



TELEDYNE
CETAC TECHNOLOGIES
Everywhereyoulook™

SDX_{HPLD}

High Performance Liquid Dilution System

For Use With Thermo Scientific™ Qtegra™ ISDS Software



Operator's Manual

Manual Part Number **480224** Rev 5, September, 2021

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1 Introduction

Overview

The Teledyne CETAC SDX_{HPLD} high performance liquid dilution system adds automated dilution to the capabilities of the ASX-560 autosampler. The autosampler draws a volume of sample from a sample vial then injects it into a vortex mixing vessel along with a volume of diluent. After vortexing, the diluted sample is sent to the ICP-MS or other analytical instrument, and the sample probe and vortex vessel are thoroughly rinsed.

The SDX_{HPLD} system is often used along with the Teledyne CETAC *ASXPRESS PLUS* rapid sample introduction system. The *ASXPRESS PLUS* greatly improves throughput, by moving the sample close to nebulizer quickly, and then rinsing the sample line while the sample is being analyzed.

About This Manual

This manual describes the procedures for installing, using, and maintaining your CETAC SDX_{HPLD} high performance liquid dilution system.

Who Should Read This Book

The primary audience for this manual consists of analytical chemists and lab technicians. To use this product, you should have a basic knowledge of chemistry, a basic knowledge of electronic sampling equipment, at least a beginning level of computer experience, and working knowledge of the analytical instrument used with the autosampler.

WARNING

CHEMICAL INJURY HAZARD

The SDX_{HPLD} system is for use only by qualified operators who have been trained in safe laboratory practices. Make sure you know the hazards associated with all of the chemicals you are using, and take the appropriate precautions. Exposure to laboratory chemicals may result in serious injury.

System Components

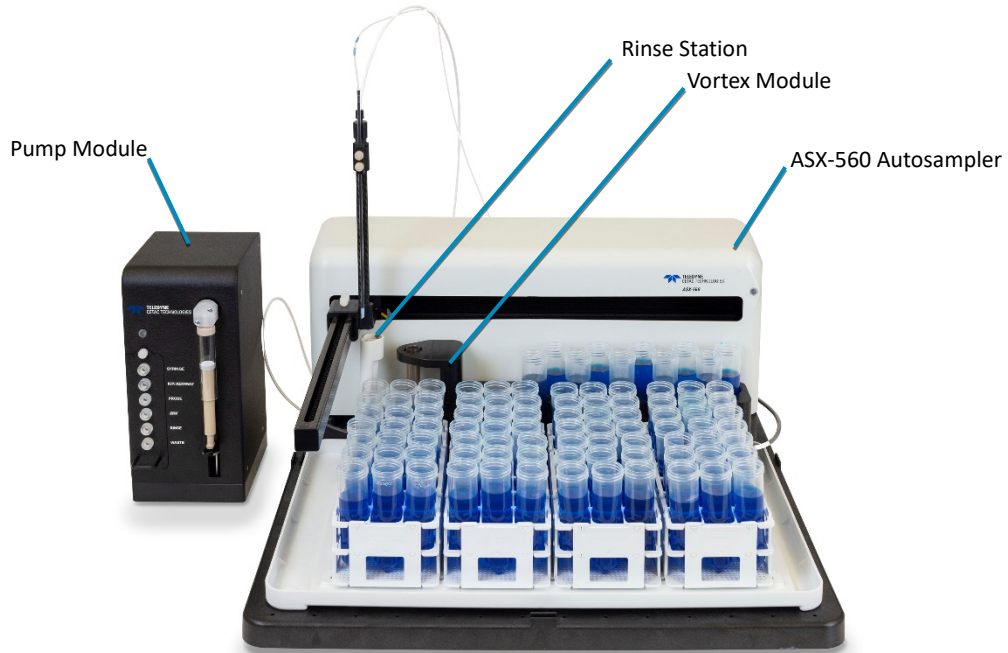


FIGURE 1-1 SDX Dilution Accessory and Autosampler—Front View

- **SDX Pump Module.** Provides precise flows of liquid through the system.
- **SDX Vortex Module.** Provides thorough mixing of samples with the diluent.
- **ASX-560 Autosampler.** Moves the probe to transfer liquid from vials into the vortex module or to the analytical instrument.
- **Rinse Station.** The flowing rinse station is located at the left end of the standards positions at the back of the sample base. It comes with tubing used to connect the rinse station to the rinse source and the waste container.

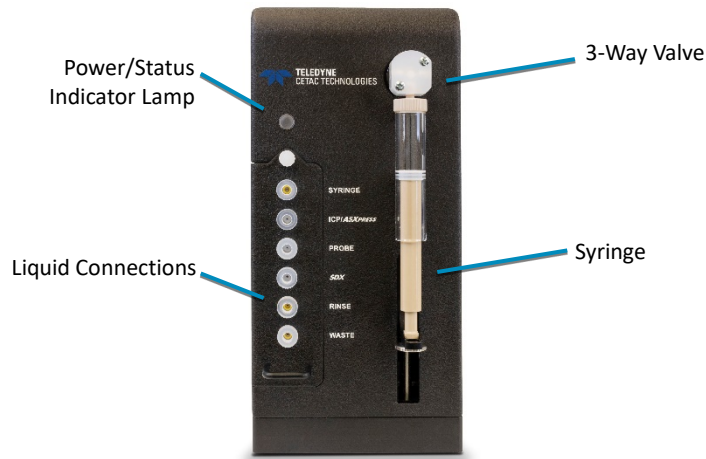


FIGURE 1-2 SDX Pump Module —Front View

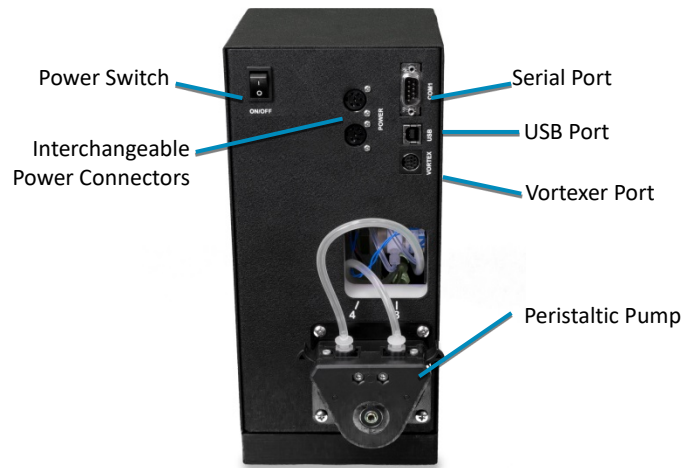


FIGURE 1-3 SDX Pump Module —Back View

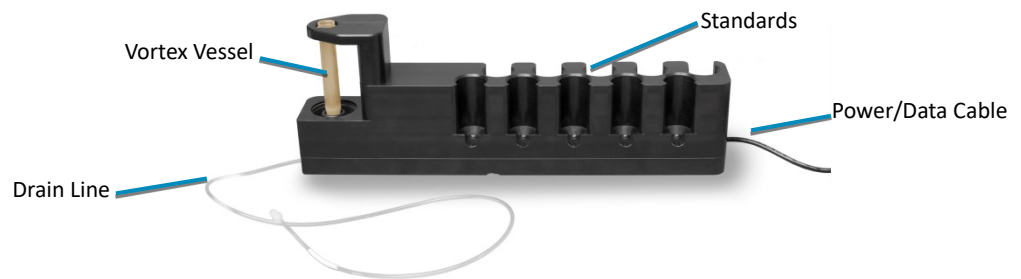


FIGURE 1-4 SDX Vortex Module

- **Power/Status Indicator Lamp.** The LED glows blue when the SDX_{HPLD} high performance liquid dilution system is connected to a power source and turned on.

The following components are located on the back of the SDX pump module:

- **One-channel peristaltic pump.** A single channel peristaltic pump moves the rinse solution into the vortex vessel then pumps away the waste.
- **Power connectors.** Power from the desktop transformer comes into one connector (either connector may be used as the input). A power bridge cable on the other connector provides power to the autosampler.
- **Vortexer port.** Powers and controls the vortexer module.
- **USB Port and Serial Port.** The USB or serial port connects the SDX pump module with the analytical instrument's host computer.

The following standard components are also shipped with the SDX_{HPLD} high performance liquid dilution system:

- Autosampler Tray
- Shelf Kit
- Power Bridge Cable.
- Tubing Kit
- 10 mL Borosilicate Syringe
- USB Cable
- Spare fittings and ferrules
- **CD.** The CD contains, if applicable:
 - USB device drivers
 - Plug-ins or drivers for various ICP software
 - Autosampler alignment files
 - Manuals
 - Other application-specific information

Supplied components depend on the application and the exact version of the product. See the packing list in the shipping container to see exactly which components are supplied.

Additional Equipment Required

When you purchase a full system, a Teledyne CETAC ASX-560 autosampler is supplied. When you purchase an upgrade, you must supply the ASX-560.

In addition to the provided equipment, you will need the following items:

- A diluent bottle
- A bottle for the vortexer rinse solution
- A liquid waste container, 10 liters or larger
- A host computer with an additional free USB or serial connector
- A Phillips screwdriver

Sample Probe

It is important to choose a sample probe with the appropriate inner diameter for your application. The probe diameter is indicated by the color of the band on the sample tubing just above the probe.

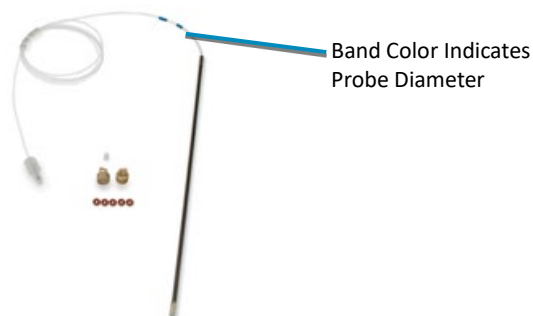


FIGURE 1-5 1.0 mm Sample Probe

| Inside Diameter | Band Color | Application |
|-----------------|------------|--|
| 0.8 mm | Red | ICP-MS or ICP-OES without <i>ASXPRESS PLUS</i> |
| 1.0 mm | 2 Blue | ICP-MS or ICP-OES with <i>ASXPRESS PLUS</i> |

Software Requirements

You will need software to control the SDX_{HPLD} sample dilution system along with the autosampler and the ICP-MS (or other instrument). At the time this guide was published, the following software was supported:

- Thermo Scientific™ Qtegra™ Intelligent Scientific Data Solution™ (ISDS) software version 2.7 or greater

Optional Accessories

You may also wish to use:

- ***ASXPRESS PLUS* Rapid Sample Introduction System.** 6-port valve system which enables rapid sample loading and probe wash out. To use the *ASXPRESS PLUS* you will also need:
 - Check valve (included with your SDX system)
 - Large I.D. (1 mm) sample probe (included with the *ASXPRESS PLUS*)

Chemical Compatibility

The SDX_{HPLD} system is intended for use with aqueous sample matrices with the following characteristics:

- aqueous solutions
- low to high acid content (HNO₃, HCl)
- low to high dissolved solids

Most components of the SDX_{HPLD} high performance liquid dilution system and sample flow path are manufactured from the same materials as the autosampler. See the *ASX-560 Operator's Manual* for information on what chemicals to avoid using with the autosampler.

Guidelines for Samples

The system is not suitable for oils applications or high viscosity samples.

- HF may be used in sample tubes.
- Acid concentration in samples must not exceed 25%.
- Samples may contain low to high dissolved solids.

NOTICE

Avoid use with chemicals which are likely to precipitate or form deposits on the internal surfaces, such as silver chloride. Samples which contain AgCl may contaminate the internal surfaces and require the replacement of the tubing, valves, and vortex vessel before the system can be used again.

Guidelines for Diluent and Rinse Solutions

The syringe includes stainless steel components which can be damaged by prolonged exposure to acid vapor.

- Do not use HF in the diluent or rinse solutions.
- Diluent and rinse solutions must not exceed 10% acid by weight.
- Diluent and rinse solutions should be free of any dissolved solids.

NOTICE

Avoid use with any chemical (including in the rinse solution) which could damage the ICP or ICP-MS. During rinsing the solution is drawn through the 5-port valve from the separate vortex rinse solution to the ICP. The rinse solution is typically a higher acid concentration for low carryover, but it is important to verify that the acid concentration is not too high for the ICP.

Where to Go for More Information

In addition to this manual, you can refer to the following resources:

- New versions of this manual may be requested on CETAC's Web site:
www.teledynecetac.com
- *SDX Spare Parts and Accessories Catalog*, available on the CETAC Web site.
- *ASX-560 Operator's Manual* provides information about installing and using the autosampler.
- Teledyne CETAC Technologies Customer Service and Support:
Phone: 1 (800) 369-2822 (USA only)
1 (402) 733-2829
E-mail: cetacservice@teledyne.com

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2 Installing the SDX Dilution Accessory

No tools are required to install the SDX dilution accessory. You can remove thumbscrews with tools if necessary, but do not tighten them with anything other than your fingers.

To install the SDX_{HPLD} high performance liquid dilution system, you must complete the following tasks. Each of these tasks will be discussed in detail later in this chapter.

- Install the autosampler.
- Install the SDX_{HPLD} high performance liquid dilution system.
- Install the software.

WARNING

PINCH/PUNCTURE HAZARD

Ensure the power switch is off and the power cord is unplugged before proceeding with installation. If the power is left on, motors may move unexpectedly and cause injury.

NOTICE

Do not trim the tubing connected to the SYRINGE PUMP and SDX ports. The system is designed to work with specific internal volumes in this tubing; changing the tubing length will cause incorrect operation and may lead to spills and equipment damage.

Do trim the tubing in the sample path from the autosampler to the SDX pump module and then to the nebulizer. This tubing should be as short as possible while allowing the autosampler to move to all sample locations. See the *ASX-560 Autosampler Quick Installation Guide* for information.

Choosing a Location

Position the SDX_{HPLD} high performance liquid dilution system near the ICP. Position the SDX pump module on a flat surface beside the ASX-560. Rinse and diluent bottles may be placed beside or behind the autosampler.

Space Requirements

The vortex module fits on the autosampler tray. You need to allow a little extra space for the pump module:

| | |
|---------------|----------------|
| Height | 25.4 cm (10") |
| Width | 13.2 cm (5.2") |
| Depth | 11.7 cm (8.5") |

TABLE 1: Physical Characteristics – SDX Pump Module

Allow *at least* 5 cm behind the pump module for cable egress and access to the power switch. Always position the equipment so that it is easy to disconnect the power cord.

