# LPG-3000 Series

## Micro Pumps

### for the UltiMate 3000 System

## Operating Instructions


Revision: 2.1
Date: September 2005



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# Declaration of Conformity

**Product:** Pump
**Types:** **LPG-3300M** and **LPG-3300MB**
**LPG-3600M** and **LPG-3600MB**

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

- Low-Voltage Equipment Directive 73/23/EEC
  changed by 93/68/EEC
- EMC Directive 89/336/EEC
  changed by 91/263/EEC; 92/31/EEC; 93/68/EEC

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

- EN 61010-1: 2002
  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 standards:

- EN 61000-6-3: 2001
  Electromagnetic Compatibility (EMC) - Generic emissions standard
  Part 1: Residential, commercial and light industry
- EN 61000-6-1: 2001
  Electromagnetic Compatibility (EMC) - Generic immunity standard
  Part 1: Residential, commercial and light industry
- EN 61000-3-2: 2001
  Electromagnetic Compatibility (EMC)
  Limits for harmonic current emissions
- EN 61000-3-3: 2002
  Electromagnetic Compatibility (EMC)
  Limitation of voltage fluctuation and flicker

This declaration is issued for the manufacturer

Dionex Softron GmbH
Dornierstrasse 4
D-82110 Germering

by the President, Dr. Peter Jochum. August 19,2005

# Certificate

TÜV

**Certificate no.** CU 72051793 01

**License Holder:**
Dionex Softron GmbH
Dornierstr. 4

82110 Germering
Germany

**Manufacturing Plant:**
Dionex Softron GmbH
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Germany

**Test report no.:** USA-PSM 30581482 001 **Client Reference:** Burkhard Seyferth

**Tested to:** UL 61010-1:2004
CAN/CSA-C22.2 61010-1:2004

**Certified Product:** HPLC Pump **License Fee - Units**

Model Designation: LPG-3000, LPG-3300, LPG-3600, LPG-3800 7

Rated Voltage: AC 100/120/220/240V, 50-60Hz
Rated Power: 136VA
Protection Class: I
Rated Ambient Temperature: 35°C max.

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Appendix: 1, 1-2

**Licensed Test mark:**

TUV Rheinland of North America, Inc. C US

**Signatures**

Stephan Schmitt
President

Dipl.-Ing. M. Raap
QA Certification Officer

**Date of Issue (day/mo/yr)**
11/07/2005

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# Table of Contents

# 1 Introduction

## 1.1 General

When working with analytical instrumentation, you should know the potential hazards of using chemical solvents.

To avoid the possibility of personal injury and/or damage to the instrument, observe the General Safety Precautions (→ page 2).

## 1.2 How to Use This Manual

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

Almost all descriptions in the manual apply to all pump models in the LPG-3000 pump series and cover both the standard (stainless steel) and biocompatible pumps. Therefore, the term "the pump" is used throughout the manual. If some detail applies to only one model or version, the model (version) is identified by name. If only the pump name, e.g. LPG-3600, is used, the information applies to all pump versions (i.e., LPG-3600M and LPG-3600MB).

**Note:** The device configuration may vary; therefore, not all descriptions necessarily apply to your particular instrument.

**Note:** The descriptions in this manual refer to firmware version 2.70 and Chromeleon 6.70.

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

**Please note:** Indicates general information intended to optimize the performance of the instrument.

**Important:** Indicates that failure to take note of the accompanying information may result in damage to the instrument.

**Important:** Indique que ne pas tenir compte de l'information jointe peut 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.

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## 1.3 General Safety Precautions

**Please note:** Before initial operation of the pump, make sure that you are familiar with the contents of this manual.

**Please note:** Observe any warning labels on the device and refer to the related sections in these operating instructions.

**Please note:** For the general safety precautions in French, refer to Consignes Générales de Sécurité (→ page 4).

Please observe the following general safety precautions when operating the instrument or carrying out any maintenance work:

- Install the HPLC system in a well-ventilated laboratory. If the mobile phase includes volatile or flammable solvents, do not allow them to enter the workspace.
- For minimum interference effects, all components of the analytical system should be connected to the same mains output (same phase).
- 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.
- The front panel tilts upward. To prevent damage to the pump when lifting or moving, always lift by the bottom or sides of the unit.
- Do not place any heavy objects on the open front panel door. This may damage the door.
- Always set a lower pressure limit for the HPLC pump. This prevents damage resulting from leakage or from running the pump dry.
- Never run the pump dry! Damage to the pistons or the piston seals could result.
- Dionex advises against recycling the solvent(s). This may impair the performance of the seals.

- When connecting the capillaries, make sure that the connectors are free from contaminants. Even minute particles may cause damage to the system (e.g., flow splitter, flow control valve, and column).
- After operation, rinse out buffers and solutions that form peroxides.
- 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!
- 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
- If you use solvents with a high salt content, do not operate the pump without rear-seal washing for a longer time (> 5 minutes). This may cause damage to the piston seals and the piston (→ Active Rear-Seal Wash System, page 31). Regularly exchange the liquid in the liquid reservoir of the rear-seal wash system (at least once a week).
- Always use the filters recommended by Dionex to prevent particulate matters from entering the HPLC system. Using other filters may considerably affect the system performance.
- If the mobile phase includes volatile or flammable solvents, avoid open flames and sparks.
- If a leak occurs, turn off the instrument and remedy the situation immediately.
- When the panels are removed, dangerous electrical connections will be exposed. Disconnect the pump from all power sources before removing the panels. The enclosure should be opened by authorized service personnel only.
- Always replace blown fuses with original spare part fuses from Dionex (→ Replacing the Fuses, page 88).
- Replace faulty power cords and communication cables.
- Many organic solvents and buffers are toxic. Know the toxicological properties of all mobile phases that you are using.
- The toxicological properties of many samples may not be well known. If you have any doubt about a sample, treat it as if it contains a potentially harmful substance.
- Wear goggles when handling mobile phases or operating the instrument. An eye wash facility and a sink should be close to the unit. If any mobile phase splashes on the eyes or skin, wash the affected area and seek medical attention.
- Dispose of all waste mobile phase in an environmentally safe manner that is consistent with all local regulations. Do not allow flammable and/or toxic solvents to accumulate. Follow a regulated, approved waste disposal program. Never dispose of flammable and/or toxic solvents through the municipal sewage system
- In an UltiMate 3000 system, some tubing is made of PEEK. While this polymer has superb chemical resistance to most organic solvents, it tends to swell when it is 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 (swelling or attack by acid is not a problem with brief flushing procedures).

- Do not use PEEK tubing that is stressed, bent, or kinked.
- Before interrupting operation for several days or more, observe the precautions in Shutting Down the Pump (→ page 90).
- Use original Dionex spare parts only. Substituting non-Dionex parts or using non-Dionex accessories may impair the performance of the instrument.
- Do not use the pump in ways other than those described in this manual.

## 1.4 Consignes Générales de Sécurité

**Veuillez noter:** Avant de commencer à utiliser la pompe, assurez-vous que vous vous êtes familiarisés avec le contenu de ce manuel.

**Veuillez noter:** Observez des étiquettes d'avertissement sur l'appareil et référez-vous aux sections correspondantes dans ce mode d'emploi.

Veuillez observer les consignes générales de sécurité suivantes lorsque vous utilisez l'instrument ou que vous procédez à des opérations de maintenance:

- Installez le système HPLC dans un laboratoire bien ventilé. Si la phase mobile contient des solvants volatils ou inflammables, empêchez qu'ils ne pénètrent dans l'espace de travail.
- Afin d'éviter au maximum les interférences, tous les éléments du système analytique doivent être raccordés à la même ligne secteur (même phase).
- 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.
- Le panneau avant bascule vers le haut. Afin d'éviter d'endommager la pompe lorsque que vous la soulevez ou la déplacez, saisissez-la toujours par le bas ou les côtés de l'unité.
- Ne placez aucun objet lourd sur la porte ouverte du panneau avant. Ceci pourrait endommager la porte.
- Réglez toujours une limite de pression minimum pour la pompe HPLC. Ceci prévient les dommages résultant de fuites ou du fonctionnement à sec de la pompe.
- Ne faites jamais fonctionner la pompe à sec! Il peut en résulter des dommages aux pistons ou aux joints de piston.
- Dionex déconseille de recycler les solvants. Ceci peut nuire aux performances des joints.
- Lorsque vous connectez les capillaires, assurez-vous que les raccords sont exempts de tout contaminant. Même d'infimes particules peuvent causer des dommages au système (ex. diviseur de débit, vanne de régulation de débit et colonne).
- 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 de la pompe à l'eau dé-ionisée.
- 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 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.
- Si vous utilisez des phases mobiles avec une forte teneur en sel, ne faites pas fonctionner la pompe sans rinçage du joint arrière pendant un temps prolongé (> 5 minutes). Ceci peut endommager les joints de piston et le piston (→ Active Rear-Seal Wash System, page 31). Remplacer régulièrement le liquide dans le réservoir du système de rinçage du joint arrière (au moins une fois par semaine).
- Utilisez toujours les filtres recommandés par Dionex afin d'empêcher les particules étrangères d'entrer dans le système HPLC. Utiliser d'autres filtres peut affecter considérablement les performances du système.
- Si la phase mobile contient des solvants volatils ou inflammables, évitez les flammes nues et les sources d'étincelles à proximité.
- Si une fuite survient, arrêtez l'instrument et résolvez le problème immédiatement.
- Quand les capots sont démontés, des connexions électriques sous haute tension deviennent accessibles. Débranchez la pompe de toute source d'alimentation électrique avant de retirer les capots. Les capots de protection devraient être démontés uniquement par le personnel de service habilité.
- Remplacez toujours les fusibles grillés par des fusibles de rechange d'origine Dionex (→ Replacing the Fuses, page 88).
- Remplacez les cordons d'alimentation électrique et les câbles de communication défectueux.
- De nombreux solvants organiques et solutions salines sont toxiques. Informez-vous des propriétés toxicologiques de toutes les phases mobiles que vous utilisez.
- Les propriétés toxicologiques de nombreux échantillons peuvent être mal connues. Au moindre doute concernant un échantillon, traitez-le comme s'il contenait une substance potentiellement dangereuse.
- Portez des lunettes de protection lorsque vous manipulez des phases mobiles ou que vous utilisez l'instrument. Une installation permettant de se laver les yeux ainsi qu'un lavabo doivent se trouver à proximité du système. Si une phase mobile, quelle qu'elle soit, gicle dans les yeux ou sur la peau, lavez la zone affectée et consultez un médecin.
- Débarrassez-vous de tous les déchets de phase mobile de manière écologique, conformément à la règlementation en vigueur au niveau local. Empêchez impérativement l'accumulation de solvants inflammables et/ou toxiques. Suivez un programme d'élimination des déchets règlementé et approuvé. Ne jetez jamais de solvants inflammables et/ou toxiques dans le système municipal d'évacuation des eaux usées.

- Dans un système UltiMate 3000, certains tubes 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 ($CHCl_3$), du diméthyle sulfoxyde (DMSO) ou du tétrahydrofurane (THF). De plus, il est attaqué par des acides concentrés tels que l'acide sulfurique et l'acide nitrique (ces acides peuvent cependant être utilisés dans le cadre de procédures de nettoyage, à condition que l'exposition soit brève).
- N'utilisez pas de tubes PEEK écrasés, pliés ou abimés.
- Avant d'interrompre le fonctionnement pendant plusieurs jours ou plus, observez les précautions figurant en Shutting Down the Pump (→ page 90).
- Utilisez des pièces de rechange d'origine Dionex. Effectuer des remplacements par des pièces ne provenant pas de Dionex ou utiliser des accessoires ne provenant pas de Dionex peut affecter les performances de l'instrument.
- N'utilisez pas la pompe de manière autre que celles décrites dans ce manuel.

## 1.5 Unpacking

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

**Please note:** Immediately report any shipping damage to both, the incoming carrier and Dionex. Shipping insurance will compensate for the damage only if reported immediately.

**Please note:** Keep the original shipping container and the packing material. They provide excellent protection for the instrument in case of future transit. Shipping the unit in any other packaging automatically voids the product warranty.

To unpack the pump, proceed as follows:

- Place the shipping container on the floor and remove the white accessories kit and the power cord.
- Grasp the pump by the sides. Slowly and carefully, pull the instrument out of the shipping container and place it on a stable surface.

  **Important:** To prevent the pump from falling, always lift the unit by the sides. Do not lift the unit by the packaging material or the front panel door.

  **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.

- Remove the foam inserts, and then remove the polythene packaging.
- Check off the contents of the accessories kit against the list in the Standard Accessories (included in the shipment) section, page 93.

## 1.6 Intended Use

The pump is designed to perform equally well as a dependable system for routine analyses or as a sophisticated research instrument for use in capillary, nano, and micro HPLC (high performance liquid chromatography) applications, especially as part of the UltiMate 3000 system. However, it 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 controlled by the **Chromeleon** Chromatography Management System. Being part of the UltiMate 3000 system, the pump can also be operated with other data systems, such as Analyst® (Applied Biosystems/MDS Sciex), HyStar™ (Bruker Daltonics) or Xcalibur® (Thermo Electron Corporation). To do so, the appropriate add-on modules to Chromeleon are required.

Please note that the pump may be operated only using the accessories originally supplied with the units (→ page 93) and within their technical specifications (→ page 91).

If there is any question regarding appropriate usage, contact Dionex before proceeding.

Dionex cannot be held liable for any damage, material or otherwise, resulting from inappropriate or improper use of the instrument.

## 1.7 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, especially as part of the UltiMate 3000 system, and can be used in numerous laboratory environments. The instrument performs equally well as a flexible and reliable module for routine analysis and sophisticated research tasks:

- The patented isokinetic pre-compression allows a precise and almost pulse-free flow.
- The technical specification meets the highest requirements for flow rate reproducibility, zero pulsation, and operational reliability.
- The pump is fully controlled by the Chromeleon Chromatography Management System, providing a high degree of system integration.
- Various safety and monitoring features are provided for system wellness and reliability (→ System Wellness, page 17).
- 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.
- For the secure and functional positioning of the solvent reservoirs on top of the pump, the solvent racks of the SRD-3000 series with integrated vacuum degasser are available from Dionex.
- The pumps of the LPG-3000 pump series are available as biocompatible versions, also. For information about the characteristics of the biocompatible pumps, refer to section 2.3.2 (→ page 11).

## 2.2 Principle of Operation

The pump is a zero-pulsation, serial dual-piston pump with electronic compressibility compensation. The two pump heads are connected in series. The solvent passes through both pump heads—working and equilibration head—successively.

Continuous delivery is achieved as follows: The working head delivers at the appropriate flow rate while simultaneously filling the serially connected equilibration head. The latter serves as a reservoir and delivers while the working head carries out the suction stroke. The characteristic feature of the patented isokinetic pre-compression is the 120-degree overlapping phase of the delivery strokes of the working and equilibration heads. When delivering compressible liquids without controlled pre-compression, the pulsation increases as the operating pressure increases, since part of the delivery stroke is required for compressing the solvent in the pump head.

Pulsation during the pre-compression phase is reduced to a minimum by velocity modulation of the drive. The highly constant delivery is ensured by a patented secondary control system (automatic compressibility compensation). The flow rate is always kept constant in relation to the atmospheric pressure.

## 2.3 Supported Configurations

### 2.3.1 Overview

The LPG-3000 pump series comprises various pump models in different versions. For an overview of the currently available pumps, refer to the table below:

| Part No. | Description |
|---|---|
| 5035.0035 | **LPG-3600M**—Dual low-pressure micro gradient pump<br>Two pumps are installed in the same enclosure. Three solvents can be connected to each pump. |
| 5037.0035 | **LPG-3600MB**—same as LPG-3600M, but biocompatible version |
| 5035.0040 | **LPG-3300M**—Single low-pressure micro gradient pump<br>Three solvents can be connected to the pump. |
| 5037.0040 | **LPG-3300MB**—same as LPG-3300M, but biocompatible version |

If you have any questions, do not hesitate to contact your Dionex sales representative or distributor.

### 2.3.2 Biocompatible Pumps

The LPG-3300MB and LPG-3600MB pumps extend LPG-3000 series by two biocompatible pump versions. Except for the fluid components, the biocompatible pumps are identical to the standard pumps (stainless steel). Therefore, almost all descriptions of the standard pumps apply to the biocompatible versions, also. If some detail applies to only one version, the version will be identified. The differences are as follows:

The fluid components are made of titanium. Titanium is a base material, similar to aluminium and magnesium. When titanium is processed, a titanium oxide film builds up on the component surface, ensuring excellent corrosion resistance. Note that titanium is not as hard as stainless steel and that it has a slightly different coloration. In addition, titanium parts are lighter than parts made of stainless steel. Nevertheless, you can easily confuse titanium with stainless steel parts.

When the connection between two titanium parts is too tight, friction between the parts makes them stick together as if welded. To avoid this problem in screwed connections, Dionex uses stainless steel parts as counterparts for the titanium parts, whenever possible.
Dionex recommends that you use only the capillaries shipped with the pump and/or original spare capillaries from Dionex. Do not over tighten the fitting connections. If necessary, retighten leaking connections.

The valve's union nut is either a stainless steel nut with a titanium inlay or it is completely made of titanium. The interior of the valve cartridges is PEEK or titanium.

**Please note:** Ring seals with a titanium spring are installed as piston seals in the biocompatible pumps, whereas common ring seals with a steel spring are used in the standard pumps. Therefore, do not confuse these seals.

## 2.4 General Pump Design

### 2.4.1 Interior View

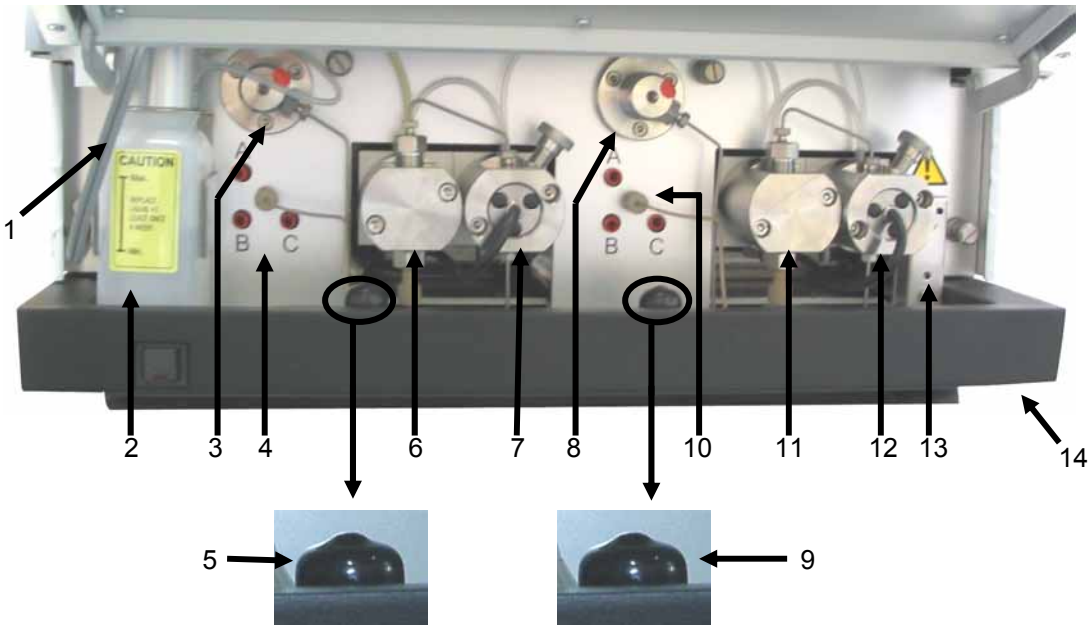



*Fig. 1: Interior view—view from the front (here: LPG-3600)*

**Please note:** In an LPG-3300 pump, components 3, 4, 6, and 7 are not installed.

| No. | Description | Part No. |
|---|---|---|
| 1 | Peristaltic pump<br>(behind the liquid reservoir for the rear-seal wash system;<br>→ Fig. 15, page 32) | ------ |
| 2 | Liquid reservoir for the rear-seal wash system | 6030.9501 (2 units) |
| 3 | Outlet block with filter holder and inline filter (→ section 3.3.6, page 35) | ------ |
| 4 | 3-channel proportioning valve | ------ |
| 5 | Capillary outlet (→ Note on page 35) | ------ |
| 6 | Working head:<br>Standard pump<br>Biocompatible pump | <br>6035.2001<br>6037.2001 |
| 7 | Equilibration head with pressure sensor and purge screw | ------ |
| 8 | Outlet block with filter holder and inline filter (→ section 3.3.6, page 35) | ------ |
| 9 | Capillary outlet (→ Note on page 35) | ------ |
| 10 | 3-channel proportioning valve | ------ |
| 11 | Working head, same as no. 6 | See no. 6 |
| 12 | Equilibration head with pressure sensor and purge screw | ------ |
| 13 | Leak sensor | ------ |
| 14 | Waste outlet (at the bottom right, underneath the pump, → Fig. 6, page 25) | ------ |

## 2.4.2 Fluid Connections

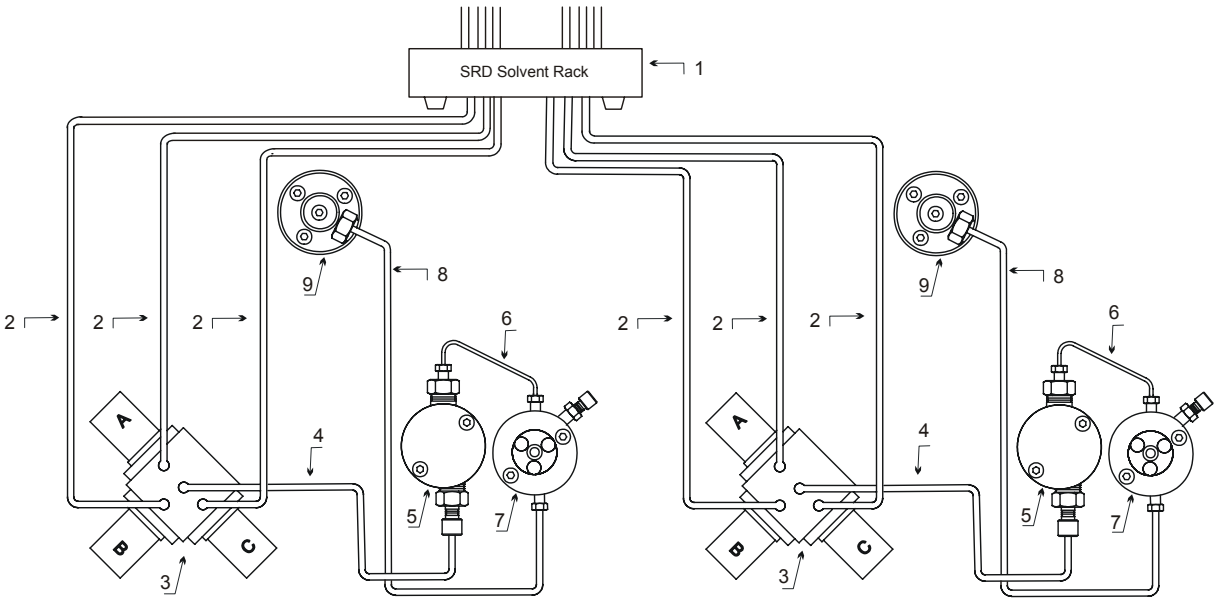



*Fig. 2: Fluid connections (here: in an LPG-3600 pump)*

**Please note:** In LPG-3300 pump, components 3 through 7 are not installed.

| No. | Description | Part No. |
|---|---|---|
| 1 | Solvent Rack with integrated vacuum degasser:<br>SRD-3600 with 6-channel degasser (for the LPG-3600 pump)<br>SRD-3300 with 3-channel degasser (for the LPG-3300 pump) | <br>5035.9230<br>5035.9240 |
| 2 | Set of solvent lines for connection of the proportioning valve to the degasser (The set includes 3 solvent lines, appropriate fittings and ferrules, and 3 solvent line labels (A, B, C).) | 6030.2547 |
| 3 | 3-channel proportioning valve | ------ |
| 4 | Capillary from proportioning valve to working head | 6035.2514* |
| 5 | Working head:<br>Standard pump<br>Biocompatible pump | <br>6035.2001<br>6037.2001 |
| 6 | Capillary from equilibration head to working head:<br>Standard pump<br>Biocompatible pump | <br>6030.3015*<br>6037.3015 |
| 7 | Equilibration head with pressure sensor and purge screw | ------ |
| 8 | Capillary from equilibration head to outlet block:<br>Standard pump<br>Biocompatible pump | <br>6035.3010*<br>6037.3010 |
| 9 | Outlet block with filter holder and in-line filter | ------ |

* These part numbers also include the appropriate fittings and ferrules.

⚠ **Important:** Use only the capillaries shipped with the pump and original spare capillaries from Dionex.

⚠ **Important:** Utilisez uniquement les capillaires fournis avec la pompe et les capillaires de rechange d'origine Dionex.

⚠ **Important:** Reuse used fittings and ferrules only for the same capillary connection. This is to avoid increased dead volume.

⚠ **Important:** La réutilisation des raccords et ferrules n'est possible que pour la connexion capillaire d'origine, afin d'éviter l'apparition de volumes morts.

⚠ **Important:** 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.

⚠ **Important:** Différents types de raccords sont utilisés dans le système UltiMate 3000. Par conséquent, installez les capillaires et les raccords uniquement dans les positions pour lesquelles ils sont prévus.

