Thermo Scientific Dionex UltiMate 3000 Series

Nano/Cap System NCS-3500RS

Nano/Cap Pump NCP-3200RS

Operating Instructions
(Original Operating Instructions)

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1 Introduction

1.1 How to Use this Manual

The layout of this manual is designed to provide quick reference to the sections of interest to the reader when operating the Thermo Scientific™ Dionex™ NCS-3500RS or NCP-3200RS. However, in order to obtain a full understanding of the module, Thermo Fisher Scientific recommends that you review the manual thoroughly before beginning operation.

The descriptions in this manual apply to the following modules in the UltiMate™ 3000 series:

- NCS-3500RS
- NCP-3200RS

The following conventions apply to the descriptions throughout this manual:

- The term "the device" or "the module" is used throughout the manual. If some detail applies to only one model or version, the model (version) is identified by name.
- The NCS-3500RS combines a binary high-pressure gradient (HPG) pump (referred to as NC pump) and a ternary low-pressure (LPG) micro pump (referred to as loading pump). If a description refers to the NC pump and the loading pump, the term "the pump module" or "the pump" is used. If some detail applies to only one pump, the pump is identified by name.
- The NCP-3200RS is a binary high-pressure gradient pump (HPG) (referred to as NC pump). This pump corresponds to the NC pump in the NCS-3500RS. Therefore, the descriptions for the pump module and the NC pump apply also for the NCP-3200RS.
- If not otherwise stated, the descriptions for the Viper™ capillary connections apply also to nanoViper™ and possible other Viper capillary connections.
- The device configuration may vary. Therefore, not all descriptions necessarily apply to your particular module.
- The representation of a component in this manual may be slightly different from the real component. However, this does not influence the descriptions.
- The descriptions in this manual refer to firmware version 1.40 and Chromeleon™ 6.80. If you want to operate the module from Chromeleon 7, note the information on page 35.

  This manual assumes that the module is used with a suitable Chromeleon software version with a valid license.

Tip: If the module is part of an UltiMate 3000 RSLCnano system, see section 3.3 (→ page 39) for information about how to arrange the modules and set up the system. For more information, refer to the "UltiMate 3000 RSCLnano - Standard Applications" system manual. The manual is shipped with the module.

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1.2 Safety Information

The CE Mark label and cTUVus Mark safety label on the instrument indicate that the instrument is compliant with the related standards.

1.2.1 Symbols on the Module and in the Manual

The table shows the symbols used on the module:

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

At various points throughout the manual, the following symbols indicate messages of particular importance:

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

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

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

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

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

1.2.2 Safety Precautions

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

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

For the safety precautions in French, see section 1.2.3 (→ page 9).

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

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

- **Protective equipment**

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

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

- **Hazardous substances**

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

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

- **Hazardous gases**

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

- **Electrostatic discharge**

  Discharge of electrostatic energy may lead to sparking and can constitute a fire hazard. Keep in mind that liquid flowing through capillaries can generate static electricity. This effect is particularly pronounced in insulating capillaries and with non-conductive solvents (for example, pure acetonitrile).

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

- **Self-ignition of solvents**

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

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

  - Capillaries, especially non-metallic capillaries may burst, slip out of their fittings or may not be screwed in. This may result in substances spraying out of the open connections.
  - In an UltiMate 3000 system, some components are made of PEEK. This polymer has superb chemical resistance to most organic solvents. However, it tends to swell when in contact with trichlormethane ($CHCl_3$), dimethyl sulfoxide (DMSO), or tetrahydrofuran (THF). In addition, it is attacked by concentrated acids, such as, sulfuric acid and nitric acid or a mixture of hexane, ethyl acetate, and methanol. In both cases, capillaries may start leaking or they can burst. Swelling or attack by concentrated acids is not a problem with brief flushing procedures.
  - Do not use tubing that is stressed, bent, kinked, or damaged.
  - Capillary connections can be contaminated by harmful substances or harmful substances can escape from open connections.
  - Some capillaries of the NCS-3500RS and some Viper system capillaries are made of MP35N®, a nickel-cobalt based alloy. Individuals with sensitivity to nickel/cobalt may show an allergic reaction from skin contact.
  - Always wear safety glasses when handling fused silica tubing, for example, during installation or when cutting capillaries to the length.

- **Hot surfaces**

  To avoid burns, do not touch any metal or plastic parts inside the column chamber while the temperature is higher than 50 °C. Wait for the column chamber to cool down, for example, before changing a column or before performing any maintenance procedures.

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

- Replace faulty communication cables.
- Replace faulty power cords. Never use a power cord other than the power cords provided for the device.
- Always replace blown fuses with original spare part fuses authorized by Thermo Fisher Scientific.
- Use only the original spare parts and accessories authorized for the device by Thermo Fisher Scientific.
- Avoid looking directly into the pump light LED. Do not use light focusing instruments for viewing the light beam. The high luminosity of the lamp can be harmful to the eyes.
- When operating the HPLC system, always set a lower pressure limit for the pump. This prevents damage resulting from leakage or from running the pump dry.
- The module is primed with 2-propanol when being shipped from the factory. During initial operation of the module, make sure that the solvents used are miscible with 2-propanol. Otherwise, follow the appropriate intermediate steps.
- 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. If the solvents are not miscible, the pump can be damaged, for example, by flocculation.
- Use only standard solvents (MS-grade) and buffers that are compatible with all parts in the module that may be exposed to solvents.
- Do *not* use methanol from aluminum reservoirs. This may impair the performance of the seals.
- Do not deliver in circles or recycle the eluent. This may impair the performance of the seals.
- When lifting or moving the module, always lift by the bottom or sides of the module. Do not lift the module by the front panel door. This may damage the door.
- A team effort is required to lift or move the NCS-3500RS. The NCS-3500RS is too heavy and/or bulky for one person alone to lift or move safely.
- The open front panel door is not designed to carry weight. Do not place any heavy objects on the open front panel door; this may damage the door.
- To avoid that pressure calibration of the loading pump is impaired, turn on the pump only when the pump pressure is down. To ensure that the pressure is down, open the purge valve of the loading pump before turning on the pump.

- Never run the pump dry. Damage to the pistons or the piston seals could result.
- Before you start operating the module, check the seal wash reservoir level and refill as needed. After turning on the instrument, wait until the wash solution has passed all pump heads.
- Always use fresh rear seal wash solution.
- To prolong the life cycle of the valves, avoid moving the valves dry.
- If the pump flow is interrupted for longer periods (> 1 hour), you have to turn off the lamps in any detector connected to the module to prevent evaporation in the flow cell.
- Always use the frits recommended by Thermo Fisher Scientific. This is to prevent particulate matters from entering the HPLC system. Using other frits may considerably affect the system performance.
- If a leak occurs, stop the pump flow, turn off the module, and remedy the situation.
- Before interrupting operation for several days or more or when preparing the module for transport, observe the precautions for shutting down the module (→ page 140).
- Do not use the module in ways other than those described in these O*perating Instructions*.
- Keep the operating instructions near the device to be available for quick reference.

Tip: To have an optimally running system, observe the recommendations in section 5.8 (→ page 138).

1.2.3 Consignes de Sécurité

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

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

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

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

- **Equipment de protection**

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

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

- **Substances dangereuses**

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

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

- **Gaz dangereux**

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

- **Décharge électrostatique**

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

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

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

- **Inflammation spontanée des solvants**

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

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

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

- ♦ Certains capillaires des NCS-3500RS, ainsi que des capillaires du système Viper, sont faits d'alliage de nickel-cobalt MP35N. Contact avec la peau peut provoquer une réaction chez les personnes qui sont sensibles au nickel/cobalt.
- ♦ Portez des lunettes de protection lorsque vous manipulez des capillaires en silice fondue (pendant l'installation, découpe, etc.).

- **Surface chaude**
  Pour éviter tout risque de brûlure, ne touchez à aucune partie en métal ou plastique à l'intérieur du compartiment de colonne tant que la température est supérieure à 50 °C. Attendez que le four refroidisse, par exemple, avant de changer une colonne ou avant de procéder à tous opérations de maintenance.
- Quand les capots de protection de l'appareil sont démontés, vous êtes exposés à des connexions électriques sous haute tension deviennent accessibles. Débranchez l'instrument de toute source d'alimentation électrique avant de retirer les capots. Ne démontez les capots de protection que si cela est explicitement demandé au cours de ces instructions. Les capots de protection devraient être démontés uniquement par le personnel de service de Thermo Fisher Scientific.
- Remplacez les câbles de communication défectueux.
- Remplacez les cordons d'alimentation électrique défectueux. Utilisez uniquement les cordons d'alimentation électrique spécifique à l'instrument.
- Remplacez toujours les fusibles grillés par des fusibles de rechange autorisés par Thermo Fisher Scientific.
- Utilisez seulement des pièces de rechange originales et des accessoires autorisés par Thermo Fisher Scientific.
- Ne regardez jamais directement la DEL pour l'éclairage intérieur dans la pompe et ne regardez pas du faisceau lumineux par des instruments qui focalisent le rayon lumineux. L'intensité lumineuse de la lampe peut être nocive pour les yeux.
- 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.
- La pompe et les vannes de colonne sont stockées sous 2-propanol. Au cours démarrage de l'instrument, assurez-vous que les solvants utilisés soient miscibles avec le 2-propanol. Sinon, suivez les étapes intermédiaires appropriées.
- 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!
- Utilisez uniquement des solvants (qualité MS) et des solutions salines compatibles avec les matériaux exposés phase mobiles.
- N'employez pas du méthanol stocké dans des réservoirs en aluminium. Ceci peut affecter les performances des joints.
- Thermo Fisher Scientific déconseille de recycler les solvants. Ceci peut nuire aux performances des joints.
- Lorsque vous soulevez ou déplacez le NCS, soulevez toujours par le bas ou les côtés, avec le panneau avant fermé afin de ne pas endommager l'instrument .Le panneau avant bascule vers le haut. Afin d'éviter d'endommager l'instrument lorsque que vous la soulevez ou la déplacez, saisissez-la toujours par les côtés de l'unité.
- Le NCS-3500RS est lourd et encombrant. Par conséquent, vous ne devriez pas soulever le NCS seul.
- Ne placez aucun objet lourd sur la porte ouverte du panneau avant. Ceci pourrait endommager la porte.
- Afin d'éviter que le calibrage de pression de la pompe de chargement ne soit pas entravé, mettez en marche la pompe seulement quand la pompe est sans pression. Toujours ouvrez la vis de purge avant mettre la pompe en marche.
- Ne faites jamais fonctionner la pompe à sec. Il peut en résulter des dommages aux pistons ou aux joints de piston.
- Avant de mettre en marche l'instrument, assurez-vous que le réservoir de rinçage du joint arrière de la pompe est rempli. Attendez jusqu'à ce que le rinçage du joint arrière ait été pompé par toutes les têtes de pompe.
- Utilisez toujours le liquide frais pour le rinçage du joint arrière.
- If faut éviter fonctionner les vannes de colonne à sec. Il peut en résulter des dommages aux vannes.
- Si le débit de la pompe est interrompu pour des périodes prolongées (> 1 heure), éteignez les lampes de tout détecteur raccordé à la pompe. Ceci empêchera l'évaporation dans la cellule.
- Utilisez toujours les frittés recommandés par Thermo Fisher Scientific afin d'empêcher les particules étrangères d'entrer dans le système HPLC. Utiliser d'autres frittés peut affecter considérablement les performances du système.

- Si une fuite survient, stoppez le débit de la pompe, arrêtez l'instrument, et résolvez le problème immédiatement.
- Avant d'interrompre le fonctionnement pendant plusieurs jours ou plus, observez les précautions figurant en page 140.
- N'utilisez pas l'instrument de manière autre que celles décrites dans ce manuel.
- Conservez ce manuel á proximité de l'instrument pour pouvoir le consulter facilement.

Veuillez noter: Veuillez noter aussi les recommandations pour la bonne pratique en section 5.8 (→ page 138).

1.3 Intended Use

For Research Use Only. Not for use in diagnostic procedures.

The device is designed to be operated only be qualified and authorized personnel. All users must know the hazards presented by the device and the used substances.

The NCS-3500RS and NCP-3200RS are designed for laboratory research use in ultra-high performance liquid chromatography (UHPLC) applications. They are part of the UltiMate 3000 RSLCnano system, but can be used also with other HPLC systems if adequate control inputs and outputs are available. A PC with USB port is required.

The module is controlled by the Chromeleon Chromatography Management System. Being part of the UltiMate 3000 system, the module can also be operated with other data systems, such as Xcalibur™. In this case, installation of additional software is required in addition to the data system software.

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

Note that the module may be operated only with accessories and spare parts recommended by Thermo Fisher Scientific (→ page 239) and within its technical specifications (→ page 235).

If there is any question regarding appropriate usage, contact Thermo Fisher Scientific before proceeding. Thermo Fisher Scientific cannot be held liable for any damage, material or otherwise, resulting from inappropriate or improper use of the instrument.

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

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

1.4 Federal Communications Commission (FCC) Note

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

2 Overview

2.1 Unit Description

The NCS-3500RS and NCP-3200RS are the "heart" of the UltiMate 3000 RSLCnano System. They perform equally well as flexible and reliable modules for routine analysis and sophisticated research tasks in nano LC and capillary LC, and can be used in numerous laboratory environments.

- The NCS-3500RS combines a binary high-pressure gradient pump (NC pump), and a ternary low-pressure micro pump as loading pump, and a column compartment in one enclosure.

  The NCP-3200RS is a binary high-pressure gradient pump (NC pump). This pump is intended for use in application setups that do not require a loading pump and column compartment. Thus, the NCP-3200RS is the ideal choice to support the NCS-3500RS as a second pump, for example, in parallel LC applications.

- The module has been especially designed to work at higher working pressures (up to 80 MPa with Classic flow meter and up to 90 MPa with ProFlow™ flow meter) and thus, is the appropriate choice for ultra-high performance LC (UHPLC) applications.

