

Accela Pump

Hardware Manual

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DOCUMENTATION
SURVEY

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Software versions: Xcalibur 2.0 or higher, ChromQuest 4.2 with SP 2 or higher, ChromQuest SI version 5.0

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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.

Accela Pump

EMC Directive 89/336/EEC, 92/31/EEC, 93/68/EEC

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

EN 61326	1997; A1, 1998; A2, 2001; A3, 2003	EN 61000-4-4	1995; A1, 2000; A2, 2001
EN 61000-3-2	2000	EN 61000-4-5	2001
EN 61000-3-3	1995; A1, 2001	EN 61000-4-6	2003
EN 61000-4-2	2001	EN 61000-4-8	2001
EN 61000-4-3	2002	EN 61000-4-11	2001

FCC Class A, CFR 47 Part 15 Subpart B: 2005

Low Voltage Safety Compliance

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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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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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, carcinógenos, mutágenos 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'une procédure 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 *Accela Pump Hardware Manual* provides you with information on how to install, maintain, and troubleshoot the Accela Pump. You operate the Accela Pump from a computer running Xcalibur™ (version 2.0 or higher) or ChromQuest (version 4.2 or higher).

Related Documentation

In addition to this guide, Thermo Fisher Scientific provides the following documents for the Accela Pump:

- *Accela Preinstallation Requirements Guide*
- *Accela Getting Connected Guide*
- *Accela Getting Started with Xcalibur Guide*

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.

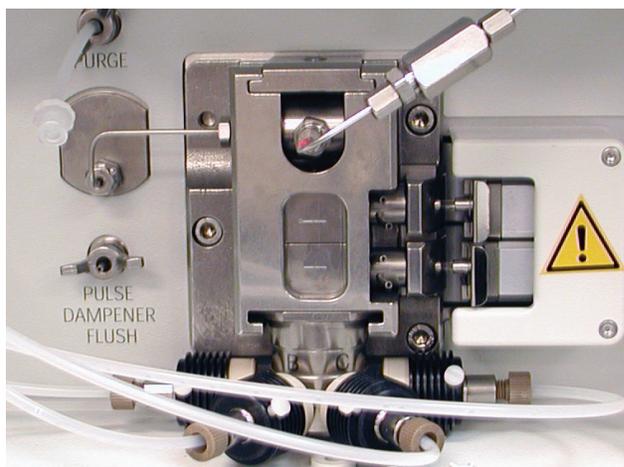
IMPORTANT Highlights information necessary to prevent damage to software, loss of data, or invalid test results; or might contain information that is critical for optimal performance of the system.

Note Highlights information of general interest.

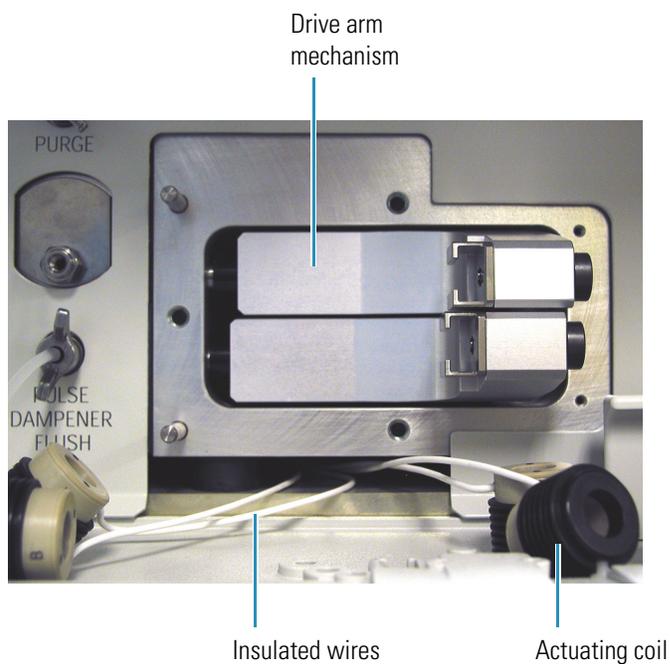
Tip Highlights helpful information that can make a task easier.

Special Precautions for the Accela Pump

Note the caution sticker on the front panel of the Accela Pump shown below. The drive arm mechanism that controls the movement of the pistons contains moving parts that can pinch your fingers.



White, insulated, electrical wires connect the actuating coils at the ends of the proportioning valves to the pump as shown below. Take care not to pinch these wires when you remove the liquid displacement assembly (LDA) from the front panel of the pump to perform maintenance.



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, keep good records of all system conditions (for example, peak shape, resolution between adjacent peaks, and % RSDs on retention times and peak areas). 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. To avoid damage caused by particulate matter, filter the samples through 0.45 or 0.2 micron (or less) filters.

Solvent Requirement

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

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, there is little immediate danger from the high pressures in an LC system. However, if a leak occurs, correct it 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

Phone	800-532-4752
Fax	561-688-8731
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Introduction

The Accela Pump is a member of the Accela™ family of ultra high performance liquid chromatography instruments.

This chapter provides an introduction to the Accela Pump shown in [Figure 1](#).

Contents

- [Functional Description](#)
- [Specifications](#)

Figure 1. Accela Pump



Functional Description

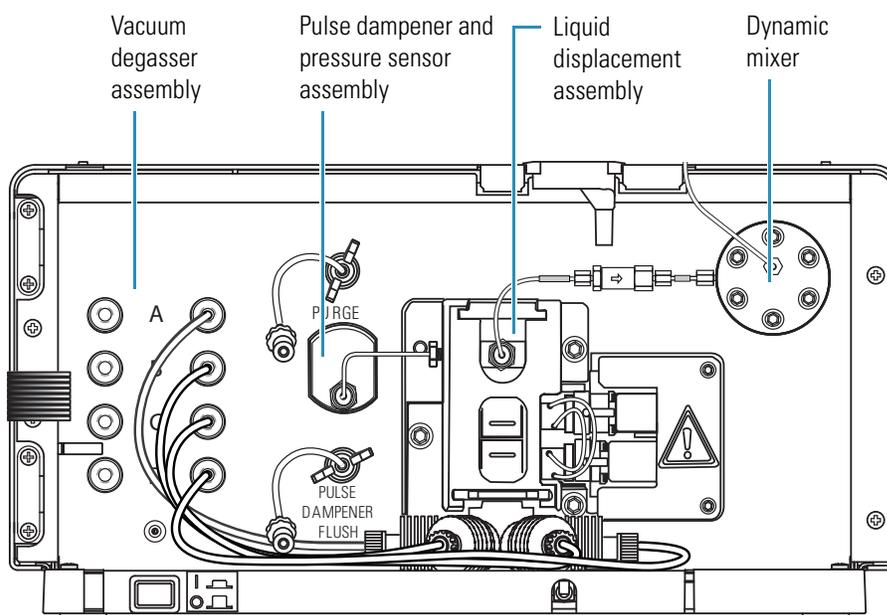
The Accela Pump is a quaternary, low-pressure mixing pump with built-in solvent degassing and pulse dampening systems. The pumping system provides optimum performance in the flow rate ranges needed for liquid chromatography and mass spectrometry. You can run precise gradients from 50 to 1000 $\mu\text{L}/\text{min}$. An extremely low gradient delay volume of 65 μL ensures minimum system cycle times. The integral vacuum degasser offers superb solvent degassing efficiency with less than 500 μL of volume, and the pulse dampener produces stable flow rates without the addition of any gradient delay volume.

The Accela Pump is a benchtop unit for inclusion in the Accela ultra high performance liquid chromatograph. It is remotely controlled with a USB communication link from a computer using the Xcalibur or ChromQuest data system. You have three manual controls: the power switch, the purge valve, and the pulse dampener flush valve. To turn on the power to the unit, push the power switch that is located on the front of the pump below the left door. To redirect the flow path away from the outlet to the autosampler, open the purge valve. To prime the pulse dampener, open the pulse dampener flush valve.

The Accela Pump has four major components: the vacuum degasser assembly, the liquid displacement assembly (LDA), the pulse dampening assembly, and the dynamic mixer (see [Figure 2](#)). In addition, the pump contains status LEDs, a low voltage power supply, and several printed circuit boards (PCBs).

Note Earlier versions of the Accela Pump do not have the dynamic mixer. If you have an older version of the Accela Pump, a Thermo Fisher Scientific field service representative can install the dynamic mixer on site for a service charge and the cost of the Accela Pump Dynamic Mixer Upgrade Kit.

Figure 2. Front panel of the Accela Pump



The following topics describe the main features of the Accela Pump:

- [Vacuum Degasser Assembly](#)
- [Liquid Displacement Assembly \(LDA\)](#)
- [Purge Valve](#)
- [Pulse Dampening Assembly](#)
- [Dynamic Mixer](#)
- [Status LEDs](#)

Vacuum Degasser Assembly

The Accela Pump contains a built-in vacuum membrane degasser that removes dissolved gasses from the mobile phase. Dissolved gasses can cause many problems in HPLC and must be kept to an absolute minimum for best performance. The solvent degassing system consists of four independent channels that are maintained at a constant vacuum of approximately 50 mm Hg absolute. Each channel has a volume of less than 500 μL , which provides superior degassing efficiency capable of limiting dissolved oxygen to a level of only 0.8 ppm. By varying its speed, the vacuum pump maintains a constant vacuum level. This eliminates the excess baseline noise and drift caused by vacuum pump cycling.

Liquid Displacement Assembly (LDA)

The frame of the liquid displacement assembly (LDA) consists of two components: the LDA body and the inlet module. The LDA body contains the inlet and outlet check valves, two sapphire pistons and their seals, upper and lower piston chambers, and various PEEK seal rings. The inlet module contains a built-in low volume mixer. Four high-precision proportioning valves are connected to the inlet module, and four actuating coils are connected to the ends of the proportioning valves. All of these components are integrated into a single mechanical-hydraulic assembly, which minimizes the gradient delay volume to only 65 μL .

Note The dynamic mixer adds an additional 35 μL of gradient delay volume.

As the lower piston withdraws, mobile phase from the proportioning valve assembly passes through the inlet check valve and fills the lower piston chamber. As the lower piston returns, the inlet check valve closes and the mobile phase is pushed through the outlet check valve and into the upper piston chamber. Both check valves are low volume and incorporate a dual ball and seat design, which ensures a positive seal with minimal delay volume.

Next, the upper piston moves into the upper piston chamber, closing the outlet check valve and forcing the mobile phase out the front of the outlet module.

The proportioning valves of the Accela Pump incorporate a finely machined ball and seat design similar to a check valve. This ball and seat design controls the flow of solvents to a higher degree of precision and accuracy than the diaphragm design used by most gradient

pumps. In addition, the ruby ball and sapphire seat are virtually wear-free as opposed to the polymeric membrane of a diaphragm valve, which becomes more brittle and less responsive as it ages.

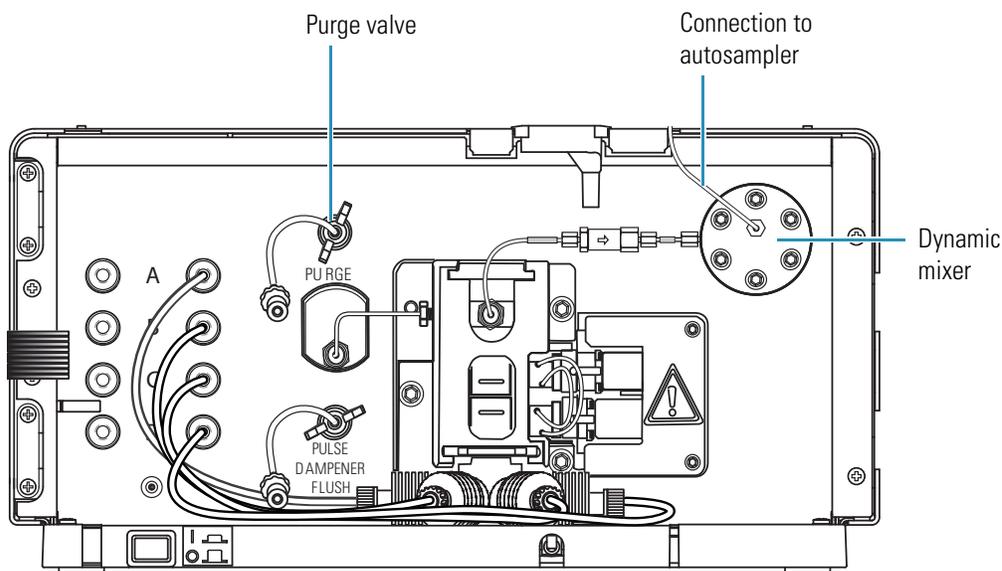
Purge Valve

The purge valve is located to the left of the LDA (see [Figure 3](#)). Turning the wingnut counterclockwise opens the purge valve.

When the purge valve is open and the solvent flow is experiencing backpressure from either an LC column or a backpressure regulator, mobile phase exits the LDA from the left side of the outlet module, passes through the crossover tubing that connects the LDA to the pressure transducer, and exits out the purge valve.

When the purge valve is closed, mobile phase flows out the front of the LDA assembly and into the high-pressure tubing that connects the LDA to the mixer and the mixer to the autosampler.

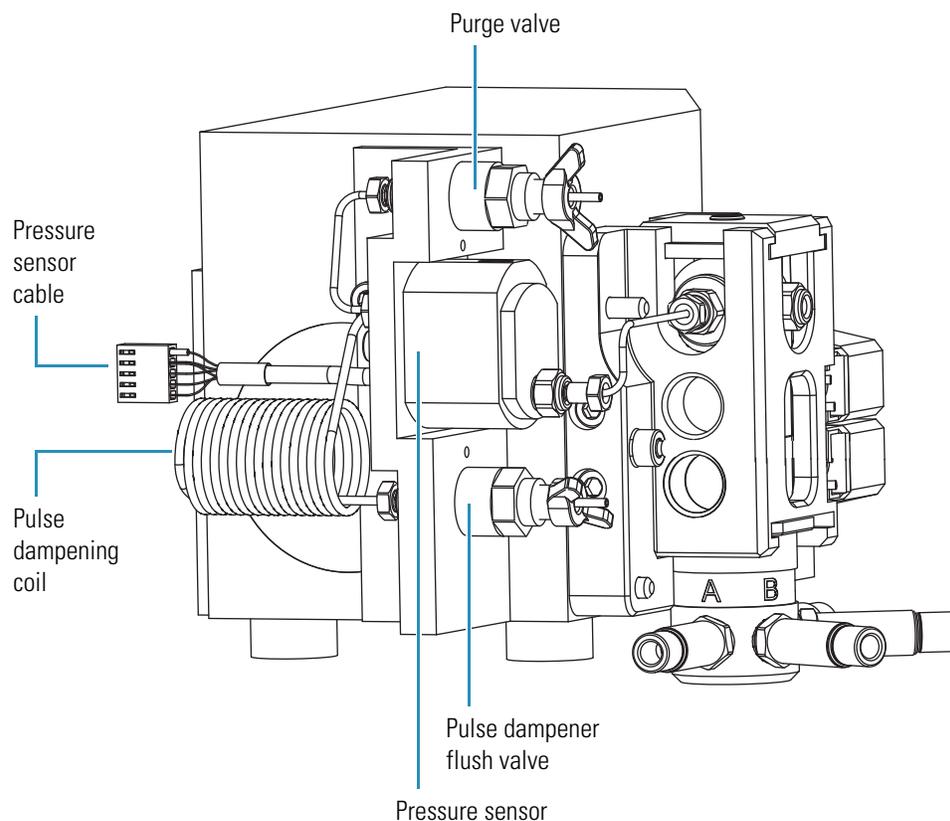
Figure 3. View of the purge valve



Pulse Dampening Assembly

The pulse dampening assembly is located behind the front panel of the pump to the left of the LDA (see [Figure 4](#)).

Figure 4. Pulse dampening assembly (located behind the front panel to the left of the LDA)



The pulse dampening assembly consists of a low volume T-connector that the mobile phase passes through. Attached to the side leg of the T-connector is a 2 mL loop of stainless steel tubing.

The loop terminates with a priming valve (pulse dampener flush valve). When the priming valve is open, you can flush or fill the dampening loop with an appropriate solvent such as methanol or isopropanol. When the priming valve is closed, the loop is shut off from the flow path and absorbs pump pulsations. Because the 2 mL loop is shut off from the flow path, it adds no gradient delay volume to the LC system.

The priming solvent in the loop does not interfere with the purity of the mobile phase, and its composition does not need to match the mobile phase.



CAUTION Keep the pulse dampener flush valve closed during normal operation of the pump. If you do accidentally open the valve while you are pumping an acidic or buffered mobile phase, prime the pulse dampener with an organic solvent such as IPA or methanol as soon as you notice the error. Because the pulse dampener is composed of two dissimilar metals, titanium and stainless steel, leaving acids or buffered solutions inside it leads to galvanic corrosion and increased baseline noise.

Dynamic Mixer

Adding the dynamic mixer to the Accela Pump ensures mixing of complex or relatively incompatible solvents and reduces the chromatographic baseline noise for applications using proportioned mobile phases. The integrated dynamic mixer also increases the accuracy and reproducibility of complex ternary and quaternary gradients. The dynamic mixer adds 35 μL of gradient delay volume to the system. You can plumb the system to bypass the dynamic mixer for mobile phases that do not require additional mixing.

If you have an older version of the Accela Pump, a Thermo Fisher Scientific field service representative can install the dynamic mixer on site for a service charge and the cost of the Accela Pump Dynamic Mixer Upgrade Kit.

Status LEDs

Four status LEDs—labeled Power, Communication, Run, and Degas—are located on the left door of the pump (see [Figure 1](#) on [page 1](#) and [Figure 5](#)). [Table 1](#) describes these LEDs.

Figure 5. Front panel LEDs



Table 1. Status descriptions for the Accela Pump LEDs

LED	Status	Meaning
Power	Green	The pump is on and is receiving power.
Communication	Amber	The pump is not communicating with the data system PC.
	Green	Communication to the data system PC has been established.
	Flashing green	A pump program is downloading from the data system PC.
Run	Amber	The power switch is in the On position, but the pump pistons are idle, producing no flow.
	Flashing amber	A firmware download is in progress or an error condition has occurred.
	Green	The pump pistons are moving, but a pump program is not running. This state can occur when the pump is under direct control or a pump program has ended.
	Flashing green	The pump is running a pump program from a downloaded method.
Degas	Amber	The degas unit is building vacuum.
	Flashing amber	A failure, such as a loss of vacuum, has occurred.
	Green	Sufficient vacuum has developed to perform chromatography.

Specifications

The specifications for the pump are as follows.

Minimum flow rate:	1.0 $\mu\text{L}/\text{min}$ isocratic, 50 $\mu\text{L}/\text{min}$ gradient
Maximum flow rate:	1000 $\mu\text{L}/\text{min}$
Flow rate resolution:	0.1 $\mu\text{L}/\text{min}$
Pressure range:	0 to 1000 bar (0 to 14500 psi)
Operating mode:	<ul style="list-style-type: none">• 0 to ~7000 psi (low-pressure range)• ~7000 to ~15000 psi (high-pressure range)
Pressure resolution:	0.01 bar (0.15 psi)
Solvent capacity:	Quaternary
Composition accuracy:	$\pm 1\%$ at a flow rate of 25 to 500 $\mu\text{L}/\text{min}$
Piston volume:	24 μL
Delay volume:	65 μL (LDA) 100 μL with dynamic mixer
Degasser type:	Vacuum membrane (Teflon AF)
Degasser capacity:	4 channels
Degasser volume:	< 500 μL per channel
Pulse dampener:	zero gradient delay volume
Wetted parts:	316 stainless steel, titanium, PEEK, sapphire, TZP-ceramic, FEP, GFP, ruby
Remote controls:	Start, USB interface for data system software
Dimensions:	18 cm \times 36 cm \times 47 cm (<i>h</i> \times <i>w</i> \times <i>d</i>)
Weight:	20 kg (44 lbs.)
Power requirements:	100/120 V ac or 220/240 V ac, 50 to 60 Hz, 500 VA max
Operating temp:	+ 10 $^{\circ}\text{C}$ to + 40 $^{\circ}\text{C}$
Storage temp:	- 40 $^{\circ}\text{C}$ to + 70 $^{\circ}\text{C}$
Operating humidity:	5 to 95% relative, non-condensing

Installation

This chapter provides instructions for the initial installation of your Accela Pump, including connections to other modules in the system. Use the Installation Checklist on the back of this page as a quick reference. Make a copy of the checklist and fill it out when you have successfully completed the installation. Include the completed checklist in your maintenance records.

Perform the installation in the sequence presented on the Installation Checklist and detailed in this chapter.

Contents

- [Installation Checklist](#)
- [Unpacking and Inspecting the Instrument](#)
- [Making the Initial Instrument Preparations](#)
- [Making the Initial Back Panel Connections](#)
- [Connecting the Low-Pressure Solvent Lines](#)
- [Connecting the Pump to the Autosampler](#)
- [Powering On for the First Time](#)

Installation Checklist

For the proper installation of your Accela Pump, complete these steps and keep this checklist in your maintenance records.

- Unpack and inspect your instrument (see “Unpacking and Inspecting the Instrument” on page 11).
- Read the safety precautions.
- Position the pump appropriately (see “Making the Initial Instrument Preparations” on page 12).
- Make the back panel connections (see “Making the Initial Back Panel Connections” on page 13).
- Connect the solvent lines (see “Connecting the Low-Pressure Solvent Lines” on page 17).
- Connect the power cord and turn on the instrument (see “Powering On for the First Time” on page 24).
- Add the pump to the instrument configuration (see Chapter 3, “Data System Instrument Configuration” on page 25).
- Prime the pulse dampener (see “Priming the Pulse Dampener” on page 41).

This Accela Pump was installed by:

(Name)

(Date)

Unpacking and Inspecting the Instrument

Carefully remove the pump from the shipping container and inspect both the pump 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 pump, a power cable appropriate for the shipping destination, and an accessory kit. [Table 2](#) lists the items in the Accela Pump Accessory Kit.

Table 2. Accela Pump Accessory Kit

Description	Part number
Adapter, Luer type	A0796-010
10 mL Luer-tipped syringe	3301-0151
Tubing, convoluted	F5034-040
Fuses, 5 × 20 mm, 2A, 250 V, TL, time delay	5120-0025
Cable, RS232, shielded	72011-63008
Cable, USB, A to B, 3.0 m, shielded, ROHS	00302-99-00014
Connector, plug, 8-pin, 3.81 mm pitch, minicomicon	00004-02511
Piston, sapphire, Accela Pump	00959-01-00126
Seal, high-pressure, GFP, Accela Pump	00950-01-00129
Tool, ball driver, 2.5 mm	00725-01-00002
Tool, proportioning valve	60053-01017
Tool, wrench, 1/4 × 5/16 in., open-ended	5401-0400
Tool, 4 mm balldriver with a screwdriver style handle	00725-00032
Tool, 4 mm L-hex wrench	00725-00034
Tool, 8 × 10 mm, open-ended wrench	00950-30005

Carefully check to make sure you received all the items listed on the packing list. If any items are missing, contact your Thermo Fisher Scientific service representative immediately.

Making the Initial Instrument Preparations

Place the pump on a laboratory bench as close as possible to a designated electrical outlet. Be sure to place the system in a draft-free location away from an open window, air conditioner vents, or other circulating air source. Applications requiring maximum detection sensitivity must have a stable room temperature. The area must also be free from dust, moisture, direct sunlight, strong electromagnetic fields, and physical vibrations. Allow at least 15 cm (6 in.) of clear space between the back panel of the pump and any wall or obstruction. This allowance provides access to the back-panel connectors and allows sufficient room for venting the electronic components.

Do not turn on the pump until you have completed the back panel and solvent line connections.



CAUTION Never connect the pump to, or operate the pump with, an electrical line source that has power drops or fluctuations of 10% below the nominal rated line voltage.

Making the Initial Back Panel Connections

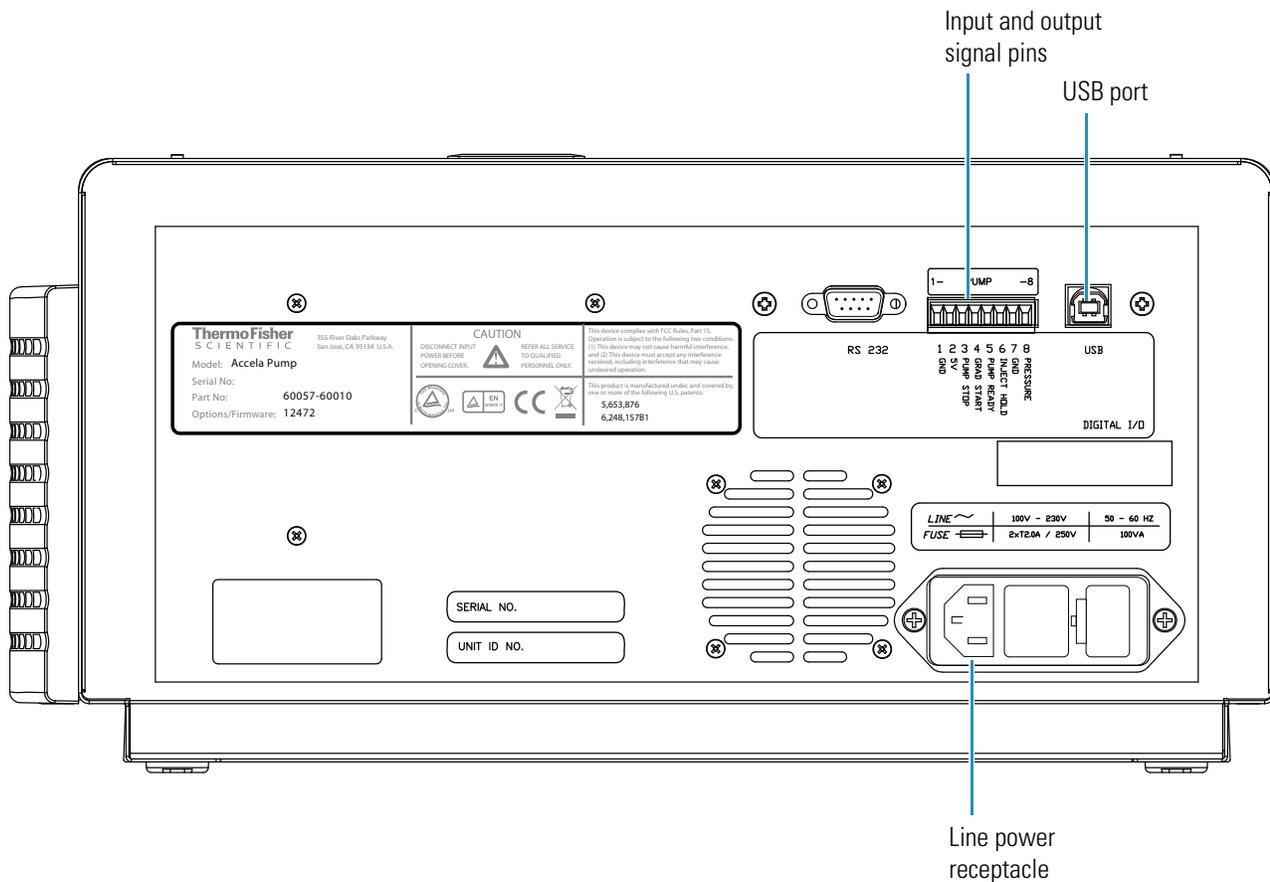
Before you can operate the Accela Pump, connect the power cable and the USB communication cable. To operate the Accela Pump as part of the LC system, connect the interconnect cable that is used to coordinate the operation of the pump with the other Accela modules. [Figure 6](#) shows the back panel of the pump.

