

Surveyor Autosampler Plus & Surveyor Autosampler Plus Lite

Hardware Manual

60053-97106 Revision E January 2009

DOCUMENTATION
SURVEY

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Software versions: Xcalibur 2.0 or higher data system, ChromQuest 4.2 or higher data system
Revision history: Revision A April 2005, Revision B May 2006, Revision C September 2006, Revision D March 2008, Revision E January 2009

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Regulatory Compliance

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

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

Surveyor Autosampler Plus

EMC Directive 89/336/EEC amended by 92/31/EEC and 93/68/EEC

EMC compliance has been evaluated by TUV Rheinland of North America, Inc.

EN 55011	1998	EN 61000-4-3	2002
EN 61000-3-2	1995, A1; 1998, A2; 1998, A14; 2000	EN 61000-4-4	1995, A1; 2001, A2; 2001
IEC 61000-3-2	2000	EN 61000-4-5	1995, A1; 2001
EN 61000-3-3	1995	EN 61000-4-6	1996, A1; 2001
IEC 61000-3-3	1994	EN 61000-4-11	1994, A1; 2001
EN 61326-1	1997		
EN 61000-4-2	1995 A1; 1998 A2; 2001	CISPR 11	1999, A1; 1999, A2; 2002
FCC Class A, CFR 47 Part 15 Subpart B:	2003		

Low Voltage Safety Compliance

Low Voltage Safety Compliance has been evaluated by TUV Rheinland of North America, Inc.

This device complies with Low Voltage Directive 73/23/EEC and harmonized standard EN 61010-1:2001, IEC 61010-1:2002, UL 61010 A-1:2004, CAN/CSA 22.2 61010-1:2004.

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THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRE OPERATION.



CAUTION Read and understand the various precautionary notes, signs, and symbols contained inside this manual pertaining to the safe use and operation of this product before using the device.

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In compliance with international regulations: Use of this instrument in a manner not specified by Thermo Fisher Scientific could impair any protection provided by the instrument.

Notice on the Susceptibility to Electromagnetic Transmissions

Your instrument is designed to work in a controlled electromagnetic environment. Do not use radio frequency transmitters, such as mobile phones, in close proximity to the instrument.

For manufacturing location, see the label on the instrument.

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WEEE Konformität

Dieses Produkt muss die EU Waste Electrical & Electronic Equipment (WEEE) Richtlinie 2002/96/EC erfüllen. Das Produkt ist durch folgendes Symbol gekennzeichnet:









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Conformité DEEE

Ce produit doit être conforme à la directive européenne (2002/96/EC) des Déchets d'Equipements Electriques et Electroniques (DEEE). Il est marqué par le symbole suivant:



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CAUTION Symbol	CAUTION	VORSICHT	ATTENTION	PRECAUCION	AVVERTENZA
	Electric Shock: This instrument uses high voltages that can cause personal injury. Before servicing, shut down the instrument and disconnect the instrument from line power. Keep the top cover on while operating the instrument. Do not remove protective covers from PCBs.	Elektroschock: In diesem Gerät werden Hochspannungen verwendet, die Verletzungen verursachen können. Vor Wartungsarbeiten muß das Gerät abgeschaltet und vom Netz getrennt werden. Betreiben Sie Wartungsarbeiten nicht mit abgenommenem Deckel. Nehmen Sie die Schutzabdeckung von Leiterplatten nicht ab.	Choc électrique: L'instrument utilise des tensions capables d'infliger des blessures corporelles. L'instrument doit être arrêté et débranché de la source de courant avant tout intervention. Ne pas utiliser l'instrument sans son couvercle. Ne pas enlever les étuis protecteurs des cartes de circuits imprimés.	Descarga eléctrica: Este instrumento utiliza altas tensiones, capaces de producir lesiones personales. Antes de dar servicio de mantenimiento al instrumento, éste deberá apagarse y desconectarse de la línea de alimentación eléctrica. No opere el instrumento sin sus cubiertas exteriores quitadas. No remueva las cubiertas protectoras de las tarjetas de circuito impreso.	Shock da folgorazione. L'apparecchio è alimentato da corrente ad alta tensione che può provocare lesioni fisiche. Prima di effettuare qualsiasi intervento di manutenzione occorre spegnere ed isolare l'apparecchio dalla linea elettrica. Non attivare lo strumento senza lo schermo superiore. Non togliere i coperchi a protezione dalle schede di circuito stampato (PCB).
	Chemical: This instrument might contain hazardous chemicals. Wear gloves when handling toxic, carcinogenic, mutagenic, or corrosive or irritant chemicals. Use approved containers and proper procedures to dispose waste oil.	Chemikalien: Dieses Gerät kann gefährliche Chemikalien enthalten. Tragen Sie Schutzhandschuhe beim Umgang mit toxischen, karzinogenen, mutagenen oder ätzenden/reizenden Chemikalien. Entsorgen Sie verbrauchtes Öl entsprechend den Vorschriften in den vorgeschriebenen Behältern.	Chimique: Des produits chimiques dangereux peuvent se trouver dans l'instrument. Portez des gants pour manipuler tous produits chimiques toxiques, cancérigènes, mutagènes, ou corrosifs/irritants. Utilisez des récipients et des procédures homologuées pour se débarrasser des déchets d'huile.	Química: El instrumento puede contener productos químicos peligrosos. Utilice guantes al manejar productos químicos tóxicos, carcinogénos, mutagénos o corrosivos/irritantes. Utilice recipientes y procedimientos aprobados para deshacerse del aceite usado.	Prodotti chimici. Possibile presenza di sostanze chimiche pericolose nell'apparecchio. Indossare dei guanti per maneggiare prodotti chimici tossici, cancerogeni, mutageni, o corrosivi/irritanti. Utilizzare contenitori aprovo e seguire la procedura indicata per lo smaltimento dei residui di olio.
	Heat: Before servicing the instrument, allow any heated components to cool.	Hitze: Warten Sie erhitzte Komponenten erst nachdem diese sich abgekühlt haben.	Haute Temperature: Permettre aux composants chauffés de refroidir avant tout intervention.	Altas temperaturas: Permita que los componentes se enfríen, ante de efectuar servicio de mantenimiento.	Calore. Attendere che i componenti riscaldati si raffreddino prima di effettuare l'intervento di manutenzione.
	Fire: Use care when operating the system in the presence of flammable gases.	Feuer: Beachten Sie die einschlägigen Vorsichtsmaßnahmen, wenn Sie das System in Gegenwart von entzündbaren Gasen betreiben.	Incendie: Agir avec précaution lors de l'utilisation du système en présence de gaz inflammables.	Fuego: Tenga cuidado al operar el sistema en presencia de gases inflamables.	Incendio. Adottare le dovute precauzioni quando si usa il sistema in presenza di gas infiammabili.
	Eye Hazard: Eye damage could occur from splattered chemicals or flying particles. Wear safety glasses when handling chemicals or servicing the instrument.	Verletzungsgefahr der Augen: Verspritzte Chemikalien oder kleine Partikel können Augenverletzungen verursachen. Tragen Sie beim Umgang mit Chemikalien oder bei der Wartung des Gerätes eine Schutzbrille.	Danger pour les yeux: Des projections chimiques, liquides, ou solides peuvent être dangereuses pour les yeux. Porter des lunettes de protection lors de toute manipulation de produit chimique ou pour toute intervention sur l'instrument.	Peligro par los ojos: Las salicaduras de productos químicos o partículas que saltan bruscamente pueden causar lesiones en los ojos. Utilice anteojos protectores al manipular productos químicos o al darle servicio de mantenimiento al instrumento.	Pericolo per la vista. Gli schizzi di prodotti chimici o delle particelle presenti nell'aria potrebbero causare danni alla vista. Indossare occhiali protettivi quando si maneggiano prodotti chimici o si effettuano interventi di manutenzione sull'apparecchio.
	General Hazard: A hazard is present that is not included in the above categories. Also, this symbol appears on the instrument to refer the user to instructions in this manual. When the safety of a procedure is questionable, contact your local Technical Support organization for Thermo Fisher Scientific San Jose Products.	Allgemeine Gefahr: Es besteht eine weitere Gefahr, die nicht in den vorstehenden Kategorien beschrieben ist. Dieses Symbol wird im Handbuch außerdem dazu verwendet, um den Benutzer auf Anweisungen hinzuweisen. Wenn Sie sich über die Sicherheit eines Verfahrens im unklaren sind, setzen Sie sich, bevor Sie fortfahren, mit Ihrer lokalen technischen Unterstützungsorganisation für Thermo Fisher Scientific San Jose Produkte in Verbindung.	Danger général: Indique la présence d'un risque n'appartenant pas aux catégories citées plus haut. Ce symbole figure également sur l'instrument pour renvoyer l'utilisateur aux instructions du présent manuel. Si la sûreté d'un procédé est incertaine, avant de continuer, contacter le plus proche Service Clientèle pour les produits de Thermo Fisher Scientific San Jose.	Peligro general: Significa que existe un peligro no incluido en las categorías anteriores. Este símbolo también se utiliza en el instrumento para referir al usuario a las instrucciones contenidas en este manual. Cuando la certidumbre acerca de un procedimiento sea dudosa, antes de proseguir, pongase en contacto con la Oficina de Asistencia Técnica local para los productos de Thermo Fisher Scientific San Jose.	Pericolo generico. Pericolo non compreso tra le precedenti categorie. Questo simbolo è utilizzato inoltre sull'apparecchio per segnalare all'utente di consultare le istruzioni descritte nel presente manuale. Quando è in dubbio la misura di sicurezza per una procedura, prima di continuare, si prega di mettersi in contatto con il Servizio di Assistenza Tecnica locale per i prodotti di Thermo Fisher Scientific San Jose.

CAUTION Symbol	CAUTION	危険警告	危險警告
	Electric Shock: This instrument uses high voltages that can cause personal injury. Before servicing, shut down the instrument and disconnect the instrument from line power. Keep the top cover on while operating the instrument. Do not remove protective covers from PCBs.	電撃: この計測器は高電圧を使用し、人体に危害を与える可能性があります。保守・修理は、必ず作業を停止し、電源を切ってから実施して下さい。上部カバーを外したままで計測器を使用しないで下さい。プリント配線板の保護カバーは外さないで下さい。	電撃: 儀器設備使用會造成人身傷害的高伏電壓。在維修之前，必須先關儀器設備並切除電源。務必要在頂蓋蓋上的情況下操作儀器。請勿拆除PCB保護蓋。
	Chemical: This instrument might contain hazardous chemicals. Wear gloves when handling toxic, carcinogenic, mutagenic, or corrosive or irritant chemicals. Use approved containers and proper procedures to dispose waste oil.	化学物質: 危険な化学物質が計測器中に存在している可能性があります。毒性、発がん性、突然変異性、腐食・刺激性などのある薬品を取り扱う際は、手袋を着用して下さい。廃油の処分には、規定の容器と手順を使用して下さい。	化学品: 儀器設備中可能存在有危險性的化學物品。接觸毒性致癌、誘變或腐蝕/刺激性化學品時，請配帶手套。處置廢油時，請使用經過許可的容器和程序。
	Heat: Before servicing the instrument, allow any heated components to cool.	熱: 熱くなった部品は冷えるのを待ってから保守・修理を行って下さい。	高温: 請先等高温零件冷卻之後再進行維修。
	Fire: Use care when operating the system in the presence of flammable gases.	火災: 可燃性のガスが存在する場所でシステムを操作する場合は、充分な注意を払って下さい。	火災: 在有易燃氣體的場地操作該系統時，請務必小心謹慎。
	Eye Hazard: Eye damage could occur from splattered chemicals or flying particles. Wear safety glasses when handling chemicals or servicing the instrument.	眼に対する危険: 化学物質や微粒子が飛散して眼を傷つける危険性があります。化学物質の取り扱い、あるいは計測器の保守・修理に際しては防護眼鏡を着用して下さい。	眼睛傷害危険: 飛濺の化学品或顆粒可能造成眼睛傷害。處理化學品或維儀器設備時請佩戴安全眼鏡。
	General Hazard: A hazard is present that is not included in the above categories. Also, this symbol appears on the instrument to refer the user to instructions in this manual.	一般的な危険: この標識は上記以外のタイプの危険が存在することを示します。また、計測器にこの標識がついている場合は、本マニュアル中の指示を参照して下さい。	一般性危険: 説明未包括在上述類別中的其他危險。此外，儀器設備上使用這個標誌，以指示用戶本使用手冊中的說明。
	When the safety of a procedure is questionable, contact your local Technical Support organization for Thermo Fisher Scientific San Jose Products.	安全を確保する手順がよくわからない時は、作業を一時中止し、お近くのサーモエレクトロンサンローゼプロダクトのテクニカルサポートセンターにご連絡ください。	如對安全程序有疑問，請在操作之前與當地的菲尼根技術服務中心聯繫。

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Preface

This manual describes the features, installation, and maintenance of the Surveyor Autosampler Plus™. This manual also describes portions of the Xcalibur™ or ChromQuest™ data systems used to perform diagnostics and maintenance procedures for the autosampler.

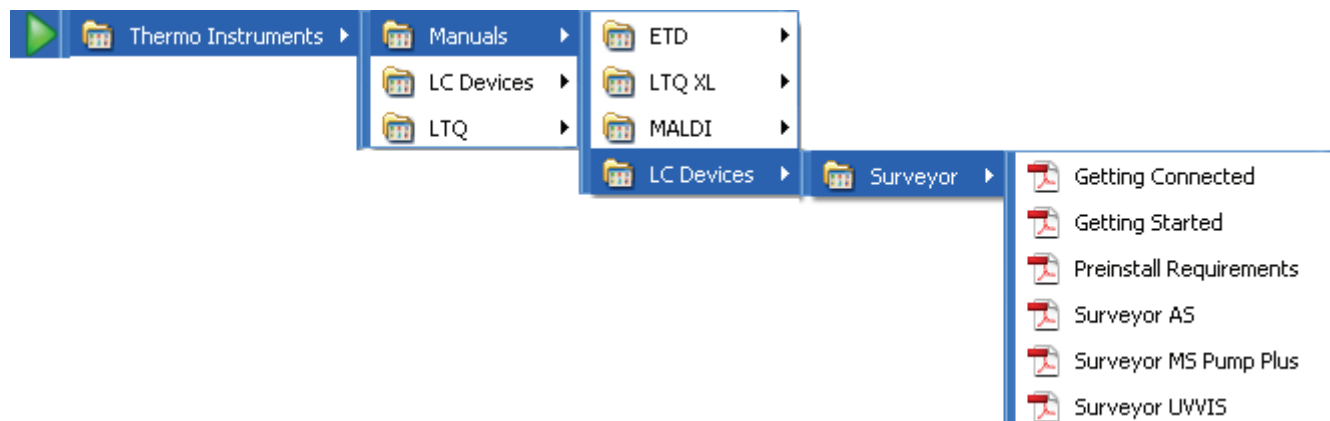
Related Documentation

In addition to this guide, Thermo Fisher Scientific provides the following documents for the Surveyor Plus Autosampler:

- *Surveyor Plus Preinstallation Requirements Guide*
- *Surveyor Plus Getting Connected Guide*
- *Surveyor Plus Getting Started with Xcalibur Guide*
- *Surveyor Plus Getting Started with ChromQuest Guide*

To access these manuals from your data system computer:

- For LC Devices 2.1.0 or 2.2.0, choose **Start > All Programs > Xcalibur > Manuals > LC Devices > Surveyor**.
- For LC Devices 2.2.1 or higher, choose **Start > All Programs > Thermo Instruments > Manuals > LC Devices > Surveyor > PDF link**.
- For ChromQuest, the manuals are provided on the software CD or the Surveyor Plus documentation CD.



Safety and Special Notices

Make sure you follow the precautionary statements presented in this guide. The safety and other special notices appear in boxes.

Safety and special notices include the following:



CAUTION Highlights hazards to humans, property, or the environment. Each CAUTION notice is accompanied by an appropriate CAUTION symbol.

IMPORTANT Highlights information necessary to prevent damage to software, loss of data, or invalid test results; or might contain information that is critical for optimal performance of the system.

Note Highlights information of general interest.

Tip Highlights helpful information that can make a task easier.

Good Laboratory Practices

To obtain optimal performance from your LC system and to prevent personal injury or injury to the environment, do the following:

- Keep good records.
- Read the manufacturers' Material Safety Data Sheets (MSDSs) for the chemicals being used in your laboratory.
- Remove particulate matter from your samples before you inject them into the liquid chromatograph.
- Use HPLC-grade solvents.
- Connect the drainage tubes from the pump, autosampler, and detector to an appropriate waste receptacle. Dispose of solvents as specified by local regulations.

Keep Good Records

To help identify and isolate problems with either your equipment or your methodology, for best results, keep good records of all system conditions (for example, % RSDs on retention times and peak areas, and peak shape and resolution). At a minimum, keep a chromatogram of a typical sample and standard mixture, well documented with system conditions, for future reference. Careful comparison of retention times, peak shapes, peak sensitivity, and baseline noise can provide valuable clues to identifying and solving future problems.

Chemical Toxicity

Although the large volume of toxic and flammable solvents used and stored in laboratories can be quite dangerous, do not ignore the potential hazards posed by your samples. Take special care to read and follow all precautions that ensure proper ventilation, storage, handling, and disposal of both solvents and samples. Become familiar with the toxicity data and potential hazards associated with all chemicals by referring to the manufacturers' Material Safety Data Sheets.

Sample Preparation

Always consider the solubility of your sample in the solvent/mobile phase. Sample precipitation can plug the column, tubing, or flowcell causing flow restriction. This obstruction can result in irreparable damage to the system. Particulate matter can be avoided by filtering the samples through 0.45 or 0.2 micron (or less) filters.

Solvent Requirements

Many chemical manufacturers provide a line of high-purity or HPLC-grade reagents that are free of chemical impurities. Typically, HPLC-grade solvents do not require filtration. You can significantly prolong the life and effectiveness of the inlet filters, check valves and seals, injector, and column by routine filtration of other types of solvents through a 0.45 or 0.2 micron (or less) fluorocarbon filter before placing them in the solvent reservoir bottles.

Choose a mobile phase that is compatible with the sample and column you have selected for your separation. Remember that some solvents are corrosive to stainless steel.

Solvent Disposal

Make sure you have a solvent waste container or other kind of drain system available at or below the benchtop level. Most solvents have special disposal requirements and should not be disposed of directly down a drain. Follow all governmental regulations when disposing of any chemical.

High-Pressure Systems and Leaks

LC systems operate at high pressures. Because liquids are not highly compressible, they do not store much energy. Accordingly, the high pressures in an LC system pose little immediate danger. However, correct any leak that occurs as soon as possible. Always wear eye and skin protection when operating or maintaining an LC system. Always shut down the system and return it to atmospheric pressure before attempting any maintenance.

Contacting Us

There are several ways to contact Thermo Fisher Scientific for the information you need.

❖ **To contact Technical Support**

Phone	800-532-4752
Fax	561-688-8736
E-mail	us.techsupport.analyze@thermofisher.com
Knowledge base	www.thermokb.com

Find software updates and utilities to download at mssupport.thermo.com.

❖ **To contact Customer Service for ordering information**

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Introduction

The Surveyor Autosampler Plus is a member of the Surveyor Plus™ family of high-performance liquid chromatography instruments. The Surveyor Autosampler Plus (see [Figure 1](#)) holds up to 200 standard vials, three 96-well plates, or three 384-well plates; contains a built-in column oven (5 to 95 °C); provides tray/sample temperature control (0 to 60 °C); and is capable of performing automated sample preparation routines.

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Figure 1. Surveyor Autosampler Plus



Autosampler Components

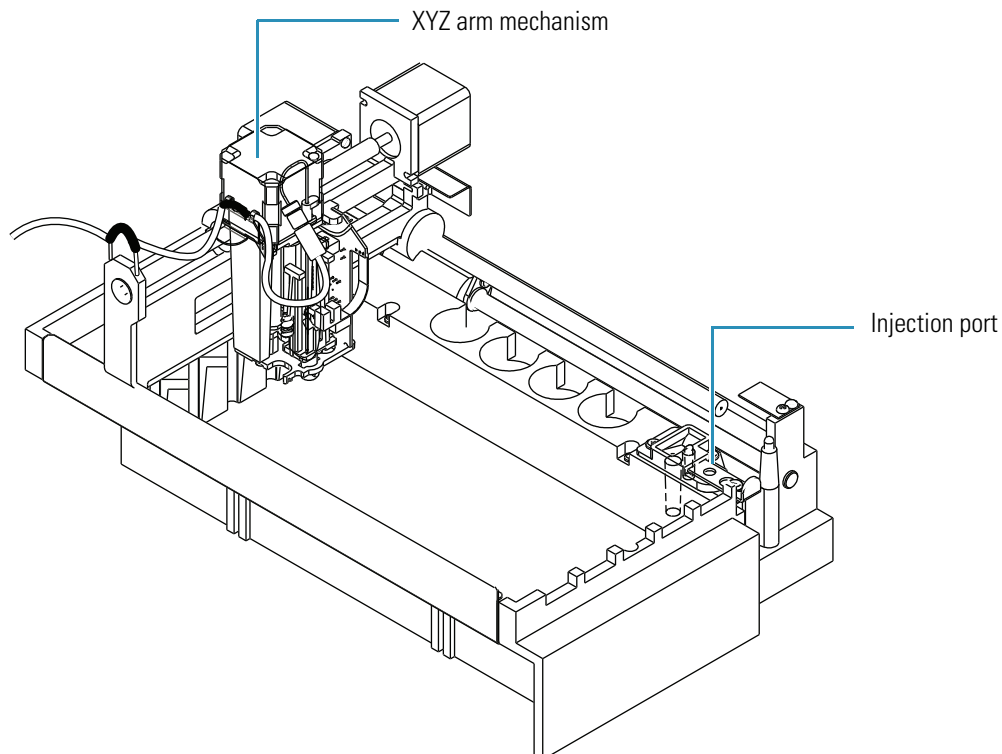
The main components of the Surveyor Autosampler Plus are as follows:

- The Tray Compartment
- The Injection System
- The Column Oven and Tray Compartment Heater/Cooler
- The Status LEDs

The Tray Compartment

Two types of sample trays are supplied with the Surveyor Autosampler Plus: a conventional sample tray and a microwell carrier. The tray compartment can hold up to five conventional sample trays or one carrier that holds three microwell plates. The tray compartment also holds up to four 16 mL capacity reservoir vials that can be used to hold solvent, reagent, or diluent. The reservoir vials are located behind the wash station and are designated RV1, RV2, RV3, and RV4. [Figure 2](#) shows an empty tray compartment.

Figure 2. Tray compartment



From the left to the right side of the tray compartment, the five conventional sample trays are designated A, B, C, D, and E. Each conventional sample tray holds up to 40 standard 1.8 mL vials for a total capacity of 200 samples. Overlays allow the sample trays to accommodate different vial sizes.

The microwell carrier can hold up to three low-density microplates or up to three high-density microplates. From the front to the back of the tray compartment, the microplates are designated A, B, and C.

The low-density microplate contains 96 wells in an 8 × 12 configuration, designated A1 through H12, for a total capacity of 288 samples. Each well can hold up to 250 µL of sample.

The high-density microplate contains 384 wells in a 16 × 24 configuration, designated A1 through P24, for a total capacity of 1152 samples. Each well can hold up to 50 µL of sample.

The tray compartment door contains a magnetic switch. The magnet is located in the door and the switch is attached to the chassis. When you open the door, the switch signals the autosampler that the door is open. If you select the Verify door is closed check box when you configure the autosampler, the XYZ arm automatically moves to the back of the tray compartment when you open the door so that you can remove trays or replace vials.

Opening the tray compartment door while the autosampler is making an injection does not interrupt the current run. The XYZ arm moves to the back of the compartment after the injection is complete and the sequence pauses. Closing the autosampler door allows the sequence to resume.

The Injection System

Figure 3 shows the injection system of the Surveyor Autosampler Plus. The major components of the injection system are as follows:

- Wash Bottle and Wash Bottle Tube
- XYZ Arm Mechanism
- Needle Tubing Assembly and Needle Assembly
- Syringe Valve
- Syringe
- Wash Station
- Injection Port of the Autosampler and Transfer Tube
- Injection Valve
- Sample Loop

You can order the replaceable components of the injection system by Thermo Fisher Scientific part number. See Chapter 7, “Consumables and Service Parts.”

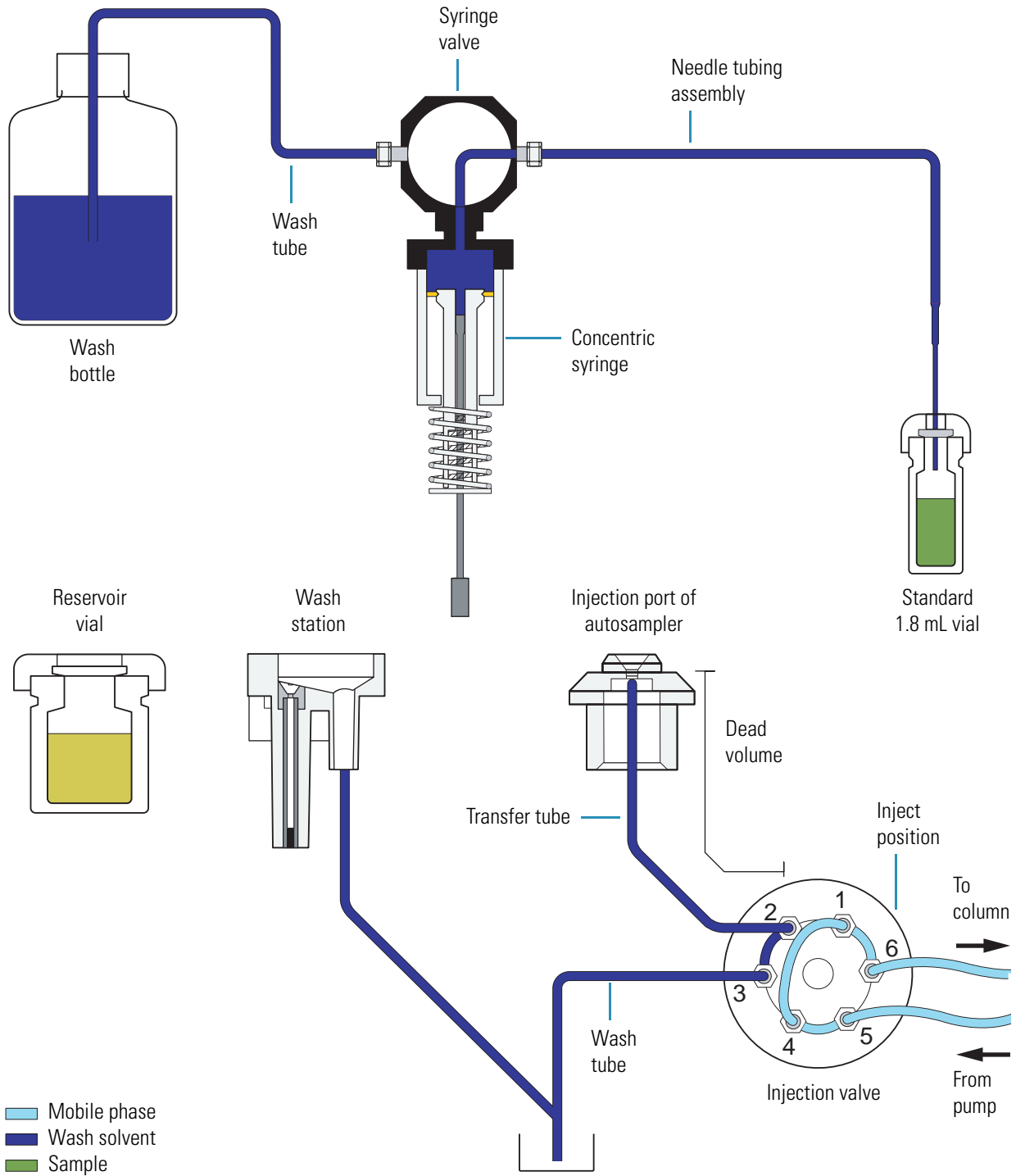


CAUTION Because the XYZ arm moves to the sample position, do not place objects taller than 4.5 cm (1.8 in.) in the tray compartment.

1 Introduction

Autosampler Components

Figure 3. Autosampler injection components



Wash Bottle and Wash Bottle Tube

The wash bottle rests in the solvent platform on the top of the Surveyor Plus stack. The wash bottle tube connects the wash bottle to the syringe valve. Both of the direct commands, Flush (from bottle) and Wash Needle (from bottle), draw solvent from the wash bottle. If you let the wash bottle run dry, the syringe barrel and the wash bottle tube fill with air. When this happens, the autosampler cannot draw sample into the needle tubing during an injection sequence.

IMPORTANT Check the volume of solvent in the wash bottle before performing a sequence of injections. Letting the wash bottle run dry compromises the performance of the autosampler.

XYZ Arm Mechanism

The XYZ arm mechanism moves the needle along the X-Y plane to the requested vial or well location. After it positions the needle above the vial or well, the XYZ arm lowers the needle along the Z-axis to the requested needle height. The syringe plunger descends, drawing sample into the needle tubing. The XYZ arm mechanism moves back to the home position, above the injection port of the autosampler, and then lowers the needle into the injection port. The syringe plunger ascends, expelling the sample from the needle tubing.

Do not move the XYZ arm manually. Instead, use the commands and options listed in [Table 1](#) to control the position of the XYZ arm. For information on using the data system commands, see [“Using the Xcalibur Direct Control Commands”](#) on page 127 or [“Using the ChromQuest Direct Commands”](#) on page 129.

Table 1. Commands and options that control the position of the XYZ arm

Action	Data system	Command or option
Make the XYZ arm automatically move to the back of the tray compartment when you open the tray door.	Xcalibur	Select the Verify door is closed check box when you specify the instrument configuration options.
	ChromQuest	Select the Verify door is closed check box when you specify the instrument configuration options.
Move the XYZ arm to the back of the tray compartment.	Xcalibur	Use the Position Arm to Access Tray direct command.
	ChromQuest	Use the Position Arm to Access Tray direct control command.
Move the XYZ arm to its home position above the injection port and behind the wash station.	Xcalibur	Use the Set Arm to Home Position direct command.
	ChromQuest	Use the Go to Home direct control command.
Move the XYZ arm to the center front of the tray compartment, allowing easy access to the needle.	Xcalibur	Use the Remove Needle direct command.
	ChromQuest	Use the Needle Removal direct control command.

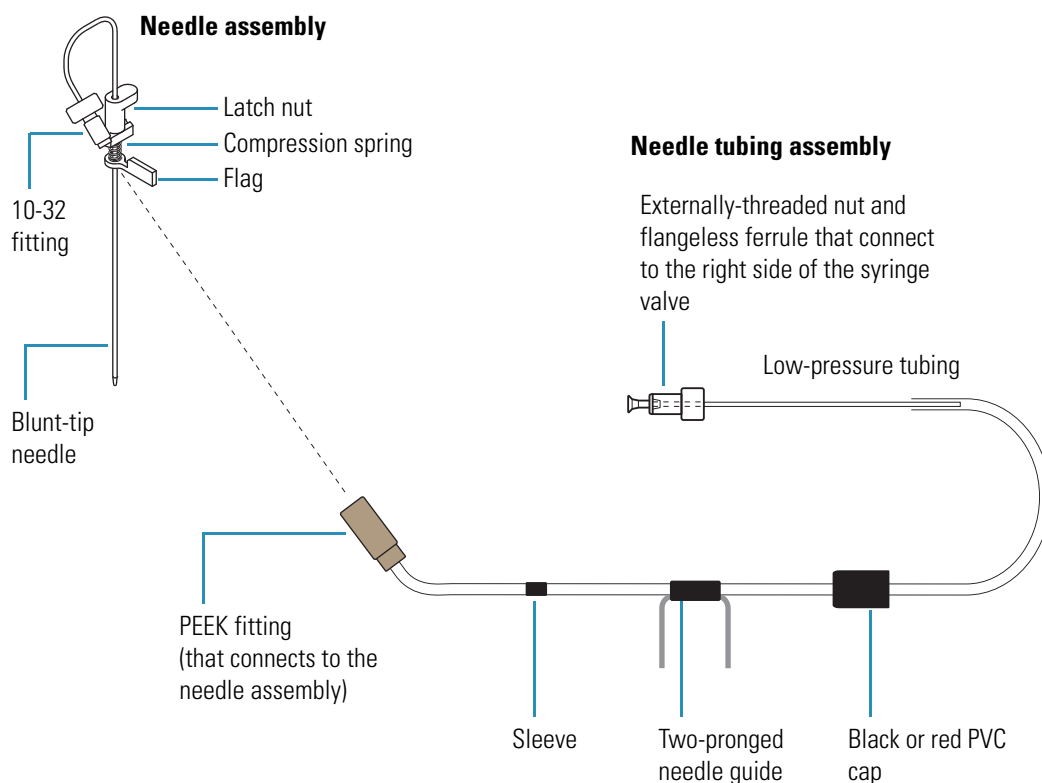
Needle Tubing Assembly and Needle Assembly

Figure 4 shows the needle assembly and the needle tubing assembly.

The needle assembly consists of a blunt-tip needle, a latch nut, a flag, a compression spring, and an externally-threaded fitting that connects to the needle tube assembly.

The needle tube assembly connects the solvent path between the needle and the syringe valve and consists of low-pressure tubing, an internally-threaded fitting that connects to the needle assembly fitting, a sleeve, a black or red PVC cap, a needle tube guide that attaches to the X-axis positioning frame, and an externally-threaded fitting with a flangeless ferrule that connects to the right side of the syringe valve.

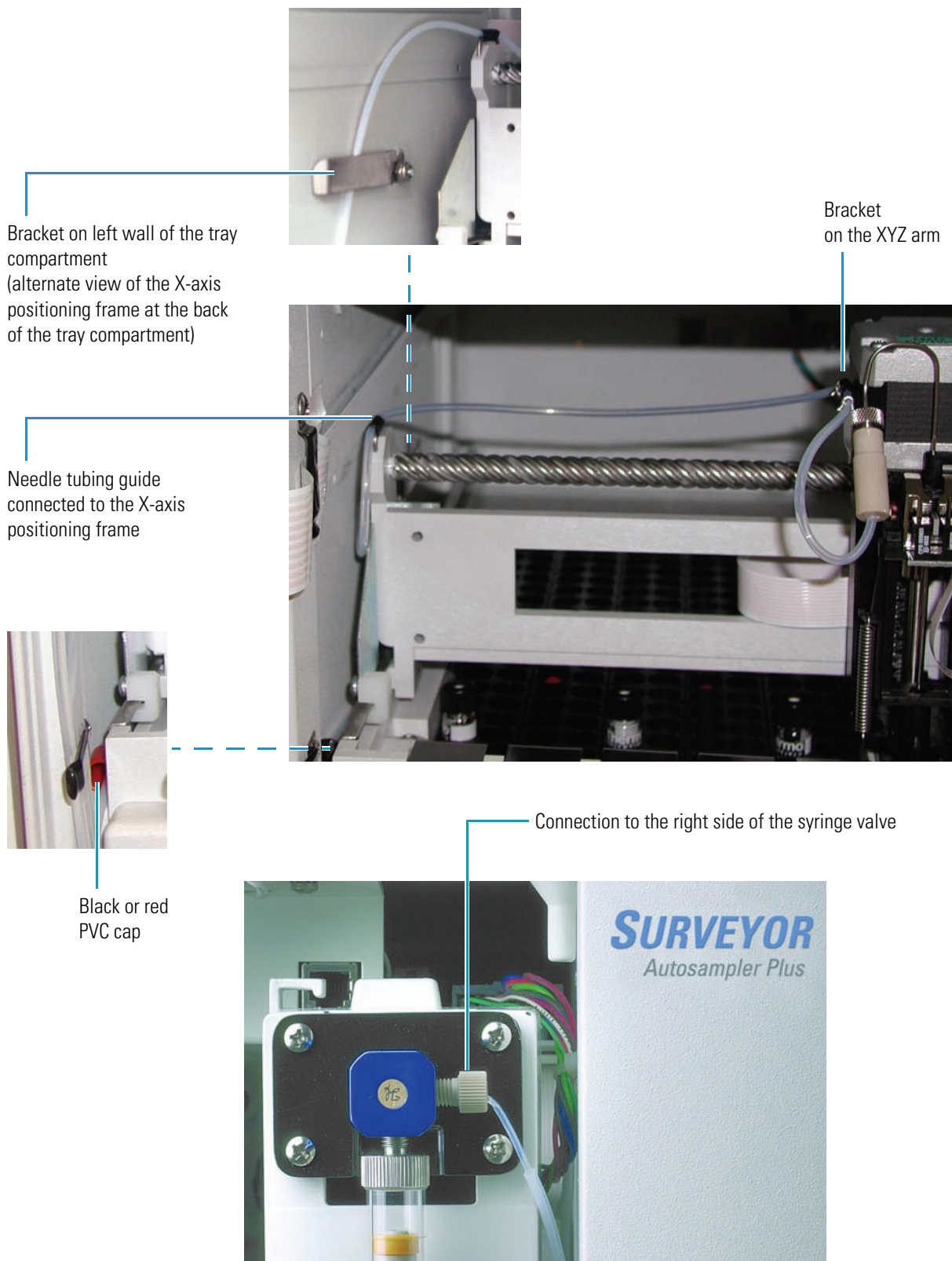
Figure 4. Needle assembly and needle tubing assembly



The needle mount on the XYZ arm holds the needle assembly. To prevent the needle tubing from interfering with the movement of the XYZ arm, the following items secure the needle tubing to the autosampler (see Figure 5):

- A bracket on the XYZ arm
- A guide on the X-axis positioning frame
- A bracket on the left wall of the tray compartment
- A PVC cap that holds the tubing below the metal runner for the X-axis positioning frame

Figure 5. Needle tubing assembly connections (not shown to scale)



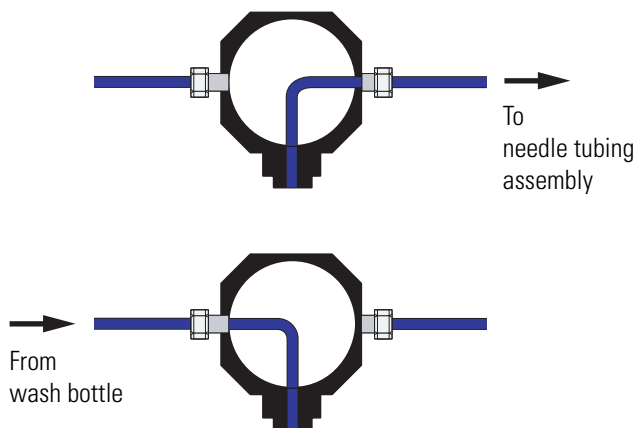
The standard needle tubing assembly holds approximately 560 μL of liquid. During an injection, the syringe draws sample into the needle tubing, not into the syringe barrel. If your autosampler is configured with a 2500 μL standard syringe, and you want to make partial loop injections greater than 500 μL or full loop injections greater than 150 μL , you must add additional needle tubing to your autosampler.