## 2.5 Front Panel Display and Controls


*Fig. 3: Pump front panel*

| No. | Front Panel Element | Description |
|---|---|---|
| 1 | Display | Several displays are available, providing information about the flow rate, pressure, and solvent components in percent of the total flow. If the pump is operated together with a flow manager of the FLM-3000 series, also the column flow and/or column pressure may appear on the display.<br>Select the display in Chromeleon (→ Information on the Front Panel Display, page 37).<br>**Note:** Below the display, magnetic buttons (soft keys) provide access to certain menus and functions (→ Soft Keys, page 41). |
| 2 | Standby button | Switches the pump to Standby mode (the LED is red).<br>To cancel Standby mode and resume operation, press the Standby button again (the LED is not lighted). |
| 3 | **LEDs** | |
| | Power | The LED is blue when the pump is turned on. |
| | Connected | The LED is green when the pump is controlled by Chromeleon. |
| | Status | The LED is red when an error has been detected, e.g., a leak.<br>Otherwise, the LED is green. |

⚠ **Important:** If you switch a pump to which an SRD-3000 solvent rack is connected to the Standby mode, the solvent rack will be set to Standby mode, also.

⚠ **Important:** Si vous commutez une pompe à laquelle est raccordée un dégazeur SRD-3000, en mode Veille, le dégazeur passera également en mode Veille.

## 2.6 Choosing the Solvents

All parts that may be exposed to solvents are made of stainless steel, titanium, PCTFE, PTFE, PEEK, sapphire, etc. (→ Wetted parts, page 91).

Use standard solvents (HPLC grade) and buffers, compatible with the flow path materials, only. Note 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. Please make sure to use the active rear-seal wash system (→ page 31).

Make sure to use special (highly pure) solvents. They are usually labeled accordingly by the vendor.

For more information about the chemical resistance of PEEK, refer to the table in section 10.1 (→ page 99).

⚠ **Important:** Dionex advises against recycling the solvent(s). This may impair the performance of the seals.

⚠ **Important:** Dionex déconseille de recycler les solvants. Ceci peut affecter les performances des joints.

**Please note:** As standard, the pump is fitted with reversed phase piston seals. However, normal phase seals can be installed instead if required. For information about the installation procedure and the corresponding part numbers, refer to Replacing the Piston Seals (→ page 82).

## 2.7 System Wellness

The pump supports several System Wellness and reliability features that can help you detect small problems before they turn into big ones:

- Leak sensor (→ page 74)
- Monitoring of piston seal tightness
  (→ **RearSealLeakCounter** in Chromeleon, page 62)
- Pressure limits
  (→ **MasterPressure** and/or **Pressure** in Chromeleon, page 61)
- Total workload monitoring
  (→ **WorkLoad** in Chromeleon, page 63)
- Active rear-seal wash system (→ page 31)
- Monitoring of the liquid level for rear-seal washing (→ Case B, page 31)
- Automatic self-test upon power-up

When an error is detected, the **Status** LED on the front panel is red and an error message appears on the front panel display. In addition, an error message is logged in the Chromeleon audit trail (→ Troubleshooting, page 65).

# 3 Installation

## 3.1 Facility Requirements

After unpacking the pump, allow the instrument to warm up for approximately 4 hours before connecting it to the power supply. This delay allows any condensation that might have occurred during shipping to evaporate. After 4 hours, check the pump; if condensation is still there, allow the pump to continue to warm up (without connecting it to the mains) until the condensation is completely gone.

Install the instrument in the laboratory on a stable surface that is free of vibrations. Make sure that the surface is resistant to solvents. Avoid locations with extreme changes in temperature (such as direct sunlight or drafts) and high air humidity. Allow sufficient clearance behind the pump for power connections and ventilation.

If the pump is part of UltiMate 3000 system, Dionex recommends that you stack the individual modules, for example, as shown in Fig. 4. However, the arrangement of the system modules depends on the application. For more application examples and for information about how to connect the UltiMate 3000 system modules, refer to *UltiMate 3000: System Installation and Application*.

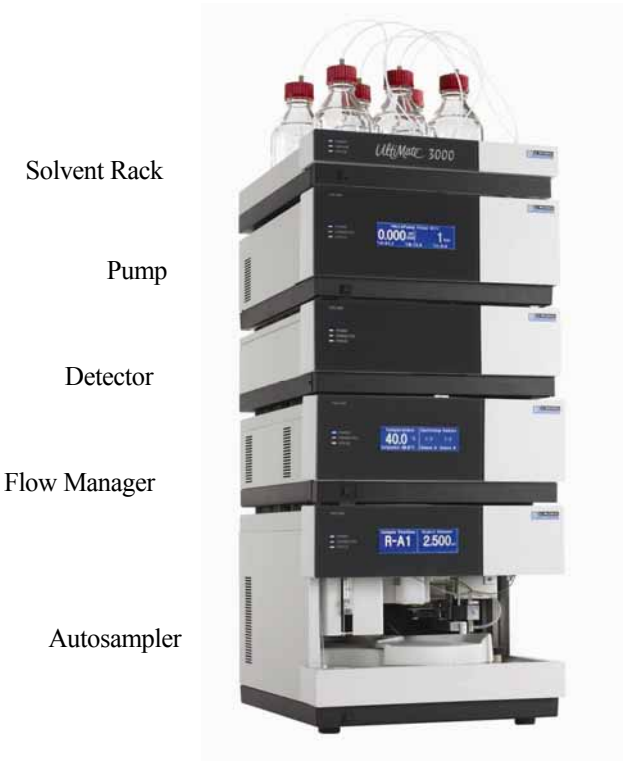



*Fig. 4: Example for an UltiMate 3000 system*

## 3.2 Rear Panel Connectors

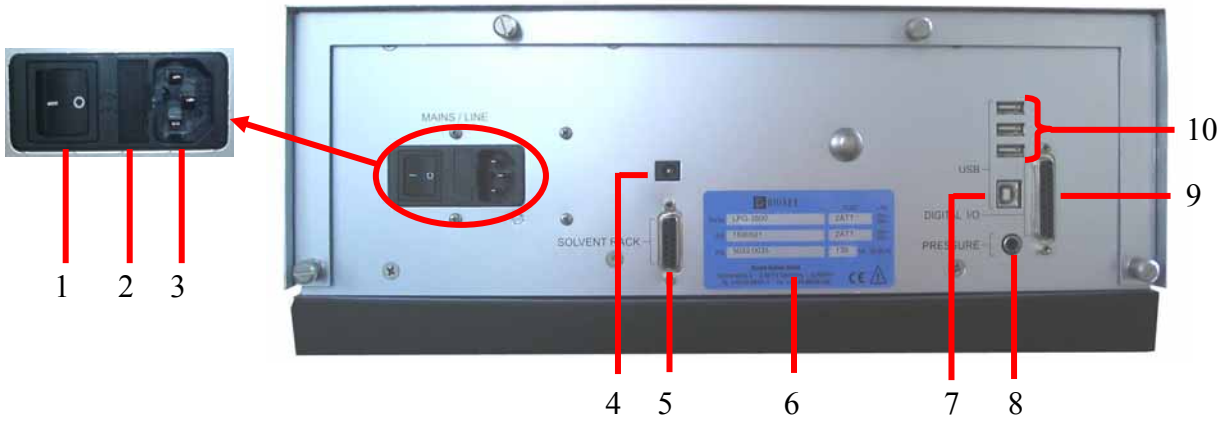



*Fig. 5: Rear panel*

| No. | Description |
|---|---|
| 1 | Power switch |
| 2 | Fuse cartridge (→ section 7.7, page 88) |
| 3 | Mains connection |
| 4 | DC Output: Reserved for future connection of low-voltage devices from Dionex. |
| 5 | Solvent Rack port for connection of an SRD-3000 solvent rack (→ section 3.2.2.3, page 23) |
| 6 | Type label |
| 7 | USB port for connection to the server PC (→ section 3.2.2.1), for example, via the autosampler of the UltiMate 3000 system (→ *UltiMate 3000: System Installation and Application*). |
| 8 | Pressure: Analog output pressure (→ section 3.2.2.4, page 23) |
| 9 | Digital I/O port for connection of an accessory, e.g., an autosampler or manual valve (→ section 3.2.2.2, page 22) |
| 10 | USB (Universal Serial Bus) ports for connection to one UltiMate 3000 device, such as a flow manager of the FLM-3000 series), or to one USB hub each (→ section 3.2.2.1, page 21) |

### 3.2.1 Power Connection

Use the power cord provided in the accessories kit to connect the pump to the mains. The instrument is equipped with a standard power supply unit with automatic voltage selector. Thus, no adjustment is required to adapt the line voltage to local voltage requirements.

### 3.2.2 Interfaces for Device Control

The Chromeleon Chromatography Management System can use a USB connection to control the pump. Data is transferred digitally via the appropriate USB cable (5 m USB cable, part no. 6911.0002 or 1 m USB cable, part no. 6035.9035). The USB ports are provided on the instrument's rear panel (→ Fig. 5, page 20).

⚠ **Important:** To ensure trouble-free operation, all USB cables (see above) should be ordered from Dionex.

⚠ **Important:** Afin de garantir un fonctionnement correct, tous les câbles USB (voir ci-dessus) doivent être commandés auprès de Dionex.

#### 3.2.2.1 USB

Connect the pump to the server PC via the USB port (→ Fig. 5, no. 7). To do so, select one of the following alternatives:

- Connect the pump directly to the USB port on the server PC.
- Connect the pump to the server PC via another UltiMate 3000 instrument that is already connected to the server PC.

  **Please note:** Apart from the solvent rack, all modules of the UltiMate 3000 system can be connected separately to the server PC. However, Dionex recommends interconnecting all modules, and then connecting the system to the Chromeleon server PC via only one connection, e.g., from the autosampler. For more information about how to connect the system modules, refer to *UltiMate 3000: System Installation and Application* (in the manual binder for the UltiMate 3000 system pump).
- Connect the pump to the server PC via a USB hub.

The other three USB ports (→ Fig. 5, no. 10) allow the pump to be connected to either one instrument in the UltiMate 3000 product line or one USB hub each. Additional UltiMate 3000 instruments can then be connected to the hub.

⚠ **Important:** Dionex recommends using these USB ports (→ Fig. 5, no. 10) for connections to Dionex instruments only. Dionex cannot guarantee correct functioning if instruments from other manufacturers are connected.

⚠ **Important:** Dionex recommande d'utiliser les ports USB (→ Fig. 5, n° 10) uniquement pour les raccordements aux instruments Dionex. Dionex ne peut garantir le bon fonctionnement si les instruments d'autres fabricants sont raccordés.

### 3.2.2.2 Digital I/O

The digital I/O port on the pump (→ Fig. 5, no. 9) allows triggering or reading in external events. The port provides 3 inputs and 4 relay outputs.

The inputs (1-3) can be used as universal inputs and read in Chromeleon.

The outputs (relays 1-4) can be used as universal outputs, controlled via Chromeleon, or assigned pump-internal special functions.

You can use the relay **Enabled** properties in Chromeleon to specify whether relays R2 (LeftCamSyncOut), R3 (OperableOut), and R4 (RightCamSyncOut) are controlled by the pump for the associated signal (Enabled property = **No**) or whether they can be used in Chromeleon (Enable property = **Yes**; → page 62).

If the relays are controlled by the pump, relays R2 and R4 provide the synchronization signal for the autosampler. The gradient running on the pump is synchronized with the Inject command of the autosampler.

**Please note:** With an LPG-3300 pump, relay R2 can be used in Chromeleon in any case.

The **Operable Out** relay output (relay 3) closes when the pump is not ready to operate, that is, in case of an error or if the instrument is turned off.

**Important:** The maximum switching voltage of the relays is 24 V. The switching current must not exceed 100 mA.

**Important:** La tension maximale de commutation des relais est de 24 V. L'intensité de commutation ne doit pas dépasser 100 mA.

For information about the pinout and the signal levels, refer to Fig. 56 (→ page 105).

### 3.2.2.3 Solvent Rack

The Solvent Rack port (→ Fig. 5, no. 5) allows connection of an SRD-3000 solvent rack with integrated degasser:

| Model | Part No. | Description |
|---|---|---|
| SRD-3600 | 5035.9230 | Solvent rack with analytical 6-channel vacuum degasser (intended for use with an LPG-3600 pump) |
| SRD-3300 | 5035.9240 | Solvent rack with analytical 3-channel vacuum degasser (intended for use with an LPG-3300 pump) |

⚠ **Important:** Do not substitute any other solvent rack for the solvent racks of the SRD-3000 series mentioned above.

⚠ **Important:** Ne remplacez les dégazeurs de la série SRD-3000 mentionnés ci-dessus par aucun autre type de dégazeur.

**Please note:** For more information about how to install and/or operate the solvent rack, refer to the *Operating Instructions* for the instrument.

For information about the pinout, refer to Fig. 57 (→ page 105).

### 3.2.2.4 Pressure (Analog Pressure Output)

The analog pressure output (→ Fig. 5, no. 8) records the operating pressure of the pump. The pressure output is set to 5 mV/bar (50 mV/MPa). You may connect a device such as the UCI-100 Universal Chromatography Interface, a recorder, or an A/D converter, to monitor the pump pressure.

**Please note:** In Chromeleon, use the **AnalogOut** property (→ page 59) to determine whether the pressure of the right or left pump of an LPG-3600 is available at the analog pressure output. (Chromeleon does not support this property for the LPG-3300 pump.)

| Pin Assignment for 2-Pin Cinch Connector | |
|---|---|
| Inner ring: | Signal (pressure) |
| Outer ring: | GND |

**Please note:** The analog pressure output always records the pressure of the pump. This is also true when the pump is operated together with a flow manager in an UltiMate 3000 system, i.e., the pump pressure, and not the column pressure, is recorded.

### 3.2.3 Preparing the Pump

⚠ **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. Otherwise, use an appropriate intermediate solvent.

⚠ **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.

- Observe the information about the facility requirements when connecting the pump to the HPLC system (→ page 19). For information about how to connect the system modules, refer to *UltiMate 3000: System Installation and Application*.
- The fluid connections depend on your application. Connect the pump to the flow manager or autosampler.

  ⚠ **Important:** When connecting the capillaries, make sure that the connectors are free from contaminants. Even minute particles may cause damage to the system (e.g., flow splitter, flow control valve, and column).

  ⚠ **Important:** Lorsque vous connectez les capillaires, assurez-vous que les raccords sont exempts de contaminants. Même d'infimes particules peuvent endommager le système (ex., diviseur de débit, vanne de régulation de débit et colonne).

  ⚠ **Important:** When connecting the pump to the flow splitter of the FLM-3000 flow manager, use the special capillary from the flow manager's accessories kit. Do not substitute this capillary for any other capillary.

  When connecting the capillary, observe the following order:
  Connect the capillary to the pump. Via the pump, rinse the capillary with isopropanol (maximum flow rate, 5 minutes). Connect the capillary to the pump connector on the flow splitter.

  ⚠ **Important:** Lorsque vous branchez la pompe au diviseur de débit du FLM-3000, utilisez le capillaire spécial du kit d'accessoires fourni avec le Flow Manager. N'utilisez aucun autre capillaire pour cet usage.

  Lorsque vous branchez le capillaire, respectez la séquence suivante: Raccordez le capillaire à la pompe. Via la pompe, rincez le capillaire à l'isopropanol (au débit maximum, pendant 5 minutes). Raccordez le capillaire au diviseur de débit.

- Connect drainage tubing to the waste outlet at the bottom right of the pump to direct condensing water or liquid leakage to an appropriate waste container.


*Fig. 6: Waste outlet*

⚠ **Important:** To prevent damage to the instrument, make sure that no part of the tubing is placed higher than the connection port.

⚠ **Important:** Afin d'éviter d'endommager l'instrument, assurez-vous qu'aucune pièce des tubes n'est placée plus haute que le port de raccordement.

- Install the solvent rack and connect the solvent lines to the degasser channels (→ *Operating Instructions* for the SRD-3000 Solvent Racks).
- Connect the solvent lines as described in Connecting the Solvent Reservoirs (→ page 26).
- Fill the liquid reservoir of the rear-seal washing (→ Active Rear-Seal Wash System, page 31).
- Use the power cord shipped with the pump to connect the instrument to the mains. Turn on the pump by pressing the power switch on the rear panel. While the pump is powered-up, the pump type and firmware version appear on the front panel display. After about 6 seconds, the following information appears: flow rate, pressure, and solvent components in percent of the total flow. You can specify in Chromeleon which of the supported displays shall appear (→ Information on the Front Panel Display, page 37).
- Purge the pump (→ page 34).
- Install the pump as described in section 5 (→ page 45).

**Please note:** For information about how to connect the UltiMate system modules and for application examples, refer to *UltiMate 3000: System Installation and Application*.

## 3.3 Fluid Connections

The front panel tilts upward to provide easy access to the fluid connections in the pump (→ Fig. 1). The open cover locks in the topmost position.

⚠ **Important:** When lifting or moving the pump, always lift by the bottom or sides of the instrument. Lifting the pump by the front panel may damage the front panel door.

⚠ **Important:** Lorsque vous soulevez ou déplacez la pompe, saisissez la toujours par le dessous ou les côtés de l'instrument. Soulever la pompe par le panneau avant risque d'endommager la porte du panneau avant.

⚠ **Important:** Do not place any heavy objects on the open front panel door. This may damage the door.

⚠ **Important:** Ne placez aucun objet lourd sur la porte ouverte du panneau avant. Ceci peut endommager la porte.

### 3.3.1 Connecting the Solvent Reservoirs

For the secure and functional positioning of the solvent reservoirs, the following solvent racks with integrated degasser are available from Dionex:

| Model | Part No. | Description |
|---|---|---|
| SRD-3600 | 5035.9230 | Solvent rack with analytical 6-channel vacuum degasser (intended for use with an LPG-3600 pump) |
| SRD-3300 | 5035.9240 | Solvent rack with analytical 3-channel vacuum degasser (intended for use with an LPG-3300 pump) |


*Fig. 7: Pump with solvent rack*

The solvent rack is shipped with solvent reservoirs and appropriate tubing. The bottle caps have 5 holes. Four of the file holes are capped by default (white caps) and one hole is open. A retaining guide holds the tubing in place.

How to connect the solvent lines to the solvent reservoir (→ Fig. 8):

- Feed the solvent line through the retaining guide and then into the open hole in the reservoir cap.
- Slide the filter frit onto the end of the solvent line.
- Place the complete assembly in the solvent reservoir.
- Tighten the reservoir cap hand-tight by holding the cap and turning the bottle.


*Fig. 8: Connecting the solvent lines to the reservoir*

⚠ **Important:** Always install filter frits on the solvent lines. This prevents contaminants from reaching the HPLC system.

⚠ **Important:** Installez toujours des filtres frittés sur les lignes de solvant. Ceci empêche les contaminants d'atteindre le système HPLC.

**Please note:** When replacing a solvent line, remove the frit first, then the solvent line, and then the retaining guide.

**Please note:** Regularly check the suction frits for permeability. Especially when working with aqueous solvents, algae and other microorganisms can grow and be deposited on the filter frits. Therefore, replace the solvents at regular intervals. Rinse the reservoirs thoroughly before refilling them. Replace the suction frits as necessary.

- The solvent lines are connected to the proportioning valve(s) at the factory (→ Fig. 9).

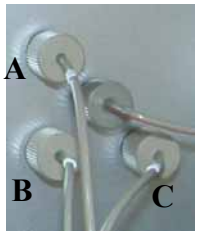



*Fig. 9: Solvent lines connected to the proportioning valve*

- Route the tubing through the opening between the pump's front panel door and top cover (→ Fig. 10).

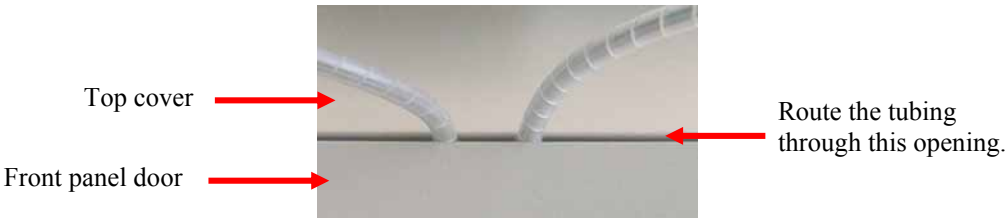
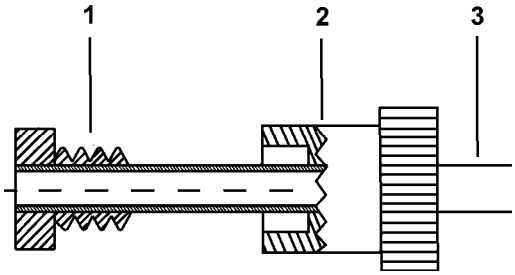



*Fig. 10: Opening between the pump's top cover and front panel door*

**Please note:** If your HPLC system includes an SRD-3000 solvent rack, make sure that the tubing connecting the pump to the degasser is as short as possible. Therefore, stack the rack onto the pump as shown in Fig. 7 (→ page 26). For information about how to connect the tubing to the degasser, refer to the *Operating Instructions* for the solvent rack.

### 3.3.2 Connections in the Low-Pressure Section

The illustration below shows the solvent connections in the low-pressure section of the pump:




| No. | Description |
|---|---|
| 1 | Ferrule |
| 2 | Fitting |
| 3 | PEEK tube |

*Fig. 11: Solvent line connection on low-pressure side*

⚠ **Important:** Do not overtighten these fitting connections; the connections should be no more than hand-tight. If necessary, retighten leaking connections.

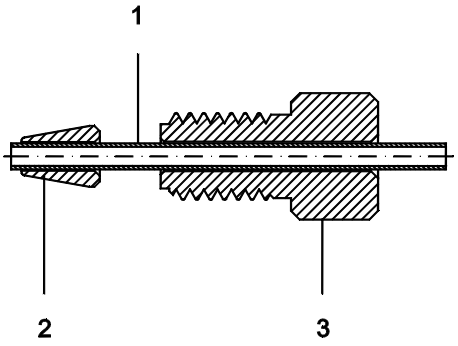
⚠ **Important:** Ne serrez pas trop ces raccords, le serrage manuel suffit. Si nécessaire, resserrez les raccords qui fuient.

⚠ **Important:** Avoid cross-threading when installing the fittings on the PTFE valve block. Cross-threading might damage the valve blocks.

⚠ **Important:** Veillez à engager correctement les raccords filetés quand vous effectuez une connexion sur le bloc electrovannes en PTFE. Une déformation des taraudages risque d'endommager définitivement le bloc electrovannes.

### 3.3.3 Connections in the High-Pressure Section

All capillary connections in the high-pressure section of the pump are supplied with fitting screws and ferrules:




| No. | Description |
|---|---|
| 1 | Capillary |
| 2 | SR-7 ferrule |
| 3 | FS-7 fitting screw |

*Fig. 12: Fitting screw and ferrule*

The following pre-configured capillaries are used in the pump:

| Description | Part No. |
|---|---|
| Capillary from working head to equilibration head:<br>Standard pump<br>Biocompatible pump | Included in:<br>6030.3015*<br>6037.3015* |
| Capillary from equilibration head to outlet block:<br>Standard pump<br>Biocompatible pump | Included in:<br>6035.3010*<br>6037.3010* |
| Capillary from the proportioning valve to working head | Included in 6035.2514* |

* These part numbers also include the appropriate fittings and ferrules.

⚠ **Important:** Do not overtighten these fitting connections; the connections should be hand-tight plus an additional one-quarter turn. If necessary, retighten leaking connections.

⚠ **Important:** Ne serrez pas trop ces raccords; un quart de tour au delà du serrage manuel suffit. Si nécessaire, resserrez les raccords qui fuient.

⚠ **Important:** Use only the capillaries shipped with the pump and original Dionex spare capillaries.

⚠ **Important:** Utilisez uniquement les capillaires livrés avec la pompe et les capillaires de rechange d'origine Dionex.

⚠ **Important:** Reuse used fittings and ferrules only for the same capillary connection. This is to avoid increased dead volume.

⚠ **Important:** La réutilisation des raccords et ferrules n’est possible que pour la connexion capillaire d’origine, afin d’éviter l’apparition de volumes morts.

⚠ **Important:** To connect the capillaries to an injection valve or selector valve, install only the ferrules and fittings shipped with the valve and observe the manufacturer's installation instructions.

⚠ **Important:** Pour brancher les capillaires à une vanne d'injection ou de sélection, installez uniquement les ferrules et les raccords livrés avec la vanne et respectez les instructions d'installation du fabricant.

⚠ **Important:** 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.

⚠ **Important:** Différents types de raccords sont utilisés dans le système UltiMate 3000. Par conséquent, installez les capillaires et les raccords uniquement dans aux endroits où ils sont prévus.

### 3.3.4 Active Rear-Seal Wash System

When using highly concentrated buffer solutions, Dionex recommends continuously rinsing the back of the piston seal to remove salt crystals and prolong the life of the seal. For this purpose, active rear-seal washing is available for the pump. Enable and disable the active seal wash system via the **RearSealWashSystem** parameter in Chromeleon (→ page 62).

The active rear-seal wash system consists of a peristaltic pump (tubing pump) and a liquid reservoir with integrated sensors. Rear-seal washing is activated periodically once per hour and runs for five minutes.

