with the same running conditions.
	Blocked flow path	Remove obstructions to the flow path. For example, remove stop plugs and replace constricted tubing.
High pressure alarm when pressure control is activated	Inappropriate pressure control parameter selected	See *Section 3.8 Pressure control, on page 100*.

Inlet valve K9

Problem	Possible cause	Action
Air in tubing after the inlet valve	Connectors not tightened	Tighten the connectors. If necessary, replace the connectors.
No flow	Wrong inlet selected	Select the correct inlet or check the inlet instructions in the method.

Problem	Possible cause	Action
	Empty buffer or sample bottle	Refill the bottle
	Faulty valve	Replace the valve. See *Section 5.6.1 Replace ÄKTA go modules, on page 183*.

Rotary valves

Problem	Possible cause	Action
Valve not switching or switching to a wrong position	Incorrect instruction in the method	Check the method.
	Hardware error	Restart (power off) the instrument. If the problem persists, replace the module. See *Section 5.6.1 Replace ÄKTA go modules, on page 183*.

Pump

Problem	Possible cause	Action
Erratic flow or pressure	Air trapped in the pump heads	Purge the pump. Refer to *ÄKTA go Operating Instructions (29360951)*.
	Buffer running out	Check that there is sufficient volume of buffer present in the flask. Prime the inlets.
	Bad piston seal	Replace the piston seal and rinse membrane. See *Section 5.5.2 Maintenance of the pump pistons and piston seals, on page 177*.
	Bad piston	Replace the piston. See *Section 5.5.2 Maintenance of the pump pistons and piston seals, on page 177*.
	Bad check valve	Replace the check valves. See *Replace the pump head check valves, on page 173*.
Small pressure pulsations that remain after a proper purge of the pump heads	Air bubble stuck in the pump seal	Run 100% methanol at >5 mL/min and >0.5 MPa for a few minutes. Alternatively, run water at 25 mL/min and >2 MPa for 1 to 2 hours.
Liquid leaking between the pump head and the side panel	Piston seal or rinsing membrane incorrectly fitted or worn	Replace or reinstall the piston seal or membrane. See *Section 5.5.2 Maintenance of the pump pistons and piston seals, on page 177*.

Problem	Possible cause	Action
Strange noise form the pump	Piston spring damaged or incorrectly mounted	Disassemble the pump head and examine the piston spring. See *Section 5.5.2 Maintenance of the pump pistons and piston seals, on page 177*.

Pressure monitor

Problem	Possible cause	Action
Pressure offset when the reading should be zero	Uncalibrated pressure sensor	Calibrate the pressure sensors. See *Section 5.4.1 Calibrate the pressure sensors, on page 158*.
	Changed temperature	Wait until the temperature has stabilized and calibrate the pressure sensors. See *Section 5.4.1 Calibrate the pressure sensors, on page 158*.

Mixer

Problem	Possible cause	Action
Leakage	Mixer not properly assembled	Reassemble the mixer. See *Section 5.3.2 Maintenance of the mixer, on page 142*.
	Bad O-ring	Check or replace the O-ring in the mixer. See *Section 5.3.2 Maintenance of the mixer, on page 142*.
Bad mixing performance	Mixer membrane missing or damaged	Check or replace the membrane in the mixer. See *Section 5.3.2 Maintenance of the mixer, on page 142*.

UV monitor

Problem	Possible cause	Action
No UV signal	The lamp is turned off	Turn the lamp on in the ***Manual instructions*** dialog, in ***Monitors*** →***UV lamp***.
Sharp dips or peaks in the UV signal. Ghost peaks	Air in the UV flow cell due to missing flow restrictor	Add the flow restrictor to the flow path. If a pH valve is installed, set the flow restrictor in-line in the ***Manual instructions*** dialog, under ***Flow path*** →***pH valve***.
Noisy UV signal	Dirt in the UV flow cell	Clean the UV flow cell, see *Clean the UV flow cell, on page 145*.

Problem	Possible cause	Action
	Dirt in the flow path	Perform a System CIP and Column CIP. Refer to *ÄKTA go Operating Instructions (29360951)*.
	The UV lamp is broken or worn out.	Contact Service.
	Broken UV flow cell	Replace the UV flow cell, see *Section 5.6.4 Replace the UV flow cell, on page 187*.
Auto zero out of accepted range	Wrong UV flow cell for current buffer	Change to a shorter UV flow cell or change buffer.
	Incorrectly installed UV flow cell	Check that the UV flow cell is fitted correctly, see *Section 5.6.4 Replace the UV flow cell, on page 187*.
	Broken UV flow cell	Replace the UV flow cell, see *Section 5.6.4 Replace the UV flow cell, on page 187*.
Distorted protein peaks in ion exchange chromatography (IEX) gradients (e.g., step gradients)	The refractive index of the buffer changes rapidly in quick IEX gradients and disturbs the shape of the protein peaks in the 2 mm UV flow cell	Run with reversed flow direction through the 2 mm UV flow cell: connect the inlet tubing at the bottom and the outlet tubing at the top of the UV flow cell.

Conductivity monitor

Problem	Possible cause	Action
Unstable conductivity	Air bubbles in the conductivity flow cell, due to missing flow restrictor	Add the flow restrictor to the flow path. If a pH valve is installed, set the flow restrictor in-line in the ***Manual instructions*** dialog, under ***Flow path →pH valve***.
	Air or dirt in the conductivity flow cell	Clean the conductivity flow cell. See *Section 5.3.4 Maintenance of the conductivity flow cell, on page 147*.
Increasing/decreasing conductivity measurement with the same buffer over time	Dirt in the conductivity flow cell	Clean the conductivity flow cell. See *Section 5.3.4 Maintenance of the conductivity flow cell, on page 147*.
	Changes in ambient temperature	Set the temperature compensation factor, in ***System Settings →Conductivity →Cond temp compensation***.

Problem	Possible cause	Action
	Uncalibrated conductivity monitor	Check the calibration with a solution with known conductivity. Calibrate the conductivity monitor, see *Section 5.4.3 Calibrate the conductivity monitor, on page 165*.
A "knee" in the beginning of a linear gradient	**B** inlet not properly primed	Prime the **B** inlet.
Non-linear conductivity response of a programmed linear gradient	Conductivity response is by nature non-linear	N/A
Fluctuating conductivity during a gradient or a Conc %B setting between 0 and 100 %B	Missing mixer or missing membrane in the mixer	Check or replace the membrane in the mixer. See *Section 5.3.2 Maintenance of the mixer, on page 142*.
	Buffers used are too difficult to mix	Change buffers or use an external large mixer.

pH monitor and pH valve

Problem	Possible cause	Action
Leakage	pH or dummy electrode not properly installed in the valve	Remove the dummy electrode and wet it properly with distilled water. Insert the dummy electrode into the pH valve and rotate it before securing it with the nut.
No or strange pH signal	Dummy electrode installed	Replace the dummy electrode with a pH electrode.
	Electrode cable not connected properly	Connect the electrode cable.
	Faulty or old electrode	Replace the electrode. See *Replace the pH electrode, on page 152*.
Incorrect pH measurement	pH not properly calibrated	Calibrate the pH monitor. See *Section 5.4.5 Calibrate the pH monitor, on page 169*.
	Bad pH electrode	Replace the electrode. See *Replace the pH electrode, on page 152*.
	Dirty pH electrode	Regenerate the pH electrode. Place the pH electrode in water for 30 minutes followed by 30 minutes in a buffer with pH 4. If the problem persists, replace the pH electrode. See *Section 5.3.6 Maintenance of the pH valve and electrode, on page 150*.

Problem	Possible cause	Action
Not possible to inject calibration solution	Blocked waste tubing or **W3** outlet	Check connector and tubing.
Alarm in UNICORN: ***(Alarm) The pH cell can only be run at pressure below 0.8 MPa.***	Post-column pressure is too high	Check the tubing and/or lower the flow rate.

Fraction collector F9-T

Problem	Possible cause	Action
Fraction collector not detected by UNICORN	The UniNet-9 cable between the Fraction collector and the ÄKTA system is not properly connected	Check that the Fraction collector is properly connected.
	Broken/Bad cable	Replace with a new cable.
	Wrong Node ID	Check that the F9-T Node ID is set to 0 (zero).
Drop sync sensor fails to detect drops and switched off the ***Drop-Sync*** function	The drop sync sensor needs to be cleaned.	Clean the drop sync sensor. See *Section 5.3.7 Maintenance and cleaning of Fraction collector F9-T, on page 154* for cleaning instructions.
	Air in the flow path	Check the flow path for air. Fill system and purge the pump. Refer to *ÄKTA go Operating Instructions (29360951).*
	Too high flow rate	Decrease the flow rate. Refer to *Fraction Collector F9-T Operating Instructions (29478336)* for appropriate flow rates for different nozzles and plate types.
	Blocked drop sync sensor	Check the drop sync sensor, or if the tubing nozzle is used, that the tubing has correct protrusion for drop sync sensor functionality.
The drop sync sensor signal LED did not manage to adjust the LED power to get a correct drop sync signal	The drop sync sensor needs to be cleaned.	Clean the drop sync sensor. See *Section 5.3.7 Maintenance and cleaning of Fraction collector F9-T, on page 154*.

Problem	Possible cause	Action
	Blocked drop sync sensor	Remove what is blocking the drop sync sensor, such as salt deposits. ***Note:*** *If the tubing nozzle is used, it must extend 4 mm or it may block the sensor.*
Plates or tubes do not fit in the plate or tube holder	Wrong plates or tubes are used	Check recommended plates or tubes in *Section 2.3.8 Fraction collector F9-T, on page 47*.
Drops do not fall into the tubes inserted in 24 deep well plates	Tubes are positioned incorrectly in the 24 deep well plate	Correct positioning of tubes in 24 deep well plates is described in *Section 2.3.8 Fraction collector F9-T, on page 47*.
	Drop position adjustment is not correct	Check that drop position is correct. In the ***System Control*** module select ***System →Adjust Drop Position (F9-T)***.
The green LED light on the dispenser head is off	The LED is switched off in the UNICORN software	Switch on the LED in ***System settings***.
The tubing/nozzle in the Fraction collector is blocked	Salt residuals in the tubing/nozzle	Cleaning of the Fraction collector tubing is described in *Fraction Collector F9-T Operating Instructions (29478336)*.
	The tubing is bent	Replace the tubing.
	The nozzle needs to be replaced	Replacing the nozzle is described in *Fraction Collector F9-T Operating Instructions (29478336)*.
The fraction volume found in the tubes or wells are smaller than expected	Leakage in the flow path	Localize and take care of the leakage, for example by tightening connectors.
	Air in the flow path	Check the flow path for air. Fill system and purge the pump, refer to *ÄKTA go Operating Instructions (29360951)* for more information.
	Bad pump function	See troubleshooting of pumps in *Pump, on page 199*.
Liquid on the plate holder or on plates beside wells	The finger tight connector on the nozzle is not tight enough	Tighten the connector. Replace the connector if the leakage is persistent.
	Wrong plate/tube type set for the selected plate position	Check plate/tube type set in the method or manual run.

Problem	Possible cause	Action
	Wrong drop position set in ***System control →Adjust Drop Position (F9-T)***	Check that drop position is correct. In the ***System Control*** module select ***System →Adjust Drop Position (F9-T)***.
	The tubes are flooded	Make sure that the fraction volume is adapted to the well/tube volume or that they have been replaced by empty ones. If using 96 microplates with a well volume of less than 300 µL, make sure to change to more narrow tubing, with an inner diameter of 0.25 mm or less and adjust delay volume accordingly.
Spillage by the Fraction collector during fractionation	The drop sync sensor needs to be cleaned.	Cleaning of Fraction collector drop sync sensor is described in *Section 5.3.7 Maintenance and cleaning of Fraction collector F9-T, on page 154*.
	The nozzle needs to be cleaned.	Remove the nozzle from the fractionation arm. Unscrew the two nozzle parts to detach the nozzle from the tubing. Clean it in distilled water, mild cleaning agent or 20% ethanol. Replace if necessary.
	Too high flow rate during usage of ***DropSync*** function.	See *Section 3.3 Fractionation overview, on page 86* for more information on the ***DropSync*** function.
	Wrong plate/tube type set for the selected plate position	Check plate/tube type set in the method or manual run.
	Wrong drop position set in ***System Control***	Check that drop position is correct. In the ***System Control*** module select ***System →Adjust Drop Position (F9-T)***. Reset it to default value or adjust it to fit the chosen plate/tube.
	The combination of high flow rates and liquids with low surface tension might lead to spillage in the Fraction collector	Lower the flow rate when using liquids with low surface tension.