Note Earlier versions of the Accela Pump do not have a digital I/O port. In addition, the fan vents on earlier versions of the Accela Pump are located on the bottom of the pump, instead of the back panel.

To make the back panel connections, follow these procedures:

- [Connecting the Power Cable](#)
- [Connecting the USB Cable](#)
- [Connecting the System Interconnect Cable](#)

Figure 6. Back panel of the Accela Pump



Connecting the Power Cable

The pump is shipped with a power cord appropriate for the shipping destination.



CAUTION Never connect the pump to, or operate the pump with, an electrical line source that has power drops or fluctuations of 10% below the nominal rated line voltage.

❖ **To connect the pump to line power**

1. Connect the power cord to the line power receptacle on the back panel of the pump.
2. Connect the power cord to an appropriate line power source.

Connecting the USB Cable

The Accela Pump Accessory Kit contains a USB cable that is approximately 3 m long.

❖ **To connect the pump to the computer with the USB cable**

1. Connect the series A plug of the USB cable to an available USB port on the computer.
[Figure 7](#) shows the USB plugs and sockets.

Figure 7. USB plugs and sockets

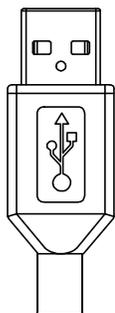
Series A socket



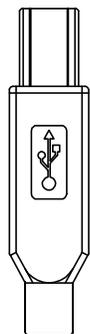
Series B socket



Series A plug



Series B plug

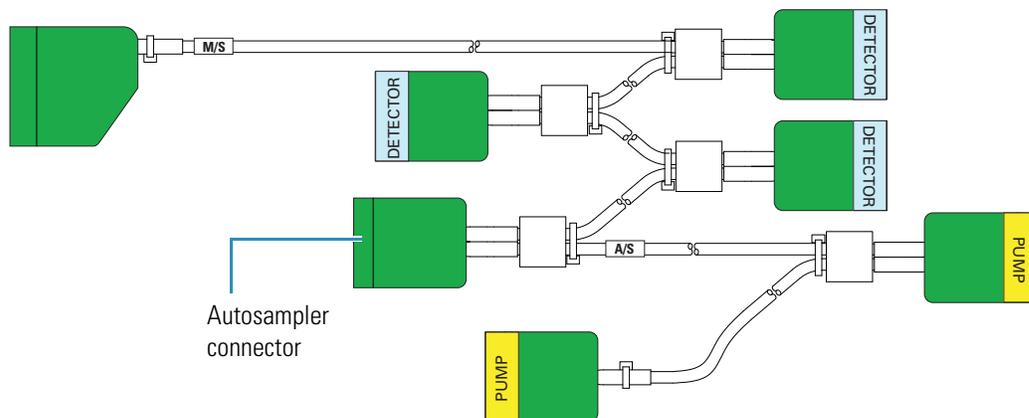


2. Connect the series B plug of the USB cable to the USB port on the back of the Accela Pump.

Connecting the System Interconnect Cable

The system interconnect cable synchronizes the timing of the Accela devices. The interconnect cable has seven combicon connectors: three are labeled DETECTOR; two are labeled PUMP; 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 8). Figure 9 shows the connections to the system modules.

Figure 8. System interconnect cable with seven combicon connectors



❖ To connect the system interconnect cable

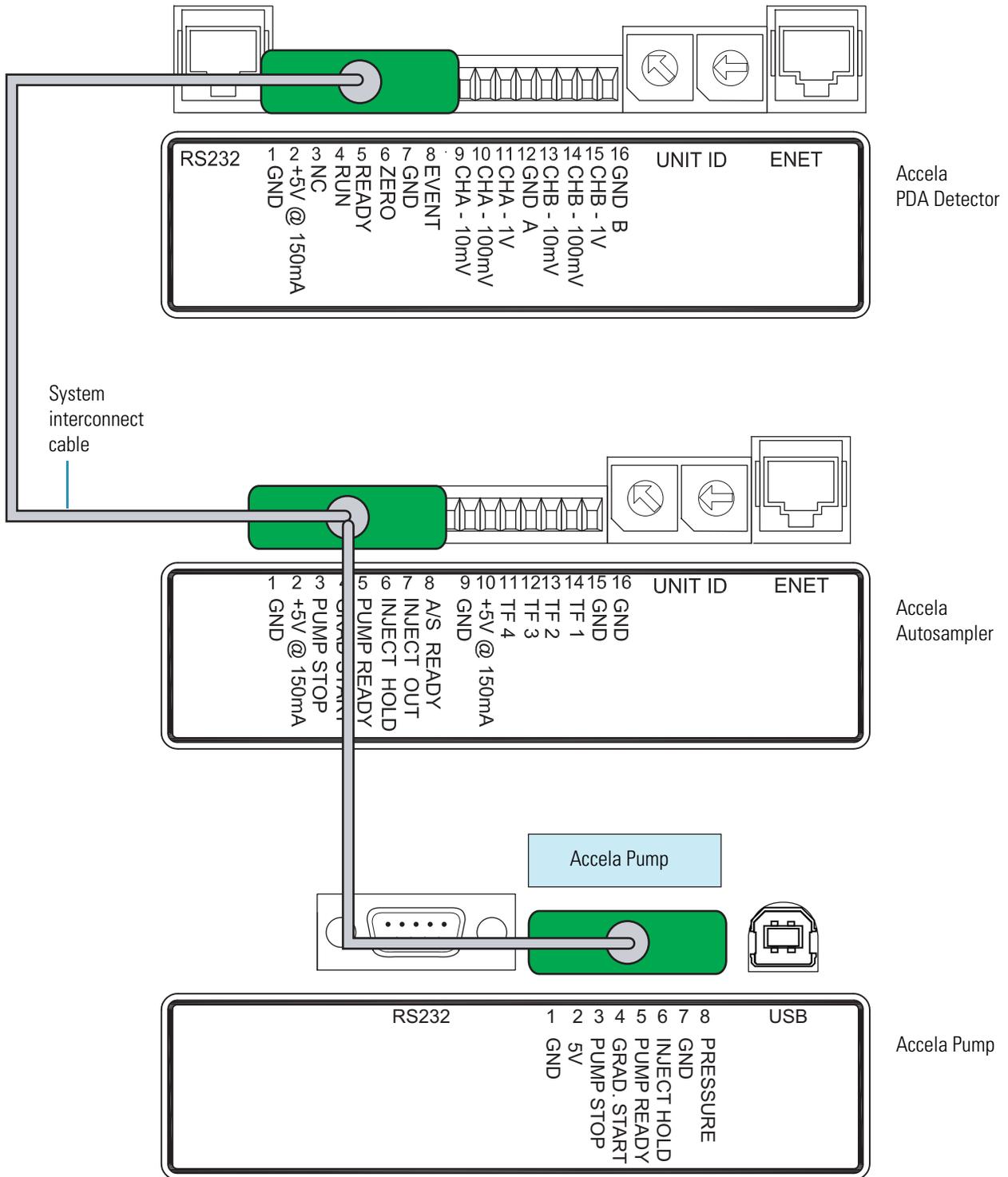
1. Plug one of the pump connectors with a yellow PUMP sticker into the 8-pin socket on the back panel of the Accela Pump.
2. Plug the autosampler connector with the A/S tag on its adjacent cable into the left, 8-pin socket on the back panel of the Accela Autosampler.
3. If your LC system contains an Accela PDA Detector, plug one of the detector connectors with a blue DETECTOR sticker into the left, 8-pin socket on the back panel of the detector.

IMPORTANT You can use the older 5-connector version of the system interconnect cable with Accela LC system. If you use the cable that has 5-combicon connectors, attach the connector that has a blue, LC PUMP label to the Accela Pump.

2 Installation

Making the Initial Back Panel Connections

Figure 9. Schematic of the connections for the system interconnect cable



Connecting the Low-Pressure Solvent Lines

Four low-pressure solvent lines connect the solvent bottles in the solvent platform to the pump. Connect these solvent lines before you operate the pump.

Because the Accela Pump contains very small, precision-machined parts that can be affected by small particles, solvents should always be HPLC-quality and free of particulate matter.

Aqueous eluents are particularly susceptible to bacterial growth that can cause numerous problems. To prevent bacteria, particulate matter, or both from entering the pump, do the following:

- Filter all solvents thoroughly.
- Discard aqueous mobile phases on a daily basis, or add a bactericide such as sodium azide to inhibit bacterial growth (0.65 g/l NaN_3 prevents the growth of most kinds of bacteria).



CAUTION Sodium azide is highly toxic and carcinogenic. Take care when disposing of solutions that contain sodium azide because azides can react with heavy metals to form explosive compounds.

When the system is left static (for example, over a weekend), air permeates through FEP tubing and can saturate solvents inside the solvent lines that connect the solvent bottles to the degassing unit. In this case, purging the lines for a few minutes proves effective.

The solvent lines that connect the degassing unit to the proportioning valves are double-walled and therefore not permeable to air.

The Accela system accessory kit contains 240 inches of 1/8 in. × OD 1/16 in. ID tubing and four Super Flangeless fittings. The system accessory kit also contains solvent bottles, solvent bottle caps, and stick-on labels for the bottle caps.

To install the solvent inlet lines, follow these procedures:

1. [Assembling the Solvent Reservoir Bottles](#)
2. [Installing the Super Flangeless Fittings](#)

Assembling the Solvent Reservoir Bottles

❖ To assemble the solvent reservoir bottles

1. Cut the 1/8 in. OD tubing into four sections of approximately 5 ft each. Make sure that you cut the ends of the tubing at a 90° angle.

Note To prevent leaking, ensure that the low-pressure tubing has square cut ends.

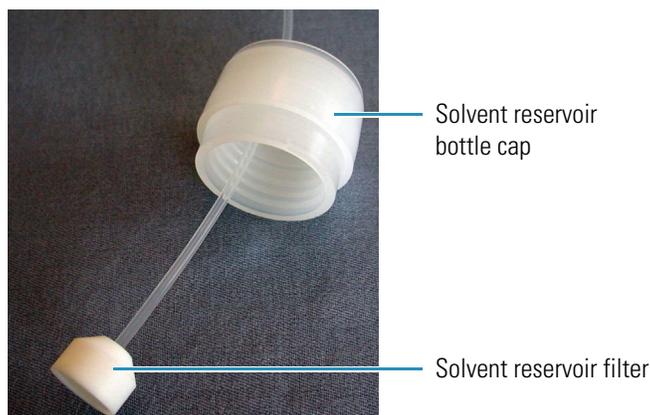
2 Installation

Connecting the Low-Pressure Solvent Lines

2. Place the label A sticker onto one of the four solvent reservoir bottle caps.
3. Pass one end of the inlet line for solvent A through the solvent reservoir bottle cap labeled A. Terminate the inlet line with one of the solvent reservoir filters included in the system accessory kit (see [Figure 10](#)).

Note Four Teflon™ end-of-line filters come with the Accela System Kit (Solvent Interconnect Kit). These filters thread onto the solvent lines. Only use non-metallic filters on solvent lines.

Figure 10. Solvent reservoir cap assembly



4. Insert the solvent reservoir filter and inlet line into one of the solvent reservoir bottles, and screw the cap onto the solvent reservoir bottle until it is secure.

Note The cap is a two-piece assembly. The upper section ([Figure 10](#)) snaps onto a threaded section. You can screw the threaded section onto the bottle and snap the upper section on after you install the tubing, or, if you are replacing existing tubing, you can unscrew the entire cap from the bottle.

5. Position the bottle in the Accela solvent platform, allowing the solvent inlet line to hang down along the left side of the Accela system.

Installing the Super Flangeless Fittings

The Super Flangeless™ fitting consists of three components: a nut, a ferrule, and a stainless steel compression ring (see Figure 11). The compression ring has two sides (see Figure 12). When you place the three components of the fitting on the end of a solvent line, the flattened side of the ring faces the nut and the angled side of the ring faces the ferrule.

Figure 11. Super Flangeless fitting components

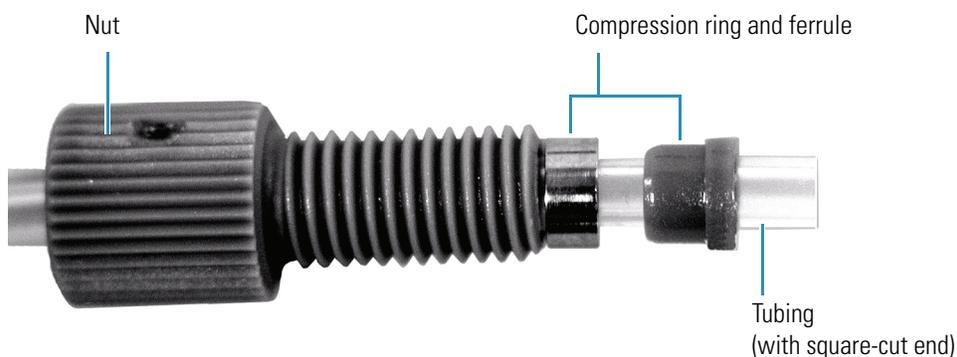
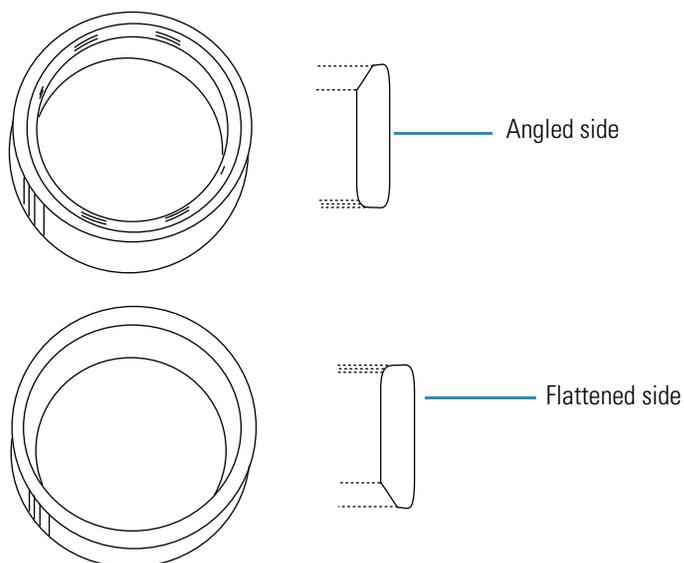


Figure 12. Drawing of the compression ring sides



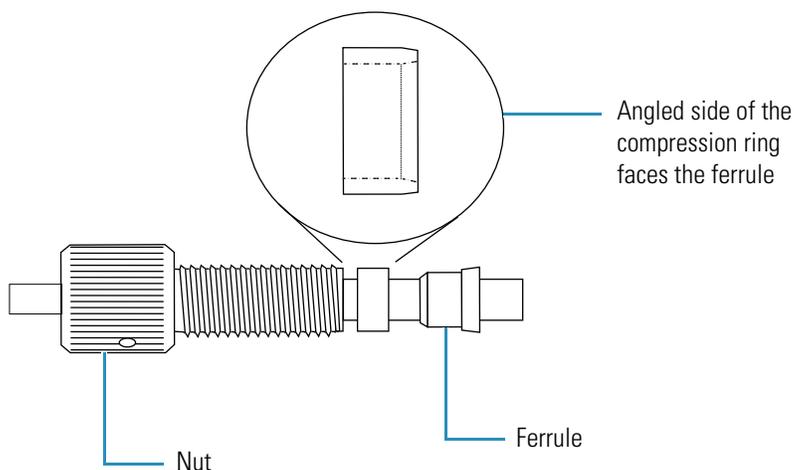
2 Installation

Connecting the Low-Pressure Solvent Lines

❖ To install a Super Flangeless fitting

1. Slide the nut onto the end of the tubing.
2. With its flattened side facing toward the nut, slide the compression ring onto the end of the tubing (see [Figure 13](#)).

Figure 13. Schematic of the Super flangeless fitting components



3. With its narrow end facing the compression ring, slide the ferrule onto the end of the tubing.
4. Swage the fitting onto the tubing (see [Figure 14](#)):
 - a. Create a compression tool by screwing a Super Flangeless nut into one end of a 1/4 inch × 28 thread internal union.
 - b. Insert the tubing with the fitting assembly into the other end of the union.
 - c. Hold the tubing to the bottom of the tool while tightening down the nut.

Figure 14. Using a compression tool to swage the fitting onto the tubing



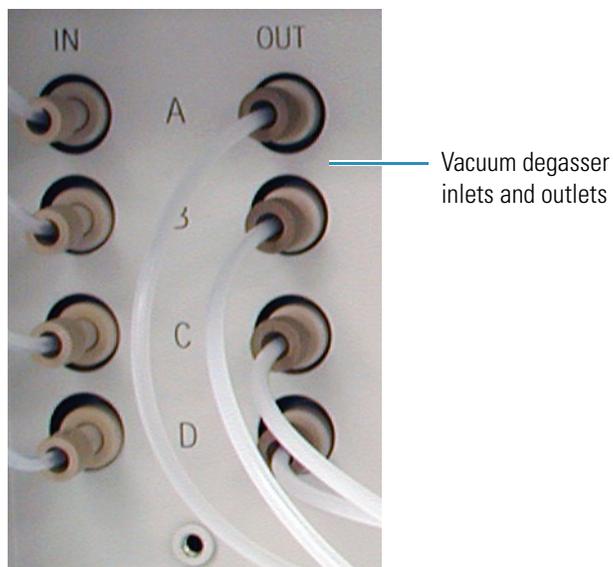
- d. Unscrew the swaged fitting and verify the following (see [Figure 15](#)):
- The end of the square-cut tubing is flush with the end of the ferrule.
 - The steel compression ring is seated over the ferrule.

Figure 15. View of fitting swaged onto tubing



5. Insert the tubing with the properly swaged fitting into inlet port A, and then tighten the nut fingertight. Be careful not to cross-thread the fitting, which can cause solvent leakage (see [Figure 16](#)).
6. Pass the solvent inlet line through the openings along the left side of each Accela module to complete the installation.
7. Repeat the above steps for the B, C, and D solvent inlet lines.

Figure 16. Vacuum degas connections



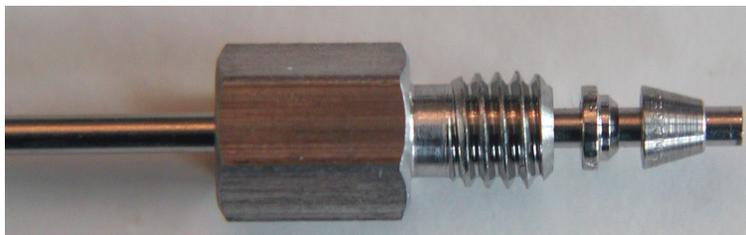
Connecting the Pump to the Autosampler

The Accela System Kit contains 1/16 in. OD × 0.005 in. ID stainless steel tubing precut to 20 cm and high-pressure fittings. These items are used to connect the outlet of the Accela Pump to the heat exchanger of the Accela Autosampler.

If you have an older version of the Accela Pump that does not have an integrated mixer, you can order the Accela Pump Dynamic Mixer Upgrade Kit to upgrade the pump, or you can use the precut, 20 cm length of high-pressure tubing to connect the outlet port of the inline filter holder directly to the heat exchanger of the Accela Autosampler.

Figure 17 shows the high-pressure fitting supplied in the system kit. This fitting consists of a nut, a back ferrule, and a front ferrule.

Figure 17. High-pressure fitting

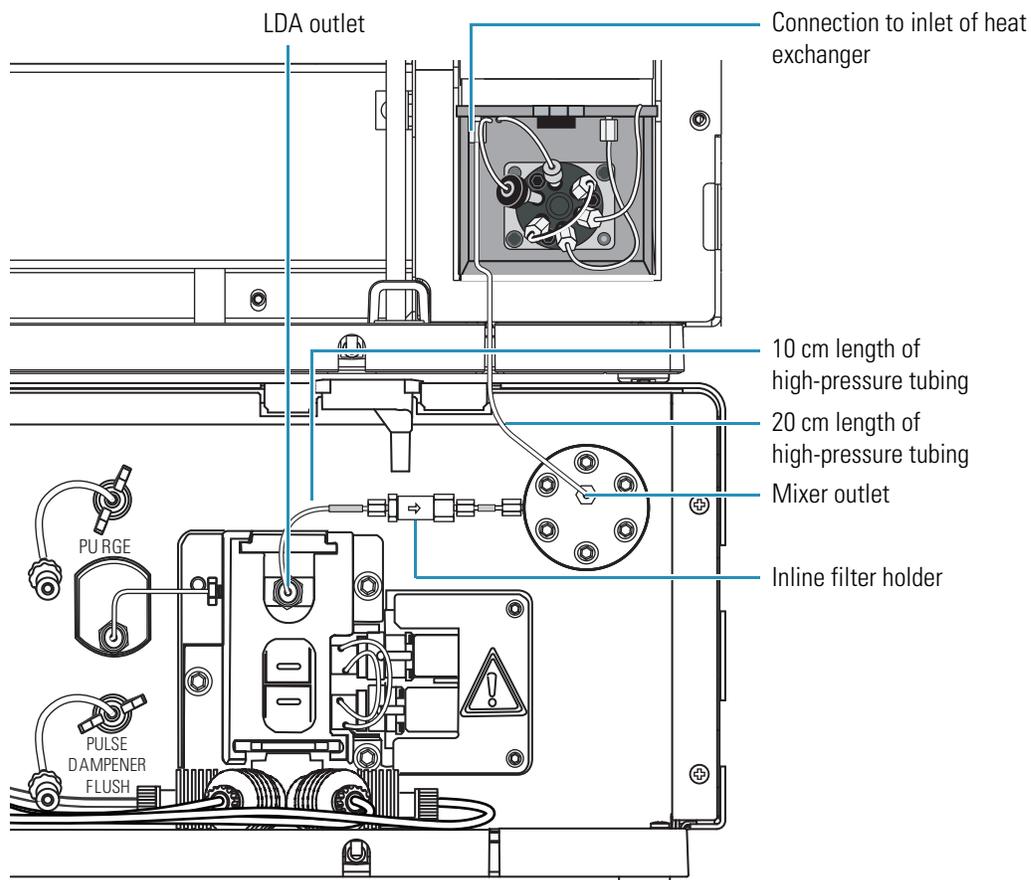


❖ To connect the Accela Pump to the Accela Autosampler

1. Place the Accela Autosampler on top of the Accela Pump.

The Accela Pump is shipped with the LDA outlet connected to the inline filter holder inlet and the inline filter holder outlet connected to the mixer inlet. You might need to reconnect the inline filter holder after performing maintenance on the liquid displacement assembly (LDA).

2. Connect the pump to the autosampler as follows:
 - a. (Factory installed) Using a precut, 10 cm length of high-pressure tubing and a high-pressure fitting, connect the LDA to the inlet of the inline filter holder (see [Figure 18](#)).
 - b. (Factory installed) Using a precut, 5 cm length of high-pressure tubing and a high-pressure fitting, connect the outlet end of the filter holder to the mixer inlet (see [Figure 18](#)).
 - c. Using a precut, 20 cm length of high-pressure tubing and a high-pressure fitting, connect the mixer outlet to the inlet of the autosampler heat exchanger. If the pump does not have a mixer, connect the outlet end of the filter holder to the inlet of the autosampler heat exchanger.

Figure 18. Connection between the pump and the autosampler

Powering On for the First Time

After you install the solvent lines, you can turn on the pump.

❖ To turn on the pump

1. Ensure that the power switch on the front of the pump below the left door 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 pump and connect it to line power.
3. Push the power switch to engage it (depressed position).

The power indicator (POWER LED) turns solid green.

4. If the POWER LED does not illuminate, see [“Pump Troubleshooting Guide”](#) on [page 84](#). Call your Thermo Fisher Scientific service representative if you require assistance.

Before you can operate the Accela Pump, first add it to the data system configuration for your instrument (see [Chapter 3, “Data System Instrument Configuration”](#) on [page 25](#)), fill the solvent lines with the appropriate solvents (see [“Removing Air from the Solvent Lines”](#) on [page 37](#)), and prime the pulse dampener (see [“Priming the Pulse Dampener”](#) on [page 41](#)).

Data System Instrument Configuration

To add the Accela Pump to the data system instrument configuration and to ensure that the Accela Autosampler recognizes the input signals issued by the pump, follow the procedures in this chapter.

Contents

- [Adding the Pump to the Xcalibur Instrument Configuration](#)
- [Configuring the Signal Polarity for the Accela AS in Xcalibur](#)
- [Configuring an Accela Instrument in ChromQuest](#)

Adding the Pump to the Xcalibur Instrument Configuration

❖ To add the Accela Pump to the Xcalibur instrument configuration

1. Depending on the data system version, do one of the following:
 - For Xcalibur versions below 2.1, from the computer desktop, choose **Start > All Programs > Xcalibur > Instrument Configuration**.
The Instrument Configuration window appears (see [Figure 19](#)).
 - For Xcalibur 2.1 and higher, from the computer desktop, choose **Start > All Programs > Thermo Foundation > Instrument Configuration**.
The Thermo Foundation Instrument Configuration window appears (see [Figure 20](#)).