Power Requirements

The SDX_{HPLD} high performance liquid dilution system is powered through a desktop "brick" power supply. The SDX pump module supplies power to the autosampler through a 24V power bridge cable.

WARNING

SHOCK AND FIRE HAZARD

Use only the power supply which is provided with the autosampler. The power supply must be plugged into an outlet which has a protective ground connection.

The power supply must be connected to an AC power source that will not apply more than 240 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.

Ensure that you position the SDX pump module so that the location where the power supply cord plugs into it is easily accessible (is not blocked) so that it can be quickly disconnected if needed. In case of hazard, the autosampler should be disconnected from the power source.

The power supply socket is on the back of the SDX pump module. Do not apply power to the power supply until ready to operate the equipment.

Unpacking the SDX Accessory

Inspect external packaging upon receipt for signs of shipping damage. Inspect all items during unpacking and notify the carrier immediately of any concealed damage.

If the system is shipped or removed from storage during cold weather, allow the packaged equipment to equilibrate to room temperature before opening

and exposing to warm, humid air. It is usually sufficient to provide four to eight hours for this purpose.

NOTICE

EQUIPMENT DAMAGE FROM CONDENSATION

If condensation forms on or inside the device, allow the condensation to dry thoroughly before connecting the device to a power source. Using the device before it is dry may cause equipment damage.

Remove the packing checklist from the shipping container, and check off items against it. Leave accessories in the packing until you are ready to install them.

NOTE

Keep the factory packaging for use in case the product ever needs to be returned or shipped to another location.

Installing the Hardware

Installing the Autosampler

- 1 If the autosampler has not been installed, follow the instructions in the *ASX-560 Autosampler Quick Installation Guide*. It is easiest if you defer connecting the rinse station plumbing until after the SDX_{HPLD} vortexer is installed.
- 2 Install the SDX spill tray. The SDX spill tray does not have a built-in standards rack; the standard ASX-560 spill tray has a built-in standards rack. Use the rinse station which came with the autosampler.



FIGURE 2-1 SDX Spill Tray

Installing the Syringe

NOTICE

The syringe should be tightened with just your fingers; using pliers or other tools could damage the syringe.

NOTICE

Install the syringe before you connect the syringe pump to a power supply.

- 1 Check that the syringe pump is in the proper position.

The “lever” of the syringe pump must be at the “1/2” position in order to install the syringe. It should be shipped in this position. To move the pump into the correct position, use the software controls or cycle power on the pump.



FIGURE 2-2 Syringe Pump at the “1/2” Position

If the pump needs to be positioned:

- a. Connect the power cables as described on page 23.
 - b. Open the software and initialize communication.
 - c. Use the software to set the syringe position to 1/2. One way to do this is to use the instrument controls to aspirate 5 mL.
- 2 Remove the yellow protective caps from the fittings on the syringe pump. The caps can be discarded.
 - 3 Screw the top of the syringe into the valve on the pump module. Tighten it with your fingers.



FIGURE 2-3 Installing the Syringe on the Valve

NOTICE

Do not over-tighten the syringe. Use only your fingers and tighten until snug.

- 4 Align the bottom of the syringe plunger with channel in the lever of the pump.



FIGURE 2-4 Bottom of Syringe Aligned With Pump Lever

- 5 Attach the syringe plunger to the syringe locking nut. Make sure the plunger is properly engaged then tighten the thumb wheel using your fingers.

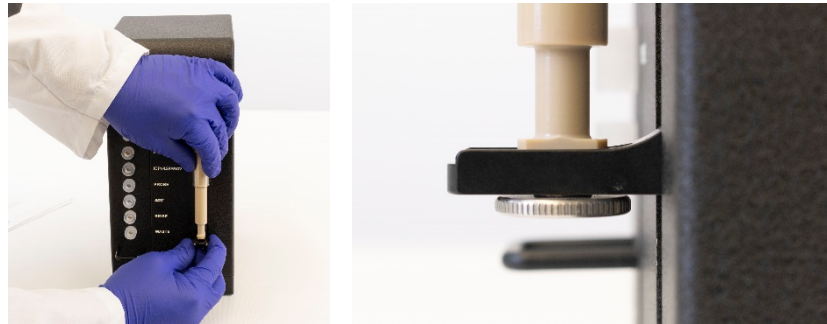


FIGURE 2-5 Attaching the Syringe Plunger

NOTICE

Make sure that the plunger is fully attached to the arm and that the nut is snug. Any gaps will result in dilution errors, due to the arm moving slightly before the plunger.

Do not over-tighten the syringe. Use only your fingers to tighten the nut.

Installing the Vortex Module

- 1 Turn the autosampler off and disconnect the power cable.
- 2 Locate the vortex vessel with its attached tubing.



FIGURE 2-6 Vortex Vessel and Tubing

- 3 Pass the tubing down through the vortex module.

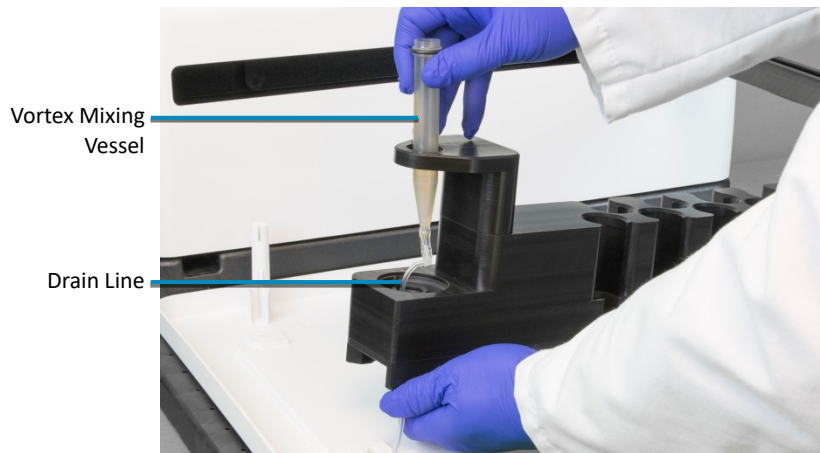


FIGURE 2-7 Installing the Vortex Vessel

- 4 Press the vortex vessel into vortex module. You should feel the vessel click into place.
- 5 Place the vortex module onto the autosampler tray, letting the tubing exit to the left. The vortex module seats on two pegs.

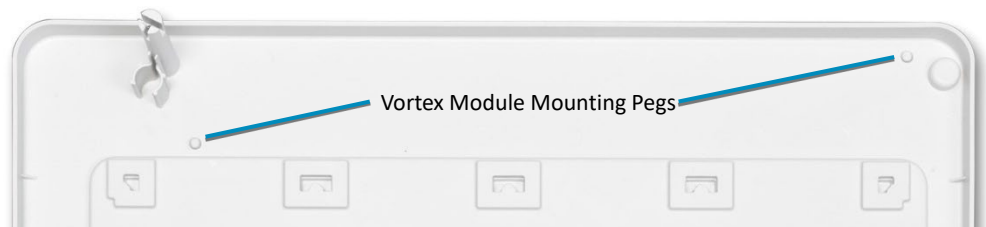


FIGURE 2-8 Placement of the Vortex Module

- 6 The vortexer cable will plug into the back of the syringe pump. You don't need to plug it in yet, but if the syringe pump will be on the left side of the

autosampler, you may feed the vortexer cable behind the vortex module. Alternatively, you can route the vortexer cable around the back of the autosampler.



FIGURE 2-9 Vortexer Cable Routing

- 7 If the rinse station is installed on the autosampler, remove it by lifting it straight up.
- 8 Press the tubing holder straight down onto the rinse station support post.

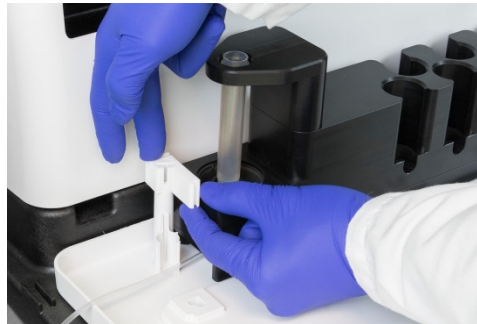


FIGURE 2-10 Installing the Tubing Holder

- 9 Press the vortex vessel tubing into the grooves in the tubing holder. Allow just enough slack so that the tubing is not stretched or kinked as the vortexer operates.



FIGURE 2-11 Arranging Tubing in the Tubing Holder

- 10 If you wish, thread the drain line tubing through the “tunnel” under the autosampler head.
- 11 Connect the rinse tubing to the rinse station (refer to the *ASX-560 Installation Guide*) then reinstall the rinse station by pressing it straight down.



FIGURE 2-12 Installing the Rinse Station






- 12 Adjust the position of the tubing so that it does not touch the side of the rinse station or the side of the vortex module. This will reduce wear on the tubing and reduce noise.

Installing the SDX Shelf (Optional)

The included shelf allows you to save bench space by placing the SDX pump module on top of the autosampler. The SDX_{HPLD} high performance liquid dilution system may be used with or without the shelf. Keep in mind that the SDX valve module should be placed as close as possible to the ICP (or to the *ASXPRESS PLUS* valve or Sprint valve if you are using one).



Parts Provided

| Quantity | Description | Image |
|----------|-------------------------------------|--|
| 1 | SDX Shelf Bottom Plate |  |
| 1 | SDX Shelf Top Plate |  |
| 2 | Flat Head Screw 6-32 x 1/2 |  |
| 4 | Long Pan Head Screw 6-32 X 1-1/2 |  |
| 5 | Short Pan Head Screw 8-32 x 1/2 |  |

Assembling the Shelf

- 1 Press the SDX shelf into place over the raised tab on the mounting bracket.
- 2 Secure the pieces by inserting the two flat head screws into the matching tapered holes on the shelf and tightening.

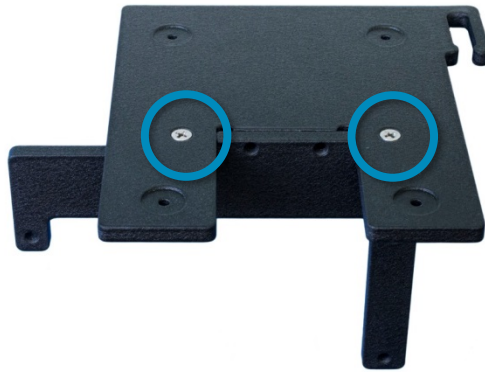


FIGURE 2-13 Assembling the Shelf—Installing the Machine Screws

- 3 Insert two short pan head screws into the holes in the raised tab of the mounting bracket and tighten.

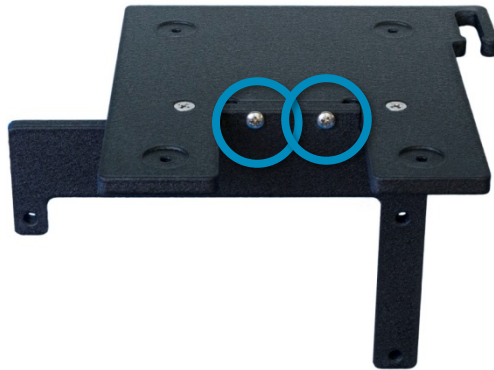


FIGURE 2-14 Assembling the Shelf—Installing the Pan Head Screws

Attaching the SDX Pump Module to the Shelf

The SDX mounting shelf includes a set of four screws designed to secure the SDX module to the shelf. Mounting the SDX using these screws is optional but recommended. If you do not wish to secure your SDX module to the shelf, you may skip this section.

- 1 Turn the SDX pump module upside-down on a secure tabletop.

- 2 Remove the four screws securing the feet to the bottom of the SDX pump module and leave the feet in place.



FIGURE 2-15 Removing Screws From the Pump Module Feet

- 3 Position the shelf assembly as shown and secure the shelf assembly to the SDX pump module using the four long pan head screws.



FIGURE 2-16 Attaching the Pump Module to the Shelf

Attaching the Shelf to the Autosampler

- 1 Remove the top two and bottom right screws from the plate above the peristaltic pump.



FIGURE 2-17 Removing 3 Screws From the Autosampler

- 2 Place the shelf assembly on top of the autosampler and line up the holes on the bracket with the holes on the back of the autosampler. Secure the shelf assembly to the autosampler using 3 short pan-head screws.

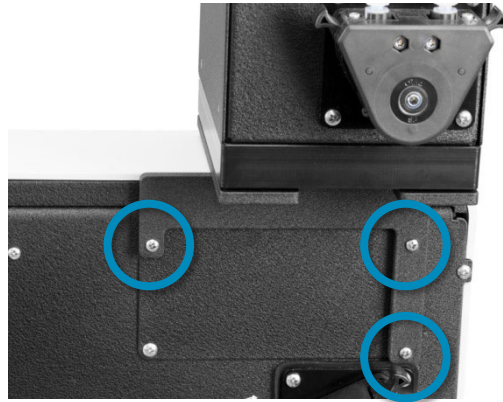


FIGURE 2-18 Attaching the Shelf

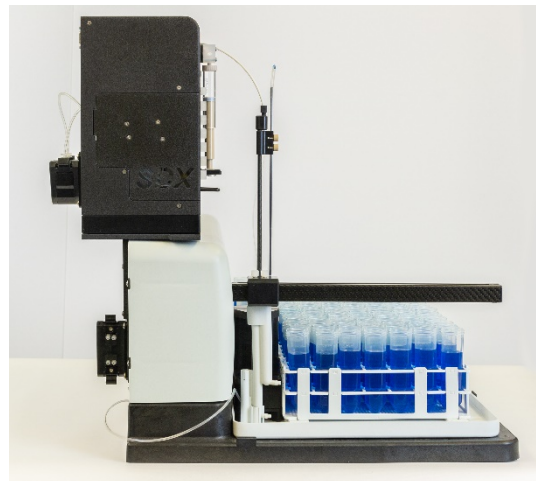


FIGURE 2-19 Shelf After Installation—Side View

Connecting the Sample Probe

- 1 Push the Z-drive over to the position farthest from the SDX pump module, then turn the rotor on the back of the autosampler to lower the Z-drive to its lowest position. This will ensure that there is enough slack in the sample line so that the probe can move freely.
- 2 If the autosampler was previously installed without the SDX, disconnect the autosampler probe line from the ICP.
- 3 Select the appropriate probe. If an *ASXPRESS* Plus system or Sprint valve is present, install the 1.0 mm I.D. sample probe in the Z-axis. If not, install the 0.8 mm I.D. sample probe.
- 4 Install the probe on the Z-drive of the autosampler. If you are not familiar with the procedure, follow the instructions in the *ASX-560 Autosampler Quick Installation Guide*.
- 5 Use the included spiral wraps to secure the sample line to the white Z-drive cable. This will keep the sample line from getting snagged when the autosampler moves.
- 6 Using the rotor on the back of the autosampler, move the Z-drive up and down. Make sure that there is still enough slack in the sample line so that the probe can move freely. Check that the sample line is not stretched, snagged, or kinked.