Problem	Possible cause	Action
Spillage in Fraction collector when the fractionation arm is moving from the plate in position 1 to that in position 2.	Too high flow rate during fractionation arm move from plate 1 to plate 2	Check the setting in ***System Control*** →***System*** →***Settings*** →***Fraction collection*** →***Flow when moving from plate 1 to plate 2***.
Mismatch between chromatogram and actual fraction number	The delay volume has not been properly set	Adjust the delay volume. In the ***System Control*** module, select ***System*** →***Settings*** →***Fraction collection*** →***Delay volume*** and adjust the value for ***Detector - Frac***. See *Delay volumes for different system configurations, on page 276* for more information.
The Fraction collector fractionates in the wrong well or tube	Unsupported deep well plate/tubes are used	Check that the used plates or tubes have the right dimensions. See *Plates, on page 52* and *Tubes, on page 53* for information on recommended plates and tubes.
	Wrong plate/tube type set for the selected plate position	Check that the set plates/tubes in the method match those placed in the Fraction collector.
	Plates/tubes are not reset when replaced with new	When starting a ***Method run***, check that plates/tubes are reset in the ***Start Protocol***.
Error upon start of a method run, indicating that the wrong plate/tubes are in place, even though the correct plate/tubes are present in the Fraction collector	The plate/tube type in the text method is not the same as that set in ***Method settings***	End the Method and make sure that the same plate/tube types are set in the text method as in ***Method settings***.
High pressure alarm when collecting fractions with the fraction collector	Too high flow rate during fractionation	Decrease the flow rate or replace the tubing between the outlet valve and the Fraction collector with tubing of larger inner diameter. ***Note:*** *Adjust the delay volume. In the* ***System Control*** *software module, select* ***System*** →***Settings*** →***Fraction collection*** →***Delay volume*** *and adjust the value for* ***Detector - Frac****.*

Problem	Possible cause	Action
The fractionation arm does not return to **Home** after completed run	***Frac behavior when ending a run*** is set to ***Remain without reset*** in ***System →Settings →Fraction collection***.	To change Fraction collector behavior when ending a run, adjust the settings in ***System →Settings →Fraction collection →Frac behavior when ending a run***.
Plates/tubes are not reset after ending a run	***Frac behavior when ending a run*** is set to ***Remain without reset*** or ***Go home without reset*** in ***System →Settings →Fraction collection***.	Choose ***Go home and reset*** in ***System →Settings →Fraction collection →Frac behavior when ending a run***.

Fraction collector F9-R

Problem	Possible cause	Action
Fraction collector bowl does not rotate properly	Fraction collector movement blocked	Make sure the Fraction collector bowl can move and is free from obstructions.
Fraction collector skips tubes	Tube sensor height is not properly set	Adjust the tube sensor height. Refer to the *Fraction collector F9-R Operating instructions (29656880)* document.
	Broken tube sensor	Contact Service.
Fraction collector failed to detect a drop	Tubing height not properly set	Adjust the tubing height. See *Connect tubing, on page 59*.
	The drop sync sensor needs to be cleaned.	Clean the drop sync sensor. See *Section 5.3.8 Maintenance and cleaning of Fraction collector F9-R, on page 156*.
	Too high flow rate	Decrease the flow rate to ≤2 mL/min.
Fraction numbering error	Incorrect setting	Set the relevant fraction number mode in ***System Settings***.

Air sensor

Problem	Possible cause	Action
Air sensor does not trigger alarm	Incorrect setting	Check the settings in the method. If running manually, set the air sensor alarm in ***Manual instructions*** →***Alarms*** →***Alarm air sensor***.

I/O-box

Problem	Possible cause	Action
Analog signal noise	Cables not connected properly	See the *Install I/O-box E9 Installation Instructions (29021463)* for details.
	Long or unshielded cable between the external equipment and the I/O-box	Use a cable as short as possible. Use a shielded cable. Connect the cable shield to the D-sub connector shield.
I/O signals do not work as expected	Cables incorrectly connected	See the *Install I/O-box E9 Installation Instructions (29021463)* for details.
	Incorrect setting	See the *Install I/O-box E9 Installation Instructions (29021463)* for details.

6.2 Software issues

Software issues, including common connection issues and suggested corrective actions, are covered in the UNICORN documentation. For software error codes refer to *Section 7.11 Error codes, on page 281*. For creating a system error report refer to *ÄKTA go Operating Instructions (29360951)*.

6.3 Purification method issues

If a purification method fails, check and perform the actions listed below:

- Clean and prepare all columns according to the column recommendations.
- Adjust the samples to binding buffer conditions.
- Clarify the samples by centrifugation and/or filtration prior to sample loading.
- Use the correct buffers for the chosen columns and proteins.
- Check the buffers for precipitation.
- Use the buffers at the running temperature of the system. If performing a run in cold environment, use cold buffers.
- Check that the buffers have the correct pH. The pH of some buffers changes with the temperature.
- Use columns suitable for the chosen target proteins.

For further help on troubleshooting a purification method, refer to a suitable chromatography handbook. Handbooks with practical tips on chromatography are available at *cytiva.com/handbooks*.

7 Reference information

About this chapter

This chapter lists the allowed environmental and operational ranges for the ÄKTA go instrument. Refer to *ÄKTA go Product Documentation* for detailed technical specifications.

In this chapter

7.1 System specifications

Introduction

This section specifies the operating data of the instrument and its components.

System specifications

Parameter	Data
System configuration	Benchtop system, external computer
Control system	ÄKTA go 1.0 UNICORN 7.4 or later version [1] ÄKTA go 2.0 UNICORN 7.6 or later version ÄKTA go 3.0 UNICORN 7.6 or later version
Connection between PC and instrument	Ethernet
Dimensions (width × height × depth)	335 × 482 × 464 mm (depth without tray 451 mm, depth without modules 380 mm)
Weight (excluding computer, columns, buffer bottles)	27 kg
Supply voltage	100 to 240 V ~ autorange
Maximum voltage fluctuation	± 10% from the nominal voltage
Frequency	50/60 Hz
Power consumption	Rated max 300 VA [2] Max with all options 150 W [3] Typical 100 W Power-save < 20 W
Enclosure protective class	IP 21
Acoustic noise level	< 60 dB(A)

[1] UNICORN 7.6 or later is required to run ÄKTA go equipped with F9-T.
[2] ÄKTA go can deliver 300 VA.
[3] ÄKTA go equipped with all options consumes 150 W.

Tubing and connectors

Flow path	Tubing	Connectors
Inlet	FEP tubing, i.d. 1.6 mm	Tubing connector 1/8" + Ferrule (yellow),

Flow path	Tubing	Connectors
Pump to Injection valve	PEEK tubing, i.d. 0.75 mm	Fingertight connector, 1/16"
After Injection valve	PEEK tubing, i.d. 0.50 mm	Fingertight connector, 1/16"
Outlet and waste	ETFE tubing, i.d. 1.0 mm	Fingertight connector, 1/16"

Environmental ranges

Parameter	Data
Storage and transport temperature range	-25°C to 60°C, during 48 h
Chemical environment	See *Section 7.3 Wetted materials and biocompatibility, on page 225*.

Operating ranges

Parameter	Data
Operating temperature range	4°C to 35°C
Relative humidity	20% to 95%, non-condensing

Pump

Parameter	Data
Pump type	Piston pump (metering type)
Flow rate range	0.01 to 25 mL/min
Pressure range	0 to 5 MPa (0 to 50 bar)
Viscosity range	0.7 to 10 cP, flow rate accuracy not specified above 3 cP
Flow rate accuracy	± 2% Conditions: 0.25 to 25 mL/min, 0.7 to 3 cP

Valves

Parameter	Data
Type	Rotary valves[1]

Parameter	Data
Number of valves	Up to 7
Functions	Standard: Inlet valve (sample and three buffer inlets), injection valve, and outlet valve (three outlets). Optional: A inlet valve, B inlet valve, sample inlet valve, column selection valve for three columns, column selection valve for five columns including pressure sensors, pH valve, and outlet valve with 12 outlet ports.

[1] The **K9** inlet valve is a membrane valve, all other valves in ÄKTA go are rotary valves

Inlet options

Parameter	Data
A inlet	1 standard or 6 optional inlets
B inlet	1 standard or 6 optional inlets
C inlet	1 inlet
Sample inlet	1 standard or 6 optional inlets (5 sample inlets and 1 buffer inlet)

Outlet options

Parameter	Data
Number of outlets	Standard: 3 (waste, outlet, and Fraction collector port) Optional: 12 (waste, outlet 1-10, and Fraction collector port)
Delay volume (UV - Fraction collector)	223 µL, with standard configuration and Fraction collector F9-R. 233 µL, with standard configuration and Fraction collector F9-T.

Mixer

Parameter	Data
Mixing principle	Static
Mixer volume	1 mL

Gradient formation

Parameter	Data
Gradient composition range	0.0% B to 100.0% B
Gradient composition accuracy	± 2% Conditions: 2% to 98% B, 0.5 to 20 mL/min, 0.7 to 2 cP
Gradient step composition fluctuation	< ± 0.3% Conditions: 2% to 98% B, 0.5 to 20 mL/min, 0.7 to 2 cP
Gradient linearity	within ± 1% Conditions: within 10% to 85% B, gradient volume ≥ 20 mL, 0.5 to 20 mL/min, 0.7 to 2 cP

Pressure sensors

Parameter	Data
Number of sensors	Up to 3
Placement of sensors	Standard: Pressure sensor in pressure monitor **R9** Optional: Pre-column pressure sensor and the post-column pressure sensor integrated in column valve **V9-C**

UV monitor

Parameter	Data
Number of monitors	1
Wavelength range	280 nm
Absorbance reading range	-6 to 6 AU
Linearity	within ± 5% Condition: 0 to 2 AU
Noise	< 0.1 mAU
Operating pressure	0 to 2 MPa (20 bar, 290 psi)

Parameter	Data
UV flow cells	Standard: Optical path length 2 mm Illuminated volume 2 µL Total volume 30 µL Optional: Optical path length 5 mm Illuminated volume 6 µL Total volume 20 µL

Conductivity monitor

Parameter	Data
Number of monitors	1
Conductivity reading range	0.01 to 999.99 mS/cm
Conductivity accuracy	± 0.01 mS/cm or ± 2%, whichever is greater Conditions: within 0.3 to 300 mS/cm
Operating pressure	0 to 2 MPa (20 bar, 290 psi)
Conductivity flow cell volume	22 µL
Temperature monitor reading range	0°C to 70°C
Temperature monitor accuracy	±1.5°C Conditions: 4°C to 35°C

pH monitor

Parameter	Data
pH reading range	0 to 14
pH accuracy	± 0.1 after calibration Conditions: within pH 2 to 12, within ± 3°C from calibration temperature
pH operating pressure range	0 to 0.5 MPa (5 bar, 72.5 psi)
pH flow cell volume	76 µL

Fraction collector, F9-T

Parameter	Data
Number of Fraction collectors	1
Number of fractions	Up to 192
Plates	2 × 96 well microplate, max vol. 0.3 mL 2 × 96 deep well plate, max vol. 2 mL 2 × 48 deep well plate, max vol. 4.5 mL 2 × 24 deep well plate, max vol. 9 mL
Tubes	0.5 mL tubes in 2 × 48 position rack 1.5 mL tubes in 2 × 24 deep well plate 2 mL tubes in 2 × 24 deep well plate 4 × 50 mL tubes in Tube rack for Fraction collector F9-T
Fraction volumes	0.02 to 50 mL
Spillage-free mode	***DropSync***
Flammable liquids	Yes
Delay volume (UV - Fraction collector)	233 µL with standard tubing and nozzle
Dimensions (W × D × H)	320 × 270 × 190 mm
Weight	4 kg

Fraction collector, F9-R

Parameter	Data
Number of Fraction collectors	1
Number of fractions	Up to 175
Tubes	175 (3 mL tubes) 95 (8 or 15 mL tubes) 40 (50 mL tubes)
Fraction volumes	0.1 to 50 mL
Spillage-free mode	***DropSync***
Flammable liquids	Yes
Delay volume (UV - Fraction collector)	223 µL with standard configuration
Dimensions (W × H × D)	320 × 250 × 400 mm

Parameter	Data
Weight	5 kg

Air sensor

Parameter	Data
Number of sensors	1
Placement	**L9-1.5** before inlet valve or between inlet valve and pump. **L9-1.2** before inlet valve only.
Sensing principle	Ultrasonic

I/O-box

Parameter	Data
Number of I/O-boxes	1
Number of ports	2 analog in, 2 analog out 4 digital in, 4 digital out
Analog range	In +/- 2 V Out +/- 1 V
Digital range	Max 5 V

7.2 Tubing and connectors

Tubing types

The table below shows the tubing types used in the instrument.

Description	Color	Scope of use	Volume/cm
PEEK, o.d. 1/16", i.d. 0.15 mm	Purple	High resolution columns with an inner diameter of 3.2 mm, used from injection valve to Fraction collector.	0.18 µL
PEEK, o.d. 1/16", i.d. 0.25 mm	Blue	High resolution columns with an inner diameter of 4 or 5 mm, used from injection valve to Fraction collector.	0.5 µL
PEEK, o.d. 1/16", i.d. 0.50 mm	Orange	Tubing used from injection valve to Fraction collector.	2.0 µL
PEEK, o.d. 1/16", i.d. 0.75 mm	Green	Tubing used from pump to injection valve.	4.4 µL
ETFE, o.d. 1/16", i.d. 1.0 mm	Transparent	Outlet and waste tubing.	7.8 µL
FEP, o.d. 1/8", i.d. 1.6 mm	Transparent	Inlet tubing.	20.0 µL
Silicone, o.d. 4.1 mm, i.d. 2.1 mm	Transparent	Pump rinse solution tubing.	35.0 µL

To calculate the internal volume (V) of specific tubing, use the formula:

$V = L \times \pi \times d^2/4$

L = length in mm

d = i.d. in mm

Tubing connectors

The table below shows the tubing connectors used in the instrument.