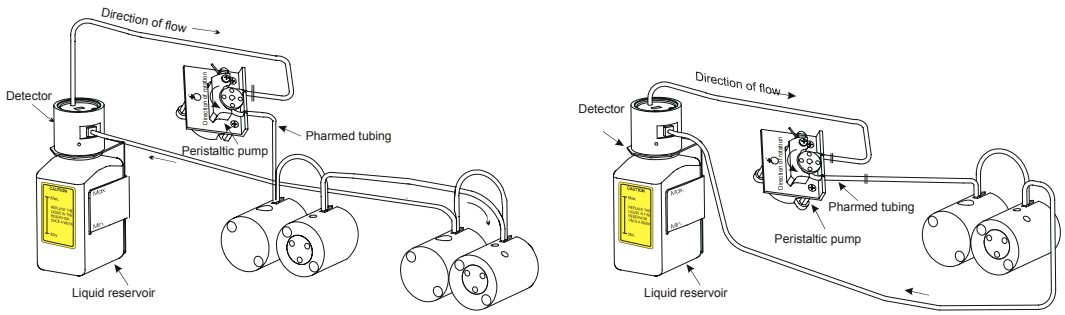



*Fig. 13: Active rear-seal wash system (connection)*
*a) for an LPG-3600; b) for an LPG-3300*

**Please note:** Fill the liquid reservoir before you turn on the pump for the first time. Approximately 50 ml of fluid will be sufficient. For information on the seal-washing medium itself, refer to below (→ page 33).

**Please note:** Regularly check the liquid level in the liquid reservoir, making sure that the level is always between the min. and max. markers on the label.

To fill the liquid reservoir or exchange the washing liquid, hold the liquid reservoir including the holding clip and push both parts together vertically toward the top. The holding clip disengages. While holding the reservoir by its cap (= detector), unscrew the reservoir including the holding clip from the cap (→ Fig. 14).

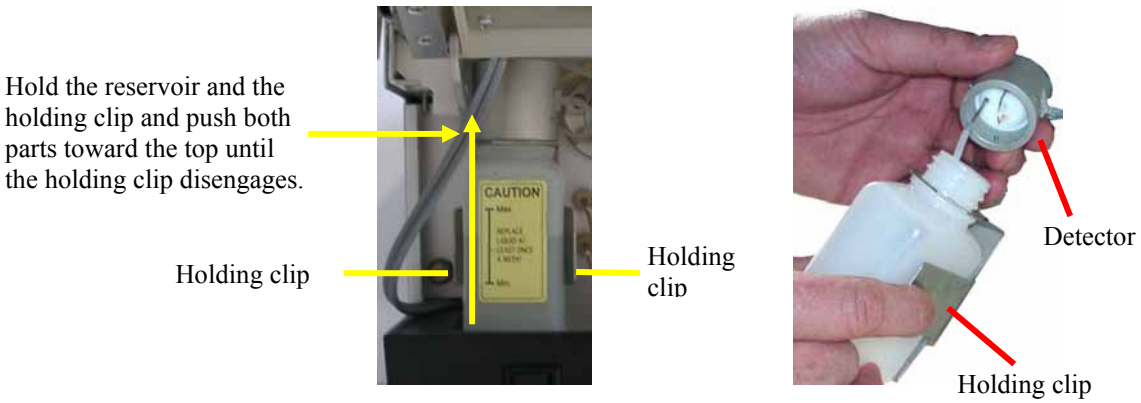



*Fig. 14: Liquid reservoir of the rear-seal wash system*

**Please note:** Verify that the peristaltic tubing is engaged in the peristaltic pump before you turn on the pump for the first time. (The peristaltic pump is installed at the top left in the pump enclosure (e.g. → Fig. 1, page 12) behind the liquid reservoir for the rear-seal wash system.) The tubing under the peristaltic pump lever remains compressed and does not relax, thus blocking the wash solution. This can happen if the pump is not running for a longer period, e.g., during shipment. That is why the pump is shipped with the active rear-seal wash tubing bypassing the peristaltic pump. We also recommend pulling the tubing out of the peristaltic pump (→ Fig. 15) if the pump is not running for more than five days. To remove the tubing, slightly press the lever leftward, remove the tubing, and release the lever.

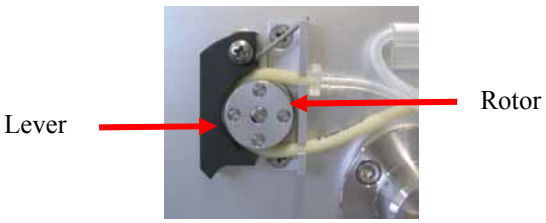



*Fig. 15: Peristaltic pump*

The sensor, which is integrated in the detector cap monitors:

- The function of the rear-seal wash system
- The main piston seal for possible leakage

**Case A - Rear-seal washing performs correctly**

The delivery period of the peristaltic pump is five minutes. During this period, liquid reaches the detector on the liquid reservoir (the drops are counted). This means that the rear-seal wash system performs correctly. The liquid reservoir contains enough liquid for seal washing, the tubing is all right, and the peristaltic pump works correctly.

**Case B - Malfunctioning of the rear-seal wash system**

If no drops reach the detector on the liquid reservoir after maximum five minutes although the peristaltic pump is pumping, this indicates that either the liquid reservoir is empty or the peristaltic tubing is broken or sticks together.

This malfunctioning may also occur if the sensor on the liquid reservoir is very dirty. The following error message appears: "The rear-seal leak sensor is malfunctioning." Clean the electrodes of the sensor, using water or solvent. Be careful not to bend the electrodes.

In all cases, the following message appears in the Chromeleon audit trail: "Rear-seal wash system has run out of wash solution". Refill the liquid reservoir or replace the defective peristaltic tubing. For more information regarding this message, refer to the Troubleshooting section (→ page 65).

**Case C - Possible leakage of the main piston seal**

If drops are counted (that is, more drops than specified via the **RearSealLeakLimit** parameter in Chromeleon (→ Chromeleon Commands and Properties, page 59)) during the 55 minutes in which the peristaltic pump is idle, this indicates possible leakage of the main piston seal. The following message appears in the Chromeleon audit trail: "The rear seal leak count is xx (= number of counted drops) and has exceeded the limit of yy (= leak threshold value)". Press Esc to confirm the message. Visually inspect the piston seals for leakage (→ page 81). Replace the piston seals and support rings as necessary (→ Removing the Piston Seal, page 84) or increase the default value for the rear-seal leak limit in Chromeleon.

For reliable sensor performance, make sure that the seal-washing medium is slightly conductive. Standard HPLC-grade water is appropriate. If a medium other than HPLC-grade water has to be used due to the solubility of the delivered solvent, make the medium slightly conductive using the appropriate additives (do not use additives with a high salt content or additives that cause solid residuals upon evaporation). Make sure that the seal-washing medium is compatible with the silicone tubing.

⚠ **Important:** If you use solvents with a high salt content, do not operate the pump without rear-seal washing for a longer time (> 5 minutes). This may cause damage to the piston seals and the piston.

⚠ **Important:** Si vous utilisez des phases mobiles avec une forte teneur en sel, ne faites pas fonctionner la pompe sans rinçage du joint arrière pendant un temps prolongé (> 5 minutes). Ceci peut endommager les joints de piston et le piston.

⚠ **Important:** 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.

⚠ **Important:** Assurez-vous que le liquide utilisé pour le rinçage du joint arrière est miscible avec le solvant afin de préserver l'étanchéité de la pompe.

⚠ **Important:** Do not forget to empty the liquid reservoir before shipping the pump.

⚠ **Important:** N'oubliez par de vider le réservoir de liquide de rinçage avant d'expédier la pompe.

🛈 **Please note:** Replace the liquid in the liquid reservoir in regular intervals. To avoid salt concentration and to prevent damage to the piston seals when using solvents with a high salt content, replace the liquid in the reservoir **at least** once a week.

### 3.3.5 Purging the Pump

Purging the pump means rinsing the system for a short time at a higher flow rate. By default, the pump is purged for 5 minutes at 6 ml/min. You may change the default settings in the Chromeleon (→ **PurgeFlow** and **PurgeTime**, page 62).

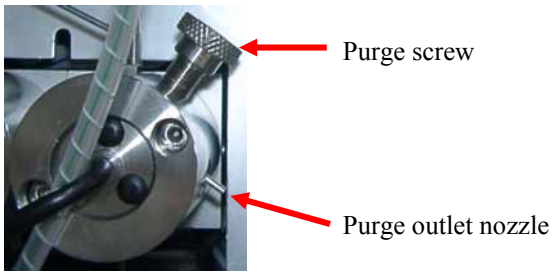



*Fig. 16: Purge screw and purge outlet nozzle*

To purge the pump, follow the steps below:

**Please note:** The two pumps of an LPG-3600 can be purged separately.

- Attach a piece of silicone tube (provided in the accessory kit) to the purge outlet nozzle on the equilibration head. Fasten the other end of the tube to a plastic syringe (provided in the accessory kit)
- Loosen the purge screw by **one** turn.
- To be able to generate negative pressure, an autosampler, flow manager, or another type of pressure drop needs to be connected to the pump outlet. If necessary, cap the pump outlet.
- Set the channel to be purged to 100%; for example, channel A.
- In Chromeleon, set **Purge** to **On** (→ page 62) and draw the solvent with the syringe. If there are no air bubbles left, stop purging by setting **Purge** to **Off**.
- Repeat the above procedure for all channels to be purged.
- Close the purge screw. Do not overthighten the screw. (In case of leakage, retighten later as necessary.)

**Important:** Do not use any tools to tighten the purge valve screw. Overtightening may destroy the cap seal. Open or close the purge screw only when the system pressure is down.

**Important:** N'utilisez pas d'outils pour serrer la vis de la vanne de purge. Une vis trop serrée risque de détruire le pointeau de la vanne . Ouvrez ou fermez la vis de purge uniquement lorsque la pression du système est basse.

### 3.3.6 Outlet Block

The pump is fitted with an outlet block (→ Fig. 17) whose inlet is fitted with a filter holder and inline filter. As standard, the pump is shipped with the appropriate frits (porosity: 0.5 µm).

**Please note**: Each of the two pumps in an LPG-3600 is fitted with a separate outlet block.

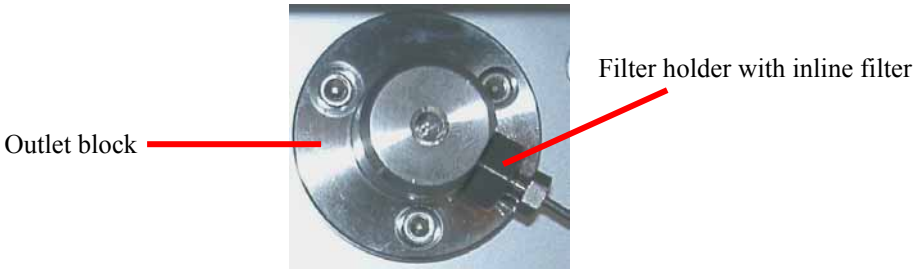



*Fig. 17: Outlet block*

**Please note**: Check the permeability of the filter frits at regular intervals. When the pump delivers water at a flow rate of 2 ml/min and when the outlet is open, the pressure should not exceed 10 bar. Replace the filter frits if necessary (→ Exchanging the Filter Frits on the Outlet Block, page 76).

**Please note**: Direct the capillaries from the outlet block to the outside through the capillary outlet in the enclosure bottom (capped by black rubber stoppers; → Fig. 1, nos. 5 and 9). Slit the stopper and thread the capillary through the slot.

**Please note**: Do not interconnect the outlet blocks of an LPG-3600 pump; always direct them to separate fluid systems.

# 4 User Interface

## 4.1 Power-Up

Use the power cord from the pump's accessories kit to connect the instrument to the mains. Turn on the pump by pressing the power switch on the rear panel. While the pump is powered up, the pump type and firmware version appear on the front panel display. After about 6 seconds, the display information specified in Chromeleon appears (→ section 4.2.1).

**Please note:** Each time the pump power is turned on, 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 **Status** LED on the front panel is red and an error message appears on the front panel display. If the pump is operated by Chromeleon, an error message is logged in the Chromeleon audit trail, also. The pump is not yet ready for analysis. Turn off the pump, take appropriate remedial action (→ Troubleshooting, page 65), and turn the pump on again.

## 4.2 Information on the Front Panel Display

### 4.2.1 Display Information upon Power-Up

Several display modes are available, providing different information about the pump. Specify in Chromeleon which display shall appear (→ **DisplayMode**, page 60).

**Please note:** Adjust the brightness and/or contrast of the front panel display via **Brightness** and **Contrast** (→ page 59) in Chromeleon.

**Please note:** The master flow is indicated in ml/min; the column flow is indicated in µl/min. The settings made in Chromeleon during the installation of the pump (→ page 52) and the flow manager (→ *Operating Instructions for the FLM-3000 Flow Managers*) determine the unit for the pressure reading. If the pressure unit is different for the left and right pump of an LPG-3600, the unit selected on the **Right Pump** page will be used.

**Please note:** If the pump for which the values appear on the display does not deliver, **Flow Off** appears in brackets instead of **Master Values** or **Column Values**.

Chromeleon supports the following display modes:

**Please note:** The pump names appearing on the display correspond to the names specified on the **Devices** page in Chromeleon (→ page 49). In the standard configuration of the pump, these are: **Loading Pump** for the left pump of an LPG-3600, **Micro Pump** for the right pump of an LPG-3600, and **Pump** for the LPG-3300.

**Please note:** The descriptions below refer to the display modes supported for an LPG-3600. For the LPG-3300, the following display modes are available: *DisplayMode = _Column* (equivalent to *Right_Column* for the LPG-3600) and *DisplayMode = Master* (equilvant to *Right_Master* for the LPG-3600).

- *DisplayMode = Both*: Shows the flow, pressure, and the components for the solvent in percent of the total flow for both the left and right pump:

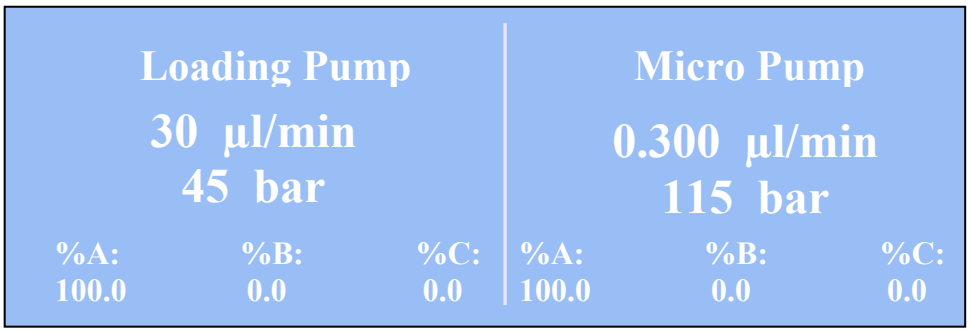



*Fig. 18: LoadingPump and MicroPump display*

- *DisplayMode = Left_Master*: Shows the flow, pump pressure, and solvent composition in percent of the total flow for the left pump (in the standard configuration, the left pump is the loading pump):

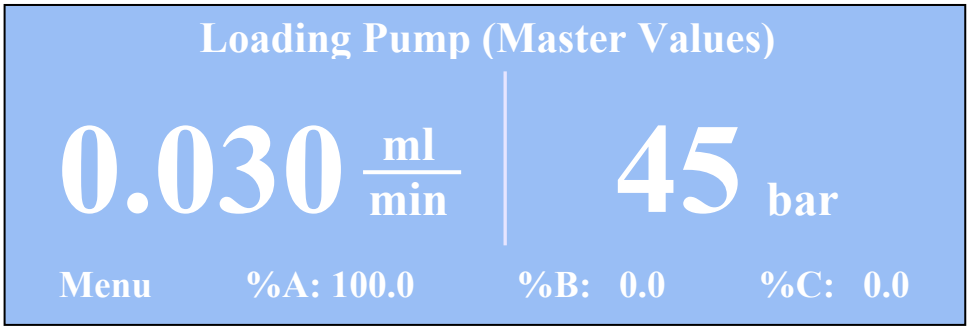



*Fig. 19: LoadingPump (Master Values) display*

- *DisplayMode = Right_Column*: Shows the flow, column pressure (i.e., the pressure after the flow splitter), and solvent composition in percent of the total flow for the right pump (in the standard configuration, the right pump is the micro pump):

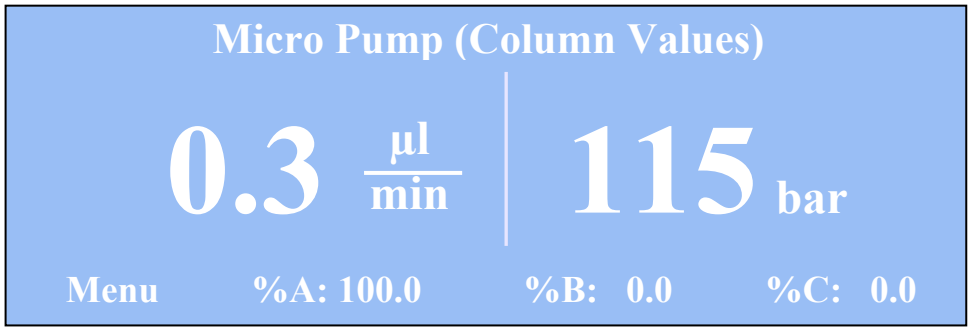



*Fig. 20: MicroPump (Column Values) display*

**Please note:** For the LPG-3300 pump, the equivalent mode is *DisplayMode = Column*.

- *DisplayMode = Right_Master*: Shows the flow, pump pressure (i.e., the pressure before the flow splitter), and solvent composition in percent of the total flow for the right pump (in the standard configuration, the right pump is the micro pump):

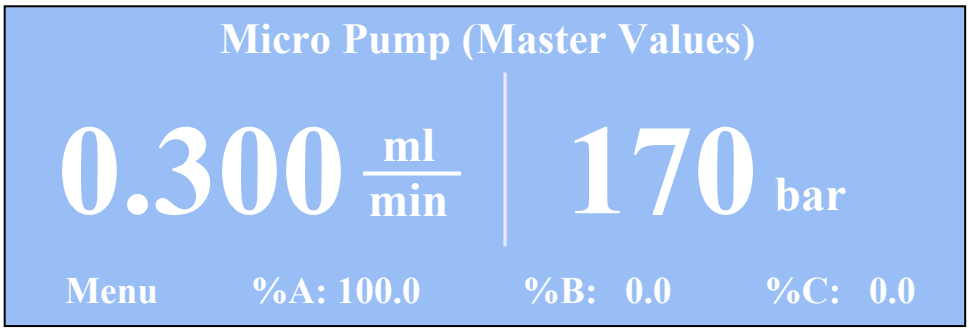



*Fig. 21: Micro Pump (Master Values) display*

**Please note:** For the LPG-3300 pump, the equivalent mode is *DisplayMode = Master*.

- *DisplayMode = Left_Column*: Shows the flow, column pressure, and solvent composition in percent of the total flow for the left pump (in the standard configuration, the left pump is the loading pump):

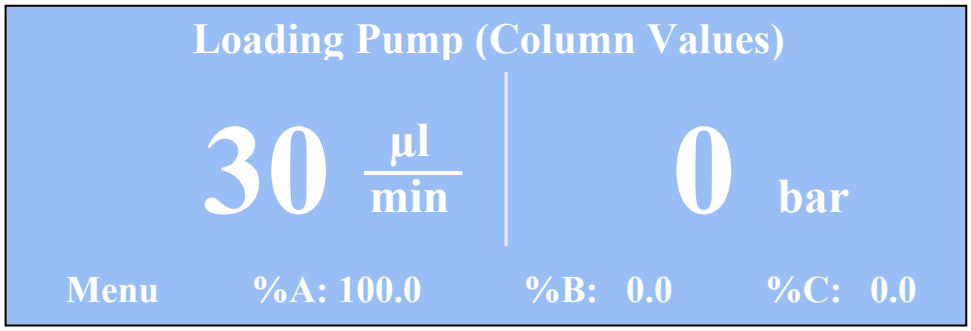



*Fig. 22: LoadingPump (Column Values) display*

**Please note:** This display mode is not meaningful for the standard configuration of the LPG-3600 in which the left pump is the loading pump.

### 4.2.2 Soft Keys

Magnetic buttons (soft keys) under the front panel display provide access to various menus, allowing you to edit certain settings and/or perform specific commands directly from the pump's front panel.

Touch the front panel just under the display with the magnetic Dionex menu pen (part no. 6300.0100) to show the soft keys (→ Fig. 23). The current front panel display determines which soft keys appear.


*Fig. 23: Accessing the soft keys*

**Please note:** The menu pen is included in the pump's accessories kit.
In an UltiMate 3000 system, another menu pen is installed in the solvent rack (→ Fig. 24).

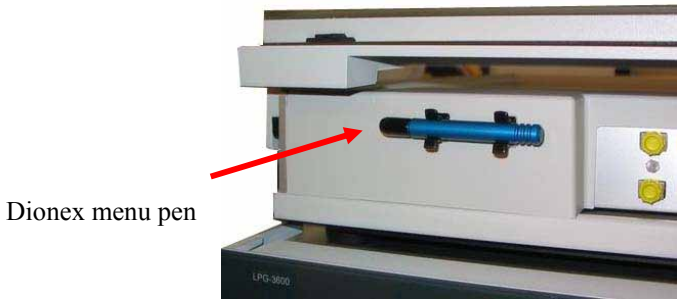



*Fig. 24: Menu pen in the solvent rack*

**Please note:** Use the menu pen in the same way to select an option, change a value, and/or perform a command.

**Please note:** The soft keys are disabled while the pump is connected in Chromeleon.

**DisplayMode = Both** *(LPG-3600 only)*:

In DisplayMode = Both (→ Fig. 18, page 38), touch the display with the menu pen just under %A, %B, or %C to show the following soft keys:

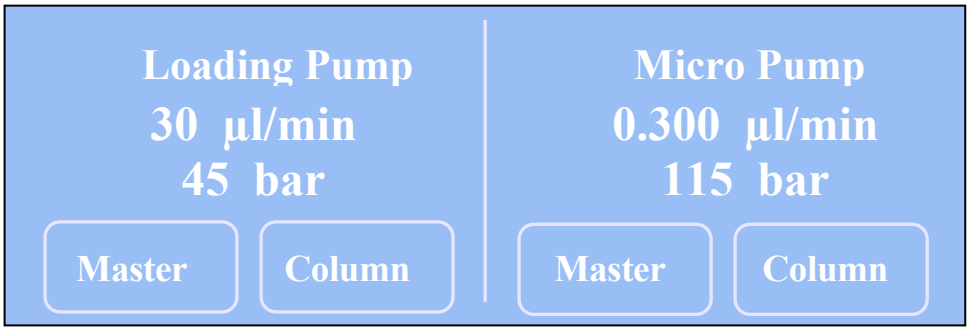



*Fig. 25: Soft keys for DisplayMode = Both*

- **Master** takes you to the display with the master values for the left pump according to DisplayMode = Left_Master (→ Fig. 19, page 38) or for the right pump according to DisplyMode = Right_Master (→ Fig. 21, page 39). In the standard configuration, the left pump is the loading pump and the right pump is the micro pump.
- **Column** takes you to the display with the column values for the left pump according to DisplayMode = Left_Column (→ Fig. 20, page 39) or for the right pump according to DisplyMode = Right_Column (→ Fig. 22, page 40).

**LPG-3660: DisplayMode = Left_Master, Left_Column, Right_Master, Right_Column**
**LPG-3300: Display Mode = Master, Column**

**Please note:** The description below refers to DisplayMode = Left_Master. However, it is the same for Left_Column, Right_Master, and Right_Column, as well as for Master and Column.

