Thermo Scientific Dionex UltiMate 3000 Series

LPG-3400XRS Pump

Operating Instructions
(Original Operating Instructions)

Revision: 1.1

Date: September 2013

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CE

Declaration of Conformity

(Original Declaration of Conformity)

Product: Thermo Scientific Dionex UltiMate 3000 - Pump

Types: **ISO-3100SD, ISO-3100BM**
HPG-3200SD, HPG-3200RS, HPG-3200BX
HPG-3400SD, HPG-3400RS
LPG-3400SD(N), LPG-3400RS, LPG-3400XRS
DGP-3600SD(N), DGP-3600RS

Dionex Softron GmbH herewith declares conformity of the above products with the respective requirements of the following regulations:

- Low-Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC

The electrical safety of the products was evaluated based on the following standard:

- DIN EN 61010-1:2010
  Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1: General Requirements

The Electromagnetic Compatibility (EMC) of the products was evaluated based on the following standard:

- DIN EN 61326:2006
  Electrical equipment for measurement, control and laboratory use
  EMC Requirements

This declaration is issued for the manufacturer

Dionex Softron GmbH
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by the Managing Director, Rüdiger Obst, and
the Vice President HPLC, Fraser McLeod.

September 2, 2013

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1 Introduction

1.1 How to Use this Manual

The layout of this manual is designed to provide quick reference to the sections of interest to the reader when operating the Thermo Scientific™ Dionex™ pump. However, in order to obtain a full understanding of the pump, Thermo Fisher Scientific recommends that you review the manual thoroughly before beginning operation.

The descriptions in this manual apply to the LPG-3400XRS pump of the UltiMate™ 3000 series.

The following conventions apply to the descriptions throughout this manual:

- The terms "the pump" or "the device" is used throughout the manual.
- If not otherwise stated, the descriptions for the Viper™ capillary connections apply also to the nanoViper™ and possible other Viper capillary connections.
- The device configuration may vary. Therefore, not all descriptions necessarily apply to your particular pump.
- It may happen that the representation of a component in this manual is different from the real component. However, this does not influence the descriptions.
- The descriptions in this manual refer to firmware version 5.7 and Chromeleon™ 6.80 Service Release 13. If you want to operate the pump from Chromeleon 7, note the information on page 29.

This manual is provided "as is". Every effort has been made to supply complete and accurate information and all technical specifications have been developed with the utmost care. The information contained in this manual should not be construed as a commitment by Thermo Fisher Scientific. Thermo Fisher Scientific assumes no responsibility for any errors that may appear in this document that is believed to be complete and accurate at the time of publication and, in no event, shall Thermo Fisher Scientific be liable for incidental or consequential damages in connection with or arising from the use of this document. We appreciate your help in eliminating any errors that may appear in this document.

The information contained in this document is subject to change without notice.

Trademarks

1.2 Safety

The CE Mark label and cTUVus Mark safety label on the rear panel indicate that the pump is in compliance with the related standards.

1.2.1 Symbols on the Pump and in the Manual

The table shows the symbols used on the pump:

Symbol	Description
~	Alternating current—Courant alternatif
	Power supply is on (—)—Le module est mis sous tension (—) and Power supply is off (**O**)—Le module est mis hors tension (**O**)
	Refer to the Operating Instructions to prevent risk of harm to the operator and to protect the instrument against damage. Référez-vous à ce manuel pour éviter tout risque de blessure à l'opérateur et/ou protéger l'instrument contre tout dommage.
	Label according to the "Measures for Administration of the Pollution Control of Electronic Information Products" (China RoHS) guideline Étiquette "Measures for Administration of the Pollution Control of Electronic Information Products" (China RoHS)
	WEEE (Waste Electrical and Electronic Equipment) label—For more information, see the WEEE Information section in the "Installation and Qualification Documents for Chromatography Instruments" binder. Étiquette DEEE (Déchets d'Equipements Electriques et Electroniques)—Pour plus d'informations, référez-vous au chapitre WEEE Information dans le classeur "Installation and Qualification Documents for Chromatography Instruments"

At various points throughout the manual, messages of particular importance are indicated by certain symbols:

Tip: Indicates general information, as well as information intended to optimize the performance of the device.

Important: Indicates that failure to take note of the accompanying information could cause wrong results or may result in damage to the device.

Important: Indique que ne pas tenir compte de l'information jointe peut conduire à de faux résultat ou endommager l'instrument.

Warning: Indicates that failure to take note of the accompanying information may result in personal injury.

Avertissement: Indique que ne pas tenir compte de l'information jointe peut entraîner des blessures corporelles.

1.2.2 Safety Precautions

When working with analytical instrumentation, you must know the potential hazards of using chemical solvents. Wear appropriate protective clothing.

Tip: Before initial operation of the pump, make yourself familiar with the contents of this manual.

For the safety precautions in French, see page 8.

Warning: All users of the device must observe the following safety precautions and all additional safety precautions in this manual to avoid the possibility of personal injury or damage to the device when operating the device or carrying out any maintenance or service procedures.

Observe any warning labels on the pump and see the related sections in these *Operating Instructions*.

- **Protective equipment**

  When performing any work on or near the HPLC system, wear personal protective equipment (protective clothing, safety gloves, safety glasses) as required by the hazard of the mobile phase and sample. For information about the proper handling of a particular substance and for advice on specific hazards, refer to the material safety data sheet for the substance you are using. Observe the guidelines of Good Laboratory Practice (GLP).

  An eyewash facility and a sink should be close to the device. If any substance splashes on the eyes or skin, wash the affected area and seek medical attention.

- **Hazardous substances**

  Many organic solvents, mobile phases and samples are harmful to health. Be sure that you know the toxic and infectious properties of all substances that you are using. You may not know the toxic or infectious properties of many substances that you are using. If you have any doubt about a substance, treat it as if it contains a potentially harmful substance. For advice on the proper handling of a particular substance, refer to the Safety Data Sheet (SDS) of the manufacturer. Observe the guidelines of Good Laboratory Practice (GLP).

  Dispose of waste substance in an environmentally safe manner that is consistent with all local regulations. Do not allow flammable, toxic, and/or infectious substances to accumulate. Follow a regulated, approved waste disposal program. Never dispose of flammable, toxic, and/or infectious substances through the municipal sewage system.

- **Hazardous gases**

  Install the HPLC system in a well-ventilated laboratory. If the mobile phase or sample includes volatile or flammable solvents, do not allow them to enter the workspace. If the mobile phase or sample includes volatile or flammable solvents, avoid open flames and sparks.

- **Electrostatic discharge**

  Discharge of electrostatic energy may lead to sparking and can constitute a fire hazard. This effect is particularly pronounced in insulating capillaries und with non-conductive solvents (for example, pure acetonitrile).

  Take appropriate measures to prevent the generation of static electricity near the HPLC system. For example, make sure that the air humidity level in the laboratory is sufficiently high and provide proper ventilation, wear anti-static clothing or shoes, prevent accumulation of air bubbles in waste lines, and use grounded waste containers. Use only non-conductive capillaries to direct solvents into the waste container. With electrically conductive capillaries make sure that they are properly grounded.

- **Self-ignition of solvents**

  Do not use solvents for which the self-ignition temperature is below 150 °C. In case of leakage, these solvents may self-ignite on a hot surface.

- **Capillaries, capillary connections, open connections**

  - ♦ Capillaries, especially non-metallic capillaries may burst, slip out of their fittings or may not be screwed in. This may result in substances spraying out of the open connections.
  - ♦ In an UltiMate 3000 system, some components are made of PEEK™. This polymer has superb chemical resistance to most organic solvents. However, it tends to swell when in contact with trichlormethane ($CHCl_3$), dimethyl sulfoxide (DMSO), or tetrahydrofuran (THF). In addition, it is attacked by concentrated acids, such as, sulfuric acid and nitric acid or a mixture of hexane, ethyl acetate, and methanol. In both cases, capillaries may start leaking or they can burst. Swelling or attack by concentrated acids is not a problem with brief flushing procedures.
  - ♦ Do not use tubing that is stressed, bent, kinked, or damaged.
  - ♦ Capillary connections can be contaminated by harmful substances or harmful substances can escape from open connections.
  - ♦ Always wear safety glasses when handling fused silica tubing, for example, during installation or when cutting capillaries to the length.

- Disconnect the pump from all power sources before removing the panels. When the panels are removed, dangerous electrical connections will be exposed. The enclosure must be opened only by Thermo Fisher Scientific service personnel.

- Always replace blown fuses with original spare part fuses authorized by Thermo Fisher Scientific.

- Replace faulty communication cables.
- Replace faulty power cords. Never use a power cord other than the power cords provided for the device.
- Use only the original spare parts and accessories authorized for the device by Thermo Fisher Scientific.
- The pump is primed with 2-propanol. During initial operation of the pump, make sure that the solvents used are miscible with 2-propanol. Otherwise, follow the appropriate intermediate steps.
- When operating the HPLC system, always set a lower pressure limit for the pump. This prevents damage resulting from leakage or from running the pump dry.
- To prevent damage to the pump when lifting or moving, always lift the unit by the bottom sides or sides. Do not lift the pump by the bottom front or front panel door. This may damage the door.
- The open front panel door is not designed to carry weight. Do not place any heavy objects on the open front panel door; this may damage the door.
- After operation, rinse out buffers and solutions that form peroxides.
- Before switching from buffer to organic solution, rinse the analytical system thoroughly with deionized or HPLC grade water.
- When switching to another solvent, ensure that the new solvent is miscible with the one contained in the HPLC system. If the solvents are not miscible, the system can be damaged, for example, by flocculation.
- If a leak occurs, turn off the pump immediately, stop the pump flow, and remedy the situation.
- Use only standard solvents (HPLC grade) and buffers that are compatible with all parts that may be exposed to solvents.
- Avoid looking directly into the pump light LED and do not use light focusing instruments for viewing the light beam. The high luminosity of the lamp can be harmful to the eyes.
- To avoid that the pressure calibration of the pump is impaired, turn on the pump only when the pump pressure is down. To ensure that the pressure is down, open the purge valve before turning on the pump.
- Never run the pump dry. Damage to the pistons or the piston seals could result.
- Before you start operating the pump, check the seal wash reservoir level and refill as needed. After turning on the pump, wait until the wash solution has passed the entire pump head.
- Always use fresh rear seal wash solution.

- Thermo Fisher Scientific advises against recycling the solvents. This may impair the performance of the seals.
- If the pump flow is interrupted for longer periods (> 1 hour), turn off the lamps in any UV or RF detector connected to the pump. This will prevent evaporation in the flow cell.
- Always use the frits recommended by Thermo Fisher Scientific to prevent particulate matters from entering the HPLC system. Using other frits may considerably affect the system performance.
- Before interrupting operation for several days or more or when preparing the pump for transport, observe the precautions for shutting down the pump (→ page 88).
- Do not use the pump in ways other than those described in these *Operating Instructions*.
- Keep the operating instructions near the device to be available for quick reference.

1.2.3 Consignes de Sécurité

Si vous utilisez d'instrumentation analytique, vous devez connaître les risques d'utilisation de produit chimiques.

Veuillez noter: Avant de commencer à utiliser l'instrument, assurez-vous que vous vous êtes familiarisés avec le contenu de ce manuel.

Avertissement: Toutes les personnes utilisant l'instrument doivent observer les consignes de sécurité suivantes et dans les autres chapitres de ce manuel pour éviter une mise en danger de sa personne ou de dommage à l'instrument pendant l'utilisation et des opérations de maintenance ou service de l'instrument.

Observez les étiquettes d'avertissement sur l'instrument et référez-vous aux sections correspondantes dans ce mode d'emploi.

- **Equipment de protection**

  Pour tous les travaux sur le système HPLC ou à proximité, portez l'équipement de protection personnel (vêtements de protection, gant de sécurité, lunettes de protection) qui correspond aux risque découlant de la phase mobile et/ou de l'échantillon. Pour les informations sur la manipulation correcte des composés et des recommandations pour les situations de risque spécifiques, veuillez consulter la fiche de données de sécurité des substances que vous utilisez. Veuillez respecter des directives des Bonnes Pratiques de Laboratoire (BPL).

  Une installation permettant de se laver les yeux ainsi qu'un lavabo doivent se trouver à proximité du système. Si une substance, quelle qu'elle soit, entre en contact avec vos yeux ou votre peau, rincez abondamment la zone affectée à l'eau, puis.

- **Substances dangereuses**

  De nombreux solvants organiques, phases mobiles et échantillons sont nuisibles à la santé. Informez-vous de propriétés toxicologiques et infectieuses de toutes les substances que vous utilisez. Les propriétés toxicologiques et infectieuses de nombreuses substances peuvent être mal connues. Au moindre doute concernant une substance, traitez-la comme s'il contenait une substance potentiellement dangereuse. Pour des instructions comment utiliser correctement des composés particuliers, veuillez consulter à la fiche de données des sécurités du fabricant respectif. Veuillez respecter des directives des Bonnes Pratiques de Laboratoire (BPL).

  Débarrassez-vous de tous les déchets de substances de manière écologique, conformément à la règlementation en vigueur au niveau local. Empêchez impérativement l'accumulation de solvants inflammables, toxiques et/ou infectieux. Suivez un programme d'élimination des déchets règlementé et approuvé. Ne jetez jamais de solvants inflammables, toxiques et/ou infectieux dans le système municipal d'évacuation des eaux usées.

- **Gaz dangereux**

  Installez le système HPLC dans un laboratoire bien ventilé. Si la phase mobile ou l'échantillon contient des solvants volatils ou inflammables, vous devez assurer qu'ils ne pénètrent dans l'espace de travail. Si la phase mobile ou l'échantillon contient des solvants volatils ou inflammables, évitez les flammes nues et les sources d'étincelles à proximité.

- **Décharge électrostatique**

  Décharge électrostatique peut provoquer la formation d'étincelles et peut présenter un risque d'incendie. Veuillez noter que des solvants fluides dans les capillaires peuvent se charger automatiquement. Cet effet se peut produire particulièrement forte dans les capillaires isolants et avec des solvants non-conducteurs (par exemple, l'acetonitrile pur).

  Prenez des mesures appropriées pour éviter les charges électrostatiques à proximité du système HPLC. Par exemple, s'assurez qu'il y a une humidité de l'air suffisante et une ventilation adéquate dans la laboratoire, portez des vêtements ou équipement de protection antistatique, évitez l'accumulation de bulles d'air dans les lignes de déchets et utilisez des réservoirs à déchets mis à la terre.

  Utilisez uniquement des capillaires non-conducteurs pour diriger solvants au réservoir de déchets. Capillaires électriquement conducteur devrait être mis à la terre.

- **Inflammation spontanée des solvants**

  N'utilisez aucun solvants avec une température d'auto-inflammabilité inférieure à 150° C. Si une fuite se produit, ces solvants peuvent s'auto-enflammer au contact d'une surface chaude.

- **Capillaires, connecteur capillaires, connexions ouvertes**

  - Des capillaires, en particulier les capillaires non-métalliques, pourraient fendre ou glisser des connecteurs ou ne peuvent pas être vissés. Ceci peut en résulter aussi que des substances pourraient jaillir des connexions ouvertes.
  - Dans un système UltiMate 3000, certaines composantes sont en PEEK. Bien que ce polymère présente une excellente résistance chimique à la plupart des solvants organiques, il a tendance à gonfler lorsqu'il est en contact prolongé avec du chloroforme (CHCl3), du diméthyle sulfoxide (DMSO) ou du tetrahydrofuran (THF). De plus, il est attaqué par des acides concentrés tels que l'acide sulfurique et l'acide nitrique ou d'un composé du hexane, éthyle acétate et méthanol. Ceci peut causer des capillaires de fuite ou risquer des capillaires d'éclater. Ces acides peuvent cependant être utilisés dans le cadre de procédures de nettoyage, à condition que l'exposition soit brève.
  - N'utilisez pas de capillaires écrasés, pliés, abimés ou endommagés.
  - Les connecteurs capillaires pour pourrait être contaminé par des substances dangereuses ou des substances dangereuses pourrait sortir des connexions ouvertes.
  - Portez des lunettes de protection lorsque vous manipulez des capillaires en silice fondue (pendant l'installation, découpe, etc.).

- Quand les capots de protection de l'appareil sont démontés, vous êtes exposés à des connexions électriques sous haute tension deviennent accessibles. Débranchez l'instrument de toute source d'alimentation électrique avant de retirer les capots. Ne démontez les capots de protection que si cela est explicitement demandé au cours de ces instructions. Les capots de protection devraient être démontés uniquement par le personnel de service de Thermo Fisher Scientific.
- Remplacez toujours les fusibles grillés par des fusibles de rechange autorisés par Thermo Fisher Scientific.
- Remplacez les câbles de communication défectueux.
- Remplacez les cordons d'alimentation électrique défectueux. Utilisez uniquement les cordons d'alimentation électrique spécifique à l'instrument.
- Utilisez seulement des pièces de rechange originales et des accessoires autorisés par Thermo Fisher Scientific.
- La pompe est stockée sous 2-Propanol. Au cours démarrage de la pompe, assurez-vous que les solvants utilisés soient miscibles avec le 2-Propanol. Sinon, suivez les étapes intermédiaires appropriées.
- Réglez toujours une limite de pression minimum pour la pompe HPLC. Ceci prévient les dommages résultant de fuites ou de long-terme fonctionnement à sec de la pompe.
- Lorsque vous soulevez ou l'instrument, tenez-le toujours par le dessous ou par les côtés de l'unité. Soulever l'instrument par la partie avant inférieure ou par le panneau avant peut endommager la porte.
- Ne placez aucun objet lourd sur la porte ouverte du panneau avant. Ceci pourrait endommager la porte.
- Après utilisation, purgez le système des tampons et des susceptibles de former des peroxydes.
- Lorsque vous passez d'une solution saline à un solvant organique, effectuez un rinçage intermédiaire du système HPLC à l'eau dé-ionisée ou qualité HPLC.
- Lorsque vous passez à un autre solvant, assurez-vous que le nouveau solvant soit miscible avec celui qui se trouve dans la pompe. Dans le cas contraire, la pompe peut être endommagée; par exemple, par des floculations!
- Si une fuite se produit, arrêtez immédiatement l'instrument, stoppez le débit de la pompe et remédiez au problème.
- Utilisez uniquement des solvants (qualité HPLC) et des solutions salines compatibles avec les matériaux exposés phase mobiles.
- De nombreux solvants organiques et solutions salines sont toxiques. Informez-vous des propriétés toxicologiques de toutes les phases mobiles que vous utilisez.

- Ne regardez jamais directement la DEL pour l'éclairage intérieur dans la pompe et ne regardez pas du faisceau lumineux par des instruments qui focalisent le rayon lumineux. L'intensité lumineuse de la lampe peut être nocive pour les yeux.
- Afin d'éviter que le calibrage de pression de la pompe ne soit pas entravé, mettez en marche la pompe seulement quand la pompe est sans pression. Toujours ouvrez la vis de purge avant mettre la pompe en marche.
- Ne faites jamais fonctionner la pompe à sec. Il peut en résulter des dommages aux pistons ou aux joints de piston.
- Avant de mettre en marche la pompe, assurez-vous que le réservoir de rinçage du joint arrière est rempli. Attendez jusqu'à ce que le rinçage du joint arrière ait été pompé par toutes les têtes de pompe.
- Utilisez toujours le liquide frais pour le rinçage du joint arrière.
- Thermo Fisher Scientific déconseille le recyclage de solvants. Ceci peut affecter les performances des joints de piston.
- Si le débit de la pompe est interrompu pour des périodes prolongées (> 1 heure), éteignez les lampes de tout détecteur UV ou RF raccordé à la pompe. Ceci empêchera l'évaporation dans la cellule.
- Utilisez toujours les frittés recommandés par Thermo Fisher Scientific afin d'empêcher les particules étrangères d'entrer dans le système HPLC. Utiliser d'autres frittés peut affecter considérablement les performances du système.
- Avant d'interrompre le fonctionnement pendant plusieurs jours ou plus, observez les précautions figurant en page 88.
- N'utilisez pas l'instrument de manière autre que celles décrites dans ce manuel.
- Conservez ce manuel á proximité de l’instrument pour pouvoir le consulter facilement.

1.3 Intended Use

For Research Use Only. Not for use in diagnostic procedures. The device is designed to be operated only be qualified and authorized personnel. All users must know the hazards presented by the device and the used substances.

The pump is designed for laboratory research use in high-performance liquid chromatography (HPLC) and ultra-high performance liquid chromatography (UHPLC) applications. It is part of the UltiMate 3000 system, but can also be used with other HPLC systems if adequate control inputs and outputs are available. A PC with USB port is required.

The pump is operated with the Chromeleon Chromatography Management System. Being part of the UltiMate 3000 system, the pump can also be operated with other data systems, such as

- Xcalibur™, Compass™/HyStar™, Atlas, or Analyst®
  To do so, installation of the DCMSLink (Dionex Chromatography Mass Spectrometry Link) software is required in addition to the installation of the data system.
- Empower™
  Installation of the Dionex Instrument Integration Software is required in addition to the installation of the data system.

For more information, contact the Thermo Fisher Scientific sales organization for Dionex HPLC Products.

Note that the pump may be operated only with accessories and spare parts recommended by Thermo Fisher Scientific (→ page 137) and within its technical specifications (→ page 135).

If there is any question regarding appropriate usage, contact Thermo Fisher Scientific before proceeding.

Warning: If the device is used in a manner not specified by Thermo Fisher Scientific, the protection provided by the device could be impaired. Thermo Fisher Scientific assumes no responsibility and will not be liable for operator injury and/or instrument damage. Whenever it is likely that the protection is impaired, the instrument must be disconnected from all power sources and be secured against any intended operation.

Avertissement: Si l'instrument est utilisé de façon non spécifiée par Thermo Fisher Scientific, la protection prévue par l'instrument pourrait être altérée. Thermo Fisher Scientific n'assume aucune responsabilité et ne sera pas responsable des blessures de l'operateur et/ou des dommages de l'instrument. Si la protection de l'instrument n'est pas garanti à tout moment, débranchez l'instrument de toutes les sources d'alimentation électrique et assurez-vous que l'instrument n'est pas utilisé involontairement.

1.4 Federal Communications Commission (FCC) Note

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the U.S. FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his expense.

2 Overview

2.1 Unit Description

The pump is a modern high-quality instrument designed for HPLC analysis, and the heart of the UltiMate 3000 system. The design has been optimized for minimum dead volume.

- The quaternary, low-pressure mixing pump provides optimum performance with a maximum operating pressure of 1250 bar. With the compact design, a minimal dead volume is obtained.
- The technical specification meets the highest requirements for flow rate reproducibility, nearly zero pulsation, and operational reliability (→ page 135).
- With the built-in vacuum membrane degasser dissolved gases are removed from the mobile phase.
- The pump is fitted with floating pistons, allowing compensation for small mechanical tolerances within the specification and thus enhancing the robustness of the pump.
- As a standard, the pump is equipped with an active rear seal wash system (→ page 24).
- The integrated force feedback controller continuously calibrates valve timing and pumping efficiency based on the measured compressibility of the solvent. Thus, the pump forms accurate gradients virtually pulsation-free. No pulse damping device is required.
- The pump is designed for easy access to the fluid components, allowing fast and reliable maintenance while the pump remains in the UltiMate 3000 system stack.
- For the secure and functional positioning of the solvent reservoirs on top of the pump in the UltiMate 3000 XRS system, the SR-3000 Solvent Rack or the OAS-3x00TXRS autosampler (which includes a reservoir tray) are available from Thermo Fisher Scientific. For further information, refer to page 58.
- The pump can be fully controlled by the Chromeleon Chromatography Management System, providing a high degree of system integration.
- All parts that may be exposed to solvents are made of materials that provide optimum resistance to the most commonly used solvents and buffer solutions.
- If an UltiMate 3000 WPS-3000TXRS autosampler is connected, the integrated degasser of the pump can be used to degas the wash liquid of the autosampler. For information about online degassing of the wash liquid, see the *Operating Instructions* for the WPS-3000TXRS autosampler.

2.2 Operating Principle

The pump is a quaternary, low-pressure gradient pump with serial dual pistons and electronic compressibility compensation. Thus, the pump forms accurate gradients virtually pulsation-free. The pump head (liquid displacement assembly) includes two cylinders—working cylinder and equilibration cylinder—that are connected in series. The solvent passes both cylinders successively.

Continuous delivery is achieved as follows: The working cylinder delivers at the appropriate flow rate while simultaneously filling the serially connected equilibration cylinder. The latter serves as a reservoir and delivers while the working cylinder carries out the suction stroke.

The characteristic feature of the pump is the overlapping phase of the delivery strokes of the working and equilibration cylinders. When delivering compressible liquids without controlled pre-compression, the pulsation increases as the working pressure increases, since part of the delivery stroke is required for compressing the solvent in the working cylinder. Pulsation during the pre-compression phase is reduced to a minimum by velocity modulation of the drive. The highly constant delivery is ensured by the force feedback control system (automatic compressibility compensation). The flow rate is always kept constant in relation to the atmospheric pressure.

2.3 Functional Schematic

The picture illustrates how the pump operates.

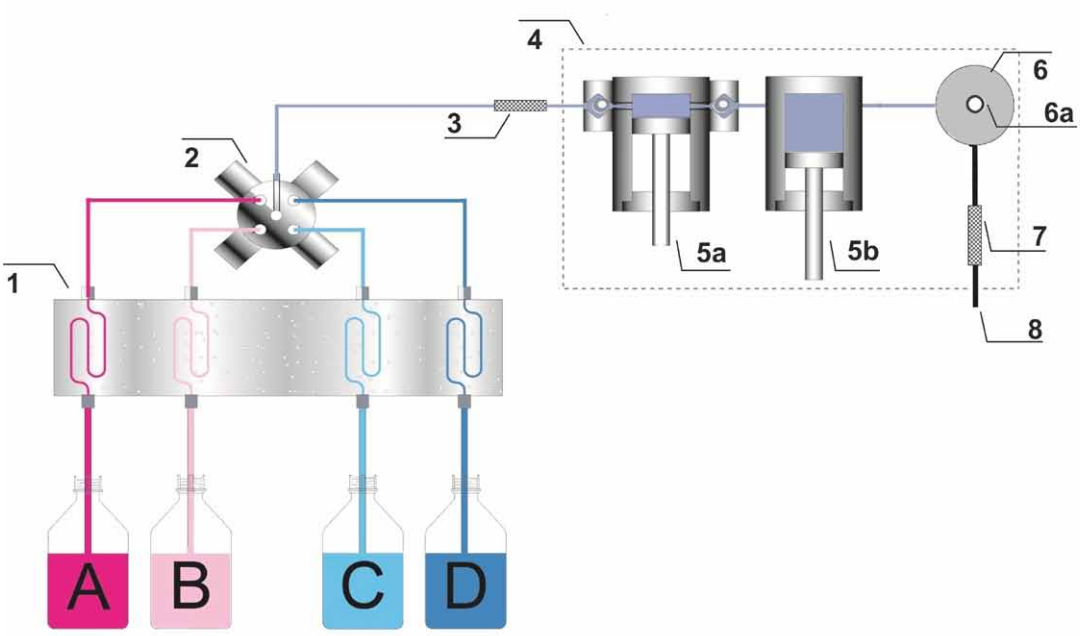


Fig. 1: Operating principle (schematic)

No.	Element	
1	Inbuilt vacuum degasser	
2	Proportioning valve	
3	Static mixer (integrated in the proportioning valve)	
4	Pump head with	
	No.	**Element**
	5a	Working cylinder
	5b	Equilibration cylinder
	6	Purge valve knob
	6a	Purge valve outlet nozzle
	7	Static mixer (integrated in the purge unit)
	8	Pump outlet

2.4 Front Panel Elements

Fig. 2: Front panel view

No.	Element	Description
1	Display	Shows information about the pump and the status screen (→ page 68)
2	Standby button	Switches the pump to Standby mode (the LED is red). To cancel Standby mode and resume operation, press the Standby button again (the LED is not lighted). *Notes:* To allow the pump to change the mode, press and hold the Standby button for at least one second.
3	**Status LEDs**	
	Power	The LED is blue when the pump is turned on.
	Connected	The LED is green when the pump is connected in Chromeleon.
	Status	The LED is green when the pump is ready for operation. The LED is red when an error has been detected, for example, a leak.

2.5 Rear Panel

Fig. 3: Rear panel view

No.	Description
1	Power switch (→ page 20)
2	Fuse cartridge (→ page 20)
3	Main power receptacle (→ page 37)
4	Digital I/O port: 8-pin terminal connector for connecting the pump to external devices (→ page 20)
5	RS-232 port
6	Mini USB 2.0 port for connecting the pump to the data system computer (→ page 20)

2.5.1 Power Switch

The power switch on the rear panel is the main power switch for the pump. Turn on the power switch before initial operation of the pump. For routine operation, leave the main power switch on. For routine on/off control, use the standby button on the front of the pump (→ page 18). Press and hold the button for one second to allow the pump to change the mode. Turn off the main power switch when instructed to do so, for example, before performing a service procedure or when interrupting operation for longer periods (one week or more). Observe the precautions on page 88.

2.5.2 Fuse Cartridge

The fuse cartridge contains two slow-blow fuses rated at 2A, 250 V. For information about how to change the fuses, see page 132.

2.5.3 USB Port

The Chromeleon Chromatography Management System can use a USB connection to control the pump. Data is transferred digitally by means of the appropriate USB cable (→ page 36). To ensure trouble-free operation, use only the cables shipped with the pump.

⚠ **Important:** Use the USB port only for connection to Dionex instruments from Thermo Fisher Scientific. Thermo Fisher Scientific cannot guarantee correct functioning if instruments from third-party manufacturers are connected.

⚠ **Important:** Thermo Fisher Scientific recommande d'utiliser le port USB uniquement pour les connexions entre les appareils Thermo Fischer Scientific et Dionex. Thermo Fischer Scientific ne garantie pas le fonctionnement si des instruments de fabricant tiers sont connectés.

For information about how to connect the pump to the Chromeleon data system computer, see sections 3.4.1 and 3.4.2 (→ page 36).