Description	Use with tubing...
Fingertight connector, 1/16"	PEEK, o.d. 1/16" EFTE, o.d. 1/16"
Tubing connector 1/8" + Ferrule (yellow) 1/8"	FEP, o.d. 1/8"

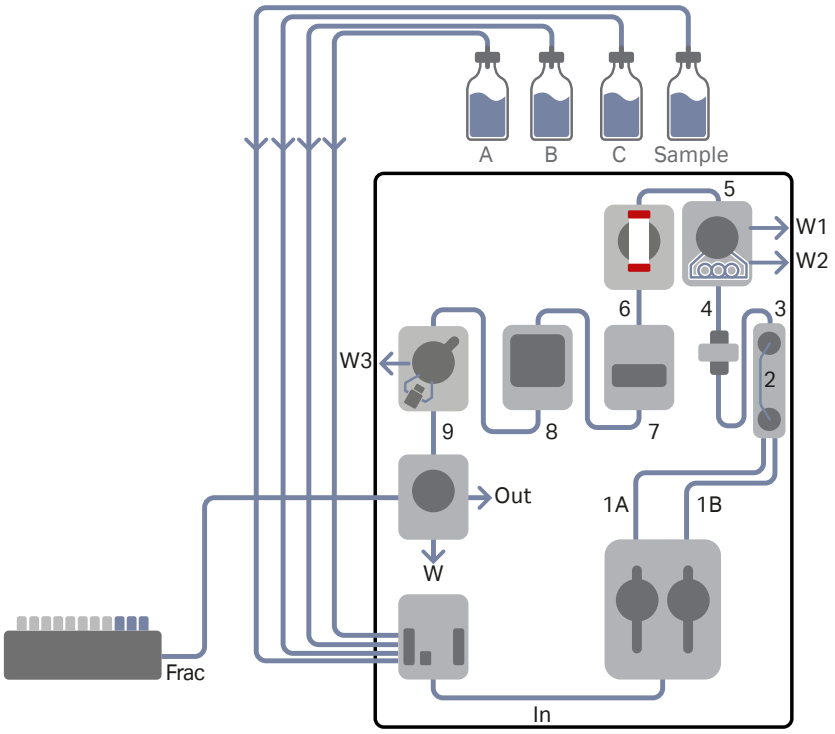
Other connectors

The table below shows other connectors used in the instrument.

Description	Scope of use
Stop plug 1/16"	Stop plug for valve ports
Luer connector (1/16" Male/Luer Female)	Syringe connector for the injection valve and pH valve
Union 1/16"F / 1/16"F	Union connector for two fingertight connectors 1/16"
Union 1/16"M / 1/16"M	Union connector for direct connection of a column to the UV monitor
Union 1/16" Male, 5/16" Female fitting tubing connector, 5/16" + Ferrule (yellow), 1/8"	Connect air sensor **L9-1.2** before the **K9** injection valve

Tubing labels

The illustration below shows the tubing labels for a system configuration with optional modules.



Inlet tubing

The table below shows the labels, standard diameters, and standard lengths of the inlet tubing.

Label	Description	Tubing	Length (mm)	Volume (mL)
In	From inlet valve **K9** to pump **P9-S**	FEP, o.d. 1/8", i.d. 1.6 mm	300	0.6
A	To inlet valve **K9**	FEP, o.d. 1/8", i.d. 1.6 mm	1250	2.5
B	To inlet valve **K9**	FEP, o.d. 1/8", i.d. 1.6 mm	1250	2.5

Label	Description	Tubing	Length (mm)	Volume (mL)
C	To inlet valve **K9**	FEP, o.d. 1/8", i.d. 1.6 mm	1250	2.5
Sample	To inlet valve **K9**	FEP, o.d. 1/8", i.d. 1.6 mm	1250	2.5

Standard tubing

The table below shows the labels, diameters, and standard lengths of the tubing used from the pump to the Fraction collector.

Label	Description	Tubing	Length (mm)	Volume (µL)
1A	Left pump head to pump flow restrictor	PEEK, o.d. 1/16", i.d. 0.75 mm	180	80
1B	Right pump head to pump flow restrictor	PEEK, o.d. 1/16", i.d. 0.75 mm	180	80
2	Pump flow restrictor to pressure monitor	PEEK, o.d. 1/16", i.d. 0.75 mm	100	44
3	Pressure monitor to mixer	PEEK, o.d. 1/16", i.d. 0.75 mm	210	93
4	Mixer to injection valve	PEEK, o.d. 1/16", i.d. 0.75 mm	180	80
5	Injection valve to column or column valve	PEEK, o.d. 1/16", i.d. 0.50 mm	170	33
6	Column or column valve to UV monitor	PEEK, o.d. 1/16", i.d. 0.50 mm	150	30
7	UV monitor to conductivity monitor	PEEK, o.d. 1/16", i.d. 0.50 mm	230	45
8	Conductivity monitor to flow restrictor	PEEK, o.d. 1/16", i.d. 0.50 mm	95	19
9	Flow restrictor to outlet valve	PEEK, o.d. 1/16", i.d. 0.50 mm	135	27
Frac	Outlet valve to Fraction collector (both F9-T and F9-R)	PEEK, o.d. 1/16", i.d. 0.50 mm	400	79

Label	Description	Tubing	Length (mm)	Volume (µL)
Frac	Outlet valve to Fraction collector F9-T in tunnel	PEEK, o.d. 1/16", i.d. 0.50 mm	800	158

Tubing to pH valve

The table below shows the labels, diameter, and standard length of the tubing for the pH valve. This tubing is delivered with the pH valve.

Label	Description	Tubing	Length (mm)	Volume (mL)
8pH	Conductivity monitor to pH valve	PEEK, o.d. 1/16", i.d. 0.5 mm	180	35
9pH	pH valve to outlet valve	PEEK, o.d. 1/16", i.d. 0.5 mm	160	31
1R	pH flow cell to flow restrictor	PEEK, o.d. 1/16", i.d. 0.5 mm	80	16
2R	Flow restrictor to pH flow cell	PEEK, o.d. 1/16", i.d. 0.5 mm	80	16

Reference capillary

The table below shows the label, diameter, and standard length of the reference capillary. The capillary is used during the System performance tests.

Label	Description	Tubing	Length (mm)	Volume (µL)
Ref 1	Reference capillary	PEEK, o.d. 1/16", i.d. 0.25 mm	400	20

Outlet tubing

The table below shows the labels, diameters, and standard lengths of the outlet tubing. The tubing is not mounted on delivery.

Label	Description	Tubing	Length (mm)	Volume (mL)
Out	Outlet port **Out1** from Outlet valve **V9-Os**	ETFE, o.d. 1/16", i.d. 1.0 mm	1500	1.2

Label	Description	Tubing	Length (mm)	Volume (mL)
Out 1 to **Out 10**	Outlet ports **Out1-10** from Outlet valve **V9-O**	ETFE, o.d. 1/16", i.d. 1.0 mm	1500	1.2

Waste tubing

The table below shows the labels, diameters, and standard lengths of the waste tubing. The waste tubing is mounted on delivery.

Label	Description	Tubing	Length (mm)	Volume (mL)
W1	Pump waste. Connected to injection valve port **W1**.	ETFE, o.d. 1/16", i.d. 1.0 mm	1800	1.4
W2	Sample loop waste. Connected to injection valve port **W2**.	ETFE, o.d. 1/16", i.d. 1.0 mm	1800	1.4
W3	pH valve waste. Connected to pH valve port **W3**.	ETFE, o.d. 1/16", i.d. 1.0 mm	1800	1.4
W	System waste. Connected to outlet valve port **W**.	ETFE, o.d. 1/16", i.d. 1.0 mm	1400	1.1

Optional tubing

The table below shows the labels, diameters, and standard lengths of optional tubing.

Label	Description	Tubing	Length (mm)	Volume (µL)
PeakCollect	ÄKTA go peak collect tubing	PEEK, o.d. 1/16", i.d. 0.50 mm	340	68

7.3 Wetted materials and biocompatibility

Introduction

This section provides information about the wetted materials in, and biocompatibility of the ÄKTA go instrument.

For detailed information about chemical resistance of the instrument to the most commonly used chemicals in liquid chromatography, refer to *ÄKTA go Operating Instructions (29360951)*.

In this section

7.3.1 Wetted materials

Introduction

The tables below list the materials that come into contact with process fluids in the ÄKTA go instrument. For details about the wetted materials, see *ÄKTA go Product Documentation*.

Primary flow path

Material	Abbreviation
Ethylene Propylene Diene Monomer	EPDM
Ethylene ChloroTriFluoroEthylene	ECTFE
Ethylene TetraFluoroEthylene	ETFE
Fluorinated Ethylene Propylene	FEP
Fully Fluorinated Propylene Monomer	FFKM
PolyChloroTriFluoroEthylene	PCTFE
PolyEtherEtherKetone	PEEK
PolyPropylene	PP
PolyTetraFluoroEthylene	PTFE
PolyVinylidene DiFluoride	PVDF
UltraHighMolecularWeightPolyEthylene	UHMWPE
Aluminum oxide	
Elgiloy	
Hastelloy® C-276	
Hastelloy C-22	
Quartz glass	
Ruby	
Sapphire	
Titanium grade 2	

Pump rinsing system

Material	Abbreviation
Ethylene Propylene Diene Monomer	EPDM
PolyEtherEtherKetone	PEEK
PolyPropylene	PP
PolyPhenylene Sulfide	PPS
PolyVinylidene DiFluoride	PVDF
Silicone	

7.3.2 General information about biocompatibility and chemical resistance

Biocompatibility

The ÄKTA go instrument is designed for maximum biocompatibility, with biochemically inert flow paths constructed mainly from titanium, PEEK and highly resistant fluoropolymers and fluoroelastomers. Titanium is used as far as possible to minimize contribution of potentially deactivating metal ions such as iron, nickel and chromium. There is no standard stainless steel in the flow path. Plastics and rubber materials are selected to avoid leakage of monomers, plasticizers or other additives.

Cleaning chemicals

Clean using 2 M sodium hydroxide, 70% acetic acid or the alcohols methanol, ethanol and isopropyl alcohol. If sodium hypochlorite is used as sanitizing agent instead of 2 M sodium hydroxide, use a concentration of maximum 10%.

Organic solvents

Chromatography of proteins works with acetonitrile up to 83%.

Strong organic solvents like ethyl acetate, 100% acetone, or chlorinated organic solvents must be avoided. These can cause swelling of plastic material and reduce the pressure tolerance of PEEK tubing. For this reason, flash chromatography and straight ("normal") phase chromatography using these solvents is not recommended on the system.

Assumptions made

The chemical resistance ratings above are based on the following assumptions:

- Synergy effects of chemical mixtures have not been taken into account.
- Room temperature and limited overpressure is assumed.

Note: *Chemical influences are time and pressure dependent. Unless otherwise stated, all concentrations are 100%.*

7.4 Predefined methods and phases

Introduction

A predefined method contains a set of phases, each phase reflecting a specific stage of a chromatography or maintenance run. You can select additional phases from the phase libraries and add these to an existing method, or remove phases that are not required.

The predefined purification methods have default values with suitable running conditions for the chosen column type such as flow and pressure limits. Other settings (for example sample application technique, sample volume, elution profile and fractionation) are set on the ***Phase Properties*** pane in the appropriate phases.

This section describes the predefined methods and phases.

A method is built up by a number of phases. Each phase represents a major process step in the method, for example, equilibration or elution. Predefined methods, that include all the phases necessary to run the system, are available for different chromatography techniques and also for system cleaning.

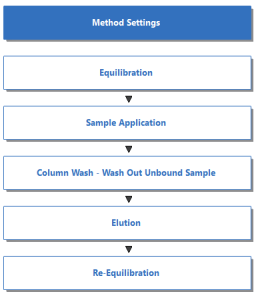
In this section

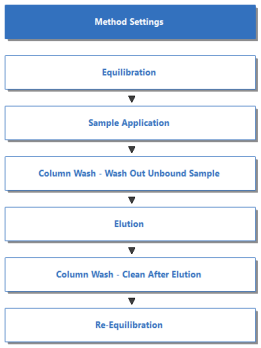
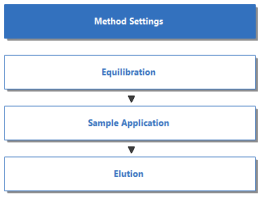
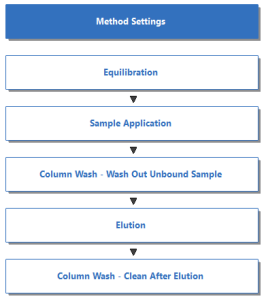
7.4.1 Predefined purification methods

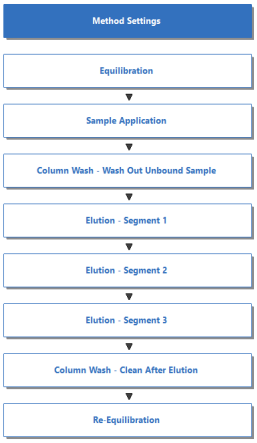
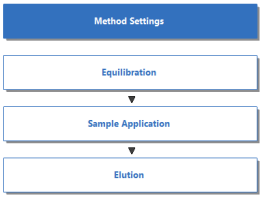
The ***Method Editor*** has predefined methods for different separation techniques. The methods include a number of relevant phases.

All methods start with the ***Method Settings*** phase that defines common parameters used in the subsequent phases.

The table below describes the available predefined purification methods and the phases included.

Predefined purification method	Principle	Included phases
Affinity Chromatography (AC)	The ***Equilibration*** step is followed by ***Sample Application***, where the protein of interest is adsorbed to the column ligand. During ***Column wash***, unbound sample is removed from the column. The ***Elution*** step is performed by using a buffer that either contains a competitor to displace the protein of interest, or changes the pH or ionic strength. Finally, ***Re-Equilibration*** fills the column with start buffer.	
Anion Exchange Chromatography (AIEX)	The ***Equilibration*** step is followed by ***Sample Application***, where negatively charged proteins are adsorbed to the column ligand. During ***Column wash***, unbound sample is removed from the column. The ***Elution*** step is performed using a gradient of increasing salt concentration (of e.g., NaCl). A second ***Column wash*** is performed with a high salt concentration to regenerate the column. Finally, ***Re-Equilibration*** fills the column with start buffer.	