The tubing extension, which is needed to make large volume injections, holds up to 1 mL of liquid. Adding this additional tubing to your autosampler allows the withdrawal of up to 1500 μL from a sample location or a reservoir vial. To attach this additional tubing to your autosampler, detach the needle tubing assembly from the syringe valve. Use the Teflon™ connector to attach the additional tubing to the needle tubing assembly. Attach the other end of the additional tubing to the syringe valve.

Syringe Valve

The syringe valve is a 2-position rotary valve (see [Figure 6](#)). In the wash bottle position, the downward movement of the syringe plunger draws wash solvent from the wash bottle into the syringe barrel. In the needle position, the downward movement of the syringe plunger draws liquid from a sample vial or a reservoir vial into the needle tubing. As the syringe plunger moves upward, it pushes liquid out of the needle tubing.

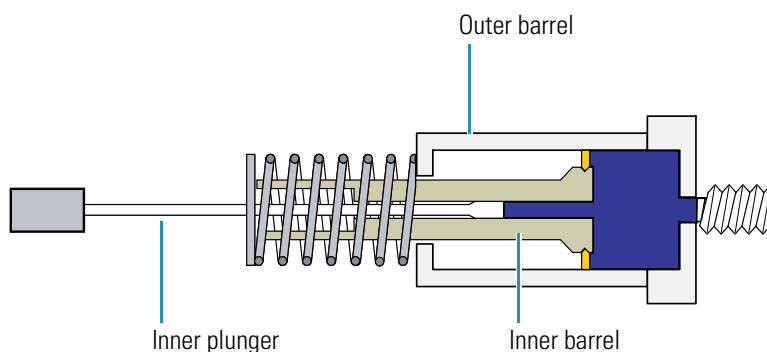
Figure 6. Two-position rotary syringe valve



Syringe

The Surveyor Autosampler Plus uses a syringe with two concentric barrels to perform liquid transfers (see [Figure 7](#)). The autosampler uses the inner barrel plunger to draw and deliver sample amounts equal to or less than the nominal size of the syringe and the outer barrel plunger to draw and expel volumes up to 560 μL .

Figure 7. Dual concentric syringe



The inner plunger wears more rapidly than the rest of the syringe. The lifespan of the inner plunger is approximately 50000 injections. Replace the inner plunger if you notice liquid leaking from the bottom of the syringe. For ordering information, see [“Consumables”](#) on [page 118](#).

Dual concentric syringes are available in 100, 250, and 500 μL sizes. In addition, a 2500 μL standard syringe is available. The size of the syringe determines the injection volume range. [Table 2](#) lists the minimum and maximum injection volumes for each syringe size.

Table 2. Allowable injection volumes based on the syringe size

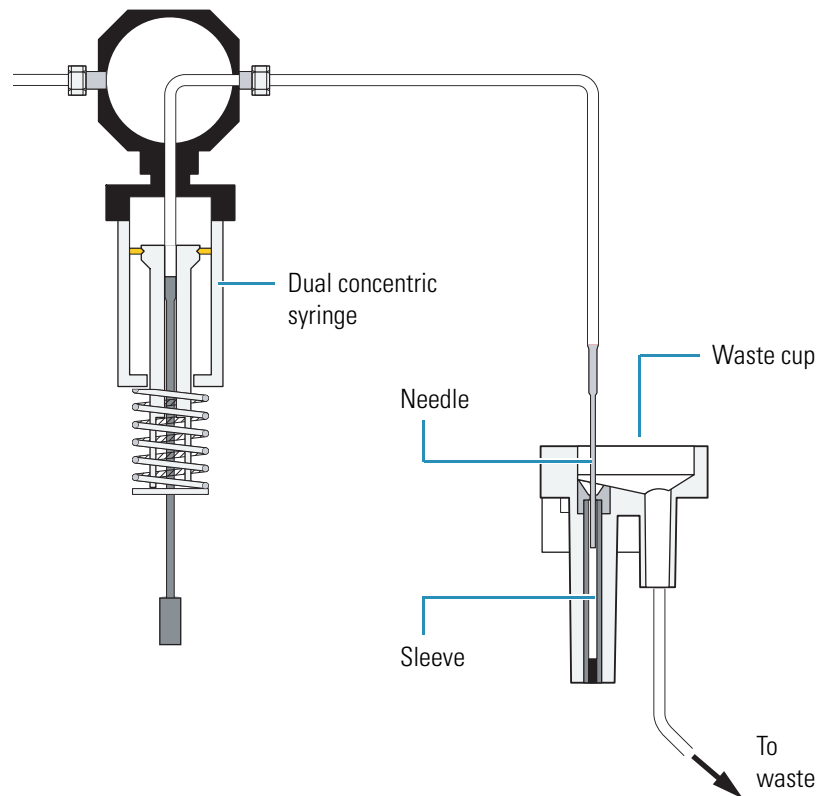
Syringe size (μL)	Injection volume (μL)			
	Minimum	Maximum (No waste)	Maximum (Partial loop)	Maximum (Full loop)
100	0.1	20	20	20
250	0.1	100	100	100
500	0.1	250	250	250
2500	0.1	1000	1000	1000*

* Requires an extension to the standard needle tubing

Wash Station

The wash station is a waste cup containing an inner sleeve slightly larger than the needle (see Figure 8). Low-pressure tubing connects the waste cup to the waste bottle. To wash the outside of the needle, the XYZ arm moves the needle to the wash station and lowers the needle into the inner sleeve of the waste cup. The syringe draws solvent from the wash bottle or requested reservoir vial, and then expels the solvent through the needle. As it fills the waste cup, the expelled solvent flows up over the exterior surface of the needle, and then out the waste tubing to the waste bottle.

Figure 8. Wash station



Injection Port of the Autosampler and Transfer Tube

A transfer tube connects the injection port (see [Figure 9](#)) to the injection valve (see [Figure 10](#)). The transfer tubing has an inner diameter of 0.012 in. One end of the tubing has a flanged stainless steel fitting that connects to the injection port. The other end of the tubing has a PEEK fitting that connects to port 2 of the injection valve (see [Figure 11](#)).

IMPORTANT

1. The label attached to the transfer tube assembly specifies the internal volume of the tubing. Because the autosampler uses this value for its injection algorithm, you must type this value in the Dead Volume box when you configure the Surveyor Autosampler Plus. If you do not enter the value listed on the label, your data might be compromised.
2. You can constrict the transfer tube by overtightening the fitting to port 2 of the injection valve. Lack of injection precision is a symptom of a constricted transfer tube.

Figure 9. Injection port of the Surveyor Autosampler Plus

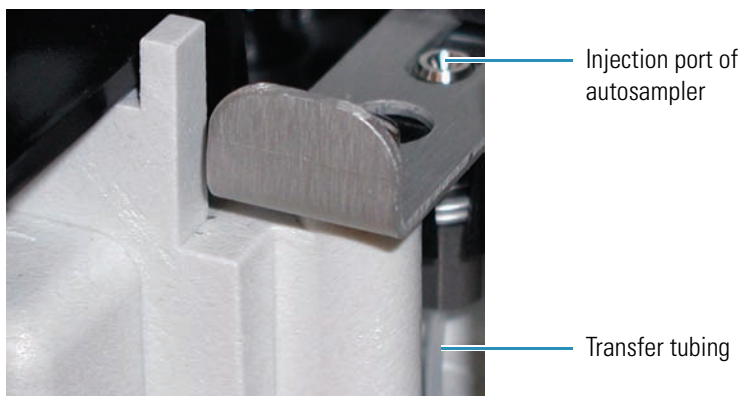
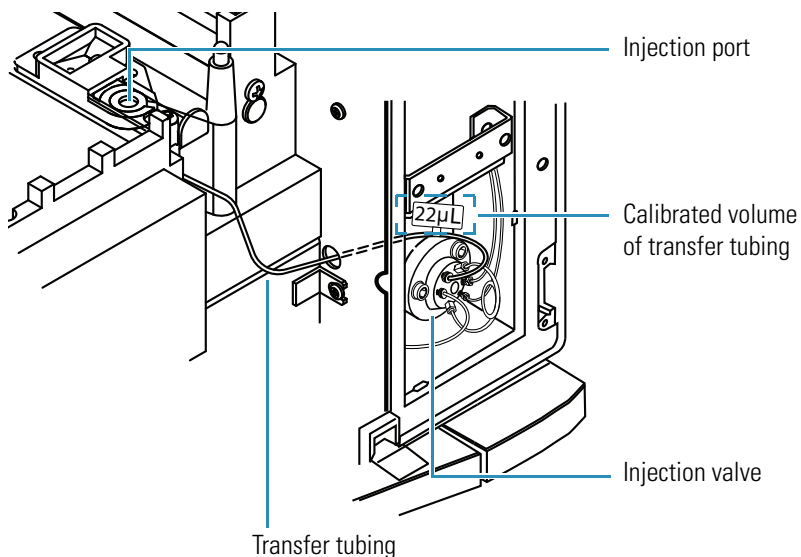


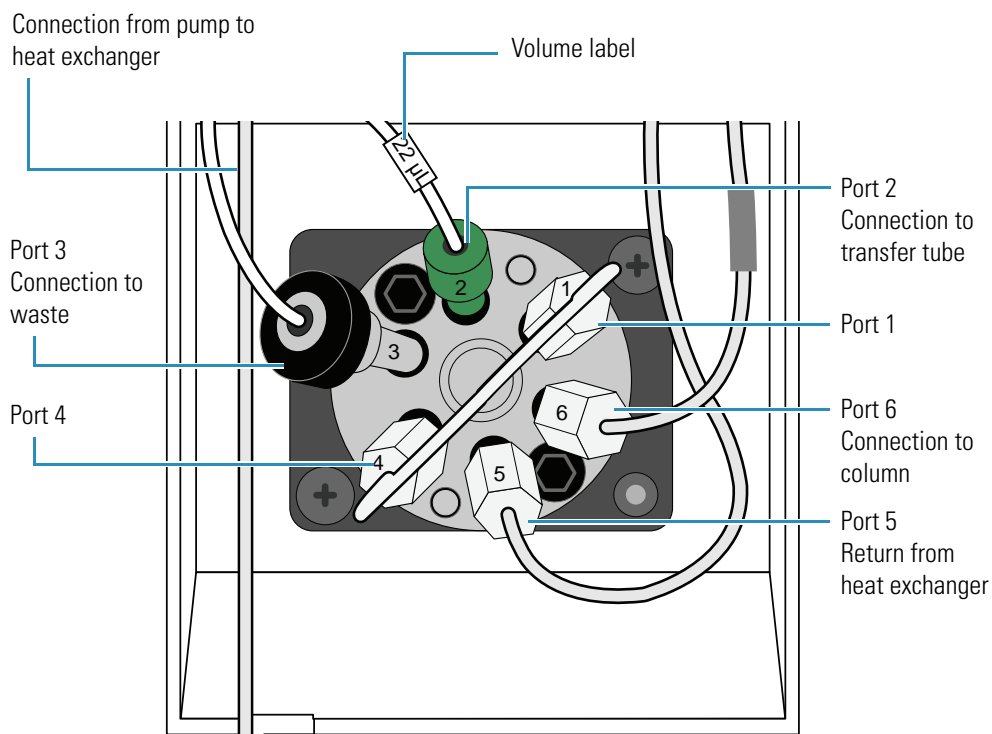
Figure 10. Transfer tubing connections (shown with the syringe drive assembly removed)



Injection Valve

The injection valve is a six-port, two-position valve that introduces sample onto the column by way of the sample loop (see [Figure 11](#)).

Figure 11. Six-port rotary injection valve



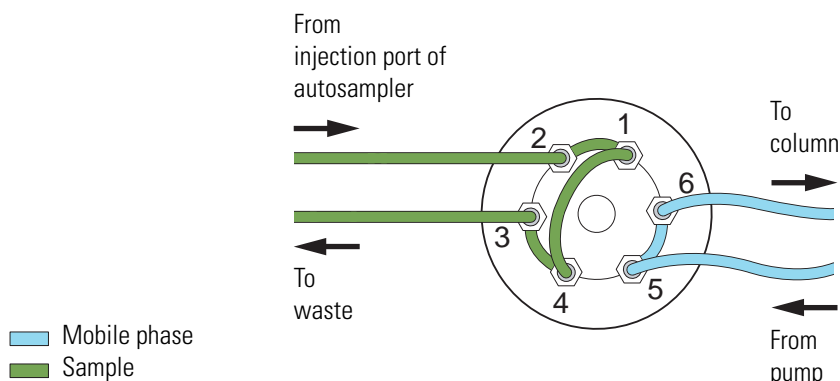
There are two positions for the injection valve: fill (load) and inject. Three passages are open in each position.

In the fill (load) position, the three passages connect the following ports:

- The injection port (2) is connected to the front of the sample loop (1).
- The back of the sample loop (4) is connected to the waste port (3).
- The solvent return from the heat exchanger (5) is connected to port (6).

To isolate the sample loop from the mobile phase stream, the autosampler rotates the valve to the load position (see Figure 12). While the mobile phase stream bypasses the loop, the syringe pushes sample through the transfer tubing and into the front of the sample loop. As the sample loop is loaded, excess solution is pushed out of the back of the sample loop to waste.

Figure 12. Fill (load) position for the six-port injection valve

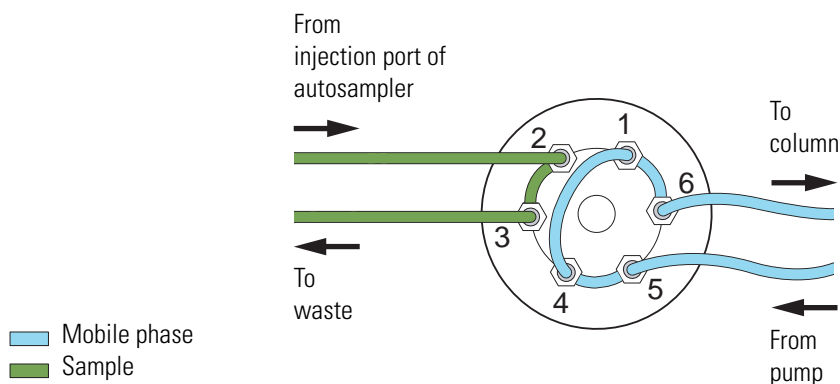


In the inject position, the three passages connect the following ports:

- The mobile phase port (5) is connected to the back of the loop (4).
- The front of the sample loop (1) is connected to the column port (6).
- The injection port (2) is connected to the waste port (3).

To put the sample loop into the path of the mobile phase stream, the autosampler rotates the valve to the inject position (see Figure 13). The mobile phase stream enters the sample loop from the back, backflushing the contents of the sample loop onto the column. Excess sample left in the transfer tube is expelled directly to waste. To allow ample rinsing of the sample loop with mobile phase, the injection valve remains in the inject position during the entire run.

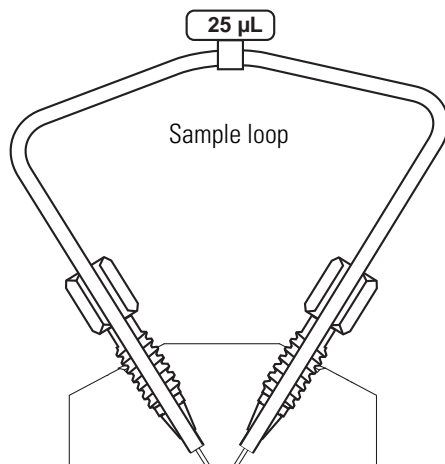
Figure 13. Inject position for the six-port injection valve



Sample Loop

The sample loop is a stainless steel tube with end fittings that holds the sample prior to its introduction onto the column. The sample loop is an interchangeable part swaged onto ports 1 and 4 of the six-port injection valve (see [Figure 14](#)).

Figure 14. Schematic of the sample loop attached to the injection valve



The autosampler is shipped with a 25 µL sample loop. Sample loops are available in nominal sizes ranging from 5 to 1000 µL. The accuracy of the sample loop volume is $\pm 20\%$. This means that the actual volume of a 25 µL sample loop is between 20 to 30 µL. For ordering information, see [“Consumables”](#) on [page 118](#).

The Column Oven and Tray Compartment Heater/Cooler

The built-in column oven controls the temperature of the air surrounding the chromatographic column. Isothermal temperature control is achieved with a Peltier device. The Peltier device is a solid-state, heat-transferring assembly used to heat or cool the column oven. The temperature control range is 5 to 95 °C.

Between the pump outlet and the autosampler injection valve, the mobile phase passes through a heat exchanger, located behind the column oven. This diversion in flow allows the mobile phase to equilibrate to the temperature of the column oven before it reaches the injection valve, but adds 250 µL of gradient delay volume to the system.

For low flow gradient applications, you might want to bypass the heat exchanger by connecting the tubing from the pump directly to the autosampler injection valve.

The tray temperature control feature provides temperature control of the samples in the range from 0 to 60 °C. A Peltier device maintains the tray temperature.

The Status LEDs

Four status LEDs (light-emitting diodes) labeled Power, Communication, Run, and Temperature are located on the front of the autosampler's right door (see [Figure 15](#)). The states of the status LEDs are listed in [Table 3](#).

Figure 15. Status LEDs



Note To control the temperature of the column oven compartment and the sample compartment, select the Wait for Temperature Ready check box when you add the Surveyor Autosampler Plus to the data system instrument configuration.

Table 3. Status LED states

LED	State	Meaning
Power	Green	The autosampler power is on.
Comm	Amber	Communication with the data system has not been established.
	Green	Communication with the data system has been established.
Run	Flashing Amber	An error condition, such as an XYZ arm jam or initialization startup error, has occurred.
	Green	The autosampler is in the Ready state.
	Flashing Green	An injection or timed event is in progress.
Temp*	Amber	A temperature change within the column oven or tray temperature zones is in progress.
	Green	The column oven and tray temperature zones are in equilibrium at the set temperature.

* The Temp LED remains green if you do not select the Wait for Temperature Ready check box when you add the Surveyor Autosampler Plus to your instrument configuration.

Injection Modes

The Surveyor Autosampler Plus can perform the following injection modes:

- [No Waste Injection](#)
- [Partial Loop Injection](#)
- [Full Loop Injection](#)

The optimum injection mode depends on the amount of sample that you have and the degree of precision that your application requires.

No Waste Injection

In the no waste injection mode, the autosampler withdraws only the exact amount of sample requested from the sample vial. Of the three injection modes, the no waste injection mode uses the least amount of sample, but it is also the least precise. Use this injection mode to conserve sample.

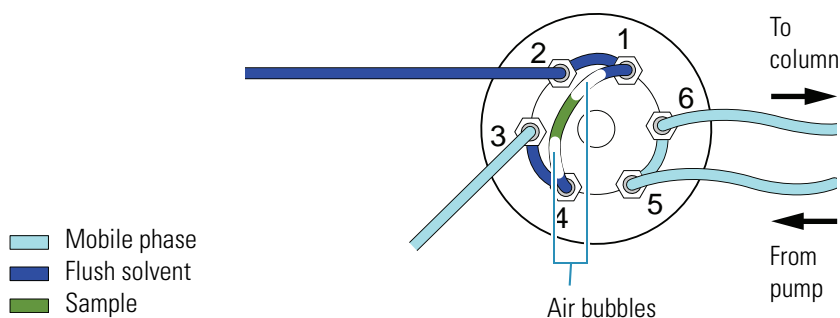
IMPORTANT For no waste injections, do the following:

- Use a sample loop that is at least 5 μL larger than the injection volume. Because the accuracy of the nominal size is $\pm 20\%$, use an estimate of 80% for the actual size. For example, use 20 μL as an estimate for the actual volume of a 25 μL loop, and inject no more than 15 μL with this loop size.
- Consider matching the chemistry of the sample matrix, the flush solution, and the mobile phase. For no waste injections, the autosampler loads approximately 2 μL of flush solvent and 3 μL of air into the sample loop, regardless of the requested injection volume.
- Inject at least 1.0 μL of sample.

Approximately 0.25 μL of the sample is lost as it travels from the injection port through the transfer tubing and into the injection valve. Because of this loss, inject at least 1.0 μL of sample with the no waste injection mode.

The quantity of lost sample depends on the syringe rate. Decreasing the syringe rate decreases the sample loss. Thermo Fisher Scientific recommends a syringe rate no greater than 4 $\mu\text{L}/\text{s}$ for the no waste injection mode.

In addition to the sample, the no waste injection mode loads approximately 2 μL of flush solvent and 3 μL of air into the sample loop. Because these values are independent of the injection volume, the chemistry of the flush solution can affect your chromatographic results. For best chromatographic results, consider matching the chemistry of the sample matrix, the flush solution, and the mobile phase. [Figure 16](#) shows the sample loop loaded with 2 μL of flush solvent, 3 μL of air, and the requested volume of sample.

Figure 16. No waste injection mode – load position

Partial Loop Injection

In the partial loop injection mode, the autosampler withdraws 22 μL of excess sample from the vial in addition to the requested injection volume. The autosampler expels approximately one-half of the excess volume to waste before it meters the center of the sample plug into the front of the sample loop. It expels the second portion of excess sample to waste after the mobile phase stream backflushes the contents of the sample loop onto the column.

Because the autosampler meters sample into the sample loop, the partial loop injection mode is less precise but more accurate than the full loop injection mode. You can inject variable amounts of sample, ranging from a minimum of 0.1 μL to a practical maximum of one-half the volume of your sample loop. The laminar flow of fluid within the stainless steel sample loop causes this maximum volume limitation.

IMPORTANT To make precise partial loop injections, limit the maximum injection volume to less than half the nominal sample loop size. Because the accuracy of the nominal volume of the sample loop is $\pm 20\%$ (which means that the actual volume of the standard 25 μL sample loop is between 20 μL and 30 μL), for best results, limit the maximum injection volume to 10 μL for the standard sample loop.

Full Loop Injection

In the full loop injection mode, the autosampler withdraws a sample volume sufficient to overfill the loop (according to the equation given on [page 18](#)). Because the actual injection volume is determined by the size of the loop, not the metering action of the stepper motor, a full loop injection is very reproducible. However, because the full loop injection mode completely fills the sample loop, you cannot inject variable amounts of sample.

The full loop injection mode is useful when you want maximum precision and have unlimited sample. However, if you want to change the injection volume, you must replace the attached sample loop with one of a different size. The available sample loop sizes are listed in “Consumables” on [page 118](#).

Note You specify the size of the sample loop when you configure the Surveyor Autosampler Plus.

In the full loop injection mode, the autosampler withdraws a large excess of solution from the sample vial according to the following equation:

$$\text{Amount withdrawn} = 3 \times IV + DV + 7.5 \mu\text{L}$$

Where:

IV = requested injection volume

DV = Volume of the transfer tube + volume of the injection port of the autosampler and the rotor slot (1.6 μL)

This equation is valid until the maximum capacity of the syringe is reached. If you request a 100 μL full loop injection and your autosampler has a 250 μL syringe, the autosampler withdraws 265 μL of sample solution, which is the maximum capacity of the syringe, from the vial. A sample volume equal to the actual volume of the sample loop is injected onto the column. [Table 4](#) lists the maximum capacity for each syringe.

Table 4. Maximum volume withdrawn for full loop injections

Nominal syringe size	Maximum volume withdrawn
Concentric 100 μL	101 μL
Concentric 250 μL	265 μL
Concentric 500 μL	535 μL
Standard 2500 μL	1544 μL *

* The data system limits the maximum amount withdrawn to 1544 μL .

Injection Sequence

The primary sequence of events for the full loop injection mode is as follows:

1. Getting ready for an injection
2. Drawing sample from the vial
3. Loading sample into the loop
4. Injecting sample
5. Post-injection events

The full loop injection mode draws enough sample to overfill both the transfer tube and the sample loop. The no waste injection mode, however, draws only the injection volume requested, and the partial loop injection mode draws only the injection amount requested plus an additional 22 μL .

As a result, unlike the full loop mode, both the partial loop and no waste injection modes require additional solvent to push the sample all the way through the transfer tubing to the injection valve before the sample is loaded into the loop. The syringe draws this extra transport solvent from the wash bottle and uses it to compensate for the volume held by the injection port of the autosampler, the transfer tube, and the rotor slot of the injection valve. Before the sample is loaded into the loop, the syringe uses the transport solvent to push the sample to the injection valve.

The primary sequence of events for both the partial loop injection mode and the no waste injection mode is as follows:

1. Getting Ready for an Injection
2. Drawing Transport Solvent (Partial Loop and No Waste Injections)
3. Drawing Sample
4. Pushing Transport Solvent (Partial Loop and No Waste Injections)
5. Loading Sample into the Sample Loop
6. Injecting Sample onto Column
7. Post-Injection Events

Table 5 outlines the sequential events that occur during an injection.

Table 5. Injection sequence

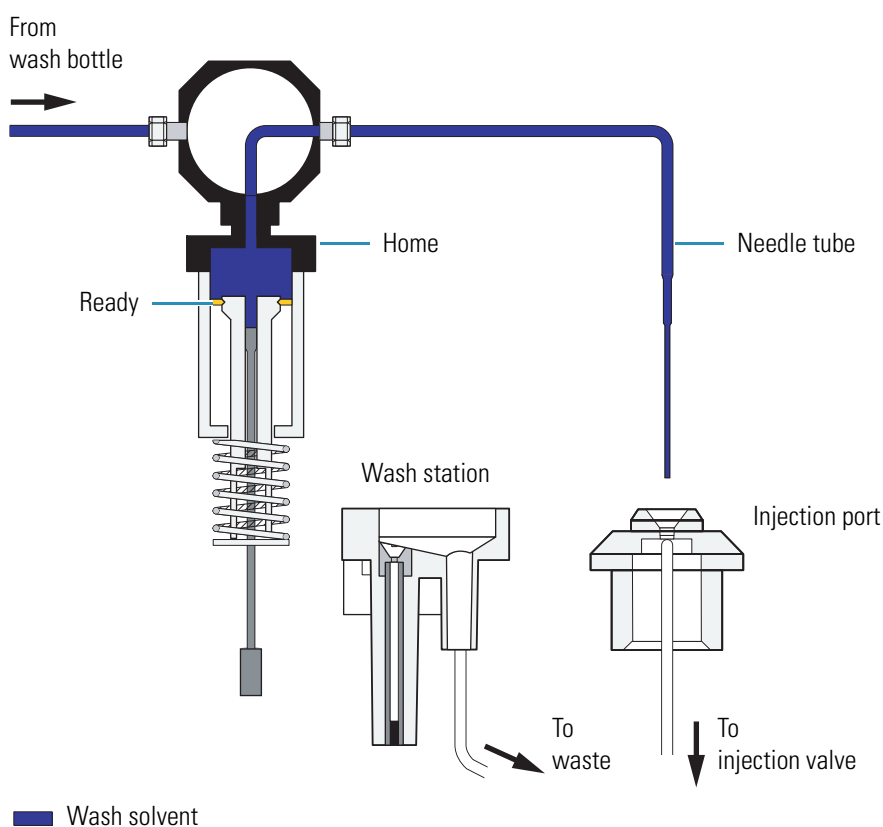
#	Full loop	#	Partial loop	No waste
1	Get ready for injection	1	Get ready for injection	Get ready for injection
			Switch injector to inject position	Switch injector to inject position
	N/A	2	Draw transport solvent	Draw transport solvent
			Switch syringe valve to wash solvent position	Switch syringe valve to wash solvent position
	Switch injector to fill position		Draw wash solvent (transport volume = total dead volume + 7.5 µL)	Draw wash solvent (transport volume = total dead volume)
2	Draw Sample	3	Draw Sample	Draw Sample
	Move XYZ arm to vial		Move XYZ arm to vial	Move XYZ arm to vial
	Switch syringe valve to needle position		Switch syringe valve to needle position	Switch syringe valve to needle position
	Draw 3 µL air bubble		Draw 3 µL air bubble	Draw 1.5 µL air bubble
	Draw sample [(3 × IV) + DV + 7.5 µL]		Draw sample equal to Inject Volume (IV) = 22 µL	Draw sample equal to Inject Volume (IV)
	Draw 3 µL air bubble		Draw 3 µL air bubble	Draw 1.5 µL air bubble
	N/A	4	Push Transport Solvent	Push Transport Solvent
	Move XYZ arm to injection port of autosampler		Move XYZ arm to injection port of autosampler	Move XYZ arm to injection port of autosampler
			Push the transport volume into the transfer tube	Push the transport volume (minus 1 µL) into the transfer tube
3	Load Sample into Loop	5	Load Sample into Loop	Load Sample into Loop
	Overfill the sample loop		Switch the injector to fill position	Switch the injector to fill position
			Meter the sample plug into the loop	Meter the sample plug + air bubbles + 2 µL wash solvent into the loop
4	Switch the injector to inject position	6	Switch the injector to inject position	Switch the injector to inject position
5	Post-Injection Events	7	Post-Injection Events	Post-Injection Events
	Perform optional flush/wash		Perform optional flush/wash	Perform optional flush/wash
	Home syringe		Home syringe	Home syringe
	Prepare for next injection		Prepare for next injection	Prepare for next injection

Getting Ready for an Injection

Before an injection sequence begins, the autosampler initializes the syringe plunger to the Ready position (see [Figure 17](#)).

- If the syringe plunger is in the Home Side of Ready position, the autosampler switches the syringe valve to the solvent bottle position, and then returns the syringe plunger downward to the Ready position at flush speed.
- If the syringe plunger is below the Ready position, the autosampler switches the syringe valve to the needle position, the XYZ arm moves the needle to the wash station, and the syringe plunger moves upward to the Ready position at flush speed.

Figure 17. Syringe, syringe valve, and needle position prior to injection (Ready position)



Drawing Transport Solvent (Partial Loop and No Waste Injections)

To draw transport solvent, the syringe valve switches to the wash bottle position. The amount of solvent that the syringe draws from the wash bottle, referred to as the transport volume, depends on both the injection mode and the configured value for the dead volume.

IMPORTANT A transfer tube connects the injection port of the autosampler to port 2 of the injection valve. The transfer tube is labeled with its factory calibrated volume. When you configure the autosampler, you must type the label value in the Dead Volume box of the Surveyor AS Configuration dialog box.

In the no waste injection mode, the syringe draws only enough solvent to compensate for the total dead volume of the system according to the following equation:

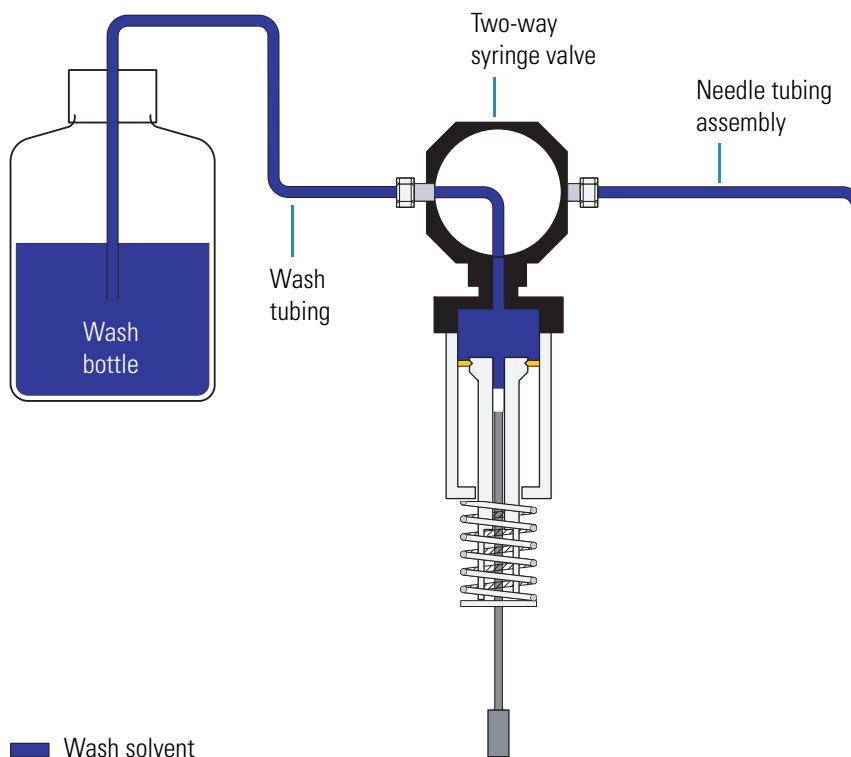
$$\text{Transport solvent volume} = \text{Total dead volume}$$

Where:

$$\text{Total Dead Volume} = \text{Transfer tube volume} + \text{volume of the injection port of the autosampler and the rotor slot of the injection valve (1.6 } \mu\text{L)}$$

In the partial loop injection mode, the syringe draws enough solvent from the wash bottle to compensate for the total dead volume of the system plus an additional 7.5 μL of solvent (see [Figure 18](#)).

Figure 18. Drawing wash solvent from the wash bottle



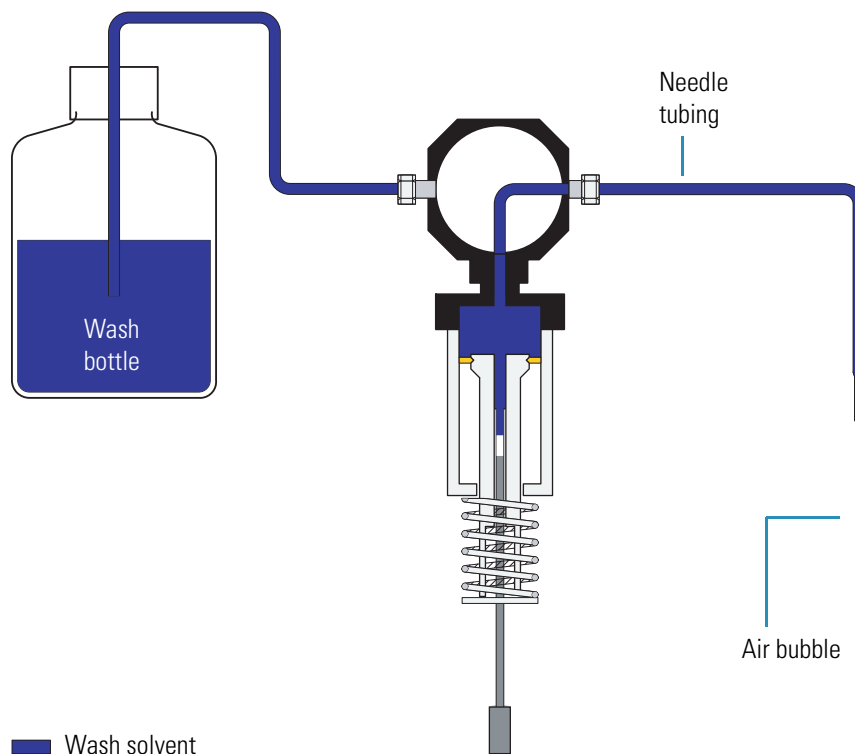
Drawing Sample

The autosampler draws sample from the sample vial or well as follows:

Note For the full loop injection mode, the injection valve rotates to the load position. For both the no waste injection mode and the partial loop injection mode, the injection valve remains in the inject position.