- Key features of the pump module

  - The NC pump includes two highly precise constant pressure pumps that are controlled by closed control loops and that enable continuous operation without the need of refill cycles.
  - The flow meter controls the partial flows of the two channels.
  - The integrated control principle ensures that the NC pump delivers highly precise gradients with the low flow rates required for nano, capillary and micro LC applications. The flow rate is kept stable, independent of backpressure or temperature changes.
  - Eluent mixing is performed at the outlet of the flow meter, thus ensuring that the gradient delay volume is as small as 25 nL.
  - Continuous direct flow delivery ("splitless") of the NC pump reduces the solvent consumption considerably compared to splitter-based systems.
  - The NC pump and the loading pump are fitted with floating pistons, allowing compensation for small mechanical tolerances within the specification and thus enhancing the robustness of the pump.
  - For the loading pump, the patented isokinetic pre-compression allows a precise and almost pulse-free flow.

  - As a standard, the pump module is equipped with an active rear seal wash system (→ page 29).
  - The technical specification meets the highest requirements for flow rate reproducibility, zero pulsation, and operational reliability (→ page 235).
- Key features of the column compartment
  - The column chamber can be equipped with one or two column switching valves.
  - The column chamber provides room for all columns, trap columns, and capillaries required for nano LC and capillary LC applications.
  - The column chamber and all components inside the chamber can be warmed up to temperatures of +7 °C above ambient to 75 °C.
  - Thermoelectric elements heat the column chamber and all internal components to the preferred temperature (settable in 0.1 °C increments). Using a heat exchanger, they allow fast temperature changes and ensure independence from the ambient temperature.
  - The columns can be warmed up to max. 75 °C. At an ambient temperature of 25 °C, an increase in temperature from 35 °C to 65 °C is typically realized in 12 minutes.
  - Temperature control allows keeping the column temperature constant within the specified range. The maximum deviation is ± 0.1 °C.
  - An electronic column identification module allows GLP-compliant documentation of the column type and all important column parameters (→ page 34).
- Various monitoring and diagnostic features are provided for optimum system performance and reliability (→ page 36).
- The module is designed for easy access to the fluid components, allowing fast and reliable maintenance while the module remains in the UltiMate 3000 system stack.
- For the secure and functional positioning of the solvent reservoirs on top of the module and for high efficiency solvent degassing, the Solvent Racks of the UltiMate 3000 series are available (→ page 20).
- The module can be fully controlled by the Chromeleon Chromatography Management System, providing a high degree of system integration.
- All parts that may be exposed to solvents are made of materials that provide optimum resistance to the most commonly used HPLC solvents and buffer solutions.

2.2 Module Configurations

2.2.1 Overview

The module is available in the following configurations:

Application	Description
Nano LC	NCS-3500RS nanoLC/ProFlow Nano/Cap system including NC-pump with ProFlow flow meter, loading pump, and column compartment Basic version *without* column switching valves
	NCP-3200RS nanoLC/ProFlow Nano/Cap pump with ProFlow flow meter, same as NCS-3500RS, however, *without* loading pump and column compartment
Capillary LC	NCS-3500RS capillaryLC Nano/Cap system including NC-pump with Classic flow meter for capillary LC, loading pump, and column compartment Basic version *without* column switching valves
	The NCP-3200RS nanoLC/ProFlow can be fitted with a Classic flow meter for capillary LC applications (→ page 202).
Micro LC	The NCS-3500RS nanoLC/ProFlow, NCS-3500RS capillaryLC and NCP-3200RS nanoLC/ProFlow can be fitted with a Classic flow meter for micro LC applications (→ page 202).

The column compartment can be fitted with one or two column switching valves. The following valves are available and must be ordered separately.

Column Switching Valve	Part No.
2-position, 6-port switching valve	6041.0004
2-position, 10-port switching valve	6041.0001

The column switching valves are suitable for pressures < 86 MPa (12500 psi). For installation details, see page 78.

2.2.2 Combinations of UltiMate 3000 Pumps and Solvent Racks

The Solvent Racks of the UltiMate 3000 system series are an ideal complement to the module, whether you need high efficiency degassing of the solvents or simply want to safely organize your solvent reservoirs.

Solvent Rack	Part No.
SRD-3200 Solvent Rack with analytical 2-channel vacuum degasser	5035.9250
SRD-3400 Solvent Rack with analytical 4-channel vacuum degasser	5035.9245
SRD-3600 Solvent Rack with analytical 6-channel vacuum degasser	5035.9230
SR-3000 Solvent Rack without degasser	5035.9200

In an UltiMate 3000 RSLCnano system, a SRD-3400 Solvent Rack with analytical 4-channel vacuum degasser should be used together with the NCS-3500RS.

Tip: If the UltiMate 3000 system includes an UltiMate 3000 series autosampler, you should degas also the wash solution on a continuous basis, by using the vacuum degasser in the Solvent Rack. The procedure how to prepare and install the liquid lines for the wash solution is similar to the steps for the solvent supply lines (→ page 63). For information about online degassing of the wash solution, see the *Autosampler manual*.

2.3 Operating Principle

For information about the operating principles of the individual components of the module, see section 8.

For the …	Find information about the ...	On page …
NC pump	Interior components (detailed view) Liquid flow path Operating principle	220 221 222
Loading pump	Interior components (detailed view) Liquid flow path Operating principle	226 227 228
Column compartment	Interior components (detailed view) Operating principle	229 230

2.4 Front Panel Elements

Fig. 1: Front panel view (here NCS-3500RS)

No.	Element	Function
1	Standby button	Switches the module to Standby mode (the LED is lighted). To cancel Standby mode and resume operation, press the Standby button again (the LED is not lighted). *Notes:* To allow the module to change the mode, press and hold the Standby button for at least one second. If you switch a module to which a SRD-3x00 Solvent Rack is connected to the Standby mode, the Solvent Rack, too, will be set to Standby mode.
2	Lever	Moves the valve actuators or, if already installed, the column switching valves toward the front (→ page 78).
3	Display	Shows information about the pump (upper display) and about the column compartment (lower display): - Status screen (→ page 85) - Functions and menus (→ pages 94 and 96) In addition, the following information appears on the pump display: - General information upon power-up of the module (→ page 85) - Messages (→ page 147)

No.	Element	Function
4	**Pump and column compartment status LEDs**	
	Power	The LEDs are blue when the module power is on.
	Connected	The LEDs are green when the module is connected in Chromeleon.
	Status	*Status LED (pump module)* The LED is green when the pump is ready for operation. The LED is red when an error has been detected, for example, a leak. *Status LED (column compartment)* The LED is green when the column compartment has reached the target temperature. The LED is orange when the column compartment has not yet reached the target temperature or when the door is open. The LED is red when an error has been detected, for example, a leak.

2.5 Rear Panel

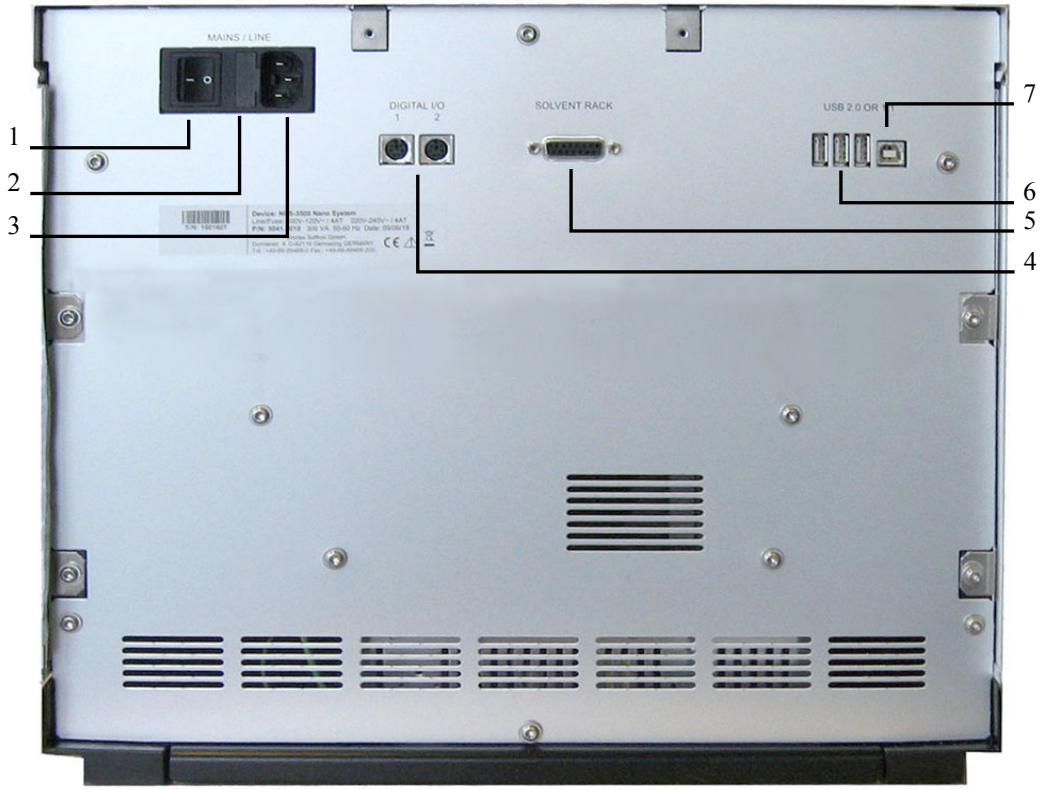


Fig. 2: Rear panel view

No.	Description
1	Power switch (→ page 25)
2	Fuse cartridge (→ page 25)
3	Main power receptacle (→ page 42)
4	Digital I/O ports (→ page 25) for communication with external devices, for example, a mass spectrometer
5	Solvent Rack port for connection of a SRD-3x00 Solvent Rack (→ page 25)
6	USB hub (3 USB ports, for USB 2.0 or 1.1) Depending on the UltiMate 3000 system configuration, for connection of one UltiMate 3000 system module each or for connection of one USB hub each (→ page 25).
7	USB port (USB 2.0 or 1.1) for connecting the module to the Chromeleon computer (→ page 25)

2.5.1 Power Switch

The main power switch is on the rear panel. The main power switch is used to turn the device on or off.

2.5.2 Fuse Cartridge

The fuse cartridge contains two slow-blow fuses rated at 2 A (NCP-3200RS) or 4 A (NCS-3500RS). For information about how to change the fuses, see page 216.

2.5.3 USB Port

The Chromeleon Chromatography Management System can use a USB (= Universal Serial Bus) connection to control the module. Data is transferred digitally by means of the appropriate USB cable (→ page 41).

You can use the internal USB hub (→ Fig. 2, no. 10) to connect three other modules in the UltiMate 3000 product line, depending on the configuration of the UltiMate 3000 system, or three external USB hubs.

⚠ **Important:** Thermo Fisher Scientific recommends using these USB ports only for connections to Dionex instruments. Thermo Fisher Scientific cannot guarantee correct functioning if third-party instruments are connected.

⚠ **Important:** Thermo Fisher Scientific recommande d'utiliser les ports USB uniquement pour les raccordements aux instruments Dionex. Thermo Fisher Scientific ne peut garantir le bon fonctionnement si les instruments d'autres fabricants sont raccordés.

For information about how to connect the module to the Chromeleon computer, see sections 3.4.1 and 3.4.2 (→ page 41).

2.5.4 Digital I/O

The digital I/O ports on the module provide two inputs and two relay outputs that can be used to exchange digital signals with external devices. For more information, see page 42.

For information about the functions of the connector pins and pin assignment, see page 255.

2.5.5 Solvent Rack

Use this port to connect a SRD-3x00 Solvent Rack with integrated vacuum degasser (→ page 20) to the module.

For information about the pin assignment of the Solvent Rack port, see page 256. For information about how to install and operate the Solvent Rack, see the *Solvent Rack manual*.

2.6 Interior Components

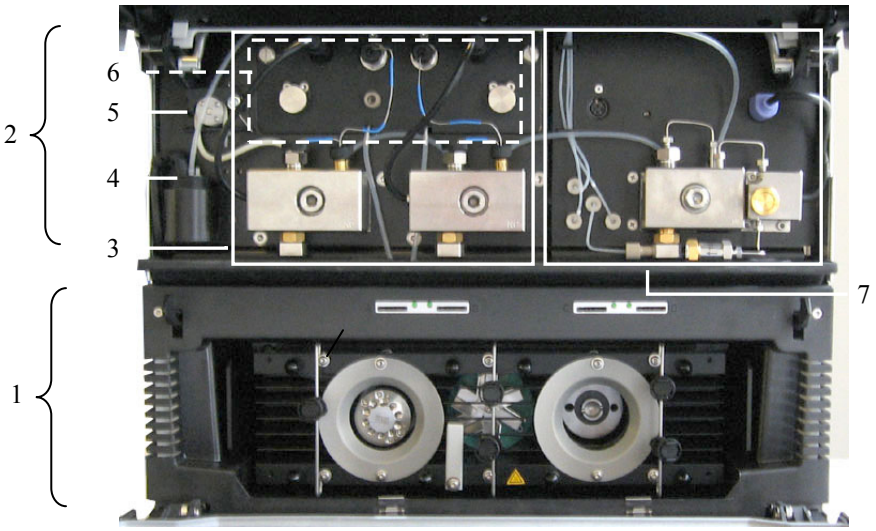


Fig. 3: Interior components (here NCS-3500RS with Classic flow meter)

No.	Description	
1	*NCS-3500RS only* Column compartment, here with one column switching valve (detailed view → page 229)	
2	Pump module with	
	No.	**Description**
	3	NC pump (detailed view → page 220)
	4	Detector of rear seal wash system (→ page 29)
	5	Peristaltic pump of the seal wash system (→ page 29)
	6	Flow meter of the NC pump (→ page 30)
	7	*NCS-3500RS only* Loading pump (detailed view → page 226)

2.7 Fluid Connections

The fluid components are located behind the front panel doors of the pump module and column compartment. The module is designed to provide easy access to the fluid components.

Pump Module

Tilt the front cover of the pump module upward. The open front panel locks in the topmost position. Observe the information under **Important** further down in this section.

Two passages in the enclosure bottom of the pump module facilitate routing the capillaries to the modules that are located below the pump module, for example, the column compartment, and ensure the shortest possible connection.