3 Data System Instrument Configuration

Adding the Pump to the Xcalibur Instrument Configuration

Figure 19. Instrument Configuration window (for Xcalibur versions lower than 2.1)

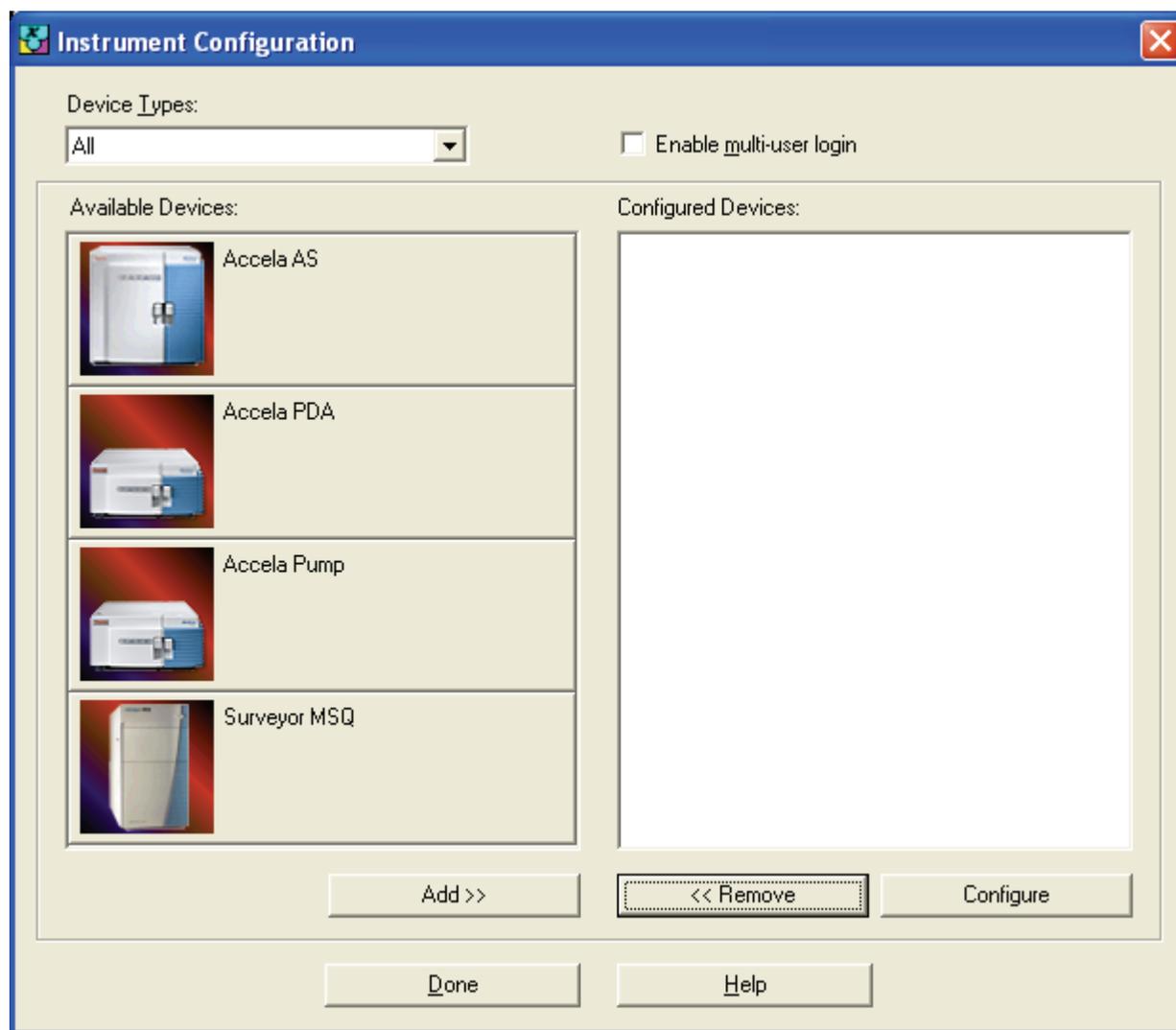
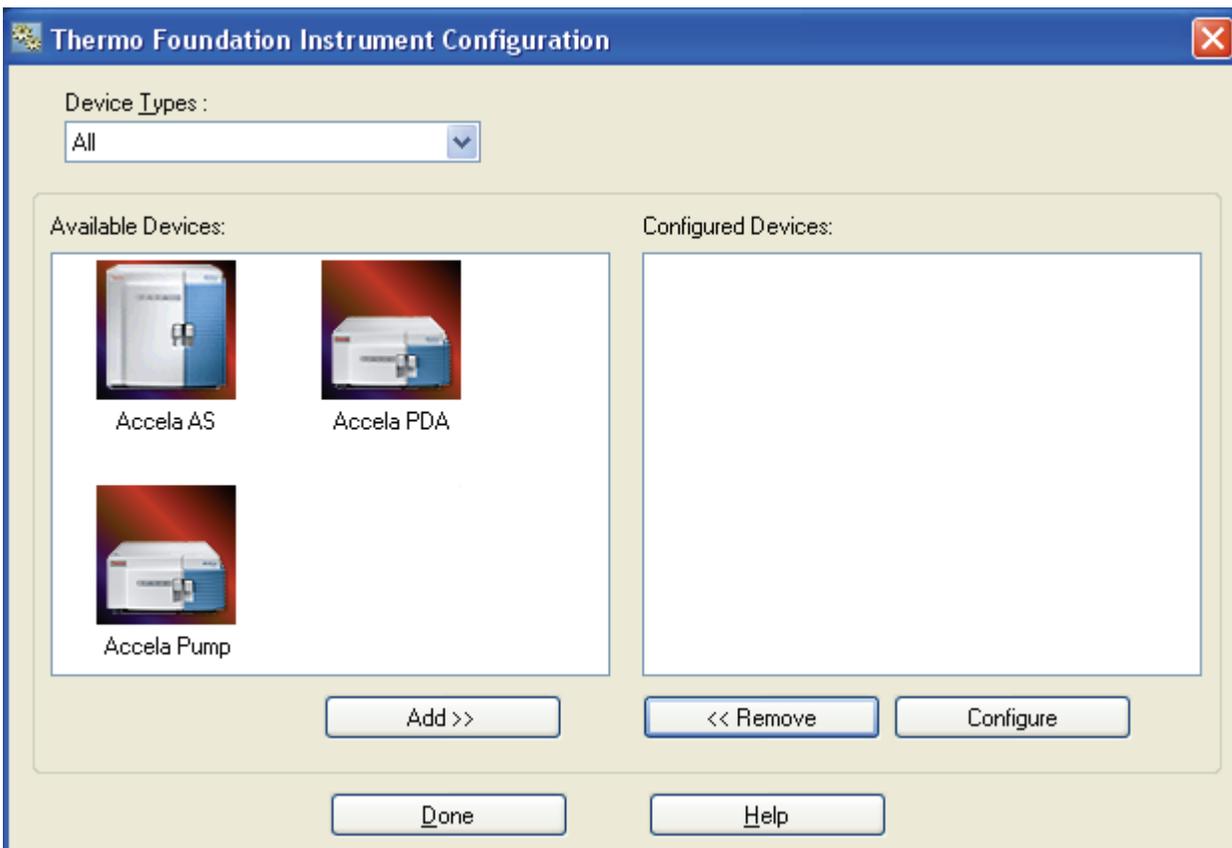


Figure 20. Thermo Foundation Instrument Configuration window (Xcalibur 2.1 or higher)



2. To show all the instruments, in the Device Types list, select **All**.

The installed instruments appear as buttons in the Available Devices pane.



Accela Pump

3. In the Available Devices pane, double-click the **Accela Pump** button.

A copy of the Accela Pump button appears in the Configured Devices pane.

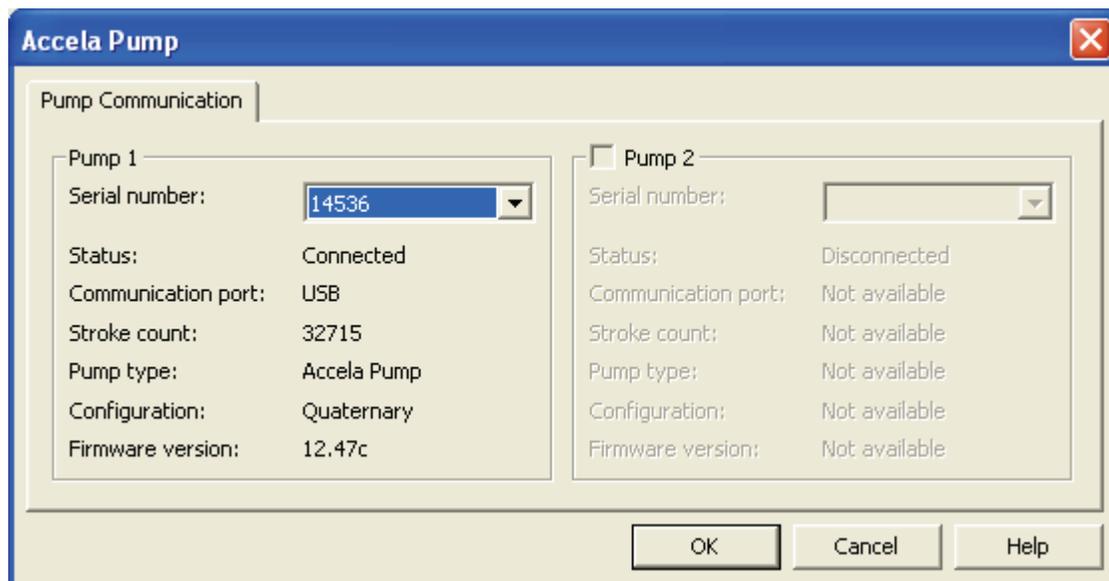
4. In the Configured Devices pane, double-click the **Accela Pump** button.

The Accela Pump dialog box appears (see [Figure 21](#)).

3 Data System Instrument Configuration

Configuring the Signal Polarity for the Accela AS in Xcalibur

Figure 21. Accela Pump dialog box (Xcalibur)



5. Click **OK** to close the Accela Pump dialog box.
6. Click **Done** to save the configuration and close the Instrument Configuration window.

Configuring the Signal Polarity for the Accela AS in Xcalibur

During an injection sequence, the pump issues a Pump Ready signal and an Injection Hold Release signal to the autosampler.

When you configure the input signal polarities for the Accela Autosampler, select the Pump ready active high check box and the Injection hold release active high check box (see [Figure 22](#)). If you do not select these two check boxes, the autosampler does not recognize the input signals from the Accela Pump, and it does not begin an injection sequence when you start a sequence.

After you submit a run, the Accela Autosampler waits for a Pump Ready signal from the pump. The pump issues this signal after its pressure transducer monitors a stable backpressure. When the autosampler receives this signal, it begins an injection sequence.

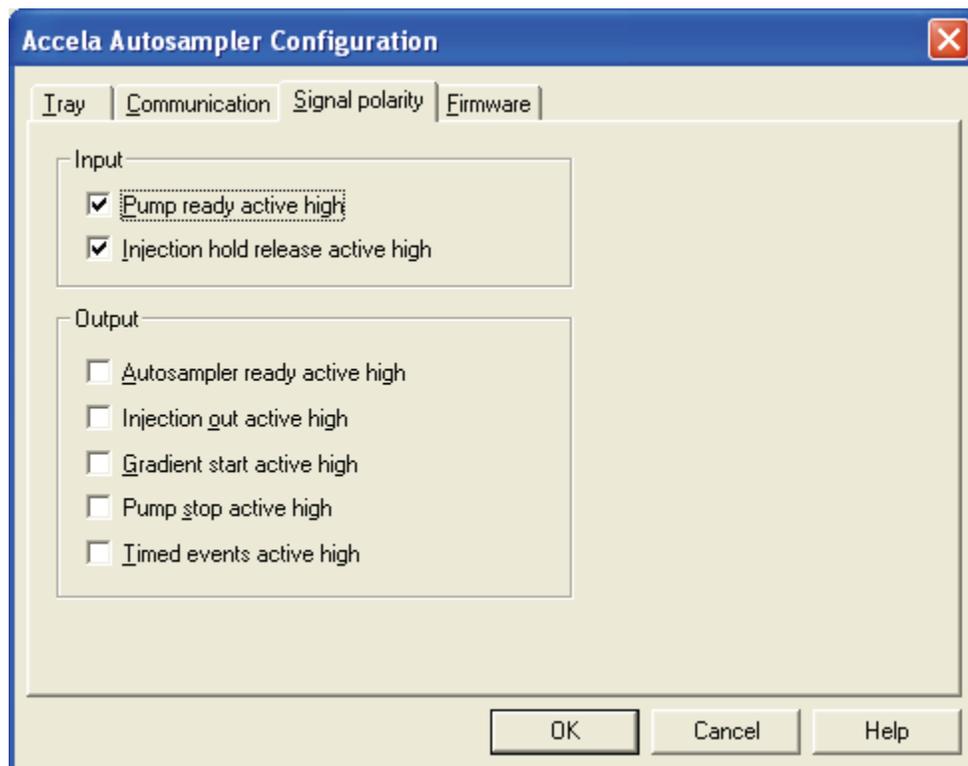
After the autosampler begins the injection sequence, it waits for an Injection Hold Release signal from the pump. The pump issues this release signal when its piston cam returns to the start position. When the autosampler receives the Injection Hold Release signal, the injection valve switches to the inject position, allowing the contents of the sample loop to be swept onto the LC column.

Note In Xcalibur, the instrument setup method for the pump contains a custom stability limit parameter. This parameter allows the user to define the acceptable level of pressure stability that must be attained before the pump issues the Pump Ready signal to the autosampler.

❖ **To check the input signal polarities for the Accela Autosampler**

1. From the computer desktop, do the following:
 - For Xcalibur versions below 2.1, from the computer desktop, choose **Start > All Programs > Xcalibur > Instrument Configuration**.
The Instrument Configuration window appears (see [Figure 19](#) on [page 26](#)).
 - For Xcalibur 2.1 and higher, from the computer desktop, choose **Start > All Programs > Thermo Foundation > Instrument Configuration**.
The Thermo Foundation Instrument Configuration window appears (see [Figure 20](#) on [page 27](#)).
2. In the Configured Devices pane, double-click the **Accela Autosampler** button.
The Accela Autosampler Configuration dialog box appears.
3. Click the **Signal polarity** tab.
The Signal Polarity page appears (see [Figure 22](#)).
4. Make sure that the **Pump ready active high** check box and the **Injection hold release active high** check box are selected.

Figure 22. Configuring the input signal polarities for the Accela Autosampler (Xcalibur)



Configuring an Accela Instrument in ChromQuest

An Accela LC system consists of an analytical pump, an autosampler, and a PDA detector.

❖ To configure an Accela instrument in ChromQuest

1. Do one of the following:
 - For ChromQuest, from the computer desktop, choose **Start > All Programs > Chromatography > ChromQuest**. Go to [step 2](#).
 - For ChromQuest SI, from the computer desktop, choose **Start > All Programs > Chromatography > ChromQuest SI Config**. The ChromQuest SI Configuration dialog box appears. Click **Instrument Configuration**. The Instrument Configuration dialog box appears. Go to [step 4](#).

2. To add the Accela instrument to the Enterprise:

 The Enterprise

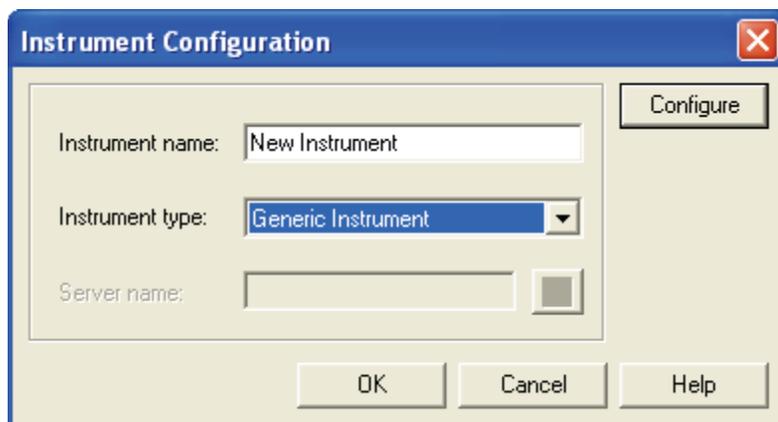
- a. Right-click **The Enterprise** button in the left pane of the Main Menu window.
- b. From the shortcut menu, choose **New > Instrument**.



- A New Instrument button appears in the right pane of the Main Menu window.
3. Right-click the **New Instrument** button and choose **Configure > Instrument**.

The Instrument Configuration dialog box appears (see [Figure 23](#)).

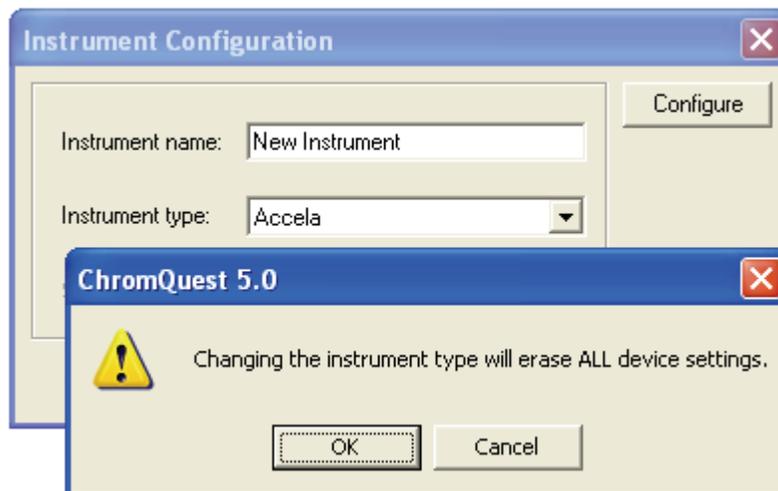
Figure 23. Instrument Configuration dialog box (ChromQuest)



4. Do the following:

- a. In the Instrument name box, type a name that identifies your instrument.
- b. In the Instrument type list, do one of the following:
 - To modify the configuration of an Accela system, do **not** select an instrument type.
 - To create a new instrument, select **Accela**. A message appears warning you that this selection erases the current configuration (see [Figure 24](#)). Click **OK**.

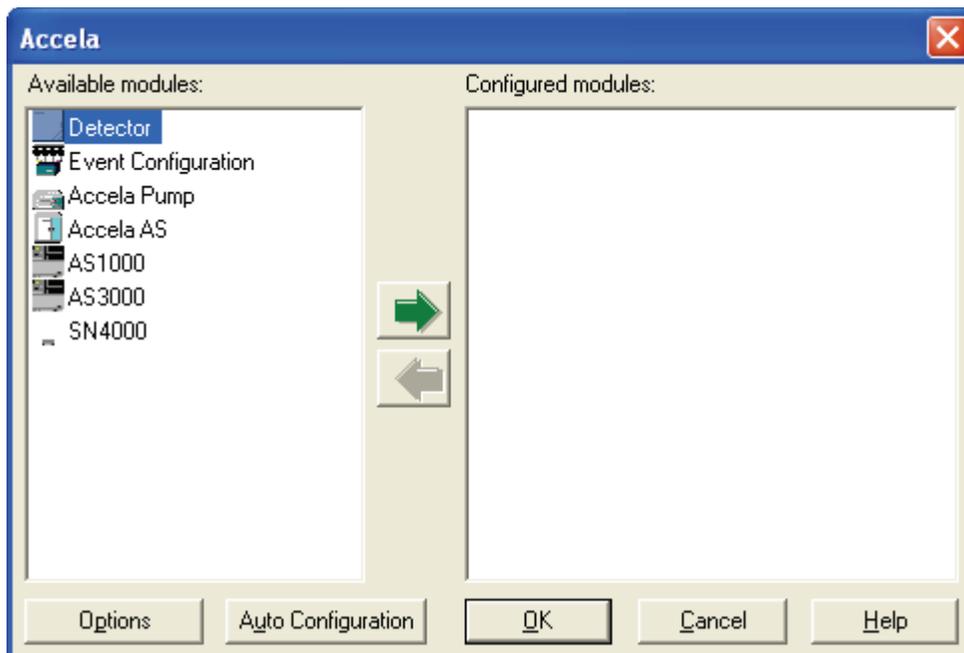
Figure 24. Warning message



c. Click **Configure**.

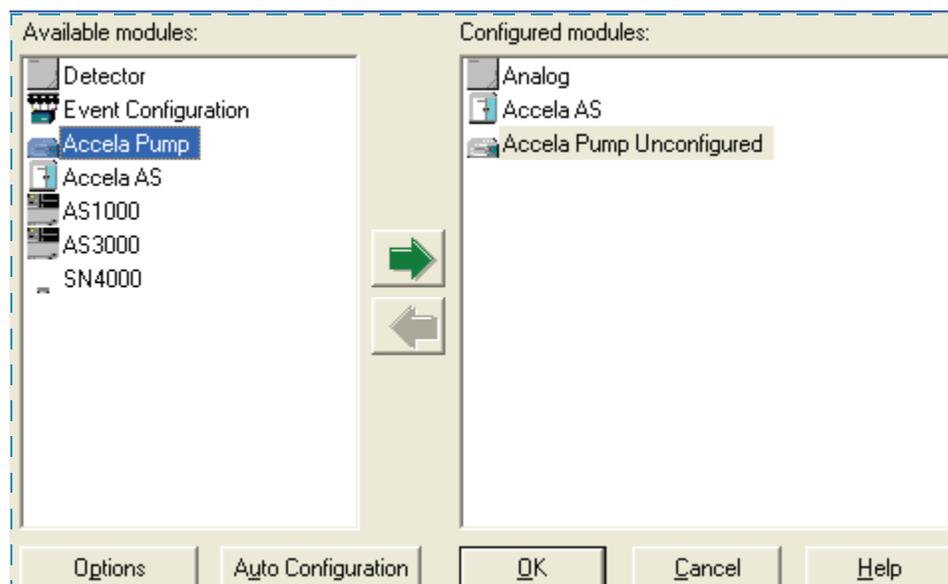
The Accela dialog box appears.

Figure 25. Accela dialog box



5. In the Available modules pane, do the following:
 - a. Double-click the **Accela Pump** button. A copy of the button appears in the Configured modules pane.
 - b. Double-click the **Accela AS** button. A copy of the button appears in the Configured modules pane.
 - c. Double-click the **Detector** button. The Analog button appears in the Configured modules pane (see [Figure 26](#)).

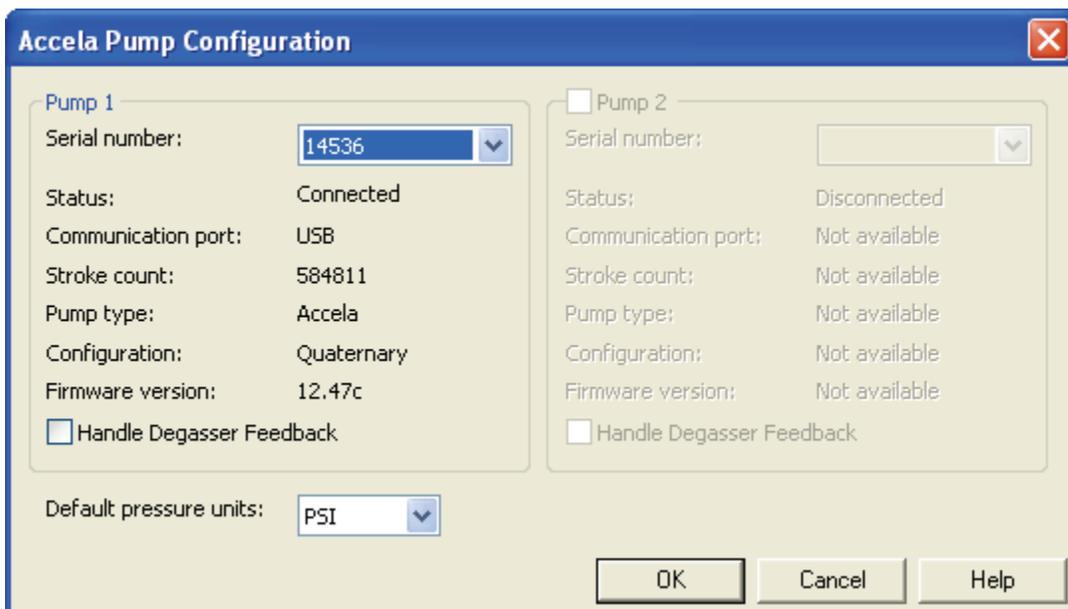
Figure 26. Accela dialog box with instrument added to the configuration



6. Configure the Accela Pump options:
 - a. In the Configured modules pane, double-click the **Accela Pump** button.

The Accela Pump Configuration dialog box appears (see [Figure 27](#)).

Figure 27. Accela Pump Configuration dialog box (ChromQuest)



Note In ChromQuest 5.0, the Accela Pump Configuration dialog box includes a Handle Degasser Feedback check box. This feature is reserved for future use.

- b. In the Default pressure units list, select the pressure units that you prefer: **bar**, **PSI**, or **MPa**.
 - c. Click **OK** to accept the entries and close the Accela Pump Configuration dialog box.

7. Configure the Accela Autosampler:

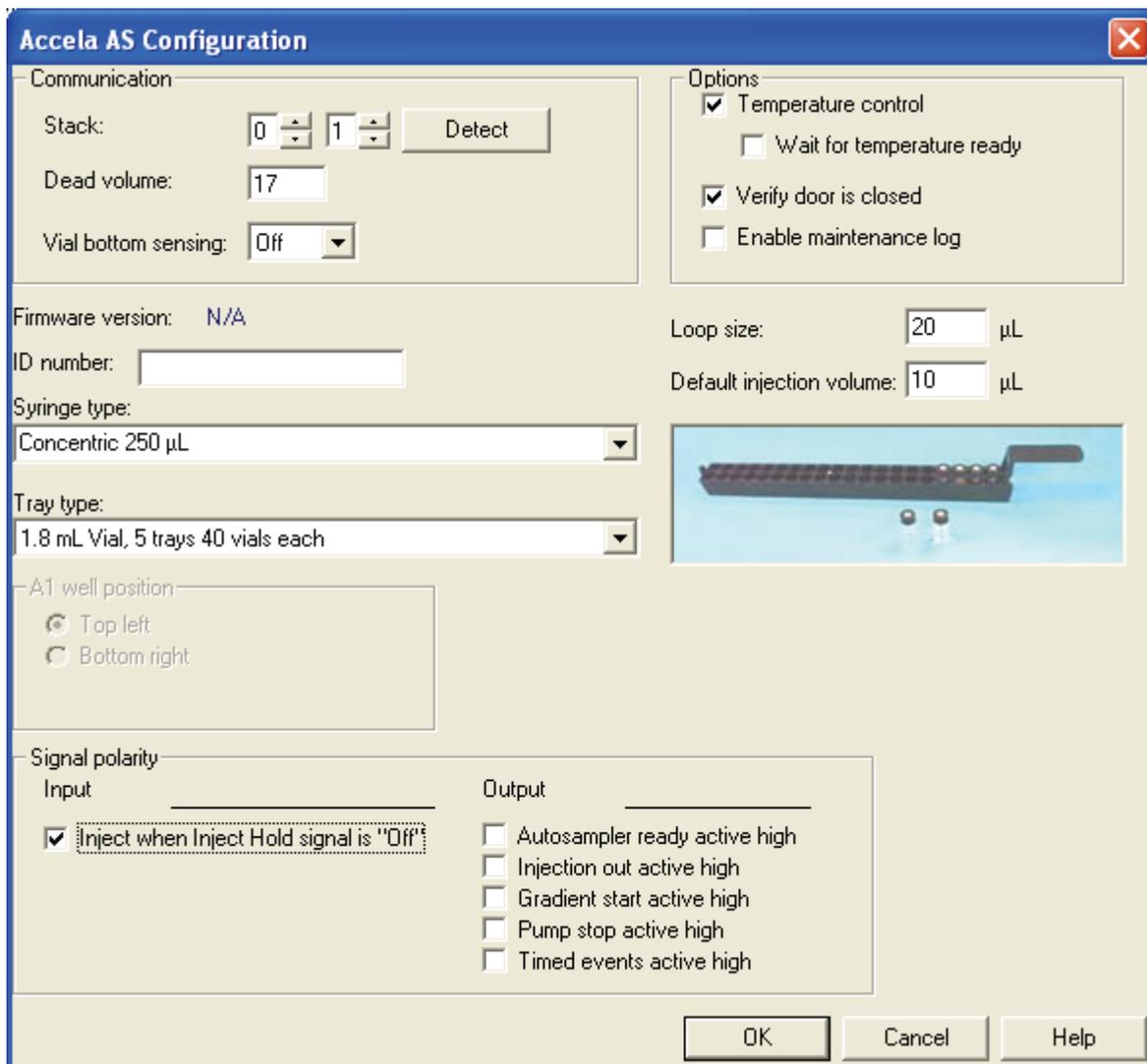
- a. In the Configured modules pane, double-click the **Accela AS** button.

The Accela AS Configuration dialog box appears.

- b. Make the appropriate selections and entries.
 - c. Ensure that the **Inject when Inject Hold signal is "Off"** check box is selected (see [Figure 28](#)).