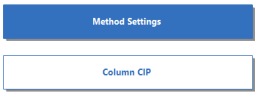
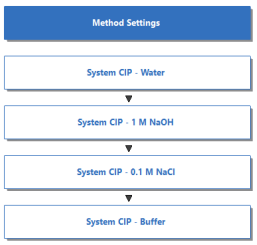
Predefined purification method	Principle	Included phases
Cation Exchange Chromatography (CIEX)	The ***Equilibration*** step is followed by ***Sample Application***, where positively charged proteins are adsorbed to the column ligand. During ***Column wash***, unbound sample is removed from the column. The ***Elution*** step is performed using a gradient of increasing salt concentration of, for example, NaCl. A second ***Column wash*** is performed with a high salt concentration to regenerate the column. Finally, ***Re-Equilibration*** fills the column with start buffer.	
Desalting (DS)	After ***Equilibration*** and ***Sample Application***, the proteins are eluted isocratically, during the ***Elution*** step. This technique is commonly used for buffer exchange.	
Hydrophobic Interaction Chromatography (HIC)	The ***Equilibration*** step is followed by ***Sample Application***, where hydrophobic proteins are adsorbed to the column ligand, using a buffer containing a high salt concentration (e.g., 2 M ammonium sulfate). During ***Column wash***, unbound sample is removed from the column. The ***Elution*** step is performed using a gradient of decreasing salt concentration. Finally, a second ***Column wash*** is performed.	

Predefined purification method	Principle	Included phases
Segmented Gradient Elution (example)	The ***Equilibration*** step is followed by ***Sample Application*** where the proteins in the sample are adsorbed to the resin. After ***Column Wash*** to remove unbound sample, ***Elution*** is performed using a segmented gradient of increasing salt concentration of, for example, NaCl. Three elution segments are included and followed by a new ***Column wash*** and a ***Re-Equilibration*** step to fill the column with start buffer.	
Size Exclusion Chromatography (SEC)	The ***Equilibration*** step is followed by ***Sample Application*** where the proteins in the sample travel through the column at different speeds, depending on the size of the molecule. Directly after, the ***Elution*** step isocratically elutes the proteins according to their size (largest first).	

7.4.2 Predefined maintenance methods

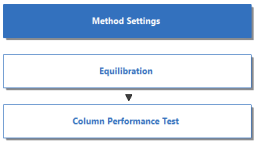
Two predefined methods for preparation and cleaning are available. These maintenance methods are used to prepare, clean, and fill the system or a column with storage solution.

The table below describes the available predefined maintenance methods.

Predefined maintenance method	Principle	Included phases
Column CIP	The method cleans a column by filling it with a cleaning solution. Select the appropriate inlet positions, and enter the solution identity, volume, flow rate and incubation time. By adding steps to the method, several cleaning solutions can be used. Suggestions for cleaning steps are available for a number of column types.	
System CIP	The system is filled with cleaning solution. Select for example inlets, outlets and column positions to be cleaned. Five ***System CIP*** phases are included in the method to facilitate the use of four different cleaning solutions. Additional ***System CIP*** phases can be added from the ***Phase Library*** if applicable.	

7.4.3 Predefined column performance test method

A predefined method to test column performance is available. The table below describes this method.

Predefined column performance test method	Principle	Included phases
Column Performance Test	After ***Equilibration*** of the column, sample is injected via a loop and eluted isocratically. A non-adsorbing sample like acetone or salt should be used. After the run, calculate column performance in the ***Evaluation*** module. The efficiency of the column is determined in terms of height equivalent to a theoretical plate (HETP), and the peak asymmetry factor (A_S). The result is logged in the column logbook.	

7.4.4 Predefined phases

The table below describes the predefined phases.

Phase name	Description
Method Settings	The first, and mandatory phase in any method. Defines common parameters used in the subsequent phases. The ***Method Settings*** phase defines: • ***Column Type*** ***Note:*** *The* ***Column Type*** *list can be filtered in two steps:* 1. *Select the chromatography technique to be used in the list* ***Show by Technique****.* 2. *Select* ***Only show suggested*** *to show the columns with a diameter suitable for the chosen ÄKTA system.* • ***Column Volume*** • ***Pressure Limit(s)*** • ***Flow Rate*** • Option to control the flow to avoid overpressure • ***Column Position*** • Flow restrictor use • ***Unit Selection*** for ***Method Base*** and ***Flow Rate*** • ***Enable pH Monitoring*** • Settings for ***Column Logbook*** • Plate types for Fraction collector ***F9-T***. ***Note:*** *Default values for pressure limits and flow rate are given for the selected column type.* *Some of these options may not be required by certain methods.*
Equilibration	Equilibrates the column before purification, or re-equilibrates the column after purification.
Sample Application	Applies sample to the column. Defines the sample application technique, the sample volume, and the handling of flowthrough.
Column Wash	Washes out unbound sample after sample application or removes strongly bound proteins after elution.
Elution	Elutes the sample from the column. Defines parameters for the elution and fractionation settings.

Phase name	Description
Column CIP	Cleans the column after purification runs by rinsing the column with a cleaning solution to remove nonspecifically bound proteins. By adding steps, several cleaning solutions can be used sequentially.
System CIP	Cleans the system after purification runs by rinsing the system with a cleaning solution. One cleaning solution is used per phase.
Column performance test	Tests the efficiency of a packed column in terms of height equivalent to a theoretical plate (HETP), and the peak asymmetry factor (A_S).
Miscellaneous	Can be added to any method at suitable places. The instructions can help the user to better organize the graphical output of the results or introduce a controlled delay in the method run.

7.5 System settings

Introduction

The system settings are used to set the parameters for the available instructions. The ***System Settings*** dialog can be accessed by selecting ***System*** →***Settings***, in the ***System Control*** module. The following subsections list the system settings available for ÄKTA go.

In this section

7.5.1 System settings - UV

The table below describes the UV related system settings available for ÄKTA go.

Instruction name	Description
Alarm UV	***Alarm UV*** enables or disables the alarm for the UV signal. When enabled, it sets the alarm limits for the UV signal from UV monitor **U9-L**. When the UV signal falls outside the set limits, an alarm is triggered and the run is paused.
Noise reduction UV	***Noise reduction UV*** filters the noise in the UV signal from UV monitor **U9-L**. A column-specific averaging time is set automatically when a column is defined in a method run and ***Averaging time*** is set as a variable.

7.5.2 System settings - Conductivity

The table below describes the conductivity related system settings available for ÄKTA go.

Instruction name	Description
Alarm conductivity	***Alarm conductivity*** enables or disables the conductivity alarm. When enabled, it sets the alarm limits for the conductivity signal. When the conductivity falls outside the set limits, an alarm is triggered and the run is paused.
Relative scale cond	***Relative scale cond*** facilitates monitoring of a gradient, for which the user sets the conductivity values for 0% and 100%. The ***Relative scale cond*** can be set in ascending manner (0% for low and 100% for high conductivity) or in descending manner (0% for high and 100% for low conductivity). ***Note:*** *The **Relative scale cond** in descending manner is especially useful for conductivity visualization in HIC, where the conductivity curve is reversed compared to the concentration curve (i.e., high conductivity at 0% B and low conductivity at 100% B).*
Cond temp condensation	***Cond temp compensation*** is used to adjust the conductivity values to a reference temperature in order to compare conductivity values between runs that have been performed at different temperatures, or to prevent fluctuation of conductivity signals due to temperature changes, such as in a refrigerator. Setting the compensation factor to 0% turns this function off.

7.5.3 System settings - pH

The table below describes the pH related system settings available for ÄKTA go.

Instruction name	Description
Alarm pH	***Alarm pH*** enables or disables the pH alarm. When enabled, it sets the alarm limits for the pH signal. When the pH falls outside the set limits, an alarm is triggered and the run is paused.

7.5.4 System settings - Pressure alarms

The table below describes the pressure alarm related system settings available for ÄKTA go.

Instruction name	Description
Alarm pressure	***Alarm pressure*** sets the alarm limits for the pressure. When enabled and the pressure falls outside the set pressure limits, an alarm is triggered and the run is paused. When a column is selected in the run, the alarm limits are automatically set to the values in the column list. For methods without column valve **V9-C**, ***Column pressure limit*** is also set as a variable. ***Low alarm*** is only triggered if the pressure first exceeds the ***Low alarm*** limit for ten seconds continuously and then falls below the ***Low alarm*** limit. ***Note:*** *Setting the **Low alarm** or the system flow rate to 0 deactivates the low pressure alarm.*
Alarm pre column pressure	***Alarm pre column pressure*** sets the alarm limits for the pre-column pressure. When enabled and the pre-column pressure falls outside the set pressure limits, an alarm is issued and the run is paused. When a column is selected in the run, the alarm limits are automatically set to the values in the column list. For methods, ***Pre column pressure limit*** is also set as a variable. ***Low alarm*** is only triggered if the pressure first exceeds the ***Low alarm*** limit for ten seconds continuously then falls below the ***Low alarm*** limit. ***Note:*** • *Setting the **Low alarm** to 0 deactivates the low pressure alarm.* • *Instruction **Alarm pre column pressure** is available only when Column valve **V9-C** is installed and selected in the component list.*

Instruction name	Description
Alarm delta column pressure	***Alarm delta column pressure*** sets the alarm limits for the delta-column pressure. When enabled and the delta-column pressure falls outside the set pressure limits, an alarm will be triggered and the run is paused. When a column is selected in the run, the alarm limits are automatically set to the values in the column list. When creating a method, ***Delta column pressure limit*** is also set as a variable. ***Low alarm*** is only triggered if the pressure first exceeds the ***Low alarm*** limit for ten seconds continuously then falls below the ***Low alarm*** limit. ***Note:*** • *Setting the* ***Low alarm*** *to 0 deactivates the low pressure alarm.* • *Instruction* ***Alarm delta column pressure*** *is available only when Column valve* **V9-C** *is installed and selected in the component list.*
Alarm Superloop pressure	***Alarm Superloop pressure*** is set to avoid overpressure in a Superloop, when a Superloop is in use. If the pressure signal falls outside the set limits, an alarm is triggered and the run is paused. ***High alarm*** sets the top limit for the Superloop pressure alarm. ***Note:*** ***Alarm Superloop pressure*** *is connected to the* ***Pressure*** *value. If* ***Alarm pressure*** *is also enabled, an alarm is triggered by the lowest set value between* ***Alarm pressure*** *and* ***Alarm Superloop pressure****. By default* ***Alarm Superloop pressure/High alarm*** *is set to 5.0 MPa.*

7.5.5 System settings - Air sensor

The table below describes the air sensor related system settings available for ÄKTA go.

Instruction name	Description
Alarm air sensor	***Alarm air sensor*** enables or disables the alarm for the air sensor. If the alarm is enabled and air is detected, an alarm is triggered and the run is paused.
Sensitivity air sensor	***Sensitivity air sensor*** is used together with the ***Alarm air sensor*** instruction and sets the sensitivity of the external air sensor. ***Normal*** (100 µL) is used to detect when a buffer or sample vessel is empty. ***High*** (30 µL) is used to detect small air bubbles. ***Note:*** *By default, the sensitivity is set to* ***Normal****.*

7.5.6 System settings - Fraction collection F9-T

The tables below describe the Fraction collector F9-T system settings available for ÄKTA go.

Instruction name	Description
Peak frac parameters UV	***Peak frac parameters UV*** sets the detection parameters for peak collection, i.e. it determines when a peak starts and ends. This information is used by the instruction ***Peak fractionation*** in order to start/end the peak collection.
Delay volume →Detector - Frac	***Delay volume →Detector - Frac***, defines the delay volume between the UV monitor and the Fraction collector, excluding the pH valve but including the tubing to the pH valve.
Delay volume →Restrictor volume	***Delay volume →Restrictor volume***, defines the volume of the flow restrictor that is added to the delay volume when the pH valve is installed, and the flow restrictor is in-line. This volume includes the volume of the tubing to the flow restrictor.
Delay volume →pH cell volume	***Delay volume →pH cell volume***, defines the volume of the pH valve that is added to the delay volume when the pH electrode is in-line.
DropSync	Drop sync synchronize movement after drop release. The available settings are ***On***, ***Off***, and ***Auto***. The Auto setting turns the drop synchronization on for flow rates below 3 mL/min, and turns it off for flows above 3 mL/min. This is done for all plate types except 96 deep well, where the limit is 5 mL/min. Do not use the Auto setting together with a micro nozzle because the micro nozzle only form drops up to 1.5 mL/min.

