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FS3700 Operators Manual

USER MANUAL
4098-01

O·I·Analytical®

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Rev. 4.1 – April 2022

OI Analytical Part Number 329998

Printed in the U.S.A.
Publication 4098-01

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Limited Warranty

OI Analytical warrants each OI Analytical manufactured product against defects in materials and workmanship under normal use and service for the time period defined below. Equipment installed by OI Analytical is warranted from the installation date; all other equipment is warranted from the ship date. If the purchaser schedules or delays installation more than 90 days after delivery, then the warranty period starts on the 91st day from date of shipment. This warranty extends only to the original purchaser. OI Analytical will, at its option, repair or replace equipment that proves to be defective during the warranty period, provided the equipment is returned to OI Analytical at the expense of the purchaser.

The warranty period for OI Analytical equipment is as follows:

THREE YEARS

(i) The Flow Solution™ FS3700 analyzer module, part #329995, when used with an OI Analytical recommended hardware configuration and installed by an OI Analytical service engineer or qualified distributor.

ONE YEAR

(i) The FS3700 photometric detector, part #329477, when purchased as part of a channel or as part #329477.
(ii) The FS3700 amperometric detector, part #330077, when purchased as part of a channel or as part #330077.
(iii) The FS3700 FIA Valve and Cable, part #330394.
(iv) 24-channel peristaltic pumps, when purchased bundled with a system under part #330113.
(v) OI Analytical autosamplers including the 3090 (part #322700), 3360 (part #323209), 3180 (part #330964), and 3360+ (part #330965).
(vi) FlowView Software, when installed and used with an OI Analytical recommended hardware configuration, will perform in substantial conformance with the documentation supplied with the Software.
(vii) FlowView Software physical media on which the Software is furnished will be free from defects in materials and workmanship under normal use.

90 DAYS

(i) Cartridges when purchased as part of a channel or individually, including part #s 330094, 330354, 330358, 330361, 330091, 330092, 330356, 330372, 330352, 330090, 330367, 330093, 330364, 330083, 330096, 330095, 330955, and 330958.
(ii) Amperometric flow cells, part #330001, when purchased as part #330001.

30 DAYS

(i) All other consumables, expendables, and parts not explicitly listed above. Items in this category are also not covered under extended warranties or service contracts.

Note: Sub-components of channels carry warranties, as listed above. No additional warranty is provided at the channel level.

This warranty shall not apply to defects originating from, but not limited to, the following:

- Improper maintenance or operation by the purchaser;
- Purchaser-supplied accessories or consumables;
- Modification or misuse by the purchaser;
- Operation outside the product's environmental and electrical specifications;
- Software, interfacing, parts, or supplies not supplied by OI Analytical;

- A computer not meeting the minimum specifications recommended by OI Analytical;
- Improper or inadequate site preparation;
- Purchaser-induced contamination or leaks.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. OI ANALYTICAL SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

Any service requests or questions should be directed to the OI Analytical Customer Support Center at (800) 336-1911 or (979) 690-1711.

Chapter 1 Introduction

Operating Principle

The FS3700 automated chemistry analyzer is a modular system for performing continuous flow analysis methods on water samples, plant or soil extracts or digests. This involves the use of continuous fluid flow within a system to mix samples and reagents, creating a change in some measurable parameter, such as conductivity or light absorbance.

Principal Applications

The principal applications for the module include monitoring natural water, drinking water, process effluent, and wastewater for a variety of contaminants including nutrients, cyanide, and other water quality parameters. Consult the OI Analytical website or contact OI sales for information on the various analytical methods available.

Specifications

This section lists the principal applications for the FS3700 analyzer, along with general, environmental, and performance specifications, and requirements for operating the module.

Electrical services, gas plumbing, glassware, reagents, and bench space availability are the responsibility of the customer and should be ready prior to the installation. The OI Analytical Customer Support Center can assist with specifications for the necessary components and appropriate gases or chemical supplies. For assistance, please call (800) 336-1911 or (979) 690-1711.

Physical Dimensions and Bench Space Requirements

Plan the install before unpacking any of the FS3700 components. Leave space behind or to the left of the analysis unit to allow for reagent bottles and waste containers. Also, allow space for the user-supplied computer and peripherals.

Module	Dimensions
FS3700 Analysis Unit (includes space requirements for pump)	27.31 cm H x 78.74 cm W x 44.5 cm D (10.5" H x 31" W x 17.5" D)
Autosampler Model 3090 (dimensions include sample probe and cabling)	55 cm H x 33 cm W x 38 cm D (22" H x 13" W x 15" D)
Autosampler Model 3360 (dimensions include sample probe and cabling)	55 cm H x 50 cm W x 50 cm D (22" H x 20" W x 20" D)

Power and Electrical Requirements

Each FS3700 module operates within the parameters listed in the following table:

Module	Voltage and Frequency	Power Rating
FS3700 Chassis	115-230 VAC; 50-60 Hz	80 VA
Autosampler Model 3090 or Model 3360	110-240 VAC; 50-60 Hz	55 VA
Precision Pump (24 channels)	115 or 230 VAC; 50-60 Hz	10 VA

NOTE: The customer must supply a power strip with surge protection and at least five plug-in positions.

Eliminate interference from ovens, motors, and compressors. A dedicated line is recommended. Electrical fluctuations in some locales, such as high voltage spikes or peak load brownouts, may require power-conditioning equipment. Isolation transformers, line conditioners, or uninterruptible power supplies (UPSs) are possible options and are strongly recommended for amperometric analysis; a surge protector power strip, RF noise filtration, and a single switch for cycling power to all modules provide minimum protection.

For other requirements, contact the OI Analytical Customer Support Center at (800) 336-1911 or (979) 690-1711.

Gas Requirements

Air

When running low-level methods, the cleanliness of the ambient air is very important. To avoid contaminating the sample, the laboratory atmosphere must be free of chemical fumes and particulates. Do not smoke near the system. If contaminates are present, use the supplied gas pillow with a purified gas.

Nitrogen or Helium Gas

Some methodologies require using nitrogen or helium (minimum 99.99% purity). When analyzing alkalinity, the remaining 0.01% must not contain CO_2 in the segmentation gas. A nitrogen pillow (PN A000811) can be used. Fill with nitrogen or helium gas and connect to the pump tube inlet. Alternatively, one can regulate the pressure from nitrogen tank to 0.0703 kg/cm (1 psi). Attach the inlet of the air gas pump to the tubing from the nitrogen regulator.

Environmental Requirements

Eliminate severe temperature fluctuations or drafts at the installation site to ensure the ambient temperature in the instrument environment is always 20 - 30 °C. Data integrity may suffer if the temperature changes more than 10 °C per hour.

Control humidity to prevent condensation. Very low humidity (<20% relative humidity) may cause static charge buildup, which may result in data-handling disruptions and equipment failures. Relative humidity: 80% max up to 31 °C, 50% max 32 - 40 °C. Indoor use only.

Reagent Preparation

NOTE: Maximize time and experience with the authorized manufacturer's technician during the installation and training by preparing all reagents and standards one day ahead of the scheduled installation date. Preparation of required reagents and standards is detailed in each methodology and may take several hours. Please contact the OI Analytical Customer Support Center at (800) 336-1911 or (979) 690-1711 with questions or concerns.

Method Reagents

Unpack the purchased method documentation and refer to the Prep Guide for reagent preparation. Make all reagents from known quality stocks exactly as specified. Store reagents according to listed storage instructions.

Deionized Water

Prepare all reagents and standards using reagent water. Prepare reagent water according to ASTM standard specifications for Type I or Type II grade. A source of degassed and deionized reagent water should be available near the system. Refer to Standard Methods for the Evaluation of Water and Wastewater; American Public Health Association; 17th ed.; Washington, DC, 1989.

Filtration

Filter all reagents and carrier solutions through a 0.45-µm nitrocellulose filter. For best results when running a flow injection analysis method, degas all reagents and carriers. A vacuum filter can satisfy both requirements in a single step.

Computer Requirements

Operating system	Windows®7 (with Service Pack 1 or higher), Windows®8 , 8.1, and 10
Other programs	Microsoft.NET Framework 4.0 or greater
System hardware	Must meet or exceed Microsoft requirements for Windows® operating system installed
USB ports	Must have an available USB port for each FS3700 system to be connected to PC

Power and Electrical Requirements

- 115-230 VAC; 50-60 Hz; 80 VA

Altitude

- < 2000 m

Performance Specifications

Range and Precision

Range and precision vary according to the analytical method in use.

- The range and precision of analysis are also affected by sample introduction, cleanliness of sample containers, reagent purity, and operator skill.

Analysis Time

Analysis times vary according to the analytical method in use. Typical time for system startup is less than 15 minutes. Typical time to process a single replicate is 2-3 minutes from sample introduction to calculation of results.

Power Requirements

DC Input

- Voltage: 24 VDC
- Current: 2.7 A DC max

AC Input (requires external AC-DC power supply, see Chapter 8)

- Voltage: 100 - 240 V AC
- Current: 0.15 - 0.3 A AC
- Frequency range: 50 - 60 Hz

Power Consumption

- 80 VA under maximum load conditions, 40 VA typical

Fuse Requirements

- 3.15 A 250V~ Slo-Blo®

Gas Requirements

- None

Safety Information

The FS3700 meets the European Community directives for emissions and safety as noted in the Declaration of Conformity for this instrument as tested and documented by a certified independent laboratory.

CE

OI Analytical designed the FS3700 in accordance with recognized safety standards for use indoors. Using the instrument in a manner not specified by the manufacturer may impair the instrument's safety protection. When the safety protection of the FS3700 is compromised, disconnect the instrument from all power sources and secure the instrument against unintended operation.

Operator Precautions

For operator safety, pay attention to **WARNING** and **CAUTION** statements throughout the manual.

A **WARNING** indicates a condition or possible situation that could result in physical injury to the operator.

A **CAUTION** indicates a condition or possible situation that could damage or destroy the product or the operator's work.

Warnings and precautions in this manual or on the instrument must be followed during operation, service, and repair of the instrument. Failure to follow these warnings and precautions violates the safety design standards and intended use of the instrument.

OI Analytical is not liable for the operator's failure to comply with warnings and precautions.

Connect the FS3700 to a dedicated AC power supply using only the power cord supplied with the instrument. If the power cord is lost or becomes damaged or faulty, replace only with the power cord listed in Chapter 8. **Any interruption of the grounding conductor or disconnection of the protective earth terminal could cause a shock that could result in personal injury.**

General Precautions

- Disconnect the AC power cord before removing covers.
- Replace or repair faulty or frayed insulation on power cords.
- Perform periodic leak checks on supply lines, fittings, and pneumatic plumbing.
- Turn off the main power switch and disconnect the main power cord before using a liquid solution to locate leaks.
- Wear safety glasses to prevent possible eye injury.
- Do not perform unauthorized modifications or substitute parts to the instrument that are not OI Analytical original parts. Any unauthorized modifications or substitutions voids the warranty.
- Verify all heated areas have cooled before handling or wear adequate hand protection to prevent burns.

NOTE: Do not throw away the factory packaging. Keep it for possible future use. This is one of the warranty conditions.

NOTE: Refer to OI Analytical methods for warnings and instructions for working with any hazardous substances needed.

NOTE: Do not position the FS3700 and accessory equipment so that it is difficult to operate the disconnecting device, i.e., the power receptacle to which the equipment is connected or the power entry module on the device located at the lower left of the chassis.

Chemical Precautions

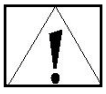
Refer to specific method documentation to understand the precautions required of each set of sample matrices and reagents.

Safety Symbols

Warning/Caution, see accompanying instruction for more information.

Indicates alternating current.

Indicates a hot surface.



Indicates hazardous voltages.

Indicates earth (ground) terminal.

Chapter 2 Instrument Components

The FS3700 Automated Chemistry Analyzer is a multichannel flow chemistry analyzer with flexible architecture for multiple configurations. This chapter depicts the front, rear, and side views of the FS3700 and lists many features of the unit.

Front View

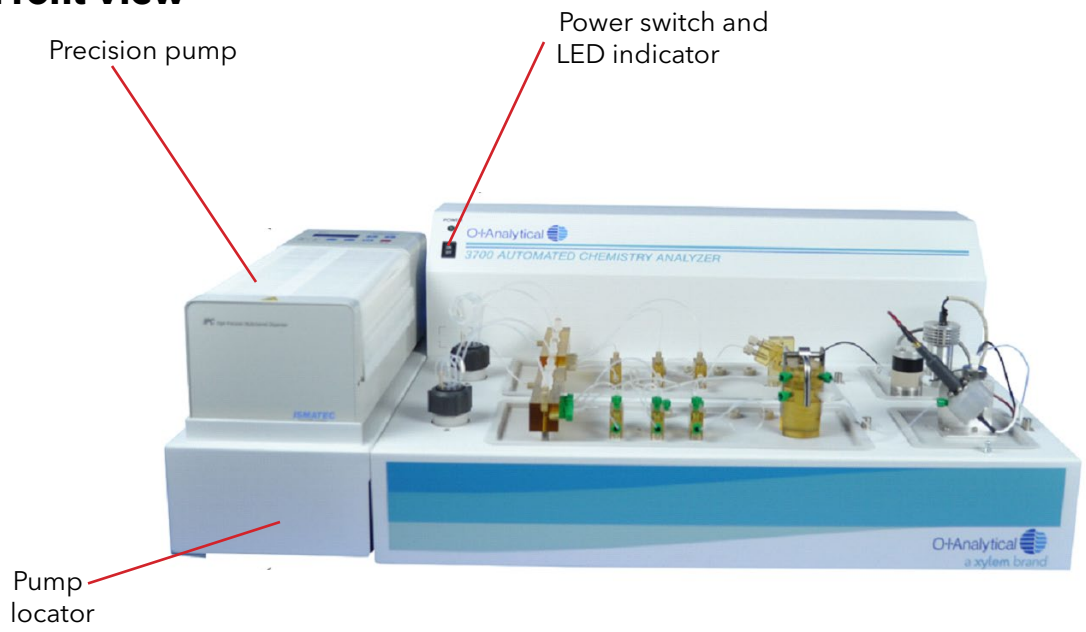


Figure 2.1. Front View of the FS3700

Power switch and power LED indicator – The LED is green when power is applied to the FS3700 unit.

Precision pump – The precision pump has its own power switch on the rear of the pump.

Pump locator – The pump locator is provided as a consistent location to place the pump, and there is room underneath to place the 24 VDC power supply for the FS3700 where it does not interfere with FS3700 setup and operation.

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Upper and Lower-Left Side View

Figure 2.2. Upper and Lower-Left Side View of the FS 3700

Power connector – Connect the power cord from the external power supply provided with the FS3700 unit.

PC communications connector – The FS3700 requires FlowView™ software on a PC to perform analysis. A cable, approximately 5 meters in length, is included with the unit that has a USB connector on one end and an RJ-12 "telephone cord" connector on the other end. The USB connector attaches to the PC and the RJ-12 connector plugs into the connector labeled PC on the unit.

PRI/AUX communications connector – This connector is used to connect an additional chassis or accessories to the FS3700. Connect a RJ-12 cable from the PRI/AUX port to the PC port of the Aux chassis 1 when configuring a FS3700 with 3, 4, 5, or 6-channels. If configuring a FS3700 with 5 or 6-channels, a RJ-12 cable will connect to the PRI/AUX port of the Aux chassis 1 to the PC port of Aux chassis 2.

SAMPLER communications connector – Plug the enclosed 5-foot RS-232 serial cable into this connector, and then to the 9-pin connector labeled COM1 on the rear of the sampler. Only one sampler is needed per system and should be connected to the primary unit.

PUMP communications connector – Plug the enclosed 2.5-foot RS-232 serial cable into this connector, then to the 9-pin connector on the rear of the precision pump.

Rear Panel View

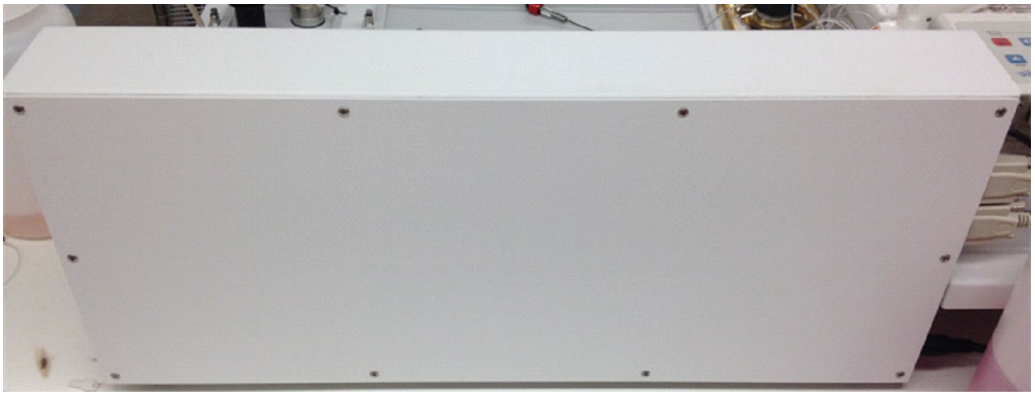


Figure 2.3. Rear Panel View of the FS3700

Access panel – This panel provides access to the main processor board, both detector boards, UV ballasts, communications boards, and other electronics.

NOTE: DO NOT open this access panel except under explicit guidance from an OI-qualified service technician. There are no operator-serviceable items located in this area of the FS3700 unit.

Precision Pump

The precision pump provides peristaltic pumping action to push reagents, samples, and segmenting gases through the system. It provides up to 24 independent pumping channels that can be individually installed or replaced without interrupting the other channels. The pump includes manually adjusting platens. Optional self-adjusting platens are also available. The actively driven rollers deliver excellent accuracy with low pulsation and increased pump tube life. The pump provides multiple pumping modes: normal speeds for routine operation, fast speed for rapid startup or flushing the system, and slow speed for reduced flow to conserve reagents.

Specifications

- Dimensions: 13.0 cm H x 17.5 cm W x 38.0 cm D (5.1" H x 6.9" W x 15" D)
- Weight: 7.9 kg (17.4 lb)
- Microprocessor-controlled DC motor
- RS-232 input for external control
- Variable speed: 0.11–11.25 rpm, adjustable in 0.1% steps or as flow rate
- Flow rate: 0.001–11 mL/minute
- 24 independently tensioned channels
- 8 rollers, 18/8 stainless steel, actively driven

- Differential pressure maximum: 1.0 bar (100 psi)
- Power requirements: 110–120 VAC, 50/60 Hz (two Slo-Blo® fuses)
  220–240 VAC, 50/60 Hz (two Slo-Blo fuses
- Power consumption: 30 Watts
- Protection rating: IP 30
- Operating conditions: 5–40 °C (41–104 °F)
  80% maximum relative humidity noncondensing

Front View

Figure 2.4 depicts the front view of the precision pump.

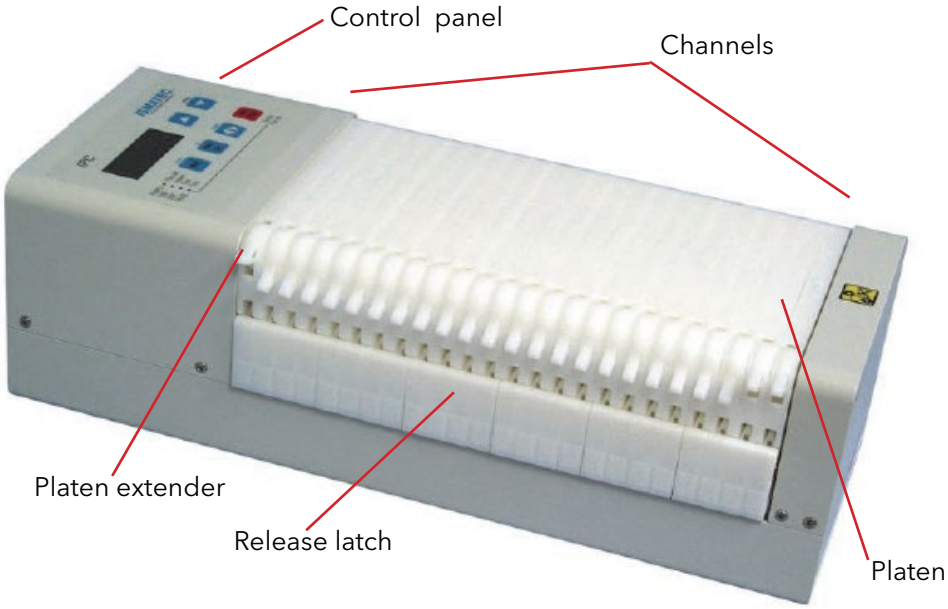


Figure 2.4. 24-Channel Precision Pump Front View

Channels	Hold the pump tubes. May be individually installed or replaced without interrupting the other channels.
Control panel	Sets variables and manually starts or stops the pump.
Platen	Holds the pump tube on the pump.
Platen extender	Extends the width of the platen and provides mounting for the pump tube collar.
Pump head	Contains the pump rollers that rotate and compress the pump tubes, pushing liquid through the tubing (not shown).
Release latch	Disengages the platen from the pump.

Back View

Figure 2.5 depicts the back view of the precision pump.

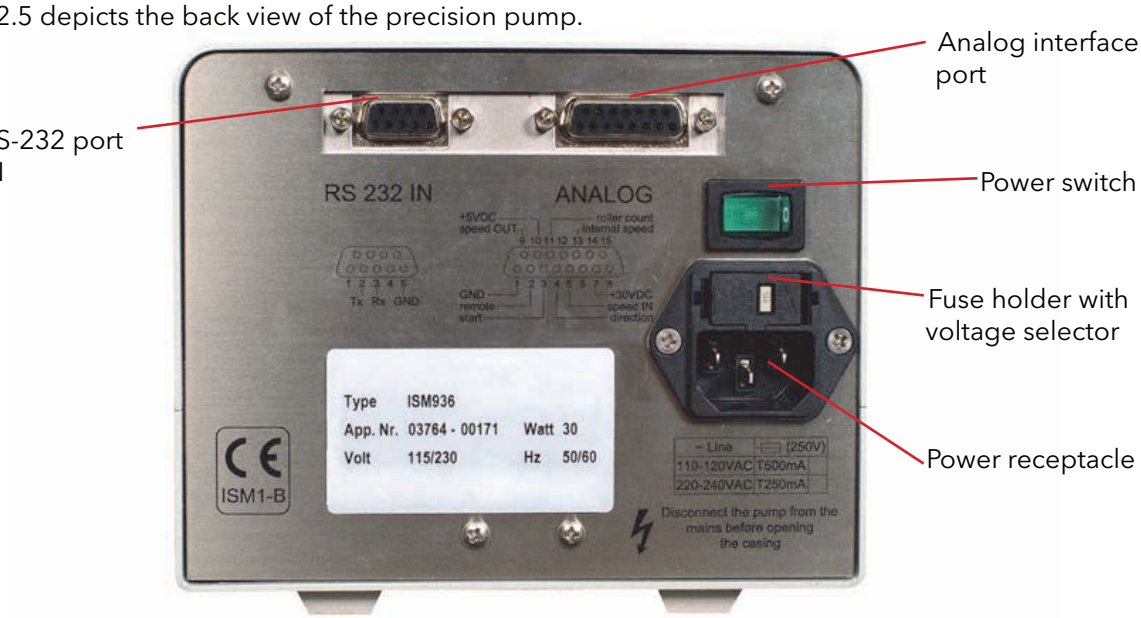


Figure 2.5. Precision Pump Back View

Analog interface port	Not used
Fuse holder with voltage selector	Fuse holder contains fuses that protect the pump from short-circuiting. Voltage selector (not shown) sets the voltage setting to either 115 V or 230 V.
Power receptacle	IEC (International Electrotechnical Commission)-type power inlet provides electrical power via a power cord that plugs into an AC outlet in the power base back.
Power switch	Turns the power to the precision pump on or off.
RS-232 port IN	9 pin female connector connects the pump.

Control Panel

Figure 2.6 depicts the control panel for the precision pump.

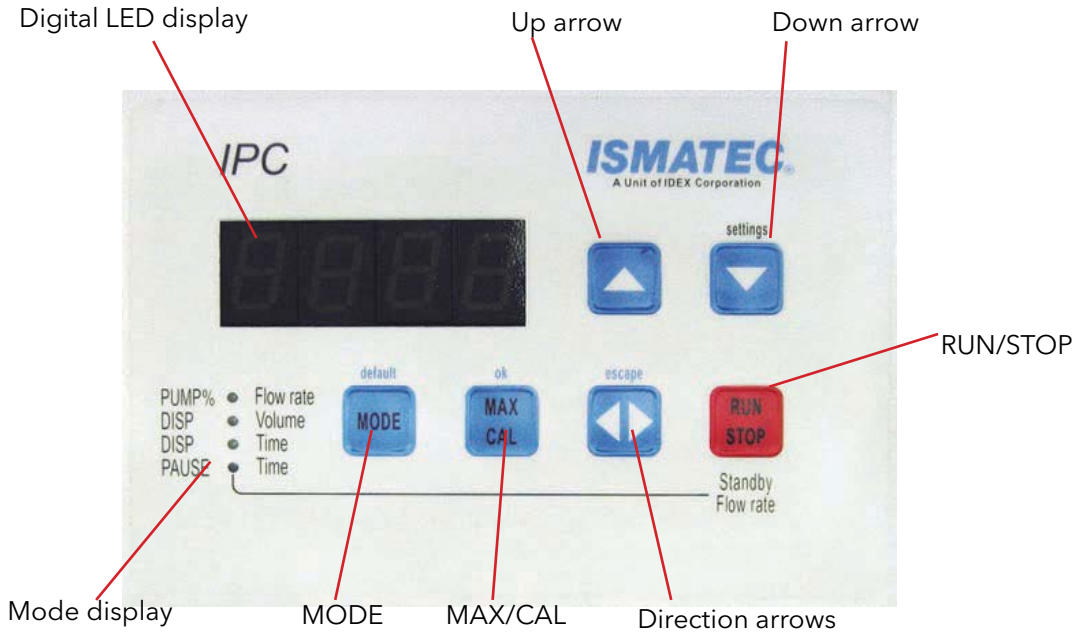


Figure 2.6. Precision Pump Control Panel

▲ (Up arrow)	Increases the pump speed (or the current value).
▼ (Down arrow)	Decreases the pump speed (or the current value). Also accesses the Basic Settings mode for the pump when depressed during pump startup.
◄ ► (Direction arrows)	Sets the flow direction; during right-to-left operation, a negative sign (–) appears on the display. In Basic Settings mode, this button will escape the menu.
Digital LED display	Shows the current pump speed and direction; during right-to-left operation, a negative sign (–) appears on the display.
MAX/CAL	Changes the pump speed between set speed and maximum speed and is used to calibrate flow rate or dispensing volume. In Basic Settings mode, this button is ok to confirm the entered values.
MODE	Selects the operational mode. In Basic Settings mode, this button sets the settings to default.
Mode display	Shows the current operational mode.
RUN/STOP	Starts or stops the roller movement, overriding the software. When pressed in combination with the Pause/Time mode, the system enters standby mode and, therefore, functions at 1% of the maximum flow rate.

Model 3090 Autosampler

The optional Model 3090 Autosampler is a true XYZ random-access autosampler used to introduce samples and standards into the analytical stream. The sample probe moves at operator-defined intervals between 90 samples and has 9 standard positions. In addition, the autosampler offers periodic automated check standard verification, automatic recalibration of standard curves, replicate sampling capabilities, and autodilution (with the optional Autodilutor).

Specifications

- X-Y-Z Autosampler
- 9 bulk standards
- 60- or 90-position rack
- Sample cup sizes: 60-position rack: 4 mL and 12 mL
90-position rack: 2 mL and 8 mL
- Dimensions: 25 cm H x 33 cm W x 33 cm D
(9.8" H x 13" D x 13" D)
- Space requirements: 76 cm H x 71 cm W x 71 cm D
(30" H x 28" D x 28" D)
- Weight: 7.9 kg (17.4 lbs)
- Input-Output: One dedicated wash pump control relay;
Three programmable relays;
I/O port;
Two serial RS-232 ports
- Power requirements: 110–240 VAC ±10%, 50/60 Hz, 40 W
- Automatic voltage selection
- External desktop power supply: Input rating 110–240 VAC, 1 A
Output rating 24 VDC, 3.33 A

Front View

Figure 2.7 depicts the front view of the Model 3090 Autosampler.

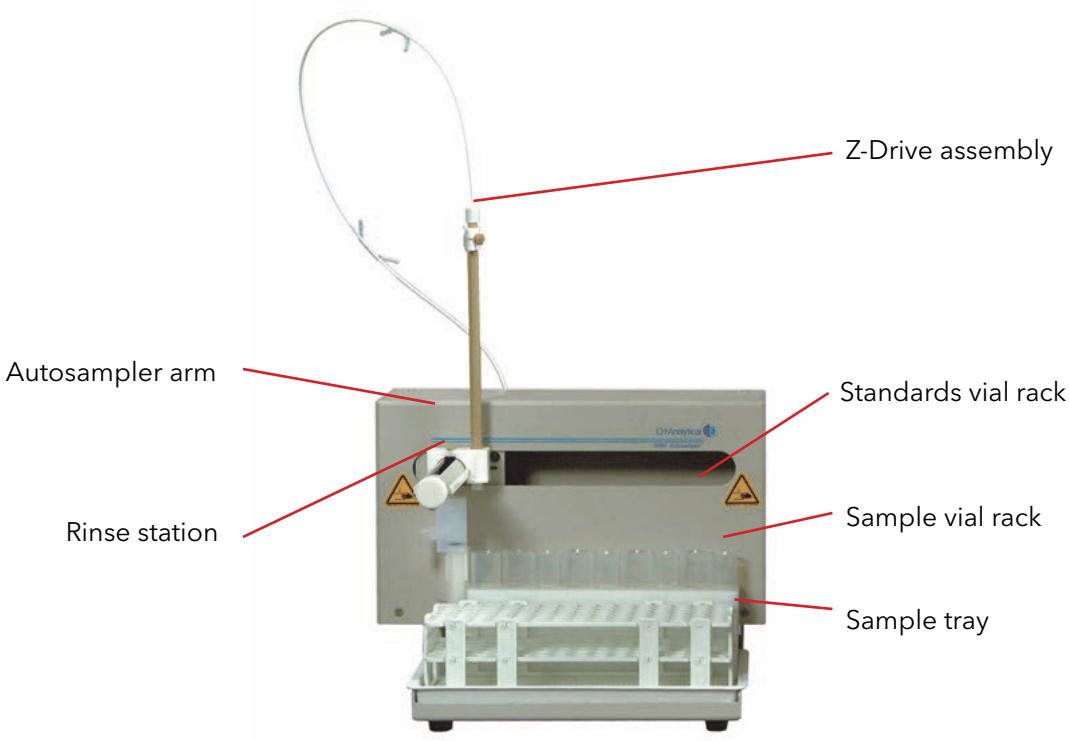


Figure 2.7. Model 3090 Autosampler Front View

Autosampler arm	Provides the probe motion in the X-Y plane (horizontally).
Rinse station	Washes the sample probe between samples. Includes tubing that connects the rinse station to the rinse source and the waste container.
Sample tray	Holds the standards vial rack and one sample vial rack. Ribs located on the bottom of the sample tray hold the racks in place.
Sample vial rack	Holds the sample vials. The 3090 Autosampler accommodates a maximum of 90 vials.
Standards vial rack	Holds nine standards vials.

Z-Drive assembly	Assembly fits onto the Autosampler arm. Assembly includes a Y-axis slider block, a guide plate, and the sample probe.

Back View

Figure 2.8 depicts the back view of the model 3090 Autosampler.

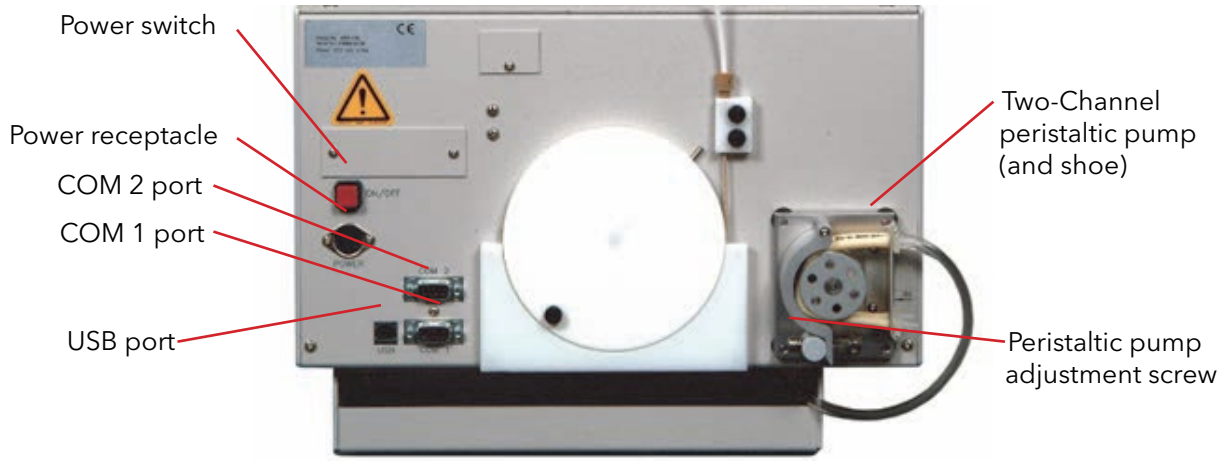


Figure 2.8. Model 3090 Autosampler Back View

COM 1 port	RS-232 serial I/O port connects the Autosampler
COM 2 port	RS-232 serial I/O port connects the Autosampler
Peristaltic pump adjustment screw	Fine-tunes the onboard peristaltic pump's flow rate.
Power receptacle	Provides electrical power via a power cable that plugs into an AC outlet in the power base back.
Power switch	Turns the power to the Autosampler on or off.
Two-Channel peristaltic pump (and shoe)	Moves the rinse solution from the rinse source through the flowing rinse station.
USB port	Not used

ML600 Autodilutor

The optional autodilutor system, used with FS3700 FlowView software and the autosampler, can also be used to automate a number of typical laboratory tasks to save time, reduce effort, and reduce sample loss.

Instrument Overview

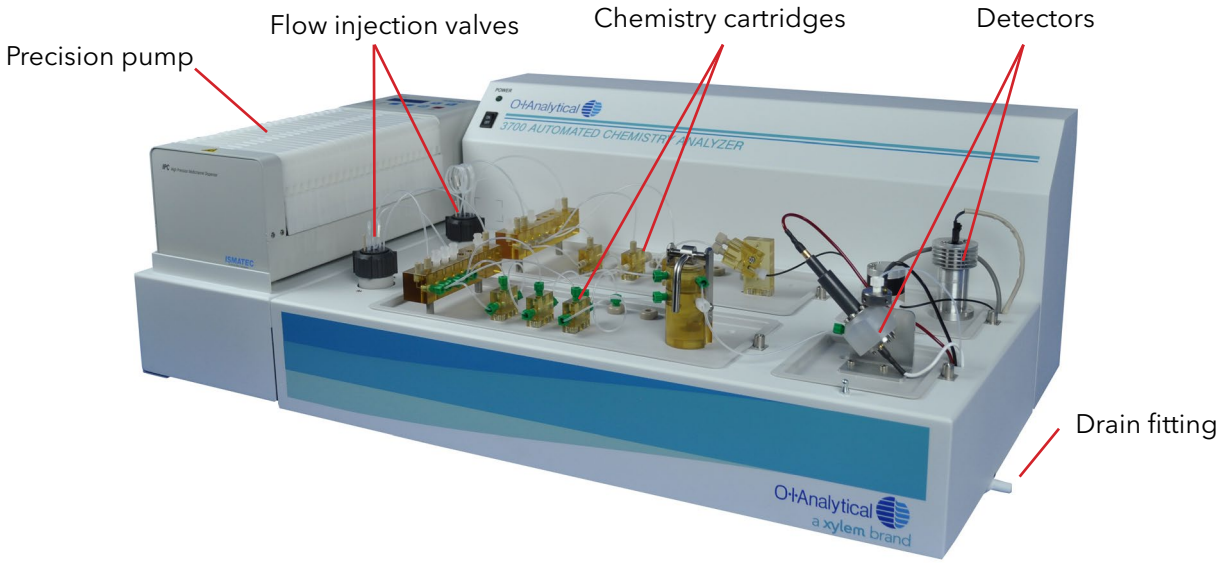


Figure 2.9. Instrument Overview

Drain fitting - Attach drain tubing to this fitting, which allows liquid to drain from the FS3700 chassis interior in the event of a fluid leak.

Flow injection valves - Optional valves are located here for performing FIA (flow injection analysis). The valves are controlled by FlowView software.

Chemistry cartridges - Cartridges contain components for mixing, segmentation, digestion, heating, etc., needed to perform the desired analyses. Consult the documentation provided with each specific cartridge for details.

Detectors - The FS3700 provides capability for amperometric or photometric detection, ion selective electrodes, and third-party detectors through the A/D (analog to digital) allowing for flexibility and a wide variety of analyses.

Channels - A channel consists of a valve (if needed), the chemistry cartridge, and a detector (see Figure 2.10).

Figure 2.10. Illustrating a Channel

Chapter 3 Installation

This chapter explains how to unpack and set up the FS3700 unit and typical options, as well as installing and configuring the FlowView software to control and monitor the FS3700.

Hardware Installation

Unpacking the Unit

Preserve packing materials in case a need arises for factory service or upgrades in the future. The FS3700 chassis is shipped without the pump locator, cartridges, or detectors installed. They ship in their own protective packaging. The sampler and pump also ship in their own packaging. Begin by unpacking all items and reviewing the inventory against the shipping documents. For a 1- or 2-channel system, two brick-type power supplies are included; one for the FS3700 chassis and one for the sampler. The pump has its own internal power supply.

Arrange the equipment so that the sampler is left most, then the pump locator and pump, then the FS3700 primary chassis.

Installing the Pump Locator, Pump, and Sampler

The pump locator must be attached to the left side of the FS3700 chassis via two thumbscrews. The feet on the pump locator allow the pump locator to rest on the benchtop at the same height as the main chassis. The pump fits on top of the pump locator within the guide rails. The sampler stands alone on the benchtop and must be close enough for the sample supply tubing to reach from the sample probe assembly to the pump and pump tubing.

NOTE: For 230V installations, please change pump fuse prior to plugging in.

Configuring the Fuse Holders

WARNING: Before powering up the pump, check for correct voltage! See Table 3.1. The pump is configured from the factory for 110V mains voltage. 230V operation changes must be made at the Power Entry fuse holder.

Table 3.1. Voltage

Mains Voltage	
Mains Voltage	**Fuse Rating (slow-blow)**
220-240 VAC 50/60 Hz	2 x 500* mA
110-120 VAC 50/60 Hz	2 x 500 mA

* For pumps without ETL certification: 250 mA

Before Starting Up

Check if the voltage setting (Figure 3.1), visible in the window of the fuse holder, complies with your local mains voltage. If necessary, the voltage setting must be changed and the two fuses must be replaced.

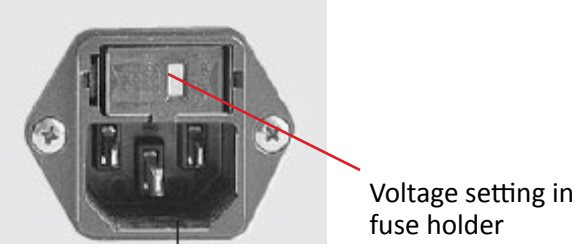


Figure 3.1.

Socket/Power Cord

Use the original power cord supplied with the pump. The socket must be earthed (protective conductor contact).

Voltage Setting 115V/230V Changing the Fuses

1. Switch the pump off, pull out the mains plug.

2. Pull out the fuse holder by opening it with a small screwdriver (size 0).

3. Take out the voltage selector plate (Figure 3.2). Turn it and reinsert it into the fuse holder so that the required voltage rating is facing the window of the fuse holder.

4. Insert two new fuses.
   - 230 VAC: 2 x 500* mA (slow-blow)
   - 115 VAC: 2 x 500 mA (slow-blow)
     *For pumps without ETL certification: 250 mA

5. Always use two slow-blow fuses of the same type complying with the local mains voltage.

6. Shut the fuse holder. The voltage rating is visible in the window.

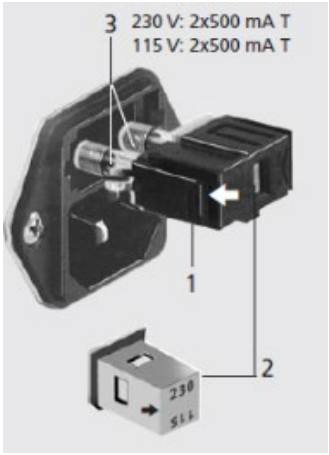


Figure 3.2.

Installing Cartridges

Cartridges are packaged separately. Remove any blank cartridges from the base chassis. Ensure the power to the unit is off and the unit is unplugged. Install cartridges into the designated slots in the main chassis (see Figure 3.3). If cartridges are equipped with a sample heater or UV digestor, connect the power/control cabling to the proper connectors inside the analytical chassis. Secure the cartridges in place using a Phillips screwdriver.

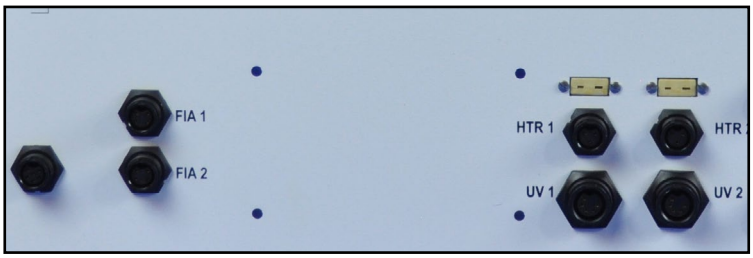


Figure 3.3. Valve, Heater, and UV Connections

Tight fitting trays may be seated by the following:

7. Place the left side of the tray in opening - all the way against the left edge of the hole.

8. While laying it down (moving it to horizontal), press downward ~1" in from the left edge.

9. Finish laying the tray in place and secure the screw.

WARNING: Turn power OFF to the FS3700 unit before installing, loosening, or removing either the detector mounting plate or the chemistry cartridge mounting plate. This area has heated surfaces if a sample heater is present. It also has high voltage and UV light eye hazards when an optional UV lamp is present.

Installing Detectors

Detectors are also packaged separately. Remove any blank detector trays from the base chassis and install the detectors into the designated slots in the main chassis. Connect the power/control cabling to the proper connectors inside the analytical chassis. For the amperometric detector, there is one connector per detector channel labeled as DET inside the chassis. Use this connector to carry the signal to the detector boards. For the photometric detector, one cable connects to the REF connector, another to the DET connector, and the third to the LAMP connector (Figure 3.4). Secure the detectors in place using a Phillips screwdriver.

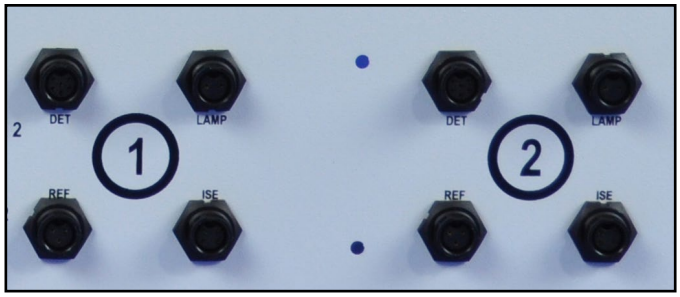


Figure 3.4. Detector Connections

Connecting Cables

Typically, there are cables that connect the FS3700 to the control PC, the sampler, and the pump. Refer to Chapter 2 for diagrams depicting the location of the proper cable connectors.

Connecting Plumbing

Connect tubing and other plumbing according to the instructions included with each analytical method and its associated tubing kit. The tubing kit for the 8-port valve is PN 330398. The tubing kit for the 10-port valve is PN 330121.

Plumbing the 8-Port Valve

The FS3700 employs valves utilizing a sample loop and a bypass loop to minimize pressure fluctuations during valve actuations. Attach tubing to the 8-port valve's threaded ports as illustrated in Figure 3.5. On the 8-port valve, two identical sample loops should be installed - one as the sample loop and one as the bypass loop. The sample loop is connected to ports 1 and 4, and the bypass loop is connected between ports 6 and 7. Ensure that the tubing is properly connected and leak free before starting an analysis.