IMPORTANT If the Inject when Inject Hold signal is "Off" check box is not selected, the system remains in the Waiting for Download state.

Figure 28. Accela AS Configuration dialog box



8. Configure the Accela PDA Detector:
 - a. Double-click the **Analog** button in the Configured modules pane.
The Detector Configuration dialog box appears.
 - b. In the Detector name box, type an identifying name for the PDA detector.
 - c. In the Detector type list, select **PDA**.
In the Acquisition source list, ChromQuest automatically selects PDA Plus ACQ.
 - d. Click  to open the PDA Plus dialog box.

- e. Keep the stack value at its default of 01 unless you are controlling more than one PDA detector from the data system computer.

Note The stack value must match the unit ID setting on the back panel of the PDA detector.

- f. In the ID number box, type an identifying number for the detector such as its serial number.
 - g. Click **OK** to close the PDA Plus dialog box.
 - h. Click **OK** to close the Detector Configuration dialog box.
9. Click **OK** to close the Accela dialog box.
 10. For ChromQuest SI, click **Close** in the ChromQuest SI Configuration dialog box to return to the computer desktop.

Preparing the Pump for Operation

After you connect the pump to the data system computer, connect the solvent lines to their respective degas inlets, and configure the pump to communicate with the data system, you are ready to prepare the pump for operation. Before you operate the Accela Pump for the first time, remove air from the solvent lines and prime the pulse dampener.

Contents

- [Removing Air from the Solvent Lines](#)
- [Using the Data System to Start and Stop the Solvent Flow](#)
- [Priming the Pulse Dampener](#)

Removing Air from the Solvent Lines

Prepare the pump for operation by removing air from the solvent lines that are connected to the built-in degassing unit.



CAUTION Using a syringe or equivalent tool to draw solvent through the LDA can damage the check valves. Use the data system controls to start and stop the solvent flow.

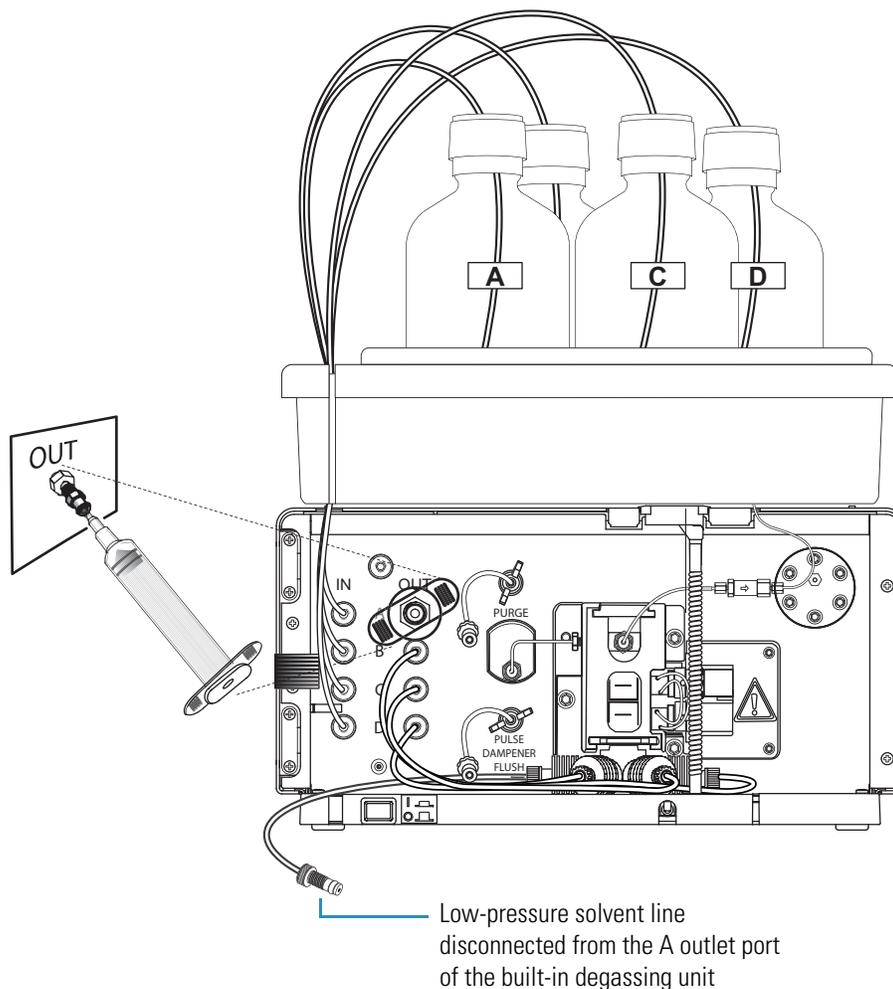
❖ To remove air from or to draw fresh solvent through a solvent line

1. For the solvent line that you are removing air from or drawing fresh solvent through (A, B, C, or D), disconnect the corresponding tubing from the degasser outlet port.
2. Connect a Luer-Lok™ fitting to the degasser outlet port that you removed the tubing from (see [Figure 29](#)).

4 Preparing the Pump for Operation

Using the Data System to Start and Stop the Solvent Flow

Figure 29. Using a syringe to draw solvent through a solvent reservoir line



3. Connect a 10 mL syringe to the Luer-Lok fitting, and pull solvent through the line.
4. Remove the Luer-Lok fitting from the port.
5. Reconnect the solvent line to the degasser outlet port.

To remove air from the LDA and from the solvent lines that connect the degassing unit to the proportioning valves, start the solvent flow by using the data system controls (see [“Using the Data System to Start and Stop the Solvent Flow”](#) on page 38).

Using the Data System to Start and Stop the Solvent Flow

You can start and stop the solvent flow by using the data system start and stop controls:

- [Using Xcalibur to Start and Stop the Solvent Flow](#)
- [Using ChromQuest to Start and Stop the Solvent Flow](#)

Using Xcalibur to Start and Stop the Solvent Flow

You can start and stop the solvent flow by using the Direct Control dialog box in the Xcalibur data system.

❖ To control the solvent flow from the pump using the direct controls in Xcalibur



1. On the Xcalibur Home Page, click the **Instrument Setup** icon in the Road Map view, or choose **GoTo > Instrument Setup**.

The Instrument Setup window opens.

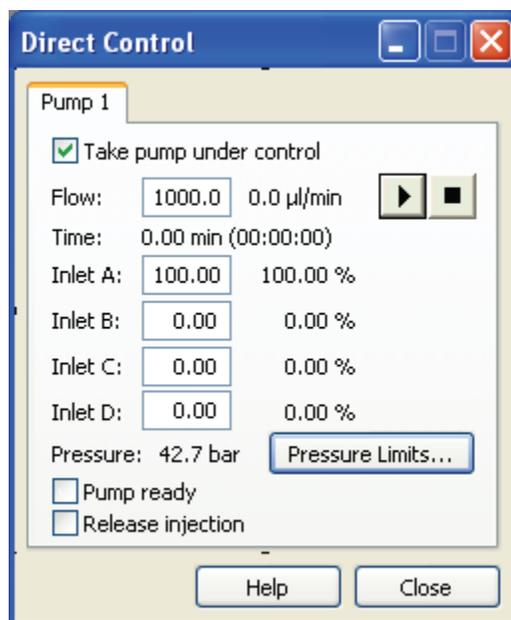


2. In the view bar, click the **Accela Pump** button.

The Instrument Setup view for the Accela Pump opens.

3. Choose **Accela Pump > Direct Control** to open the Direct Control dialog box shown in [Figure 30](#).

Figure 30. Xcalibur Direct Control dialog box for the Accela Pump



4. Select the **Take pump under control** check box.
5. Type percentages for the inlet (solvent) lines that you want to draw solvent through.
6. Type a flow rate of **1000** (µL/min).
7. If you do not want the LC column in the solvent path, do the following:
 - a. Open the purge valve by turning the wingnut counterclockwise.
 - b. Place a beaker under the purge valve to collect solvent.
8. Click (Start) to start the solvent flow.

4 Preparing the Pump for Operation

Using the Data System to Start and Stop the Solvent Flow

9. Click  (Stop) to stop the solvent flow.
10. If you opened the purge valve to let the solvent flow bypass the LC column, close the purge valve by turning the wingnut clockwise.

Using ChromQuest to Start and Stop the Solvent Flow

You can start and stop the solvent flow by using the Direct Control area of the Instrument Status page for the Accela Pump.

❖ To start and stop the solvent flow by using the ChromQuest data system

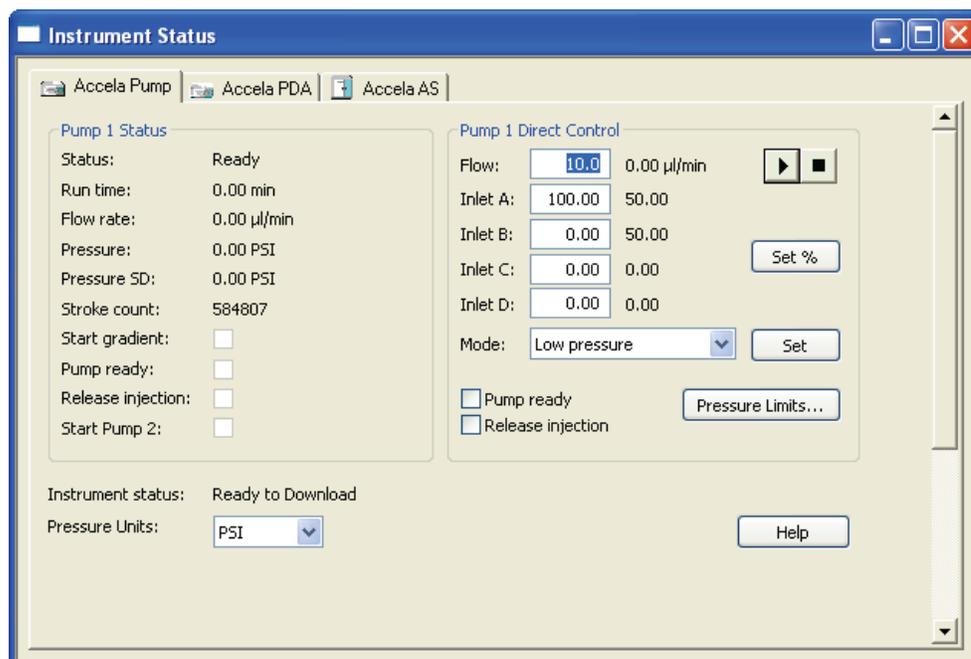
1. From the Main Menu window, double-click the icon for your instrument.

The online Instrument window opens.

2. Choose **Control > Instrument Status**.

The Instrument Status window appears with the Accela Pump page displayed (see [Figure 31](#)). Use the Accela Pump page to view the pump status or to start an isocratic solvent flow.

Figure 31. Accela Pump page of the Instrument Status window



3. In the Flow box, type **1000**.
4. Type percentages for the inlet (solvent) lines through which you want to draw solvent.
5. Click **Set%**.

6. If you do not want the LC column in the solvent path, do the following:
 - a. Open the purge valve by turning the wingnut counterclockwise.
 - b. Place a beaker under the purge valve to collect solvent.
7. Click  (Start) to start the solvent flow.
8. Click  (Stop) to stop the solvent flow.
9. If you opened the purge valve to let the solvent flow bypass the LC column, close the purge valve by turning the wingnut clockwise.

Priming the Pulse Dampener

Priming the pulse dampener involves filling its dampening loop with a solvent such as methanol or isopropanol. When the loop is filled with solvent, it can effectively dampen pressure pulsations from the rest of your system. Closing the pulse dampener flush valve after you fill the loop shuts the loop off from the flow path. Prime the pulse dampener before the initial operation of the pump and periodically thereafter.

Note Do **not** fill the pulse dampener with an aggressive acid, an aqueous solution, or a buffered solution. The recommended filling solvents are methanol, acetonitrile, or isopropyl alcohol. If you accidentally fill the pulse dampener with an acidic or buffered solvent, flush the loop with a miscible solvent, and then refill it with methanol, acetonitrile, or isopropyl alcohol.

❖ To prime the pulse dampener

1. Fill a solvent reservoir with particulate-free, HPLC-grade methanol.
2. Connect an HPLC column or a flow restrictor to the LDA outlet.
3. Insert the tip of the 10 mL syringe into the tubing that is connected to the pulse dampener flush valve, and then open the valve by turning it counterclockwise.
4. Set the flow rate to 1000 $\mu\text{L}/\text{min}$.
5. Fill the loop completely to expel any air that might be trapped.

The volume of the dampening coil is 2 mL.
6. Set the flow rate to one that is appropriate for your system.
7. Close the pulse dampener flush valve by turning the valve clockwise.

Unless you need to refill the dampener loop of the pulse dampener with fresh solvent, keep the pulse dampener flush valve closed.

Diagnostics

Use the following procedures to monitor the pump pulsation, test the pump proportioning accuracy, and determine the delay volume of the pump.

Contents

- [Monitoring the Pump Pulsation](#)
- [Testing the Pump Proportioning](#)
- [Determining the Delay Volume of the Pump](#)

Monitoring the Pump Pulsation

The pump continuously monitors the system pressure and bases its pressure readout on a 30 s interval. The pump pulsation should be less than 1% at backpressures greater than 100 bar (1450 psi).

Note Because the Accela Pump does not use electronic pulse damping, the Accela Pump pressure fluctuation often appears to be higher than that for conventional pumps.

Trapped air bubbles, contaminated proportioning valves, or contaminated check valves can cause excessive pump pulsation. If the pulsation of the pump is greater than 1 percent at pressures greater than 100 bar, purge air out of the piston chambers, and clean the proportioning valves and the check valves (see [“Minimizing Pump Pulsation”](#) on [page 55](#)).

If you cannot reduce the variation in backpressure by performing these procedures, disassemble and clean the LDA, and replace the primary piston seals (see [“Replacing the Primary Pistons Seals”](#) on [page 67](#)).

Note All low-pressure HPLC pumps require eluents that have been properly degassed. The Accela Pump has a built-in vacuum degasser. Plumbing the pump to bypass this degasser introduces a potentially unacceptable level of air into the piston chambers.

The following topics describe how to monitor the pump pulsation from the data system:

- [Using Xcalibur to Monitor the Pump Status](#)
- [Using ChromQuest to Monitor the Pump Status](#)

Using Xcalibur to Monitor the Pump Status

You can find information about the pressure variation (absolute pressure and standard deviation of the pressure) on the Status page of the Information view. This view appears on the left side of the Home Page window.

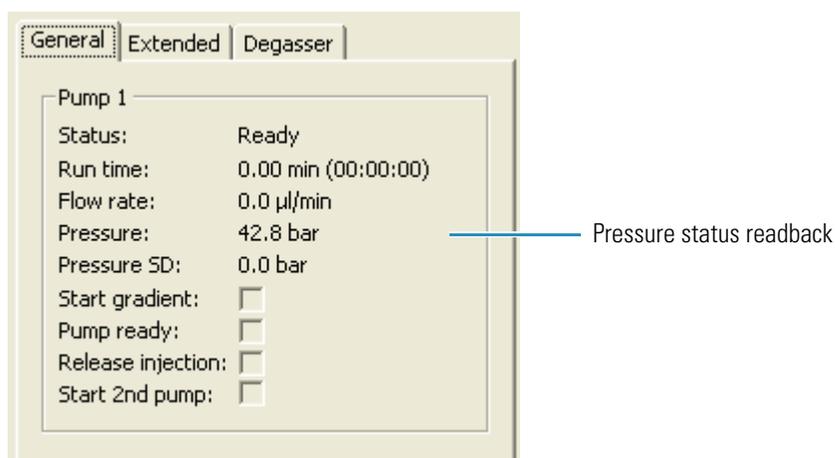
If you cannot see the Information view, it has been turned off.

❖ To open the Info view and check the status of the Accela Pump

1. From the Home Page window, choose **View > Info View** to turn the Information view on and off.
2. To display the Status page, click the **Status** tab.
3. To display the status pages for the Accela Pump, click the **Accela Pump** listing in the directory tree.

Check the value for the standard deviation of the pressure listed on the General page (see [Figure 32](#)).

Figure 32. Status pages for the Accela Pump



Using ChromQuest to Monitor the Pump Status

Table 3 lists the possible statuses for the Accela Pump.

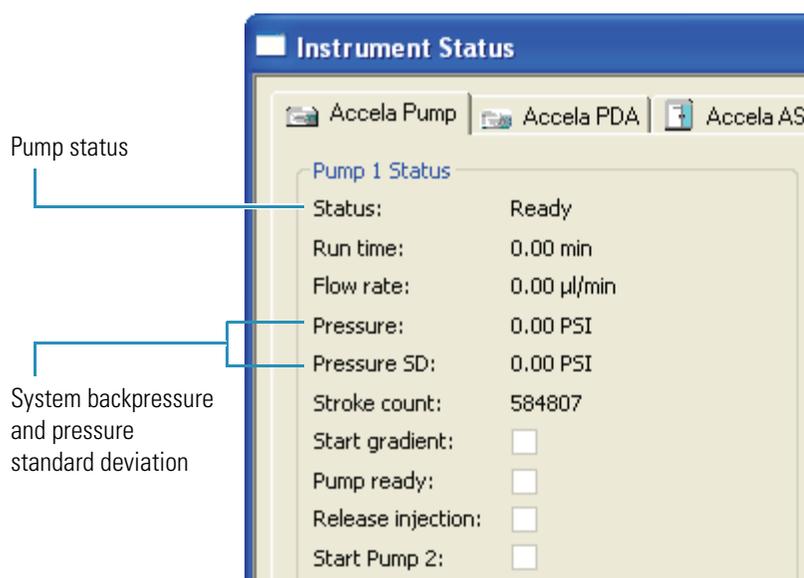
Table 3. Status descriptions for the Accela Pump

Status	Meaning
Ready to Download	The pump is online, but is producing a zero flow rate.
Homing	The pistons are moving to the home position. At lower flow rates, the pistons take longer to reach the home position.
Ready	The pump is waiting for the start signal.
Running Isocratic	The pump is under direct control and pumping an isocratic mobile phase or running a method that contains a one-line pump program.
Running Gradient	The pump is running a method that contains a pump program of two or more lines.
High Pressure Error	The system pressure has risen above the maximum allowable pressure specified in the method or by setting global pressure limits.
Low Pressure Error	The pressure has fallen below the minimum allowable pressure specified in the method or by setting global pressure limits.
Error	A generic run-time error has occurred.

❖ To check the status of the Accela Pump from the ChromQuest data system

1. Open the online Instrument window.
2. Choose **Control > Instrument Status**.

The Instrument Status window appears with the Accela Pump page displayed (see Figure 33). The pump status appears on the left side of the page.

Figure 33. Pump Status area of the Accela Pump page (ChromQuest)

3. Check the status of the Accela Pump.
4. Check the system backpressure and the pressure SD (based on pressure readings taken over a 30 second period).

Testing the Pump Proportioning

Test the proportioning accuracy of the pump periodically by running a step gradient.

Use two eluents, methanol and spiked methanol, for this procedure. The absorbance reading for the 100% spiked methanol solution should be in the 600 to 800 mAU range.

- If your detector contains a standard 10 mm LightPipe flow cell, prepare the spiked methanol solution by adding 7 mg of ethyl paraben (Pump Test Mix, P/N A4904-010) to 1 L of HPLC-grade methanol.
- If your detector contains a 50 mm LightPipe flow cell, prepare the spiked methanol solution by adding 7 mg of ethyl paraben to 4 L of HPLC-grade methanol.

Plumb your system to bypass the autosampler. Use a flow restrictor to maintain a backpressure greater than 40 bar.

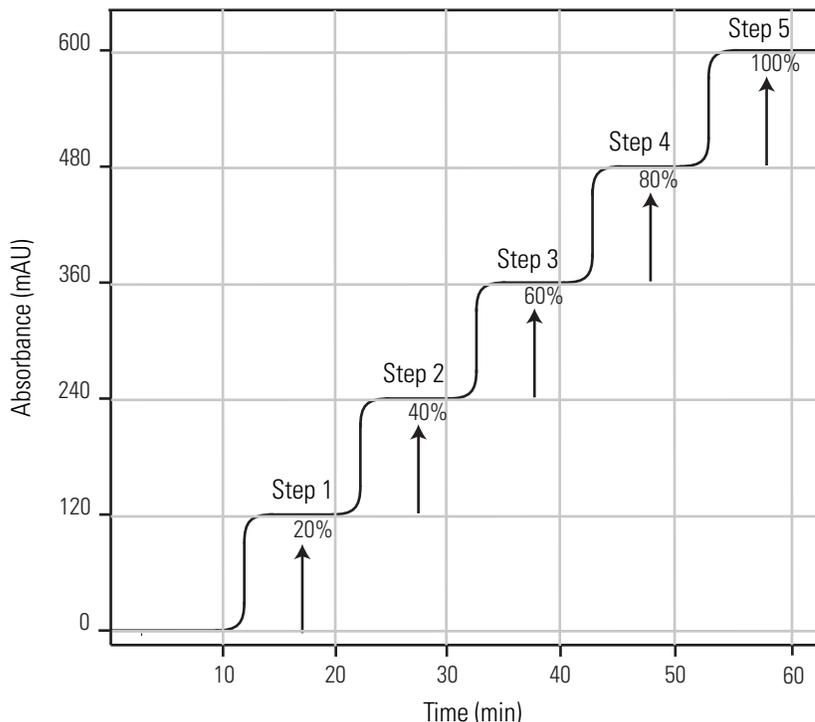
Use the following detector settings and chromatographic conditions to run and monitor the step gradient listed in [Table 4](#):

- Flow: 200 µL/min
- Pressure: approximately 100 bar by restriction
- Eluents: A: methanol B: spiked methanol
- Steps: 10 min hold, 20% increments
- Detection: UV (254 nm)

Table 4. Gradient program

Time (min)	%A	%B
0.00	100.0	0.0
10.0	100.0	0.0
10.01	80.0	20.0
20.0	80.0	20.0
20.01	60.0	40.0
30.0	60.0	40.0
30.01	40.0	60.0
40.0	40.0	60.0
40.01	20.0	80.0
50.0	20.0	80.0
50.01	0.0	100.0
60.0	0.0	100.0

The gradient program described in [Table 4](#) should create a gradient profile containing five steps of equal height as shown in [Figure 34](#). Inaccuracies in the step heights indicate proportioning errors.

Figure 34. Step gradient profile for testing compositional accuracy

Step heights should be within $\pm 1\%$ of the theoretical values. In the step gradient shown in [Figure 34](#), the absorbance value for 100% spiked solvent is 600 mAU (600 mAU – 0 mAU). Therefore, the theoretical values for the 20%, 40%, 60%, and 80% steps are 120, 240, 360, and 480 mAU, respectively. A deviation greater than 6 mAU for any of the steps would be a failing result. If the pump passes both the pulsation and proportioning tests, it is working properly.

If the pump fails the pulsation test or the proportioning test, try to restore proper performance by cleaning the proportioning valves as described in [“Cleaning the LDA Components without Disassembling the LDA”](#) on [page 56](#). If this fails to restore proper pump performance, disassemble and clean the LDA and replace the primary seals as described in [“Replacing the Primary Pistons Seals”](#) on [page 67](#).

Determining the Delay Volume of the Pump

The gradient delay volume of your pump is an important variable if you are developing gradient methods that you plan to transfer to other instruments. The gradient delay volume of the Accela Pump consists of the wetted components that lie in the flow path between the solvent proportioning valves of the pump and the outlet of the LDA.

❖ To determine the gradient delay volume of the pump

1. Set up your LC system:
 - a. Bypass the autosampler by connecting the pump directly to the detector with tubing of known volume. The volume of the inlet tubing to the Accela PDA Detector is 0.32 $\mu\text{L}/\text{inch}$. (P/N 803260, inlet tubing, insulated, red PEEK, 1/16 in. OD \times 0.005 in. ID)
 - b. Prepare a spiked methanol solution as described in “Testing the Pump Proportioning” on page 46.
 - c. Fill one solvent reservoir bottle with 100% methanol.
 - d. Fill a second solvent reservoir bottle with the spiked methanol solution.
 - e. Purge the solvent lines to replace the old solvents with the new solvents.

2. Create a data acquisition method.

Use the following detector settings and chromatographic conditions to run and monitor the linear gradient listed in Table 5:

- Flow: 200 $\mu\text{L}/\text{min}$
- Pressure: approximately 100 bar by restriction
- Eluents: A: methanol B: spiked methanol
- Detection: UV (254 nm)

Table 5. Gradient program for testing gradient delay volume

Time (min)	%Methanol	%Spiked Methanol
0.00	100.0	0.0
0.01	100.0	100.0

3. Equilibrate the system until the baseline stabilizes. To equilibrate the system, depending on the data system you are using, do one of the following:
 - For Xcalibur, go to step [step 4](#).
 - For ChromQuest, go to step [step 5](#).

4. From the Xcalibur data system, do the following:
 - a. In the Direct Control dialog box for the Accela Pump, select the **Take the pump under control** check box (see “Using Xcalibur to Start and Stop the Solvent Flow” on page 39).
 - b. In the Flow box, type **200** to set the flow rate to 200 $\mu\text{L}/\text{min}$.
 - c. In the Inlet box for the solvent reservoir bottle that contains 100% methanol, type **100**.
 - d. Click  (Start).
 - e. Click **Close** to exit the Direct Control dialog box.
 - f. Go to [step 6](#).
5. From the ChromQuest data system, download the method.
6. Collect one data file:
 - For Xcalibur, create a one-line sequence containing the instrument method, and then run the sequence.
 - For ChromQuest, click the **Single Run** button. Enter the appropriate information in the Single Run dialog box, and then start the run.
7. Calculate the gradient delay volume of the pump:
 - a. To determine the total gradient delay volume, multiply the gradient delay time by the flow rate.
 - b. To determine the gradient delay volume of the pump, subtract the volume of the tubing connecting the pump to the detector from the total gradient delay volume.

The results of your run should look like the chromatogram shown in [Figure 35](#). The gradient delay volume of the pump is calculated as follows:

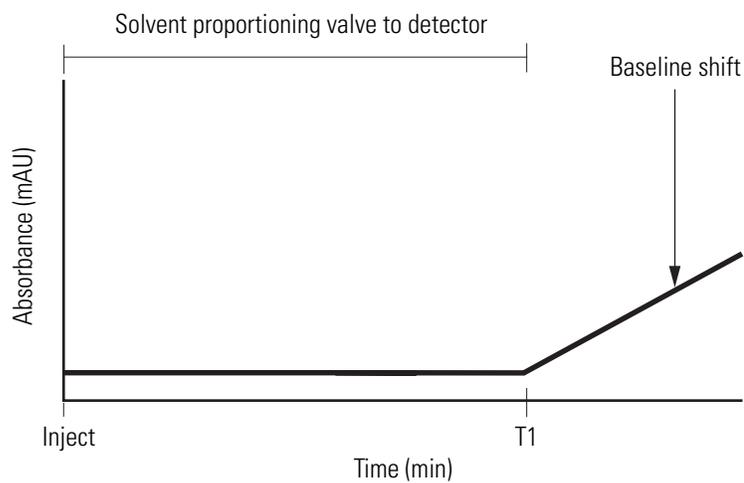
$$\text{Total gradient delay volume} = T1 \times \text{flow rate}$$

$$\text{Gradient delay volume of the pump} = T1 \times \text{flow rate} - \text{tubing volume}$$

$$= (0.45 \text{ min} \times 200 \mu\text{L}/\text{min}) - (0.32 \mu\text{L}/\text{inch} \times 25 \text{ inches})$$

$$= 82 \mu\text{L}$$

Figure 35. Graphical display of the baseline shift that occurs as the spiked mobile phase reaches the detector



Maintenance

To properly maintain your pump, monitor its performance. If the pressure pulsation increases or the proportioning accuracy decreases, take remedial action. To lengthen the lifespan of the seals, always flush the piston guide bushings with distilled water after pumping buffered solutions.