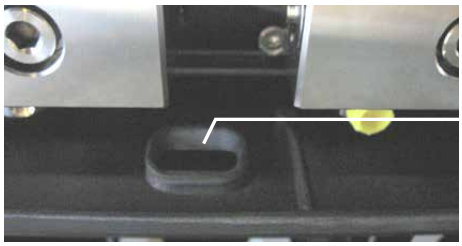


Fig. 4: Capillary passage in the pump module

Column Compartment

Unlock the front panel door as shown in the picture. The door tilts downward. To close the column chamber, tilt the front panel upward. The door locks automatically.

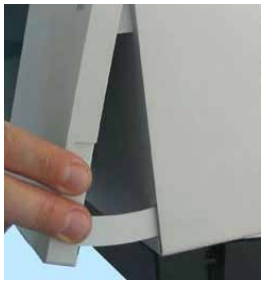


Fig. 5: Unlocking the front panel door

⚠ **Important:** The open front panel doors of the pump and column compartment are not designed to carry weight. Therefore, you should not place any objects on the open doors.

When lifting or moving the module, always lift by the bottom or sides of the module. Do *not* lift the module by the front panel door. This may damage the door.

⚠ **Important:** Ne placez aucun objet lourd sur les portes ouvertes des panneaux avant. Ceci peut endommager les portes.

Lorsque vous soulevez ou déplacez l'instrument, saisissez-la toujours par les côtés de l'instrument. Soulever l'instrument par le panneau avant risque d'endommager les portes des panneaux avant.

When connecting the capillaries and routing them to other system modules, observe the general information in section 4.2 (→ page 57). For more information about the liquid flow paths in the module, see section 8 (→ page 219).

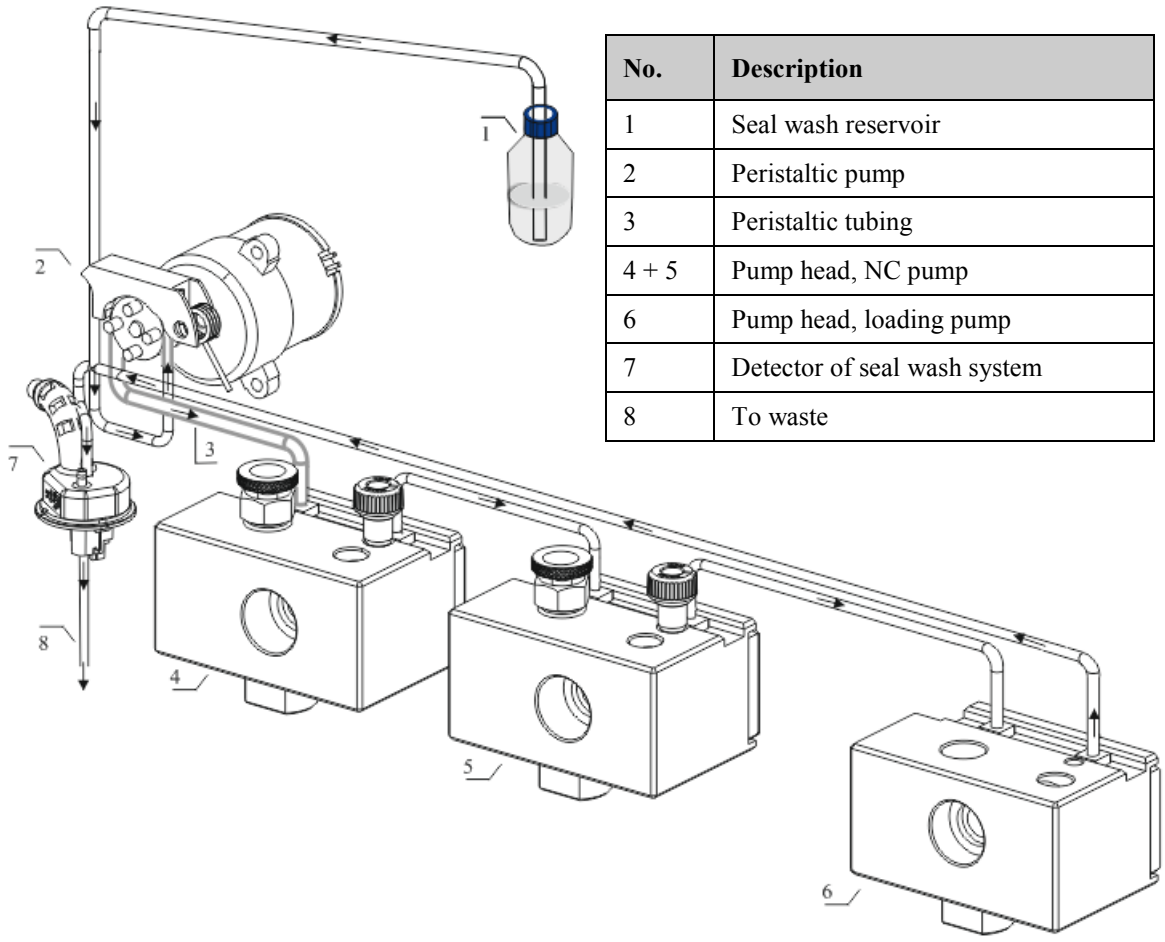
2.8 Pump Module

The following sections provide a brief overview of the key features of the pump module.

2.8.1 Rear Seal Wash System

The pump module is equipped with an active rear seal wash system. Rear seal washing helps avoiding damages to the pistons, piston seals, and support rings, and thus prolongs the seal lifetime.

The rear seal wash system consists of a peristaltic pump, a detector, and a reservoir containing seal wash solution. The wash solution passes the individual components as shown in Fig. 6.



No.	Description
1	Seal wash reservoir
2	Peristaltic pump
3	Peristaltic tubing
4 + 5	Pump head, NC pump
6	Pump head, loading pump
7	Detector of seal wash system
8	To waste

Fig. 6: Rear seal wash system (here in the NCS-3500RS)
(The arrows indicated the flow path of the wash solution through the pump.)

For information about how to set up the rear seal wash system, see page 67. For more information about how to operate the pumps with rear seal washing, see section 5.5.7 (→ page 122).

2.8.2 Flow Meter

The flow meter, which is located above the pump heads of the NC pump, controls the required partial flows of the two solvent channels so that the selected target flow and the selected solvent composition are reliably met. Two types of flow meters are available:

- ProFlow flow meter with thermal flow sensors, for nano LC (*flow connections overview* → page 31)
- Classic flow meter with flow selectors, for either capillary LC or micro LC (*flow connections overview* → page 31)

The following flow meters and selectors are available for different flow ranges:

Description	**Part No.**
ProFlow flow meter for nano LC (50 – 1500 nL/min), with thermal flow sensors *Note:* Operation of the module with a ProFlow flow meter requires a suitable firmware and Chromeleon version. For details, contact Thermo Fisher Scientific sales organization.	6041.7850
Classic flow meters with flow selector, for:	
Capillary LC (0.5 – 10 µL/min)	6041.7902A
Micro LC (5 – 50 µL/min)	6041.7903A
Flow selectors for Classic flow meters: ♦ Flow selector for capillary LC (0.5 – 10 µL/min) ♦ Flow selector for micro LC (5 – 50 µL/min)	 6041.0003 6041.0014
Note: ♦ To modify from a ProFlow flow meter to a Classic flow meter or vice versa, exchange the complete flow meter. ♦ To modify the flow range of a Classic flow meter, install the respective flow selector for capillary or micro LC.	

For more information about the flow meter, see pages 110 and 222.
For information about how to replace a flow meter or a flow selector (Classic flow meters only) for a different flow range, see section 7.7 (→ page 202).

ProFlow Flow Meter Flow Connections

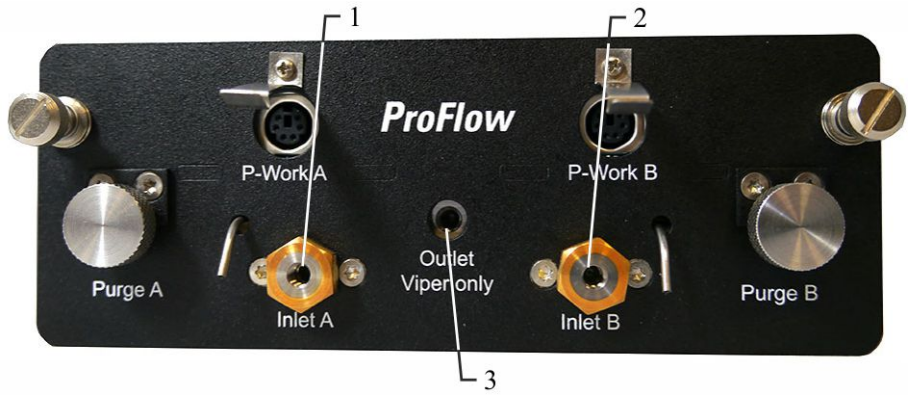


Fig. 7: ProFlow flow meter

No.	Description	For capillary connection…
1	Flow meter inlet (from left pump head) With built-in inline filter	From left pump head to flow meter
2	Flow meter inlet (from right pump head) With built-in inline filter	From right pump head to flow meter
3	Flow meter outlet (pump outlet)	From flow meter to autosampler

Tip: Operation of the module with a ProFlow flow meter requires a suitable firmware and Chromeleon version.

Classic Flow Meter Flow Connections

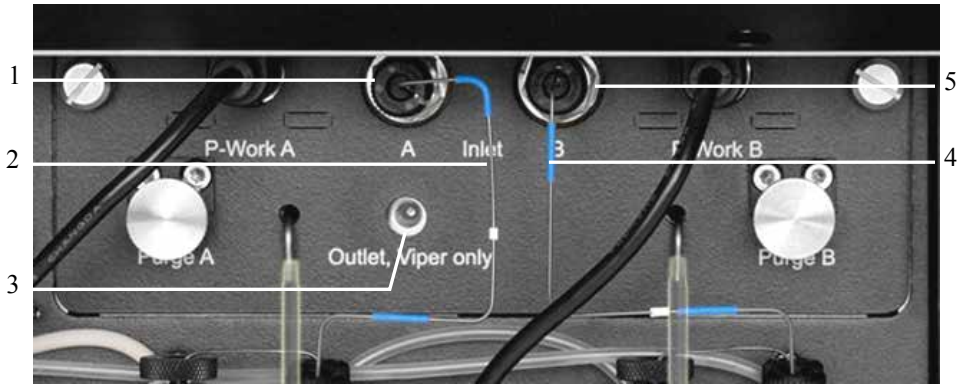


Fig. 8: Classic flow meter

No.	Description	No.	Description
1	Flow meter inlet (from left pump head)	4	Capillary from right pump head to flow meter
2	Capillary from left pump head to flow meter	5	Flow meter inlet (from right pump head)
3	Flow meter outlet (pump outlet)		

2.8.3 Leak Sensor

A leak sensor is installed inside the pump module. Leak detection is enabled as a standard when the module is shipped.

If liquid collects in the drip tray under the fluid connections, the leak sensor reports a leak. The **Status** LED on the front panel door turns red. A beep sounds and a message appears on the pump display and in the Chromeleon Audit Trail. When the leak sensor reports a leak, eliminate the cause for the leakage and dry the leak sensor (→ page 177).

For more information, see section 5.5.9 (→ page 124).

2.8.4 Purge Valve

NC pump

Both pump heads (solvent channels) of the NC pump have their own purge valve with purge screw and purge outlet. The purge screw and purge outlet are located in the flow meter above the pump head to which they belong.

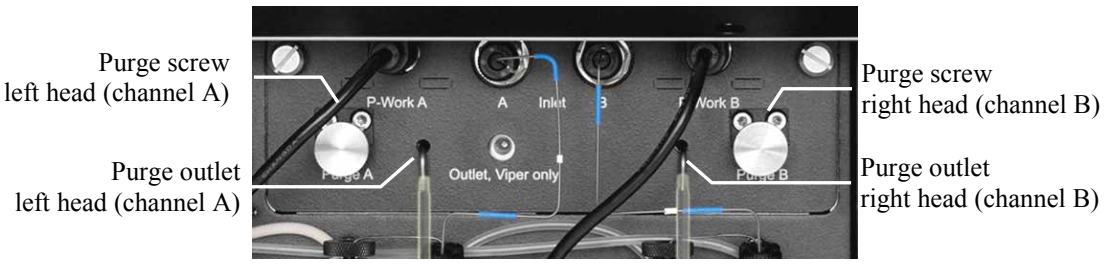


Fig. 9: Purge valves of the NC pump (here: Classic flow meter)

Loading pump

The loading pump has a purge unit that comprises the purge valve with purge screw and purge outlet. In addition, the purge unit comprises the pressure transducer of the system pressure.

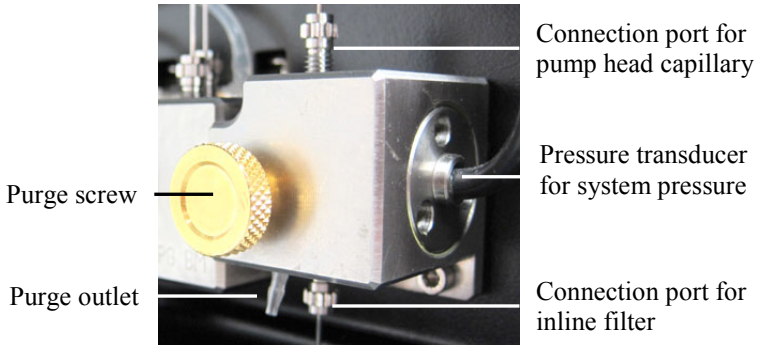


Fig. 10: Purge unit

2.8.5 Inline Filter (Loading Pump)

The loading pump has an inline filter that is located below the pump head. The filter volume is 10 µL. The filter frit is a titanium frit with a porosity of 2 µm.