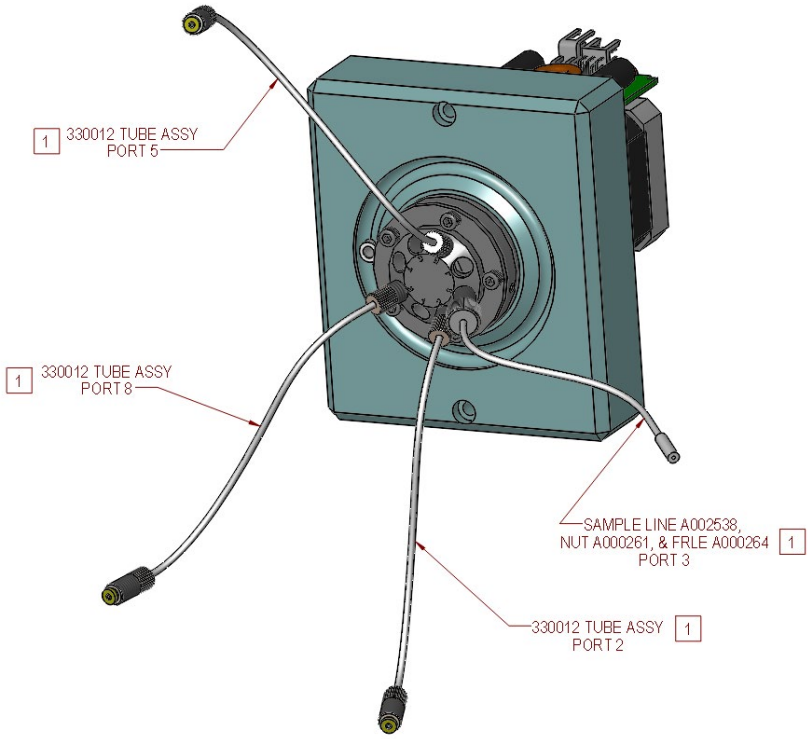


Figure 3.5. 8-Port Valve with Tubing Kit

Plumbing the 10-Port Valve

The FS3700 employs valves utilizing a sample loop and a bypass loop to minimize pressure fluctuations during valve actuation. When plumbing or servicing a valve, changing tubing, or replacing the sample and/or bypass loop, it is **imperative** that tubing is properly seated prior to running liquid through the valve.

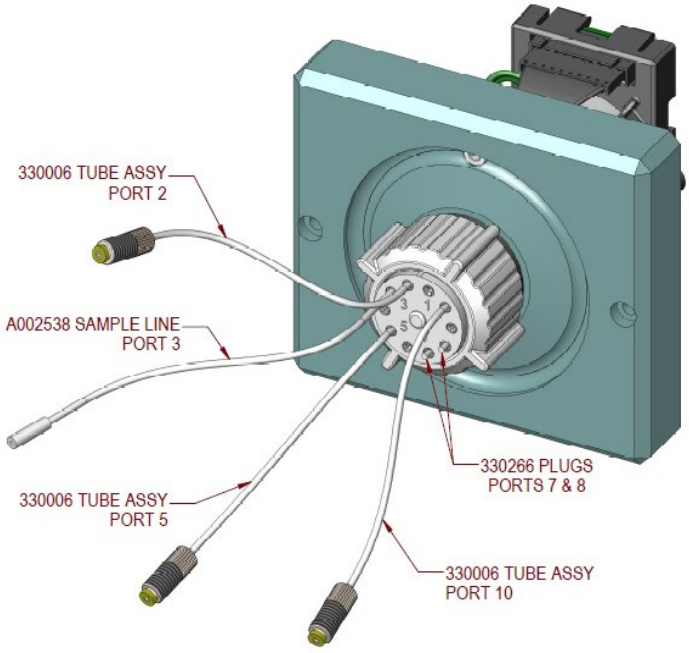


Figure 3.6. 10-Port Valve with Tubing Kit

Tubing may be properly seated in one of two ways:

Recommended Procedure

1. Loosen the spanner nut (shown in Figure 3.7), but do not fully unscrew it.

2. Remove tubing, as needed (i.e., a 100 µL sample and bypass loop, so that 200 µL loops can be installed).

3. Insert tubing through the ram and integrated ferrule. Then, gripping a tube as close to the ram as possible, gently and firmly push the tube downward. You should feel a slight click or pop as the tubing passes through the o-ring and is securely seated. Take care not to bend or kink any of the tubing.

4. Once all connections are made, tighten the spanner nut and test the valve to ensure no leaks are present.

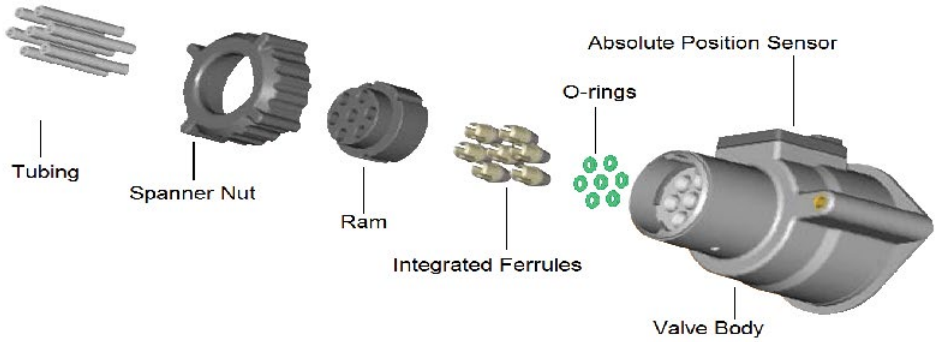


Figure 3.7. Exploded Diagram of the 10-Port Valve

Alternate Procedure for Plumbing the 10-Port Valve

When servicing a valve via this procedure, work in a well-lit, uncluttered area. A small tool, like a dental pick, may be required to remove the o-rings from the valve body prior to step 3. DO NOT lose the green o-rings. Operating valves without all o-rings in place will void the warranty for the valve.

1. Unscrew and remove the valve assembly from the FS3700.

2. Unscrew and remove the spanner nut and remove the ram.

3. Holding all tubing vertically, pass all tubes through the spanner nut and their appropriate position of the ram. Slide an integrated ferrule over each tube, and carefully place a green o-ring around each of the tubes.

4. The ram is keyed so it can only be placed in the valve body in one position. Ensure that the ram is positioned correctly (and that each tube with o-ring is positioned in the corresponding channel of the valve body). Then, press the ram back into position (while holding tubes securely so they do not slip out) and tighten the spanner nut around the valve body.

5. Test the valve with liquid, carefully observing for several minutes to ensure there are no leaks present.

Plumbing the Valve to the Cartridge

The chemistry cartridge diagram provided in each FS3700 method details the proper connections between the valve and the chemistry cartridge distribution manifold. In general, these connections are:

- Valve port 2 is connected to port 9 on the distribution manifold.
- Valve port 5 is connected to port H on the distribution manifold.
- Valve port 8 (for 8-port valves, see Figure 3.8) or valve port 10 (for 10-port valves, see Figure 3.9) is connected to port 1, 2, or 3 on the distribution manifold (this varies by chemistry).

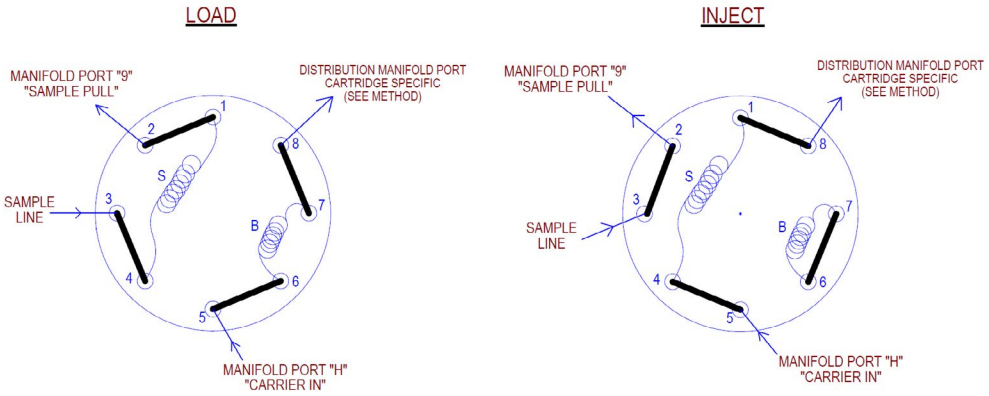


Figure 3.8. Plumbing the 8-port Valve to the Cartridge

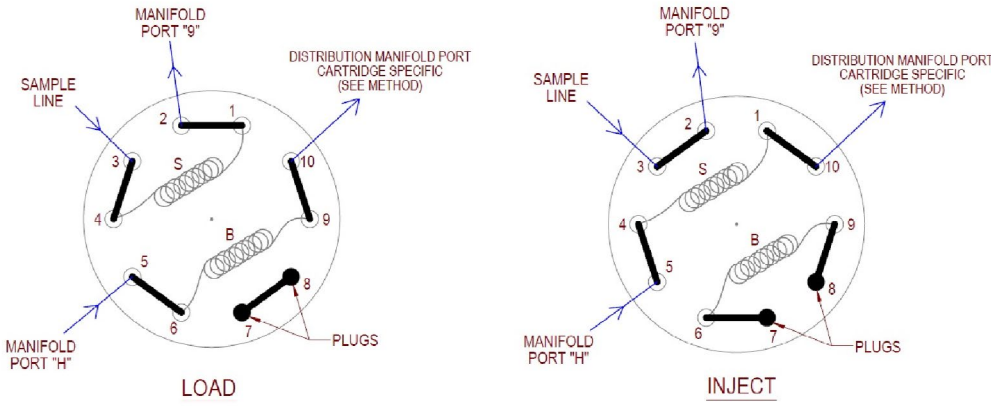


Figure 3.9. Plumbing the 10-port Valve to the Cartridge

Installing and Removing Pump Platens

The pump platens can be installed or removed individually without affecting adjacent channel operation.

Install a platen by positioning it above the matching guides on the pump base (Figure 3.10). Press down until both sides lock into place. Be sure to observe the correct flow direction as shown by the directional arrows on the platens. Install the platen so the arrow points from the source on the right to the output on the left.

Remove a platen by pressing the release latches on either side of the platen.

NOTE: The platens can install on the pump in either direction without damage. However, always install platens with the arrow pointing in the correct flow direction to avoid confusion when tracing flow through the system.

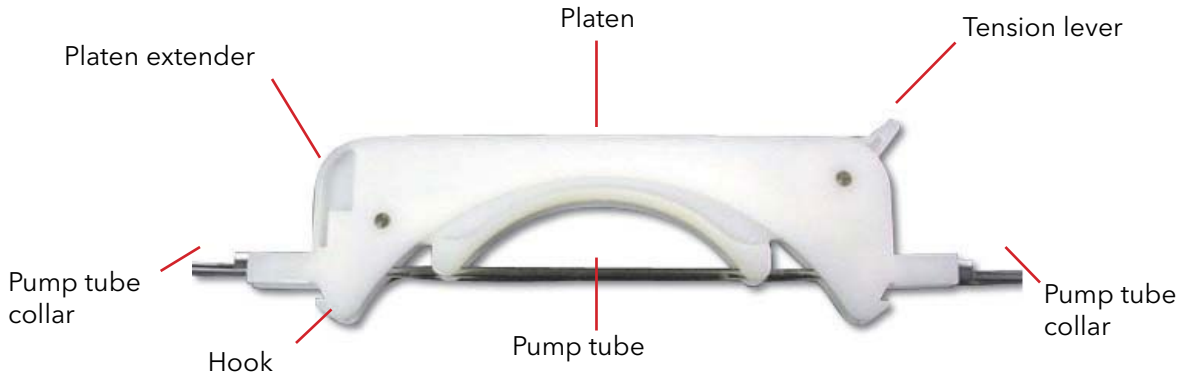


Figure 3.10. Adjustable Platen

Installing Platen Extenders

The pump includes platen extenders to extend the pump platen's width. Also, pump tube collars mount on the platen extenders. The pump tube collars provide correct tubing tension as the pump tubes pass over the pump rollers. Install platen extenders by pressing them into the grooves on each end of the platen. Be sure the tubing groove in the extender matches the corresponding groove in the pump platen. Always install platen extenders to provide the correct pump tube tension.

Installing Tubing

OI Analytical installs the required pump tube for each analytical cartridge at the factory. This tubing is labeled to show where it connects. In addition, each tube is color coded by two collars. These collars serve the following functions:

- They identify the internal diameter and tubing flow rate.
- They identify tubes for correct installation according to the analytical method.
- They correctly tension the pump tubes when mounted on the platens.

Install pump tubes on the pump using the following steps:

1. Remove a platen from the pump by pressing the release latches on either side of the platen. Install platen extenders, if necessary.

   NOTE: Platen extenders must be installed on both sides of the platen. If not already installed, install them before proceeding.

2. Hook one of the collars into the channel on the platen bottom. Be sure to observe the flow direction as shown by the directional arrows on the platen top.

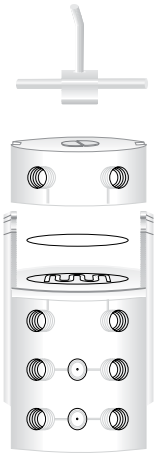
3. Stretch the pump tube slightly so the second collar fits into the channel on the platen's opposite side.

4. Install the platen on the pump as described previously.

5. Verify the flow direction is correct from the input on the right to the output on the left, and the directional arrow orients correctly.

Membrane Modules

Configure the membrane module for a variety of applications depending on the installed membrane's characteristics (Figure 3.11).



Dialysis Membrane Module

Gas Diffusion Membrane Module

Figure 3.11. Membrane modules

Dialysis Membrane Module

Use the dialysis membrane module for sample dilution and filtration. Only a part of the sample (analyte) passes through the dialysis membrane, resulting in sample dilution. The larger interfering macromolecules and particulates do not pass through the membrane, resulting in sample filtration.

- Type C membrane
- Type H membrane

Gas Diffusion Module

Use the gas diffusion module equipped with a gas-permeable membrane for gas separation. Use a solvent-extraction membrane for aqueous-organic phase separations. See the analytical method for a description of the correct membrane used for a particular application.

- Teflon
- Polypropylene

Installing the Membrane

See Chapter 6 for instructions on installing or replacing the membrane.

Installing the Amperometric Cell, if Equipped

Tools Required

- 3/32" Allen wrench

Procedure

1. Power down the FS3700.

2. Remove the protective boot from the reference electrode (PN 329513) (Figure 3.12).

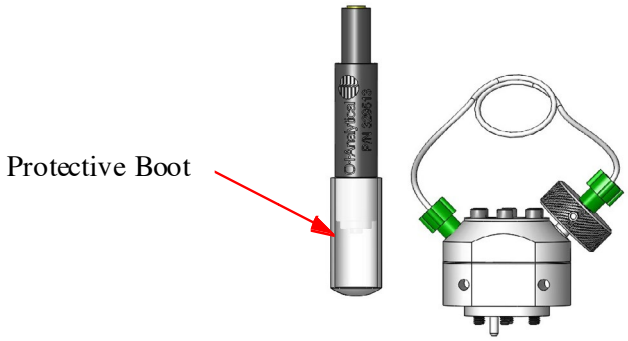


Figure 3.12.

3. Screw the reference electrode into the upper cell assembly (Figure 3.13).

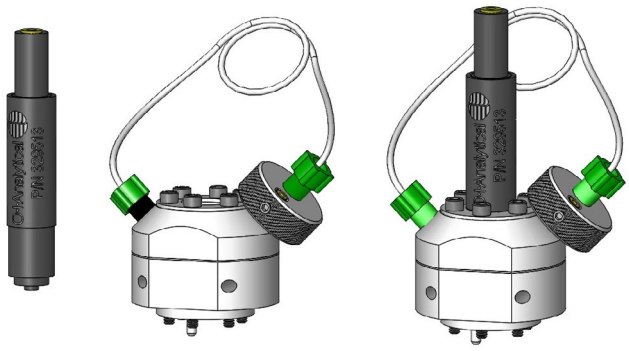


Figure 3.13.

4. Refer to Figure 3.14 for steps 5 through 10.

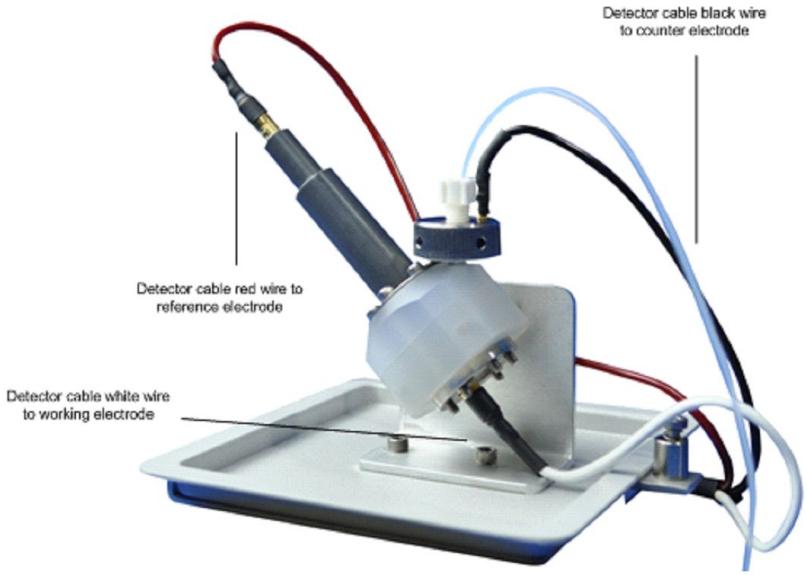


Figure 3.14.

5. Orient the flowcell so that the cell's upper half has the inlet to the left and the SS counter electrode to the right.

6. Push the flowcell onto the mounting pins located on the detector module.

7. Connect the red wire from the lower signal cable to the reference electrode plug.

8. Connect the white wire to the working electrode plug.

9. Connect the black wire to the counter electrode (stainless steel cross fitting) (PN 329509).

10. Connect the flow tube from the base flow of the gas diffusion module to the inlet on the left side of the flowcell body.

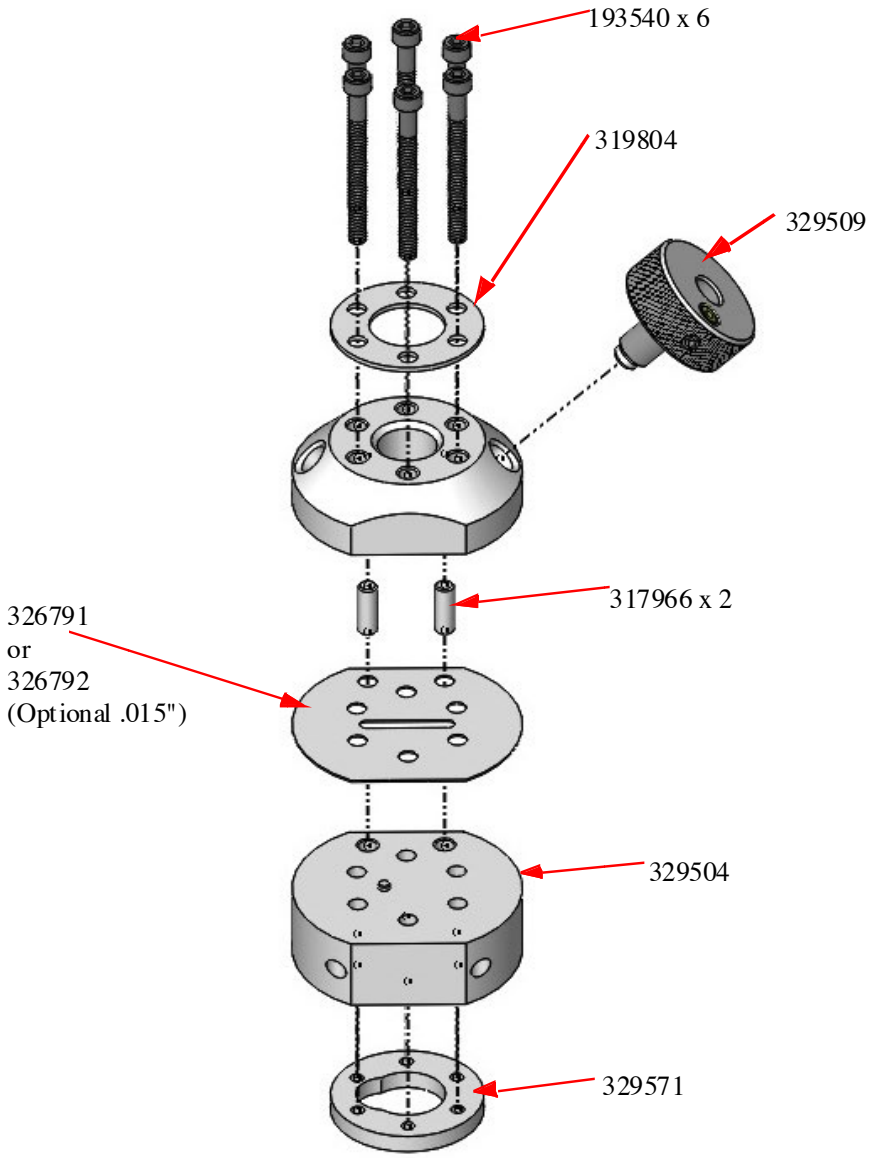


Figure 3.15. Amperometric Flowcell Component Detail

11. Power up the FS3700 and it should be ready for use with amperometric methods. Follow the method instructions for gain settings, etc.

Installing the Photometric Detector, if Equipped

Figure 3.16. Photometric Detector Assembly

Tools Required

- None

Procedure

1. Power down the FS3700.
2. Connect the detector cabling inside the front chassis stage.
3. Connect the flow cell tubing.
4. Power the FS3700 and it should be ready for photometric methods. Follow the method instructions regarding filters, etc.

Installing A Filter in the Photometric Detector

1. Before installing a filter in the photometric detector, ensure that the filter is free of debris, fingerprints, and other contaminants.
2. If necessary, secure the filter in the filter holder with setscrew (PN 319573). Do not overtighten the setscrew, as this may crack the filter.
3. Holding the assembled filter holder by the edge, install the filter with the mirror surface facing the light source (up).
4. Press the filter assembly into place. The spring-loaded setscrew on the photometric detector (PN A001822) will hold the filter securely in the correct position.

Installing Tubing Connections

Installing the Sample Line

Locate the sample line (PN A002538) in the autosampler accessory kit. If using multiple channels, connect the sample line to an adequate number of stream splitters as pictured and described below (Figure 3.17). Locate the stream splitters (PN A303-0110-00 and A303-0111-00) in the FS3700 accessory kit.

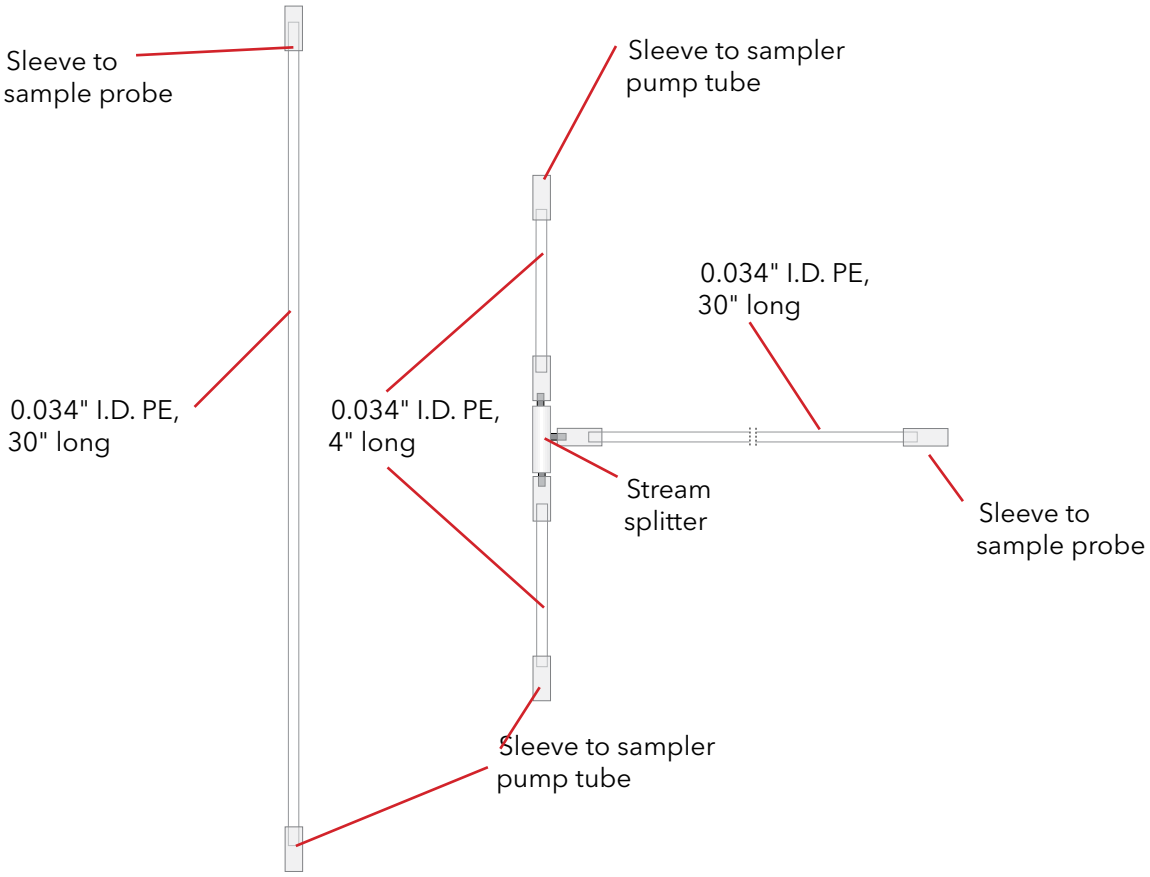


Figure 3.17. Single- and Dual-Channel Sample Lines

Single-Channel Operation

Connect the single-channel sample line's sleeved end to the sample probe. Connect the other end (or use the appropriate nipple) to the "Sample In" pump tube for the channel to be run.

Multiple-Channel Operation

Prepare a tubing assembly that contains enough stream splitters to connect one sample line to each channel by the corresponding "Sample In" pump tube. Connect the line with the sleeved end to the sample probe. Use this configuration for SFA, FIA, or SFAFIA.

Analytical Cartridge

Follow the flow diagram provided with the method to install the pump tubes. If using FIA or SFA-FIA, consult the diagram to make any additional tubing connections, including from the valve and to the detector.

Installing the FlowView Software

Prior to installing FlowView software, confirm that the target PC meets the minimum requirements for the software, which are listed in Chapter 1. For more details, refer to Microsoft support documentation, located at http://windows.microsoft.com/en-us/windows7/products/system-requirements.

NOTE: To install the software, the operator MUST be logged in with Administrator privileges for the PC. Consult with your IT department for assistance.

NOTE: Prior to installing the FlowView software, be sure to perform all Windows updates available for this PC and operating system.

Follow these steps to install the FlowView software.

1. Insert the **Software Installation CD** into the CD drive on the PC.

NOTE: If the AutoRun feature does not automatically launch the Install program, go to "\<CD Drive>\Setup.exe" directory, and click **Setup.exe**.

2. Click **Next** to begin the installation process.

3. Follow the prompts to complete the installation. Click **Finish** on the last screen.

4. Next, a utility program will automatically start to install FTDI drivers for the USB-to-RS485 communications between the FS3700 unit and the FlowView application on the PC. See Figure 3.18. Click **Unpack** to extract the driver installer. Click **Next** to begin the driver installation process. Click **Finish** when driver installation is complete.

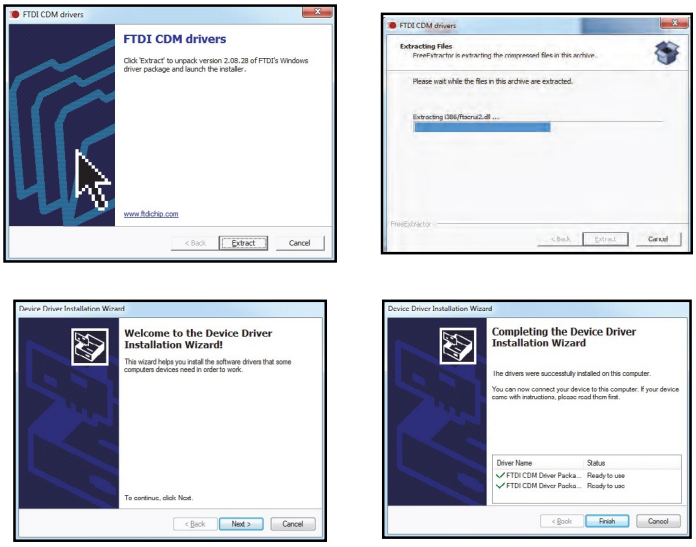


Figure 3.18. FTDI Driver Installation

Configuring the FlowView Software Connection

Connecting and Configuring the USB-to-RS485 Converter

The USB-to-RS485 converter is used to connect the FlowView software to the FS3700. When the converter is plugged into the USB port, the device driver program will automatically configure the USB port to act as a virtual com port (VCP). That VCP will then be used in the FlowView Launcher program to configure a launch icon for the FS3700 system (See **FlowView Launcher**).

NOTE: If more than one FS3700 system is going to be connected to the same PC, then one USB-to-RS485 converter and an available USB port will be required for each connection.

Follow these steps to configure the USB-to-RS485 converter:

1. Insert the USB end of the USB-to-RS485 converter into an available USB port in the PC. Be sure the cable can reach all the way to the FS3700 chassis without strain.

2. Windows should automatically recognize that the converter has been installed and run the FTDI driver to assign it a virtual com port (VCP).

3. Verify the assigned VCP by accessing the Control Panel>Device Manager screen and reviewing the Ports section. A new VCP should have been assigned. See Figure 3.19 as an example.

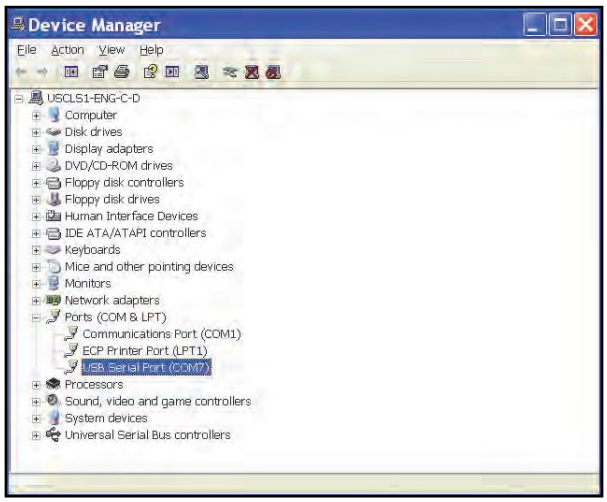


Figure 3.19. Windows Device Manager - Ports

4. This VCP should be used in the FlowView Launcher application when creating an icon for this FS3700 unit.

5. Connect the other end of this cable to the PRI connector port on the top-left side of the FS3700 chassis.

FlowView Launcher

The FlowView Launcher software is used to configure launch icons for each FS3700 system, and to provide access to the FlowView software and other system utilities. After installing the FlowView software onto a suitable PC, and configuring to the USB-to-RS485 converter, launch the FlowView Launcher software from the Start menu (Figure 3.20).

Refer to Chapter 5 for more details on using FlowView software.

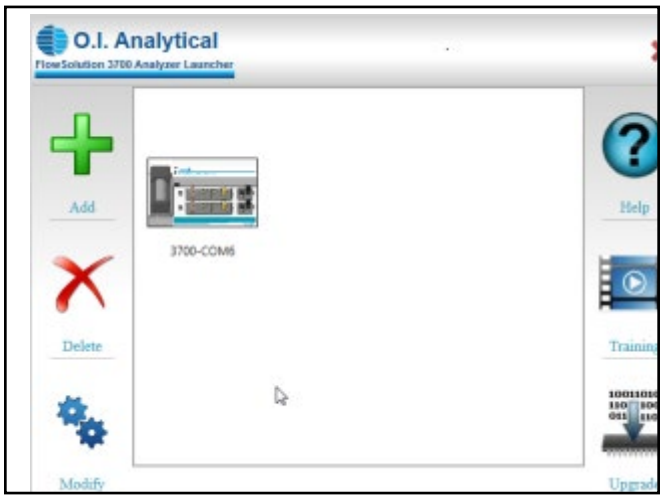


Figure 3.20. FlowView™ Software Launch Screen

Chapter 4 Autosampler

This chapter provides information on installing and operating the Model 3090 and Model 3360 Autosamplers. Unless specified, all instructions apply to both models.

CAUTION: Using tools such as screwdrivers or pliers to perform most installation tasks may result in a damaged or unusable instrument.

The 3090 and 3360 Autosamplers are designed for simple installation. Installation consists of two primary parts: preparing for installation and assembling the Autosampler. For the most part, install the Autosampler without using tools. Remove thumbscrews with tools if necessary, but only finger tighten when replacing them. The following lists the tasks required to install the Autosampler:

Prepare for installation.
- a. Unpack the Autosampler.
- b. Place the Autosampler.

Assemble the Autosampler.
- a. Mount the Z-drive assembly.
- b. Attach the Z-drive mounting blocks.
- c. Install the sampler probe.
- d. Set the Z-axis travel.
- e. Connect the rinse station.
- f. Assemble the sample vial racks.

Preparing for Installation

Unpacking the Autosampler

Before installing the Autosampler, ensure the intended location meets the bench space and power requirements listed in Chapter 1.

Inspect external packaging upon receipt for holes, tears, smashed corners, or any other outward signs of damage from rough handling or abuse during shipment. Inspect all items during unpacking and notify the carrier immediately of any damage.

CAUTION: If condensation forms on or inside the Autosampler, allow it to dry thoroughly before connecting the Autosampler to a power source and operating it. Failure to do so may cause equipment damage.

If the Autosampler is shipped or removed from storage during cold weather, allow the packaged equipment to attain room temperature before opening and exposing to warm, humid air. Provide four to eight hours for this purpose.

Remove the packing checklist from the shipping container and check off items against it. Leave accessories in their packaging until ready to install them on the Autosampler.

NOTE: Do not throw away the factory packaging.

NOTE: All instruments returned to OI Analytical for service or warranty repair must be shipped in the original box with its packing material. *If instruments become damaged due to improper shipping, OI Analytical is not responsible for the cost of repairs*. For proper shipping materials, contact the OI Analytical Order Entry Department at (800) 673-3750 or (979) 690-1711.

Autosampler Placement

Place the Autosampler within 1.2 m (48") of a power outlet. Position the Autosampler so the power supply cord plug is easily accessible (not blocked) and the plug can be quickly disconnected if needed. The power supply socket is located on the back of the Autosampler below the power switch. Do not provide power to the power supply until ready to operate the Autosampler.

Rinse Water Requirements

The waste receptacle inlet should be at least 30–60 cm (12–24") lower than the Autosampler rinse station outlet. For most applications, the Autosampler uses reagent water as a rinse agent. If routinely using a different rinse agent, place the rinse agent source within 2 m (79") of the Autosampler. Position a liquid waste receptacle within 2 m (79") of the Autosampler.

Assembling the Autosampler

Mounting the Z-Drive Assembly

Attach the Z-drive assembly (PN 323158) to the Autosampler arm to allow movement and function of the sample probe. Figure 4.1 illustrates the Z-drive assembly components.

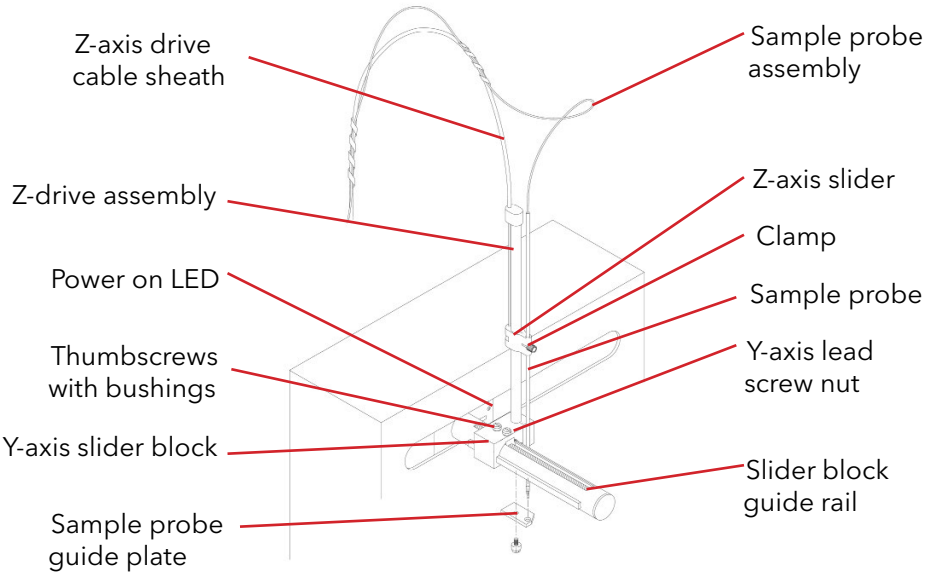


Figure 4.1. Z-Drive Assembly

WARNING: Ensure AC power is off before proceeding with the installation.

1. Position the Z-drive assembly at the free end of the Autosampler arm with the Z-drive assembly pointing up.

2. Match the 6 x 3-mm grooves in the Y-axis slider block with the guide rails on the Autosampler arm.

3. Slide the block along the arm tube until the holes in the block align with the matching holes in the Y-axis lead screw nut (Figure 4.2).

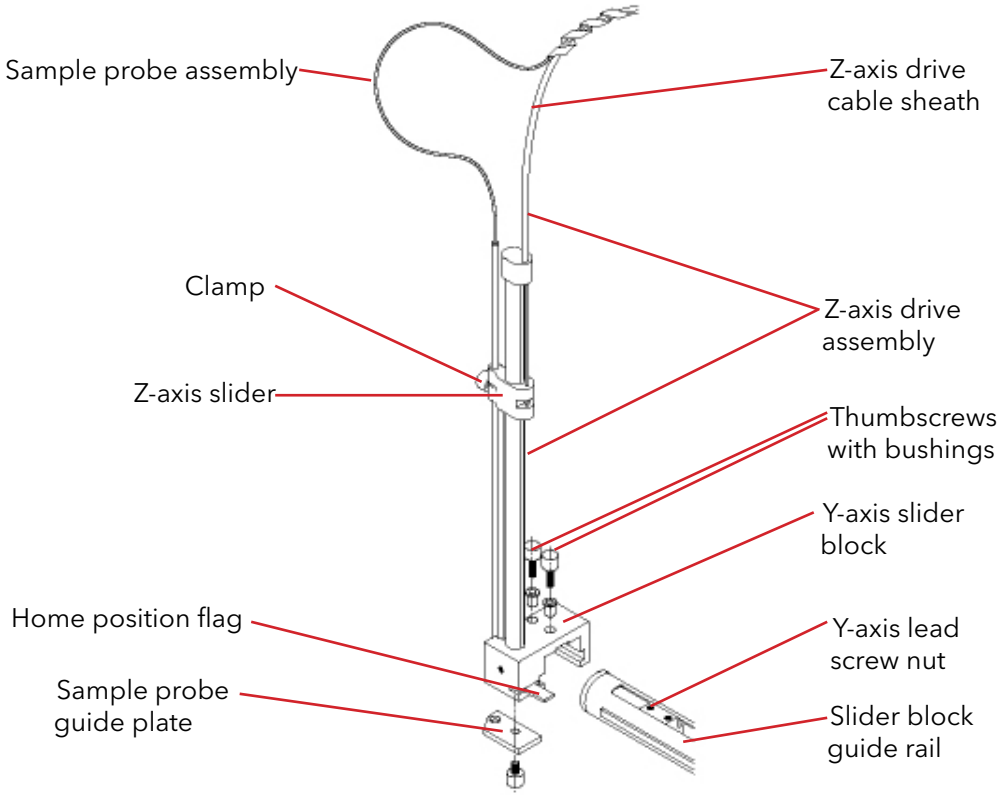


Figure 4.2. Z-Drive Assembly with Z-Axis Slider

4. Secure the Y-axis slider block to the Y-axis lead screw nut using the 12-mm nylon thumbscrews installed from the top (through the bushings). Take care to only finger tighten the nylon thumbscrews.

Attaching the Z-Drive Mounting Blocks

Attach the Z-drive to the mounting blocks by completing the following steps:

5. Loop the 1.5-mm O.D. PEEK® Z-axis drive tubing around the bottom of the Z-axis rotor groove (Figure 4.3).

CAUTION: Failure to connect the cables correctly results in Autosampler malfunction.

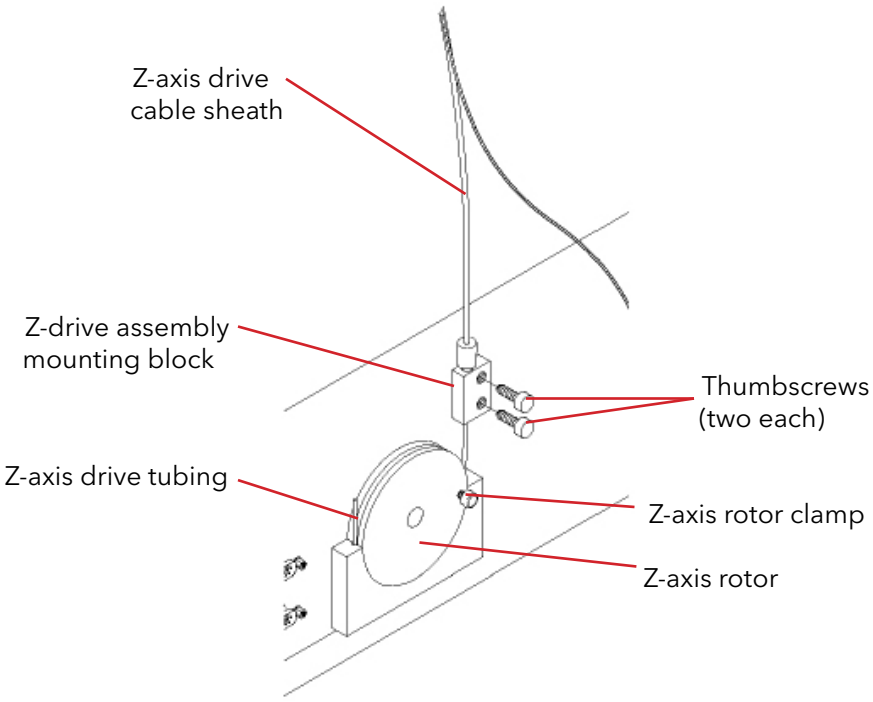


Figure 4.3. Autosampler Back View Showing the Z-Axis Rotor and Mounting Blocks

6. Ensure the front white cable (labeled "A") goes to the left side of the Z-axis rotor (as viewed from the back of the Autosampler). The rear white cable (labeled "B") goes to the right side of the Z-axis rotor (as viewed from the back of the Autosampler). See the important caution message.

7. Attach the mounting blocks to the back of the Autosampler chassis with the stainless steel thumbscrews provided. Mount the blocks with the holes to the far left and far right sides as viewed from the back or the rotor will not function properly. Do not tighten the rotor clamp at this time.

Installing the Sample Probe

Install the sample probe by completing the following steps:

1. Install the clamp in the slot on the Z-axis slider (Figure 4.1).

2. Install the sample probe through the slider block and push through the clamp (Figure 4.1).

3. Move the Z-axis slider (plus attached sample probe) to the top of the Z-axis drive.

CAUTION: Failure to leave the appropriate length of tubing and to tighten the clamp may result in probe damage.

4. Leave approximately 105 mm (4.1") of the sample probe extending above the top of the Z-axis slider (with the slider at the top of the Z-axis drive).

5. Tighten the clamp. Position the clamp as illustrated in Figure 4.1.

6. Verify the probe tip clears the top of the rinse station when the Autosampler is in the home position above the rinse station. The Autosampler arm with the attached Z-axis drive can be manually moved to the rinse station without damage to the Autosampler.

7. Retain the sample transfer tubing at approximately 15 cm and 40 cm (6" and 16") above the top of the Z-axis drive, leaving an untangled service loop of approximately 13–15 cm (5.1–6") above the probe.

The sample transfer tubing should still have slack remaining when the probe is at the maximum downward limit.

Setting the Z-Axis Travel

Set the Z-axis travel of the Z-drive assembly by completing the following steps:

1. Adjust the Z-axis slider (with attached sample probe) so the slider is approximately 3 mm below the top of Z-axis drive (Figure 4.1).

2. Rotate the Z-axis rotor (Figure 4.3) clockwise so the rotor stop pin is against the rotor stop.

3. Finger tighten the rotor clamp. Ensure the PEEK Z-axis drive tubing fully seats in the rotor clamp groove. Otherwise, the PEEK tubing can slip, resulting in no movement of the Z-axis slider.

4. Manually rotate the Z-axis rotor back and forth several times to check for full unhindered movement of the Z-axis slider.