Connecting the Tubing

NOTICE

Do not pull the fittings out of the tubing. Some of the tubing is FEP lined Tygon; if you pull out the fittings, the FEP lining will stretch and separate from the outer tubing.

Connect the tubing to the front of the pump module. Each tube is labeled to match its connector. It is usually easiest to work from the bottom up:

- 1 Connect the WASTE tube to the WASTE connector. Tighten the fitting with your fingers.



FIGURE 2-20 Connecting the WASTE Tube

- 2 Place the other end of the WASTE tube in the waste container.

CAUTION

Ensure that the tubing outlet is placed so that it will remain above the surface of the liquid in the waste container. If the end of the tube is immersed, the waste solution might back up and overflow.

- 3 Connect the RINSE tube.



FIGURE 2-21 Connecting the RINSE Tube

- 4 Place the other end of the RINSE tube in the bottle of vortex vessel rinse solution.
- 5 Connect the VORTEX→SDX tube (the tube connected to the bottom of the vortex vessel) to the SDX port.



FIGURE 2-22 Connecting the VORTEX→SDX Tube

- 6 Trim the sample probe tube to be as short as possible, while allowing the sample probe to move easily to every position after it is connected to the SDX.

NOTICE

Do not trim the tubing connected to the SYRINGE PUMP and SDX ports. The system is designed to work with specific internal volumes in this tubing; changing the tubing length will cause incorrect operation and may lead to spills and equipment damage.

- 7 Install the nut and ferrule on the end of the sample probe tube then connect the sample probe tube to the PROBE connector.

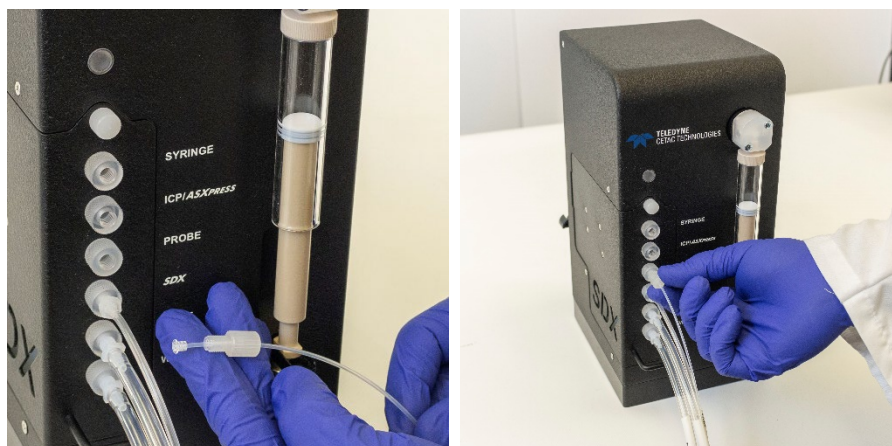


FIGURE 2-23 Connecting the PROBE Tube

If you are *not* using an *ASXPRESS PLUS* rapid sample introduction system:

- 8 Connect the ICP tube to the ICP/*ASXPRESS* port.



FIGURE 2-24 Connecting the ICP Tube

- 9 Connect the other end of the ICP tube to the sample uptake connector on the peristaltic pump of the ICP-MS or other instrument. Keep this line as short as possible (you may trim this tubing). Skip to step 15.

If you *are* using an *ASXPRESS PLUS* rapid sample introduction system:

- 10 Position the *ASXPRESS PLUS* valve as close as possible to the ICP nebulizer.
- 11 Connect the *ASXPRESS PLUS* system to the ICP, as described in the *ASXPRESS PLUS Installation Guide*.
- 12 Connect the *ASXPRESS PLUS* sample intake tubing (port #2) to the check valve.

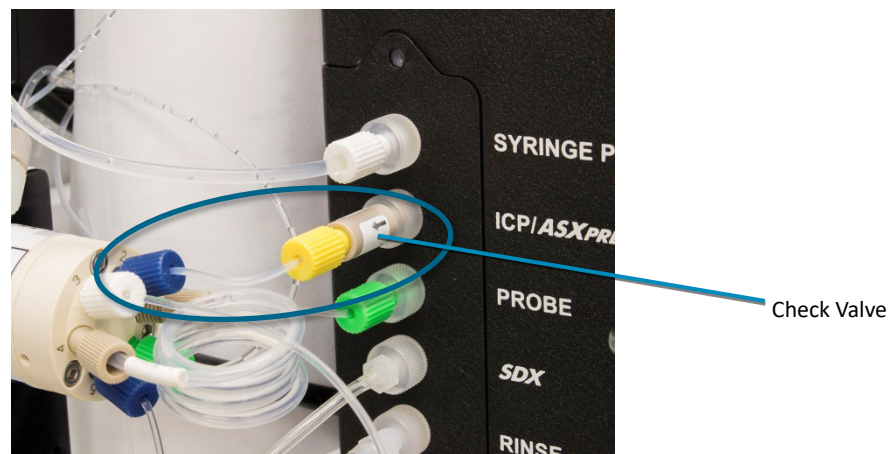


FIGURE 2-25 Check Valve for the *ASXPRESS PLUS*

- 13 Connect the check valve to the ICP/*ASXPRESS* port on the SDX.

- 14 Connect the other end of the *ASXPRESS PLUS* sample intake tubing to port #2 ("AUTOSAMPLER") on the *ASXPRESS PLUS* valve.
- 15 Connect one end of the sample loop to the SYRINGE connector, and the other end to the left side of the three-port valve.



FIGURE 2-26 Connecting the Sample Loop

- 16 Connect the SYRINGE(R)-DILUENT tube to the right side of the valve.



FIGURE 2-27 Connecting the Diluent Tube

- 17 Place the other end of the SYRINGE(R)-DILUENT tube in the bottle of diluent.

Connecting the Rinse Station Tubing

- 1 Connect the autosampler rinse station tubing, as described in the *ASX-560 Autosampler Quick Installation Guide*.

Connecting the Power Cables

The SDX_{HPLD} high performance liquid dilution system is powered by the autosampler's external desktop "brick" power supply. The autosampler is then powered through the SDX pump module.

Ensure that you position the pump module so that the location where the power supply cord plugs into it is easily accessible (is not blocked) and it can be quickly disconnected if needed. In case of hazard, the system should be disconnected from the power source.

WARNING

FIRE AND SHOCK HAZARD

Use only the desktop power supply which is supplied with the autosampler. The power supply must be plugged into an outlet which has a protective ground connection.

NOTICE

Plugging or unplugging the vortexer cable while the SDX pump module is powered on could result in equipment damage.

- 1 Make sure the power switches on the back of the SDX and on the back of the autosampler are turned OFF.



FIGURE 2-28 Power Switch

- 2 If you are not using the shelf, place the SDX pump module next to the autosampler. In most cases, it works best to position it on top of or to the left of the autosampler.
- 3 Connect the vortexer cable to the VORTEX connector on the back of the SDX pump module.



FIGURE 2-29 Connecting the Vortexer Cable

- 4 Connect the power bridge cable between a POWER port on the back of the SDX (either one will work!) and the ASX-560 power connector.

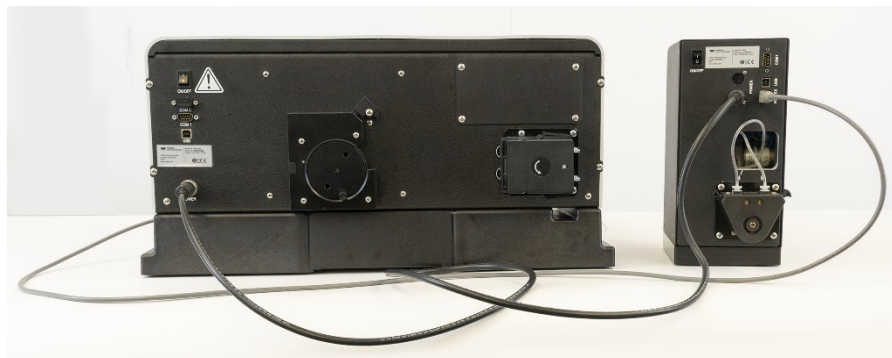


FIGURE 2-30 Vortexer Cable and Power Bridge Cable Connections

- 5 Connect the desktop power supply to the other POWER port on the back of the SDX.
- 6 Connect a USB cable between the SDX pump module and the computer. See “Connecting a USB Cable” on page 35 for details.



FIGURE 2-31 Power and USB Cables

The SDXHPLD pump module, the autosampler, and, if applicable, the *ASXPRESS PLUS* should each be connected directly to the host computer. See page 36 for details on connecting an *ASXPRESS PLUS*.

- 7 Check the plug on the power cord to verify that it is of the correct type for your country.
- 8 Plug the power cord into a power outlet.

- 9 Plug the power cord into the power supply.



FIGURE 2-32 Power Supply

- 10 Turn on the power switches of the ASX-560 and the SDX pump module.

It is important to use the appropriate power cord for your country. See

- “Power requirements” on page 76.
- “Power Cord Set Requirements” on page 77.

Connecting the SDX Accessory to the Host Computer

Software on the host computer controls the analytical instrument, the autosampler, and the SDX_{HPLD} high performance liquid dilution system. The SDX_{HPLD} high performance liquid dilution system uses a separate USB (or serial) connection to the computer; SDX commands are not passed through the autosampler.

- Communication is normally through a USB interface. A virtual COM port is created so that the connection looks like a standard RS-232 serial port to the host PC software.
- If necessary, a serial (RS-232) connection may be used instead of a USB connection.
- The SDX_{HPLD} pump module, the autosampler, and the Sprint valve (or *ASXPRESS PLUS*) should each be connected directly to the host computer.

Connecting a USB Cable to the SDX_{HPLD}

Use either a serial cable or a USB cable (not both).

You will need an "A-B" USB cable.



FIGURE 2-33 USB Cable

- 1 Power on both the computer and the SDX_{HPLD} high performance liquid dilution system.
- 2 Plug one end of the cable into the host computer's USB port and the other end into the SDX_{HPLD} high performance liquid dilution system's USB port.

The computer screen should display a "New Hardware Found" window. A USB driver must be installed to make the USB port emulate an RS-232 COM port, and the installation must be repeated for each USB connection.

- 3 Allow the Windows Found New Hardware Wizard to use Windows Update to search for a driver.

In most cases, the driver will be found online and installed automatically. This process may take several minutes.

If the driver is not installed automatically, insert the CD-ROM and allow the wizard to search the CD-ROM and install the driver (the exact procedure depends on the version of the Windows operating system). For Microsoft Windows 7, you may need to navigate to the "FTDI Driver" folder on the CD-ROM to find the driver file named "ftdiport.inf". The hardware will be identified as an "FT 232R USB UART" and then as a "USB Serial Converter."

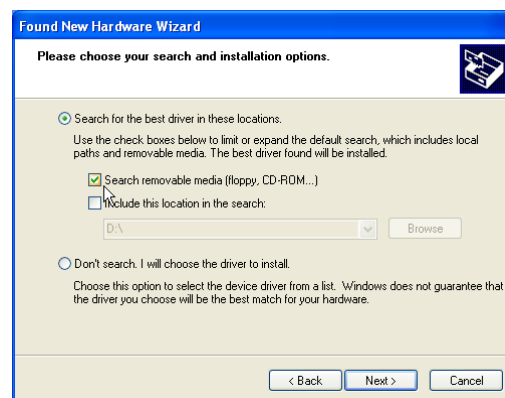


FIGURE 2-34 Windows Found New Hardware Wizard (Windows 7)

- 4 When driver installation is complete, make a note of which COM port number was assigned. The COM port number may be displayed in a “bubble” in the lower right corner of the screen.
- 5 Confirm that the COM port selected for the USB matches the port selected in the host computer's instrument control software.

Connecting a Serial Cable

Use either a serial cable or a USB cable (not both).

You will need to supply your own serial cable with two male DB-9 connectors.

- 1 Plug one end of the cable into the host computer's serial (COM) port.
If the computer has more than one serial port, make sure to use the same port which is selected in the instrument control software.
- 2 Finger-tighten both screws of the connector.
- 3 Connect the other end of the cable to the SDX_{HPLD} high performance liquid dilution system's serial port.
- 4 Finger-tighten both screws of the connector.

NOTE ABOUT SERIAL CABLES

Do not use a “null modem” adapter. Do not use a USB-to-serial adapter.

When interconnecting any computing devices, keep the communications cables away from sources of electromagnetic or radio frequency (RF) interference, such as electric motors, transformers, fluorescent light ballasts, or RF energy sources. Limit cable runs for RS-232C to less than 16 meters. If these conditions cannot be satisfied, use low-impedance, fully shielded cables to provide satisfactory operation. The cables are available from many sources, but you will need to specify the correct mating connectors and “straight-through” (DTE-DCE) wiring.

Connecting an ASXPRESS PLUS

Without the SDX_{HPLD}, there are two ways to connect the ASXPRESS PLUS (or Sprint valve):

| Connection | Description | How to Connect the SDX _{HPLD} |
|--------------|--|---|
| Direct | Separate USB connections to the ASXPRESS PLUS and autosampler. | Simply add a connection to the SDX _{HPLD} . |
| Pass-through | Autosampler communication passes through the ASXPRESS PLUS. | You must move the communication cables. See the instructions below. |

When you use the SDX_{HPLD} each device needs to have its own connection to the PC.

Changing to a Pass-Through Connection to a Direct Connection

If you are adding the SDX_{HPLD} to a system which has an *ASXPRESS PLUS* and autosampler, and the connection passes through the *ASXPRESS PLUS*, then:

- 1 Remove the OEM COM cable between the PC and the *ASXPRESS PLUS*.
- 2 Remove the serial cable between the *ASXPRESS PLUS* and the autosampler.
- 3 Install a USB or serial cable to directly connect the PC to the autosampler.
- 4 If necessary, adjust settings in the ICP software (or other instrument control software) so the *ASXPRESS PLUS* does not attempt to send commands to the autosampler.