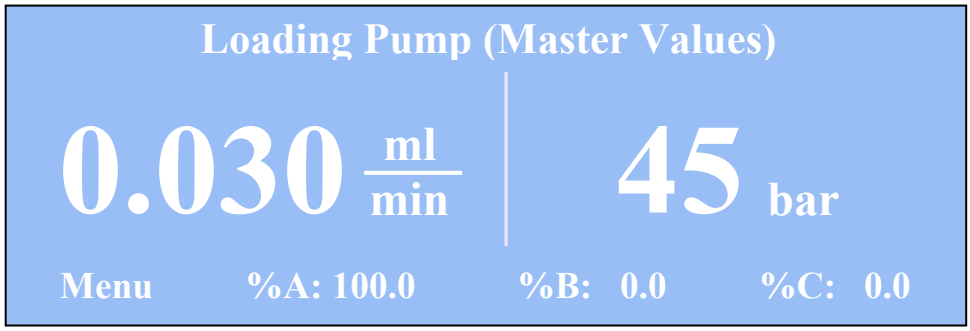



*Fig. 26: LoadingPump (Master Values)*

- Touch the display with the menu pen just underneath **Menu** to show the following soft keys:

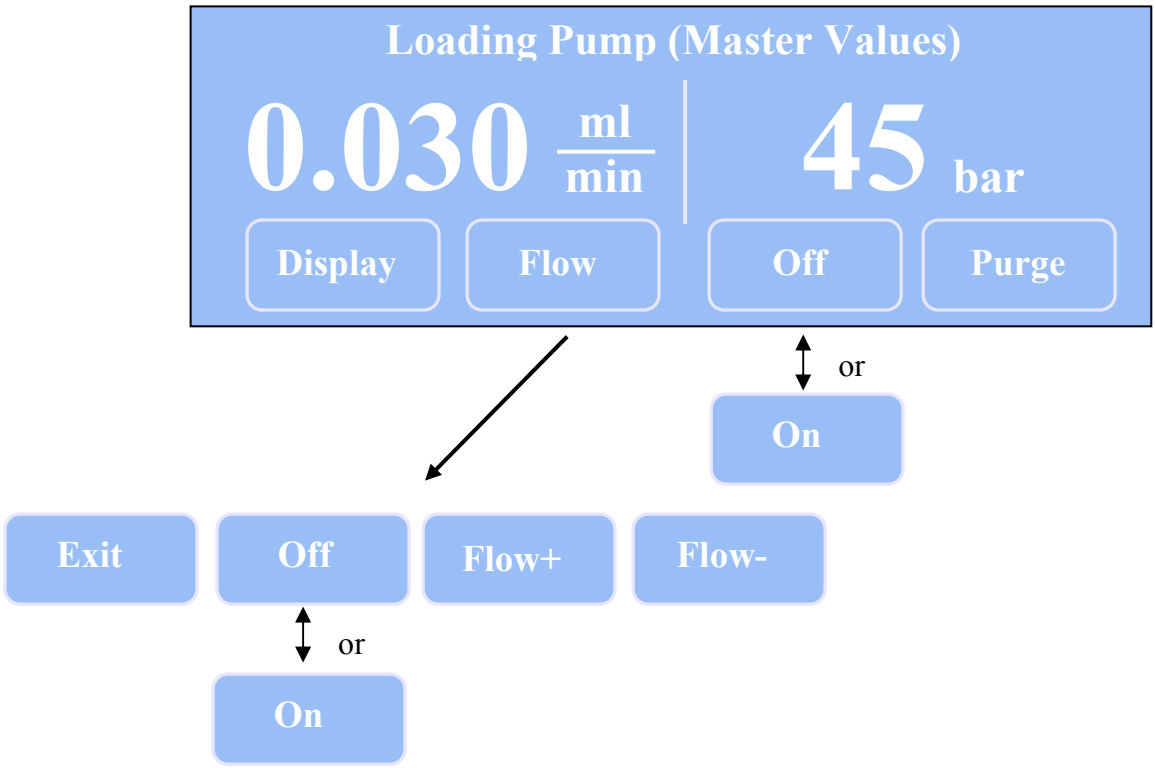



*Fig. 27: Soft keys for Menu and Flow*

- **Display**
  *LPG-3600:* **Display** takes you to DisplayMode = Both (→ Fig. 18, page 38).
  *LPG-3300:* Display toggles between the two display modes supported for the LPG-3300 pump (Column and/or Master).
- **Flow** opens a submenu with the following soft keys:
  - Select **Exit** to leave the **Flow** menu.
  - **On** turns the pump flow on. **Off** turns the pump flow off.
    (The command that can be performed is displayed.)
  - **Flow+** increases the flow rate.
  - **Flow-** reduces the flow rate.
- **On** turns the pump flow on. **Off** turns the pump flow off. (The command that can be performed is displayed.)
- **Purge** purges the pump.

- Touch the display with the menu pen just underneath %A, %B, or %C (here: %B) to show the following soft keys:

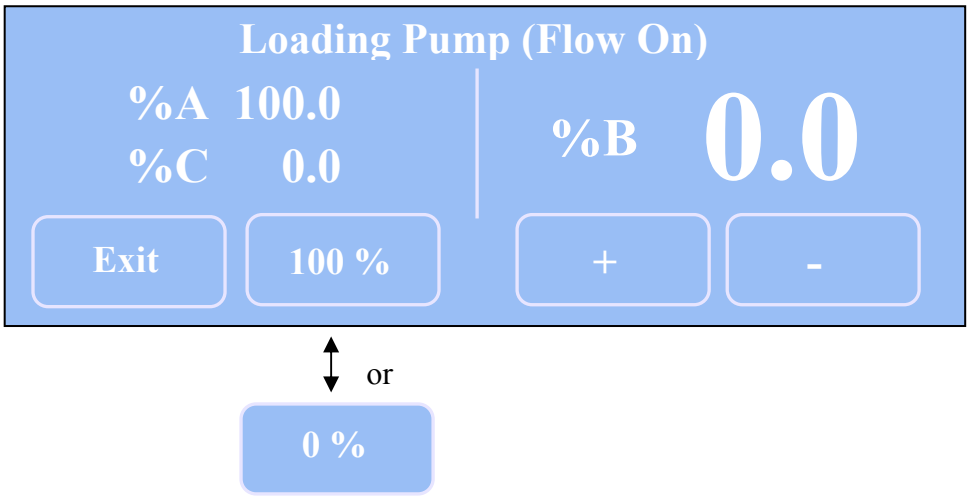



*Fig. 28: Soft keys for the % values (here for %B)*

- Select **Exit** to leave the soft key menu.
- **100%** sets the solvent to 100%. **0%** sets the solvent 0 %. (Here for %B.)
- + increases the percentage of the sovlent (here: %B) in increments of 5.
- **-** recudes the percentage of the solvent (here: %B) in increments of 5.

# 5 Automated Control by Chromeleon

## 5.1 General

The pump can be controlled by the Chromeleon Chromatography Management System. To control the pump, a Chromeleon version 6.60 Service Pack 3 or higher and a Timebase Class 1 Chromeleon license are required. (If you have any questions, please contact your Dionex sales representative.)

The pump is connected to the Chromeleon server PC via the USB port (→ Fig. 5, page 20) on the instrument's rear panel. Follow the installation steps below.

## 5.2 USB Installation

**Please note: Install Chromeleon software before connecting the pump to the USB port on the Chromeleon server PC.**

Observe the information about the facility requirements (→ page 19). Use the power cord shipped with the pump to connect the instrument to the mains. Turn on the pump by pressing the power switch on the rear panel. Use the USB cable from the pump's accessories kit (→ page 93) to connect the pump to the USB port on the Chromeleon server PC.

**Please note:** Apart from the solvent rack, all modules of the UltiMate 3000 system can be connected separately to the server PC. However, Dionex recommends interconnecting all modules, and then connecting the system to the Chromeleon server PC via only one connection, e.g., from the autosampler. For more information about how to connect the system modules, refer to *UltiMate 3000: System Installation and Application* (in the manual binder for UltiMate 3000 system pump).

**Please note:** The USB connection to the PC or the USB hub must not exceed 5 m.

During the Chromeleon installation, the Windows USB drivers are copied to the appropriate locations. When you connect the pump for the first time, the Plug&Play Manager (Hardware Wizard) guides you through the remaining USB installation and installs the drivers as required. Afterward, follow the instructions in section 5.3 (→ page 46) to install and configure the pump in the Chromeleon Server Configuration program.

## 5.3 Installing the Pump in Chromeleon

Follow the steps below to install the pump in the Chromeleon installation program (= Server Configuration):

**Please note:** The description below refers to Chromeleon 6.70.

- Start the Server Monitor program by selecting **Server Monitor** on the **Start → Programs → Chromeleon** menu on the task bar. Start the server and close the Server Monitor window. The Server Monitor icon appears on the task bar.

  **Please note:** Clicking the **Quit Monitor** button quits (exits) the Server Monitor program, but it does not stop the server. To stop the server, click the **Stop** button.

- Start the **Server Configuration** program by selecting Server Configuration on the **Start → Programs → Chromeleon** menu on the taskbar.
- If necessary, click the "+" sign beside the server name to display the items underneath.
- Select the timebase to which to add the pump.
- Select **Add Device…** on the **Edit** or context menu.
- The **Add device to timebase** dialog box is opened. Select **Dionex LC Packings Capillary/Nano LC Modules** from the left list box, and then select **LPG-3x00 Pump** from the right list box. Click **OK** to confirm your selection.

A wizard guides you through the installation of your pump:

Clicking **Next>** takes you to the next wizard page.

Clicking **<Back** returns you to the previous wizard page.

### General Wizard Page

Define the general instrument parameters.

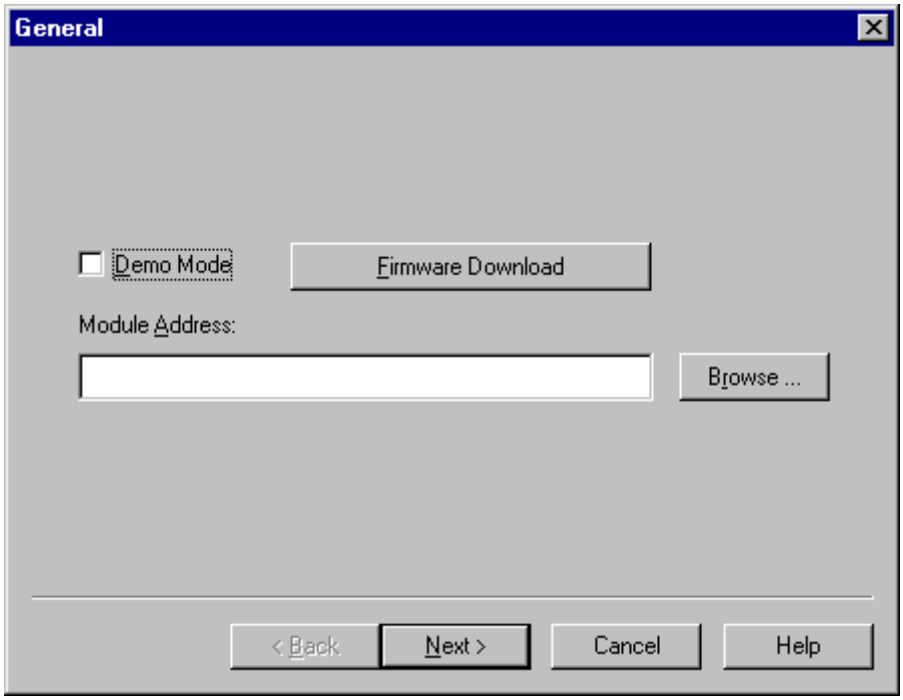



*Fig. 29: General wizard page*

- Verify that the **Demo Mode** check box is cleared. If the **Demo Mode** is enabled, the **Module Address** input field is disabled. *Note:* If you exit this page without specifying a module address, Demo Mode is enabled automatically. In Demo Mode, Chromeleon simulates the functions of the pump (→ Note on page 56).
- Click **Browse…** to select the **Module Address** of the pump that you want to use. A window is opened showing information about all pumps that are connected via a USB connection.

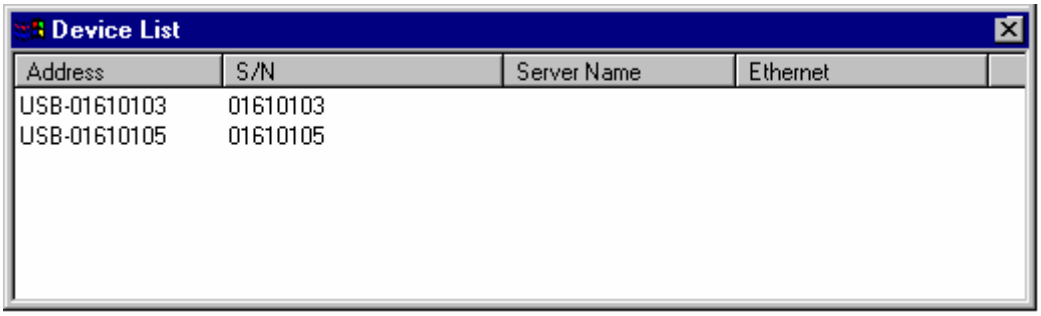



*Fig. 30: Device list*

The **Address** column lists all modules that are available via USB (identified by the prefix **USB** plus the module's serial number).

The **S/N** column lists the module's serial number. The **Server Name column** is empty. Entries that might appear in the **Ethernet** columns are irrelevant.

Select the pump by double-clicking. The module's address is automatically entered in the **Module Address** field on the **General** wizard page.

- Click the **Firmware Download** button to download the current firmware version from Chromeleon to the pump. (The button is disabled if the **Demo Mode** is enabled.) The current firmware version is displayed as well as the version of the file that is available in the **\Bin** directory of your Chromeleon installation (UM3_LPG.HEX).

  **Please note:** The pump is shipped with the most recent firmware version installed. Therefore, you do not need to download the firmware from Chromeleon when you install the pump.

  Click **OK** to start the firmware download. Please note that the Chromeleon server needs to be in **running idle** mode for the download. The download can take several seconds. The download is complete when **Download finished successfully** appears in the Chromeleon audit trail.

  **Important:** During the download, make sure that the communication between the pump and Chromeleon is not interrupted and do not turn off the instrument. Problems or errors during the download may lead to malfunction of the pump. In this case, turn off the pump. Turn on the pump again and repeat the download as described above.
  If the download is not successful, contact Dionex Service.

  **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. Des problèmes ou des erreurs durant le téléchargement peuvent entraîner des dysfonctionnements de la pompe. Dans ce cas, arrêtez la pompe. Remettez la pompe en marche et répétez l'opération de téléchargement tel que décrit ci-dessus.
  Si le téléchargement échoue, contactez le service après-vente Dionex.

  **Please note:** Make sure that the pump is unpressurized (e.g., the purge screw on the outlet block is loose) and that the flow is turned off. Immediately after the new firmware has been downloaded from Chromeleon to the instrument, the pump performs a reset. For about 15 seconds, the pump's internal bootloader is updated. Therefore, do not turn off the pump while the bootloader is updating.

Clicking **Next>** takes you to the next wizard page.

- When you install the pump for the first time, the following message appears when you leave the **General** page (while the Demo Mode is disabled):


*Fig. 31: Message upon initial installation of the pump*

Chromeleon attempts to connect to the pump, retrieve the settings from the pump's firmware, and set the options (pump type and pump head) on the corresponding wizard pages. Click **Ok** to confirm the message.

### Devices Wizard Page

Specify whether the related pump is connected to the flow splitter of an FLM-3000 flow manager:

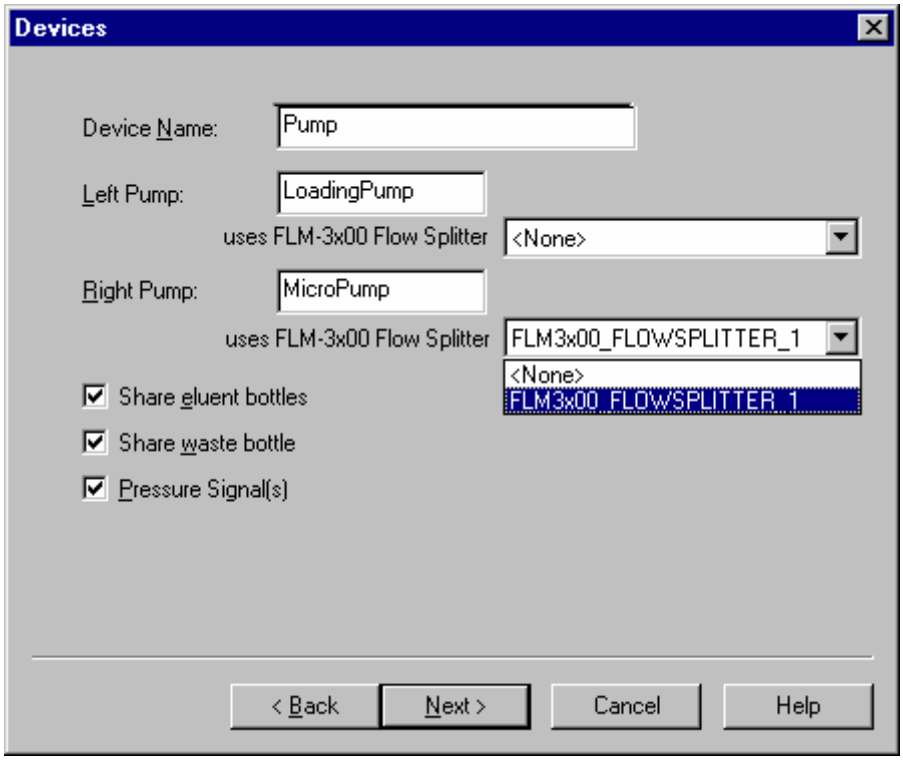



*Fig. 32: Devices wizard page (here: for an LPG-3600)*

- The **Device Name** field reports the name under which the pump is identified in the installation environment and in the Chromeleon client. Accept the default device name (**Pump**).

**Please note:** If you change the default device name, you have to re-link the corresponding controls of the related control panel(s).

- *LPG-3600 only:*
  The **Left Pump** and **Right Pump** fields report the names under which the two pumps of an LPG-3600 are identified in the installation environment and in the Chromeleon client. The default names are **LoadingPump** for the left pump and **MicroPump** for the right pump. Dionex recommends accepting these default names, also.

- If your HPLC system includes a flow manager of the FLM-3000 series, use the **uses FLM-3x00 Flow Splitter** fields to specify whether the pump is connected to a flow splitter. The default entry is **<None>**. To change the setting, click the arrow next to the input field and select the splitter from the drop-down list.

  **Please note:** When you assign a flow splitter to a pump, the pump flow settings apply directly to the flow on the splitter outlet, i.e., the split ratio is considered automatically.

  **Please note:** In the standard configuration of the UltiMate 3000 system with an LPG-3600 pump, Dionex recommends assigning the flow splitter to the right pump (MicroPump).

- *LPG-3600 only:*
  The **Share eluent bottles** check box is selected by default. Accept this setting if both pumps of the LPG-3600 are connected to the same set of solvent reservoirs. Clear the check box if the pumps are connected to different sets of reservoirs. In this case, Chromeleon supports the **%A/B/C_RemainTime** and **%A/B/C_WarningLimit** properties (→ page 59) separately for each pump.

  The **Share waste bottle** check box is selected by default, also. Accept this setting if both pumps are connected to the same waste container. Clear the check box if the pumps are connected to different waste containers. In this case, Chromeleon supports the **WasteRemainTime** und **Waste_WarningLimit** properties (→ page 62) separately for each pump.

  **Please note:** If the check boxes are selected, Chromeleon assigns the properties the same values for each pump.

- The **Pressure Signal(s)** check box is selected by default. Accept this setting if you want to record the pump pressure. Chromeleon generates the appropriate channel(s) for data acquisition.

  **Please note:** For an LPG-3300, the name under which the channel appears in the Chromeleon **Commands** dialog box is generated from the entry in the **Device Name** input field. For an LPG-3600, the names are generated from the entries in the **Right Pump** and **Left Pump** input fields. In all cases, the names are extended by **_Pressure**.

If the LPG-3300 or LPG-3600 micro pump has a flow splitter assigned, the name ends in **_MasterPressure**. (In the LPG-3600 standard configuration, the names are **MicroPump_MasterPressure** and **LoadingPump_Pressure**; → page 61.)

Clicking **Next>** takes you to the next wizard page.

### Configuration complete Wizard Page

Basic configuration of the pump is complete. However, on the following wizard pages, you may make additional settings and/or determine which relays and digital inputs shall be available in Chromeleon:

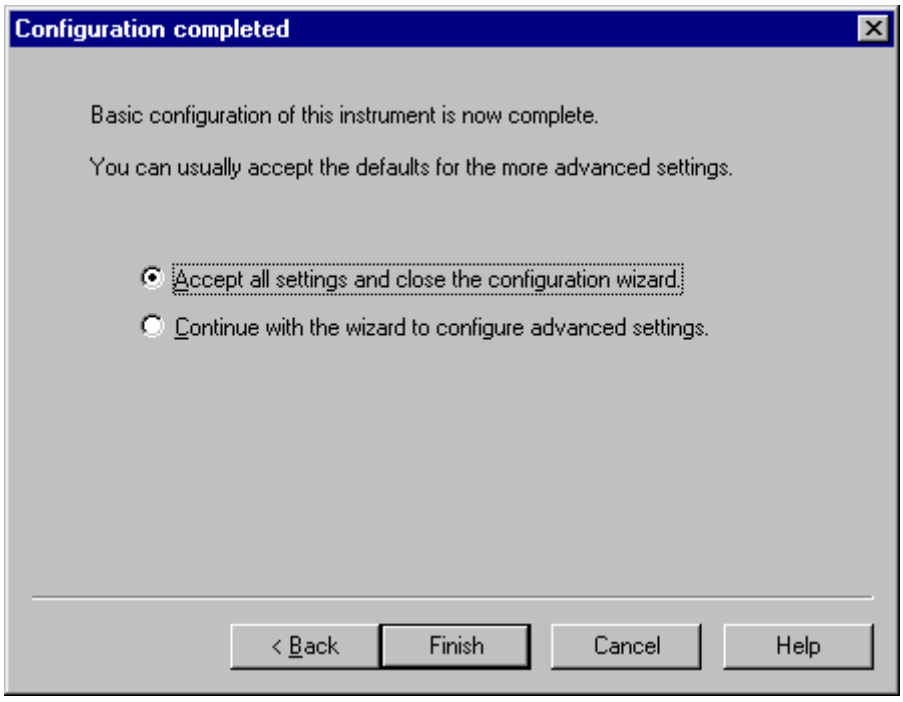



*Fig. 33: Configuration completed wizard page*

- **Accept all settings and close the configuration wizard** is selected by default. Click **Finish** if you want to complete the configuration and accept the default values for the more advanced settings. Afterward, save and close the Server Configuration.

- Select **Continue with wizard to configure advanced settings** to continue with the advanced settings (flow limits, pressure limits, and/or solvent names) and to determine which relays and digital inputs shall be available in Chromeleon. Clicking **Next>** takes you to the next pages.

**Please note:** You may as well open the configuration pages for the advance settings after the installation. Select **LC Packings LPG-3x00 Pump** in the Chromeleon Server Configuration program, and then select **Properties** on the context menu.

### Right Pump and Left Pump and/or Head Type & Limits Wizard Pages

**Please note:** Except for the name, these pages are identical.
If you install an LPG-3600, the wizard provides the **Right Pump** and **Left Pump** pages. The settings on the **Right Pump** page relate to the right pump of the LPG-3600 and the settings on the **Left Pump** page relate to the left pump.
If you install an LPG-3300, the wizard page is called **Head Type and Limits**.

Determine the upper and lower limits for the flow rate and the pressure and select the pressure unit.

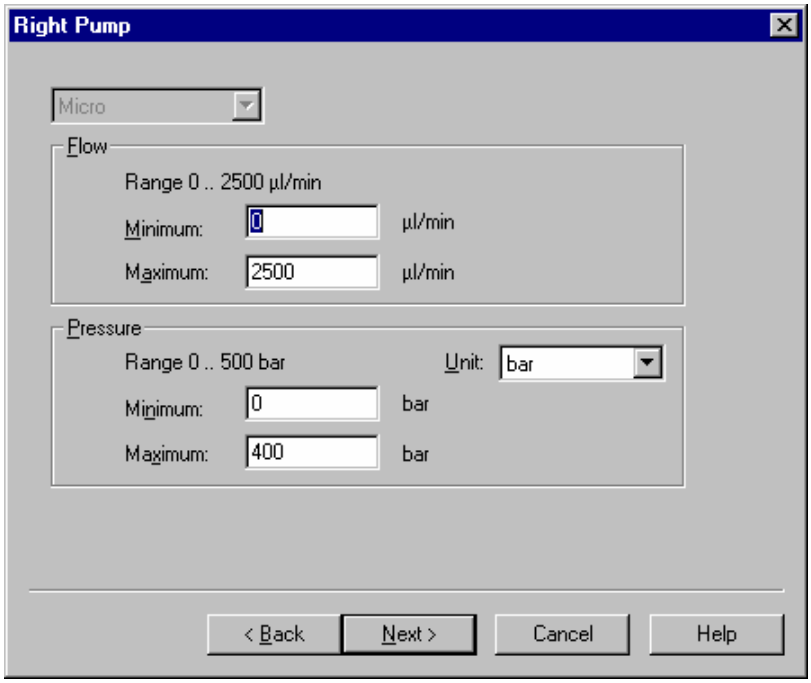



*Fig. 34: Right Pump wizard page*

- On the top left, the installed pump head is indicated. The pump head type affects the maximum allowed flow rate and pressure.

- Determine the limits for the flow rate:

| Flow | Description |
|---|---|
| Range | Shows the allowed flow rate range. The range depends on the pump type and the installed pump head. |
| Minimum | Enter a new value to change the lower limit for the flow rate range. |
| Maximum | Enter a new value to change the upper limit for the flow rate range. |

- Determine the limits for the system pressure and select the pressure unit:

| Pressure | Description |
|---|---|
| Range | Shows the allowed pressure range. The range depends on the pump type and the installed pump head. |
| Unit | Select the pressure unit (psi, bar, or MPa). |
| Minimum | Enter a new value to change the lower limit for the minimum pressure. |
| Maximum | Enter a new value to change the limit for the maximum pressure. |

Clicking **Next>** takes you to the next wizard page.

### Right Solvents and Left Solvents and/or Solvents Wizard Pages

**Please note:** Except for the name, these pages are identical.
If you install an LPG-3600, the wizard provides the **Right Solvents** and **Left Solvents** pages. The settings on the **Right Solvent** page relate to the right pump of the LPG-3600 and the settings on the **Left Solvent** page relate to the left pump.
If you install an LPG-3300, the page is called **Solvents**.