2.5.4 Digital I/O

The digital I/O port provides two TTL inputs and three digital outputs that can be used to exchange digital signals with external devices. For connecting an external device to the digital I/O port, use the appropriate cable with an 8-pin I/O terminal connector. For details, see page 37.

For information about the functions of the connector pins and pin assignment, see page 151.

🛈 **Tip:** If you want to connect a WPS-3000TXRS, an OAS-3x00TXRS autosampler, or a Corona or Coulochem III detector to the pump, refer to page 37 for details.

2.6 Interior Components

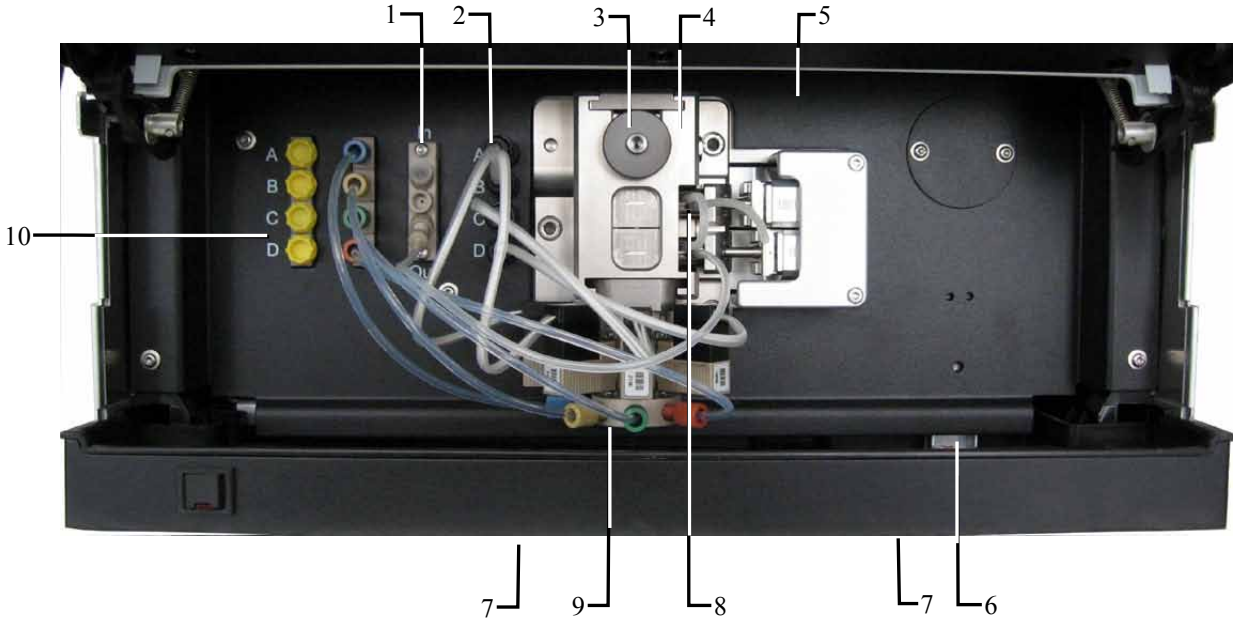


Fig. 4: Interior components

No.	Description
1	Rear seal wash system (→ page 24)
2	Ports for bayonet-type connectors from the proportioning valve
3	Purge valve knob on the purge unit (→ page 27)
4	Pump head (→ page 25) Containing working cylinder and equilibration cylinder, static mixer, check valves and purge unit
5	Pump lights (here hidden by the front panel door)
6	Leak sensor (→ page 28)
7	Capillary passages (in the pump module) (→ page 23)
8	Ports for rear seal wash tubing
9	4-channel proportioning valve (→ page 27)
10	4-channel vacuum degasser (→ page 28)

2.7 Flow Path

The picture illustrates the liquid flow path through the pump.

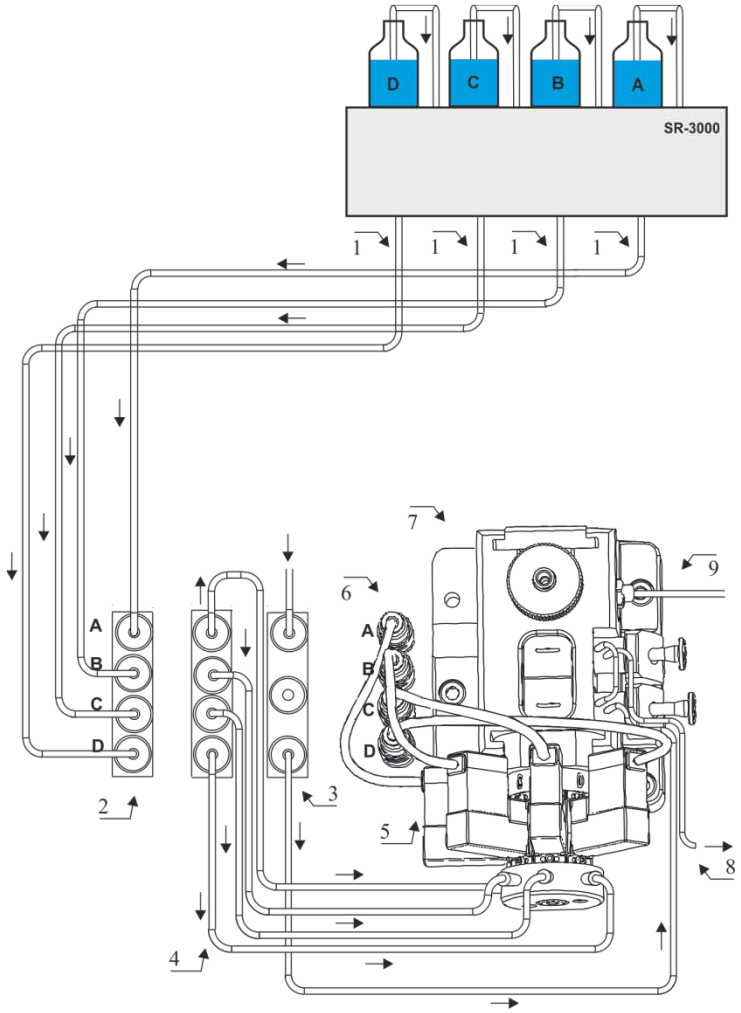


Fig. 5: Flow path through the LPG-3400XRS pump

No.	Description	Part No.
	SR-3000 Solvent Rack	→ page 58
1	Solvent supply lines to degasser (4 lines)	6043.8109
2	Analytical 4-channel vacuum degasser	------
3	Rear seal wash system (In port from seal wash reservoir and Out port to guide bushings)	------
4	Tubing from degasser outlet to proportioning valve (4 lines)	Included in 6043.0015
5	4-channel proportioning valve with integrated static mixer	6043.0270

No.	Description	Part No.
6	Bayonet-type connectors from the proportioning valve	------
7	Pump head containing working cylinder and equilibration cylinder (entire assembly), purge unit with purge valve knob and integrated static mixer, displacement chambers with check valve cartridges	→ section 7.3, page 106
8	Rear seal wash tubing from guide bushing to waste	Included in 6043.0056
9	Pump outlet (here: tubing connected)	------

Note: Tubing and capillaries are shipped with the appropriate fitting connections.

2.8 Fluid Connections

The front panel door tilts upward to provide easy access to the fluid connections in the pump. Tilt the front cover upward. The open front panel locks in the topmost position.

⚠ **Important:** The open front panel door is not designed to carry weight. Therefore, you should not place any objects on the open door.

When lifting or moving the pump, always lift by the sides of the device. Do not lift the pump by front panel door. Lifting the pump by the front panel door may damage the door.

⚠ **Important:** Ne placez aucun objet lourd sur la porte ouverte du panneau avant. Ceci peut endommager la porte.
Lorsque vous soulevez ou déplacez la pompe, saisissez-la toujours par les côtés de l'instrument. Soulever la pompe par le panneau avant risque d'endommager la porte du panneau avant.

Two passages in the bottom of the interior front panel facilitate routing the capillaries to the modules that are located below the pump and ensure the shortest possible connection.

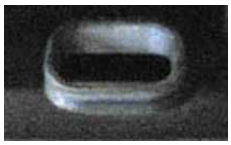


Fig. 6: Capillary passage

2.9 Rear Seal Wash System

The pump is equipped with an active rear seal wash system. Rear seal washing helps avoiding damages to the pistons and piston seals, and thus prolongs the seal lifetime. The rear seal wash system consists of a membrane pump, a wash liquid reservoir, and wash ports on the piston guide bushings to connect the seal wash tubing.

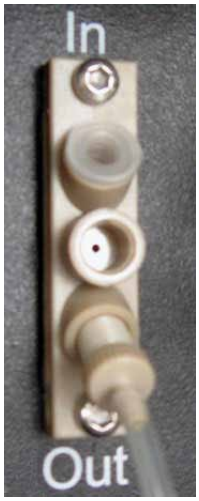


Fig. 7: Membrane pump

For information about how to set up the rear seal wash system, see page 62. For more information about how to operate the pump with rear seal washing, see section 5.4.6 (→ page 83).

2.10 Pump Head (Liquid Displacement Assembly)

The pump head contains two displacement chambers, one inlet and one outlet check valve, a purge unit with the pump outlet and a purge valve knob, a static mixer, and two sapphire pistons and their seals.

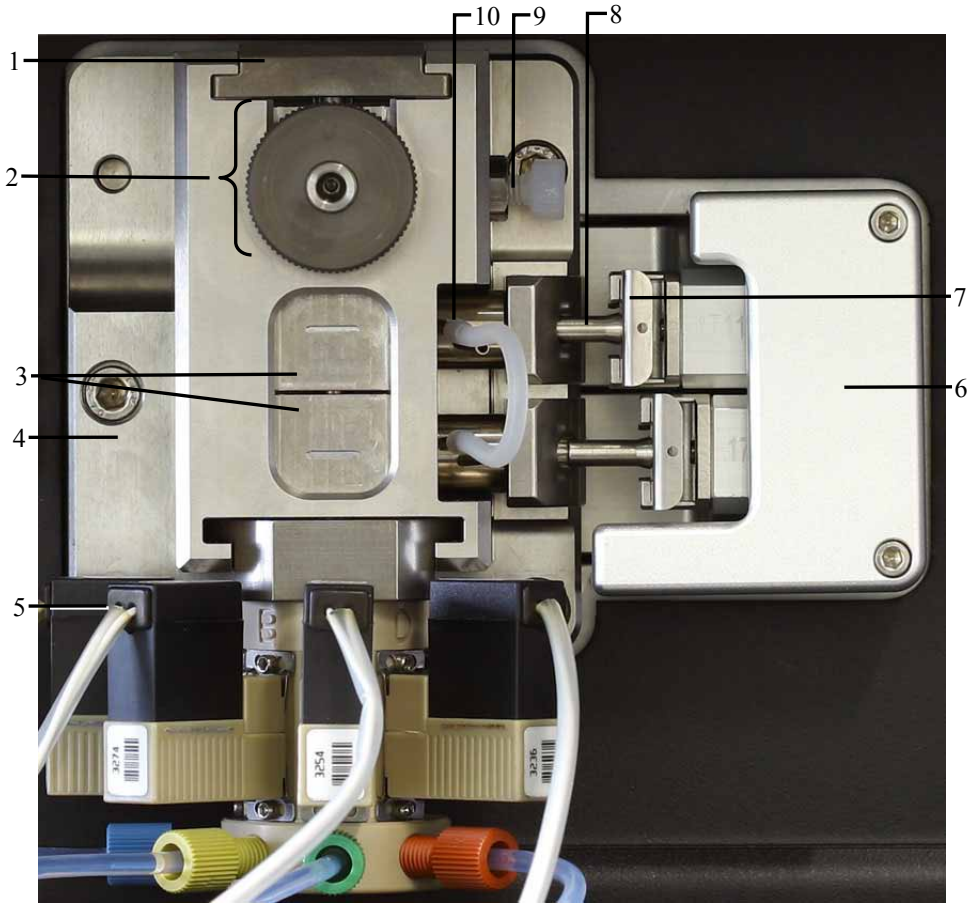


Fig. 8: Pump head and proportioning valve

No.	Description
1	Compression lid
2	Purge unit with purge valve knob
3	Displacement chambers
4	Pump head main body
5	4-channel proportioning valve
6	Piston drive unit
7	Piston retaining spring
8	Piston
9	Pump outlet
10	Rear seal wash tubing connecting the guide bushings

2.11 Mixing System

The pump is equipped with an integrated two-step mixing system including two static mixers. One static mixer is located before the pistons (in the proportioning valve), and the other static mixer is located after the pistons (in the purge unit).

The static mixers improve the mixing quality of the combined solvent streams, resulting in a smoother baseline.

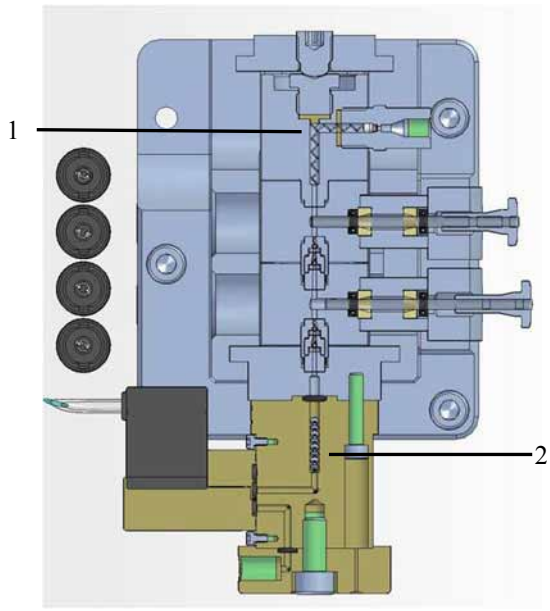


Fig. 9: Two-step mixing system (view into an open pump head)

No.	Description
1	Static mixer (high pressure)
2	Static mixer (low pressure)

For mixing complex or relatively incompatible solvents, a dynamic mixer can be installed in addition to the static mixers. Dynamic mixers with different mixing volumes (see table) are available as an option, and are installed by authorized service personnel. For more information, contact the Thermo Fisher Scientific Service for Dionex HPLC Products.

Description	Part No.
Dynamic mixer, mixing volume 35 µL	Contact Service.
Dynamic mixer, mixing volume 75 µL	Contact Service.

2.12 Purge Unit

The purge unit is included in the pump head and comprises a static mixer, the pump outlet, a purge valve knob, and a purge outlet nozzle.

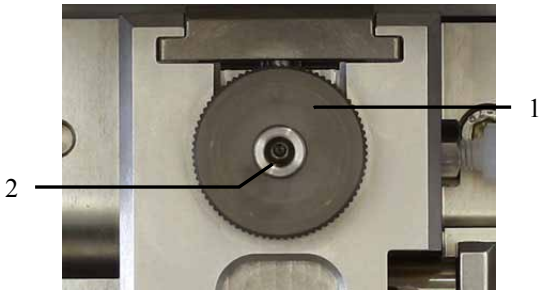


Fig. 10: Purge unit in the pump head

No.	Description
1	Purge valve knob
2	Purge outlet nozzle

Tip: You may open the purge valve (by turning the valve knob counterclockwise) to reduce the system pressure.

2.13 Proportioning Valve

The proportioning valve is directly attached to the bottom of the pump head. It includes four valve channels, four bayonet-type valve connectors, a static mixer, and various seal rings.

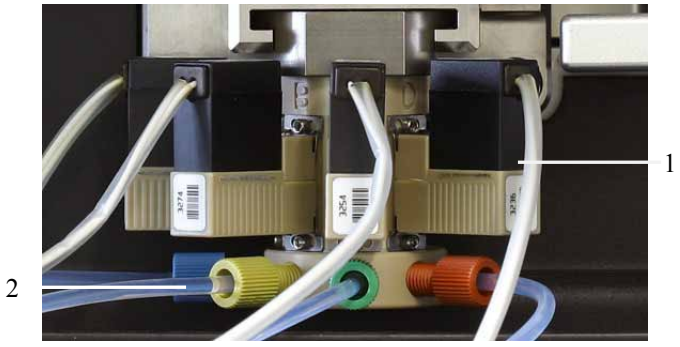


Fig. 11: 4-channel proportioning valve

No.	Description
1	Valve connectors
2	Valve tubing

2.14 Leak Sensor

A leak sensor is installed inside the pump. If liquid collects in the drip tray under the fluid connections, the leak sensor reports a leak. The **Status** LED on the front panel door changes to red, a beep sounds and an error is reported in the Chromeleon Audit Trail.

When the leak sensor reports a leak, eliminate the cause for the leakage and dry the leak sensor (→ page 105).

Leak detection is enabled as a standard when the pump is shipped. For more information, see section 5.4.8 (→ page 84).

2.15 Vacuum Degasser

The pump contains a vacuum membrane degasser with four independent channels to remove air bubbles trapped in the solvents. Dissolved gases can cause many problems and must be kept to an absolute minimum for best performance. The vacuum degasser contains a vacuum chamber in which a vacuum is generated to degas the liquid. The vacuum in the channels is kept at a constant level.

Degassing is enabled by default.

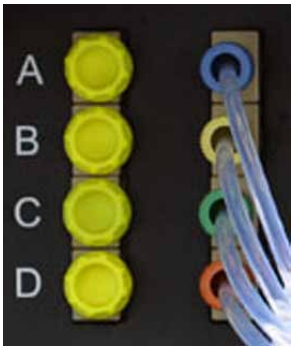


Fig. 12: Degasser channel inlets and outlets

Tip: Normal phase eluents usually show only a low concentration of dissolved gases. Therefore, it is normally not required to use a degasser with these eluents.

If the UltiMate 3000 system includes a WPS-3000TXRS autosampler, you should degas also the wash liquid on a continuous basis. The procedure how to prepare and install the wash liquid lines is similar to the steps for the solvent supply (→ page 60). For more information, see the *Operating Instructions* for the WPS-3000TXRS autosampler.

Observe the general precaution for degasser operation (→ page 85).

2.16 Operation with Chromeleon

The pump can be controlled by the Chromeleon Chromatography Management System. To control the pump, an appropriate Chromeleon version and license are required.

Two modes of software control are available:

- *Direct Control*

  With direct control, you select operating parameters and commands in the Commands (F8) dialog box. Direct commands are executed as soon as they are entered. For routine operation, most parameters and commands are available also on a control panel. For more information about direct control, see page 70.

- *Automated Control*

  With automated control, you create a program (or PGM File). This is a list of control commands, executed in chronological order, for automated operation of the pump. Programs can be created automatically with the help of a software wizard or manually by editing an existing program. For more information about automatic control, see page 72.

Tips: All software details in this manual refer to *Chromeleon 6.80*.

If you want to operate the pump with Chromeleon 7, refer to the following documents for information about how to perform the related processes in Chromeleon 7 (all documents are included in the Chromeleon 7 shipment):

- *Chromeleon 7 Help*—provides extensive information and comprehensive reference material for all aspects of the software.
- *Quick Start Guide*—describes the main elements of the user interface and guides you step-by-step through the most important workflows.
- *Reference Card*—provides a concise overview of the most important workflows.
- *Installation Guide*—provides basic information about module installation and configuration. For specific information about a certain module, refer to the *Chromeleon 7 Instrument Configuration Manager Help*.

Note the following:

- Chromeleon 7 terminology is different from the terminology used in Chromeleon 6.80. For details, refer to the 'Glossary - Chromeleon 7,' which is available in the Documents folder of your Chromeleon 7 installation.
- Chromeleon 7 may not yet support all functions supported in Chromeleon 6.80.

2.17 Wellness and Predictive Performance

System Wellness in Chromeleon monitors the health of the pump. Therefore, the pump supports several performance and reliability features that can help you detect small problems before they turn into big ones:

- Internal monitoring of all mechanical operations
- Automatic self test upon power up
- Leak sensor (→ page 28)
- Active rear seal wash system (→ page 24)

When an error is detected, the Status LED on the front panel door is red, a beep sounds, and an error code appears on the pump display (→ page 94).

3 Installation

3.1 Facility Requirements

The installation site must meet the following requirements:

- The main power switch and the main power receptacle are on the rear panel. Make sure that
  - ♦ Free and unrestricted access to the main power switch is ensured at all times.
  - ♦ The power cord of the device can be easily reached and disconnected from the power line at all times. Provide sufficient space behind the device to unplug the cable.
- Make sure that the installation site meets the power and environmental specifications listed in the 'Technical Information' section (→ page 135).
- Install the pump in the laboratory on a stable surface. Make sure that the position is horizontal and free of vibrations.
- Make sure that the surface is resistant to solvents.
- Avoid locations with extreme changes in temperature. Also, avoid locations with extreme direct sunlight and high humidity.
- Allow sufficient clearance behind and to the sides of the pump for ventilation.

3.2 Unpacking

All electrical and mechanical components of the pump are carefully tested before the module is shipped from the factory. After unpacking, inspect the module for any signs of mechanical damage, which might have occurred during transit.

Tips: Immediately report any shipping damage to both, the incoming carrier and Thermo Fisher Scientific. Shipping insurance will compensate for the damage only if reported immediately.

Keep the original shipping container and packing material. They provide excellent protection for the pump in case of future transit. Shipping the pump in any other packaging automatically voids the product warranty.

1. Place the shipping container on the floor and remove the accessories kit, power cord, and solvent reservoir.
2. Grasp the pump by the sides. Slowly and carefully, pull the module out of the shipping container and place it on a stable surface

   Important: To prevent the pump from falling, grasp the pump by the sides, and then lift the pump together with the foam spacers out of the shipping container. Do not lift the pump by the foam spacers or the front panel.

   Important: Afin d'empêcher la pompe de tomber, saisissez-la par les côtés. Ne soulevez la pompe à l'aide du matériau d'emballage ou par la porte du panneau avant.
3. Remove the foam spacers, and then remove the polythene packaging.
4. Tilt the front panel upward and remove the foam inserts securing the front panel door during shipment.
5. Before connecting the pump to the power source, wait approximately four hours to allow the module to come to room temperature and to allow any condensation that might have occurred during shipping to evaporate. After four hours, check the pump; if condensation still exists, allow the pump to continue to warm up (without connecting it to the power source) until the condensation is completely gone.

3.3 Positioning the Pump in the UltiMate 3000 System

The positioning of the pump and the arrangement of the system modules depend on the UltiMate 3000 system and the application.

Module arrangement with a WPS-3000TXRS autosampler

If the pump is part of an UltiMate 3000 system for analytical HPLC applications with a WPS-3000TXRS autosampler, you should stack the individual modules as shown in Fig. 13 and interconnect them on the rear panel as shown in Fig. 14.

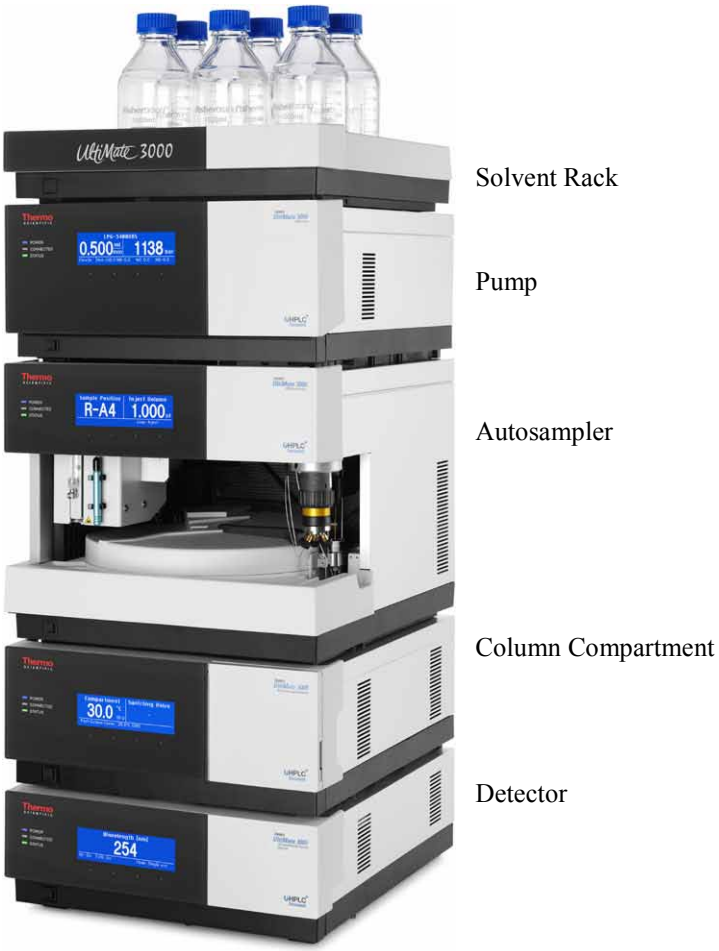


Fig. 13: Module arrangement for an UltiMate 3000 XRS system with WPS-3000TXRS (example)

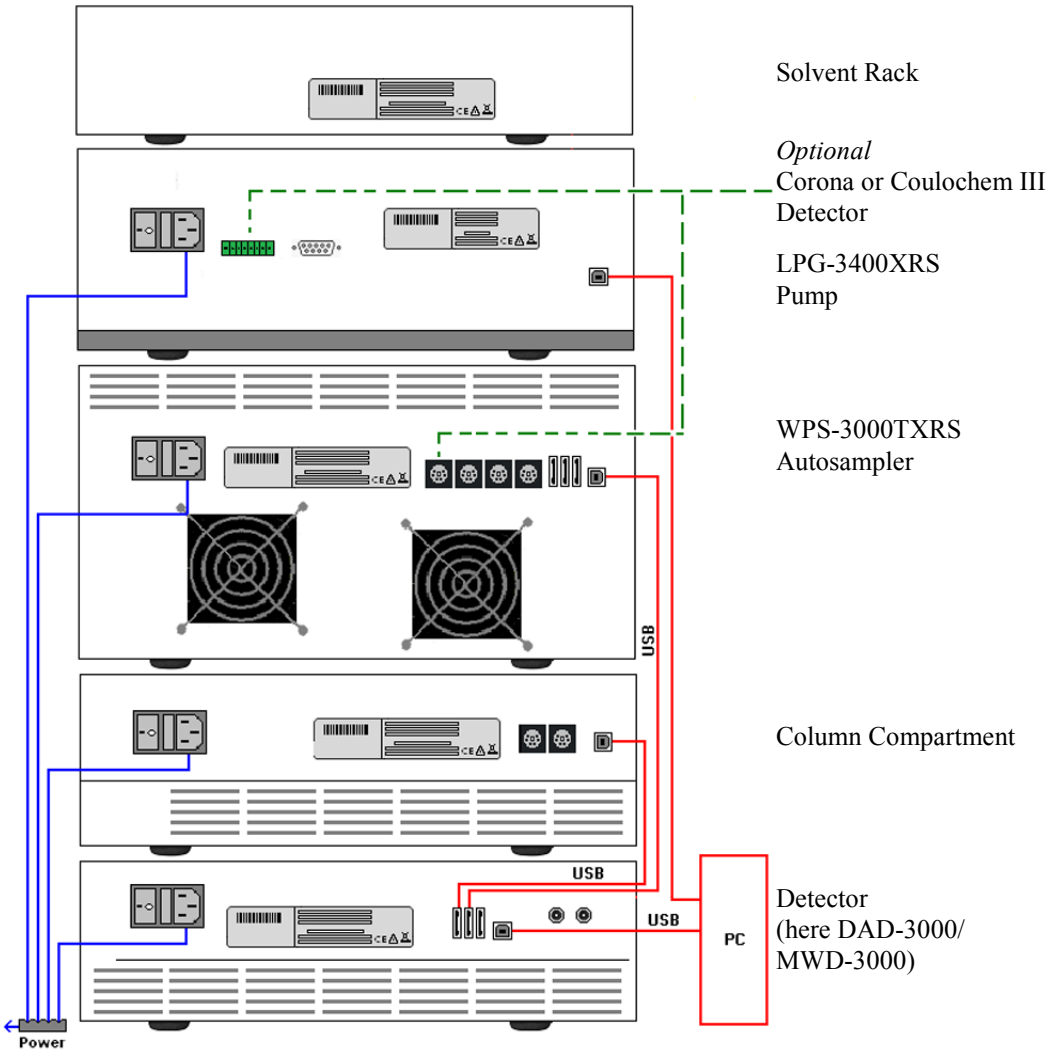


Fig. 14: Example for the rear panel connections on an UltiMate 3000 XRS system with WPS-3000TXRS autosampler

Apart from the solvent rack, all modules of the UltiMate 3000 system can be connected separately to the Chromeleon data system computer by using the USB port on the rear panel of the module. Thermo Fisher Scientific recommends connecting the pump directly to the computer and interconnecting all other modules, and then connecting them to the Chromeleon data system computer. For systems with a DAD-3000(RS) or MWD-3000(RS), you can use *only* the hub on the detector for the connection.

Module arrangement with an OAS-3x00TXRS autosampler

If the pump is part of an UltiMate 3000 system for analytical HPLC applications with an OAS-3x00TXRS autosampler, you should stack the individual modules below the autosampler and interconnect them on the rear panel as shown below.