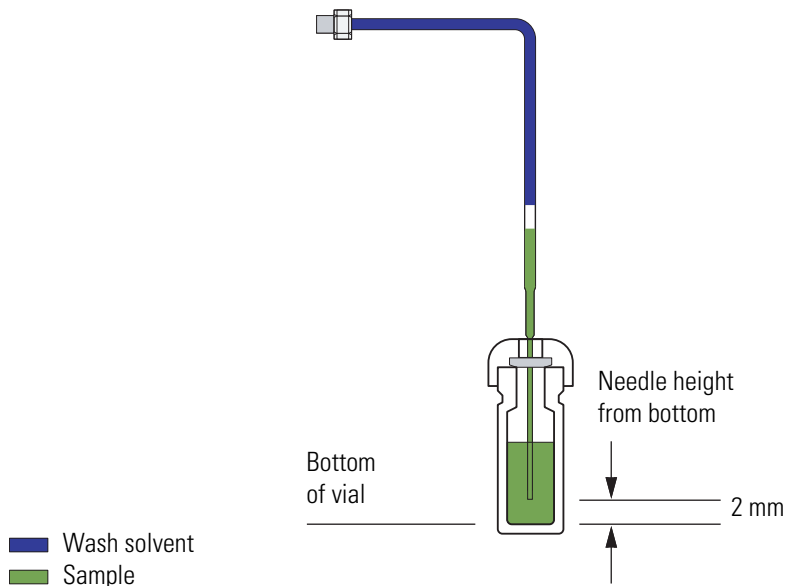
1. The XYZ arm moves to the sample vial.
2. The syringe valve switches to the needle position.
3. The inner syringe plunger descends, drawing an air bubble into the tip of the needle. Depending on the injection mode, the autosampler draws the following volume of air (see Figure 19):
 - For partial loop and full loop injections, the syringe draws 3 μL of air.
 - For no waste injections, the syringe draws 1.5 μL of air.

Figure 19. Drawing the first air bubble



- The XYZ arm lowers the needle tip into the sample vial to the depth requested (see [Figure 20](#)).

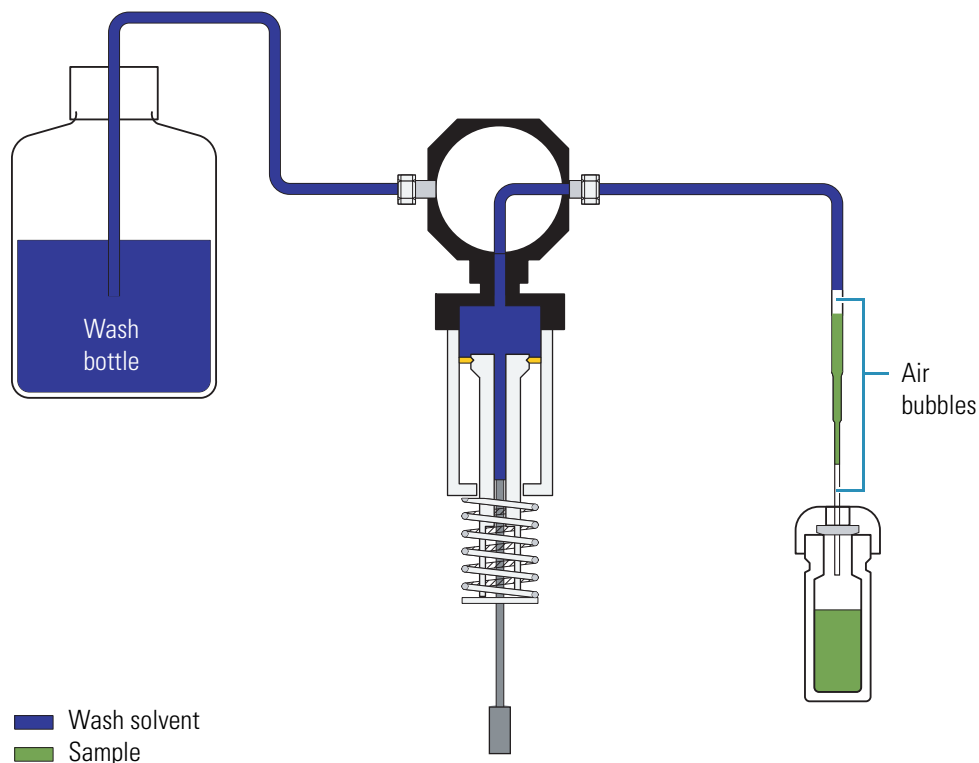
Figure 20. Needle withdrawing sample from a standard vial



Note The autosampler lowers the needle tip to the position requested in the Needle Height From Bottom box of the Surveyor Autosampler Plus page of the Instrument Setup dialog box. The allowable range is 0.1 to 18 mm from the bottom of the vial.

- The inner syringe plunger descends further, drawing sample at syringe sample speed. The volume of sample that the autosampler draws from the vial depends on the requested injection volume and the injection mode as follows:
 - For no waste injections, the autosampler draws only the requested injection volume.
 - For partial loop injections, the autosampler draws the requested injection volume plus an additional 22 μL .
- The XYZ arm raises the needle out of the sample vial (see [Figure 21](#)). The inner syringe plunger descends further, drawing a second air bubble into the needle. The sample plug is now sandwiched between the two air bubbles.

Figure 21. Drawing second air bubble, thereby sandwiching the sample plug with air



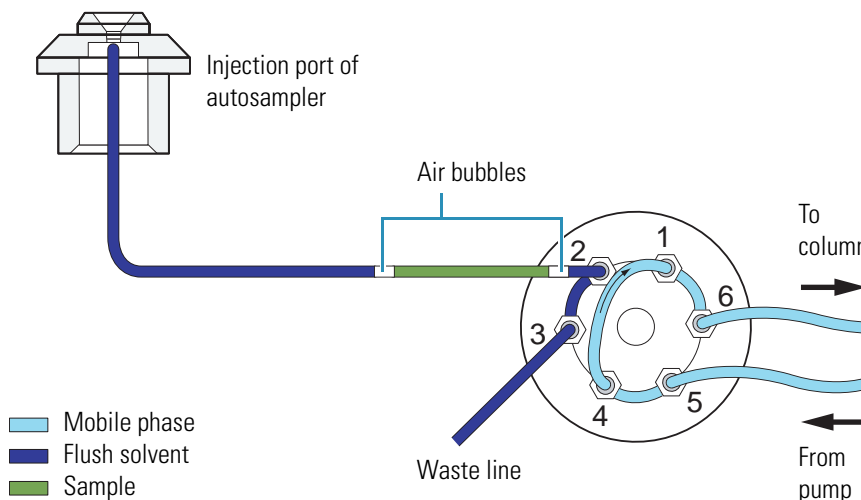
Pushing Transport Solvent (Partial Loop and No Waste Injections)

The XYZ arm moves to the home position, and then lowers the needle into the injection port of the autosampler. The inner syringe plunger moves upward, pushing the sample plug followed by the transport solvent into the transfer tube.

Depending on the injection mode, the following action occurs:

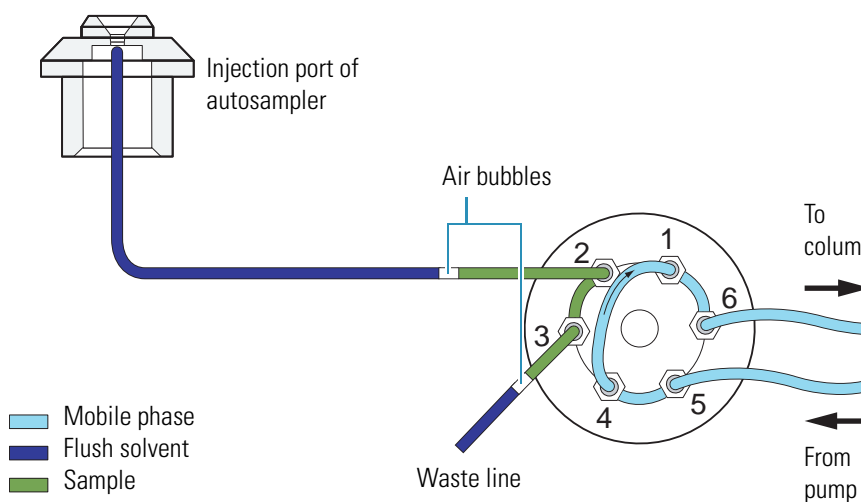
- For no waste injections, the needle expels $1\ \mu\text{L}$ less than the transport volume into the transfer tube. The sample plug falls just short of the entry to the injection port (port 2) of the injection valve (see Figure 22).

Figure 22. No Waste injection – Pushing transport solvent step



- For partial loop injections, the needle expels the transport volume, which is equal to the dead volume between the injection port of the autosampler and the injection valve plus an excess of $7.5\ \mu\text{L}$, into the transfer tube. This pushes $4.5\ \mu\text{L}$ of the sample plug plus the first $3\ \mu\text{L}$ bubble through the injection valve and out to waste (see Figure 23).

Figure 23. Partial Loop Injection – Pushing transport solvent step



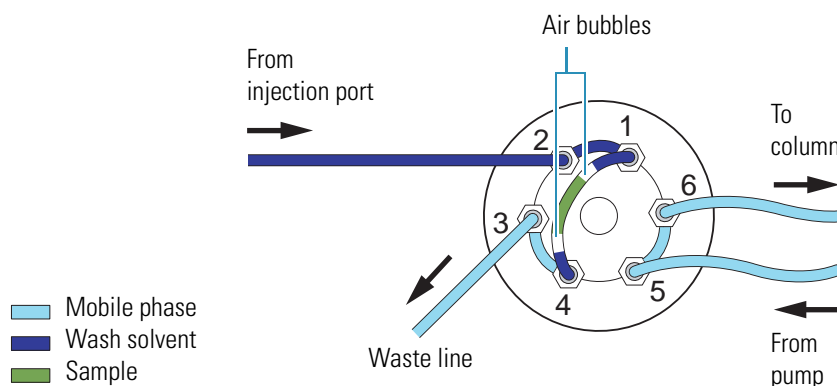
Loading Sample into the Sample Loop

The injection valve switches to the fill position for both the partial loop injection mode and the no waste injection modes. For a full loop injection, the injection valve switches to the fill position at the beginning of the injection sequence. The syringe then pushes the sample into the sample loop. The autosampler issues a momentary Gradient Start signal.

Depending on the injection mode, the following action occurs:

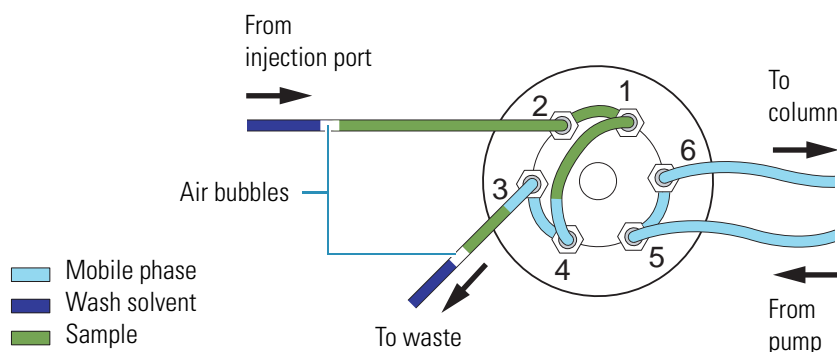
- For no waste injections, the syringe meters the requested sample volume plus 5 μL into the sample loop. This pushes the sample plug, the two bracketing air bubbles, and approximately 2 μL of wash solvent into the sample loop (see [Figure 24](#)).

Figure 24. No Waste injection – Loading the sample loop



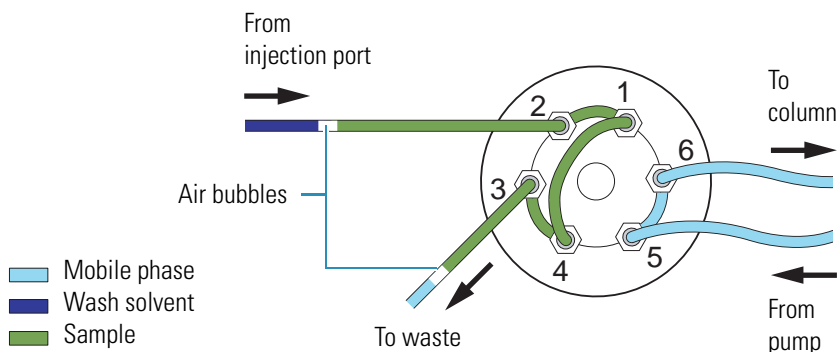
- For partial loop injections, the syringe meters the requested sample volume into the sample loop. This leaves approximately 16 μL of excess sample plus the second 3 μL air bubble in the transfer line (see [Figure 25](#)).

Figure 25. Partial Loop injection – Loading the sample loop



- For full loop injections, the needle expels the sample into the sample loop. As the sample loop becomes overfilled, excess sample exits through the waste line (see [Figure 26](#)).

Figure 26. Full Loop injection – Loading the sample loop

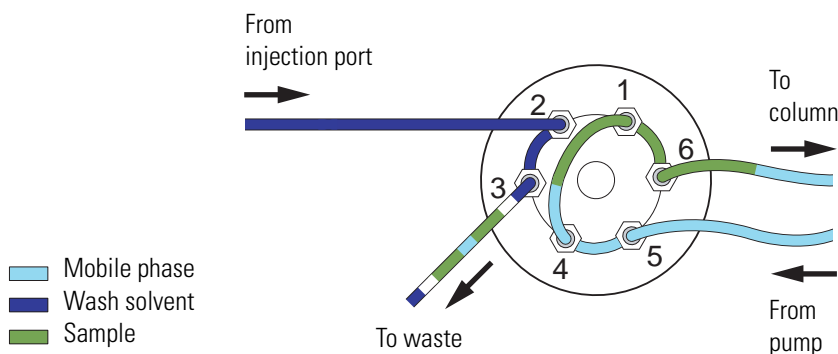


Injecting Sample onto Column

The autosampler backflushes the contents of the sample loop onto the column as follows:

1. The injection valve switches to the inject position.
2. Mobile phase enters the sample loop from the back, sweeping the contents of the sample loop onto the column (see [Figure 27](#)).
3. The autosampler issues a momentary Inject Out signal.

Figure 27. Partial Loop injection – Injecting sample



Post-Injection Events

At the end of an injection, the autosampler performs the following operations:

1. The autosampler performs an optional flush, wash, or both as requested in the instrument method.
 - **Flush** (optional): During an internal flush, the XYZ arm lowers the needle into the injection port, and then dispenses a specified volume of solvent through the needle and transfer line out to waste. You can select the solvent wash bottle or a reservoir vial as the source. The internal flush removes excess or residual sample from the injection flow path. It does not flush the sample loop.
 - **Wash** (optional): During an external wash, the XYZ arm lowers the needle into the wash station, and then dispenses a specified volume of solvent through the needle. As the wash station overfills, the wash solvent flows up over the exterior of the needle, and then out to waste. You can select the solvent wash bottle or a reservoir vial as the source.
2. The autosampler moves the syringe plunger to the Ready position, and then switches the syringe valve to point to the wash bottle.
3. The autosampler prepares for the next injection by moving the XYZ arm to the Home position, located above the injection port of the autosampler.

Autosampler Operation

The Xcalibur and ChromQuest data systems let you control the Surveyor Autosampler Plus. The power switch is the only manual control. The data system Help, the *Surveyor Plus Getting Started with ChromQuest Guide*, and the *Surveyor Plus Getting Started with Xcalibur Guide* provide information on how to operate the Surveyor Autosampler Plus.

Both Help and the Getting Started Guides include information on how to do the following:

- Calibrate the well bottom position for custom vials or wellplates (see “[Calibrating the Surveyor Autosampler Plus](#)” on page 50).
- Perform direct commands to flush the syringe, move the XYZ arm (see “[XYZ Arm Mechanism](#)” on page 5), inject sample, and so on.
- Create an acquisition method.

For information on accessing the manuals, see “[Related Documentation](#)” on page xiii and “[Contacting Us](#)” on page xvi.

Automated Sample Preparation

With the automated sample preparation feature, you can build a pretreatment routine that the autosampler performs before it performs an injection. The pretreatment routine can consist of multiple tasks including transferring liquid between sample vials, transferring liquid from one of the four reservoir vials to a sample vial, mixing, and more.

The autosampler performs each task by drawing liquid into or expelling liquid from the needle tubing. It uses the inner plunger of the concentric syringe for liquid transfers that require a high degree of precision, such as a transfer of liquid between sample vials. It uses the outer plunger of the concentric syringe for liquid transfers that require less precision, such as sample mixing, which is performed using an aspirate and expunge technique.

For a complete list of sample preparation tasks that the autosampler can perform and a set of rules for creating sample preparation routines, refer to the Help provided with the data system.

Specifications

The specifications for the Surveyor Autosampler Plus are listed below.

Sample capacity:	<ul style="list-style-type: none"> • 200 vials in five removable trays • 288 samples in three 96-well microplates • 1152 samples in three 384-well microplates
Standard vial:	<ul style="list-style-type: none"> • 1.8 mL volume
Injection precision:	<ul style="list-style-type: none"> • $\leq 1.0\%$ RSD at 5 μL and up
Partial loop injection volume:	<ul style="list-style-type: none"> • 10 μL with standard 25 μL sample loop and 250 μL syringe • Up to 1000 μL injection volume with optional loops and syringes
Fixed loop (full loop) injection volume:	<ul style="list-style-type: none"> • 25 μL with standard loop and 250 μL syringe • Up to 1000 μL injection volume with optional loops and syringes
Sample carryover:	<ul style="list-style-type: none"> • $\leq 0.1\%$ • 6 mL flush volumes can be set for internal and external needle wash cycles
Minimum sample volume:	<ul style="list-style-type: none"> • 1 μL can be injected from 5 μL
Needle height control:	<ul style="list-style-type: none"> • Programmable in 0.1 mm increments • Active vial bottom search selectable on/ off
Column oven:	<ul style="list-style-type: none"> • Settable in 1 $^{\circ}\text{C}$ increments from 5 to 95 $^{\circ}\text{C}$
Tray temperature control:	<ul style="list-style-type: none"> • Settable in 1 $^{\circ}\text{C}$ increments from 0 to 60 $^{\circ}\text{C}$ • Typical vial temperature from 4 to 50 $^{\circ}\text{C}$
Reagent vials:	<ul style="list-style-type: none"> • Four 16 mL vials can be specified for flush/wash or dilution functions
Remote inputs:	<ul style="list-style-type: none"> • Pump ready, inject hold
Remote outputs:	<ul style="list-style-type: none"> • Pump stop, autosampler ready, inject, gradient start, four timed events
Ambient environment:	<ul style="list-style-type: none"> • 10 to 40 $^{\circ}\text{C}$, 5 to 95% relative humidity
Dimensions:	<ul style="list-style-type: none"> • 37 cm \times 36 cm \times 50 cm ($h \times w \times d$)
Weight:	<ul style="list-style-type: none"> • 30 kg
Power requirements:	<ul style="list-style-type: none"> • 100/120/220/240 VAC nominal; 550 VA 50/60 Hz
Product certification:	<ul style="list-style-type: none"> • CSA, TÜV/GS, FCC (EMI), VDE (EMI)

Installation

This chapter describes the initial installation of the Surveyor Autosampler Plus, including connections to other chromatographic instruments. The “[Installation Checklist](#)” on [page 35](#) is an abbreviated version of this chapter that you can use as a quick reference on how to conduct a successful installation. Make a copy of the checklist and fill it out when the installation is complete. Include the completed checklist in your maintenance records.

This chapter also describes how to change the sample loop, a piece of stainless steel tubing with two end fittings connected to the injection valve. For full loop (fixed loop) injections, the sample loop size determines the injection volume.

Note Install the Surveyor Autosampler Plus & Surveyor Autosampler Plus Lite in the sequence presented in the Installation Checklist.

Contents

- [Software Compatibility](#)
- [Installation Checklist](#)
- [Unpacking and Inspecting the Instrument](#)
- [Making Initial Instrument Preparations](#)
- [Making the Back Panel Connections](#)
- [Mounting the Syringe Drive Assembly](#)
- [Connecting the Solvent Lines](#)
- [Powering On the Autosampler for the First Time](#)
- [Calibrating the Surveyor Autosampler Plus](#)
- [Changing the Sample Loop](#)

Software Compatibility

You can control the Surveyor Autosampler Plus from either the ChromQuest or Xcalibur data system. Compatible firmware and a firmware upgrade utility are provided with these data systems (see [“Downloading Firmware to the Autosampler”](#) on [page 122](#)):

- For ChromQuest, the device drivers are provided on the ChromQuest CD.
- For Xcalibur, the device drivers are provided on the LC Devices CD.

Installation Checklist

The following installation summarizes the steps that you need to complete to properly install your Surveyor Autosampler Plus.

- Unpack and inspect your instrument (page 36).
- Read the safety notices (front of manual).
- Make the initial instrument preparations (page 36).
- Make the initial back panel connections (page 37).
- Power On the autosampler for the first time (page 49).
- Install Xcalibur 2.0 (or higher) or ChromQuest 4.2 (or higher) and connect remote communication outputs, as required.
- Add the Surveyor Autosampler Plus to the data system instrument configuration. For instructions on specifying the configuration options for the Surveyor Autosampler Plus, refer to the *Surveyor Plus Getting Started with Xcalibur Guide*, the *Surveyor Getting Started with ChromQuest Guide*, or the Help provided by the chromatography data system.

This Surveyor Autosampler Plus was installed by:

(Name)

(Date)

Unpacking and Inspecting the Instrument

Carefully remove the autosampler from the shipping container and inspect both the autosampler and packing for any signs of damage. If you find any damage, save the shipping materials and immediately contact the shipping company.

The shipping container contains the Surveyor Autosampler Plus and an accessory kit. The syringe drive mount is packaged inside the tray compartment of the autosampler. Carefully check to make sure you received all the items listed on the packing list. Ensure that the needle tubing assembly is attached to the XYZ arm and the right side of the syringe valve, a 250 μ L dual-concentric syringe is attached to the syringe drive mount, and a 25 μ L sample loop is attached to the injection valve.

If any items are missing, contact your Thermo Fisher Scientific representative immediately.

To connect the autosampler to the other instruments in the Surveyor Plus stack, you must have the Surveyor System Kit (see “[Autosampler Accessory Kit](#)” on [page 120](#)). This kit is provided with orders for instruments sold together with either the Xcalibur or ChromQuest data system or as a separate option.

Making Initial Instrument Preparations

Place the autosampler on a bench top. Allow at least 15 cm (6 in.) of space between the back panel of the autosampler and any wall or obstruction. This provides clearance for the back-panel connectors and cool air flow.

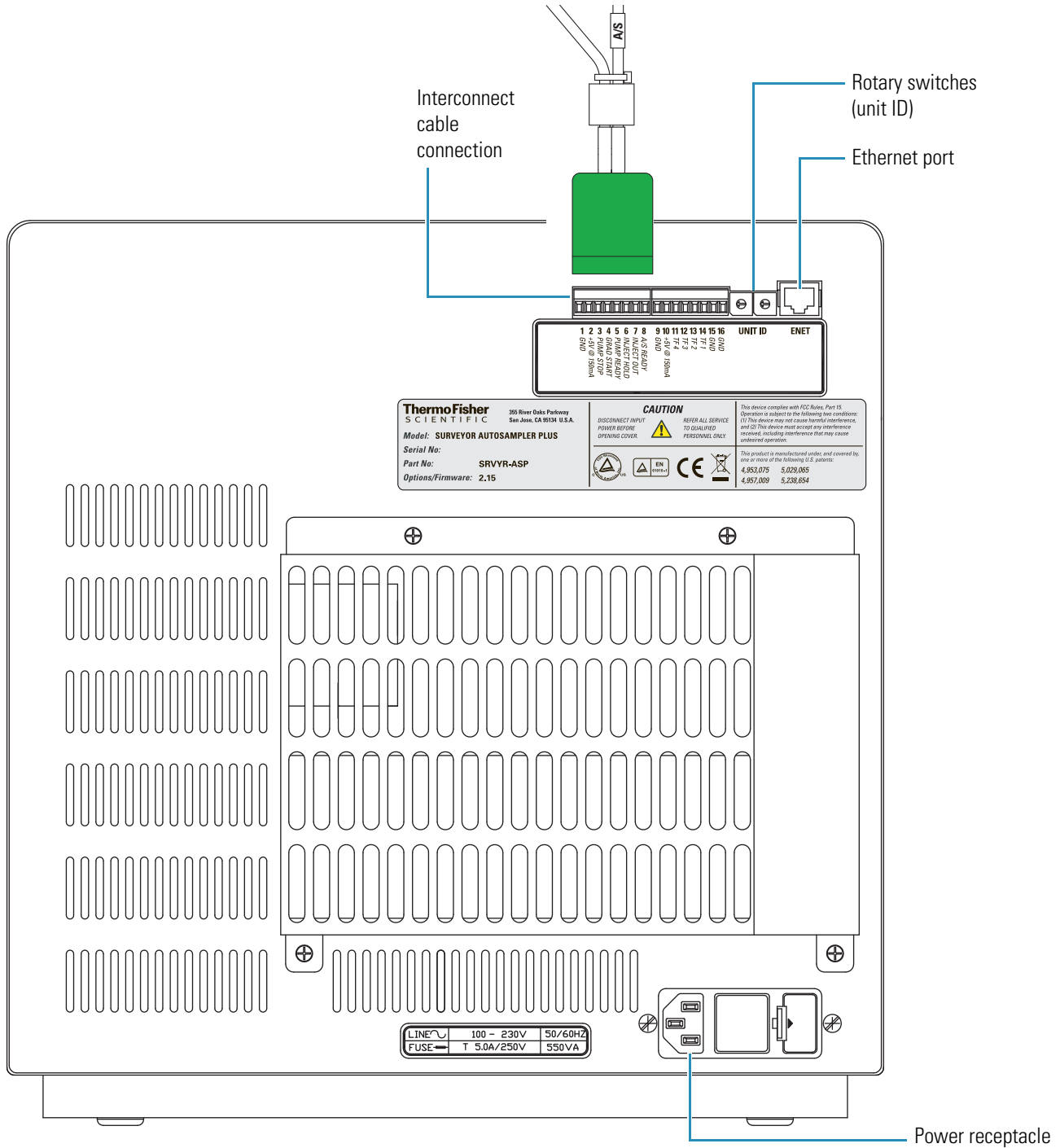
To install the autosampler, you must have the following tools:

- 5/16 in. open-end wrench
- Narrow flat-head screwdriver

Making the Back Panel Connections

To operate the Surveyor Autosampler Plus, connect the power, Ethernet, and system interconnect cable to the back panel (see Figure 28) of the autosampler, and check the unit ID setting.

Figure 28. Back panel of the Surveyor Autosampler Plus



This section contains the following topics:

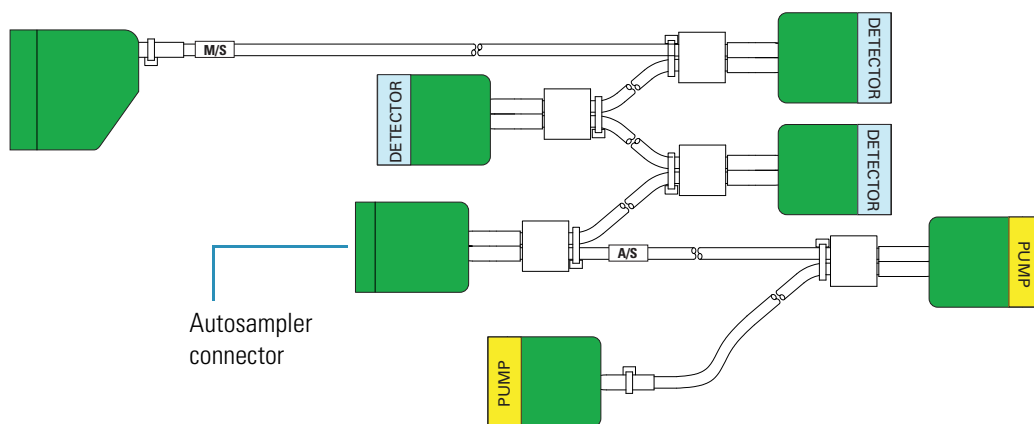
- [Connecting the System Interconnect Cable](#)
- [Connecting the Ethernet Cable](#)
- [Checking the Unit ID Settings](#)
- [Connecting the Autosampler to Line Power](#)

Connecting the System Interconnect Cable

The system interconnect cable that synchronizes the timing of the Surveyor Plus devices is in the Surveyor System Kit. The current version of the interconnect cable has seven combicon connectors: three have a blue, DETECTOR label; two have a yellow, PUMP label; one has a small, A/S tag on its adjacent cable; and one has a small, M/S tag on its adjacent cable (see [Figure 29](#)).

Tip The former version of the interconnect cable has five combicon connectors: one is labeled DET; one is labeled LC PUMP; one is labeled MS PUMP; one is labeled A/S; and one is labeled M/S. Before you connect the M/S connector of this version of the interconnect cable to the Surveyor MSQ Plus MS detector, you must modify its wiring.

Figure 29. System interconnect cable with seven combicon connectors

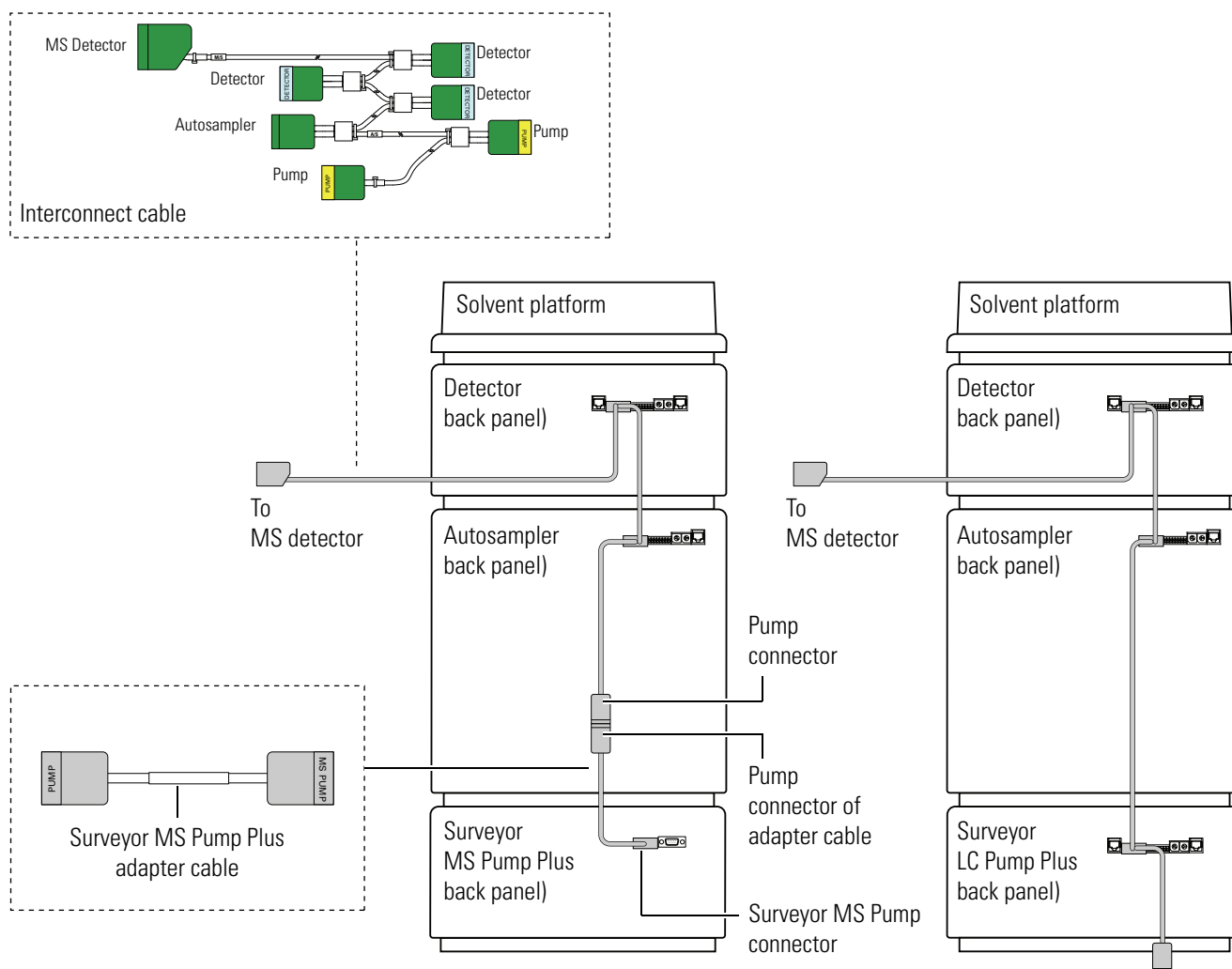


❖ To connect the interconnect cable

1. Plug the AS connector into the left 8-pin socket on the back panel of the Surveyor Autosampler Plus (see [Figure 30](#)).
2. Connect the cable to the analytical pump:
 - To connect the Surveyor LC Pump Plus, plug a PUMP connector into the left 8-pin socket on the back panel of the pump.
 - To connect the Surveyor MS Pump Plus, connect an additional adapter cable to one of the PUMP connectors, and then plug the adapter cable into the 8-pin socket on the back panel of the pump.

3. If your LC system contains a Surveyor PDA Plus Detector, attach one of the DETECTOR connectors to it.
4. To connect a Thermo Scientific mass spectrometer, refer to the *Surveyor Plus Getting Connected Guide* for instructions on how to connect the system interconnect cable.

Figure 30. System Interconnect cable connections



Not drawn to scale

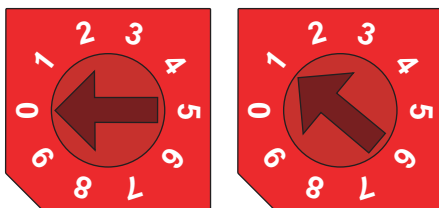
Connecting the Ethernet Cable

Connect the Ethernet port on the back panel of the autosampler to the Ethernet switch using the 7 ft. length, CAT-5 Ethernet cable with ferrite supplied in the accessory kit.

Checking the Unit ID Settings

The Surveyor Autosampler Plus is shipped with the unit ID preset using the two rotary switches located on the back panel (see [Figure 31](#)). The unit ID must correspond with the stack number that you specify in configuring the Surveyor Autosampler Plus.

Figure 31. Rotary switches set to 01



The Surveyor AS Configuration dialog box in the data system application contains a box for entering the stack number. The range of values for the unit ID is 01 to 99. The default value is 01. The value of 00 is reserved for special service functions.

Connecting the Autosampler to Line Power

The Surveyor Autosampler Plus is shipped with one of these power cords.

Destination	Plug type	Voltage rating	Current rating	Part number
United Kingdom	BS 1363	250 V ac	5 A	6003-0810
Switzerland	SEV 1011	250 V ac	10 A	6003-0620
China and Europe	CEE 7/7	250 V ac	10 A	6003-0330
United States and Canada	NEMA 5-15P	125 V ac	10 A	6003-0160

Local codes in your area might require the installation of another type of plug and receptacle. The Thermo Fisher Scientific field engineer for your country will provide the appropriate power plugs.

❖ To connect the autosampler to line power

1. Ensure that the power switch on the front of the unit is in the Off position (released or out position).
2. Check the fuses (see [“Replacing a Fuse”](#) on [page 93](#)).
3. Connect the plug to the power receptacle (see [Figure 28](#) on [page 37](#)) on the back panel of the autosampler.
4. Connect the other end of the power cord to line power.

When you are ready to power on the autosampler, go to [“Powering On the Autosampler for the First Time”](#) on [page 49](#).

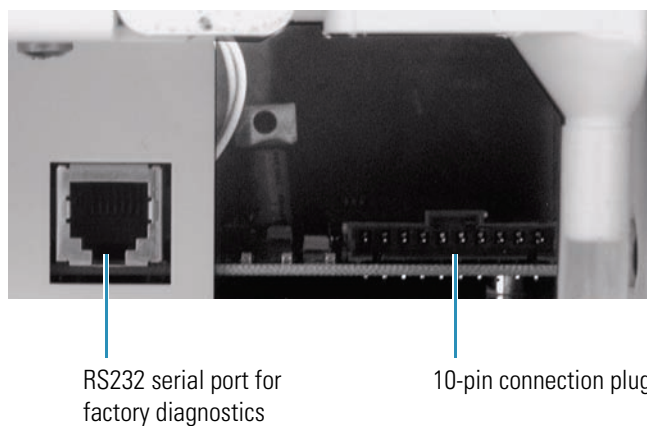
Mounting the Syringe Drive Assembly

The syringe drive assembly arrives packed in foam inside the tray compartment of the Surveyor Autosampler Plus. The needle assembly arrives inserted in its mount on the Z-axis drive mechanism. The needle tubing assembly is connected to the needle assembly and the tubing is routed through brackets on the XYZ arm and the left wall of the tray compartment. In addition the needle tubing guide is connected to the X-axis positioning frame, and the PVC cap is pushed below the metal runner for the X-axis positioning frame.

❖ To mount the syringe drive assembly to the autosampler

1. Attach the cable on the back of the syringe drive assembly to the 10-pin connection plug of the autosampler (see [Figure 32](#) and [Figure 32](#)).

Figure 32. 10-pin connection plug



2. Mount the syringe drive assembly (see [Figure 33](#) and [Figure 34](#)) onto the mounting studs of the autosampler:
 - a. Lower the upper part of the assembly onto the top, vertical mounting stud.
 - b. Push the lower part of the assembly onto the bottom two, horizontal mounting studs.

Note To minimize vibration, the gaskets surrounding the mating holes on the backside of the syringe drive assembly allow it to float freely on the mounting studs. This makes the mounting of the syringe drive assembly feel wobbly, rather than tight and firm.