Determine the number and names of the solvents delivered by the pump:

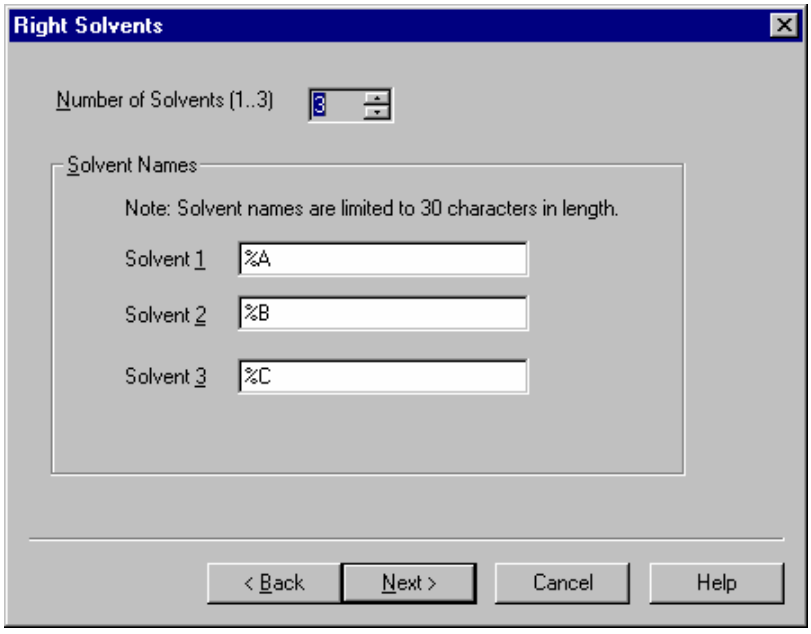



*Fig. 35: Right Solvents wizard page*

- In the **Number of Solvents** field, use the arrows to indicate how many solvents are delivered by the pump. The maximum number of solvents for an LPG-3300 is 3. The maximum number of solvents for an LPG-3600 is 2x3.
- Under **Solvent Names**, enter a name for each connected solvent in the corresponding input field. A maximum of 30 characters is permitted. The names of the solvents appear, for example, in the gradient display of the online control panel and in the report.

### Relays Wizard Page

This page lists all available relays. Select a check box to enable or disable the corresponding relay. Make sure that the required relays are selected; if they are not, they will not be available in Chromeleon. Also, refer to section 3.2.2.2 (→ page 22).

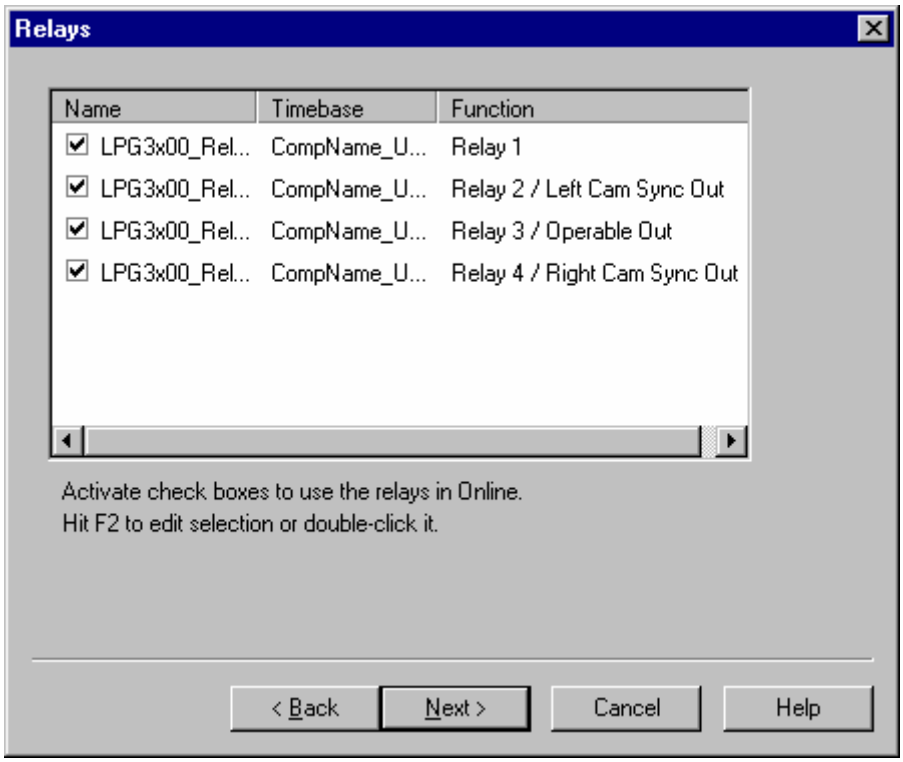



*Fig. 36: Relays wizard page*

Clicking **Next>** takes you to the next wizard page.

### Inputs Wizard Page

This page lists all available remote inputs. Select a check box to enable or disable the corresponding remote input. Make sure that the required inputs are selected; if they are not, they will not be available in Chromeleon.

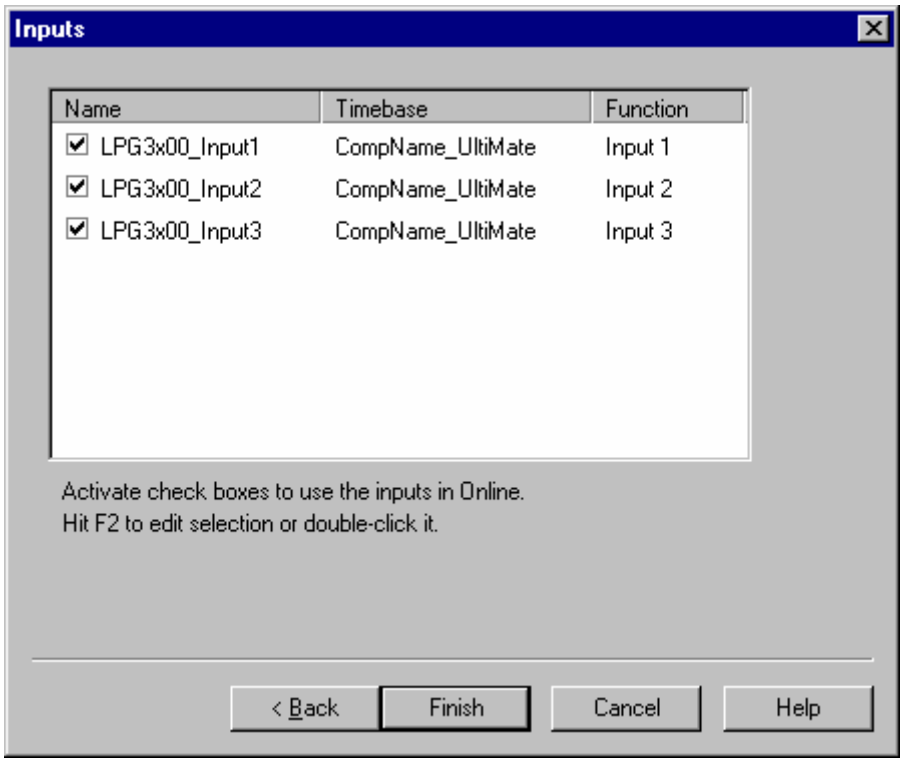



*Fig. 37: Inputs wizard page*

Click **Finish>** to complete the installation of the pump. Afterward, save and close the Server Configuration.

**Please note:** Before turning off the pump by the power switch, always **disconnect** the module in Chromeleon. Disconnecting the module in Chromeleon is not required to set the pump to the Standby mode.

**Please note:** You may as well reopen the wizard pages later again to change the settings. Select **LC Packings LPG-3x00 Pump** in the Chromeleon Server Configuration program, and then select **Properties** on the context menu.

When you reopen die **General** tab page later again, a **Retrieve configuration from pump** button is available. Click this button to transfer the current pump configuration to Chromeleon. However, this is necessary only if you connect a different pump or if automatic matching was not performed correctly when the wizard was started.

In addition, Chromeleon provides an **Error Levels** tab page. This tab page classifies the severity of any errors that occur. It is generally not necessary to change the default settings.

**Please note:** You may simulate the functions of the pump, also. To do so, select the **Demo Mode** check box on the **General** wizard page and click **OK**. The following dialog box appears:

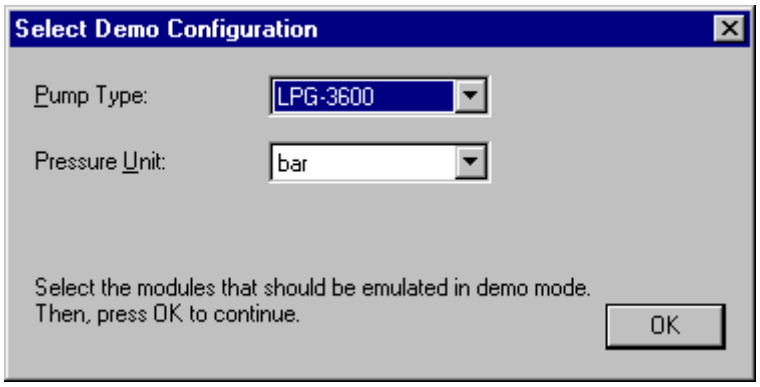



*Fig. 38: Select Demo Configuration dialog box*

Select the **Pump Type** and the **Pressure Unit** (MPa, bar, or psi) from the associated drop-down lists. Confirm your selection by clicking **OK** and configure the pump in the installation wizard as described above.

For more information about how to configure the pump, refer to the Chromeleon online Help.

## 5.4 Synchronizing the WPS-3000 Autosampler with the Pump

If your system includes a WPS-3000 or WPS-3000T autosampler, you can synchronize the injection command of the autosampler with the strokes of the UltiMate 3000 system pump (LGP-3600 or LPG-3300). Synchronization ensures that all injections are performed at the same phase of the pump cycle.

**Please note:** Dionex recommends always enabling synchronization as synchronization helps enhancing the analytical results considerably.

Follow the steps below:

- In the Chromeleon Server Configuration program, right-click **LC Packings WPS-3000 Well Plate Sampler**.
- Select **Properties** on the context menu.
- On the **Segments** tab page, indicate whether synchronization shall be performed. Click the arrow of the **Sync Inject with pump** field and select an option from the drop-down list:

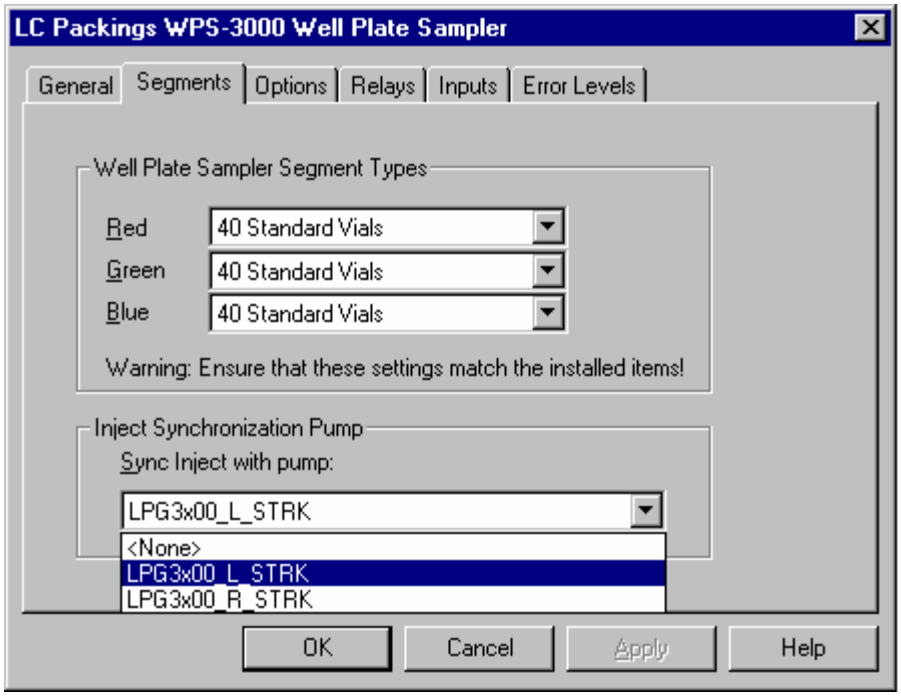



*Fig. 39: Segments tab page*
*(here: when the UltiMate 3000 system includes an LPG-3600 pump)*

**Please note**: The options are available only if both the autosampler and the pump are installed in Chromeleon.

- Select **None** to disable synchronization.
- When the UltiMate 3000 system includes an LPG-3600 pump:
  Select **LPG3x00_L_STRK** to enable synchronization with the left pump. To enable synchronization with the right pump, select **LPG3x00_R_STRK**.
- When the UltiMate 3000 system includes an LPG-3300 pump:
  Select **LPG3x00_STRK** to enable synchronization.

**Please note:** You can change the default synchronization assignment for a specific application, using the **PumpDevice** and **SyncWithPump** properties in the **Commands** dialog box under **Sampler** on the control panel or in the program file (PGM).

To disable synchronization for a specific application, set **SyncWithPump** to **Off**. Use the **PumpDevice** property to select the pump for which synchronization shall be performed (**MicroPump** or **LoadingPump** for an LPG-3600; **Pump** for an LPG-3300).

Changing the settings for these properties from the **Commands** dialog box does not change the standard synchronization setting on the **Segments** tab page.

## 5.5 Operating the Pump with Chromeleon

Chromeleon can control the pump in two ways:

- Directly, via either the toolbar icons and menu commands or the controls on an appropriate control panel (e.g., Ultimate_3000_Pump.pan)
- Via time-based programs (PGM-File or programmable buttons).

### 5.5.1 Chromeleon Commands and Properties

The following commands, properties, signals, and relays are available under **Pump** in the **Commands** dialog box when **Expert** mode is enabled; some of them are displayed only if the corresponding check boxes have been selected in the Server Configuration program. (For information about how to set the Expert mode, refer to the *Chromeleon online Help*.) Besides, the installed Chromeleon version determines which commands and properties are available. The table below lists the entries in alphabetical order. The list refers to Chromeleon 6.70.

**Please note:** For an LPG-3600, the entries **MicroPump** (for the right pump) and **LoadingPump** (for the left pump) appear in the **Commands** dialog box underneath the main **Pump** entry.

| Chromeleon | Description |
|---|---|
| **%A, %B, %C** | Reports the partial flow of the corresponding component in percent of the total flow. Click the "+" sign beside the name to display the items underneath:<br>**Value–**reports the partial flow (read-only)<br>**Equate–**the name can be selected by the user. |
| **%A/B/C_Level** | Monitors the solvent level. Click the "+" sign beside the name to display the items underneath:<br>**Value–**enter the amount of solvent available when you start the sequence<br>**LowerLimit–**enter the minimum liquid level for the associated solvent. An error message appears in the audit trail if the liquid level reaches the lower limit. Select **Disable** to disable solvent level checking.<br>Also, refer to note 1 underneath this table. |
| **%A/B/C_RemainTime** | Reports the approximate time until the associated solvent reservoir will be empty to the lower limit (see **%A/B/C_Level**).<br>Also, refer to note 1 underneath this table. |
| **%A/B/C_WarningLimit** | Specify the percentage for the solvent warning level. The default percentage is 10%. A warning appears in the Chromeleon audit trail when the solvent level in the associated reservoir has reached the specified percentage above the lower limit (see **%A/B/C_Level**).<br>Also, refer to note 1 underneath this table. |
| **AnalogOut**<br>(LPG-3600 only) | Specifies for which pump the pressure is available at the analog output (**PumpRight** or **PumpLeft**). |
| **Brightness** | Adapts the brightness of the pump's front panel display to your requirements. |
| **CamRevolutionsRight** *and* **CamRevolutionsLeft** | Reports the number of revolutions of the cam of the pump (read-only). For an LPG-3600, **CamRevolutionsRight** refers to the right pump and **CamRevolutionsLeft** refers to the left pump. |

| Chromeleon | Description |
|---|---|
| **Connect** | Connects the pump to Chromeleon.<br>(Also, refer to **Connected** and/or **Disconnect**.) |
| **Connected** | Reports whether the pump is connected to Chromeleon, that is, under computer control. (Also, refer to **Connect** and/or **Disconnect**.) |
| **Contrast** | Adapts the contrast of the pump's front panel display to your requirements. |
| **Degasser** | Turns the degaser of an SRD-3000 solvent rack with integrated degasser on or off.<br>For pumps operated with an SRD-3000 solvent rack with integrated degasser, the setting should always be **On**. For pumps that are operated without degasser or with an external third-party degasser, select **Off**. |
| **DegasserVacuum** | Reports whether the degasser in the SRD-3000 solvent rack reached the operating vacuum (**OK** or **NotOK**; read-only). |
| **Disconnect** | Disconnects the pump from Chromeleon<br>(also, refer to **Connected, Connect**). |
| **DisplayMode** | Specifies which information appears on the pump's front panel display. For an LPG-3600, select **Left_Master**, **Left_Column**, **Right_Master**, **Right_Column**, or **Both**. For an LPG-3300, select **Master** or **Column**. For more information, refer to Information on the Front Panel Display (→ page 37). |
| **FirmwareVersion** | Indicates the firmware version of the pump (read-only). |
| **Flow** | Sets the flow rate.<br>For pumps *without* flow splitter assignment on the **Devices** page in the server configuration program (→ page 49), Flow refers the total flow through the pump. For pumps *with* flow splitter assignment in the server configuration program, Flow refers to the flow through the column. In this case, **MasterFlow** reports the total flow through the pump. |
| **HeadType** | Reports the pump's head type (read-only). The pump head affects the flow rate and the system pressure. |
| **Leak** | Reports whether the pump's leak sensor detected a leak (read-only): **NoLeak** or **Leak**. If a leak has been detected, the corresponding message is logged in the audit trail. |
| **LeakAlarm** | Reports whether there is a leak alarm (**On** = yes; **Off** = no; read-only). |
| **LeakAlarmOff** | Turns off the beep for the current alarm. A new beep sounds when the leak sensor detects another leak. |
| **LeakDelay** | Sets the time for how long a leak may occur before the pump shuts down. |
| **LeakSensorMode** | Specifies how leak detection is performed:<br>**Enabled–**enables leak detection. When the sensor is activated, a message appears in the Chromeleon audit trail and an acoustic beep sounds.<br>**Silent–**enables leak detection. When the sensor is activated, a message appears in the Chromeleon audit trail, but no beep sounds.<br>**Disabled–**disables leak detection. |
| **LoadingPump_Pressure** (LPG-3600 only) | Refer to **MicroPump_MasterPressure** (→ page 61). |
| **LPG3x00_Input1** *to* **LPG3x00_Input2** | The associated input is available only if you have selected the related check box on the **Inputs** tab page in the Server Configuration program. Reports the status of the associated digital input (On or Off). |
| **LPG3x00_Relay1** *to* **LPG3x00_Relay4** | The associated relays are available only if you have selected the related check box on the **Relays** tab page in the Server Configuration program. Click the "+"sign beside the name to display the items underneath: **State** (reports and/or sets the state of the relay), **Duration** (when set, the relay's state toggles after the specified time), **On** (turns the relay on), and **Off** (turns the relay off). |

| Chromeleon | Description |
|---|---|
| **MasterFlow** | Reports the flow (in µ/min) through the master pump, i.e., the total flow, which is the flow before the flow splitter (read-only). This property is available only if a flow splitter is assigned to the right pump (MicroPump) on the **Devices** page in the server configuration program (→ page 49; also, see **Flow**). |
| **MasterPressure** | Reports the pressure of the master pump, i.e., the pressure before the flow splitter. This property is available only if a flow splitter is assigned to the right pump (MicroPump) on the **Devices** page in the server configuration program (→ page 49; also, see **Pressure**).<br>Click the "+" sign beside the name to display the items underneath:<br>**LowerLimit–**sets the lower pressure limit<br>**UpperLimit–**sets the upper pressure limit<br>**Value**–reports the pump pressure (read only).<br>If the pressure is outside the specified limits, the system aborts the batch and starts an emergency program if necessary. |
| **MaximumFlowRampDown** | Enter the limit for the flow rate deceleration. |
| **MaximumFlowRampUp** | Enter the limit for the flow rate acceleration. |
| **MicroPump_MasterPressure** *(also, LoadingPump_Pressure and Pump_Pressure)* | These signals support recording the pressure as a separate channel. They are available only if the **Pressure Signal(s)** check box is selected in the pump's properties (on the **Devices** tab page in the Server Configuration program). (The channel names are generated from the entries in the related input fields on the **Devices** tab page, extended by **_Pressure** or **_MasterPressure**, → page 49).<br>Click the "+" sign beside the name to display the items underneath:<br>**Signal–**reports the current signal value (read-only).<br>**Delta–**reports the signal's slope (= the difference between the current value and the value one second ago. This is useful for triggers. Read-only.)<br>**AcqOn–**starts data acquisition.<br>**AcqOff–**terminates data acquisition.<br>**Retention–**reports the retention time of the signal.<br>**MaxAutoStep–**sets the maximum step rate for Auto Step Mode (range: 0.1...5.1 s; default: 5.1 s)<br>**Step–**sets the step for data acquisition (range: 0.01...4.80 s; **Auto** selects the best step dynamically.)<br>**Average–**averages all measured values over the step interval. (Default: **On**. **Off** records only the last point of each interval.) |
| **ModelNo** | Indicates the pump type (read-only). |
| **ModelVariant** | Indicates the variant (read-only): **LPG** for low-pressure gradient. |
| **Motor** | Turns the pump flow **On** or **Off**. |
| **ParkPercentage** | Enables peak parking. For peak parking, the flow is reduced to the specified percentage of the current flow. (Also, see PeakParked.) |
| **PeakParked** | Reports the status of peak parking. Reports **Yes** while the pump delivers the reduced flow set by ParkPercentage, |
| **Pressure** | Reports the pressure.<br>For pumps *without* flow splitter assignment on the **Devices** page in the server configuration program (→ page 49), Pressure refers to the current pump pressure. For pumps *with* flow splitter assignment in the server configuration program, Pressure refers to the current column pressure. In this case, **MasterPressure** reports the current pump pressure.<br>Click the "+" sign beside the name to display the items underneath:<br>**LowerLimit–**sets the lower pressure limit<br>**UpperLimit–**sets the upper pressure limit<br>**Value**–reports the pump pressure (read only).<br>If the pressure is outside the specified limits, the system aborts the batch and starts an emergency program if necessary. |

| Chromeleon | Description |
|---|---|
| **Pump_MasterPressure** | Refer to **MicroPump_MasterPressure** (→ page 61). |
| **Purge** | Turns the purge flow **On** or **Off**. (Also, see **PurgeFlow**, **PurgeTime**.) |
| **PurgeFlow** | Enter the flow rate for purging. The allowed input range depends on the installed pump head. The default setting is 2 ml/min. (Also, see **PurgeFlow**, **PurgeTime**.) |
| **PurgeTime** | Enter the purge time. The default purge time is 300 seconds. (Also, see **Purge**, **PurgeFlow**.) |
| **RearSealLeakCounter** | Reports the number of drops that passed the piston seals in the past hour. |
| **RearSealLeakLimit** | Specifies the leak detection threshold for the rear seal wash system (2 to 100 drops/hour). If the limit is met, a message is displayed in the audit trail. |
| **RearSealWashPump** | Reports whether the peristaltic pump of the rear seal wash system is running (**Active**) or not (**Idle**) |
| **RearSealWashSystem** | Turns the rear-seal wash system on (**Interval** or **Automatic**) or **Off**. **Interval** activates rear-seal washing once per hour for five minutes. However, the drop sensor is not active, i.e., monitoring the piston seals for tightness is disabled. **Automatic** periodically activates rear-seal washing once per hour until the drop sensor has counted 50 drops. The drop sensor is active, i.e., the piston seals are monitored for tightness. **Off** turns the rear-seal wash system off. |
| **Relay2Enabled** | Controls whether relay 2 of an LPG-3600 can be used in Chromeleon (**Yes**) or whether it is controlled by the pump for the **Left Cam Sync Out** signal (**No**; → section 3.2.2.2, page 22).<br>With an LPG-3300, relay 2 can always be used in Chromeleon. |
| **Relay3Enabled** | Controls whether relay 3 can be used in Chromeleon (**Yes**) or whether it is controlled by the pump for the **Operable Out** signal (**No**; → section 3.2.2.2, page 22). |
| **Relay4Enabled** | Controls whether relay 4 can be used in Chromeleon (**Yes**) or whether it is controlled by the pump for the **Right Cam Sync Out** signal (**No**; → section 3.2.2.2, page 22). |
| **SelfTest** | Runs a number of internal tests and checks all of the main components. |
| **SelfTestPassed** | Reports whether the pump has passed the self test (**Yes**). If the pump does not pass the self-test, an error message appears in the Chromeleon audit trail. |
| **SerialNo** | Indicates the pump's serial number (read-only). |
| **SolventRackLeak** | Reports whether the leak sensor in the SRD-3000 solvent rack detected a leak (**Leak** or **NoLeak**; read-only). |
| **Standby** | Sets the pump into the **Standby** mode or cancels this mode (**NoStandby**). |
| **WasteLevel** | Monitors the waste level. Click the "+" sign beside the name to display the items underneath:<br>**Value–**enter the actual waste level before starting a sequence<br>**UpperLimit–**enter the capacity of your waste container before starting a sequence. An error message appears in the audit trail if the liquid level reaches the lower limit. Select **Infinite** to disable waste level checking.<br>Also, refer to note 2 underneath this table. |
| **WasteRemainTime** | Reports the approximate time until the associated waste container will be full to the upper limit (see **WasteLevel**).<br>Also, refer to note 2 underneath this table. |
| **WasteWarningLimit** | A warning appears in the Chromeleon audit trail when the waste level has reached the specified percentage of the upper limit (see **Waste_Level**). Specify the percentage here.<br>Also, refer to note 2 underneath this table. |

| Chromeleon | Description |
|---|---|
| **WorkLoadRight** *and* **WorkLoadLeft** | Reports the workload of the pump (read-only). The workload is calculated from the flow, pressure, and time parameters and is indicated in MegaJoule [MJ]. For an LPG-3600, **WorkLoadRight** refers to the right pump and **WorkLoadLeft** refers to the left pump. |

**Note 1:** If the two pumps of an LPG-3600 are connected to separate sets of solvent reservoirs, clear the **Share eluent bottles** check box on the **Devices** tab page (→ page 49) in the pump's properties in the Server Configuration program to have Chromeleon support the **%A/B/C_RemainTime** properties separately for each pump.