Instruction name	Description
Collection of pre-fractionation volume	The options for ***Collection of pre-fractionation volume*** are: • ***Auto*** ***Auto*** sets the pre-fractionation volume to be collected in a separate well/tube position if the fraction volume is below 5 mL. If the fraction volume is 5 mL or more, the pre-fractionation volume is collected in the same tube/well as the first fraction. • ***Combined with first*** fraction is used when the pre-fractionation volume is collected in the same position as the first fraction. ***Note:*** *If the sum of pre-fractionation plus fraction volume exceed the maximum volume for the well/tube, the pre-fractionation volume is automatically collected in a separate well/tube.* • ***Separate position*** is used when the pre-fractionation volume is collected in a position that is different from the first fraction.
Last position filled action	***Last position filled action*** determines what action should be taken after the last position has been filled during fractionation. The options for ***Last position filled action*** are: • ***Out 1*** directs the flow to outlet 1 after the last position has been filled. • ***Pause*** sets the method to pause after the last position has been filled. • ***Waste*** directs the flow to waste after the last position has been filled. ***Note:*** *It is possible to enable collection in more than two plates when* ***Last position filled action*** *is set to* ***Pause****.*

Instruction name	Description
Flow when moving from plate 1 to plate 2	***Flow when moving from plate 1 to plate 2*** sets system behavior when moving between plates. The options for ***Flow when moving from plate 1 to plate 2*** are: • ***Keep flow***, keeps the flow rate when the fractionation arm is moving from plate 1 to plate 2. For high flow rates, drops may be lost during movement. • ***Direct flow to waste,*** directs the flow to waste when the fractionation arm is moving from plate 1 to plate 2. When the fractionation arm reaches its position the outlet valve is turn to frac again. • ***Auto*** chooses ***Keep flow*** or ***Direct flow to waste*** depending on flow rate. ***Keep flow*** is selected for flow rates below 1.5 mL/min, ***Direct flow to waste*** for flow rates above or equal to 1.5 mL/min.
Frac behavior when ending a run	***Frac behavior when ending a run*** sets what shall happen after the run has ended. The options for ***Frac behavior when ending a run*** are: • ***Go home without reset*** moves the fractionation arm to its home position without resetting the plate(s). • ***Go home and reset*** moves the fractionation arm to the home position and resets the plate(s). • ***Remain without reset*** keeps the fractionation arm at its last position without resetting the plate.
LED mode	***LED mode*** turns the green light in the fractionation arm On or Off during fractionation.

7.5.7 System settings - Fraction collection F9-R

The tables below describe the Fraction collector F9-R system settings available for ÄKTA go.

Instruction name	Description
Fractionation settings	***DropSync*** synchronizes tube change to drop release. The available settings are ***On*** or ***Off***. It is recommended to use ***DropSync*** for flow rates below 2 mL/min. Higher flow rates can however be used, depending on the properties (for example viscosity) of the liquid.
Peak frac parameters UV	***Peak frac parameters UV*** sets the detection parameters for peak collection, i.e. it determines when a peak starts and ends. This information is used by the instruction ***Peak fractionation*** in order to start/end the peak collection.
Fraction numbering mode	Determines whether the fraction number is reset at the end of a method or not. ***Note:*** *The default setting for* ***Fraction numbering mode*** *is* ***Reset***.
Delay volume →Detector - Frac	***Delay volume →Detector - Frac*** is used to define the delay volume between the monitor and the Fraction collector. The instruction is used to make sure that the collected fractions correspond to the fractions indicated in the chromatogram.
Delay volume →Restrictor volume	***Delay volume →Restrictor volume***, defines the volume of the flow restrictor that is added to the delay volume when the pH valve is installed, and the flow restrictor is in-line. This volume includes the volume of the tubing to the flow restrictor.
Delay volume →pH cell volume	***Delay volume →pH cell volume*** is used to set the pH cell volume. This volume is added to the volume defined in ***Delay volume →Detector - Frac*** when the pH electrode is in-line.

7.5.8 System settings - Wash settings

The table below describes the wash related system settings available for ÄKTA go.

Instruction name	Description
Pump wash settings	***Pump wash settings*** sets the flow rate and the wash volume used during ***Pump wash***.
System wash settings	***System wash settings*** sets the flow rate and post wash volume used for ***System wash***.

7.5.9 System settings - Watch parameters

The table below describes the watch parameter settings available for ÄKTA go.

Instruction name	Description
Watch UV parameters	***Watch UV parameters*** sets the ***Accepted fluctuation*** and ***Delta peak*** limit of the UV signal for some of the tests in the ***Watch*** and ***Hold until*** instructions.
Watch cond parameters	***Watch cond parameters*** sets the ***Accepted fluctuation*** and ***Delta peak*** limit of the conductivity signal for some of the tests in the ***Watch*** and ***Hold until*** instructions.
Watch pressure parameters	***Watch pressure parameters*** sets the value for the ***Accepted fluctuation*** of the pressure signals used for the test ***Stable signal*** in the instructions ***Watch*** and ***Hold until***.
Watch flow parameters	***Watch flow parameters*** sets the value for the ***Accepted fluctuation*** of the flow rate signal used for the test ***Stable signal*** in the instructions ***Watch*** and ***Hold until***.
Watch pH parameters	***Watch pH parameters*** sets the value for the ***Accepted fluctuation*** of the pH signal used for the test ***Stable signal*** in the instructions ***Watch*** and ***Hold until***.
Watch analog in parameters	***Watch analog in parameters*** sets the ***Accepted fluctuation*** and ***Delta peak*** limit of the analog signal for some of the tests in the ***Watch*** and ***Hold until*** instructions.

7.5.10 System settings - I/O-box

The table below describes the I/O-box related system settings available for ÄKTA go.

Instruction name	Description
Noise reduction analog in X	***Noise reduction analog in X*** filters the noise in the analog signal in port number X.
Digital out X	***Digital out X*** sets the value of the signal sent out by digital port number X to either 0 or 1. The default value is 1.
Alarm analog in X	***Alarm analog in X*** enables or disables the alarm for the analog signal in port number X. When enabled, it sets the alarm limits for the analog signal. If the alarm is enabled and the analog signal falls outside the set limits, an alarm is triggered and the run is paused.
Alarm digital in X	***Alarm digital in X*** enables or disables the alarm for the signal in digital port number X. The alarm can be triggered by either of the signal values, 0 or 1. If the alarm is enabled and the condition set in ***Value*** occurs, an alarm is triggered and the run is paused.
Configure analog out X	***Configure analog out X*** enables the user to send one of the pre-defined signals (UV signal, conductivity, temperature, pH or concentration of eluent B) to the analog out port number X, and also to set the range of that signal.

7.5.11 System settings - Advanced

The table below describes the advanced system settings available for ÄKTA go.

Instruction name	Description
Power-save	***Power-save*** sets the instrument into power saving mode. When the function is enabled, the instrument enters power-saving mode after having been in state ***Ready*** for a certain time period. The instrument turns into state ***Ready*** when a method run, a method queue or a manual run ends. The time interval before the instrument enters power-saving mode is defined by the user.
Instrument control panel	***Instrument control panel*** locks/unlocks the control panel located on the front side of the instrument. When unlocked, the buttons on the instrument control panel are active and can be used to control a few basic functions of the instrument. When the instrument control panel is locked, no functions are available.
Pressure control parameters	***Pressure control*** regulates the flow rate if the pressure reaches close to the defined limit. ***Pressure control*** can be used to avoid method stops due to pressure alarms. ***Pressure control*** is enabled in the instruction ***Flow***. ***Pressure control parameters*** provides the P and I factors used in the regulator and can be adjusted for different columns.
Max flow during valve turn	***Max flow during valve turn*** sets the maximum flow rate used during the turning of the injection valve and outlet valve in order to avoid high pressure alarms. If the flow rate in the run is higher than this value, the flow rate is lowered during valve turn.

7.5.12 System settings - Data collection

The table below describes the data collection related system settings available for ÄKTA go.

Instruction name	Description
Data collection: • ***UV*** • ***Conductivity*** • ***Conc B*** • ***Flow*** • ***pH*** • ***Pressure*** • ***Temperature*** • ***Pre Column Pressure*** • ***Delta Column Pressure*** • ***Post Column Pressure*** • ***Linear Flow*** • ***% Cond*** • ***UV cell path length*** • ***Counted Volume***	The ***Data collection*** settings determine the maximum number of data points collected for a given curve. Data reduction occurs if the maximum number of data points is exceeded. To avoid data reduction, set the maximum number of data points to be collected to 180000 or insert a ***New Chromatogram*** instruction in the method. ***Note:*** *The default setting is 54000 data points, which corresponds to 1.5 h for a signal of 10 Hz.* ***Tip:*** *The* ***New Chromatogram*** *instruction can be accessed from the* ***Miscellaneous*** *phase.*

7.6 Manual instructions

In this section

7.6.1 Executing Manual instructions

To manually interact with the system using ***Manual instructions***, follow the steps below.

Step	Action
1	In the ***System Control*** module: • select ***Manual*** →***Execute Manual Instructions*** or • use the shortcut ***Ctrl + m***. *Result:* The ***Manual instructions*** dialog opens.
2	In the ***Manual instructions*** dialog: **a.** Click the **+** symbol to show the instructions for the instruction group that you want to excecute. **b.** Select the instruction that you want to excecute. **c.** Enter the parameters for the instruction.
3	To execute several instructions at the same breakpoint, select and choose parameters for the instruction and click ***Insert***. Repeat for several instructions.
4	To adjust parameter fields during method run, check the ***Auto update of parameters during run*** box.
5	To perform the instructions, click ***Execute***.

All available manual instructions are described in the following subsections.

7.6.2 Manual instructions - Pump

The table below describes the pump-related manual instructions available for ÄKTA go.

Instruction name	Description
Flow	***Flow*** defines the system flow rate. The flow rate can be set either as volumetric, linear, or column flow. A column type must be selected before using linear or column flow.
Gradient	***Gradient*** sets a gradient (linear or stepwise) using the pump and inlet valve. ***Note:*** *Set gradient length value to 0 to perform a step gradient.*
System wash	***System wash*** is used to fill the system with the selected buffer composition. If a column valve is installed, the flow can be directed to the waste position of either the injection valve or the outlet valve. The flow is directed to the end of the flow path if outlet valve is not present. ***Note:*** • *Pressing **End** during **System wash** terminates both the wash and the run immediately.* • *Pressing **Continue** during **System wash** will terminate the wash and the run continues from the point at which the **System wash** instruction was executed.* • *If **System wash** is performed during a gradient operation, the current component B concentration is maintained during the wash.* • *An instruction issued during **System wash** cannot be executed until the wash is completely finished and all valves have turned back to the previous positions.* • ***System wash** cannot be executed when the system is in state **Hold**.*

Instruction name	Description
Pump wash	***Pump wash*** is used to change buffers in the specified inlet tubing, and in the pump and mixer. It is also used to wash away previously used buffers and sample. ***Note:*** • *Pressing **End** during **Pump wash** terminates both the wash and the run immediately.* • *Pressing **Continue** during **Pump wash** terminates the wash and the run continues from the point at which the **Pump wash** instruction was executed.* • *An instruction issued while a **Pump wash** is in progress is not executed until the wash is completely finished and all valves have turned back to the previous positions.* • ***Pump wash** cannot be executed when the system is in state **Hold**.*

7.6.3 Manual instructions - Flow path

The table below describes the flow path related manual instructions available for ÄKTA go.

Instruction name	Description
Inlet	***Inlet*** opens the selected inlet port. Positions ***A***, ***B***, ***C***, or ***Sample*** can be selected.
Optional A inlet	***A inlet*** turns inlet valve **A** to the selected position.
Optional B inlet	***B inlet*** turns inlet valve **B** to the selected position.
Optional Sample inlet	***Sample inlet*** turns the sample inlet valve to the selected position.
Injection valve	***Injection valve*** turns the injection valve to the selected position. Positions ***Load***, ***Inject***, or ***Waste*** can be selected. An injection mark appears in the chromatogram when the inlet valve switches to ***Inject***.
Column position	***Column position*** turns the Column valve to the position specified in the parameter ***Position***. The direction of the flow is specified in the parameter ***Flow Direction***.
pH valve	***pH valve*** sets the pH cell and the flow restrictor to position ***In-line*** or ***Off-line***. The pH valve also has a calibration position. This position is only available when performing calibration of the pH monitor (in ***System control*** select ***System*** →***Calibrate***). The calibration position can also be used to fill the pH cell with storage solution since the pH valve is in open position. ***Note:*** • *It is not possible to turn the pH valve during any type of fractionation as it affects the delay volume.* • *The **pH valve** instruction can be given during the delay volume of the different stop fractionation instructions, but it is executed only after the set delay volume has been collected.*
Injection mark	***Injection mark*** makes an injection mark in the chromatogram at the point where this instruction is executed.
Outlet valve	***Outlet valve*** turns the outlet valve to the selected position. The instruction gives a mark in the chromatogram when the valve is switched to the selected position.

7.6.4 Manual instructions - Alarm

The table below describes the alarm related manual instructions available for ÄKTA go.