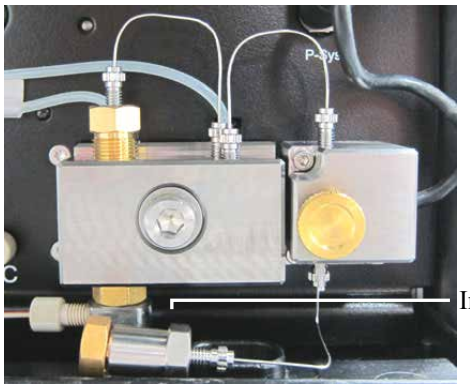


Fig. 11: Inline filter (loading pump)

2.9 Column Compartment

The following sections provide a brief overview of the key features of the column compartment.

2.9.1 Gas and Humidity Sensors

A gas sensor and a humidity sensor are installed inside the column compartment. The sensors detect any gas or humidity that may accumulate in the column chamber. You can adjust the sensitivity of the gas sensor and the humidity sensor in Chromeleon or on the front panel display (→ page 130).

When a certain concentration of gas or humidity is reached inside the column compartment (while the door of the column chamber is closed), the related sensor is activated and the **Status** LED on the front panel door turns red. A message appears on the front panel display and in the Chromeleon Audit Trail. It depends on the sensor settings whether a beep sounds in addition to alert you (→ page 130).

When a sensor reports excessive gas or humidity, find and eliminate the source for the leakage (→ page 178).

2.9.2 Column Switching Valves

The column compartment can be equipped with one or two column switching valves (→ page 19) and thus, provides highest flexibility for all applications that required different columns at similar temperatures. The switching valves are installed in the column chamber, where they are brought to the preferred temperature together with the columns.

For information about how to connect the components to the column switching valve, see page 82.

2.9.3 Column Identification System (Column ID)

The column compartment is fitted with an electronic column identification system (column ID) that allows you to store column-specific information on a column-ID chip card. This information provides a GLP-compliant overview of the column status. The chip card is connected to the column for the column life cycle. Column identification is supported for up to four columns simultaneously.

The information on the column ID chip card is continuously updated and can be reviewed at any time in Chromeleon, as long as the column and chip card are installed in the column compartment. For more information about the column ID, see page 129.

2.10 Operation from Chromeleon

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

Two modes of software control are available:

- *Direct Control*

  With direct control, you select operating parameters and commands in the **Commands** (F8) dialog box. Direct commands are executed as soon as they are entered. For routine operation, most parameters and commands are available also on a control panel. For more information about direct control, see page 89.

- *Automated Control*

  With automated control, you create a program (or PGM File). This is a list of control commands, executed in chronological order, for automated operation of the module. You can create programs automatically with the software wizard or manually by editing an existing program. For more information about automatic control, see page 92.

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

If you want to operate the module from *Chromeleon 7* (availability with Chromeleon 7.1 and later), refer to the following documents for information about how to perform the related processes in Chromeleon 7 (all documents are included in the Chromeleon 7 shipment):

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

Note the following:

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

2.11 System Wellness, Predictive Performance, and Diagnostics

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

- Internal monitoring of all mechanical operations
- Automatic self test upon power up
- Active rear seal wash system (→ page 29)
- Leak sensor in the pump module to detect liquid leaks (→ page 32)
- Leak sensors in the column compartment to detect excessive gas and/or humidity (→ page 34)
- Electronic column identification system to provide a GLP-compliant overview of the column status (→ page 34)

When an error is detected, the **Status** LED on the related front panel door is red, a beep sounds, and a message appears on the pump display (→ page 147).

When the module is operated from Chromeleon, additional features are available:

- Functions for estimating the lifetime of consumables and monitoring and recording service and (re)qualification information (= predictive performance; → page 132)
- Diagnostics functions for checking the performance of certain module components (→ page 134).

3 Installation

3.1 Facility Requirements

The installation site must meet the following requirements:

- The main power switch and the main power receptacle are on the rear panel. Make sure that
  - ♦ Free and unrestricted access to the main power switch is ensured at all times.
  - ♦ The power cord of the device can be easily reached and disconnected from the power line at all times. Provide sufficient space behind the device to unplug the cable.
- Make sure that the installation site meets the power and environmental specifications listed in the Technical Information section (→ page 235).
- Install the module in the laboratory on a stable surface. Make sure that the position is horizontal and free of vibrations.
- Make sure that the surface is resistant to solvents.
- Avoid locations with extreme changes in temperature.
- Also, avoid locations with extreme direct sunlight and high humidity.
- Allow sufficient clearance behind and to the sides of the module for ventilation and do not place any objects between the module and the module located below it in the system stack

3.2 Unpacking

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

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

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

1. *Only NCS-3500RS*

   Place the shipping container on the floor, remove the container cover, and take out the spacer box. The NCS packaging box may remain in the bottom part of the shipping container.

2. Open the packaging box of the module, and remove the accessories kit and power cord. Some accessories may be shipped in a separate box.

3. Grasp the module by the sides. Slowly and carefully, pull the module out of the shipping container and place it on a stable surface.

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

   A team effort is required to lift or move the NCS-3500RS. The NCS-3500RS is too heavy and/or bulky for one person alone to lift or move safely.

   ⚠ **Important:** Afin d'empêcher l'instrument de tomber, saisissez-la par les côtés. Ne soulevez l'instrumente à l'aide du matériau d'emballage ou par les portes des panneaux avants.

   Le NCS-3500RS et lourd et encombrant. Par conséquent, vous ne devriez pas soulever l'instrument seul.

4. Remove the foam spacers, and then remove the polythene packaging.

5. Tilt the front panel of the pump module upward and remove the foam inserts securing the front panel door during shipment.

6. *Only NCS-3500RS*

   Unlock the front panel door of the column compartment (→ page 27) and remove the two foam inserts securing the valve drives during shipment.

7. Before connecting the module to the power source, wait approximately four hours to allow the instrument to come to room temperature and to allow any condensation that might have occurred during shipping to evaporate.

   After four hours, check the module; if condensation still exists, allow the module to continue to warm up (without connecting it to the power source) until the condensation is completely gone.

3.3 Positioning the Module in the UltiMate 3000 RSLCnano System

If the module is part of an UltiMate 3000 RSLCnano system, stack the individual modules (→ Fig. 12) and interconnect them on the rear panel (→ Fig. 13). The arrangement of the system modules depends on the application.

For information about how to arrange and set up an RSLCnano System, refer to the "UltiMate 30000 RSLCnano - Standard Applications" system manual. The system manual is shipped with the module.

Solvent Rack
(SRD-3400)

NCS-3500RS

Detector
(VWD-3400RS)

Autosampler
(WPS-3000TPL RS)

Fig. 12: Module arrangement for an UltiMate 3000 RSLCnano system (example)

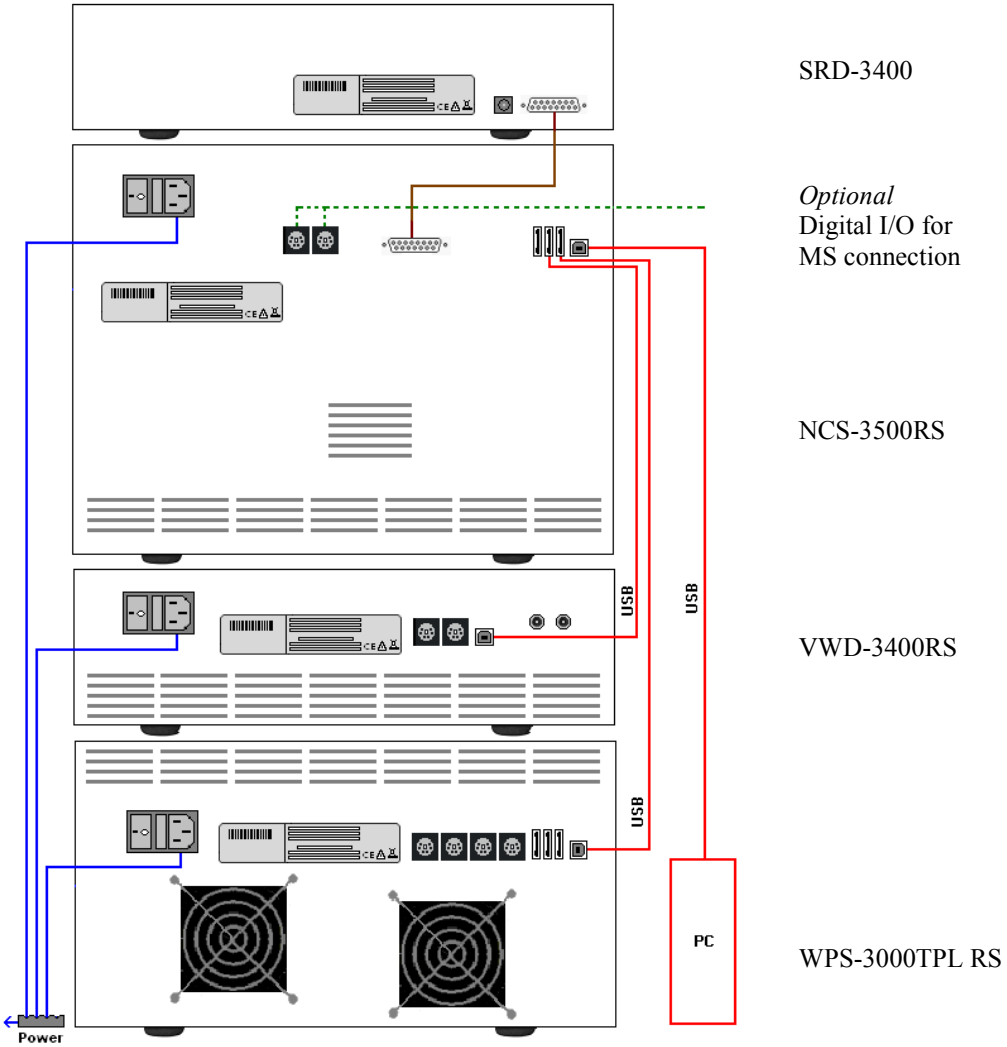


Fig. 13: Example for the rear panel connections on an UltiMate 3000 RSLCnano system

Thermo Fisher Scientific recommends interconnecting all modules of the RSLCnano system and then connecting the system to the Chromeleon computer with only one connection. For systems with a VWD-3400RS, use *only* the hub on the NCS-3500RS or NCP-3200RS, respectively. For systems with a DAD-3000RS or MWD-3000RS detector, you can use *only* the hub on the detector.

Apart from the Solvent Rack, all modules of the UltiMate 3000 RSLCnano system can be connected also separately to the Chromeleon computer by using the USB port on the rear panel of the module.

3.4 Connecting the Module

3.4.1 General Information

If you want to operate the module from Chromeleon
Before you connect the module to the USB port on the Chromeleon computer and turn on the module power, verify that Chromeleon is installed on the computer and that the license code is entered. Only if you install Chromeleon first, the USB driver for the module is automatically loaded and the Windows® operating system can detect the module when the power is turned on.

3.4.2 Connecting the USB Cable

Connect the module to the Chromeleon computer by using the USB ports on the rear panel (→ Fig. 2, page 24). Select one of the following alternatives:

- Connect the module directly to the USB port on the Chromeleon computer.
- Connect the module to the computer by using an external USB hub. (However, this may be the source for communication problems, depending on the quality of the hub.)

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

To ensure trouble-free operation, use only these cables for the connection (both cables are provided in the accessories kit for the module):

USB Cable	Part No.
USB cable, type A to type B, high speed USB 2.0 (cable length: 5 m)	6911.0002
USB cable, type A to type B, high speed USB 2.0 (cable length: 1 m)	6035.9035

3.4.3 Connecting the Power Cord

Use the power cord shipped with the module to connect the module to the main power source. Connect the power cord from the main power receptacle on the rear panel (→ Fig. 2, page 24) to a grounded power source. No manual adjustment is required to adapt the line voltage to local voltage requirements.

Warning: Never use a power cord other than the power cords provided for the device.
Do not use multiple sockets or extension cords. Using defective multiple sockets or extension cords may cause personal injury or damage to the device.

Avertissement: Utilisez uniquement les cordons d'alimentation électrique spécifique à l'instrument.
N'utilisez pas des blocs multiprise ou des câbles prolongateurs. Cela pourrait entraîner des blessures corporelles ou endommager l'instrument.

3.4.4 Connecting a Solvent Rack

If the UltiMate 3000 system includes a SRD-3x00 Solvent Rack, connect the **Solvent Rack** port on the rear panel of the module to the 15-pin D-Sub connector on the rear panel of the Solvent Rack. The appropriate connection cable is included in the accessories kit of the Solvent Rack.

3.4.5 Connecting Devices (Mass Spectrometers) to the Digital I/O-Port

To connect a device, for example, a mass spectrometer, to a digital I/O port on the rear panel of the module, use a 6-pin mini-DIN signal cable (part no. 6000.1004). The cable is available from Thermo Fisher Scientific.

1. Plug the 6-pin connector of the mini-DIN cable into the **Digital I/O** port **1** (or **2**). For information about the functions of the connector pins and pin assignment, see page 255.
2. For each relay output or digital input to be used, connect the appropriate signal wire and ground wire to the corresponding connectors on the device (→ documentation provided with the device).

   For example, if you want to use a relay output to control a mass spectrometer, use the wires 5 (brown) and 6 (white).
3. When setting up the module in the Chromeleon **Server Configuration** program (→ page 46), select the corresponding relay outputs on the **Relays** page and the digital inputs on the **Inputs** page.

   The relay outputs and digital inputs are then available in Chromeleon, for example, in the **Commands** dialog box under **PumpModule**, and can be programmed as required.

3.5 Setting Up the Module in Chromeleon

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

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

3.5.1 Loading the USB Driver for the Module

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

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

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

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

To resolve the problem:

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

b) Turn off the power to the module.

c) Install Chromeleon.

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

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

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

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

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

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

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

b) Turn off the power to the module.

c) Install Chromeleon.