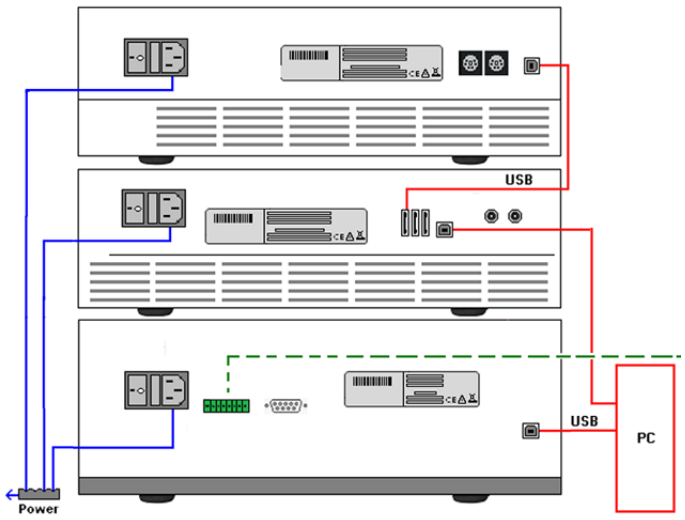
OAS-3x00TXRS Autosampler

Column Compartment

Detector

LPG-3400XRS Pump

Fig. 15: Module arrangement of an UltiMate 3000 XRS system with OAS-3x00TXRS (example)



Column Compartment

Detector

OAS-3x00TXRS Autosampler and/or Corona or Coulochem III Detector *(optional)*

LPG-3400XRS Pump

Fig. 16: Example for an UltiMate 3000 XRS system: the rear panel connections on the modules below an OAS-3x00TXRS autosampler

For details about the module arrangement, positioning and interconnecting with an OAS-3x00TXRS autosampler, refer to the *Operating Instructions* for the autosampler.

3.4 Connecting the Pump

3.4.1 General Information

If you want to operate the pump with Chromeleon

Verify that Chromeleon is installed on the computer and that the license code is entered before you connect the pump to the USB port on the data system computer and turn on the pump power. Only if you install Chromeleon first, the USB driver for the pump is automatically loaded and the Windows® operating system can detect the pump when the power is turned on.

3.4.2 Connecting the USB Cable

When connecting the pump in an UltiMate 3000 system, take into consideration that the pump has a USB 2.0 port and a high data transfer rate.

Therefore, connect the pump directly to the USB port on the data system computer via the mini USB port on the rear panel of the pump (→ Fig. 3, page 19).

If you want to connect the pump to the computer via an external USB hub, note that connecting the pump via USB hubs may be the source for communication problems to the computer, depending on the quality of the hub.

Use the following USB cable that is provided in the accessories kit of the pump:

USB Cable	**Part No.**
USB cable, type A to type mini B, high speed USB 2.0 (cable length: 5 m)	6911.0008

Tip: The USB standard limits the USB cable length to 5 meters. Each USB device can be separated from the PC or next USB hub by no more than 5 meters.

3.4.3 Connecting the Power Cord

Use the power cord shipped with the device to connect the pump to the main power source. Connect the power cord from the main power receptacle on the rear panel to a grounded power source. No manual adjustment is required to adapt the line voltage to local voltage requirements.

Warning: Never use a power cord other than the power cords provided for the device.

Do not use multiple sockets or extension cords. Using defective multiple sockets or extension cords may cause personal injury or damage to the device.

Avertissement: Utilisez uniquement les cordons d'alimentation électrique spécifique à l'instrument.

N'utilisez pas des blocs multiprise ou des câbles prolongateurs. Cela pourrait entraîner des blessures corporelles ou endommager l'instrument.

3.4.4 Connecting the Digital I/O

The Digital I/O port on the rear panel of the pump serves as the interface to connect the UltiMate 3000 XRS series autosampler in order to allow

- Transmitting the Inject Response signal between the autosampler and the pump
- Synchronizing the injection command with the pump strokes

In addition, other external devices (the Corona or Coulochem III detector, for example) can be connected to the Digital I/O, too.

To connect the WPS-3000TXRS or OAS-3x00TXRS autosamplers or other external devices to the Digital I/O port on the pump, use the appropriate cable with an 8-pin I/O terminal connector (→ Fig. 17). The parts stated below are available from Thermo Fisher Scientific. For information about the functions of the connector pins and the pin assignment, see page 151.

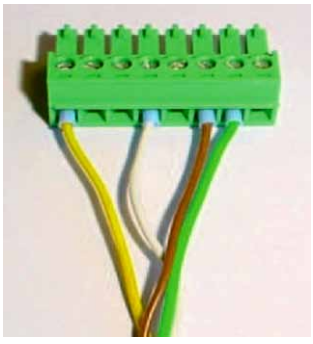


Fig. 17: 8-pin I/O terminal connector
(here on the synchronization cable OAS-3x00TXRS to pump)

3.4.4.1 Connecting a WPS-3000TXRS Autosampler for Stroke Sync

If you want to use inject response only

In this case, it is not necessary to connect the autosampler directly to the pump. The inject response signal is transmitted via Chromeleon. Thus, only connection to the data system via USB computer is required.

If you want to use pump stroke synchronization

Follow the steps below to connect the autosampler to the Digital I/O on the rear panel of the pump.

The following parts are required (the parts are included in the accessories kit for the pump):

Description	Part No.
Signal cable (6-pin mini DIN)	6000.1004
8-pin I/O terminal connector	n.a.

1. Locate the 6-pin mini DIN signal cable and the 8-pin I/O terminal connector.
2. Connect the mini DIN connector to the Digital I/O port 1 (2, 3, or 4) of the WPS-3000TXRS autosampler.

   Tip: The ports are numbered 1 to 4 from left to right.
3. Connect the wires of the signal cable to the 8-pin I/O terminal connector:
   To attach the wires to the 8-pin terminal connector, carefully loosen the locking screws on the connector, insert the appropriate wires, and retighten the locking screw. Observe the wire and pin assignment as described on page 151.
4. Connect the 8-pin I/O terminal connector to the Digital I/O on the rear panel of the pump.
5. To set up pump stroke synchronization with the autosampler, specific settings for the pump are required on the configuration pages of the WPS-3000TXRS (→ page 76).

If you want to use pump stroke synchronization with the autosampler and want to connect a Corona or Coulochem III detector to the pump at the same time, refer to section 3.4.4.4 (→ page 43).

3.4.4.2 Connecting an OAS-3x00TXRS Autosampler

To connect the OAS-3x00TXRS autosampler to the pump, the following cables are required:

Cable	Part No.
Autosampler interconnect cable —included in the autosampler shipment For information about the connectors, see page 39.	6043.0004
Synchronization cable to connect the autosampler to the pump for pump stroke synchronization RS-232 cable to connect the autosampler to the RS-232 port on the Chromeleon data system computer for inject response transmission RS-232-USB Interface cable required in addition to the RS-232 cable if an RS-232 port is not available on the computer All cables are included in the accessories kit for the autosampler.	6043.0002 6043.0005 6073.2000

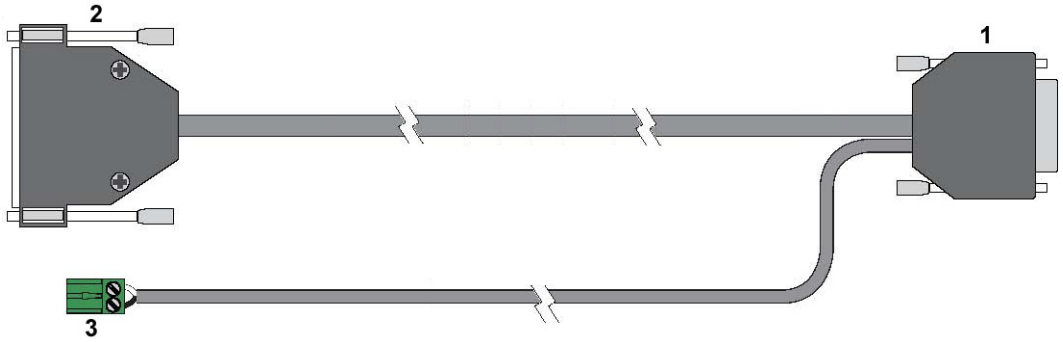


Fig. 18: OAS-3x00TXRS interconnect cable

No.	Description
1	15-pin Sub-D connector, connects the appropriate port on the autosampler
2	25-pin Sub-D connector, connects the synchronization cable
3	2-pin connector, connects, for example, to the RS-232 synchronization cable to connect the autosampler to the RS-232 port on the Chromeleon data system computer and/or to the Start In pins of a mass spectrometer

For further information about the cables, refer to the *Operating Instructions* for the autosampler.

1. Locate the autosampler interconnect cable (part no. 6043.0004) and the synchronization cable (part no. 6043.0002). Both cables are shipped with the autosampler.
2. Connect the 25-pin Sub-D connector of the interconnect cable to the 25-pin Sub-D connector of the synchronization cable.

3. Plug the 8-pin terminal connector of the synchronization cable into the Digital I/O port on the pump.

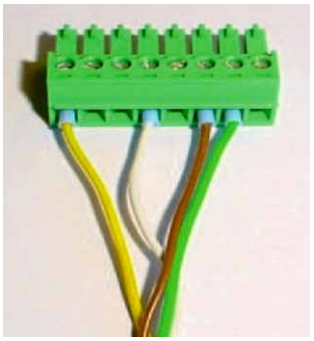


Fig. 19: 8-pin terminal connector on synchronization cable

4. Plug the 15-pin Sub-D connector of the interconnect cable into the **Interface 1** port on the autosampler.

5. Connect the RS-232 synchronization cable to the 2-pin connector on the synchronization cable:

   To attach the wires to 2-pin connector, carefully loosen the locking screw on the connector, insert the appropriate wire, and retighten the locking screw. Observe the wire assignment (brown to brown and white to white).

6. *Optional - If the system includes a mass spectrometer*

   Before connecting the interconnect cable to a mass spectrometer, observe all notes and instructions on the Start In connector provided in the *Operating Instructions* of the mass spectrometer. Manual adaption of the 2-pin connector on the interconnect cable may be required.

   Make sure that the wires attached to the 2-pin connector are in the correct pins respectively as required by the Start In connector pin assignment on the mass spectrometer. If they are not, open the locking screws on the connector and arrange the wires correctly. Afterward, close the locking screws again.

   Connect the 2-pin connector with the Start In connector on the mass spectrometer either by plugging in the connector or by attaching the appropriate cable from the mass spectrometer to the 2-pin connector on the autosampler interconnect cable.

   The wires should match the signals as shown in the following table:

Interconnect Cable 2-pin connector	**Mass Spectrometer connector or cable**
Brown wire	Input
White wire	Ground

Tip: If the mass spectrometer starts before the autosampler has triggered the injection, or if the mass spectrometer does not start at all, the wires may not be assigned correctly. Check the assignment of the wires on the 2-pin connector and on the Start In connector.

7. Connect the other end of the RS-232 synchronization cable to the RS-232 port on the Chromeleon data system computer.

   If an RS-232 port is not available on the data system computer, use the RS-232 to USB Interface cable from the accessories kit for the autosampler for the connection between the RS-232 synchronization cable and the USB port on the computer.

   Turn on the power to the data system computer and connect the interface cable to the USB port on the computer. When the interface cable is connected for the first time, you will be prompted to install the USB driver for the cable (recommended driver version: 2.06.00 or later). The driver is available in the **Drivers\W&T RS232-USB Interface Cable** directory on the Chromeleon software DVD.

8. To make sure that inject response and pump stroke synchronization work properly, specific settings are required on the configuration pages of the autosampler, and/or on the autosampler control terminal. For details, see page 76 or the *Operating Instructions* for the autosampler.

3.4.4.3 Connecting a Corona or Coulochem III Detector

To connect a Corona or Coulochem III detector to the pump, the following parts are required:

Description	Part No.
Signal synchronization cable from pump to Corona or Coulochem III detector The cable is included in the accessories kit for the Corona or Coulochem III detector.	6043.0003
8-pin I/O terminal connector The connector is included in the accessories kit for the pump.	n.a.

1. Locate the signal synchronization cable, which is included in the accessories kit for the Corona or the Coulochem III detector, and the 8-pin I/O terminal connector, which is included in the accessories kit for the pump.
2. Connect the wires of the cable to the 8-pin I/O terminal connector:
   To attach the wires to the 8-pin connector, carefully loosen the locking screws on the connector, insert the appropriate wires, and retighten the locking screw. Observe the wire and pin assignment as described on page 151.
3. Connect the 8-pin I/O terminal connector to the Digital I/O port on the pump with the screws pointing upward (→ Fig. 17, page 37).
4. Insert the loose wires on the other end of the cable into the connector on the Corona or Coulochem III detector. For details, see the *Chromeleon Help*.
5. For details about the settings for the Corona or Coulochem III detector, see the *Chromeleon Help*.

For further information about the detector, refer to page 53 or see the *Chromeleon Help*.

3.4.4.4 Connecting a WPS-3000TXRS and a Corona or Coulochem III

To connect both a WPS-3000TXRS autosampler and a Corona or Coulochem III detector to the Digital I/O port of the pump, the following parts are required:

Description	Part No.
Signal cable (6-pin mini-DIN) For details, see section 3.4.4.1.	6000.1004
8-pin I/O terminal connector For details, see section 3.4.4.1.	n.a.
Signal synchronization cable from pump to Corona or Coulochem III detector For details, see section 3.4.4.3.	6043.0003

1. Locate the mini DIN signal cable and the terminal connector which are included in the pump accessories kit, and the signal synchronization cable, which is included in the accessories kit for the Corona or Coulochem III detector.
2. Connect the mini DIN connector on the signal cable to the Digital I/O port 1 (2, 3, or 4) of the WPS-3000TXRS autosampler.
3. Connect the wires on the mini DIN signal cable and the wires on the signal synchronization cable to the 8-pin I/O terminal connector:

   To attach the wires to the 8-pin terminal connector, carefully loosen the locking screws on the connector, insert the appropriate wires from the cables, and retighten the locking screw. Observe the wire and pin assignment as described on page 151.
4. Connect the 8-pin I/O terminal connector to the Digital I/O on the rear panel of the pump.
5. Insert the loose wires on the other end of the signal synchronization cable into the connector on the Corona or Coulochem III detector. For details, see the *Chromeleon Help*.
6. For details about the settings for the Corona or Coulochem III detector, see the *Chromeleon Help*. To set up pump stroke synchronization with the autosampler, specific settings for the pump are required on the configuration pages of the autosampler (→ page 76).

For further information about the detector, refer to page 53 or see the *Chromeleon Help*.

3.4.4.5 Connecting an OAS-3x00TXRS and a Corona or Coulochem III

To connect both an OAS-3x00TXRS and a Corona or Coulochem III detector to the Digital I/O of the pump, the following cables are required:

Cable	Part No.
Autosampler interconnect cable	6043.0004
Signal synchronization cable	6043.0002
RS-232 cable	6043.0005
RS-232-USB Interface cable - *if a RS-232 port is not available on the computer* For details about the cables, see section 3.4.4.2.	6073.2000
Signal synchronization cable from pump to Corona or Coulochem III detector For details, see section 3.4.4.3.	6043.0003

1. Locate the required cables.
2. Connect the wires of the signal synchronization cable (part no. 6043.0003; for the connection from Corona or Coulochem III to the pump) to the 8-pin I/O terminal connector of the synchronization cable (part no. 6043.0002; for the connection from autosampler to pump):

   To attach the wires to the 8-pin terminal connector, carefully loosen the locking screws on the connector, insert the appropriate wires, and retighten the locking screw. Observe the wire and pin assignment as described on page 151.

   Tip: To prevent the already plugged-in wires from falling out when opening the screws, carefully turn the screws just enough to insert the wires from the signal synchronization cable.
3. Connect the autosampler as described in section 3.4.4.2, step 2 to 7.
4. Insert the loose wires on the signal synchronization cable (part no. 6043.0003) into the appropriate connector on the Corona or Coulochem III detector. For details, see the *Chromeleon Help*.
5. For details about the settings for the Corona or Coulochem III detector, see the *Chromeleon Help*.

   To make sure that inject response and pump stroke synchronization work properly, specific settings are required on the configuration pages of the autosampler, and/or on the autosampler control terminal. For details, see page 76 or the *Operating Instructions* for the autosampler.

For further information about the detector, refer to page 53 or see the *Chromeleon Help*.

3.5 Setting Up the Pump in Chromeleon

This section provides brief instructions for setting up the pump in Chromeleon. For details, see the *Chromeleon Help*.

Tip: When the pump is connected to the data system computer, verify that the Chromeleon software is installed *before* turning on the pump power for the first time. Only then, the USB driver for the pump is automatically loaded and the Windows operating system can detect the pump when the power is turned on.

3.5.1 Initial Installation

1. Turn on the computer power, if it is not already on.
2. Under Windows® XP, Windows® 7 or Windows® Server 2008 log on as a
   - Local administrator if the computer is a local computer.
   - User with local computer administrator privileges if the computer is a network computer.
3. Open the **Chromeleon Server Monitor** program by double-clicking the Chromeleon Server Monitor icon  on the Windows taskbar.

   If the Server Monitor icon is not on the taskbar, click **Start** on the taskbar, point to **Programs** (or **All Programs**, depending on the operating system), point to **Chromeleon,** and then click **Server Monitor**.
4. Click **Start** to start the server.
5. Click **Close** to close the Server Monitor window. The Server Monitor icon  appears on the taskbar.

   Tip: Clicking the **Quit Monitor** button quits (exits) the Server Monitor program, but does not stop the server. To stop the server, click **Stop**.
6. Turn on the main power switch on the rear panel of the pump.
7. *Depends on the operating system*

   Windows® 7 and Windows® Server 2008
   will automatically detect the new pump and perform the USB installation. If Windows fails to detect the pump and launches a wizard instead, this indicates that you connected the pump to the computer and turned on the power for the first time *before* you installed Chromeleon.

   To resolve the problem:

   a) Click **Cancel** to exit the wizard.

   b) Turn off the pump.

c) Install Chromeleon.

d) Turn on the power to the pump. Windows will now detect the pump and install the USB software for the pump automatically.

Windows XP
will automatically detect the new pump and launch the Found New Hardware Wizard, which guides you through the USB installation. Select the following options:

a) If asked whether Windows can connect to Windows Update to search for software, select **No, not this time**.

b) Accept the default option (Install the software automatically) and click **Next>**.

c) Click **Finish** when the wizard reports that the software for the pump has been installed.

If Windows fails to detect the pump and a message box asks for a USB configuration file (cmwdmusb.inf), this indicates that you connected the pump to the computer and turned on the power for the first time *before* you installed Chromeleon. To resolve the problem:

a) Click **Cancel** in the Windows message box.

b) Turn off the pump.

c) Install Chromeleon.

d) Turn on the power to the pump. Windows will now automatically detect the pump and launch the **Found New Hardware** Wizard.

3.5.2 Installing the Pump in Chromeleon

1. Start the Chromeleon **Server Monitor** and the Chromeleon server if they are not yet running (→ page 45).
2. Start the Chromeleon **Server Configuration** program by clicking **Start** on the taskbar. Point to **Programs** (or **All Programs**, depending on the operating system), point to **Chromeleon**, and then click **Server Configuration**.
3. If necessary, click the plus sign next to the server name to display the items underneath.
4. Select the timebase to which the pump will be assigned, or create a new timebase (on the **Edit** menu, click **Add Timebase**).
5. Open the **Add device to timebase** dialog box. To do so, click **Add Device** on the **Edit** menu or right-click the timebase and click **Add Device** on the menu.
6. On the **Manufacturers** list, click **Dionex HPLC: UltiMate 3000** and on the **Devices** list, click the pump you want to add, **LPG-3400XRS Pump**.
7. The configuration pages for the pump are opened. On each configuration page, verify that the settings are correct and select additional settings if needed. For a description of the pages, see section 3.5.3.1 (→ page 48).
8. On the **File** menu, click **Save Installation** and then close the **Server Configuration** program.

3.5.3 Configuring the Pump in Chromeleon

3.5.3.1 Initial Installation

On each configuration page for the pump, check and change the settings if necessary and select additional settings if needed. You may reopen the configuration pages later again to change the settings (→ page 52).

Tip: Changing the settings for a specific application in the **Commands** dialog box, in a program file (PGM), or on a control panel will not change the standard settings on the configuration pages.

For additional information about a page, click **Help**.

General Page

Select the port to which the pump is connected (**Module Address**).

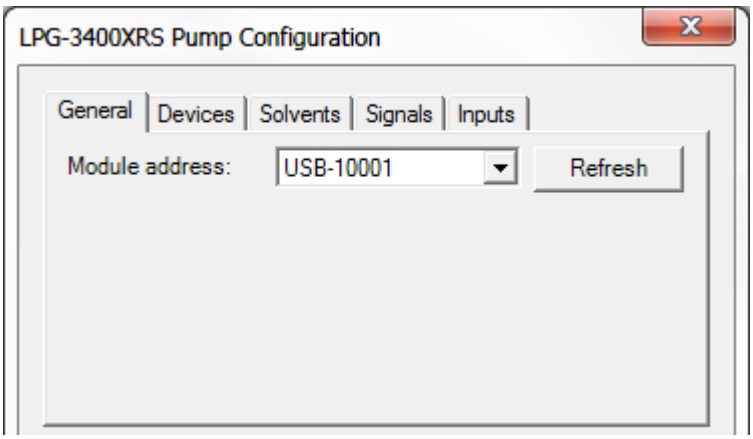


Fig. 20: General page

- **Module Address**
  Select the module address of the pump. The connection type is stated as a prefix to the module. If the pump is not in the list, for example, because it is turned off, turn on the pump and click **Refresh.** The driver can only detect a pump when the pump is turned on.

Devices Page

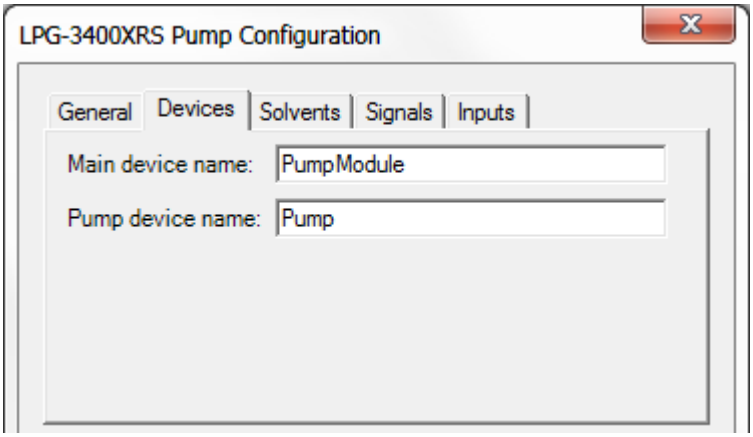


Fig. 21: Devices page

- **Main Device Name**
  Default name: *PumpModule*
  Displays the name used to identify the pump in the installation environment and in the Chromeleon client. To control the pump with the existing control panels, accept the default name. If you enter a different name, you may have to re-link the controls on the control panels and edit the name in the program files.

- **Pump Device Name**
  Default name: *Pump*
  Under this name, specific groups of properties and commands are listed in the **Commands** dialog box, for example, the flow-related properties and commands of the pump. There you can set, for example, the flow rate and change the upper and lower pressure limits.

  To control the pump with the existing control panels, accept the default name. If you enter different names, you may have to re-link the controls on the control panels and edit the name in the program files.

  Tip: If you want to connect a WPS-3000TXRS autosampler to the pump and set up stroke synchronization, write down the **Pump device name**. You will need the name for the stroke synchronization settings on the autosampler configuration pages (→ page 76).

Solvents Page

Check and change pressure units and enter the names of solvents delivered by the pump if necessary.

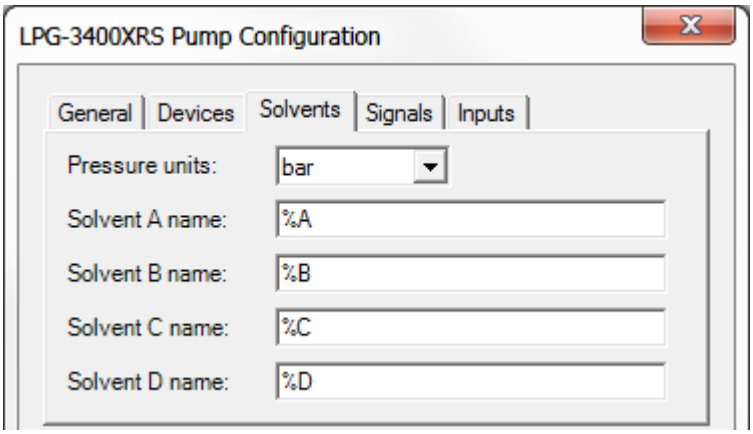


Fig. 22: Solvents page

- **Pressure Units**
  The following pressure units are available: bar, psi, MPa. Default setting is "bar".

- **Solvent Names**
  Enter a name for each connected solvent. A solvent name can contain a maximum of 30 characters. The names of the solvents appear, for example, in the gradient display of the online control panel and in the report.

Signals Page

The **Signals** page lists all available signals. Select a check box to enable the corresponding signal. If a check box is cleared, the signal will not be available in Chromeleon. To change a signal name, overwrite the existing entry directly in the corresponding line. To change the pressure unit, make your selection on the **Solvents** page.

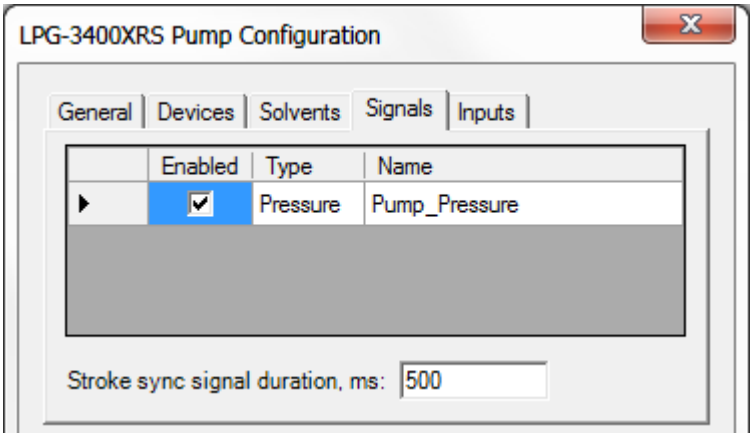


Fig. 23: Signals page

The signal for the pump pressure (**Pump_Pressure**) is selected by default. Accept this setting if you want to record the pump pressure. Chromeleon then generates the appropriate channels for data acquisition. For more information, see section 5.4.5 (→ page 82).

The duration for the stroke sync signal (500 ms) is entered by default. Accept this setting for proper function of the pump stroke synchronization between the autosampler and the pump.

Tip: If during the run no stroke sync signal is available at flow rates of 1.3 mL or higher, the default duration of the stroke sync signal may have been changed. Open the configuration pages for the pump and check the value for the stroke sync signal duration. If necessary, enter the default value (500 ms).

Inputs Page

The **Inputs** page lists all available remote inputs. Select a check box to monitor the input in the **Commands** (F8) dialog box in Chromeleon.

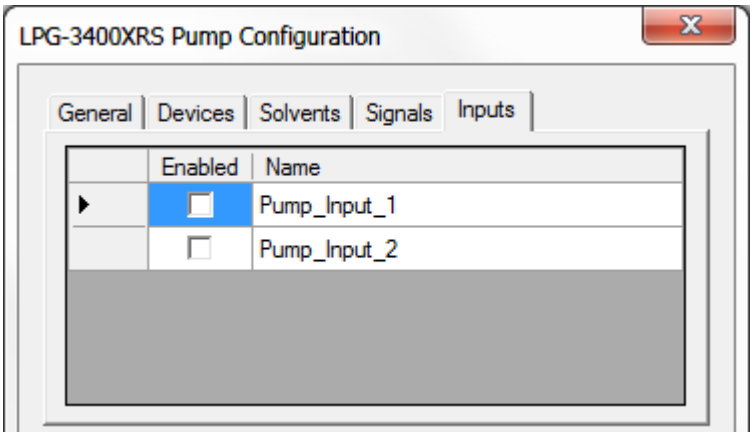


Fig. 24: Inputs page

To change an input name, overwrite the existing name directly in the corresponding line.

The inputs are assigned as follows:

- **Pump_Input_1** is assigned to the autosampler of the UltiMate 3000 XRS series.
- **Pump_Input_2** is assigned to the Corona or Coulochem III detector.

For further information about the digital inputs, refer to page 151.

3.5.3.2 Changing the Configuration Properties

To change the standard configuration settings, reopen the configuration pages:

1. Start the **Server Configuration** program (→ page 47).
2. Right-click the pump in the timebase and click **Properties** on the menu.
3. Change the settings as needed. For a description of the pages, see section 3.5.1 (→ page 48).
4. To save the configuration, click **Save Installation** on the **File** menu and then close the **Server Configuration** program.

3.6 Setting Up the Pump in DCMSLink

To set up the pump in DCMSLink, refer to *DCMSLink Installation Guide*, which is provided on the DCMSLink DVD in the *Additional Documents\DCMSLink User Documents* folder.

1. Install and configure the DCMSLink software (→ *DCMSLink Installation Guide*).
2. Open the Chromeleon **Server Configuration** program (→ *DCMSLink Installation Guide*).
3. In the **Server Configuration** program, add the pump to the timebase. Follow the appropriate steps in section 3.5.2 (→ page 47).
4. Configure the pump as described in section 3.5.3 (→ page 48).

For more information about DCMSLink, refer to the *DCMSLink Quick Start Guide*, which is also provided on the DCMSLink DVD and to *DCMSLink Help*.

3.7 When a Corona or Coulochem III Detector is connected

Note the following if you want to connect a Corona or Coulochem III detector to the pump:

- For information about how to connect the detector to the pump, follow the instructions for connecting the Corona or Coulochem III detector on page 42, or follow the instructions in the *Chromeleon Help*. The *Help* provides separate sections for connecting these detectors to the pump of the UltiMate 3000 XRS series, including details about the appropriate cabling and settings required in the Server Configuration program.

- *Only Corona*
  When the pump and detector are connected and configured as described in section 3.4.4.3 or in the *Chromeleon Help*, pumping is stopped if an error occurs in the detector. Check the detector and take appropriate remedial action (→ *Detector manual*).

- *Only Coulochem III*
  When the pump and detector are connected and configured as described in section 3.4.4.3 or in the *Chromeleon Help*, the detector cell is automatically turned off when the pump flow is zero.

- *Connecting an UltiMate 3000 XRS series autosampler and a Corona or Coulochem III detector*
  If you want to connect both an autosampler of the UltiMate 3000 XRS series and a Corona or Coulochem III detector to the pump, follow the instructions in section 3.4.4.4 or 3.4.4.5.

For more information about the Corona or Coulochem III detector, see the *Chromeleon Help*.