CAUTION: Do not maneuver the sample probe directly as damage may result.

5. With the Z-axis in the full-up position, hold the Z-axis slider and move the sample probe tube up and down so that 3–6 mm (0.11–0.23") extends below the sample probe guide plate.

NOTE: To make fine adjustments to the sample probe X-Y targeting, loosen the nylon screw on the probe guide plate 1/8- to 1/4-turn and move the guide plate up 0.2 mm from the original location. Be sure to tighten the nylon screw before operating the Autosampler.

Connecting the Rinse Station

The cabinet-mounted rinse station is located at the extreme left position in the standards rack. The standards rack and rinse station location for each Autosampler model are shown in Figures 4.4 and 4.5.

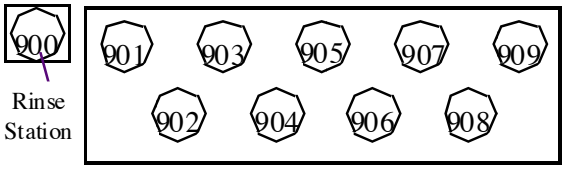


Figure 4.4. Model 3090 Autosampler Standards Rack

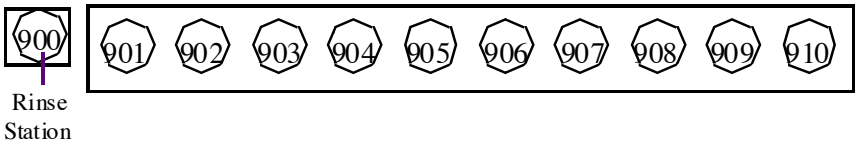


Figure 4.5. Model 3360 Autosampler Standards Rack

Rinse Solution

Typically, reagent water is used as the rinse solution, which the onboard peristaltic pump drives into the rinse station.

Because the peristaltic pump inlet is at the top of the pump and the outlet is at the bottom, the rinse solution flows from the bottom to the top of the rinse station. Up-flow rinsing is the most effective method for decontaminating the sample probe tube between samples. Reversing the connections and the rinse water flow reduces the effectiveness of the rinse station and can cause cross-contamination and unsatisfactory performance.

The waste rinse solution drains from the top of the rinse station by means of a pumped drain, which is the standard arrangement for draining the rinse station. If using a pumped drain is not desired, a gravity drain arrangement is satisfactory. This section contains instructions for both the pumped drain and gravity drain arrangements.

Pumped Drain Arrangement

In the pumped drain arrangement, the rinse solution moves through the onboard peristaltic pump to the inlet at the bottom of the rinse station (Figure 4.6). The solution then drains out the top of the rinse station and into the rinse solution waste container through the second channel of the onboard peristaltic pump.

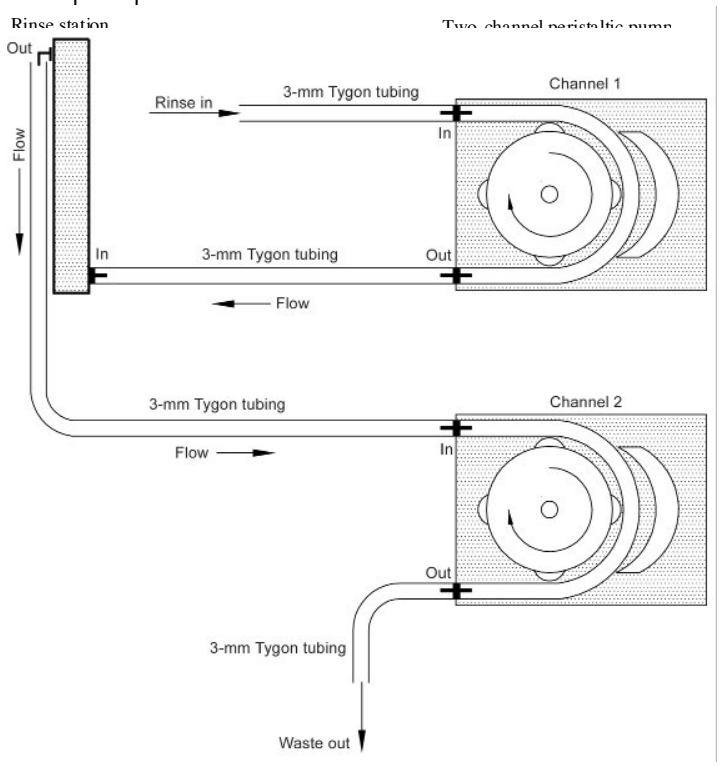


Figure 4.6. Pumped Drain Arrangement

Connect the rinse station using the pumped drain arrangement by completing the following steps:

1. Connect the rinse water source to the onboard peristaltic pump by inserting the 3-mm I.D. Tygon® tubing onto the inlet at the top of the pump. Use the tubing provided for the rinse uptake.

2. Connect channel 1 of the peristaltic pump to the rinse station by completing the following steps:

    a. Use approximately 30 cm (12") of the 3-mm I.D. Tygon tubing provided for the rinse solution uptake.
    b. Insert one end of the 3-mm I.D. Tygon tubing onto the outlet at the bottom of the pump. Insert the tubing carefully because the peristaltic pump fitting grips the tubing tightly. Applying too much force can break the fitting.
    c. Insert the other end of the 3-mm I.D. Tygon tubing onto the rinse tube inlet at the bottom of the rinse station. Insert the tubing carefully to avoid breaking the fitting.

3. Connect the rinse station to channel 2 of the onboard peristaltic pump by completing the following steps:

    a. Use approximately 30 cm (12") of the 3-mm I.D. Tygon tubing provided.
    b. Insert the 3-mm I.D. Tygon tubing onto the top outlet of the rinse station.
    c. Place the other end of the tubing onto the pump inlet (top of channel 2). Insert the tubing carefully to avoid breaking the fitting.

4. Connect channel 2 of the onboard peristaltic pump to the rinse solution waste container by completing the following steps:

    a. Use up to 1.8 m (71") of the tubing provided for the pumped drain.
    b. Insert the 3-mm I.D. Tygon tubing onto the peristaltic pump outlet. Insert the tubing carefully because the rinse station fitting grips the tubing tightly. Applying too much force can break the fitting.
    c. Place the other end of the tubing into the waste container. Ensure the tubing outlet is not immersed in the waste solution. Immersing of the drain tube outlet may cause the waste solution to back up and overflow.

Gravity Drain Arrangement

In the gravity drain arrangement, the rinse solution moves through the onboard peristaltic pump to the inlet at the bottom of the rinse station (Figure 4.7). It then drains out the top of the rinse station by means of a gravity drain.

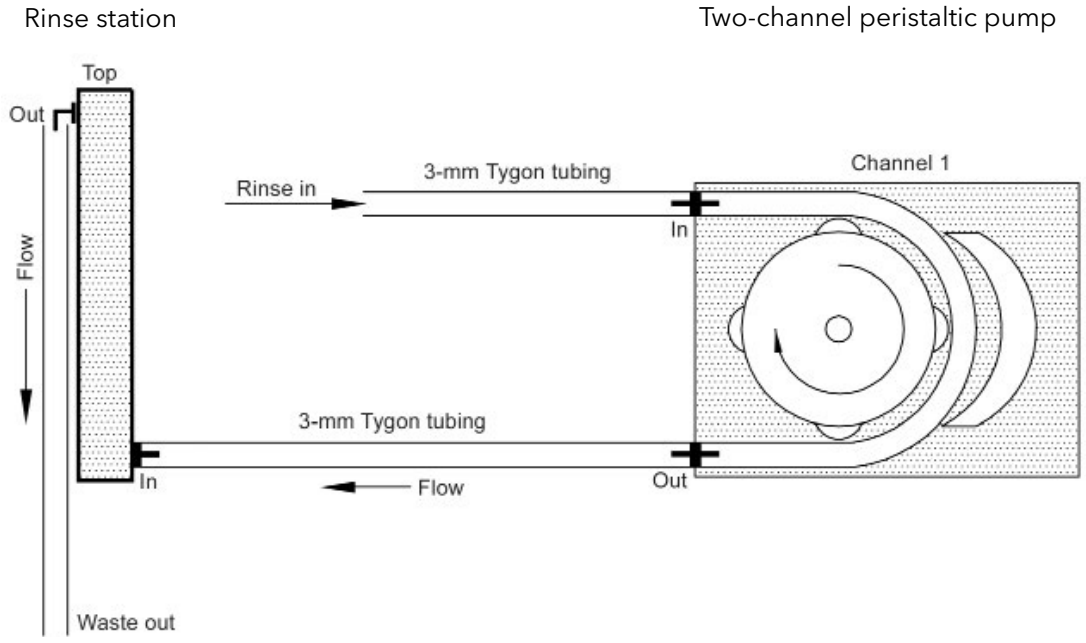


Figure 4.7. Gravity Drain Arrangement

Connect the rinse station using a gravity drain by completing the following steps:

1. Connect the rinse solution source to the onboard peristaltic pump by inserting the 3-mm I.D. Tygon tubing onto the inlet at the top of the pump. Use the tubing provided for the rinse solution uptake.

2. Connect channel 1 of the peristaltic pump to the rinse station by completing the following steps:

    a. Use approximately 30 cm (12") of the 3-mm I.D. Tygon tubing provided for the rinse solution uptake.
    b. Insert one end of the 3-mm I.D. Tygon tubing onto the outlet at the bottom of the pump. Insert the bottom tubing carefully to avoid breaking the fitting.
    c. Insert the other end of the 3-mm I.D. Tygon tubing onto the rinse station inlet at the bottom of the rinse station. Insert the bottom tubing carefully to avoid breaking the fitting.

3. Connect the rinse station to the waste container by completing the following steps:

    a. Use up to 1.8 m (71") of the 5-mm I.D. Tygon tubing provided for the gravity drain.
    b. Ensure the waste container is at least 30–60 cm (12–24") lower than the rinse station outlet.
    c. Insert the 5-mm I.D. Tygon tubing onto the rinse station outlet (on top). Insert the tubing carefully because the rinse station fitting grips the tubing tightly. Applying too much force can break the fitting.
    d. Place the other end of the tubing into the rinse solution waste container. Ensure the tubing outlet is not immersed in the waste solution. Immersing the drain tube outlet may cause the waste solution to back up and overflow.

Using the Precision Pump with the Rinse Station

The FlowView software controls the onboard peristaltic pump. In some instances, such as in SFA, the customer may need to pump rinse water into the Autosampler rinse station prior to engaging the FlowView software. Use two channels of the precision pump, and disconnect the onboard peristaltic pump as follows.

Disconnecting the Cabinet-Mounted Onboard Peristaltic Pump

1. Unplug the Autosampler.

2. Remove the sample probe (reverse the steps in "Installing the Sample Probe").

3. Remove the rinse station.

4. Remove the outer cover of the Autosampler.

5. Unplug the onboard peristaltic pump from the board.

Assembling the Sample Vial Racks

The sample vial racks may be purchased with either 60 or 90 positions. Because the racks have the same dimensions, they are used interchangeably within the same Autosampler. However, the two sample vial racks handle different sizes of sample cups. Refer to Table 4.1 to determine which cup sizes to use with each rack.

Table 4.1. Sample Cup Depths

Cup Capacity (mL)	Default Depth (mm)	Cup Dimensions (mm)	Rack Size
2	93	12 x 25	90-position
4	113	12 x 30	60-position with shelf
8	150	13 x 100	90-position
12	150	16 x 100	60-position

Assembling and Placing the Sample Vial Racks

Sample vial racks for the Autosampler ship unassembled and are easy to assemble without tools. After assembling the sample vial racks, place them in the sample tray before proceeding with the installation.

WARNING: Before loading or unloading any sample vial racks on the sample tray, park the Autosampler arm and probe in the home position by cycling the power off and on. The home position is the initial position when the unit powers on. Never attempt to load, unload, or reposition a sample vial rack or sample vial while the Autosampler is operating.

Assemble and position the sample vial racks using the following steps:

1. Snap the racks together as shown in the instructions included with each rack. The racks are easily disassembled to prepare for storage or shipment.

NOTE: Keep at least one copy of the assembly instructions provided for each rack.

2. Place the sample vial rack so the feet on the rack's underside engage the locating ribs on the sample tray's surface.

NOTE: Correctly placed sample vial racks do not move more than ±2 mm in either a left-right or forward-backward direction. Tilted sample vials indicate an improperly placed rack, which must be corrected before operating the Autosampler.

Sample Vial Rack Numbering

An assembled sample vial rack has the number convention shown in the following figures. Please note that Figures 4.8 and 4.9 apply to the Model 3090 Autosampler, while Figures 4.10 and 4.11 apply to the Model 3360 and 3360+ Autosampler.

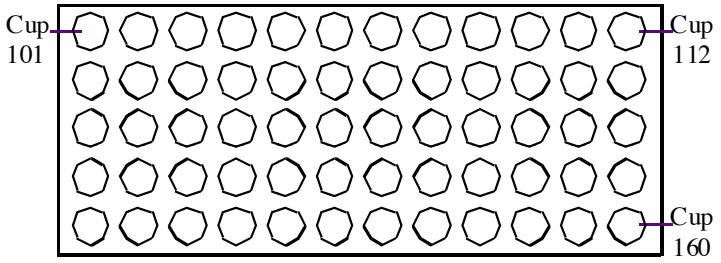


Figure 4.8. Model 3090 60-position Sample Vial Rack

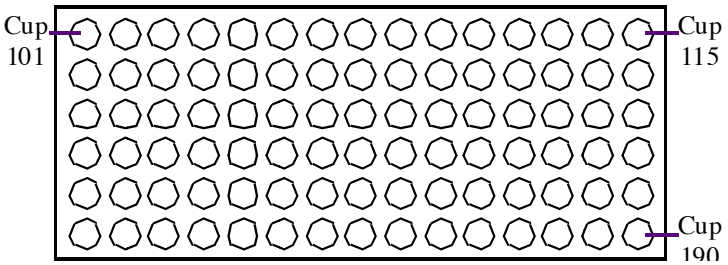


Figure 4.9. Model 3090 90-position Sample Vial Rack

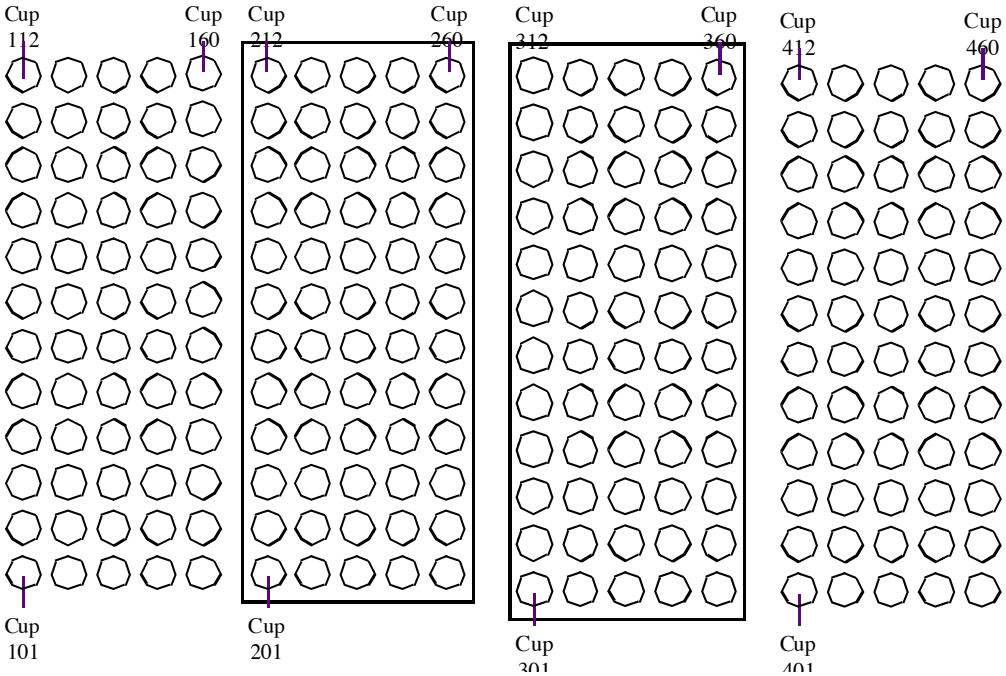


Figure 4.10. Model 3360 and 3360+ 60-position Sample Vial Rack

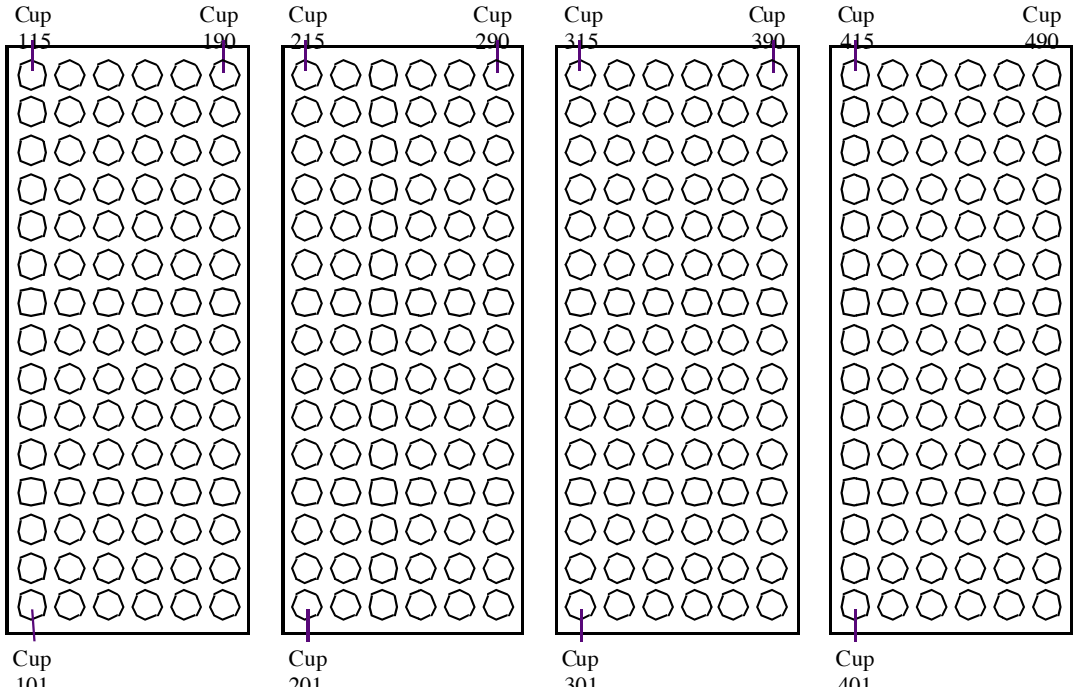


Figure 4.11. Model 3360 and 3360+ 90-position Sample Vial Rack

NOTE: At this point, if this is the initial installation, proceed to the next chapter. Otherwise, continue with configuring the Autosampler.

Establishing External Connections

Connect the Autosampler to the power source and to the FS3700.

WARNING: Use only the external desktop power supply provided with the unit or an exact replacement.

CAUTION: The Autosampler is intended to operate from an AC power source that does not apply more than 253 VAC between the supply conductors and ground. A protective ground connection by way of the grounding connector in the power cord is required for safe operation.

1. Plug the power supply cord into the autosampler power connector. Ensure the autosampler and the FS3700 are turned off.

2. Plug the power supply cord into the appropriate wall power outlet.

3. Plug the one end of the autosampler communications cable (PN A001736) to the COM 1 port on the autosampler back, depicted in Figure 4.12. The autosampler communications cable is included in the FS3700 startup kit.

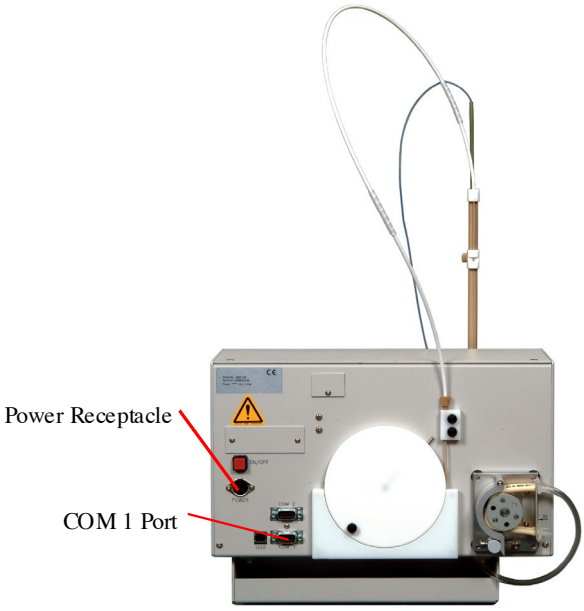


Figure 4.12. Autosampler Back Panel

4. Connect the other end into the Sampler port on the back of the FS3700, depicted in Figure 4.13.

Figure 4.13. FS3700 Back Panel

5. Finger tighten both screws of the cable adapter.

Configuring the Autosampler

The FlowView software controls the Autosampler through the Configure Analyzer screen. See Chapter 5 for information about rack and sample location numbers, as well as command information.

Verifying Installation

After installing the Autosampler, verify it is installed correctly. Verifying installation consists of two parts:

CAUTION: Attempting to use it before ensuring correct installation may result in damage to the Autosampler.

1. Ensure communication between the Autosampler and the FS3700 works by using the FlowView™ Maintenance screen.

2. Ensure the sample probe functions properly.

Testing the Interface

If communication among the Autosampler, the Analysis Unit, and the PC is not established correctly, the Autosampler will not function. Before testing the interface, ensure the communication port connectors are properly attached between the Analysis Unit and the Autosampler and the Autosampler and the PC.

Checking the Autosampler Components

The following Autosampler components may be damaged from shipping or installation: the sample probe, peristaltic pump tubing, and rinse station and its tubing. Check these components for damage before operating the Autosampler using the following steps:

1. Shut down and unplug the Autosampler.

2. Visually inspect the sample probe, peristaltic pump tubing, and rinse station and tubing for leaks or signs of damage.

3. If a leak or other damage to an Autosampler component is found, replace the component. For more information, see the appropriate section in Chapter 6.

Testing the Sample Probe

The sample probe must descend into the center of each sample vial to ensure satisfactory sample uptake. Shipping or rough handling can disturb the Autosampler's alignment. If incorrectly aligned, the sample probe does not function properly. Test the sample probe before running samples on the Autosampler.

CAUTION: Before testing the sample probe, ensure all Autosampler components are installed correctly. Securely tighten all thumbscrews and ensure the communications cable from the FS3700 to the COM 1 port on the Autosampler is properly connected.

Test the sample probe by observing the sample probe operation:

1. Load the Autosampler sample tray with an empty sample vial rack. For information about placing the sample vial rack, see "Assembling and Placing the Sample Vial Racks"in this chapter.

2. Turn on the Autosampler and verify the LED power indicator is on.

NOTE: The LED power indicator is green. When the Z-drive assembly is in the home position, the indicator is located behind it.

3. Through FlowView, designate sample positions at the left rear, left front, right rear, and right front of the sample rack.

4. Place sample vials in the designated positions.

5. Command the Autosampler to move the sample probe to the designated sample positions. Check that the sample probe correctly accesses each position and the probe descends into the center of each sample vial.

NOTE: If the Autosampler alignment is not correct, contact the OI Analytical Customer Support Center at (800) 336-1911 or (979) 690-1711.

Operating the Autosampler

Start the Autosampler by completing the following steps:

1. Ensure the rinse station is properly connected. For more information about proper connections, see "Connecting the Rinse Station" in this chapter.

2. Turn on the Autosampler power switch.

NOTE: The green LED indicator along the Autosampler X-axis is lit when the power is on.

3. Adjust the peristaltic pump shoe using an Allen wrench on the adjustment screw until achieving the desired rinse solution flow rate.

CAUTION: Ensure no air bubbles are visible in the rinse uptake tubing before running samples with the Autosampler.

4. Purge air from the rinse system by placing the rinse solution uptake tubing in the rinse solution source and running the rinse solution through the rinse station.

5. Access FlowView and start a run. The Autosampler runs until it reaches the end of the sampling sequence.

Shutting Down the Autosampler

Shut down the Autosampler by completing the following steps:

1. Drain the rinse system by removing the rinse solution uptake tubing from the rinse solution source. Let the peristaltic pump run until all solution drains from the tube attached to the rinse station outlet.

If not using reagent water for the rinse solution, flush the rinse system with reagent water before shutting down the Autosampler. For more information, see "Flushing the Rinse Station and Flow Path" below.

2. Release the pressure shoe on the peristaltic pump.

3. Turn off the Autosampler power switch.

Flushing the Rinse Station and Flow Path

Generally, the Autosampler can operate without flushing the rinse system. Under normal circumstances, simply drain the rinse system prior to shutting down the Autosampler. However, flushing the rinse station and flow path is necessary under the following circumstances:

- during initial startup of the Autosampler after installation, and
- following the use of strong bases, acids, or organic solvents as rinse agents.

Flushing the rinse system during initial startup of the Autosampler removes any contaminants that could cause interference during sample analysis. Flushing the rinse system after using strong rinse agents prevents flow path degradation and failure.

Flush the rinse station and flow path by completing the following steps:

1. Insert the rinse uptake tubing into a reagent water source.

2. Run the rinse solution through the rinse station and flow path for 5–10 minutes.

3. After flushing the rinse system, proceed with the sampling sequence or drain the rinse system as part of the shutdown procedure. For information about running the sampling sequence, see "Operating the Autosampler". For more information about draining the rinse system, see the previous section, "Shutting Down the Autosampler".

Chapter 5 FlowView Software

FlowView software provides the capability for defining methods, calibrations, and sequences to run analyses on the FS3700. It also allows access to reporting and maintenance functions for the FS3700 system.

FlowView Operation

The steps to perform analysis on a configured FS3700 system are to 1) create a method, define method parameters such as heating temperature, sample timing, valve operation, peak marking, and QC parameters; 2) load defined method(s) into the configuration, confirming detector gain settings and pump speeds; 3) build a sample table to include the standards, samples, and QC that is desired; 4) perform the analyses and monitor the results; and 5) export or print results after post-processing. These steps are described in more detail in the following pages.

FlowView Launcher

The FlowView Launcher software is used to add, modify, and delete launch icons for each FS3700 instrument attached to the PC. Once created, these icons provide access to the FlowView software.

After installing the FlowView software on a PC that meets the system requirements and configuring the USB-to-RS485 converter, launch the FlowView Launcher software from the Windows Start menu, which opens the Launch screen.

Adding an Analyzer

To add a new FS3700 system to the launcher list, click **Add**, and give the instrument an appropriate name (typically the instrument serial number); then, select a COM port address (as created during the USB-to-RS485 converter installation process). Refer to Figure 5.1.

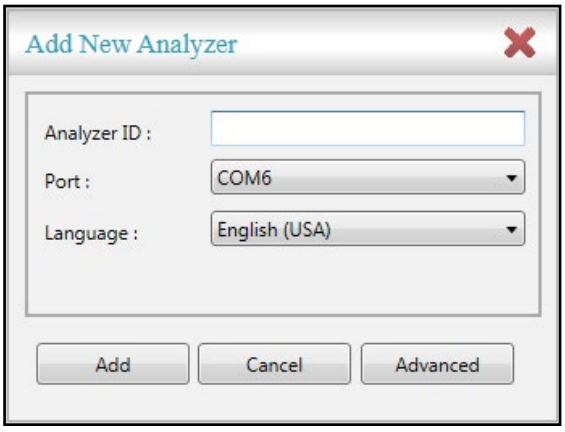


Figure 5.1. FlowView Launcher - Add Instrument Dialog

To enable 3+ channels with the FS3700 or perform advanced hardware address configuration, click **Advanced**. This will allow you to manually configure the hardware addresses and enable aux chassis. This is done to ensure correct communication with the attached hardware. See Figure 5.2.

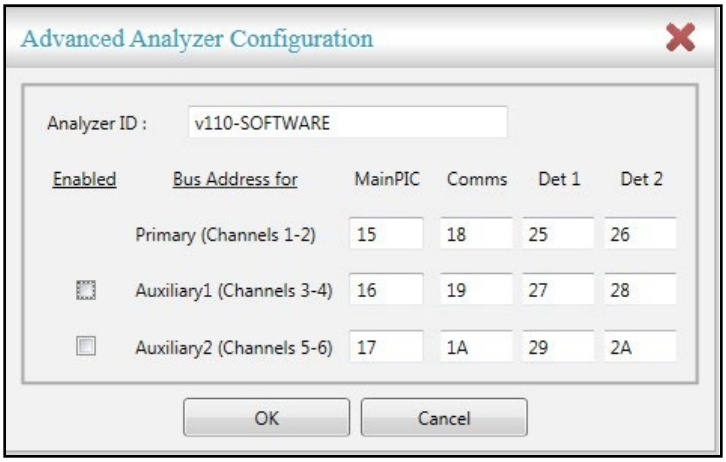


Figure 5.2. FlowView Launcher - Advanced Analyzer Configuration Dialog

NOTE: This should only be done by trained service personnel or when instructed by OI Technical Support Staff.

NOTE: The FlowView software can be launched multiple times to control more than one multichannel FS3700 system. A unique launch icon, USB-to-RS485 converter, and COM port address will be required for each FS3700 system.

Modifying an Analyzer

To make changes to a system configuration, select the system icon to be changed and press **Modify**, which brings up the Modify dialog. From the modify dialog, the COM port can be modified or advanced address configuration may be accessed.

Deleting an Analyzer

To delete a FS3700 Launcher icon, select the desired icon and click **Delete**.

NOTE: If a FS3700 is accidentally deleted, saved data and methods are not affected for that analyzer. To restore access, simply follow the steps for **Add A New Analyzer** and utilize the exact name of the deleted FS3700.

Starting FlowView

Launching the Software

To launch FlowView software, double-click the launch icon of the desired FS3700. A software launch screen will appear briefly while communications are established between the FlowView software and the FS3700 system. Once connected to the FS3700, the FlowView Home screen will appear.

FlowView Home Screen

The FlowView Home Screen is the top-level screen of the FlowView program. As such, it allows the operator to easily navigate through the lower-level screens using the six large icons, which are arranged in order of use from left-to-right and top-to-bottom. See Figure 5.3 below.

To move between the main screens, the operator first needs to return to the Home screen. Each of these six screens will return back to the Home Screen by clicking the Home icon in the upper corner of the screen. In addition to the large icons, the Home screen (and all lower-level screens) has a Status/ Information Bar (Figure 5.4) at the bottom of the screen.

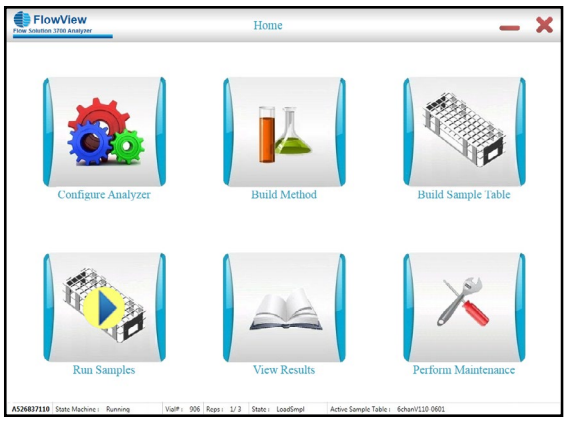


Figure 5.3. FlowView Home Screen

FlowView Status/Information Bar

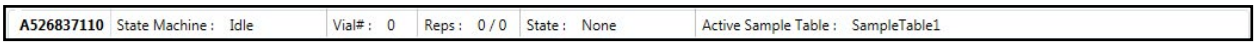


Figure 5.4. FlowView Status/Information Bar

The Status/Information Bar shows the following information (from left to right):

Analyzer ID Shows the instrument ID or name given in the Launcher for this analyzer

State Machine Shows system status as Standby or Running

Vial# Identifies current vial being processed

Reps Identifies current replicate being processed

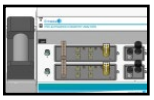
State Identifies the current state machine processing step

Active Sample Table Displays the name of the sequence currently set as active

Configuring the System

Configure Analyzer

The first button on the **Home** screen is **Configure Analyzer**. This screen is used to define/display the hardware settings of the flow system, and *must be completed* before any analysis can be performed. Click **Configure Analyzer** to access these settings, arranged on four screens.



Configure the System

The Primary Chassis configuration page (Figure 5.5) depicts a diagram of an FS3700 Flow Analyzer. The diagram is interactive; when a component on the diagram is clicked, the screen displays all options and settings to be configured for that component.

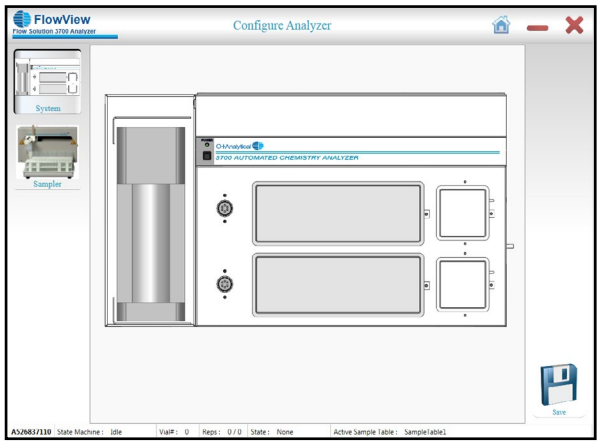


Figure 5.5. FlowView Configure Analyzer Screen

Pump Configuration Settings

- Pump Speed (percentage) Before and During Analysis 0.0% - 100.0%, and amount of time before automatically starting the run (Figure 5.6).
- Pump Speed (percentage) After Analysis 0.0% - 100.0%

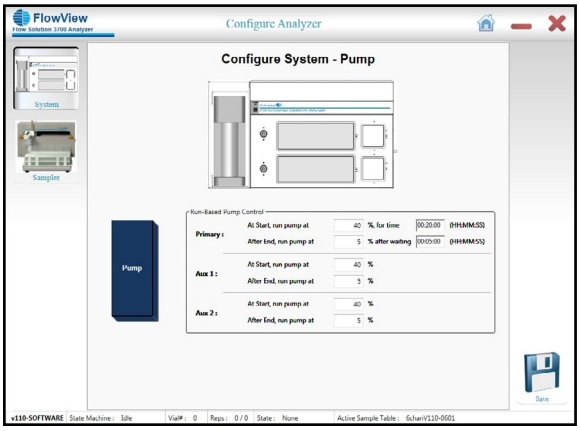


Figure 5.6. FlowView - Configure Pump Screen

Cartridge Configuration Settings

- Enable or disable each channel
- Select the analysis method to be associated with each channel

Open this page to configure the chemistries (methods) configured on each chassis. The Primary Chassis is the FS3700 Flow Analyzer that is directly connected to the host computer via the USB-to-RS485. The analysis channels, Channel 1 and Channel 2 (if equipped), are located on the primary chassis. If additional analysis channels are configured, they are designated Channel(s) 3, 4, 5, and 6. A second unit, if present, is designated Auxiliary Chassis 1 and hosts Channels 3 and 4. A third unit, if present, is designated Auxiliary Chassis 2 and hosts Channels 5 and 6. Neither Auxiliary Chassis 1 nor 2 will interface directly to the host computer. Auxiliary Chassis 1 will connect to the PRI/AUX port of the Primary Chassis, and Auxiliary Chassis 2 will connect to the PRI/AUX port of Auxiliary Chassis 1.

NOTE: Once the methods have been loaded and the configuration has been saved, the values for SFA/FIA, sample load, cycle time, heater, and UV will be visible in the configuration. See Figure 5.7.

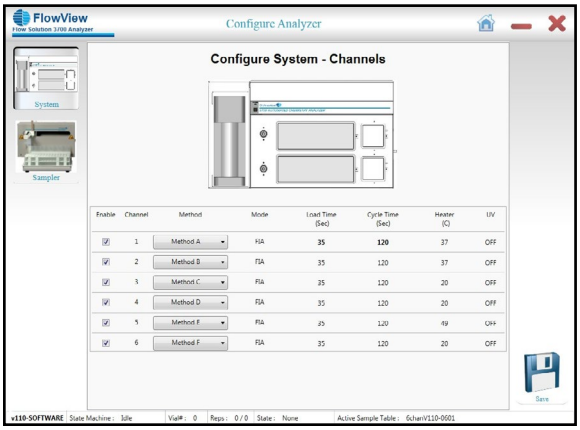
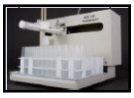


Figure 5.7. FlowView - Configure Channels Screen

The longest Load Time for any enabled channel will be used as the Load Time for all channels during a run. Likewise, the longest Cycle Time for any enabled channel will be used as the Cycle Time for all channels during a run. The largest value for Load Time and Cycle Duration are **bolded** for clarity.



Configure the Autosampler

Press **Sampler** on the left side of the screen. On the **Configure Autosampler** page (Figure 5.8), first select the model # for the Autosampler used for sample introduction. The choices are the 3090 Sampler, which is a one-tray sampler that has a maximum capacity of 90 cups/vials, or the 3360 Sampler, a four-tray sampler with a max capacity of 360 cups/vials.

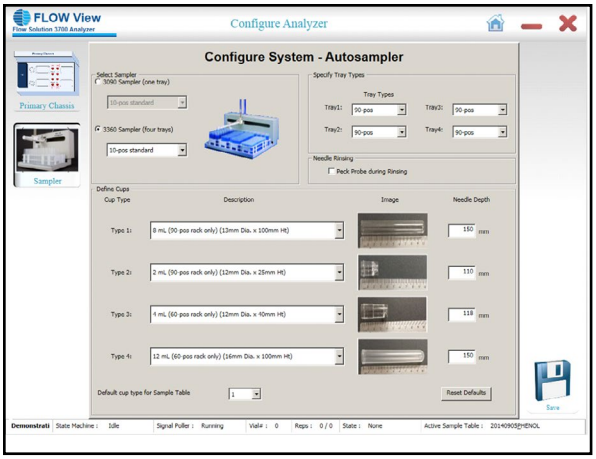


Figure 5.8. FlowView - Configure Autosampler Screen

Configure Trays: Choose between 60- and 90-position trays.

Configure Cup Types and Depths: There are four different cup types that can be specified, each cup type can be associated with its own unique sample probe depth when sampled. The cup types can then be changed on a per-sample basis within the sequence table. This allows for a mix of cup types to be used within one sequence run.

Configure Wash Source: An alternate source of rinse/wash water can be specified here. This is where the sample probe will move when not sampling a cup position from the sequence tray, or when commanded via the sequence to sample position zero or 900.

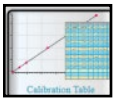
Configure Diluent Source: An alternate diluent source for use by the optional autodilutor may be specified here.

For more information on autosampler operation, see Chapter 4.

Building Methods

Build Method

The **Build Method** button on the **Home** screen provides access to saved method settings and allows creation of a new method configuration.



Calibration Table

The Calibration Table screen (Figure 5.9) allows the operator to type in all the information needed by the system to process calibration standards (STDs), initial calibration verification standards (ICV), continuing calibration verification standards (CCV), and other QC sample types.

Standards are numbered from STD1 to STD12 to allow flexibility in the number of standards used. To utilize a standard or QC sample type, check Included and specify a target concentration. Please note that standards and QC sample types (e.g., STD5 or ICV) are common to all methods. When running

multichannel configurations, it is important to ensure mixed standards are formulated correctly, or to utilize different standards if separate calibrants will be utilized (e.g., STD1-5 for Channels 1, 2 and 3; STD6-11 for Channels 4 and 5).

The Calibration Table screen also provides multiple QC sample types that, when included in the sequence, perform special calculations and trigger actions, such as pausing a run, flagging results for review, or triggering a re-calibration. Quality control requirements can be set individually for up to 13 different quality control sample types, including ICV (initial or internal calibration verification), CCV1-3 (continuing calibration verifications), RL (reporting limit), CCB (continuing calibration blank or control chart blank), EFFCHK (extraction efficiency check standard), LFB (laboratory fortified blank), MS (matrix spike), MSD (matrix spike duplicate), LCS (laboratory control standard), and two additional user-defined quality control types. Actions may be assigned to each of these quality control requirements to flag the sample and continue the run, or to stop the run. In addition, over-range sample handling may be controlled from this page. If a sample response is measured above the highest calibration standard, the sample can be flagged or the run stopped.

To utilize a QC sample type, check Included and specify a target concentration. You may specify a QC Tolerance and action (flag and continue, or stop the run) if the QC Tolerance is not met. The Calibration Table screen is also the where the curve fit (linear, weighted linear, 2nd order), concentration units, handling of over-range samples, and method name are specified. To change the method name, simply click in the method name field at the top of this screen and change the value. When you are done making changes to the Calibration Table, save changes and move to the next screen.

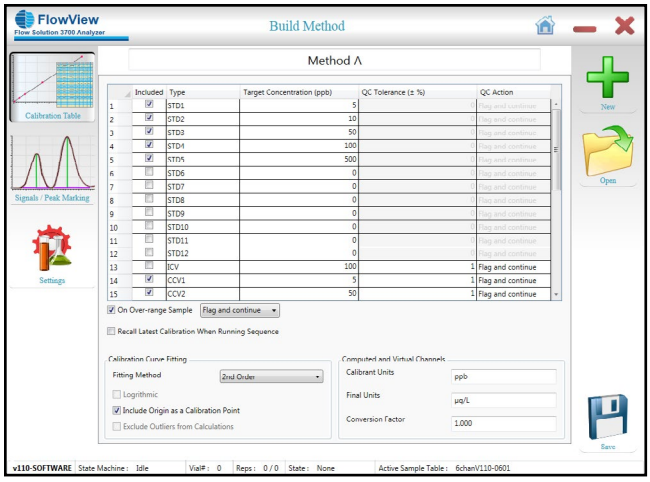


Figure 5.9. FlowView™ Build Methods - Calibration Table Screen

Signals/Peak Marking

The Signals/Peak Marking screen (Figure 5.10) determines whether peak area or peak height is used as the basis of all calculations. Smoothing options can also be set here. Options for discriminating peaks, peak corrections, and tuning peak start/stop logic are available as well.

NOTE: To optimize peak discrimination, it is recommended that the minimum peak height be set to a height slightly less than the height of your lowest standard. This ensures that baseline variations will not affect peak marking during online data collection.

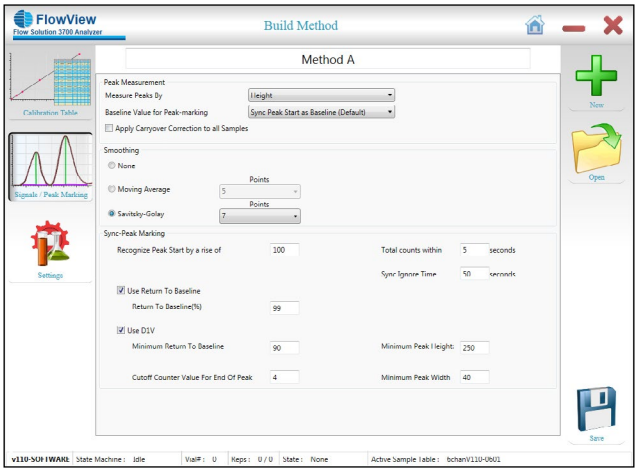


Figure 5.10. FlowView Build Method - Signals / Peak Marking Screen

Method Settings

The Method Settings screen (Figure 5.11) is used to define the hardware settings for the method/chemistry. In the provided fields, configure the analysis settings: mode as SFA or FIA, sample load time, cycle duration, and methodology (e.g., EPA 335.4). This information is included in the documentation provided with all FS3700 channels and cartridges.

NOTE: All SFIA and iSFA methods should be configured as "FIA".

Using the **Configuration and Start-Up** section of the FS3700 method, configure the heater, UV, and detector settings as recommended. When you are finished with changes to Method Settings, click **Save** to save the method.

You can now load the method into the configuration, create/modify another method, or build the sample table for the sequence that you will run.

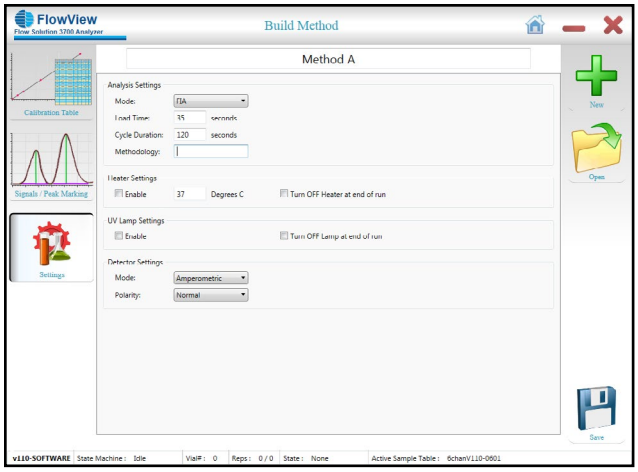


Figure 5.11. FlowView Build Method - Method Settings Screen

Building a Sequence

Build Sample Table

The **Build Sample Table** button on the **Home** screen provides access to saved sequences and the creation of new ones. A tabular editing format is provided with columns for the cup position, sample name, sample/batch/LIMS identification, dilution, sample type, etc.