Instruction name	Description
Alarm pressure	***Alarm pressure*** sets the alarm limits for the pressure. When enabled and the pressure falls outside the set pressure limits, an alarm is triggered and the run is paused. When a column is selected in the run, the alarm limits are automatically set to the values in the column list. For methods without column valve **V9-C**, ***Column pressure limit*** is also set as a variable. ***Low alarm*** is only triggered if the pressure first exceeds the ***Low alarm*** limit for ten seconds continuously and then falls below the ***Low alarm*** limit. ***Note:*** *Setting the **Low alarm** or the system flow rate to **0** deactivates the low pressure alarm.*
Alarm pre column pressure	***Alarm pre column pressure*** sets the alarm limits for the pre-column pressure. When enabled and the pre-column pressure falls outside the set pressure limits, an alarm is issued and the run is paused. When a column is selected in the run, the alarm limits are automatically set to the values in the column list. For methods, ***Pre column pressure limit*** is also set as a variable. ***Low alarm*** is only triggered if the pressure first exceeds the ***Low alarm*** limit for ten seconds continuously then falls below the ***Low alarm*** limit. ***Note:*** • *Setting the **Low alarm** to 0 deactivates the low pressure alarm.* • *Instruction **Alarm pre column pressure** is available only when Column valve **V9-C** is installed and selected in the component list.*

Instruction name	Description
Alarm delta column pressure	***Alarm delta column pressure*** sets the alarm limits for the delta-column pressure. When enabled and the delta-column pressure falls outside the set pressure limits, an alarm is triggered and the run is paused. When a column is selected in the run, the alarm limits are automatically set to the values in the column list. When creating a method, ***Delta column pressure limit*** is also set as a variable. ***Low alarm*** is only triggered if the pressure first exceeds the ***Low alarm*** limit for ten seconds continuously then falls below the ***Low alarm*** limit. ***Note:*** • *Setting the* ***Low alarm*** *to 0 deactivates the low pressure alarm.* • *Instruction* ***Alarm delta column pressure*** *is available only when column valve* **V9-C** *is installed and selected in the component list.*
Alarm UV	***Alarm UV*** enables or disables the alarm for the UV signal. When enabled, it sets the alarm limits for the UV signal from UV monitor **U9-L**. When the UV signal falls outside the set limits, an alarm is triggered and the run is paused.
Alarm conductivity	***Alarm conductivity*** enables or disables the conductivity alarm. When enabled, it sets the alarm limits for the conductivity signal. When the conductivity falls outside the set limits, an alarm is triggered and the run is paused.
Alarm pH	***Alarm pH*** enables or disables the pH alarm. When enabled, it sets the alarm limits for the pH signal. When the pH falls outside the set limits, an alarm is triggered and the run is paused.
Alarm air sensor	***Alarm air sensor*** enables or disables the alarm for the external air sensor. If the alarm is enabled and air is detected, an alarm is triggered and the run is paused.
Alarm analog in X	***Alarm analog in X*** enables or disables the alarm for the analog signal in port number X. When enabled, it sets the alarm limits for the analog signal. If the alarm is enabled and the analog signal falls outside the set limits, an alarm is triggered and the run is paused.
Alarm digital in X	***Alarm digital in X*** enables or disables the alarm for the signal in digital port number X. The alarm can be triggered by either of the signal values, 0 or 1. If the alarm is enabled and the condition set in ***Value*** occurs, an alarm is triggered and the run is paused.

Instruction name	Description
Alarm Superloop pressure	***Alarm Superloop pressure*** is set to avoid overpressure in a Superloop, when a Superloop is in use. If the pressure signal falls outside the set limits, an alarm is triggered and the run is paused. ***High alarm*** sets the top limit for the Superloop pressure alarm. ***Note:*** ***Alarm Superloop pressure*** *is connected to the* ***Pressure*** *value. If* ***Alarm pressure*** *is also enabled, an alarm is triggered by the lowest set value between* ***Alarm pressure*** *and* ***Alarm Superloop pressure****. By default* ***Alarm Superloop pressure →High alarm*** *is set to 5.0 MPa.*

7.6.5 Manual instructions - Monitors

The table below describes the monitor related manual instructions available for ÄKTA go.

Instruction name	Description
Auto zero UV	***Auto zero UV*** sets the UV signals from UV monitor **U9-L** to 0 mAU.
UV lamp	Sets the UV lamp ***On*** or ***Off***. Default is ***On***. The UV lamp is turned ***On*** when the system changes state to ***Run***, ***Hold***, or ***Wash***.
Noise reduction UV	***Noise reduction UV*** filters the noise in the UV signal from UV monitor **U9-L**. When a column is selected in a method run, column-specific averaging time is set automatically and ***Averaging time*** is set as a variable.
Relative scale cond	***Relative scale cond*** facilitates monitoring of a gradient, for which the user sets the conductivity values for 0% and 100%. The ***Relative scale cond*** can be set in ascending manner (0% for low and 100% for high conductivity) or in descending manner (0% for high and 100% for low conductivity). ***Note:*** *The **Relative scale cond** in descending manner is especially useful for conductivity visualization in HIC, where the conductivity curve is reversed compared to the concentration curve (i.e., high conductivity at 0% B and low conductivity at 100% B).*
Reset auto zero UV	***Reset auto zero UV*** resets the UV signal to the actual measured value, by removing the offset generated when ***Auto zero UV*** was performed.

7.6.6 Manual instructions - I/O-box

The table below describes the I/O-box related manual instructions available for ÄKTA go.

Instruction name	Description
Auto zero analog in X	***Auto zero analog in X*** sets the value of the analog signal in the analog port number X to 0 mV.
Reset auto zero analog in X	***Reset auto zero analog in X*** sets the signal in analog port number X to its current value, i.e. the actual voltage in the analog port number X.
Noise reduction analog in X	***Noise reduction analog in X*** filters the noise in the analog signal in port number X.
Digital out X	***Digital out X*** sets the value of the signal sent out by digital port number X to either 0 or 1. The default value is 1.
Pulse digital out X	***Pulse digital out X*** generates a pulsed signal in digital port number X. The signal changes from the initial state (0 or 1) to the opposite state and returns to the initial state after the defined length of time.
Configure analog out X	***Configure analog out X*** enables the user to send one of the pre-defined signals (UV signal, conductivity, temperature, pH or concentration of eluent B) to the analog out port number X, and also to set the range of that signal.

7.6.7 Manual instructions - Fraction collection F9-T

The tables below describe the Fraction collector **F9-T** manual instructions available for ÄKTA go instrument.

Instruction name	Description
Fractionation	***Fractionation*** sets the fractionation parameters when collecting fractions with the Fraction collector. ***Plate type*** sets the type of plates or tubes used. ***Fraction size*** sets the size of the fraction in each well/tube. The fractionation size can be set in time or in volume. ***Start position*** sets at which position fractionation shall start. The options for ***Start position*** are: • ***Set A.1***; resets the plate position and fractionation starts in A1 in the first plate of the chosen type. • ***First available position***; fractionation starts in the first available position. • ***First available row***; fractionation starts in the first available row. • ***First available plate***; fractionation starts in the first available plate. • ***Skip two positions*** sets the start position two positions ahead of the first available position. • ***Set position*** enables you to set any position as start position. You choose your start position in a plate by typing the plate number, the letter of the corresponding row and the column number, e.g. 2.A.1. When setting a start position in a 50 mL tube, type the letter and number of the corresponding tube, e.g. T.1. The start position can also be set by clicking the position in the ***Process*** picture. If the chosen start position is used the plate is reset.
Peak fractionation	***Peak fractionation*** enables collection of only those peaks that fulfill the conditions set in the ***Peak fractionation parameters UV*** instruction described below. Fraction marks are set in the chromatogram for each collected peak. The settings are the same as for ***Fractionation***.

Instruction name	Description
Combined fractionation	***Combined fractionation*** combines fractionation and peak fractionation. This enables a more dynamic fractionation where a fixed fractionation is performed between detected peaks. When a peak start is detected, peak fractionation starts and continues until peak end is detected. At peak end, the fixed fractionation is resumed until a new peak start is detected. Fraction marks are set in the chromatogram for each new fraction collected. The settings are the same as for ***Fractionation***.
Stop fractionation	***Stop fractionation*** ends the fractionation after the set delay volume has been collected. The outlet valve is then turned to position ***Waste***.
Next position	The fractionation goes to the next position after the delay volume has been collected. When no fractionation is ongoing, ***Next position*** moves the fractionation arm instantly. When issuing ***Next position*** while the flow is directed to Waste or Out 1, the fractionation arm moves over the positions. These positions is marked in the chromatogram, but no fractions are collected in these positions.
Next plate	The fractionation goes to the next plate after the set delay volume has been collected. Next plate can only be issued when plate 1 and plate 2 are of the same type.
Go home	***Go home*** makes the fractionation arm move to its home position. Using this command is only possible when fractionation is not ongoing, e.g. pause during ongoing fractionation.
Go to right	***Go to right*** makes the fractionation arm move as far right as possible. Using this command is only possible when fractionation is not ongoing, e.g. pause during ongoing fractionation.
Reset plate	***Reset plate*** resets all positions in plates or racks and sets them as available for fractionation. The command cannot be performed for the current plate/rack when fractionation is ongoing.
Flow when moving from plate 1 to plate 2	***Flow when moving from plate 1 to plate 2*** sets what shall happen when the fractionation arm is moving between plates.
Frac behavior when ending a run	***Frac behavior when ending a run*** sets what happens after the run has ended.
Peak frac parameters UV	***Peak frac parameters UV*** sets the detection parameters for peak collection, i.e. it determines when a peak starts and ends. This information is used by the instruction ***Peak fractionation*** in order to start/end the peak collection.

7.6.8 Manual instructions - Fraction collection F9-R

The tables below describe the Fraction collector **F9-R** manual instructions available for ÄKTA go.

Instruction name	Description
Fractionation	***Fractionation*** is used to set the fractions size when collecting fractions with a Fraction collector. The fractions size can be set in time or in volume.
Stop fractionation	***Stop fractionation*** ends the fractionation after the set delay volume (specified in ***System Settings*** →***Fraction collection*** →***Delay volume***) has been collected. The outlet valve is then turned to position ***Waste***. ***Note:*** *If* ***Stop fractionation*** *is issued when both* ***Fractionation*** *and* ***Peak fractionation*** *are active, fractionation is stopped after the set delay volume has been collected. The outlet valve remains in position* **Frac** *and peak fractionation continues.*
Peak fractionation	***Peak fractionation*** enables collection of only those peaks that fulfill the conditions set in the ***Peak fractionation parameters UV*** instruction described below.
Stop peak fractionation	***Stop peak fractionation*** ends the peak fractionation after the set delay volume (specified in ***System Settings*** →***Fraction collection*** →***Delay volume***) has been collected. The outlet valve is then turned to position **Waste**.
Feed tube	***Feed tube*** moves the tube rack forward one tube after the set delay volume has been collected and a fraction mark is set. If fractionation or peak fractionation is not ongoing, ***Feed tube*** moves the rack instantly and no fraction mark is set.
Reset frac number	Sets fraction numbers to restart from 1. The restart occurs when the instruction is issued. The instruction overrides the continuous numbering mode if ***Fractionation numbering mode*** is set to ***Continue*** in ***System Settings***.
Peak frac parameters UV	***Peak frac parameters UV*** sets the detection parameters for peak collection, i.e. it determines when a peak starts and ends. This information is used by the instruction ***Peak fractionation*** in order to start/end the peak collection.

7.6.9 Manual instructions - Wash settings

The table below describes the wash related manual instructions available for ÄKTA go.

Stage	Description
Pump wash settings	***Pump wash settings*** sets the flow rate and wash volume used during pump washes. ***Note:*** *The flow rate should not exceed 10 mL/min if narrow inlet tubing (i.d. 0.75 mm) is used.*

7.6.10 Manual instructions - Watch parameters

The table below describes the watch parameter instructions available for ÄKTA go.

Instruction name	Description
Watch UV parameters	***Watch UV parameters*** sets the ***Accepted fluctuation*** and ***Delta peak*** limit of the UV signal for some of the tests in the ***Watch*** and ***Hold until*** instructions.
Watch cond parameters	***Watch cond parameters*** sets the ***Accepted fluctuation*** and ***Delta peak*** limit of the conductivity signal for some of the tests in the ***Watch*** and ***Hold until*** instructions.
Watch pressure parameters	***Watch pressure parameters*** sets the value for the ***Accepted fluctuation*** of the pressure signals used for the test ***Stable signal*** in the instructions ***Watch*** and ***Hold until***.
Watch flow parameters	***Watch flow parameters*** sets the value for the ***Accepted fluctuation*** of the flow rate signal used for the test ***Stable signal*** in the instructions ***Watch*** and ***Hold until***.
Watch pH parameters	***Watch pH parameters*** sets the value for the ***Accepted fluctuation*** of the pH signal used for the test ***Stable signal*** in the instructions ***Watch*** and ***Hold until***.
Watch analog in parameters	***Watch analog in parameters*** sets the ***Accepted fluctuation*** and ***Delta peak*** limit of the analog signal for some of the tests in the ***Watch*** and ***Hold until*** instructions.

7.6.11 Manual instructions - Advanced

The table below describes the advanced manual instructions available for ÄKTA go.

Instruction name	Description
Pressure control parameters	By using ***Pressure control parameters*** the method can be run with the set flow rate without the risk of method stop due to pressure alarm. ***Pressure control parameters*** is enabled in the instruction ***Flow***. ***Pressure control parameters*** provides the P and I factors used in the regulator and can be adjusted for different columns. ***Min allowed flow rate*** can be set either as volumetric or as linear flow. A column type must be selected before using linear flow.
Start volume count	***Start volume count*** starts the volume counter function. The counted volume is saved into a memory. This instruction is best used in combination with ***Watch*** instructions.
Stop volume count	***Stop volume count*** stops the volume counter function. The counted volume is stored in the memory and can be recalled with the instruction ***Hold counted volume***. The counted volume can also be recalled in following runs and is stored until a new ***Stop volume count*** instruction is issued. This instruction is best used in combination with ***Watch*** instructions.
Set trigger X	Triggers are used together with a ***Watch*** instruction to trigger a user defined action. There are 12 triggers available and each trigger can have a value of 0 or 1. The instruction ***Set trigger X*** sets the value of the selected trigger to 0 or 1 (0 is default). In a second step, ***Watch*** can be used to monitor the trigger. When inserting a ***Watch*** instruction in a method, setting the signal parameter of the watch to ***Trigger X*** will make the watch monitor the value of the specified trigger. The watch is activated when the value (0 or 1) of the trigger equals the value specified in ***Watch***, i.e. when the watch condition is fulfilled. The action specified by the user when setting up ***Watch*** will at this point be performed. ***Note:*** ***Watch*** *is only available as a method instruction.*

Instruction name	Description
Set counter	***Set counter*** sets the value of the counter 1-4 to a value between -10 000 and +10 000. The default value is 0. To facilitate scouting runs, the counter mode can be set to On or Off. The default value is On. Setting the mode to Off does not disable ***Update counter***. When used together with the ***Watch*** instruction, with counter 1-4 selected as signal, changing the value of counter 1-4 can be used to trigger a user-defined action. For more information, see the help for the ***Watch*** instruction. The counter value is stored and can be recalled in following runs. The value is kept until a new counter value is set from the instructions ***Set counter*** or ***Update counter***.
Update counter	***Update counter*** updates the value of counter 1-4 with the values -1, 0, or +1. The default value is +1. When used together with the Watch instruction, with counter 1-4 selected as signal, changing the value of counter 1-4 can be used to trigger a user-defined action. For more information, see the help information of the ***Watch*** instruction. The counter value is stored and can be recalled in following runs. The value is kept until a new counter value is set from the instructions ***Set counter*** or ***Update counter***.