2 Installation

Mounting the Syringe Drive Assembly

Figure 33. Back side of syringe drive assembly

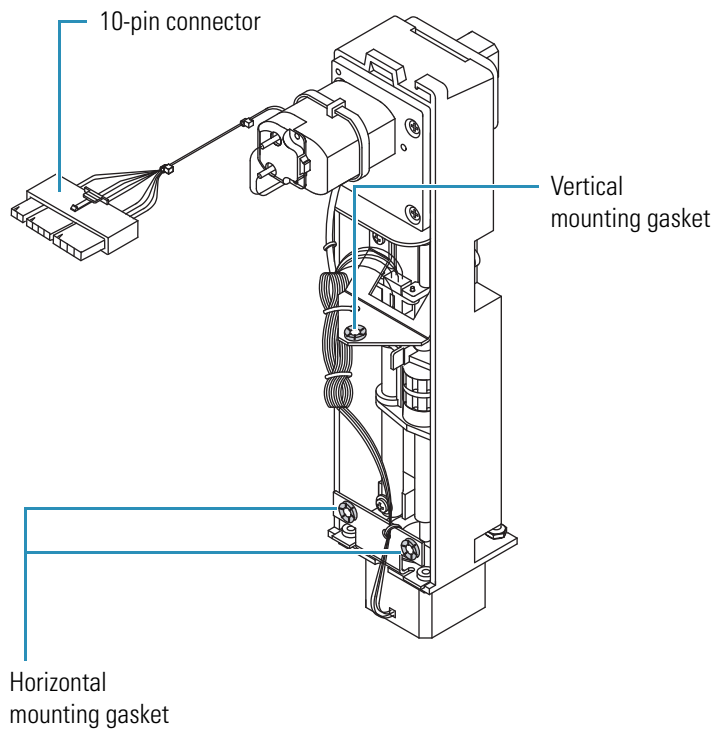
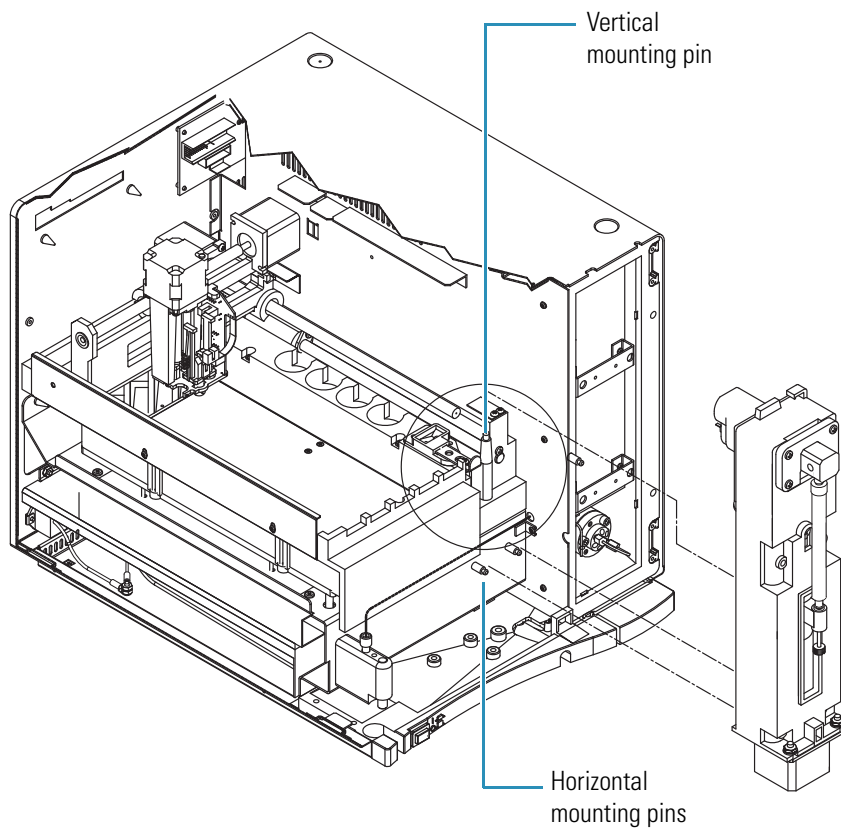


Figure 34. Mounting the syringe drive assembly



Connecting the Solvent Lines

Before you operate the LC system, connect the wash bottle tubing to the left side of the syringe valve, connect the needle tubing to the right side of the syringe valve, and connect the autosampler to the pump.

This section contains the following topics:

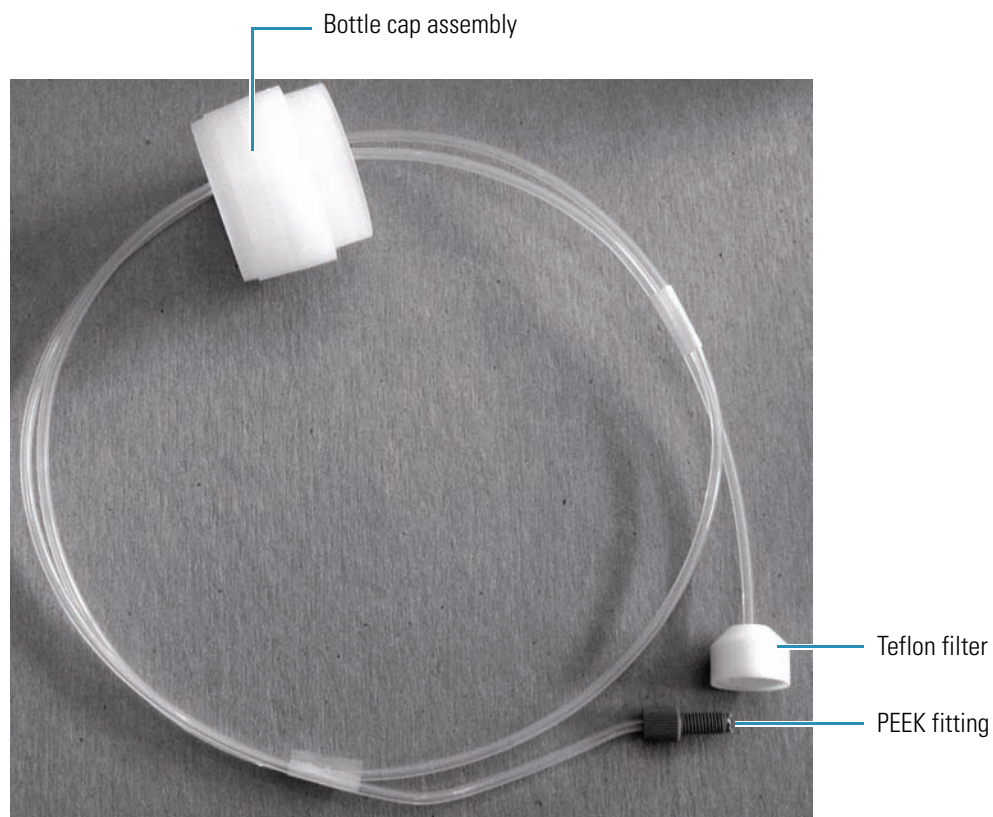
- [Connecting the Wash Bottle](#)
- [Connecting the Needle Tubing](#)
- [Connecting the Autosampler to the Pump](#)
- [Bypassing the Column Oven](#)

IMPORTANT If the wash bottle tubing runs dry during a sequence of injections, the autosampler makes “blank” injections.

Connecting the Wash Bottle

The Wash Bottle Kit supplied in the Surveyor System Kit contains a 1L bottle and a tubing assembly (see [Figure 35](#)). The wash bottle supplies flush solvent to the autosampler.

Figure 35. Wash bottle tubing assembly



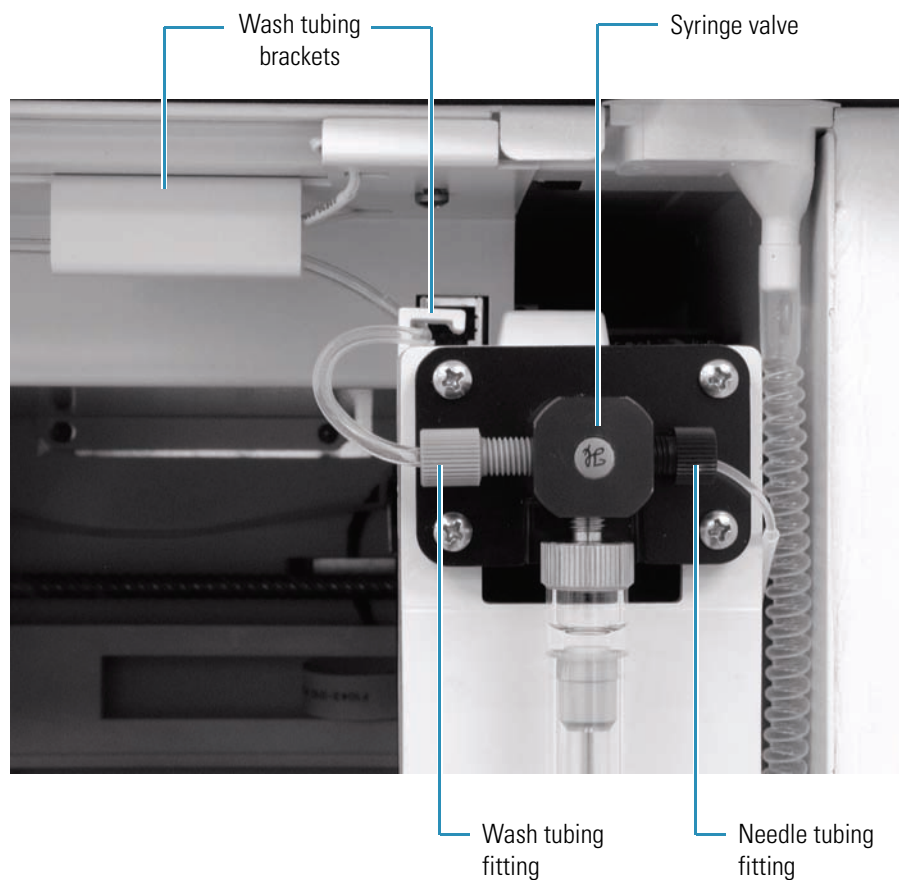
2 Installation

Connecting the Solvent Lines

❖ To connect the wash bottle

1. Fill the wash bottle with an appropriate solvent, and then place it in the solvent platform on the top of the system stack.
2. Insert the Teflon filter into the bottom of the bottle, screw the cap on, and then route the tubing through the bracket on the autosampler chassis and the bracket on the top of the syringe drive assembly (see [Figure 36](#)).
3. Connect the PEEK fitting to the left side of the syringe valve (see [Figure 36](#)).

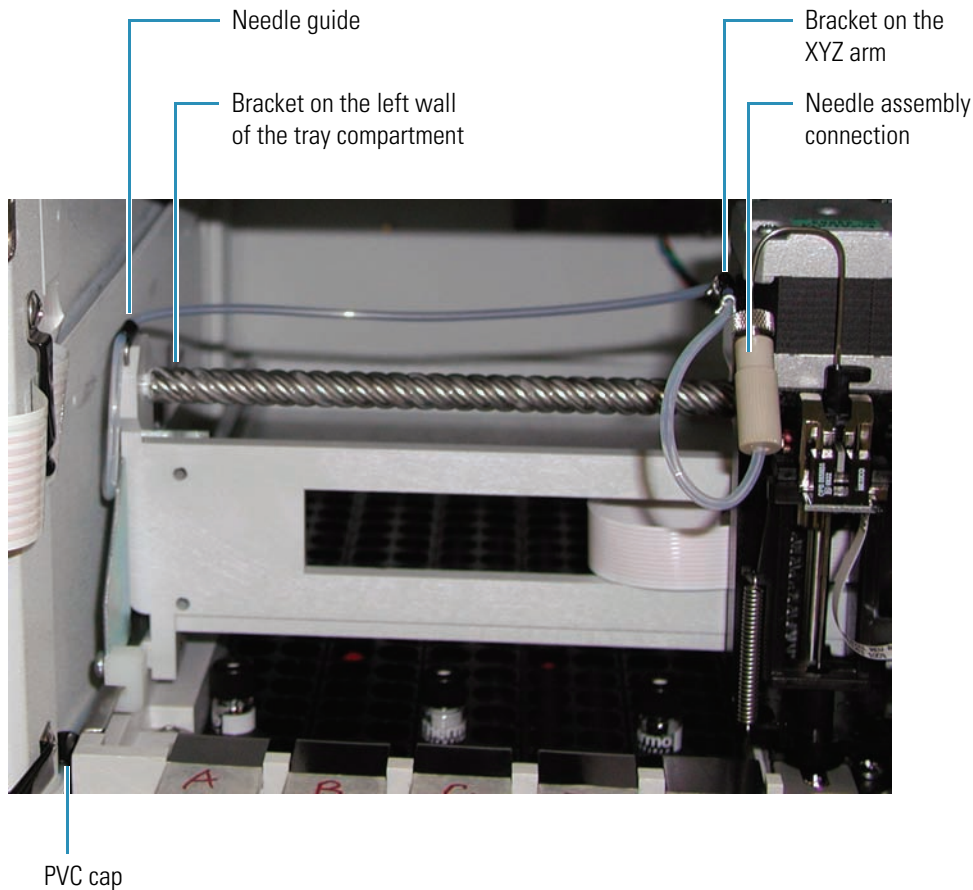
Figure 36. Wash tubing connections



Connecting the Needle Tubing

The Surveyor Autosampler Plus is shipped with the needle tubing assembly connected to the needle assembly and routed through brackets on the XYZ arm and the left wall of the tray compartment. In addition, the two-pronged needle tubing guide is connected to the X-axis positioning frame, and the PVC cap (red or black) is pushed below the metal runner for the X-axis positioning frame (see [Figure 37](#)).

Figure 37. Needle tubing connections (as shipped)





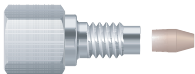
CAUTION The needle tubing is easily damaged. Before you operate the autosampler, make sure that the needle tubing is routed through the support brackets, that the needle tubing guide is connected to the X-axis positioning frame, and that the PVC cap is pushed below the metal runner for the X-axis positioning frame.

❖ To connect the needle tubing to the syringe valve

1. Make sure that the needle tubing is routed through the appropriate brackets, that the needle guide is attached to the X-axis positioning frame, and that the PVC cap is pushed below the metal runner for the X-axis positioning frame.
2. Connect the externally-threaded needle tubing fitting to the right side of the syringe valve (see [Figure 36](#) on [page 44](#)).

Connecting the Autosampler to the Pump

To connect the autosampler to the pump, you must have the following parts.

Description	Part Number
 Extra long bushing (Lite only)	2522-0066
 Ferrule (Lite only)	00101-18122
 Fingertight nut and ferrule set	00101-18088
Stainless steel tubing, 0.010 in. ID, 30 cm (12 in.)	

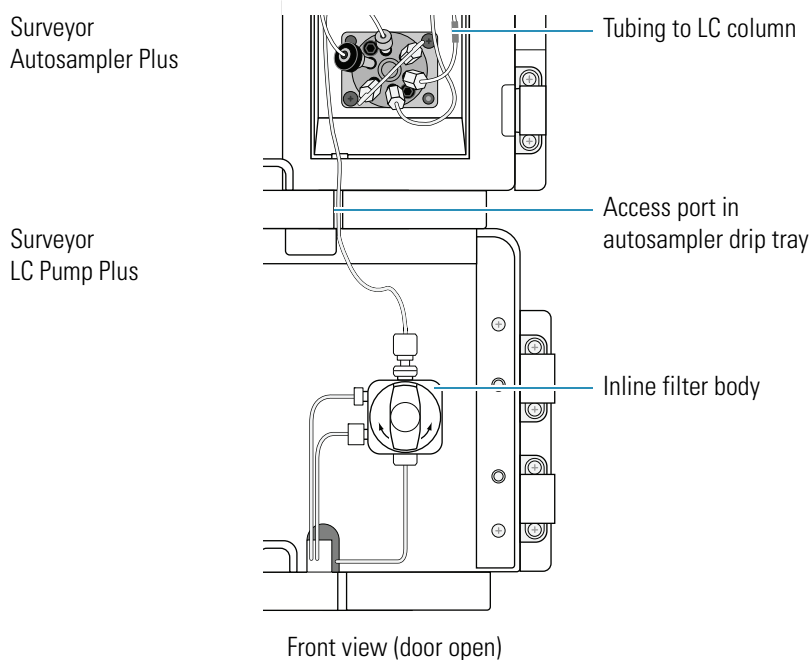
❖ To connect the autosampler to the pump

1. Depending on your autosampler model, do one of the following:
 - For the Surveyor Autosampler Plus Lite, use the extra long bushing and the ferrule that come in the Surveyor Autosampler Plus Accessory Kit to attach the 30 cm (12 in.) length, 0.010-in. ID, stainless steel tubing (P/N) that also comes in the kit to port 5 of the injection valve.
 - For the Surveyor Autosampler Plus, pull the stainless steel tubing that exits the column oven of the autosampler forward and then downward through the access port in the bottom of the autosampler as shown in [Figure 38](#).

Tip To decrease the gradient delay volume of your system, bypass the tubing behind the column oven. This tubing allows the mobile phase to equilibrate to the requested column oven temperature, but it also adds 250 μ L of gradient delay volume to your system.

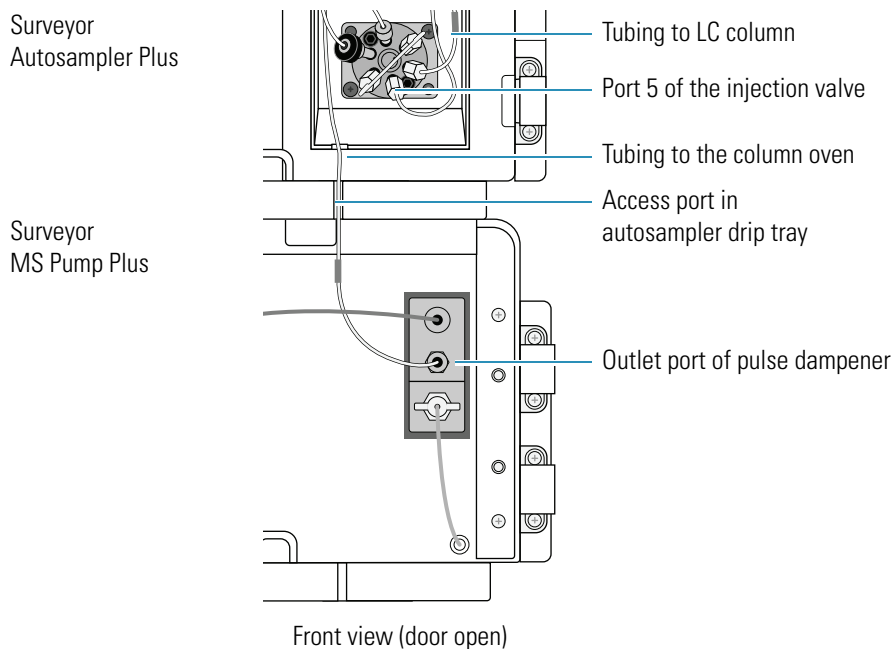
2. Place the fingertight nut and ferrule set (P/N 00101-18088) onto the free end of the stainless steel tubing, and then attach the tubing to the pump:
 - For the Surveyor LC Pump Plus, screw the fitting into the in-line filter body on the top of the purge manifold (see [Figure 38](#)). Do not overtighten the fingertight fitting.

Figure 38. Surveyor LC Pump Plus (original version) connection to autosampler



- For the Surveyor MS Pump Plus, screw the fitting into the outlet port of the pulse dampener (see [Figure 39](#)). Do not overtighten the fingertight fitting.

Figure 39. Surveyor MS Pump Plus connected to the autosampler



Bypassing the Column Oven

To decrease the gradient delay volume of the system, you can connect the solvent flow from the pump directly to the autosampler injection valve, bypassing the heat exchange tubing behind the column oven.

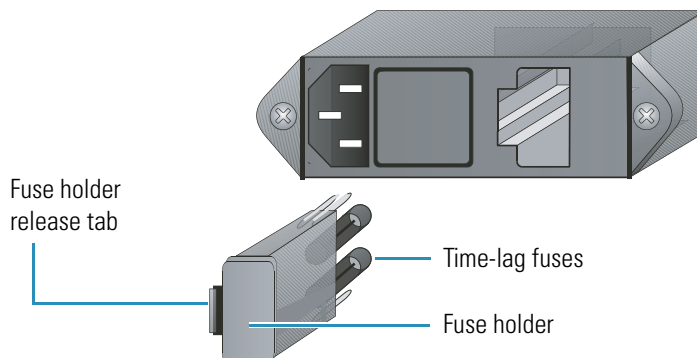
❖ To bypass the tubing behind the column oven

1. Disconnect the column oven return tubing from port 5 of the injection valve.
2. Do one of the following:
 - For the Surveyor LC Pump Plus, use the fingertight ferrule and nut set (P/N 00101-18088) to connect a 30 cm length of high-pressure tubing to the in-line filter body on the top of the purge manifold. Use high-pressure fittings to connect the other end of the tubing to port 5 of the injection valve.
 - For the Surveyor MS Pump Plus, use the fingertight ferrule and nut set (P/N 00101-18088) to connect a 30 cm length of high-pressure tubing to the pulse dampener outlet. Use high-pressure fittings to connect the other end of the tubing to port 5 of the injection valve.

Powering On the Autosampler for the First Time

The autosampler is shipped with two 5.0 amp, 250 V, TL, 5 × 20 mm fuses and a power cord that is appropriate for its shipping destination. The fuses are housed in the fuse compartment in the lower-right corner of the autosampler's back panel (see [Figure 40](#)).

Figure 40. Power entry module



After the solvent lines and tubing are installed, you can power on the autosampler.

❖ To turn on the power to the autosampler

1. Ensure that the power switch at the front of the unit is in the Off position (released or out position).
2. Attach the power cord to the power entry module on the back panel of the autosampler and connect it to the power source.
3. Turn the power on by pushing the power button in to engage it.

Note that the power indicator briefly lights amber and then turns solid green. If it does not light at all, see [Chapter 6, “Troubleshooting.”](#) If it stays amber or flashes amber or green, turn the power off for several seconds, and then turn it back on again. Call your Thermo Fisher Scientific service representative if you require assistance.

Calibrating the Surveyor Autosampler Plus

The Surveyor Autosampler Plus is factory calibrated. The data system contains the following four calibration options for the autosampler:

- A column oven temperature calibration option
- A tray compartment temperature calibration option
- An XYZ arm position calibration option
- A well bottom distance calibration option that determines the depth of custom vials or microplate wells)

Only a Thermo Fisher Scientific service representative can perform the first three calibration options.

Before you use any of the three custom tray options, perform the calibration that determines the Z-axis distance that the needle must travel to reach the bottom of your custom vial or well plate.

❖ To access the well bottom distance calibration option from the Xcalibur data system



1. From the Roadmap view in Xcalibur, click the **Instrument Setup** icon.

The Instrument Setup window appears.



2. Click the **Surveyor AS** icon in the viewbar.

The Instrument Setup view for the Surveyor Autosampler Plus appears.

3. From the Surveyor AS menu, choose **Calibration**.

The Calibration dialog box appears.

4. Select the **Well Bottom Distance** option.

❖ To access the well bottom distance calibration option from the ChromQuest data system

1. From the online Instrument window, choose **Control > Instrument Status**.
2. Click the **Surveyor AS** tab.
3. Click **Diagnostics**.
4. Click the **Calibration** tab.
5. Select the **Bottom Distance Calibration** option.

For instructions on how to perform this calibration, refer to the data system Help.

Changing the Sample Loop

Several sample loop sizes are available for the Surveyor Autosampler Plus (see [Table 6](#)).

Table 6. Sample loops

Description	Part Number
5 μL	00109-99-00007
10 μL	00109-99-00008
20 μL	00109-99-00009
25 μL	00109-99-000010
50 μL	00109-99-000011
100 μL	00109-99-000012
500 μL	00109-99-000013
1000 μL	00109-99-000014

❖ To change the sample loop

1. Make sure that the autosampler is in Idle mode.
2. Using an open-end wrench, loosen the fittings at ports 1 and 4, and gently pull out the two ends of the sample loop. If you want to reuse the sample loop, label the end fittings with the port number (1 or 4) that the swaged fitting was connected to.
3. Insert the ends of the new sample loop in the same orientation as the old one.
4. Firmly press one end of the sample loop into port 1 of the injection valve as you hand-tighten the nut.
5. Firmly press the other end of the sample loop into port 4 of the injection valve as you hand-tighten the nut.
6. Using a 1/4 in. open-end wrench, gently tighten the fittings by an additional 3/4 turn .

Tip To connect tubing with a two-piece stainless steel fitting to a mating port, press the tubing against the bottom of the port as you hand-tighten the fitting. Then tighten the fitting by an additional 3/4 turn with a wrench. Once you use the wrench to tighten the fitting, the ferrule portion of the two-piece fitting is permanently connected to the tubing.

To connect tubing with a pre-swaged fitting to a mating port, press the tubing against the bottom of the port as you hand-tighten the fitting. Then tighten the fitting by an additional 1/4 to 1/2 turn with a wrench.

Sample Loading

Before you load your samples into the autosampler, make sure that your samples are completely soluble in the mobile phase and that you have filtered your samples and solvents through a 0.5 micron filter. These techniques minimize sample precipitation in the lines and remove particulate matter that could obstruct the flow through the autosampler injector or the column. In addition, make sure that the vial caps are securely fastened to the vials.

After you finish preparing your samples, you are ready to load them into the Surveyor Autosampler Plus. The Surveyor AS Accessory Kit (see [“Autosampler Accessory Kit”](#) on [page 120](#)) contains trays that hold standard vials, inserts that hold 100 μ L vials, and carrier plates that hold microplates.

Contents

- [Standard Tray Type](#)
- [Specialized Tray Types](#)
- [Important Precautions](#)
- [Recommended Vials, Microplates, and Microplate Covers](#)

Standard Tray Type

The Surveyor Autosampler Plus Accessory Kit contains five standard trays. Trays A, B, C, D, and E are arranged in the autosampler from left to right. Each tray holds 40 standard, 1.8 mL vials arranged in two rows of 20. The accessory kit also contains a supply of standard, 1.8 mL vials, silicone and Teflon septa, and screw-top vial caps. You can order additional vials from Thermo Fisher Scientific.

The part numbers of the replaceable components in the accessory kit are listed in [“Autosampler Accessory Kit”](#) on [page 120](#).

IMPORTANT If you are using screw cap vials, the caps must be firmly tightened. If the caps are not firmly tightened, the needle might push the septum into the bottom of the vial.

This section contains the following procedures:

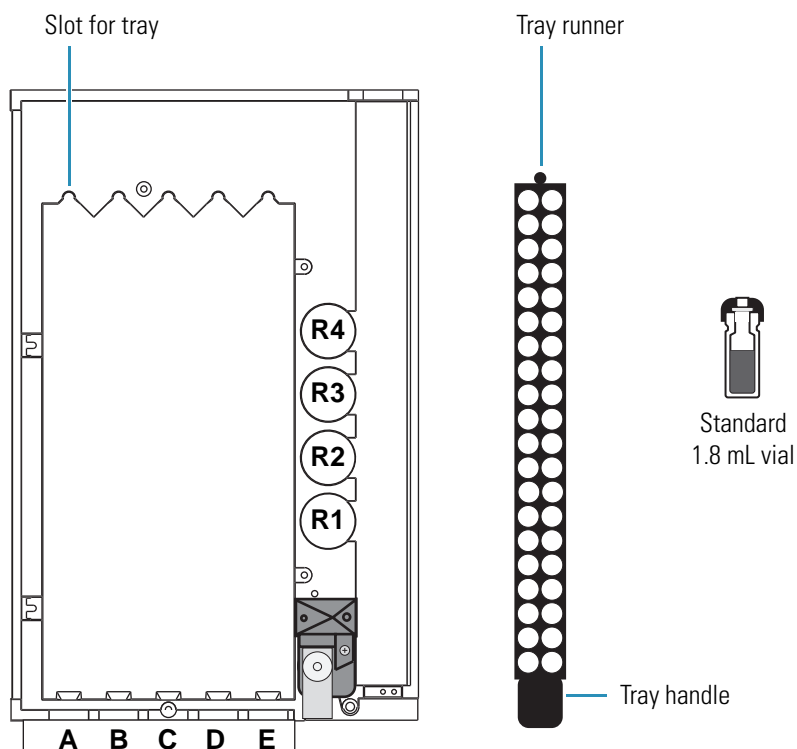
- [Installing the Standard Tray Type](#)
- [Moving the XYZ Arm to the Back of the Tray Compartment](#)

Installing the Standard Tray Type

❖ To install the sample trays into the tray compartment of the autosampler

1. Open the left door of the autosampler.
 - If you selected the Verify door is closed check box when you configured the autosampler, the XYZ arm moves to the back of the tray compartment.
 - If the XYZ arm does not move to the back of the tray compartment, perform the appropriate direct command from the data system (see [“Moving the XYZ Arm to the Back of the Tray Compartment”](#) on page 55).
2. Hold the tray handle, tilting the back end of the tray down.
3. Insert the tray runner into the slot at the back of the tray compartment (see [Figure 41](#)).
4. Lower the front of the tray into place and press down firmly to seat the tray.

Figure 41. Tray compartment and standard tray



IMPORTANT Be sure that each tray is properly seated. If a tray is not completely seated, the autosampler will not operate correctly.

IMPORTANT To trigger the vial sensor, you must position custom vials in the tray so that the top of the vial reaches the minimum height of 1.55 in. Custom vials that fall below this minimum height do not trigger the vial sensor. When an acquisition sequence incurs a vial that is below the minimum height, the sequence halts and the following message appears: Vial Not Found.

Note When you open the autosampler door, the XYZ arm automatically moves to the back of the autosampler, allowing you to add samples to the tray during a run. Once the door is closed, the arm returns to its position and resumes the operation that was in progress before the door was opened. You can enable this door interlock feature when you specify the configuration options for the autosampler.

The accessory kit also contains a tray adapter for 100 μ L vials and a tray adapter plate for microcentrifuge tubes.

❖ **To use the tray adapter**

Insert the tray adapter into the standard tray, and then secure it with the 1/4 in. Phillips head screw that is included in the accessory kit.

Moving the XYZ Arm to the Back of the Tray Compartment

If you did not select the Verify door is closed check box when you configured the autosampler, the XYZ arm does not move to the back of the tray compartment when you open the tray compartment door. From the data system, use a direct command to move the XYZ arm.

❖ **To move the XYZ arm to the back of the tray compartment**

Do the following:

- For Xcalibur, open the Direct Control dialog box for the autosampler (see “[Using the Xcalibur Direct Control Commands](#)” on [page 127](#)). Select **Position Arm to Access Tray**, and then click **Apply**.
- For ChromQuest, open the Direct Controls page for the autosampler (see “[Using the ChromQuest Direct Commands](#)” on [page 129](#)). Select **Position Arm to Access Tray**, and then click **Submit**.

Specialized Tray Types

In addition to the standard tray option, you can order carrier trays that hold microplates and PCR plates from Thermo Fisher Scientific (see [Table 7](#)).

Table 7. Sample trays and adapters

Description	Part Number
Short microwell carrier (body)	60053-20004
Short microwell carrier handle	60053-20003
Short microwell carrier handle clip	F1072-010
Riser plate	60053-20001
Cooling Adapter	60053-20002

In combination with the riser plate, the short microwell carrier holds up to three 96-well microplates or up to three 384-well microplates (see [Figure 42](#) and [Figure 43](#)). Separately, the short microwell carrier holds either 1 mL or 2 mL deep well plates (see [Figure 44](#)). In combination with the cooling adapter, the short microwell carrier holds PCR plates (see [Figure 45](#)). The tall microwell carrier holds up to three 96-well microplates or up to three 384-well microplates (see [Figure 46](#)).

Note If your samples require low temperature cooling, use the cooling adapter and the PCR plates instead of the standard 96-well microplates.

Figure 42. Short microwell carrier, riser plate, and 96-well microplates

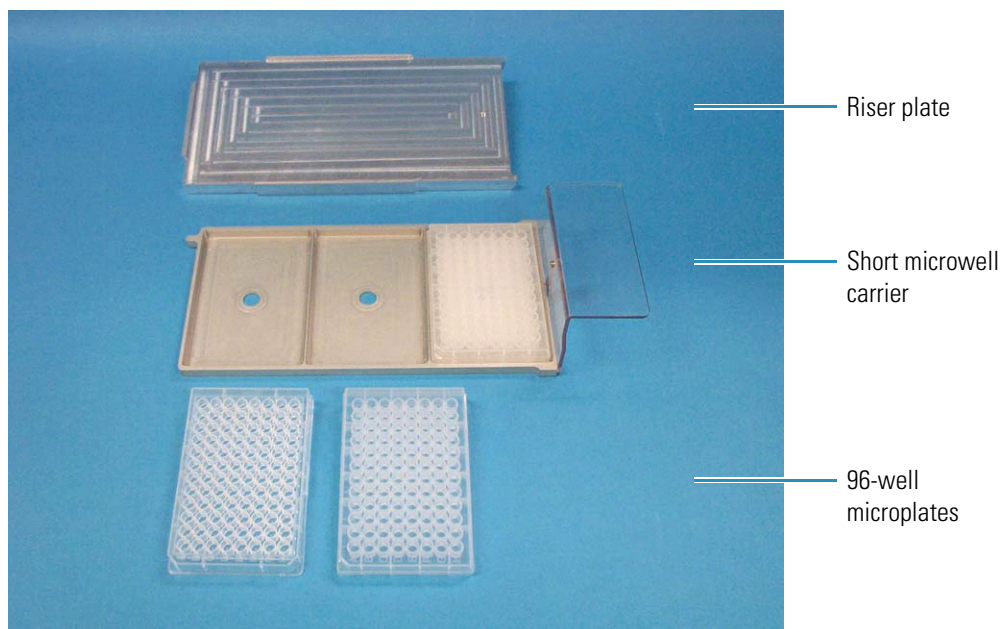


Figure 43. Short microwell carrier, riser plate, and 384-well microplates

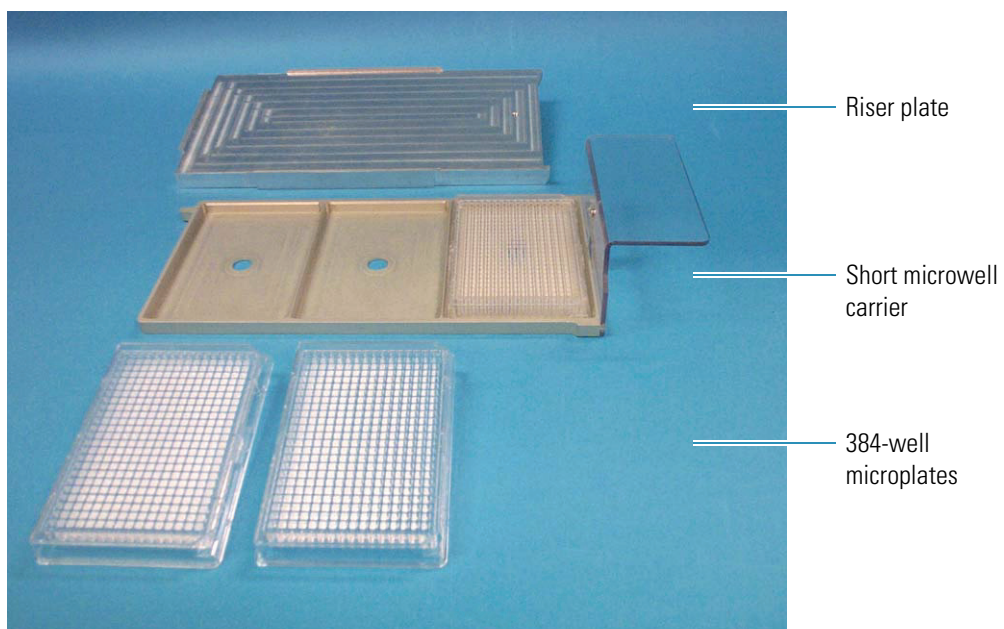


Figure 44. Short microwell carrier holding deep well plates

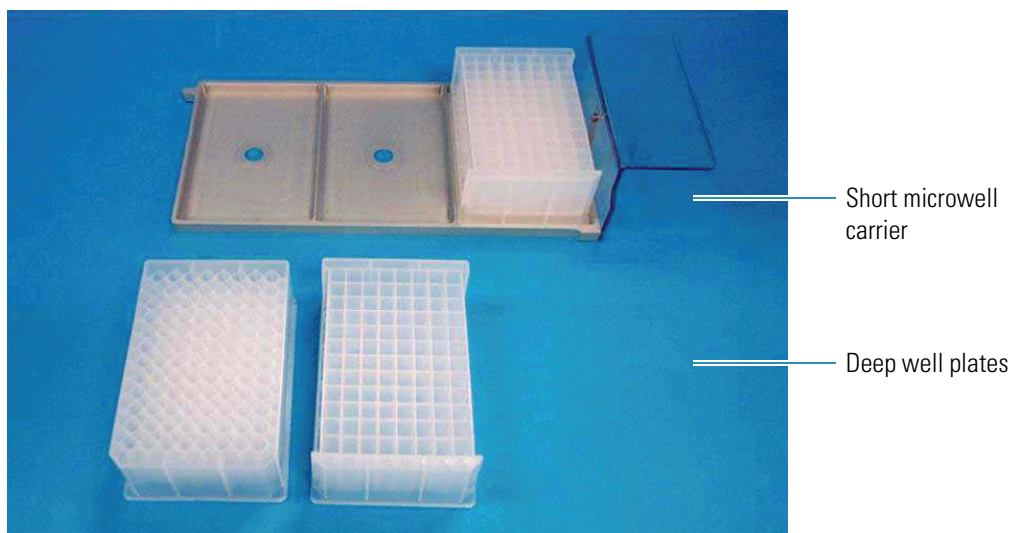


Figure 45. Short microwell carrier, cooling adaptor, and PCR plate

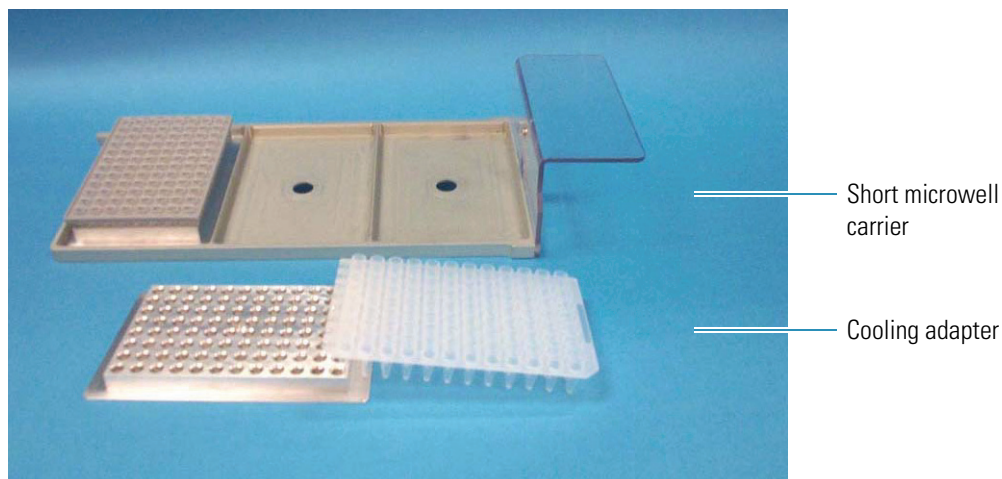
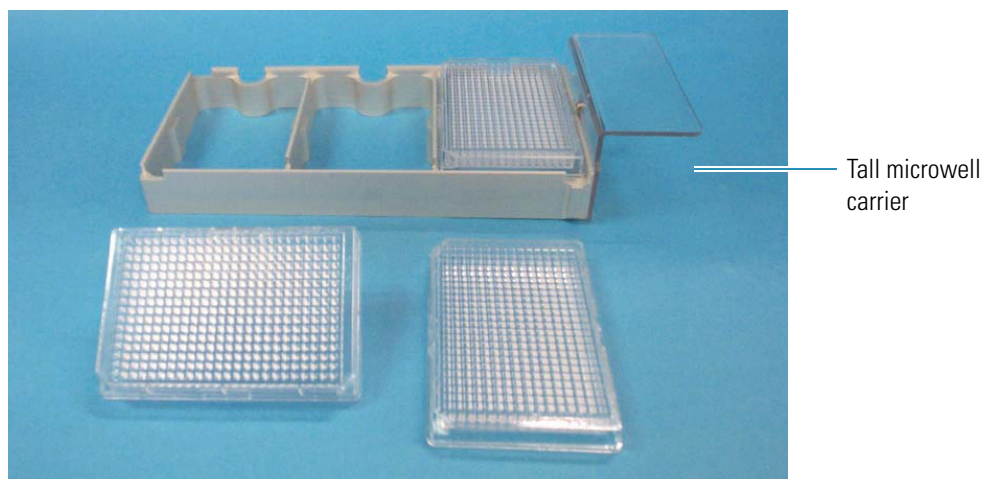


Figure 46. Tall microwell carrier



Important Precautions

Because the needle mechanism moves to the vial or well during an injection sequence, objects taller than 4.5 cm (1.8 in.) can stall the autosampler arm. You must check the height of custom trays before you place them in the tray compartment.