Columns on this screen (Figure 5.12) may be re-arranged and re-sized as desired by the user. To move a column, click and drag the column label to the left or right. Below are a list of the fields available for use in this screen.

Sample Name, **Sample ID** **Batch ID** **LIMS ID**	Sample identifiers, as defined by the user (alpha-numeric)
Type	Type of sample at that cup position. Can be set to sample (SPL), standard (STD#), various QC sample types (detailed in the methods section), baseline, (RB), SYNC (to define the synchronization peak), and CO for carry-over compensation. See the FAQ section for more information.

Cup #	Cup location for the sample/standard you wish to run: • Position 900 (or 0) is the wash position. • Position 901-090 are on the standards rack at the rear of the sampler tray. • Positions 101-1xx are on the first tray (the 3090 sample only has first tray). • Positions 201-2xx, 301-3xx, and 401-4xx (when using the 3360). The tray number is the first digit, the "xx" is the position on the tray. 60-position trays will be numbered x01-x60 (e.g., 101-160), while 90-position trays will be numbered x01-x90. • For example a four-tray sampler with two 60-position racks (1 and 2), the two 90-position racks (3 and 4) will have valid positions of 900, 901-909, 101-160, 201-260, 310-390, and 401-490.
Rep #	Number of consecutive replicates you wish to run of the given sample/standard
M-Dil	Manual Dilution, a multiplier to compensate for dilutions that occur during sample preparation or without the use of an autodilutor.
A-Dil	For use with an autodilutor, this is the amount that the sample will be diluted.
User 1, User 2, Comments	Additional fields provided to store alpha-numeric information.
Vial	Type of vial at a given sample location (positions 1xx, 2xx, 3xx, and 4xx). Can be used in combination with System Configuration settings to allow sampling of supernatant from some samples and the bottom layer from other samples.

When building your sequence table, the tool bar on the left-hand side of the screen assists you in building and modifying a sample table. The tool bar on the right-hand side allows for the creation, opening, printing, saving, and deletion of sample tables. **Add Sample** will add a new sample, appended to the end of the run. **Insert Sample** will add a new sample above the row you currently have highlighted. To highlight a row, click the **row number** (far left column). Once a selection is highlighted, it can be copied, moved up, moved down, or deleted. In the same way, multiple rows can be highlighted by clicking a row number and dragging up or down.

Add Sample	Appends a new sample line at the end of the table. The next unused tray position is used to populate the Cup # field (101, 102, etc.), and a unique placeholder name fills the Sample Name field. These values may be modified, and new information may be entered into the other fields.
Insert Sample	Inserts a new sample line just above the currently highlighted line. The next unused tray position is used to populate the Cup # field (101, 102, etc.), and a unique placeholder name fills the Sample Name field. These values may be modified, and new information may be entered into the other fields.
Move Up	Shift a highlighted sample line or multiple-line selection up the table one row at a time.

Move Down Shift a highlighted sample line or multiple-line selection down the table one row at a time.

Delete Sample Delete the highlighted sample line or multiple-line selection.

When copying data for import or export, take note of how data is selected. If you highlight rows top-to-bottom, then click **Copy Sample** and **Paste Sample**, the rows will paste in the expected order. If you highlight rows bottom-to-top, then click **Copy Sample** and **Paste Sample**, the rows will paste in reverse order. Pasting data into Excel after clicking **Copy Sample** will yield comma-separated data in the order the columns appear in FlowView. Keyboard shortcuts may be used to copy/paste individual cell contents. Additionally, **CTRL-C** can be used to copy highlighted data into an Excel workbook (pasted data appears in column-format).

When importing sample lists into FlowView, information must be comma-separated with the fields in the exact same order as they appear in the FlowView table. If necessary, adjust the output from your LIMS or re-order the columns in FlowView so both match. Data may also be pasted using the **Paste Sample** command. If any errors are encountered with the data formatting, import will halt at the location where the error was encountered.

Copy Sample This button will copy to the Windows clipboard a highlighted single line or multiple-line selection.

Paste Sample To paste from the Windows clipboard, select a single line in the Sample Table. The **Paste Sample** button will insert either a single-line or multiple line section above the highlighted insertion line.

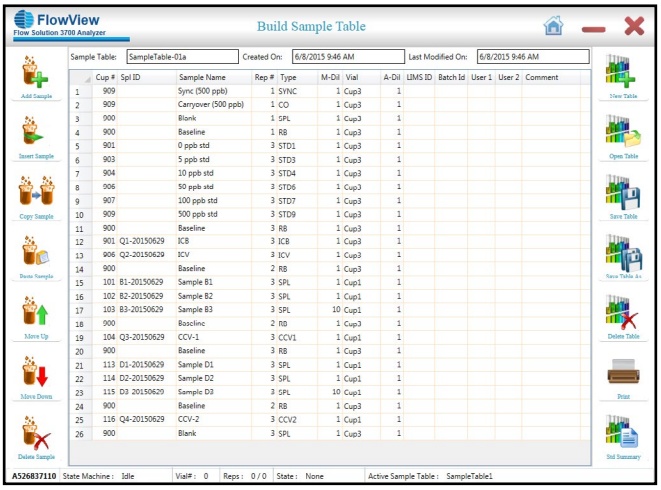
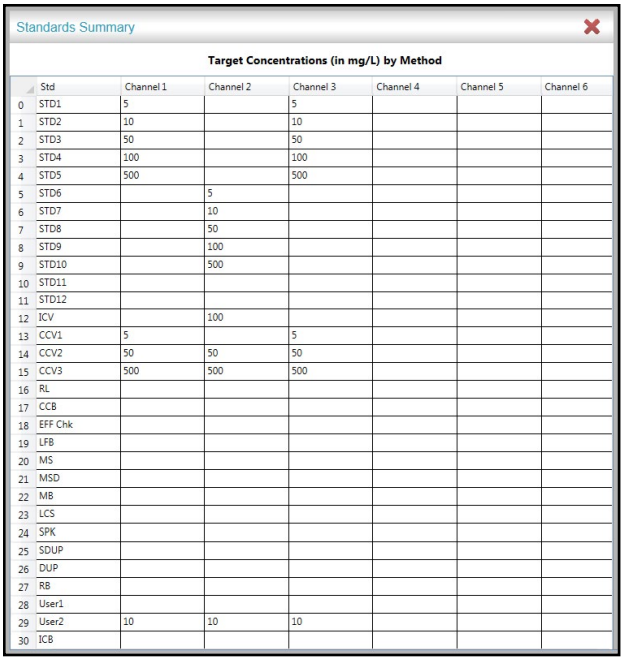


Figure 5.12. FlowView™ Build Sample Table Screen

The **Standards Summary** (**Std Summary**) button launches a window (Figure 5.13) for the review of standards across all channels. When mixed standards are used, each channel's method file should contain standard curve values for the same range of standards (e.g., STD1-7). Confirming this information prior to analysis minimizes time needed to post-process results files. If any changes are needed to the standards, return to the **Build Method** screen and open the method that needs to be changed. Once the changes have been made and the method has been saved, re-load the method into **Configure Analyzer**, and click **Save**.



Standards Summary

Target Concentrations (in mg/L) by Method

	Std	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6
0	STD1	5		5			
1	STD2	10		10			
2	STD3	50		50			
3	STD4	100		100			
4	STD5	500		500			
5	STD6		5				
6	STD7		10				
7	STD8		50				
8	STD9		100				
9	STD10		500				
10	STD11						
11	STD12						
12	ICV		100				
13	CCV1	5		5			
14	CCV2	50	50	50			
15	CCV3	500	500	500			
16	RL						
17	CCB						
18	EFF Chk						
19	LFB						
20	MS						
21	MSD						
22	MB						
23	LCS						
24	SPK						
25	SDUP						
26	DUP						
27	RB						
28	User1						
29	User2	10	10	10			
30	ICB						

Figure 5.13. FlowView - Standards Summary Window

Preparing for the Run

Run Samples

The **Run Samples** button on the **Home** screen provides access to start and end an analysis, monitor the baseline prior to starting a run, monitor data as it is collected, view the calibration curve as it is created, and modify the sequence during the run (Figure 5.14). To start, select the sample table you wish to load and specify a name for the results file. You will also need to provide your operator ID (name, initials, or ID #) to start an analysis.

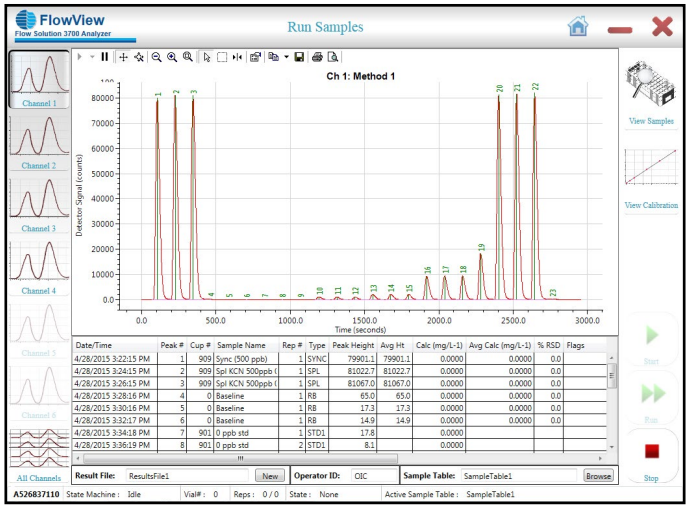


Figure 5.14. FlowView Run Samples Screen

WARNING: Before loading or unloading any sample vial racks on the sample tray, park the Autosampler arm and probe in the home position. This can be accomplished by cycling the power off and on or using the FlowView Maintenance Screen (see Chapter 6). The home position is the initial position when the unit powers on. Never attempt to load, unload, or reposition a sample vial rack or sample vial while the Autosampler is operating.

Active Sample Table

To select the "Active" sample sequence to be run, click **Browse** near the bottom of the screen, and choose an available Sample Table.

Result File

Specify a filename for the result data by clicking **New** in the Result File section.

- Click **Start** 

.
- Pre-sequence baseline is displayed for each channel.
- Allow time for the detector baseline to stabilize.
- Adjust tubing, settings, etc., as needed during this time.

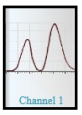
NOTE: The FS3700 will automatically enter Run mode if the pre-run timer expires (set on the Configuration System-Pump page).

- Click **Run** 

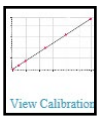
.
- The Autosampler will initiate, then progress through the series of vials for injection into the FS3700 Flow Analyzer.
- The sample peaks for each active channel can be monitored in the viewing window.
- Updated result data for each active channel is displayed in the result table after each sample replicate has completed.

Channel Display Options

If multiple channels are active, the display area can be toggled to display either one individual channel, or all active channels in split-screen.



To view one channel, click **Channel#** to display that individual channel's results and detector signal in the viewing area. A button is provided for each active channel.



To view the calibration curve for a channel during a run, click **View Calibration**. Here, as in **View Results**, you can find the curve equation and calculated value for the standard (Figure 5.15). Exit the screen and re-open this window for the latest information on the calibration curve for the run in progress.

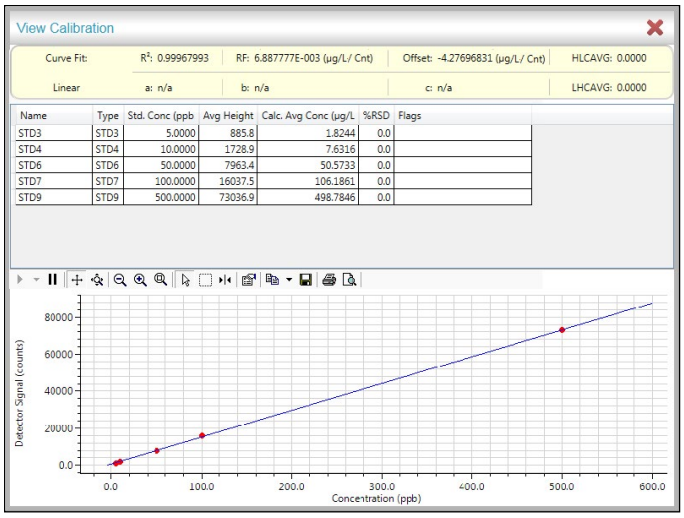
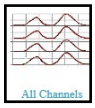


Figure 5.15. FlowView View Calibration Screen



Click **All Channels** to display a split-screen view of all detector signals sample peaks.

To view or edit the sample table during a run, click **View Samples**.

The sample currently being processed will be highlighted with a green line. Samples below the green line will be white and may be modified using the toolbar on the left-hand side of the screen. Samples above the green line will be grey, indicating that they have already been run. These samples may not be modified during the run. For help understanding the features available for modifying the sample table, return to the **Sample Table** section. For help modifying sample information after a sample has been run, turn to the **View Results** section.

Monitoring Operations

If multiple channels are enabled in the configuration, switch the view between one or all channels using the buttons on the left side. Click **Stop** if it is necessary to terminate the sequence before it is complete.

In the center of the screen is a graphical presentation of the detector signal(s) according to which channels are selected for viewing. Peaks are marked as they are observed and calculated in real-time, and the calculated results are displayed in a tabular format at the bottom of the page.

Stopping the Run

The run will automatically stop when the entire sequence is processed.

- To stop a run in progress, click the **Stop** button 

.
- The detector signal viewing area is deactivated.
- The active result file is closed and no further data is collected.

Viewing Results

View Results

View Results on the **Home** screen provides access to data review, data processing, and data export for FlowView. This screen allows for peak settings and calibration settings to be redefined for a completed run or a run-in-progress (Figure 5.16). If changes are made to a results file, they may be saved to a new results file; they cannot be saved over the original file.

Click **Open Results** and select the filename to load data.

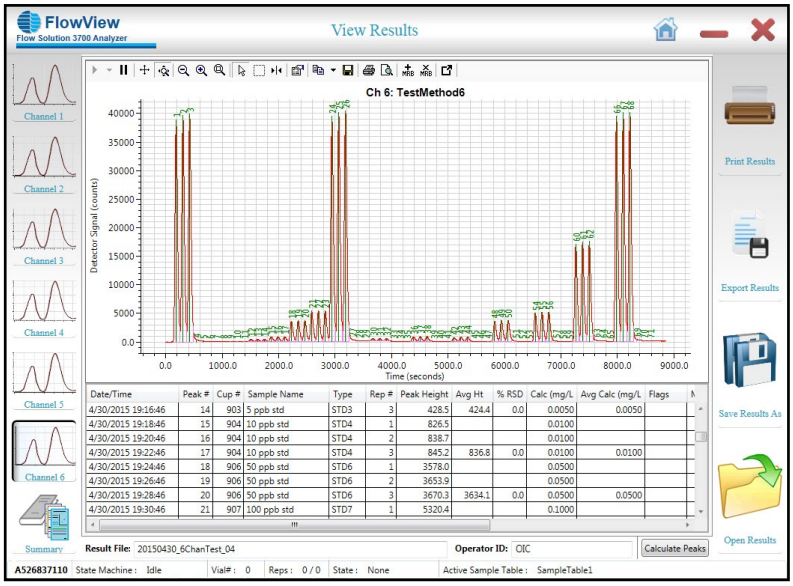
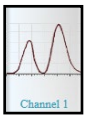


Figure 5.16. FlowView - View Results Screen



Click **Channel1** to display the results from Channel1. Likewise, any other single channel from the completed sequence can be displayed individually.

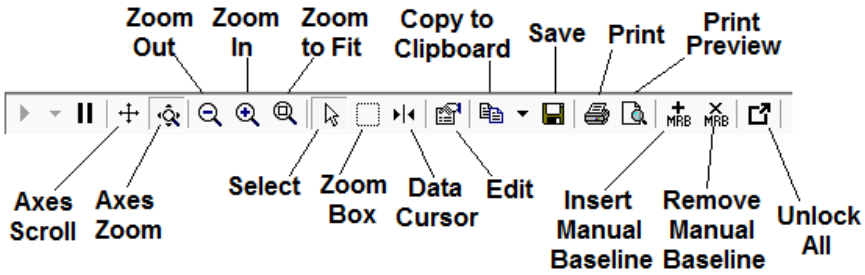


Figure 5.17. FlowView Peak Graph Toolbar Detail

The Peak Graph Toolbar (Figure 5.17) in View Results includes the following tools for data processing:

Axes scroll	Use on the graph axes to scroll the axes up-down or left-right without changing the zoom.
Axes zoom	Use on the graph axes to zoom the time or detector signal axes. Zooms on the value at the center of the axis.
Zoom out	Zooms out in all directions.
Zoom in	Zooms in to the center of the peak graph.
Zoom to fit	Displays peak graph so full-time range and full-detector range are visible.
Select	Used to move (and lock) peak marks - see detail below.
Zoom box	Use on the peak graph to specify the range to be zoomed into.
Data cursor	Used to find the (X,Y) coordinates of any point on the peak graph.
Edit	Opens the edit dialog, which affects how the peak graph is displayed. OI Analytical does not recommend changing settings in the Edit dialog.
Copy to clipboard	Copies the peak graph portion of the screen exactly as it appears when the button is pushed.
Save	Opens a dialog box to print an image of the peak graph exactly as it appears when the button is pushed.
Print	Opens a dialog box to print an image of the peak graph exactly as it appears when the button is pushed.
Print preview	Provides a preview of what will be printed.
Insert manual baseline	When selected, will add a manual baseline point when you left-click in the peak graph.

Remove manual baseline	When selected, will remove a manual baseline point when you left-click on a manual baseline point in the peak graph.
Unlock all	Will unlock all manually specified peak marks. This does not affect manual RBs.
Calculate peaks	Recalculates samples, standards, calibration curves, etc., based on the current values set in the Summary (Methods, Sample Table) and manually defined objects in the peak graph window. If a user has manually edited a peak mark, a dialog will open providing the option to **Remark All Peaks**, which removes all manually marked peaks (marking all peaks automatically), or **Remark only unlocked peaks,** which uses the manually marked peaks to re-mark and re-calculate all other peaks in the run.

Manual Baseline Adjustment

Manual RB points may be inserted as necessary. These inserted RB points will serve to define the baseline for all future peaks, until another manual or automatic RB is encountered.

To insert manual RBs, select **Insert Manual Baseline** from the Peak Graph tool bar, then point and left-click at the point in time where the RB should be inserted. The manual RB point will be inserted into the graph at that time point. The Calculate Peaks function will automatically run, re-marking and re-calculating all subsequent peaks.

To move/relocate a manual RB point, the operator will choose **Select** from the Peak Graph tool bar, then left-click the Manual RB marker and drag it to the desired new location. Upon doing so, the Manual RB marker will be moved to the new location. The Calculate Peaks function will automatically run, re-marking and re-calculating all subsequent peaks.

To remove a manual RB point, select **Remove Manual Baseline** from the Peak Graph tool bar, then point at the manual RB point to be removed and left-click. The manual RB marker will then be removed and the Calculate Peaks function will automatically run.

These manual RBs will be assigned a peak height/area value equal to the Y-value in the graph at which they're placed. Additionally, a new row will be displayed in the Results Table (between the peak rows where the RB was inserted), with a date/time stamp of the date/time when the RB as inserted. Manual RBs will also be shown in the Print or Export results, so that they can be tracked.

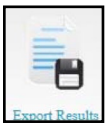
NOTE: To keep the modification to an existing RB file, the operator will need to use **Save As**.

Manual Peak Marking

In the event that a peak is not marked properly, peak markers may be moved manually so data can be re-processed and re-calculated.

Using **Select**, you manually click and move the peak marker. When a peak marker is moved manually, the new position is defined as the Peak Max and the software locks this peak. This locked peak becomes the basis of peak marking for subsequent peaks until the end of the run or until another manually marked peak is encountered. After changes have been made, click **Calculate Peaks**. A dialog will open asking if you wish to use the manually marked peaks. Select **Remark only unlocked peaks** to use the manually marked peaks to re-mark and re-calculate the other peaks in the run.

To remove manual peak marking, click **Unlock All** and then click **Calculate Peaks**, or click **Calculate Peaks** and select the first option **Remark ALL Peaks**. All manually marked peaks will be removed and peak marking will be automatically applied using the settings in the method.



Click **Export Results** to open a dialog to select what information and file format you wish to save the results for the active channel (Figure 5.18). The order of the columns will be the same as they appear in **View Results**. If a different order is desired, close the export results dialog, rearrange the columns into the desired order (by clicking and dragging column headers) and click **Export Results** to re-open the dialog.

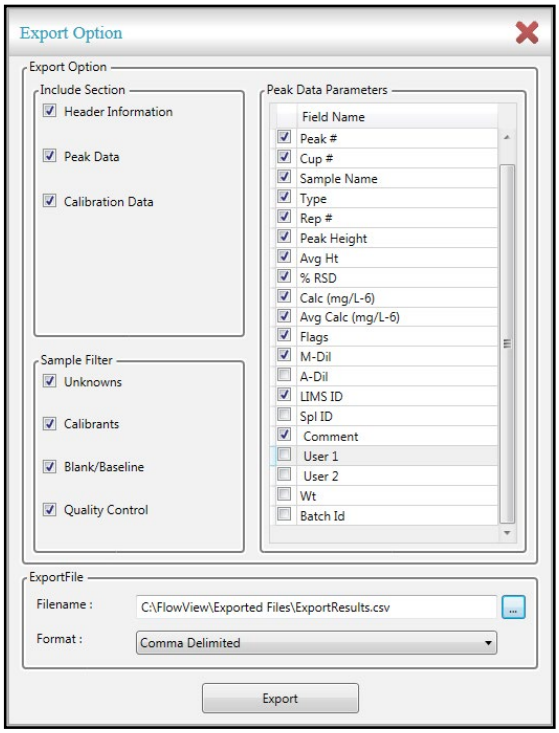


Figure 5.18. FlowView - Export Options Dialog

Click **Print Results** to open a dialog to select what information, graphs, and calibration data you wish to print for the active channel. The order of the columns will be the same as they appear in **View Results**. If a different order is desired, close the export results dialog, rearrange the columns into the desired order (by clicking and dragging column headers) and click **Print Results** to re-open the dialog.

Click **Summary** to display the complete set of the configuration, method, calibration, and results from a sequence (Figure 5.19).

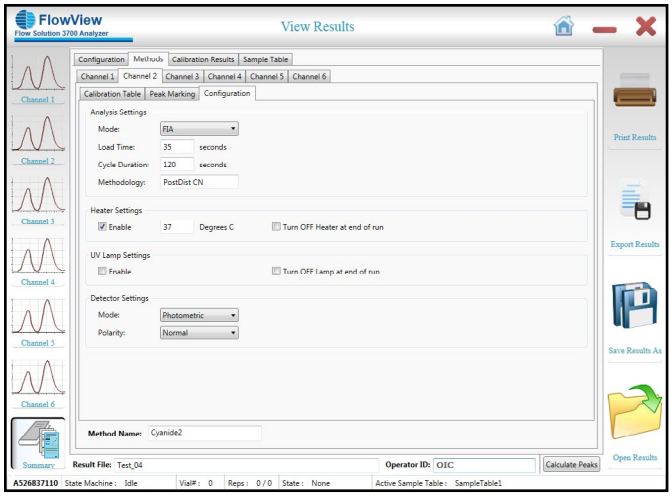


Figure 5.19. FlowView - View Results Summary

The tabs across the top allow you to access information saved with the results from the **Configure Analyzer**, **Build Method**, and **Build Sample Table** screens on the **Configuration**, **Methods**, and **Sample Table** tabs (respectively).

Peak Settings and Re-calculation

Multiple parameters may be modified after data collection from the tabs in **View Results,** including sync peak delay, peak width, sample and standard types, peak marking parameters, baseline handling, etc. To view how these changes affect the peak marking and calibration, click **Calculate Peaks**.

To save data modified after collection, click **Save Results As** and enter a new filename. Please note that modified data cannot be saved over the original data file.

Calibration Results (tab)

The calibration curve and statistics may be accessed and printed from the **Calibration Results** tab (Figure 5.20).

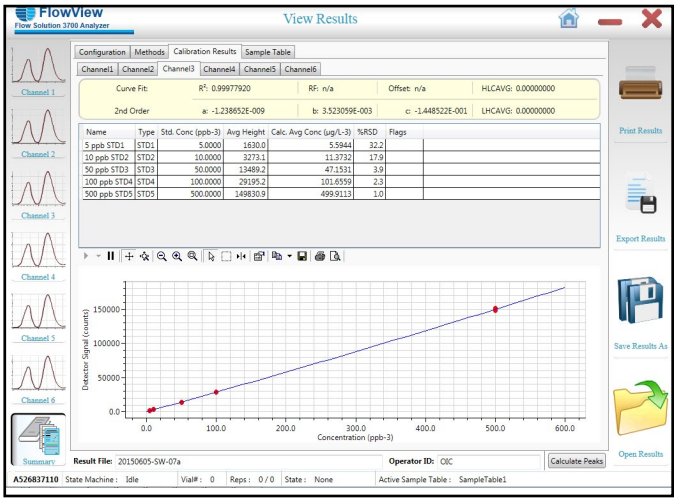


Figure 5.20. FlowView - View Results - Calibration

To change the curve fit, change the **Calibration Curve Fitting** type on the **Calibration Settings** tab under the **Methods** tab (Figure 5.21).

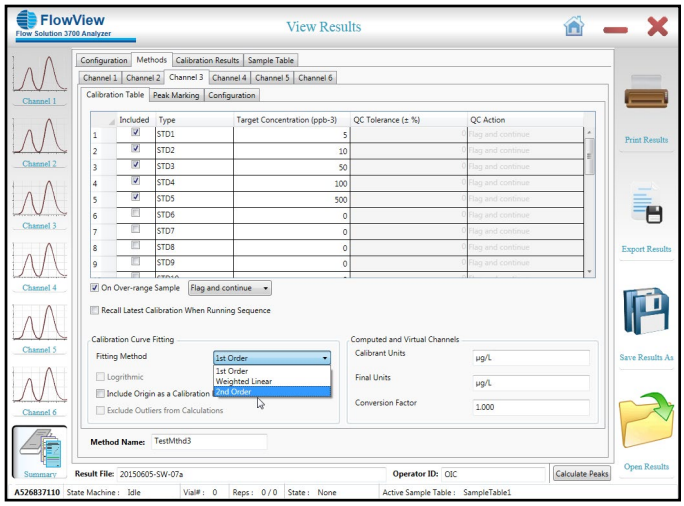


Figure 5.21. FlowView - View Results - Method

Chapter 6 ML600 Autodilution Module

This chapter provides information on installing and operating the ML600 Autodilutor from Hamilton. The optional autodilution module can be used with the FS3700 and our updated FlowView Software, and our autosamplers. this module is designed to automated laboratory tasks, save time, reduce efforts and reduce sample loss. If you did not purchase the FS3700 with an autodilutor, this section of the manual does not apply. Installation can be completed without tools.

The optional autodilutor system, used with FS3700 FlowView software and the autosampler, can also be used to automate a number of typical laboratory tasks to save time, reduce effort, and reduce sample loss.

Product Highlights

- Provides automatic generation of calibration standards from Stock solution
- Increases precision, accuracy, and reproducibility versus manual methods
- Provides automatic pre-dilution of known over-range samples
- User operator-defined dilution factors
- Provides automatic detection, dilution and re-run of over-range samples
- Generates dilution factors for over-range dilutions based on sample
- Provides automatic re-run of Followers after over-range samples
- Ensures that following samples are not adversely affected by over-range samples
- Provides automatic CCV-based Sample Table updates
- Appends Followers and Over-Range samples to Sample Table while maintaining required spacing of CCV samples

Preparing for Installation

a. Unpack the ML600
b. Place the ML600 between the autosampler (if applicable) and the FS3700.

Unpacking the Autodilutor

Before installing the autodilutor, ensure the intended location meets the bench space and power requirements.

Inspect external packaging upon receipt for holes, tears, smashed corners, or any other outward signs of damage from rough handling or abuse during shipment. Inspect all items during unpacking and notify the carrier immediately of any damage.

NOTE: Do not throw away the factory packaging

Module Specifications

Dilutor Module

Table 6.1 - Dilutor Module Specifications

Feature	Specifications
Dilution Ratio Range	1:1.5 to 1:1,000
Drive	1.8˚ Stepper motor with optical encoder
Configuration	Dual-syringe
Dilution Syringe	5 mL or 10 mL
Sample Syringe	0.100 mL, 0.250 mL, or 0.500 mL
Fluid Path	Borosilicate, PTFE, CTFE, PFA
Power Requirements	100-240 VAC, 50-60 Hz, (3A/1.5A)
Power Supply	Separate module (included)
Communications to PC	USB-to-RS232 (from PC to Dilutor) (cable included)
Communications to Valve	TTL (cable included)
Dimensions	7.0 x 5.5 x 10.5 inch (177.8 x 139.7 x 266.7 mm)
Weight	13 lbs (5.9 kg)
Operating temperature	41-104 ˚F (5-40 ˚C)
Storage temperature	-4 – 158 ˚F (-20 - 70˚C)
Humidty range	20-90% non-condensing
Compliance	FCC Part 15, Class B EMC: EN 61326-1, Class B

Valve Module

Table 6.2 - Valve Module Specifications

Feature	Specifications
Ports	4
Positions	2 (A=Normal/Bypass; B=Dilution/In-line)
Power Requirements	100-240 VAC, 50-60 Hz, (2.2A/1.1A)
Power Supply	Separate module (included)
Communications to Dilutor	TTL (cable from Dilutor module)
Dimensions	4.2 x 2.4 x 7.0 inch (106.7 x 61.0 x 177.8 mm)
Weight	4 lbs (1.8 kg)

Dilutor Module Views

Dilutor Module – Front View

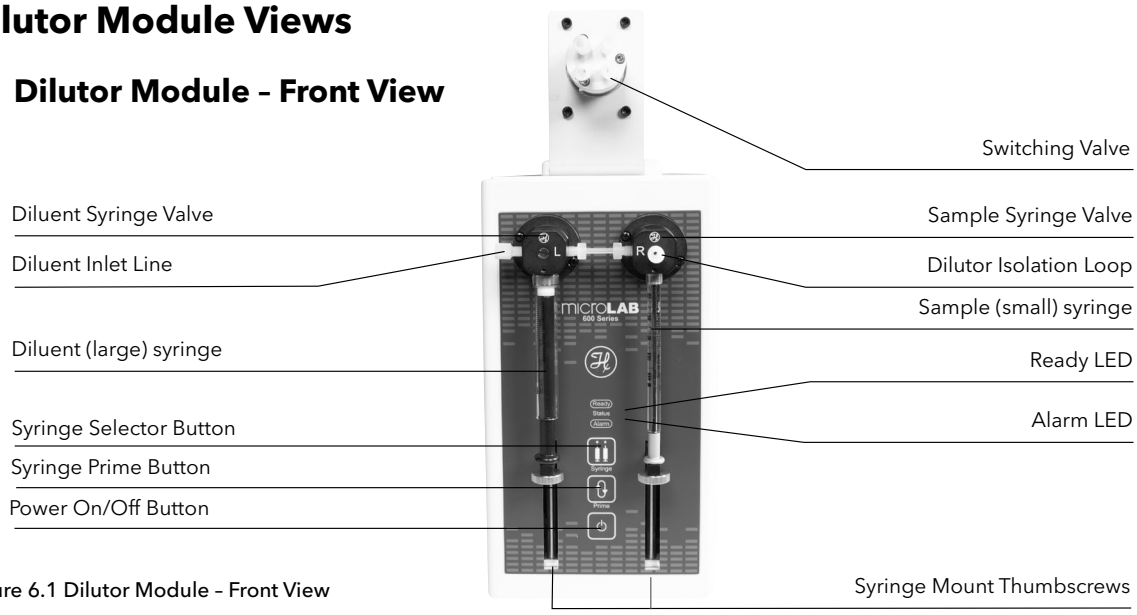


Figure 6.1 Dilutor Module – Front View

Diluent Syringe Valve
The diluent syringe valve connects the diluent syringe to the diluent inlet line. The valve rotates automatically at the appropriate time to aspirate diluent from the reservoir and dispense it toward the autosampler needle probe.

Diluent Inlet Line
The diluent inlet line connects the diluent syringe valve to the diluent reservoir.

Diluent (large) Syringe
The diluent syringe aspirates precise amounts of diluent from the diluent reservoir and dispenses it toward the autosampler needle probe.

Syringe Selector Button
This button specifies which syringe will be primed when the Syringe Prime Button is pressed. A small blue LED lights up over either or both syringes indicating which syringe is active. Push the button to toggle between "both", "left", and "right" syringe options. By default, both syringes will be set to be primed when syringe module is first powered up.

Syringe Prime Button
The syringe prime button is used to prime the instrument prior to use or to lower the syringe drive allowing replacement of the syringes.

- To change the syringes: To lower the syringe drives, press and hold the Prime button. After three seconds, the drive will begin to lower. Continue to press the button until the drives are halfway down.

- For Syringe Optimization, see page 114.

Power On/Off Button
The power on/off button is used to activate or deactivate the syringe module. When the power is On, the blue power LED will be lit.

Sample Syringe Valve
The sample syringe valve connects the sample syringe to the autosampler needle probe. The valve rotates automatically at the appropriate time to aspirate sample from the needle probe (from sample or wash cup) and then dispense it back to the needle probe (to dilution cup).

Dilutor Isolation Loop
The dilutor isolation loop connects the Syringe Sample Valve ("R") to the Dilution Valve module, which has direct access (via the Autosampler probe) to the sample and dilution cups along with the wash station. **NOTE:** The loop must be the appropriate length for the Sample Syringe selected for the Dilutor module, in that the loop must always be slightly larger in volume that the syringe to ensure that sample never enters the sample syringe itself.

Sample (small) Syringe
The sample syringe aspirates precise amounts sample from the autosampler needle probe when in the sample cup, and then dispenses the sample back through the probe when in the dilution cup.

Ready LED
The Ready LED is used to indicate the status of the syringe pump module. Below are the different types of indication:

- Rapid Blinking – This indicates the pump is in networking mode. This mode is not used in the FS3700 configuration.

- Slow Blinking – Blinking about once per second indicates the pump is ready, but not initialized. When the FS3700 system is connected to the pump, the ready indicator will blink until the FS3700 establishes connection and initializes the pump.

Alarm LED
The Alarm LED indicates if a problem has occurred with the syringe module. If a problem arises, for example a syringe stall, the red LED will light. See Page 112 for troubleshooting tips.

Syringe Mount Thumbscrews
The thumbscrews are used to connect the syringes to each syringe drive. Be sure that each screw is firmly hand-tight to ensure that the syringe will not come loose during operation.

Valve Module (shown above the dilutor module)
The selection valve switches between normal mode (which bypasses the syringe dilution module) and dilution mode (which puts the syringe dilution module in-line with the autosampler.

Dilutor Module – Back View

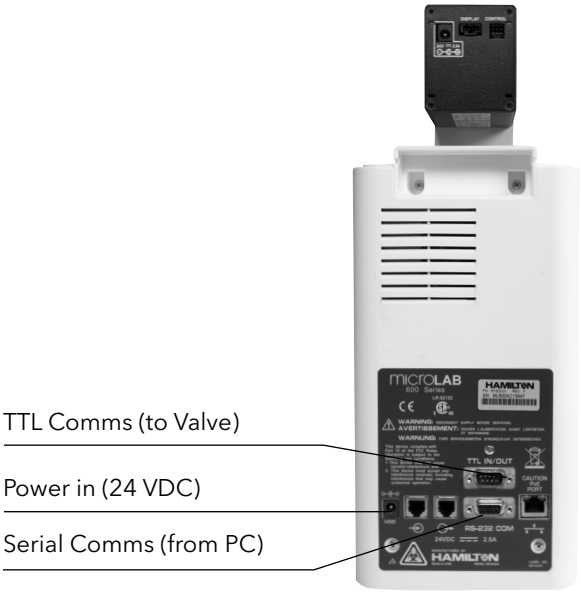


Figure 6.2 Dilutor Module – Back View

Power In (24VDC):

This power connector is used to connect the Dilutor module to the external 24VDC power supplied (provided).

TTL Comms (to Valve):

This connection uses a custom TTL cable (provided), which connects to the 4-Port Dilutor Valve module. This allows the FlowView software to control the 4-Port valve directly via the Dilutor module.

Serial Comms (from PC):

The connection uses a USB-to-RS232 cable (provided) to connect from the PC to the Dilutor module. This allows the FlowView software to directly control the Dilutor module.

Valve Module – Front View

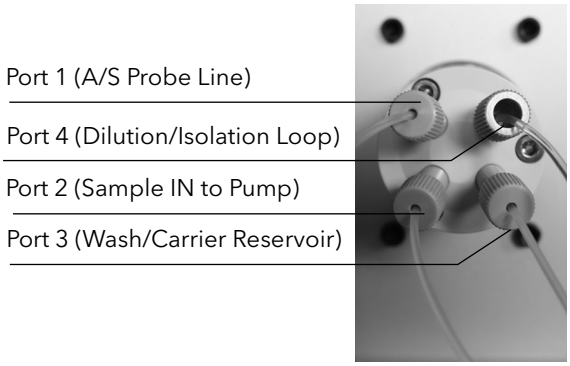


Figure 6.3 depicts the front view of the Valve module.

Port 1 (A/S Probe Line):

Port 1 is used to connect the autosampler probe line to the Dilution Module syringe valve or Sample Pump. In normal mode, this connection provides the FS3700 pump direct access to the autosampler (as if the dilution module was not installed). In dilution mode, this connection provides the dilution module direct access to the sample and dilution cups along with the wash station to enable the making of dilutions in the autosampler tray.

Port 2 (Sample IN to Pump):

Port 2 connects the Sample In line (from the System Pump) to either the Autosampler (in Normal mode) or the Rinse Reservoir (in Dilution) mode.

Port 3 (Wash/Carrier Reservoir):

Port 3 connects the Rinse Reservoir to either the Autodilutor system (in Normal mode) or the System Pump (in Dilution mode).

Port 4 (Dilution/Isolation Loop):

Port 4 connects Dilution/Isolation Loop to either the Rinse Reservoir (in Normal mode) or the Autodilutor system (in Dilution mode). NOTE: It is critical that the volume of the Loop is 10-20% larger than the volume of the Sample Syringe. This ensures that the sample is never drawn into the sample syringe during dilution operations.

Normal mode (Position A):

Port 1 connected to Port 2; Port 3 connected to Port 4. This mode allows the FS3700 system to function as if the Autodilutor system is not attached.

Dilution mode (Position B):

Port 1 connected to Port 4; Port 2 connected to Port 3. This mode connects the Autodilutor system to the Autosampler to perform dilutions, while the FS3700 system pump is connect to Rinse water to maintain a stable baseline while the dilutor is working.

Valve Module – Back View

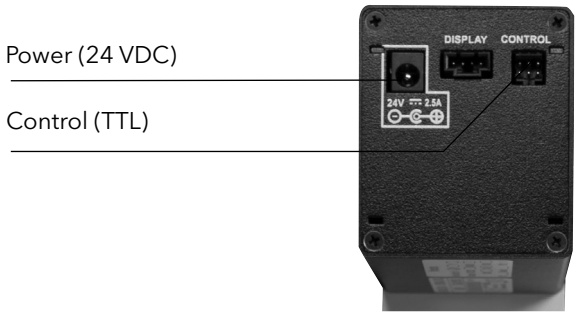


Figure 6.4. Valve Module - Back View

Power (24VDC):

Provides the connection for the separate AC/DC power supply module to power the Valve module.

Control (TTL):

Provides the TTL signal cable connection to the Dilutor module to receive commands to rotate the valve and to report valve position and status.

Installation

Module Placement and Connections

Basic Configuration (w/o Autodilutor)

FS3700 systems with 1–2 channels include a FS3700 Chassis, 1-2 Channels (Method cartridges), a Precision Pump and an Autosampler, as depicted in Figure 6.5.

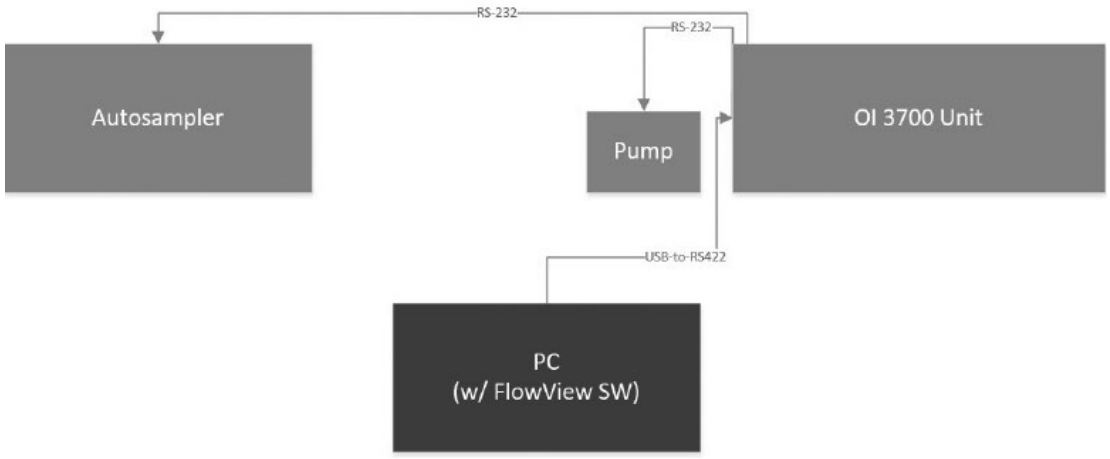


Figure 6.5 - FS3700 System with 1–2 Channels and Autosampler

Autodilutor Configuration

An optional module for the Autodilutor system (including Autodilutor Syringe Module and 4-Port Bypass Valve) can also be added, as depicted in Figure 6.6.

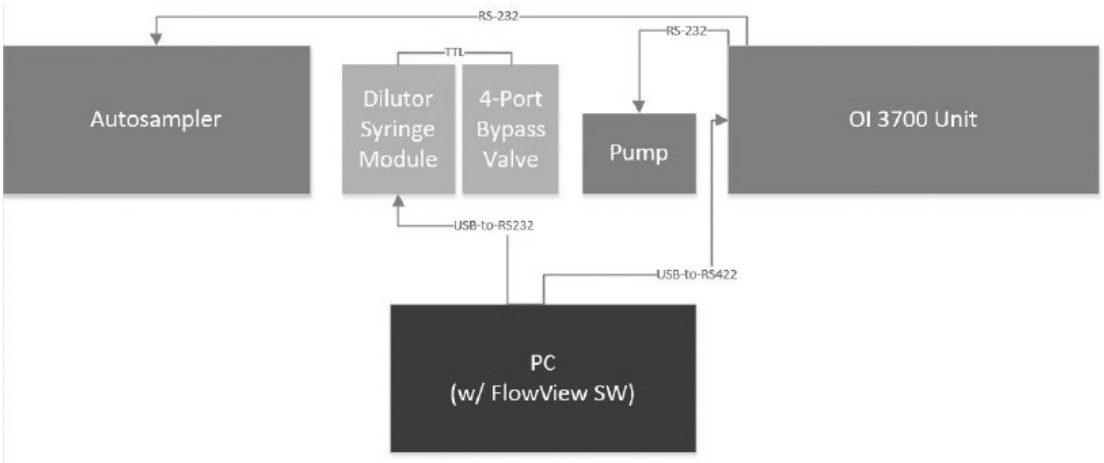


Figure 6.6 - FS3700 System with 1–2 Channels, Autosampler, and Dilution Module

Installing the Autodilutor System

Install the Autodilutor System using the following steps:

1. **Place the Autodilutor modules (refer to Figure 6.6)**
   a. Place the dilutor module and valve module between the autosampler and the FS3700 multi-channel pump.
   NOTE: To save space, the Valve Module can be placed on top of the Dilutor Module.
   b. Be certain that the Power switch on each module is OFF.

2. **Make the Power and Serial connections to the modules: (refer to Figures 6.2, 6.4 and 6.6)**
   a. Connect the power supply between the Dilutor Module ("VDC" Power In connector) and the power outlet
   b. Connect the power supply between the Valve Module ("24 VDC" Power In connector) and the power outlet
   c. Connect the TTL signal cable from the "TTL IN/OUT" port on the Dilutor Module to the "Control" port on the Valve Module
   d. Connect the USB-to-RS232 cable from the "RS232 COM" port on the Dilutor Module to an available USB port on the FlowView PC.
   NOTE: Be sure to have installed the FlowView software and Serial Drivers first, before making this connection, so that the COM port can be detected and assigned.