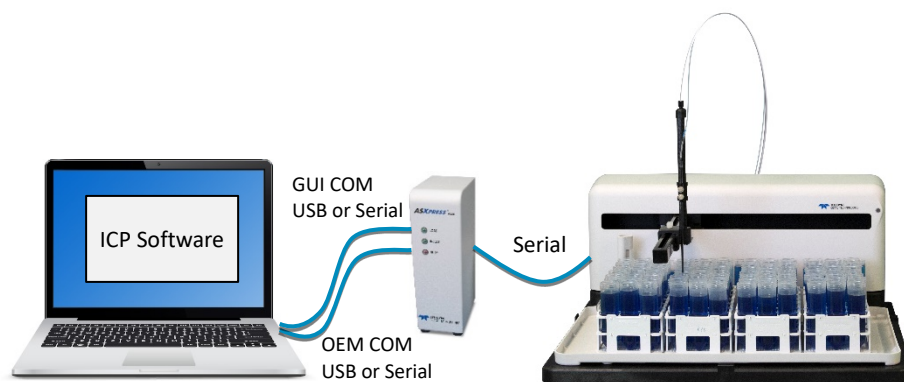


FIGURE 2-35 Pass-Through Connection Without SDX_{HPLD}



FIGURE 2-36 Direct Connections With SDX_{HPLD}

Installing and Configuring the Software

The SDX_{HPLD} is operated through a plug-in for your instrument control software. For instructions on installing and configuring the software, see the *SDX_{HPLD} Operators Manual*.



NOTICE

Do not operate the SDX syringe pump until the software has been configured. The settings in the software depend on the inside diameter of the sample probe you are using. Setting the sample aspiration or dispense speed too high can destroy the syringe and valves. See the *Operator's Manual* on the CD-ROM for more information.

Verifying Operation

Align the Autosampler

If you purchased a complete system, alignment is not necessary.

If you installed the SDX_{HPLD} as an upgrade to an existing ASX-560 autosampler, you must perform an alignment. For alignment instructions, see "Aligning the Autosampler" in the *ASX-560 Autosampler Operator's Manual*. You will need to use the alignment file from the CD-ROM which you received with the SDX_{HPLD}.

3 Using the SDX Accessory

Starting the System

WARNING

PINCH HAZARD

Keep fingers, hair, and loose clothing away from the moving parts of the autosampler.

To start the autosampler and SDX:

- 1 Ensure that all tubing is properly connected.
- 2 Visually inspect the sample area for misplaced vials and obstructions. Also make sure that any caps have been removed from the vials.
- 3 Turn the autosampler and SDX pump module power switches on.
The LED power indicator lights up when the power is on.
- 4 Use the control software to prime the lines (to purge air from the rinse solution and diluent lines). See page 57 for instructions.

Shutting Down the System

To shut down the autosampler and SDX, complete the following steps:

- 1 Drain the rinse and diluent tubing by removing the uptake tubing from the source containers. Let the pumps run until all liquid is drained.
If you use a rinse solution other than deionized water, flush the autosampler's rinse system with deionized water before shutting down the autosampler.
- 2 Turn off the SDX power switch.

- 3 Turn off the autosampler power switch.
- 4 If you will be performing maintenance, unplug the power cord either at the power supply or at the wall outlet.

Choosing Rinse Solutions

If you use solvents other than the ones recommended in this section, you should also carefully read "Chemical Compatibility" on page 12.

Probe Rinse Solution

The rinse uptake tube leading to the autosampler's peristaltic pump should be placed in a bottle of rinse solution. This rinse connection is the same, whether or not the SDX will be used with the autosampler.

In general, optimal carryover results from using 1% HCl for the rinse solution.

NOTICE

The probe rinse solution must be compatible with the ICP. The probe rinse solution is aspirated into the ICP.

Vortex Vessel Rinse Solution

The RINSE tube from the SDX pump module should be placed in a bottle of rinse solution.

In general, optimal carryover results from using 3% HNO₃ for the vortex rinse solution.

NOTICE

The vortex rinse solution must be compatible with the ICP. During the dilution, vortexer rinse solution is aspirated through the 5-port valve and into the ICP. If you use a rinse solution which is too strong, the ICP could be seriously damaged.

Flushing the Tubing

Generally, you can operate the autosampler and SDX without flushing the tubing. Under normal circumstances, you can simply drain the rinse solution and diluent prior to shutting down the autosampler. However, you need to flush the tubing, rinse station, and vortex vessel under two circumstances:

- During initial startup of the autosampler after installation.
- After the use of strong bases, acids, or organic solvents as rinse agents.

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

Flushing the Autosampler Rinse Station and Tubing

To flush the autosampler rinse station and flow path, complete the following steps:

- 1 Place the rinse uptake tubing into a container of deionized water.

NOTE

If you are flushing the rinse system during initial startup, first use a 2% nitric acid solution as the rinse agent, followed by deionized water.

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

Flushing the Vortex Vessel and SDX Rinse Tubing

- 1 Make sure that all of the tubing and fittings are properly installed.
- 2 Place the rinse uptake line in the rinse solution.
- 3 Use the fill function found in the control software. This will feed rinse solution into the bottom of the mixing vessel and activate the vortex action.
- 4 Use the drain function in the control software to remove the waste.
- 5 Repeat the fill/drain sequence until the rinse line is completely full and the vortex vessel has been flushed a minimum of 3 times.

Flushing the Syringe and Sample Probe

- 1 Ensure that the diluent uptake line is in the diluent source.
- 2 Use the control software to perform at least 2 purge cycles.

If changing diluent solution, you should purge the old solution with at least 2 purge cycles with the rinse tubing exposed to air to remove residue followed by 2 cycles in the new solution.

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4 Using the SDX with Thermo Scientific™ Qtegra™ ISDS Software

This chapter describes how to use the Teledyne CETAC SDX_{HPLD} High Performance Liquid Dilution System with the Thermo Scientific™ Qtegra™ Intelligent Scientific Data Solution™ software.

Once the SDX plug-in is installed and enabled, you need to select the appropriate settings in several places:

- ASX-560 settings in the Configurator.
- Sprint Valve settings in the Configurator.
- Instrument Controls.
- Method Editor.

NOTICE

Do not operate the SDX syringe pump until the software has been configured. Software settings depend on the diameter of the probe. **Incorrect settings will result in motor failure and valve damage.**

Installing the Plug-In

You will need to have administrative privileges on the computer to install the software.

- 1** Run the ASX-560/Sprint Valve/SDX plug-in installation package, accepting all default options.
- 2** Patch the Microsoft .NET framework software, if necessary.

Up to version (at least) Qtegra 2.7, only the .NET 4.5 libraries are installed. There are several bugs in .NET 4.5 which will cause the ASX-560/SDX plug-in to be laid out oddly. Please install the .NET 4.5.1 patch which can be acquired

free from Microsoft. This only applies to customers running Window 7 and Windows 8, as Windows 8.1 and Windows 10 already include these libraries.

Determining Which COM Port To Use

The plug-in will need to know which COM port is connected to the autosampler, which port is connected to the SDX pump module, and which port is connected to the Sprint valve (or *ASXPRESS PLUS*).

If you are using a USB connection, the COM port numbers were assigned by the USB driver when you connected the USB cables for the first time. Ideally, the port numbers were written down at that time.

If you do not know which port numbers were assigned, you can use the Windows Device Manager to distinguish the port numbers:

- 1 Connect the USB cables between the computer and the autosampler and SDX pump module, and turn them on.
- 2 Open the **Windows Device Manager**. The quickest way to do this is to click the Windows Start button and enter “device manager” in the search field.
- 3 In Device Manager, click **Ports (COM & LPT)**. You will see a list of all of the COM port numbers which have been assigned.

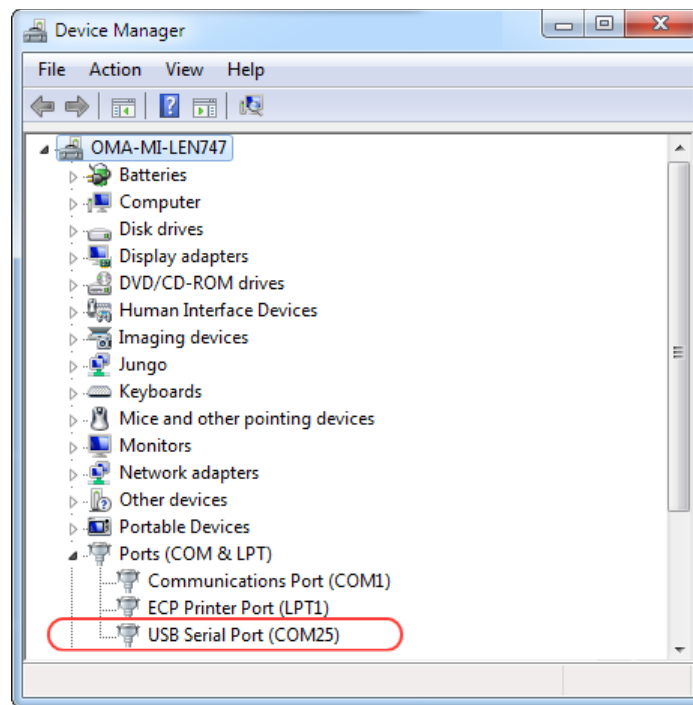


FIGURE 4-1 COM Port Assigned to a USB Port in Device Manager

- 4 Unplug the USB cable from the SDX pump module.
- 5 Note which COM port disappears from the list. This is the port number of the SDX pump module.

- 6 Repeat for the autosampler.

Determining the COM Port for the Sprint Valve

- 1 Use the same process as for the SDX pump module. *Two* COM port numbers will be associated with the Sprint Valve. Now you need to distinguish which COM port to use with the plug-in.
- 2 Open C-TERM (supplied on the CD that comes with the autosampler) or another terminal program and connect to one of the COM ports.
- 3 In C-TERM, enter @VER.

If the COM port is the correct one for the Sprint Valve, you will see a response beginning with "CETAC Technologies ASXPRESS+". If there is no such response, try the other COM port.

Determining the COM Port for a CETAC ASXPRESS PLUS

Use the same process as for the SDX pump module. There are several USB connectors on the back of the ASXPRESS PLUS electronics module; make sure the USB cable is plugged into the GUI COM port.

If you wish, you may print this chart to record the COM port numbers which are being used:

| Device | COM Port |
|---------------------|----------|
| ASX-560 Autosampler | |
| SDX Pump Module | |
| ASXPRESS PLUS | |

Enabling the SDX_{HPLD} System

- 1 Open the **Configurator** application.
- 2 Find the ASX-560 and select **Default settings....** (In most cases you will want some of the basic settings, such as the COM port number, to be the default. Changes can also be made in the Experimental Configuration Settings.)

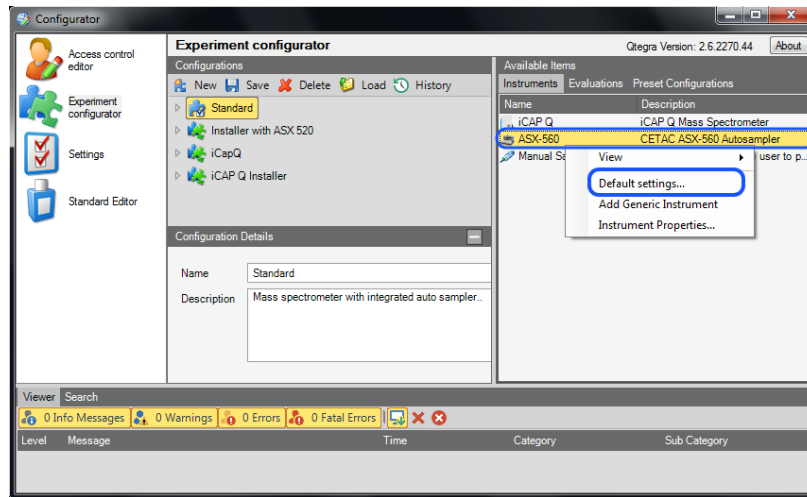


FIGURE 4-2 Accessing Settings in the Configurator

- 3 Set **Enable SDX** to **True**. This will add an SDX tab in the Settings window.

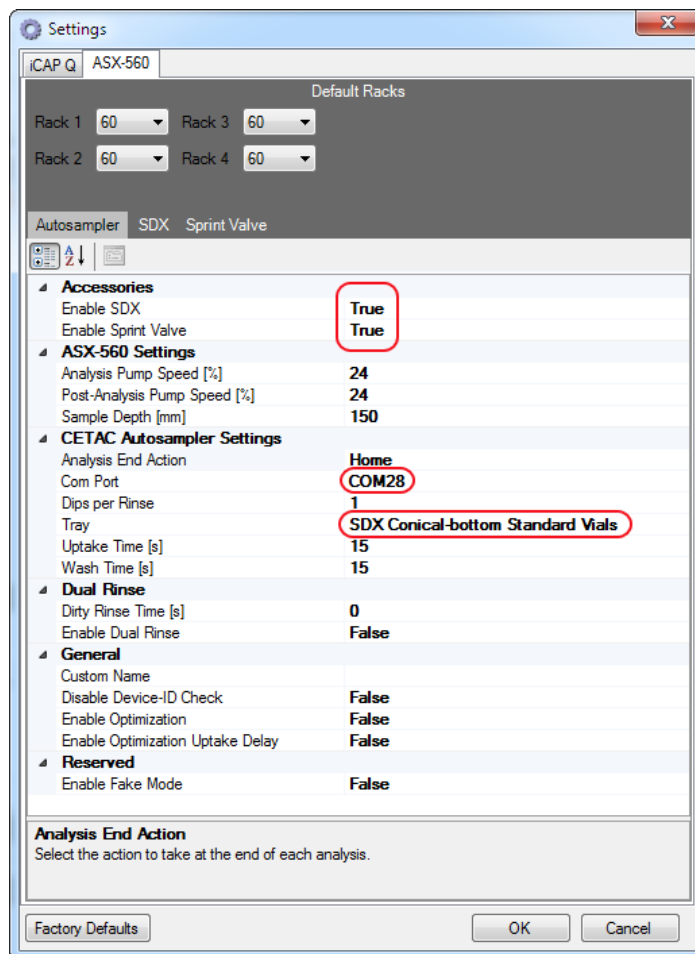


FIGURE 4-3 Autosampler Settings

- 4 If you will be using a Sprint Valve (Teledyne CETAC *ASXPRESS PLUS* rapid sample introduction system), set **Enable Sprint Valve** to **True**. This will add a Sprint Valve tab in the Settings window.
- 5 Select the **Com Port** where the autosampler is connected.