4 Preparation for Operation (Startup)

4.1 Overview of Actions

⚠ **Important**: The pump is filled with 2-propanol when being shipped from the factory. During initial operation of the pump, make sure that the solvents used are miscible with 2-propanol. Otherwise, follow the appropriate intermediate steps.

⚠ **Important:** La pompe est stockée sous 2-propanol lorsqu'elle est expédiée depuis l'usine. Lors du démarrage initial de la pompe, assurez-vous que les solvants utilisés sont miscibles. Dans le cas contraire, utilisez un solvant intermédiaire approprié. Même d'infimes particules peuvent endommager le système.

After you have unpacked, positioned and connected the pump as described in sections 3.1 through 3.4 (→ page 31 and following pages), prepare the pump for operation. Follow this sequence of steps:

1. *If you want to connect a Corona or Coulochem III detector to the pump*
   Refer to section 3.4.4 for details (→ page 37).
   Before you attach the column and cell, flush the system with several volumes of the mobile phase to be used.
2. Connect the pump to the other modules of your UltiMate 3000 system, as required by your application.
   When you connect capillaries to the pump, observe the general precautions on page 57.
3. Connect the solvent reservoirs, and then connect the solvent supply lines to the degassing channels (→ page 58).
4. Connect drain tubing (→ page 62).
   This is a *must*, as also the seal wash solution is directed to waste through the drain system. If drain tubing is not connected, modules that are located below the pump in the UltiMate 3000 system stack, may suffer severe damage from the liquid leaving the drain port.
5. Set up the rear seal wash system and flush the system with the seal wash solution (→ page 62).

6. *Operating the pump with Chromeleon or DCMSLink*

   - Set up the pump in Chromeleon (→ page 45) or DCMSLink (→ page 45) if it is not already set up.
   - *Pump stroke synchronization in Chromeleon*
     If your UltiMate 3000 system includes a WPS-3000TXRS or OAS-3x00TXRS autosampler, you can link the pump with the autosampler for pump stroke synchronization (→ page 37), and make the necessary settings in Chromeleon (→ page 76).

7. Turn on the power to the pump (→ page 67).
8. Purge the pump (→ page 62).
9. Check and change the leak sensor setting if necessary (→ page 84).
10. Before using the pump for sample analysis, equilibrate the entire system (→ page 66).

4.2 General Precautions for Connecting and Handling Capillaries

When you connect capillaries to the pump, observe the following general precautions:

- Observe the precautionary statements for capillaries and capillary connections in section 1.2.2 (→ page 4).
- When you connect capillaries, make sure that the connectors are free from contaminants. Even minute particles may cause damage to the system
- Use only the capillaries shipped with the pump and the spare capillaries recommended by Thermo Fisher Scientific.
- Thermo Fisher Scientific recommends using Viper capillary connections whenever possible. When using Viper capillaries, observe the information in the instructions shipped with the capillary.
- Different fitting systems are used in an UltiMate 3000 system. Therefore, install the capillaries and fittings only at the positions for which they are intended. Depending on the fitting connection, observe the following:

  ♦ *Viper fitting connections*

  Loosen or tighten the Viper connection *only* by using the black knurled screw and *only* with your hand (do *not* use tools). The knurled screw can be easily removed and reattached to the capillary at any time.

  First, tighten the screw hand-tight. If the connection leaks, tighten the screw a little more. If leakage continues, remove the capillary, clean the capillary ends carefully by using a cloth or tissue wetted with isopropanol, and reinstall the capillary. If the connection continues to leak, replace the Viper capillary.

  Capillaries with Viper fitting connections can be reused also for a different connection.

  ♦ *Conventional fitting connections (non-Viper)*

  Do not overtighten these fitting connections. (The torque should not exceed 3 Nm for steel capillaries or 1.6 Nm for titanium capillaries.) If you observe leakage on the connection, tighten a little further.

  If leakage still exists, first consider cleaning the connection port with a cleaning swab (part no. 6040.0006). Replace the capillary and/or fitting if this does not eliminate the problem.

  Reuse used fittings and ferrules only for the same capillary connection. This is to avoid increased dead volume or damage to the system and leakage.

4.3 Solvent Reservoirs

For the secure and functional positioning of the solvent reservoirs, solvent racks and reservoir trays can be used as an ideal complement to the pump. To safely organize your solvent reservoirs, the following options are available in the UltiMate 3000 system:

- *If your system includes a WPS-3000TXRS autosampler*
  You can use the UltiMate 3000 SR-3000 Solvent Rack without degasser (part no. 5035.9200).
- *If your system includes an OAS-3x00TXRS autosampler*
  You can use the tray for solvent reservoirs, which is included in the autosampler shipment (→ Fig. 15, page 35). For details, see the *Operating Instructions* for the autosampler.

Fig. 25: Pump with SR-3000 Solvent Rack

If the UltiMate 3000 system includes a WPS-3000TXRS autosampler, you should degas also the wash liquid on a continuous basis, for example, by using the inbuilt vacuum degasser of the pump. The procedure how to prepare and install the wash liquid lines is similar to the steps for the solvent supply. For more information, see the *Operating Instructions* for the autosampler.

4.3.1 General Notes

When connecting the solvent reservoirs, observe the following general precautions:

- Before first use, rinse solvent bottles thoroughly using highly pure solvents.
- Always use the original solvent lines. This prevents contaminants from reaching the HPLC system that may increase wear and cause damage to the system.
- Regularly check the filter frits for permeability. This is especially important when using aqueous solvents. Aqueous solvents may contaminate the filters with algae and other microorganisms that deposit on the filter frits. Therefore, use fresh solvents at regular intervals. Clean the reservoirs thoroughly before filling them. Replace the filter frits as necessary.
- Be sure to use the solvent supply lines with the appropriate filter frits. As a standard, solvent lines with stainless steel frits are provided in the accessories kit of the pump.
- Make sure that the tubing connecting the pump to the degasser is as short as possible and locate the solvent reservoirs as close as possible to the pump. To avoid formation of air bubbles in the reservoirs and reformation of air bubbles in the solvent, make sure that the reservoirs are on the same level or higher as the pump.
- Before connecting the solvent supply lines, make sure that the connectors are free of contaminants. Even minute particles can allow air to enter the degasser, and thus reduce the degassing effectiveness.
- Normal phase eluents usually show only a low concentration of dissolved gases. Therefore, it is normally not required to use a degasser with these eluents.

Keep the following in mind:
When the fluid components of the pump are filled with liquid and the solvent reservoirs are located above the pump outlet during pump operation, the hydrostatic pressure in the system may cause eluent to escape when you open a fluid connection in the pump. *Before* you open a fluid connection, position the reservoirs below the connection to be opened.

4.3.2 Connecting the Solvent Reservoirs

The solvent supply lines from the degasser outlets to the proportioning valve are connected to the pump at the factory. To connect the solvent supply lines from the solvent reservoirs to the degasser inlets, use the solvent supply lines from the accessories kit for the pump and follow the steps below.

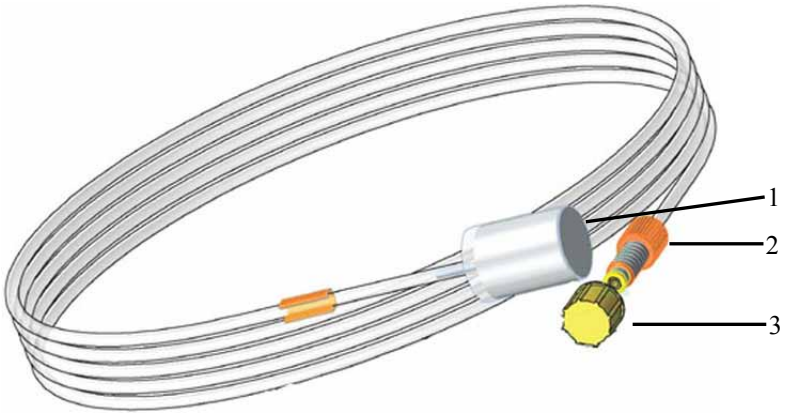


Fig. 26: Solvent supply line

No.	Description
1	Filter frit
2	Ferrule
3	Ferrule cap

1. Remove the filter frits from the solvent supply lines by pulling them off.
2. Feed the solvent supply line through the retaining guide, which holds the tubing in place in the reservoir, and then into the open hole in the reservoir cap.
3. *If required*
   Cut the tubing straight if necessary. The end of the solvent supply line should be cut straight and not deformed. Use only the original solvent supply lines.
4. Re-install the filters on the supply lines.
5. Place the entire assembly in the solvent reservoir.
6. Tighten the reservoir cap hand-tight. Press the retaining guide into the hole in the reservoir cap to hold the solvent supply line in place inside the reservoir.
   When replacing a solvent supply line, remove the filter, then the retaining guide, and then the solvent supply line.
7. Remove the caps on the supply line ferrules and the plugs on the degasser inlets.

8. Connect the solvent supply lines from the reservoirs to the inlets of the inbuilt vacuum degasser.
   Make sure that the supply lines are connected to the degasser inlets correctly. The colors of the ferrules on the degasser inlets should match the colors of the ferrules connected to the degasser outlets.
9. For the secure and functional positioning of the solvent reservoirs in the UltiMate 3000 system, place them in the reservoir tray of the SR-3000 Solvent Rack or the OAS-3x00TXRS autosampler.

4.4 Connecting Drain Tubing

To discharge liquids that might have accumulated in the interior, the pump has a drain port at the bottom right of the enclosure.

Fig. 27: Drain port

Direct liquid leaks to waste through the drain system of the UltiMate 3000 system. The required components are shipped with the pump, but can be ordered also separately. The drain kit (part no. 6040.0005) includes all components for system drainage and detailed installation instructions.

4.5 Setting Up the Rear Seal Wash System

A membrane pump is installed on the left of the pump head and has an In and Out port (→ Fig. 28). The ports for the rear seal wash tubing are on the piston guide bushings (→ Fig. 29, page 63). Use the required tubing to connect the membrane pump with the seal wash reservoir from the rear seal wash system kit (part no. 6043.0056), which is included in the accessories kit of the pump.

Verify that the seal wash solution is discharged properly to the waste by guiding the rear seal wash tubing from the piston guide bushings to the waste. If it is not, any modules that are located below the pump in the UltiMate 3000 system stack may suffer severe damage from the liquid leaving the drain port.

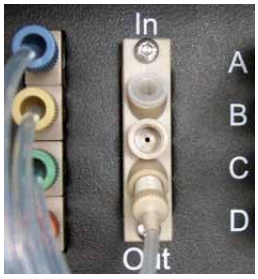
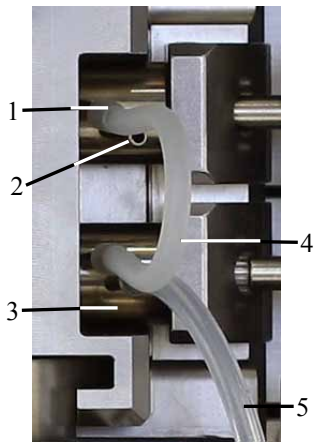


Fig. 28: Ports on the membrane pump

Tips: To remove air from the piston guide bushings during rear seal washing, the short tubing should be connected from the lower guide bushing to the upper guide bushing, and the tubing from the lower wash port on the upper guide bushing to waste (→ Fig. 29, page 63).

Make sure that the rear seal wash system is constantly connected to the wash ports on the guide bushings, and that the seal wash reservoir never runs empty of fresh, HPLC grade water.

The tubing from the Out port of the membrane pump to the guide bushings, and the tubing to connect the guide bushings are installed at the factory. To install the remaining tubing and set up rear seal washing, follow the steps below.



No.	Description
1	Upper guide bushing
2	Wash port *(here for tubing to waste)*
3	Lower guide bushing
4	Short silicone tubing to connect the wash ports
5	Tubing to seal wash pump

Fig. 29: Connecting the rear seal wash tubing

Connecting the Rear Seal Wash Tubings

1. Fill the seal wash reservoir. A reservoir is provided in the accessories kit for the pump. Observe the precautions for the composition of the seal wash solution on page 83.
2. Connect the tubing from the In port of the membrane pump with the seal wash reservoir. If necessary, prolong the tubing, for example, by using part of the silicone tubing from the accessories kit for the pump.
3. Place the seal wash reservoir in the Solvent Rack SR-3000 or in the reservoir tray of the OAS-3x00TXRS autosampler of the UltiMate 3000 system.
4. Connect silicone tubing from the accessories kit for the pump to the free tubing on the upper guide bushing, and route the tubing to an appropriate waste container (→ section 4.4, page 62).
5. Flush the system with seal wash solution (→ page 83). The seal wash solution is routed through the guide bushings to the lower wash port on the upper guide bushing, and to waste.
6. Verify that the seal wash solution is discharged properly to the waste (→ section 4.4, page 62).

For information about how to operate the pump with rear seal washing, see section 5.4.6 (→ page 83).

4.6 Purging the Pump

Purging the pump means rinsing the system for a short time at a higher flow rate. The purge cycle has to be initiated manually. During the purge cycle, the pump is purged with the following settings:

Purge Flow	Purge Time
2 mL/min	5 min

If necessary, you may change these standard settings in Chromeleon in the **Commands** dialog box.

Keep in mind that when the fluid components of the pump are filled with liquid and the solvent reservoirs are located above the pump outlet during pump operation, the hydrostatic pressure in the system may cause eluent to escape when you open a fluid connection in the pump. *Before* you open a fluid connection, position the reservoirs below the connection to be opened.

1. Attach the Luer-Lok™ adapter from the accessories kit for the pump to the purge outlet nozzle.

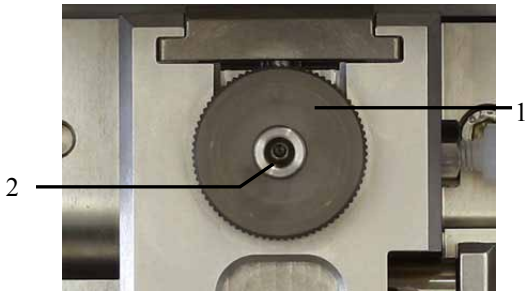


Fig. 30: Purge unit

No.	Description
1	Purge valve knob
2	Purge outlet nozzle

2. Attach the free end of the Luer-Lok adapter to a plastic syringe. (A syringe is provided in the accessory kit of the pump.)
3. Open the purge valve by turning the knob one turn counterclockwise.
4. To be able to generate negative pressure, an autosampler or another type of pressure drop needs to be connected to the pump outlet. If necessary, cap the pump outlet.

5. Purge the pump from Chromeleon.

   a) In Chromeleon, open the **Commands** dialog box for the pump.

   b) Set the channel to be purged to 100%.
   In Chromeleon, you cannot set %A directly. Thus, if %A be 100%, you have to set all other components of the eluent to 0%.

   c) Start the purge cycle. To do so, set **Purge** to **On**.
   The purge cycle is performed with the selected settings (→ page 64).

   d) When the specified **PurgeTime** has elapsed, **Purge** is automatically reset to **Off**.

   e) Repeat the above steps for all channels (even if they are not used for the application) until all air bubbles are gone.

6. Close the purge valve (turn the valve knob clockwise). Turn the valve knob only with your hand (use no tools). If the valve knob leaks, tighten a little more. Overtightening the valve knob can damage the cap seal.

4.7 Equilibrating the System

Before using the pump for sample analysis, equilibrate the UltiMate 3000 system:

1. Pump the starting solvent through the entire system until the system is free of any other liquid composition.
2. Heat or cool all temperature-controlled devices to the temperature required for the application.
3. Set the detector wavelengths and turn on the lamps.
4. Monitor the pump pressure. Verify that the reading is correct for the application and is stable.
5. Monitor the detector signal and verify that the baseline signal is at the expected reading for your application and is stable.

Perform system equilibration in Chromeleon or select the required commands and parameters on the front panel menus of the modules.

To equilibrate the system from Chromeleon

- Select and perform the operating commands and parameters from the **Commands** dialog box.
- Create and run an equilibration program to automate the process (→ page 72).

5 Operation and Maintenance

The pump is operated with the Chromeleon Chromatography Management System. For details, see section 5.3 (→ page 69).

5.1 Power-Up

To start the pump for the first time, turn on the main power switch on the rear panel of the pump. The following sequence of events occurs when the pump is powered up:

- The pump runs a series of internal tests. During these self-diagnostics, all of the main components are checked.
- If an error is detected, the pump is not ready for analysis. The **Status** LED on the front panel door changes to red and an error code appears on the pump display. If the pump is operated with Chromeleon, the message is also displayed in the Chromeleon Audit Trail. Turn off the pump, take appropriate remedial action (→ page 93), and turn on the pump again.

For routine operation, leave the main power switch on. For routine on/off control, use the standby button on the front of the pump (→ page 18). Press and hold the button for one second to allow the pump to change the mode. Turn the main power switch off when instructed to do so, for example, before performing a service procedure.

5.2 Status Screen

After the pump has been turned on, the display immediately shows the status screen.

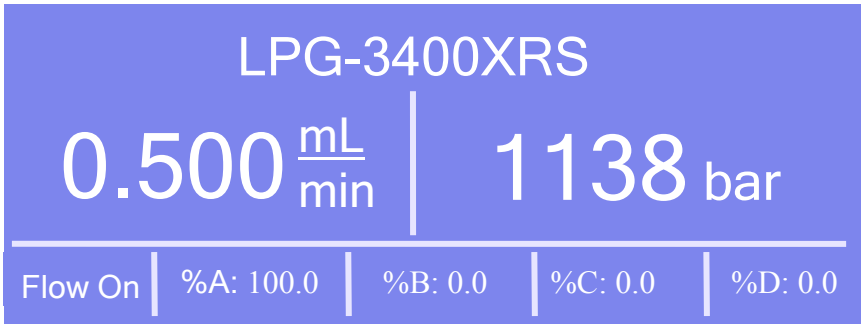


Fig. 31: Status screen (example)

The status screen shows the following information:

- Pump name
  The pump name is the name specified under **Pump device name** on the **Devices** page in Chromeleon Server Configuration program (→ page 49).
- The currently set flow
- The current pressure
- The components of the solvent in percent of the total flow.
- The pump status

The pump status can be:

The screen shows…	When …
Flow on or **Running**	The pump is delivering with the specified flow rate. The display always shows the flow rate that the pump is actually delivering. When a flow ramp has been set in Chromeleon, it may take some time until the specified target flow is reached.
Flow off	The pump is not delivering. While is pump is idle, the nominal flow rate is displayed and the flow value is flashing.
Purge	The pump is purged.
Hold	When you performed the **Hold** command for the pump from Chromeleon. The retention time is stopped; however, the pump continues delivering with the current settings (flow rate, solvent composition). Perform the **Continue** command in Chromeleon to cancel the Hold command. For more information, see the *Chromeleon Help*.
E*xxyy	An error is reported for the pump. For more information, refer to page 94.

You can adapt the screen brightness and contrast to your requirements if necessary (→ page 84).

5.3 Operation with Chromeleon

Before you begin, verify that

1. The Chromeleon software is installed on the computer and the license code is entered.
2. The pump is connected to the Chromeleon data system computer by means of an USB connection.
3. The pump is set up in Chromeleon, as described in section 3.5 (→ page 45).

Before you can operate the pump with Chromeleon, you have to connect the timebase in which the pump is installed to the Chromeleon client program (→ section 5.3.1).

Two modes of software control are available:

- *Direct control* with the parameters and commands in the Commands dialog box (→ page 70) or on a control panel (→ page 71).
- *Automated control* with a control program (PGM) (→ page 72).

5.3.1 Connecting to Chromeleon

1. Start the Chromeleon Server Monitor and the Chromeleon server if they are not yet running (→ page 45).
2. Start the Chromeleon client by clicking the Chromeleon icon  on the desktop.
   If the Chromeleon icon is not on the desktop, click **Start** on the taskbar, point to **Programs** (or **All Programs**, depending on the operating system), point to **Chromeleon,** and then click **Chromeleon**.
3. Connect the Chromeleon client program to the timebase in which the pump is installed. For details about how to do this from the **Commands** dialog box, see page 70. For details about how to do this on a control panel, see page 71

When the pump is correctly connected to Chromeleon:

- The **Connected** LED on the front panel is green.
- Functions for estimating the lifetime of consumables and monitoring and recording service and (re)qualification information are provided (→ page 86).
- The Standby button on the front panel remains active.

Before turning off the pump by the main power switch, always disconnect the pump in Chromeleon.

5.3.2 Direct Control

With direct control, you select operating parameters and commands in the **Commands** (F8) dialog box. Direct commands are executed as soon as they are entered. For routine operation, most parameters and commands are available also on a control panel.

To open the Commands dialog box for the pump

1. Open a control panel (any panel is possible). To open a control panel, open the Chromeleon Browser and double-click a control panel in the **Dionex Templates/Panels** folder.
2. Connect the control panel to the timebase in which the pump is installed. On the **Control** menu, select **Connect to Timebase**, and then select the timebase on the **Timebase** tab. For information about the **Timebase** dialog, click **Help**.

   Tip: The **Control** menu is visible only when a control panel is already open.
3. Press the F8 key or select **Command** on the **Control** menu.
4. To see the parameters and commands that are available for the pump, click the plus sign next to **PumpModule**. Here you see
   - General pump properties and commands, such as, **Connect**, **Connected**, **Disconnected**, **LeakSensorMode**, and **Degasser**.
   - Specific groups of properties and commands (listed under the **Pump device name** specified during the configuration of the pump (→ page 49)), for example, the flow-related properties and commands.

   The commands and parameters available in the dialog box vary, depending on the
   - Chromeleon version
   - Options selected for the pump in the **Properties** dialog (→ page 48).
   - Display filter level (**Normal**, **Advanced**, or **Expert**)
5. Change the display filter level if necessary. Right-click in the commands list and select the filter level on the menu.

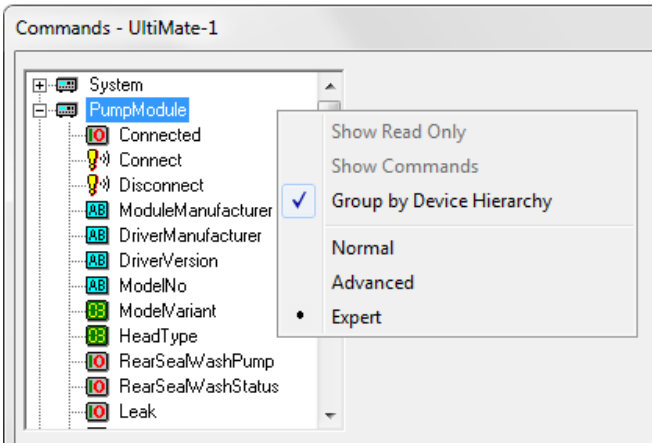


Fig. 32: Commands dialog box

6. Verify that the pump is connected to Chromeleon. If it is not, click **Connect** to connect the pump.

For a list of the commands and properties that are supported for the pump, see the *Chromeleon Help*. In addition to the pump commands and parameters, the **Commands** dialog box provides access to all of the commands and parameters available for all devices that are installed in the selected timebase.

To open a control panel for the pump

1. On the **View** menu, click **Default Panel Tabset** or click the corresponding icon on the toolbar, and then connect to the Chromeleon server.

   Chromeleon creates centralized control panels, called panel tabsets, for all timebases available on the Chromeleon server. A panel tabset provides control panels for the individual modules in a timebase and, in addition, one or more panels for performing system-wide functions, for example, creating and running sequences. For more information about panel tabsets, see the *Chromeleon Help*.

2. On the Panel Tabset for your timebase, click the page for the pump.

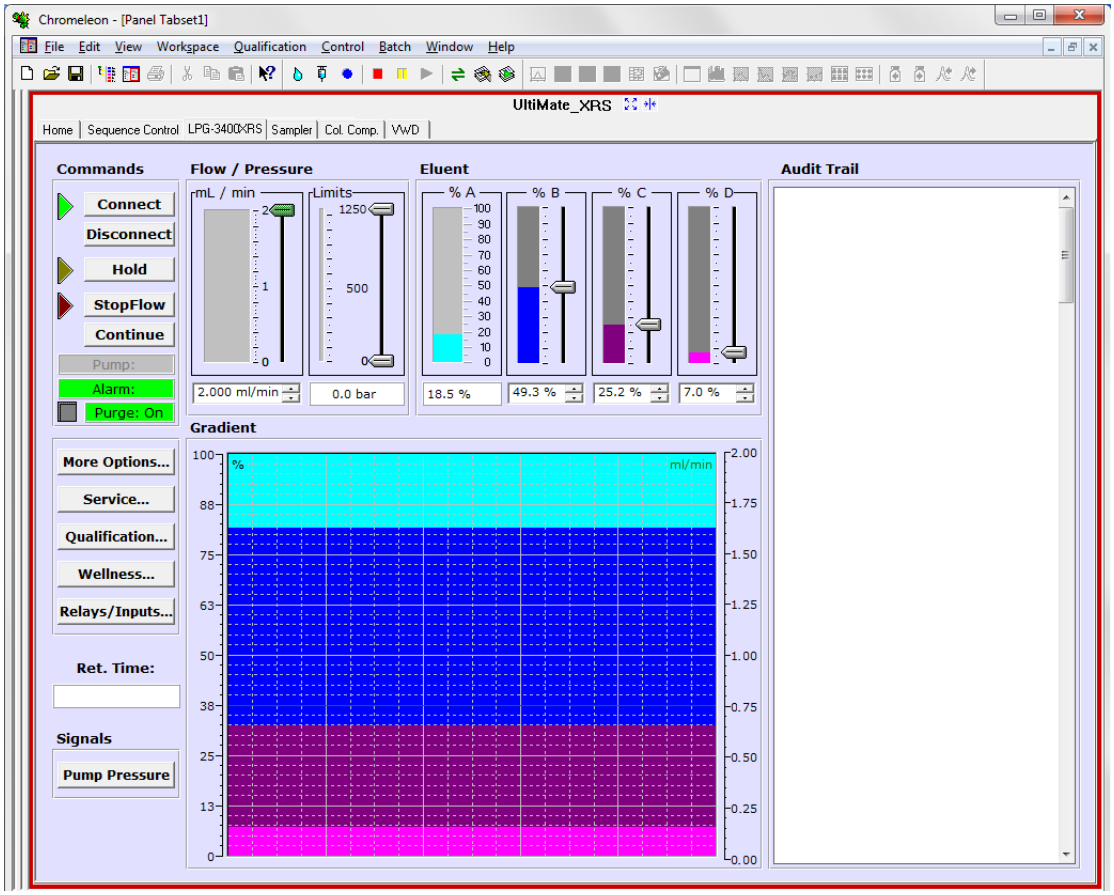


Fig. 33: Pump control panel

3. Verify that the pump is connected to Chromeleon (the LED next to the **Connect** button is green). If it is not, click **Connect**.

The control panel provides access to the operating parameters and commands required for routine operation of the pump. Additional functions are available in the Commands dialog box. To open the **Commands** box from the panel tabset, select **Command** on the **Control** menu.

5.3.3 Automated Control

With automated control, you create a program file (PGM) for automated operation of the pump. Programs can be created automatically with the help of a software wizard or manually by editing an existing program. For details, see the *Chromeleon Help*.

To create a program with the Program Wizard

1. Open the Program Wizard. On the **File** menu, select **New**, and then select **Program File**.
2. The wizard guides you through program creation. On each wizard page, make the desired settings or accept the standard values. For additional information about a page, click **Help**.
3. After you finish the wizard, Chromeleon automatically creates the corresponding program.
4. To start the program, follow the steps on page 73.

To create a program manually

1. Open an existing program.

   Select and double-click the program you want to open.
   —or—
   On the **File** menu, select **Open**. In the dialog box, select **Program** on the **Object of Type** list and select the program.

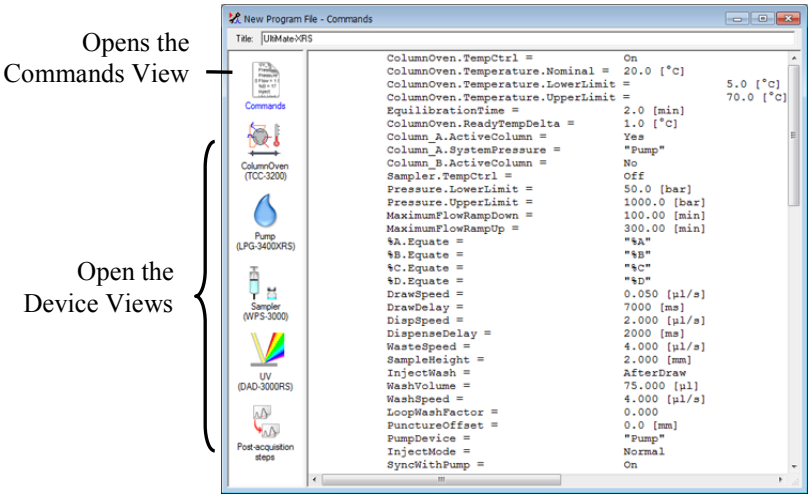


Fig. 34: Chromeleon program (here program shown in the Commands view)

2. Change the settings in the program as desired.

   The easiest way is to edit a program is to do this in the Device Views (→ Fig. 34). Click a device icon and change the settings on the device pages. Editing the program in the Device Views ensures correct command syntax.

   If you cannot edit a certain parameter in the Device View, click **Commands** to open the Commands View. The **Commands** view shows the entire program, listing the control commands in chronological order. For more information, see the *Chromeleon Help*.

3. To start the program, follow the steps in the next section.

To start a program

Program for sample analysis

1. Create a sample list (sequence). A sequence must include the program and a method for evaluating the sample data (for example, for peak identification, area determination, and amount determination).

2. Assign the program and method to each sample on the list.

3. Add the sequence to the batch and start the batch.

For information about each of the above steps, see the *Chromeleon Help*.

Other programs

Add the program to the batch and start the batch.

5.4 Information for Operating the Pump

This section provides specific information about settings and functions that should be considered for operating the pump.

Also observe the information about special functions that Chromeleon supports for operating the pump (→ page 86).