The liquid displacement assembly (LDA) contains the parts of the pump that are subject to routine wear and tear. These parts are the primary piston seals, the pistons, and the check valves. Occasionally, the secondary piston seals, the check valve film seals in the top and bottom of the displacement chambers, and the outlet film seal might also require replacement.

If you detect a leak from the LDA, remove the LDA from the pump, disassemble the LDA, clean its components, and replace the primary piston seals.



CAUTION Do not disassemble the dynamic mixer. It does not contain serviceable parts.

Contents

- [Flushing the Piston Guide Bushings](#)
- [Minimizing Pump Pulsation](#)
- [Cleaning the LDA Components after Disassembling the LDA](#)
- [Removing the LDA from the Pump](#)
- [Disassembling the LDA](#)
- [Replacing the Primary Pistons Seals](#)
- [Assembling the Liquid Displacement Assembly](#)
- [Connecting the LDA to the Pump](#)
- [Servicing the Proportioning Valves](#)
- [Replacing the Solvent Reservoir Filters](#)
- [Replacing a Fuse](#)

Flushing the Piston Guide Bushings

As the pistons move back and forth within the displacements chambers, a small quantity of mobile phase leaks behind the primary piston seals. With buffered mobile phases, a precipitate (also known as creep or salt build-up) forms as the liquid fraction evaporates. The abrasion caused by this precipitate can scratch the piston and shorten the life of the piston seals.

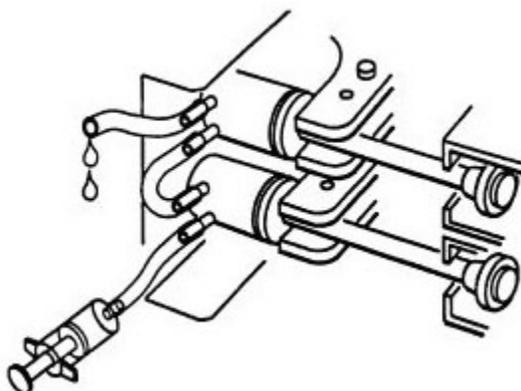
To lengthen the life of the primary piston seals and the pistons, always rinse the piston guide bushings with distilled water after pumping buffered solutions (see [Figure 36](#)).

The piston guide bushings come with two pieces of standard 1/8 in. × 1/16 in. PTFE tubing.

❖ To flush the piston guide bushings

1. If the outer piece of PTFE tubing has not been cut, cut it through the middle.
2. Connect a syringe filled with distilled water to the bottom piece of outer tubing and gently flush the water through the system.

Figure 36. Flushing the piston guide bushings



Minimizing Pump Pulsation

Trapped air bubbles, contaminated proportioning valves, or contaminated check valves can cause excessive pump pulsation. If the pulsation of the pump is greater than 1 percent at pressures greater than 100 bar, purge air out of the piston chambers, and clean the proportioning valves and the check valves.

If you cannot reduce the variation in backpressure by performing these procedures, disassemble and clean the LDA, and replace the primary piston seals as described in “Replacing the Primary Pistons Seals” on page 67.

To reduce pump pulsation, follow these procedures:

- [Removing Air from the Piston Chambers](#)
- [Cleaning the LDA Components without Disassembling the LDA](#)

Removing Air from the Piston Chambers

Air trapped in the piston chambers causes an excessive variation in the backpressure.

Note All low-pressure HPLC pumps require eluents that have been properly degassed. The Accela Pump has a built-in vacuum degasser. Plumbing the pump to bypass this degasser introduces a potentially unacceptable level of air into the piston chambers.

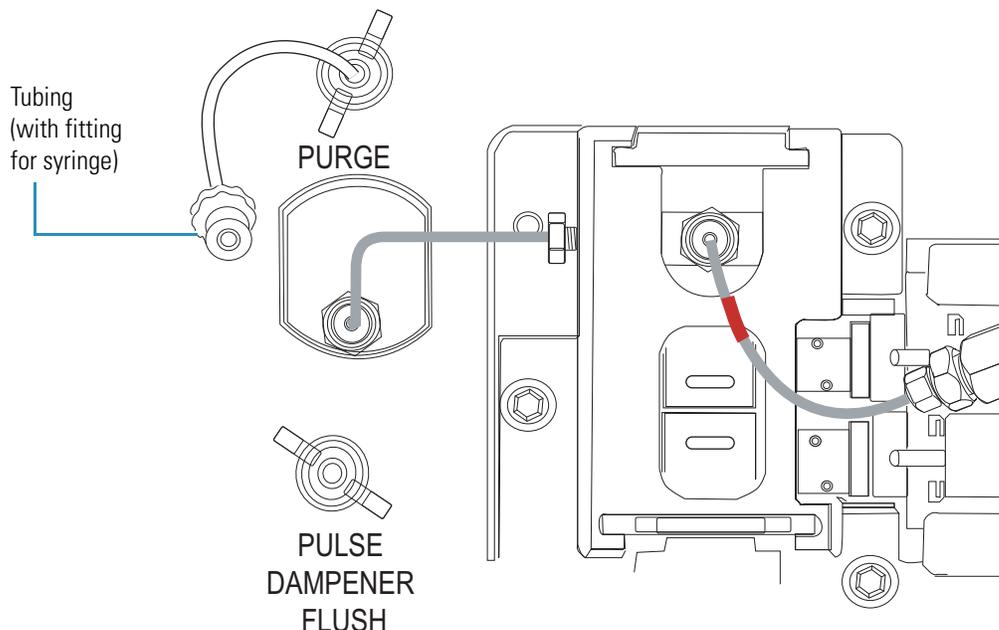
❖ To purge air out of the piston chambers

1. Open the purge valve by turning its wingnut counterclockwise (see [Figure 37](#)).
2. Insert the 10 mL syringe, which is supplied in the accessory kit, into the tubing attached to the purge valve.
3. Pump 100% methanol or 100% acetonitrile through the liquid displacement assembly (LDA) at a flow rate of 200 $\mu\text{L}/\text{min}$ for 10 to 15 minutes.

Note Purging the pump at a low flow rate with 100% organic solvent works much better than purging the pump at a high flow rate with (partly) aqueous eluents.

4. Close the purge valve and return to the initial conditions.
5. Check the pressure variation to determine if performing this procedure remedied the pressure stability problem.

Figure 37. View of the tubing connected to the purge valve



Cleaning the LDA Components without Disassembling the LDA

Contaminated check valves and contaminated proportioning valves can cause an excessive variation in backpressure. To remove the contamination, open the purge valve to bypass the LC column and pump the appropriate flush solvents through the LDA.

❖ To clean the check valves and the proportioning valves

1. Open the purge valve by turning the wingnut to the left side of the LDA counterclockwise (see [Figure 37](#)).



CAUTION Opening the purge valve redirects the flush solvent out the purge valve, rather than out the front of the LDA. If you do not open the purge valve, the flush solvent flows through the LC components such as the LC column that are downstream of the LDA.

2. Set up the system to pump the same solvent on all four channels by connecting all four solvent reservoir lines to one solvent bottle.
3. Attach a 10 mL disposable syringe to the tubing attached to the purge valve. The syringe is supplied in the Accela Pump Accessory Kit (see [“Accela Pump Accessory Kit”](#) on [page 97](#)).

4. If you were pumping buffered mobile phase through the system, pump HPLC-grade water on all four channels at a flow rate of 200 $\mu\text{L}/\text{min}$ for 30 minutes. Empty the contents of the syringe into a suitable waste receptacle, and then pump an additional 6 mL of water through the LDA.
5. Sequentially pump solvents of increasing polarity through the LDA. The last flush solvent should be miscible with the mobile phase that you plan to use.

Table 6. Polarity indexes of various HPLC solvents

Solvent	Polarity index
Isopropanol	3.9
Methanol	5.1
Acetonitrile	5.8
Water	9.0

6. Close the purge valve.
7. Retest the pressure variation by returning to the initial conditions that displayed the problem. Make sure that the backpressure at these conditions is at least 40 bar.

Cleaning the LDA Components after Disassembling the LDA

The check valves, pistons, displacements chambers, and inlet module are the most likely components to have problems with contamination. You cannot clean the primary piston seals. If the primary piston seals contain particulate matter, replace them.

If flushing the LDA (see “[Cleaning the LDA Components without Disassembling the LDA](#)” on [page 56](#)) does not remove the contamination, disassemble the LDA, and then follow these cleaning procedures:

- [Cleaning the Check Valves](#)
- [Cleaning the Pistons](#)
- [Cleaning the Displacement Chambers and the Inlet Module](#)

For instructions on disassembling the LDA, see “[Disassembling the LDA](#)” on [page 64](#).

Cleaning the Check Valves

To clean the check valves, Thermo Fisher Scientific recommends using a 10 mL syringe with a very short piece of silicon tubing at the Luer exit.

❖ To clean the check valves

Using a 10 mL syringe with a very short piece of silicon tubing at the Luer exit, gently flush the check valves with these solvents: 5 mL acetone, followed by 5 mL of distilled water with a few drops of detergent, and then 5 mL methanol.

If you cannot achieve free flow through the check valve, replace it.



CAUTION Do not use an ultrasonic bath to clean the check valves. Sonicating the check valves can damage their small ruby balls.

Cleaning the Pistons

If precipitate is visible on the pistons, clean them with a soft tissue and cleaning paste. Then rinse the pistons with methanol.

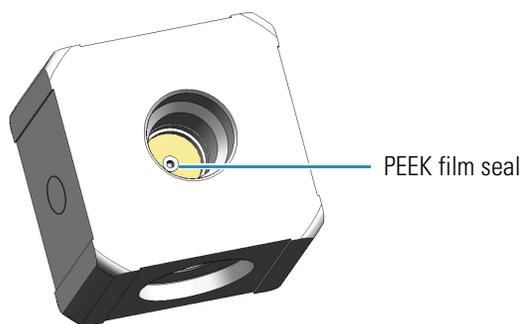
Cleaning the Displacement Chambers and the Inlet Module

Clean the displacement chambers if the primary piston seals have started to decompose and you notice black, fibrous, particles in the chamber.

❖ To clean the displacement chambers and the inlet module

1. Pry the piston seals out of the bores of the displacement chambers:
 - a. Carefully insert a piston into the hole in the center of the seal, but do not push the piston further into the bore of the displacement chamber.
 - b. Gently pry the seal out of the bore.
2. Using a needle, graphite pencil, or equivalent tool, carefully remove the PEEK film seals (see [Figure 38](#)). Be careful not to scratch the displacement chambers as you remove the film seals, as this might cause leaking.

Figure 38. View of the PEEK film seal inside a displacement chamber



Note Both ends of the lower displacement chamber, the lower end of the upper displacement chamber, and the bottom of the outlet module contain a PEEK film seal for a total of four film seals.

3. Place the displacement chambers and the inlet module in an ultrasonic bath. First use water (to remove any buffer precipitate) and then use acetone.
4. After cleaning the displacement chambers and the inlet module, reinstall the PEEK film seals if they do not show signs of damage.
5. Replace the primary and secondary piston seals before assembling the LDA.

Removing the LDA from the Pump

To remove the LDA from the front panel of the pump, use the following tools. Almost all of these tools are provided in the Accela Pump Accessory Kit:

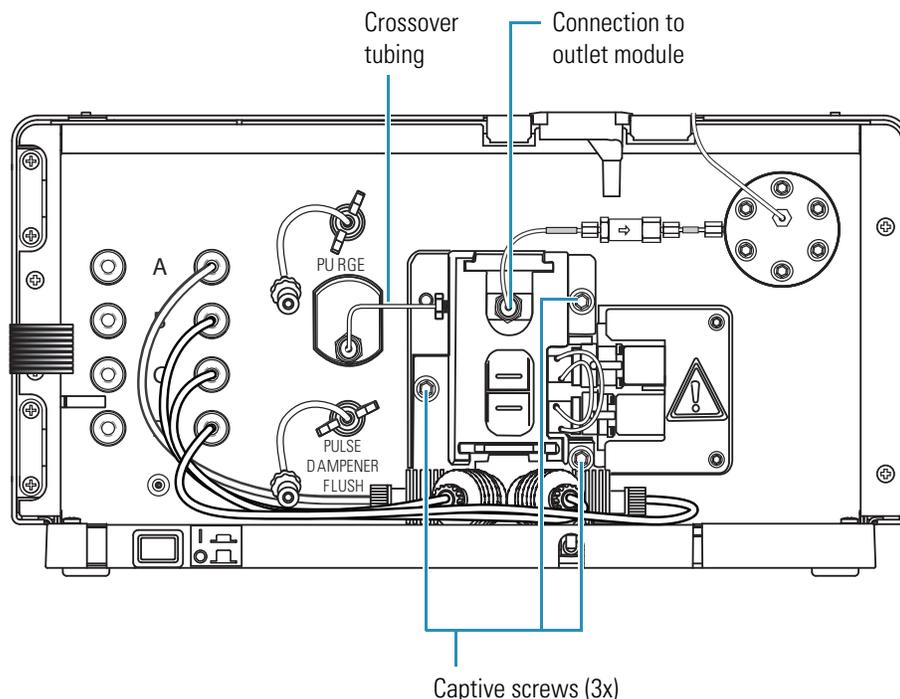
- 4 mm balldriver
- 2.5 mm balldriver
- 4 mm L-hex wrench
- 8 mm × 10 mm open-ended wrench
- 5/16 in. × 1/4 in. open-ended wrench
- Flat-blade screwdriver (not provided)

❖ To remove the LDA from the pump

1. Turn off the power to the pump.
2. Raise the solvent filter in each bottle above the solvent level so that only the fluid in the lines drains out. Use a beaker to collect the mobile phase contained in the lines.
3. Using an 8 mm open-ended wrench, disconnect the crossover tubing from the pulse dampener (see [Figure 39](#)).
4. Using a 1/4 in. open-ended wrench, disconnect the stainless steel tubing from the outlet module of the LDA (see [Figure 39](#)).

Note There are two versions of the LDA for the Accela Pump. In the original version of the LDA, the lower displacement chamber had an etched flow-direction arrow. [Figure 39](#) shows the current version of the LDA.

Figure 39. View of the high-pressure tubing connections

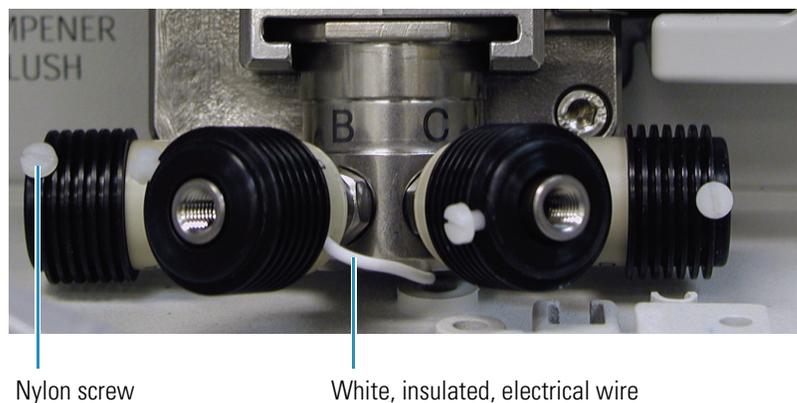


5. Unscrew the low-pressure solvent lines connected to the solvent proportioning valves.
6. Using a flat blade screwdriver, loosen the small, nylon screws that secure the actuating coils to the proportioning valves, and then pull the actuating coils off the ends of the proportioning valves (see [Figure 40](#)).



CAUTION Take care not to pinch the wires that connect the actuating coils to the pump. Pinching a connecting wire can irreversibly damage the thin electrical wire housed within the white insulated coating. The damage might not be apparent until you attempt to run the pump.

Figure 40. View of the actuating coils with their nylon screws

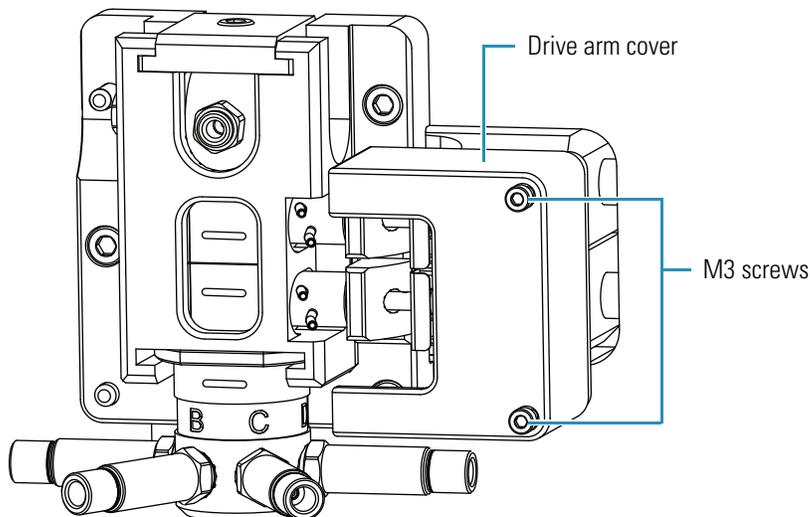


6 Maintenance

Removing the LDA from the Pump

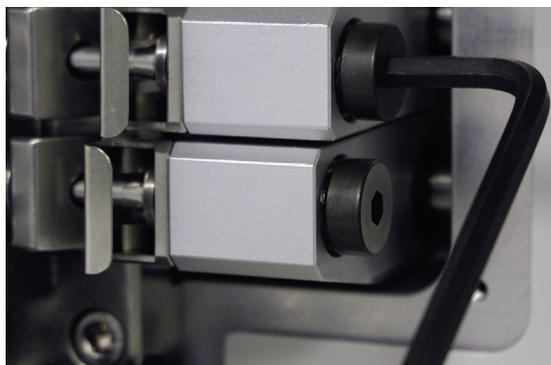
- Using a 2.5 mm balldriver, remove the two M3 screws that secure the drive arm cover to the pump (see [Figure 41](#)).

Figure 41. Removing the drive arm cover



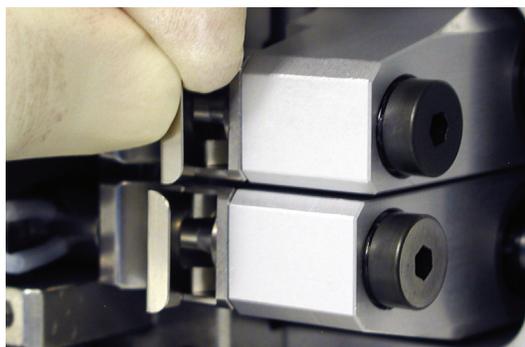
- Using a 4 mm L-hex wrench, turn the two clamping screws 3 to 4 turns to loosen the piston spring clamps (see [Figure 42](#)).

Figure 42. Loosening the clamping screws



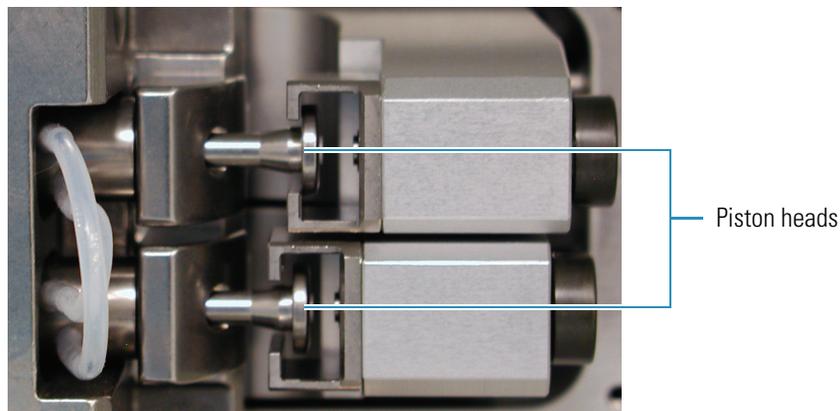
- Remove the two piston spring clamps as shown [Figure 43](#).

Figure 43. Removing the piston spring clamps (retaining clips)



10. Gently push the piston heads to the left so that they do not contact the Z-arms as shown in [Figure 44](#).

Figure 44. View of the piston heads pushed to the left

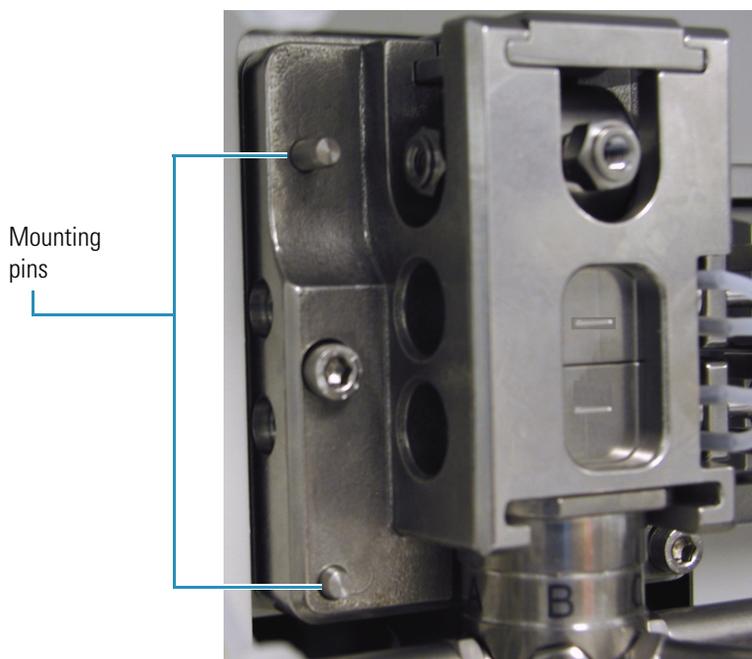


11. Using a 4 mm ball driver, loosen the three captive screws that secure the LDA to the front panel of the pump (see [Figure 39](#) on [page 61](#)).
12. Pull the LDA forward until it clears the two mounting pins, and then lift it up approximately 1 cm. [Figure 45](#) shows the two mounting pins.



CAUTION Take care not to pinch the wires that connect the actuating coils to the pump. Pinching a connecting wire can irreversibly damage the thin electrical wire housed within the white insulated coating. The damage might not be apparent until you attempt to run the pump.

Figure 45. Pulling the LDA off the mounting pins



Disassembling the LDA

To prevent contamination of the internal surfaces of the LDA, make sure that you have a clean benchtop to work on before you disassemble the LDA.

To replace the piston seals, remove the holding hooks, bushings, and pistons from the LDA body. To replace the check valves, completely disassemble the LDA.

To disassemble the LDA, follow these procedures:

1. [Removing the Holding Hooks, Bushings, and Pistons from the LDA Body](#)
2. [Removing the Stacked Components from the LDA Body](#)

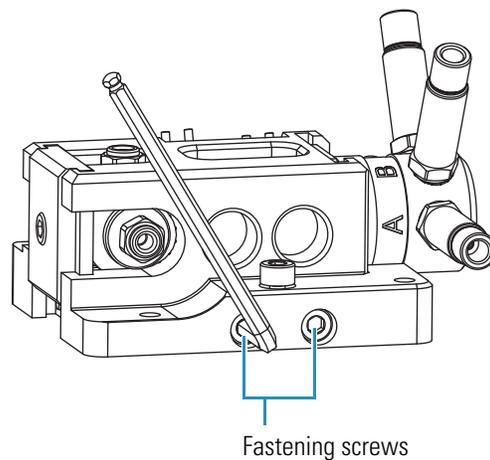
Removing the Holding Hooks, Bushings, and Pistons from the LDA Body

❖ **To remove the holding hooks, bushings, and pistons from the LDA Body**

1. Using the 4 mm L-Hex wrench, loosen the fastening screws on the left side of the LDA as shown in [Figure 46](#).

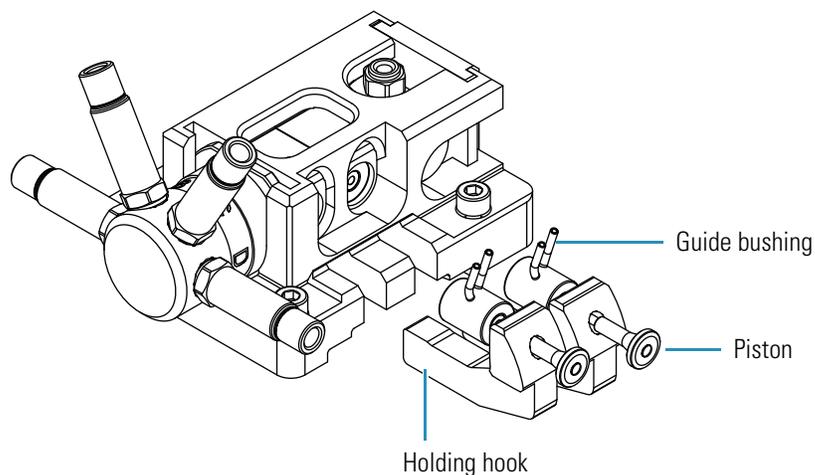
These screws secure the holding hooks to the body of the LDA. As you loosen the screws, the holding hooks move to the right. You can detach the holding hooks completely with approximately nine turns on the screw fasteners.

Figure 46. Loosening the fastening screws that secure the holding hooks



2. Remove the holding hooks, bushings, and pistons from the LDA body (see [Figure 47](#)).

Figure 47. Removing the holding hooks, bushings, and pistons from the LDA body



If you are replacing the primary piston seals but do not need to clean the stacked components of the LDA, go to [“Replacing the Primary Pistons Seals”](#) on [page 67](#). You can remove the primary piston seals from the displacement chambers without removing the displacement chambers from the LDA body.

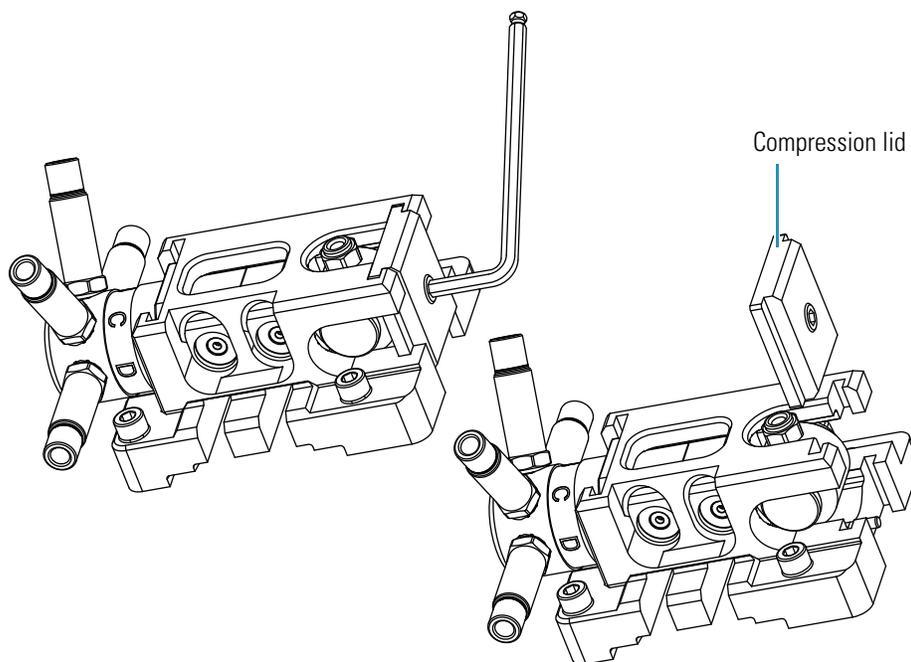
Removing the Stacked Components from the LDA Body

To replace the check valves, remove the stacked components from the LDA body.