NOTE

Each component of the system—the autosampler, the SDX pump module, and the Sprint Valve—is connected to a different COM port. USB connections will appear as “virtual” COM ports.

- 6 Set the **Tray** according to the kind of standard vials you will be using: **SDX Conical Bottom Standard Vials** or **SDX Flat Bottom Standard Vials**.

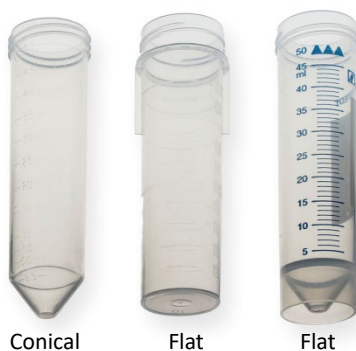


FIGURE 4-4 Tray Setting For Standard Vials

- 7 Click the **SDX** tab to view and modify the SDX settings, as described in the next section.

Choosing the Best SDX Settings

Some of the settings do not need any explanation. Here is some information on some of the less obvious settings. Some settings change the balance between speed and accuracy. Keep in mind that any of the settings can affect the accuracy of the dilutions; some experimentation will be required during your method development so that you can be confident that the settings are best for the needs of your laboratory.

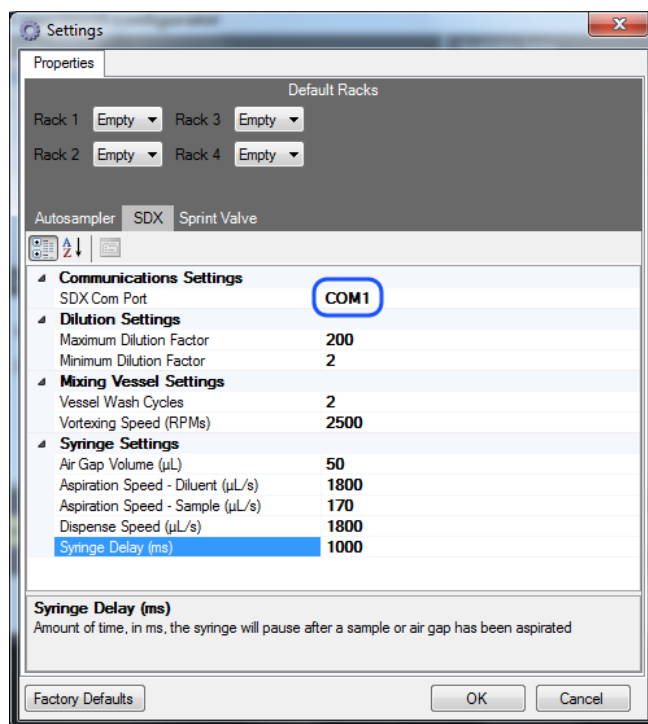


FIGURE 4-5 SDX Settings Window (Default Settings Shown)

SDX Com Port

Be sure to specify the COM port where the SDX is connected. This port number cannot be the same as the one used for the autosampler.

Maximum Dilution Factor

The maximum dilution factor can have a large effect on the accuracy of your method. The SDX is capable of performing dilutions of 2:1 to 5000:1. For reasons of analytical performance or speed of analysis, it may be desirable to limit the dilution range that Qtegra will be allowed to perform.

The Qtegra ISDS software can automatically determine the dilution factor to use, but it will be restricted to the range between Minimum Dilution Factor and Maximum Dilution Factor.

For a single dilution, the maximum dilution factor is 100:1. The final volume is 9 mL. The SDX system will choose appropriate volumes of sample and diluent to achieve the desired dilution factor. As the dilution factor increases, the volume of the sample aliquot decreases, so any error in the volume of the sample aliquot will be magnified. The best balance between speed and accuracy is generally in the range of 10:1 to 100:1.

For dilution factors of 101:1 and greater, serial dilution is used. To provide the greatest accuracy throughout the dilution range, serial dilution always begins with a 50:1 dilution.

Minimum Dilution Factor

The minimum dilution factor has a large effect on the speed of your method, especially below 10:1. The lower the dilution factor, the longer it takes to aspirate the necessary sample volume. The minimum possible dilution is 2:1 (4.5 mL of sample plus 4.5 mL of diluent for a final volume of 9 mL).

Vessel Wash Cycles

The SDX system has a wash cycle which rinses the mixing vessel. This procedure can be repeated as often as necessary to achieve the desired carryover. Each wash cycle takes 10-11 seconds. For most quantitative analysis, 2 or 3 wash cycles should be sufficient. In general, optimal carryover results from using 3% HNO₃ for the vortex rinse solution.

NOTICE

The vortex rinse solution must be compatible with the ICP. During the dilution, vortexer rinse solution is aspirated into the ICP. See page 40.

Vortexing Speed

The vortexing speed should always be 2500 RPM.

Air Gap Volume

A pre-sample air gap is always inserted between the diluent in the probe line and the sample being aspirated. For most applications the minimum air gap of 50 µL is sufficient; for big diameter tubing, a larger air gap may be necessary.

Aspiration Speed - Diluent

Leave the diluent aspiration speed at its default setting (1800 µL/second).

Aspiration Speed - Sample

A sample aspiration speed of 170 µL/s works well for most samples.

Slower sample aspiration speeds are more accurate, but increase dilution time.

Dispense Speed

The best dispense speed depends on the diameter of the sample probe:

| Probe I.D. | Probe band color | Application | Recommended dispense speed | Recommended sample aspiration speed |
|------------|------------------|-------------------------------------|----------------------------|-------------------------------------|
| 0.8 | Red | ICP-MS or ICP-OES, no ASXPRESS PLUS | 600 µL/s | 170 µL/s |
| 1.0 | 2 Blue | ASXPRESS PLUS | 1800 µL/s | 170 µL/s |

If the dispense speed is too fast, the syringe pump may stall and (acidic) solvent may be forced out of the syringe valve, potentially causing damage and generate an error.

NOTICE

If the dispense speed is too fast, solvent may leak and cause equipment damage.

If the system detects over pressure due to dispense speeds that are set too high, the syringe will freeze in place. If that happens, you will need to restart the equipment, flush the lines, and adjust the speed.

Repeatedly running the syringe over-pressure will damage the syringe valve and reduce the life of the syringe motor.

Syringe Delay

The syringe delay allows liquid and air pressure to equalize throughout all of the tubing after a syringe movement is complete. Pressure equalization improves quantitative sample transfer accuracy. The optimal value will depend on solvent viscosity and sample tubing diameter. If you suspect there may be oscillations, increase the delay for maximum accuracy and repeatability.

Balancing Accuracy and Speed



Here is a summary of the key factors which affect the tradeoff between speed and accuracy:

| Setting | For speed | For accuracy |
|-------------------------|------------------------|--------------|
| Maximum Dilution Factor | ▲ (but keep below 100) | ▼ |
| Minimum Dilution Factor | ▲ | |
| Vessel Wash Cycles | ▼ | ▲ |
| Sample Aspiration Speed | ▲ | ▼ |
| Syringe Delay | ▼ | ▲ |

SDX Settings: Summary



Band color indicates probe diameter. The settings in **bold** must be configured correctly to avoid equipment damage.

| Setting | Default | Min Value | Max Value | Recommended Settings | |
|-----------------------------------|---------|---------------------------------|------------------------------------|---|--|
| | | | | Without ASXPRESS PLUS | With ASXPRESS PLUS |
| Probe I.D. (mm) | | | | 0.8 | 1.0 |
| Probe Color Code | | | | Red | 2 Blue |
| | | | |  |  |
| Maximum Dilution Factor | 200 | 2 and ≥ Minimum Dilution Factor | 5000 | * | * |
| Minimum Dilution Factor | 2 | 2 | 5000 and ≤ Maximum Dilution Factor | * | * |
| Vessel Wash Cycles | 2 | 1 | 4 | 2-3 | 2-3 |
| Vortexing Speed (RPMs) | 2500 | 500 | 3000 | 2500 | 2500 |
| Air Gap Volume (μL) | 50 | 50 | 200 | 50 | 50 |
| Aspiration Speed - Diluent (μL/s) | 1800 | 50 | 3500 | 1800 | 1800 |
| Aspiration Speed - Sample (μL/s) | 170 | 50 | 3500 | 170 | 170 |
| Dispense Speed (μL/s) | 1800 | 50 | 3500 | 600 | 1800 |
| Syringe Delay (ms) | 1000 | 500 | 5000 | * | * |

* These settings depend on your application.

Choosing the Best Sprint Valve Settings

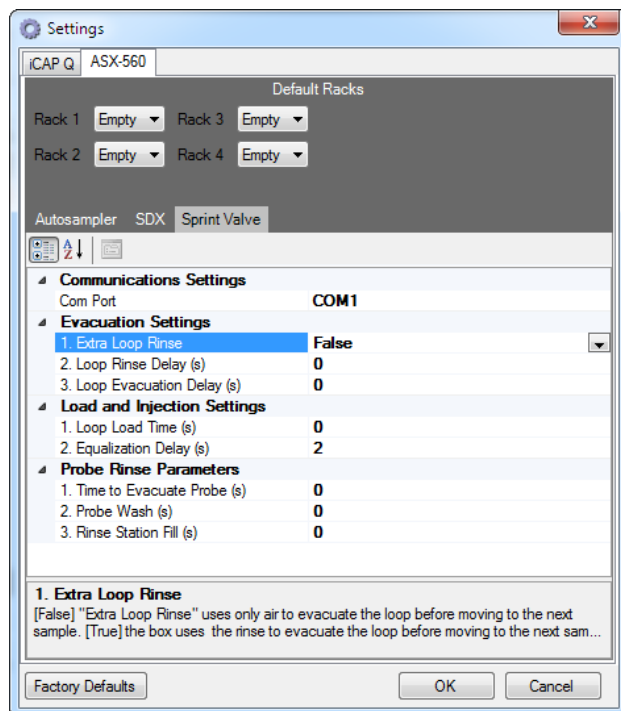


FIGURE 4-6 Sprint Valve Settings Window (Before Setting For SDX)

Com Port

Be sure to specify the COM port where the valve is connected, not the SDX COM port.

Extra Loop Rinse

If *Extra Loop Rinse* is not selected only air is used to evacuate the loop before moving to the next sample, otherwise solvent is pulled through the loop, then the loop is evacuated.

Loop Rinse Delay

Loop Rinse Delay is the amount of time solvent is pulled through the sample loop before the loop is evacuated. Pulling extra solvent through the loop can help reduce carryover.

Loop Evacuation Delay

Loop Evacuation Delay is the amount of time the loop is evacuated with air before moving to the sample.

Loop Load Time

Loop Load Time is the amount of time the vacuum pump is on and is used to fill the loop with sample.

Equalization Time

Equalization Time is the amount of time, after the sample loop is filled and the vacuum pump turned off but before the valve switched to inject, spent allowing the line pressure equilibrium to establish and prevents sample out-gassing and nebulization disruption.

Time to Evacuate Probe

Time to Evacuate the probe is the amount of time spent evacuating the probe line of sample before it is moved to the rinse station.

Probe Wash

Probe Wash is the amount of time the probe spends in the rinse station rinsing—the pump will be pulling rinse solvent through the probe line.

Rinse Station Fill

Rinse Station Fill is the amount of time, after rinsing the probe, for the autosampler pump to remain on once the probe is moved out of the rinse station.

Choosing the Autosampler Settings

Most of the settings do not need any explanation or do not need to be changed. Here is some information on some of the less obvious settings.

Pump Speed

The pump speed is specified as a percentage of the maximum speed. The flow volume corresponding to any given pump speed depends on many factors including tubing size, tubing length, and solvent viscosity.

Post-Analysis Pump Speed

Note that there is the ability to customize the autosampler peristaltic pump speed, including the ability to run the pump speed more slowly after the LabBook is complete so as to reduce the use of solvent without eliminating the return of the sample probe to the rinse station.

Dual Rinse

Leave Enable Dual Rinse set to False.

Adding the ASX-560 to an Instrumentation Configuration

- 1 Drag the ASX-560 from the list of available instrument and add it to a configuration containing an analyzer (for example, an iCAP Q or an iCAP 7600).

NOTE

If you are building a new configuration, add the analyzer first, and then add the ASX-560. Some functionality may not be available if the order is reversed.

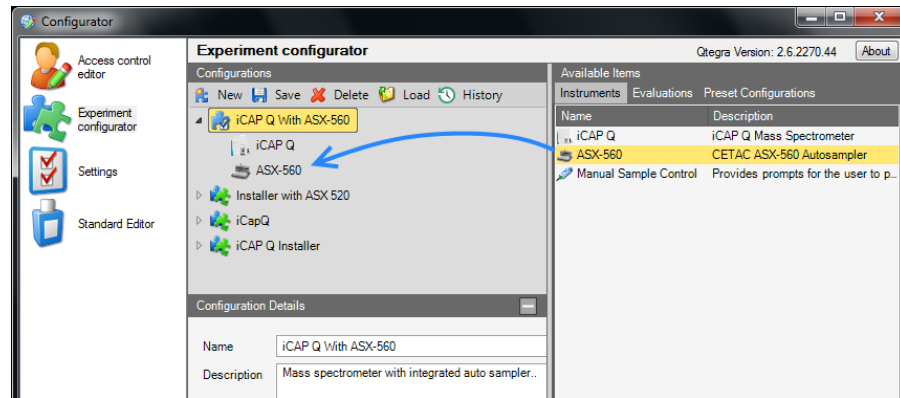


FIGURE 4-7 Adding the Autosampler to a Configuration

Using the Instrument Controls

- 1 Select the configuration which includes the ASX-560.