5.4.1 Choosing the Solvents

Observe the following precautions for solvent selection:

- Observe the precautionary statements in section 1.2.2 (→ page 4).
- The pump is primed with 2-propanol. During initial operation of the pump, make sure that the solvents used are miscible with 2-propanol. Otherwise, follow the appropriate intermediate steps.
- Use only HPLC grade or LC-MS grade water (0.2 µm, filtered).

  If water from water purification systems is used that are not properly maintained, polymeric contamination may seriously damage the column, rapidly block the solvent frits, and result in early piston seal wear.
- Use only standard solvents and buffers that are compatible with all parts of the UltiMate 3000 system that may be exposed to solvents.

  For information about the wetted parts in the pump, see the Technical Information section (→ page 135). For information about the wetted parts in the other UltiMate 3000 system modules, refer to the 'Technical Information' section in the operating instructions for the modules.
- Make sure to use special (highly pure) solvents. They are usually labeled accordingly by the vendor.

- Mind the special properties of the solvents, such as viscosity, boiling point, UV absorption (UV/VIS detector), refractive index (refractive index detector), and dissolved gas (degasser).
- Buffer concentration: Typically up to 1 mol/L (< 0.1 mol/L chloride ions).
  pH range: 1 through 13
  In rare cases, reactions with the stainless steel or titanium have been observed for pH values < 3 in combination with special solvents and longer application times. Therefore, you should purge the system thoroughly after these applications and monitor the system behavior.
- The pump is shipped with reversed phase piston seals (RP).
  Keep in mind that using chloroform, trichlorobenzene, methylene chloride, tetrahydrofuran, or toluene as solvents chemically damages the seals. Chemical reactions may also occur when using tetrachloromethane, diethyl ether, di-isopropyl ether, ketones, toluene, methylcyclohexane, and monochlorobenzene. If you use these solvents, contact the Thermo Fisher Scientific sales organization for Dionex HPLC Products.
- Observe also the solvent compatibility of the degassing membrane.
  Whenever possible, avoid using the following solvents: hexafluoroispropanol, hydrofluoric acids, perfluorinated solvents, and halocarbons.
- In an UltiMate 3000 system, some components are made of PEEK. This polymer has superb chemical resistance to most organic solvents. However, it tends to swell when in contact with trichlormethane ($CHCl_3$), dimethyl sulfoxide (DMSO), or tetrahydrofuran (THF). In addition, it is attacked by concentrated acids, such as, sulfuric acid and nitric acid or a mixture of hexane, ethyl acetate, and methanol. (Swelling or attack by concentrated acids is not a problem with brief flushing procedures.) For more information about the chemical resistance of PEEK, see the table in section 10.1 (→ page 143).
- Before switching from buffer to organic solution, rinse the pump thoroughly with deionized water.
- When switching to another solvent, ensure that the new solvent is miscible with the one contained in the pump. Otherwise, the pump can be damaged; for example, by flocculation.
- When replacing solvents, make sure that the solvents are miscible. Mix immiscible solvents with an intermediate solvent (for example, isopropanol) to replace them step-by-step.
- After operation, rinse out buffers and solutions that form peroxides.

⚠ **Important:** Neither recycle the solvent nor use methanol from aluminum reservoirs. This may impair the performance of the seals.

⚠ **Important:** Thermo Fisher Scientific déconseille de recycler les solvants ou employer du méthanol stocké dans des réservoirs en aluminium. Ceci peut affecter les performances des joints.

5.4.2 Using Pump Stroke Synchronization with the Autosampler

When an UltiMate 3000 XRS series autosampler is linked to the pump, the inject command of the autosampler can be synchronized with the pump strokes. To set up synchronization, you can specify that the pump is linked to the autosampler in Chromeleon. Thermo Fisher Scientific recommends always specifying the pump because this setting

- Indicates which pump delivers the flow. The information is important if you want to operate the system in bypass mode (possible only with WPS-3000TXRS). For information about the bypass mode, see the *Operating Instructions* for the WPS-3000TXRS autosampler or *Chromeleon Help*.
- Allows synchronizing the injection command of the autosampler with the strokes of the pump. Synchronization ensures that all injections are performed at the same phase of the pump cycle, considerably enhancing the retention time precision with gradient applications.

Before adapting the settings in Chromeleon, make sure that the respective autosampler is properly connected to the Digital I/O of the pump as described in section 3.4.4.The settings required for inject response and stroke synchronization depend on the autosampler type:

- Settings for the WPS-3000TXRS autosampler (→ see below).
- Settings for the OAS-3x00TXRS autosampler (→ page 80).

If your UltiMate 3000 system includes a WPS-3000TXRS autosampler

Transmission of the Inject Response Signal

To use inject response, no direct connection between the pump and the autosampler and no additional settings are required. The inject response signal is transmitted via Chromeleon.

Synchronization of the Pump Strokes with the Autosampler

To use pump stroke synchronization, make sure that the autosampler is connected to the pump as described in section 3.4.4.1 (→ page 38) before you make any synchronization settings:

1. Start the **Server Configuration** program (→ page 47).
2. Right-click the WPS-3000TXRS autosampler in the timebase and click **Properties** on the menu.

3. Click the **Segments / Pump Link** page. Select the pump on the **Flow through sampler is delivered by pump(s)** list (→ Fig. 35).

   - If you want to link the autosampler to the pump
     Select **UM3WPS_STRK_1** if the pump is connected to **Input_1** (= Digital I/O port 1) on the autosampler. If the pump is connected to Digital I/O port 2, select **UM3WPS_STRK_2**.
   - If you do not want to link the autosampler to the pump
     Select **<None>**.

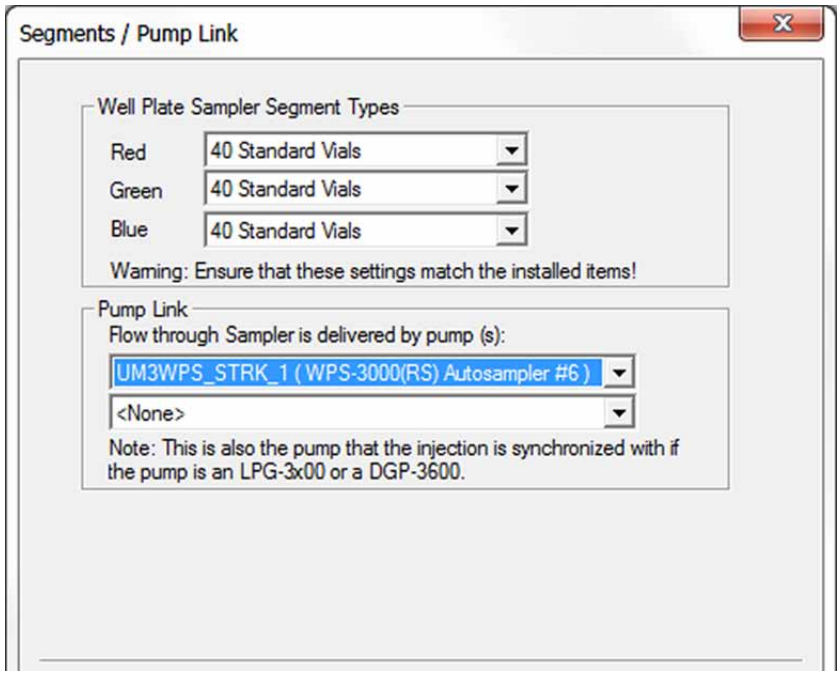


Fig. 35: Segments/Pump Link settings

When the system includes an additional pump, set the other, free signal for the second pump that you want to link to the autosampler in the second drop down list.

4. Click the **Inputs** page and select **Input_X** (where X = the port, to which you connected the pump). If the pump is connected to Digital I/O port 1, for example, select **Input_1** (→ Fig. 36).

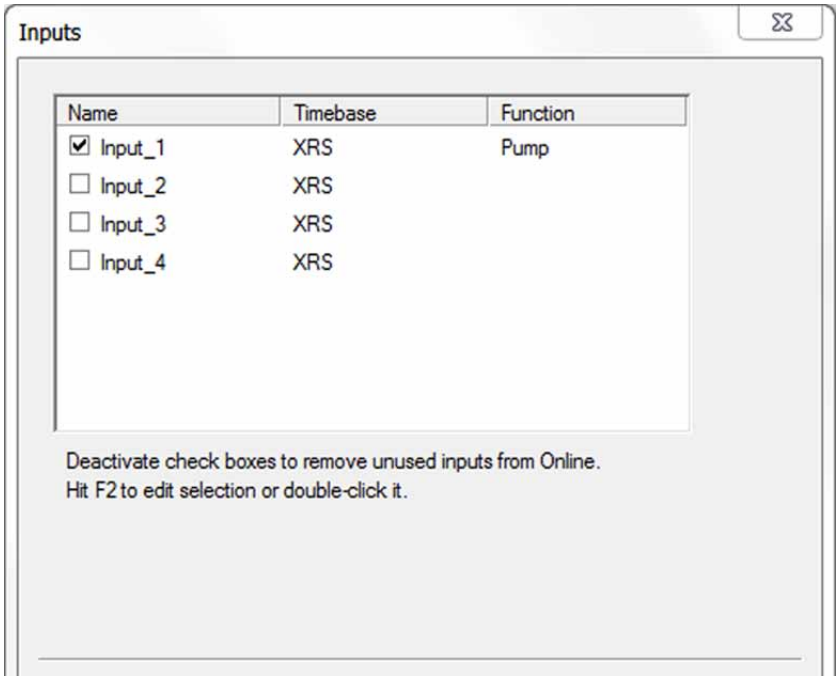


Fig. 36: Inputs page: Input_1 selected (example)

Make sure that the input setting matches the pump link setting. For example, if the pump is connected to Digital I/O port 1 on the rear panel of the autosampler, verify that **Input_1** is selected on the **Inputs** page and **UM3WPS_STRK_1** on the **Segments / Pump Link** page.

When the system includes an additional pump to the LPG-3400XRS pump, select the appropriate **Input** for the second pump that you want to link to the autosampler.

5. Double-click **Input_X** and specify the name of the pump under **Pump Device** (→ Fig. 37). Make sure that you enter the same name as specified on the configuration pages of the pump on the **Devices** tab under **Pump device name** (→ page 48).

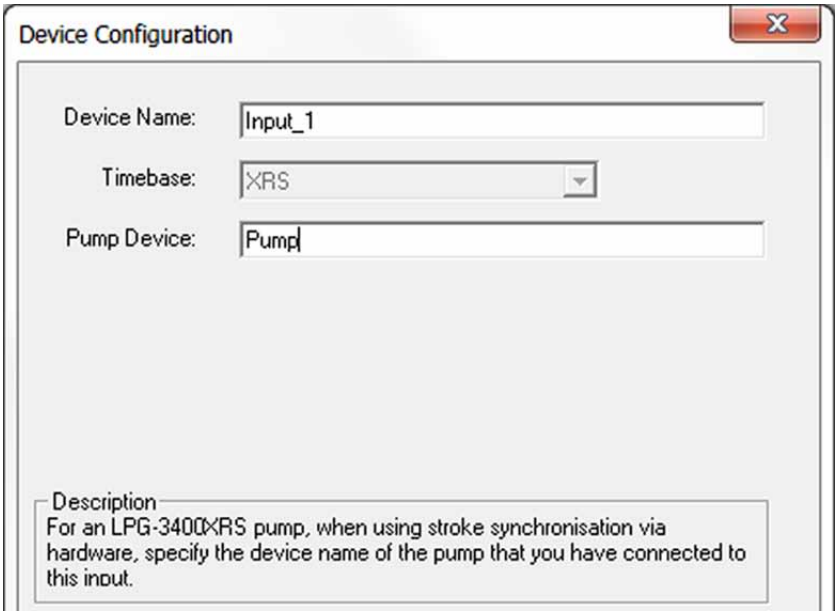


Fig. 37: Device Configuration page

If you selected two pumps on the **Inputs** page, repeat this step for the second pump.

Changing the Stroke Synchronization Settings

The pump link setting on the **Segments / Pump Link** page is the standard setting. To change the setting for a specific application, use the **SyncWithPump** and **PumpDevice** properties in the **Commands** dialog box or in the program (PGM).

- To disable synchronization, set **SyncWithPump** to **Off**.
- To use a different pump, enter the pump under **PumpDevice**, and then verify that **SyncWithPump** is set to **On**.

The standard setting on the **Segments / Pump Link** page remains unchanged.

If your UltiMate 3000 system includes an OAS-3x00TXRS autosampler

For the proper functioning of the pump stroke synchronization with the OAS-3x00TXRS, settings are required in the Chromeleon Server Configuration and on the control terminal of the autosampler. Both, the inject response signal and the synchronization signal must be configured.

Verify that the autosampler is connected to the pump as described in section 3.4.4.2 (→ page 39) before you make any synchronization settings.

Setting Up the Inject Response Signal

- Start the **Server Configuration** program (→ page 47), and right-click the OAS-3x00TXRS in the timebase. Click **Properties** on the menu.

  Verify that **Signal received via** is set to **Serial port** and that the port is specified in the **Inject Response Input Port** box.

- Make sure that the inject response signal is properly set on the autosampler. On the control terminal, navigate to the **Out Signals** menu (path: **Menu > Setup > Objects > Out Signals**), select **Injected**, and verify that **Destination** is set to **SW-Out1**. If it is not, change the setting as required.

Setting Up the Stroke Synchronization Signal

- In the autosampler configuration dialog, the pump to which the autosampler is linked is specified in the **PumpLink (LPG only)** box.

- The synchronization signal is configured on the autosampler. On the control terminal, navigate to the
  - **Sync Signals** menu (path: **Menu > Setup > Objects > Sync Signals**), select **Inject2**, and set **Source** to **TTL-In1**.
  - **Events** menu (path: **Menu > Setup > Objects > Events**) and verify for **TTL-In1** that **Active State** is set to **Low**. If it is not, change the setting as required.

Only if all settings are correct, synchronization will be successful.

For details or if you do not want to use synchronization later again, see the *Operating Instruction* for the autosampler.

5.4.3 Setting the Flow Rate, Flow Acceleration, and Flow Deceleration

In Chromeleon, you can set how fast the pump starts delivering with the selected flow rate (flow acceleration) and how fast the pump flow is reduced (flow deceleration).

- If the values are too low, it will take accordingly long for the pump to reach the necessary flow, and thus to build up the necessary pressure or reduce the flow and thus, the pressure as required.
- If the values are too high, this may or reduce the lifetime of the column.

Thermo Fisher Scientific recommends that you set these parameters to values between 1/3 and factor 3 of the (column) flow rate.

1. In Chromeleon, open the **Commands** dialog box for the pump (→ page 70).
2. Select **Flow** and enter the desired flow rate in the **Nominal** box.
   The property is listed under **PumpModule > [Pump Device Name]** (→ page 49).

   The allowed flow rate range is indicated in the **Properties** dialog for the pump (→ page 50). In the **Properties** dialog box, you can change the upper and lower limit for the flow rate within the allowed range.
3. Under **MaximumFlowRampUp**, check and change the flow acceleration setting if necessary.
   Under **MaximumFlowRampDown**, check and change the flow deceleration setting if necessary.

5.4.4 Setting the Pressure Limits

The pump firmware and Chromeleon provide standard values for the upper and lower pressure limits. The limits depend on the pump type. You are free to change the limits within the allowed pressure range.

If the pump pressure is outside the specified limits, an error is reported. If the pump is operated with Chromeleon, a message is displayed in the Chromeleon Audit Trail. In addition, Chromeleon stops the flow and aborts the batch. Check the 'Troubleshooting' section for a short description of possible causes along with recommended courses of action (→ page 93).

- *Lower pressure limit*
  Helps to prevent the pump, and thus the column, from running dry. A typical setting is 2 MPa.
- *Upper Pressure Limit*
  Helps to protect the column from too high a pressure. The application and column type determine the setting.

To set the pressure limits in Chromeleon

A - Pressure range

The range within which the pressure limits can be set and the pressure unit are specified in the in the **Properties** dialog for the pump (→ page 50). You can set the upper and lower pressure limits only within the specified range.

B - To change the pressure limits for a specific application

1. Open the **Commands** dialog box for the pump (→ page 70).
2. Select **Pressure** and enter the new limits under **LowerLimit** and **UpperLimit**.
   The property is listed under **PumpModule > [Pump Device Name]**.

5.4.5 Recording the Pump Pressure

On the **Signals** page, the check box for the pump pressure is selected by default when the pump is installed and configured in Chromeleon (→ page 51). With this setting, Chromeleon generates the appropriate channel for recording the pump pressure. The channel is then available in the **Commands** dialog box for the pump.

If a problem occurs, the pump pressure channel can provide helpful information to identify and eliminate the source for the problem. Therefore, you should record the pump pressure in the Chromeleon file.

5.4.6 Rear Seal Wash System

Rear seal washing helps avoiding damages to the pistons, piston seals, and support rings, and thus prolongs the seal lifetime. For information about how to connect the rear seal wash system, see page 62.

5.4.6.1 Working with Rear Seal Washing

The rear seal wash system is enabled and cannot be disabled. As a standard, one seal washing cycle is performed per hour. However, you can start an additional wash cycle or stop a running cycle.

1. Open the **Commands** dialog box for the pump.
2. Select **RearSealWashPump**. If **RearSealWashPump** =
   - **Idle**, select **Active** to start a wash cycle.
   - **Active**, select **Idle** to stop the running wash cycle.

Observe the following:

- Always use fresh rear seal wash solution.
- Observe the precautions for the composition of the seal wash solution (→ section 5.4.6.2).
- Make sure the seal was reservoir does not run empty. Check the liquid level in the seal wash reservoir at regular intervals.
- Regularly check the volume in the waste container for the seal wash solution. Empty the container as necessary.

5.4.6.2 Choosing the Seal Wash Solution

Observe the precautions for the composition of the seal wash solution:

- Make sure that the liquid used for rear seal washing is miscible with the solvent. This is to avoid impairing the tightness of the pump.
- Make sure that the seal wash solution is compatible with the silicone tubing.
- If a liquid other than HPLC grade water has to be used due to the miscibility of the delivered solvent, make the liquid slightly conductive by using the appropriate additives. (Do not use additives with a high salt content or additives that cause solid residuals upon evaporation.)
- *NP applications*
  For these applications, isopropanol (to ensure that the liquid is conductive) is recommended.

5.4.7 Purging the Pump

If you observe pressure pulsation, a high noise level, or pulsation during the operation of the pump or if the analysis is not reproducible, this may indicate that there are air bubbles in the system.

In this case, purge the pump as described in section 4.6 (→ page 64).

5.4.8 Detecting Liquid Leaks in the Pump

Leak detection is enabled as a standard when the pump is shipped. When leak detection is active and the leak sensor reports a leak

- The **Status** LED on the front panel door is red.
- A message appears in Chromeleon Audit Trail.
- The Leak property in Chromeleon is set to **Leak**.
- A beep alerts you.
- The pump stops flow if the leak sensor reports a leak for at least 3 minutes.

When the leak sensor reports a leak,

- Locate the source for the leak, eliminate the cause, and dry the leak sensor (→ page 105).
- You can disable the alarm temporarily.

  To do so, open the **Commands** dialog box for the pump and perform the **AlarmOff** command.

  This also turns off the beep and allows you to restart the pump flow.

  If the leak sensor does not report Leak = NoLeak within 30 minutes after you have restarted the flow, another leak alarm will be issued and the pump flow will be stopped again.

You may disable leak detection permanently. (However, it is not recommended to do so.) In Chromeleon, open the **Commands** dialog box for the pump and set **LeakSensorMode** to **Disabled**.

5.4.9 Adjusting the Screen Brightness or Contrast

You can adjust the screen brightness or screen contrast to your requirements from Chromeleon. Open the **Commands** dialog box for the pump. Change the screen brightness under **Brightness** and/or the screen contrast under **Contrast**.

5.4.10 Vacuum Degasser

5.4.10.1 General Notes for Degasser Operation

In normal operation, the degasser is quiet. Even if the vacuum pump is running, the operating noise is very low. With higher load, the operating noise may slightly increase. However, this does not impair the degassing performance.

In addition, observe the following to ensure optimum degassing performance:

- Thermo Fisher Scientific recommends filling *all* channels with eluent and degassing *all* channels (even if they are not used for the application). This will reduce the speed of the vacuum pump and reduce the degasser noise.
- To avoid contamination of the degasser, you should prepare fresh solvents, clean the solvent supply lines, and rinse the degassing channels at regular intervals (→ page 131).
- Thermo Fisher Scientific advises *against* recycling the solvents. This may impair the degassing performance.
- Before connecting the solvent supply lines, make sure that the connectors are free of contaminants. Even minute particles can allow air to enter the degasser, and thus reduce the degassing effectiveness.
- When replacing solvents, make sure that the solvents are miscible. Mix immiscible solvents with an intermediate solvent to replace them step-by-step.
- Thoroughly rinse the degasser with methanol or isopropanol after operation. The methanol or isopropanol do not need to be removed afterward.
- For longer periods of inactivity or when saliferous buffers are used (which may result in salt crystallization in the gas separation membrane, thereby impairing the degassing performance), rinse with deionized water followed by either methanol or isopropanol.
- Also, observe the information about the solvent compatibility of the degasser (→ page 75).

5.4.10.2 Turning the Degasser On and Off

You can turn the integrated vacuum degasser of the pump on and off from Chromeleon. To do so, open the **Commands** dialog box for the pump and set **Degasser** to **On** or **Off**. Alternatively, you can also open the **Tabset Panel** for the pump (→ page 71) and click **More Options**. Under **Degasser**, set **Mode** to **On** or **Off**.

To monitor the degasser vacuum, open the **Commands** dialog box for the pump and check the **DegasserVacuum** property (**OK** or **NotOK**).

Tip: Thermo Fisher Scientific recommends always leaving the degasser on while the pump is on.

5.5 Special Chromeleon Functions

This section provides a short overview of some special functions that Chromeleon supports for the pump.

To learn more about ...	See page ...
Predictive performance	See next section
Using the digital inputs	87
Operational Qualification and Performance Qualification	87

All of these functions are available in the **Commands** dialog box (unless otherwise noted). In addition, some functions are available also on the control panel for the pump. For additional information about a function, see the *Chromeleon Help*.

5.5.1 Predictive Performance

Predictive Performance provides various functions for estimating the lifetime of consumables and for monitoring and recording service and (re)qualification information.

Commands Dialog Box

Open the **Commands** dialog box for the pump and enter the limits for the predictive performance parameters. For a list of the commands and counters that are supported for the pump, see the *Chromeleon Help*.

To keep the predictive performance information up-to-date, Thermo Fisher Scientific recommends the actions listed in the table.

After you have …	Perform the following command …
Replaced the valve cartridges	CheckValveServiceDone[1]
Replaced a piston	PistonsChanged[1]
Replaced the piston seal	SealChanged[1]
Replaced the entire pump head assembly	CheckValveServiceDone[1], PistonsChanged[1], SealChanged[1]
Serviced the pump (for example, annual maintenance)	ServiceDone[2]
Performed instrument qualification	QualificationDone[2]

[1] Listed in the Commands dialog box under PumpModule > [Pump Device Name]_Wellness_LeftBlock

[2] Listed in the Commands dialog box under PumpModule_Wellness

For information about the [Pump Device Name], see page 49.

These commands reset the related counters and update the information when the action was performed.

Control Panel

On the control panel for the pump, click **Wellness**, **Qualification**, and **Service** to see the related predictive performance commands and parameters on separate panels. On these panels, you can enter the limits and reset the counters. In addition, wellness bars provide visual indicators of qualification and service periods. The color-coding of the wellness bars provides information about the status:

Color	Description
Green	OK.
Yellow	The value will soon reach the specified limit and/or the related component needs servicing or should be replaced soon.
Orange	(Only for monitoring Qualification properties.) The value has reached the specified limit. However, a Grace Period has been specified during which the pump may still be operated.
Red	The value has reached the specified limit or the specified grace period has expired. Replacement of a component, servicing, or qualification of the pump is overdue. The pump can no longer be operated; besides, it is not possible to start a batch.

In addition, a message appears in the Chromeleon Audit Trail when a limit has been reached.

5.5.2 Monitoring the Digital Inputs (Digital I/O)

To monitor the digital inputs, verify that

- The device you want to control is connected to the Digital I/O port on the rear panel of the pump and that the appropriate cable is used for the connection (→ page 37).
- The digital input you want to use is selected in the **Properties** dialog for the pump (→ page 51).

When these conditions are fulfilled, the digital input is available for monitoring in Chromeleon in the **Commands** dialog box for the pump. For information about the functions of the connector pins and pin assignment, see page 151.

5.5.3 Operational Qualification and Performance Qualification

Operational Qualification and Performance Qualification allow you to check and document the performance of the HPLC system. All materials required for performing qualification and detailed instructions are available on request.

5.6 Shutting Down the Pump

Observe the following precautions before interrupting the operation or before shipping the pump:

- Rinse out any solvents if necessary. Fill the pump with methanol or a similar alcohol, such as 2-propanol or ethanol. If a buffer is used as a part of the mobile phase, flush the system with several volumes of methanol/water (50:50) before it is shut down. This will prevent salt buildup inside the unit.
- If operation is interrupted for more than one week, fill the pump with methanol or a similar alcohol, such as 2-propanol or ethanol. If the solvents in the pump are not miscible with water, use an appropriate intermediate solvent.
- Rinse out buffers or solvents that form peroxide.
- Turn off the lamps in any UV or RF detectors that are connected to the pump. This will prevent evaporation of the solvents in the flow cell.
- When using an electrochemical (EC) detector with the pump, *always* turn off the potential to the EC cells *before* shutting off the pump flow to prevent damage to the cells.
- If you want to ship or move the pump to a new location, be sure that no liquid remained in the waste line of the rear seal wash system. The waste line is routed directly from the piston guide bushing to the waste.
- Ship the pump only in the original shipping container and observe the packing instructions.

  If the original shipping container is not available, appropriate shipping containers and packing material can be ordered from the Thermo Fisher Scientific sales organization for Dionex HPLC Products. The packing instructions are included in the "Installation and Qualification Documents for Chromatography Instruments" binder and are available on request. Shipping the pump in anything other than the original packaging voids the warranty.

If you are running Chromeleon, you can set the pump and HPLC system into the standby mode or automate system shutdown.

Standby Program

A standby program sets the HPLC system into standby mode. The application can be reactivated very quickly afterward. The main program steps are:

- The pump flow is automatically reduced at the end of the program.
- The temperature of all temperature-controlled modules in the system is reduced.

Shutdown Program

A shutdown program automates shutdown of the HPLC system. The main program steps are:

- The pump flow is automatically stopped at the end of the program.
- Certain system components and functions are turned off (for example, detector lamps, temperature control).

To create a standby or shutdown program

Select one of the following alternatives:

- Select and perform the operating commands and parameters from the **Commands** dialog box (→ page 70).
- Create and run a corresponding program to automate the process (→ page 72).

5.7 Routine and Preventive Maintenance

The pump is made of high-quality components and materials to minimize maintenance requirements. All surfaces are resistant to weak acids, alkali, and organic solvents. Nevertheless, immediately wipe up all liquids spilled onto the pump surface, by using lint-free cloth or paper. If surfaces are exposed for longer periods, these liquids can cause damage.

Perform the maintenance procedures listed in the table at regular intervals to ensure optimum performance and maximum uptime of the pump. The exact maintenance schedule for the pump will depend on a number of factors.

Frequency	What you should do...
Daily	Before you start operating the pump, inspect the fluid lines for air bubbles and degas the solvent.
	Check the fluid lines for indications of leakage.
	Check the fluid connections for indications of salt deposits.
	If the eluent is pure water, replace the eluent in the reservoir on a daily basis.
	Check the liquid level in the seal wash reservoir.
	Regularly check the volume of the liquid in the waste container for the drain and seal wash liquids and empty the container as needed.
	When buffer solutions are used, flush the system thoroughly after use. Use a solvent that does not contain buffers or salts.
Regularly	Fill the seal wash reservoir, by using fresh liquid. Observe the precautions for the composition of the seal wash solution on page 83.
	Inspect the tubing for possible damage, such as cracks, nicks, cuts, or blockage.
	When buffer solutions are used, you should inspect the pump for leakage at least once a month (→ page 109).
	Check the filter frits in the solvent line filters for permeability. Replace the filter frits in regular intervals especially when using aqueous solvents. Aqueous solvents may contaminate the filters with algae and other microorganisms that deposit on the filter frits. Therefore, use fresh the solvents at regular intervals. Rinse the reservoirs thoroughly before filling them.

Frequency	What you should do...
Regularly	Check the drain line connected to the drain port at the bottom right of the pump. Verify that the tubing is unclogged and is routed below the drain port. Check the volume of the liquid in the waste container and empty as needed.
	To avoid contamination of the degasser, you should prepare fresh solvents, clean the solvent supply lines, and rinse the degassing channels at regular intervals (→ page 131).
Annually	*Recommended:* Have authorized Service personnel perform preventive maintenance once a year.

Tip: Chromeleon supports functions for estimating the lifetime of consumables (Predictive Performance, → page 86).

The following maintenance kit with all necessary parts is available from Thermo Fisher Scientific to perform required maintenance procedures:

Description	Part No.
Maintenance kit, including Silicone tubing (O.D. 280 x I.D. 130 mm; L 0.35 m) 2 check valve cartridges 2 piston retaining springs 2 primary piston seals 2 secondary piston seals	6043.1954

6 Troubleshooting

6.1 Overview

The following features help you to identify and eliminate the source for problems that may occur during the operation of the pump or UltiMate 3000 system.

- **Status LED**

  The status LEDs (light emitting diodes) on the front panel provide a quick visual check of the operational status of the pump. They indicate whether the pump is turned on, connected in Chromeleon, and operating properly (→ page 18).

- **Error Codes**

  If a fault or error is detected during the operation of the pump, an error code is displayed on the pump display. If the pump is operated with Chromeleon, the corresponding error message is displayed in the Chromeleon Audit Trail. Check the following pages for recommended courses of action.