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

3.5.2 Installing the Module

After the USB software for the module has been installed (→ page 43), install and configure the module in Chromeleon:

1. Start the Chromeleon Server Monitor and the Chromeleon server if they are not yet running (→ page 43).
2. Start the Server Configuration program in Chromeleon.
   Click **Start** on the taskbar. Point to **Programs** (or **All Programs**, depending on the operating system), point to **Chromeleon**, and then click **Server Configuration**.
3. If necessary, click the plus sign next to the server name to display the items underneath.
4. Select the timebase to which the module will be assigned, or create a new timebase (on the **Edit** menu, click **Add Timebase**).
5. Open the **Add device to timebase** dialog box. To do so, click **Add Device** on the **Edit** menu or right-click the timebase and click **Add Device** on the menu.
6. On the **Manufacturers** list, click **Dionex HPLC: UltiMate 3000** and on the **Devices** list, click the module you want to add, for example, **NCS-3500RS Nano/Cap System**.
7. The configuration pages for the module are opened. On each configuration page, verify that the settings are correct and select additional settings if needed. For a description of the pages, see section 3.5.3.1 (→ page 46).
8. On the **File** menu, click **Save Installation** and then close the Server Configuration program.

3.5.3 Configuring the Module

3.5.3.1 Initial Installation

On each configuration page for the module, check and change the settings if necessary and select additional settings if needed. You may reopen the configuration pages later again to change the settings (→ page 53).

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

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

General Page

Display general information about the module:

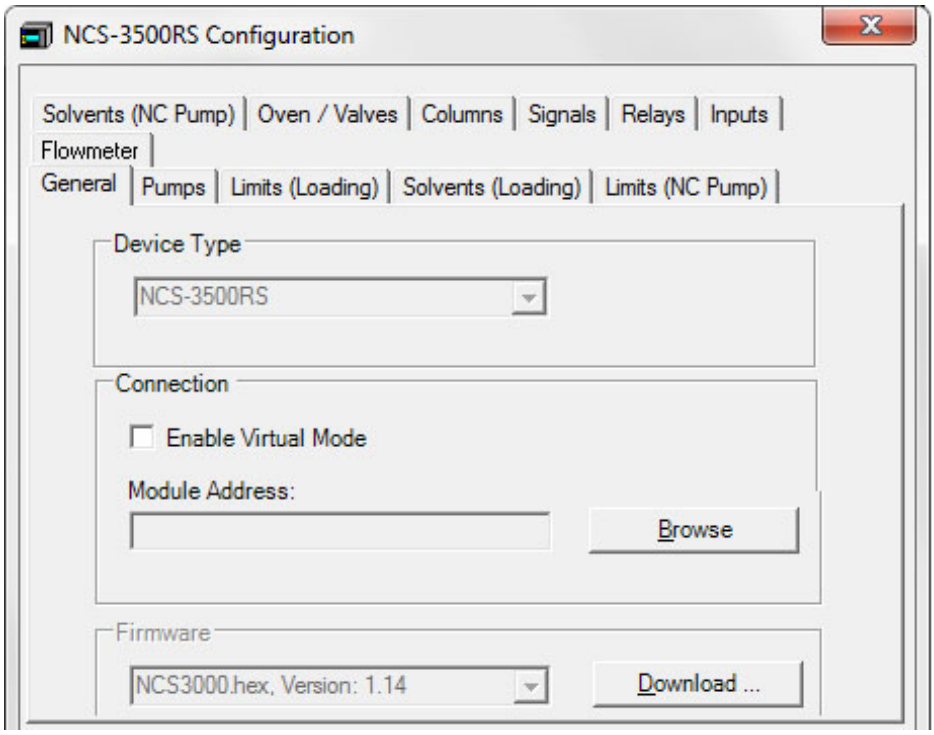


Fig. 14: General page

- **Device Type**
  Indicates the device model.

- **Enable Virtual Mode**
  This check box should be cleared because Chromeleon only simulates the functions of the module when the virtual mode is active. If the Virtual Mode is enabled, the **Module Address** box will be unavailable.

- **Module Address**
  Select the address of the module if necessary. Click **Browse** and then double-click the module that you want to use on the **Device List**. The address is automatically entered in the **Module Address** box. The button appears dimmed if the virtual mode is enabled.

- **Download**
  Click the **Download** button to transfer the firmware version available for the module in Chromeleon to the module. The button appears dimmed if the virtual mode is enabled. The module is shipped with the most recent firmware version. If a firmware update is ever required, follow the steps in section 7.14 (→ page 217).

Pumps Page (NCS-3500RS) or Devices Page (NCP-3200RS)

Displays the names used to identify the pump module and pumps in Chromeleon, and sets whether the degasser of a SRD-3x00 Solvent Rack can be operated via the pump module.

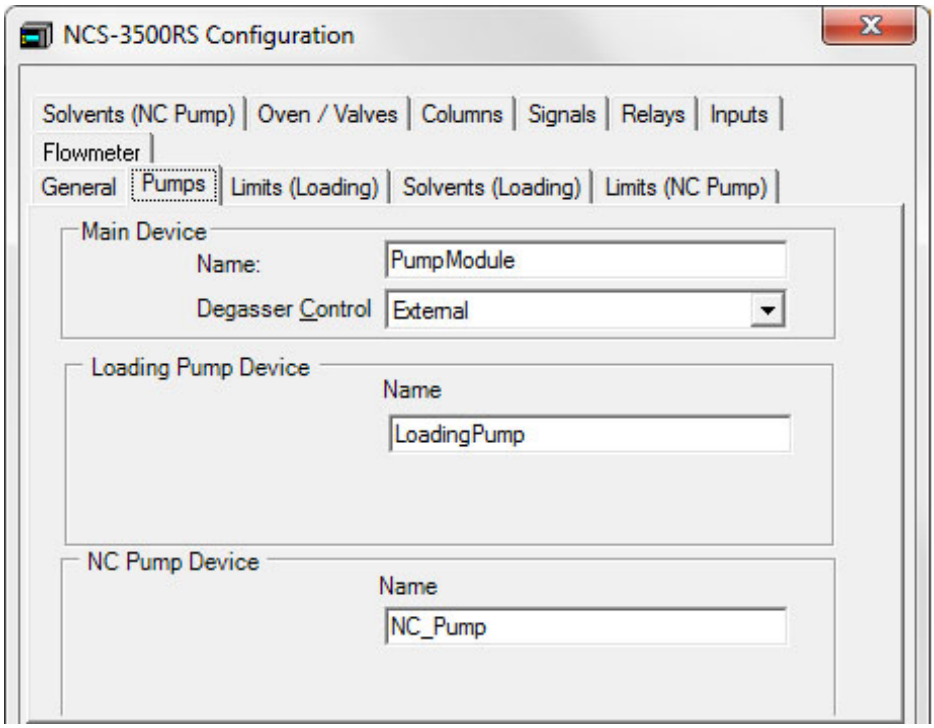


Fig. 15: Pumps page

- **Main Device**
  - **Name** (default name *PumpModule*)
    Displays the name used to identify the pump module in the installation environment and in the Chromeleon client. Under *PumpModule*, the following commands and properties are displayed, for example, in the **Commands** dialog box (→ page 89):
    - General properties and commands related to the entire pump module, such as the commands and properties for the seal wash system, leak detection, or the degasser in a SRD-3x00 Solvent Rack that is connected to the module.
    - Specific groups of properties and commands for the pumps of the pump module. These commands and properties appear under the pump name (→ *Loading Pump Device* and *NC Pump Device* further down in this section).

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

- **Degasser Control**
  Click the arrow of the **Degasser Control** box and select **External** on the list if a SRD-3x00 Solvent Rack is connected to the module. With this setting, the degasser in the Solvent Rack can be operated and monitored via the pump module. The related commands and properties are available, for example, in the **Commands** dialog box (under *PumpModule*).
  In all other cases, select **None**.

- **Loading Pump Device, NC Pump Device (NCS-3500RS), or Pump Device (NCP-3200RS)**
  (default names *LoadingPump, NC_Pump* (NCS-3500RS and NCP-3200RS))
  Under this name, specific groups of properties and commands are listed in the **Commands** dialog box for the related pump. There you can set, for example, the flow rate and the partial flows, change the upper and lower pressure limits, and start a purge cycle.
  To control the pump with the existing control panels, accept the default name. If you enter different names, you may have to re-link the controls on the control panels and edit the names in the program files.

Limits Page

The loading pump and the NC pump of the NCS-3500RS have separate **Limits** pages, displaying the allowed ranges for the flow rate and pressure of the related pump. You can change the upper and lower limits within the allowed ranges. In addition, you can change the pressure unit and, for the loading pump, change the flow unit.

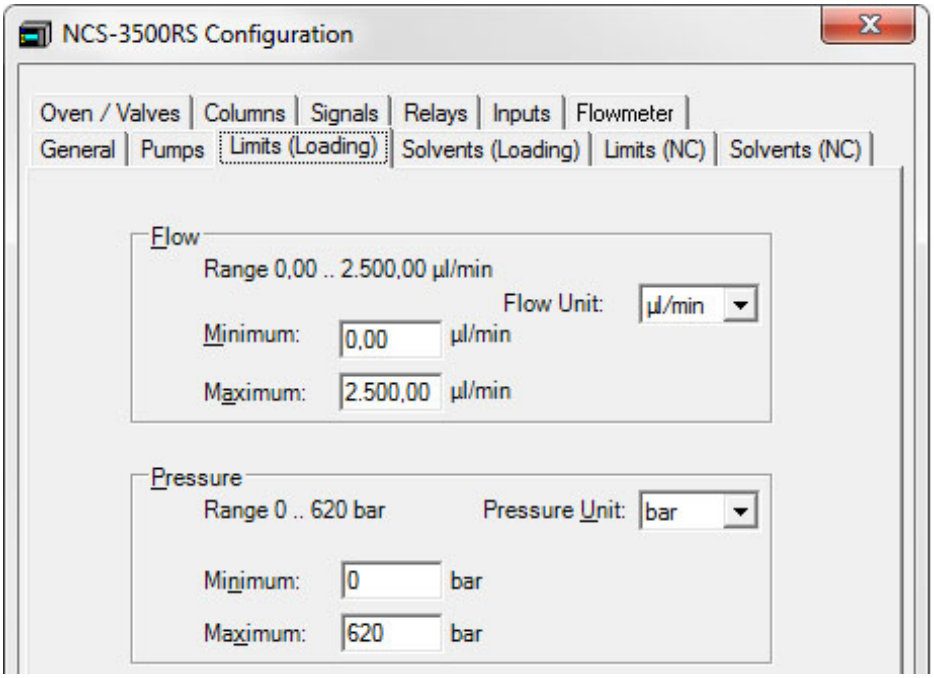


Fig. 16: Limits page (here for the loading pump)

- **Flow**
  Shows the allowed flow range.

  Enter a new value in the **Minimum** and/or **Maximum** box to change the limits for the flow rate within the allowed range.

  On the **Limits (Loading)** page, under **Flow Unit**, you can select the unit in which the loading pump flow is displayed (µl/min or ml/min).

- **Pressure**
  Shows the allowed pressure range.

  Enter a new value in the **Minimum** and/or **Maximum** box to change the pressure limits within the allowed range.

  Click the arrow of the **Pressure Unit** box and select a different pressure unit (psi, bar, or MPa) on the list if required.

These values are the absolute limits. Within these limits, you can set specific limits on a control panel or in a program file.

Solvents Page

The loading pump and the NC pump of the NCS-3500RS have separate **Solvents** pages. Check and change the number of solvents delivered by the pump and the solvent names if necessary.

- **Number of Solvents**
  Indicate how many solvents are delivered by the pump. The pump type determines how many solvents can be delivered.

Pump Type	Max. Number of Solvents
NC pump	2
Loading pump	3

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

  Tip: Changing the solvent names on the **Solvents** page does not set up the flow meter to operate properly with the respective solvent. Make sure that the flow meter is also configured for the solvents that you use (→ section 4.5.2, page 69).

Oven / Valves Page

Displays the name used to identify the column compartment in Chromeleon and sets whether the temperature is recorded as a separate channel and which column switching valves are installed.

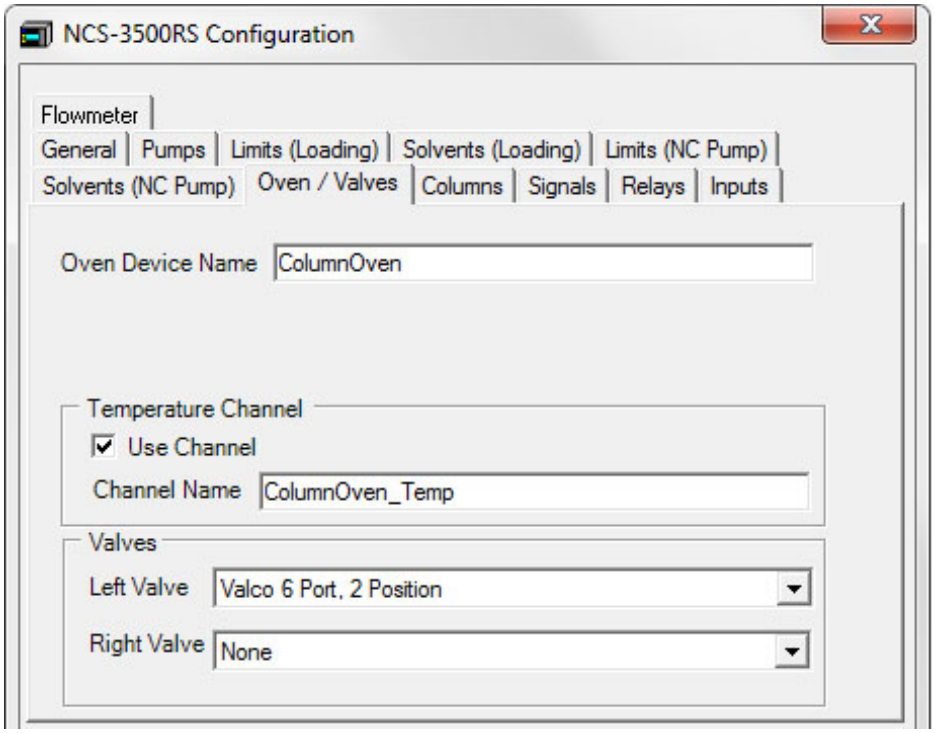


Fig. 17: Oven / Valves page

- **Oven Device Name** (default name *ColumnOven*)
  Displays the name used to identify the column compartment in the installation environment and in the Chromeleon Client program. To control the column compartment with the existing control panels, accept the default name. If you enter a different name, you may have to re-link the controls on the control panels and edit the name of the column compartment in the program files.