3. **Make the Dilutor Module plumbing connections: (refer to Figure 6.1)**
   a. Connect the other end of the Dilution Isolation Loop to the Sample Valve port ("R")
   b. Connect the Diluent Inlet Tube from the Diluent Reservoir to the Diluent Valve port ("L")
   c. Connect the short tube between the "L" and "R" ports
   d. Install the Sample and Diluent Syringes. See Chapter 5 Maintenance for details.

4. **Make the Valve Module plumbing connections: (refer to Figure 6.3)**
   a. Connect the Autosampler probe Sample tube to Port 1
   b. Connect the Sample In tube (from the multi-channel pump) to Port 2
   c. Connect the Rinse Reservoir Tube from the Rinse Reservoir to Port 3
   d. Connect one end of the Dilutor Isolation Loop to Port 4

Configuring FlowView Software for Autodilutor

Install the updated version of the FlowView software (with Autodilutor features) using the standard software installation procedure defined in the FS3700 User's Manual.

Launcher Configuration

Then, launch the FlowView software to reach the FS3700 FlowView Launcher screen. Click "ADD (+)" and configure the FlowView system to define the COM port for the Autodilutor option. See Figure 6.7.

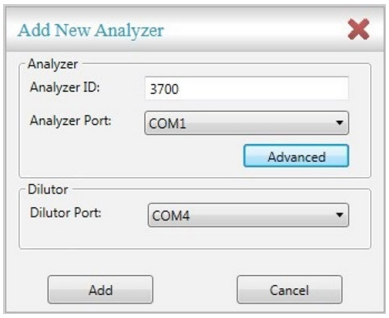


Figure 6.7 - FlowView – Add New Analyzer to define Autodilutor

Configure Analyzer – Configure Dilutor Page

Launch the new analyzer (with the dilutor defined) and update the analyzer configuration to enable the autodilutor system. (See Figure 6.8.)

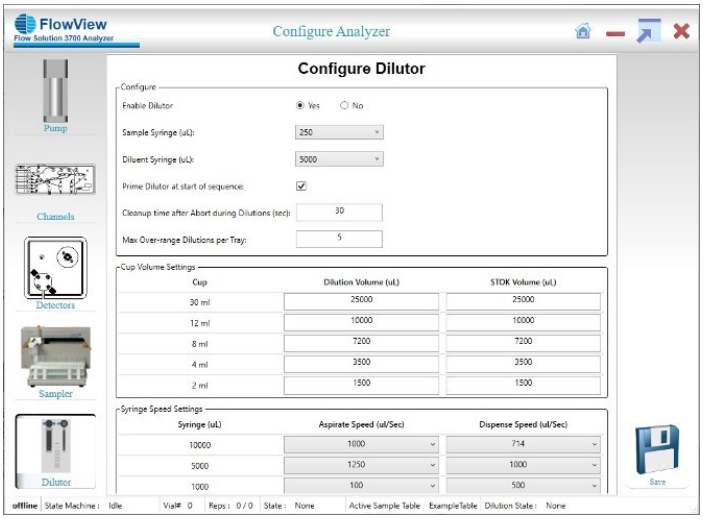


Figure 6.8 - FlowView – Add New Analyzer to define Autodilutor

The Dilutor configuration page is divided into 4 sections: Configure, Cup Volume Settings and Syringe Speed Settings.

The Configure section allows the operator to define the following parameters:

- Enable Dilutor (Yes/No)
  - o Specify if the Autodilutor module is to be active in the current configuration.
  - o If enabled:
- The Dilutor MUST have a proper working COM port in the Launcher icon
- The Dilutor and Valve modules must both be powered-On and with proper cable connections made
- The FlowView software will allow for automatic dilutions in this configuration.
  - o If not enabled,
- FlowView will not perform any dilutions

- Sample Syringe (uL)
  - o The syringe sizes supported are: 250uL, 500uL and 1000uL
  - o The smaller the size, the more accurate the dilutions, but the more time required to make dilutions

- Diluent Syringe (uL)
  - o The syringe sizes supported are: 5000uL and 10000uL
  - o The smaller the size, the more accurate the dilutions, but the more time required to make dilutions

- Prime Dilutor at Start of Sequence
  - o If checked, this option will ensure that the Dilutor and Valve modules are primed at the start of each sequence.

- Cleanup Time after Abort during Dilutions
  - o In the event that the sequence is aborted while performing a Dilution, this time will allow the autosampler probe needle to cleanup in the Wash/Rinse cup to flush any potentially high-concentration standard or sample from the needle.

- Max Over-Range Dilutions per Tray
  - o Since it is possible that every unknown sample could potentially be over-range and require a dilution, the software needs to establish a maximum number of dilutions that can be performed per tray. This vial positions in the tray will be "reserved" for dilutions and the operator must place empty cups in those positions in the tray. Thus, these vial positions cannot be used to specify the location of normal samples to be processed.

    NOTE: Specify enough vials per tray to handle the expected number of over-range samples, without specifying too may and thus loosing excess sampling positions.

    NOTE: Over-range vials will **ONLY** be diluted to cups within the same autosampler tray. For example, if Tray1 has more over-range samples that it has defined dilution cups, those samples will not be diluted into any other tray, and thus those dilutions will **NOT** be performed.

The Cup Volume Settings section allows the operator to define the following parameters:

- "Usable" cup volume are defined for each nominal cup size: 30mL (STDs), 12mL, 8mL, 4mL, and 2mL

  - o The larger the cups being used, the more accurate the dilutions.

  NOTE: The nominal cup size for the STOCK cup is set to 30mL. If using a larger STOCK cup, the volumes can be increased to allow for more available volume to be used for dilutions.

- The Dilution volume specifies how much sample or sample will be made into each dilution cup.

  o The larger the volume specified, the more accurate the dilutions.

- The STOCK volume specifies how much sample the operator is providing in each cup that will be available for dilutions.

  o If the volume is too low, then dilutions may be not possible if there is not enough sample to draw to make the dilutions.

  The Syringe Speed Settings section allows the operator to define the aspirate and dispense speeds for each Diluent and Sample Syringe

- The aspirate speed is the speed used when drawing the sample or diluent from the cup or reservoir.

- The dispense speed is the speed used when pushing the sample or diluent into the dilution cup.

  NOTE: The default speeds provided were selected to ensure maximum performance based on typical samples with viscosity similar to water. Higher viscosity samples will required slower syringe speeds for both aspirate (to avoid cavitation) and dispense (to avoid syringe stalls).

Configure Analyzer – Configure Autosampler Page

To support the auto-generation of standards for the calibration, the new "STOCK" vial type has been added to the cup configuration with a default nominal volume for the 30mL STD vial type. The volume defined for this cup is used use in the dilution calculations for available volume for making standard dilutions. See Figure 6.9.

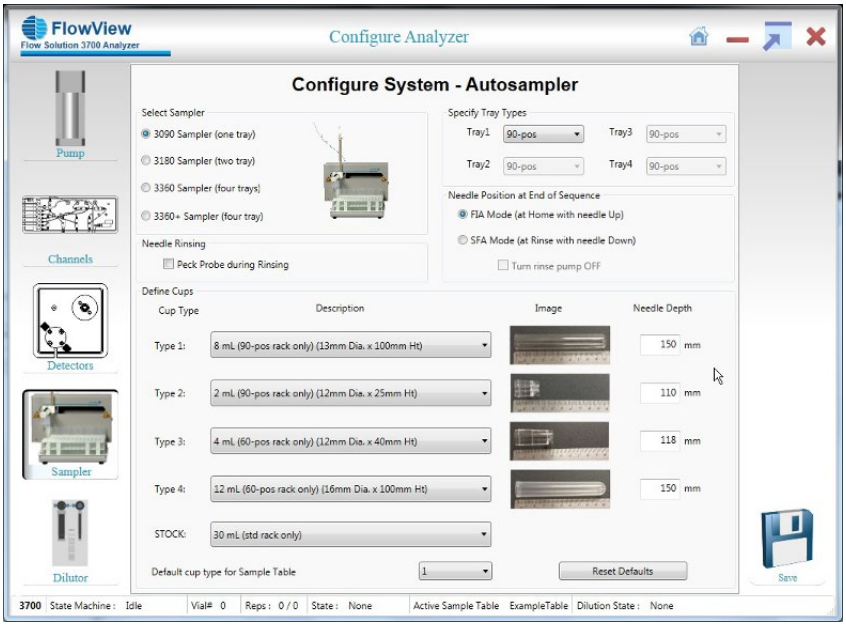


Figure 6.9. FlowView – New STOCK cup type

Operation

General Notes about Autodilutions

In most basic terms, auto-dilution is the automated mixing of a concentrated sample or standard with a diluent (typically DI water) to reduce its effective concentration. Typically, this is done for one of three purposes:

- To generate calibration standards by diluting from Stock solution
- To pre-dilute samples with an expected concentration beyond the calibration curve (i.e. over-range)
- To automatically dilute and re-run samples that have been analyzed and found to be over-range

For tips on optimizing dilutor performance, see page 114.

NOTE: When running a sequence, ALL Auto-Generated Standards and Sample Pre-dilutions will be performed before the system advances into the Run mode to begin analyzing samples. While processing the dilutions, the status of each sample dilution will be updated in the Dilution Status column…advancing from Not Started, to In Progress, to Completed. This process will continue until all dilutions have been performed. Then, and only then, will FlowView advance to processing the samples in the sample table. **This is especially important to remember in the event that the sequence is stopped for any reason.**

Fundamentals of Autodilutor Operation

Normal Mode

In Normal mode, depicted in Figure 6.10, the Sample-In line (from sampler probe) connects directly to the Sample Outline (To Pump). The sample always passes through the Dilutor valve (Position A), by bypasses the syringe module which is idle in this mode.

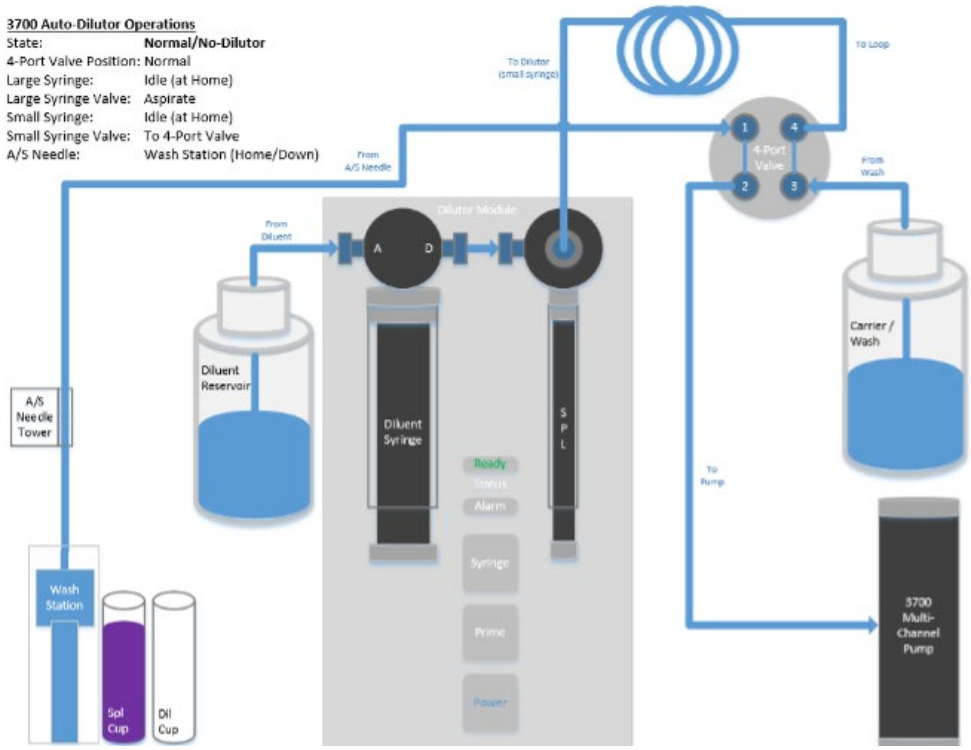


Figure 6.10- Normal Mode

Dilutor Mode

Dilution mode consists of several steps to perform a complete dilution, as follows:
Step 1 – Aspirate Sample
Step 2 – Dispense Sample
Step 3 – Aspirate Diluent
Step 4 – Dispense Diluent

Step 1 – Aspirate Sample

When the Autodilutor is in Dilution mode, depicted in Figure 6.11, the Dilution Valve switches to Position B, which connects the Dilutor Module to the Autosampler. The From Wash line directly connects to Sample Out (To Pump), delivering wash solution to the cartridge via the pump.

The autosampler probe moves to a specified sample vial to be diluted. The syringe draws up the calculated sample volume at a specified rate (defined in the Configuration → Dilutor screen), as shown in Figure 4.2.

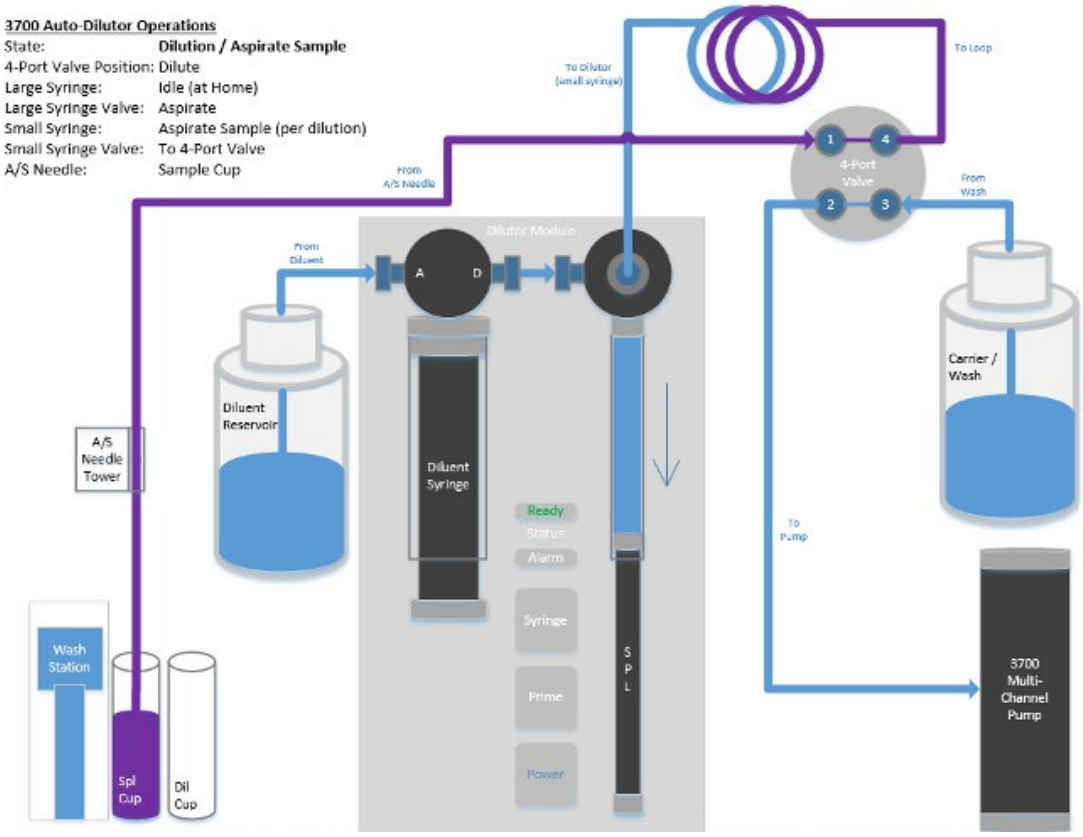


Figure 6.11 - Sample Aspirating in Dilution Mode

Step 2 – Dispense Sample

The autosampler probe then moves to the dilution vial, and dispenses the sample into the vial at the specified rate (defined in the Configuration->Dilutor screen), as depicted in Figure 6.12.

NOTE: If more than one transfer of sample is required to meet the dilution ratio and final dilution volume (defined in the Configuration->Dilutor screen), the system will repeat these Aspirate/Dispense steps until all of the needed sample is transferred to the target dilution cup.

NOTE: To prevent over-sampling, the autosampler probe momentarily immerses in the wash reservoir to remove excess sample droplet from the last transfer, before adding the diluent to the vial.

3700 Autodilutor Operations

State:	Dilution/Dispense Sample
4-Port Valve Position	Dilute
Large Syringe:	Idle (at Home)
Large Syringe Valve:	Aspirate
Small Syringe:	Dispense Sample (to Home)
Small Syringe Valve:	To 4-Port Valve
A/S Needle:	Dilution Cup

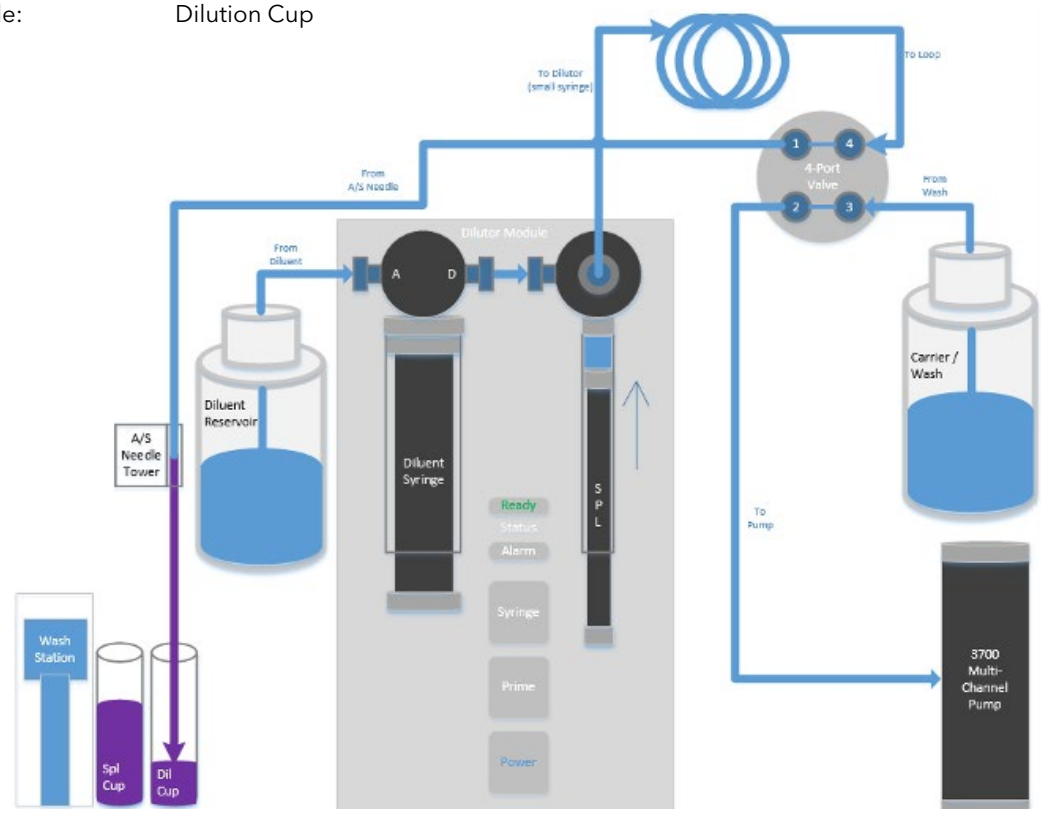


Figure 6.12: Sample Dispensing in Dilution Mode

Step 3 – Aspirate Diluent

Once all the sample has been transferred, diluent is drawn from the Dilution Reservoir into the Diluent Syringe at the specified rate (defined in the Configuration->Dilutor screen), as depicted in Figure 6.13.

NOTE: The autosampler does not have to move during this step, as the Dilutor can aspirate the Diluent directly from the Diluent Reservoir.

3700 Autodilutor Operations

State:	Dilution/Aspirate Diluent
4-Port Valve Position	Dilute
Large Syringe:	Aspirate Diluent (per dilution)
Large Syringe Valve:	Aspirate
Small Syringe:	Idle (at Home)
Small Syringe Valve:	To 4-Port Valve
A/S Needle:	Dilution Cup

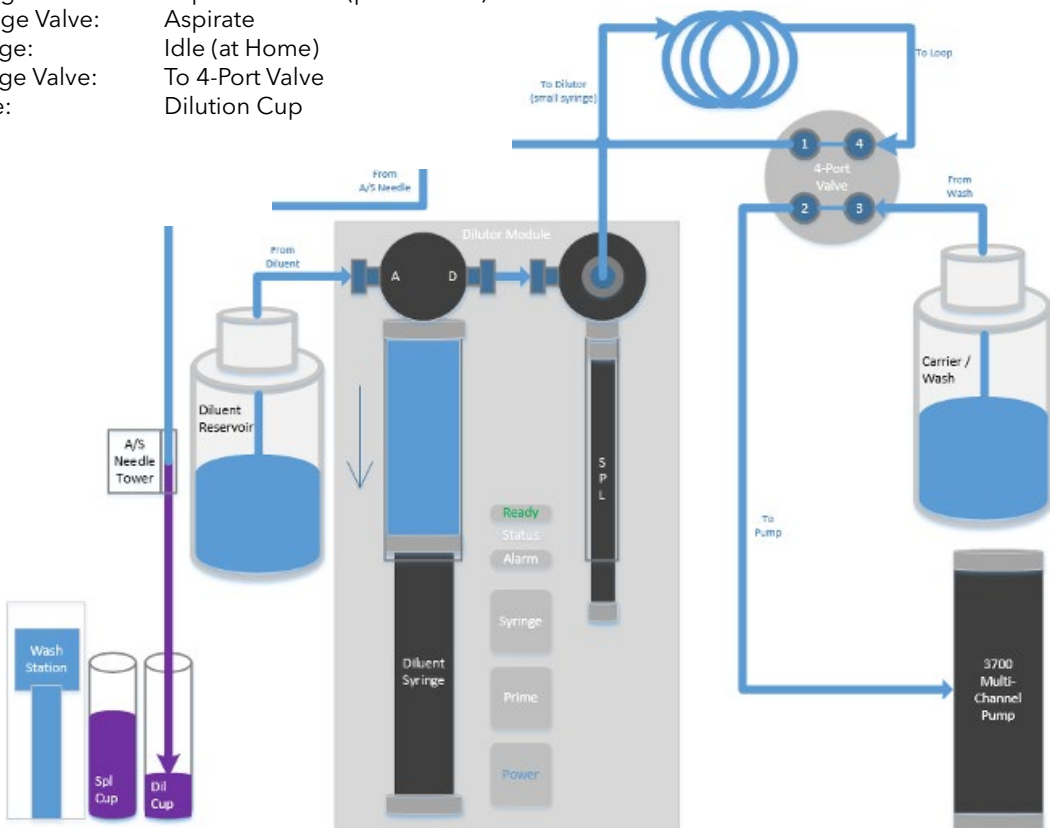


Figure 6.13 Aspirating the Diluent Water

Step 4 – Dispense Diluent

The diluent is then pushed from the syringe through the probe into the target dilution vial at the specified rate (defined in the Configuration->Dilutor screen), as depicted in Figure 6.14. This diluent addition mixes with the sample and generates the final sample concentration.

NOTE: If more than one transfer of diluent is required to meet the dilution ratio and final dilution volume (defined in the Configuration->Dilutor screen), the system will repeat these Aspirate/Dispense steps until all of the needed diluent is transferred to the target dilution cup.

3700 Autodilutor Operations

State:	Dilution/Dispense Diluent
4-Port Valve Position	Dilute
Large Syringe:	Aspirate Diluent (to Home)
Large Syringe Valve:	Dispense
Small Syringe:	Idle (at Home)
Small Syringe Valve:	To 4-Port Valve
A/S Needle:	Dilution Cup

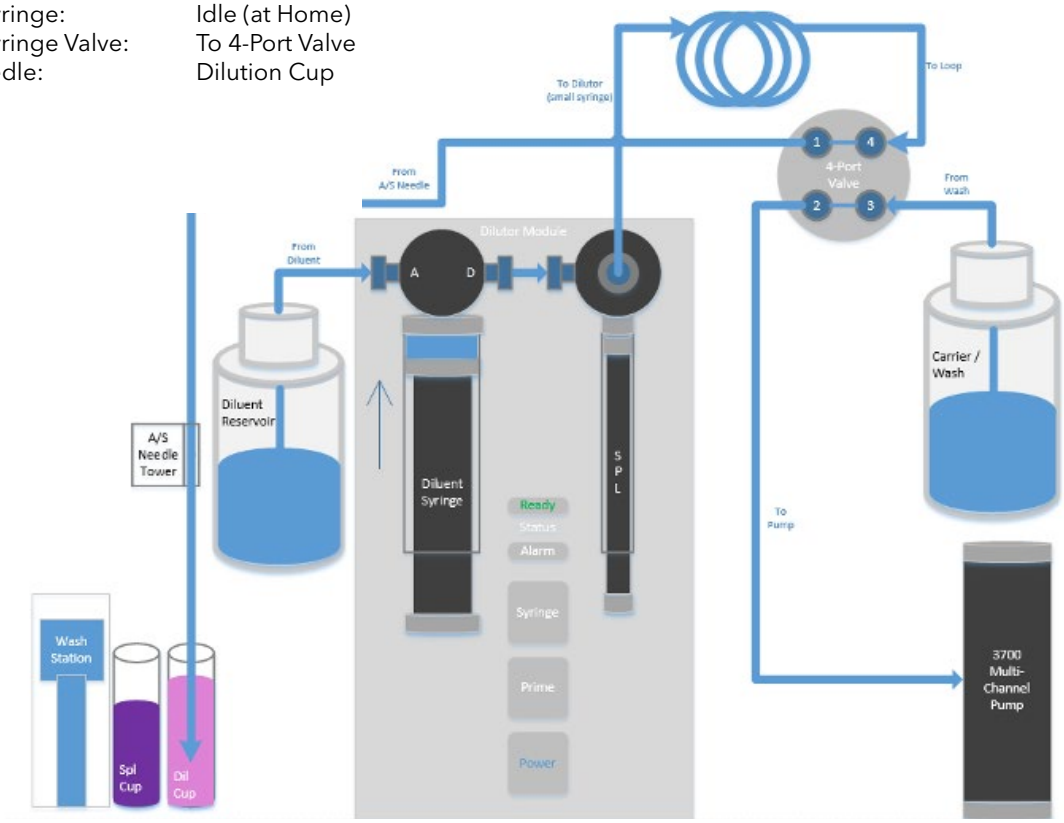


Figure 6.14 Dispensing the Diluent to make Diluted Sample

This process repeats until all Standards, Pre-Dilutions or Over-range samples are diluted.

Auto-Generation of Calibration Standards

The FS3700 Autodilutor system has the ability to automatically generate all of the standards defined in the Method Calibration Table. This feature saves time and reduces errors related to operator manual dilutions.

Standards can be auto-generated by Autodilutor system from one of the following sources:

1. The highest Standard concentration included (checked) in the Calibration table
   a. The operator must provide that Standard in the A-Dil Vial specified in the Sample Table editor.

2. The STOCK concentration (as defined and checked) in the Calibration table
   a. The operator must provide that STOCK in the A-Dil Vial specified in the Sample Table editor.
   b. Basically, if the A-Dil Vial specified is NOT a STD type sample, then FlowView will assume that the STOCK vial is to be used.

   NOTE: The STD or STOCK vial can be placed anywhere in the tray. However, to maximize the volume of standard available for dilution, it is typically best to use a vial in the Standards Rack.

Define the Standard Concentrations

As with non-dilution runs, the Method Calibration Table must first be defined to enable the applicable standards and show the Target Concentration of each Standard. See Figure 6.15

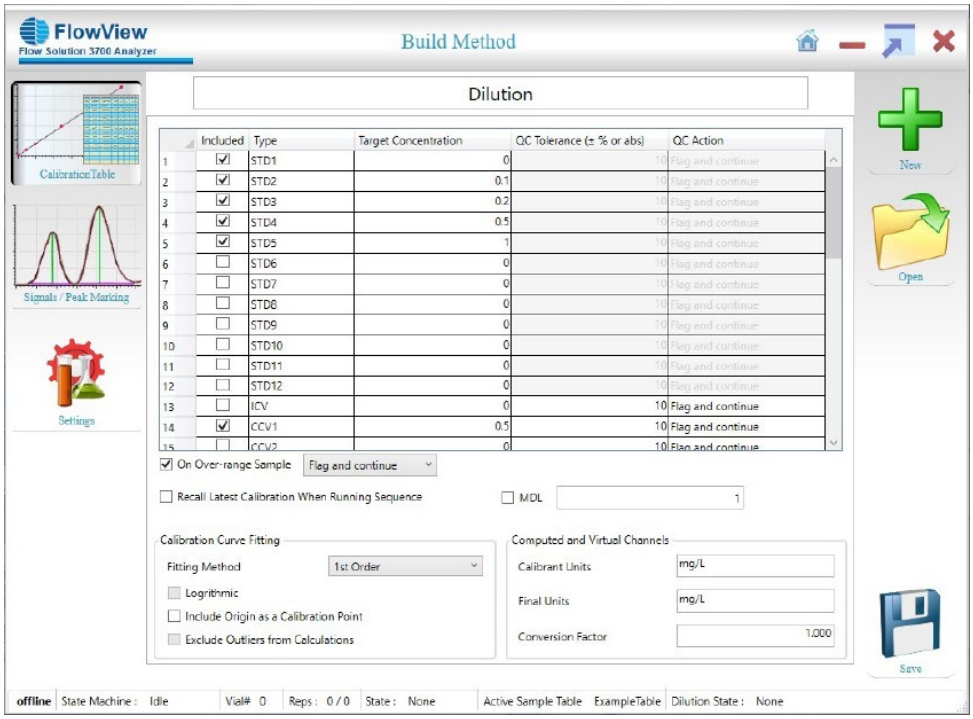


Figure 6.15 Define the Standard Concentrations in the Method Calibration

The checkbox for each Standard to be auto-generated must be checked to indicate that Standard is included in the calibration curve. Likewise, the Target Concentration must be specified for each active Standard in the table.

Define the Stock Concentrations

If the STOCK vial is to be used to auto-generate the Standards, then the checkbox for the STOCK must be checked to indicate that STOCK is included in the calibration curve. Likewise, the Target Concentraiton for the STOCK must be specified in the table as well.

NOTE: The STOCK concentration must be at least 1.5x greater than the largest Standard to be generated, as that is the minimu dilution factor allowed.

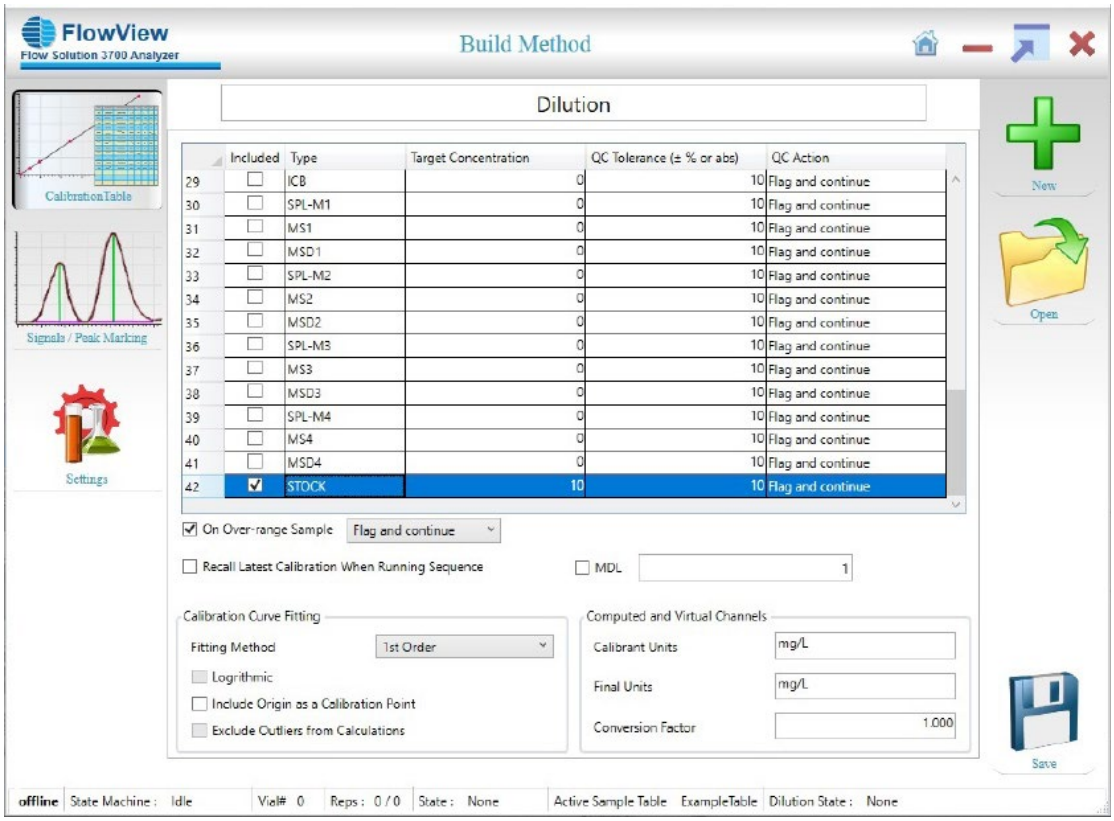


Figure 6.16 Define the STOCK Concentration in the Method Calibration

Define the Method in the Channel Configuration

In order for a method to be "active" in a sequence, the Method name must be specified in at least one of the Channels in the system Configuration. See Figure 6.17

NOTE: When running multiple channels simultaneously with different methods using the auto-generation of calibration standards feature, it is important to understand all active methods in the configuration must have standards with the same dilution rations between the stock and all included standards.

FlowView will use the STOCK and Standards defined in the Method for the first active Channel when determining all dilution ratios.

Failure to follow these rules will result in incorrect dilutions and calibrations for all incompatible methods in the Configuration.

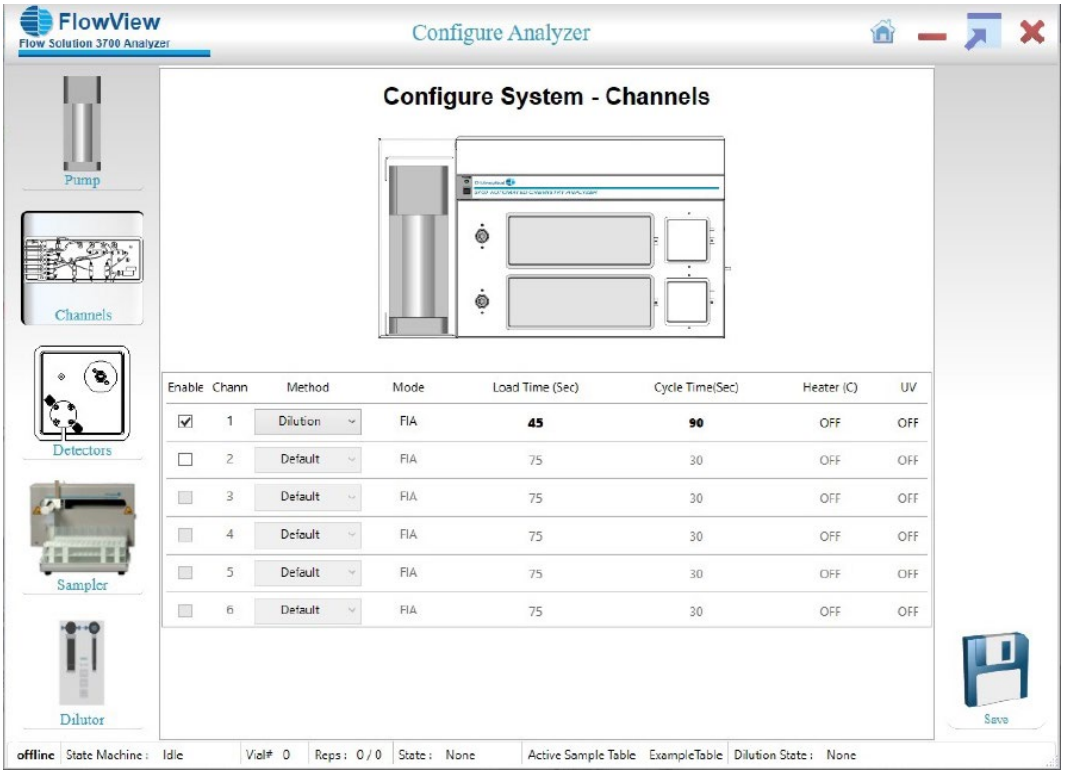


Figure 6.17 Specify the Method for the Channel in the System Configuration

In this example, the Method name "Dilution" is specified for Channel 1, which is the only enabled Channel in the Configuration currently. Thus, all auto-generated calibration dilutions will be calculated based on the "Dilution" method specified.

NOTE: It is important that all Method and Configuration definitions and changes for Standards MUST be made and SAVED prior to editing or running the Sample Table. This is required because the Sample Table will use these Method Standard and STOCK concentrations when calculating the dilution factors for auto-generating the Standards.

Build the Sample Table

The sample table can be built using either the Highest Standard or the Stock.

Using the Highest Standard

Operators will often use the highest standard as the source for auto-generating the remaining calibration standards. See Figure 6.18

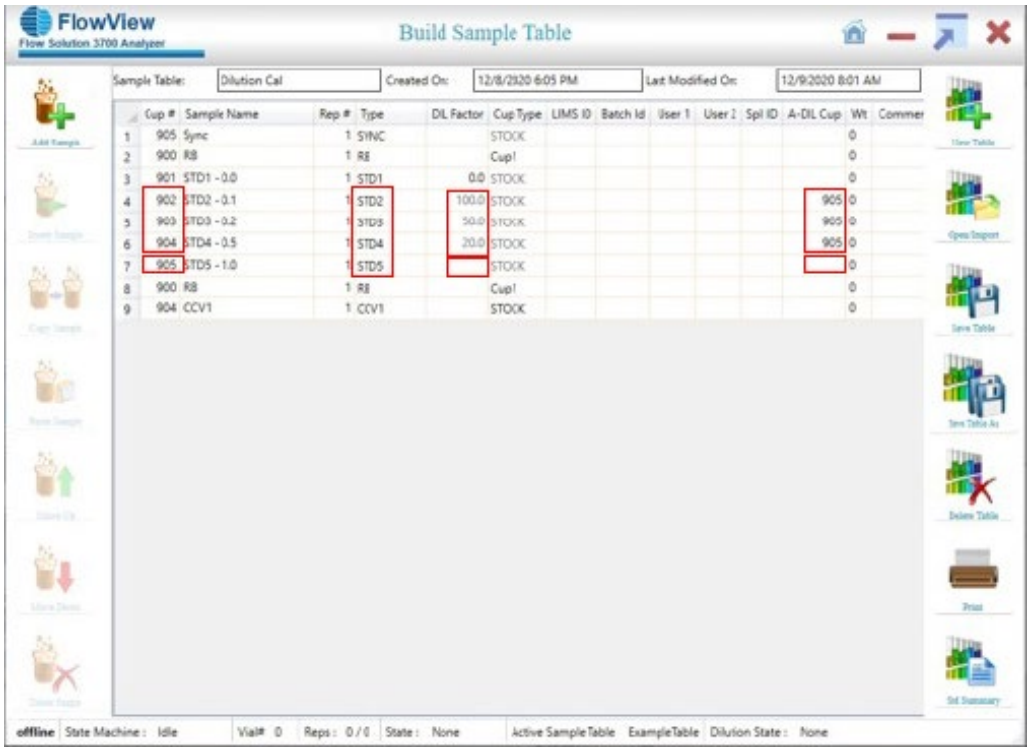


Figure 6.18

Use the following entries when building the sample table for auto-generation.

*STD1 is 0ppm. Typically, STD1 is DI water and must be provided by the operator in cup 901.

STD5 is 1.0ppm. This is the highest standard provided by the operator in cup 905 used as the source for making standards.

To prove STD2 through STD4 are autogeenearted, simple enter the cup number used to make A-DIL cup for each standard.

To indicate that STD2 thru STD4 are to be auto-generated, simply enter the cup number of the Standard to use as the source in the A-DIL Cup column for each STD. In this case, that is cup 905 for

STD5.
As 905 is entered as the A-DIL Cup for each STD, the Dil Factor column will automatically populate with the proper dilution factor needed to perform the dilution for that Standard concentration, based on the STD5 concentration. These values will be grey-out and inaccessible for editing to avoid any manual entry errors.

NOTE: Direct dilutions are limited to 1:1000 dilution ratio.

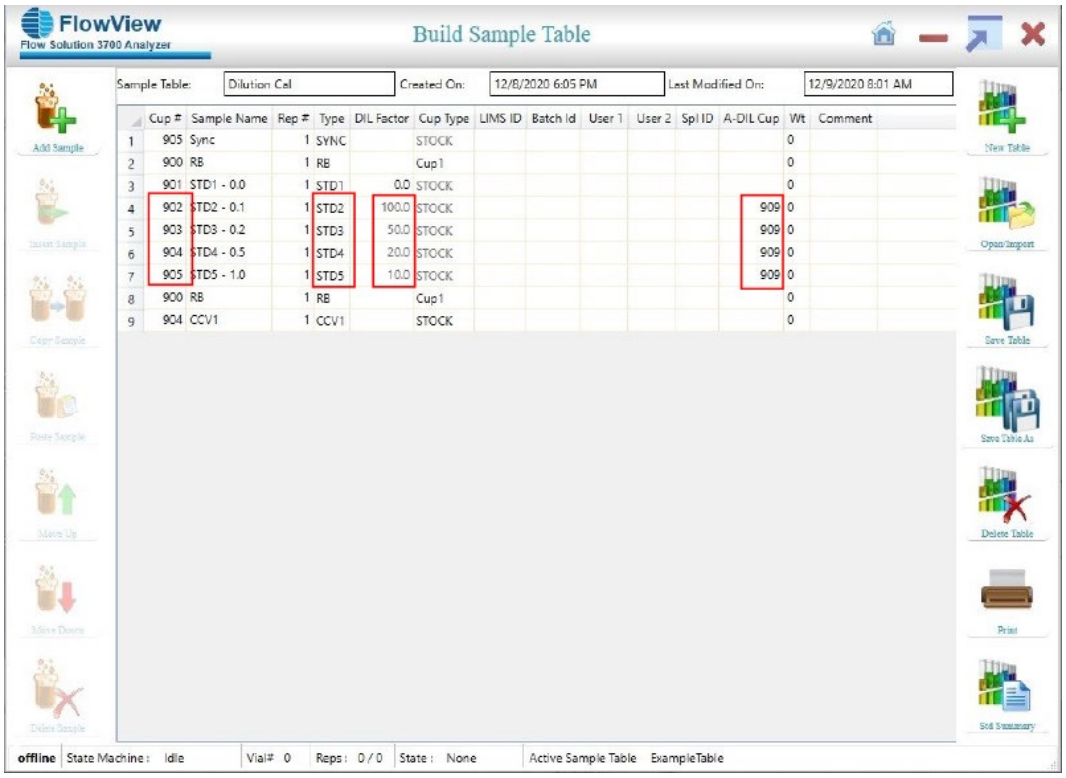


Figure 6.19

Using the Stock

Use the Stock as the source for auto-generating the calibration standards that will not be included in the curve. See Figure 6.20

STD1 is 0 ppm. This is typically DI Water, and must be provided by the operator in cup 901.

To indicate that STD2 thru STD5 are to be auto-generated, simply enter the cup number of the cup to use as the source in the A-DIL Cup column for each STD. In this case, that is cup 909 for the STOCK.

As 909 is entered as the A-DIL Cup for each STD, the Dil Factor column will automatically populate with the proper dilution factor needed to perform the dilution for that Standard concentration, based on the STOCK concentration. These values will be grey-out and inaccessible for editing to avoid any manual entry errors.