The vials, vial caps, microplates, and microplate covers listed in the next section have been tested for use with the Surveyor Autosampler Plus. Because the tip of the needle is blunt, the durometer (material hardness) of the vial cap septum is extremely important, as the needle might not properly pierce septa that are not recommended.

In addition, ensure that you screw on the recommended vial caps tightly. If the vial cap is loose, the needle can dislodge the septum during an injection. The needle can also dislodge the septum if it pierces the edge of the septum, rather than its center. If you suspect the needle is out of alignment, call your local Thermo Fisher Scientific service engineer to calibrate its alignment.

If you are using one of the three custom tray configurations, you must perform a calibration that determines the distance between the needle tip and the vial or well bottoms. Performing this calibration ensures that the needle tip descends to the height specified in your instrument method as it withdraws sample from the vial or well. Perform this calibration whenever you change the custom tray type configuration or use a different type of custom vial or microplate. For instructions on how to perform this calibration, refer to the data system Help for the autosampler or the getting started guide for your data system.

Recommended Vials, Microplates, and Microplate Covers

Thermo Fisher Scientific has tested and recommends the following vials, microplates, and microplate covers for use in your Surveyor Autosampler Plus.

Table 8 contains a list of recommended sample vials.

Table 8. Approved vials

Description	Qty/pkg	Part Number
1.8 mL vial with septa and screw cap	100	A4954-010
1.8 mL amber vial with septa and screw cap	100	A4965-010
Shell vial with cap	100	A4948-010
Shell vial with 100 μ L insert and cap	100	60053-62008
1.8 mL vial with cross-slit septa and screw cap	100	A5400-010

All 96-well microplates that meet the dimensions of the Society for Biomolecular Screening and that have a maximum height of 0.80 cm (0.32 in.) are suitable. Polypropylene is the preferred material when working with organic samples.

Table 9 lists the approved 96-well microplates. The supplier is SUN-SRi, a subsidiary of Thermo Fisher Scientific Inc.

Table 9. Recommended 96-well microplates

Description	Qty/pkg	Supplier catalog number
96-well, U-bottom, Polypropylene, working well volume, 250 μ L	10	500 833
	100	500 811
96-well, V-bottom, Polypropylene working well volume, 190 μ L	10	500 835
	100	500 813

3 Sample Loading

Recommended Vials, Microplates, and Microplate Covers

Table 10 lists the approved covers for 96-well microplates. SUN-SRi and Matrix Technologies are subsidiaries of Thermo Fisher Scientific Inc.

Table 10. Recommended 96-well microplate covers

Description	Qty/pkg	Source	Supplier catalog number
Micromat II/PS Round Pink Material: Teflon coated silicone rubber	10/pkg	SUN-SRi	400 079
Micromat CLR 96 well PS 7 mm Material: clear silicone rubber	10/pkg	SUN-SRi	300 005
Clear heat-seal film	100/pkg	Matrix Technologies	AB-0685
VIEWseal™ dry film adhesive backed tape	100/pkg	Greiner Bio-One	676070

All 384-well microplates that meet the dimensions of the Society for Biomolecular Screening and that have a maximum height of 0.32 in. are suitable. Polypropylene is the preferred material when working with organic samples.

Table 11 lists the approved 384-well microplates. The supplier is SUN-SRi, a subsidiary of Thermo Fisher Scientific Inc.

Table 11. Recommended 384-well microplates

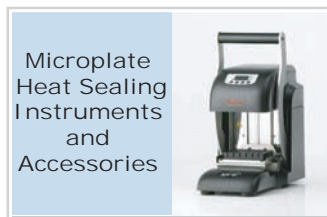
Description	Qty/pkg	Source	Supplier catalog number
384-well, U-bottom, Polypropylene working well volume, 90 µL	10	SUN-SRi	500 841
	100	SUN-SRi	500 819

Table 12 lists the approved 384-well microplate covers. Matrix Technologies is a subsidiary of Thermo Fisher Scientific Inc.

Table 12. Recommended 384-well microplate covers

Description	Qty/pkg	Source	Supplier catalog number
Clear heat-seal film	100/pkg	Matrix Technologies	AB-0685
VIEWseal™ dry film adhesive backed tape	100/pkg	Greiner Bio-One	676070

For more information about the heat-seal covers and sealing equipment supplied by Matrix Technologies, click the following link:



CAUTION Do **not** use the following covers with your Surveyor Autosampler Plus:

- Parafilm "M", manufactured by American National Can
- POWERseal™, manufactured by Greiner Bio One
- Adhesive sealing tapes



Parafilm "M" and POWERseal covers leave small pieces of material on the needle that eventually clog the injection port. Adhesive sealing tapes leave an adhesive film on the needle causing system contamination. The adhesive builds up on the needle and in the injection port, and eventually the needle becomes completely clogged.

Maintenance

This chapter contains information on the maintenance record keeping options contained in the Xcalibur data system, the suggested maintenance schedule, and the maintenance procedures necessary to optimize the performance of your autosampler.

Contents

- [Maintenance Schedule](#)
- [Replacing the Rotor Seal](#)
- [Replacing the Flush Solvent Inlet Filter](#)
- [Replacing the Transfer Tubing](#)
- [Lubricating the Lead Screw of the Syringe Drive Assembly](#)
- [Troubleshooting Blockage in the Injection System](#)
- [Replacing the Needle Tubing Assembly](#)
- [Replacing the Needle Assembly](#)
- [Changing the Syringe or Replacing the Inner Plunger](#)
- [Cleaning the Needle Guide](#)
- [Replacing a Fuse](#)
- [Maintenance Cycles](#)

For your own safety and to protect the autosampler from damage, follow the safety precautions in this manual when performing maintenance on the autosampler.



CAUTION To avoid electrical shock, do not remove the top cover or remove parts beyond the descriptions in the operation portions or in the maintenance topics of this manual.

Maintenance Schedule

The Surveyor Autosampler Plus requires only a few simple maintenance procedures to keep it in optimum working condition. [Table 13](#) contains the maintenance schedule for the autosampler. A Thermo Fisher Scientific service representative or other qualified person must perform the last procedure, the alignment of the XYZ arm.

To make the maintenance of your autosampler easier, the data system (Xcalibur or ChromQuest) keeps track of how many injections, injection valve cycles, needle cycles, and syringe cycles the autosampler has performed. The data system alerts you to perform maintenance when the number of cycles exceeds a preset value. For information on setting up the tracking system, see [“Maintenance Cycles” on page 94](#).

Note You are responsible for maintaining your autosampler. Routine maintenance does not fall under Thermo Fisher Scientific warranty; however, planned maintenance contracts are generally available. Contact your local representative if you are interested in purchasing a planned maintenance contract.

Table 13. Maintenance procedures and schedule

Frequency	Procedure	Performed by
Monthly	Checking the solvent tubing connections for leaks	User
Monthly	Running a standard sample	User
Every 15 000 to 20 000 injections	Replacing the rotor seal	User
Semiannually	Replacing the flush solvent inlet filter	User
As necessary	Replacing the injection port	User
As necessary	Clearing a plugged line or needle	User
As necessary	Changing the syringe	User
As necessary	Replacing a fuse	User
Semiannually	Cleaning and lubricating the syringe drive mechanism	User
Annually	Cleaning and lubricating the XYZ arm	Field service
Annually	Verifying the XYZ arm alignment	Field service

Note [Table 13](#) lists recommended maintenance intervals based on operating the autosampler under typical conditions. Operating of the autosampler under certain harsh conditions (corrosive solvents, extreme temperatures, and so on) might require more frequent maintenance than indicated in the table.

Replacing the Rotor Seal

The rotor seal forms a high-pressure seal between the stator and the rotor. Replace the rotor seal when you notice a leak between either the stator and the stator ring or the adjacent ports of the injection valve, or when you notice a decrease in injection precision.

Replacing the rotor seal requires these tools.

Tool	Use
1/4 in. open-end wrench	To remove the tubing from injection valve ports 5 and 6
9/64 in. hex wrench	To disassemble the injection valve

IMPORTANT Because component cleanliness affects the useful life of the injection valve, replace the rotor seal in a clean environment.

To replace the rotor seal, follow these procedures:

1. “[Disconnecting the Solvent Lines](#)” on page 66
2. “[Disassembling the Injection Valve](#)” on page 67

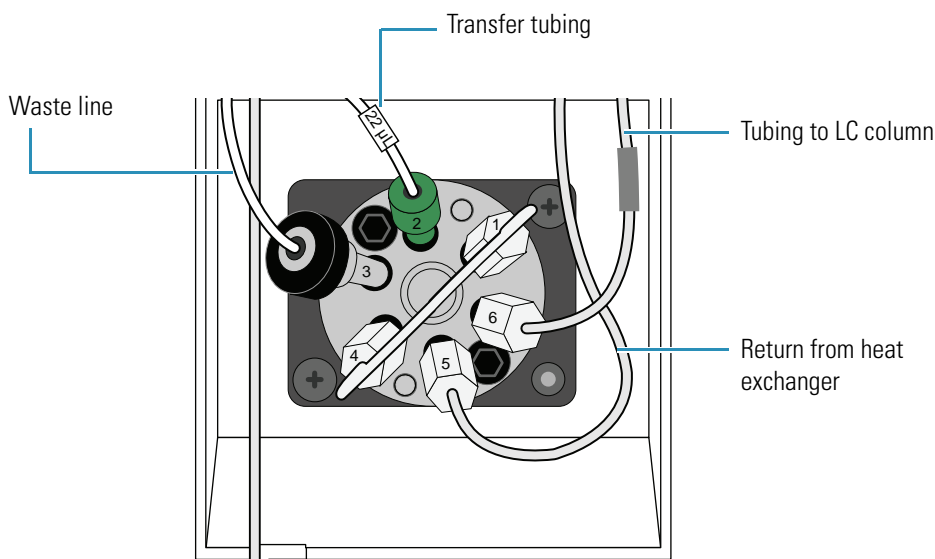
IMPORTANT To replace the rotor seal, you do not need to remove the injection valve from the autosampler or the sample loop from the injection valve. Once the sample loop has been swaged onto the injection valve, the fittings are no longer interchangeable. If you do remove the sample loop from the injection valve, take note of which fitting was connected to port 1 and which fitting was connected to port 4. For information on installing a sample loop, see “[Changing the Sample Loop](#)” on page 51.

3. “[Cleaning the Stator](#)” on page 68
4. “[Installing a New Rotor Seal](#)” on page 68
5. “[Reconnecting the Solvent Lines](#)” on page 69

Disconnecting the Solvent Lines

To replace the rotor seal, you must first disconnect the solvent lines connected to ports 2, 3, 5, and 6.

Figure 47. Injection valve with solvent lines connected



❖ To disconnect the solvent lines to the injection valve

1. Disconnect the waste tubing from port 3 of the injection valve.
2. Disconnect the transfer tubing from port 2 of the injection valve.
3. Using a 1/4 in. open-end wrench, disconnect the 1/16 in. ID high-pressure tubing from ports 5 and 6.

IMPORTANT You do not need to remove the sample loop from the injection valve to disassemble the injection valve. Once the sample loop has been swaged onto the injection valve, the fittings are no longer interchangeable. If you do remove the sample loop from the injection valve, take note of which fitting was connected to port 1 and which fitting was connected to port 4. When you reinstall the sample loop, connect the fittings to their respective ports.

Disassembling the Injection Valve

❖ To disassemble the injection valve

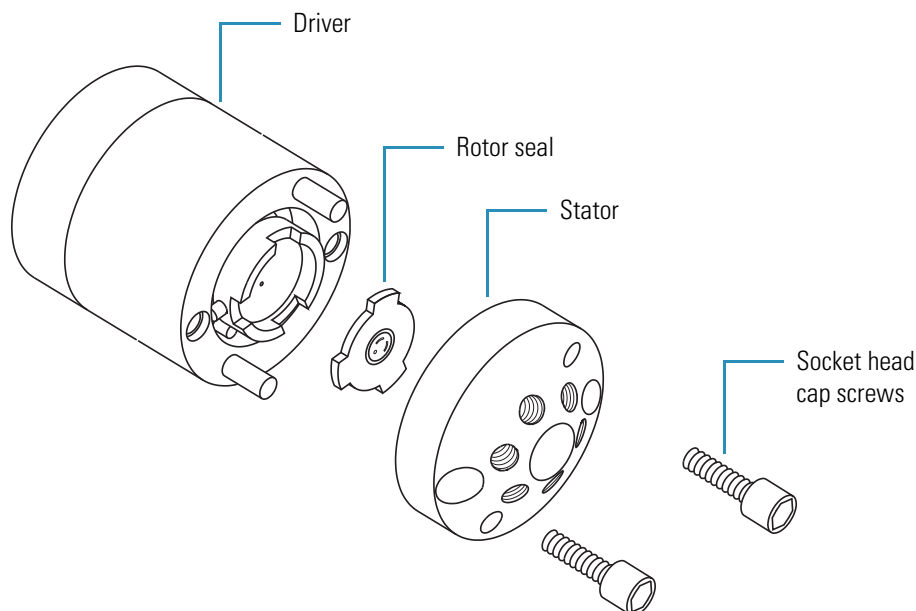
1. Using a 9/64 in. L-hex wrench, remove the two socket head cap screws that secure the stator to the stator ring and the valve body (see Figure 48).



CAUTION The polished (sealing) surface of the stator contains six ports that excess handling can easily damage. As you remove the stator from the injection valve, avoid touching this polished surface, and never place the polished surface face down on a hard surface.

2. Gently pry the rotor seal away from the driver (see Figure 48).
3. Examine the sealing surface of the rotor seal for scratches. If scratches are visible, replace the rotor seal.

Figure 48. Exploded view of the injection valve



Cleaning the Stator

❖ **To clean the stator (cap)**

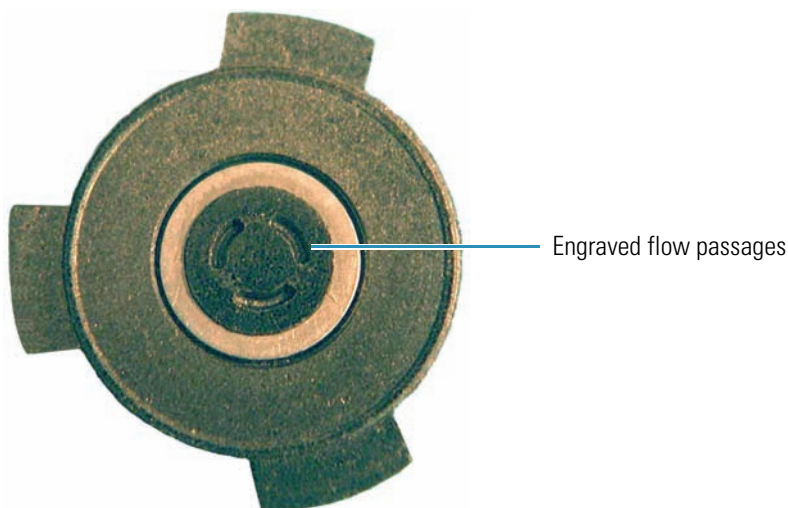
1. Inspect the stator (cap) to determine if it requires cleaning.
2. If it is dirty, swab it with HPLC-grade methanol. If more stringent cleaning is required, use a sonicator.
3. Inspect the remaining valve components for contamination. Clean as necessary.

IMPORTANT If the stator is scratched, replace it. Scratches can damage the rotor seal and cause cross-port leaks.

Installing a New Rotor Seal

The rotor seal has two sides. The side containing the three grooves (see [Figure 49](#)) faces the stator.

Figure 49. Rotor seal, showing the engraved flow passages



❖ **To install a new rotor seal**

1. Replace the rotor in the driver, making sure that the rotor sealing surface with its engraved flow passages is facing out.

The pattern is asymmetrical to prevent improper placement.

2. Replace the stator. Insert the two socket head screws and tighten them gently until both are snug. Do not overtighten them.

Reconnecting the Solvent Lines

After you reassemble the injection valve, reconnect the solvent lines to the valve, and then leak test the valve.

❖ To reconnect the solvent lines to the injection valve



- Hand-tighten the transfer tube fitting to port 2 and the waste tube fitting to port 3. Never use a wrench to tighten these fittings.

CAUTION Never use a wrench to tighten the transfer tube fitting. Over-tightening the fitting can do the following:

- Restrict the end of the tubing, which leads to less sample reaching the sample loop and results in smaller than expected peak areas or blank injections. A restriction in the end of the tubing can also cause the syringe to make a grinding sound during an injection sequence.
 - Strip the threads on the fitting, which leads to solvent leaks.
- Hand-tighten the waste tube fitting to port 3.
 - Press the end of the return tubing from the heat exchanger to the bottom of port 5 as you hand-tighten the high-pressure fitting. Then use a wrench to tighten the fitting by an additional 1/4 turn.
 - Using high-pressure tubing and two high-pressure fittings, reconnect the LC column to port 6 of the injection valve.

Note To reconnect tubing with a pre-swaged stainless steel fitting to a valve port, hand-tighten the fitting as you press the tubing against the bottom of the port, and then use a wrench to tighten the fitting by an additional 1/4 to 1/2 turn.

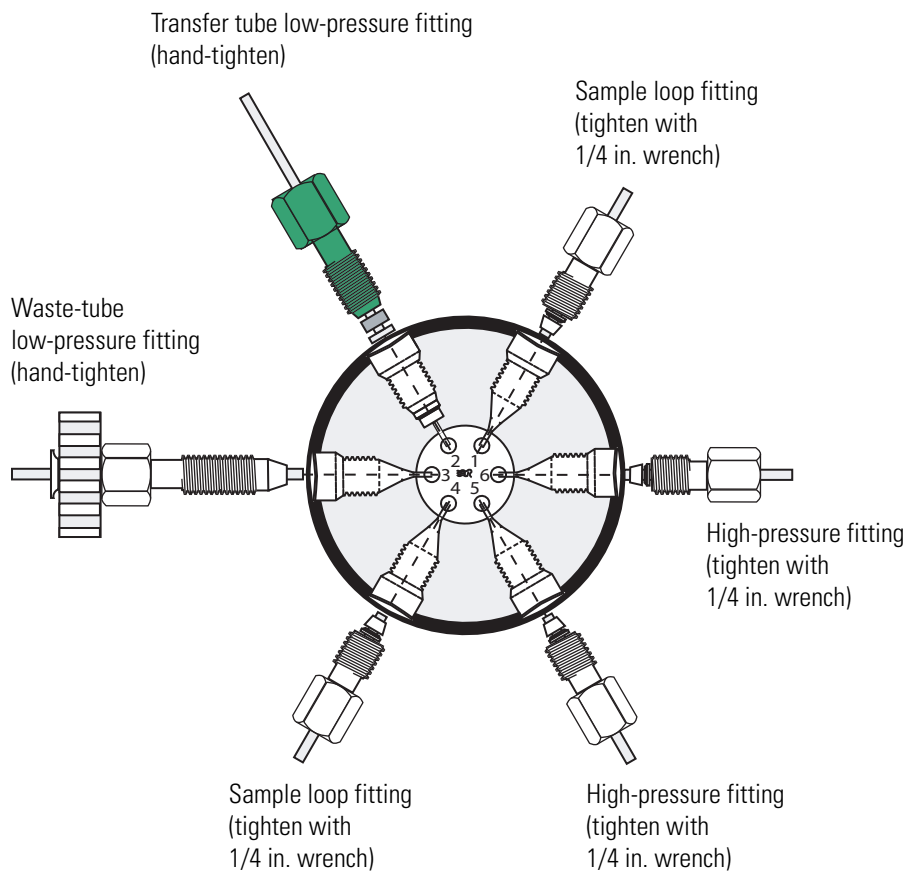
To connect tubing with a two-piece stainless steel fitting to a mating port, press the tubing against the bottom of the port as you hand-tighten the fitting. Then tighten the fitting by an additional 3/4 turn with a wrench. Once you use the wrench to tighten the fitting, the ferrule portion of the two-piece fitting is permanently connected to the tubing.

3. Turn on the solvent flow from the LC pump and check for leaks.

4 Maintenance

Replacing the Flush Solvent Inlet Filter

Figure 50. Schematic of the tubing connections to the injection valve



Replacing the Flush Solvent Inlet Filter

Properly filtering your flush solvent extends the life of your injection valve and column.

❖ To replace the inlet filter

1. Be sure the autosampler is in Idle mode.
2. Remove the flush-solvent bottle cap and lift out the inlet tubing.
3. Remove the old inlet filter.



CAUTION Be sure to follow all of the safety precautions for each solvent, as prescribed by the MSDS provided by the manufacturer.

4. Install a new filter, and then put the line back into the bottle. Tighten the solvent cap.
5. Flush the inlet filter and lines with an appropriate volume of solvent.

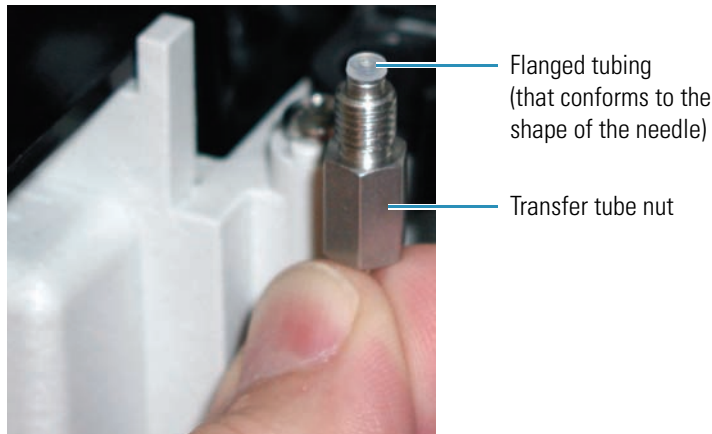
Replacing the Transfer Tubing

The transfer tubing that connects the injection port of the autosampler to port 2 of the injection valve can become worn, damaged, or plugged with use.

Replace the transfer tubing if it becomes plugged or if your injections become less reproducible (which can be an indication of a worn or damaged transfer tube). In addition, replace the transfer tubing when you replace the needle.

Tip Because the flanged end of the transfer tubing (see [Figure 51](#)) conforms to the shape of the needle, it is good practice to replace the transfer tubing when you replace the needle. The reverse is not true. The tip of the needle does not conform to the shape of the transfer tube fitting, so you do not need to replace the needle when you replace the transfer tubing.

Figure 51. View of transfer tube nut



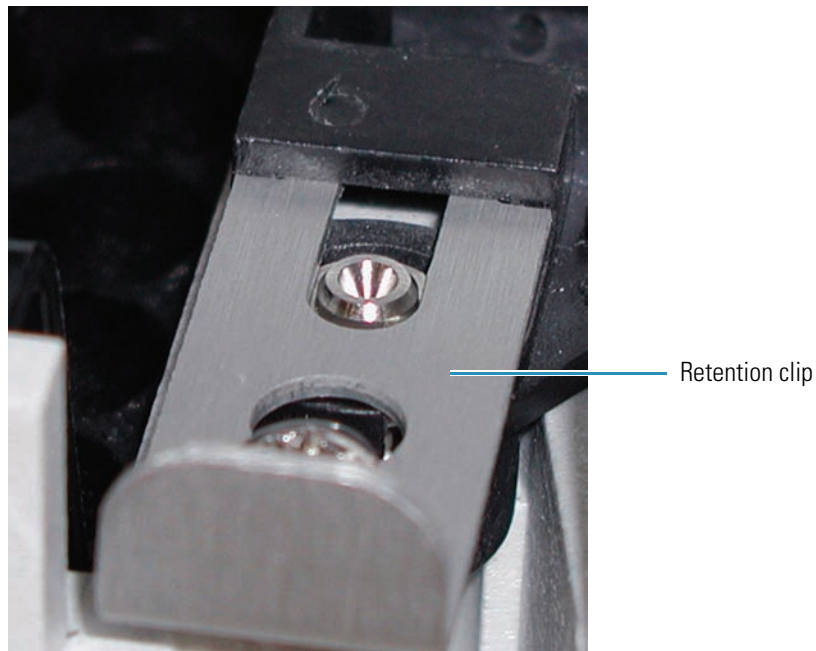
❖ To replace the transfer tubing

1. Open the door to the tray compartment. If the XYZ arm does not move to the back of the tray compartment, do the following:
 - For Xcalibur, open the Direct Control dialog box for the autosampler (see [“Using the Xcalibur Direct Control Commands”](#) on page 127). Select **Position arm to access tray**, and then click **Apply**.
 - For ChromQuest, open the Direct Controls page for the autosampler (see [“Using the ChromQuest Direct Commands”](#) on page 129). Select **Position arm to access tray**, and then click **Submit**.
2. Using both hands to remove the syringe drive assembly, pull the bottom of the assembly straight out, away from the mounting studs, and then lift the assembly up and away from the autosampler.
3. To remove the aluminum retention clip (see [Figure 52](#)) from the wash station housing, pull it forward, and then upward.

4 Maintenance

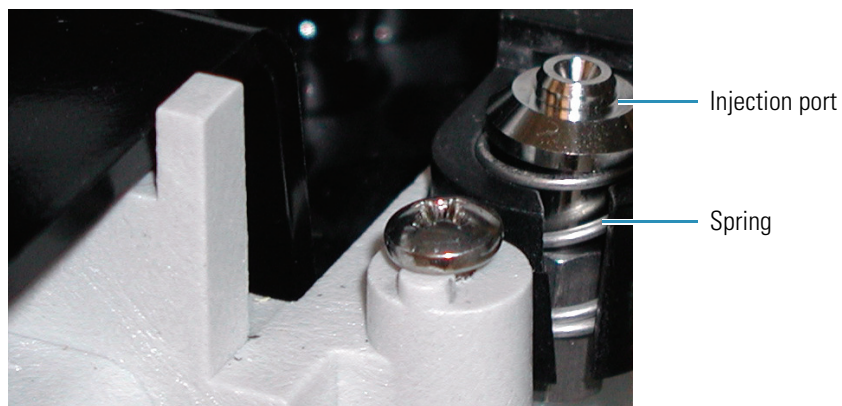
Replacing the Transfer Tubing

Figure 52. Removing the retention clip



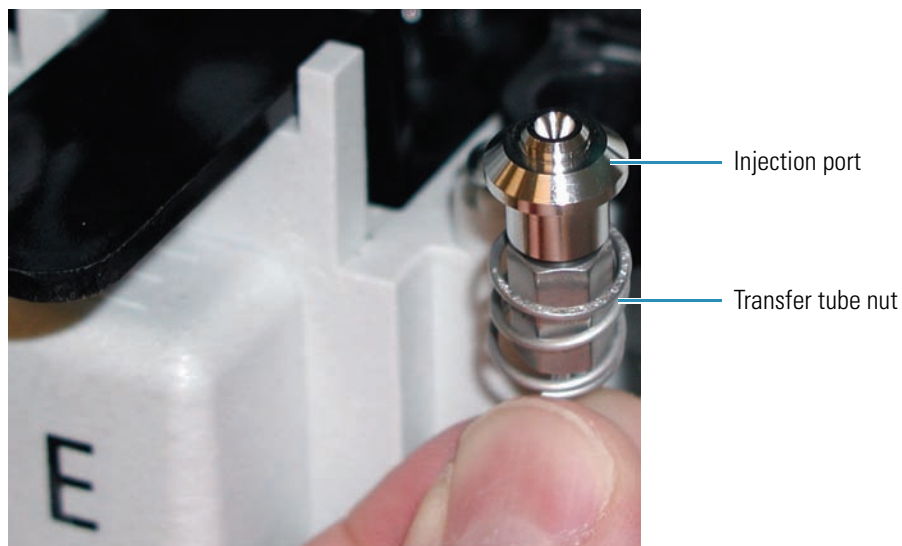
4. Pull the injection port out from the wash station (see [Figure 53](#)).

Figure 53. Removing the injection port



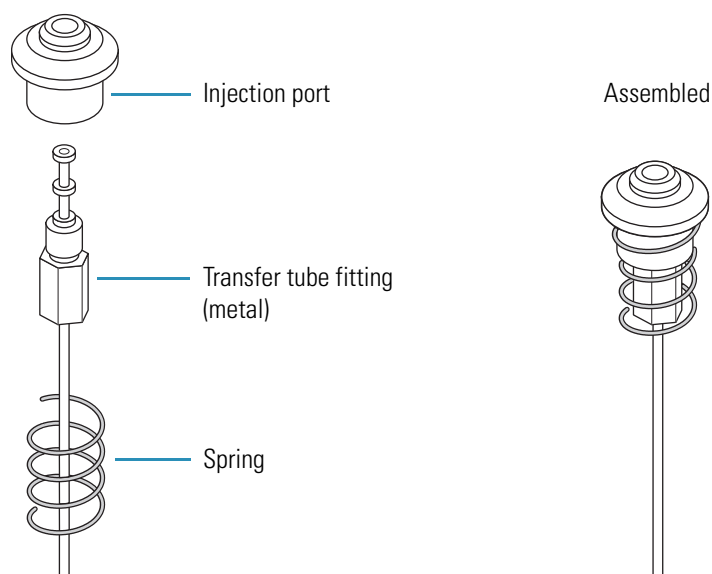
5. Unscrew the transfer tube nut from the injection port fitting (see [Figure 54](#)) and from port 2 of the injection valve, and then pull the tubing to the left through the hole in the wall between the tray compartment and the oven compartment (see [Figure 10](#) on [page 11](#)). Discard the used transfer tube.

Figure 54. View of the injection port connected to the transfer tube nut



6. Screw the injection port onto the nut of the new transfer tubing.
7. Set the injection port into the spring (see [Figure 55](#)). Then insert it into the port in front of the wash station.

Figure 55. View of transfer tubing, spring, and injection port

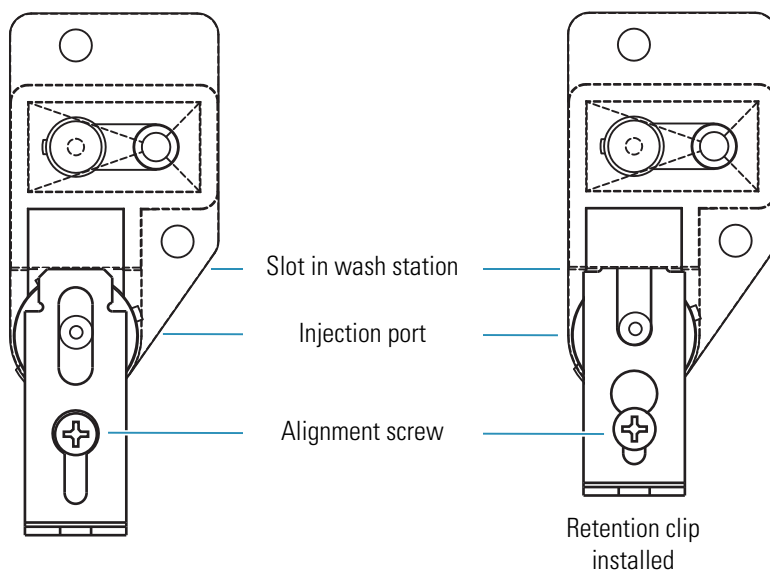


4 Maintenance

Replacing the Transfer Tubing

8. Reinstall the retention clip (see [Figure 56](#)):
 - a. Align the retention clip with the slot located in front of the wash station.
 - b. Using the retention clip to push the injection port down, align the circular cutout in the retention clip over the alignment screw.
 - c. Insert the end of the retention clip into the wash station slot as far as it will go.

Figure 56. Reinstalling the retention clip



9. Route the other end of the transfer tube through the hole in the wall between the tray and column oven compartments (see [Figure 10](#) on [page 11](#)).
10. Taking care to avoid overtightening, hand tighten the fitting to port 2 of the injection valve. Never use a wrench to tighten this fitting.



CAUTION Never use a wrench to tighten the transfer tube fitting. Overtightening constricts the transfer tube, causing poor injection precision or blank injections. Eventually, the damaged transfer tube becomes completely plugged.

IMPORTANT You must modify the instrument configuration by entering the new value for the internal volume of the transfer tubing.

11. Remount the syringe drive assembly (see “[Mounting the Syringe Drive Assembly](#)” on [page 41](#)).
12. Modify the instrument configuration for the internal volume of the new transfer tube.

For information on entering the volume of the transfer tubing, refer to the data system Help.

Lubricating the Lead Screw of the Syringe Drive Assembly

As a part of routine maintenance, lubricate the lead screw of the syringe drive assembly once every six months or as needed. If the syringe drive skips steps and does not return to the home position after you perform a Flush Syringe direct command, lubricate the lead screw before you continue operation.

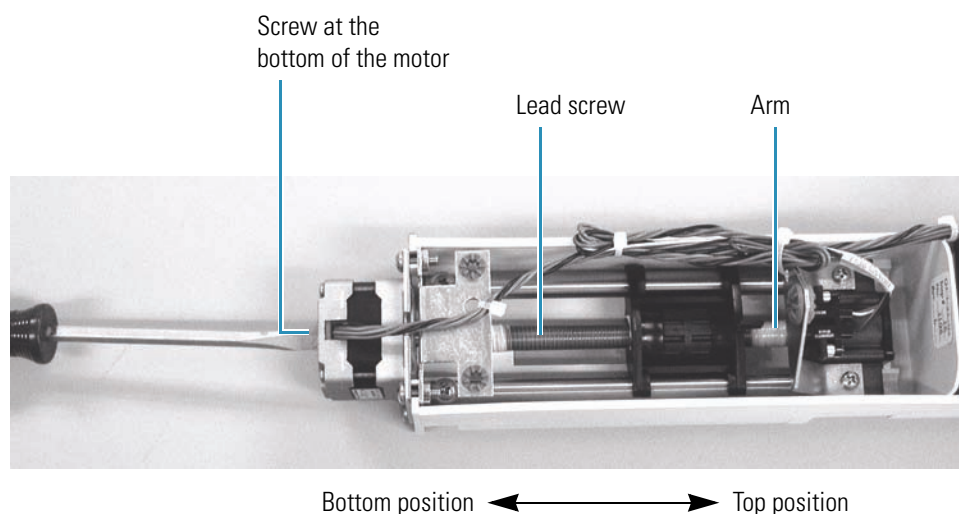
You need the following tools and materials to lubricate the lead screw:

- Flat-head screwdriver
- TriFLO™ lubricant (For ordering information, see Lubricant on [page 118](#).)