- **Temperature Channel** (default name *ColumnOven_Temp*)
  The **Use Channel** check box is selected by default. Accept this setting if you want to record the temperature of the column compartment as a separate channel (→ page 131).
  The name specified in the **Channel Name** text box is used to identify the temperature channel in the installation environment and in the Chromeleon Client program. Accept the default name. If you enter a different name, you may have to re-link the controls on the control panels and edit the channel name in the program files.

- **Left Valve** and **Right Valve**
  Indicate which type of column switching valve is installed. Check and change the settings if necessary.

Columns Page

The Columns page shows all columns that are available for column monitoring (→ page 34).

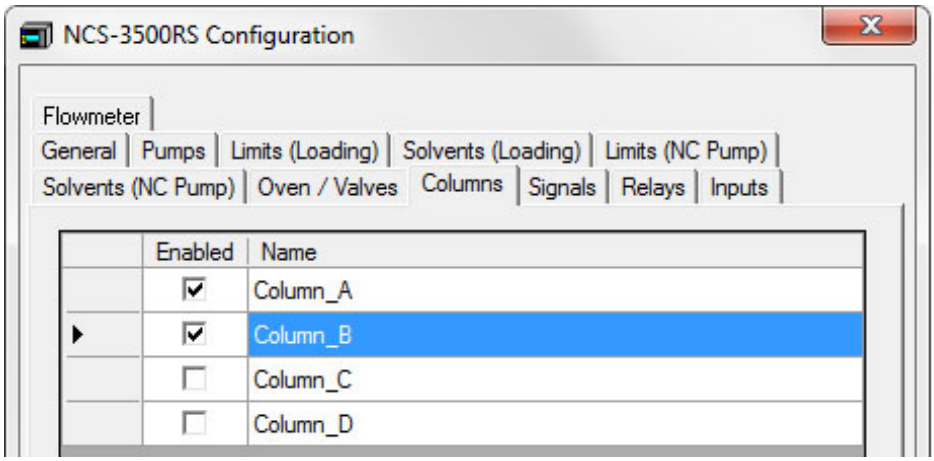


Fig. 18: Columns page

Select the columns for which you want to use column identification by the check box in the **Enabled** column. If a check box is cleared, the column will not be available in Chromeleon. The **Name** column displays the name used to identify the column in the installation environment and in the Chromeleon Client program. To use existing control panels, accept the default name.

To change a column name, overwrite the existing name directly in the corresponding line. If you enter a different name, you may have to re-link the controls on the control panels and edit the column name in the program files.

The information about the column is continuously updated and can be reviewed at any time in Chromeleon (→ page 129).

Signals Page

The **Signals** page lists all available signals. Select a check box to enable the signal. If a check box is cleared, the signal will not be available in Chromeleon. To change a signal name or the scaling factor, overwrite the existing entry directly in the corresponding line.

The NC pump pressure signal is selected by default. Accept this setting if you want to record the column pressure of the NC pump. If a signal channel is selected, Chromeleon generates the channel for data acquisition.

Depending on the flow meter that is installed, make sure that the corresponding signals are selected in order to gain information from the signal channels on the respective flow meter performance.

For more information, see section 5.5.6 (→ page 121).

Relays Page

The **Relays** page lists all available relays. Select a check box to enable the relay. If a check box is cleared, the relay will not be available in Chromeleon. To change a relay name, overwrite the existing name directly in the corresponding line. For more information about the relays, see page 25.

Inputs Page

The **Inputs** page lists all available remote inputs. Select a check box to enable the remote input. If a check box is cleared, the input will not be available in Chromeleon. To change an input name, overwrite the existing name directly in the corresponding line.

Flowmeter Page

The **Flowmeter** page shows the flow meter installed in the NC pump.

The settings that are displayed depend on the flow meter that is installed. When a module is selected under **Module Address** on the **General** page, the flow meter type is detected automatically and displayed on the **Flowmeter** page.

Flowmeter Type

To be able to use a certain solvent with the NC pump, consider the correct setting for the respective flow meter:

- *ProFlow flow meter*
  With a ProFlow flow meter, the flow meter must know the solvent type.
  The solvent list shows the pre-defined and user-defined solvents for each pump block channel.

- *Classic flow meter*
  With Classic flow meters, the solvent viscosity must be known.
  A viscosity list shows the pre-defined and user-defined solvent viscosity values for the flow meter.

- *Update button*
  After you have changed the solvent or viscosity list, click the **Update** button to refresh the flow meter configuration.

Solvent List (ProFlow) / Viscosities (Classic)

- The solvent list (ProFlow flow meter) or the viscosities (Classic flow meters) of the most common solvents is available in Chromeleon as a default (→ page 69).

- If the solvent type (ProFlow flow meter) or the viscosity (Classic flow meters) of the solvent that you are using is not yet available in Chromeleon, see section 5.5.3 Adding Solvents to the Flow Meter Configuration (→ page 114).

3.5.3.2 Changing the Configuration Properties

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

1. Start the **Server Configuration** program (→ page 45).
2. Right-click the module in the timebase and click **Properties** on the menu.
3. Change the settings as needed. For a description of the pages, see section 3.5.3.1 (→ page 46).
4. To save the configuration, click Save Installation on the File menu and then close the **Server Configuration** program.

4 Preparation for Operation (Startup)

4.1 Overview

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

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

After you have unpacked, positioned and connected the module (→ sections 3.1 through 3.4, page 37 and following pages), prepare the module for operation:

1. *If the RSLCnano system includes a SRD-3x00 Solvent Rack*
   Connect the 15-pin D-Sub port on the rear of the Solvent Rack with the Solvent Rack port on the rear of the module (→ page 25).
2. *If you want to connect a mass spectrometer to the module*
   Connect the Digital I/O port on the rear of the module with the appropriate port on the mass spectrometer (→ page 42).
3. Connect the solvent reservoirs (→ page 62).
4. Connect drain tubing (→ page 65).

   ⚠ **Important:** If drain tubing is not connected, modules that are located below this module in the UltiMate 3000 system stack, may suffer severe damage from the liquid leaving the drain port.

   ⚠ **Important:** Si le drainage n'est pas attaché, il peut résulter des dommages par des solvants aux modules qui se trouvent au-dessous de l'instrument dans l'UltiMate 3000 système.
5. *If you want to operate the module from Chromeleon*
   - Set up the module in Chromeleon if it is not already set up (→ page 43).
   - If you want to operate the degasser of a SRD-3x00 Solvent Rack from Chromeleon, verify on the **Pump** page of the Properties dialog for the module that **Degasser Control** is set to **External** (→ page 47).
6. Turn on the power to the module (→ page 85).

7. *Pump Module*

   a) Set up the seal wash system (→ page 67) and flush the system with the seal wash solution (→ page 67).

   b) This step depends on the flow meter that is installed:

   - *Classic flow meter*
     Specify the viscosity of the solvents used with the NC pump (→ page 69).
   - *ProFlow flow meter*
     Set the solvent types for the solvents used with the NC pump (→ page 69).

   Keep in mind that the module can deliver exact flow rates and gradients only if the viscosity (Classic flow meter) or solvent type (ProFlow flow meter) is set correctly.

   c) Purge the pumps of the pump module (→ page 72).

   d) Check and change the leak sensor setting if necessary (→ page 124).

   e) Adjust the brightness and contrast of the front panel display if necessary (→ page 125).

8. *Column Compartment*

   a) Install the valves if required (→ page 78).

   b) Install the separation columns (→ page 80).

   c) Install a trap column if required for your application (→ page 82).

   d) Establish the fluid connections between the columns and switching valves, as required by your application. For information about how to connect the capillaries to the valve, see section 4.6.4 (→ page 82).

   e) Turn on temperature control if applicable and set the temperature setpoint (→ page 127).

   f) Activate column identification if applicable (→ page 129).

   g) Check and change the sensitivity settings for the gas and humidity sensors if necessary (→ page 130).

   h) Adjust the brightness and contrast of the front panel display if necessary (→ page 125).

9. Connect the module to the other modules of your RSLCnano system, as required by your application. When connecting the capillaries, observe the general information on page 57.

10. Before starting sample analysis, equilibrate the entire system (→ page 83).

4.2 Capillaries and Capillary Routing

The following sections provide information about how to connect capillaries and route them inside the module and to the other modules in your UltiMate 3000 system.

4.2.1 Connecting and Handling Capillaries

When connecting capillaries to the module, observe the following general precautions:

- Observe the precautionary statements for capillaries and capillary connections in section 1.2.2 (→ page 5).
- Thermo Fisher Scientific recommends using Viper or nanoViper capillary connections whenever possible.
- *Only* Viper or nanoViper capillaries with knurled screws must be connected to the flow meter outlet.

  Tip: Viper or nanoViper capillaries with torque toothing cannot be connected to the flow meter outlet.

- When you connect capillaries, make sure that the connectors are free from contaminants. Even minute particles may cause damage to the system.
- 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.
- Use only the capillaries shipped with the module and original spare capillaries.
- Depending on the fitting connection, also observe the following:
  - *Viper connections - Depending on the Viper fitting:*

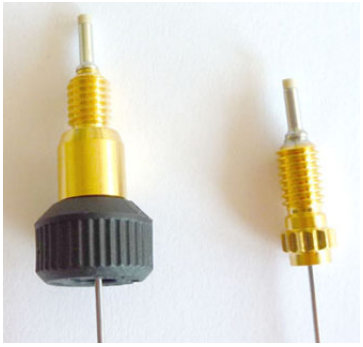


Fig. 19: Viper fitting connections
(left: with knurled screw (example), right: with torque toothing)

Tips: You can reuse capillaries with Viper fitting connections also for a different connection.

If the knurled screw is a black screw (as shown in Fig. 19), you can remove it from the capillary and reattach it later again.

- *Viper fitting with torque toothing (NCS-3500RS)*

  Loosen or tighten these Viper connections *only* with your hand and by using the special installation tool (part no. 6040.2314). The installation tool is provided in the accessories kit for the NCS.

  When tightening a connection, first tighten the connection hand-tight. Then, use the tool to tighten the connection further. Use the tool as shown in Fig. 20. Tighten until you hear a click, indicating that the torque limitation has been reached. Loosen a connection in the same way.

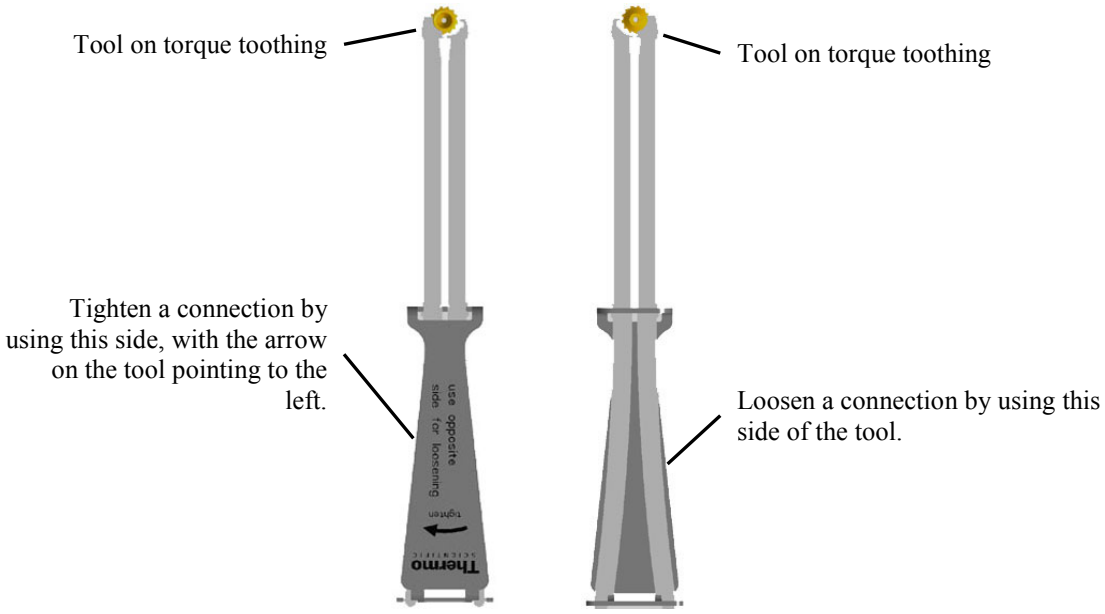


Fig. 20: Installation tool for Viper capillaries with torque toothing

If leakage is observed at the connection port, remove the capillary, clean the capillary ends carefully by using a cloth or tissue wetted with isopropanol, and reinstall the capillary. If the connection continues to leak, install a new Viper capillary.

- *Viper fitting with knurled screw*

  Loosen or tighten these Viper connections *only* by using the black knurled screw and *only* with your hand (do *not* use tools). If you observe leakage on the connection, tighten the screw a little further.

  If leakage continues, remove the capillary, clean the capillary ends carefully by using a cloth or tissue wetted with isopropanol, and reinstall the capillary. If the connection continues to leak, replace the Viper capillary.

- *Conventional fitting connections (non-Viper)*

  Do not over-tighten these fitting connections. If you observe leakage on the connection, tighten a little further.

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

  To avoid increased dead volume or damage to the system and leakage, reuse fittings and ferrules only for the same capillary connection.

4.2.2 Routing Capillaries

When routing capillaries in the module or to other system modules, observe the following general information:

Pump Module

- Two passages in the enclosure bottom of the pump module (→ Fig. 4, page 27) facilitate routing the capillaries to the modules that are located below the pump module and ensure the shortest possible connection.

- Two clips are installed in the pump module, for example, to secure the solvent lines to the interior front panel of the pump.

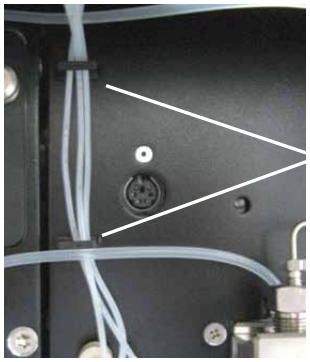


Fig. 21: Clips in the pump module

Column Compartment

- Capillaries to be routed to the outside *on the sides* of the column chamber *have to be* routed through the guides provided on the left and right of the column chamber.