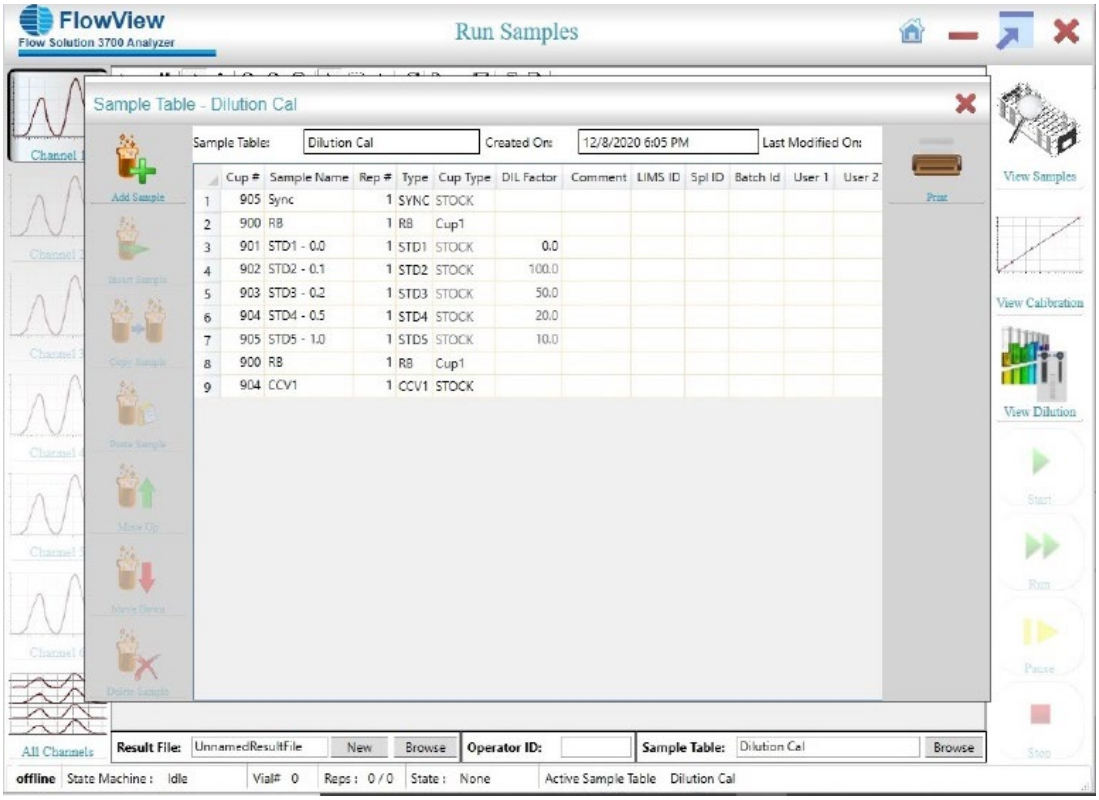


Figure 6.20

Since 909 is not defined in the Sample Table as a STD type, FlowView automatically assumes that this vial is the STOCK vial. This cup will be provided by the operator to be used as the source for making the auto-generated standards.

NOTE: Direct dilutions are limited to 1:1000 dilution ratio.

Load the Sample Table and View Samples

In the Run Samples screen, load the Sample Table as usual and use the View Samples screen to confirm the order of samples is correct.

Review the Dilution Status Table

Click the View Dilution button to access the Dilution Status table. For the STOCK example, confirm that the dilutions listed show STD2, STD3, STD4, and STD5 all being diluted. See Figure 6.21.

NOTE: STD5 would not be show if it was the High Standard used to make the other STDs.

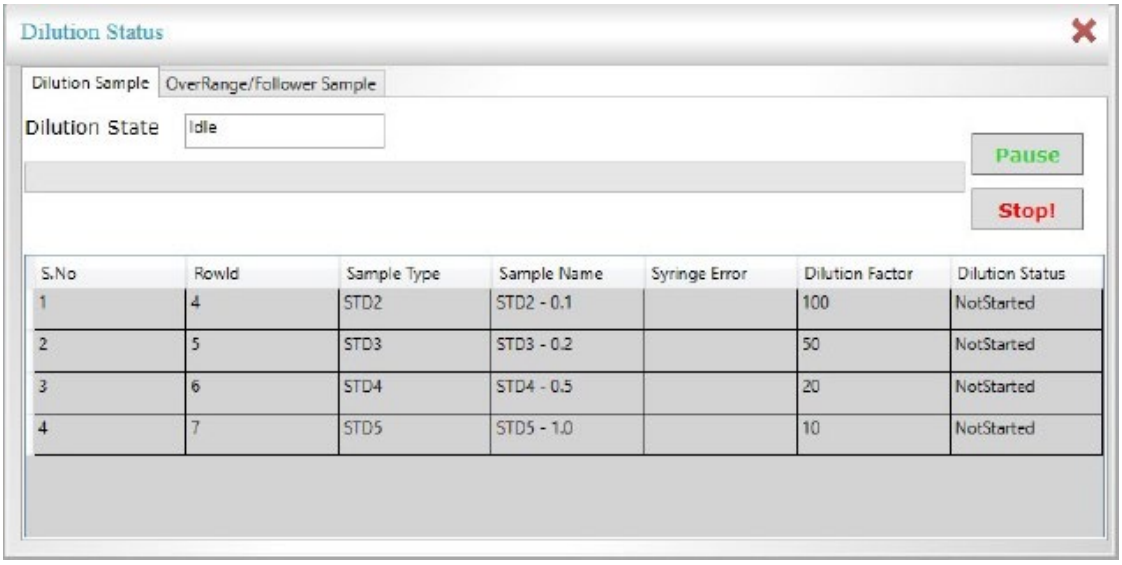


Figure 6.21

Run the Sample Table

When ready, click the Start button to initiate the sample sequence. After some initialization activity, the Dilution Status screen will appear to show the progress of the dilutions.

All auto-generated standard and sample pre-dilutions will be made before the system advances into the run mode to begin analyzing samples. The status of each dilution will be updated in the Dilution Status column, moving from Not Started to In Progress to Completed.

Automatic Pre-Diluiton of Known Over-Range Samples

When supplied with samples that the operator knows are "over-range" for the current Method Calibration, the operator can choose to automatically pre-dilute the samples at a specified dilution factor prior to processing the samples. This saves the operator time by not having to perform the dilution manually. It also saves time during the sequence processing since the sample will only have to be analyzed once, assuming the operator selects an appropriate pre-dilution factor.

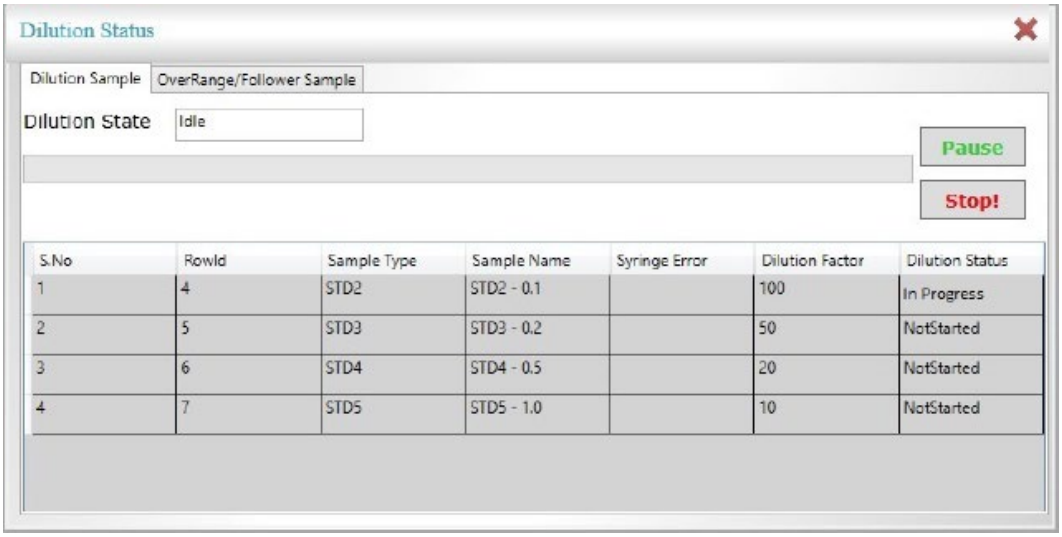


Figure 6.22

Build the Sample Table (Using highest Standard)

To specify a pre-dilution of a sample type, simply specify the following items in the Sample Table:

- The source vial in the A-Dil column
- The destination vial in the Cup # column
- The dilution factor in the M-Dil column

NOTE: The sample Type must be "SPL". Also, the Vial type must indicate the destination Cup type for the diluted sample. The size of the destination cup and the dilution factor will have the greatest effect on the accuracy of the dilution.

The example above shows that 4 pre-diluted samples have been specified. The original samples are placed in the source vials 401-404…and the destination vials are specified as 101-104, respectively. Each sample can be diluted with a unique user-selected dilution factor from the following list: 2, 3, 4, 5, 10, 15, 20, 25, 50, 75, 100, 200, 300, 500, 1000x.

This type of pre-dilution sequence of samples can be specified anywhere SPL processing is considered valid. However, as with regular undiluted samples, it is not recommended to place such a sequence of samples in the middle of a series of calibration standards, as this would not be a good laboratory practice.

Load the Sample Table

Once the Sample Table has been build, the table can be loaded as the active table in the Run Samples screen as usual. The formatting of these pre-dilution sample rows will not change once loaded.

Review the Dilution Status Table

Once the Sample Table has been loaded, the dilutions to be performed can be reviewed and confirmed in the Dilution Status table. If the pre-dilution samples do not appear in the table, then a formatting error may have occured when creating these rows in the Build Sample Table screen.

Run the Sample Table

Once the Sample Table has been fully defined with all regular and dilution samples, then click the Start button the initiate the sample sequence. After come initialization activity, the Dilution Status screen will appear to show the progress of the dilutions.

Reviewing the Sample Results

After all the dilutions have been made, the standards and samples will be processed in order. As each sample is analyzed, the caluculated results will be reported to the Sample Results Table as usual. In the case of pre-diluted samples, the final calculated concentration, including dilution, will be show.

For example:

- A Method is defined with a 0-10ppm calibration range
- A pre-dilution sample has a suspected concentration of 50-100ppm (i.e. over-range for this method)
  - For this example, the unknown actual concentration of this sample is 70.0ppm
- Pre-dilution is specified for this sample at 20x dilution factor (to target the lower-middle of the method calibration range)
  - In this example, a 10x dilution factor could have been used. But note that a higher unknown sample concentration (say 105ppm) might have still exceeded the Method range using the lesser dilution.
- The sample is diluted 20x and analyzed
  - On-screen, the peak shape of the diluted sample on the peak graph will be roughly equivalent to an undiluted sample between 2.5-5.0ppm
  - For this example, we'll say the diluted concentration is calculated as 3.5ppm (based on the peak height or area)
- However, when the sample result is reported, the calculated concentration will be shown as 70.0ppm (3.5ppm x 20x dilution factor.

Post-processing Diluted Samples

Using the View Results screen, it is possible to post-process and modify numerous settings in an original sequence to correct or recalculate a sample that was perhaps improperly processed. These settings include the Sample Name, Sample Type, and such.

NOTE: In the case of pre-dilutions, the dilution factor assigned cannot be changed. This is due to the fact that the original dilution factor specified when the sample was processed is the physical dilution that was performed. In the example above, the dilution factor was 20x. The operator may decide later that that setting was a mistake, or simply less than optimal. However, the fact remains that the sample was diluted by the 20x factor and thus cannot be changed in post-processing.

Automatic Over-Range Dilution Processing

If over-range samples are not manually or automatically pre-diluted, FlowView offers the ability to automatically dilute samples processed during the sequence that exceed the calibration range of the Method. This is known as automatic over-range dilution processing. To allow for automatic over-range dilutions, several settings need to be properly configured in FlowView, including the following:

- Dilutor hardware configuration settings (discussed in section 3.3)
  - Select the best hardware configuration to optimize the range of sample dilutions that may be required.
- Max over-range dilutions per tray (discussed in section 3.3)
  - This setting limits how many over-range samples can be processed for each tray.

Defining and Using Dilution Cups for Each Tray

To allow the operator to more easily manage the "empty" dilution vials for over-range samples, dilutions are performed based on some basic rules described below.

- Vials in any given tray will always (and only) take place within that same tray.
  - If a vial in Tray 1 is over-range, it will be diluted into an empty vial in Tray 1.
  - If a vial in Tray 4 is over-range, it will be diluted into an empty vial in Tray 4.
- The maximum allowable over-range dilution vials in each tray is specified in the Config->Dilution->Configure page.
  - So, if the Max Dilutions per tray = 5 (in a 90-position tray), then vial positions 86-90 will automatically be reserved by the SW for dilution vials.
    - For example, in Tray 1, vials 186-190 will be reserved for automatic dilutions.
  - FlowView will not allow sample vials to be specified in the Sample Table in these 5 positions.
- Dilution vials automatically start with the last tray position and working forward
  - If a 90-position tray is used, the first dilution vial will be #90. The second dilution vial will be #89. This will continue until the Max Over-Range vials have been met, at which time no further automatic over-range dilutions will be performed.
- Empty vials of the correct size MUST be placed by the operator in these dilution positions in the tray for the samples to be diluted.
  - The empty vial must be of the proper size, as specified by the Cup Type of the original sample in the Sample Table
    - For example, if the Cup Type specifies an 8mL cup for the original sample, then an 8mL vial must be placed in the tray for the dilution sample.
    - If multiple Cup Types are defined for unknown samples in the Sample Table, then it is recommended to use the largest vial size for the dilution vials
  - **NOTE:** The system cannot determine if a vial exists in each dilution position, nor if it is the correct size. Failure to place the proper empty vial in each dilution position may result in sample spillage and a failure to perform and analyze the dilution sample properly.

Method Configuration for Over-Range Diluations

Over-range auto-dilution will ONLY occur if the dnable auto-dilution checkbox is checked and saved in the Method prior to the Start of the sequence. Thus, it is possible that the FS3700 system can be configured with an autodilutor, but the operator chooses to run methods without using the Auto-dilution feature.

Once auto-dilution is enabled, the operator must specify some critical settings for the behavior of the auto-dilution feature, include the Over-Range Threshold, the re-run of "Followers", and the automatic insertion of CCVs.

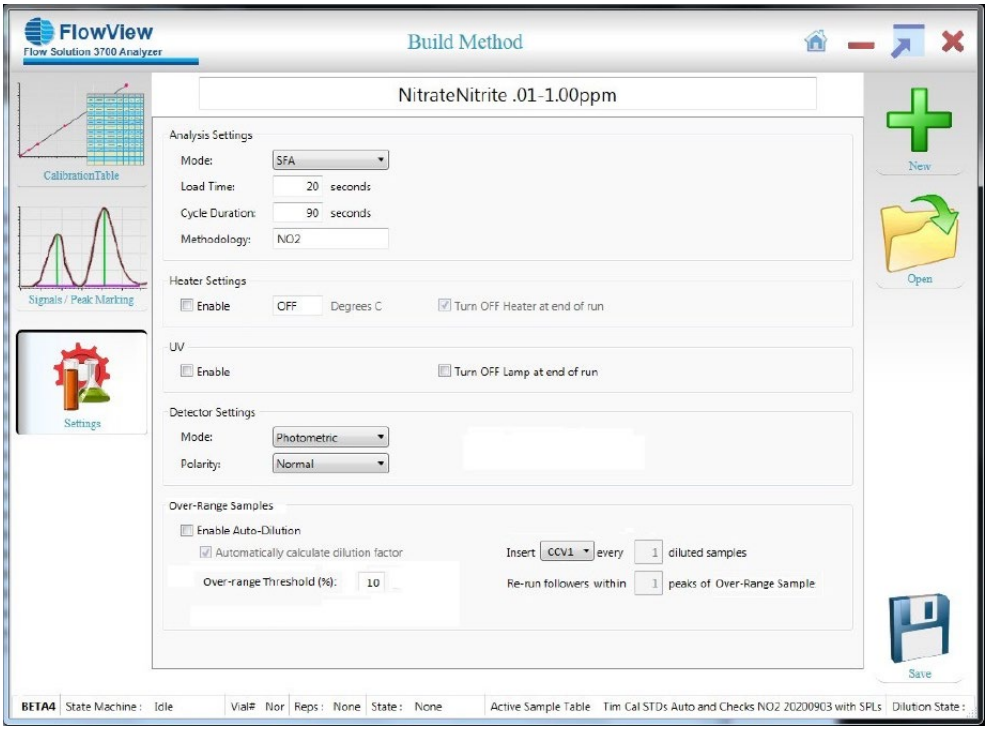


Figure 6.23

The over-range threshold is the decision criteria for auto-diluting a sample during a sequence. When a "qualifying" sample type completes all replicates, the avg concentration value is compared against the highest active calibration standard in the Method. If the average concentration for the sample is greater than the highest concentration Standard in the calibration (including the Over-range threshold), then the sample will be marked for dilution.

Example:

STD7	= 10ppm (highest active STD)
Over-Range Threshold	= 10%
Sample Avg Conc	= 11.250 ppm
Thus, 11.250 ppm	> 11.000 ppm, so the sample is marked for auto-dilution

NOTE: "Qualifying" sample types for dilution include:

- SPL, MS(x), and MSD(x)
- These are the only sample types that FlowView considers for auto-dilution and re-run
- All other sample types will not trigger an auto-dilution, regardless of their calculated Avg Conc

Followers – samples that were immediately processed after an Over-Range sample was detected. In such a case, the calculation of the "follower" sampler may have been adversely affected by carry-over from the preceding Over-Range sample, depending on the relative concentration of the Over-Range sample versus the concentration of the Follower.

The option for **"Re-run Followers within N peaks of Over-range sample"** allows the operator to specify how many Followers after the last Over-Range sample to automatically re-run.
NOTE: If the sample after an Over-Range sample is also found to be exceed the calibration curve, then it is marked as an **Over-Range** sample. Otherwise, it is marked as a **Follower** sample. If successive samples are identified as Over-Range, then FlowView will continue to look for the Follower that occurs after the last Over-Range sample.

- Example 1 (Two Over-range samples…# of Followers = 1)
  - The sample at Row 27 is determined to be over-range at 12.0ppm (vs a high STD of 10.0ppm and a threshold of 10%)
  - Thus, the sample at Row 28 would potentially qualify as a "follower"
  - However, the sample at Row 28 is then calculated at 11.5ppm (vs a high STD of 10.0ppm and a threshold of 10%) …and thus is considered as an Over-range sample requiring dilution…and not as a Follower
  - Thus, the sample at Row 29 would potentially qualify as a "follower"
  - If the sample at Row 29 is <= 11.0ppm, then FlowView will mark this as a Follower and will continue with normal sample processing.

- Example 2 (One Over-Range sample…# of Followers = 2)
  - The sample at Row 27 is determined to be over-range at 12.0ppm (vs a high STD of 10.0ppm and a threshold of 10%)
  - The sample at Row 28 would potentially qualify as a "follower"
  - Then, the sample at Row 28 is calculated at 11.0ppm (just on-range of the calibration + threshold)…and will be marked as Follower #1.
  - Then, the sample at Row 29 is calculated at 10.5ppm…and will be marked as Follower #2.
  - Since the max number of Followers = 2, then FlowView will stop looking for Followers and process subsequence samples normally…as if no preceding over-range sample had occurred.

NOTE: Since followers are defined as samples that are already on-scale of the calibration, they will be re-run at the same original concentration from the same original vial, without dilution.

The **CCV** (Continuing Calibration Verification) sample type is often inserted by the operator at regular intervals in a typical sequence to ensure that samples are being processed against a calibration that is still accurate for the active channels. However, when Auto-diluted samples and Followers are to be added to the end of the sequence automatically (without operator intervention), then the CCV intervals for those samples might be lost.

Thus, FlowView offers the ability for the operator to select the specific CCV sample (i.e. CCV1, CCV2, or CCV3) to be inserted into the extended auto-dilution sequence, using a specified interval between diluted samples.

NOTE: The CCV type selected MUST be active in the Calibration table for this Method, otherwise FlowView will not allow the sequence the run when Start is pressed.

Over-Range Diluations for Multi-Channel/Multi-Method Configurations

The Max Over-range Dilutions setting is specified in the Config screen so that it is Method-independent. However, samples are analyzed and determined to be over-range based on the response of the sample in each channel. Thus, if two separate methods are assigned (e.g. "Nitrate" and "Nitrite") to each channel, then the analysis of each vial is compared against the calibration curve for each method/channel.

- If **either** channel reports an over-range sample, that vial will be re-run on both channels after it is auto-diluted, since both channels have to actively process any sample.
- If **both** channels report an over-range sample, then the dilution factor for the auto-dilution will be the greater of the two calculated dilution factors.
    - That is, if vial 113 requires a 50x dilution on Channel 1…and a 100x dilution on Channel 2, then the 100x dilution factor will be used for the auto-dilution.

NOTE: When processing channels with different Methods, the CCV and Follower settings must be the same for both Methods. This is required to avoid conflicts for how many Follower samples to process and how many CCV's of which type are to be inserted.

Real-Time Processing of Over-Range and Followers

When the Start button is pressed to initiate a sequence with the Autodilutor enable, FlowView performs a series of checks to confirm that the Configuration, Method, and Sequence are all properly defined to execute the dilutions as required. Once the cross-checks are performed, FlowView will start the sequence as normal.

If automatic calibration dilutions or automatic sample pre-dilutions are specified in the sequence, FlowView will perform ALL of those "known" dilutions first, prior to starting processing of the first sample in the sequence.

During sequence processing, FlowView will analyze samples as usual. If the average concentration of all reps of a sample is found to be "over-range" by more than the Over-Range Threshold % defined in the Method, then FlowView will automatically mark that sample as Over-Range and place it in the Dilution List to be auto-diluted after the original sequence has run to completion.

If Re-run Followers is enabled, then FlowView will consider the next sample after the Over-Range sample as a potential Follower. If the next sample is not Over-Range itself, then it will be considered a Follower and added to the end of the original sequence for reprocessing (without any dilution). If the next sample does go Over-Range itself, then it is marked as Over-Range, and the search for Followers continues with the next sample, etc.

Once the original sequence runs to completion, the processing of Followers and Over-Range samples will begin immediately.

NOTE: FlowView will dilute all Over-Range samples first **BEFORE** resuming with processing samples in the new extended sequence.

NOTE: The operator **CANNOT** add more samples to the extended Active Sequence once the Dilution and reprocessing steps are underway. The sequence will be locked to allow FlowView to create and maintain proper CCV(x) spacing around the Followers and Over-range samples during the extended sequence.

Automatic Calculation of Dilution Factors

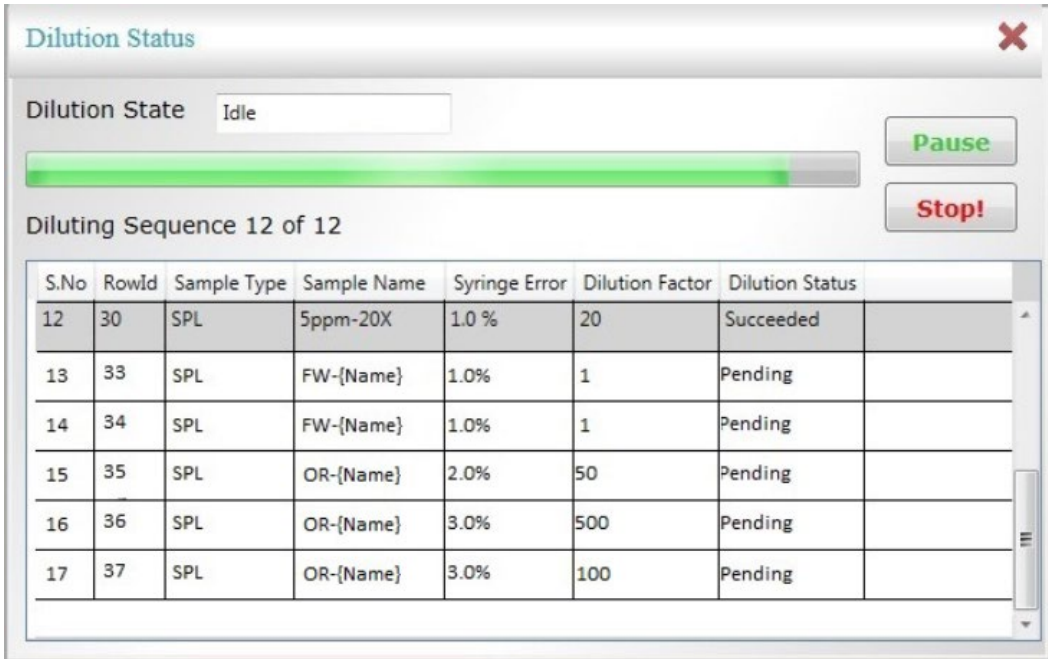
The Dilution Factor for each sample added to the Dilution List is automatically calculated by FlowView based on how much the sample exceeded the maximum of the calibration range for that Method. This calculation will analyze the Average Conc (for all reps) of the Over-range sample, and determine a proper dilution factor to place the final diluted concentration near the middle of the calibration curve.

For example,

- If the calibration range in the Method is 0-10ppm, then the "middle" of the curve is 5ppm.
- The calculation of the Dilution Factor will round-up the value of (Avg_Conc / Cal_Curve_Middle_Conc)
    - The dilution factor will be rounded up to the nearest nominal dilution factor from the following list: 2, 3, 4, 5, 10, 15, 20, 25, 50, 75, 100, 200, 300, 500, 1000x
- So, if the Average Conc of a sample is found to be 19.2ppm, then the dilution factor would be calculated as 19.2/5 = 3.8x dilution. This will be rounded up to 4x dilution.

Tracking of Over-Range and Follower Sampless

Since it is important not to interfere with the operator's ability to add/modify samples in the current sequence, FlowView does not modify the on-screen active sequence until the sequence runs to its normal completion. FlowView reuses the same Dilution Status screen to build and display the list of samples to be post-processed as Dilutions/Followers. That way, the operator can review the list at any time.



S.No	RowId	Sample Type	Sample Name	Syringe Error	Dilution Factor	Dilution Status
12	30	SPL	5ppm-20X	1.0 %	20	Succeeded
13	33	SPL	FW-{Name}	1.0%	1	Pending
14	34	SPL	FW-{Name}	1.0%	1	Pending
15	35	SPL	OR-{Name}	2.0%	50	Pending
16	36	SPL	OR-{Name}	3.0%	500	Pending
17	37	SPL	OR-{Name}	3.0%	100	Pending

Figure 6.24. FlowView – Dilution Status Screen – used to track Over-Range and Follower Samples

Some notes on Follower Samples:

- Followers are shown first in the list, in the order they were encountered in the original sequence, even if the follower was found after some earlier over-range samples
- Followers get the prefix "FW-", with the original Sample Name appended, so that the original sample name can be readily identified.
- Followers are listed first because they will be processed first in the extended sequence.

Some notes on Over-Range Samples:

- Over-range samples are shown at the end of the list, after all followers, in the order they were encountered in the original sequence.
- Over-Range samples get the prefix "OR-", with the original Sample Name then appended, so that the original sample name can be readily identified.
- Over-Range samples are listed last to allow the Followers to be processed first, since those samples do not require dilution.

- The Dilution Factor and potential syringe error will be shown for each Over-Range sample. This is to help the operator realize how much dilution is required for each sample, and to determine if the sequence and method setup is suitable for samples requiring this much dilution.
  NOTE: If the potential error is high, the calibration range, sample size, and cup sizes can all be considered to correct this issue.

When FlowView performs the dilutions of the over-range samples, the diluted sample is placed into the target vials, as determined by the Dilution Factor and the auto-assigned vial number.

- The dilution status window will be updated as each sample is diluted
- The active sequence table will be updated to show each over-range sample, along with its dilution factor and A-Dil cup, etc

FlowView software will process these Followers and Over-Ranges dilutions and update the Active Sequence at the same time. Thus, the final Active Sequence (as view in the View Results screen) will show the final order of all samples processed in the sequence.

Re-Analyzing Follower Samples

Since all Followers were already determined to be within the calibration range (plus threshold), FlowView will process these samples normally, as it would have done in the original sequence.

- Samples will be drawn from the SAME original sample cup as when it was first analyzed.
- No dilution factors will be used in the calculation of the final Follower concentration values.

NOTE: Followers will be appended to the sequence using the CCV(x) spacing logic as specified in the Method.

Since all Followers were already determined to be within the calibration range (plus threshold), FlowView will process these samples normally, as it would have done in the original sequence.

- Samples will be drawn from the SAME original sample cup as when it was first analyzed.
- No dilution factors will be used in the calculation of the final Follower concentration values.

NOTE: Followers will be appended to the sequence using the CCV(x) spacing logic as specified in the Method.

Re-Analyzing Over-Range Samples

Since FlowView has already performed the dilutions of the over-range samples and placed them in the extended Active Sequence, the diluted samples can then be analyzed as follows:

- Samples will be drawn from the auto-assigned vials
- The raw calculated concentration value (as if the sample had not been diluted) will be shown in the Notes column
- The dilution-adjusted concentration value will be shown in the concentration column. This value indicates what FlowView projects the original over-range concentration value of the sample should have been.

- **NOTE:** This is especially important when Method calibrations use polynomial or 3rd Order curve fits. The potential error when the sample was originally run increases significantly the more the reported value exceeds the calibration curve limit. That is, a sample that exceeds the range by 10x has much lower accuracy confidence than one that only exceeds the range by 2x.

NOTE: Over-Range will be appended to the sequence using the CCV(x) spacing logic as specified in the Method.

Auto-Insertion and Processing CCV Samples in Extended Sequences

If any samples are marked as Follower or Over-Range, then FlowView will automatically check when the last CCV(x) was analyzed at the end of the original sequence. FlowView will automatically insert CCV(x) rows in the extended Active Sequence using the following rules:

- FlowView will if it must first insert a CCV(x) sample prior to starting the Followers based on the "every N samples" setting
  - For example, if the original sequence ends with a CCV(x) row, then N Followers/Over-Range samples can be added to the extended sequence before another CCV(x) row must be added to the extended sequence.
  - However, if the original sequence ends with a CCV(x) row followed by an RB row, then only N-1 Followers/Over-Range samples can be added to the extended sequence before another CCV(x) row must be added to the extended sequence.
- Similarly, a CCV(x) sample will be inserted after every N samples, based on the Method setting
- The vial position used to draw the CCV(x) sample from will be determined by the vial assigned to the first instance of this CCV(x) used in the sequence.
  - Thus, if CCV1 is specified, and CCV1 first occurs in the sequence at row 13 with a vial position of 904, then the 904 position will be used for ALL CCV1 instances added to the extended auto-dilution portion of the sequence.
  - This means that the CCV(x) selected MUST occur in the sequence table. FlowView will cross-checked for this detail when Start is pressed.
- Finally, FlowView will ensure that the last vial in the extended sequence is another CCV(x) sample, to "bracket" the extended sample sequence

Example of an Extended Sequence Processing:

This simulated screenshot below shows how the Followers and Over-range dilutions are added to the active sequence.

- Two Follower samples are shown first (rows 33 and 34) and will be analyzed first.
- Since a CCV(x) existed on 2 samples from the end (row 31), no leading CCV(x) was added to the extended sequence.
- Over-range samples are then shown after the Followers (rows 35, 36, and 37).
- The CCV(x) is inserted at the required intervals (not needed in this example) and at the end of the extended sequence (row 38) to "bracket" the additional samples.

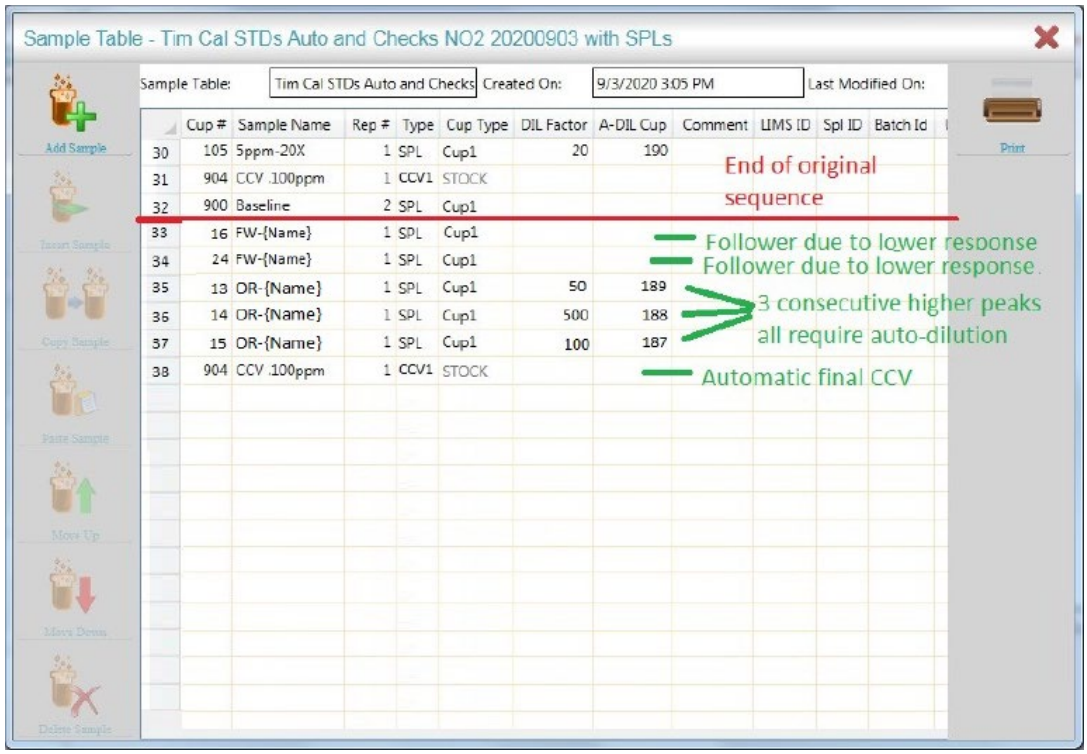


Figure 6.25 FlowView – Active Sequence Screen – shows Over-Range and Follower Samples (with comments)

ML600 Maintenance

In general, the ML600 should provide simple, trouble-free operation with minimal maintenance. Since the autodilutor system is only active during dilution operation, its maintenance intervals will directly depend on the frequency at which dilutions are performed.

The two syringes and 4-port valve are the only moving components in the system and thus are typically the only wear items to be maintained.

- Given that the isolation loop prevents any sample from ever entering either of the syringes, the wear and tear on the syringes is only due to actuations with DI Water as the fluid, which should be very minimal.
- The 4-port valve only rotates twice during each set of dilutions…once at the beginning of the dilution cycle to move to Dilution position…and once at the end of the cycle to return to Normal position.

Other items, such as the sample tubing, may only need to be replaced if a sample is thought to have contaminated it.

The dilution reservoir and associated tubing should be cleaned or replaced as needed to ensure no bacterial growth occurs.

Installing/Replacing Syringes

Example of an Extended Sequence Processing

The syringe plunger tip will need to be conditioned prior to inserting the plunger into the syringe barrel. To condition the plunger tip,

- wet the tip with DI water and insert into the glass syringe barrel
- manually stroke the syringe 10 times while applying steady and even pressure
- be sure to avoid twisting movements
- leave the syringe plunger in the syringe barrel when finished

Prepare Syringe(s) for Installation

NOTE: For this dilution application, be sure to install the larger (diluent) syringe in the left syringe position, and the smaller (sample) syringe in the right syringe position.

After conditioning the syringe(s) as described above, perform the following steps:

- Power ON the Microlab 600
  Press the Power On/Off button

- Move the syringes down halfway for easy installation/removal.
  Press and hold the Prime button for 3 seconds. The syringe drives will initialize and then both drives will move downward.

- Continue to hold the Prime button until the syringe drive has moved down about halfway
  Release the Prime button and the syringes will stop moving.

- If replacing an existing syringe, Loosen the setscrew in the valve (which secures the syringe to the valve) by turning it counterclockwise using the Allen wrench provided.

  Loosen the thumbscrew at the base of the plunger, by turning counterclockwise until it is free

  Loosen and remove the syringe by turning counterclockwise until it is free from the valve

- Install the new syringe.

  Insert the syringe into the valve and turn the glass barrel clockwise until it is finger-tight.

  Pull the plunger down to the drive stem and align it with the thumbscrew.

  While holding the plunger, fasten the thumbscrew into the plunger by turning clockwise until it is finger-tight.

  NOTE: Syringes that are over-tightened may cause leaks or damage the valve. Syringes that are under-tightened may cause leaks.

  Gently tighten the setscrew clockwise into the valve until it just touches the syringe, using the Allen wrench provided, to secure the syringe in place.

  NOTE: DO NOT OVERTIGHTEN, as the setscrew may crack the glass syringe barrel.

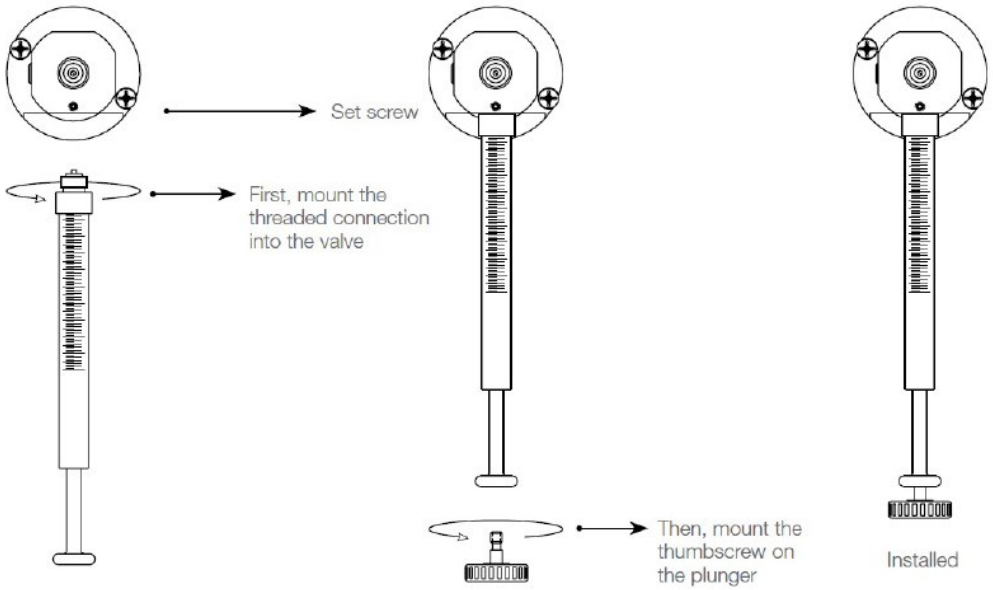


Figure 6.26 FlowView – Installing a new syringe into the dilutor syringe module

WARNING: In the event that cracked or broken syringe needs to be removed, always wear protective gloves and eyewear.

Initialize and Prime the Syringe(s)

Once the syringe(s) are installed, use the Initialize button to re-initialize the syringe module. This will home the syringes and clear any internal errors that may have occurred when manually moving the syringes with the Prime button.

Then, press the Prime button to prime both syringes with DI water. NOTE: If any errors occur on the syringe module, use the Initialize button again to clear those errors.

Configure the Syringe(s) in FlowView

Once the installation is complete, refer to Section 3.3 of the manual to Configure the syringe sizes and various dilution-related settings.

General Autodilutor Maintenance

This section discusses routine and nonscheduled maintenance for the Autodilutor system.

Perform Maintenance Screen

The Perform Maintenance screen offers a few features to test and reset the Autodilutor system.

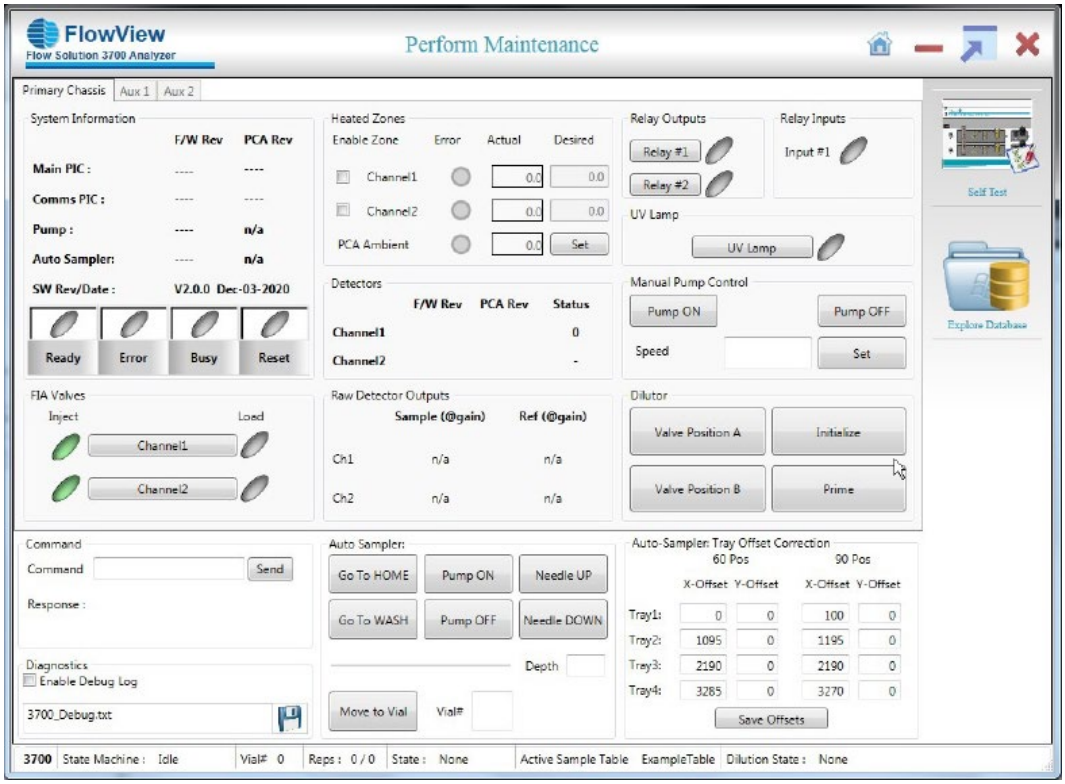


Figure 6.27 Perform Maintenance Screen

Dilutor Module Commands

Initialize – The Initialize command instructs the Dilutor Module to perform a system reset, initialize its internal settings, clear any current errors, and dispense both syringes to the Home (up) position. This feature can be particularly useful is the Dilutor Module has stalled or received some other error during sample processing. NOTE: Before using the Initialize feature, be certain that the probe is at the Wash/Waste position, since the move to Home the syringes will push the liquid through the needle probe.

Prime – The Prime command instructs the Dilutor Module to fully prime both the Diluent and Sample syringes. This process will aspirate diluent water from the Dilutor diluent reservoir and dispense it to the autosampler probe.

NOTE: Before using the Prime feature, be certain that the probe is at the Wash/Waste position, since the move to Prime the syringes will push the liquid through the needle probe.

Valve Module Commands

Valve Position A – The command will instruct the Valve Module to rotate the valve to the A position. This is the Normal (non-dilution) position.

Valve Position B – The command will instruct the Valve Module to rotate the valve to the B position. This is the Dilution position.

Other Routine Maintenance

Cleaning the Tubing and Fittings

Periodically inspect the sample being aspirated and dispensed from the Autodilutor module. If the sample….

Routinely flush the tubing and connectors of the Dilutor Module and Valve module with rinse or reagent water at the end of the work day to remove any residue and prevent buildup. This can be due by using the Dilutor Prime feature of the Perform Maintenance screen. With the autosampler probe in the Wash/Rinse station, perform the Dilutor Prime step. Repeat as needed.

ML600 Basic Troubleshooting

Table 6.3 lists the symptoms, probable causes, and corrective actions for troubleshooting basic issues with the Autodilutor system.

Symptom	Probable Cause	Corrective Action
AutoDilutor is not responding to initializing at Power-On	Power supply not connected or power outlet is not working	Confirm power supply is connected and plugged into a working power outlet.

Table 6.3 Basic Autodilutor Symptoms, Probable Causes, and Corrective Actions

Advanced Troubleshooting

Table 6.4 lists the symptoms, probable causes, and corrective actions for troubleshooting advanced issues with the Autodilutor system.

Symptom	Probable Cause	Corrective Action
Auto-Diluted calibration curve is at the wrong concentration range.	STOCK concentration value in Method is incorrect	Modify Method to adjust the STOCK concentration .
Cavitation		
Stall error		

Table 6.4 Advanced Autodilutor Symptoms, Probable Causes, and Corrective Actions

ML600 Replacement Parts

Modules and Accessories

Product	Unit	P/N
Dilutor Module	Each	332823
Valve Module	Each	332824
Start-up Kit	Each	332831

Table 6.5 Modules and Accessories

Syringes

Product	Size	Unit	P/N
Autodilutor Syringe (Sample)	1,000 mL	Each	332827
	0.500mL	Each	332821
	0.250 mL	Each	332820
Autodilutor Syringe (Sample)	5.000 mL	Each	332822
	10,000 mL	Each	332829

Table 6.6 Replacement syringes available.

ML600 Tips to Optimize Dilutor Performance

While the fundamentals of auto-dilution are fairly simple, there are several key factors that can affect the accuracy and repeatability which much be considered when performing auto-dilutions. These include:

- **Dilution factor**
  - This is one of the most important considerations in making a dilution factor. In general, a 2:1 dilution is much easier to make than a 1000:1 dilution.
  - The dilution factor must be user-specified (or automatically determined) for each individual dilution that is required.
  - Whenever possible, specify the lowest dilution factor that will get a sample in the middle of the calibration range.