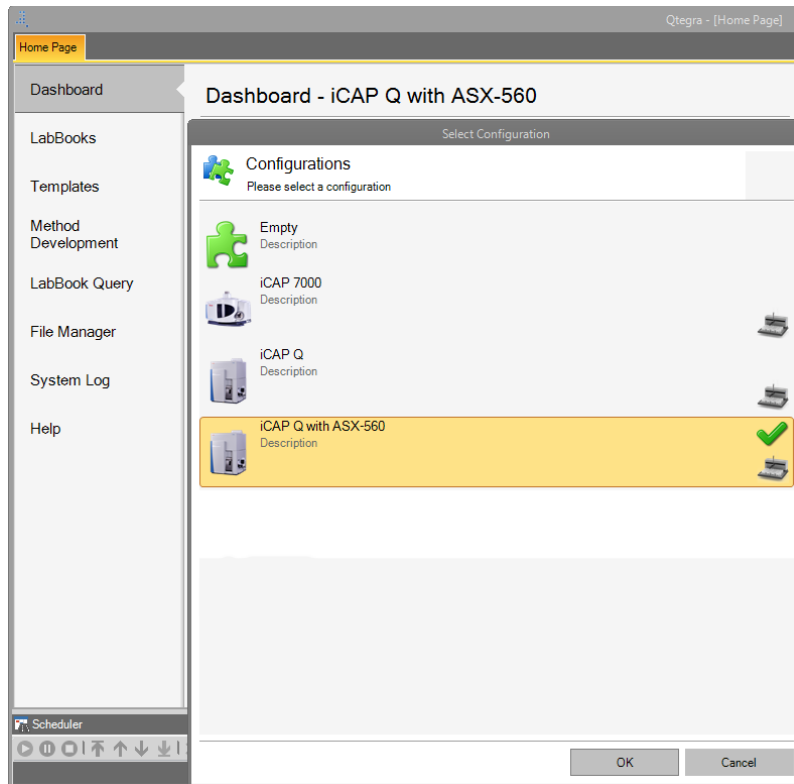


FIGURE 4-8 Selecting a Configuration

- 2** Access the instrument controls in the Dashboard, under ASX-560. For the iCAP Q ICP-MS, you can also access this under Instrument Controls.

Rack Layout

On the Rack Layout View tab, you can verify that the rack layout matches that used by the SDX (FIGURE 4-9).

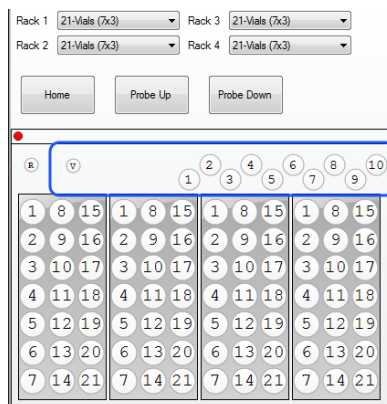


FIGURE 4-9 SDX Rack Layout

SDX Controls

On the SDX tab, you can directly control the pumps and vortexer.

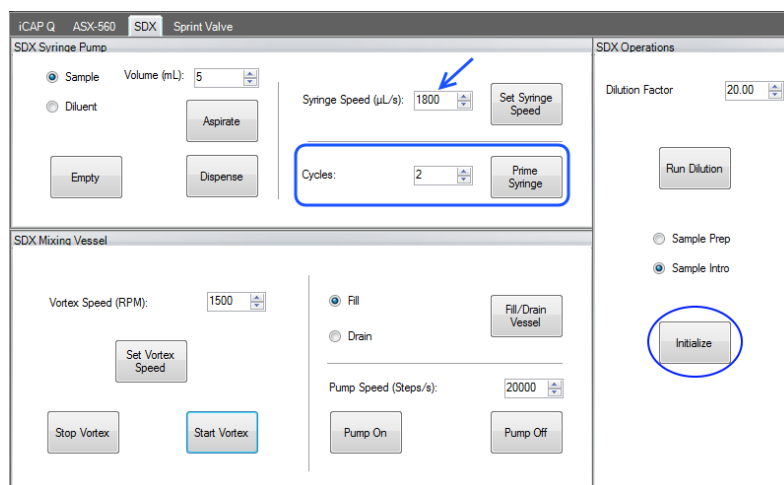


FIGURE 4-10 SDX Controls

Prime Syringe. To prime the solvent lines, click Prime Syringe.

Syringe Speed. The default speed was set in the SDX settings. See “Dispense Speed” on page 49.

NOTICE

If the dispense speed is too fast, solvent may leak and cause equipment damage. Always set the dispense speed to reflect the diameter of the probe which is installed.

The remainder of the controls are primarily for diagnostic purposes.

Run Dilution allows a dry run of the dilution process, and can be used to verify that all fittings are properly tightened.

Initialize. If the syringe stalls during an analysis due to over-pressure, then it is necessary to re-initialize the syringe.

Fill/Drain Vessel. Use this control to flush the vortex vessel and the SDX rinse tubing.

Sprint Valve Controls. Similarly, the Sprint Valve controls allow verification of pump and valve functionality similar to that found in the stand-alone Sprint Valve Config software.

Moving the Syringe to the 1/2 Position

To install or remove the syringe, the syringe plunger must be in the “1/2” position. To do this using the SDX controls:

- 1 Click **Empty** to move the syringe to its home position.
- 2 Enter a volume of 5 mL.
- 3 Click **Aspirate**.

Priming the Lines

Before you begin running samples, the lines need to be primed (filled with liquid).

- 1 Make sure that the bottles of rinse solution and diluent are in place.
- 2 In the SDX Controls, click **Prime Syringe**. When the cycle is complete, click **Prime Syringe** a second time.
- 3 Select **Fill**.
- 4 Click **Fill/Drain Vessel**. Repeat until liquid is visible in the vortex vessel.
- 5 Select **Drain**.
- 6 Click **Fill/Drain Vessel**.

Setting Up the Method Editor

When you wish to use the SDX system with a method, some settings must be configured in the method editor.

Intelligent Dilution

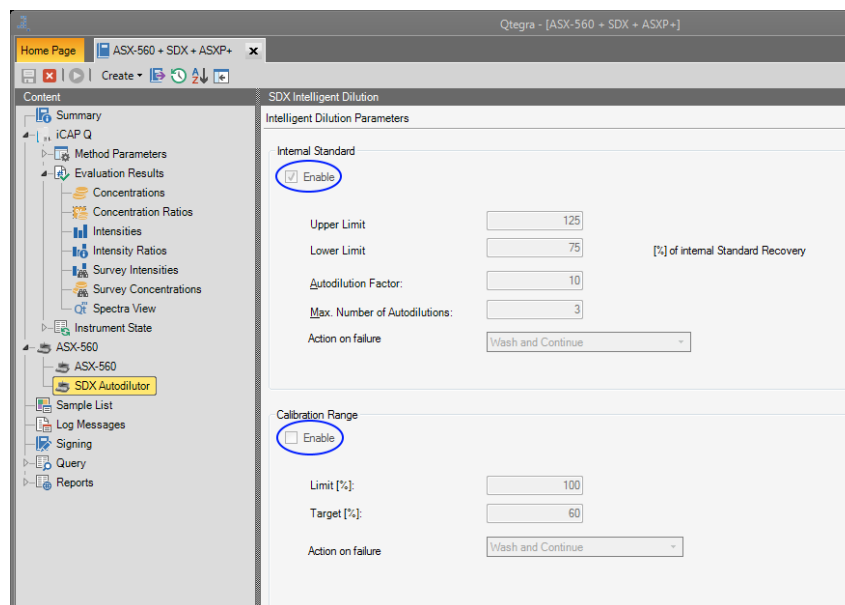


FIGURE 4-11 Method Editor Settings

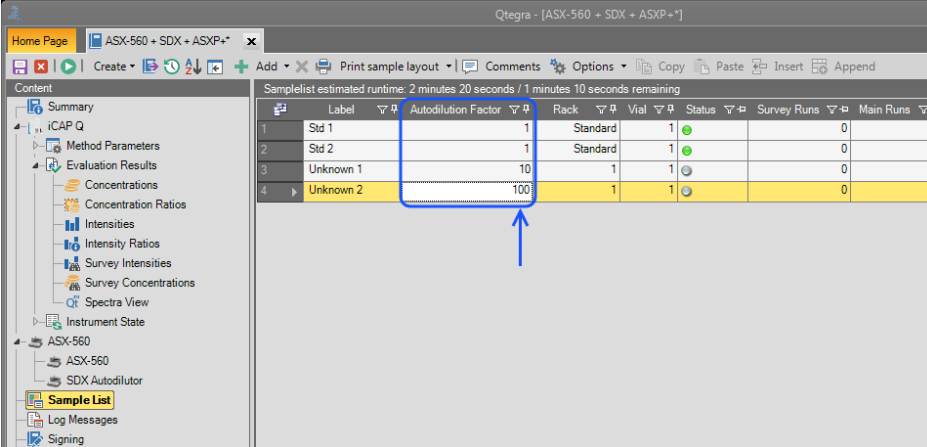
In the *Internal Standard* group, a dilution will be automatically performed if the internal standard recovery falls outside the prescribed range.

In the *Calibration Range* group, a dilution will be performed if the sample concentration exceeds the *Limit %* of the most concentrated calibration standard. Qtegra will use the SDX to attempt to bring the concentration to the

level specified in *Target %*. The software will use the element which is farthest out of range to calculate the dilution factor. The actual dilution performed may be constrained by the dilution limits specified in the Configurator settings. This group must be *enabled*, otherwise intelligent dilution based on sample concentration will not be performed.

Prescriptive Dilution

Qtegra can prescriptively dilute samples if so desired. In the example seen in FIGURE 4-12, we have specified that sample “Unknown 1” will be diluted 10:1 before analysis, and sample “Unknown 2” will be diluted 100:1 before it is analyzed.



| | Label | Autodilution Factor | Rack | Vial | Status | Survey Runs | Main Runs |
|---|-----------|---------------------|----------|------|--------|-------------|-----------|
| 1 | Std 1 | 1 | Standard | 1 | ● | 0 | 1 |
| 2 | Std 2 | 1 | Standard | 1 | ● | 0 | 1 |
| 3 | Unknown 1 | 10 | 1 | 1 | ● | 0 | 1 |
| 4 | Unknown 2 | 100 | 1 | 1 | ● | 0 | 1 |

FIGURE 4-12 Specifying Prescriptive Dilution in the Qtegra Sequence Editor

5 Maintaining the SDX Accessory

Routine maintenance of the autosampler consists of daily and weekly cleaning of specific autosampler components. Routine maintenance also includes checking for leaks or other damage. Additional periodic maintenance tasks may be required, such as replacement of tubing.

NOTICE

Discharge static buildup and ground to the autosampler base or cabinet before performing any maintenance. Do not touch or short-circuit the contacts on the communication ports.

Periodic Maintenance Tasks

The recommended maintenance intervals in TABLE 2 are based on typical use. You should adjust the intervals depending on the samples and solvents you are using, and depending on the lower detection limit of your methods.

| Interval | Task |
|------------------------|---------------------------------|
| Daily or Weekly | Check for leaks |
| | External cleaning |
| | Clean vortex vessel |
| 6 Months | Replace peristaltic pump tubing |
| | Replace external tubing |
| | Replace vortex vessel |
| Yearly | Replace internal tubing |
| | Replace syringe |
| | Replace 3-port valve |

TABLE 2: Recommended Maintenance Intervals

Checking for Leaks

You should regularly check all tubing for leaks.

- 1 Shut down and unplug the autosampler and SDX_{HPLD} high performance liquid dilution system.
- 2 Visually inspect the syringe and all tubing and fittings for leaks or signs of deterioration.

If you detect a leak or other damage to a component, you must replace it. For more information, see the appropriate section in this chapter.

Cleaning the Vortex Vessel

Clean the vortex vessel at least once a month or whenever visible residue remains after rinsing. More frequent cleaning may be required depending on how often the system is used and the nature of the samples.

NOTICE

Do not scratch the inside surface of the vortex vessel during cleaning as this will shorten its life and add potential carryover.

- 1 Remove the vortex vessel and disconnect the drain tube.
- 2 Soak the vortex vessel in a solvent appropriate for the samples to which the vessel has been exposed.
- 3 Sonicate until all visible deposits have been removed.
- 4 Rinse with nanopure water and allow to dry completely.
- 5 Inspect the vortex vessel to ensure that the cleaning was adequate.
- 6 Attach the drain tube and reinstall the vortex vessel.

Replacing the Vortex Vessel

Replace the vortex vessel, along with the drain tube and the gasket around the vortex vessel, at least once every six months. More frequent replacement may be required depending on how often the system is used and the nature of the samples. If you notice that carryover is increasing, that is a sign that the vortex vessel may need to be replaced.

Cleaning the SDX Accessory

Clean the SDX_{HPLD} high performance liquid dilution system in the same way that you clean the autosampler.

- 1 Shut down and unplug the autosampler and SDX_{HPLD} high performance liquid dilution system.

For information about shutting down the system, see page 39.

- 2 Wipe the SDX pump module cabinet and vortex module using a towel dampened with a lab-grade cleaning agent.

NOTICE

Do not allow the cleaning agent to come into contact with the autosampler lead screws or with the guide shaft of the syringe.

NOTICE

Do not clean with carbon tetrachloride.

- 3 Wipe again with a towel dampened with clear water.

This process removes any remaining contaminants.

- 4 Dry using a lint-free towel.

The autosampler and SDX must be completely dry before you turn the power on.

Replacing Peristaltic Pump Tubing

Routine maintenance of the SDX_{HPLD} high performance liquid dilution system includes replacement of the peristaltic pump tubing both on the back of the autosampler and on the back of the SDX pump module. This tubing will probably be the most frequently replaced item. Replace the tubing every 6 months. If you use strong bases, acids, or solvents as rinse agents, the tubing may break down rapidly and need replacement more frequently.

The tubing is installed as a single cartridge.

To replace the peristaltic pump tubing, complete the following steps:

WARNING

PINCH HAZARD

Turn off power before servicing the peristaltic pump or pump tubing.

- 1 Shut down and unplug the SDX_{HPLD} high performance liquid dilution system.
- 2 Release the pressure shoe by lifting the handle. The shoe is a flexible band which is held in place by spring-loaded handles.
- 3 Disconnect the luer fittings which connect to the internal tubing.
- 4 Lift the end of the tubing cartridge straight up.
- 5 Replace the tubing by sliding the plates on the end of the tubing cartridge into the slots in the pump.
- 6 Reinstall the pressure shoe.

- 7 Reconnect the luer fittings.

Opening the Pump Module

The SDX pump module can be opened up for easy access to the valves and internal tubing.

- 1 Remove the thumbscrew on the front of the pump module.



FIGURE 5-1 Removing the Thumbscrew

- 2 Gently pull the valve and tubing assembly forward.
- 3 Lift the valve and tubing assembly away from the pump module.

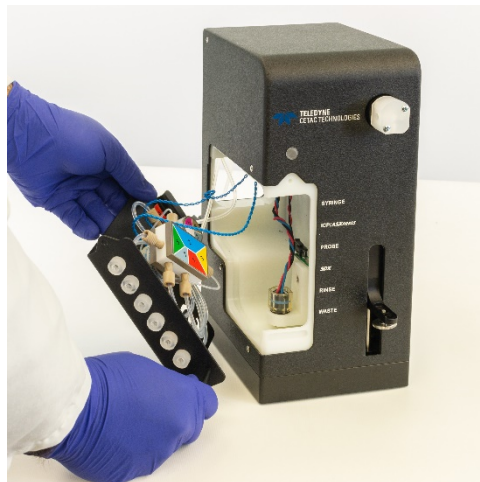


FIGURE 5-2 Interior of the SDX Pump Module

Completely Removing the Valve and Tubing Assembly

If you wish to completely remove the valve and tubing assembly:

- 1 Disconnect the two blue wires from the pump module. Note that the connectors are different sizes, so when it comes time to reinstall the assembly, it will be easy to connect them correctly.
- 2 Disconnect tube #4 and tube #8 from the peristaltic pump.