❖ To remove the stacked components from the LDA body

1. Using the 4 mm L-Hex wrench, loosen the top set screw, and then slide the LDA compression lid out (see [Figure 48](#)).

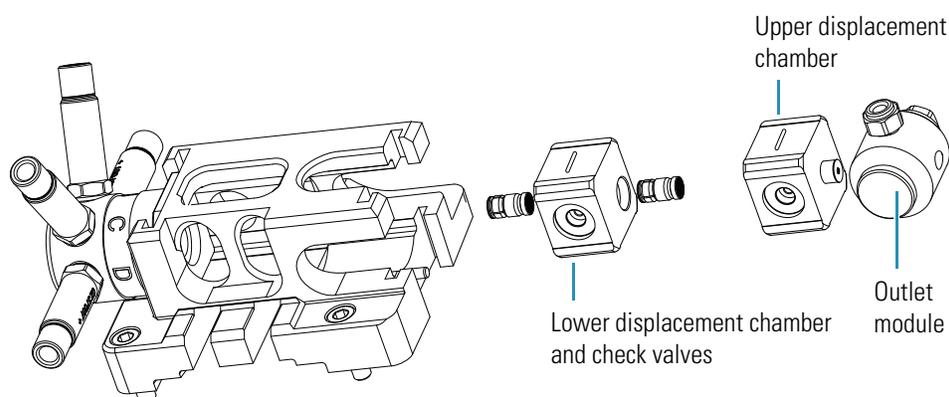
Figure 48. Removing the compression lid from the LDA



2. Remove the inner components of the LDA body. These components include the outlet module, the upper displacement chamber, and the lower displacement chamber with check valves.

[Figure 49](#) shows the stacked components of the current LDA. For information on the previous version of the LDA, see [Appendix A, “Discontinued Versions of the Accela Pump.”](#)

Figure 49. Removing the stacked components from the LDA body



Replacing the Primary Pistons Seals

When you disassemble the LDA, you must replace the primary piston seals.

❖ To replace the primary piston seals

1. To remove air from the springs, soak a pair of new primary piston seals (with the springs facing upwards) in methanol or isopropanol for 5 minutes.



CAUTION Do not place the piston seals in an ultrasonic bath. Sonicating the piston seals can damage the smooth surface of the seals.

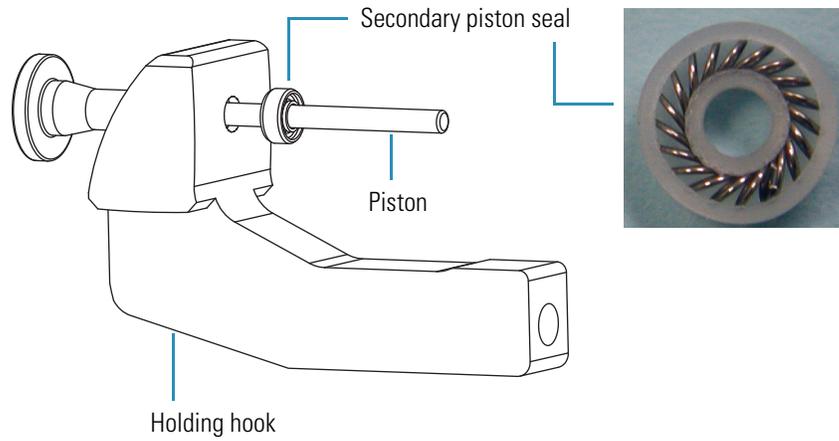
2. Remove the LDA from the pump (see “[Removing the LDA from the Pump](#)” on page 60).
3. Remove the holding hooks, bushings, and pistons from the LDA body (see “[Removing the Holding Hooks, Bushings, and Pistons from the LDA Body](#)” on page 64).
4. Remove the used primary piston seals (see [Figure 52](#) on page 69):
 - a. Carefully insert a piston into the hole in the center of the seal, but do not push the piston further into the bore of the displacement chamber.
 - b. Gently pry the seal out of the bore.
5. Carefully slide the piston through the bore in the holding hook. And then, with its spring facing toward you, slide the white, secondary piston seal onto the piston (see [Figure 50](#)).

Note The secondary piston seals are reusable.

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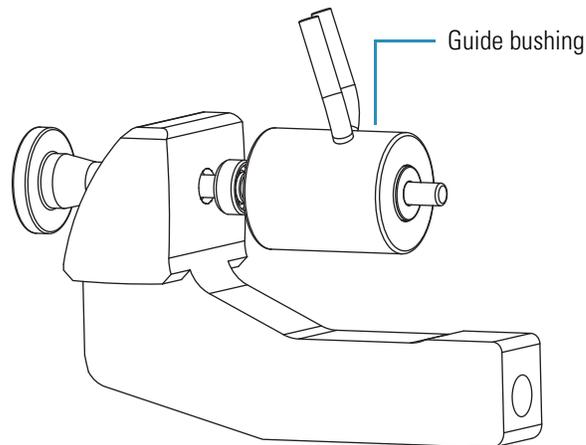
Replacing the Primary Pistons Seals

Figure 50. View of the piston inserted into the holding hook and the secondary piston seal installed on the piston



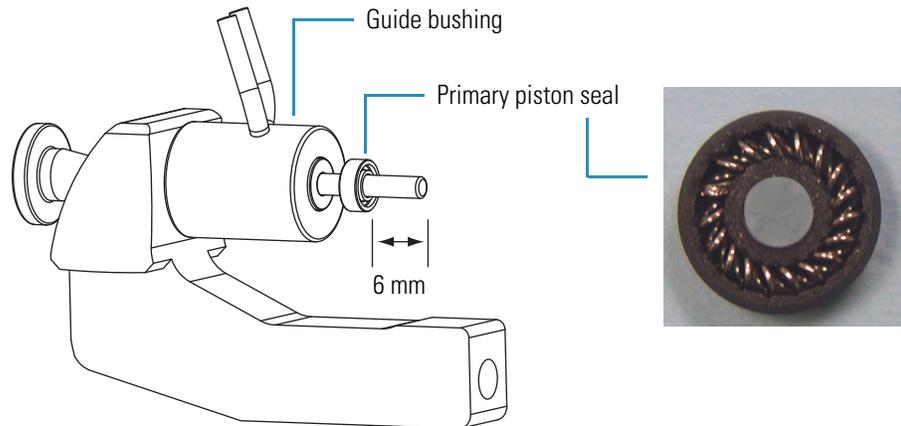
6. Slide the guide bushing onto the piston (see [Figure 51](#)).

Figure 51. View of the holding hook, piston, secondary piston seal, and guide bushing assembly



7. With its spring facing toward you, slide the black, primary piston seal onto the piston. The piston should protrude by approximately 6 mm as shown in [Figure 52](#).

Figure 52. View of the final assembly



8. Finish reassembling the LDA:

- If you did not remove the stacked components from the LDA, go to [“Installing the Holding Hooks and the Piston Assemblies”](#) on [page 73](#).
- If you removed the stacked components from the LDA, go to [“Inserting the Components of the LDA Stack into the LDA Body”](#) on [page 71](#).

Assembling the Liquid Displacement Assembly

To assemble the LDA, follow these procedures:

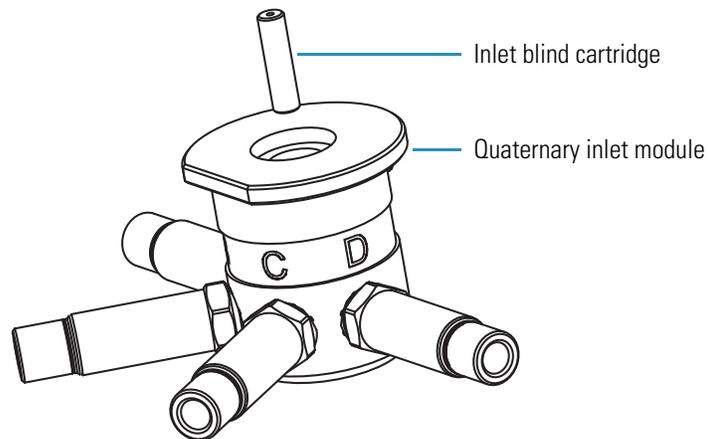
1. [Connecting the Quaternary Inlet Module to the LDA Body](#)
2. [Inserting the Check Valves into the Lower Displacement Chamber](#)
3. [Inserting the Components of the LDA Stack into the LDA Body](#)
4. [Installing the Holding Hooks and the Piston Assemblies](#)

Connecting the Quaternary Inlet Module to the LDA Body

❖ To connect the quaternary inlet module to the LDA body

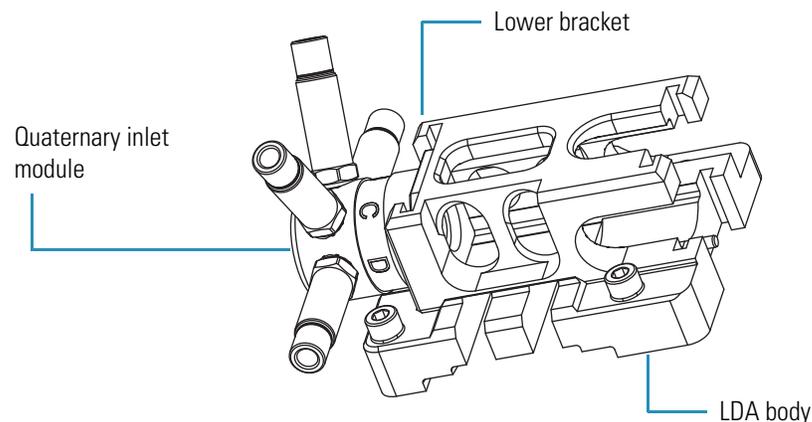
1. Insert the inlet blind cartridge into the quaternary inlet module (see [Figure 53](#)).

Figure 53. Inserting the inlet blind cartridge



2. Slide the top rim of the quaternary inlet module into the bracket on the bottom of the LDA body (see [Figure 54](#)).

Figure 54. Connecting the outlet module to the LDA body



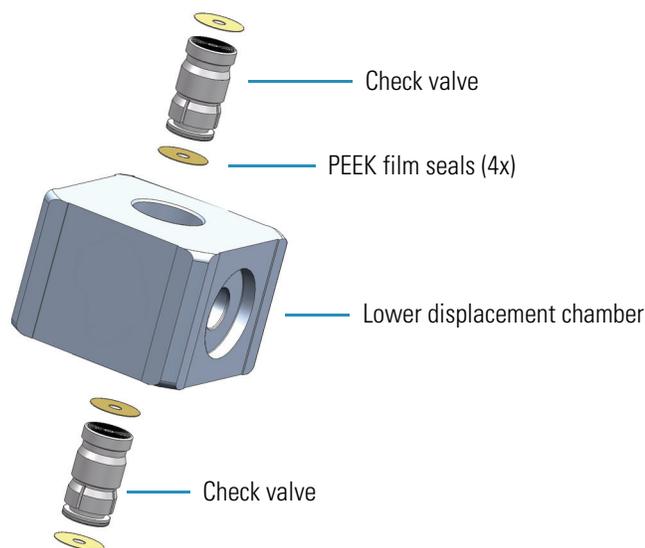
Inserting the Check Valves into the Lower Displacement Chamber

Note There are two versions of the LDA. For information on the discontinued version, see [Appendix A, “Discontinued Versions of the Accela Pump.”](#)

❖ To install the check valves

1. Insert the PEEK film seals into both bores of the lower displacement chamber.
2. Insert the check valves into both bores of the lower displacement chamber (see [Figure 55](#)).

Figure 55. Lower displacement chamber, check valves, and PEEK film seals



3. Because the fit between the check valve and the displacement chamber bores is loose, place the LDA body on a flat service as you insert the lower displacement chamber and check valve assembly.

Inserting the Components of the LDA Stack into the LDA Body

If they are installed correctly, the inner components of the LDA form a perfect stack that ensures smooth movement of the pistons.

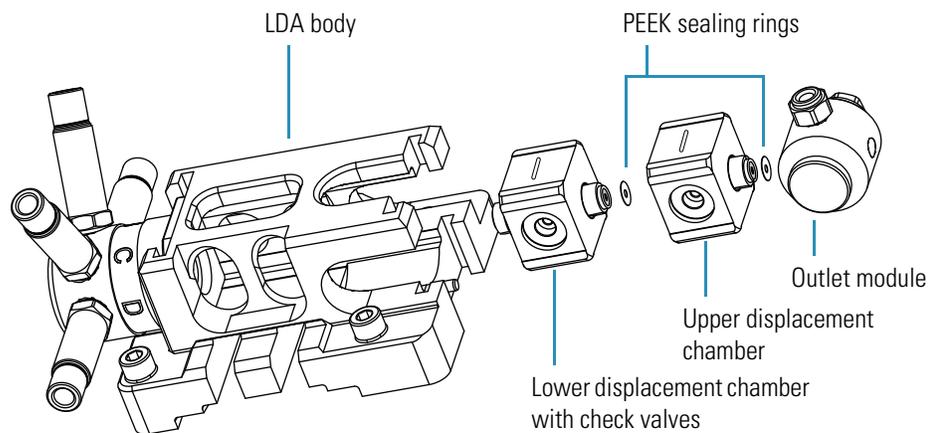
❖ To install the inner components of the LDA stack

1. Because the fit between the check valves and the lower displacement chamber is loose, place the LDA body on a flat surface, and then insert the lower displacement chamber and check valve assembly into the LDA body (see [Figure 56](#)).
2. Install the upper displacement chamber and two PEEK film seals ([Figure 56](#)).
3. Install the outlet module (see [Figure 56](#)).

6 Maintenance

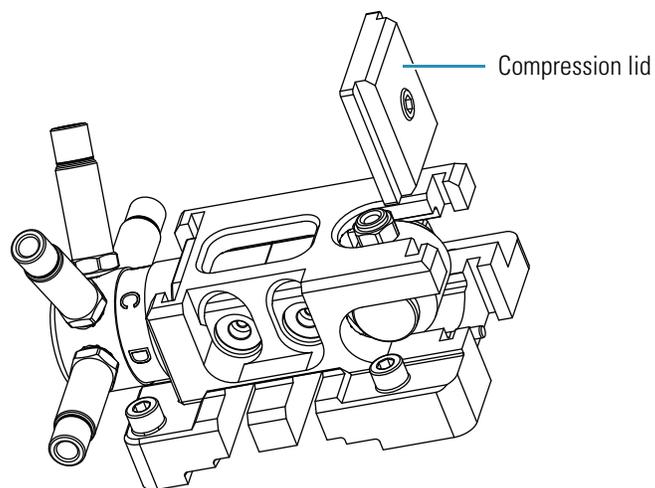
Assembling the Liquid Displacement Assembly

Figure 56. Installing the stacked components of the LDA



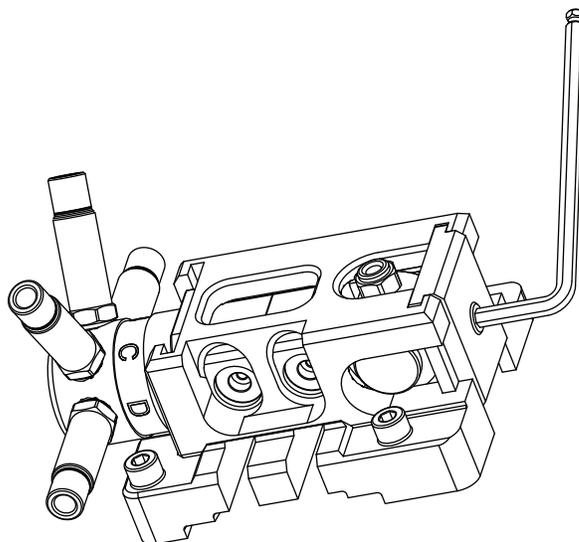
4. Slide the compression lid into the upper bracket of the LDA body (see [Figure 57](#)).

Figure 57. Sliding the compression lid into the LDA body



- Using a 4 mm L-hex wrench, tighten the compression lid as shown in [Figure 58](#).

Figure 58. Tightening the compression lid



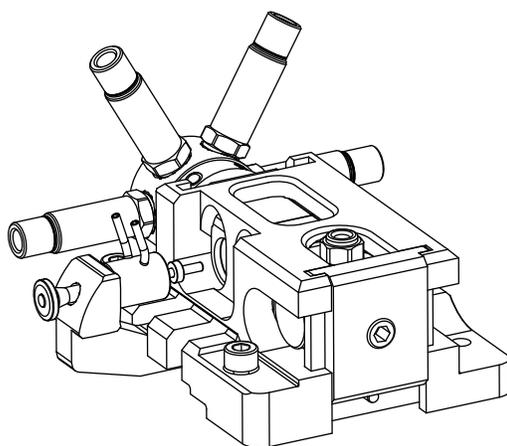
Installing the Holding Hooks and the Piston Assemblies

Note For instructions on assembling the holding hook and piston assembly, see “Replacing the Primary Pistons Seals” on page 67.

❖ **To install the holding hooks and piston assemblies**

- Slide each holding hook and piston unit into its designated slot (see [Figure 59](#)).

Figure 59. Sliding the holding hook and piston assembly into the LDA body



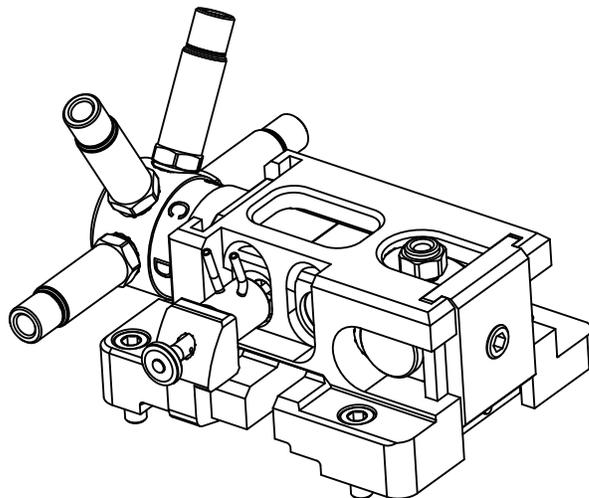
6 Maintenance

Assembling the Liquid Displacement Assembly

2. Slide the pistons as far as possible into the displacement chambers (see [Figure 60](#)).

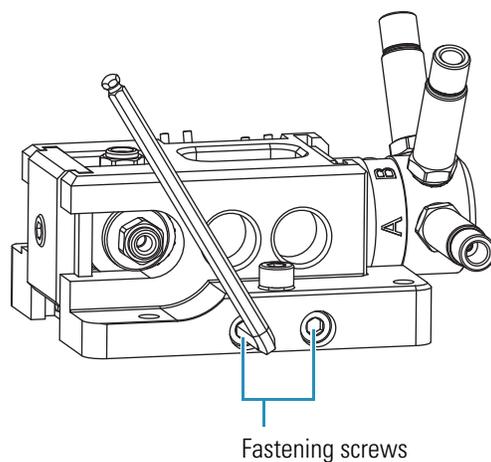
The piston acts as a guiding aid as you tighten the fastening screws in [step 3](#).

Figure 60. View of the piston pushed into the displacement chamber



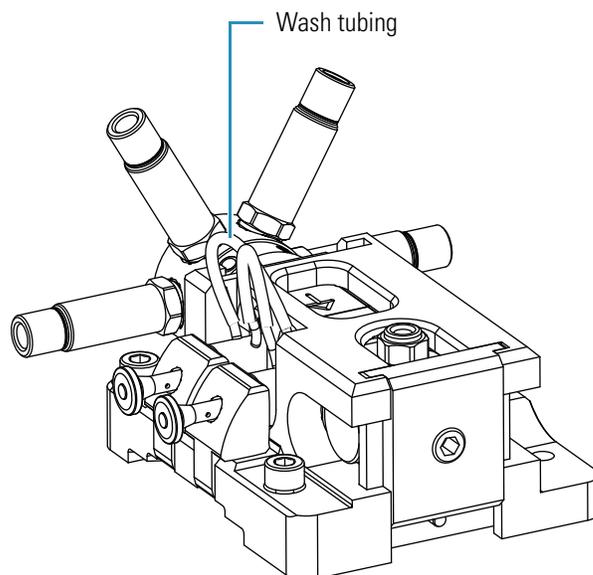
3. Using a 4 mm L-hex wrench, tighten the fastening screws (see [Figure 61](#)).

Figure 61. Tightening the fastening screws



4. Readjust the guide bushing flush adaptors, and then reattach the wash tubing (see [Figure 62](#)).

Figure 62. View of the LDA with the wash tubing installed on the guide bushings



Connecting the LDA to the Pump

After you reassemble the LDA, connect it to the front panel of the pump.

❖ To connect the LDA to the front panel of the pump

1. Taking care not to pinch the wires that connect the coils to the pump, mount the LDA onto the front panel of the pump. The two guide pins on the pump align with the two alignment holes in the LDA body (see [Figure 63](#)).

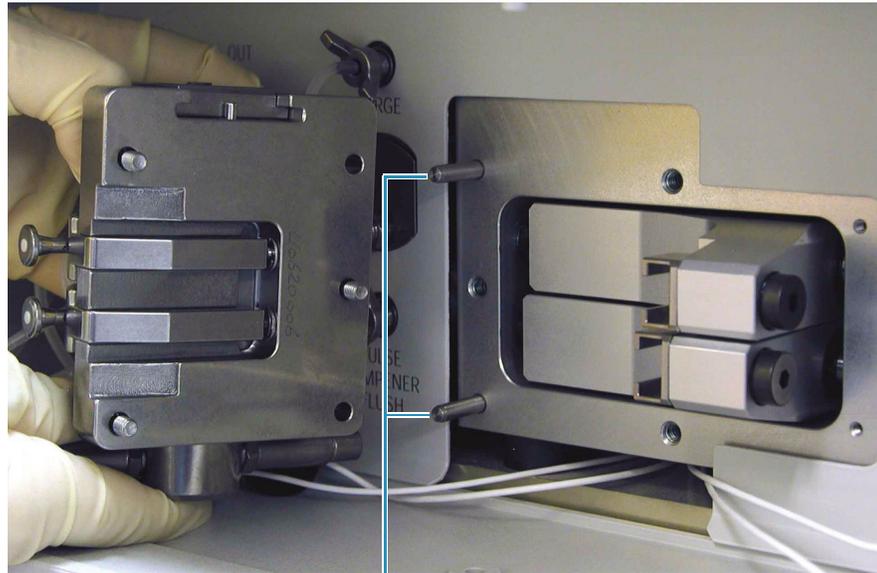


CAUTION Although the damage is not visible, pinching one of these connecting wires can irreversibly damage the internal copper wire, which conducts electricity to magnetize the coil. This damage causes the proportioning valve to stop functioning.

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Connecting the LDA to the Pump

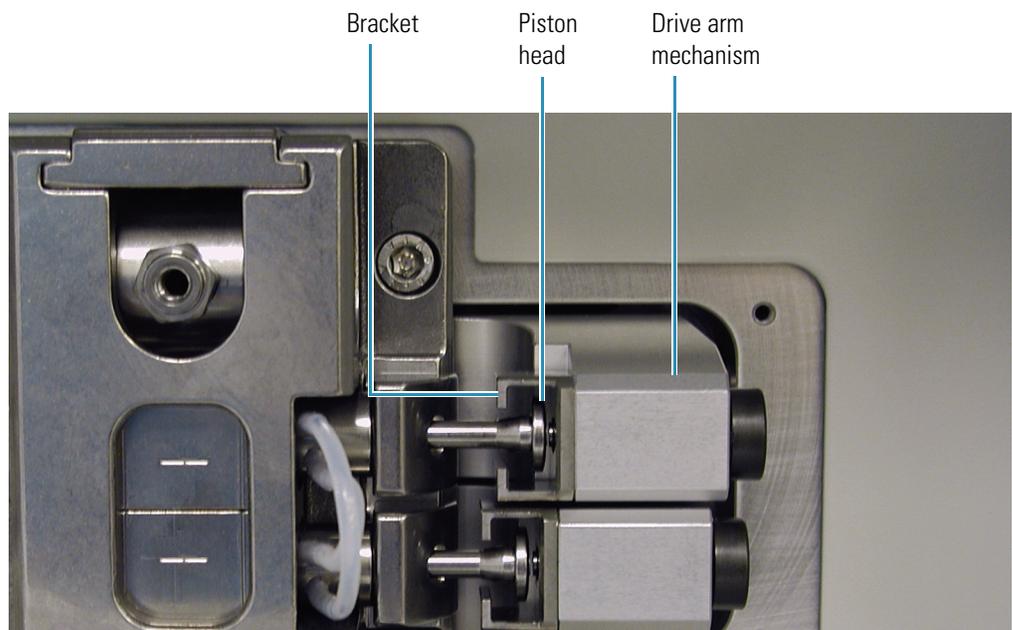
Figure 63. View of the alignment pins for the LDA body



Alignment pins

2. Alternately tighten the three captive screws that secure the LDA to the pump.
3. Push the heads of the pistons toward the arms of the drive mechanism, leaving a gap between the piston head and the brackets at the ends of the arms (see [Figure 64](#)).

Figure 64. Pushing the piston heads towards the drive mechanism arms



4. Insert the two piston retaining clips between the piston heads and the brackets of the drive mechanism arms.

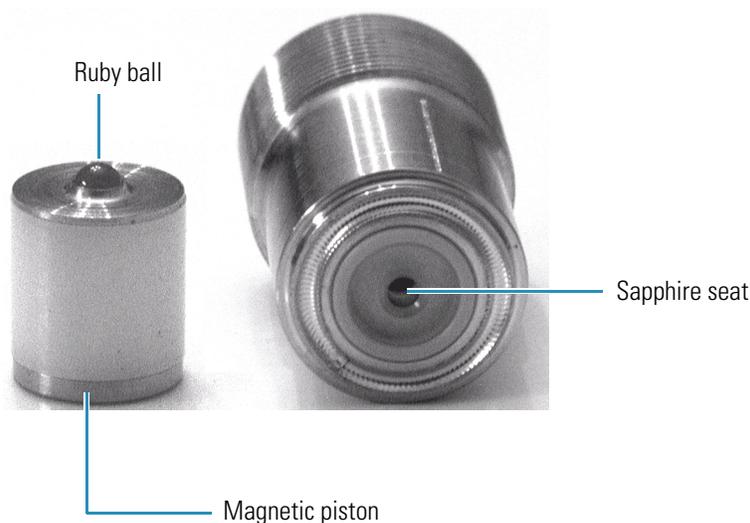
5. Using a 4 mm L-hex wrench, tighten the clamping screws on the right side of the drive arm mechanisms.
6. Using a 2.5 mm balldriver, replace the drive arm cover and tighten the screws.
7. Attach the actuating coils to their respective proportioning valves.
8. Attach the solvent lines to their respective proportioning valves.
9. Connect the crossover tubing to the pressure sensor assembly and the left side of the LDA. Using an 8 mm open-ended wrench, tighten the fittings.
10. Connect the LDA outlet to the dynamic mixer inlet. Using a 1/4 in. open-ended wrench, tighten the high-pressure fittings.
11. To ensure that your pump is functioning properly, turn on the solvent flow, check for leaks, and perform the pump pulsation and proportioning tests described in [Chapter 5, "Diagnostics."](#)

Servicing the Proportioning Valves

Each proportioning valve of the Accela Pump contains an electromechanically actuated ball and seat valve. The ruby ball portion of the valve sits on one end of a magnetic piston that floats within the body of the valve. The sapphire seat where the ball rests is located on the back of the valve face (see [Figure 65](#)).