Tip: For information about operating problems that might occur during the operation of the pump or an UltiMate 3000 system, see Operating Problems (→ page 94).

6.2 Error Codes on the Pump Display

Each time a fault or error occurs during the operation of the pump, the **Status** LED on the front panel door changes to red, and an error code appears in the lower left corner on the pump display.

When the pump is operated with Chromeleon

- The error is also displayed in the Chromeleon Audit Trail.
  Consider also checking the Audit Trail messages, they may provide additional information.
- Error codes on the pump display can be removed by performing the **ClearDisplayError** command in Chromeleon.

The error code is displayed in the form " E*xxyy" (where "xx" = the actual error code and "yy" = a code indicating the pump status). The table below lists the pump-related error codes ("xx") and their descriptions and suggests appropriate remedial actions.

Tip: Note the complete error code (in the exact form "E*xxyy") in case you need to contact the Thermo Fisher Scientific Service for Dionex HPLC Products to eliminate the problem.

If additional codes appear that are not listed in the table, also note the exact error code and contact Thermo Fisher Scientific Service for Dionex HPLC Products if you are unable to eliminate the problem.

Error Code ("xx")	Description	Remedial Action
01	The system pressure has fallen below the set lower pressure limit.	*Displayed after 60 seconds* The solvent reservoirs may be empty. Fill the reservoirs and purge the system (→ page 84). There may be air bubbles in solvent supply line. Check the filter frits; purge the system (→ page 84). The solvent may emit gas when mixing. Degas the solvent. Check the degasser. There may be a leak in the system. Find and eliminate the source for the leak. Tighten loose connections. One of the check valves may be defective. Clean or replace the valve cartridges (→ page 124). Purge the system (→ page 84). Turn the pump off and on again by pressing the power switch on the rear panel.

Error Code ("xx")	Description	Remedial Action
02	The system pressure has exceeded the set upper pressure limit.	Check whether the flow path after the purge unit is blocked. Open the purge valve. If the flow path is blocked - The column may be contaminated. Rinse or replace the column. If the problem occurs due to column ageing, it may be sufficient to increase the setting for the upper pressure limit. - The autosampler may be blocked. Find and eliminate the source for the blockage. If the flow path is *not* blocked, the static mixer in the purge unit may be blocked. Consider replacing the purge unit (→ page 125). Turn the pump off and on again by pressing the power switch on the rear panel.
03	The cam position is unknown.	Turn the pump off and on again by pressing the power switch on the rear panel. If the message appears more often, contact Service.
04	Motor current too large	The motor current is too high when the pump is running. Turn the pump off and on again by pressing the power switch on the rear panel. Verify that the check valve cartridges are installed in the direction of flow (→ page 124). The motor may be defective. Contact Service.
05	Position error	A position error is reported for the pump. Turn the pump off and on again by pressing the power switch on the rear panel. If the message appears again, contact Service.
07	Proportioning valve error	The pump was unable to activate one or more channels of the proportioning valve. Verify that all bayonet-type valve connectors are properly connected to the ports. Turn the pump off and on again by pressing the power switch on the rear panel. The proportioning valve may be defective. Replace the proportioning valve (→ page 126).
09	Motor malfunction	The motor is malfunctioning. An error in the motor electronics occurred. Turn the pump off and on again by pressing the power switch on the rear panel. If the message appears again, contact Service.
0a	Cam identification error	A cam identification error is reported for the pump. Turn the pump off and on again by pressing the power switch on the rear panel. If the message appears again, contact Service.

Error Code ("xx")	Description	Remedial Action
0d	Leak detected.	*This code appears after 180 seconds after the leak sensor leak has reported a leak for the pump. The flow is automatically turned off.* Find and eliminate the source for the leak. Dry the leak sensor and tray (→ page 105).
0e	Degasser malfunction	A degasser error is reported. The vacuum level monitoring function of the degasser in the pump may have recognized insufficient vacuum. Turn the pump off and on again by pressing the power switch on the rear panel. You may also check the degasser vacuum in Chromeleon (**Commands** dialog box). After about 1 minute, the setting should change from **NotOk** to **OK**. Inspect the degassing module for indications of leakage if the vacuum is still insufficient. The degassing module may be defective and should be replaced. Contact Service.
0f	An emergency stop was requested over the digital input line.	This message appears if a Corona detector is connected to the pump and the digital input is configured to stop the pump when an error occurs in the detector. Check the detector and take appropriate remedial action (→ *Detector manual*).
10	Parameter initialization error	A parameter initialization error is reported for the pump. Contact Service.
11	Communication error	A communication error is reported for the pump. Contact Service.
14	Power failure	The power supply dropped below 18V. This may also be the case when a short voltage drop or loss occurs in the power supply. Check the power supply and the power cord. Turn the pump off and on again by pressing the power switch on the rear panel. If the message appears again, contact Service.

6.3 Operating Problems

The table provides information about common operating problems that might occur with the pump or an UltiMate 3000 system and lists probable causes, as well as remedial actions.

For more information and remedial actions, see the manuals for the other modules of the UltiMate 3000 system.

Problem	Probable Cause	Remedial Action
No information appears on the pump display.	The pump is not connected to the mains.	Connect the power cord.
	The power is turned off.	Turn on the power to the pump.
	The pump is in standby mode.	Press the Standby key on the front panel.
	The screen brightness or contrast is not adjusted correctly.	Adjust the brightness and/or contrast (→ page 84).
	The fuses blow.	Replace the fuses (→ page 132).
	Replacement fuse blows immediately.	Contact Service.
	An error occurred in the electronic system.	Contact Service.
The pump does not work correctly when operated with Chromeleon.	There is no connection between the pump and the Chromeleon data system computer.	Check the USB cable and connection to the computer.
	The USB port on the computer is not ready for operation.	Check the USB port on the computer.
The rear seal wash system is leaking.	The seal washing tubing is not connected properly; the tubing is damaged by bending or is blocked.	Check the seal wash tubing (→ page 62). Place the eluent bottles at the height of or below the pump. Replace the tubing if required.
The system has very high backpressure.	One or more capillaries in the system are blocked or damaged by bending.	Check the capillaries in the system systematically from the detector to the pump, remove the blockage, or replace the capillaries.
	The static mixer in the purge unit is blocked.	Replace the purge unit (→ page 125).
	The column is contaminated or blocked.	Rinse or replace the column.

Problem	Probable Cause	Remedial Action
The system has very high backpressure. *(Cont'd)*	The high viscosity of the rear seal wash solution has a negative impact on pressure measuring system.	Check the rear seal wash solution for viscosity and organic content. Use a solution with a low organic content to facilitate the piston movement.
High baseline drift	The column is contaminated.	Clean or replace the column.
	The system is not sufficiently equilibrated.	Flush the system until equilibration. Usually, a volume of 5–10 times the column volume will be sufficient.
	The eluents are degraded or inhomogeneous.	Before you start an analysis, be sure that the eluents are already homogenized in the reservoirs. Use fresh solvent and check the eluent filter frits. In aqueous solvents, growth of microorganisms is possible.
	The mobile phase is delivered in circles.	Direct the mobile phase to waste.
	The environmental conditions are unstable.	Make sure that the temperature and the humidity are constant. Avoid draft. Verify on the detector that the lamp and flow cell covers are in proper position and that the front panel door is closed.
	For additional causes, refer to the operating instructions for the detector.	→ *Detector manual*
High noise level, non-periodic baseline fluctuation	The solvent is degraded or of poor quality/purity.	Use fresh and appropriate solvents (HPLC quality).
	For additional causes, refer to the operating instructions for the detector.	→ *Detector manual*
Periodic baseline fluctuation, pulsation	There are pressure fluctuations from the pump.	Purge the pump (→ page 62).
	There are air bubbles in the system.	Purge the pump (→ page 62).

Problem	Probable Cause	Remedial Action
Pressure pulsation or inconstant pressure	The solvent is not degassed sufficiently.	Degas the eluent.
	The solvent is degraded.	Use fresh solvent.
	There are pressure fluctuations from the pump.	Purge the pump (→ page 62). Clean the pump head components (→ page 127).
	There are air bubbles in the system.	Purge the pump (→ page 62).
Pressure pulsation or inconstant pressure *(Cont'd)*	The inlet valve or outlet valve on the working cylinder is dirty.	Clean the inlet check valve and/or outlet check valve. Consider replacing the check valve (→ page 124).
	The static mixer in the purge unit is blocked.	Replace the purge unit (→ page 125).
Peak tailing	There is too much extra column volume.	Use short capillary connections with an appropriate inner diameter.
	There are bad capillary connections.	Replace the capillaries. Make sure that you use Viper capillaries.
Peak Broadening, increased dead time	The inner diameter of the capillary to the detector is too large.	Use a capillary with an appropriate inner diameter.
	The filter frits on the solvent line filters are clogged.	Check the filter for permeability. Replace the filter if necessary (→ page 58).
	The capillaries are clogged or there a bad capillary connections.	Replace the capillaries. Make sure that you use Viper capillaries.
	The sample loop is clogged.	Replace the sample loop (→ *Autosampler manual*).
	The proportioning valve is defective.	Replace the proportioning valve (→ page 126).
	The column is overloaded or contaminated.	Clean or replace the column.
	The eluent has changed.	Use fresh solvent.
Reproducible ghost peaks in the chromatogram.	The degassing channels are contaminated.	Rinse the degassing channels (→ page 131).
	The solvents are degraded, dirty or of poor purity/quality.	Use fresh and appropriate solvents (HPLC quality).
	Contamination occurs somewhere in the system.	Flush the system using an appropriate solvent.

Problem	Probable Cause	Remedial Action
Additional peaks appear in the injection peak.	With gradients, the equilibration time after the flush cycle is too short.	Extend the equilibration time.
	The dead volume is too high.	Eliminate possibly existing dead volume.
Spikes	There is electrical interference from other modules.	Isolate the electrical circuit from strong current consumers. Consider installing an uninterruptible power supply (UPS).
	For additional causes, refer to the operating instructions for the detector and for the column compartment.	→ *Detector manual* → *TCC manual*
Negative peaks	The sample solvent and mobile phase differ in composition.	Dissolve the sample in the mobile phase.
	The absorption of the solute is lower than the absorption of mobile phase.	Select a different wavelength. Use a mobile phase with less UV background absorption.
Poor peak area precision	The capillary connections are not installed properly or they are not tight.	Check and tighten the capillary connections. Make sure that you use Viper capillaries.
		Consider replacing the needle seat (→ *Autosampler manual*).
		Consider replacing the needle (→ *Autosampler manual*).
	There are dead volumes in the capillary connections.	Make sure that you use Viper capillaries, and that the capillaries are installed correctly.
	The piston seals are leaking.	Replace the piston seals (→ page 118).
	There is air in the working cylinder.	Purge the pump (→ page 62).
	There is pump pulsation.	Use degassed solvents.
	The gradient is irreproducible.	Change the gradient.
		Check the pump function and degassing.
		Check the filters on the solvent lines for contamination and replace as necessary.

Problem	Probable Cause	Remedial Action
Poor peak area precision *(Cont'd)*	The sample is unstable and decomposes.	Use new sample or change the conditions. Cool the sample in the autosampler if possible.
	Baseline fluctuations	See the remedial actions provided in the related baseline sections further up in this table.
	The environmental conditions are unstable.	Make sure that the temperature and the humidity are constant. Avoid draft. Consider using a thermostatted column compartment.
	Contamination occurs somewhere in the system.	Flush the system using an appropriate solvent.
	For additional causes, see the Autosampler manual.	→ *Autosampler manual*
No flow	The system is leaking.	Find and eliminate the leak.
	The solvents are degraded, dirty or of poor purity/quality.	Use fresh solvent. Use fresh and appropriate solvents (at least HPLC grade).
	Contamination occurs somewhere in the system.	Flush the system with an appropriate solvent.
	One or both valve cartridges are not installed correctly (not in the direction of flow) or are defective.	Install the cartridges in the direction of flow or replace the cartridges if necessary (→ page 124).
	There are air bubbles in the eluent or in the pump head.	Purge the pump (→ page 62) and check the degasser.
	The static mixer in the purge unit is blocked.	Replace the purge unit (→ page 125).
	There are air bubbles in the flow path.	Perform a wash cycle (→ *Autosampler manual*). Non-degassed wash liquid is used. Degas the wash liquid (→ *Autosampler manual*).

Problem	Probable Cause	Remedial Action
Flow fluctuation	The inlet path is blocked.	Check the inlet lines, filter of the pump, proportioning valve etc. for signs of blockage.
	There is air in the inlet path.	Purge the pump (→ page 62) and check the degasser.
	The check valves are dirty or defective.	Clean the check valves or replace the valve cartridges (→ page 124).
	The piston seals are leaking.	Replace the piston seals (→ page 118).
Poor degassing	There is a leak in the capillaries or solvent supply lines or there are loose connections.	Inspect the capillary and solvent supply line connections for leakage; tighten loose fitting connections.
	The degasser is not working properly.	Inspect the degassing channels for indications for leakage. Check the degasser vacuum.
	The flow rate is too high.	Reduce the flow rate.
Degasser noise	The vacuum pump of the degasser is running at high speed.	Fill and degas *all* channels (even if they are not used for the application).
Mass spectrometer starts before injection or does not start.	The wires of the 2-pin connector on the interconnect cable are not installed correctly.	Check the assignment of the wires and the Start In connector on the mass spectrometer. Make sure the interconnect cable is properly connected (→ page 39).

7 Service

7.1 General Notes and Safety Precautions

The following sections describe all service and repair procedures for the pump that the user may perform. All other maintenance and service procedures must be performed only by Thermo Fisher Scientific service personnel.

Warning: The fluid components of the device may be filled with solvents that are harmful to health. Wear appropriate personal protective equipment. Rinse the fluid components with an appropriate solvent to remove harmful substances.

For information about the proper handling of a particular substance and for advice on specific hazards, refer to the material safety data sheet for the substance you are using. Observe the guidelines of Good Laboratory Practice (GLP).

Avertissement: Les composants fluidiques de l'instrument peuvent être remplis de solvants nocifs. Portez l'équipement de protection personnel approprié. Rincez les composants fluidiques avec un solvant approprié afin d'éliminer les substances nocives.

Pour les informations sur la manipulation correcte des composés et des recommandations pour les situations de risque spécifiques, veuillez consulter la fiche de données de sécurité des substances que vous utilisez. Veuillez respecter des directives des Bonnes Pratiques de Laboratoire (BPL).

Before starting maintenance or service procedures, observe the following precautions:

- For all service and repair procedures, observe all precautionary statements provided in these operating instructions.
- Use only the original spare parts authorized for the device by Thermo Fisher Scientific.
- Before returning any device for repair, contact Thermo Fisher Scientific Service for Dionex HPLC Products. An RMA (Return Material Authorization) number is required to track your device. Always use the original packaging and observe the packing instructions when shipping the pump. Shipping the pump in anything other than the original packaging voids the warranty.

  If the original shipping container is not available, appropriate shipping containers and packing material can be ordered from the Thermo Fisher Scientific sales organization for Dionex HPLC Products. The packing instructions are included in the "Installation and Qualification Documents for Chromatography Instruments" binder and are available on request.

- The device contains voltage lines. Turn off the main power switch and disconnect the power cord prior to servicing the pump.

For instructions on shutting down the pump, see page 88.

Tips: Do not forget to test the pump for leakage after you have carried out maintenance or repair work on the fluid connections (→ page 129).

Never disassemble the pump head with bare hands. Put on a pair of clean room gloves to prevent contamination on the pump parts. Even minute particles may cause damage to the system and result in poor pump performance.

7.2 Eliminating Leakage

The leak sensor is installed inside the pump and reports a leak when liquid collects in the drip tray under the fluid connections. Locate the source for the leak, eliminate the cause, and dry the leak sensor.

Fig. 38: Leak sensor

1. Wait until the pressure is down to zero.
2. Inspect the fluid connections in the pump for signs of leakage. Tighten or replace leaking connections if necessary.
3. With a cloth or tissue, absorb all liquid that has collected in the tray. Make sure that you do not bend or damage the sensor.
4. Allow the sensor to adjust to the ambient temperature for a few minutes. The red sensor LED should now be dark. (The yellow LED may be dark or illuminated; this LED does not indicate errors.)
5. If no errors are reported, operation can be resumed.
6. Do not forget to test the pump for leakage after you have carried out maintenance or repair work on the fluid connections (→ page 129).

Tip: If the sensor is not dry, the Status LED remains red.

7.3 Pump Head, Pistons and Piston Seals

To replace the piston seals, the check valve cartridges or the purge unit, or to clean the components of the pump head, remove the pump head from the interior front panel, and then disassemble it (→ page 110). To reassemble the pump head components and return the pump to operating condition, follow the instructions, starting on page 113.

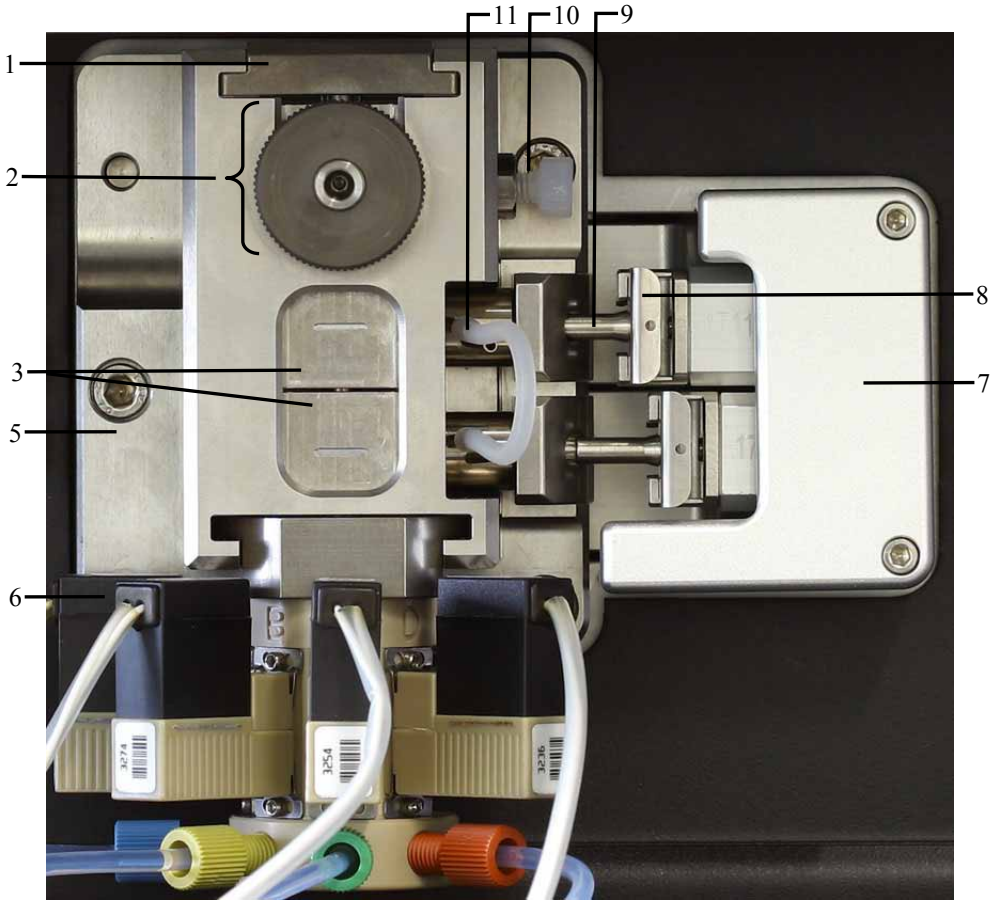


Fig. 39: Pump head with proportioning valve

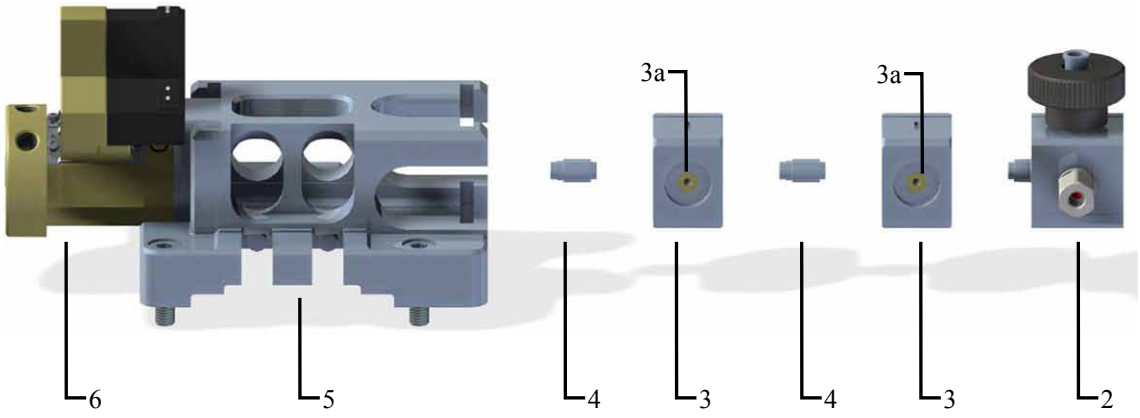


Fig. 40: Explosion view of a pump head with proportioning valve

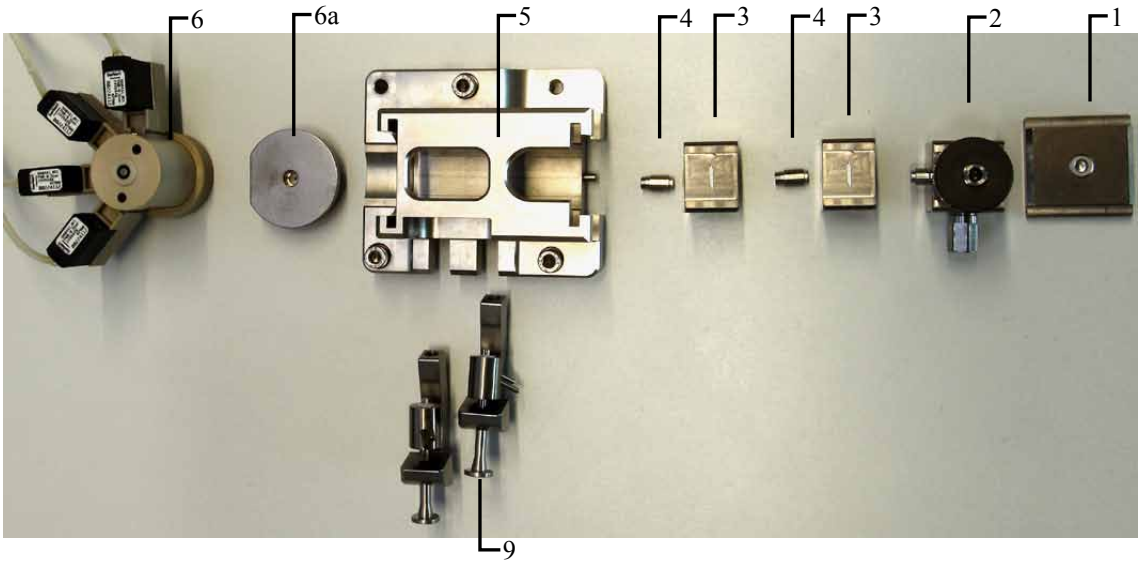


Fig. 41: Components of the pump head

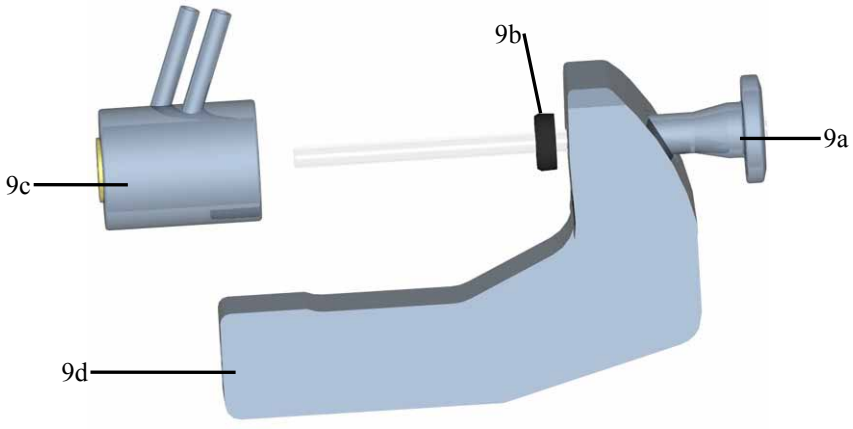


Fig. 42: Holding hook with piston and guide bushing

No.	Description	Part No.
	Pump head, entire assembly (except proportioning valve), including:	6043.0106
1	Compression lid	----
2	Purge unit including static mixer, purge valve with knob and outlet nozzle	6043.0120
3	Displacement chambers	----
3a	Primary piston seal	Included in 6043.1954
4	Check valve cartridge	Included in 6043.1954
5	Pump head main body	----
6	Proportioning valve with four valve channels and static mixer	6043.0270

No.	Description	Part No.
6a	Adapter plate for proportioning valve	----
7	Piston drive unit	----
8	Piston retaining spring	Included in 6043.1954
9	Holding hook with piston	----
9a	Sapphire piston	6043.0169
9b	Secondary piston seal	Included in 6043.1954
9c	Piston guide bushing with ports for rear seal wash tubing containing primary piston seal	----
9d	Holding hook with two clamping screws	----
10	Pump outlet	----
11	Tubing for rear seal washing	Included in 6043.0056

When performing service procedures on the pump head, make sure that you

- Purge and rinse the pump to remove toxic solvents.
- Turn off the pump on the main switch on the rear panel of the pump before you start the service procedures.
- Perform the procedures in the order described in this manual to prevent damage to the components of the pump head as well as the piston and the piston seals.
- Clean all parts with a clean wipe and preferably isopropanol before reassembling the pump head.

7.3.1 Visually Inspecting the Pump for Piston Seal Leakage

You can inspect the pump visually for liquid leaks from the piston seals. As the pistons move back and forth within the displacement chambers, a small quantity of mobile phase leaks behind the primary piston seals. Before inspecting whether liquid leaks from the piston seals, make sure that

- The rear seal wash tubing is properly connected to the rear seal wash system (→ page 62). If the seal wash tubing is not connected properly or if the tubing is crimped or kinked, the liquid may leak into the pump.
- After performing service procedures on the pump head, the pump head is reassembled correctly, and the screws are tightened properly.

1. Flush the seal wash system with the seal wash solution.
2. Observe the pistons for liquid leaking out. In addition, use one or more paper strips and cut them to approximately 5 x 2 cm. Insert the paper strip between the displacement chambers and check whether liquid are present between the chambers.
   - ♦ If no leak can be observed, the pump head is sealed tightly.
   - ♦ Liquid leaking out from the displacement chambers indicates leakage from one or both check valve cartridges. Replace the check valve cartridges and repeat the test starting with step 1. To replace check valve cartridges, see section 7.3.4.
   - ♦ Liquid leaking out from the guide bushings indicates leakage from one or more piston seals. Replace the primary piston seals in the displacement chambers and repeat the test starting with step 1. If no leakage is observed, replace the secondary piston seals in the piston guide bushings and repeat the test starting with step 1. To replace piston seals, see section 7.3.3.

7.3.2 Pump Head and Pistons

Tip: When performing service procedures for the pistons and the piston seals, remove the pistons from the seals as little as possible to preserve the quality of the seals.

7.3.2.1 Removing and Disassembling the Pump Head

To remove the pump head from the interior front panel

1. Tilt the front cover upward.
2. If necessary, purge the pump to remove toxic solvents.
3. Turn off the main power switch and disconnect the power cord.
4. Remove the four bayonet-type proportioning valve connectors on the left side of the pump head. As a help, you can use the tool for the bayonet-type connectors from the accessories kit for the pump (part no. 6043.0061).
5. Put on a pair of clean room gloves to prevent contamination on the valve parts. Even minute particles may cause damage to the system and result in poor pump performance.
6. Disconnect all fluid connections from the pump head (solvent lines, rear seal wash tubing, capillaries on the outlet).
7. Two clamping screws fix the piston drive unit cover on the right side (→ Fig. 43). Loosen the two screws using a ball-head screwdriver (size 4 mm, included in the accessories kit of the pump). Thus, you loosen the springs which hold the pistons in the piston drive unit.
   Be sure to open the clamping screws enough to avoid damage to the pistons.

Fig. 43: Loosening the clamping screws on the drive unit cover

8. Remove the two piston retaining springs on the front by gently sliding them away from the pistons (→ Fig. 44).
   Make sure that the pistons do not touch the piston drive unit. If they do, move the pistons slightly toward the left.

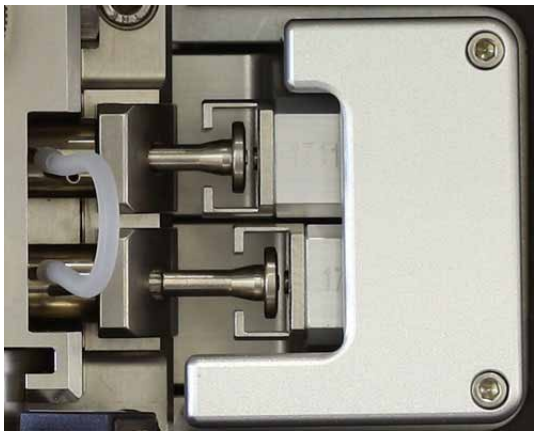


Fig. 44: Pistons without piston retaining springs

9. *If not yet done*
   Remove the outlet plug on the pump outlet.

10. Loosen the three screws which attach the pump head to the interior front panel using a ball-head screwdriver (size 4 mm) from the accessories kit of the pump.
    When unlocking the screw next to the proportioning valve, be careful not to apply force on the proportioning valve.