Replacing the Internal Tubing

Replacing the Valve and Tubing Assembly

The valve and tubing assembly is normally replaced *as a single unit*. If contamination occurs, both the tubing and internal valve components are likely to be contaminated. Replacing the entire assembly means you don't have to assess whether the valves are contaminated. This also eliminates any chance of accidentally damaging the valves by overtightening or cross-threading the tubing fittings. A replacement assembly is available from Teledyne CETAC Technologies.

Replacing the Internal Tubing

You can also replace just the tubing and associated fittings. If you're not worried about internal contamination of the valves, this is more economical than replacing the entire assembly. A replacement tubing kit is available from Teledyne CETAC Technologies.

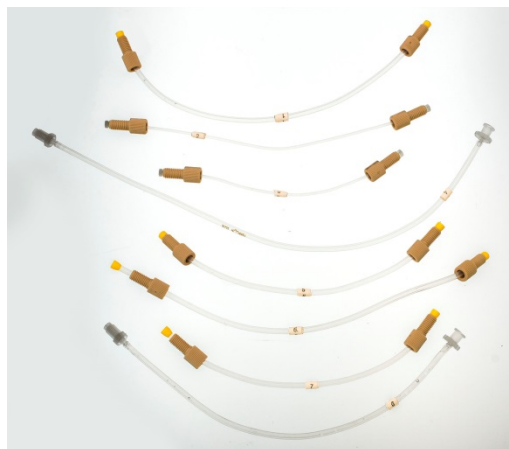


FIGURE 5-3 Contents of Internal Tubing Replacement Kit

NOTICE

Tighten the fittings using only your fingers. Turn the fittings slowly at first, making sure they are not cross-threaded. Using excessive force will damage both the fittings and the valves.

You can remove the fittings with pliers if necessary, but do not tighten them with anything other than your fingers. The valves are constructed of fairly soft polymers which can easily be damaged if you are not careful.

NOTICE

Use only the replacement tubing kit from Teledyne CETAC Technologies. The internal volume of the tubing is critical; use of other tubing may result in incorrect dilution volumes. Use of fittings other than the ones supplied may create tiny crevices which can result in carryover problems.

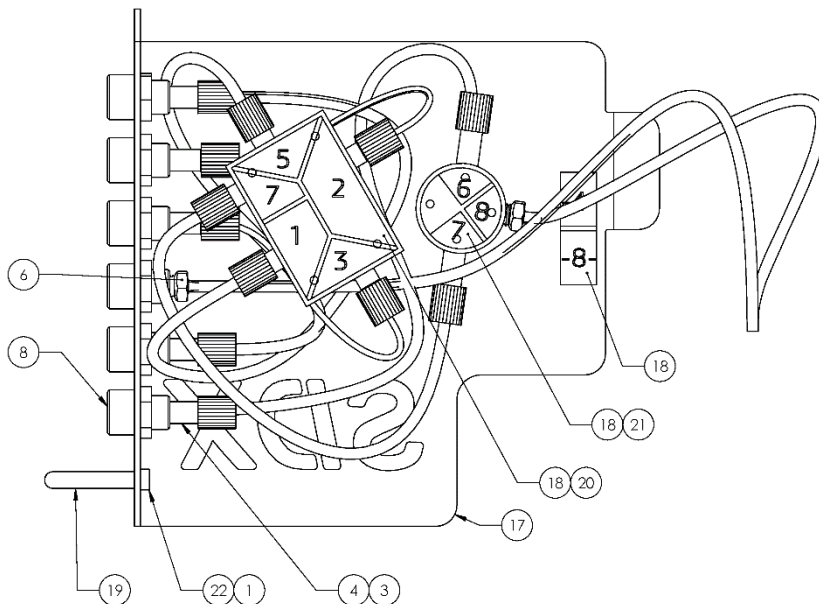


FIGURE 5-4 Routing of Internal Tubing--Overview

| Tube No. | Description | Length (inches) |
|----------|------------------------------------|-----------------|
| 1 | PFA .065" ID x .125" OD | 10 |
| 5 | PFA .065" ID x .125" OD | 8 |
| 6 | PFA .065" ID x .125" OD | 9 |
| 7 | PFA .065" ID x .125" OD | 8 |
| 2 | PFA .035" ID x .62" OD | 6 |
| 3 | PFA .035" ID x .62" OD | 5 |
| 4 | FEP lined Tygon 1/16" ID x 1/8" OD | 12* |
| 8 | FEP lined Tygon 1/16" ID x 1/8" OD | 8* |

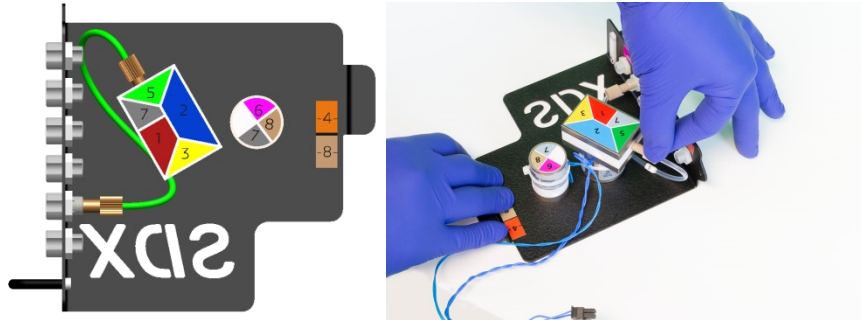
* It is especially important that the combined length of these two tubes is 20 inches.

TABLE 3: Internal Tubing

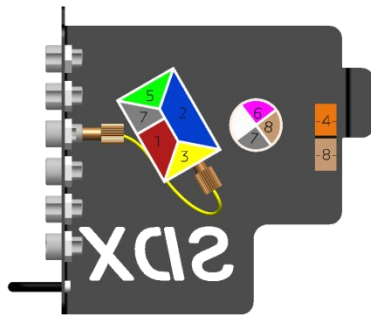
- 1** Open the SDX pump module and lay the valve and tubing assembly on the work surface.
- 2** Remove the valve and tubing assembly (see page 63).
- 3** Remove and discard all of the old tubing.

- 4 Replace the tubing as shown in the following illustrations. Note that each tube is numbered. It is easiest to replace the tubes in the sequence shown.

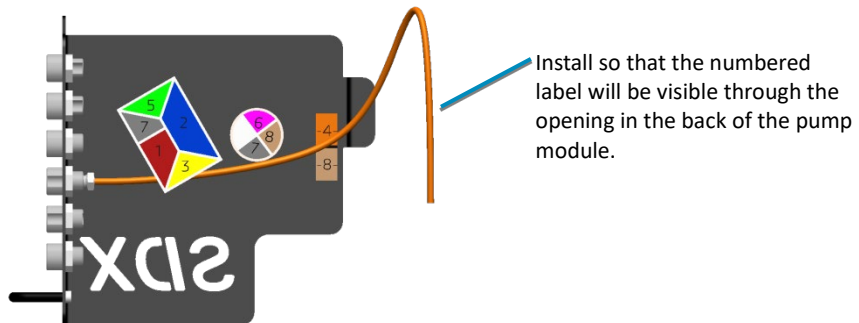
Tube #5:



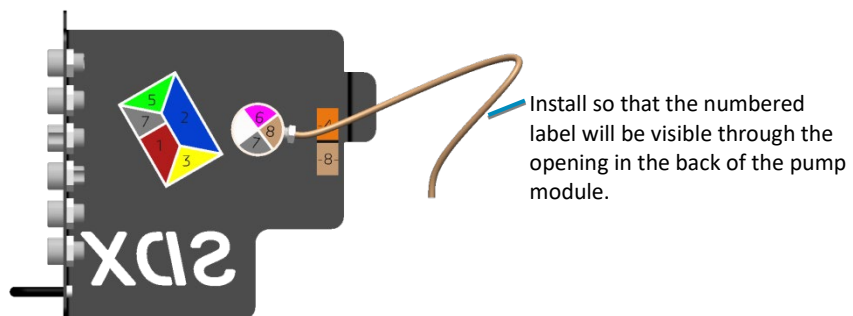
Tube #3:



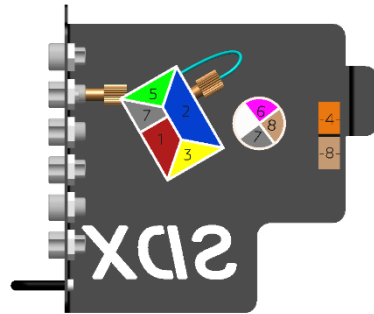
Tube #4:



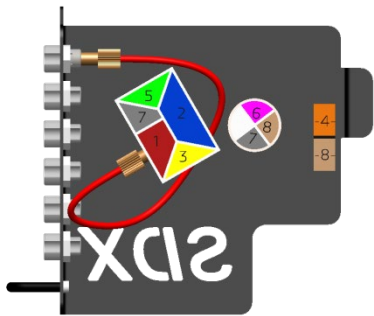
Tube #8:



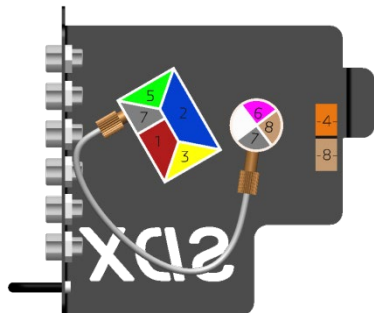
Tube #2:



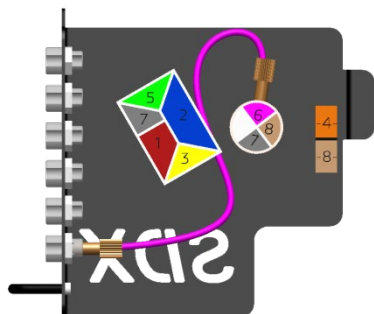
Tube #1:



Tube #7:



Tube #6:



Replacing the Sample Loop

It is recommended that you use a replacement sample loop from Teledyne CETAC Technologies. This sample loop has an internal volume of 4.5 mL. Do not use a sample loop with a different internal volume.

Preparing for Long-Term Storage

If you will not be using the system for a long time (a few weeks or more), you can increase the life of the components by making sure everything stays dry.

If the System Has Never Been Used

If the system has never been used, store it in a cool, dry place.

If the System Has Been Used

- 1 Flush the lines to remove water and contaminants. Spectroscopy grade isopropyl alcohol works well for this purpose.
- 2 Remove and dry the syringe. You can disassemble the syringe and dry it using compressed air, then insert the plunger back into the syringe. Leave the plunger in the syringe while it is being stored.

NOTICE

Do not take the syringe apart for storage. If the plunger is left outside of the syringe, it may no longer seal properly.

- 3 Store in a cool, dry place.

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6 Troubleshooting

In the event that the product does not function properly, isolate the problem to determine if it originates in the host computer, the analytical instrument, or the autosampler.

This chapter explains how to troubleshoot autosampler problems. If you cannot solve a problem using the steps given in this chapter, you should contact Teledyne CETAC Technologies Customer Service and Support.

Status LED

The LED on the front of the SDX pump module has the following modes:

- **Off:** The SDX pump module is powered off.
- **Steady Blue:** The SDX pump module is powered on.
- **Flashing Red:** An internal leak has been detected OR the vortex motor is stalled.

If the LED is flashing red, turn the power switch off then on again. If the LED shows steady blue, the problem was a stalled vortex motor and no further action is needed. If the LED continues to flash red, the problem is probably a leak inside the SDX pump module. Discontinue using the system until the leak has been fixed.

Stalled Syringe

If the system detects over pressure due to dispense speeds that are set too high, the syringe will freeze in place. If that happens:

- 1 Restart the SDX valve module and the autosampler.
- 2 Flush the lines to waste.
- 3 Reduce the dispense speed.
- 4 Prime the system.

- 5 Start the dilution again.

Power System Problems

A possible cause of system malfunction is a problem in the power system. If the system is not functional, it is possible that it is not receiving power. If this is the case, the LED power indicator light on the SDX will be off. To troubleshoot this problem, complete the following steps in sequence until the problem is solved:

- 1 Check that the power switches on both the autosampler and SDX pump module are turned on.
- 2 Check that the power cord is plugged in firmly between the power input on the SDX pump module and the external power supply and also between the power supply and the wall outlet.

If the cable is plugged in, ensure that it is not damaged in any way.

- 3 Check that the LED on the power supply is illuminated.

If the LED is not illuminated, check the wall outlet using a device approved for that purpose.

If the wall outlet is working and the voltage is acceptable, unplug the external power supply from the SDX, but leave it plugged into the wall.

- If the LED is not lit, the power supply is faulty and requires replacement.
 - If the LED is lit when unplugged from the SDX but turns off when plugged into the SDX, the SDX or the autosampler may have an internal short and require repair.
- 4 If the external power supply LED is illuminated while plugged into the SDX, cycle the SDX power switch. The status LED on the front of the pump module should light up.
 - If the cords are properly connected, power is available, the external power supply is good, and the unit still does not initiate, continue by checking for communication problems and software setup problems.

Communications Interface Problems

Operation of the autosampler is directed by the host computer. A malfunction can indicate a problem with the RS-232 or USB cable (connected between the host computer and the autosampler) or with the configuration of the software on the host computer. The following sections explain how to troubleshoot these problems.

Vortexer Cable Problems

- 1 Turn off the power switch on the SDX pump module.

NOTICE

Plugging or unplugging the vortexer cable while the SDX pump module is powered on could result in equipment damage.

- 2 Check that the vortexer cable is securely seated in the connector on the back of the SDX pump module.

RS-232 Serial Cable Problems

- 1 Check the host computer to ensure that the RS-232 cable is connected to the appropriate COM port.

If the cable is plugged in, ensure that it is tightened properly and not damaged in any way.

- 2 Check the serial port settings (9600, N, 8, 1).

If the wrong port or baud rate is selected, change the configuration.

USB Cable Problems

Either RS-232 or USB may be used, but not both at once.