The ruby ball normally rests against the sapphire seat, shutting off the solvent flow. Electrical pulses from the coils surrounding the valve cause the magnetic piston to glide back and forth within the body of the valve, allowing solvent to flow through the valve and into the inlet module.

Figure 65. Ruby ball and sapphire seat of the proportioning valve



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Servicing the Proportioning Valves

Occasionally, after extended periods of disuse, the free-floating piston inside the proportioning valve freezes against its sapphire seat. When this occurs, dislodging the frozen valve requires a greater mechanical force than the magnetic field applied by the actuating coils.

You can dislodge the frozen proportioning valve with the proportioning valve tool supplied in the accessory kit. This tool fits through the solvent inlet in the end of the valve face (see [Figure 66](#)).



CAUTION Do **not** disassemble the proportioning valve. If you disassemble the valve, send the valve back to the factory for repair or order a new valve.

❖ To dislodge the frozen valve inside the proportioning valve

Push the tool (which is a piece of stainless steel wire) into the valve until you contact the piston, and then gently push the piston away from the valve face.

Figure 66. Proportioning valve, shown with the valve tool



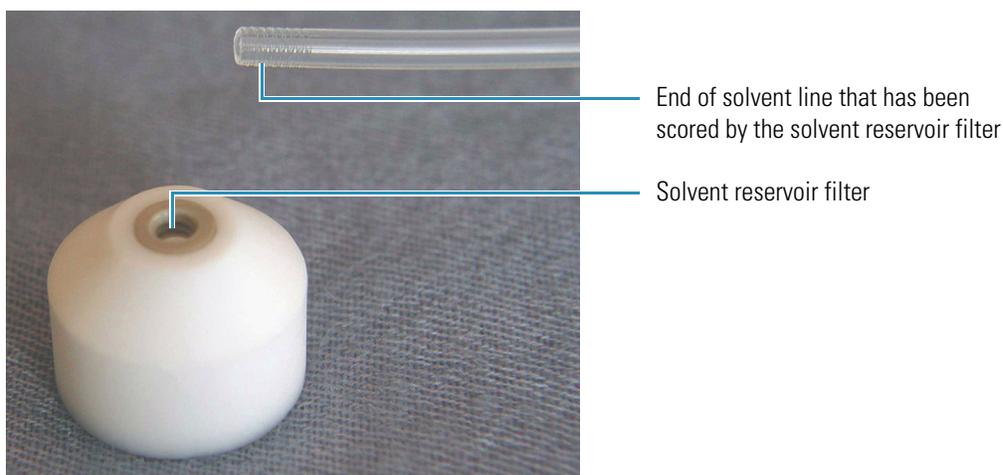
Replacing the Solvent Reservoir Filters

The solvent reservoir filter removes particulate matter from the mobile phase before it enters the solvent line. Eventually particulate matter from the mobile phase builds up on the filter and restricts the flow of solvent. A clogged solvent reservoir filter can cause the formation of air bubbles in the solvent line, erratic flow rates, and an abnormally low system backpressure.

To you determine that the solvent reservoir filter is clogged, remove the filter from the solvent line and monitor the system backpressure as the pump draws solvent into the solvent line. If the pressure trace is normal in the absence of the solvent reservoir filter, replace the filter.

Thermo Fisher Scientific offers two solvent reservoir filters: a 10 micron pore size Teflon™ filter (P/N A4258-010) and a 10 micron pore size stainless steel filter (P/N A4929-010). [Figure 67](#) shows the Teflon filter.

Figure 67. Solvent reservoir filter and solvent line



Replacing a Fuse

Instrument power is supplied by two 2.0 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 pump (next to the power cord). If an electrical component in your pump 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 pump 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 (2.0 amp, 250 V, TL, 5 × 20 mm) into the holder with the metal end visible.

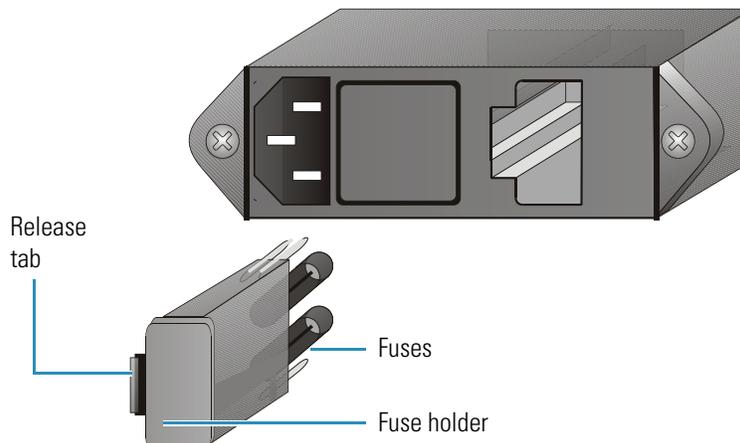


CAUTION When you are replacing fuses, use only fuses of the type and current rating specified. Do not use repaired fuses and do not short-circuit the fuse holder.

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

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.

Figure 68. Power entry module



Troubleshooting

If properly maintained, the Accela Pump can operate free of trouble for many years. You can avoid most pump problems with periodic maintenance, as described in [Chapter 6, “Maintenance.”](#) However, in the event that an error message is displayed or you suspect a mechanical or electrical failure, you might be able to diagnose the source of the problem. If the diagnosis indicates that a problem exists with serviceable parts inside the pump, contact a Thermo Fisher Scientific service representative.

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For more detailed chromatographic troubleshooting, refer to any HPLC troubleshooting reference book or call your Thermo Fisher Scientific service representative.

Troubleshooting Tips

Begin the diagnosis of the problem with your Accela Pump by eliminating all other possible sources of trouble. Before you invest time trying to diagnose a suspected pump problem, you should verify that the pump is the only source of difficulty. Systematically eliminate all other instruments in your Accela LC system as the source of trouble. If you are not sure which component of your chromatography system is responsible for poor system performance, see [“General System Troubleshooting”](#) on [page 82](#) for some useful suggestions.

When you are sure that the pump is the source of the problem, proceed to the [“Pump Troubleshooting Guide”](#) on [page 84](#) for help in determining the exact cause.

General System Troubleshooting

The following are common problems that occur with a liquid chromatography system.

❖ **No flow**

1. Check mobile phase connections.
2. Check for leaks.
3. See problem 8 on [page 85](#).

❖ **High backpressure**

1. Check the flow rate and system/column specifications.
2. Check for tubing or column blockage.
3. Check for blockage in the injection valve.
4. See “[Pump Troubleshooting Guide](#)” on [page 84](#).

❖ **Unstable baseline or drift**

1. System column is not equilibrated; allow more equilibration time.
2. Refer to the troubleshooting guide for your detector.
3. See problem 7 on [page 85](#).

❖ **Baseline noise**

1. Check for air bubbles in the system.
2. Check for system solvent contamination.
3. The pulse dampener is contaminated; prime the pulse dampener.

❖ **No peaks**

1. Check the detector and data system connections.
2. Refer to the troubleshooting guide for your autosampler.
3. Check sample retention with chromatographic conditions.
4. See problem 8 on [page 85](#).

❖ **Contaminating/ghost peaks**

1. Clean the system and the column.
2. Refer to the troubleshooting guide for your autosampler.

❖ **Poor peak shape**

1. Check the system for leaks.
2. Check the fittings and tubing lengths.
3. Check the column performance.
4. Refer to the troubleshooting guide for your autosampler.
5. Refer to the troubleshooting guide for your detector.

❖ **Poor retention time reproducibility**

1. Check the system for leaks and bubbles.
2. System/column is not equilibrated and more time should be allowed.
3. Check the column performance.
4. Refer to the troubleshooting guide for your detector.
5. See problem 7 on page [page 85](#).

❖ **Poor peak area reproducibility**

1. Check the column performance.
2. Refer to the troubleshooting guide for your autosampler.

❖ **No instrument or device control**

1. Check the cable connections.
2. Check the system configuration.
3. Refer to the troubleshooting guide for each instrument.

Pump Troubleshooting Guide

The information in [Table 7](#) can help you to identify specific pump-related problems.

Table 7. Troubleshooting pump-related problems (Sheet 1 of 2)

Problem	Cause	Diagnostic/Remedy
1. No response when power is switched on	a. Loose power cord	a. Plug the power cord into line power
	b. Defective power cord	b. Replace the cord
	c. Blown power entry module fuse	c. Replace fuse (see “Replacing a Fuse” on page 80)
2. LEDs not illuminated	a. Defective LED PCB	a. Contact Thermo Fisher Scientific service representative
	b. Loose LED cable	b. Reconnect the LED cable (see page 86)
3. Pump motor does not run	a. Max pressure set to zero	a. Change the max pressure in Instrument Setup, in the Direct Control dialog box, or both
	b. Defective motor	b. Contact Thermo Fisher Scientific service representative
	c. Disconnected motor cable	c. Contact Thermo Fisher Scientific service representative
	d. Defective drive circuit	d. Contact Thermo Fisher Scientific service representative
	e. Blown internal fuse	e. Contact Thermo Fisher Scientific service representative
4. Incorrect solvent composition	a. Dirty proportioning valve	a. Flush the valve with the appropriate solvents (see “Cleaning the LDA Components without Disassembling the LDA” on page 56)
	b. Loose actuating coil	b. Reattach actuating coil (see page 61)
	c. Proportioning valve timing not properly set	c. Contact Thermo Fisher Scientific service representative
	d. Defective proportioning valve	d. Contact Thermo Fisher Scientific service representative
	e. Defective proportioning valve drive circuit	e. Contact Thermo Fisher Scientific service representative
5. Pump does not start or stop remotely	a. Incorrect connection of synchronization cable	a. Reconnect synchronization cable (see “Connecting the System Interconnect Cable” on page 15)

Table 7. Troubleshooting pump-related problems (Sheet 2 of 2)

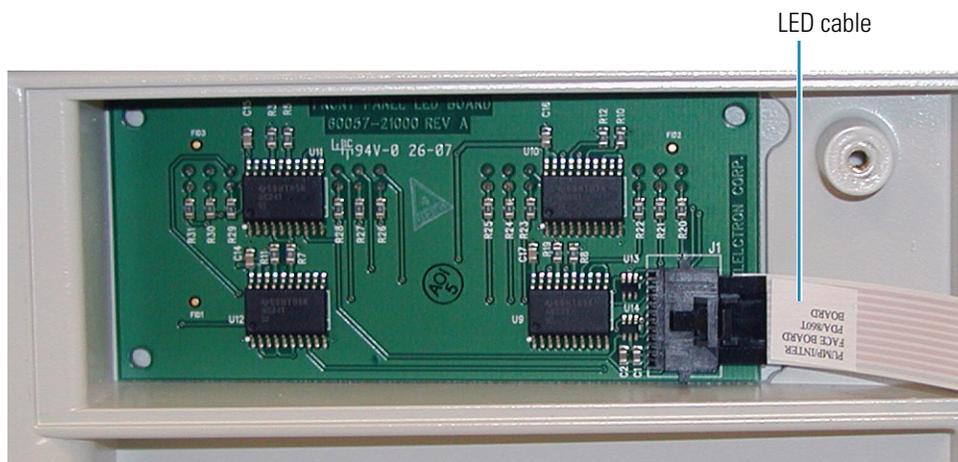
Problem	Cause	Diagnostic/Remedy
6. Proportioning valves do not click	a. Loose actuating coil	a. Reattach the actuating coil (see page 61)
	b. Defective proportioning valve	b. Contact your Thermo Fisher Scientific service representative
	c. Defective proportioning valve drive circuit	c. Contact your Thermo Fisher Scientific service representative
	d. Proportioning valves are stuck	d. See “ Servicing the Proportioning Valves ” on page 77
7. Erratic flow rate	a. Restricted inlet tubing	a. Replace the inlet tubing
	b. Restricted outlet tubing	b. Replace the outlet tubing
	c. Dirty proportioning valve	c. Flush the LDA with the appropriate solvents (see “ Cleaning the LDA Components without Disassembling the LDA ” on page 56) or replace the proportioning valves
	d. Dirty check valve	d. Flush the LDA with the appropriate solvents (see “ Cleaning the LDA Components without Disassembling the LDA ” on page 56) or replace the check valves
	e. Leaking piston seal	e. Replace the piston seals (see “ Replacing the Primary Pistons Seals ” on page 67)
	f. Clogged solvent reservoir filter	f. Replace the filter (see “ Replacing the Solvent Reservoir Filters ” on page 79)
8. No flow	a. Loose or disconnected solvent lines	a. Check for leaks in the solvent lines at the degassing inlets and outlets, the proportioning valve inlets, and the crossover tube connections
	b. Excessive air in the solvent lines	b. Remove the air from the solvent lines (see “ Removing Air from the Solvent Lines ” on page 37)
	c. Open venting valve	c. Close the venting valve on the left side of the LDA

❖ **To reconnect the loose LED cable**

1. Using a #2 Phillips screwdriver, remove the screw that secures the LED cover to the inner-left door, and then remove the cover.



2. Reconnect the LED cable to the board.



3. Secure the LED cover to the door.

Pump Pulsation

Pump pulsation is the variation in pressure with time due to the motion of the pump pistons. Pump pulsation can be divided into these categories:

- [Normal Pressure Pulsation](#)
- [Abnormal Pressure Pulsation](#)

Normal Pressure Pulsation

The pump continuously monitors the system pressure and bases its pressure readout on a 30 second interval. Under normal operating conditions, the Accela Pump shows very small variation in pressure. At pressures greater than 100 bar (10 MPa, 1450 psi), the pump pulsation should be less than 1 percent. For instructions on monitoring the backpressure of your system from the data system, see [“Monitoring the Pump Pulsation”](#) on [page 43](#).

The pressure status readback at the bottom of the Direct Control dialog box for the pump is in units of standard deviation. At a backpressure of 100 bar, a standard deviation of less than 1 bar (0.1 MPa, 14.5 psi) is acceptable. The pressure status readback for the pump in the Information view is in units of percentage standard deviation. At backpressures greater than 100 bar, a standard deviation value of 1.0 percent or less is acceptable.

Note Because the Accela Pump does not use electronic damping, its pressure fluctuation often appears to be higher than that for conventional pumps.

Abnormal Pressure Pulsation

Abnormal pressure pulsations can normally be divided into two categories. Large pressure pulsations are generally considered to be those with a standard deviation in pressure of greater than 10 bar (1 MPa, 147 psi). Minor pressure pulsations are those with a standard deviation in pressure of less than 10 bar.

Pressure Pulsations with SD over 10 Bar

Pressure pulsations with a standard deviation of the pressure greater than 10 bar are, in most cases, caused by air bubbles trapped in one of the piston chambers. To clear trapped air bubbles, run the pump at about 200 $\mu\text{L}/\text{min}$ with methanol or acetonitrile for about 15 minutes. This flow rate is much more effective than purging at higher flow rates.

Insufficient flow to the pump can also cause strong pump pulsations. If the above procedure does not reduce the pulsation, replace the solvent reservoir filters and thoroughly purge air from the system.

If you determine that the abnormal pump pulsation is not related to trapped air, the cause might be related to one or more damaged piston seals. Replace both piston seals as described in [Chapter 6, “Maintenance.”](#)

If the problem still persists after replacing the seals, the problem is likely due to a contaminated check valve. For low flow (< 50 $\mu\text{L}/\text{min}$) applications, cleaning a check valve is normally not effective. Most likely you must replace one or both check valve assemblies.

Pressure Pulsations with SD between 3 and 10 Bar

Pressure pulsations with a standard deviation of 3 to 10 bar are of various origins. You can continue working, but you should try to find the reason for the pulsation as soon as possible.

Baseline Noise at Low Pressures

UHPLC pumps are optimized to deliver a constant flow with a minimum of pressure fluctuations when they are set up to operate at an appropriate backpressure. The Accela Pump provides stable flow in both operating modes: low pressure and high pressure. When your LC system is set up to operate at a backpressure below 7000 psi (483 bar), make sure that you select the low-pressure operating mode (0 to ~7000 psi) for your instrument control method.

Under extreme conditions (flow rates of less than 100 $\mu\text{L}/\text{min}$) and with a low backpressure (less than 40 bar), you might observe a slight instability in the detector baseline at high sensitivity.

This problem can usually be fixed by adding a flow restrictor to your system between the Accela Pump and autosampler to increase the backpressure to a level greater than 40 bar (4 MPa, 580 psi).

Some typical applications susceptible to this problem include the following:

- Flow Injection Analysis (FIA) using an LC/MS performed at 10 to 50 $\mu\text{L}/\text{min}$ without an HPLC column
- Capillary LC at 3 to 5 $\mu\text{L}/\text{min}$ and 15 to 20 bar

Any variation of backpressure and flow rate will affect the UV detector performance at high sensitivity. The Accela Pump should normally be operated with at least 40 bar of backpressure. If necessary, use a flow restrictor to increase the backpressure of your system.

Insufficient Solvent Flow from the Pump Outlet

If there is insufficient flow when the pump is running, the problem is usually a result of one of the following:

- [Pump Cavitation](#)
- [Blocked Proportioning Valve](#)
- [Blocked Check Valve](#)

Pump Cavitation

A restriction in flow from the solvent reservoir to the pump can cause the pump to cavitate, which results in erratic mobile phase delivery. In extreme cases, there might be no flow at all. The reason is usually either a blocked solvent reservoir filter or a restricted solvent inlet line. A possible but much less probable cause is a restriction inside of the vacuum degasser.

If replacing the solvent reservoir filter does not solve the problem, do the following:

1. Disconnect the solvent reservoir A line from the inlet port of the degasser and verify unrestricted flow of solvent through the tubing.
2. If the solvent flow is normal, reconnect the line to the inlet port of the degasser and disconnect the corresponding degasser outlet line.
3. Check for unrestricted flow of solvent through the degassing chamber. The flow out of the degasser is normally slower than that going to the degasser.
4. Repeat the procedure for solvents B, C, and D.

Suspect a problem with the degasser only if there is virtually no flow coming out of the degasser.

Blocked Proportioning Valve

If flow from the degasser is normal, then the next area to check is the proportioning valve.

❖ To check for blockage in a proportioning valve

1. Set the pump to deliver 100% of solvent A at a flow rate of 1000 $\mu\text{L}/\text{min}$.
2. Measure the actual flow rate.
3. Repeat steps 1 and 2 for each channel.

If one or more of the values are low, clean the LDA by flushing it the appropriate solvents, as described in [“Cleaning the LDA Components without Disassembling the LDA”](#) on page 56.

Occasionally, a valve might freeze closed if it hasn't been used for an extended period of time. To open the valve, insert the valve tool (stainless steel wire) into the valve inlet and push the floating piston away from the valve seat, as described in [“Servicing the Proportioning Valves”](#) on [page 77](#).

Blocked Check Valve

Insufficient flow rate can also be a result of a blockage in one or both check valves. In this case, clean the LDA by flushing it the appropriate solvents, as described in [“Cleaning the LDA Components without Disassembling the LDA”](#) on [page 56](#).

Irreproducible Retention Times

There are many reasons for retention time problems. Some of the more common causes are as follows:

- An old or damaged column
- Inconsistent stationary phase (Was a new column installed?)
- A validated method that lacks robustness
- Changes in mobile phase composition
- Temperature fluctuations
- Pump problems

If you suspect the pump to be responsible, replace the column with a flow restrictor and run a step gradient, as described in [“Testing the Pump Proportioning”](#) on [page 46](#).

Contamination of the proportioning valves is likely to cause inaccuracy in the steps. Clean the LDA by flushing it with the appropriate solvents, as described in [“Cleaning the LDA Components without Disassembling the LDA”](#) on [page 56](#).

Accessories and Replacement Parts

This chapter contains a list of replaceable parts and their corresponding part numbers. To place an order, contact your local Thermo Fisher Scientific service representative.

Contents

- Liquid Displacement Assembly (LDA) Parts
- Accela Pump Accessory Kit
- Accela System Kit
- Solvent Interconnect Kit
- Other Parts and Assemblies

Liquid Displacement Assembly (LDA) Parts

The part number for the liquid displacement assembly (LDA) is 00950-01-00111.

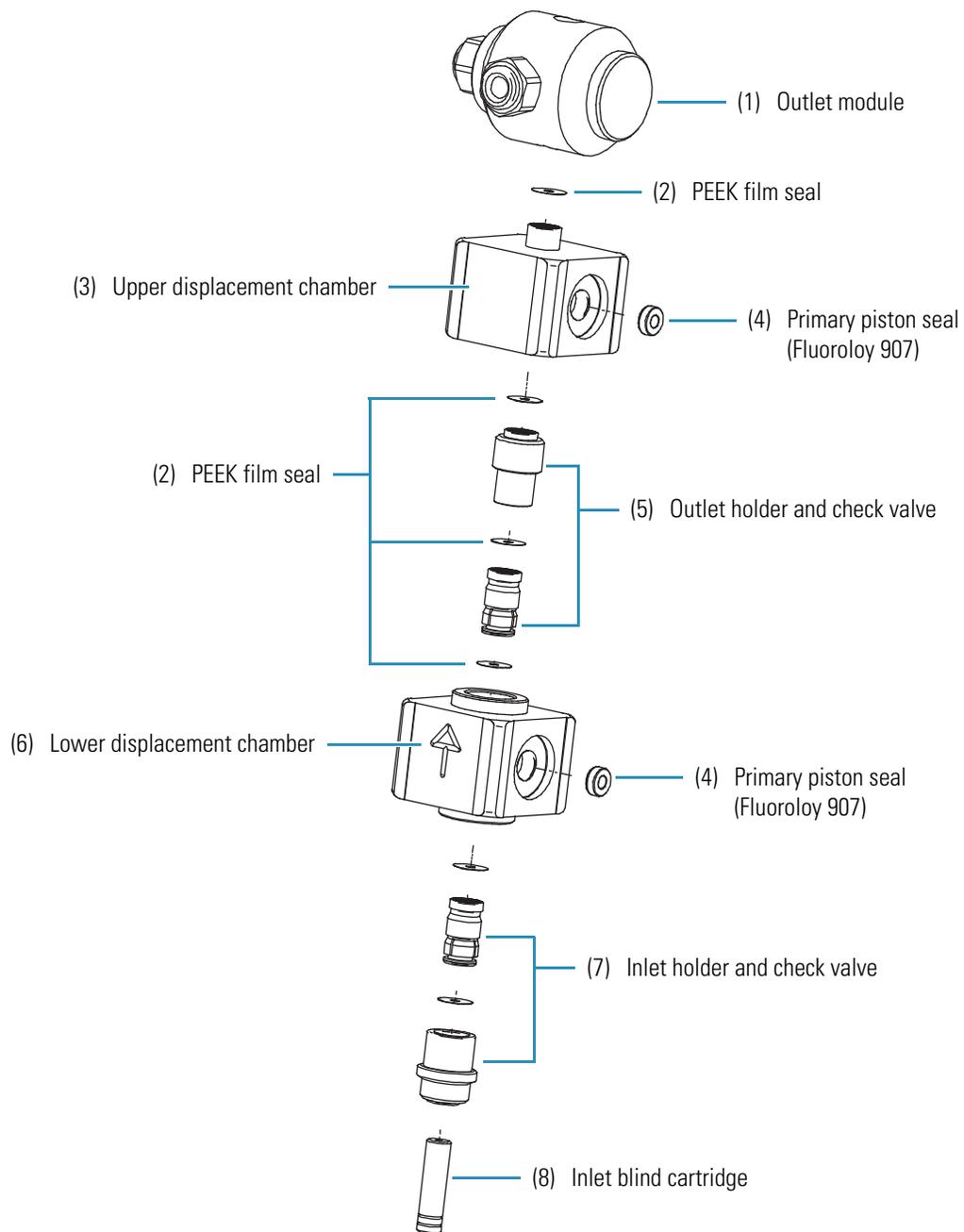
The LDA replaceable parts listed in [Table 8](#) correspond to the items labeled in [Figure 69](#), [Figure 70](#), and [Figure 71](#), from top to bottom. The additional parts listed in [Table 9](#) correspond to the items labeled in [Figure 72](#) from top to bottom.

When you replace the check valves, order the parts listed in [Table 8](#). The part numbers for the check valves include the holders and PEEK film seals. The difference between the inlet and outlet check valve assemblies is the holder, not the check valve. Use the check valve holders if your pump has the original version of the LDA.