**Note 2:** If the two pumps of an LPG-3600 are connected to separate waste containers, clear the **Share waste bottle** check box on the **Devices** tab page (→ page 49) in the pump's properties in the Server Configuration program to have Chromeleon support the **WasteRemainTime** properties separately for each pump.

For information about individual commands and parameters or the command syntax, refer to a Chromeleon control panel. Select **Command** on the **Control** menu. The **Commands** dialog box is opened. You can also open this box by pressing the F8 key. In the left list box, click the "+" sign beside **Pump, MicroPump** and/or **LoadingPump** to display the items underneath.

For more information (also about any parameter or command that might not be listed here), refer to the *Chromeleon online Help*.

**Please note:** When the pump is correctly connected to Chromeleon, the **Connected** LED on the instrument's front panel is green.

**Please note:** The soft keys are disabled while the pump is connected in Chromeleon.

**Please note:** The **Standby** button on the instrument's front panel remains active when the flow manager is operated by Chromeleon.

**Please note:** If your UltiMate 3000 system includes an FLM-3000 flow manager and if you specified in the flow manager's properties on the **Configuration** tab page that the column pressure is recorded as a separate channel, an additional **ColumnPressure** entry appears in the **Commands** dialog box (under the related **ColumnOven**), also.

| Chromeleon | Description |
|---|---|
| **ColumnPressure** | Click the "+"sign beside the name to display the items underneath:<br>**Delta–**reports the signal's slope, i.e., the difference between the current value and the value one second ago. This is useful for triggers.<br>**Signal–**has the following entries: **Value–**reports the current signal value (read-only), **UpperLimit–**sets the upper signal limit, and **LowerLimit–**sets the lower signal limit.<br>**AcqOn–**starts data acquisition.<br>**AcqOff–**terminates data acquisition.<br>**Retention–**reports the retention time of the signal (read-only).<br>**MaxAutoStep–**sets the maximum step rate for Auto Step Mode (range: 0.1...5.1 s; default: 5.1 s).<br>**Step–**sets the step for data acquisition (range: 0.01...4.80 s; **Auto** selects the best step dynamically.)<br>**Average–**averages all measured values over the step interval. (The default setting is: On. Off records only the last point of each interval.) |

**Please note:** Operational and/or Performance Qualification allows you to check and document the quality of your HPLC system. All required materials and detailed instructions are available from Dionex on request.

### 5.5.2 Operation after a Power Failure

If the pump is controlled by Chromeleon, the program file (PGM File) can include a command that automatically restarts operation as desired after a power failure. For more details, refer to the *Chromeleon online Help*.

# 6 Troubleshooting

Each time a fault or mechanical failure occurs during the operation of the pump, an error message appears on the pump's front panel display. The error message is logged in the Chromeleon audit trail, also. The following table summarizes the most frequently observed error messages, lists possible causes, and suggests appropriate remedial actions.

**Please note:** For some messages, the name specified on the **Devices** page in the Chromeleon Server Configuration program (→ page 49) may appear in front of the actual message text, e.g., MicroPump.

| Message | Cause | Remedial Action |
|---|---|---|
| Abnormal drive current for xx seconds since (= time). | The capillary from the working head to the equilibration head is blocked.<br>The outlet valve is blocked, defective, or incorrectly installed. | Inspect the capillary for indications of blockage. Replace the capillary if necessary.<br>Check the valve for permeability.<br>If the message appears again, contact Dionex Service. |
| Camshaft index too early or too late. | Internal error in the driving unit. | Turn the pump off and on again. If the error message appears again, contact Dionex Service. |
| Camshaft sensor always alight. | Internal error in the driving unit. | Turn the pump off and on again. If the error message appears again, contact Dionex Service. |
| Camshaft sensor missing or dark. | Internal error in the driving unit. | Turn the pump off and on again. If the error message appears again, contact Dionex Service. |
| Degasser malfunction. | The vacuum level monitoring function of the solvent rack degasser was activated. | If a solvent rack of the SRD-3000 solvent rack series with integrated degasser is connected to the pump, turn the rack off and on again via the standby button. If the error message appears again, contact Dionex Service. |
| Drive current too large. Camshaft xx°. | One or more capillaries are blocked.<br>Note: When this message appears, the pump continues running. | Inspect and check the capillaries for signs of blockage. Replace the capillaries if necessary. |
| Excessive drive current. Camshaft xx°. | One or more capillaries are blocked.<br>Note: When this message appears, the pump stops running. | Inspect and check the capillaries for signs of blockage. Replace the capillaries if necessary. |
| Invalid flow value. | The entered value is invalid for this pump version configuration. | Enter a flow value that it is within the permissible range. |
| Invalid parameter. | You entered an invalid. | Enter a valid parameter. |
| Invalid partial flow setting. | The entered partial flow setting is not valid. | Enter a partial flow setting that is within the permissible range and is logically correct. |

| Message | Cause | Remedial Action |
|---|---|---|
| Leak detected. Flow stopped. | The pump's leak sensor (→ Fig. 40, page 74) has detected a leak. The flow is automatically turned off. | Find and eliminate the leak. Dry the leak sensor and the tray (→ section 7.3, page 74). |
| Motor malfunction. | Internal error in the driving unit. | Turn the pump off and on again. If the error message appears again, contact Dionex Service. |
| Motor position error. The motor is overloaded. | The pump's motor is overloaded. | Inspect the system for indications of blockage.<br>This message can also appear if the upper pressure limit is exceeded (→ page 68). |
| One of the piston seals is leaking. | Rear-seal washing is enabled but the peristaltic pump is not running. Nevertheless, liquid reaches the seal-wash detector. | Solvent is leaking through the main piston seal of one or more pistons.<br>If this leakage does not affect your analysis, increase the value for the piston leak in Chromeleon (→ **RearSealLeakLimit**, page 62).<br>If the leakage affects your analysis, replace the piston seals (→ section 7.6.2.3, page 84). |
| Parameter could not be changed while pump is running. | You tried to change a parameter in a program while the pump or a program was running. | Stop the pump or program and try it again. |
| Possible piston seal leak detected. | More drops that specified under RearSealLeakLimit reach the liquid reservoir. | Visually inspect the piston seals for leakage (→ section 7.6.1, page 81). Replace the piston seals and support rings as necessary (→ section 7.6.2, page 82) or increase the default value for the piston leak in Chromeleon (→ **RearSealLeakLimit**, page 62). |
| Pressure fallen below lower limit. | The solvent supply is used up.<br>There are air bubbles in solvent line.<br>The solvent emits gas when mixing.<br>There is a leak in the system.<br>One of the check valves is defective.<br>The lower pressure limit cannot be reached for the specified flow. | Refill the solvent; purge the system (→section 3.3.5, page 34).<br>Check the filter frits, purge the system (→section 3.3.5, page 34.<br>Degas the solvent and check the degasser.<br>Find and eliminate the leak; tighten loose fitting connections.<br>Clean or replace the valve; purge the system (→section 3.3.5, page 34), as necessary.<br>The main task of the lower pressure limit is to monitor the system for leakage. Leakage may occur at the fittings and or screw joints, the high-pressure switching valve, or the pump's piston seals. |

| Message | Cause | Remedial Action |
|---|---|---|
| Rear-seal wash system has run out of wash solution. | Rear-seal washing is enabled and the peristaltic pump lights, but no liquid reaches the seal-washing detector. | Make sure the liquid reservoir contains sufficient liquid.<br>Verify that the peristaltic tubing is connected correctly (→ Fig. 13, page 31).<br>The peristaltic tubing is permanently blocked or drawing air. Replace the tubing as necessary.<br>Clean the sensor on the liquid reservoir.<br>Make sure that the seal washing liquid is sufficiently conductive (→section 3.3.4, page 31). |
| Relay 2 is configured for inject synchronization. Please change pump configuration. | You tried to use relay 2 as a standard relay in a program, although it has been set to synchronize the gradient with the Inject of the autosampler. | In Chromeleon, set the **EnableLeftCamSyncOut** property to **Off** (→ page 62) or use a different relay. |
| Relay 3 is configured as 'Operable' Out. Please change pump configuration. | You tried to use relay 3 as a standard relay in a program, although it has been configured as Operable Out. | In Chromeleon, set the **EnableOperableOut** property to **Off** (→ page 62) or use different relay. |
| Relay 4 is configured for inject synchronization. Please change pump configuration. | You tried to use relay 4 as a standard relay in a program, although it has been set to synchronize the gradient with the Inject of the autosampler. | In Chromeleon, set the **EnableRightCamSyncOut** property to **Off** (→ page 62) or use a different relay. |
| Solvent rack leak detected. | There is a leak in the system or a fitting connection is loose. | Find and eliminate the leak or tighten the leaking connection and dry the leak sensor (→ *Operating Instructions* for the SRD-3000 solvent racks) |
| The maximum purge pressure was exceeded. | After you have initiated purging in Chromeleon (**Purge** property set to **On**), a pressure of more than 50 bar built up. | Check whether the purge screw is open. Loosen the purge screw if necessary. |
| The rear-seal leak count is xx (counted drops) and has exceeded the limit of yy (leak detection threshold). | More drops that specified under RearSealLeakLimit reach the liquid reservoir. | Visually inspect the piston seals for leakage (→ section 7.6.1, page 81). Replace the piston seals and support rings as necessary (→ section 7.6.2, page 82) or increase the default value for the rear seal leak limit in Chromeleon (→ **RearSealLeakLimit**, page 62). |
| The rear-seal leak sensor is malfunctioning. | The sensors on the liquid reservoir are very dirty.<br>The rear-seal leak sensor is defective | Clean the electrodes of the sensor, using water or solvent.<br>Contact Dionex Service. |

| Message | Cause | Remedial Action |
|---|---|---|
| The system pressure exceeded the safety limit. | The resistance to flow is so high in the system that the defined upper pressure limit is exceeded for the selected flow. | Inspect the system, especially the capillaries, for indications of blockage. Other possible causes are a blocked sampler, broken capillaries, or incorrectly mounted valves.<br>If the problem occurs due to column ageing, it may be sufficient to increase the setting for the upper pressure limit. |
| | The column is contaminated. | Rinse or replace the column. |
| | Minute parts from vial septa block the system. | Clean the blocked spot.<br>Use different septa.<br>Check the crimper setting. |
| | The filter frit in the outlet block is blocked | Replace the filter frit (→ section 7.4, page 76). |
| This function cannot be adjusted by the user. | You tried to change a parameter that cannot be changed by the user. | Only a Dionex service representative can change this parameter. |
| Upper pressure limit exceeded. | The column is contaminated. | Rinse or replace the column. |
| | Minute parts from vial septa block the system. | Find and clean the blocked spot.<br>Use different septa.<br>Check the crimper setting. |
| | The resistance to flow is so high in the system that the defined upper pressure limit is exceeded for the selected flow. | Inspect the system, especially the capillaries, for indications of blockage. Other possible causes are a blocked sampler, broken capillaries, or incorrectly mounted valves.<br>If the problem occurs due to column ageing, it may be sufficient to increase the setting for the upper pressure limit. |
| | The filter frit in the outlet block is blocked | Replace the filter frit (→ section 7.4, page 76). |

**Please note:** In addition to the error messages mentioned above, other messages may appear. In this case, please note the exact wording of the message and contact Dionex Service.

**Please note:** For information about common operating problems that might occur with the UltiMate system, probable causes, and remedial actions, refer to *UltiMate 3000: System Installation and Application*.

If communication between the Chromeleon and the pump cannot be established, related error messages may appear in the Chromeleon audit trail, also. Refer to the table below for the most important error messages, along with possible causes and the corresponding remedial actions.

⚠ **Important:** Please keep in mind that for up to 30 seconds after a change to the server configuration, messages referring to the previous configuration may still be displayed. These messages can be ignored. Always note the device name reported in the message, e.g., LPG3600@USB-01610103 (where 1610103 is the serial number).

⚠ **Important:** Gardez à l'esprit que pendant 30 secondes suite à un changement de configuration du serveur, les messages faisant référence à la configuration précédente peuvent encore être affichés. Ces messages peuvent être ignorés. Notez toujours le nom de l'appareil mentionné dans le message, ex. LPG3600@USB-01610103 (1610103 étant le numéro de série).

| Message | Probable Cause | Remedial Action |
|---|---|---|
| LPG3600@USB-01610103 - Device not found on the USB. | The USB connection between the pump and the Chromeleon server is interrupted.<br>The power supply to the pump is interrupted. | Check the USB connection.<br>Check the mains connection of the pump. |
| Error opening LPG3600@USB-01610103 – The System cannot find the file specified | The USB connection between the pump and the Chromeleon server is interrupted.<br>The power supply to the pump is interrupted. | Check the USB connection.<br>Check the mains connection of the pump. |
| Error issuing control request to LPG3600@USB-01610103 | The Chromeleon server cannot connect to the specified pump. | Check the USB connection.<br>Check the mains connection of the pump.<br>Remove the pump specified in the message from the server configuration or else, select a different pump from the list of available pump in the server configuration program (via Properties/Browse). |
| Error reading from LPG3600@ USB-01610103 Data error (cyclic redundancy check) | There is a transmission error between the pump and the Chromeleon server. | Check the USB connection. The connection to the next hub must not exceed 5 m. The overall connection length, including the hub connections must not exceed 30 m (→ page 45).<br>Replace any defective USB cable or hub. |
| Error reading from LPG3600@ USB-01610103 | The connection between the pump and the Chromeleon server is interrupted.<br>The power supply to the pump is interrupted. | Check the USB connection.<br>Check the mains connection of the pump. |

**Please note:** In addition to the error messages mentioned above, other messages may appear. In this case, please note the exact wording of the message and contact Dionex Service.

# 7 Routine Maintenance

## 7.1 General Notes

The pump is made of high-quality components and materials, which keep maintenance requirements to a minimum. The painted surfaces are relatively resistant to weak acids, alkali, and organic solvents. Nevertheless, immediately wipe up all liquids spilled onto the pump's surface, using lint-free cloth or tissue (avoid rubbing). If surfaces are exposed for longer periods, these liquids can cause damage.

The following sections describe all maintenance procedures that can be carried out by the user. Dionex personnel should perform any additional servicing, as well as annular inspections to detect contamination, wear, etc. This is, for example, to prevent the camshaft from running dry.

If unexpected problems occur, please contact Dionex Service.

**Warning:** Strictly observe all warning notes when carrying out maintenance or repair work.

**Avertissement:** Observez strictement toutes les notes d'avertissement lorsque vous procédez à des opérations de maintenance ou de réparation.

**Warning:** Do not operate the pump when the enclosure is open unless instructed to do so. Observe all warning notes.

**Avertissement:** Ne faites pas fonctionner la pompe lorsque le capot de protection est enlevé, sauf instruction dans ce sens. Observez toutes les notes d'avertissement.

**Warning:** Keep in mind that the fluid components of the pump may be filled with toxic solvents. Therefore, purge the pump with an appropriate solvent and put on protective clothing before starting maintenance or repair work.

**Avertissement:** Gardez à l'esprit que les circuits hydrauliques de la pompe peuvent être remplis de solvants toxiques. Par conséquent, purgez la pompe avec un solvant approprié et portez des vêtements de protection avant de commencer les opérations de maintenance ou de réparation.

**Important:** Use original Dionex spare parts only. Substituting non-Dionex parts or using non-Dionex accessories may impair the performance of the instrument, thereby voiding the product warranty. Refer to the warranty statement in the terms of sale for more information.

**Important:** Utilisez les pièces de rechange d'origine Dionex. Effectuer des remplacements avec des pièces ne provenant pas de Dionex ou utiliser des accessoires ne provenant pas de Dionex peut affecter les performances de l'instrument, rendant ainsi caduque la garantie de produit. Référez-vous à la déclaration de garantie dans les conditions générales de vente pour plus d'information.

⚠ **Important:** Before you return any instrument to Dionex for repair, contact Dionex Service or your local distributor. An RMA (Return Material Authorization) number is required in order to track your instrument. Always use the original packaging when shipping the pump. Shipping the pump in anything other than the original packaging will void the warranty. Refer to the warranty statement in the terms of sale for more information.

⚠ **Important:** Avant de retourner tout instrument à Dionex en vue de réparations, contactez le service après-vente Dionex ou votre distributeur local. Un numéro RMA (Return Material Authorization ou autorisation de retour de matériel) est nécessaire afin d'assurer la traçabilité de votre instrument. Utilisez toujours l'emballage d'origine lorsque vous expédiez la pompe. Expédier la pompe dans tout autre contenant que l'emballage d'origine rend caduque la garantie. Référez-vous à la déclaration de garantie dans les conditions générales de vente pour plus d'information.

**Please note:** Do not forget to test the pump for leakage after you have carried out maintenance or repair work on the fluid connections (→ Testing the Pump for Leakage (Leak Rate), Seite 89).

For instructions on shutting down the pump, refer to page 90.

## 7.2 Maintenance Intervals

Perform the maintenance procedures listed below 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, including the solvents used for your application. You may find that some maintenance tasks must be performed more frequently than others.

| 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 any signs of leakage. |
| | Check the fluid connections for any signs of salt deposits. |
| | When using buffer solutions, flush the system thoroughly after use with a solvent that does not contain buffers and/or salts. |
| **Regularly** | Inspect the tubing for possible damage, such as cracks, nicks, cuts, or blockage. |
| | Regularly check the liquid level in the liquid reservoir, making sure that the level is always between the min. and max. markers on the label. |
| | Also, replace the liquid in the liquid reservoir in regular intervals. To avoid salt concentration in the reservoir and thus, to prevent damage to the piston seals when using solvents with a high salt content, replace the liquid in the reservoir at least once a week. |
| | Regularly inspect the inline filter in the pump's outlet block for contaminants. Replace the filter frit if necessary (→ Exchanging the Filter Frits on the Outlet Block, page 76). |
| | When using buffer solutions, Dionex recommends inspecting the pump for leakage at least once a month (→ Visually Inspecting the Piston Seals for Leakage, page 81). |

All other maintenance procedures must be performed by Dionex Service personnel. Have a Dionex service representative check the pump once a year to prevent contamination, excessive wear, etc. If unexpected problems occur, please contact your Dionex service representative.

## 7.3 Leak Sensor

**Please note:** Check the pump for leaks every day. Tighten leaking tubing and capillary connections.

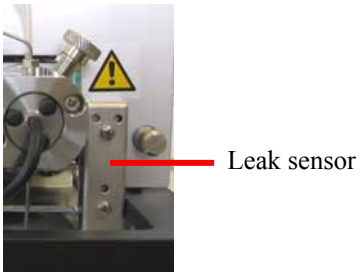



*Fig. 40: Leak sensor*

The pump is equipped with a leak sensor that is activated when the sensor is exposed to moisture.

When the leak sensor detects a leak, the **Status** LED on the front panel is red.

**Please note:** The LED remains red as long as the leak sensor is exposed to moisture.

### The pump is operated by Chromeleon

When the pump is operated by Chromeleon, you can determine whether leak detection shall be performed and whether an acoustic beep shall sound in case of an alarm (→ **LeakSensorMode** property, page 60). When the sensor is activated, an acoustic beep sounds, depending on the **LeakSensorMode** setting. You can then perform the **LeakAlarmOff** command (→ page 60) to turn off the beep for the current alarm. If the leak sensor is still exposed to moisture after the **LeakDelay** (→ page 60) has expired, the pump flow is turned off automatically, if necessary, and an error message (**Leak detected**) appears in the Chromeleon audit trail. A new beep sounds when the sensor is activated again.

**Please note:** If you eliminate the leak and dry the sensor before the LeakDelay has expired, the LED is green again. If you eliminate the leak and dry sensor after the LeakDelay has expired, the LED becomes green when you turn on the pump flow again (for an LPG-3600, both pump flows).

### The pump is operated in standalone mode

If the pump is not operated by Chromeleon, an error message (Leak detected) appears on the front panel display and an acoustic beep sounds. To turn off the beep, touch the front panel just under the display with the magnetic Dionex menu pen. The error message remains flashing on the display.

To find and eliminate the leak, follow the steps below wearing appropriate protective clothing:

- Wait until the pressure is down to zero.
- Turn off the pump and disconnect the power cord.
- Inspect the pump heads for solvent leaks. If there is any leakage, tighten the tubing and capillary connections. Dry the components. If the pump head continues to leak, replace the piston seals.
- Remove the liquid and dry the leak sensor. To do so, use a cloth to absorb any liquid that has accumulated on the lower end of the sensor in the tray.
- Connect the power cord and turn on the pump.
- If no errors are reported after turning on the pump, operation can be resumed.

## 7.4 Exchanging the Filter Frits on the Outlet Block

The outlet block is fitted with a filter holder and inline filter (→ Fig. 41).

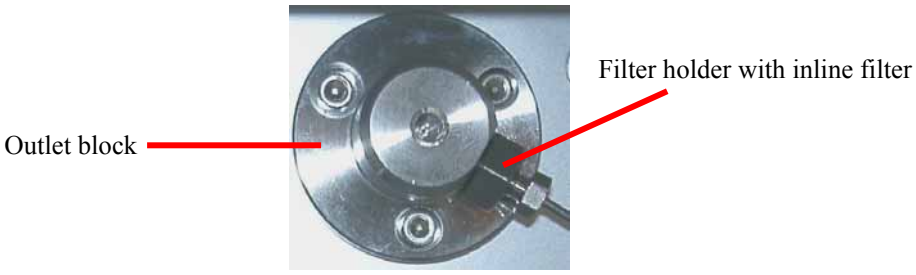



*Fig. 41: Outlet block*

**Please note:** Check the permeability of the filter frits at regular intervals as described in Outlet Block (→ page 35).

To replace the inline filter, follow the steps below:

- Remove the filter holder (standard pump: part no. 6030.2103; biocompatible pump: part no. 6030.2112) from the outlet block, using the open-end wrench from the pump's accessories kit. The inline filter is in the filter holder (→ Fig. 42).

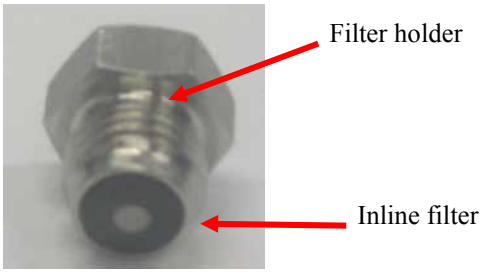



*Fig. 42: Filter holder with inline filter*

- Remove the filter from the filter holder. A special filter removal tool is available from Dionex as an option (part no. 6035.3051). Place the filter holder onto the filter removal tool and slightly press it downward (→ Fig. 43).


*Fig. 43: Removing the inline filter*

- Insert the new filter frit into the filter holder.

| Part No. | Description |
|---|---|
| 6000.0045 | 10 filter frits, stainless steel, 0.5µm |
| 6268.0022 | 10 filter frits, PEEK, 0.5µm |

- Tighten the filter holder onto the outlet block hand-tight.

**Please note**: Wetting the filter frit on the side that goes into the holder, e.g., with isopropanol, keeps the frit in the holder when you tighten the assembly onto the outlet block.

## 7.5 Replacing the Check Valves

The working head contains two double check valves: an inlet valve and an outlet valve. The inlet valve is mounted on the bottom side of pump head; the outlet valve is mounted on its topside. When removed, you can recognize the inlet valve by the inner thread that ends in a planar surface, while the outlet valve has a conical cavity for the capillary connection. Remove one or both valves:

- If necessary, rinse the pump to remove toxic solutions.
- Set the pump flow rate to 0. Wait until the pressure in the system is down to zero.
- Undo the solvent tube at the pump inlet and the U-tube at the outlet.
- Undo the corresponding valve cartridge using a 13 mm wrench.
- Insert the new valve cartridge. Make sure you insert the cartridge in the direction of solvent flow direction, as indicated by the arrow on the cartridge (→ Fig. 44). Tighten the valve.
- Attach the removed U-tube to the outlet valve. First, tighten this hand-tight and then tighten it an additional one-quarter turn, using a wrench.
- Screw the solvent tube onto the inlet valve again. Take care to avoid cross-threading.
- To prevent contaminants from entering the HPLC system, thoroughly rinse the pump (using at least 30 ml HPLC-grade water or purely organic solution). Loosen the purge screw to prevent the rinsing liquid from entering the HPLC system.
- Test the pump for leakage (→ Testing the Pump for Leakage (Leak Rate), page 89). Tighten any leaking connections.