- 1 Check the USB cable to ensure that it is plugged into the port on the back of the SDX pump module.
- 2 Check the host computer to ensure that the USB cable is connected to the appropriate USB port.

NOTE

If you move the USB cable to a different USB port, the driver may assign a new COM port number.

- 3 Check that the USB cable is not damaged in any way.

Software Configuration Problems

If the communication cable is connected properly and the system is still not functioning with the instrument control software, ensure that the software is communicating correctly with the autosampler. To do so, use the manual controls in the software to turn the peristaltic pump or vortexer on and off.

If the instrument control software fails to operate the autosampler, check that the same COM port number is configured in the software and in the USB device driver.

Dilution Errors

- Make sure that the syringe plunger is fully attached to the arm. Make sure the locking nut is tight—but tighten it only with your fingers. Any gaps will result in dilution errors, due to the arm moving slightly before the plunger. FIGURE 6-1 shows the kind of dilution errors that can result when the syringe locking nut is loose.

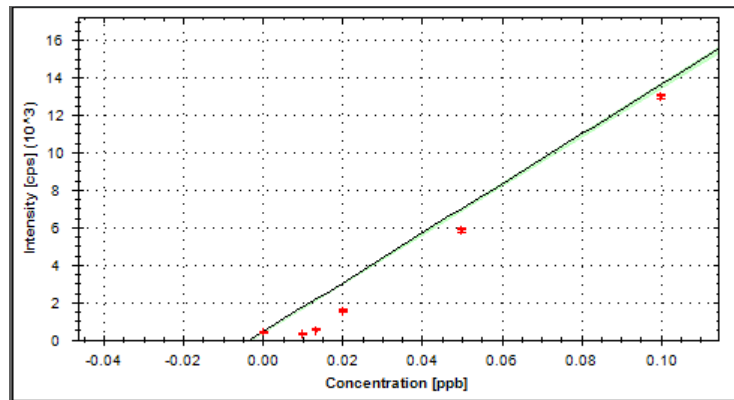


FIGURE 6-1 Typical Calibration Curve When the Syringe Is Loose

- Try using a smaller dilution factor. For dilution factors of 101:1 and greater, serial dilution is used. Any volumetric error in the two dilutions is multiplied, so dilutions near the limit of 5000:1 will have errors of around 10% and are generally not recommended.
- If the first few samples are dramatically incorrect, make sure that the lines have been primed before operation.

Contamination and Carryover Problems

Contamination and carryover can come from many sources. There are three basic questions to ask yourself:

- Is my rinse solution clean?
- Are surfaces being adequately rinsed?
- Are there hidden reservoirs (such as rough spots on wetted surfaces) where contaminants could be hiding?

Here are some specific things to check:

Rinse Solution / Reagent Problems

- 1 Ensure that the **rinse reservoir level** is high enough for the end of the intake tube to be submerged.
- 2 Ensure that the **waste line** completely empties prior to dilution. If it is not emptying completely the waste container may be full or the tubing may have been damaged or is restricted. Check the end of the rinse drain tube—it should be above the surface of the liquid in the waste container. Empty the waste container. Remove restrictions in tubing and replace if necessary.
- 3 Replace the **rinse solution** if necessary, especially if the rinse solution is being recycled.
- 4 Replace the **diluent solution** if necessary.
- 5 If using an **internal standard**, test the solution and replace it if necessary.

System Configuration Problems

- 1 Increase the number of **wash cycles**. This is done in the software.
- 2 Check the autosampler rinse station tubing configuration. Rinse solution should **flow upward** from the bottom of the rinse station.
- 3 Examine the **sample transfer tubing** which goes to the ICP. Make sure that it is as short as possible while still free to move. Make sure that there are **no unnecessary fittings** on the sample transfer tubing—fittings can create small reservoirs where contaminants can hide.
- 4 Check that **fittings** and ferrules are properly tightened. Loose connections can result in syphoning.

Worn / Contaminated Component Problems

- 1 Ensure that that **rinse solution** is being fed into the **vortex mixing vessel** during the wash cycle. If the mixing vessel is not filling properly, then the tubing may have been damaged or is restricted (flattened or kinked). Remove the restrictions and replace the tubing if necessary.
- 2 Ensure that the **rinse line remains full** during sample prep and sampling. If the line is emptying during these steps, check the following fittings: Rinse (interior and exterior), #1 and 5 ports on the valve, syringe pump fittings (interior and exterior), and the sample side of the syringe pump valve.
- 3 Clean the **vortex mixing vessel**. If the cleaning is not effective, or if the vessel is more than six months old, replace the mixing vessel and associated tubing.
- 4 Replace the **SDX peristaltic pump tubing**.
- 5 Replace the **ICP peristaltic pump tubing**. (This is not necessary if you are using a Sprint Valve.)
- 6 If running with a Sprint Valve, clean the **valve rotor and stator**.
- 7 Check all external and internal tubing for signs of particulate matter. If present, replace the **SDX valve and tubing assembly**.
- 8 Remove the syringe and syringe pump valve. Check for signs of **corrosion** on all metal parts. If liquid is present, the diluent is flowing through the weeping hole and is an indication that the syringe **pressure** is too high and needs to be lowered. Replace the syringe valve.
- 9 Watch for liquid **dripping** from the sample probe as it moves. It may be necessary to slow the autosampler down to reduce droplet shedding. This can be adjusted using the ASX Dashboard utility (see the autosampler *Operator's Manual*). Dripping may also occur if the sample probe is contaminated.

Returning the Product to CETAC for Service

Refer to the following information if you need to return the product to Teledyne CETAC Technologies for service.

Shipping the Product

Follow these guidelines when shipping the product:

- **Use the original packing materials.** If the original shipping materials are not available, you may be able to purchase packaging from Teledyne CETAC. Alternatively, place a generous amount of shock-absorbing material around the instrument and place it in a box that does not allow movement during shipping. Seal the box securely.
- **Contact Teledyne CETAC Technologies before shipping the product.** See “Where to Go for More Information” on page 13 for contact information. Have the model, serial number, and a description of the issue ready. You will be given an RMA (return merchandise authorization) number to track the instrument.
- Write the following information on a tag and attach it to the product:
 - Name and address of the owner
 - Product model number and serial number
 - RMA number
 - Description of service required or failure indications
- Pre-pay all shipping expenses including adequate insurance.
- Clearly label the box with the RMA number. If the RMA number is not visible on the outside of the box, Teledyne CETAC reserves the right to decline delivery and return the unopened box to you at your expense.
- Mark the shipping container as FRAGILE.
- In all correspondence, refer to the instrument by model name or number and full serial number.
- Do not return products which are contaminated by radioactive materials, infectious agents, or other materials constituting health hazards to CETAC employees.

Product Warranty Statement

NOTE

Contact Teledyne CETAC Technologies or refer to the warranty card which came with your product for the exact terms of your warranty.

7 Safety and Regulatory Information

Review this product and related documentation to familiarize with safety markings and instructions before you operate the instrument.

Characteristics

Environmental Characteristics

These environmental characteristics indicate the conditions for *safe operation*. The recommended environment for the best performance may be different.

| | |
|--|---|
| Operating Temperature | +5° C to +40° C (+41° F to +104° F) |
| Non-Operating Temperature | +0° C to +55° C (+32° to +131° F) |
| Operating Altitude | Up to 2,000 m (6,562 ft) |
| Operating Relative Humidity | 0% to 80% non-condensing for temperatures up to 31° C, decreasing linearly to 50% at 40° C |
| Non-Operating Relative Humidity | 0% to 95% non-condensing |
| Pollution Degree | Pollution Degree 2 Normally no pollution or only dry, non-conductive pollution occurs. The pollution has no influence. Occasionally, however, a temporary conductivity caused by condensation may be expected. |

TABLE 4: Environmental Characteristics

For indoor use only.

Avoid sudden, extreme temperature changes which could cause condensation on circuit boards in the product.

See page 12 for information on chemical compatibility.

Electrical Characteristics

Power requirements


| | |
|---|---|
| Power Supply (Provided with Autosampler) | <p>Input: AC Voltage, Frequency, and Current 100-240 V ~ 47-63 Hz 1.07 A Installation Category: CAT II (Line voltage in appliance and to wall outlet)</p> <p>Output: 24 V DC, 3.33 A</p> |
| SDX Pump Module | <p>POWER Input (either connector labeled POWER): DC Voltage and Current  24 V 3.33 A Installation Category: CAT I (Mains isolated) Connect only to the 24V power output on the autosampler, using the supplied bridge cable.</p> <p>POWER Output: 24 V DC, 3.33 A</p> <p>VORTEXER Output: Connect only to the SDX vortex module. (max 24 VDC)</p> |
| SDX Vortex Module | <p>Input: Connect only to the VORTEXER connector on the back of the SDX pump module using the attached cable. (max 24 VDC) Installation Category: CAT I (Mains isolated)</p> |

TABLE 5: Power Requirements

Input and output connectors

| | |
|---------------|---|
| SERIAL | DB-9 RS-232 serial connection to a controller PC. (max ±12 VDC, 8 mA) |
| USB | USB connection to a controller PC. (max 5 VDC) |

Safety Notices

WARNING

INJURY HAZARD

If the equipment is used in a manner not specified by Teledyne CETAC Technologies, the protection provided the equipment may be impaired.

Repair or service that this not covered in this manual should only be performed by qualified personnel.

Power Cord Set Requirements

The power cord set supplied with your instrument meets the requirements of the country where you purchased the instrument. Power is supplied to the SDX pump module through the autosampler's 24 V power supply.

Power Cord Safety Maintenance

The operator should check the power/signal supply cord condition. The equipment should not be operated if the mains inlet is cracked or broken. Any obvious damage to the case (from a drop or fall) should be checked by service personnel for loose or damaged parts. See individual parts lists for approved replacement parts.

Mains Disconnect

The power switch on the rear panel is not the mains disconnect. Power mains disconnect is accomplished by unplugging the power cord at the power supply or at the wall outlet. Ensure the power cord is easily accessible and removable, in the event of an emergency which requires immediate disconnection.

WARNING

SHOCK HAZARD

Ensure that power cord is disconnected before removal of any covers.

Cleaning Instructions

For additional cleaning information, see “cleaning” in the index.

To clean the exterior surfaces of the instrument, complete the following steps:

- 1 Shut down and unplug the instrument.
- 2 Wipe the instrument exterior surfaces only using a towel dampened with a lab-grade cleaning agent.
- 3 Repeat step 2, using a towel dampened with clear water.
- 4 Dry the instrument exterior using a dry towel.

WARNING

SHOCK HAZARD

Do not allow any liquid to enter the instrument cabinet other than as intended through the specified tubing, or come into contact with any electrical components. The instrument must be thoroughly dry before you reconnect power, or turn the instrument on.

Mechanical Hazards

If you insert any part of your body between the moving parts of the equipment, you could be injured.

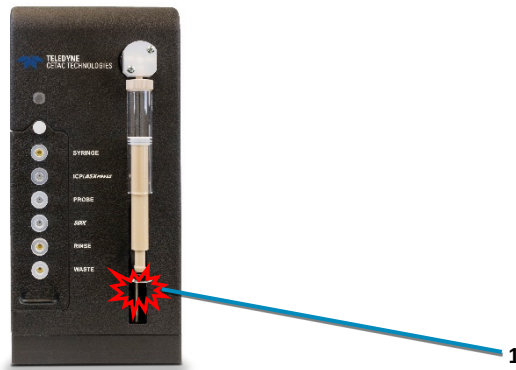


FIGURE 7-1 Overview of Mechanical Hazards

WARNING

1 - PINCH HAZARD

Keep fingers, hair, and loose clothing away from the moving parts of the syringe pump.

Operating Environment

WARNING

SHOCK HAZARD

To reduce the risk of fire hazard and electrical shock, do not expose the unit to rain or humidity. To reduce the risk of electrical shock, do not open the cabinet. All maintenance is to be performed by an Authorized CETAC Service Provider.

Protection provided by the equipment may be impaired if the equipment is used in a manner not specified by the manufacturer.

WARNING

SHOCK HAZARD

Equipment is not intended for wet locations. Miscellaneous liquids in the equipment could cause hazardous conditions.

WARNING

EXPLOSION HAZARD

Do not operate in an explosive atmosphere.

WARNING

CHEMICAL HAZARDS

Learn about the chemicals which will be used in and near the autosampler, and observe the necessary precautions. Always use appropriate personal protective equipment, including protective eyewear, lab coat, and gloves.

Explanation of Caution and Warning Notices



Warning symbol marked on equipment. This symbol means "Attention! Refer to the manual."

WARNING

A **WARNING** indicates a hazardous situation, which, if not avoided, could result in death or serious injury. Do not proceed beyond a **WARNING** notice until the indicated conditions are fully understood.

CAUTION

A **CAUTION** indicates a hazardous situation, which if not avoided, could result in minor or moderate injury. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

NOTICE

A **NOTICE** calls attention to a procedure or practice that if not correctly performed or adhered to, could result in equipment damage, loss of data, or inaccurate data.

A **NOTE** emphasizes a point, provides a useful tip, or provides additional information.

Electromagnetic Interference

FEDERAL COMMUNICATIONS COMMISSION (FCC) NOTICE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential environment is likely to cause harmful interference, in which case the user will be required to correct the interference at his expense.

MODIFICATIONS

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Teledyne CETAC Technologies may void the user's authority to operate the equipment.

CABLES

Connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods to maintain compliance with FCC Rules and Regulations.

CANADIAN NOTICE

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus as set out in the interference-causing equipment standard entitled "Digital Apparatus" ICES-001 of the Department of Communications.

AVIS CANADIEN

Cet appareil numérique respecte les limites de bruits radioélectriques applicables aux appareils numériques de Classe A prescrites dans la norme sur le matériel brouilleur: "Appareils Numériques," NMB-001 édictée par le ministre des Communications.

KOREAN NOTICE

| 사용자 안내문 |
|---|
| 이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다. |

* 사용자 안내문은 "업무용 방송통신기자재"에만 적용한다.

| Warning Statement |
|---|
| EMC Registration is done on this equipment for business use only. The product may cause interference when used in a home. |

- This warning statement applies to a product for business use.

Explanation of Regulatory Marks



Do not dispose in domestic household waste.

The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste, in compliance with the European Waste Electrical and Electronic Equipment Directive (WEEE, 2002/96/EC).

For instructions on how to return end-of-life equipment, producer-supplied electrical accessories, or auxiliary items for proper disposal please contact the supplier or importer. In the event a supplier cannot be reached, contact Teledyne CETAC Technologies customer service department at 1 (800) 369 2822.



The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.

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