Table 8. LDA Parts

Item	Qty	Description	Part number	Material
1	1	Outlet module, Accela Pump	00950-01-00124	Ti
2	4	Seal, PEEK film, Accela Pump	00950-01-10013	PEEK
3	1	Chamber, upper displacement, Accela Pump	00950-01-00123	Ti
4	2	Seal, high-pressure GFP, Accela Pump	00950-01-00129	PTFE/GFP/Ti
5	1	Check valve (outlet) Outlet holder, check valve cartridge, and PEEK seal for the Accela Pump	00950-01-00274	Ti/ruby/sapphire
6	1	Chamber, lower displacement, Accela Pump	00950-01-00121	Ti
7	1	Check valve (inlet) Inlet holder, check valve cartridge, and PEEK seal for the Accela Pump	00950-01-00273	Ti/ruby/sapphire
8	1	Cartridge, blind, inlet, Accela Pump	00950-01-00120	PEEK
9	1	Lid, compression w/set screw, Accela Pump	00950-01-00125	Ti
10	2	Piston guide bushing	00950-01-00127	Ti/zirconia
11	1	Quaternary inlet module	00950-01-00119	Ti
12	2	Piston, sapphire	00950-01-00126	Sapphire
13	4	Nylon screw (for actuating coil)	00109-04-00005	Nylon
14	2	Secondary piston seal (wash seal)	00950-01-00128	PE/Stainless steel
15	4	Coil unit for proportioning valve	00201-11344	Stainless steel /PEEK
16	4	Proportioning valve	00110--01-00007	Ti/ruby/sapphire/zirconia
17	4	Sealing ring, proportioning valve	00201-11320	PTFE

Figure 69. Liquid displacement assembly (original version, parts 1 to 8)



8 Accessories and Replacement Parts

Liquid Displacement Assembly (LDA) Parts

Figure 70. Liquid displacement assembly (current version, parts 1 to 8)

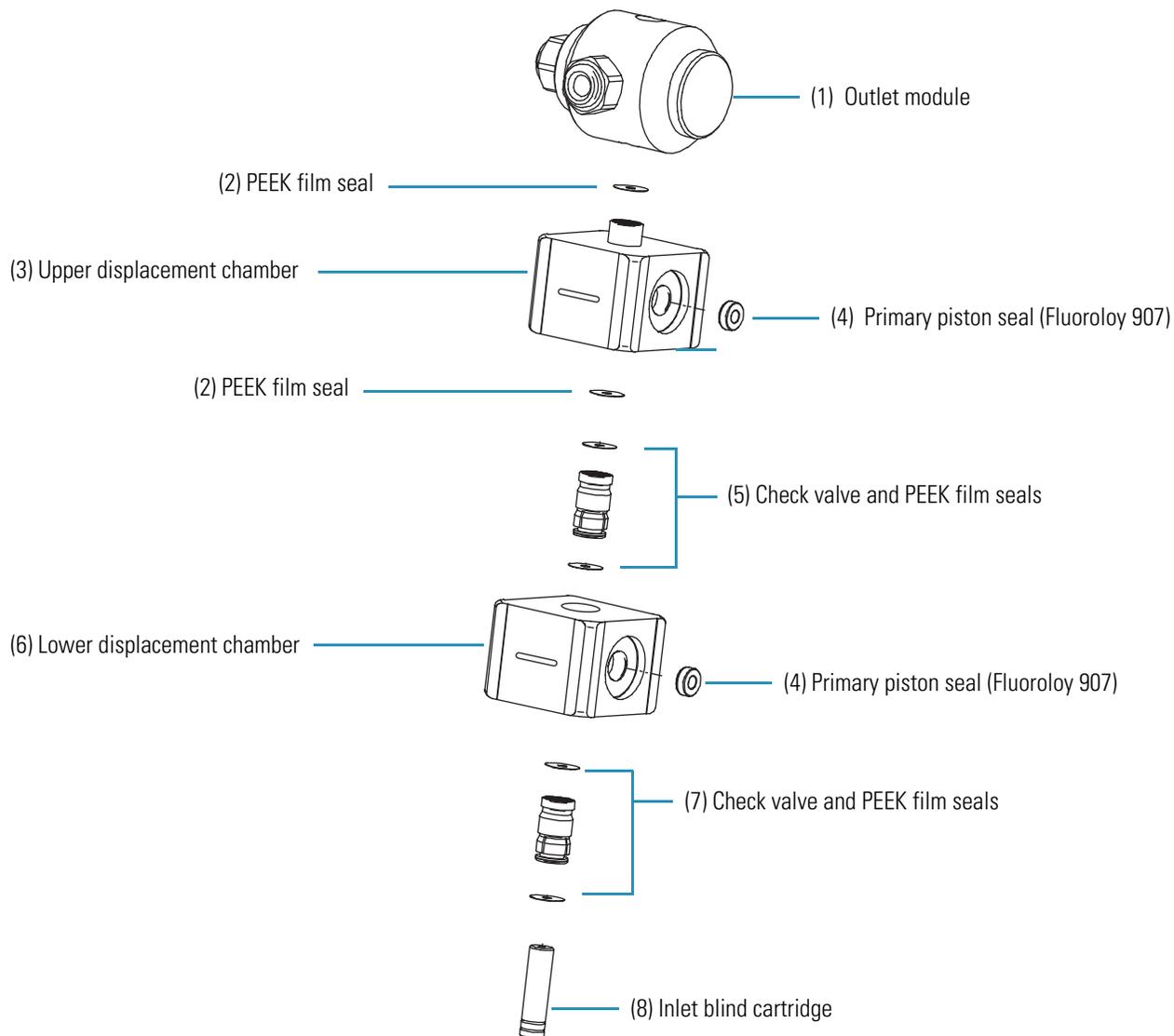
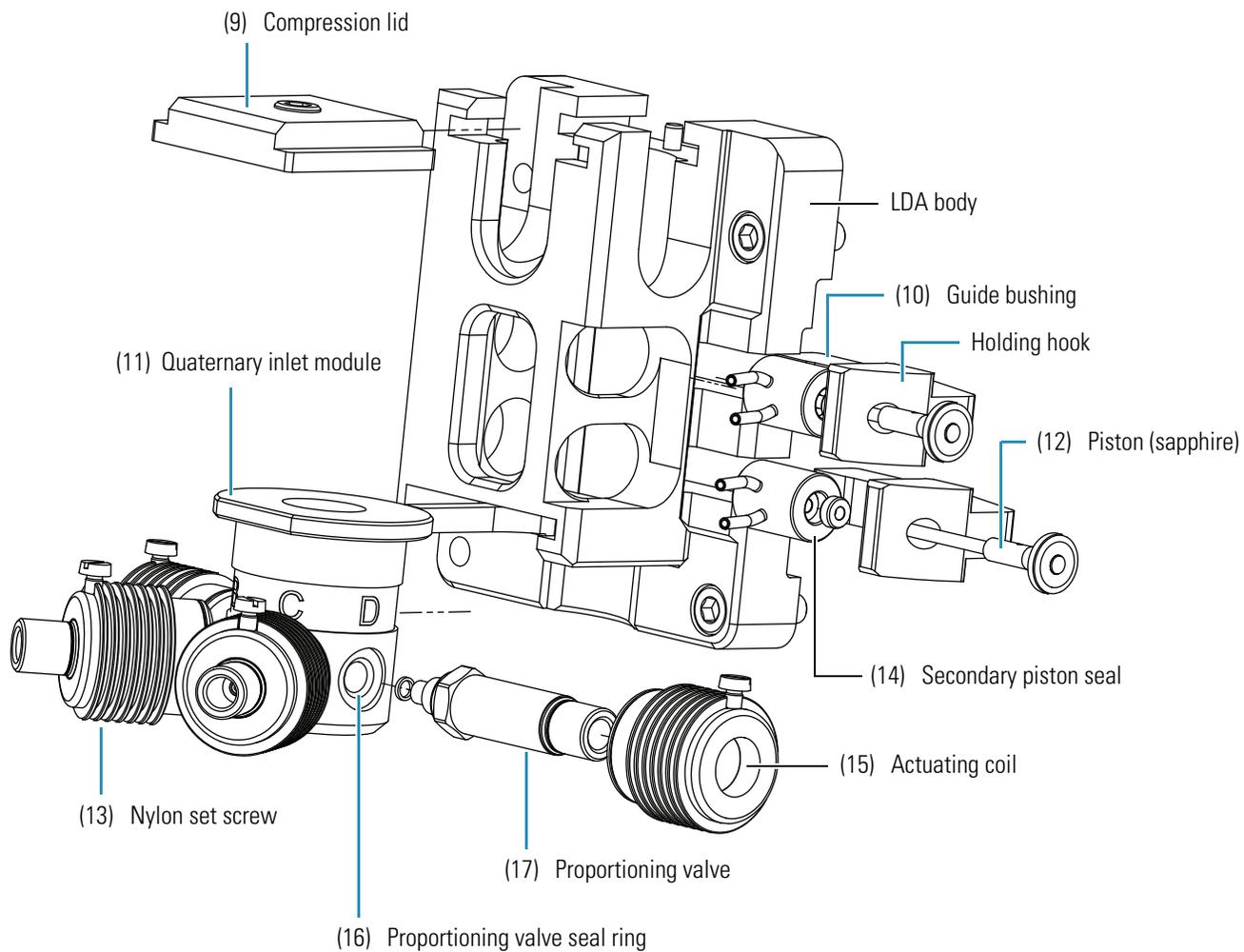


Figure 71. Liquid displacement assembly (parts 9 to 17)



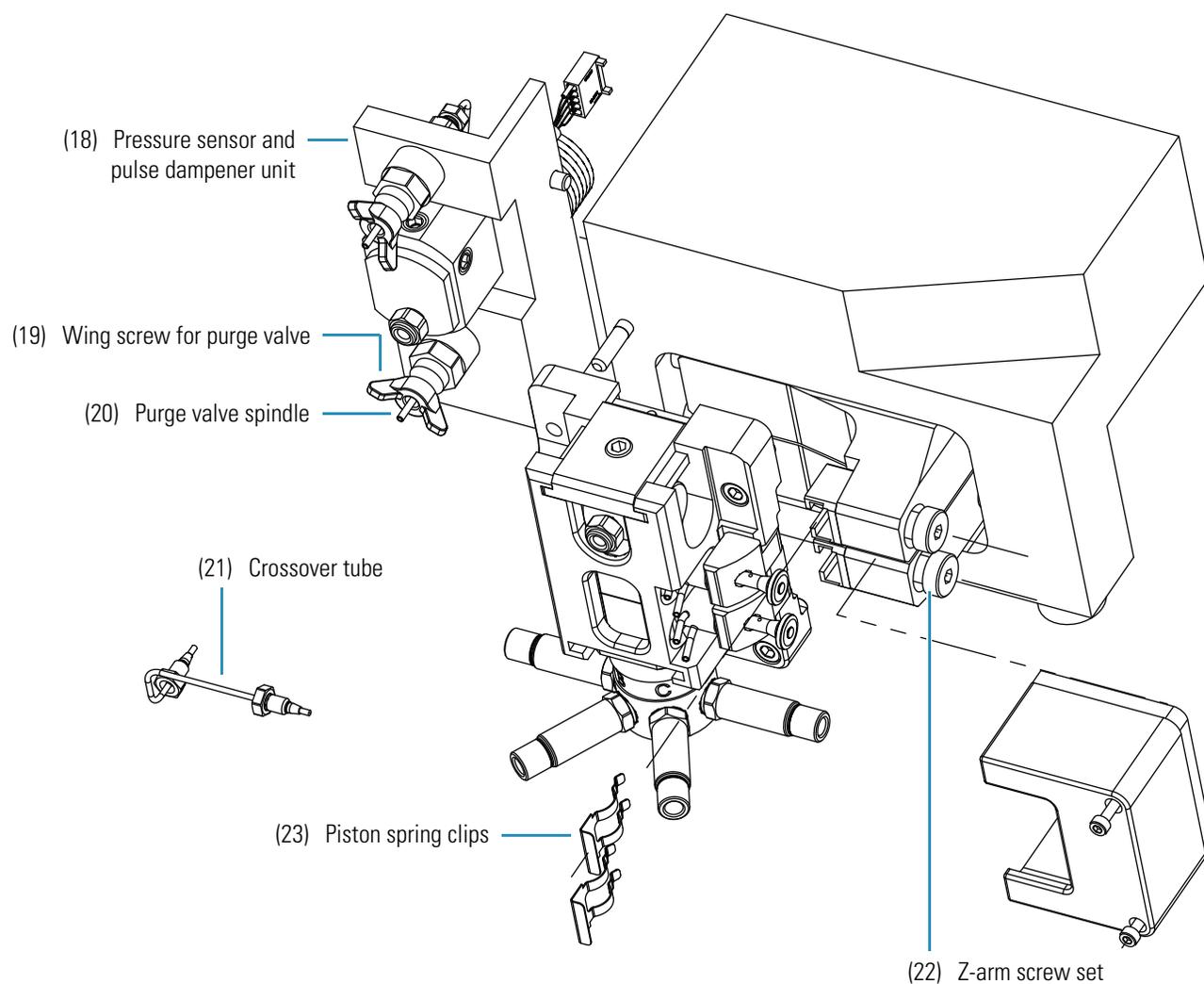
8 Accessories and Replacement Parts

Liquid Displacement Assembly (LDA) Parts

Table 9. Additional LDA parts

Item	Qty	Description	Part number	Material
18	1	Pressure sensor and pulse dampener unit	00950-01-00112	Ti, 316 stainless steel
19	2	Wing screw for purge valve	00950-01-00117	Ti
20	2	Purge valve spindle	00950-01-00118	Ti/Ruby
21	1	Crossover tubing	00950-01-00113	Ti
22	2	Z-arm screw set	00950-01-00115	Ti
23	2	Piston spring clips	00201-11328	Stainless steel

Figure 72. View of assembled LDA and additional replaceable parts



Accela Pump Accessory Kit

The following items are contained in the Accela Pump Accessory Kit (P/N 60157-62001).

Cable, assembly, RS232, shielded, external PC	72011-63008
Cable, USB, 3 m length, ROHS	00302-99-00014
Connector, plug, 8 pin, 3.81 mm pitch, Minicombicon	00004-02511
Fuse, 2 A, TL, 250 V, Slo-Blo (5 × 20 mm) (2 each)	5120-0025
Luer-type adaptor	A0796-010
Piston unit, sapphire (2 each)	00950-01-00126
Screwdriver, ball driver, hex, 4 mm	00725-00032
Seal, H/P, (2 each)	0950-01-00129
Syringe, Luer-Lok, 10 mL	3301-0151
Tool, Prop Valve, MS Pump	60053-01017
Tool, balldriver, Hex, 2.5 mm	00725-01-00002
Tubing, convoluted, pump waste.	F5034-040
Wrench 1/4 in. and 5/16 in.	5401-0400
Wrench, L-hex, 4 mm	00725-00034
Wrench, open-end, 8 × 10 mm	00950-30005

Accela System Kit

The Accela System Kit, P/N 60057-60060, contains the cables, tubing, fittings, and so on used to interconnect the system modules.

Ethernet switch, 5 port, 10T/100TX, 100 - 240V.	00025-01-00024
Cable, Ethernet patch with two ferrites	97355-98006
Cable, Surveyor Plus LC/MS interconnect	60053-63034
Filter cartridge, UHP, 0.5 μ.	00109-99-00020
Fitting, swaged, ferrule, back	00101-08-00002
Fitting, swaged, ferrule, front	00101-08-00001
Solvent bottle holder	60057-60014
Solvent bottle, 1 liter.	1413-0430
Kit, Solvent Interconnect, LC/MS system	F5050-010
Tubing, stainless steel, 0.005 in. ID, 1/16 in. OD, 10 cm length.	00301-01-00008
Tubing, stainless steel, 0.005 in. ID, 1/16 in. OD, 20 cm length.	00301-01-00009
Nut, compression, long, Rheodyne, 1/16 in., 10-32	00101-07-00001
LC Devices	XCALI-64999
Accela device drivers for ChromQuest 4.2.	CHROM-98008

Solvent Interconnect Kit

The following items are included in the Solvent Interconnect Kit (P/N F5050-010).

Bottle cap solvent bottles	A0343-010
Solvent bottle cap adaptor	A3191-010
Solvent filter, 10 micron Teflon	A4258-010
Tubing, 1/8 in. OD, 240 in length	3219-2004
Fitting, Super Flangeless, 1/8 in. tube, PEEK	00101-18225
Ferrule, Super Flangeless, 1/8 in. tube, PEEK	00101-18017
Label set solvent bottles	A4158-020
Marker LTR "A"- clip on	608250001
Marker LTR "B"- clip on	608250002
Marker LTR "C"- clip on	608250003
Marker LTR "D"- clip on	608250004

Other Parts and Assemblies

The following items include miscellaneous parts and assemblies.

Cable assembly, DC power supply	60157-63000
Cable assembly, Fan, Accela UHPLC	60157-63002
Cable assembly, RS232, internal, degasser board	60157-63004
Cable assembly, flexible, LED, internal	60157-63006
Cable assembly, degasser LED	60157-63008
Cable assembly, COMM and gradient LED	60157-63010
Cable assembly, RS232, internal	60157-63012
Cable assembly, AC power internal	60157-63014
Cable assembly, interface, UHPLC	60157-63018
Cable, motor index	00950-01-00001
Cable, USB 2.0, A to B, 14 in. UL	00302-99-00009
Compression nut, 1/16 in., 10-32, stainless steel	2522-1880
Filter holder, inline, and frit	00109-99-00019
Fitting, swage front ferrule for 1/16 in. tubing, stainless steel	00101-08-00001
Fitting, swage back ferrule for 1/16 in. tubing, stainless steel	00101-08-00002
Kit, maintenance, Accela Pump	60157-62002
Kit, Seal, Accela Pump	60157-62003
Kit, Accela Pump Dynamic Mixer Upgrade	60157-62004
Mixer, dynamic	00109-99-00037
PCB assembly, interface	60157-61000
Power cord (European)	6003-0330
Power cord (U.S.A.)	6003-0160
Pressure Transducer and pulse dampening assembly	00950-01-00112
Pump test mix (vials containing 7 mg ethyl paraben)	A4904-010
RS232 cable	72011-63008
Solvent inlet and outlet line tubing (order by length)	3219-2004
Solvent reservoir filter	A4258-010

Tubing, no-ox kit, 31, 22, 18, and 17 cm lengths of low-pressure tubing and fittings (tubing and fittings that connect the degassing unit outlet ports and the proportioning valves)	00950-01-00021
Tubing, stainless steel, 5 cm length, 0.005 in. ID,	00301-01-00017
Tubing, stainless steel, 10 cm length, 0.005 in. ID	00301-01-00008
Tubing, stainless steel, 20 cm length, 0.005 in. ID	00301-01-00009
Vacuum degas assembly.	00108-01-00011

Discontinued Versions of the Accela Pump

There are two versions of the LDA. The differences between the current and previous versions lie in the inlet module, lower displacement chamber, and upper displacement chamber. You can identify the previous version of the LDA by the flow-direction arrow etched onto the front face of the lower displacement chamber.

Note The following parts have been changed in the current LDA: the upper and lower displacement chambers, and the quaternary inlet module. If you need to replace any of these parts, you must replace all three parts.

Contents

- [Installing the Check Valves in the Discontinued LDA](#)
- [Installing the Components of the Discontinued LDA Stack](#)

Installing the Check Valves in the Discontinued LDA

There are two types of check valves. The version of the Accela Pump that does not have an integrated dynamic mixer originally shipped with check valves that screwed into the lower displacement chamber. The version of the Accela Pump that has an integrated dynamic mixer contains check valves that do not screw into the lower displacement chamber. The current check valves are compatible with all versions of the pump. Installing the check valves in the original version of the LDA requires the use of adapter holders.

Depending on the check valve type, follow one of these procedures:

- [Installing the Check Valves and Holders](#)
- [Installing the Screw-In Check Valves \(discontinued version\)](#)

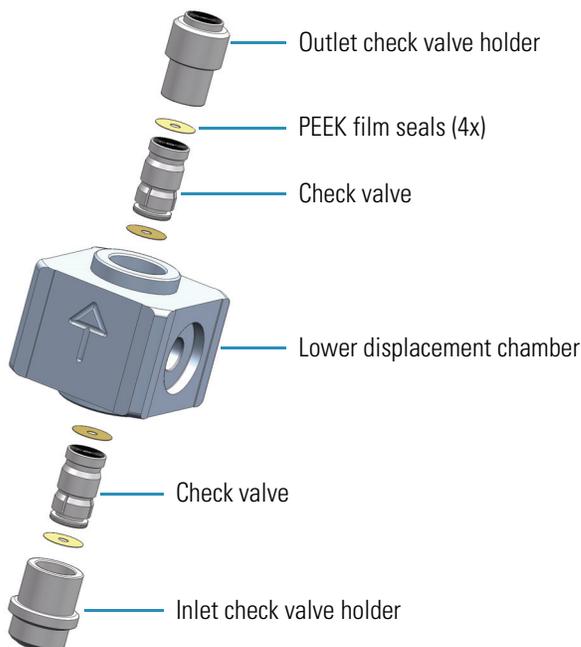
Installing the Check Valves and Holders

This procedure describes how to install the current version of the check valves in the discontinued LDA.

❖ **To install the check valves and their holders**

1. Insert the PEEK film seals into both bores of the lower displacement chamber.
2. Insert the check valves and PEEK seals into their respective holders (see [Figure 73](#)).

Figure 73. Lower displacement chamber, check valves, holders, and PEEK film seals



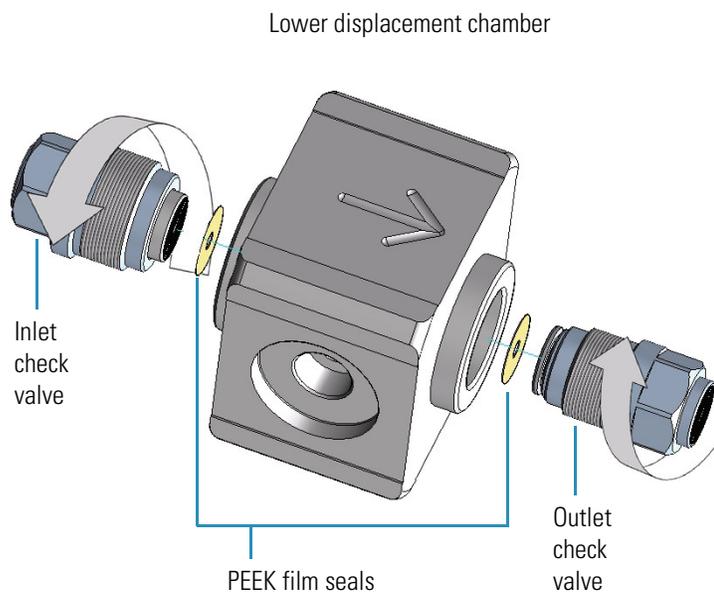
3. Insert the holders into the bores of the lower displacement chamber.
4. Because the fit between the check valve holders and the displacement chamber bores is loose, place the LDA on a flat surface as you insert the lower displacement chamber and check valve assembly.

Installing the Screw-In Check Valves (discontinued version)

❖ **To install the check valves that screw into the lower displacement chamber**

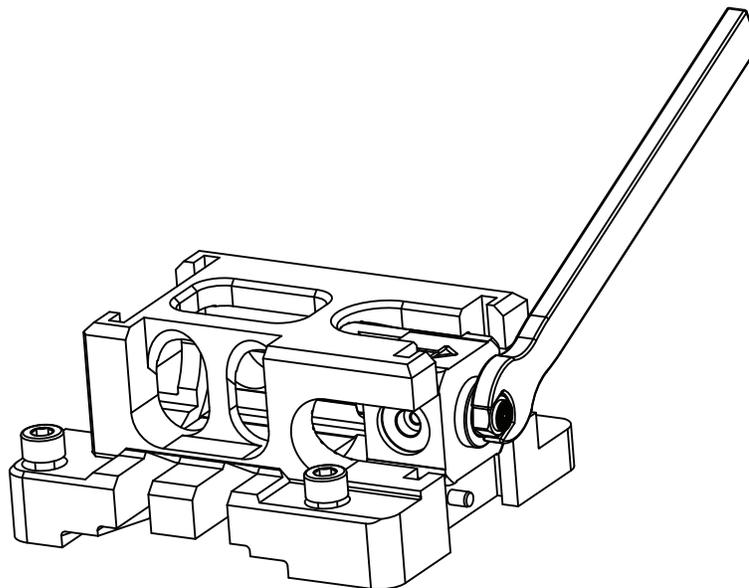
1. Install the PEEK film seals and check valves into the lower displacement chamber as shown in [Figure 74](#):
 - a. Insert a film seal into the lower bore of the lower displacement chamber, and then screw the inlet check valve into the bore, fingertight.
 - b. Insert a film seal into the upper bore of the lower displacement chamber, and then screw the outlet check valve into the bore, fingertight.

Figure 74. Installing the PEEK film seals and discontinued check valves



2. Insert the lower displacement chamber into the LDA body just far enough so that the body serves as a vice, and then tighten the check valve fitting with an 8 mm open-ended wrench (see [Figure 75](#)).
3. Remove the displacement chamber from the LDA body. Rotate it and repeat [step 2](#).

Figure 75. Tightening the outlet check valve fitting



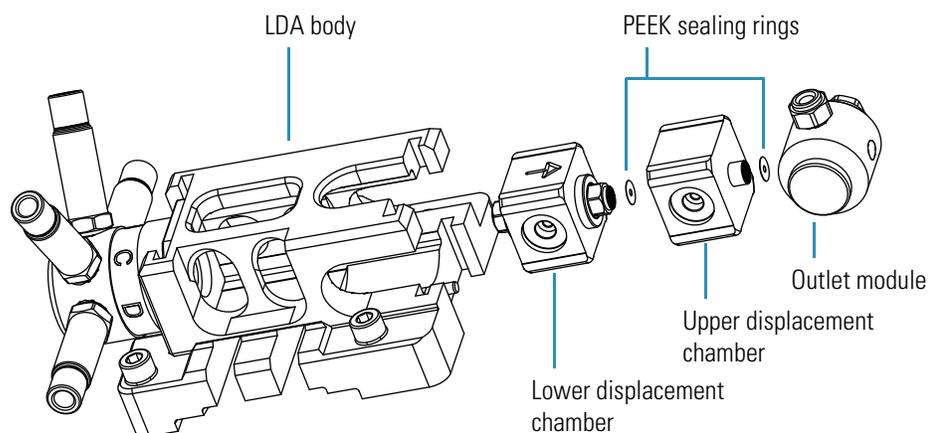
Installing the Components of the Discontinued LDA Stack

If they are installed correctly, the inner components of the LDA form a perfect stack that ensures smooth movement of the pistons.

❖ To install the inner components of the LDA stack

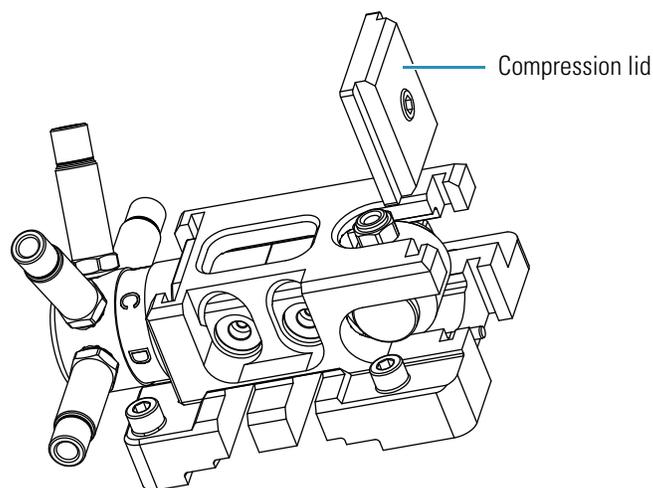
1. Because the fit between the check valve holders and the lower displacement chamber is loose, place the LDA on a flat surface, and then insert the lower displacement chamber and check valve assembly. The orientation arrow on the lower displacement chamber points away from the LDA body (see [Figure 76](#)).
2. Install the upper displacement chamber and two PEEK film seals.
3. Install the outlet module.

Figure 76. Installing the stacked components of the LDA



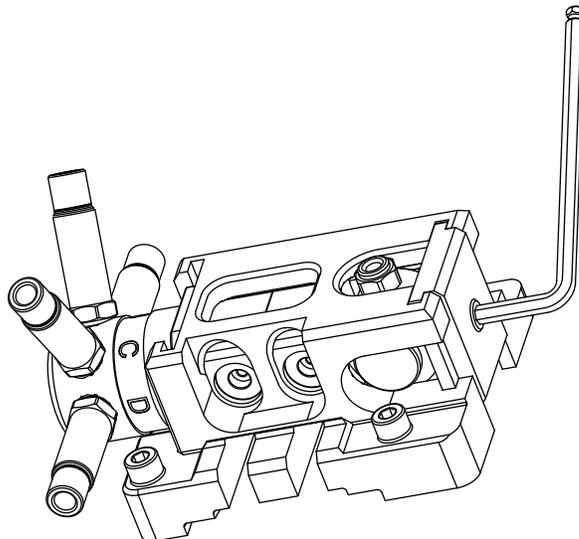
4. Slide the compression lid into the upper bracket of the LDA body (see [Figure 77](#)).

Figure 77. Sliding the compression lid into the LDA body



5. Using a 4 mm L-hex wrench, tighten the compression lid as shown in [Figure 78](#).

Figure 78. Tightening the compression lid



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