## 7.6 Pistons and Piston Seals

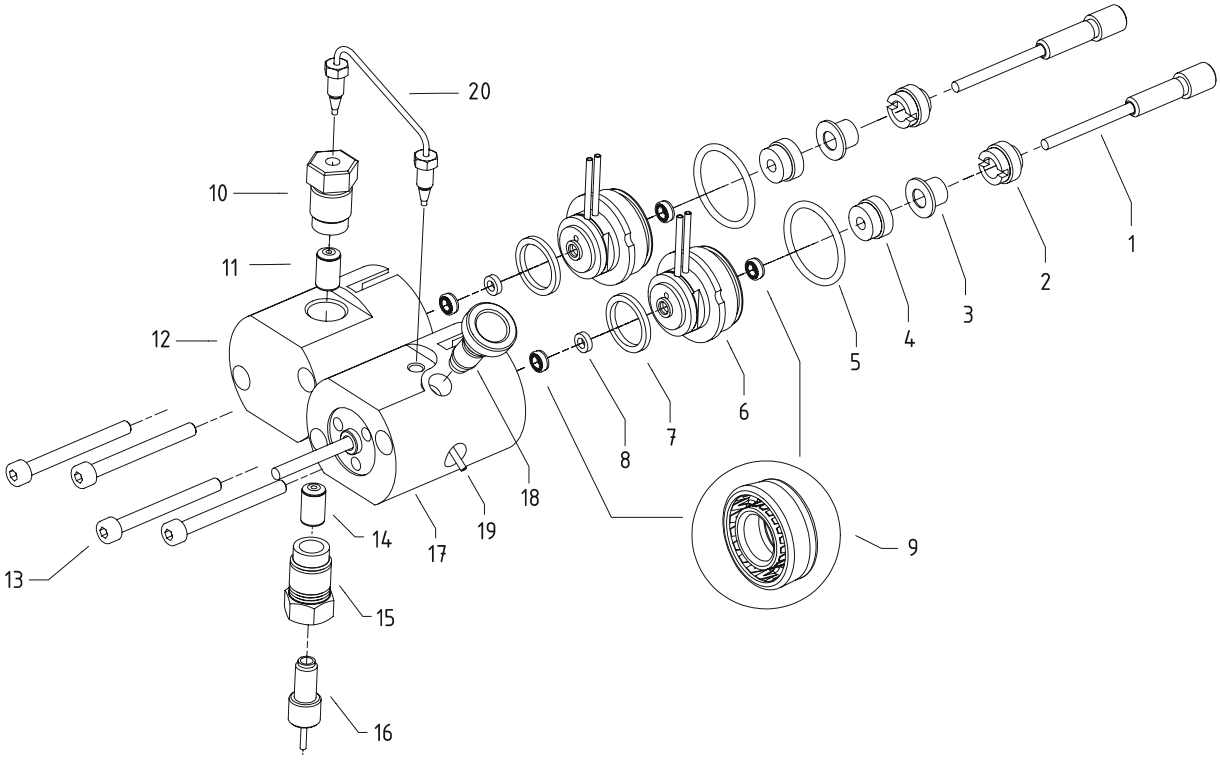



*Fig. 44: Pump heads, pistons, and piston seals*

### LPG-3300M and LPG-3600M (standard pumps)

| No. | Description | Part No. |
|---|---|---|
| 1 | Piston unit | 6030.0032 |
| 2 | Piston retaining screw | 6001.0105 |
| 3 | Bushing with draining device | 6000.4001 (= 5 bushings) |
| 4 | Retaining screw (DR) | Included in 6035.2010* |
| 5 | O-ring (20x2) | Included in 6035.2010* |
| 6 | Rear-seal wash system (piston head bushing) | Included in 6035.2010* |
| 7 | Ring seal (DR-8) | 2266.0082 (= 10 seals) |
| 8 | Support ring (piston seal) | 6025.2010A (for reversed phase)<br>6025.2011A (for normal phase) |
| 9 | Piston seal (1/8") | |
| 10 | Outlet valve (incl. valve cartridge) | 6020.2200 (also includes no. 11) |
| 11 | Valve cartridge (identical to no. 14) | 6020.2300 |
| 12 | Working head | 6035.2001 |
| 13 | Allen screw (I-M4x40) | ------ |
| 14 | Valve cartridge (identical to no. 11) | 6020.2300 |
| 15 | Inlet valve (includes valve cartridge) | 6020.2100 (also includes no. 14) |
| 16 | Capillary from proportioning valve to working head | 6035.2514 (also includes the appropriate fittings and ferrules) |
| 17 | Equilibration head with pressure sensor and purge screw | ------ |
| 18 | Purge screw | 6020.2030 |
| 19 | Purge outlet nozzle | ------ |
| 20 | Capillary from working head to equilibration head (top) | 6030.3015 |

* Part no. 6035.2010 (rear-seal wash system) includes one piston seal, O-ring, piston head bushing (mircro), and retaining screw each.

## LPG-3300MB and LPG-3600MB (biocompatible pumps)

| No. | Description | Part No. |
|---|---|---|
| 1 | Piston unit | 6030.0032 |
| 2 | Piston retaining screw | 6001.0105 |
| 3 | Bushing with draining device | 6000.4001 (= 5 bushings) |
| 4 | Retaining screw (DR) | Included in 6035.2010* |
| 5 | O-ring (20x2) | Included in 6035.2010* |
| 6 | Rear-seal wash system (piston head bushing) | Included in 6035.2010* |
| 7 | Ring seal (DR-8) | 2266.0082 (= 10 seals) |
| 8 | Support ring (piston seal) | } 6266.0305 (for reversed phase) |
| 9 | Piston seal (1/8") | |
| 10 | Outlet valve (incl. valve cartridge) | 6037.2200 (also includes no. 11) |
| 11 | Valve cartridge (identical to no. 14) | 6037.2300 |
| 12 | Working head | 6037.2001 |
| 13 | Allen screw (I-M4x40) | ------ |
| 14 | Valve cartridge (identical to no. 11) | 6037.2300 |
| 15 | Inlet valve (includes valve cartridge) | 6037.2100 (also includes no. 14) |
| 16 | Capillary from working head to proportioning valve | 6035.2514 (also includes the appropriate fittings and ferrules) |
| 17 | Equilibration head with pressure sensor and purge screw | ------ |
| 18 | Purge screw | 6020.2030 |
| 19 | Purge outlet nozzle | ------ |
| 20 | Capillary from working head to equilibration head (top) | 6037.3015 |

* Part no. 6035.2010 (rear-seal wash system) includes one piston seal, O-ring, piston head bushing (mircro), and retaining screw each.

### 7.6.1 Visually Inspecting the Piston Seals for Leakage

Each piston has two piston seals. The seals prevent solvent from leaking either into the rear seal chamber or over the piston and into the instrument. During normal operation, the detector on the liquid reservoir automatically checks the main piston seals for leakage.

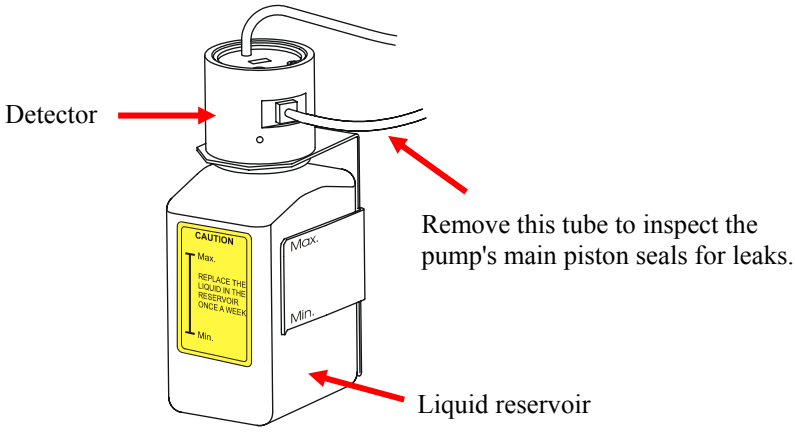



*Fig. 45: Liquid reservoir of the rear-seal wash system*

To inspect the pump visually for possible leaks from the main piston seals, follow the steps below:

- First, disable active rear-seal washing by setting the **RearSealWashSystem** command in Chromeleon to **Off** (page 62), and then enable seal washing again (setting = Automatic). The peristaltic pump starts pumping, delivers approximately 2 ml of liquid, and then stops.
- Remove the tubing from the detector of the rear-seal wash system (→ Fig. 45). Remove some of the liquid by shaking the tube.
- Reinstall the tubing on the detector.
- Set the flow rate. Arrange the system in such a way that approximately 300 bar (30 MPa, 4350 psi) of backpressure is generated.
- Observe the air/liquid level in the silicone tube to evaluate possible leakage. If the level travels in the tube, this indicates leakage.

  **Please note:** The peristaltic pump will start a new washing cycle after one hour. Therefore, be sure to finish your observation before that time.

  If the level remains unchanged, the piston seals seal tightly. If the level rises or falls, it indicates a leak from one or more of the main piston seals. In this case, replace all piston seals and the supporting rings as described in Removing the Piston Seals (→ page 84).

### 7.6.2 Replacing the Piston Seals

The procedure for replacing the piston seals consists of the following main steps (for details, refer to the sections below):

- Remove the pump heads and pistons.
- Clean the pistons.
- Remove the piston seals.
- Reinstall the piston, piston seal, and pump head.

**Please note**: By default, all pumps are equipped with piston seals made of UHMW-PE. Please note that using chloroform, trichlorobenzene, methylene chloride, tetrahydrofuran, or toluene as solvents chemically damages the UHMW-PE seals. Chemical reactions may also occur when using tetrachloromethan, diethyl ether, ethyl ether, di-isopropyl ether, ketones, methylbenzene, methycyclohexane, and monochlorobenzene. If you use these solvents, please contact your Dionex sales representative.

**Please note:** As standard, the pumps are fitted with reversed phase piston seals. However, normal phase seals can be installed instead if required. For information about the installation procedure and the corresponding part numbers, refer to Removing the Piston Seals (→ page 84).

#### 7.6.2.1 Removing the Pump Heads and Pistons

To reach the piston heads and pistons, it is not necessary to open the pump enclosure. Tilt the front cover upward. The pistons are freely accessible via the pump heads.

- If necessary, purge the pump to remove toxic solvents.
- Set the pump flow rate to 0. Wait until the system pressure is down to zero.
- Disconnect all fluid connections from the pump heads.

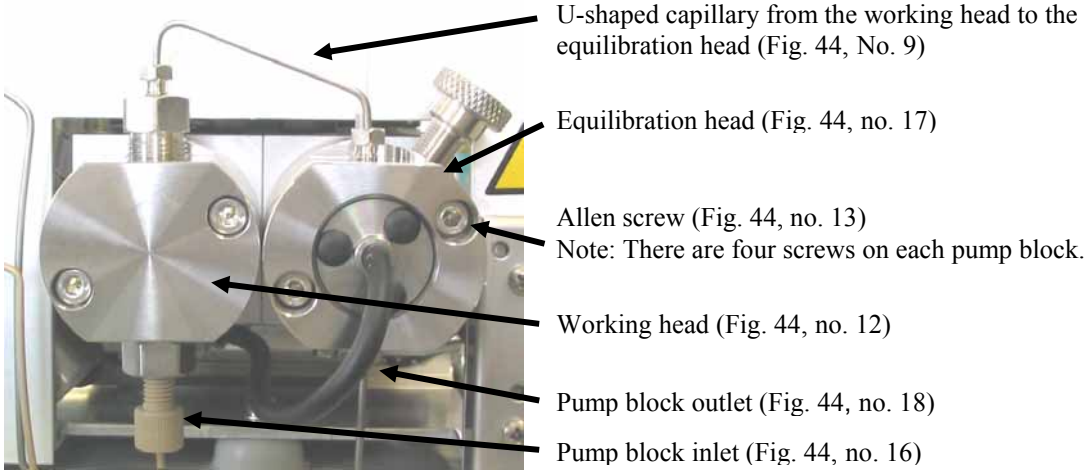



*Fig. 46: Installed pump heads*

- Loosen the Allen screws on the two pump heads (→ Fig. 46) and carefully remove the pump heads.

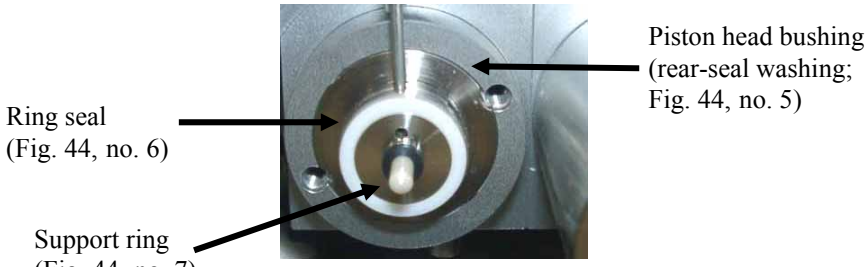



*Fig. 47: Pump head removed*

- Remove the support ring. Please note that the support ring may also be in the removed pump head.
- Carefully remove the bushing of the seal-washing chamber from the piston (including the seal, → Fig. 47), using the extractor from the pump's accessories kit (→ Fig. 48).

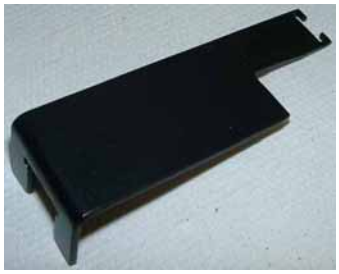


*Fig. 48: Extractor for bushing with draining device*

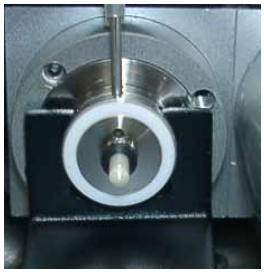


*Fig. 49: Extractor on bushing*

- Remove the bushing with draining device (→ Fig. 44, no. 3) from the piston unit (→ Fig. 44, no. 1), using the extractor from the pump's accessories kit (→ Fig. 50 and Fig. 51).

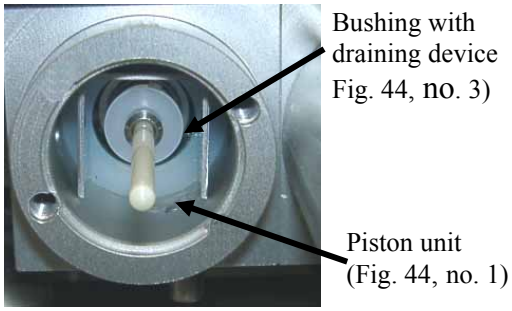



*Fig. 50: Piston and bushing with draining device*

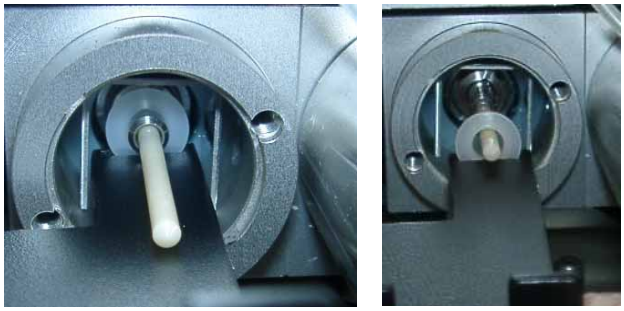


*Fig. 51: Removing the bushing with draining device*

- Loosen the piston retaining screw (→ Fig. 44, no. 2), using the flat-blade screwdriver (provided in the accessories kit). Move the piston forward, toward the front cover of the pump, and remove it from the enclosure.

#### 7.6.2.2 Cleaning the Pistons

- Remove the pump head and, if necessary, the piston as described above under Removing the Pump Head.
- Clean the piston.
- Carefully rinse the piston, and then rub it several times with a dry, lint-free tissue.
- Apply some thin-bodied, resin-free oil (thin film) **only** to the **metal** part of the piston unit.

#### 7.6.2.3 Removing the Piston Seals

Each piston has two piston seals. One seal is located in the pump head and the other is in the rear seal chamber. Replace the seals approximately every 4 months.

**Please note**: Do not use sharp tools, such as tweezers, etc.

- Use a disassembled piston to remove the piston seal from the pump head (→ Fig. 44, no. 9). On the working head (with valve cartridges), use a dummy plug (FS-8, part no. 6000.0044) to close the outlet valve. On the equilibration head, close the boreholes with dummy plugs. Insert the piston tip into the piston seal. The pressure loosens the seal. If you cannot remove the piston seal in this way, use an M4 screw; for example, the one used for holding the pump heads. Insert the screw into the seal. Remove the seal. This procedure destroys the piston seal!

  **Important**: When replacing the piston seal in the pump head, always replace the support ring as well. (For part number information, refer to the table below.) This is to prevent leakage.

  **Important:** Lorsque vous remplacez le joint de piston de la tête de pompe, remplacez systématiquement la rondelle anti-extrusion. (Pour des informations sur les références des pièces, référez-vous au tableau ci-dessous.) Ceci est destiné à éviter toute fuite.

| Part No. | Description |
|---|---|
| 6025.2010A*<br>*or*<br>6266.0305 | Support ring/piston seal kit (reversed phase) for standard pumps<br><br>Support ring/piston seal kit (reversed phase) for biocompatible pumps |
| 6025.2011A* | Support ring/piston seal kit (normal phase) for standard pumps |

* All spare part kits comprise one support ring and two piston seals.

- To remove the piston seal that is installed in the rear seal chamber, remove the retaining screw (→ Fig. 44, no. 4) on the rear of the pump head bushing first, using the flat-blade screwdriver that is provided in the accessories kit. Then, remove the seal. Use the piston to push the piston out of the bushing.

### 7.6.2.4 Reinstalling the Piston, Piston Seal, and Pump Head

**Please note:** Dionex recommends that you always install new piston seals. However, you may still install piston seals that were removed from a pump head in the rear-seal wash system.

- Assemble the rear seal chamber. To do so, take the piston in one hand and slide the new piston seal over the piston. Insert the piston seal together with the piston into the pump head bushing. The piston is used to facilitate centering. Remove the piston so that the piston seal remains in the piston head bushing. Install and tighten the pump head bushing retaining screw hand-tight.

  **Important:** When installing the piston seals, make sure that the "open" sides of both piston seal springs point away from the pump enclosure (→ Fig. 44, no. 9).

  **Important:** Lorsque vous installez des joints de piston, assurez-vous que les côtés "ouverts" des joints, montrant le ressort spiral, soient dirigés vers l'avant de la tête de pompe (coté pression) (→ Fig. 44, no. 9).

- Install the piston in the pump block and tighten the piston retaining screw using the flat-blade screwdriver provided in the accessories kit.
- Slide the bushing with the draining device (→ Fig. 44, no. 3) onto the shaft. Make sure the orientation is correct (→ Fig. 52).

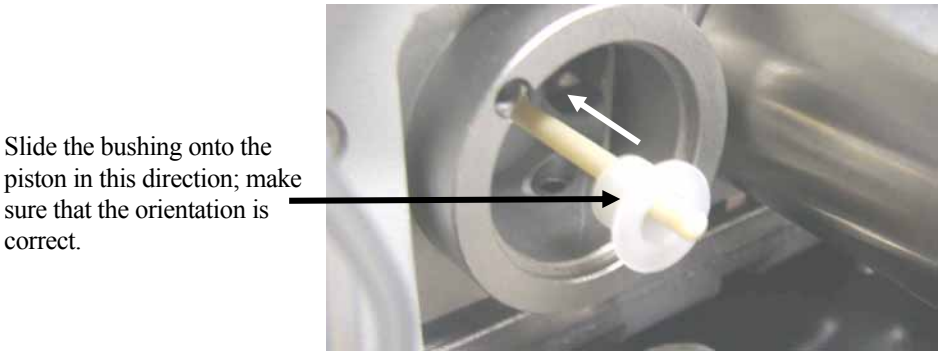



*Fig. 52: Correct orientation of the bushing with draining device*

- Verify that the O-ring seal is installed on the pump head bushing (→ Fig. 53). Slightly grease the O-ring seal if necessary.


*Fig. 53: Pump head bushing with O-ring seal*

- Slide the complete pump head bushing over the piston unit. Then, slide the piston unit into the pump block.
- Slide the new support ring and the new piston seal onto the piston. Make sure the orientation of the piston seal is correct (→ Fig. 44, no. 9 and Fig. 54).

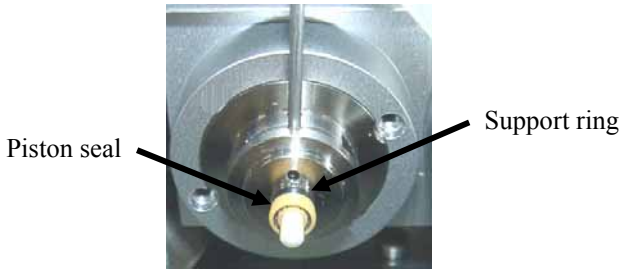



*Fig. 54: Piston seal on pump head bushing of the rear-seal wash system*

- Slide the ring seal (→ Fig. 44, no. 7; part no. 2266.0082 for 10 seals) onto the pump head bushing (→ Fig. 44, no. 6).
- Verify that the uninstalled pump head has not seal installed (e.g., the old seal).
- Slide the pump head onto the piston (turn and push as necessary) until the second piston seal is correctly in place.

⚠ **Important:** If you do not insert the piston seal in the way described above, but into the disassembled pump head, it may get jammed and thus become useless.

⚠ **Important:** Si vous n'insérez pas le joint de piston de la manière décrite ci-dessus, mais dans la tête de pompe démontée, il peut se coincer de travers et ainsi devenir inutilisable.

⚠ **Important:** The working head is installed on the left side of the pump block (inlet). You can identify the head by the two large boreholes for the inlet and outlet valves.

⚠ **Important:** La tête de travail est installée sur le côté gauche du bloc de pompe (entrée). Vous pouvez reconnaître la tête aux deux grands taraudages destinés aux supports des clapets d'entrée et de sortie.

🛈 **Please note**: To avoid damage to the piston seal during installation, Dionex recommends moistening the piston seal, the piston, and the pump head with HPLC-grade water directly before you install them.

- Tighten the pump heads with the Allen screws (→ Fig. 44, no. 13).
- Insert the inlet and outlet valves into the working head. The outlet valve (top) has a conical cavity for the capillary connection. The inlet valve (bottom) has a planar surface for the solvent tube connection.

- Attach the capillary connections. Tighten them hand-tight, and then tighten them an additional one-quarter turn, using a ¼" wrench.
- Attach the solvent tube to the inlet valve. Take care to avoid cross-threading.
- Attach the tubing of the piston seal wash system to the corresponding capillaries (→ Fig. 13, page 31).
- To prevent contaminants from entering the HPLC system, rinse the pump thoroughly (using at least 30 ml HPLC-grade water or pure organic solution). Loosen the purge screw to prevent rinsing liquid from entering the HPLC system.
- Test the pump for leakage (→ Testing the Pump for Leakage (Leak Rate), page 89). Tighten any leaking connections.

**Please note:** Never run the pump dry. Damage to the pistons or piston seals could result.

**Please note:** When exchanging the piston seals, always exchange the liquid in the reservoir of the rear-seal wash system and rinse the fluidics, too.

**Please note:** After you have installed new piston seals, Dionex recommends that you connect drainage tubing to the purge outlet and operate the pump for 15 minutes with isopropanol at a flow rate of 1 ml/min, with the purge valve being open. (Do not have the pump deliver in circles.)
Close the purge valve. On the pump outlet, install a flow resistance, e.g., a capillary, that can generate approximately 300 bar, at a flow rate of 1 ml/min. Uninstall the capillary and inspect the filter frit on the outlet block for permeability (→ Outlet Block, page 35).
Afterward, connect the pump to the system.

**Please note:** In rare cases, it may happen that new seals show an increased leakage rate during the first hours of operation. In this case, exchange the liquid in the reservoir of the rear-seal wash system once again and rinse the fluidics.

## 7.7 Replacing the Fuses

**Warning:** Before replacing the fuses, turn off the pump. Be sure to 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.

- Remove the fuse cartridge, using a small screwdriver (→ Fig. 55).

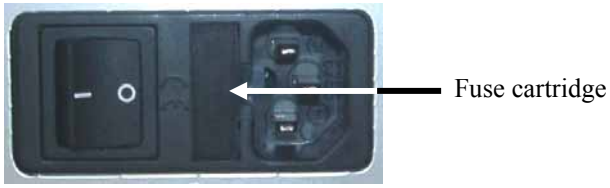



*Fig. 55: Fuse cartridge*

- Replace the fuses with fuses of the appropriate rating.

**Important:** Always install two new fuses. Do not operate the pump with only one fuse.

**Important:** Installez toujours deux nouveaux fusibles. Ne faites pas fonctionner la pompe avec seulement un fusible.

**Important:** Use only the fuses indicated below or those listed in the Accessories/Spare Parts List (→ page 93).

**Important:** Utilisez uniquement les fusibles indiqués ci-dessous ou ceux qui sont répertoriés dans la liste des accessoires/pièces de rechange (→ page 93).

| Description | Part No. |
|---|---|
| Fuse, 2 A, idle, 5 x 20 mm, 250V | Included in Fuses Kit, part no. 6030.9003<br>For information about which fuses are contained in the kit, refer to section 9.3 (→ page 95). |

- Reinstall the fuse cartridge.
- Reconnect the power cord to its source and turn on the pump.

## 7.8 Testing the Pump for Leakage (Leak Rate)

After you have carried out any maintenance or repair work on the fluid system, test the pump for leakage. With this test, a pump pressure of > 300 bar (4350 psi) is built up.