Fig. 22: Capillary guides (here on the right of the column chamber)

- Capillaries to be routed to the outside *on the top or bottom* of the column chamber can be routed out of the interior at any position between the top or bottom of the enclosure and the front panel door to make sure that the connections are as short as possible.

Place the capillaries in such a manner that they do not open a small path for ambient air into the column chamber (that is, place the capillaries preferably in a 90-degree angle related to the door seal). An improper seal may reduce the heating performance of the column compartment.

Clips to secure any capillaries routed from the top to the bottom of the column chamber are provided in the accessories kit of the NCS-3500RS. Insert the capillary into the left or right side of the clip and attach the clip to the enclosure bottom (→ Fig. 23).

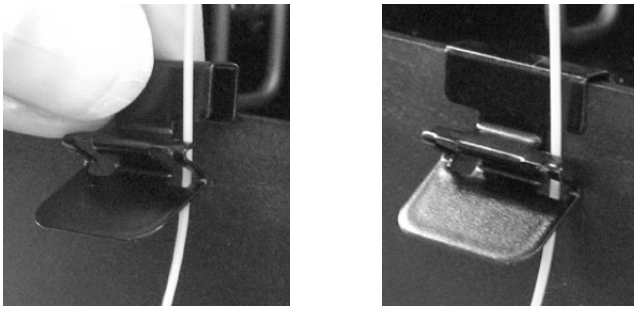


Fig. 23: Clip with capillary attached in the column compartment

4.3 Solvent Reservoirs

For the secure and functional positioning of the solvent reservoirs, the UltiMate 3000 system series includes Solvent Racks with and without integrated vacuum degasser (→ page 20). In an UltiMate 3000 RSLCnano system, a SRD-3400 Solvent Rack with analytical 4-channel vacuum degasser should be used together with the NCS-3500RS. All Solvent Racks are shipped with solvent reservoirs and appropriate tubing, including frit holders with filter frits.

Fig. 24: NCS-3500RS with Solvent Rack

If the UltiMate 3000 RSLCnano system includes an UltiMate 3000 series autosampler, you should degas also the wash solution on a continuous basis, for example, by using the vacuum degasser in the Solvent Rack. The procedure how to prepare and install the liquid lines for the wash solution is similar to the steps for the solvent supply lines. For more information, see the Autosampler manual.

4.3.1 General Notes

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

- Before using the solvent reservoirs for the first time, rinse them thoroughly by using high-purity solvents.
- Always install filter frits on the solvent supply lines. This prevents contaminants from reaching the HPLC system that may increase wear and cause damage to the system.
- Regularly check the filter frits for permeability. This is especially important when using aqueous solvents. Aqueous solvents may contaminate the filters with algae and other microorganisms that deposit on the filter frits. Therefore, use fresh the solvents at regular intervals. Clean the reservoirs thoroughly before refilling them. Replace the filter frits as necessary.

- As a standard, filter holders with 10 µm stainless steel frits are provided in the accessories kit of the Solvent Rack. Do *not* use these frits with the module. Replace the stainless steel frits with the 10 µm PEEK frits from the accessories kit of the module. Open the filter holder and remove the filter frit. When placing the new filter frit into the bottom part, make sure that the frit is in a level position (avoid tilting the frit).
- Make sure that the tubing connecting the pump to the degasser is as short as possible and locate the solvent reservoirs as close as possible to the pump. To avoid formation of air bubbles in the reservoirs and reformation of air bubbles in the solvent, make sure that the reservoirs are on the same level or higher as the pump. Therefore, stack the Solvent Rack onto the module (→ Fig. 24).
- Before connecting the solvent supply lines, make sure that the connectors are free of contaminants. Even minute particles can allow air to enter the degasser, and thus reduce the degassing effectiveness.

4.3.2 Connecting the Solvent Reservoirs

4.3.2.1 NC Pump

The solvent supply lines are connected to the NC pump at the factory. Solvent lines for NC pumps with a ProFlow flow meter are equipped with shut off valves.

Connect the solvent supply lines directly to the solvent reservoirs.

1. Feed the solvent supply line through the retaining guide, which holds the tubing in place in the reservoir. Then, feed it into the open hole in the reservoir cap.
2. Verify that a 10 µm PEEK frit is installed in the filter holder. Replace the frit if necessary. 10 µm PEEK frits are available in the accessories kit of the module.
3. Slide the filter holder with filter frit onto the end of the solvent supply line.
4. *If required*
   Cut the tubing straight if necessary. The end of the solvent supply line should be cut straight and not deformed. Use only the original solvent supply lines.
5. Place the entire unit in the reservoir.
6. Tighten the reservoir cap hand-tight. Press the retaining guide into the hole in the reservoir cap to hold the solvent supply line in place inside the reservoir.

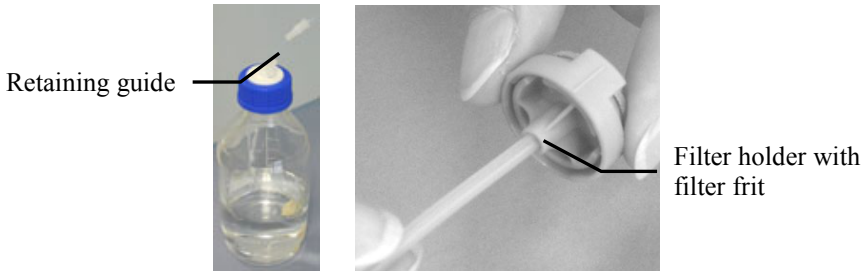


Fig. 25: Connecting the solvent supply lines to the reservoirs

When replacing a solvent supply line, remove the frit first, then the retaining guide, and then the solvent supply line.

7. *Recommended*

   For the secure and functional positioning of the solvent reservoirs, place them in the tray of the Solvent Rack.

8. Keep the following in mind for NC pump operation and maintenance:

   When the fluid components of the NC pump are filled with liquid and the solvent reservoirs are located above the pump outlet during pump operation, the hydrostatic pressure in the system may cause eluent to escape when you open a fluid connection in the NC pump. *Before* you open a fluid connection, position the reservoirs below the connection to be opened. Empty the solvents lines. If solvent shut off valves are installed on the solvent lines, you can close the shut off valves instead.

4.3.2.2 Loading Pump

1. Prepare the solvent reservoirs as described in section 4.3.2.1 (→ page 63).

2. The solvent supply lines are connected to the loading pump at the factory. Connect the solvent supply lines from the reservoirs and from the pump to the degassing module of the Solvent Rack. For information about how to connect the tubing to the degasser, see the *Solvent Rack manual.*

   If a degasser is connected to the loading pump but is not used (degasser turned off), change the flow path and connect the solvent reservoirs directly to the pump, instead. Use the solvent supply line (1.0 mm I.D.) and solvent supply line filter with 10 µm PEEK frit from the accessories kit of the NCS for the connection. To connect the components, follow the steps in section 4.3.2.1.

3. *Recommended*

   For the secure and functional positioning of the solvent reservoirs, place them in the tray of the Solvent Rack.

4.4 Connecting Drain Tubing

To discharge liquids that might have accumulated in the interior and the seal wash solution, the module has two drain ports at the bottom right.

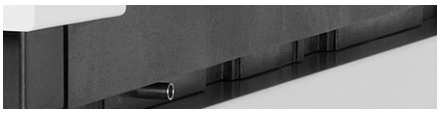


Fig. 26: Drain port (here at the bottom front)

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

- *Front port*

  Liquid leaks inside the column compartment are routed to the *front* port.

  a) If the module is the bottom module in the UltiMate 3000 system stack
  Install an elbow to the port and connect drain tubing of suitable length to reach the edge of the lab bench, direct the tubing over the edge of the lab bench, and place the free end of the tubing into the waste container (→ *Installation Instructions of the UltiMate 3000 drain system*).

  b) If the module is not the bottom module in the UltiMate 3000 system stack
  Install an elbow to the port, connect drain tubing of suitable length, and place the free end of the tubing into the waste container.

- *Rear port*

  Liquid leaks inside the pump module and the seal wash solution are routed to the *rear* port.

  a) *If the module is the bottom module in the UltiMate 3000 system stack*
  Install an elbow to the port and connect drain tubing of suitable length to reach the edge of the lab bench, direct the tubing over the edge of the lab bench, and place the free end of the tubing into the waste container (→ *Installation Instructions of the UltiMate 3000 drain system*).

  b) If the module is not the bottom module in the UltiMate 3000 system stack
  Install an elbow to the port, connect drain tubing of suitable length, and then connect the tubing to the drain system of the UltiMate 3000 system.

Verify that the seal wash solution is discharged properly to the waste.

1. Remove the seal wash tubing from the detector.

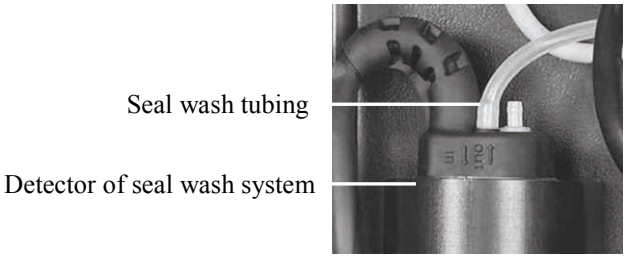


Fig. 27: Detector of the seal wash system

2. Attach silicone tubing to the connection port (→ Fig. 28) and fill in MS-grade water until the liquid exits the drain port at the bottom right of the module.

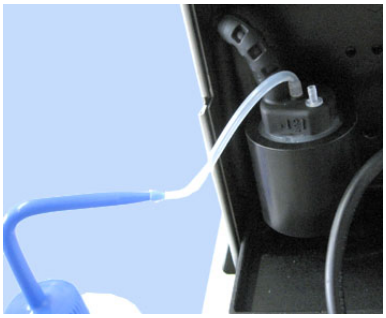


Fig. 28: Filling water into the connection port

3. Verify that the liquid is discharged properly. If it is not, any modules that are located below this module in the UltiMate 3000 system stack may suffer severe damage from the liquid leaving the drain port.

4. Reconnect the seal wash tubing to the detector.

4.5 Pump Module

4.5.1 Setting Up the Rear Seal Wash System

The peristaltic pump is installed at the top left in the pump module. 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, for example, during shipment. That is why the pump is shipped with the active rear seal wash tubing *bypassing* the peristaltic pump.

1. Verify that the peristaltic tubing (white PharMed® tubing) is engaged in the peristaltic pump.
   If the tubing is not yet engaged in the peristaltic pump, press the lever to the right, place the tubing in the pump, and release the lever.

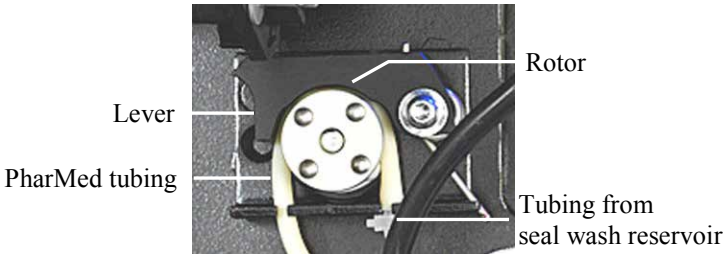


Fig. 29: Peristaltic pump

2. Fill the seal wash reservoir (250 mL, a reservoir is provided in the accessories kit of the NCS). Observe the precautions for the composition of the seal wash solution on page 122.
3. Connect the silicone tubing from the peristaltic pump with the seal wash reservoir. If necessary, prolong the tubing. (Silicone tubing is provided in the accessory kit of the module.)
4. Place the seal wash reservoir in the Solvent Rack of the UltiMate 3000 system.
5. The seal wash solution is routed to the drain port at the bottom right of the module. Verify that drain tubing is connected to the port and routed to an appropriate waste container (→ section 4.4, page 65).
6. Flush the system with seal wash solution.
   a) Remove the seal wash tubing from the detector.

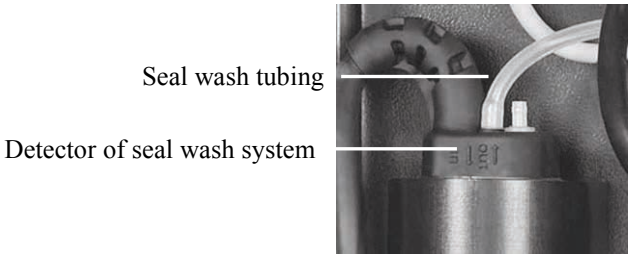


Fig. 30: Tubing connection on the seal wash detector

b) Draw seal wash solution into a syringe at the open end of the tubing. Press the lever of the peristaltic pump to the right so that the liquid can easily pass the system.

c) Reconnect the tubing to the detector.
Connect the tubing to the *inner* port (→ Fig. 30, page 67). The *outer* port has no function.

7. Verify that the seal wash solution is discharged properly (→ page 66).

For information about how to operate the pump with rear seal washing and for details about what happens, see section 5.5.7 (→ page 122).

4.5.2 Flow Meter Settings

Relevant only for the NC pump

To be able to use a certain solvent with the NC pump, consider the setting for the respective flow meter:

- With the ProFlow flow meter, the solvent type must be set (→ see page 70).
- With Classic flow meters, the solvent viscosity must be set (→ see page 71).

Only if the settings are made correctly, the module can deliver exact flow rates and gradients. As a standard, a list is available in Chromeleon, respectively:

- *ProFlow flow meter:* With the most common solvent types (for example, water, acetonitrile, and methanol), and mixtures (for example, mixture of water and acetonitrile 20:80 (v/v)).
- *Classic flow meter:* With the viscosity values of the most common solvents (for example, water, acetonitrile, and methanol) and mixtures (such as mixtures of water and acetonitrile 50:50 (v/v) or 20:80 (v/v)).

If the solvent that you want to use is not available in the solvent list (ProFlow flow meter) or viscosity list (Classic flow meters) in Chromeleon, refer to section 5.5.3 Adding Solvents to the Flow Meter Configuration (→ page 114).

Tip: The steps below refer to Chromeleon 6.80.