❖ To clean and lubricate the lead screw of the syringe drive assembly

1. Detach the syringe drive assembly from the autosampler (see “[Mounting the Syringe Drive Assembly](#)” on [page 41](#)).
2. Lubricate the lead screw as follows:
 - a. Apply 2 to 3 drops of TriFLO lubricant to the top part of the lead screw.
 - b. Use a flat head screwdriver to turn the screw at the bottom of the motor (see [Figure 55](#)) counterclockwise until the arm is at the top position.

Figure 57. View of the lead screw



- c. Apply lubricant to the bottom part of the lead screw.
3. Reconnect the syringe drive assembly to the autosampler.
 4. Set the syringe to its home position (see “[Setting the Syringe to the Home Position](#)” on [page 91](#)).

5. Ensure that the lead screw has been properly lubricated by watching the movement of the syringe as the autosampler flushes the syringe:
 - a. Fill the wash bottle with HPLC-grade water.
 - b. Perform a **Flush Syringe** direct command:
 - i. Open the Direct Controls page (ChromQuest) or the Direct Control dialog box (Xcalibur) for the autosampler.
 - ii. Select the **Flush Syringe** command.
 - iii. In the Reservoir list, select **Flush bottle** (Xcalibur) or **Bottle** (ChromQuest).
 - iv. In the Volume (μL) box, type **6000**.
 - v. In the Flush speed ($\mu\text{L}/\text{sec}$) box, type **100**.
 - vi. To download the command to the autosampler, click **Apply** (Xcalibur) or **Submit** (ChromQuest).

If the lead screw has been properly lubricated, it does not stall as you flush water through the system at a speed of 100 $\mu\text{L}/\text{sec}$.
6. Refill the wash bottle with an appropriate solvent mixture for your applications.

Troubleshooting Blockage in the Injection System

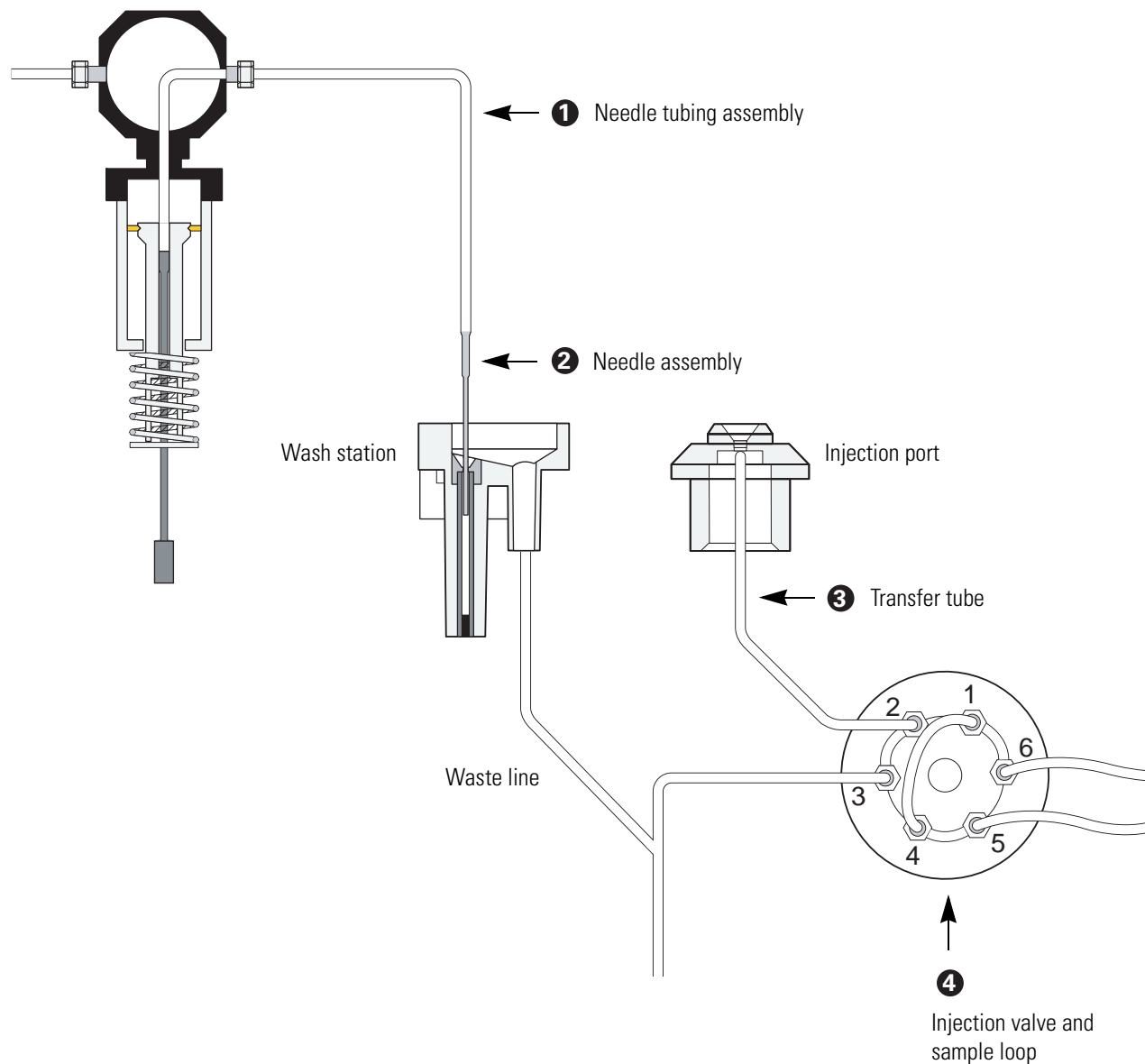
The presence of blockage in the tubing or a plugged needle condition can cause the syringe drive to stall. A stalled syringe drive makes a grinding sound because the syringe motor must overcome a greater force to move the plunger.

If you have a plug (as indicated by an abnormally loud grinding sound made by the syringe drive), determine where the plug is located by systematically checking the following sections of the injection system (see [Figure 58](#)):

- Section 1: Needle tubing assembly
- Section 2: Needle assembly
- Section 3: Transfer tubing
- Section 4: Injection valve and sample loop

Tip The transfer tube, needle, and small ports in the stator of the injection valve are the most commonly plugged components of the injection system. A damaged syringe valve can also reduce the solvent flow and cause a grinding sound.

Figure 58. Possible locations of a plug



❖ **To find and clear a plug, follow these procedures**

1. “Testing the Needle Tubing for Blockage” on page 78
2. “Testing the Needle for Blockage” on page 78
3. “Testing the Transfer Tube for Blockage” on page 79
4. “Cleaning the Injection Valve or the Sample Loop” on page 80

Testing the Needle Tubing for Blockage

❖ To test the needle tubing for blockage

1. Move the XYZ arm to the front-center of the tray compartment (see [“Setting the Needle to the Removal Position”](#) on page 82).
2. Unscrew the needle tubing from the needle and place the needle tubing fitting into a beaker.
3. As you perform a **Wash Needle** direct command with a 2000 μL volume, observe the solvent flow and listen for a grinding sound from the syringe drive.
4. Depending on whether solvent flows freely out the end of the needle tubing and you hear a grinding sound from the syringe drive, do one of the following:
 - If the wash solvent flows out of the needle tubing at a normal rate and you do not hear a grinding sound, the needle tubing is not the source of blockage. Skip [step 5](#) and [step 6](#) and go to the next procedure to test the needle for blockage.
 - If the flow appears to be constricted, go to [step 5](#).
5. Verify that the syringe valve is not the cause of the constricted flow:
 - a. Unscrew the needle tubing from the right side of the syringe valve.
 - b. Perform a **Wash Needle** direct command using a 2000 μL volume, and observe the solvent flow out of the right side of the syringe valve.
 - c. Depending on whether solvent flows freely out of the right side of the syringe valve, do one of the following:
 - If solvent flows out of the right side of the syringe valve, the needle tubing was the source of the blockage and you must replace it.
 - If solvent does not flow out of the right side of the syringe valve, you must replace the syringe valve.
6. After you replace the syringe valve or the needle tubing, home the position of the syringe (see [“Setting the Syringe to the Home Position”](#) on page 91).

Testing the Needle for Blockage

❖ To test the needle for blockage

1. Remove the needle from the needle mount on the XYZ arm by pulling the latch nut of the needle assembly forward, and then pulling the needle up out of the needle mount.
2. Reconnect the needle tubing to the needle.
3. Holding the needle over the beaker, perform a **Wash Needle** direct command using a 2000 μL volume. Watch how freely solvent flows from the end of the needle, and listen for a grinding sound from the syringe drive.

4. Depending on whether solvent flows freely out of the end of the needle and you hear a grinding sound from the syringe drive, do one of the following:
 - If the solvent flow is constricted, run a clean wire through the needle to clear the blockage. If you cannot clear the blockage, replace the needle assembly as described in [“Replacing the Needle Tubing Assembly”](#) on [page 82](#). After you replace the needle assembly, set the syringe to its home position.
 - If solvent flows out of the end of the needle at a normal rate and you do not hear a grinding sound from the syringe drive, the needle is not the source of blockage.

Note For best results, detach the needle tubing from the needle before you attempt to insert the needle into the needle mount on the XYZ arm.

5. If the needle is not the source of blockage, disconnect the needle from the needle tubing.
6. Move the XYZ arm to the front center of the tray compartment (see [“Setting the Needle to the Removal Position”](#) on [page 82](#)).
7. Insert the needle into the needle mount on the XYZ arm, and then push the latch nut backward.
8. Reconnect the needle tubing to the needle, and then ensure that the needle tubing is routed through the appropriate brackets (see [“Replacing the Needle Tubing Assembly”](#) on [page 82](#)).
9. Go to the next procedure to test the transfer tube for blockage.

Testing the Transfer Tube for Blockage

❖ To test the transfer tube for blockage

1. Disconnect the transfer tube from port 2 of the injection valve (see [Figure 58](#)).
2. Place the free end of the transfer tube into a beaker to collect solvent.
3. As you perform a **Flush Syringe** direct command, listen for an abnormally loud grinding sound.
 - If the syringe drive does not stall, then the plug is in the injection valve or the sample loop. Reconnect the transfer tube to port 2 of the injection valve and go to the next procedure, [“Cleaning the Injection Valve or the Sample Loop.”](#)
 - If the solvent flow is constricted through the transfer tube, replace the transfer tube (see [“Replacing the Transfer Tubing”](#) on [page 71](#)).
4. After you replace the transfer tube, home the position of the syringe (see [“Setting the Syringe to the Home Position”](#) on [page 91](#)).

Cleaning the Injection Valve or the Sample Loop

If the blockage was not in the needle tubing assembly or the transfer tube, it must be in either the injection valve or the sample loop. Clear the blockage, and then set the syringe to the home position. To clean the stator, rotor seal, or sample loop, you do not need to remove the driver portion of the injection valve from the autosampler .



CAUTION Do **not** clean the injection valve with a cleaning wire, which can damage the valve.

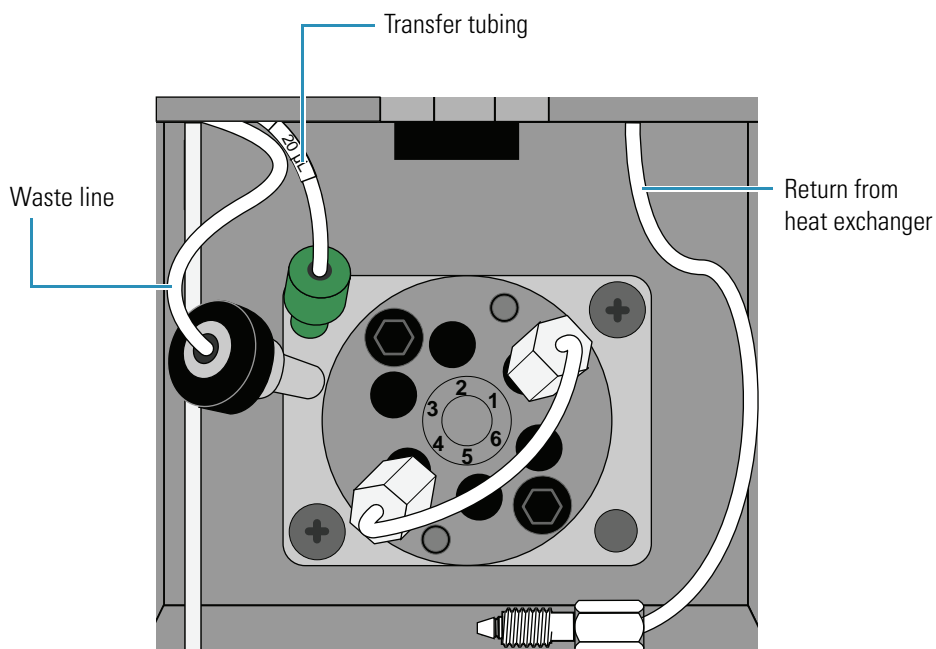
❖ To clear the blockage from the sample loop

1. Remove the sample loop from the valve.
2. Clear blockage from the sample loop by pushing a wire through it. Or, connect a new sample loop to the valve.
3. After you reconnect the sample loop, home the position of the syringe.

❖ To clear the blockage from the injection valve

1. Disconnect the solvent lines from the valve:
 - Disconnect the low-pressure lines from ports 2 and 3.
 - Using a 1/4 in. open-end wrench, disconnect the high-pressure lines from ports 5 and 6.

Figure 59. Injection valve with the low-pressure and high-pressure solvent lines removed



- Using a 1/4 in. open-end wrench, disconnect the sample loop from ports 1 and 4.

IMPORTANT Once the sample loop has been swaged onto the injection valve, the fittings are no longer interchangeable. When you remove the sample loop from the injection valve, take note of which fitting was connected to port 1 and which fitting was connected to port 4. When you reinstall the sample loop, connect the fittings to their respective ports.

- Disassemble the valve (see “[Disassembling the Injection Valve](#)” on [page 67](#)).



CAUTION The polished (sealing) surface of the stator contains six ports that excess handling can easily damage. As you remove the stator from the injection valve, avoid touching this polished surface, and never place the polished surface face down on a hard surface.

- Place the stator (with the front face down) and the rotor seal side-by-side in a beaker. Fill the beaker with HPLC-grade methanol or acetonitrile, and then place the beaker in an ultrasonic bath and sonicate for approximately 10 minutes.
- Reassemble the valve (see “[Installing a New Rotor Seal](#)” on [page 68](#)).
- Reconnect the solvent lines (see “[Reconnecting the Solvent Lines](#)” on [page 69](#)).
- After you clear the source of the blockage, home the position of the syringe (see “[Setting the Syringe to the Home Position](#)” on [page 91](#)).

Replacing the Needle Tubing Assembly

The needle tubing assembly connects the solvent path between the needle and the syringe valve.



CAUTION The needle tubing is easily damaged. Before you operate the autosampler, take care to route the needle tubing through the support brackets.

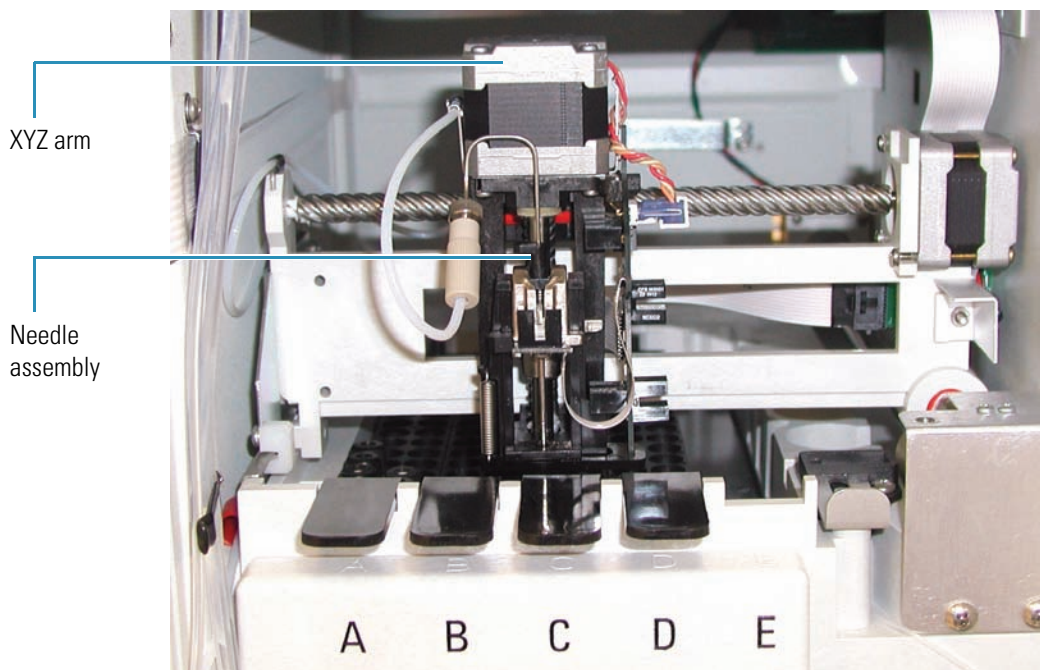
To replace the needle tubing assembly, follow these procedures:

1. “Setting the Needle to the Removal Position,” on this page
2. “Installing the Needle Tubing Assembly” on page 83
3. “Installing the Needle Tubing Assembly” on page 83
4. “Setting the XYZ Arm to the Home Position” on page 87

Setting the Needle to the Removal Position

Setting the needle to the removal position moves the XYZ arm to the front-center of the tray compartment and lowers the needle one inch.

Figure 60. XYZ arm set to the front center of the tray compartment



❖ To set the needle to the removal position

Do the following:

- For Xcalibur, open the Direct Control dialog box for the autosampler (see “Using the Xcalibur Direct Control Commands” on page 127). Select **Needle Removal**, and then click **Apply**.
- For ChromQuest, open the Direct Controls page for the autosampler (see “Using the ChromQuest Direct Commands” on page 129). Select **Position Arm to Replace Needle**, and then click **Submit**.

Removing the Needle Tubing Assembly

❖ To remove the needle tubing assembly

1. Move the XYZ arm to the front center of the tray compartment (see “Setting the Needle to the Removal Position” on page 82).
2. Unscrew the needle tubing from the needle assembly.
3. Remove the needle tubing from the bracket on the XYZ arm (see Figure 62 on page 84).
4. Pull the two-pronged needle tubing guide out of the X-axis positioning frame (see Figure 63 on page 85).
5. Use the Position Arm to Access Tray command to move the XYZ arm to the back of the tray compartment (see “Moving the XYZ Arm to the Back of the Tray Compartment” on page 55).
6. Remove the needle tubing from the bracket on the left wall of the tray compartment (see Figure 64 on page 85).
7. Pull the tubing out of the tray compartment. A black or red PVC cap keeps the tubing positioned below the metal runner for the X-axis positioning frame.
8. Remove the syringe drive assembly from the autosampler (see “Mounting the Syringe Drive Assembly” on page 41).
9. Remove the needle tubing from the right side of the two-way syringe valve.

Installing the Needle Tubing Assembly

❖ To install a new needle tubing assembly

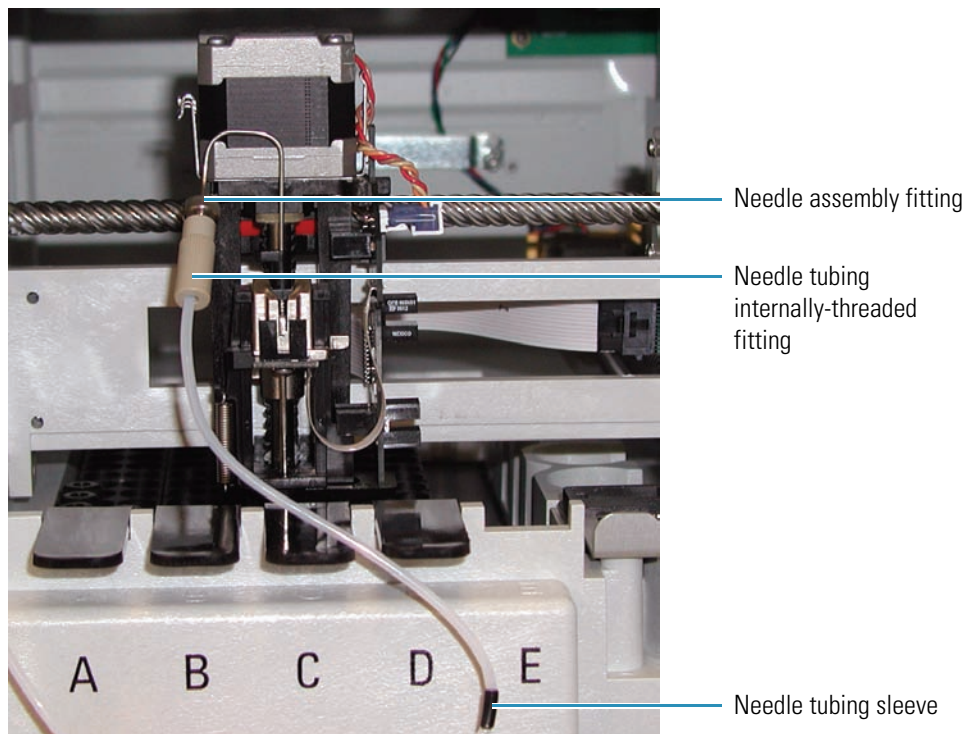
1. Connect the internally-threaded fitting of the needle tubing assembly to the needle assembly fitting (see Figure 61).
2. Verify that the length of tubing between the internally-threaded fitting and the black sleeve is approximately 16.5 cm (6.5 in.) in length (see Figure 61).

4 Maintenance

Replacing the Needle Tubing Assembly

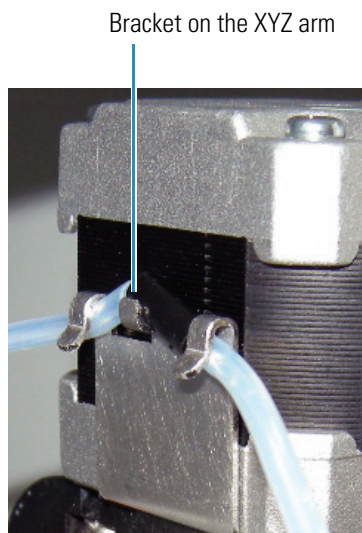
Tip When the needle tubing assembly is connected to the needle assembly, the distance between the needle tubing fitting and the letter E on the tray compartment is approximately 16.5 cm (6.5 in.).

Figure 61. Verifying the position of the needle tubing sleeve



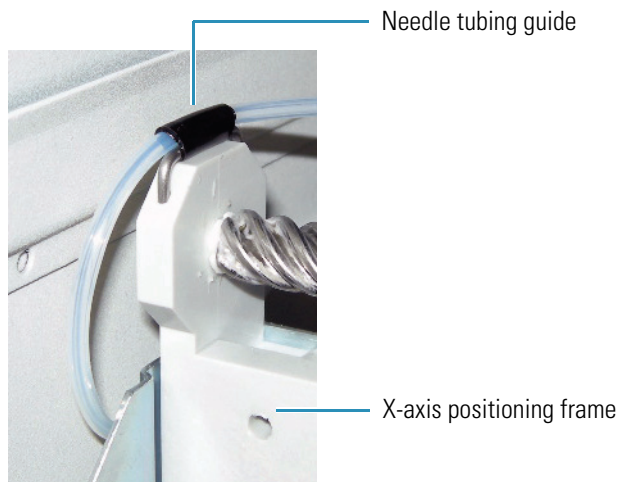
3. Route the needle tubing through the bracket on the XYZ arm. Seat the black sleeve in the middle of the bracket (see [Figure 62](#)).

Figure 62. Needle tubing routed through the bracket on the XYZ arm



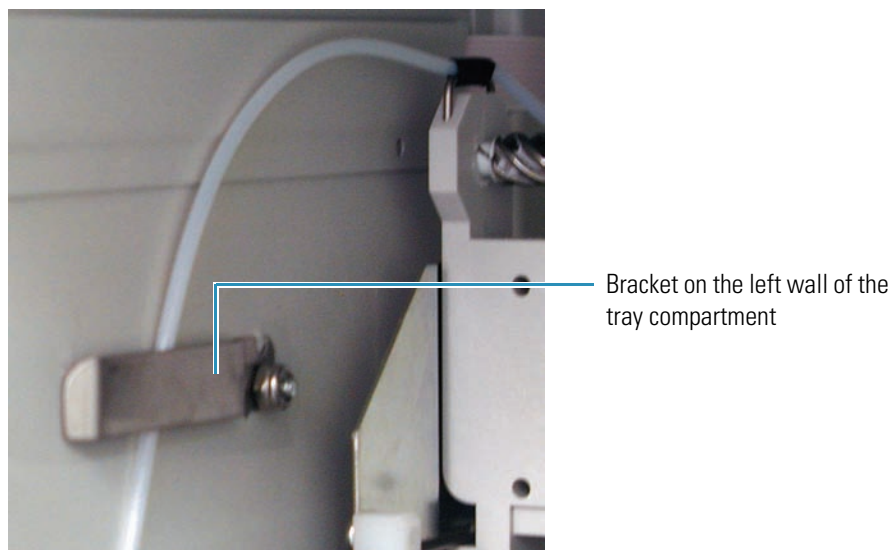
4. Insert the prongs of the needle tubing guide into the alignment holes in the X-axis positioning frame (see [Figure 63](#)).

Figure 63. Needle tubing guide inserted into the alignment holes in the X-axis frame



5. Move the XYZ arm to the back of the tray compartment (see [“Moving the XYZ Arm to the Back of the Tray Compartment”](#) on [page 55](#)).
6. Route the needle tubing through the bracket on the left wall of the tray compartment (see [Figure 64](#)).

Figure 64. Bracket on the left wall of the tray compartment

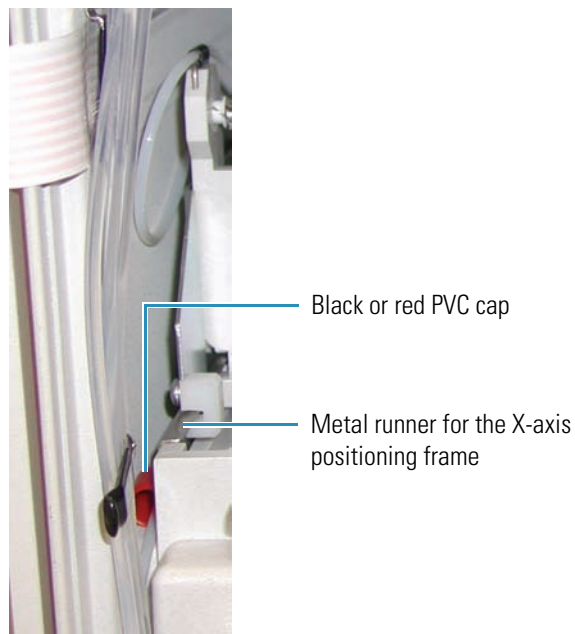


4 Maintenance

Replacing the Needle Tubing Assembly

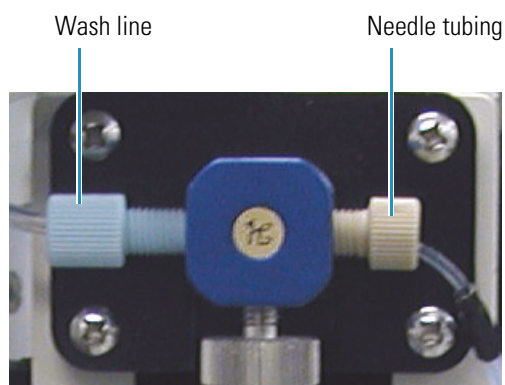
7. Push the black or red PVC cap (that is attached to the needle tubing assembly) below the metal runner for the X-axis positioning frame (see [Figure 65](#)).

Figure 65. Location of the black or red PVC cap



8. Connect the needle tubing to the right side of the syringe valve (see [Figure 66](#)).

Figure 66. Two-way syringe valve



9. Reconnect the syringe drive assembly to the autosampler (see “[Mounting the Syringe Drive Assembly](#)” on page 41).
10. Move the XYZ arm to the home position (see “[Setting the XYZ Arm to the Home Position](#)” on page 87).

Setting the XYZ Arm to the Home Position

To set the XYZ arm to the home position, use the appropriate command from the data system.

❖ To set the XYZ arm to the home position

Do the following:

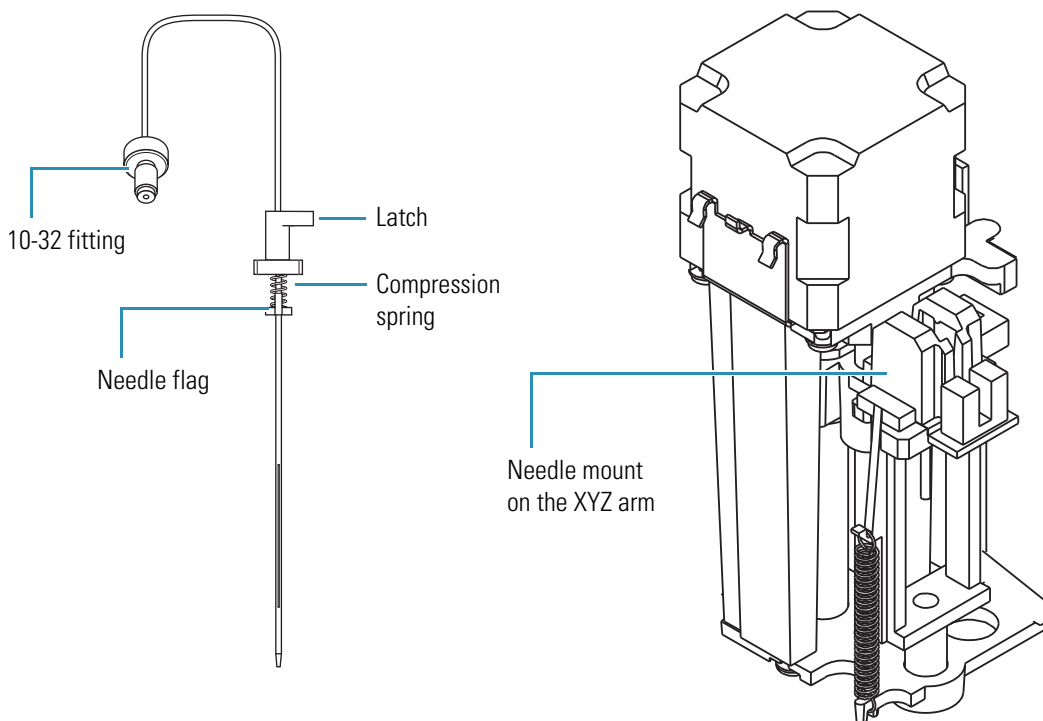
- For Xcalibur, open the Direct Control dialog box for the autosampler (see “Using the Xcalibur Direct Control Commands” on page 127). Select **Set Arm to Home Position**, and then click **Apply**.
- For ChromQuest, open the Direct Controls page for the autosampler (see “Using the ChromQuest Direct Commands” on page 129). Select **Go To Home**, and then click **Submit**.

The home position of the XYZ arm is directly behind the wash station.

Replacing the Needle Assembly

The needle assembly is a welded piece of 0.012 in. ID stainless steel tubing with an externally-threaded fitting, a needle flag, a latch, and a compression spring (see Figure 67). It slides into the needle mount on the XYZ arm and is secured with the latch.

Figure 67. Needle assembly



4 Maintenance

Changing the Syringe or Replacing the Inner Plunger

❖ To replace the needle assembly

1. Move the XYZ arm to the front-center of the tray compartment (see [“Setting the Needle to the Removal Position”](#) on page 82).
2. To remove the needle assembly:
 - a. Unscrew the needle tubing assembly from the needle assembly.
 - b. Pull the latch nut of the needle assembly forward.
 - c. Pull the needle up out of the needle mount on the XYZ arm.
3. To install a new needle assembly:
 - a. Slide the needle into the needle mount on the XYZ arm.
 - b. Turn the latch to the right.
 - c. Attach the needle tubing assembly to the needle assembly.
4. Home the position of the XYZ arm (see [“Setting the XYZ Arm to the Home Position”](#) on page 87).

Changing the Syringe or Replacing the Inner Plunger

You must change the syringe if a different size is required for your application. For the dual-concentric syringe, the lifespan of the inner plunger is approximately 50 000 injections. If the inner plunger of the 250 μL syringe wears out—that is, if fluid leaks out of the bottom of the syringe, you must replace the plunger. The part number of the inner plunger is listed under [“Consumables”](#) on page 118.

To replace the syringe or the syringe plunger, follow these procedures:

1. [“Setting the Syringe to the Removal Position”](#) on page 89
2. [“Removing the Syringe from the Autosampler”](#) on page 89
3. [“Replacing the Inner Plunger of the Syringe”](#) on page 90
4. [“Installing the Syringe”](#) on page 90
5. [“Setting the Syringe to the Home Position”](#) on page 91

Setting the Syringe to the Removal Position

❖ To set the syringe to the removal position

Do the following:

- For Xcalibur, open the Direct Control dialog box for the autosampler (see “Using the Xcalibur Direct Control Commands” on page 127). Select **Set Syringe to Removal Position**, and then click **Apply**.
- For ChromQuest, open the Direct Controls page for the autosampler (see “Using the ChromQuest Direct Commands” on page 129). Select **Position Syringe for Removal**, and then click **Submit**.

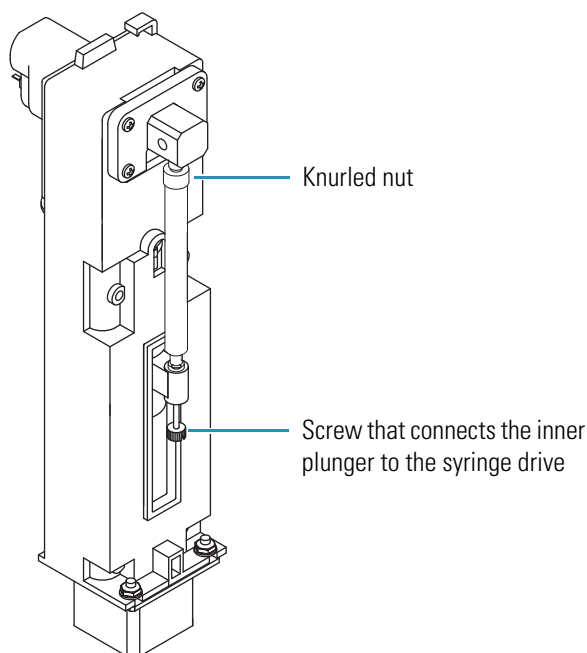
The inner plunger of the dual-concentric syringe and the syringe drive move downward.

Removing the Syringe from the Autosampler

❖ To remove the syringe

1. Set the syringe to the removal position (see the previous procedure, [Setting the Syringe to the Removal Position](#)).
2. Undo the screw that connects the syringe plunger to the syringe drive (see [Figure 68](#)).
3. Loosen and remove the syringe by turning the knurled top of the syringe counterclockwise (see [Figure 68](#)).

Figure 68. Syringe mounted to the syringe drive assembly



4 Maintenance

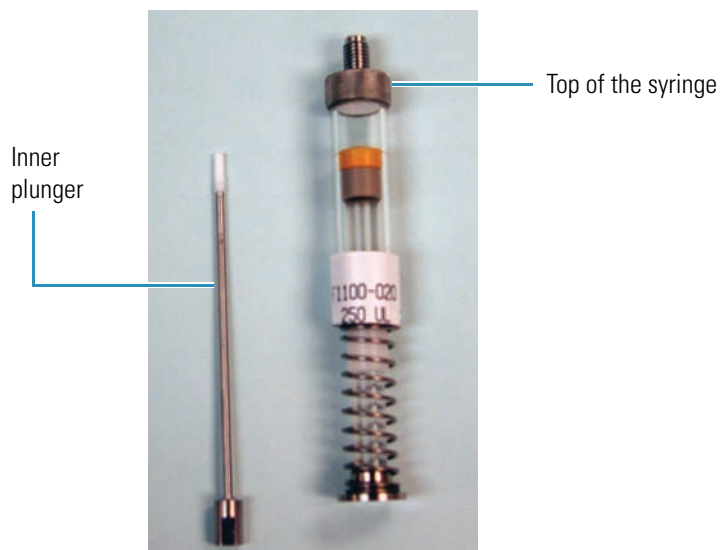
Changing the Syringe or Replacing the Inner Plunger

Replacing the Inner Plunger of the Syringe

❖ To replace the inner plunger

1. Remove the syringe from the autosampler (see [“Removing the Syringe from the Autosampler”](#) on page 89).
2. Pull the worn plunger out of the bottom of the syringe (see [Figure 69](#)).
3. Replace the worn plunger with a new replacement inner plunger.