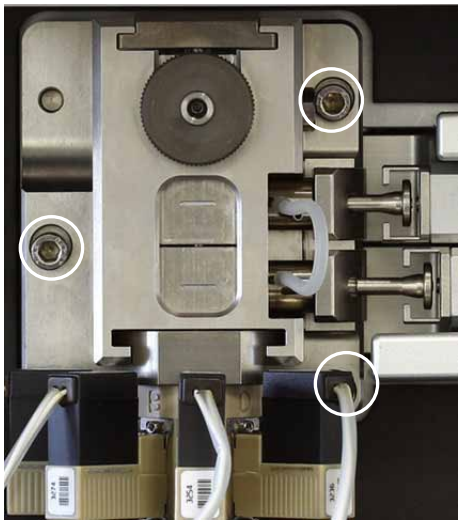


Fig. 45: Loosening the pump head screws

11. Gently slide off the pump head over the two guide pins on the interior front panel. Be careful that the pistons do not touch the piston drive unit to prevent damage to the pistons.

To disassemble the pump head

Tip: Never disassemble the pump head with bare hands. Put on a pair of clean room gloves to prevent contamination on the pump parts. Even minute particles may cause damage to the system and result in poor pump performance.

1. Put the pump head on a clean surface.
2. Remove the short tubing from the rear seal wash ports on the guide bushings.
3. Remove the tubing from the proportioning valve.
4. Loosen the two clamping screws for the holding hooks on the left side of the pump head (→ Fig. 46) using a ball-head screwdriver (size 4 mm). Hold the pump head while loosening the screws.

Fig. 46: Clamping screws for holding hooks

5. Gently remove the holding hooks with the pistons and the guide bushings while holding the pump head.
6. Loosen the set screw that holds the compression lid in place by using an hexagon socket head wrench (size 4 mm). Remove the compression lid by sliding it out.
7. Slide out the purge unit.
8. Slide out the displacement chambers with the check valves. The small notch on the displacement chambers can be used as a help to move the displacement chambers with the fingernail.
9. After having disassembled the pump head, you can
   - Replace the piston seals (→ page 118).
   - Replace the check valve cartridges (→ page 124).
   - Replace the purge unit (→ page 125).
   - Replace the proportioning valve (→ page 126).
   - Clean all pump head components properly (→ page 127).

7.3.2.2 Reassembling and Installing the Pump Head

Description	Part No.
Pump head (entire assembly)	6043.0106
Piston, sapphire	6043.0169

To reassemble the pump head

Tip: Make sure you have cleaned all parts of the pump head with isopropanol and a clean wipe before reassembly.

1. Form one stack out of the two displacement chambers, the two check valve cartridges, and the purge unit. The bores for the pistons and piston guide bushings should be on the same side as the pump outlet.

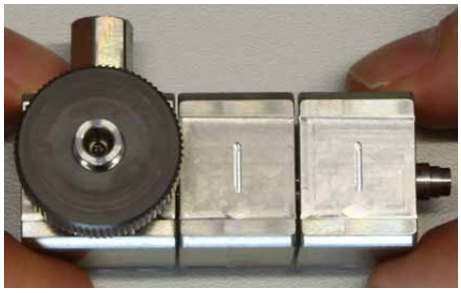


Fig. 47: Stack out of displacement chambers, valve cartridges, and purge unit with pump outlet

Tip: The check valve cartridges and the displacement chambers are identical, respectively.

Mind the correct orientation of the valve cartridges and the displacement chambers. Verify that the valve cartridges are installed in the direction of flow. A flow direction sign on the check valve cartridges shows the correct orientation (→ Fig. 48, page 114). The displacement chambers should be positioned such that the small notches point upward and the bores for the guide bushings are on the same side as the pump outlet on the purge unit (→ Fig. 47).

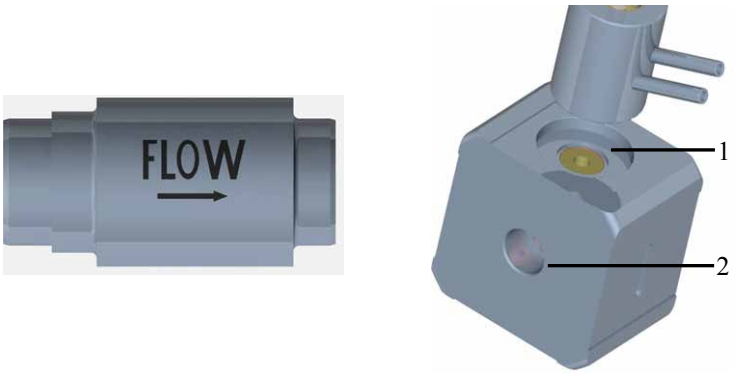


Fig. 48: Left: Check valve cartridge with orientation sign
Right: Displacement chamber with bore for guide bushing (1), and bore for check valve cartridge (2)

2. Hold the main body and slide the complete stack into the main body.
3. Carefully slide the compression lid into the main body. If the compression lid does not fit, verify that the stack is installed correctly.
4. Hold the pump head and tighten the compression lid screw by using the hexagon socket head wrench from the accessories kit (recommended torque: 5-7 Nm).
5. *If it is not yet done*
   Carefully reassemble piston, guide bushing, and holding hook. Mind the correct orientation of the guide bushing. Make sure that the ports for the rear seal wash tubing face to the hook (→ Fig. 49).

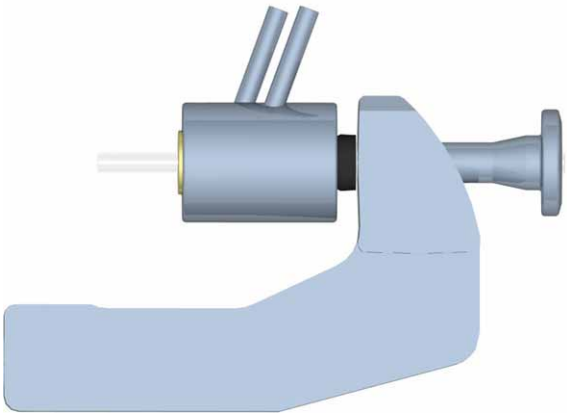


Fig. 49: Holding hook assembled:
Holding hook, guide bushing and piston with secondary piston seal

6. Carefully pre-align the assembled holding hook with the main body of the pump head by sliding the holding hook with the piston and guide bushing into the main body. Do not push the piston into the seal yet (→ Fig. 50).

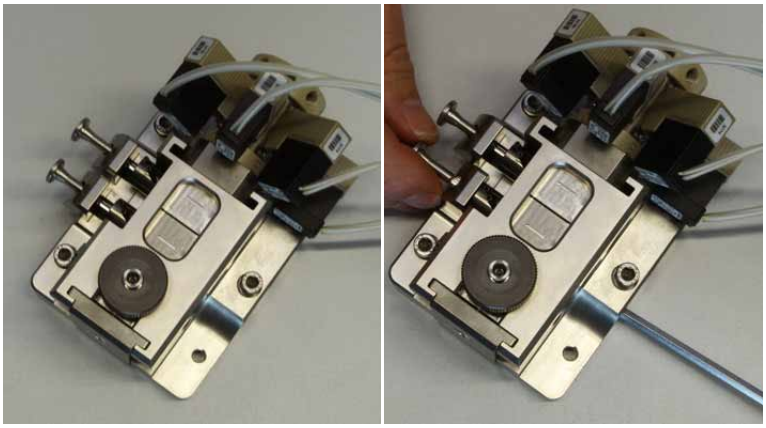


Fig. 50: Installing the holding hooks

7. Pull both holding hooks in position by slightly turning the clamping screws of the holding hooks, not yet locking up the screws. Do not push the pistons into the seals yet, the pistons must be aligned first.

8. Without applying force, align the pistons and gently move both pistons into the seals (→ Fig. 51).

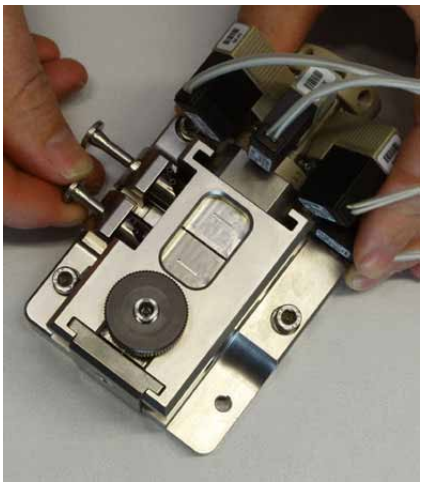


Fig. 51: Carefully move the pistons

9. Lock up the clamping screws for the holding hooks using a ball-head screwdriver (recommended torque: 5-7 Nm).

10. Re-connect the short tubing from the rear seal wash ports on the guide bushings.

11. Re-install the tubing on the proportioning valve.

To install the pump head to the interior front panel

1. Use the guide pins on the interior front panel to carefully place and align the pump head on the interior front panel. Align the pistons so that they do not touch the piston drive unit while installing the pump head. Make sure the guide pins match the bores in the pump head correctly.
2. Tighten the three screws that attach the pump head to the interior front panel with a ball-head screwdriver. When tightening the screw near the proportioning valve do not touch or apply force on the proportioning valve.
3. Align the pistons with the piston drive unit (→ Fig. 44, page 111). Make sure that they do not touch the drive unit to prevent damage to the pistons.
4. Insert the piston retaining springs before the piston head. Make sure that the lips of the springs face the piston drive unit (→ Fig. 52).

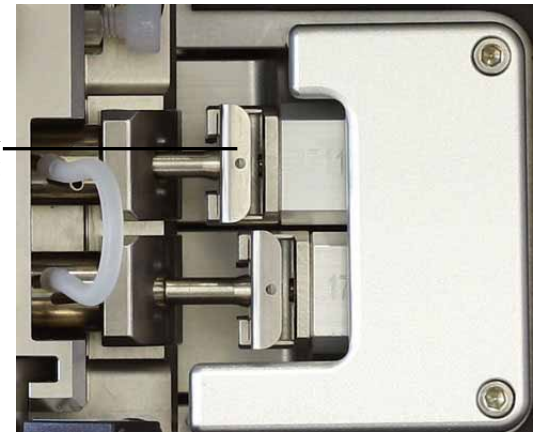


Fig. 52: Piston retaining springs correctly installed

5. Tighten the two clamping screws on the right side of the drive unit cover carefully with a ball-head screwdriver. Thus, you tighten the springs which hold the pistons in the piston drive unit.
6. Reconnect the four bayonet-type proportioning valve connectors and the fluid connections (solvent lines, rear seal wash tubing, capillaries on the pump outlet) on the pump head.
7. Reconnect the power cord and turn on the main power switch.
8. Flush the pump head with isopropanol (→ step 1 on page 109).
9. Rinse the pump thoroughly with at least 30 mL of HPLC grade water to prevent contaminants from entering the HPLC system.

10. Test the pump for leakage (→ page 129). Tighten leaking connections.

11. *When you operate the pump under Chromeleon*
    When you replaced the pistons, piston seals or check valve cartridges, update the related service information for predictive performance in Chromeleon. To do so, perform the required command as described in section 5.5.1 (→ page 86).

    If you replaced the entire pump head assembly, perform the **SealChanged**, **CheckValveServiceDone**, and **PistonsChanged** commands.

7.3.3 Replacing the Piston Seals

The piston seals prevent solvent from leaking into the rear seal wash system or into the pump. Leaking may cause unstable flow rates and baseline noise.

Each piston has two piston seals: A primary piston seal in the displacement chamber (→ Fig. 54, page 119), and the secondary piston seal in the guide bushing (→ Fig. 60, page 122).

The replacement procedure for the piston seals consists of

1. Removing the pump head and disassembling the pump head (→ page 110).
2. Replacing the primary piston seals (→ page 119).
3. Replacing the secondary piston seals (→ page 121).
4. Cleaning the pistons and the other pump head components (→ page 127)
5. Re-assembling the pump head and re-installing the pistons and the pump head (→ page 113)
6. After you have replaced the piston seals, observe the recommendations on page 123.

Before installing new piston seals, always verify that they have been cleaned in isopropanol for at least 10 minutes.

Tips: The pump is shipped with reversed phase piston seals (RP).

Keep in mind that using chloroform, trichlorobenzene, methylene chloride, tetrahydrofuran, or toluene as solvents chemically damages the seals. Chemical reactions may also occur when using tetrachloromethane, diethyl ether, di-isopropyl ether, ketones, toluene, methylcyclohexane, and monochlorobenzene. If you use these solvents, contact the Thermo Fisher Scientific sales organization for Dionex HPLC Products.

7.3.3.1 Replacing the Primary Piston Seals

The primary piston seals are reversed phase (RP) piston seals, and are located in the displacement chambers.

Description	Part No.
Piston seals kit, with 2 primary piston seals 2 secondary piston seals	6043.0295

1. Remove and disassemble the pump head (→ page 110).
2. Disassemble the stack of purge unit, displacement chambers and valve cartridges.
3. Slide the tip of the plunger from the seal handling tool into the primary piston seal in the displacement chamber. The seal handling tool is included in the accessories kit for the pump.

Fig. 53: Seal handling tool with plunger (1) and support bushing (2)

4. Gently unplug the seal by pulling on the plunger while slightly turning the pin on the plunger tip and applying side force.

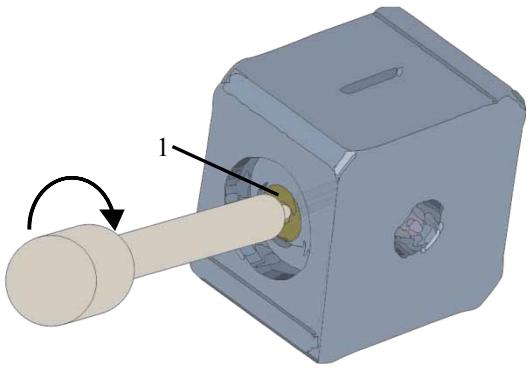


Fig. 54: Removing the primary piston seal (1) from the displacement chamber

5. Insert the plunger into the support bushing so that the tip of the plunger comes out on the other end of the support bushing.

6. Slide the replacement primary seal over the tip of the plunger until it is flush with the surface of the plunger. The open side of the seal must face away from the tool.

Fig. 55: Piston seal positioned on the seal handling tool (open seal side facing away)

7. Pipette a few drops of isopropanol on the edge in the displacement chamber on which the piston seal will rest.

8. Insert the seal handling tool with the replacement seal positioned on the plunger into the bore for the seal in the displacement chamber (→ Fig. 56). Do not apply any side load onto the seal during this process.

Fig. 56: Installing the replacement seal using the seal handling tool

9. Hold down the support bushing and pull the plunger out until it is out of the seal.

Fig. 57: Piston seal installed in the displacement chamber

10. Gently remove the seal handling tool from the displacement chamber.

11. Form a stack out of the purge unit, displacement chambers and valve cartridges (→ Fig. 58). The bores for the pistons and piston guide bushings should be on the same side as the pump outlet.

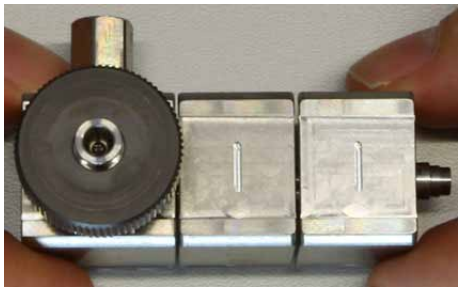


Fig. 58: Stack of displacement chambers (notches pointing upward), valve cartridges, and purge unit

12. Proceed as described in section 7.3.3 (→ page 118).

7.3.3.2 Replacing the Secondary Piston Seals

The secondary piston seals are reversed phase (RP) piston seals, and are located in the piston guide bushings.

Description	**Part No.**
Piston seals kit, with 2 primary piston seals 2 secondary piston seals	6043.0295

1. *If it is not yet done*
   Remove and disassemble the pump head (→ page 110).

2. Carefully remove the piston from the holding hook and the piston guide bushing by gently pulling the piston out.

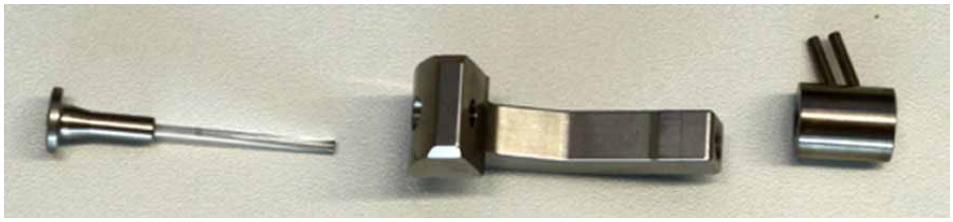


Fig. 59: Holding hook disassembled

3. Slide the tip of the plunger from the seal handling tool into the seal in the guide bushing. Mind the correct orientation of the guide bushing. The seal is on the side of the bushing to which the seal wash ports point.
   The seal handling tool is included in the accessories kit for the pump.

4. Gently remove the seal by slightly turning the plunger and applying side force.
5. Carefully move the piston through the bore in the holding hook.
6. Place the holding hook on a clean surface with the hook pointing upward (→ Fig. 60).
7. Slide the replacement secondary piston seal carefully over the piston with the open side facing away from the piston head.
8. Carefully slide the guide bushing on the piston with the rear seal wash ports facing towards the holding hook (→ Fig. 60). You can use the hook as a help to carefully push the seal in the guide bushing.
9. Gently move the secondary piston seal into the groove in the guide bushing by pushing the guide bushing toward the holding hook.

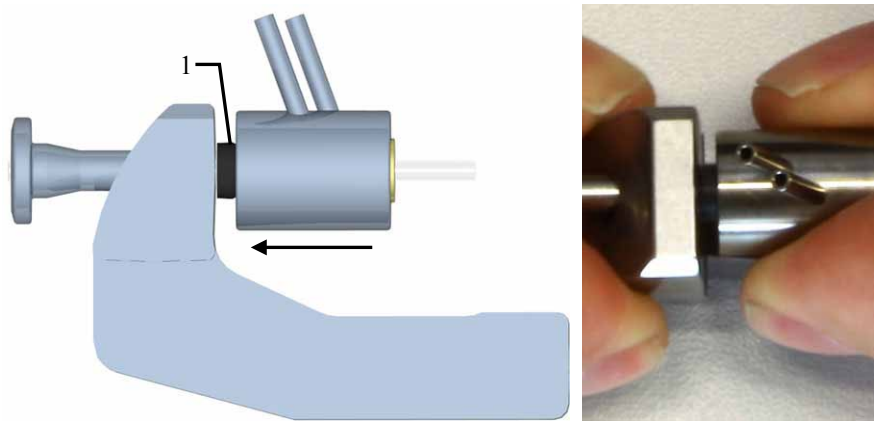


Fig. 60: Installing the secondary piston seal (1)

10. Proceed as described in section 7.3.3 (→ page 118).

7.3.3.3 Recommended Actions after Piston Seal Replacement

Observe the following recommendations when you have replaced the piston seals in the pump head:

Tip: Pump performance and the seal life cycle depend directly on the actions recommended in this section. Therefore, you should perform these actions whenever you replaced the piston seals.

- Allow new piston seals to run in.

  a) Connect drain tubing to the purge outlet nozzle.

  b) Open the purge valve (turn the valve knob counterclockwise).

  c) Operate the pump for 15 minutes with isopropanol at a flow rate of 1 mL/min. Do not deliver in circles.

  d) Close the purge valve (turn the valve knob clockwise).

  e) On the pump outlet, install a flow restrictor, for example, a capillary, that can generate approximately 7-10 MPa at a flow rate of 1 mL/min.

  f) Have the pump deliver isopropanol at 1 mL/min for another 30 minutes.

  g) Remove the capillary from the pump outlet and connect the pump to the system.

- Never run the pump dry. Damage to the pistons or the piston seals could result.

7.3.4 Replacing the Check Valve Cartridge

Two check valve cartridges are installed in the pump head: one inlet check valve cartridge between proportioning valve and displacement chamber, and one outlet check valve cartridge between the two displacement chambers.

The two check valve cartridges and the displacement chambers are identical, respectively.

Description	Part No.
Check valve cartridge (identical for inlet and outlet valve nut)	6043.0145

1. Remove and disassemble the pump head (→ page 110).
2. Disassemble the stack of purge unit, displacement chambers and valve cartridges.
3. Remove the cartridges from the displacement chamber bores.
4. Clean the replacement cartridges and the other pump head components (→ page 127).
5. Install the check valve cartridges in the respective bores in the displacement chambers.
   Mind the correct orientation of the valve cartridges and the displacement chambers. Verify that the valve cartridges are installed in the direction of flow. A flow direction sign on the check valve cartridges shows the correct orientation (→ Fig. 61). The displacement chambers should be positioned such that the small notches point upward and the bores for the guide bushings are on the same side as the pump outlet on the purge unit (→ Fig. 62).

Fig. 61: Flow direction sign on check valve cartridge

6. Form a stack out of the purge unit, displacement chambers and valve cartridges (→ Fig. 62). The bores for the pistons and piston guide bushings should be on the same side as the pump outlet.

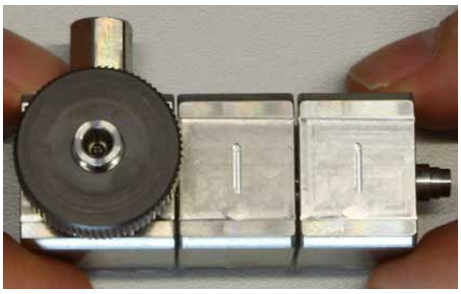


Fig. 62: Stack of displacement chambers (notches pointing upward), valve cartridges, and purge unit

7. Reassemble the pump head with the new valve cartridges and re-install it to the interior front panel (→ page 113).

7.3.5 Replacing the Purge Unit

The purge unit includes a static mixer, the purge valve knob, the purge valve outlet nozzle and the pump outlet. To replace the purge unit, follow the steps below.

Description	Part No.
Purge unit, entire assembly	6043.0120

1. Remove and disassemble the pump head (→ page 110).
2. Disassemble the stack of purge unit, displacement chambers and check valve cartridges.
3. Clean the replacement purge unit and the other pump head components (→ page 127).
4. With the new purge unit, form a stack out of the displacement chambers and check valve cartridges (→ Fig. 47, page 113).
   Mind the correct orientation of the purge unit, the check valve cartridges and the displacement chambers (→ page 113).
5. Re-assemble the pump head and re-install it to the interior front panel (→ page 113).

7.3.6 Replacing the Proportioning Valve

The proportioning valve includes four channels and a static mixer. To replace the proportioning valve, follow the steps below.

Description	Part No.
Proportioning valve, entire assembly	6043.0270

1. Remove the pump head from the interior front panel (→ page 110).
2. Unscrew the two screws on the bottom of the proportioning valve.
3. Remove the proportioning valve from the pump head main body.
4. Install the replacement proportioning valve. Be sure that the valve is correctly aligned to the pump head main body (→ Fig. 63). Hold the proportioning valve in a vertical position to avoid that the static mixer falls out and may be damaged.

Fig. 63: Installing the proportioning valve (here with pump head body)

5. Tighten the two screws on the bottom of the proportioning valve.
6. Reattach the pump head to the pump (→ page 113).

7.4 Cleaning the Pump Head Components

When performing service procedures to the pump head components, make sure that you clean the components properly with a dry, lint-free tissue and isopropanol to avoid contamination in the system. Be sure that you use clean room gloves.

Piston seals should be cleaned in isopropanol for at least 10 minutes before they are re-installed in the pump head.

7.4.1 Cleaning the Pistons

Cleaning the pistons is required only if you reinstall the pistons you removed. Verify that the pistons are clean and free of damage. As the pistons are made of sapphire, hold the rear side of the piston into the light. Dirt particles will be enlarged by the refraction of the light.

Tips: Even if the piston seems to be clean, consider performing the fingernail test in addition. Hold the piston and carefully move your fingernail over the surface. After performing this test, you have to clean the piston again.

The piston is clean when the surface is completely smooth (no inconsistent or rough areas).

When the piston is in the guide bushing, you can also test it by turning the piston in the guide bushing. If the piston cannot be turned smoothly, remove the piston and clean it or inspect it for signs of damage.

Fig. 64: Piston

1. *If it is not yet done*
   Remove and disassemble the pump head (→ page 110).
   Carefully remove the piston from the holding hook and the guide bushing by gently pulling the piston out.
2. Carefully rinse the piston (preferably with isopropanol), and then rub it several times with a dry, lint-free tissue.
3. Consider repeating the fingernail test.
4. Inspect the piston for signs of damage. If no damage is visible, reinstall the piston. If the piston is scratched or scored, install a new piston.
5. Reassemble the holding hook, guide bushing and piston by sliding the piston into the bore of the holding hook and through the guide bushing as shown in Fig. 49 on page 114.
6. Reassemble the pump head and reattach it to the pump (→ page 113).

7.4.2 Cleaning the Check Valve Cartridges

If you use buffers with high concentrations of salts, clean the cartridges as part of a regularly scheduled, preventive maintenance procedure every 6 to 12 months depending on your usage. Clean the cartridges if they are not functioning properly or if you experience residual pulsation that is too high.

⚠ **Important:** Do not use an ultrasonic bath to clean the cartridges. Sonicating the cartridges can damage the small ruby balls.

⚠ **Important:** Ne pas utiliser un bain à Ultra-son pour nettoyer les clapets anti-retour, cela pourrait abîmer les petites billes en ruby.

1. Remove and disassemble the pump head (→ page 110).
2. Disassemble the stack of purge unit, displacement chambers and valve cartridges.
3. On the Luer exit of a 10 mL syringe, install a very short piece of silicone.
4. Flush the check valves with 10 mL of distilled water.
5. Repeat step 4 with 10 mL of isopropanol.
6. Verify that fluid flows freely through the cartridge. Mind the flow direction indicated by the flow direction sign on the cartridge. If you cannot achieve free flow through the cartridge, replace it with a new one (→ page 124).
7. Reassemble the pump head and reattach it to the pump (→ page 113).

If the cartridges are still not functioning properly or if you still experience residual pulsation which is too high, replace the cartridges (→ section 7.3.4).

7.5 Testing the Pump for Leakage

After you have carried out any maintenance or repair work on the fluid system, test the pump for leakage.

1. Close the pump outlet with a fitting plug. (Appropriate fitting plugs are provided in the accessories kit of the pump.)
2. In Chromeleon, set the upper pressure limit under **[Pump Device Name] > Pressure > UpperLimit**. For information about the [Pump Device Name], see page 49.
3. In Chromeleon, select a flow rate of, for example, 50 µL/min.
4. Decrease the flow to 10-20 µL/min as soon as the pressure builds up to 80-90 MPa.
5. Have the pump deliver some µL/min until a pressure of 100 MPa has built up.
6. When this pressure has been built up and when the pump delivers a master flow of 1 µL/min, the pressure should increase or remain constant at least. If it does not or if you notice a leakage after approximately 15 minutes, consider retightening the compression lid screw a little bit more. Repeat the test starting with step 1. If the leakage still exists, proceed with step 7.
7. Find and eliminate the cause for the leak, and then perform the test described under this list. Possible sources are:

   - *Capillary connections*
     Inspect them for signs of leakage and tighten leaking connections.
   - *Piston seals*
     - Inspect the piston seals for leakage (→ page 109).
     - Consider replacing the piston seals (→ page 118).
   - *Check valve cartridges*
     - Remove the valve cartridges and clean them (→ page 128).
     - Consider replacing the valve cartridges (→ page 124).
   - *Purge unit*
     - Inspect the purge valve knob and purge unit for indications of leakage.
     - Consider replacing the purge unit (→ page 125).

Check

a) Build up pressure in the pump. This is the best way to identify a leaking connection.

b) Allow 5 minutes for the pump to stabilize. This is important as the pressure drops faster during the first 5 minutes, because the seals and other components have to adjust the pressure.

c) After the stabilization time, monitor the pressure drop.

d) Tighten the connection a little more tight. The pressure will suddenly increase a little.

e) Monitor if the pressure drops at the same rate as before. If the pressure drops significantly slower, the connection was leaking.

8. In Chromeleon, reset the upper pressure limit to the value used before the leak test.

Tip: If leakage from a pump head is observed, check also the tubing connected to the rear seal wash system. If the seal wash tubing is not connected properly, or if the tubing is crimped or kinked, the liquid may leak into the pump.

7.6 Vacuum Degasser (Rinsing the Degassing Channels)

To avoid contamination of the degasser, you should prepare fresh solvents, clean the solvent supply lines, and rinse the degassing channels at regular intervals.

Rinsing the degassing channels is especially important for the channel that degasses aqueous solvents (for reverse-phase chromatography).

Usually, it is sufficient to rinse all channels with organic solvent. (Use a fresh bottle.) When you use water and acetonitrile or methanol, it is usually sufficient to rinse the degassing channels once per week.

However, adapt the rinsing intervals to the solvents in use. In persistent cases, for example, reproducible ghost peaks in the chromatogram, follow these steps:

1. Install a backpressure capillary on the pump outlet. The capillary should be appropriate for generating a backpressure of 20 to 30 MPa.
2. Rinse the degassing channels for 1 hour with about 20% nitric acid at the flow rate normally used for your application. Use fresh HPLC grade water.
3. Rinse the degassing channels with fresh HPLC grade water until the pH value is neutral.
4. Rinse the degassing channels for two hours with fresh acetonitrile at the flow rate normally used for your application.
5. Prepare fresh solvents for your application (using new bottles) and connect them to the degassing channels.
6. Install new solvent lines with filter frits.
7. Uninstall the backpressure capillary and reconnect the system as required by your application.
8. Equilibrate the system (→ page 66).

7.7 Replacing the Main Power Fuses

Warning: Turn off the pump. Disconnect the power cord from its source.

Avertissement: Avant de remplacer les fusibles, arrêtez la pompe. Assurez-vous de bien débrancher le cordon d'alimentation de la source secteur.

1. Remove the fuse cartridge, using a small screwdriver.

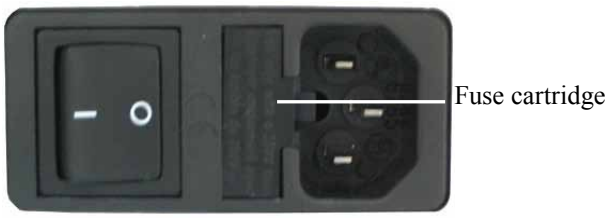


Fig. 65: Fuse cartridge

2. Replace the fuses.

   Warning: Always install two fuses. Use only the fuses indicated in the following table.