- Close the pump outlet with a dummy plug (FS-8, part no. 6000.0044).
- In Chromeleon, set the upper pressure limit to 400 bar (5800 psi):
  For pumps without flow splitter assignment: Set **Pressure > UpperLimit** to 400 bar (→ page 61).
  For pumps with flow splitter assignment: Set **MasterPressure > UpperLimit** to 400 bar (→ page 61).
- In Chromeleon, select a flow rate of, for example, 50 µl/min.
- Decrease the flow as soon as the pressure builds up (typically between 100 and 200 bar (1450 and 2900 psi). Have the pump deliver some µl/min until a pressure of 350 bar (5075 psi) has build up.
- At about 350 bar, the pressure should now increase or remain constant at least when the pump delivers a master flow of 1 µl/min.
- In case of leakage, visually inspect the piston seals for leakage (→ page 81) and tighten leaking connections, if necessary.
- Reset the upper pressure limit to the value used before the test.

This test also provides information about the leak rate of the pump.

**Please note:** Perform the test for the two pumps of an LPG-3600 separately if necessary.

## 7.9 Shutting Down the Pump

Please observe the following precautions before interrupting the operation for more than one week or before shipping the pump:

⚠ **Important:** Rinse out any solvents. 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 a methanol/water mixture (50/50) before it is shut down. This will prevent salt buildup inside the unit. If the solvents in the pump are not miscible with water, replace the solvents step-by-step. Do not forget to fill the rear-seal wash system (→ Active Rear-Seal Wash, page 31).

⚠ **Important:** Purgez la pompe pour évacuer tout solvant. Remplissez la pompe de méthanol (ou d'un alcool similaire tel que du 2-propanol ou de l'éthanol). Si la phase mobile contenait des sels, purgez le système avec plusieurs volumes d'un mélange de méthanol/eau (50/50) avant de l'arrêter. Ceci empêchera l'accumulation de sels dans l'instrument. Si les solvants présents dans la pompe ne sont pas miscibles avec l'eau, remplacez les solvants étape par étape. N'oubliez pas de remplir le réservoir du système de rinçage des joints (→ Active Rear-Seal Wash, page 31).

⚠ **Important:** Do not forget to empty the liquid reservoir of the rear seal wash system before shipping the pump (→ page 31).

⚠ **Important:** N'oubliez pas de vider le réservoir de liquide du système de rinçage des joints avant d'envoyer la pompe (→ page 31).

⚠ **Important:** Rinse out buffers or solvents that form peroxide.

⚠ **Important:** Purgez la pompe de toutes solutions salines ou solvants susceptibles de former des peroxydes.

⚠ **Important:** 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.

⚠ **Important:** Eteignez les lampes de tout détecteur UV ou RF raccordé à la pompe. Ceci empêchera l'évaporation dans la cellule.

🛈 **Please note:** Dionex recommends pulling the tubing out of the peristaltic pump (→ Fig. 15) if the pump is not running for more than five days. To remove the tubing, slightly press the lever upward, remove the tubing, and release the lever. This will prevent that the tubing remains compressed and does not relax, thus blocking the wash solution.

🛈 **Please note:** Ship the unit only in the original packaging. Shipping the unit in any other packaging automatically voids the warranty. Refer to the warranty statement in the terms of sale for more information.

# 8 Technical Information

| | |
|---|---|
| **Flow range selection:** | 10 µl/min to 2500 µl/min |
| **Flow accuracy and reproducibility:** | ± 0.5% at 200 µl/min |
| **Gradient formation:** | LPG-3600: Dual low-pressure ternary gradient<br>LPG-3300: Single low-pressure ternary gradient |
| **Gradient accuracy:** | Typically ± 1.0 % at 200 µl/min |
| **Gradient precision:** | Typically < 0.5 % at 200 µl/min |
| **Pressure range:** | 0.1 - 50 MPa (7250 psi) |
| **Compressibility compensation:** | Automatic and solvent-independent SmartFlow technology |
| **Solvent degassing:** | External via the appropriate solvent rack from the SRD-3000 solvent rack series |
| **Remote control:** | All functions controllable via USB 1.1<br>Integrated USB 1.1 hub with three free USB ports |
| **I/O interfaces:** | 3 digital inputs<br>4 programmable relays |
| **Analog output:** | 1 analog output for pressure monitoring |
| **Safety features:** | Leak sensor<br>Active rear-seal washing with monitoring of the piston seal tightness and the liquid level of the liquid reservoir |
| **User input/display:** | LCD indicating system parameters<br>Standby button<br>3 LEDs (Power, Connected, and Status) for status monitoring<br>4 soft keys for operation during initial installation and maintenance |
| **GLP:** | In Chromeleon:<br>Full support of automatic equipment qualification (AutoQ) and System Wellness monitoring.<br>All system parameters are logged in the Chromeleon audit trail. |
| **Wetted parts:** | Stainless steel (1.4571), titanium, sapphire, ruby, UHMW polyethylene, PCTFE, PTFE, PEEK, zirconium oxide ($ZrO_2$), aluminum oxide ($Al_2O_3$) |
| **Power consumption:** | 136 VA<br>Automatic voltage selection |

| | |
|---|---|
| **Environmental conditions:** | Range of use: Indoor use<br>Temperature: 10 to 35°C (50 to 95°F)<br>Air humidity: 80% relative humidity, non-condensing<br>Overvoltage category: II<br>Pollution degree: 2 |
| **Dimensions (h x b x t):** | 19 x 42 x 51 cm (7.5 x 16.5 x 20 in.) |
| **Weight:** | LPG-3600: 20.5 kg (45.2 lbs)<br>LPG-3300: 16.8 kg (37 lbs) |

Technical information: May 2005.
All technical specifications are subject to change without notice.

# 9 Accessories and Spare Parts

Accessories and spare parts 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 (included in the shipment)

The following accessories are shipped with the pump. (Note: The list is subject to change without notice.) Some parts listed below are included in one of the spare part kits. For information about these kits, refer to section 9.3 (→ page 95).

| Description | Part No.* | Quantity in the accessories kit |
|---|---|---|
| **Accessory kit for LPG-3300 and LPG-3600 pumps (standard and biocompatible pumps), including:** | 5035.9035 | |
| Power cord (200-240 V), 2m *or*<br>Power cord (90-130 V), 2m<br>(depending on the destination country) | 6000.1000 *or*<br>6000.1001 | 1 |
| Fuse, 2A, TT (5 x 20 mm) | Included in 6030.9003 | 2 |
| 25-pin D-Sub connector (male) with connector housing | 6000.4003 | 1 |
| Solvent filter | 6000.0041 | 1 (= 10 filters) |
| Silicone tube (OD x ID: 2.80 x 1.30 mm) | Included in 6000.0010 | 3 tubes |
| Plastic syringe (12 ml) | Included in 6000.0010 | 1 syringe |
| Plastic bag (70 x 100 x 0.05 mm) | | 3 |
| Extractor for pump head bushing | 6000.0046 | 1 |
| Dionex menu pen (magnetic) | 6300.0100 | 1 |
| Tool kit for analytical pumps, including 1 off:<br>Open-end wrench (1/4 x 5/16), open-end wrench (11 x 13)<br>pin wrench (size 3), flat-blade screwdriver (for 1/8" pistons) | 6007.9302 | 1 |
| Tubing and Tee piece for waste fluid connection | Included in 6000.5001 | 1 each |
| Remote input - pressure output cable | 6005.9002 | 1 |
| USB cable, type A to type B, USB 2.0, 1m | 6035.9035 | 1 |
| USB cable, type A to type B, USB 2.0, 5m | 6911.0002 | 1 |
| Chromeleon 6 Service Pack CD or<br>CM Driver Update CD | 4580.0316 or<br>5950.0092 | 1 |
| LPG-3000 Pump Series Operating Instructions and<br>UltiMate 3000: System Installation and Application<br>(English-language versions) | 4820.3551 | 1 |
| Assortment box for accessories | 6000.0043 | 1 |

* The part number always refers to the packing unit. For more information, please contact your Dionex sales representative.

## 9.2 Optional Accessories

| Part No. | Description | Remarks |
|---|---|---|
| 5035.9230 | SRD-3600 Solvent Rack | With analytical 6-channel vacuum degasser (intended for use with an LPG-3600 pump) |
| 5035.9240 | SRD-3300 Solvent Rack | With analytical 3-channel vacuum degasser (intended for use with an LPG-3300 pump) |

## 9.3 Spare and Wear Parts

| Description | Part No.* |
|---|---|
| Bushing with draining device (5 bushings) | 6000.4001 |
| Capillary (long) from loading pump to autosampler switching valve, standard devices (130 µm ID x 75 cm, PEEK, including appropriate fittings | 6720.0032 |
| Capillary (long) from loading pump to autosampler switching valve, biocompatible devices (130 µm ID x 75 cm, PEEK, including appropriate fittings for biocompatible pumps) | 6721.0032 |
| Capillary (short) from loading pump and to autosampler switching valve (standard devices), (130 µm ID x 60 cm, PEEK, including appropriate fittings) | 6720.0031 |
| Capillary (short) from loading pump and to autosampler switching valve (biocompatible devices), (130 µm ID x 60 cm, PEEK, including appropriate fittings | 6721.0031 |
| Capillary (long) from pump to flow manager (standard devices) for 2D LC Comprehensive applications, including the appropriate fittings and ferrules | 6035.2556 |
| Capillary (long) from pump to flow manager (biocompatible devices) for 2D LC Comprehensive applications, including the appropriate fittings and ferrules | 6037.2556 |
| Capillary (short) from pump to flow manager, standard devices, for 2D LC Comprehensive applications, including the appropriate fittings and ferrules | 6035.2554 |
| Capillary (short) from pump to flow manager, biocompatible devices, for 2D LC Comprehensive applications, including the appropriate fittings and ferrules | 6037.2554 |
| Capillary (long) from pump to flow manager (standard devices), including the appropriate fittings and ferrules | 6035.2550 |
| Capillary (long) from pump to flow manager (biocompatible devices), including the appropriate fittings and ferrules | 6037.2550 |
| Capillary (short) from pump to flow manager (standard devices), including the appropriate fittings and ferrules | 6035.2553 |
| Capillary (short) from pump to flow manager (biocompatible devices), including the appropriate fittings and ferrules | 6037.2553 |
| Capillary (standard pump) from equilibration head to outlet block, including the appropriate fittings and ferrules. | 6035.3010 |
| Capillary (biocompatible pump) from equilibration head to outlet block, including the appropriate fittings and ferrules. | 6037.3010 |
| Capillary (standard pump) from working head to equilibration head, including the appropriate fittings and ferrules. | 6030.3015 |
| Capillary (biocompatible pump) from working head to equilibration head, including the appropriate fittings and ferrules. | 6037.3015 |
| Capillary from proportioning valve to working head (including the appropriate fittings and ferrules) | 6035.2514 |
| Filter frit (The kit includes 10 PEEK frits, 0.5 µm.) | 6268.0022 |
| Filter frit (The kit includes 10 stainless steel frits, 0.5 µm.) | 6000.0045 |
| Filter holder (outlet block), standard pump | 6030.2103 |
| Filter holder (outlet block), biocompatible pump | 6030.2112 |
| Filter removal tool (1/4"), for the filter in the filter holder on the outlet block | 6035.3051 |
| Flat-blade screwdriver (for 1/8" pistons) | 6001.0114 |
| FS-8 dummy plug | 6000.0044 |

| Description | Part No.* |
|---|---|
| Fuses kit, including:<br>5 fuses (0.20A, idle, 5 x 20 mm)<br>15 fuses (overload protection, 2A, idle, 5 x 20 mm)<br>5 fuses (4A, idle, 6.3 x 32 mm) | 6030.9003 |
| Inlet (double check) valve (with valve catridge), biocompatible pump | 6037.2100 |
| Inlet (double check) valve (with valve catridge), standard pump | 6020.2100 |
| Liquid reservoir for rear-seal wash system (2 reservoirs) | 6030.9501 |
| Outlet (double check) valve (with valve catridge), biocompatible pump | 6037.2200 |
| Outlet (double check) valve (with valve catridge), standard pump | 6020.2200 |
| Piston retaining screw | 6001.0105 |
| Piston unit | 6030.0032 |
| Purge screw | 6020.2030 |
| Rear-seal wash system, including:<br>1 piston seal (analytical), 1 O-ring, 1 pump head bushing (micro), 1 DR retaining screw | 6035.2010 |
| Rear-seal wash system, tubing kit, including:<br>1 tube connector<br>1m silicone tubing<br>Note: Do not use this silicone tubing in the peristaltic pump. For the peristaltic pump tubing, order part no. 6000.5000. | 6030.9502 |
| Retaining guide (solvent bottle) | 6000.0042 |
| Ring seal (DR-8, 10 seals) | 2266.0082 |
| Solvent lines from proportioning valve to degasser of an SRD-3000 series solvent rack, The set includes:<br>3 solvent lines plus appropriate fittings and ferrules<br>3 solvent line labels (A, B, C). | 6030.2547 |
| Support ring/piston seal spare parts kit (normal phase) for standard pump pumps<br>The kit includes 1 support ring and 2 piston seals. | 6025.2011A |
| Support ring/piston seal spare parts kit (reversed phase) for biocompatible pumps<br>The kit inludes 1 support ring and 2 piston seals. | 6266.0305 |
| Support ring/piston seal spare parts kit (reversed phase) for standard pump pumps<br>The kit inludes 1 support ring and 2 piston seals. | 6025.2010A |
| Syringe and tubing kit, including:<br>5 plastic syringes<br>3 silicone tubes (2.80 mm OD x 1.30 mm ID) | 6000.0010 |
| Tubing for peristaltic pump (Pharmed tubing) | 6000.5000 |
| Valve cartridge (to be used for the inlet and outlet valve), biocompatible pump | 6037.2300 |
| Valve cartridge, same as 6020.2300, but in ceramics | 6020.2400 |
| Valve cartridge (to be used for the inlet and outlet valve), standard pump | 6020.2300 |
| Waste fluidics kit, including<br>2 m tubing<br>5 Tee pieces | 6000.5001 |

| Description | Part No.* |
|---|---|
| Working head, biocompatible pump | 6037.2001 |
| Working head, standard pump | 6035.2001 |

* The part number always refers to the packing unit. For more information, please contact your Dionex sales representative.

# 10 Reference Information

## 10.1 Chemical Resistance of PEEK

For information about the chemical resistance of PEEK, refer to the table below:

| Medium | Concentration [%] | Temperature | Duration | Resistance | Notes |
|---|---|---|---|---|---|
| Acetaldehyde | techn. pure | 23 | | + | |
| Acetone | 100 | 23 | 7 days | + | |
| Ammonia | 28 | 23 | 7 days | + | |
| Ammonium sulphate | | 23 | | + | |
| Amyl acetate | 100 | 23 | | + | |
| Amyl alcohol | techn. pure | 23 | | + | |
| Benzaldehyde | | 23 | 7 days | + | |
| Benzene | 100 | 23 | 7 days | + | |
| Benzene/Benzene mixture | | 60 | 42 days | + | |
| 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 | 100 | 23 | | + | |
| Chromic acid | 40 | 23 | | + | |
| Citric acid | | 23 | | + | |
| Copper(II) sulphate | | 23 | | + | |
| Cyclohexane | 100 | 23 | | + | |
| Cyclohexanol | 100 | 23 | | + | |
| Cyclohexanone | | 23 | | + | |
| Diethyl ether | 100 | 23 | 7 days | + | |
| Diisopropyl ether | 100 | 23 | | + | |
| Dimethylformamide | 100 | 23 | 7 days | + | |
| Dioctylphthalate | | 23 | | + | |
| Dioxan | | 23 | | + | |
| Ethanoic acid | 96 | 23 | 7 days | + | |
| Ethanol | 96 (Vol.) | 23 | 7 days | + | |
| Ethyl acetate | 100 | 23 | | + | |
| Ethylene glycol | | 23 | | + | |
| Ferric chloride | | 23 | | + | |
| Formaldehyde | 30 | 23 | | + | |
| Formic acid | 95 | 104 | 42 days | + | |

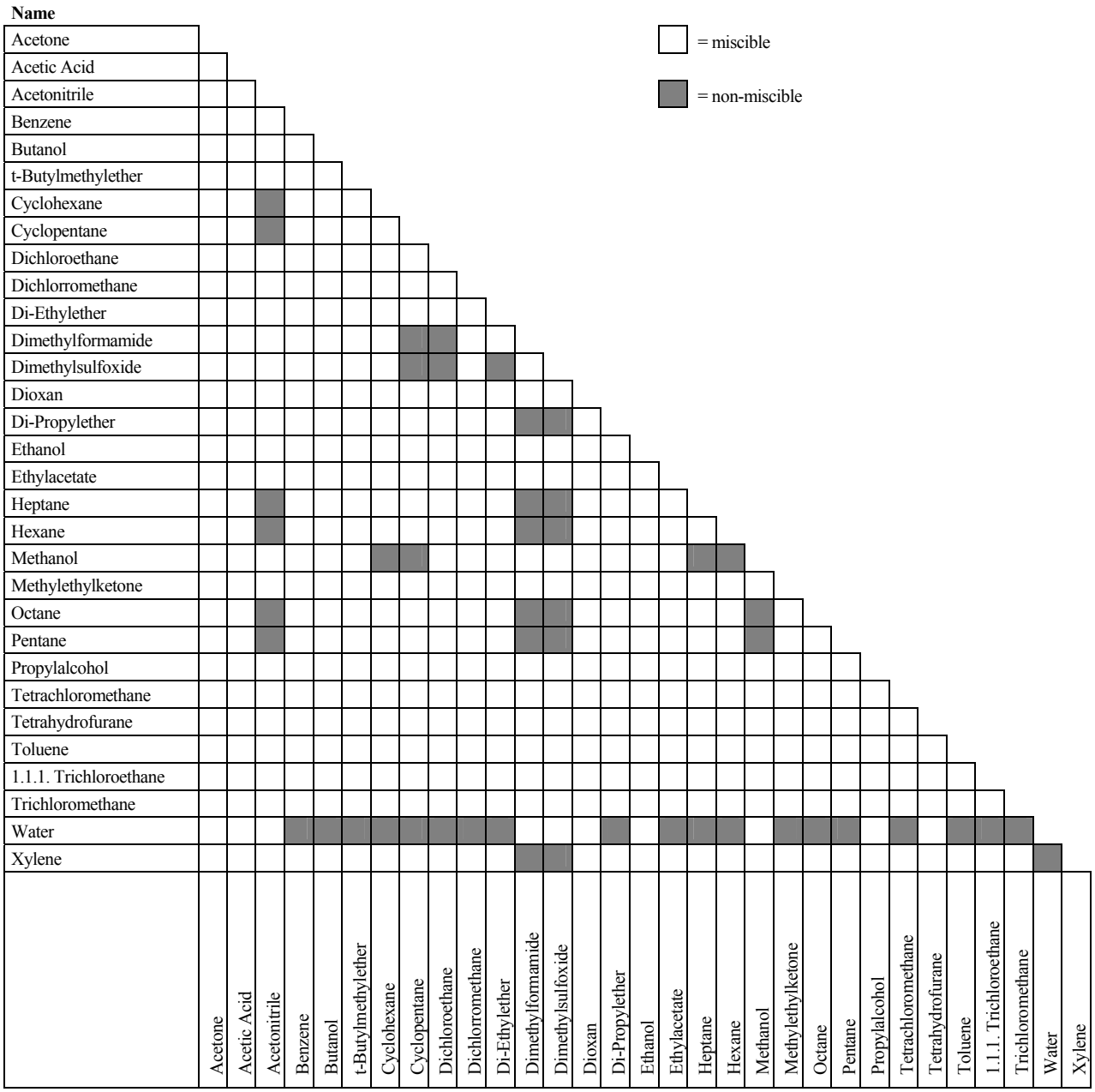
| Medium | Concentration [%] | Temperature | Duration | Resistance | Notes |
|---|---|---|---|---|---|
| Glycerin | | 23 | | + | |
| Heptane | 100 | 23 | 7 days | + | |
| Hydrochloric acid | 37 | 23 | | + | |
| Hydrofluoric acid | | 23 | | - | |
| Hydrogen peroxide | 30 | 23 | 7 days | + | |
| Hydrogen sulphide | | 23 | | + | |
| Kerosene (Paraffin) | | 23 | | + | |
| Lactic acid | | 23 | | + | |
| Magnesium chloride | | 23 | | + | |
| Methanol | 100 | 23 | | + | |
| Methyl ethyl ketone | 100 | 23 | | + | |
| Methylisobutylcetone | 100 | 23 | | + | |
| Nitric acid | 40 | 23 | 7 days | + | |
| Nitric acid | 65 | 23 | 7 days | + | |
| Nitrobenzene | 100 | 23 | | + | |
| Paraffin oil | | 60 | | + | |
| Perchlorethylene | 100 | 23 | | + | |
| Phenol | diluted | 23 | | + | |
| Phenol | conc. | 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 days | + | |
| Sodium hydroxide | 30 | 130 | | + | |
| Sodium thiosulphate | | 23 | | + | |
| Sulphur dioxide | | 23 | | + | |
| Sulphuric acid | 40 | 130 | | + | |
| Sulphuric acid | 50 | 23 | 7 days | + | |
| Sulphuric acid | 98 | 23 | | - | dissolved |
| Toluol | 100 | 23 | 7 days | + | |
| Trichloroethylene | 100 | 23 | 7 days | + | |
| 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.

**Please note:** Note that certain compositions of some solvent systems may result in miscibility gaps.

For information about solvent miscibility, refer to the table below (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 separate.



## 10.3 Properties of Common Solvents

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

| | Acetronitrile | Dichloromethane | Hexane | Isorpopanol | 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 ($\eta$) at 20°C (cP = mPa*s) | 0.37 | 0.44 | 0.33 | 2.3 | 0.60 | 0.55 | 1.00 |
| Density ($\rho$) (g/ml) | 0.78 | 1.32 | 0.66 | 0.78 | 0.79 | 0.88 | 0.997 |
| $\eta/\rho$ (cP*ml/g) | 0.47 | 0.33 | 0.50 | 2.9 | 0.76 | 0.62 | 1.00 |
| Compressibility ($\chi$) 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 $\Delta p/l$ (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 ID tubing
$F_C$ (ml/min) = 113 x 0.25 mm x $\eta$ (cP) / $\rho$ (g/ml)
Fc is an example of a hydrodynamic calculation.

[2] $\Delta p/l$ = linear drop in pressure for 1 ml/min and 0.25 mm ID tubing
$\Delta p/l$ (MPa/m) = 6.8 x $10^{-6}$ x 1 ml/min x 100 cm x $\eta$ (cP) / $(0.25\ mm)^4$
$\Delta p/l$ 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 | Diethylether | Ethanol | Ethylacetate | Heptane | Hexane | Isopropanol | Methanol | Tetrahydofurane |
|---|---|---|---|---|---|---|---|---|---|
| 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]

**Please note:** 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., 1985Technischer Anhang

# 11 Technical Appendix - Pinouts

| Pin | Signal Name | Signal Level | Remarks |
|---|---|---|---|
| 1 | | | Marked wire/reserved |
| 2 | | | Reserved |
| 3 | RELAY 3 OUT | Potential free | Closing contact |
| 4 | RELAY 1 OUT | Potential free | Opening contact |
| 5 | RELAY 2 OUT | Potential free | Opening contact |
| 6 | RELAY 3 OUT | Potential free | Opening contact/Operable Out |
| 7 | RELAY 1 OUT | Potential free | Middle contact |
| 8 | RELAY 2 OUT | Potential free | Middle contact |
| 9 | GND | Ground | Reference potential |
| 10 | HOLD IN | Ground | Reference potential |
| 11 | STOP IN | Ground | Reference potential |
| 12 | START IN | Ground | Reference potential |
| 13 | | | Reserved |
| 14 | RELAY 4 OUT | Potential free | Closing contact |
| 15 | RELAY 4 OUT | Potential free | Middle contact |
| 16 | RELAY 4 OUT | Potential free | Opening contact |
| 17 | | | Reserved |
| 18 | RELAY 3 OUT | Potential free | Middle contact/Operable Out |
| 19 | RELAY 1 OUT | Potential free | Closing contact |
| 20 | RELAY 2 OUT | Potential free | Closing contact |
| 21 | Vcc_Save | +5V/500mA | |
| 22 | HOLD IN | TTL | Digital input 1 |
| 23 | STOP IN | TTL | Digital input 2 |
| 24 | START IN | TTL | Digital input 3 |
| 25 | | | Reserved |

*Fig. 56: 25-pin D-Sub I/O port (female)*

| Pin | Signal Name | Signal Level | Remarks |
|---|---|---|---|
| 1 | | | Reserved |
| 2 | Solvent Rack Error | | TTL_high with solvent rack errors |
| 3 | | | Jumper to pin 9 |
| 4 | Solvent Rack Leak | | TTL high with solvent rack leaks |
| 5 | | | Reserved |
| 6 | V_Degas | +24V_supply | Supply for the solvent rack |
| 7 | GND_Degas | Ground_supply | Reference potential for VC_Degas |
| 8 | VCC | +5V | Voltage for logic devices |
| 9 | | | Jumper to pin 3 |
| 10 | GND | | Reference potential for VCC |
| 11 | GND | | Reference potential for VCC |
| 12 | GND | | Reference potential for VCC |
| 13 | | | Reserved |
| 14 | V_Degas | +24V_supply | Supply for the solvent rack |
| 15 | GND_Degas | Ground_supply | Reference potential for VC_Degas |

*Fig. 57: 15-pol. Solvent Rack port (female)*

# 12 Index

## L



## M



## O



## P



## R

## S



## T



## U



## W