Figure 69. Inner plunger removed from the dual-concentric syringe



Installing the Syringe

❖ To reinstall the syringe

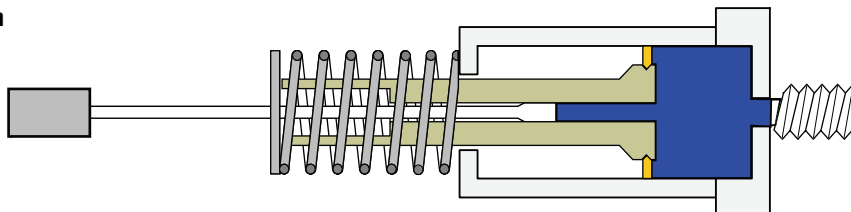
1. Screw the knurled nut on top of the syringe into the syringe valve.
2. Reconnect the bottom of the inner plunger to the syringe drive.
3. Home the position of the syringe plungers (see [“Setting the Syringe to the Home Position”](#) on page 91).

Setting the Syringe to the Home Position

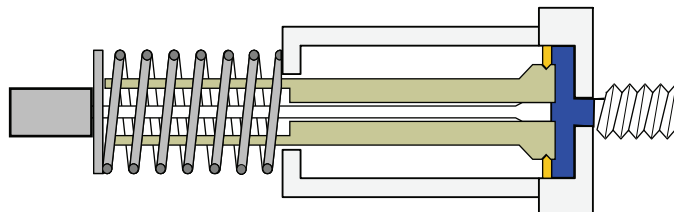
Figure 70 shows the relative positions of the syringe plungers in the syringe removal position and the home position.

Figure 70. Relative positions of the syringe plungers

Removal position



Home position



❖ To set the syringe to the home position

Do the following:

- For Xcalibur, open the Direct Control dialog box for the autosampler (see “Using the Xcalibur Direct Control Commands” on page 127). Select **Set syringe to home position**, and then click **Apply**.
- For ChromQuest, open the Direct Controls page for the autosampler (see “Using the ChromQuest Direct Commands” on page 129). Select **Position Syringe to Home**, and then click **Submit**.

The inner plunger moves upward until the nut on the bottom of the plunger meets the washer on the bottom of the syringe. Then both plungers move upward until they are 1.5 mm (0.06-in.) below the top of the outer syringe barrel.

IMPORTANT If you change the size of the syringe, you must change the syringe type parameter for the configuration of the Surveyor Autosampler Plus.

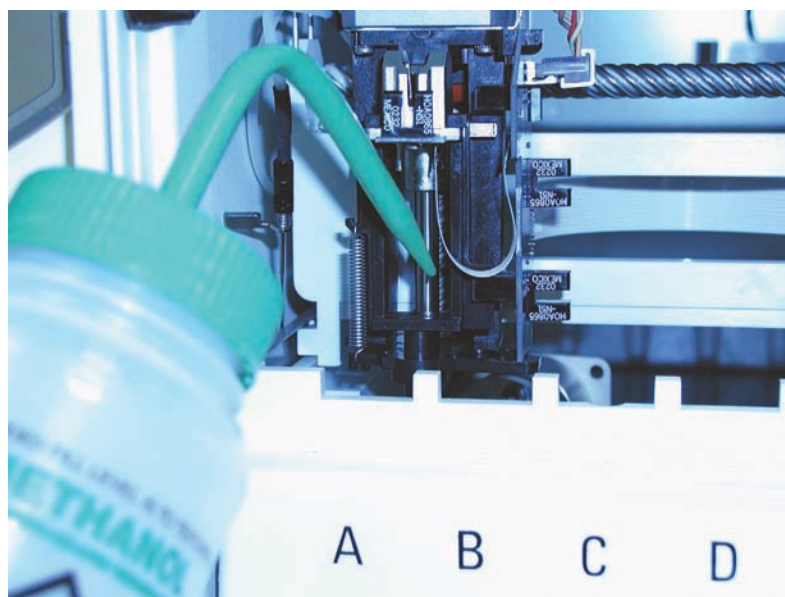
Cleaning the Needle Guide

Clean the needle guide to reduce carryover from dirty samples or complex matrices.

❖ **To clean the needle guide**

1. Remove the needle assembly.
2. Rinse the hole in the bottom of the needle guide (vial stripper) and the outside of the needle with an appropriate solvent (see [Figure 71](#)).
3. Reinstall the needle after you finish cleaning it.

Figure 71. Cleaning the needle guide



Replacing a Fuse

Instrument power is supplied by two 5.0 amp, 250 V, TL, 5 mm OD × 20 mm length fuses. The fuses are housed in the fuse compartment on the lower right corner as you are facing the back panel of the autosampler (next to the power cord). If an electrical component in your autosampler stops working, first check for a blown fuse.



CAUTION Disconnect the power cord before you replace fuses.

❖ To replace a fuse

1. Turn off the autosampler and disconnect its power cord.
2. Use a flat blade to press down on the plastic tab at the top edge of the fuse compartment and pull out the fuse holder.
3. Inspect each fuse for a burned or broken wire (which indicates a blown fuse).
4. Pull the blown fuse out of the holder and discard it. Place the new fuse (5.0 amp, 250 V, TL, 5 × 20 mm) into the holder with the metal end visible.



CAUTION When you are replacing fuses, use only fuses of the type and current rating specified. Do not use repaired fuses and do not short-circuit the fuse holder.

5. Snap the fuse holder back into place.
6. Reconnect the power cord and turn on the autosampler.

If the replacement fuse fails in a short time, you have a serious electrical problem. Leave the blown fuse in place and contact your Thermo Fisher Scientific service representative.

Maintenance Cycles

The rotor seal, injection needle, and inner syringe plunger wear with use. From the data system, you can set the scheduled maintenance time (SMT) for these autosampler components.

Setting the Maintenance Cycles in Xcalibur

Each page of the Maintenance Information dialog box contains a Usage limit box, Current counter readback, Set new limit button, and Zero counter button. Use each page to set a new usage limit, view the current counter readback, or zero the current counter reading.

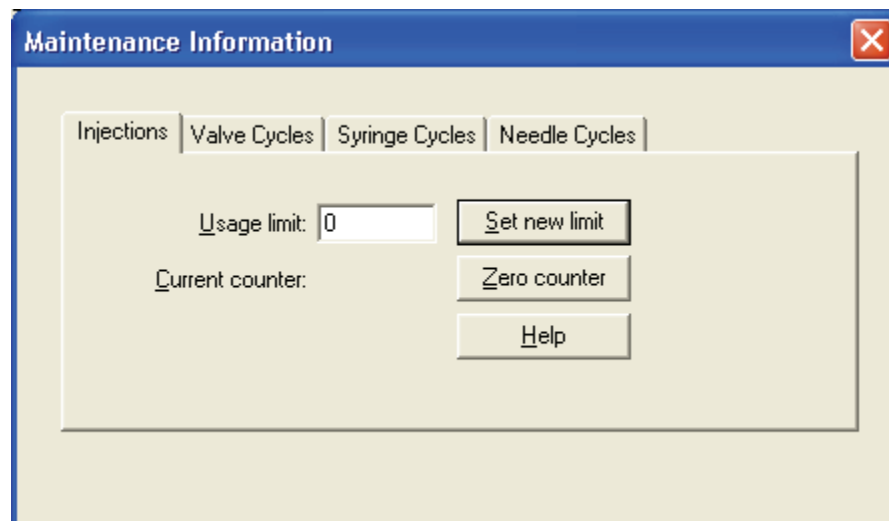
If the counter exceeds the usage limit, the autosampler cannot start a run until you perform the scheduled maintenance, or you select the Enable Maintenance Log check box of the Surveyor AS Configuration dialog box.

❖ To set the scheduled maintenance limits in Xcalibur

1. In the Instrument Setup window for the autosampler, choose **Surveyor AS > Maintenance**.

The Maintenance Information dialog box appears (see [Figure 72](#)).

Figure 72. Maintenance Information dialog box in Xcalibur



2. Open the appropriate page:
 - To set the maximum number of times that the autosampler can make an injection before the scheduled maintenance message appears, click the **Injections** tab to open the Injections page.
 - To set the maximum number of times that the autosampler can switch the valve between the fill and inject positions before the scheduled maintenance message appears, click the **Valve Cycles** tab to open the Valve Cycles page.

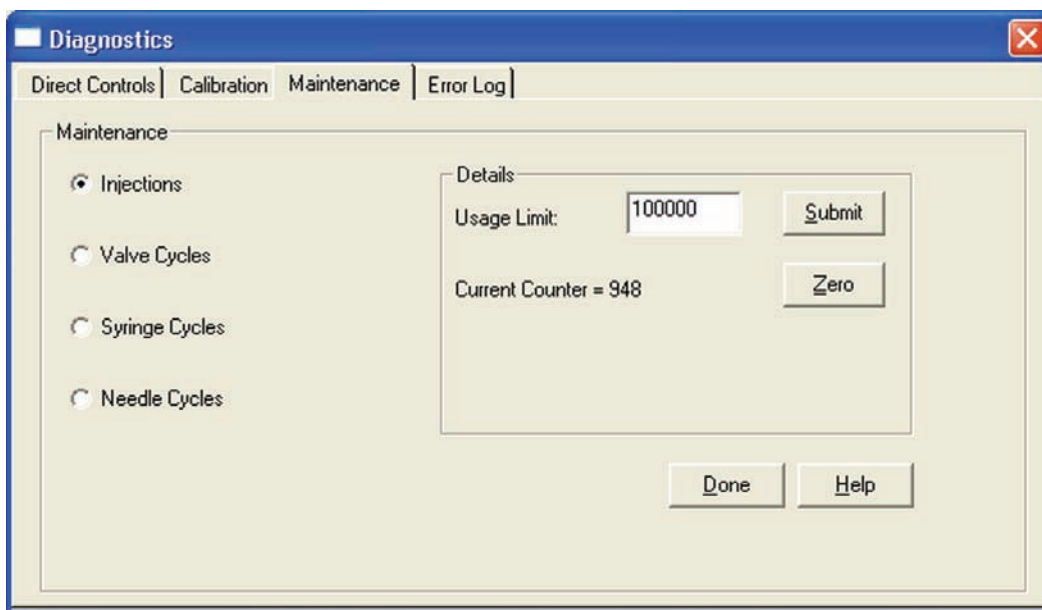
- To set the maximum number of times that the autosampler can insert the needle into a septum, the injection port, or the wash station before the scheduled maintenance message appears, click the **Needle Cycles** tab to open the Needle Cycles page.
 - To set the maximum number of times that the autosampler can return the syringe to the Ready position before the scheduled maintenance message appears, click the **Syringe Cycles** tab to open the Syringe Cycles page.
3. To change the usage limit, type the new value in the Usage limit box, and then click **Set new limit**.

Setting the Maintenance Cycles in ChromQuest

The Maintenance page in ChromQuest contains four options: Injections, Valve Cycles, Syringe Cycles, and Needle Cycles. After you select an option, its corresponding Details box appears on the right side of the Maintenance page. You can use each Details box to set a usage limit, view the current counter readback, or zero the current counter reading (see [Figure 73](#)).

If the counter exceeds the usage limit, the autosampler cannot start a run until you perform the scheduled maintenance or you clear the Enable Maintenance Log check box of the Surveyor AS Configuration dialog box.

Figure 73. Maintenance page in ChromQuest

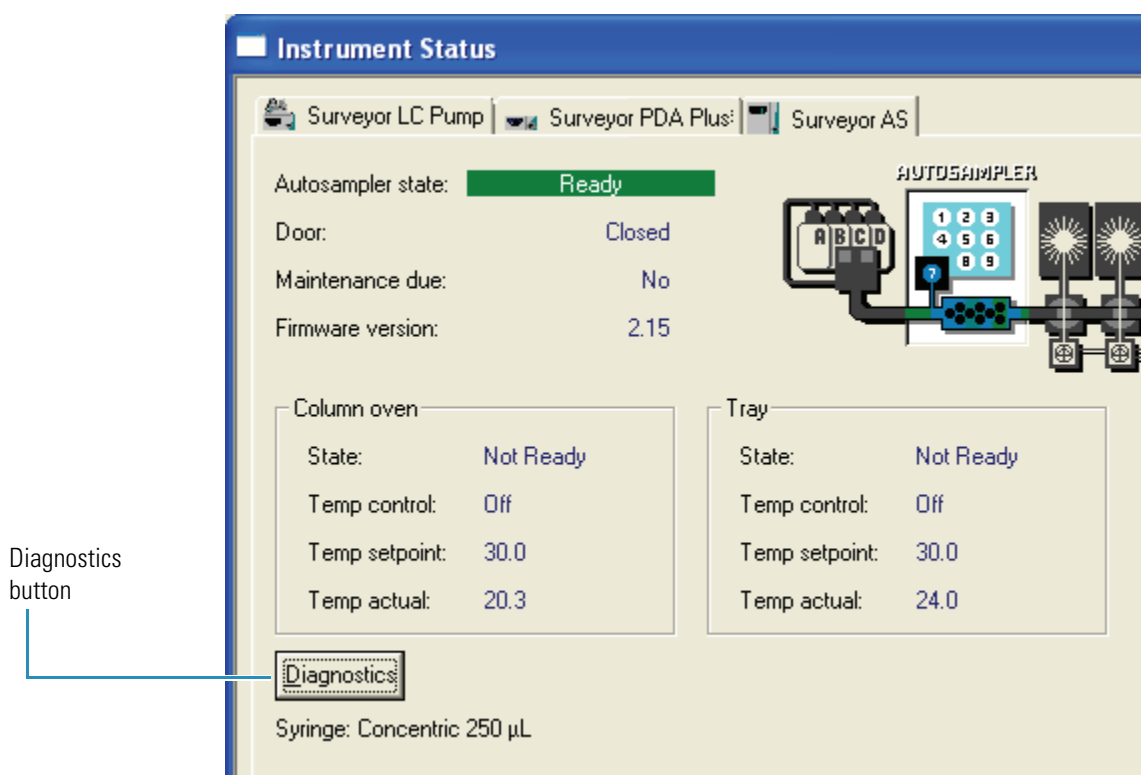


❖ To open the Maintenance page in ChromQuest and set the maintenance cycles

1. In the online Instrument window, choose **Control > Instrument Status**.
The Instrument Status window appears.
2. Click the **Surveyor AS** tab.

The Surveyor AS status page appears (see [Figure 74](#)).

Figure 74. Surveyor AS status page in ChromQuest



3. Click **Diagnostics**.

The Diagnostics dialog box appears.

4. Click the **Maintenance** tab.

The Maintenance page appears (see [Figure 73](#) on [page 95](#)).

5. Click the option that you want to set:

- To set the scheduled maintenance time for the number of user-defined injections, select the **Injections** option.
- To set the scheduled maintenance time for the number of user-defined valve cycles (from Fill to Inject), select the **Valve Cycles** option.
- To set the scheduled maintenance time for the number of user-defined syringe cycles in which the syringe is put in the Ready position, select the **Syringe Cycles** option.
- To set the scheduled maintenance time for the number of user-defined needle cycles in which the needle is inserted into a septum, injection port, or wash station, select the **Needle Cycles** option.

6. To change the usage limit, type the new value in the Usage Limit box, and then click **Submit**.

Diagnostics

The Surveyor Autosampler Plus diagnostics are used to test the major electronic circuits within the instrument and to indicate whether the circuits pass or fail the tests. If there is a problem with the instrument electronics, the diagnostics can often locate the problem. However, to distinguish a hardware failure from an electronic failure, you must have someone who is familiar with system operation and basic hardware theory run the diagnostics.

Many of the Surveyor Autosampler Plus components can be tested by using the diagnostics. The Thermo Fisher Scientific service philosophy is to troubleshoot the problem to the lowest part, assembly, PCB, or module listed in [Chapter 7, “Consumables and Service Parts.”](#) You or a Thermo Fisher Scientific field service engineer should replace the autosampler components when the autosampler diagnostics indicate the need.

Contents

- [Power Up Diagnostics](#)
- [Error Log in Xcalibur](#)
- [Error Log in ChromQuest](#)
- [Autosampler Validation](#)

Power Up Diagnostics

Surveyor Autosampler Plus power up diagnostics run automatically when you turn on the autosampler. No other connections are needed. They take about 2 minutes to run. (Most of the time required for the power up diagnostics is occupied testing the RAM.)

If there is a memory error of a fatal type, the right three lights of the Status LEDs turn amber. If this happens, contact Thermo Fisher Scientific Technical Support. The CPU PCB probably needs to be replaced.

If diagnostics detect any other type of error, the Run Status LED illuminates amber and an error message is written to the persistent memory log. This error log can be accessed through the data system. Startup diagnostics error messages are listed in [Table 14](#).

When the test passes, a message is written to the persistent error log. No other events occur.

Table 14. Autosampler startup error messages (Sheet 1 of 2)

Error	Explanation
EC_SDIAGS_BAD_Z_FLAG	The Z-axis home flag failed.
EC_SDIAGS_BAD_S_FLAG	The S-axis home flag failed.
EC_SDIAGS_BAD_X_FLAG_INT	The X-axis interrupt failed.
EC_SDIAGS_BAD_Y_FLAG_INT	The Y-axis interrupt failed.
EC_SDIAGS_BAD_Z_FLAG_INT	The Z-axis interrupt failed.
EC_SDIAGS_BAD_S_FLAG_INT	The S-axis interrupt failed.
EC_SDIAGS_BAD_1_MOTION_TIMER	Motion Timer A failed.
EC_SDIAGS_BAD_2_MOTION_TIMER	Motion Timer B failed.
EC_SDIAGS_BAD_3_MOTION_TIMER	Motion Timer C failed.
EC_SDIAGS_BAD_4_MOTION_TIMER	Motion Timer D failed.
EC_SDIAGS_BAD_Z_BOTTOM_FLAG	The Z bottom flag failed.
EC_SDIAGS_TIMER_SETUP_ERROR	Occurs if an error status is returned by the disable interrupt call.
EC_SDIAGS_NO_INJ_CABLE	The injector motor cable is not connected.
EC_SDIAGS_BAD_INJ_POS	The inject valve did not change position.
EC_SDIAGS_BAD_SYRINGE_VALVE_INT	The syringe valve interrupt did not occur.
EC_SDIAGS_BAD_FLUSH_VALVE_INT	The flush valve interrupt did not occur.
EC_SDIAGS_BAD_CAPACITOR	The capacitor did not charge to the acceptable level.
EC_SDIAGS_X_MOTOR_NOT_PRESENT	The X motor was not detected.
EC_SDIAGS_Y_MOTOR_NOT_PRESENT	The Y motor was not detected.
EC_SDIAGS_Z_MOTOR_NOT_PRESENT	The Z motor was not detected.
EC_SDIAGS_S_MOTOR_NOT_PRESENT	The S motor was not detected.
EC_SDIAGS_XZ_CONNECTOR_NOT_CONNECTED	The cable that connects the X and Z motors is not connected.
EC_SDIAGS_BAD_REG_VALUE	One of the memory registers is not set correctly.

Table 14. Autosampler startup error messages (Sheet 2 of 2)

Error	Explanation
EC_SDIAGS_MOTOR_ERROR	The motor diagnostic bits did not change to the correct state.
EC_SDIAGS_ISR_TIMEOUT	The interrupt did not occur before the interrupt timeout did.
EC_SDIAGS_MOTOR_ERROR	The motor diagnostic bits did not change to the correct state.
EC_SDIAGS_ISR_TIMEOUT	The interrupt did not occur before the interrupt timeout did.
EC_SDIAGS_METAL_OUTOF_RANGE	The oven or tray metal readings were not within the specified low and high.
EC_SDIAGS_OVEN_AIR_OUTOF_RANGE	The oven air readings were not within the specified low and high.
EC_SDIAGS_24V_OUTOF_RANGE	The oven or tray 24 volt readings were not within the specified low and high.
EC_SDIAGS_12V_OUTOF_RANGE	The oven or tray 12 volt readings were not within the specified low and high.
EC_SDIAGS_OVEN_MIRROR_OUTOF_RANGE	The readings for the oven mirror were not within the specified low and high.
EC_SDIAGS_UNKNOWN_DEVICE	A call was made to the temperature diagnostics with an unknown device.
EC_SDIAGS_VIAL_MIRROR_OUTOF_RANGE	The readings for the tray mirror were not within the specified low and high.
EC_SDIAGS_HOME_ERROR	A move to the home flag did not set the home flag bit correctly.

Error Log in Xcalibur

The error log in the Xcalibur data system lists the diagnostic error messages. You can access the error log through the status page of the Information view, which is normally displayed on the left side of the Home Page window. If this view is not displayed, it has been turned off.

❖ To open the Information view


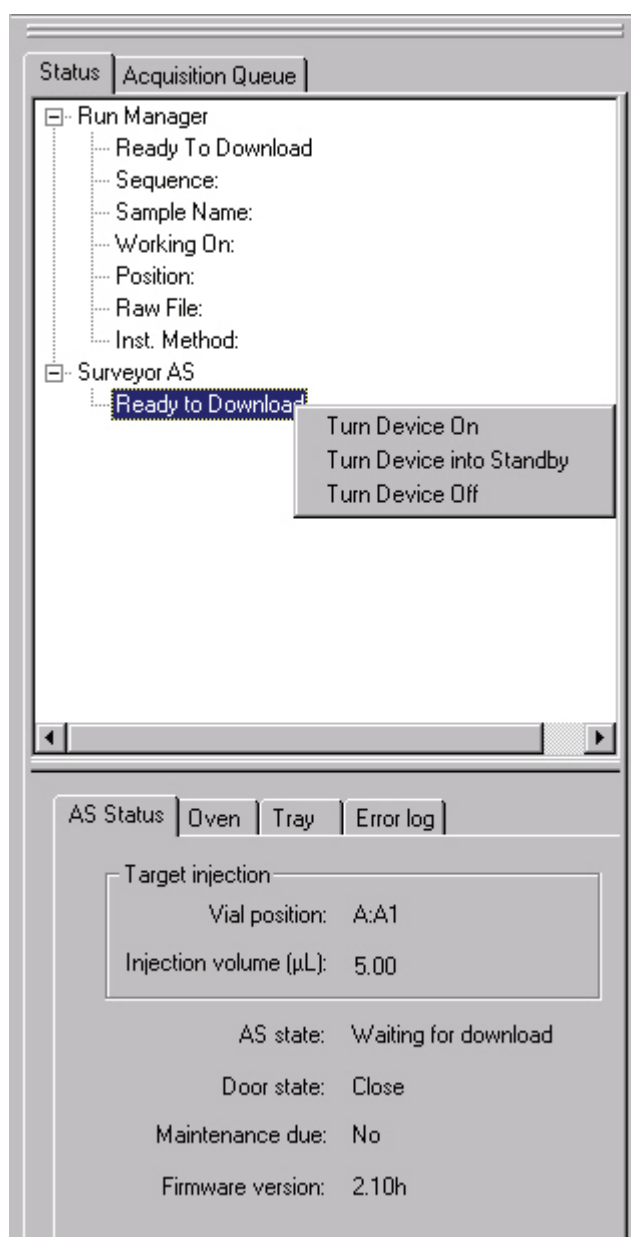
In the Home Page window, choose **View > Info View** from the menu bar or click  (Information View) on the toolbar to turn the Information view on and off (see [Figure 75](#)).

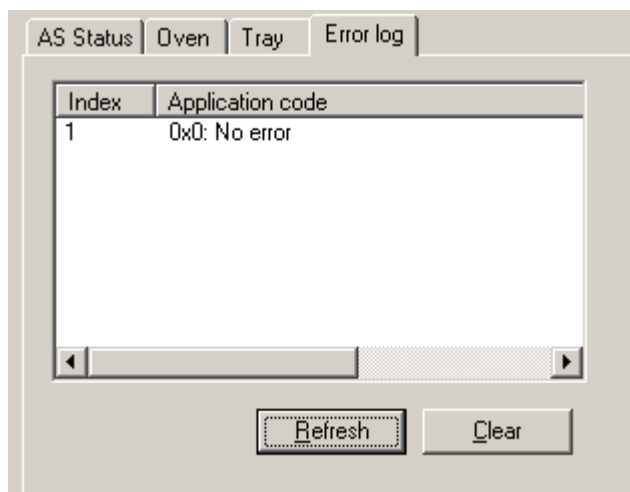
Figure 75. Information view with the Status page for the autosampler displayed



❖ **To access the error log for the Surveyor Autosampler Plus**

1. Click the **Surveyor AS directory** in the Status window to activate its status pages.
2. Click the **Error log** tab to open the Error Log page. See [Figure 76](#).
3. Click **Refresh** to display the list of errors.
4. After reviewing the error list, click **Clear** to erase the list.

Figure 76. Error log for the Surveyor Autosampler Plus



Error Log in ChromQuest

The error log in the ChromQuest data system lists the diagnostic error messages.

❖ **To open the Error Log in ChromQuest**

1. From the Instrument window, choose **Control > Instrument Status** to display the Instrument Status window.
2. Click the **Surveyor AS** tab to display the autosampler page of the Instrument window.
3. Click **Diagnostics** to display the Diagnostics dialog box.
4. Click the **Error log** tab to display the error log for the autosampler.
 - To view the error log, click **Refresh**.
 - To clear the error log, click **Clear**.

Autosampler Validation

The Xcalibur data system keeps track of validation information. Use the Validation Information dialog box to enter the date when the validation occurred and the name of the person who performed the validation.

To open the Validation Information dialog box, from the Instrument Setup window, choose **Surveyor AS > Validation**.

The Validation Information dialog box has the following pages:

- Sample Tray Low Temp
- Sample Tray High Temp
- Column Oven Low Temp
- Column Oven High Temp
- Inject Reproducibility
- Dilution Reproducibility

Use these pages to enter the calendar dates when the validation occurred and the initials of the person who performed the validation. See [Figure 77](#).

Figure 77. Validation Information dialog box

The screenshot shows the 'Validation Information' dialog box. It features a title bar with a close button. The main area contains a grid of six tabs: 'Sample Tray Low Temp', 'Sample Tray High Temp', 'Inject Reproducibility', 'Dilution Reproducibility', 'Column Oven Low Temp' (which is selected and highlighted with a dotted border), and 'Column Oven High Temp'. Below the tabs, there are two columns: 'Set values' and 'Current values'. Under 'Set values', there is a 'Time:' label with a date field containing '03/11/2005' and an 'Initial name:' label with an empty text box. Under 'Current values', there is a field containing 'Invalid'. At the bottom, there are 'Set' and 'Help' buttons.

Troubleshooting

This chapter provides information to help you troubleshoot possible autosampler problems.

When troubleshooting, consider the following:

- Did the system fail when you were running samples?
- Did problems occur after you performed maintenance on the instrument?
- Did you change the system configuration, cables, or peripherals just before the problem occurred?

If the answer is yes to the first question above, the issue might be a hardware failure.

If the answer is yes to one of the latter two question above, the issue is probably mechanical, not electrical. Verify that alignment, configurations, and cable connections are correct.

If, after reviewing the troubleshooting table included in this chapter, you would like additional assistance in troubleshooting a particular problem, contact Thermo Fisher Scientific Technical Support or your service representative.

Contents

- [General Chromatography Troubleshooting](#)
- [Autosampler-Specific Troubleshooting](#)
- [Common Operator Errors](#)
- [Determining the Transfer Tubing Volume](#)

General Chromatography Troubleshooting

Table 15 lists general chromatographic problems. It will help you define the particular instrument component or condition causing the problem. Once you know the cause, use the ordered outline to fix the problem or refer to the individual Surveyor Plus instrument's troubleshooting guide. Each of these problems can be detected by monitoring the chromatography running conditions or by observing the chromatogram. For more detailed chromatographic troubleshooting, refer to any HPLC troubleshooting reference book, or contact technical support or your service representative.

Table 15. General chromatography troubleshooting table (Sheet 1 of 2)

Symptom	Remedy
No flow	<ul style="list-style-type: none"> • Check the mobile phase connections. • Check for leaks. • Refer to the hardware manual for your pump.
High backpressure	<ul style="list-style-type: none"> • Check the flow rate and system/column specifications. • Check for tubing or column blockage. • Refer to the hardware manual for your pump.
Unstable baseline or drift	<ul style="list-style-type: none"> • System/column not equilibrated; allow more time. • Refer to detector troubleshooting guide.
Baseline noise	<ul style="list-style-type: none"> • Check for air bubbles in system, degas solvents. • Check for system/solvent contamination. • Refer to the hardware manual for your pump.
No peaks	<ul style="list-style-type: none"> • Check the detector and data system computer connections. • See “Autosampler-Specific Troubleshooting” on page 105. • Check sample retention with chromatographic conditions.
Contamination/ghost peaks	<ul style="list-style-type: none"> • Clean the system and column. • See “Autosampler-Specific Troubleshooting” on page 105. • Refer to the hardware manual for your pump.
Poor peak shape	<ul style="list-style-type: none"> • Check the system for leaks. • Check fittings and tubing lengths. • Check column performance. • See “Autosampler-Specific Troubleshooting” on page 105. • Refer to the hardware manual for your pump. • Refer to the hardware manual for your detector.

Table 15. General chromatography troubleshooting table (Sheet 2 of 2)

Symptom	Remedy
Poor retention time reproducibility	<ul style="list-style-type: none">• Check the system for leaks and bubbles.• System/column not equilibrated, allow more time.• Check column performance.• Refer to the hardware manual for your pump.• See “Autosampler-Specific Troubleshooting” on page 105.
Poor peak area reproducibility	<ul style="list-style-type: none">• Check column performance.• See “Autosampler-Specific Troubleshooting” on page 105.
Non-integrated peaks or too many peaks	<ul style="list-style-type: none">• Refer to the hardware manual for each of the modules in your LC system.• Refer to the data system manual for information on setting peak identification and integration.
No instrument or device control	<ul style="list-style-type: none">• Check the cable connections.• Check the system configuration.• Refer to the hardware manuals for each of the modules in your LC system.

Autosampler-Specific Troubleshooting

This section focuses on problems that might occur with the autosampler portion of your HPLC system. It contains the following topics:

- [Chromatography Problems](#)
- [Hardware Problems](#)

Chromatography Problems

Table 16 lists potential chromatography problems associated with the autosampler.

Table 16. Chromatography problems (Sheet 1 of 3)

Symptom	Possible problem	Remedy
1. Baseline drift when the injection valve changes from inject to fill	a. Lack of thermal stability in the column oven compartment, detector, or mobile phase	a. Eliminate drafts around the column compartment. Wait until the column oven has reached thermal equilibrium. If the problem persists, contact your Thermo Fisher Scientific service representative.
2. Shifting retention times	a. Temperature variations in the lab	a. Stabilize temperature.
	b. Column heater problems	b. Contact your Thermo Fisher Scientific service representative.
3. Sensitivity changes	a. Inconsistent sample injection volumes	a. Check for a partially blocked injection valve and observe the pressure. If the problem persists, replace the injection valve (see Chapter 4, "Maintenance.")
	b. Leaks between the injection valve and the column causing inconsistent sample volume injection	b. Tighten/remake fitting.
	c. Air bubbles aspirated into the lines along with sample	c. Replenish/prepare fresh sample and repeat the injection. Slow down syringe speed.
	d. Incomplete sample mixing during sample preparation	d. Thaw frozen samples completely before sample preparation to prevent sample "layering."
	e. Sample adsorption to the walls of the injection valve or sample loop	e. Change the mobile phase composition.
	f. Sample solvent incompatible with the mobile phase	f. Change solvent, use different mobile phase if possible.
	g. Sample insoluble in solvent	g. Be sure sample solvent is lower elution strength than mobile phase.
	h. Air in syringe/sample lines	h. Flush sample lines.

Table 16. Chromatography problems (Sheet 2 of 3)

Symptom	Possible problem	Remedy
4. Irregular peak shapes	a. The volume of sample injected exceeds the column's capacity	a. Decrease the volume injected or dilute the sample.
	b. The strength of the solvent used to dilute the sample exceeds the initial concentration of the mobile phase	b. If appropriate for your application, ensure that the flush solvent is of the same composition as the solvent used to dissolve the sample and that its organic content never exceeds the initial composition of the mobile phase.
	c. Degradation of sample component(s)	c. Prepare fresh sample and repeat the injection.
5. Band broadening	a. Fitting problem at the injector-column connection	a. Inspect for damage, mismatch, incorrect assembly.
	b. Tubing ID too large	b. Use 0.010 in. ID tubing from the injection valve to the column and from the column to the detector.
6. Smaller than expected peak heights	a. Small injection due to incorrect size syringe in configuration	a. Check the syringe size in the autosampler device driver configuration.
	b. Incorrect injection volume for the injection mode	b. Check the injection volume value in the file. For partial loop injections, limit the maximum injection volume to half the sample loop size. For no waste injections, limit the maximum injection volume to 5 μ L less than the sample loop size.
	c. Incorrect value for the transfer tubing	c. Check the dead volume value in the configuration. The dead volume for the transfer tubing is specified on its attached label. See Figure 10 on page 11 .
	d. Air in lines	d. Perform a Needle Wash direct command to remove air from the wash bottle tubing and the syringe.
	e. Incorrectly adjusted syringe drive mechanism	e. Contact your Thermo Fisher Scientific service representative.

6 Troubleshooting

Autosampler-Specific Troubleshooting

Table 16. Chromatography problems (Sheet 3 of 3)

Symptom	Possible problem	Remedy
7. Peaks during a blank injection (from a previous injection)	a. Sample carryover due to residual sample in the sample loop	a. Increase flush volume. Increase injection volume; add a blank vial between sample vials; or use a stronger flush solvent.
	b. Sample carryover due to incorrectly assembled sample loop fittings (adding dead volume that can contain residual sample)	b. Check and redo connections.
	c. Sample carryover due to a contaminated needle guide	c. Clean the needle guide.
	d. Sample too concentrated	d. Dilute sample.
8. No peaks	a. Empty wash bottle or excessive air in the wash tubing	a. Fill the wash bottle with solvent. Remove air from the wash tubing and the syringe.
	b. Plugged or bent needle	b. Clean/replace needle. Tighten fittings and syringe.
	c. Leaking flush valve fitting	c. Tighten fitting.
	d. Plugged or leaking tubing	d. Replace faulty tubing.
9. Lack of precision, an accuracy problem, or both on a sample of known content-random error	a. Air leak	a. Tighten all fittings and repeat the run.
	b. Worn out syringe	b. Replace syringe (see “Changing the Syringe or Replacing the Inner Plunger” on page 88).
	c. Worn out rotor seal	c. Replace rotor seal (see “Replacing the Rotor Seal” on page 65).
10. Irreproducibility of peak areas	a. Plugged or bent needle	a. Clean/replace needle (see “Replacing the Needle Assembly” on page 87). Tighten fittings and syringe.
	b. Leaking flush valve fitting	b. Tighten fitting.
	c. Plugged or leaking tubing	c. Replace faulty tubing.
	d. Sample viscosity too low or too high	d. Change viscosity setting.
	e. Wash solvent viscosity too low or too high	e. Change wash solvent or flush speed.

Hardware Problems

Table 17 lists the potential hardware problems associated with the autosampler.

Table 17. Hardware problems associated with the Surveyor Autosampler Plus (Sheet 1 of 4)

Symptom	Possible problem	Remedy
Startup		
1. Nothing works when instrument is turned on.	a. Power cord unplugged or faulty	a. Plug in/replace cord.
	b. Blown fuse	b. Replace fuse (see “ Replacing a Fuse ” on page 93).
	c. Defective power switch, driver, transformer	c. Contact your Thermo Fisher Scientific service representative.
Communications		
2. No Ethernet communication	a. Incorrect computer NIC settings	a. Check address. Use only TCP/IP protocol.
	b. Ethernet hardware problem	b. Check Ethernet switch and Ethernet cables.
3. External devices are not triggered.	a. Incorrect timed event settings in the acquisition method	a. Check timed event settings in the acquisition method.
	b. Interface equipment problem	b. See “ Connecting the System Interconnect Cable ” on page 38 or refer to the <i>Surveyor Plus Getting Connected Guide</i> for information on contact closure connections.
Vials		
4. Instrument cannot locate vial.	a. Incorrect vial position entered into sample sequence	a. Check sample sequence.
	b. Sample incorrectly placed in sample tray	b. Check tray arrangement.
	c. XYZ arm misaligned	c. Recalibrate XYZ arm. See data system Help topic, “Calibrating the XYZ Arm Position”, or the <i>Surveyor Plus Getting Started with Xcalibur Guide</i> .
	d. XYZ arm movement restricted	d. Remove restriction and home arm. See “ Important Precautions ” on page 58 .
	e. Loose left-hand guide bracket	e. Ensure that bracket is tightly attached and level.