7.6.12 Manual instructions - Other

The table below describes the other manual instructions available for ÄKTA go.

Instruction name	Description
Set mark	***Set mark*** inserts a mark into the current chromatogram with the text entered for the parameter ***Mark text*** .
Timer	***Timer*** sets the system to pause or end after a set volume or time has passed. ***Select base*** sets the base to either accumulated time or accumulated volume. ***Timeout*** sets the volume or time. ***Action*** sets the action to perform (pause or end).

7.7 Available run data

The table below lists all available ***Run data*** for ÄKTA go.

Run Data	Range/Unit	Description
Connection	N/A	System connection to the software.
System state	N/A	Status of connection and run.
Acc. Volume	mL	Total accumulated volume in the current method or manual run.
Block volume	mL	Accumulated volume in the current block (method run only).
Acc. Time	min	Total accumulated time in the current method or manual run.
Block time	min	Accumulated time in the current block (method run only).
Scouting no.	N/A	The current scouting number in the scouting scheme.
Counted volume	mL	The current counted volume.
Flow	0.01 to 25 mL/min	The set flow rate of the pump.
Linear Flow	cm/h	The set flow velocity of the pump. Only available if a column is selected.
Pressure	0 to 5 MPa	The pressure signal (at the pump).
PreC pressure	0 to 5 MPa	The pre-column pressure signal.
DeltaC pressure	0 to 5 MPa	The delta-column pressure signal.
PostC pressure	0 to 5 MPa	The post-column pressure signal.
Conc B	0.0% to 100.0% B	The set concentration B or the current value during a gradient.
Air Sensor	No air, Air	The current state of the air alarm for the air sensor.
UV	-6000.000 to 6000.000 mAu	The UV absorbance signal of the UV monitor.
Conductivity	0.00 to 999.99 mS/cm	The conductivity signal.
% Cond	0.0% to 100.0%	The conductivity signal as a percentage of a set range.

Run Data	Range/Unit	Description
Temperature	0.0°C to 99.0°C	The temperature signal (in the conductivity flow cell).
pH	0.00 to 14.00	The pH signal.
Inlet	Closed, A, B, C, Sample	The set position of inlet valve **K9**.
Optional A inlet	A1 – A6	The set position of the A inlet valve.
Optional B inlet	B1 – B6	The set position of the B inlet valve.
Optional sample inlet	S1 – S5, Buffer	The set position of the sample inlet valve.
Injection valve	N/A	The set position of the injection valve.
Column position	N/A	The set position of the column valve.
Column flow direction	N/A	The set flow direction position of the Column valve **V9-C** and the Column valve **V9-Cm**.
pH valve	N/A	The set position of the pH valve.
Outlet	N/A	The set position of the outlet valve.
Frac position (**F9-T**) ***Frac Tube number*** (**F9-R**)	N/A	The current tube position of the Fraction collector.
Analog In 1, to ***Analog In 2***	-2000.0 to 2000.0 mV	The I/O-box analog input signals.
Digital In 1, to ***Digital In 4***	0, 1	The I/O-box digital input signals.
Digital Out_ 1, to ***Digital Out_ 4***	0, 1	The set value of the I/O-box digital output signals.
Counter 1, to ***Counter 4***	N/A	The current value of the counters.

7.8 Available curves

The table below lists all available curves for ÄKTA go.

Curve	Range	Sampling frequency	Description
UV	-6000.000 to 6000.000 mAU	10 Hz	The UV absorbance signal of the UV monitor.
Conductivity	0.00 to 999.99 mS/cm	5 Hz	The conductivity signal.
Conc B	0.0% to 100.0%	1 Hz	The set concentration B or the current value during a gradient.
Flow	0.01 to 25.00 mL/min	1 Hz	The set flow rate of the pump.
pH	0.00 to 14.00	1 Hz	The pH signal.
Pressure	0.00 to 5.00 MPa	2 Hz	The pressure signal (at the pump).
Temperature	0.0°C to 99.0°C	0.5 Hz	The temperature signal (in the conductivity flow cell).
Pre Column Pressure	0.00 to 5.00 MPa	1 Hz	The pre-column pressure signal.
Delta Column Pressure	0.00 to 5.00 MPa	1 Hz	The delta-column pressure signal.
Post Column Pressure	0.00 to 5.00 MPa	1 Hz	The post-column pressure signal.
Fraction	N/A	N/A	The fraction marks and number.
Injection	N/A	N/A	The position mark for an injection instruction.
Linear Flow	cm/h	1 Hz	The set flow velocity of the pump. Only available if a column is selected.
% Cond	0.0% to 100.0%	1 Hz	The conductivity signal as a percentage of a set range.
Run Log	N/A	N/A	Shows all registered actions.
Analog In 1, to ***Analog In 2***	-2000.0 to 2000.0 mV	10 Hz	The I/O-box analog input signals.

Curve	Range	Sampling frequency	Description
UV cell path length	2 or 5 mm	1 Hz	The nominal cell path length of the UV monitor.
Digital In 1, to ***Digital In 4***	0, 1	10 Hz	The I/O-box digital input signals.
Digital Out_1, to ***Digital Out_4***	0, 1	10 Hz	The I/O-box digital output signals.
Flow (CV/h)	CV/h	1 Hz	The set flow velocity of the pump. Only available if a column is selected.
Counted volume	0 to 1 000 000 mL	10 Hz	The calculated volume between ***Start volume count*** and ***Stop volume count***.

7.9 Delay volumes

Introduction

The delay volumes of a system can be determined by performing a theoretical determination of delay volumes. Delay volumes for standard configurations are listed in *Delay volumes for different system configurations, on page 276*.

Explanation of delay volume

During fractionation there is a delay in retention between when the fractionation mark is seen in the UV to when the same liquid is dispensed in the fraction collector. This delay, called delay volume, corresponds to the volume of the flow path from the UV monitor to the Fraction collector, which has to be dispensed before what is seen in the UV reaches the Fraction collector.

The delay volume should be correctly set in UNICORN to make sure that the collected fractions correspond to the fractions indicated in the chromatogram.

By default, the delay volume is set for a system with standard configuration and 40 cm tubing length between the outlet valve and the Fraction collector. If a pH valve is installed, change the delay volume setting according to *Delay volumes for different system configurations, on page 276*. Depending on the position of the valve, volumes for the pH cell and restrictor will be added automatically.

Pre-fractionation volume

The first delay volume dispensed during fractionation is called the pre-fractionation volume. This is the liquid present in the flow path from UV to Fraction collector when the fractionation starts.

Set the delay volume in UNICORN

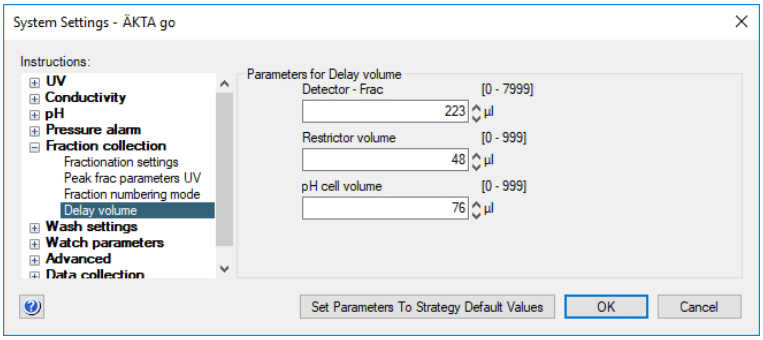
The delay volume is set in ***System Settings*** for the following options:

- ***Detector - Frac***
- ***Restrictor volume***
- ***pH cell volume***

For detailed descriptions, see *Section 7.5.6 System settings - Fraction collection F9-T, on page 244* and *Section 7.5.7 System settings - Fraction collection F9-R, on page 247*.

Follow the steps below to set the delay volume.

Note: *Change the delay volumes only if the system configuration has changed. Changing tubing dimensions or modules between the UV monitor and the Fraction collector affects the delay volume.*

Step	Action
1	Open the ***System Settings*** dialog by selecting ***System*** →***Settings*** in the ***System Control*** module.
2	Select ***Fraction collection*** →***Delay volume*** and type in the volume in each field: 
3	Click ***OK*** to save the new delay volumes.

Delay volumes for different system configurations

The tables below list the delay volumes between the UV detector and the Fraction collector for different system configurations.

Note: *The values are based on the 2 mm UV flow cell for the UV monitor. When using the 5 mm UV flow cell, subtract 5 µL to the volumes shown.*

Delay volumes for a system without a pH valve installed

Nozzle	Placement of fraction collector, tubing length	Standard tubing (i.d. 0.5 mm)	Tubing (i.d. 0.25 mm)	Tubing (i.d. 0.75 mm)
F9-T standard nozzle	Next to system, 40 cm	233 µL	106 µL	434 µL
F9-T standard nozzle	In tunnel under ÄKTA go, 80 cm	311 µL	126 µL	611 µL

Nozzle	Placement of fraction collector, tubing length	Standard tubing (i.d. 0.5 mm)	Tubing (i.d. 0.25 mm)	Tubing (i.d. 0.75 mm)
F9-R tubing holder	Next to system, 40 cm	223 µL	96 µL	424 µL
F9-T flexible nozzle	Next to system, 40 cm	223 µL	96 µL	424 µL
F9-T flexible nozzle	In tunnel under ÄKTA go, 80 cm	301 µL	116 µL	601 µL
F9-T micro nozzle	Next to system, 40 cm	224 µl Not recom-mended[1]	97 µL	Not recom-mended[1]
F9-T micro nozzle	In tunnel under ÄKTA go, 80 cm	302 µl Not recom-mended[1]	117 µL	Not recom-mended[1]

[1] Not recommended due to large delay volumes, not suitable for micro application.

Delay volumes to add for a system with a pH valve installed

Input field in UNICORN	Standard tubing (i.d. 0.5 mm)	Tubing (i.d. 0.25 mm)	Tubing (i.d. 0.75 mm)
Detector - Frac[1]	26 µL	11 µL	54 µL
Restrictor volume	48 µL	25 µL	88 µL
pH cell volume	76 µL	76 µL	76 µL

[1] Add the volume specified here for Detector to Frac to the correct volume for Detector to Frac found in table above. The volume specified here is the extra volume in the tubing needed to connect the pH valve in the flow path between the conductivity monitor and the outlet valve.

Theoretical determination of delay volumes

A theoretical determination is performed as described in the steps below:

Step	Action
1	Identify all components in the system flow path that contribute to the delay volume.
2	Determine the internal volumes of all hardware modules and tubing. See *Section 7.10 Internal volumes, on page 279* for information about theoretical module volumes and *Section 7.2 Tubing and connectors, on page 219* for information about tubing lengths and dimensions.
3	To obtain the total delay volume, sum up the following: • half of the UV flow cell volume • all volumes of tubing and modules that are located after the UV monitor in the flow path ***Note:*** *For pH valve* **V9-pH** *always use the volume for the valve in bypass position (15 µL).* *The system automatically adds the volume for the flow restrictor and the pH flow cell, depending on the position of the valve.*

7.10 Internal volumes

The table below shows the flow path volumes of the modules and components in ÄKTA go. For tubing volumes, see *Tubing types, on page 219*.

Component	Volume (µL)
Inlet valve **K9**	**A** inlet: 350 **B** inlet: 300 **C** inlet: 250 **Sample** inlet: 200
Inlet valves **V9-ImA**, **V9-ImB**, or **V9-ImS**	88
Air sensor **L9-1.5**	35
Air sensor **L9-1.2**	20
Pump **P9-S** (total volume for two heads, including inlet manifold and check valves)	1392
Pump flow restrictor	30
Pressure monitor **R9**	45
Mixer	1000
Injection valve **V9-J**	5
Column valve **V9-C**	110
Column valve **V9-Cm**	17
UV monitor **U9-L**: Flow cell 2 mm	30
UV monitor **U9-L**: Flow cell 5 mm	20
Conductivity monitor **C9** flow cell	22
Flow restrictor **FR-902**	10
pH valve **V9-pH**, in ***By-pass*** position	15
pH flow cell	76
Outlet valve **V9-O**	9
Outlet valve **V9-Os**	9
F9-T standard nozzle	10
F9-T micro nozzle	1
F9-T tubing nozzle	0
F9-R tubing holder	0

Note: *The valve volumes shown above are average values. The actual internal volume might differ depending on the chosen flow path.*

7.11 Error codes

Introduction

This section describes the software error codes for each module, and suggested corrective actions.

All modules

Error code	Description	Action
0 - 19	Internal instrument error	Restart the instrument. If recurrent, contact Service.

Instrument control unit

Error code	Description	Action
21 - 69	Internal instrument error	Restart the instrument. If recurrent, contact Service.