- **Target dilution volume**
  - The target dilution volume is the total volume of diluted sample that will be made. For best accuracy, this volume should always be a large as possible. Making a 1000:1 dilution into 1mL of total volume will be much less accurate than making into 10mL of total volume.
  - In an auto-dilution system, this target volume must be fully contained in the Target Dilution Cup.
  - Thus, in FlowView, the Target dilution volume is specified for each Cup Size in the Configure Dilutor screen. The default value is near the maximum volume of each cup size, but allows for some volume at the top to ensure that no sample is spilled over the side of the cup.

- **Target cup size**
  - When specifying the auto-dilution, the target dilution volume will be mixed into a target cup.
  - In FlowView, the Cup type is specified for each vial in the Sample Table.
  - The correct cup must physically be placed in the appropriate position in the tray.
  - By default, the larger the Target Cup size, the larger the Target Dilution Volume.

- **Sample volume**
  - Sample volume is determined automatically by FlowView, based on the Dilution Factor and the Target dilution volume (based on the Cup size).
  - Thus, it is possible for the operator to manipulate the sample volume used by increasing/decreasing the Dilution Factor and the Target Cup size.
  - The larger the Target cup size and the lower the dilution factor the larger the Sample Volume will be. For example, a 10x dilution will use 10 times more sample volume than a 100x dilution…assuming the same Target dilution cup volume.
  - The larger the Sample volume, the more accurate the dilution. This is especially true when the sample volume required is a small percentage of the Sample Syringe stroke.

- **Sample Syringe volume**
  - The volume of the sample syringe installed on the dilutor can also have a significant impact on the dilutions that are performed.
  - The default Sample Syringe installed in the FS3700 AutoDilutor is 250uL. This selection was made to allow for the most accurate sample volume aspirate/dispense performance, while also trying to minimize the number of sample transfer moves required for common dilutions.

- Using a smaller syringe would provide even greater accuracy, but will increase the number of sample transfer moves.
- Using a larger syringe would reduce the number of sample transfer moves, but could adversely affect accuracy.

- **Percentage of Sample Syringe stroke**
  - An important consideration of the sample aspirate/dispense accuracy is the sample volume as a percentage of the sample syringe stroke.
  - In general, the greater the sample volume as a percent of the syringe size, the more accurate the sample aspirate/dispense will be.
  - For example, if 200uL of sample is to be transferred using a 250uL syringe, that equals 80% of the syringe stroke. This will result in a very accurate aspirate/dispense.
  - However, if 10uL of sample is to be transferred using a 250uL syringe, that equals 4% of the syringe stroke. This small percentage of stroke could have an adverse effect on accuracy.

- **Number of sample transfers**
  - The number of transfers of the sample will be automatically determined and performed by FlowView based on the Sample Volume and the Sample Syringe Size.
  - For example, if 1mL of sample is required and a 250uL syringe is installed, then FlowView will automatically aspirate, move, and dispense the sample 4 times to move the total required volume.
  - Although the number of sample transfers does not directly affect dilution accuracy, it does contribute to the total time required to perform each dilution.
- **Sample Cup volume**
  - The starting sample cup volume is a simple variable of this auto-dilution process.
  - The cup volume must simply be large enough to hold all of the sample required to perform any and all dilutions that will be made from that cup. If the cup will only be used once, the calculation is easy. If the cup will be used multiple times, then the volume of each usage will need to be considered when specifying the starting cup size.
  - NOTE: It is the operator's responsibility to ensure that enough sample has been put into the sample cup.

- **Diluent volume**
  - Diluent volume is determined automatically by FlowView, based on the Dilution Factor and the Target dilution volume (based on the Cup size).
  - In general, diluent volume is much larger than sample volume, and thus typically has less effect on the final dilution accuracy.

- **Dilution Syringe volume**
  - By default, the FS3700 AutoDilutor includes a 5mL dilution syringe. This syringe provides sufficient accuracy for most dilutions, while requiring a minimum of syringe refills.

- **Percentage of diluent syringe stroke**
  - Similar to the sample syringe stroke percentage, the dilution syringe stroke percentage needs to be considered when making dilutions.
  - However, since diluent volume is typically much larger than sample volume, it is less likely to operate in the lower percentages of the diluent syringe stroke.

- **Number of diluent transfers**
  - The number of diluent transfers is determined automatically by FlowView. These transfers are minimized by using the 5mL syringe.
  - Also, since the autosampler doesn't have to move to add more diluent to the target cup, multiple transfers do not add significant time to making the dilution.
- **Dilutor Syringe Speeds**
  - By default, FlowView configures the Dilutor syringe speeds for aspirate and dispense to achieve an optimum balance between speed and performance, based on samples with a viscosity similar to plain water.
  - These defaults should always be sufficient for the Diluent syringe, assuming that the standard large-diameter supply tubing is used from the diluent bottle to the diluent syringe.
  - However, if the samples being processed for auto-dilution have a notably higher viscosity than water, then the aspirate/dispense speeds for the Sample syringe may need to be slowed down to avoid cavitation.

- **Carry-over and Needle Washing**
  - When processing auto-dilutions, concentrated sample carry-over is always a primary concern, as it can not only affect the dilution accuracy of a given sample, but can also cause cross-contamination with other samples.
  - The FlowView software automatically performs specific needle-washing steps to significantly reduce the potential for carry-over within and between sample dilutions.

- **Distance between the Sample and Dilution cups**
  - Although it does not affect dilution accuracy, minimizing the distance between the source sample cup and the target dilution cup will save time in moving the autosampler arm and reduce wear-and-tear on the autosampler.

Thus, it is important to consider all of these potential factors when designing an auto-dilution sequence.

In summary, the best dilutor performance can be achieved by doing the following:
- Minimize the dilution factor (as much as possible)
- Maximize the target cup size
- Minimize the sample syringe size
- Minimize the distance between the sample and dilution cups
- Optimize the aspirate/dispense speeds for the sample syringe based on sample viscosity

Chapter 7 Maintenance

Regular maintenance is important to proper and consistent functionality of any flow chemistry system. The FS3700 requires a minimal amount of ongoing maintenance.

Routine Maintenance

FlowView Maintenance Screen

Click **Perform Maintenance** on the FlowView home screen to access the Maintenance screen (Figure 7.1). This screen allows the operator to confirm communications with electronics boards in the FS3700 chassis to send commands to the sampler and other components, and to manually control certain components, such a valves, heaters, and UV lamps. This screen also provides a Self-Test feature.

If installed, FIA valves may be switched from Inject to Load and back by clicking **Channel #1 or Channel #2**. Likewise, click **UV Lamp** to toggle the optional UV lamp on or off. Buttons are also provided to send the sampler to its home position, perform a needle rinse, or move the needle up or down to a desired position.

Heaters can be controlled by clicking the check box next to each to turn it on, then type in the desired setpoint (up to 50 °C), then click **Set** to trigger the heater to begin heating.

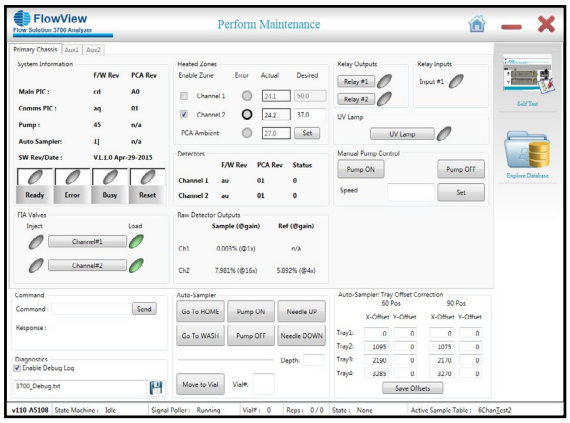


Figure 7.1. FlowView Maintenance Screen

Self-Test

Click **Self-Test** to display the Self Test status window (Figure 7.2). Initiate a self test of the FS3700 system by clicking **Start.** This test runs continuously until **Stop** is clicked. The heaters are turned on and set to a pre-determined setpoint, the valves are switched, and the communication to the pump and sampler are checked. In addition, the detector signals are monitored and displayed on the Run Samples screen during the self test.

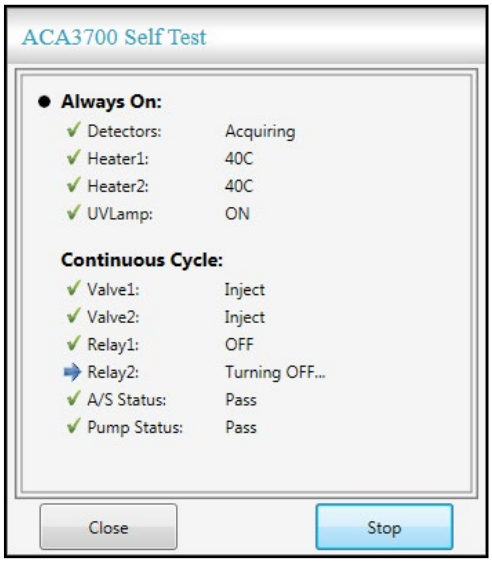


Figure 7.2. FlowView - Self Test Window

Explore Database

The **Explore Database** button provides a handy shortcut to the instrument directory where results, methods, and sequences are stored. For more information regarding FlowView directory structure, see the FAQ section in Chapter 7.

Idle Time Maintenance

- For normal day-to-day operation, do not pump the cartridge or system dry. This introduces dirt or other residue into the system and causes a substantial increase in system startup time.
- Leave startup solution in the system unless the system will be out of operation for several days.
- If the system will be idle for 1–3 weeks, flush with and leave deionized (DI) water in the lines.
- If the system will be idle for more than 3 weeks, pump the system dry after flushing with deionized (DI) water.

Daily Maintenance

Daily System Maintenance

- Calibrate the instrument with the full calibration set.
- Replace any tubing that appears dirty or damaged.
- Replace flattened, darkened, or damaged pump tubes. Replacing all chemistry reagent pump tubes in a cartridge at the same time is recommended to produce accurate, consistent results.

NOTE: Replace the manifold pump tubing as a set to ensure that proper reagent ratios are maintained. OI Analytical sells convenient Tubing Kits for this purpose, complete with an organizer to indicate which manifold port number is assigned to each tube; refer to Chapter 9 for a listing of supplies and replacement parts.

WARNING: Observe safe handling practices when working with samples and hazardous reagents.

- Properly dispose of plastic sample cups and glass laboratory tubes.
- Empty waste containers and properly dispose of all waste.
- Flush all reagent and sample residue by pumping startup solution and the appropriate cleaning solutions (refer to the specific Analytical Method) through the system for 15–20 minutes at the end of each work day.

NOTE: Waste disposal regulations vary from area to area. Contact the proper regional authority for the correct waste collection and handling procedures.

NOTE: Actuate the FIA valves a few times during flushing.

Daily Autosampler Maintenance

Clean the autosampler daily by wiping it down with a damp cloth and clean up spills as they occur.

Daily Flowcell and Debubbler Maintenance

- Routinely flush the flowcell and debubbler with startup solution at the end of the work day to remove any residue buildup. Refer to the Analytical Method for specific instructions.
- If pumping water through the flowcell and debubbler does not dislodge all of the debris or residue, flush the flowcell or debubbler using a syringe filled with the method-recommended cleaning agent. When flushing with a syringe, always flush out to waste and not back toward the system.

Daily Precision Pump Maintenance

Release tension on the precision pump tube platens when not running assays and at the end of each work day. Failure to release platen latch pressure, prematurely shortens pump tube life.

Daily Chemistry Cartridge Maintenance

- For FIA methods, flush the cartridge after daily operation by pumping startup solution and reagent water for 10–15 minutes at shutdown.
- For SFA methods, flush the cartridge after daily operation by pumping startup solution for 10–15 minutes at shutdown.

Weekly Maintenance

Weekly Precision Pump Maintenance

Clean the pump rollers and platen surfaces with a tissue.

Monthly Maintenance

Monthly System Maintenance

- Replace instrument reagents. Discard opened and unused reagents after 30 days unless the method states otherwise.
- Clean the front surface of the FS3700 with a damp tissue or cloth.
- Replace all pump tubes.
- Flush the system manifold with the appropriate cleaning agent for 10–15 minutes. Refer to the Analytical Method for the appropriate cleaning agents.

NOTE: Do not pump anything except base reagent through an amperometric cell.

Monthly Precision Pump Maintenance

Clean the roller head assembly every month with reagent water and a soft lint-free cloth. Check for grooves or signs of wear on the rollers. Use steel wool to remove any rust or corrosion.

Monthly Amperometric Detector Maintenance

Polish the silver working electrode to maintain optimal sensitivity; refer to polishing instructions supplied with the electrochemical cell.

Semi-Yearly and Yearly Maintenance

Semi-Yearly Precision Pump Maintenance

Every six months, apply Brasso® polish to the individual pump rollers. Apply the polish with a clean terry cloth to all sides of each roller, allow the Brasso to cure for 15 minutes, and remove all dried polish by buffing with a fresh terry cloth. Verify all dried polish is removed from each roller.

Yearly System Maintenance

Change all fluidic tubing associated with the chemistry cartridges once a year.

Yearly Photometric Detector Maintenance

Clean the PEEK body of the flowcell by sonicating it in methanol. See "Removing and Replacing the Flowcell" on the next page.

Removing and Replacing the Flowcell

1. Turn off power to the FS3700.
2. Loosen the two screws holding the photodiode assembly and flowcell housing to the detector face using a 3/32" Allen wrench.
3. Remove the screws and gently pull the photodiode assembly away from the flowcell just far enough to allow removal of the flowcell.
4. Pull the flowcell away from the detector face.

NOTE: The photodiode is accessible at this point. If the photodiode needs cleaning, see "Cleaning the Lamp and Photodiode" below.

5. Disconnect the flowcell inlet and outlet connections.

6. To replace the flowcell O-rings (PN A000689), remove the Allen nuts (PN A000686) from both sides of the flowcell. When disassembling the flowcell, be very careful not to drop or lose the quartz windows (Figure 7.3).

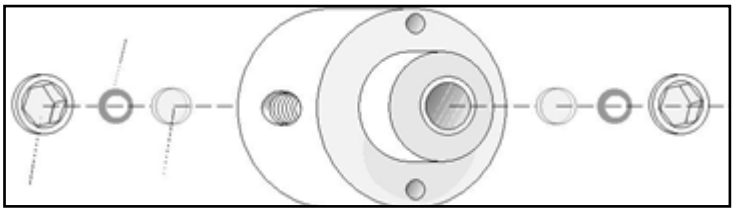


Figure 7.3.

NOTE: The cell may have to be tapped on a benchtop to dislodge the quartz windows from their cell body cavities.

NOTE: With the flowcell disassembled, look through the sample pathway of the cell; the internal walls should appear smooth and shiny. If needed, buff the flowcell walls using wool yarn soaked in DI water. Fold the yarn in half and thread it through the opening; then, quickly move the flowcell back and forth over the yarn.

7. Replace the flowcell by performing steps 1–5 of this section in reverse.

Cleaning the Lamp and Photodiode

The lamp and photodiode do not need to be cleaned under normal conditions. If they become dirty through a leak of sample, clean them with HPLC-grade methanol and lint-free lens paper.

Replacing the Lamp

Order a replacement lamp assembly, PN 329480. Remove the cable from the old lamp and remove the old lamp by removing the setscrews at the top of the assembly, then secure the new lamp in its place. Plug the connector into the UV connector for the desired channel inside the analytical module.

Changing the UV Digestion Lamp or Digestion Coil

WARNING: Before removing a digestion coil, flush the coil with DI water, then air. This will remove any potential contaminants that may be present in the coil.

WARNING: Turn off power to the FS3700 and unplug the unit before loosening or removing either the detector mounting plate or the chemistry cartridge mounting plate. This area has heated surfaces if a sample heater is present. It also has high voltage and UV light eye hazards when an optional UV lamp is present.

WARNING: Do not attempt to change the UV lamps or coils without first powering off the FS3700.

WARNING: Avoid exposure to hazardous UV radiation. Do not turn on the UV lamp without the chemistry cartridge in place and secure with its retaining hardware.

1. Turn off power to the FS3700 unit.
2. Remove the chemistry cartridge as described below.
3. Unplug the connector for the UV lamp.
4. Remove the lamp from the sockets by carefully rotating it to release the prongs on each end.
5. Pull the digestor coil and lamp slightly away from the unit and remove the lamp.
6. To install a new coil, carefully disconnect the tubing from the ends of the coil and remove the coil from the unit. Install the new coil onto the tubing.
7. To install a new lamp, insert it into the coil and replace the lamp into the sockets.
8. Center the coil on the lamp, leaving only the front and rear sockets exposed to prevent potential UV radiation leakage.
9. After installing the lamp and coil, check for leaks or restrictions in the fittings and tubing. Connect the appropriate cartridge tubing to the inlet and outlet fittings and pump fluid throughout the coils.
10. If the module is leak free, reinstall the cover.

Membrane Module

Gas Diffusion Membrane Replacement

1. With the pump turned off, lift and remove the compression lever on the upper portion of the gas diffusion module (Figure 7.4).

Figure 7.4. Installing the Gas Diffusion Membrane

2. Lift the upper manifold off and remove the old membrane.

3. Replace with a new gas diffusion polypropylene membrane (PN A001520) or Teflon membrane (PN A002040). Center it over the serpentine channel.

CAUTION: Overtightening the tension adjustment screw can rupture the membrane, causing baseline instability and noise.

4. Replace the upper manifold and tighten the tension adjustment screw, being careful not to overtighten.

Dialysis Membrane Installation

1. Release the upper manifold by lifting and removing the compression lever (Figure 7.5).

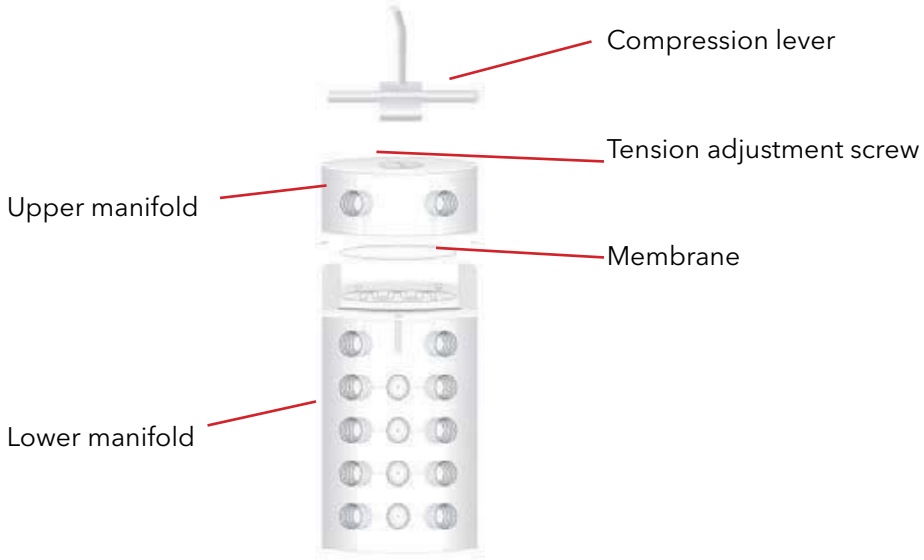


Figure 7.5. Installing the Dialysis Membrane

2. Lift the upper manifold up from the lower manifold.

3. Remove the existing membrane.

4. Install or replace with the appropriate membrane as specified in the analytical method.

5. Replace the upper manifold. It can only be installed in one direction.

6. Replace and latch the compression lever.

Membrane Module Cleaning

Run reagent water through the membrane module daily. Once a month, rinse it with the cleaning solution specified in the analytical method.

Precision Pump Operation

The following sections provide information on operating the precision pump.

Adjusting Pumping Action

OI Analytical supplies the pump with adjustable platens. Optional self-tensioning platens are also available. The operation of both types are depicted in Figure 7.6.

CAUTION: Failure to release tension shortens tube life.

Individually adjust tube compression with a tension lever on each adjustable platen to affect pumping action. Raise the tension lever with the pump operating until liquid begins to flow through the tubing. For best operation, adjust the tension for all tubes on a cartridge to the same level. Release tension on tubes not in use or when the pump power is off by pressing down on the tension lever or by pressing the release latches on either side of the platen.

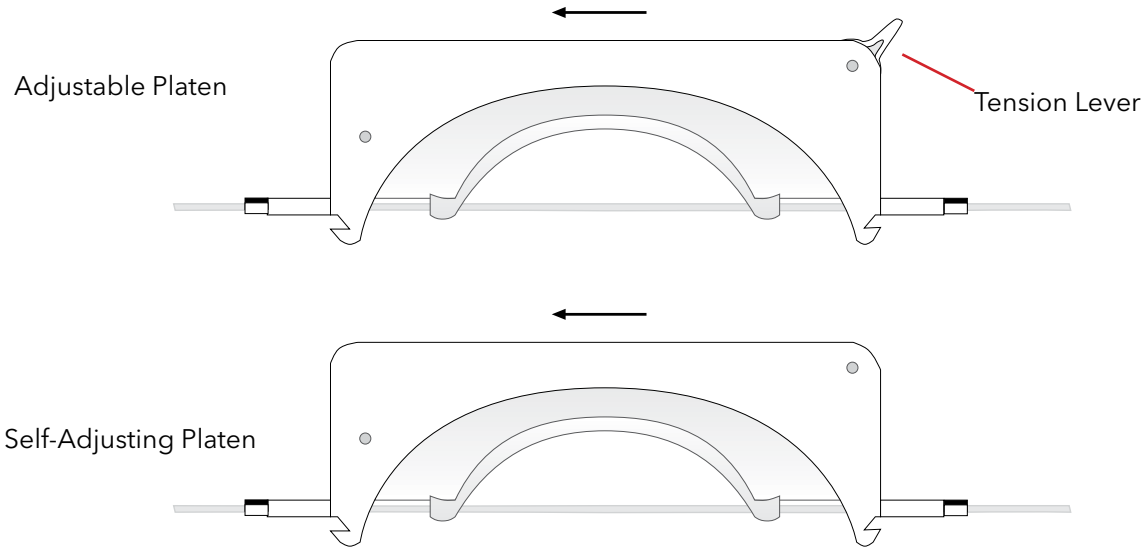


Figure 7.6. Pump Platens

Setting Pump Speed Manually

The pump provides multiple pump speeds to allow operational flexibility. Set the pump speed using the up (▲) and down (▼) arrows. The available speeds range from 0% to 100%. Set the pump to maximum speed by pressing and holding down Max/Min. When released, the pump returns to the currently set speed.

Setting the Pump Direction Manually

Set the flow direction through the pump with the direction arrows (◄►). Pressing the left arrow (◄) engages normal flow from right to left. A negative sign appears on the display to indicate the flow direction. Engage the right arrow (►) to reverse the flow from left to right.

Tubing Flow Rate

The liquid flow rate across the pump depends on the pump tube internal diameter and the pump speed. Table 6.1 lists the pump tubes and their flow rates with the speed switch set to 40% and pumping water without backpressure.

Table 7.1. Flow Rates for PVC Pump Tubes

Internal Diameter (inches)	Color Codes	Nominal Flow Rate (mL/minute)
0.015	orange/green	0.10
0.020	orange/yellow	0.18
0.025	orange/white	0.25
0.030	black/black	0.32
0.035	orange/orange	0.41
0.040	white/white	0.56
0.045	red/red	0.71
0.051	gray/gray	0.84
0.056	yellow/yellow	1.01
0.060	yellow/blue	1.12
0.065	blue/blue	1.35
0.073	green/green	1.57
0.081	purple/purple	2.05
0.090	purple/black	2.45
0.100	purple/orange	2.71
0.110	purple/white	3.24

Operating Notes

The following sections provide notes on properly operating the system.

Multiple-Channel Operation

Multiple-channel operation simply and efficiently measures several analytes at once. The following details additional items to note when running a multiple-channel method.

Cycle Duration Time

Simultaneous analysis can be only as fast as the slowest test. Compare the cycle duration time listed in the timed events table for each chemistry to be run. The multiple channel method uses the longest cycle duration time of the chemistries. The sample and wash times correspond to the chemistry-specific methodology.

Helper Line

Install a helper line (black/black pump tube) when using an orange/white or smaller sample pump tube. The helper line assists in quickly moving sample to the pump.

Sample Matrices

When performing simultaneous analyses, select methods with similar matrices. For example, the simultaneous analysis of orthophosphate and total Kjeldahl nitrogen (TKN) cannot be performed using the same sample. The TKN samples are digested and have an acidic matrix, while orthophosphate samples are tested in a water matrix. In considering sample matrices, also look at the sample preparation and preservation procedures used. In most tests, the sample wash matches the sample matrix. Some gas diffusion methods do not follow this rule.

Sample Stream Splitters
The sample splits after the autosampler and before the pump. For a dual channel, use a sample line that contains a three-port stream splitter (PN A303-0110-00). For additional channels, use either multiple-port stream splitters or add additional three-port stream splitters.

Sample Cup Volume (Vial Type)
Multiple-channel runs use more sample than single-channel runs because the sample pulls from the sample cup faster. Be sure that the sample cups selected contain enough volume for the number of samples and replicates required.

Pump Tubes
The Precision Pump holds 24 pump tubes. The pump tubes are color coded to indicate their size and flow rates, as shown in Table 7.1.

Segmenting with SFA and SFA/FIA
Ambient air is the most common segmentation gas, but is not always the cleanest or the best choice. Frequently, nitrogen or helium gas can be the superior choice and some methodologies require their use as a segmentation gas. Use a gas pillow (PN A000811) to deliver the gas. Fill the gas pillow with nitrogen or helium and connect it to the pump tube inlet. Alternatively, regulate the pressure from a nitrogen tank to one psi. Attach the inlet of the air-gas pump tube to the tubing from the nitrogen regulator.

Determining Optimal Performance
Consider a test as performing optimally when meeting the following criteria.

- The peak shapes are consistent and acceptable according to the analytical method.
- In most cases, the sample zone dispersion produces <1% sample-to-sample interaction or carryover.
- The baseline has a low enough noise component so the minimum quantitation concentration produces a peak that is three times the baseline's standard deviation. Use smoothing to eliminate some of the high-frequency baseline noise.
- The correlation coefficient of the calibration curve is as close to 1 as possible. OI Analytical recommends it be at least 0.995. When running a method across a wide concentration range, changing the fitting method helps achieve a satisfactory correlation coefficient.
- Ten replicates of the same sample or standard provide an acceptable coefficient of variation. Consult the individual laboratory protocol for acceptability limits for reproducibility.
- Analyzing quality control (QC) or check standards yield values that fall within accepted limits.

Minimizing Contamination for Low-Level Analysis

When analyzing environmental samples in the parts per billion (ppb) range, contamination in the laboratory becomes a serious problem that must be overcome. Contamination can come from various sources and can affect the laboratory water system, the reagents used in the analyses, and the samples themselves.

Clean Deionized Water

Clean deionized water is the most critical element for successful low-level analysis. Impure water appears in the analysis as high background, which causes noise and the inability to obtain desired detection limits. Deionized water must meet ASTM type I purity specifications or better. Obtain it from commercially-available laboratory water purification systems. Passing ASTM type II water through a mixture of strongly acidic cation and strongly-basic anion exchange resins also provides acceptable water.

Clean Laboratory Environment

A clean laboratory environment is essential. Proper air circulation and filtering systems can be necessary in some cases (e.g., when performing low-level ammonia or nitrate analysis in an area near industries or farms). Do not use ammonia-based cleaners in the building, avoid smoking (smoke contains high ammonia and nitrate levels), and never use phosphate-based detergents to clean glassware.

Dedicated Glassware

Keep dedicated glassware for preparing reagents and standards for each analysis. Initially clean and then acid-rinse glassware, followed by several rinses with deionized water. Rinse any container used for samples thoroughly with acid and water. For optimum precision and accuracy, use Class A volumetric glassware.

Reagent Filtering

Most low-level analyses benefit from filtering reagents, but the filtering process can introduce contamination either from the filter media itself or cross-contamination from other uses. For example, using a vacuum filter apparatus to filter an ammonium chloride buffer for nitrate determination followed by reagents for ammonia determination likely results in serious contamination of the ammonia reagents. If possible, use a separate filtering apparatus. One inexpensive and efficient filtering method for smaller volumes uses large disposable syringes and readily-available syringe filters (0.45–5.0 µm).

In all cases, rinse the filter itself with water before filtering the reagents, unless the filters in use are shown not to be contaminated. Avoid using most paper filters.

Sample Analyte Absorption from the Atmosphere

Samples can absorb analytes rapidly from the surrounding atmosphere, especially ammonia. Any precautions taken to minimize sample exposure to the atmosphere before the analysis increases accuracy. When running low-level analyses, cover sample trays with an appropriate inert material and remove just prior to analysis.

Accuracy, Precision, and Detection Limits

The following sections provide additional information on obtaining increased accuracy, precision, and detection limits while operating the system.

Accuracy

Accuracy describes how close to an accepted value an experimental value falls. In the laboratory, accuracy is generally expressed as percent recovery (%R). Calculate %R using Equation 6.1. Acceptable accuracy is generally 90–110% throughout most ranges for most analyses.

(Equation 6.1) *%R = [Experimental Value/Accepted Value] x 100*

Precision

Precision describes reproducibility of results. It measures how closely several measurements taken in the same manner agree. In the laboratory, precision is often measured in terms of percent relative standard deviation (% RSD). Use Equation 6.2 to calculate the % RSD.

(Equation 6.2) *%RSD = [Standard Deviation/Mean] x 100*

Note that mean and x are equivalent terms for the average of a set of values. For small sets of data, determine the standard deviation (S) using Equation 6.3.

(Equation 6.3)

$$S = \sqrt{\frac{\sum_{i=1} (x_i - x)^2}{N - 1}}$$

Where:

- xi = the value of the current measurement
- x = the mean value of all of the measurements
- N = the total number of measurements

Method Detection Limit

To determine the method detection limit (MDL), run at least seven replicates of a known standard at one-to-five times the estimated detection limit. Multiply the standard deviation (S) of those values by the analyst's t value for the 99% confidence level (t). See Equation 7.4.

(Equation 7.4) *MDL = S x t*

Test Performance Log

Keeping an operating log of test results helps improve future tests, provides a record to identify anomalies, and serves as a guide for other operators performing similar tests. The following test log provides a convenient format for recording this information. It can be reproduced and used to log test parameters and results.

Test Performance Log	
Date	
Test	
Operator	
Run number	
Analyte	
Analysis range (analyte concentration)	
Cycle duration time (seconds)	
Wavelength (nm)	
High standard height	
High standard concentration	
Mid standard height	
Mid standard concentration	
Low standard height	
Low standard concentration	
Initial serial communications window readings	
Method name	
Table name	
Results file name	
Reagents	
Operational notes	
Troubleshooting notes	
Maintenance notes	

Analytical Method

Each cartridge includes an analytical method. Read the information carefully before beginning an analysis for the first time. The analytical method provides:

- the test method principles, interferences, raw materials required, handling and operating precautions, and detailed reagent and calibrant preparation. It also contains specific operating notes or procedures.

- the flow diagram, which describes the cartridge component layout, mixing coils, heaters, pump tubes, reagents, and detector wavelength filters.

Preparing Reagents and Calibrants

Preparing quality reagents and calibrants is critical for performance. Follow the guidelines below to prepare quality solutions.

Reagent Preparation

- Always use ASTM type I or II deionized water in preparing reagents, calibrants, carrier, and wash solutions.

- Use reagent-grade chemicals or better in preparing reagents, calibrants, carrier, and wash solutions.

- Filter all solutions using 0.45-µm nitrocellulose filters.

- Degas solutions using one of the following methods.
  - Degas by placing under a strong vacuum for five minutes. Magnetic stirring or sonicating aids degassing. Vacuum filtration satisfies both filtering and degassing requirements.
  - Purge with a stream of nitrogen or other inert gas through a glass frit for approximately five minutes.
  - Degas deionized water by boiling in an Erlenmeyer flask for approximately five minutes. Remove from heat, cover with an inverted beaker, and allow the water to cool.

- After degassing, store degassed reagents in tightly sealed containers to protect them from reabsorbing atmospheric gases. For best results, store degassed reagents under a slight vacuum when not in use.

Calibrant Preparation

Unless stated otherwise, use Class A glassware for all measurements to achieve the greatest accuracy. Use Equation 6.5 to calculate the volume of stock or intermediate calibrant.

(Equation 7.5) $$C_1 \times V_1 = C_2 \times V_2$$

Where:

C_1 = Concentration (in mg/L) of stock solution (or calibrant)
V_1 = Volume (in L) of stock solution (or calibrant) to be used
C_2 = Desired concentration (in mg/L) of working calibrant to be prepared
V_2 = Final volume (in L) of working calibrant to be prepared

Solve Equation7.5 for the volume of stock solution to use (V_1),and obtain Equation 7.6. Because the desired concentration (C_2), final volume (V_2), and concentration of stock solution (C_1) are all known for any given calibrant concentration in a defined volume, the volume of stock solution to be used (V_1) is easily calculated.

(Equation 7.6) $$V_1 = (C_2 \times V_2) / C_1$$

Waste

Comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land-disposal restrictions. In addition, the laboratory is responsible for protecting air, water, and land resources by minimizing and controlling all releases from fume hoods and bench operations. Comply with any sewage discharge permits and regulations.

Changing Detectors

The modularity of the FS3700 make it simple to swap detectors if desired. First, disconnect fluid/tubing connections from the cartridge and to waste. Next, use a Philips screwdriver to free the detector mounting plate, then lift the detector out of its mounting hole in the chassis from the right side, and slide the freed detector to the right. Finally, unplug the cable connections between the detector and the interior bulkhead of the FS3700 chassis.

WARNING: Turn off power to the FS3700 unit before loosening or removing either the detector mounting plate or the chemistry cartridge mounting plate. This area has heated surfaces if a sample heater is present. It also has high voltage and UV light eye hazards when an optional UV lamp is present.

Changing Chemistry Cartridges

Disconnect fluid/tubing connections from the tubing manifold and precision pump, and to the detector. Next, use a Philips screwdriver to free the cartridge mounting plate, then lift the cartridge out of its mounting hole in the chassis. Finally, unplug the cable connections, if present, between the sample heater and the UV lamp, and the interior bulkhead of the FS3700 chassis.

WARNING: Turn off power to the FS3700 unit before loosening or removing either the detector mounting plate or the chemistry cartridge mounting plate. This area has heated surfaces if a sample heater is present. It also has high voltage and UV light eye hazards when an optional UV lamp is present.

Upgrading Instrument Firmware

The **Upgrade** button on the FlowView Launcher is used to update the firmware of the FS3700. New firmware for the FS3700 is periodically available and is typically bundled on the installation CD for FlowView. You may also check to see if you have the latest firmware by emailing a screenshot of your maintenance page (while the software is connected to the instrument) to tech.support@xyleminc.com.

To upgrade the firmware, ensure that only the FlowView Launcher is active, the FS3700 that you wish to upgrade is powered on and connected to the PC USB/COM port, and that no instances of FlowView are currently controlling FS3700s.

1. Select/highlight the Instrument ID in Launcher that you wish to upgrade.

2. Click **Upgrade**. The Firmware Upgrade window will open (see Figure 7.7).

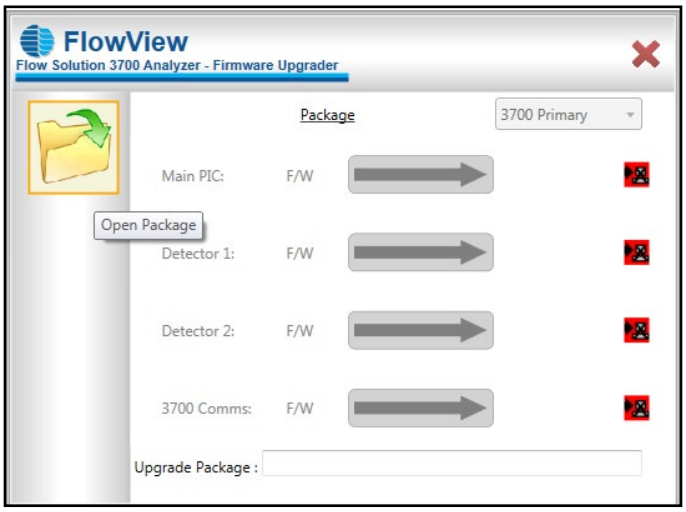


Figure 7.7. Firmware Upgrade Window

3. Click **Open Package** to select a package (.PKG) upgrade file.

4. Browse for the file, select it and then click **Open**. The "Select Upgrade" dialog will open (see Figure 7.8).

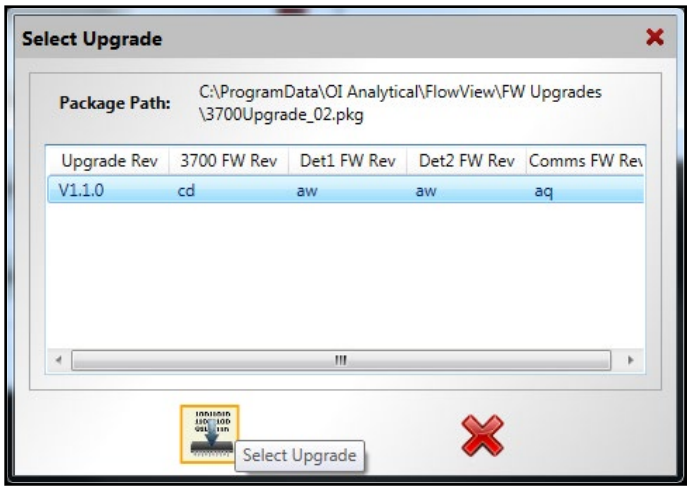


Figure 7.8. Select Upgrade Dialog

- Multiple FW combos may be available in a single firmware package.
- Highlight the desired choice to and click **Select Upgrade** to load the firmware package into the Firmware Upgrade window.

5. Firmware transfer is now ready if the board icons are green. The version of firmware in the upgrader package (.PKG) is listed on the left, the version of firmware currently on the board is listed on the right.

6. If the board icons are red, check that all cables are securely connected, that the correct communications port is selected, and ensure that another instance of FlowView is not running. You may want to close all programs and/or reboot the computer before trying again.

7. To upgrade the firmware for a board, click the **yellow arrow**. DO NOT INTERRUPT THIS PROCESS.

WARNING: Do not attempt to upgrade more than one board or chassis at a time.

8. When the transfer is complete, the green arrow turns green and indicates "Success". The computer icon is green if board reinitializes and is ready (see Figure 7.9).

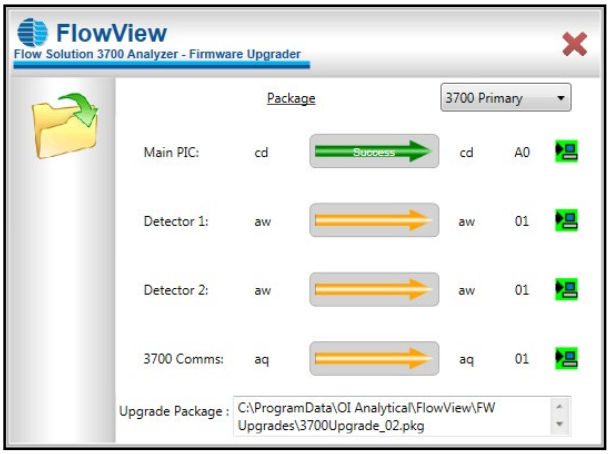


Figure 7.9. Firmware Upgrade Window - Successful Upgrade

9. When you are done upgrading firmware, close the Firmware Upgrade window.

Autosampler Maintenance

The following sections describe the maintenance procedures for the autosampler, including cleaning the unit, checking for leaks, and replacing components.

Cleaning the Autosampler

Cleaning the autosampler is the primary maintenance task performed. Failure to do so regularly causes increased wear and reduces the autosampler's life.

Clean the autosampler both daily and weekly to prevent damage and extend its life. Clean up spills and remove contaminants, such as abrasives, from the autosampler's moving parts. Also, chemically neutralizing spills may be necessary. The following sections explain daily and weekly cleaning procedures.

Daily External Cleaning

Using the autosampler often results in spills on autosampler components such as the sample tray. Clean the autosampler daily by completing the following steps:

1. Shut down and unplug the autosampler.

   For information about shutting down the autosampler, see Chapter 4, "Shutting Down the Autosampler".

2. Wipe the sample tray, autosampler chassis, and autosampler arm using a towel dampened with a laboratory grade cleaning agent.

CAUTION: Do not allow the cleaning agent to come into contact with the lead screws. Also, never lubricate either of the two lead screws.

3. Repeat step 2, using a towel dampened with clear water to remove any remaining contaminants.

4. Thoroughly dry the sample tray, autosampler chassis, and autosampler arm using a dry towel.

Weekly Cleaning

Although daily cleaning removes spills and contaminants from most of the autosampler components, the following procedure outlines how to clean the autosampler more thoroughly once a week.

WARNING: Never lubricate the lead screws. The lead screw nuts are compounded with a dry film lubricant. Oiling the lead screws causes gumming, galling, and binding of the sample probe assembly.

1. Shut down and unplug the autosampler.

2. Remove the sample tray.

3. Wipe loose particles off the Y-axis lead screw with a dry, lint-free cloth.

   The Y-axis lead screw is a large metal screw located inside the autosampler arm tubing, depicted in Figure 7.10.

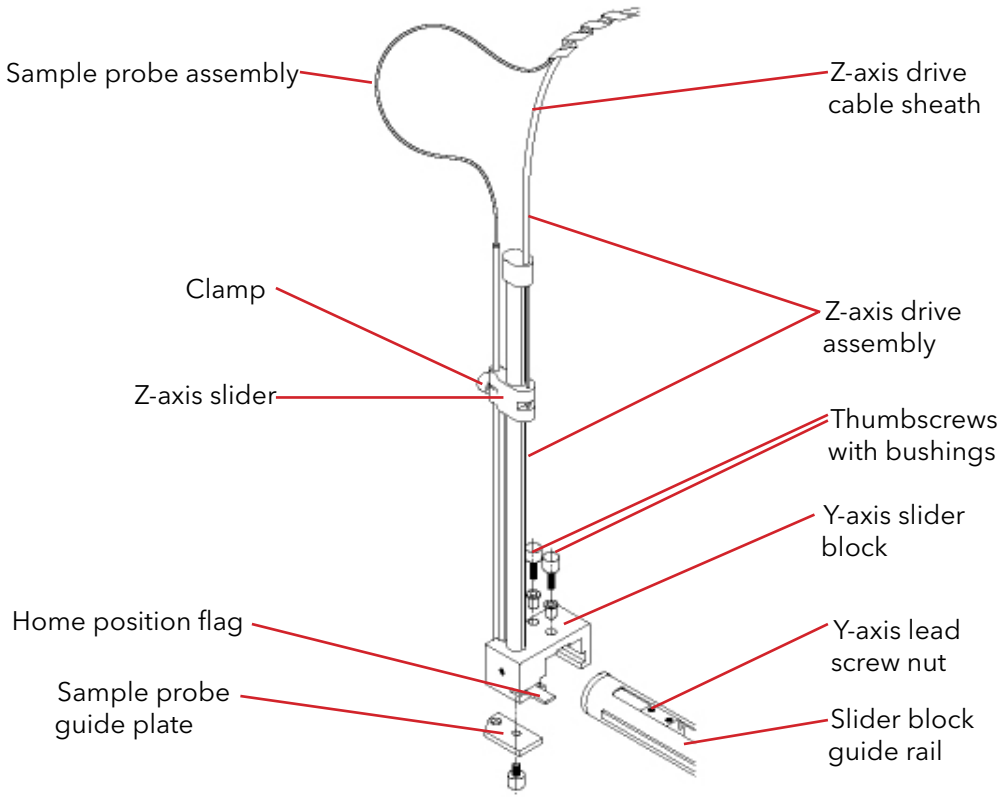


Figure 7.10. Z-Drive Assembly on Autosampler Arm

4. Wipe the autosampler exterior and base clean using a towel dampened with a laboratory grade cleaning agent, followed by a towel dampened with clear water.

NOTE: Pay extra attention to the slider block and guide rails along the tube of the autosampler arm.

5. Wash the sample tray in a warm detergent solution. Make sure all spills and stains are removed.

6. Rinse the sample tray with water.

7. Thoroughly dry the sample tray.

8. Replace the sample tray on the autosampler base.

For information about removing or replacing the tray, see "Replacing the Sample Tray".

Checking for Leaks

Several of the autosampler components have a limited life and wear out under normal use: the sample probe, peristaltic pump tubing, and rinse station and its tubing. Periodically check these components for leaks by completing the following steps:

1. Shut down and unplug the autosampler.

2. Visually inspect the sample probe, peristaltic pump tubing, and rinse station and its tubing for leaks or signs of deterioration.

3. If a leak or other damage to an autosampler component is detected, the component must be replaced.

For more information, see the section in this chapter on replacing various components.