6 Troubleshooting

Autosampler-Specific Troubleshooting

Table 17. Hardware problems associated with the Surveyor Autosampler Plus (Sheet 2 of 4)

Symptom	Possible problem	Remedy
5. Vials do not fit in tray.	a. Incorrect vials	a. Vial diameter should be 11 mm to 12 mm (0.44 to 0.4 in.).
6. Torn septum	a. Bent needle	a. Replace needle (see “ Replacing the Needle Tubing Assembly ” on page 82).
7. Septum pushed into vial	a. Incorrect vial caps	a. Use only recommended vials and vial caps. See “ Recommended Vials, Microplates, and Microplate Covers ” on page 59.
	b. Loose vial caps	b. Ensure that the vial caps are fully tightened.
Injection valve		
8. Injector valve will not switch.	a. Slipping injector drive	a. Contact your Thermo Fisher Scientific service representative.
9. Injection valve continues to rotate until fault is generated.	a. Loose or faulty sensor cable	a. Contact your Thermo Fisher Scientific service representative.
10. Injection valve does not rotate to the proper position.	a. Valve requires excessive torque.	a. Contact your Thermo Fisher Scientific service representative.
11. Motor fails to stop after syringe is fully returned.	a. Possible defective sensor	a. Contact your Thermo Fisher Scientific service representative.
12. Sample loop will not fill.	a. Blocked injection valve	a. Follow “ Troubleshooting Blockage in the Injection System ” on page 76 to isolate blockage. DO NOT clean valve with a cleaning wire or you could damage the valve.
13. Valve seal wears rapidly.	a. Too much valve seal pressure against valve	a. Decrease LC system pressure.
	b. Particulate matter in valve	b. Use an inline filter before the injection valve.
	c. Inadequately filtered sample	c. Filter with a 0.5 m filter before injection.
	d. Buffer crystallization	d. Do not allow buffers to stand in system. Run a flush sequence when the system is not in use.

Table 17. Hardware problems associated with the Surveyor Autosampler Plus (Sheet 3 of 4)

Symptom	Possible problem	Remedy
Needle		
14. Needle bent or broken	a. Incorrect vials	a. See the list of recommended replacement parts in Chapter 7, “Consumables and Service Parts.”
	b. Alignment problem	b. Contact your Thermo Fisher Scientific service representative.
	c. Arm sticking	c. Contact your Thermo Fisher Scientific service representative.
15. Needle plugging	a. Multiple/incorrect septum	a. Verify a single septum of the type recommended (see “Recommended Vials, Microplates, and Microplate Covers” on page 59).
	b. Worn needle	b. Replace needle (see “Replacing the Needle Assembly” on page 87).
Needle Tubing		
16. Blockage in the needle tubing	a. Crimped needle tubing	a. Replace needle tubing (see “Replacing the Needle Tubing Assembly” on page 82).
Syringe		
17. Loud buzzing from syringe drive	a. Plugged lines or needle	a. Clear lines or needle (see “Troubleshooting Blockage in the Injection System” on page 76).
	b. Defective limit switch	b. Contact your Thermo Fisher Scientific service representative.
Transfer tube		
18. Lack of injection precision and accuracy, lack of precision or blank injections	a. Constricted or plugged transfer tube	a. Replace the damaged transfer tube. Avoid overtightening the fitting to port 2 of the injection valve (see “Replacing the Transfer Tubing” on page 71).

6 Troubleshooting

Autosampler-Specific Troubleshooting

Table 17. Hardware problems associated with the Surveyor Autosampler Plus (Sheet 4 of 4)

Symptom	Possible problem	Remedy
Leaks		
19. Leakage during loop filling	a. Blocked loop or waste line, or valve not deflected far enough	a. Flush sample loop or replace; check and flush waste line.
20. Cross-port leakage	a. Worn rotor seal	a. Replace rotor seal (see “Replacing the Rotor Seal” on page 65).
21. Liquid on vial caps	a. Leaky syringe valve	a. Replace syringe valve.
	b. Leaky injection valve	b. Replace rotor seal (see “Replacing the Rotor Seal” on page 65).
Other		
22. Contaminated sample	a. Dirty vials	a. Replace vials.
	b. Improper septum made of silicone or other rubber-like material	b. Use recommended septum (see “Recommended Vials, Microplates, and Microplate Covers” on page 59).
23. Elevated system pressures	a. Block between column and autosampler	a. Check for blockage and tubing restrictions.

Common Operator Errors

Operator errors can compromise the performance of the Surveyor Autosampler Plus.

The most common operator errors are the following:

- Letting the wash bottle to run dry
- Routing the needle tubing incorrectly
- Selecting an incorrect syringe type when you specify the configuration options for the autosampler
- Requesting an inappropriate injection volume for the sample loop size and the injection mode
- Entering an incorrect dead volume for the transfer tubing
- Overtightening the transfer tube fitting to port 2 or the wash tube fitting to port 3 of the autosampler injection valve

Insufficient Wash Solvent

Allowing the wash bottle to run dry disrupts the ability of the syringe to draw liquid into the needle tubing, which consequently results in blank injections. Fill the wash bottle with solvent, and remove air from the wash line tubing before running a sequence of injections.

Damaged Needle Tubing

Because the needle tubing is easily damaged, routing the needle tubing correctly is critical to the performance of the autosampler. Take care to avoid kinking the tubing as you route it through the bracket on the XYZ arm.

Incorrect Syringe Type

Because the autosampler cannot detect the syringe type connected to the syringe drive assembly, confirm that the syringe type in the Surveyor AS Configuration dialog box matches the autosampler syringe.

The injection volume algorithm used by the autosampler depends on the syringe type that you select when you configure the data system. The distance that the inner syringe plunger must descend to draw the specified injection volume increases as the syringe size decreases. For example, to draw 10 μL of sample, the inner plunger of a 100 μL syringe must descend farther than the inner plunger of a 250 μL syringe. If you replace the 250 μL syringe with a 100 μL syringe, but neglect to modify the data system configuration, the autosampler injects a smaller than expected volume injection volume because the syringe plunger does not descend far enough to draw the requested injection volume.

Inappropriate Injection Volume

For best results, follow these rules:

- For no waste injections, limit the maximum injection volume to 5 μL less than the sample loop volume. Limit the minimum injection volume to 1 μL of sample.
- For partial loop injections, limit the maximum injection volume to half the sample loop volume.
- For full loop injections, request an injection volume that is the same size as your sample loop.

Incorrect Dead Volume

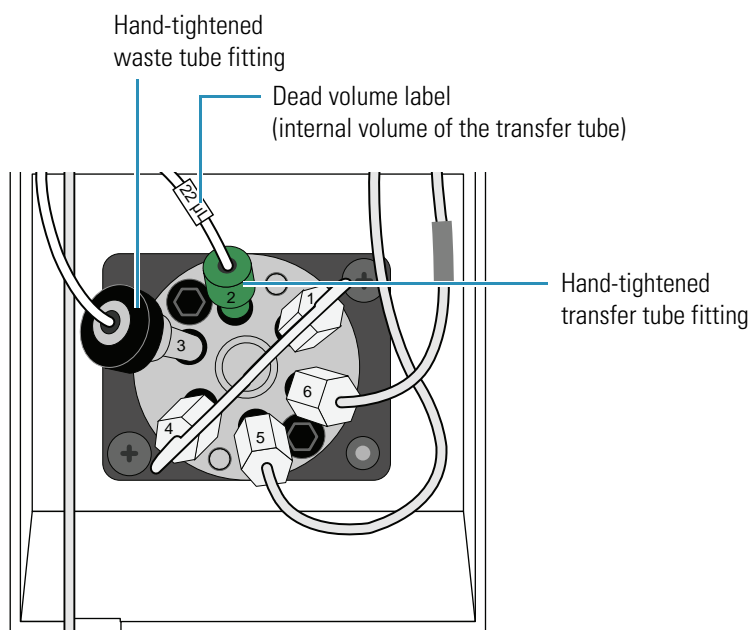
The dead volume of the 0.012 in. ID transfer tubing is specified on its attached label. Entering an incorrect dead volume when you specify the configuration options for the autosampler can result in lower than expected peak areas or blank injections.

Overtightened Transfer Tube or Wash Tube Fittings

Avoid overtightening the low-pressure fittings to the injection valve:

- Overtightening the transfer tube fitting constricts the transfer tube, causing a lack of injection precision. Eventually, the constricted transfer tube becomes plugged.
- Overtightening the waste tube fitting constricts the waste tube, increasing the backpressure in the injection system.

Figure 78. Transfer tubing connection to port 2 of the injection valve



Determining the Transfer Tubing Volume

The Dead volume configuration parameter is critical for the no waste injection mode. Specifying an incorrect dead volume value can result in lower than expected peak areas or blank injections. For best results, the specified dead volume must equal the actual volume of the transfer tubing that connects the autosampler injection port to port 2 of the injection valve.

❖ To determine the volume of the transfer tubing

1. From the Xcalibur or ChromQuest data system, set up an acquisition method for an analyte that you know the chromatographic conditions for.

Use chromatographic conditions that result in a relatively short retention time for the analyte (to minimize the run time). In the method, select the **No waste injection** option.

You can also use the autosampler test mix (0.5 percent toluene in methanol) that comes with the autosampler. With the chromatographic conditions listed in [Table 18](#), toluene elutes at approximately two minutes.

Table 18.Chromatographic conditions for toluene

Parameter	Setting
Mobile phase	80:20 methanol\water
Flow rate	1 mL/min
Column	100 × 4.6 mm, C-18 column, 5 micron particle size, or equivalent
Temperature	Ambient
Wavelength	260 nm, 1 nm bandwidth for the PDA detector

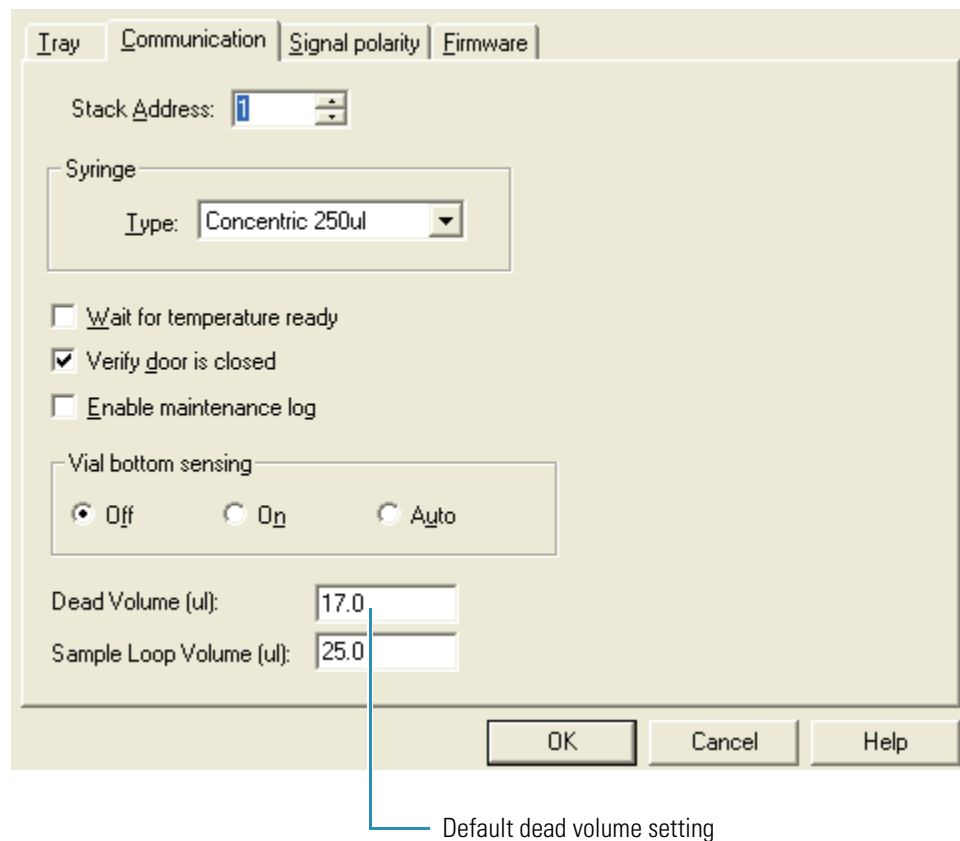
2. Change the value for the Dead Volume autosampler configuration parameter. Start with a value of 15.

[Figure 79](#) shows the Communication page of the Surveyor AS Configuration dialog box in Xcalibur. The default dead volume value is 17.0. Each transfer tube is labeled with the dead volume determined by the manufacturer (see [Figure 78](#) on [page 114](#)).

6 Troubleshooting

Determining the Transfer Tubing Volume

Figure 79. Communication page (in Xcalibur)



3. From the Xcalibur or ChromQuest data systems, inject 1 μL of sample using the no waste injection mode.
4. Repeat [step 2](#) and [step 3](#), increasing the dead volume by 1 μL each time until you have data points from 15 to 23 μL .
5. Plot the peak area versus dead volume. You should see an increase in peak area until it reaches a plateau. Due to injection variability, the plateau might not be flat. Select the dead volume where the maximum is first reached.

Consumables and Service Parts

This chapter provides a comprehensive listing of Surveyor Autosampler Plus parts that you can order and replace: consumables and service parts.

A consumable item is an item that is expected to wear with use or that comes in contact with system fluids or samples and therefore must be replaced periodically.

A service part is a subassembly of the autosampler that is normally replaced by Thermo Fisher Scientific service representatives or other qualified personnel.

This chapter also includes an itemized list of the parts in the Surveyor Autosampler Plus Accessory Kit. This list will help you identify each part in the kit and help you associate each part with its use in the autosampler.

Contents

- [Consumables](#)
- [Service Parts](#)
- [Autosampler Accessory Kit](#)

Consumables

The following is a list of parts that you might need for routine maintenance and operation of the autosampler:

Accessory Kit, Surveyor Autosampler Plus	60053-62041
Assembly, needle	60053-60013
Assembly, needle tubing	60053-60102
Assembly, wash bottle kit.	60053-60041
Assembly, syringe valve	A3692-010
Assembly, transfer tube, 0.012-in. ID	60053-60014
Cooling adapter, 96 well	60053-20002
Filter, flush solvent	A4258-010
Grease, silicon/Teflon (for lead screw)	00301-01910
Kit, Surveyor AS Plus Maintenance.	60053-62044
Kit, Needle Tubing	60053-62043
Kit, Wash Bottle	60053-62009
Lubricant, Triflow	1611-0030
Port, needle	60053-20031
Syringe, dual-concentric, 100 μ L	F1100-010
Syringe, dual-concentric, 250 μ L	F1100-020
Syringe, dual-concentric, 500 μ L	F1100-030
Plunger, replacement, concentric, 100 μ L	F1123-010
Plunger, replacement, concentric, 250 μ L	F1123-020
Plunger, replacement, concentric, 500 μ L	F1123-030
Reservoir vials, 16 mL.	00301-07527
Retainer, needle port (injection port).	60053-10035
Syringe, standard, 2500 μ L (with needle tubing extension)	60053-62002
Syringe, 2.5 mL.	60053-60006
Sample loop, 5 μ L.	00109-99-00007
Sample loop, 10 μ L.	00109-99-00008
Sample loop, 20 μ L.	00109-99-00009
Sample loop, 25 μ L.	00109-99-00010
Sample loop, 50 μ L.	00109-99-00011
Sample loop, 100 μ L.	00109-99-00012
Sample loop, 500 μ L.	00109-99-00013
Sample loop, 1000 μ L.	00109-99-00014
Stripper	F1034-010
Valve, injector	60053-30002
Vial caps, 100 μ L	60053-40009
Seal, rotor, PPS	00109-03-00007
Tubing assembly, 2.5 mL syringe.	60053-60005
Vial Kit, 1.8 mL w/250 μ L insert, 100 per pack	60053-62017
Vial Kit, screw top, 2 mL, 100 count, includes caps and septa (2 each)	A4954-010

Service Parts

The following is a list of service parts. These service parts are normally replaced only by Thermo Fisher Scientific service representatives or by other qualified personnel.

Assembly, arm	F1075-010
Assembly, cooler	F1076-010
Assembly, cooler fan	F1110-010
Assembly, left door	60053-60051
Assembly, right door	60053-60064
Assembly, injector drive.	A3574-020S
Assembly, oven	F1077-010
Assembly, oven fan	F1086-010
Assembly, Oven Sensor	F9050-010
Assembly, tray sensor.	F9090-010
Base, Z-axis pod	F1033-010
Cable, injector sensor	A3513-010
Cable, door LED.	F5025-010
Cable, temperature control	F1002-010
Cable, assembly, DC oven motor	F1017-010
Cable, assembly temperature control.	F1002-010
Cable, A/C input power	F1079-010
Cable, A/C to options PS	F1080-010
Cable, backplane power.	F1082-010
Cable, oven DC power	F1083-010
Cable, cooler DC power	F1083-020
Cable, injector power	F1116-010
Drive, injector	A3574-020S
Drive, syringe	A3560-050
Enclosure	F1007-010
Gasket, oven door	F1064-010
Kit, Autosampler Calibration	60053-62001
Kit, adjustable arm lifting stop bracket	60053-62028
PCB, Arm Motor	F9045-010
PCB, CPU Spare.	60053-60049
PCB, Interconnect	F9040-010
PCB, LED	F9030-010
PCB, Temperature Control	F9020-010
Power supply, main	4004-0062
Power supply, option.	4004-0663
Switch, door	A3520-020
Wash station	F1052-010

Autosampler Accessory Kit

The following list contains items in the Surveyor Autosampler Plus accessory kit, (P/N 60053-62041). The accessory kit includes consumables (such as vials, fittings, and test mixtures) as well as the durable accessories (such as Microplates, tray adapters, tools, and a power cord).

Bottle, 16 mL, includes cap, for sample prep (4 each)	00301-07527
Zinc clamp	00007-07612
Carrier, microplate	60053-20004
Handle, microwell carrier	60053-20003
Clip, microwell handle	F1072-010
Clamp, small OD column (2 each)	F1112-010
Connector, plug, 8-pin, 3.8 mm pitch, Minicombicon (2 each).	00004-02511
Fuse, 5 A, 5 × 20 mm, time lag (4 each)	5101-1856
Patch cord, shielded, RJ-45, cat-5, yellow, 7-ft <i>l</i>	7011-63302
Procedure, Microplate Carrier Assembly Instructions	60053-97024
Riser, cooler plate	60053-20001
Screw, 4-40 × 1/4, SEMS stainless steel	2851-1044
Screw, pan head, 4-40 × 1/4, stainless steel, for tray adapters (5 each)	7111-0404
Screw, pan head, 8-32 × 0.312, INT SEM stainless steel (2 each)	2814-1174
Test mixture, pkg., 1 mL, 5 count, for performance qualification	A4991-010
Test mixture, pkg., 1 mL, 5 count, dilution, for performance qualification	A5135-010
Tray adapter for 100 L vial (5 each).	F1124-010
Tray adapter plate for microcentrifuge tubes (5 each)	F1008-020
Tubing, convoluted, for autosampler solvent waste	F5034-050
Tubing, stainless steel, 0.010-in. ID × 1/16-in. OD, 4-in. <i>l</i> , injection valve – column	A0941-060
Tubing, stainless steel, 0.010-in. ID × 1/16-in. OD, 12-in. <i>l</i> , column – detector.	A0941-010
Wrench, combination, 1/4 × 5/16.	5401-0400
Vial Kit, screw top, 2 mL, 100 count, includes caps and septa (2 each)	A4954-010

Firmware Updates

Periodically, upgrades to the autosampler firmware might become available. In anticipation of future upgrades, both the Xcalibur and ChromQuest data systems come with the Surveyor Firmware Upgrade utility, which allows you to download firmware files to your Surveyor Plus instrument modules. Firmware upgrade files have a .bin extension.

As they become available, you can find the update files for the Surveyor Autosampler Plus and the Surveyor PDA Plus Detector on the Thermo Scientific Product Support Web site.

For Xcalibur, the current firmware files and the Surveyor Firmware Upgrade utility are automatically installed to your personal computer during the installation of the data system. These files are in the following folder:

Drive:\Xcalibur\system\Surveyor Firmware

For ChromQuest, you can access the utility by choosing **Start > All Programs > Chromatography > Surveyor Firmware Upgrade Utility**.

Contents

- [Copying the Firmware Files from the ChromQuest CD](#)
- [Preparing the Autosampler for a Firmware Download](#)
- [Downloading Firmware to the Autosampler](#)

Copying the Firmware Files from the ChromQuest CD

You can find the firmware files for the Surveyor system on the ChromQuest CD. These files are not automatically loaded to your computer when you install ChromQuest.

❖ To install these files

1. Insert the ChromQuest CD into your CD-ROM drive.
2. From the Windows desktop, double-click My Computer.
3. Right-click the **CQ** icon.
4. From the shortcut menu, choose **Explore** to access the contents of the CD.
5. Copy the contents of the Firmware folder to your ChromQuest directory.

Preparing the Autosampler for a Firmware Download

❖ To prepare the autosampler for a firmware download

1. Make sure you have the firmware files that you intend to download and the Surveyor Firmware Upgrade Utility on your computer.

For Xcalibur, these files reside in the following folder:

drive:\Xcalibur\system\Surveyor Firmware.

2. Make a note of the current settings of the rotary switches on the back panel of the autosampler.

At the conclusion of this procedure, you return the switches to these settings.

3. Make sure that your autosampler is connected to the computer by way of the standard Ethernet connection.
4. Turn off the power to the autosampler.
5. Use a small, flat-head screwdriver to set the rotary switches on the back panel of the autosampler to 00.
6. Turn the autosampler power on.

The Communication LED blinks amber to confirm that the autosampler is configured for downloading the firmware.

Downloading Firmware to the Autosampler

❖ To download firmware to the autosampler

1. Start the Surveyor Firmware Upgrade Utility by doing one of the following:

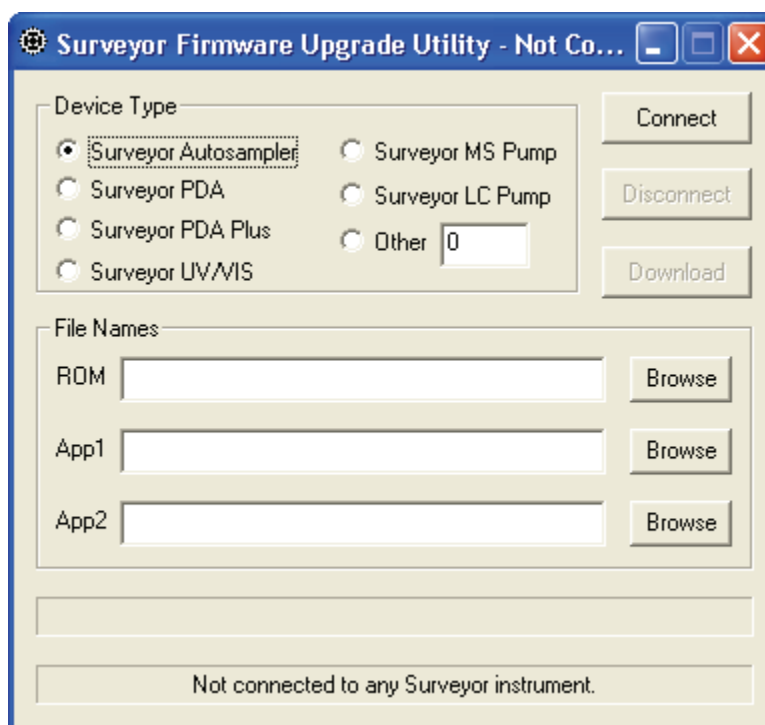
- For Xcalibur, browse to the following directory, and then double-click **Surveyor Firmware Upgrade Utility.exe file**.

drive:\Xcalibur\system\Surveyor Firmware

- For ChromQuest, from the computer desktop, choose **Start > All Programs > Chromatography > Surveyor Firmware Upgrade Utility**.

The Surveyor Firmware Upgrade Utility window opens (see [Figure 80](#)).

Figure 80. Surveyor Firmware Upgrade Utility window, showing the Surveyor Autosampler device selected



CAUTION Do **not** interrupt the firmware download process. After you click **Connect**, do not turn off the power to the Surveyor Autosampler Plus or close the Surveyor Firmware Upgrade Utility window until the download process is finished. If you terminate the connection during the download process or lose power to the autosampler, contact your local Thermo Fisher Scientific representative. The firmware board will need to be reprogrammed.

2. In the Surveyor Firmware Upgrade Utility window, initiate communication between the utility and the Surveyor Autosampler Plus:
 - a. Under Device Type, select the **Surveyor Autosampler** option (see [Figure 80](#)).
 - b. Click **Connect**.
 The status display at the bottom of the Surveyor Firmware Upgrade Utility window indicates that a connection has been made.
3. Under File Names, select the appropriate firmware files for the Surveyor Autosampler Plus:
 - a. For ROM, click **Browse** to browse to and select the ROM file (“ROM*.bin”).
 The file name appears in the ROM box.
 - b. For App1, click **Browse** to browse to and select the APP1 file (“AS*.bin”).
 The file name appears in the App1 box.

A Firmware Updates

Downloading Firmware to the Autosampler

- c. For App2, click **Browse** to browse to and select the APP2 file (“AS*.bin”).
The file name appears in the App2 box.

IMPORTANT You must select a *ROM* file, an *APP1*, and an *APP2* file. Your Surveyor AS will not work properly if these files are not downloaded together.

4. After you select the appropriate firmware files, click **Download** and wait for the download to finish.

The utility notifies you when the download is complete.

Note Once the Download Completed Successfully message appears, you can safely turn off the power to the autosampler and close the Surveyor Firmware Upgrade Utility.

5. To return the autosampler to normal operation after you finish upgrading the firmware:
 - a. Close the Surveyor Firmware Upgrade Utility to terminate the connection with the Surveyor Autosampler Plus.
 - b. Turn off the power to the Surveyor Autosampler Plus.

IMPORTANT Make sure to turn the Surveyor Autosampler Plus power off before adjusting the rotary switches.

- c. Set the rotary switches back to their original settings.

IMPORTANT The Surveyor Autosampler Plus will not connect to the Xcalibur data system when the rotary switch address is set to 00.

- d. Turn on the Surveyor Autosampler Plus power to resume normal operation.

Quick Reference Guides

This appendix contains the following two-page quick reference guides:

- [Using the Xcalibur Direct Control Commands](#)
- [Using the ChromQuest Direct Commands](#)

Using the Xcalibur Direct Control Commands

Direct Control Commands

The On/Off switch is the only manual control provided with the autosampler. To perform tasks, such as moving the XYZ arm to the back of the tray compartment, use the direct control commands in Xcalibur or the tune application for your Thermo Scientific mass spectrometer.

Command	Description
Position arm to access tray	Moves the XYZ arm to the back of the tray compartment, so that you can remove trays from or place trays into the tray compartment. Note. If the tray compartment door is open and you selected the Verify Door Is Closed check box when you configured the autosampler, the autosampler does not execute this command until you close the tray compartment door.
Flush syringe	Flushes the needle tubing and the interior of the needle with flush solvent.
Flush syringe at Fill position	Flushes the needle tubing, the interior of the needle, and the sample loop with flush solvent.
Wash needle	Washes the exterior of the needle with solvent.
Needle removal	Sets the needle to the needle removal position. CAUTION. To avoid damaging the needle, execute this command before you remove the needle.
Set oven temperature	Sets the temperature of the column oven compartment without downloading an instrument method. The allowable temperature range is 5 to 95 °C. Important. Avoid setting the temperature above the boiling point of the mobile phase.
Set tray temperature	Sets the temperature of the tray compartment without downloading an instrument method. The allowable temperature range is 0 to 60 °C.
Turn off oven temperature	Turns off the oven temperature control, allowing the temperature of the column oven compartment to return to ambient.
Turn off tray temperature	Turns off the tray temperature control, allowing the temperature of the tray compartment to return to ambient.
Inject sample	Injects a sample. The available parameters are Vial, Volume, and Injection Mode. The allowable vial or well entries depend on the tray configuration: <ul style="list-style-type: none">• For conventional trays, the allowable entries are A:01 to E:40.• For 96-well plates, the allowable entries are A:A1 to C:H12.• For 384-well plates, the allowable entries are A:A1 to C:P24.
Move needle	Moves the XYZ arm to a specific vial or well location.
Set injector position	Switches the position of the injection valve. The injection valve has two positions: fill and inject.
Set syringe to removal position	Sets the syringe to its removal position.
Set syringe to home position	Sets the syringe to its home position.
Set Arm to Home Position	Moves the XYZ arm to its home position, which is just above the injection port.

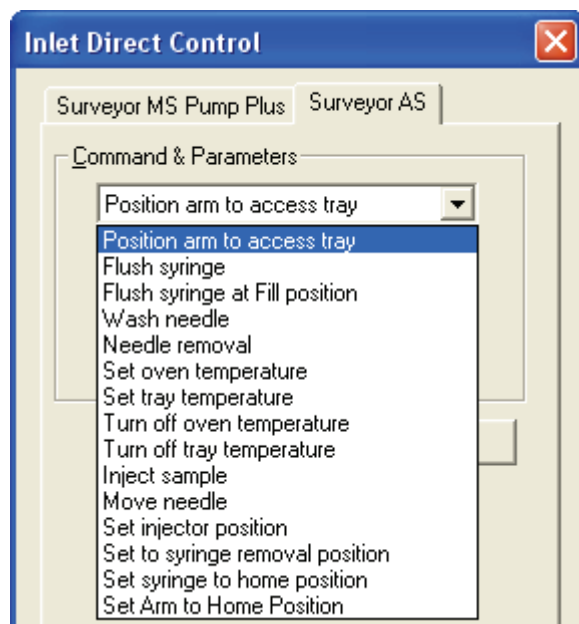
Applying a Direct Command

You can access the direct control commands from Xcalibur or the tune application for your mass spectrometer.

❖ To open the Inlet Direct Control dialog box from the tune application

1. In the Tune window, choose **Setup > Inlet Direct Control**. The Inlet Direct Control dialog box appears with tabbed pages for each configured LC device.
2. Click the **Surveyor AS** tab.

The Surveyor AS page appears.



❖ To open the Direct Control dialog box from the Xcalibur Roadmap view

1. Click the **Instrument Setup** icon.

The Instrument Setup window appears. The view bar on the left side of the window displays the configured instruments.

2. In the view bar, click the **Surveyor AS** button. The Instrument Setup window for the autosampler appears.
3. From the menu bar, choose **Surveyor AS > Direct Control**. The Direct Control dialog box appears.



❖ To apply a direct command

1. In the Commands list, select a command.

If the command requires additional parameters, these parameters appear below the Commands list. Make the appropriate entries and selections.

2. To execute the command, click **Apply**.

Using the ChromQuest Direct Commands

Direct Commands

The On/Off switch is the only manual control provided with the Surveyor Autosampler Plus. To perform tasks, such as moving the XYZ arm to the back of the tray compartment, use the direct commands in ChromQuest.

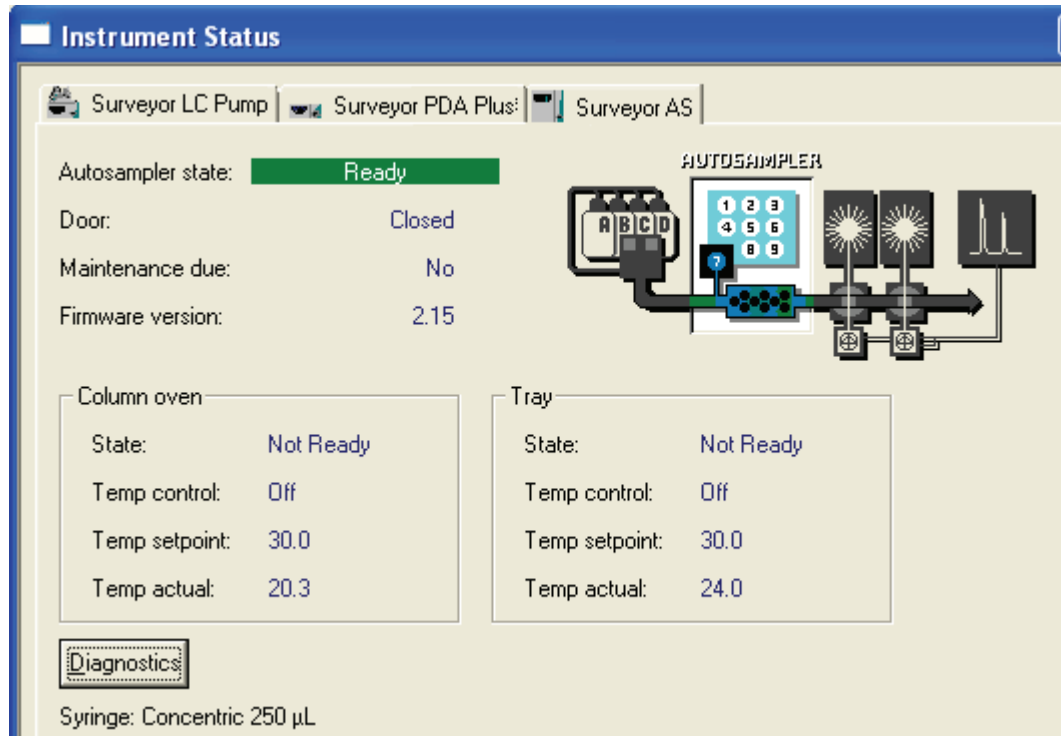
Command	Description
Position arm to access tray	Moves the XYZ arm to the back of the tray compartment, so that you can remove trays from or place trays into the tray compartment. Note. If the tray compartment door is open and you selected the Verify Door Is Closed check box when you configured the autosampler, the autosampler does not execute this command until you close the tray compartment door.
Flush Syringe	Flushes the needle tubing and the interior of the needle with flush solvent.
Flush With Injection In Fill Position	Flushes the needle tubing, the interior of the needle, and the sample loop with flush solvent.
Set Oven Temperature	Sets the temperature of the column oven compartment without downloading an instrument method. The allowable temperature range is 5 to 95 °C. Important. Avoid setting the temperature above the boiling point of the mobile phase.
Set Tray Temperature	Sets the temperature of the tray compartment without downloading an instrument method. The allowable temperature range is 0 to 60 °C.
Turn Off Column Oven	Turns off the oven temperature control, allowing the temperature of the column oven compartment to return to ambient.
Turn Off Tray Temperature	Turns off the tray temperature control, allowing the temperature of the tray compartment to return to ambient.
Temperature Control Upload	Determines if the autosampler has the optional temperature control feature.
Wash Needle	Washes the exterior of the needle with solvent.
Move Needle	Moves the XYZ arm to a specific vial or well location.
Set Injector Position	Switches the position of the injection valve. The injection valve has two positions: fill and inject.
Initialize Hardware	Performs the following sequence of operations: <ol style="list-style-type: none"> 1. Switches the two-way syringe valve to the flush bottle position 2. Homes the syringe 3. Sets the syringe plunger back to the ready position 4. Switches the two-way syringe valve back to the needle position 5. Homes the syringe After the autosampler initializes, it goes into the Waiting for Download state.
Position Arm to Replace Needle	Sets the needle to the needle removal position. CAUTION. To avoid damaging the needle, execute this command before you remove the needle.
Position Syringe to Home	Sets the syringe to its home position.
Position Syringe for Removal	Sets the syringe to its removal position.
Go to Home	Moves the XYZ arm to its home position, which is just above the injection port.

Submitting a Direct Command

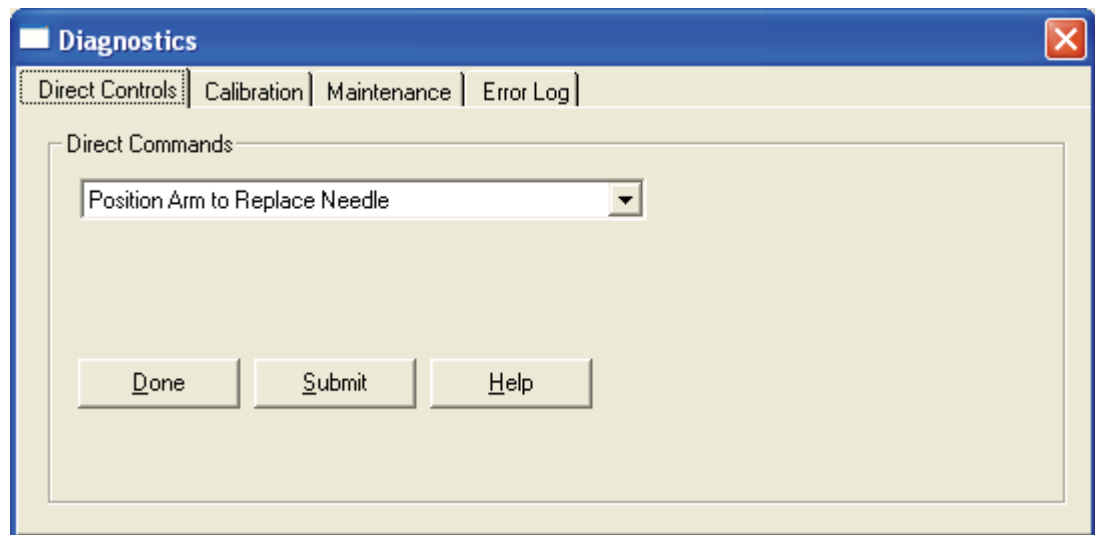
You can access the direct control commands from the Instrument Status window.

❖ To submit a direct command

1. In the online Instrument window, choose **Control > Instrument Status**. The Instrument Status window appears.
2. Click the **Surveyor AS** tab. The status page for the autosampler appears.



3. Click **Diagnostics**. The Diagnostics dialog box appears with the Direct Controls page displayed.



4. In the Direct Commands list, select a command. If the command requires additional parameters, these parameters appear below the Commands list. Make the appropriate entries and selections.
5. To execute the command, click **Submit**.

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