Valve

Error code	Description	Action
20	Internal instrument error	Restart the instrument. If recurrent, contact Service.
22	Valve not finding position	Restart the instrument. If recurrent, contact Service.
23	Faulty air sensor	Restart the instrument. If recurrent, contact Service.
24	Internal instrument error	Restart the instrument. If recurrent, contact Service.
25	High temperature	See *Section 6.1 Hardware issues, on page 196*.

Inlet valve K9

Error code	Description	Action
51	High temperature	See *Section 6.1 Hardware issues, on page 196*.

Error code	Description	Action
52, 53	Internal instrument error	Restart the instrument. If recurrent contact Service.

Pump

Error code	Description	Action
51 - 53	Internal pump error	Check that there is no blockage of the pump outlet. Restart the instrument. If recurrent contact Service.
54	High temperature	See *Section 6.1 Hardware issues, on page 196*.

Pressure monitor

Error code	Description	Action
20, 21	Internal instrument error	Restart the instrument. If recurrent contact Service.
23	High temperature	See *Section 6.1 Hardware issues, on page 196*.
24 - 27	Internal instrument error	Restart the instrument. If recurrent contact Service.

UV monitor

Error code	Description	Action
51	High temperature	Switch off the instrument, then check the troubleshooting section, see *Section 6.1 Hardware issues, on page 196*.
52	Low lamp intensity	Contact Service.
54	Autozero out of range	Autozero requested when AU value is larger than 2.
55	Low lamp intensity	Contact Service.
58	Low light intensity, S channel	No light through the UV flow cell. Check solution absorption and that the cell is fitted correctly.

Error code	Description	Action
59, 60	Internal instrument error	Restart the instrument. If recurrent contact Service.
61	Measurement error	Restart the instrument. If recurrent contact Service.

Conductivity monitor

Error code	Description	Action
20 - 27	Internal instrument error	Restart the instrument. If recurrent contact Service.
28	High temperature	See *Section 6.1 Hardware issues, on page 196*.
29	Temperature data error	Restart the instrument. If recurrent contact Service.
32 - 34	No factory calibration	Contact Service.

pH monitor

Error code	Description	Action
20, 21	Internal instrument error	Restart the instrument. If recurrent contact Service.
25	No factory calibration	Contact Service.
26	High temperature	See *Section 6.1 Hardware issues, on page 196*.

Fraction collector F9-T

Error code	Description	Action
20	The internal temperature of the Fraction collector is too high.	See *Section 6.1 Hardware issues, on page 196*.
21	The Fraction collector failed to detect a drop.	See *Fraction collector F9-T, on page 203*.

Error code	Description	Action
23	The fractionation volume is too small compared to the delay volume. New position changes will be lost.	Increase fractionation volume.
26	Delayed position change.	Avoid mixing fast and slow longer movements of the fraction collector. Check also that the drop sync works properly.
27	An invalid mode change was requested.	Restart the instrument with the power switch at the next convenient occasion. If this warning recurs, generate a System error report refer to *ÄKTA go Operating Instructions (29360951)*) and contact service.
28	Too fast position changes.	Reduce flow or increase the fractionation volume.
29	Axis not verified. Start fractionation was attempted without a successful Find Zero Position.	Restart the instrument with the power switch at the next convenient occasion. If this warning recurs, generate a System error report (refer to *ÄKTA go Operating Instructions (29360951)*) and contact service.
30	Position filled.	Reduce fractionation time or flow.
31	Error in one or both optical sensors on the y axis.	Restart the instrument with the power switch at the next convenient occasion. If this warning recurs, generate a System error report (refer to *ÄKTA go Operating Instructions (29360951)*) and contact service.
32	Restart position error. An error occurred when trying to move to the next start position.	Restart the instrument with the power switch at the next convenient occasion. If this warning recurs, generate a System error report (refer to *ÄKTA go Operating Instructions (29360951)*) and contact service.
33	Encoder has identified a loss of steps.	Restart the instrument with the power switch at the next convenient occasion. If this warning recurs, generate a System error report (refer to *ÄKTA go Operating Instructions (29360951)*) and contact service.

Error code	Description	Action
35	Find zero position failed.	Restart the instrument with the power switch at the next convenient occasion. If this warning recurs, generate a System error report (see *Section 7.5.6 System settings - Fraction collection F9-T, on page 244*) and contact service.
36	Drops were detected during two movements in a row.	Decrease the flow rate or turn ***DropSync*** off, see *Section 7.5.6 System settings - Fraction collection F9-T, on page 244*.

Fraction collector F9-R

Error code	Description	Action
20	High temperature	See *Section 6.1 Hardware issues, on page 196*.
21	Drop sync sensor warning	Clean the drop sync sensor and remove air bubbles from the flow path.
22	Tube sensor error	Check that the tube sensor is adjusted properly.
24	Internal instrument error	Restart the instrument. If recurrent contact Service.
25	Fast tube change	Increase the fraction size or lower the flow rate.
26	Internal instrument error	Restart the instrument. If recurrent contact Service.
27	Drop sync sensor error	Clean the drop sync sensor.
28	Fast tube change	Increase the fraction size or lower the flow rate.

Instrument control panel

Error code	Description	Action
25	High temperature	See *Section 6.1 Hardware issues, on page 196*.

Air sensor

Error code	Description	Action
20	High temperature	See *Section 6.1 Hardware issues, on page 196*.

I/O-box

Error code	Description	Action
20	High temperature	See *Section 6.1 Hardware issues, on page 196*.
21	Analog in signal below -2 V	Check the external equipment connected to the I/O-box.
22	Analog in signal above 2 V	Check the external equipment connected to the I/O-box.
23 - 28	Internal instrument error	Restart the instrument. If recurrent contact Service.

7.12 Node ID

Node ID for standard modules

The table below lists the Node ID for the standard modules.

Module	Label	Node ID
Pump	**P9-S**	0
Pressure monitor	**R9**	0
Inlet valve	**K9**	0
Injection valve	**V9-J**	25
UV monitor	**U9-L**	0
Conductivity monitor	**C9**	0
Outlet valve (1 outlet)	**V9-Os**	19

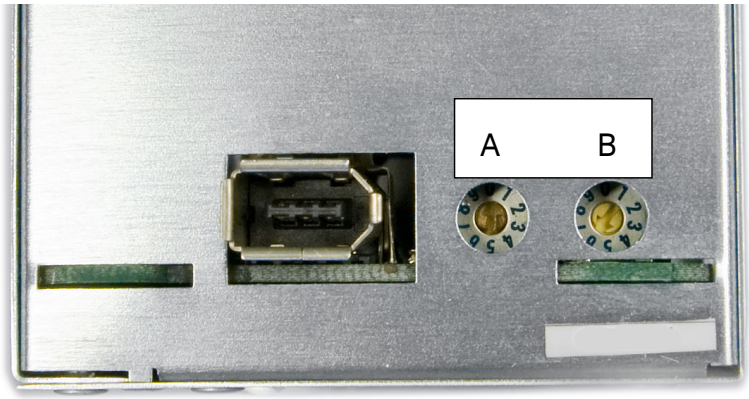
Node ID for optional modules

The table below lists the Node ID for the optional modules.

Module	Label	Node ID
A inlet valve	**V9-ImA**	27
B inlet valve	**V9-ImB**	28
Sample inlet valve	**V9-ImS**	29
Column valve (3 columns)	**V9-Cm**	26
Column valve (5 columns)	**V9-C**	5
Pre-column pressure sensor	N/A	2
Post-column pressure sensor	N/A	3
pH valve	**V9-pH**	11
Outlet valve (10 outlets)	**V9-O**	8
Air sensor	**L9-1.5**	0
Air sensor	**L9-1.2**	0
Fraction collector	**F9-R**, **F9-T**	0
I/O-box	**E9**	0

Set the Node ID

Follow the steps below to, set, verify, or change the Node ID of a module.

Step	Action
1	Remove the module according to the respective instruction.
2	The Node ID of a module is set by the position of an arrow on a rotating switch at the back of the module. **a.** The first switch, labeled **A**, sets the tens. **b.** The second switch, labeled **B**, sets the units. Valve modules have two rotating switches, as shown in the image below: For example, to set the Node ID to 6 for a valve module, switch **A** is set to **0** and switch **B** is set to **6**. 
3	Check the Node ID and compare it with the listed Node IDs in the tables above.
4	To change the Node ID, use a screwdriver to set the arrows of the switches to the correct number.
5	If applicable, re-install the module in the instrument.

8 Ordering information

About this chapter

This chapter lists accessories and user replaceable spare parts available for the ÄKTA go instrument.

Tubing

Item	Product code
PEEK tubing, i.d. 0.15 mm, 2 m	18115659
PEEK tubing, i.d. 0.25 mm, 2 m	18112095
PEEK tubing, i.d. 0.50 mm, 2 m	18111368
PEEK tubing, i.d. 0.75 mm, 2 m	18111974
FEP tubing, i.d. 1.6 mm, 3 m	18112116
ETFE tubing, i.d. 1.0 mm, 2 m	18111583
Reference capillary **Ref 1**	28950749
Pump rinsing system tubing	29011348
ÄKTA go peak collect tubing, i.d. 0.50 mm, 34 cm	29732059
Union 1/16" male/male, i.d. 0.5 mm (5-pack)	28954326
Tubing cutter	18111246
Inlet filter holder kit	11000407
Inlet filter set	11000414

Holders

Item	Product code
Adapter for air sensor	28956342
Bottle holder	28956327
Column clamp	28956319
Column holder	28956282
Multidirectional column clamp	29383530
Column holder rod	28956270

Item	Product code
Flexible column holder	28956295
Multi-purpose holder	29011349
Rail extension	29011352
Tube holder (5-pack)	28954329
Tubing holder comb	28956286
Tubing holder spool	28956274
Inlet filter holder kit	11000407
Screw lid GL45 kit	11000410

Pump P9-S

Item	Product code
P9 Seal kit 65 mL	28960250
P9 Piston kit 100 mL	18111213
Check valve kit	28979364

Pressure monitor

Item	Product code
Pressure monitor **R9-1n**	29383536

Mixer

Item	Product code
Mixer	29383537
Mixer O-rings and membrane	29393228

Valves

Item	Product code
Inlet valve **K9**	29383535
Injection valve **V9-J**	29298324
Column valve kit **V9-C**	29011367
Column valve **V9-Cm**	29383526
A Inlet valve **V9-ImA**	29383527
B Inlet valve **V9-ImB**	29383528
Sample inlet valve **V9-ImS**	29383529
Outlet valve kit **V9-O**	29012261
Outlet valve kit **V9-Os**	29011356
pH valve kit **V9-pH**	29011359

Injection valve accessories

Item	Product code
Sample loop 10 µL	18112039
Sample loop 50 µL	29325047
Sample loop 100 µL	18111398
Sample loop 500 µL (mounted at delivery)	18111399
Sample loop 1 mL	18111401
Sample loop 2 mL	18111402
Sample loop 5 mL	18114053
Sample loop 10 mL	18116124
Superloop 10 mL	18111381
Superloop 50 mL	18111382
Superloop 150 mL	18102385
Fill port	18112766
Injection kit	18111089
Connector 1/16" male and Luer female	28985812

UV monitor

Item	Product code
UV monitor **U9-L**	29011360
UV flow cell 2 mm	29011325
UV flow cell 5 mm	18112824
UV Test Kit, 1 and 2 mm	29276997
UV Test Kit, 5 and 10 mm	29276998

Conductivity monitor

Item	Product code
Conductivity monitor **C9n**	29011363

pH valve

Item	Product code
pH electrode	29387193
O-ring 5.3 × 2.4 mm	28956497

Flow restrictor

Item	Product code
Flow restrictor **FR-902**	18112135

Fraction collector F9-T

Item	Product code
Fraction collector **F9-T**	29454032
Tunnel for Fraction collector **F9-T**	29476924
Tube rack for Fraction collector **F9-T**[1]	29418016
Standard nozzle for Fraction collector **F9-T**[1]	29477967
Micro nozzle for Fraction collector **F9-T**	29501534
Tubing nozzle for Fraction collector **F9-T** [1]	29510082

Item	Product code
Tubing guide for nozzle[2]	29507802
Microplate holder for Fraction collector **F9-T**	29476921
Tube rack - 0.5 mL tubes	29491085

[1] Included with Fraction collector F9-T
[2] Included with Tunnel for Fraction collector F9-T

Fraction collector F9-R

Item	Product code
Fraction collector **F9-R**	29011362
Tube Rack Complete, 175 x 12 mm	19868403
Tube Rack Complete, 95 x 10-18 mm	18305003
Tube Rack Complete, 40 x 30 mm	18112467
Bowl	18305103
Tube support	18305402
Tubing holder	18646401
Tube rack upgrade kit, 175 x 12 mm	19724202
Tube rack upgrade kit, 95 x 18 mm	19868902
Tube rack upgrade kit, 40 x 30 mm	18112468
Drive sleeve	19606702
Micro nozzle **F9-R**	29501533
Eppendorf tube holder	18852201

I/O box

Item	Product code
I/O box **E9**	29011361

Air sensor

Item	Product code
Air sensor **L9-1.5**	28956500

Item	Product code
Air sensor **L9-1.2**	28956502

Online filter

Item	Product code
Filter 10PP	56302238

Module components

Item	Product code
Module Panel	29011364
Extension box ***Note:*** *Includes external module cables.*	29110806

Cables

Item	Product code
Jumper 1 IEC 1394 (F-type)	28956489
External module cable, short (F-type)	29012474
External module cable, long (F-type)	29011366

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Index

S

T

V

W

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29391392 AC V:16 10/2023