Replacing Peristaltic Pump Tubing

Routine maintenance of the autosampler includes replacing the peristaltic pump tubing. Because of the operating nature of peristaltic pumps, the tubing is the most frequently replaced item on the autosampler. Using strong bases, acids, or solvents as rinsing agents may cause the tubing to break down more rapidly. The following procedure outlines how to replace the tubing.

CAUTION: Replace the new tubing carefully. Damage may result if applying too much force.

1. Shut down and unplug the autosampler.

2. Release the pressure shoe.

3. Remove the old tubing by carefully pulling or cutting it to remove it.

4. Carefully push the new tubing onto the mounting block fittings.

5. Reconnect the pressure shoe.

Replacing the Sample Probe

Replace the sample probe if it leaks or shows other signs of deterioration. The following procedure outlines how to replace the probe.

CAUTION: Applying too much force when removing the sample probe can damage the Z-drive assembly.

1. Shut down and unplug the autosampler.

2. Remove the old sample probe and tubing.

3. Install the new sample probe.

For information about installing the sample probe, see Chapter 4, “Installing the Sample Probe”.

Replacing the Rinse Station Tubing

If the rinse station tubing is typically exposed to deionized water as a rinsing agent, frequent replacement is not necessary. However, other rinsing agents, such as acids or solvents, are likely to deteriorate the tubing more rapidly. The following procedure outlines how to replace the rinse station tubing.

1. Shut down and unplug the autosampler.
2. Move the autosampler arm 20–30 cm (8–12") away from the home position by gently pushing it. Moving the autosampler arm ensures the sample probe is not damaged while replacing the rinse station tubing.
3. Disconnect the rinse solution uptake and drain tubing. Apply only a linear force when removing the tubing to prevent breaking the fittings.
4. Remove the rinse station tube.
   a. Rotate the rinse station tube counterclockwise ¼ turn.
   b. Remove the rinse station tube from the mounting block by lifting the tube straight up.
5. Carefully push the rinse station tube into the mounting block and rotate it clockwise ¼ turn.
6. Reconnect the rinse solution uptake and drain tubing. Apply only a linear force when replacing the tubing to prevent the fittings from breaking.
7. Move the autosampler arm back to the home position.

Replacing the Sample Tray

Cleaning the autosampler sample tray each week extends its life and makes frequent replacement unnecessary. However, the following procedure outlines how to replace the sample tray, should it need to be replaced.

1. Shut down and unplug the autosampler.
2. Remove all sample vial racks.
3. Move the autosampler arm 20–30 cm (8–12") away from the home position by gently pushing it. Moving the autosampler arm ensures the sample probe assembly is not damaged while replacing the sample tray.
4. Raise the rinse station tube approximately 2 cm (1").
5. Raise the front edge of the damaged tray at least 2.5 cm (1").
6. Slide the damaged tray forward. If removing the sample tray is difficult, raise the front edge higher before sliding it forward.
7. Install the new tray.
8. Lower the rinse station tube. Ensure the rinse station tube is positioned securely.
9. Move the autosampler arm back to the home position.
10. Replace the sample vial racks.

Chapter 8 Troubleshooting

This chapter describes some of the common issues that an operator might face when using the FS3700 and some logical steps to find and solve the problem.

Self-Test

Click **Self-Test** to display the Self-Test status screen. Initiate a self test of the FS3700 system by clicking **Start here**. This test runs continuously until **Stop** is clicked (Figure 8.1). The heaters are turned on and set to a pre-determined setpoint, the valves are switched, and the communications to the pump and sampler are checked. In addition, the detector signals are monitored and displayed on the Run Samples screen during the self test.

This tool is, in general, a good place to start with troubleshooting.

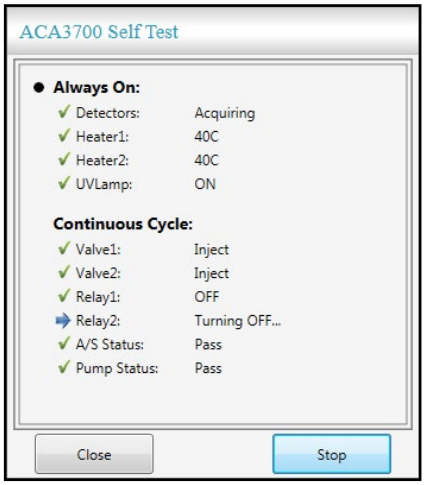


Figure 8.1. FlowView - Self Test Window

Other Issues

If You Observe	Try the Following
The A/S appears to be sampling in the wrong spots and the needle is possibly out of alignment	Check the configuration to confirm that the correct autosampler profile (90-position or 360-position) is selected. Save any changes made. Test alignment on the **Perform Maintenance** screen.
On the **Maintenance** screen, the firmware or board revision information is garbled or missing	Turn off the system and follow the desired boot-up order: first peripherals, then the FS3700 itself, then the PC GUI. **Allow the FS3700 to remain off for a full 10 seconds before powering it back on.**

If You Observe	Try the Following
Intermittently the communication lags or on-screen information does not update swiftly	Examine the connection from the FS3700 to the PC and eliminate extension cables or USB hubs. The FS3700 PC interface cable needs to be inserted directly into a PC system USB port. Ensure that the Debug log is not enabled, unless you have been instructed to turn on this feature by OI Analytical Technical Support.
The data that was just collected appears to be missing	Check the display parameters to confirm that you are observing the desired channel. The system resets to displaying Channel 1 after each calculation or re-calculation of parameters.
Signal appears to be severely attenuated or missing	• Check the flow path for fluid leaks, blockages, or precipitates. Verify that all cables are securely connected. • Confirm that the correct methods are loaded into the configuration, method settings are correct, and that all required accessories (heaters, UV lamps) are turned on and operating properly. • If problems persist, verify that all reagents and standards are formulated properly by manually performing the chemistry in the hood. Using a test tube, add standard and reagents in the appropriate ratios to confirm that color develops. • If problems persist, confirm plumbing connections and detector performance by introducing dye or food coloring in place of a sample.
The Launcher does not allow an instrument to be added or when the GUI is started, all of the status indicators are gray rather than green, yellow, or red.	Visit the device manager in Windows and make certain that the USB port being called by the instrument is available and make sure that the computer account used to run the software has Administrator privileges. Attempt to run the software as Administrator.

FAQs

FlowView refused to install because Microsoft.NET Framework was not up to date on the PC. Where/How do I install .NET so installation can proceed?

In deference to differing IT policies for laboratories, the FlowView installer does not automatically install or update the MS .NET Framework on the PC. However, recent versions of the MS .NET Framework are provided on the installation CD. Consult your IT department for the proper version and installation.

How can I change the directory that FlowView installs itself and saves data?

Per Microsoft's guidelines for "Windows Logo Program", the FlowView software program files are automatically installed in "\OI Analytical\FlowView\" under the appropriate Windows "C:\Programs Files" or "C:\Program Files(x86)" directory, depending on whether the O/S is 32-bit or 64-bit.

Likewise, the data for the FlowView software is located in the "C:\ProgramData\OI Analytical\FlowView\Database" directory. A unique subdirectory is automatically created for each new instrument added to the FlowView Launcher program. The data for each instrument can be found in the various subdirectories under this new, instrument-specific directory.

NOTE: The C:\ProgramData directory is hidden by default; however, it may be accessed by typing "C:\ProgramData" in the address bar of Windows Explorer.

To what directory does FlowView save data, sequences, and results?

Per Microsoft's guidelines for "Window Logo Program", the data for FlowView software is located in the "C:\ProgramData\OI Analytical\FlowView\Database" directory.

A unique subdirectory is automatically created for each new instrument added to the FlowView Launcher program. The data for each instrument can be found in the various subdirectories under this new, instrument-specific directory.

For example, if the instrument was named "3700", the directory would be:
C:\ProgramData\OI Analytical\FlowView\Database\Instrument_3700\.

To simplify access to these directories, desktop shortcuts can be created to point directly to the directories of interest. **Explore Database** on the **Maintenance** screen can also be used to access this directory.

How do I change the size of the FlowView window?

For a consistent viewing experience on tablets, laptops, and workstations, the FlowView window is a fixed size. It can be made to cover the whole screen, by setting your screen resolution to 1024 x 768.

How do I update the FlowView from a CD or a zip file?
FlowView should be uninstalled and re-installed when upgrading.

Is it possible to change the standards during the run when collecting data?

Yes, if the proposed new standards are already defined in the Method, the active sequence can be changed for any standards that have not yet been run. Changes to an active method cannot be made while a sequence is running. However, all aspects of the Method, Calibration, and Sequence can be changed in the **View Results** screen, after the run has been completed.

How can we recalculate the results post run? If you change something in the method, the only thing that is changing is the calibration curve, but not the results table?

After making the desired changes to the Method, Calibration, or Sequence, simply click **Calculate Peaks** to recalculate the results and update peak values and the calibration curve.

How can I access the FlowView User's Manual?

The FlowView manual can be accessed by clicking **Help** on the FlowView Launcher screen.

What's the easiest way to zoom into the baseline?

There are several ways to do this.

- The zoom box may be used several times to get closer to the peak baseline you're interested in.
- The zoom box may be used to zoom in on a small vertical segment and long horizontal segment, then use axes scroll to refine as needed.
- Axes scroll may be used to set the baseline to the center of the signal axis. Axes zoom can then be used to zoom in on the baseline with the full time range visible.

How do I correct an unstable or drifting baseline?

- Insertion of manual baseline points (from the Peak Graph toolbar)
- Changing a blank sample to a RB, or vice-versa, by editing the Sample Table (Summary > Sample Table).
- Use the Advanced baseline instead of Sync Peak Start as Baseline (set in Method > Channel# > Peak Marking).
- Refer to the Maintenance section to assess if your system needs to be cleaned, pump tubes need to be replaced or properly tensioned.
- Utilize the detector covers to minimize the effect of environmental changes (e.g., temperature) on data collection.

How do I correct a peak that is not properly marked?

- Manually adjust the peak mark to the correct position.
- Increase the minimum peak height to a value just below the lowest standard (set in Method > Channel# > Peak Marking).
- The minimum peak width can be increased or decreased to adjust the peak window where the peak marking function is looking for the peak (ensure that consecutive peaks fall into the expected peak width minimum peak width to the minimum peak height to a value just below the lowest standard (set in Method > Peak Marking).
- If the minimum peak height or minimum peak width correct the issue – adjust your method to use the new value.

How do I correct a problem with my sync peak?

- Manually adjust the peak mark to the correct position
- Adjust the Sync Ignore Time so that it ends just before the sync peak starts.
- Increase the minimum peak height to a value just below the lowest standard (set in Method > Channel# > Peak Marking).
- If the minimum peak height or sync ignore time correct the issue – adjust your method to use the new value.

One of my standards is misidentified, has the wrong concentration specified, or should be excluded. What can I do?

- Standards may be changed to samples, or vice-versa, by editing the Sample Table (Summary > Sample Table).
- Standard concentration may be changed (Summary > Methods > Channel > Calibration Table).
- Standards may be excluded from one or all channels (either through deselecting them in Summary > Methods > Channel > Calibration Table, or by assigning them a different type in Summary > Sample Table).

An error was made on the sample table prior to the run and there's a typo for a sample. What can I do?

- Correct the typo before the sample is run (Run Samples > View Samples).
- Make corrections by editing the Sample Table (Summary > Sample Table).
- After changes are made – save the modified results file to ensure traceability.

How do I update the firmware on my FS3700?

Refer to the instructions provided in Chapter 7, "Upgrading Instrument Firmware".

What is the CO (carryover) feature? How and why should I use it?

For most users, carryover compensation is not needed. The carryover feature can be a useful tool for users wishing to run their flow analyzer faster than 60 samples per hour. To enable Carryover Correction, the feature must be enabled under Method > Signals/Peak Marking and a CO sample included in a run (this can be added on the **Build Sample Table** screen). When asked for a vial number – enter the vial containing your highest standard. When loading a sample table with a CO sample in the Run Samples screen, multiple lines will appear in the place of the CO sample: two replicates of a sample named CO (High) (with sample type = "COHigh", which will inject your high standard) and two replicates of a sample named CO (Zero) (with a sample type = "COZero", which will inject blanks from the wash station). Using this specific sequence of injections, two different carryover compensations will be calculated.

1. CO compensation for the slight positive carryover that may be found when transitioning between successive injections of a high sample and a low sample (high-to-low carryover, HLC).

2. CO compensation for the slight negative carryover that may occur when transitioning between successive injections of a low sample (like a blank) and a high sample (low-to-high carryover, LHC).

These separate values will be calculated and displayed with the calibration curve, listed as HLCAVG and LHCAVG. When carryover correction is enabled, FlowView evaluates if a peak is larger or smaller than the previous peak. If a peak is smaller than the previous peak, the difference between those two peaks is calculated, the height/area of the higher peak is compared to the value observed for COHigh, and the smaller peak is compared to the value observed for COZero. Proportional compensation is then applied to correct for any positive carryover attributable to the previous injection. In the same way, if a peak is larger than the previous peak – a similar calculation is made to compensate for any peak suppression that may be attributable to the previous injection. If you are interested in reading more about this feature, please contact the OI Service department and request the FlowView Carryover Whitepaper.

How do I reach customer support for my FS3700 and FlowView?

Domestically you can call 1-800-336-1911 toll free or email tech.support@xyleminc.com. Please include a screenshot of your maintenance screen when emailing tech support.

General Troubleshooting Guidelines

Look for the simplest and most obvious cause for a particular problem or solution.

- Verify all modules are plugged in and the power switches are on.
- Verify tubing connections and observe flow through the system.

Eliminate operator errors.

- Consult this manual for proper operating procedures.
- Review the analytical method(s) and flow diagram(s) to verify operating parameters.

Isolate and define the problem as chemical, hydraulic, software, or electrical or mechanical. The following lists some common problem areas under each category.

Chemical	Hydraulic	Software	Electrical or Mechanical
reagents	pump tubes	timed events	optics
standards	bubble size	ignore time	detector
pH	surfactant	peak finding	cabling
temperature	pump	calibrant	lamps
age	fittings	baseline lead	circuit components

Change only one component or variable at a time and note the changes and results. In this manner, the problem becomes more clearly defined.

Document the solution. Keep a log of troubleshooting activity including the problem, symptom(s), cause(s), and solution(s). This information can be helpful for future troubleshooting sessions or for other users.

Troubleshooting Tables

The following sections troubleshoot methods for the system as a whole and for the various components.

General System Troubleshooting

Table 8.1 discusses symptoms of some common system problems, possible causes, and some potential solutions.

Table 8.1. General Symptoms, Probable Causes, and Corrective Actions

Symptom	Probable Cause	Corrective Action
Noisy photometric detector baseline	Bubbles in the reference electrode	Degas the reagents and carrier.
	Bubbles in the flowcell	Dislodge bubbles by pinching the flowcell pull-off tube and waste line for five seconds, then release.
	Pump tube deterioration	Replace pump tubes.
	Poor reagent quality	Remake the reagents. Verify the reagent raw materials are not too old.
	Cartridge contamination	Clean the cartridge.
	Flowcell leak	Remove the flowcell and locate the leak source.
	Particle trapped in the flowcell	Flush the flowcell with alcohol using a syringe or disassemble and clean the flowcell. Filter the reagents.
	Source lamp not turned on	Adjust configuration for lamp power to >50% and save the configuration.
	Source lamp deterioration	Check the lamp. Replace it if necessary.
	Insufficient surfactant	Remake the solutions adding more surfactant.
Bubbles break up	Pump tube contamination	Clean or replace the pump tubes.
	Pump tubes blocked	Clean or replace the pump tubes.
	Incorrect pump tube size	Use the correct pump tube size.
	Worn or defective fittings	Check the ferrules and fittings. Replace if necessary.
	Partially-plugged port	Determine where bubbles break up. Clean the blocked port with a probe and solvent.

Symptom	Probable Cause	Corrective Action
Bubbles getting past the debubbler	Too many bubbles	Correct any air flow problems.
	Insufficient surfactant	Remake the solutions adding more surfactant.
	Reagent tube pumping air	Refill or reposition the reagent container.
	Sample tube pumping air	Check the sample probe position, sample cup levels, and wash reservoir level.
	Debubbler pump tube installed incorrectly	Check and correct pump tube installation.
Bubbles trapped in the flowcell	Bubbles break up in the cartridge	Flush the cartridge.
	Bubbles too small	Replace the air pump tube.
	Stray bubbles	Dislodge bubbles by pinching the flowcell pull-off tube and waste line for five seconds, then release.
	Flowcell contamination	Flush the flowcell.
	Insufficient surfactant	Remake the solutions adding more surfactant.
	Bubble in solutions	Degas the reagents and carrier.
Carryover or poor washout	Cycle duration time too short	Verify or increase the cycle duration time.
	Adsorption to tubing or flowcell	Replace the tubing. Clean the flowcell.
Frequent air spikes	Sample loop not filling completely	Increase sample load time in method, and reload method into the configuration.
	Bubbles not removed by the debubbler	Verify the debubbler pull-off pump tube is installed with the correct size.
	Outgassing in the sample line	Degas reagents. Install a backpressure coil.
	Bubbles in reagent	Degas reagents.
Leakage	Loose nut connections	Check fittings for a smooth internal finish. Verify the O-ring is seated properly.
	Poor connections	Check ferrules and fittings. Replace if necessary.
	Holes in tubing	Replace the tubing.
	Blocked tubing	Clean or replace the tubing.

Symptom	Probable Cause	Corrective Action
Low sensitivity	Deteriorated reagent or standard	Prepare fresh reagent or standard.
	Deteriorated pump tube	Replace the pump tubes.
	Flowcell contamination	Flush to clean the flowcell.
	Incorrect wavelength filter	Check the filter. Change to the correct wavelength filter if necessary.
	Wrong loop size	Verify the correct loop size in the method. Change to the correct size if necessary.
	Poor flow rate	Verify flow is free and consistent.
	Filter delaminated	Replace the filter.
	Deteriorated source lamp	Check and replace the lamp if necessary.
	Incorrect heat bath temperature	Check and reset the temperature if necessary.
No reaction or no color product	No analyte in sample or standard	Remake the standards.
	Wrong sample dilution	Verify the sample dilution.
	Deteriorated reagent or standard	Prepare fresh reagent or standard.
	Reagent lines connected to the wrong containers	Connect the lines to the correct containers.
	Wrong wavelength filter	Change to the correct filter.
	No reagent flow	Check the pump. Increase the pump platen pressure. Check for tubing blockages.
	Sample probe not reaching sample	Refill the sample cup.
	FIA valve not actuating	Verify FIA valve control from the maintenance screen, and correct as necessary.

Symptom	Probable Cause	Corrective Action
Drift or baseline shift	Flowcell contamination	Flush to clean flowcell.
	Reagent deterioration	Prepare fresh reagent.
	Pump tube deterioration	Replace the pump tubes.
	Source lamp deterioration	Check and replace the lamp if necessary.
	Bubbles in flowcell	Dislodge bubbles by pinching the flowcell pull-off tube and waste line for five seconds, then release.
	Unstable reaction temperature	Bring reagents to room temperature. Verify the heater temperature.
Blocked flow	Particles or buildup in tubing	Clean or replace the tubing.
	Particles or buildup in cartridge	Flush to clean the cartridge.
	Tubing deterioration	Replace the tubing.
Poor precision	Sample loop not filling completely	Check the sample loop size. Adjust the sample load time in the method and reload the method into the configuration.
	Inconsistent flow	Check for blockage in the pump tubes.
	Tubing deterioration	Replace the tubing.
	Inadequate sampling time	Adjust the sampling time.
	Poor reagent quality	Remake the reagents and standards.
SYNC peak does not get marked	Ignore time set too long	Shorten the ignore time.
	Peak-finding parameters too stringent	Decrease requirements for rise and fall in the peak-finding parameters.
	Poor reagents or standards	Remake the reagents and standards.
Valve not switching	Poor module connection	Verify connections. Ensure the valve is properly seated.

Precision Pump

Table 8.2 lists symptoms and probable causes, along with corrective actions, associated with the precision pump.

Table 8.2. Precision Pump Symptoms, Probable Causes, and Corrective Actions

Symptom	Probable Cause	Corrective Action
Pump does not power up	Unit not plugged in	Plug in the power cord.
	Blown fuse	Replace the fuse.
Pump does not rotate	Poor module connection	Verify pump connections.
	No power	See "Pump does not power up"
Carrier or reagent flow ceases	Leakage in system	Check the valve, cartridge, and fittings for leaks.
	Empty reagent containers	Refill the reagent containers.
	Blocked flow lines	Check the fittings for blockage.
	Worn air pump tube	Replace the air pump tube. Replace the air (orange/white) pump tube with a larger pump tube (black/black or white/white).
Flow surges	Blocked reagent bottle straw	Check for blockage in the straw.
	Blocked cartridge tubing	Clean or replace the tubing.
	Heat bath temperature set too high	Check and reset the temperature
	Insufficient or old surfactant	Increase the surfactant amount. Make the reagents with the new surfactant.

Autosampler

The following sections cover troubleshooting problems with the autosampler.

Power System Problems

A power system problem can cause a 3090 Autosampler malfunction. This may be occurring if the green LED power indicator is off. If the Autosampler is not functional, check the power source.

1. Check the electrical outlet and see if the external power supply is plugged in.

2. Check the power switch of the external power supply and see if it is turned on.

RS-232 Interface Cable Problems

The following procedure outlines how to check the RS-232 cable.

1. Check the Autosampler power switch to ensure it is on.

2. Check the RS-232 cable to ensure it is plugged into the COM 1 port on the Autosampler. Ensure it is properly tightened.

3. Check the host computer to ensure the RS-232 cable is connected to the appropriate COM port. Ensure it is tightened properly.

Z-Drive Assembly Problems

A malfunction may be caused by a problem in the Z-drive assembly. Hearing a loud chattering noise when the power switch is on or if the sample probe is not moving may indicate a Z-drive assembly malfunction. The following procedure outlines how to troubleshoot Z-drive assembly problems.

NOTE: If freeing the Z-drive assembly is not possible, replace it. Order a new Z-drive assembly from OI Analytical.

1. Ensure the **Y-axis slider block** and **Z-drive assembly** are installed.

   If the Z-drive assembly is not installed, follow the instructions provided in *Mounting the Z-Drive Assembly*. If the Z-drive assembly is already installed, continue with step 2.

2. Check the **Y-axis block home position flag** for damage.

   The home position flag is shown in Figure 8.1. If the flag is damaged, replace the entire Y-axis slider block. For information about mounting the Y-axis slider block on the Autosampler arm, see *Mounting the Z-Drive Assembly*. If the home position flag is undamaged, continue with step 3.

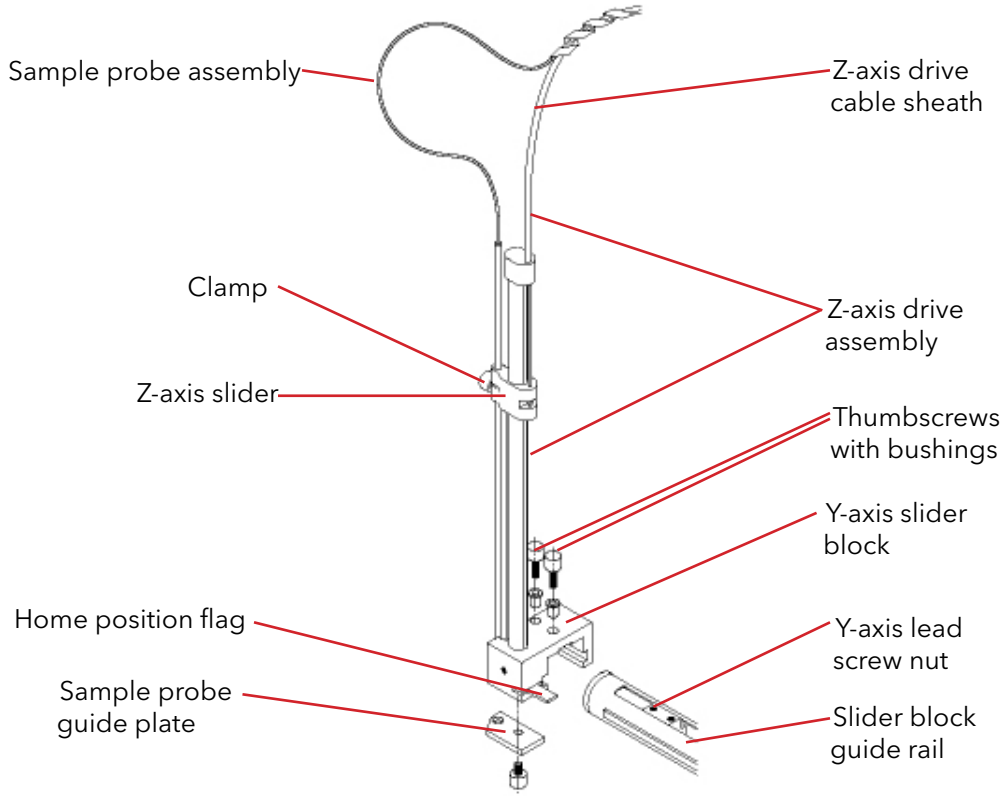


Figure 8.1. Z-Drive Assembly with Y-Axis Block Home position Flag

3. Check the sample probe for movement. If the sample probe is binding, free the sample probe assembly.

FIA Valve

The following sections cover troubleshooting problems with the FIA valve.

Testing for Proper Loading and Injecting

Many of the problems encountered during FIA relate to proper sample loading and injecting. Use the following procedures to check FIA valve performance.

Verify the sample fills the sample loop completely:

NOTE: The dye powder produces a harmless solution.

1. Pump startup solution or reagent water through the cartridge and valve.
2. Fill a sample cup with dye solution.
3. Place it in the autosampler sample rack.
4. Adjust the sample table to account for the additional sample cup.
5. Start a run.
6. Watch the dye solution travel through the tubing to the FIA valve.

   The dye solution should fill the sample loop completely. The dye should exit before the valve switches to the inject position. If this does not occur, increase the loop fill time by increasing the length of time before the valve is instructed to move to the inject position and repeat steps 5 and 6.

NOTE: This test can be performed without dye solution by watching an air bubble that is sucked into the tubing when the sample probe moves from the wash solution to the sample cup. The air bubble should be seen exiting before the valve switches to the inject position.

7. Verify the sample injects properly by watching the dye after the sample loop loads and the FIA valve moves to the inject position.

   In most cases, the dye should completely flush from the loop to the analytical cartridge. Check the following if the flow through the tubing or valve seems slow:

   - Tighten the tension on the platen for the sample pull-off pump tube (if using manually-adjustable platens).
   - Replace the sample pull-off pump tube.
   - Check for blockages in the tubes and fittings.
   - Check for overtightened nut and ferrule tubing connections. Loosen and finger tighten the nuts on the connections into the valve.
   - Replace the sample line and tubing from the sample probe to the valve.

   If excess air appears in the tubing along the flow path, check for loose connections on the valve and the path between the sample probe and the valve.

Check the following if the valve appears to load but not inject, or inject but not load:

- Ensure the valve actuates using the FlowView maintenance screen commands. Listen for the sound of the electric motor and view the LED switching modes from load to inject.
- Verify the FlowView load and inject times are set properly.

Determine the proper wash time setting by observing peak separation (carryover) during an actual analysis. If the peaks do not separate satisfactorily, increase the wash time.

Model 515 Distillation Module

Table 8.3 lists the symptoms, probable causes, and corrective actions for issues with the Model 515 Distillation Module.

Table 8.3. Distillation Module Symptoms, Probable Causes, and Corrective Actions

Symptom	Probable Cause	Corrective Action
Temperature is incorrect or unstable	Wrong temperature setting	Reset the temperature.
	System not equilibrated	Allow sufficient time to reach the set temperature.
Heater does not heat.	Unit not plugged in	Plug in the power cord.
	Blown fuse	Replace the fuse.
	Unit in set mode	Press the set button to verify the unit is not in set mode.

Detector and Flowcell

Table 8.4 lists the symptoms, probable causes, and corrective actions for the detector and flowcell.

Table 8.4. Detector/Flowcell Symptoms, Probable Caues, and Corrective Actions

Symptom	Probable Cause	Corrective Action
Poor sensitivity	Oxidized or dirty silver working electrode	Remove and polish the silver working electrode.
	Wrong injection valve loop size	Verify 200-µL injection loop.
	Injection loop not filling completely	Adjust the settings in the Timed Events screen.
	Depleted reference electrode filling solution	Replace reference electrode.
	Clogged or coated gas diffusion membrane	Replace the gas diffusion membrane.
	Incorrect electrode bias voltage	Set the correct bias voltage in the method.
	Improperly made reagents or calibrants	Check reagent preparation; remake reagents and calibrants if necessary.
	Bubble trapped in the flowcell	Pinch the flowcell pull-through tube and waste line for five seconds, then release.
	Worn pump tubes	Replace the pump tubes.

Symptom	Probable Cause	Corrective Action
Noisy baseline	Ruptured gas diffusion membrane	Replace the gas diffusion membrane.
	Depleted reference electrode filling solution	Replace the reference electrode.
	Dissolved gases in reagents or carrier	Degas all the reagents and carrier.
	Bubble trapped in the reference electrode reservoir	Refill the reference electrode reservoir to eliminate all bubbles.
Decreasing sensitivity	Bad base reagent	Replace the base reagent. Clean the working electrode.
Poor RSDs	Flowcell not conditioned	Condition the flowcell.
	Injection loop not filling completely	Adjust the Timed Events Table.
	Worn pump tubes	Replace pump tubes.

Chapter 9 Consumables, Replacement Parts, and Options

FS3700	
Description	**Part Number**
MODEL- FS3700 Analyzer w/24-channel pump	330113
MODEL- FS3700 Analyzer	330000
CHANNEL-3700 Cyanide, Total (ASTM D7511)	330076
CHANNEL-3700 Cyanide, Available (ASTM D6888)	330106
CHANNEL-3700 Cyanide, Available (USEPA OIA-1677)	330107
CHANNEL-3700 Ammonia/TKN by gas diffusion - SFA (USEPA 351.2)	330109
CHANNEL-3700 Nitrite (NO2) + Nitrate (NO3), (USEPA 353.2)	330108
CHANNEL-3700 Phenol - Post distillation (USEPA 420.4)	330110
CHANNEL-3700 Phosphate, all forms (USEPA 365.1)	330111
CHANNEL-3700 Phosphate, low-level (USEPA 365.1)	330112
CHANNEL-3700 Cyanide, Free (ASTM D7237)	330355
CHANNEL-3700 Cyanide, Post-distillation (USEPA 335.4)	330351
CHANNEL-3700 Ammonia Nitrogen (USEPA 350.1)	330353
ASSY-3700 PHOTOMETRIC DETECTOR	329477
ASSY-3700 AMPEROMETRIC DETECTOR	330077
CART-3700 Cyanide, Total (ASTM D7511)	330090
CART-3700 Cyanide, Available (ASTM D6888)	330091
CART-3700 Cyanide, Available (USEPA OIA-1677)	330092
CART-3700 Ammonia/TKN by gas diffusion (USEPA 351.2)	330094
CART-3700 Nitrite (NO2) + Nitrate (NO3), (USEPA 353.2)	330093
CART-3700 Phenol - Post distillation (USEPA 420.4)	330083
CART-3700 Phosphate, all forms (USEPA 365.1)	330096
CART-3700 Phosphate, low-level (USEPA 365.1)	330095
CART-3700 Cyanide, Free (ASTM D7237)	330356
CART-3700 Cyanide, Post-distillation (USEPA 335.4)	330352
CART-3700 Ammonia Nitrogen (USEPA 350.1)	330354
Tube Kit-3700 Cyanide, Total (ASTM D7511) - FIA	330090TK
Tube Kit-3700 Cyanide, Available (ASTM D6888) - FIA	330091TK
Tube Kit-3700 Cyanide, Available (USEPA OIA-1677)	330092TK

Tube Kit-3700 Ammonia/TKN by gas diffusion (USEPA 351.2) - SFA	330094TK
Tube Kit-3700 Nitrite (NO2) + Nitrate (NO3), (USEPA 353.2) - FIA	330093TK
Tube Kit-3700 Phenol - Post distillation (USEPA 420.4) - FIA	330083TK
Tube Kit-3700 Phosphate, all forms (USEPA 365.1) - FIA	330096TK
Tube Kit-3700 Phosphate, low-level (USEPA 365.1) - FIA	330095TK
Tube Kit-3700 Cyanide, Free (ASTM D7237) - FIA	330356TK
Tube Kit-3700 Cyanide - Post distillation (USEPA 335.4) - FIA	330352TK
Tube Kit-3700 Ammonia Nitrogen (USEPA 350.1) - FIA	330354TK
Pump Tubes	
Description	**Part Number**
Pump Tube Assortment Pack (2 of every-sized pump tube)	A000362
Orange/Blue Pump Tubes (12 pack)	A000200
Orange/Yellow Pump Tubes (12 pack)	A000346
Orange/Green Pump Tubes (12 pack)	A000345
Orange/White Pump Tubes (12 pack)	A000347
Black/Black Pump Tubes (12 pack)	A000348
Orange/Orange Pump Tubes (12 pack)	A000349
White/White Pump Tubes (12 pack)	A000350
Red/Red Pump Tubes (12 pack)	A000351
Gray/Gray Pump Tubes (12 pack)	A000352
Yellow/Yellow Pump Tubes (12 pack)	A000353
Yellow/Blue Pump Tubes (12 pack)	A000354
Blue/Blue Pump Tubes (12 pack)	A000355
Green/Green Pump Tubes (12 pack)	A000356
Purple/Purple Pump Tubes (12 pack)	A000357
Purple/Black Pump Tubes (12 pack)	A000358
Purple/Orange Pump Tubes (12 pack)	A000359
Purple/White Pump Tubes (12 pack)	A000360
White/White Viton Pump Tube	319711
Gray/Gray Viton Pump Tube	319712
White/White Silicone Pump Tube (6 pack)	A116-0497P10
Tubing Parts and Assemblies	
Description	**Part Number**
Air Inject Tubing Assy - Orange/Green	330023
Air Inject Tubing Assy- Black/Black	330267
Debubbler Pull Tubing Assy - Black/Black	330260
Debubbler Pull Tubing Assy - White/White	330024
Debubbler Pull Tubing Assy - Red/Red	330270

Debubbler Pull Tube Assy - 3700	330259
Sample Pull Tubing Assy - Green/Green	330025
Gas Diffusion Waste Tubing Assy	330022
Pump Tube Assy w/barb fittings - Purple/White	330376
Pump Tube Assy w/barb fittings - Purple/Orange	330377
Pump Tube Assy w/barb fittings - Purple/Black	330378
Pump Tube Assy w/barb fittings - Purple/Purple	330379
Pump Tube Assy w/barb fittings - Green/Green	330380
Pump Tube Assy w/barb fittings - Blue/Blue	330381
Pump Tube Assy w/barb fittings - Yellow/Blue	330382
Pump Tube Assy w/barb fittings - Yellow/Yellow	330383
Pump Tube Assy w/barb fittings - Grey/Grey	330384
Pump Tube Assy w/barb fittings - Red/Red	330385
Pump Tube Assy w/barb fittings - White/White	330386
Pump Tube Assy w/barb fittings - Orange/Orange	330387
Pump Tube Assy w/barb fittings - Black/Black	330388
Pump Tube Assy w/barb fittings - Orange/White	330389
Pump Tube Assy w/barb fittings - Orange/Yellow	330390
Pump Tube Assy w/barb fittings - Orange/Green	330391
Pump Tube Assy w/barb fittings - Orange/Blue	330392
Reagent Line - Pump Tube Yellow/Blue	330268
Reagent Line - Pump Tube Orange/Blue	330269
Tubing Assy - 3700 FEP .031"ID Vlv To Mnfld	330006
Tubing Assy - 10cm Flanged .8mm ID FEP	330251
Tubing Assy - 25cm Flanged .8mm ID FEP	330252
Tubing Assy - 10cm FEP .031"ID	330011
Tubing Assy - 20cm FEP .031"ID	330012
Tubing Assy - 25cm FEP .031"ID	330013
Nut-Headless 1/4-28 1/16" OD Tubing	330007
Union, 1/4-28 (3 pack)	A001758
Ferrule, 0.063" ID (6 pack)	A001759
Ferrule, 0.087" ID	317305
Female Luer, 1/4-28 (3 pack)	A002666
Male Luer, 1/16 (10 pack)	A001769
Male Luer, 3/32 (10 pack)	A002778
Male Luer, 1/8 (10 pack)	A002797
Nipple, N9	A116-0010P01
Nipple, N8 (6 pack)	A116-0003P01
Nipple, N7 (6 pack)	A116-0005P01
Nipple, N13 Stainless Steel	A116-0061P01

3-Port Splitter, Glass	A303-0110-00
3-Port Splitter, Stainless Steel	A303-0114-00
3-Port Splitter, Air Injection	A000301
4-Port Splitter, Glass	A303-0111-00
Pillow Assembly	A000811
Back Pressure Coil	A001309
Valves	
Description	**Part Number**
ASSY-3700 10-port FIA Valve & Cable	330086
Tubing Kit - 10-port FIA Valve	330121
Sample Loop - 100 µL for 10-port valve	330015
Sample Loop - 200 µL for 10-port valve	330016
Sample Loop - 400 µL for 10-port valve	330020
Bypass Loop - 100 µL for 10-port valve	330018
Bypass Loop - 200 µL for 10-port valve	330019
Bypass Loop - 400 µL for 10-port valve	330021
ASSY-3700 8-port FIA Valve & Cable	330394
Tubing Kit - 8-port FIA Valve	330398
25 µL Sample Loop (or Bypass Loop) for 8-port valve	285650
50 µL Sample Loop (or Bypass Loop) for 8-port valve	285668
100 µL Sample Loop (or Bypass Loop) for 8-port valve	285676
200 µL Sample Loop (or Bypass Loop) for 8-port valve	285684
300 µL Sample Loop (or Bypass Loop) for 8-port valve	285692
400 µL Sample Loop (or Bypass Loop) for 8-port valve	319334
FS3700 Parts & Accessories	
Description	**Part Number**
Amperometric Reference Electrode with Instructions (3700/9310)	328121
Gas Diffusion Membrane - Polyproylene (pack of 5)	A001520
Gas Diffusion Membrane - Teflon (pack of 25)	A002040
ASSY-3700 Air Addition Tee	330262
ASSY-3700 Mixing Tee	329498
ASSY-3700 Amperometric Cell Tested	330001
ASSY-3700 Amperometric Det Tray	329387
ASSY-3700 Analytical Plate Common	329490
ASSY-3700 Gas Diffusion Manifold - Low Level	329040
ASSY- Membrane Manifold (dialysis or gas diffusion - high level) PS	328113
ASSY- Membrane Manifold (dialysis or gas diffusion - high level) PVDF	319538
ASSY-3700 Debubbler Mount	330017

Debubbler	A000172
ASSY-3700 Photometric Detector Diode	329482
ASSY-3700 Photometric Lamp	329480
ASSY-3700 Reference Diode	329478
ASSY-3700 Sample Heater (FEP)	329486
ASSY-3700 Sample Heater (PEEK)	330078
ASSY-3700 UV ballast	330055
ASSY-3700 UV digestor w/lamp	329996
Cable-3700 Amperometric detector signal cable	330061
Cable-3700 Detector lamp power	329799
Cable-3700 Pump Interface	330186
Cable-3700 Sampler Interface	330187
Cable-USB to RS422 conversion 5m	329241
CD-3700 SW w/Manual	330122
Cover - 3700 Detector Cover	329515
Kit - 24VDC Desktop Power Supply (3700/9310)	329296
Nut-Hex SS 3/8-24	179267
Term-Ring Red #8	297952
Scr-Shldr Thumb SS 6-32X13/32"L	330114
Flowcell - 3700 20mm PEEK tested	330003
Flowcell - 3700 10mm PEEK tested	321212
Flowcell - 3700 5mm PEEK tested	321213
Filter Holder with set-screw	319573
Filter - 405 nm	A305-1405-00
Filter - 410 nm	A305-1410-00
Filter - 420 nm	A305-1420-00
Filter - 450 nm	A305-1450-00
Filter - 455 nm	A305-1455-00
Filter - 460 nm	A305-1460-00
Filter - 480 nm	A305-1480-00
Filter - 505 nm	A305-1505-00
Filter - 520 nm	A305-1520-00
Filter - 530 nm	A305-1530-00
Filter - 540 nm	A305-1540-00
Filter - 550 nm	A305-1550-00
Filter - 560 nm	A305-1560-00
Filter - 570 nm	A305-1570-00
Filter - 580 nm	A305-1580-00

Filter - 590 nm	A305-1590-00
Filter - 600 nm	A305-1600-00
Filter - 620 nm	A305-1620-00
Filter - 640 nm	A305-1640-00
Filter - 660 nm	A305-1660-00
Filter - 690 nm	A305-1690-00
Filter - 810 nm	A305-1810-00
Filter - 815 nm	A305-1815-00
Filter - 880 nm	A305-1880-00
Filter - 1000 nm	A305-1000-00
Chemicals/Reagents	
Description	**Part Number**
Brij-35 21% solution, 30mL	326126
DOWFAX 2A1, 30mL	328852
Base Reagent (cyanide) - 1L	A001103
TA-1 Acidification Reagent	A001505
TA-2 Acidification/Sulfide Abatement Reagent	A001872
Total Carrier/SCR Reagent - 1L	A001668
WAD A Ligand Exchange Reagent	A001416
WAD B Ligand Exchange Reagent	A001417
WAD Carrier Reagent - 1L	A001125
WAD AR Reagent - 1L	A001501
Kleenflow Acid - 500mL	A002295
Kleenflow Basic - 500mL	A002294
OIA1677/D7511 Cyanide control Std, 5mL	328942
150 ppm CN QC Standard (Copper Cyanide)	328685
25 ppm CN QC Standard (Copper Cyanide)	328686
ASTM Cyanide Challenge Matrix (D7365) - 500mL	327788
Chemical Reagent Kits - the reagents needed to perform a method	
Description	**Part Number**
KIT-REAGENT Cyanide, Available (ASTM D6888)	330255
KIT-REAGENT Ligands for Available Cyanide	330253
KIT-REAGENT Cyanide, Total (ASTM 7511)	330009
KIT-REAGENT Cyanide, Available (USEPA OIA-1677)	330254
Pumps & Autosamplers	
Description	**Part Number**
Pump, Peristaltic 8-channel Pump (110V)	322695

Pump, Peristaltic 8-channel Pump (220V)	323121
Pump, Peristaltic 16-channel pump (110V)	324057
Pump, Peristaltic 16-channel pump (220V)	324058
PUMP ASSY-24CH FSIV/3100 110V	324066
PUMP ASSY-24CH FSIV/3100 220V	324067
3090 X/Y Autosampler (90 sample capacity) (90V-240V)	324068
3360 X/Y Autosampler (360 sample capacity) (90V-240V)	324069
SAMPLER MODULE-3090, 90 position, XYZ - no kit	322700
SAMPLER MODULE-3360, 360 position, XYZ - no kit	323209
PEEK Autosampler Probe for RA/3090/3360 Sampler	325331
Autosampler Drain Tubing Kit	322520
90-Position Sample Vial Rack. NOTE: Accommodates 2- and 8-mL vials	323165
60-Position Sample Vial Rack. NOTE: Accommodates 4- and 12-mL vials	A002541
Replacement Platen for Ismatec Pump	A000166
Digestion/Distillation	
Description	**Part Number**
Block Digestor for TN/TP 24 positions 110V (CR3200 WTW)	1P22-2
Distillation Module	A515000
Chiller (for on-line distillation methods). NOTE: Requires tubing kit	261909
Chiller Tubing Kit	302810
Containers	
Description	**Part Number**
Sample Vials, Glass 8-mL (13 X 100 mm) (pack of 1000). Used on 90-position racks	A000514
Sample Vials, Polypropylene 8-mL (13 X 100 mm) (Pack of 1000). Used on 90-position racks	A002547
Sample Vials, Polystyrene 12-mL (17 X 100 mm) (Pack of 2000). Used on 60-position racks.	A001293
Standards Vials, 50-mL (pack of 20). NOTE: Used on the 3360 Sampler	324394
Standards Vials, 30-mL (pack of 50). NOTE: Used on the 3090 Sampler	324056
Reagent Bottles, Amber Glass 250-mL (pack of 5)	A000102
Reagent Bottles, Clear LDPE 500-mL (pack of 5)	A000104
Wash Bottle (1L)	A000113
Wash Bottle (2L)	A003110
Waste Bottle (2L)	A000115
Waste Container (4L)	A001126
CUBITAINER - Reagent (4L)	327416
Vials - 40mL low bleed w/cap & septa (Pack of 72)	296053

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