   Avertissement: Installez toujours deux nouveaux fusibles. Utilisez uniquement les fusibles indiqués ci-dessous.

Description	Part No.
Fuse, 2A, slow-blow (5 x 20 mm)	Included in the Fuses Kit, part no. 6030.9003 For information about the kit, see section 9.3 (→ page 140).

3. Reinstall the fuse cartridge.
4. Reconnect the power cord to its source. Turn on the power to the pump.

7.8 Updating the Pump Firmware

The pump is shipped with the most recent firmware version. If a newer version of the firmware is available, the **Thermo Fluspeed Series Pump Firmware Upgrade Wizard 2.0** is required to update the firmware.

Before performing a firmware update, check the firmware version installed in the pump. The firmware version is displayed in the **Commands** (F8) dialog box in Chromeleon, at the Expert display filter level.

⚠ **Important:** To ensure that the update is successful, make sure that the communication between the pump and the computer is *not* interrupted during the update and that you do *not* turn off the pump.

⚠ **Important:** Au cours du téléchargement, assurez-vous que la communication entre la pompe et Chromeleon n'est pas interrompue et n'arrêtez pas l'instrument. Ceci peut entraîner des dysfonctionnements de l'instrument.

Installing the Wizard

The installation file for the wizard is available on the Chromeleon CD (Thermo Tools\LPG-3400XRS Firmware Upgrade Tool).

1. Double-click the **readme.txt** file and follow the instructions.

   Tip: Leave the **readme.txt** file open to assist you during the firmware update.

2. Double-click the "fpfuw" file (.exe extension) to install the Firmware Upgrade Wizard. For the exact file name, see the **readme.txt** file.

3. Follow the instructions in the installation wizard.

4. When the installation has been successful, click **Finish** to close the installation wizard.

Upgrading the Pump Firmware

1. Before you begin, verify that

   - The USB connection between the pump and the computer is established.
   - The pump is unpressurized (for example, the purge valve is open) and the flow is turned off.
   - The Chromeleon server is stopped. All processes on the Chromeleon server PC and in Chromeleon have been stopped.

2. In the Windows Start menu, under programs, open the Thermo Fluspeed Pump Firmware Upgrade Wizard. Follow the instructions provided in the wizard.

3. On the **Select Pump** page, the pump is identified automatically. If two or more pumps are connected to the computer with which you perform the update, select the desired pump.
4. On the **Select Action** page, select **Upgrade firmware**.
5. On the **Parameters** page, select the firmware update file. The file is located in the Chromeleon installation folder, under "\bin\DDK\V1\Drivers\Thermo\Ultimate\LPG3400XRS". For further information on the path, see the **readme.txt** file.
6. The wizard now performs the firmware update. Follow the instructions given in the wizard during the update.
7. When the firmware update is successful, click **Finish** to close the wizard.

   If the firmware update was not successful, check if the pump is still in boot loader mode (Standby button is flashing). If the pump is still in boot loader mode, push the Standby button to switch off the mode. Repeat the firmware update procedure. If the firmware update is still not successful, contact Thermo Fisher Scientific Service for Dionex HPLC Products.

8 Technical Information

Operating principle	Serial dual-piston pump
Compressibility compensation	Fully automated, independent of the composition of the mobile phase
Flow rate range **Recommended** **Settable**	 10 - 2,000 µL/min 1 - 2,000 µL/min
Flow rate accuracy	+/- 0.5 % or 1 µL/min, whichever is greater
Flow rate precision	< 0.05 % RSD or < 0.01 min SD, whichever is greater
Pressure range	2 - 125 MPa (18037 psi)
Pressure ripple	Typically < 1 % or < 0.2 MPa, whichever is greater
Gradient formation	Low-pressure gradient proportioning
Proportioning accuracy	± 0.5 % (of full scale)
Proportioning precision	< 0.15 % SD
Number of solvents	4
Gradient delay volume	Minimum of 200 µL (by default 200 µL; with optional dynamic mixer 235 µL or 275 µL, depending on the mixer)
Solvent degassing	4 degassing channels Max. flow rate 10 mL/min Degassing capacity ~2 ppm residual gas at 1 mL/min Delay volume per channel ~480 µL
Biocompatibility	No
Weight	15.8 kg
Dimensions	20 x 42 x 51 cm (h x w x d)
PC connection	All functions controllable via USB (USB 2.0) or RS-232
I/O Interfaces	8-pin I/O terminal connector
Safety features	Leak sensor, active rear seal wash system, excess pressure monitoring
User input/display	LCD indicating system parameters Standby button 3 LEDs (Power, Connected, and Status) for status monitoring
GLP features	In Chromeleon: Support of automatic equipment qualification (AutoQ™ routines) and System Wellness monitoring. All system parameters are logged in the Audit Trail.

Wetted parts	Stainless steel, titanium, sapphire, aluminum oxide (Al2O3), PEEK™, PTFE, FEP, UHMW polyethylene, perfluoro-elastomer, nickel/molybdenum alloy, ruby
Power requirements	100-115V, 60 Hz; 200-240V, 50 Hz; max. 220 VA; 1,9A @115V, 1,0A@230V
Emission sound pressure level:	< 70 dB(A) in 1-m-distance
Environmental conditions	Range of use: Indoor use; temperature: 5 to 35 °C (50 to 95°F); air humidity: 80% relative humidity, non-condensing; overvoltage category: II; pollution degree: 2

Technical information: September 2013

All technical specifications are subject to change without notice.

9 Accessories, Consumables, and Spare Parts

Accessories, spare parts, and consumables for the pump are always maintained at the latest technical standard. Therefore, part numbers are subject to alteration. However, updated parts will always be compatible with the parts they replace.

9.1 Standard Accessories

Description	Part No.	Quantity in the kit
Accessories kit for the LPG-3400XRS pump, including		
Solvent supply lines with filter frits (SST, porosity: 20 µm)	6043.8109	4
Viper capillary kit for UltiMate 3000 XRS system with LPG-3400XRS pump, including 1 capillary (0.1 x 350 mm (I.D. x L), SST, Viper) e.g. to connect the WPS-3000TXRS to the TCC-3000RS (column inlet) 1 capillary (0.13 x 550 mm (I.D. x L), SST, Viper e.g. to connect the pump to the WPS-3000TXRS (top-down stack configuration) 1 capillary (0.065 x 250 mm (I.D. x L), PEEK, Viper e.g. to connect the TCC-3000RS (column outlet) to the detector	6043.2301	1
Rear seal wash system kit, including 1 tubing, silicone (1/8" O.D. x 1/16" I.D., 70 mm) 1 tubing, silicone (1/8" O.D. x 1/16" I.D., 2 m) 1 tubing, FEP (1/8" O.D. x 1/16" I.D., 2 m) 1 tubing, silicone (1/8" O.D. x 1/16" I.D., 257 mm) 1 ferrule, flangeless (ETFE, 1/8" O.D.) 1 nut, flangeless (PEEK, 1/8" O.D.) 1 filter frit (SST, 20 µm) 1 seal wash reservoir 100 mL, with cap and cap plug (for tapered hole) 10 labels for seal wash tubing, red	6043.0056	1
USB cable, type A to type B mini USB, high speed 2.0, 5 m	6911.0008	1
Luer-Lok adapter, PE, 1/16" O.D.	n.a.	
8-pin I/O terminal connector	n.a.	1
Fuse, 2A, slow-blow (5 x 20 mm)	Included in 6030.9003	2
Tool for proportioning valve bayonet-type connectors	6043.0061	1

Description	Part No.	Quantity in the kit
Components for UltiMate 3000 system drainage: Cable clips (self-adhesive) Y piece T piece Elbow Connecting tube Drain tubing Installation instructions	Included in 6040.0005	 4 5 4 12 1 6 m 1
HPLC Troubleshooting Guide Poster	6040.0050	1
Plastic syringe (12 mL)	Included in 6000.0010	1 syringe
Sealing plug for eluent bottles	Included in 6000.0042	2
Signal mini DIN cable, 6-pin	6000.1004	1
Ball-head screwdriver, size 4 mm	n.a.	1
Hexagon socket wrench, size 4 mm	n.a.	1
Syringe, 20 mL, disposable	n.a.	1
Seal handling tool	6043.7158	1

9.2 Optional Accessories

Description	Part No.
Capillaries, kit of capillaries, for UltiMate 3000 systems with standalone OAS-3x00TXRS The kit includes the following Viper capillaries for connecting UltiMate 3000 modules in a system with a standalone OAS-3x00TXRS: 4 Viper capillaries, stainless steel (1 each of 0.10 x 65 mm, 0.10 x 250 mm, 0.13 x 750 mm, and 0.18 x 750 mm (I.D. x L)	6845.2301A
Dynamic mixer, mixing volume 35 µL	Contact Service.
Dynamic mixer, mixing volume 75 µL	Contact Service.
Signal synchronization cable from pump to Corona or Coulochem III detector	6043.0003
UltiMate 3000 SR-3000 Solvent Rack	5035.9200

9.3 Consumables and Spare Parts

The part number always refers to the packing unit. Unless otherwise stated, the packing unit is 1 unit. For more information, contact the Thermo Fisher Scientific sales organization for Dionex HPLC Products.

Description	Part No.
Bottle cap (4 caps) for seal wash and solvent reservoirs (including caps to close the holes in the bottle cap)	6270.0013
Capillaries, set of capillaries including 4 capillaries from degasser outlet to proportioning valve 2 capillaries, silicone (1/8" O.D. x 1/16" I.D., 70 mm) 1 capillary, FEP (3 mm O.D. x 2 mm I.D., 120 mm) 1 connector	6043.0015
Capillaries, Viper, for UltiMate 3000 XRS system with LPG-3400XRS pump *A - Viper capillaries* Capillary (0.1 x 350 mm I.D. x L), SST, Viper e.g. to connect the WPS-3000TXRS to the TCC-3000RS (column inlet) Capillary (0.13 x 550 mm I.D. x L), SST, Viper e.g. to connect the pump to the WPS-3000TXRS (top-down stack configuration) Capillary (0.065 x 250 mm I.D. x L), PEEK, Viper e.g. to connect the TCC-3000RS (column outlet) to the detector *B - Viper capillary kit* Viper capillary kit for UltiMate 3000 XRS System with LPG-3400XRS pump	 6040.2235 6040.2305 6041.5625 6043.2301
Check valve cartridge (identical for inlet valve nut and outlet valve nut)	6043.0145
Drain kit for UltiMate 3000 systems The kit includes all required components and detailed installation instructions.	6040.0005
Fitting plug (Viper, SST)	6040.2303
Fuses kit, including: 15 fuses, overload protection (2A, slow-blow, 5 x 20 mm) 5 fuses (0.20A slow-blow, 5 x 20 mm) 5 fuses (4A, slow-blow, 6.3 x 32 mm) 2 fuses (4A, slow-blow, 5 x 20 mm) *Note:* Use only the slow-blow fuses rated at 2A (5 x 20 mm) with the pump.	6030.9003
HPLC Troubleshooting Guide Poster	6040.0050
Maintenance kit, including Silicone tubing (O.D. 280 x I.D. 130 mm, 0.35 m) 2 check valve cartridges 2 piston retaining springs 2 primary piston seals 2 secondary piston seals	6043.1954
Piston retaining springs with 2 springs	6043.0303

Description	Part No.
Piston seals set, reversed phase 2 primary piston seals 2 secondary piston seals	6043.0295
Piston, sapphire, 2 pistons	6043.0169
Power cord, Australia, China	6000.1060
Power cord, Denmark	6000.1070
Power cord, EU	6000.1000
Power cord, India/SA	6000.1090
Power cord, Italy	6000.1040
Power cord, Japan	6000.1050
Power cord, Switzerland	6000.1030
Power cord, UK	6000.1020
Power cord, US	6000.1001
Seal handling tool	6043.7158
Tool for proportioning valve bayonet-type connectors	6043.0061
USB cable, type A to type B mini USB, high speed 2.0, 5 m	6911.0008
Valve cartridge, check valve → Check valve, valve cartridge	

10 Reference Information

10.1 Chemical Resistance of PEEK

PEEK has superb chemical resistance to most organic solvents. However, it tends to swell when in contact with trichlormethane ($CHCl_3$), dimethyl sulfoxide (DMSO), or tetrahydrofuran (THF). In addition, it is attacked by concentrated acids, such as, sulfuric acid and nitric acid or a mixture of hexane, ethyl acetate, and methanol. Swelling or attack by concentrated acids is not a problem with brief flushing procedures.

For information about the chemical resistance of PEEK, see the table.

Medium	**Concentration [%]**	**Temperature**	**Maximum Duration (Days)**	**Resistance (+ = yes; - = no)**
Acetaldehyde	techn. pure	23		+
Acetic acid	96	23	7	+
Acetone	100	23	7	+
Ammonia	28	23	7	+
Ammonium sulphate		23		+
Amyl acetate	100	23		+
Amyl alcohol	techn. pure	23		+
Benzaldehyde		23	7	+
Benzene	100	23	7	+
Benzene/Benzene mixture		60	42	+
Benzoic acid		23		+
Borax		60		+
Bromine		23		-
Butane		23		+
Butanol	100	23		+
Calcium hydroxide		23		+
Carbon dioxide	100	23		+
Carbon tetrachloride	100	23		+
Chloric gas		23		+
Chlorine (liquid)		23		-
Chlorobenzene	100	23		+
Chloroform (trichlormethane)	100	23		+
Chromic acid	40	23		+

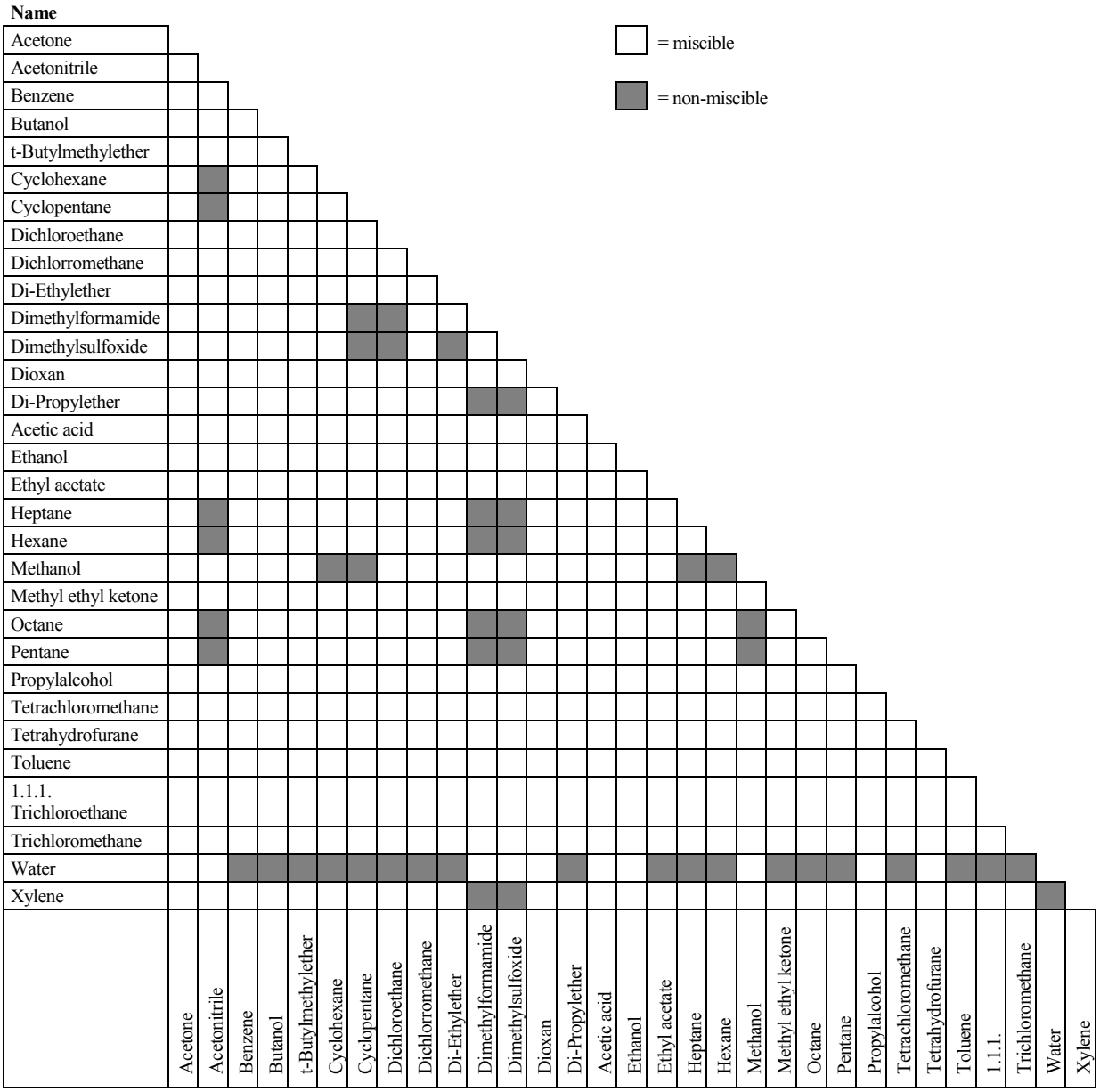
Medium	Concentration [%]	Temperature	Maximum Duration (Days)	Resistance (+ = yes; - = no)
Citric acid		23		+
Copper sulphate		23		+
Cyclohexane	100	23		+
Cyclohexanol	100	23		+
Cyclohexanone		23		+
Diethyl ether	100	23	7	+
Diisopropyl ether	100	23		+
Dimethylformamide	100	23	7	+
Dioctylphthalate		23		+
Dioxan		23		+
Ethanol	96 (Vol.)	23	7	+
Ethyl acetate	100	23		+
Ethylene glycol		23		+
Ferric chloride		23		+
Formaldehyde	30	23		+
Formic acid	95	104	42	+
Glycerin		23		+
Heptane	100	23	7	+
Hydrochloric acid	37	23		+
Hydrofluoric acid		23		-
Hydrogen peroxide	30	23	7	+
Lactic acid		23		+
Magnesium chloride		23		+
Methanol	100	23		+
Methyl ethyl ketone	100	23		+
Methyl isobutyl ketone	100	23		+
Nitric acid	40	23	7	+
Nitric acid	65	23	7	+
Nitrobenzene	100	23		+
Paraffin oil		60		+
Paraffin oil		23		+
Perchlorethylene	100	23		+
Phenol	diluted	23		+

Medium	Concentration [%]	Temperature	Maximum Duration (Days)	Resistance (+ = yes; - = no)
Phenol	Concentrated	23		-
Potassium dichromate		23		+
Potassium hydroxide		23		+
Potassium nitrate		23		+
Potassium permanganate		23		+
Propane		23		+
Propyl alcohol		100		+
Pure benzene		60		+
Silicone oil		160		+
Sodium chloride		23		+
Sodium hydrogen carbonate		23		+
Sodium hydroxide	40	23	7	+
Sodium hydroxide	30	130		+
Sodium thiosulphate		23		+
Sulphur dioxide		23		+
Sulphur dioxide		23		+
Sulphuric acid	40	130		+
Sulphuric acid	50	23	7	+
Sulphuric acid (dissolved)	98	23		-
Toluene	100	23	7	+
Trichlormethane (chloroform)	100	23		+
Trichloroethylene	100	23	7	+
Water		23		+
Xylene	100	23		+
Zinc chloride		23		+

10.2 Solvent Miscibility

Miscibility describes the ability of liquids to form homogeneous mixtures in all proportions (one-phase system). Solvent miscibility is important during elution and when changing from one solvent to another. Thus, when you prepare solvents consider the miscibility and homogeneous mixing of the single components. Note that certain compositions of some solvent systems may result in miscibility gaps.

For information about solvent miscibility, see the table (source: Handbuch der HPLC, GIT Verlag, 1995). The table provides a general idea of solvent miscibility. Under certain conditions, non-miscible liquids may mix or miscible liquids may separate.



10.3 Properties of Common Solvents

The table summarizes the properties of the most important solvents in HPLC [1, 2]

	Acetronitrile	Dichloromethane	n-Hexane	Isopropanol	Methanol	Tetrahydrofurane	Water
UV Transmission at [nm]							
20% (0.7 AU)	190	235	200	210	210	255	--
80% (0.1 AU)	195	245	225	230	235	370	--
98% (0.01 AU)	220	260	260	260	260	310	< 190
Refraction Index (RI) at 20 °C	1.344	1.424	1.376	1.378	1.329	1.406	1.333
Boiling Point (BP) in °C at 1013 hPa	82	40	69	82	65	66	100
Vapor Pressure (VP) at 25 °C	118	582	202	60	169	216	32
Viscosity (η) at 20 °C (cP = mPa*s)	0.37	0.44	0.33	2.3	0.60	0.55	1.00
Density (ρ) (g/mL)	0.78	1.32	0.66	0.78	0.79	0.88	0.997
η/ρ (cP*mL/g)	0.47	0.33	0.50	2.9	0.76	0.62	1.00
Compressibility (χ) at 20 °C ($MBar^{-1}$)	99	97	160	100	123	93	46
Critical Flow F_c (mL/min) [1)]	13	9.4	14	83	21	18	28
Linear Drop in Pressure Δp/l (MPa/m) 2)	0.06	0.08	0.06	0.40	0.10	0.10	0.17
Polarity (P') [3)]	5.8	3.1	0.1	3.9	5.1	4.0	10.2

[1)] F_C = critical flow for 0.25 mm I.D. tubing
F_C (mL/min) = 113 x 0.25 mm x η (cP) / ρ (g/mL)
F_C is an example of a hydrodynamic calculation.

2) Δp/l = linear drop in pressure for 1 mL/min and 0.25 mm I.D. tubing
Δp/l (MPa/m) = 6.8×10^{-6} x 1 mL/min x 100 cm x η (cP) / $(0.25\ mm)^4$
Δp/l is an example of a hydrodynamic calculation.

[3)] P' is the polarity calculated by L.R. Snyder [3] from experimental measurements by L. Rohrschneider [4].

References

[1] K.K. Unger, E. Weber (Hrsg.), *Handbuch der HPLC*, GIT Verlag, 1995
[2] D.R. Lide, *Handbook of Chemistry and Physics*, 79th Edition, CRC Press, 1998-1999
[3] L.R. Snyder, *Journal of Chromatographic Sciences*, 16, 223, 1978
[4] L. Rohrschneider, *Analytical Chemistry*, 45, 1241, 1973

10.4 Safety Information about Flammable Solvents

The following table provides an overview of safety information for flammable solvents in HPLC

	Acetonitrile	Diethyl ether	Ethanol	Ethyl acetate	Heptane	Hexane	Isopropanol	Methanol	Tetrahydro-furane
Boiling point (°C)	82	35	78	77	98	69	82	65	66
Vapor pressure (hPa)	118	735	93	121	55	202	60	169	216
Flash point (°C)	6	-45	12	-4	-4	-22	12	11	-14
Auto-ignition temperature (°C)	520	190	490	490	230	260	540	510	320
Explosion Limits (%)	3-16	2-36	3-19	2-36	1-7	1-8	2-12	7-36	2-12

The table is based on the following definitions and references.

Definitions

- The flash point is the lowest temperature at an atmospheric pressure of 1013 mbar at which a liquid gives off enough vapors to ignite with an external ignition source when mixing with the air above the liquid.[1]
- Substances whose flash point is below 38 °C are classified as flammable.[2]
- The auto-ignition temperature is the lowest temperature at which substances can self-ignite at atmospheric pressure without an external ignition source, that is, without external ignition by sparks or flames. The thermal energy required to reach the auto-ignition temperature is created by a spontaneous chemical reaction or physical processes in or on the surface of the combustible substances. The determination of the auto-ignition temperature is imprecise and depends on the equipment and apparatus in use. Nevertheless, it indicates the maximum permissible surface temperature of equipment and apparatus when they are exposed to an air-vapor mixture of these substances. [1, 2]
- The explosion limit are the upper and lower concentration limits of a mixture of a flammable gas or vapor with air in which this mixture can explode when being heated or by means of sparks. [1]

Tip: Volatile solvents are not necessarily flammable as well. For example, chloroform is volatile but non-flammable.

References

[1] Otto-Albrecht Neumüller, *Römpps Chemie-Lexikon*, 8. Auflage, 1987

[2] W.E. Baker et al., *Explosion Hazards and Evaluation*, Elsevier Sci. Publ., 1983

[3] H. Bennett, *Concise Chemical and Technical Dictionary*, Edward Arnold Ed., 1986

[4] D.R. Lide, *Handbook of Chemistry and Physics*, 79th Edition, CRC Press, 1998-1999

[5] G.W.C. Kaye and T.H. Laby, *Tables of Physical and Chemical Constants*, 16th Edition, Longman Ed., 1995

[6] Union des Industries Chimiques, *L'Electricité Statique en Atmosphère Explosive*, Septembre 1982

[7] B.P. Mullins, *Spontaneous Ignition of Liquid Fuels*, Butterworths Ed., 1955

[8] Chemical Safety Sheets, *Working Safely with Hazardous Chemicals*, Kluwer Acad. Publ., Samson Chem. Publ., Dutch Inst. for the Working Environment, and Dutch Chem. Ind. Assoc., 1991

[9] F.A. Williams, *Combustions Theory*, Benjamin / Cummings Publ., 1985

11 Appendix – Digital I/O (Pin Assignment)

The Digital I/O port of the pump is an 8-pin I/O terminal connector, which provides two TTL inputs and three digital outputs that can be used to exchange digital signals with external devices. To connect an external device to the Digital I/O port on the rear panel, use the appropriate cable with an 8-pin I/O terminal connector.

The two inputs and one digital output are assigned as follows:

- One input is assigned to the connection to an autosampler of the UltiMate 3000 XRS series (Pin 4, "Injected"). It is also assigned **Pump_Input_1** in Chromeleon. For further information, refer to page 51.
- One input is assigned to the connection to a Corona or Coulochem III detector (Pin 3). It is also assigned **Pump_Input_2** in Chromeleon. For further information, refer to page 51.
- One digital output is assigned to the StrokeSync function (Pin 6). This output is used for the pump stroke synchronization between the pump and autosampler of the UltiMate 3000 XRS series.

The tables in this section describe the functions assigned to the pins and the color and label of the respective cables used to connect the pump in an UltiMate 3000 system using the Digital I/O.

When you connect wires to the 8-pin I/O terminal connector, mind the correct orientation of the connector. Pin 1 starts always on the left side with the screws pointing upward. Be sure that the wires with the correct colors are inserted into the correct pins.

For further information about connecting the respective cables to the Digital I/O, refer to page 37.

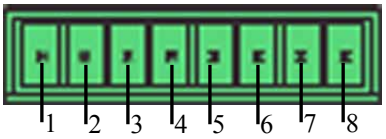


Fig. 66: Digital I/O port on the pump

Pin	Signal Name	Pin	Signal Name
1	GND	5	Pump ready (out)
2	5V	6	Stroke sync (out)
3	Pump stop (in)	7	GND
4	Injected (in)	8	No flow (out)

Pin Assignment: WPS-3000TXRS Autosampler to the Pump

To connect the pump to a WPS-3000TXRS autosampler, use the signal cable (part no. 6000.1004) and connect it to the separate 8-pin I/O terminal connector from the accessories kit of the pump. Insert the wires of the signal cable into the pins of the terminal connector as shown in the table below.

Pump: 8-pin Digital I/O terminal		**WPS-3000TXRS: Pin and signal cable assignment**	
Pin	**Signal Name**	**Wire Color**	**Signal Name**
6	Stroke sync (out)	yellow	Stroke sync (out)
7	GND	green	GND

Fig. 67: Pin assignment from WPS-3000TXRS to pump

Pin Assignment: Corona or Coulochem III Detector to the Pump

To connect the pump to a Corona or Coulochem III detector, use the signal synchronization cable (part no. 6043.0003) and connect it to the separate 8-pin I/O terminal connector from the accessories kit of the pump. Insert the wires of the signal synchronization cable into the pins of the connector as shown in the table below.

Pump: 8-pin Digital I/O terminal		**Corona/Coulochem III: Pin and Signal synchronization cable assignment**			
Pin	**Signal Name**	**Wire Color**	**Signal Name Corona**	**Wire Color**	**Signal Name Coulochem III**
1	GND	green	Pump off - (out)	white	Cell off- (in)
3	Pump stop	yellow	Pump off + (out)		
8	No flow			brown	Cell off+ (in)

Fig. 68: Pin assignment with Corona or Coulochem III detector

Connecting a WPS-3000TXRS autosampler in addition

To connect a WPS-3000TXRS autosampler in addition to the detector to the pump, also use the signal cable (part no. 6000.1004). Insert the wires of the signal synchronization cable to the 8-pin I/O terminal connector and additionally insert the wires of the signal cable as shown in Fig. 67.

Connecting an OAS-3x00TXRS autosampler in addition

To connect an OAS-3x00TXRS autosampler in addition to the detector to the pump, connect the signal synchronization cable (part no. 6043.0003) to the 8-pin I/O terminal connector on the synchronization cable (part no. 6043.0002) as shown in the table below.

Make sure that the wires of the synchronization cable stay in the correct pins while inserting the wires of the signal synchronization cable from the detector.

Pump: 8-pin Digital I/O terminal		**Sync. Cable**	**Corona/Coulochem III: Pin and signal synchronization cable assignment**			
Pin	**Signal Name**	**Wire Color**	**Wire Color**	**Signal Name Corona**	**Wire Color**	**Signal Name Coulochem III**
1	GND	yellow	green	Pump off – (out)	white	Cell off- (in)
3	Pump stop		yellow	Pump off + (out)		
4	Injected (in)	white				
6	Stroke sync (out)	brown				
7	GND	green				
8	No flow				brown	Cell off+ (in)

Fig. 69: Pin assignment from OAS-3x00TXRS and Corona/Coulochem III detector to pump

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