Note the following for operation under Chromeleon 7:

- For Classic flow meters, set the viscosity value in the **Command** window for the NC pump on the **Properties** page, as described further down.
- For the ProFlow flow meter, set the solvent type in the **Command** window for the NC pump on the **Properties** page, as described below.

For more information, see the *Chromeleon Help*.

Setting the Solvent Type (ProFlow Flow Meter)

To set the solvent type for the solvent that you are using, follow these steps:

1. In Chromeleon, open the **Commands** dialog box for the NC pump (→ page 89).
2. Select **%A_Solvent** (or **%B_Solvent**) and then select the preferred solvent from the list.

   Tip: If you are using a solvent with up to 2 % additive, it is sufficient to select the main solvent.
   Solvent mixtures with higher percentages of a component require a solvent calibration.

Fig. 31: Setting the solvent type (ProFlow flow meter only)

If the solvent type that you are using is not yet available in the list, perform a solvent calibration for the solvent to be defined in the flow meter and added to the list in Chromeleon. See section 5.5.3.1, page 114.

Setting the Solvent Viscosity (Classic Flow Meter)

To set the viscosity for the solvent that you are using, follow these steps:

1. In Chromeleon, open the **Commands** dialog box for the NC pump (→ page 89).
2. Select **%A_Viscosity** (or **%B_Viscosity**) and then select the preferred solvent from the list.

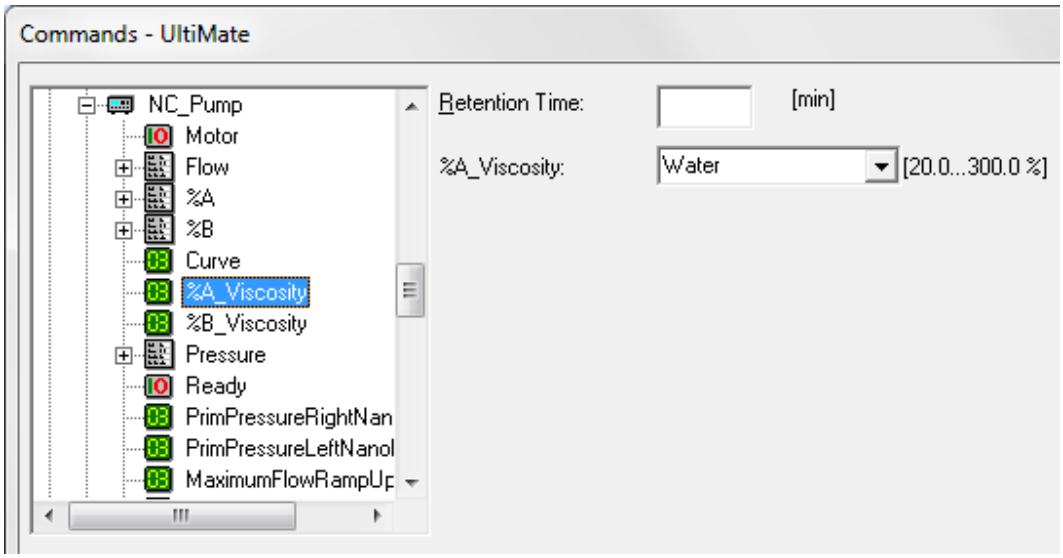


Fig. 32: Setting the solvent viscosity (Classic flow meter only)

3. If the viscosity for the solvent that you are using is not yet available in Chromeleon
   - ♦ Follow the steps on page 114 to perform a viscosity measurement for the solvent to be added to the list in Chromeleon.
   - ♦ Type a viscosity value that has been established earlier as described in this manual directly in the input box.

     Note that values entered here will *not* be added to the Chromeleon viscosity list. This value will be used until you establish and save a new value or enter a different value in Chromeleon.

Note the following for the solvent viscosity setting:

- The viscosity values are relative and refer to water at 42 °C.
- It is not possible to calculate the viscosity of premixed solvents from the viscosities and mixing ratio of the components. Therefore, establish the viscosity as described in section 5.5.3.2 on page 114.
- If you are using a solvent with up to 2 % additive, it is sufficient to select the main solvent from the list.

4.5.3 Purging the Pumps

Purging means rinsing the system for a certain time (for the loading pump at a higher flow rate). Purging is required to

- Remove the 2-propanol with which the module is filled during shipment completely from the pump before you begin sample analysis.
- Remove air bubbles from the system, for example, after refreshing the solvents in the reservoirs.
- Remove any previous solvent from the pump when you want to change solvents.

If the pump has not been purged sufficiently, pressure pulsation, a high noise level or pulsation during the operation of the pump may occur or the analysis may not be reproducible.

Due to the large liquid volumes in the NC pump and the low flow rates during operation, it is especially important that the pump is purged sufficiently long. Only then, you can be sure that the previous solvent has been completely removed when you change solvents. If the previous solvent has not been removed completely, shifts in retention time may be observed for a longer period without a reason being obvious.

For information about how purge the

- NC pump, see section 4.5.3.1 (→ page 73).
- Loading pump, see section 4.5.3.2 (→ page 76).

4.5.3.1 Purging the NC Pump

The purge procedure for the NC pump consists of two steps:

1. Purging the pump heads (separately or together)
2. Purging the flow meter

To make sure that the pump is free of air bubbles, both steps must be performed in the correct order.

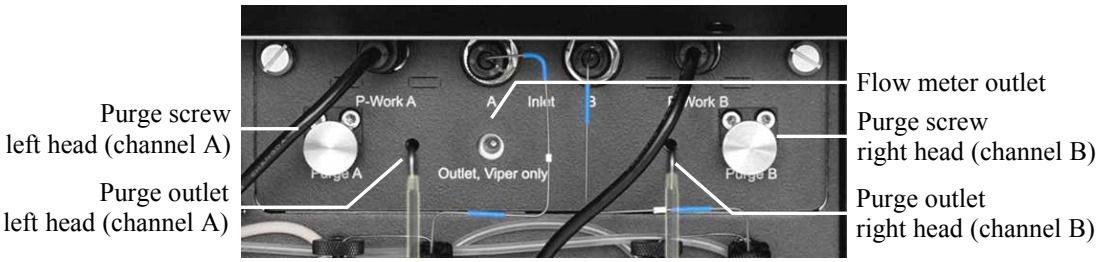


Fig. 33: Purge valves of the NC pump (here: Classic flow meter)

Tip: When the fluid components of the pump are filled with liquid and the solvent reservoirs are located above the pump outlet during pump operation, the hydrostatic pressure in the system may cause eluent to escape when you open a fluid connection in the pump.

Before you open a fluid connection, position the reservoirs below the connection to be opened. Empty the solvents lines. If solvent shut off valves are installed on the solvent lines, you can close the shut off valves instead.

4.5.3.1.1 Purging the Pump Heads

1. Attach a syringe to the free end of the silicone tubing on the purge nozzle of the pump head (left head, right head, or both) that you want to purge. Two syringes are provided in the accessories kit of the module.
2. Open the purge valve for the pump head that you want to purge. Turn the purge screw counterclockwise with your hand to the stop.

Tip: Proper pump head purging is possible *only* if the purge valve is opened *to the stop*. Turn the purge screw about 3 to 4 turns counterclockwise. Even if the screw can easily be turned earlier, the purge outlet will not be open completely.

3. Purge the pump head from Chromeleon or from the pump display.

   To purge the pump heads from Chromeleon

   a) In Chromeleon, open the **Commands** dialog box for the NC pump.
   The properties and commands for purging the NC pump appear under **PumpModule > NC_Pump**.

   b) Select **PurgeWhat** and then select the pump head that you want to purge: **LeftBlock**, **RightBlock**, or **BothBlocks**.

   c) Start the purge cycle. To do so, set **Purge** to **On**.

   The pump head is purged for the time specified under **Purge Time**. The standard setting is 30 minutes. When the **PurgeTime** has elapsed, **Purge** is automatically reset to **Off**. You can stop purging also manually by setting **Purge** to **Off**.

   Observe the following information about the purge time:

   - *When refreshing solvents (same solvents)*

     If you refreshed the solvents in the reservoirs, you should purge the pump head to make sure that the fresh solvent is available throughout the system. The purge time depends on the flow meter installed:

     - *ProFlow flow meter:* Purge for about 5 minutes.
     - *Classic flow meter:* Purge for about 10 minutes.

   - *When changing solvents (to a different type)*

     If you want to change solvents, purge the pump head to make sure that the previous solvent is completely removed from the pump heads and solvent supply line filters of the flow meter. The purge time depends on the flow meter installed:

     - *ProFlow flow meter:* Purge for about 15 minutes.
     - *Classic flow meter:* Purge for a minimum of 30 minutes.

   - *Removing air bubbles*

     When removing air bubbles (without changing the solvent), you can stop the purge cycle manually when no more air bubbles appear at the purge outlet. As an alternative, you can reduce the **PurgeTime** as appropriate.

   To purge the pump heads from the pump display

   a) On the pump display, select the **Control** menu for the NC pump and select **Purge** (→ page 101).

   b) Choose Select and **Execute** to open the **Purge** screen.

c) On the **Purge** screen, select **Start** for the pump head that you want to purge (or for both).

The pump head is purged for the time specified under **Purge Time**. The **Purge Time** is set on the **Preferences** menu (→ page 102); the standard setting is 30 minutes. When the specified **Purge Time** has elapsed, the purge cycle is automatically stopped. You can stop the purge cycle also manually by selecting **Stop** on the Purge screen. Observe the information for the purge time further up in this section (→ page 74).

4. Close the purge valve. Turn the purge screw clockwise with your hand to the stop.

5. Purge the flow meter (→ section 4.5.3.1.2).

4.5.3.1.2 Purging the Flow Meter

To make sure that air bubbles and, if applicable, previous solvents are completely removed from the NC pump, you *have to* purge the flow meter after you have purged the pump heads.

1. Close the purge valves if they are not yet closed.
Turn the purge screw clockwise with your hand to the stop.

2. Connect the nanoViper capillary (0.25 x 155 mm I.D. x L, MP35N) from the accessories kit of the module to the flow meter outlet. The other end of the capillary must remain open.

3. Purge the flow meter from Chromeleon or from the pump display.

To purge the flow meter from Chromeleon

a) In Chromeleon, open the **Commands** dialog box for the NC pump.
The properties and commands for purging the flow meter appear under **PumpModule > NC_Pump**.

b) Select **PurgeWhat** and then select **Flow Meter**.

c) Start the purge cycle. To do so, set **Purge** to **On**.

The flow meter is purged for the time specified under **PurgeTime**. The standard setting is 30 minutes. When the **PurgeTime** has elapsed, **Purge** is automatically reset to **Off**. You can stop purging also manually by setting **Purge** to **Off**.

To make sure that any air bubbles that might be trapped in the NC pump are completely removed, observe the following information about the minimum purge time.

Application	Recommended purge time (minimum)
Nano LC (ProFlow flow meter)	10 minutes
Capillary LC	5 minutes
Micro LC	5 minutes

To purge the flow meter from the pump display

a) On the pump display, select the **Control** menu for the NC pump and select **Purge** (→ page 101).

b) Choose Select and **Execute** to open the **Purge** screen.

c) On the **Purge** screen, select **Start** for the flow meter.
Note the following:

- The flow meter is purged for the time specified under **Purge Time**. The **Purge Time** is set on the **Preferences** menu (→ page 102); the standard setting is 30 minutes. When the specified **Purge Time** has elapsed, the purge cycle is automatically stopped. You can stop the purge cycle also manually by selecting **Stop** on the Purge screen.
- To make sure that any air bubbles that might be trapped in the NC pump are completely removed, observe the information about the purge time further up on this page.
- While the flow meter is being purged, the pressure at the flow meter outlet is monitored internally. However, the column pressure reading does not reflect the actual column pressure. As a result, an overpressure condition can occur even thought the column pressure reading is still 0 bar. In this case, remove any components from the flow meter outlet that can cause a pressure build-up.

4.5.3.2 Purging the Loading Pump

1. Attach a piece of silicone tubing to the purge outlet on the purge unit. Silicone tubing is provided in the accessory kit of the module.

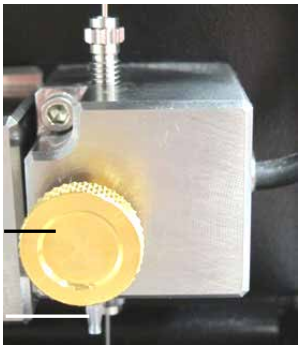


Fig. 34: Purge valve on the purge unit

2. Attach the free end of the tube to a plastic syringe.
A syringe is provided in the accessory kit of the module.

3. Open the purge valve (turn the screw one turn counterclockwise).

4. To ensure efficient purging verify that either an autosampler is connected to the loading pump outlet or the outlet is capped.

5. Purge the pump from Chromeleon or from the pump display.

To purge the pump from Chromeleon

a) In Chromeleon, open the **Commands** dialog box for the loading pump.
The properties and commands for purging the loading pump appear under **PumpModule > LoadingPump**.

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

c) Start the purge cycle. To do so, set **Purge** to **On**.

The loading pump is purged with settings specified for **PurgeFlow** and **PurgeTime**. The standard settings are as follows: **PurgeFlow** = 2 mL/min, **PurgeTime** = 5 minutes.

When the **PurgeTime** has elapsed, **Purge** is automatically reset to **Off**. You can stop purging also manually by setting **Purge** to **Off**.

d) Repeat the purge cycle for *all* channels of the loading pump (even if they are not used for the application) until all air bubbles are gone.

To purge the pump from the pump display

a) On the pump display, select the **Control** menu for the loading pump (→ page 101).

b) Set the channel to be purged to 100% (for example, **%A**).

Start the purge cycle. To do so, set **Purge** to **On**.
The pump is purged with the **Purge Flow** and **Purge Time** settings from the **Preferences** menu (→ page 102). The standard settings are as follows: **Purge Flow** = 2 mL/min, **Purge Time** = 5 minutes.

c) Draw the liquid with the syringe.

d) When the **Purge Time** has elapsed, **Purge** is automatically reset to **Off**. You can stop purging also manually by setting **Purge** to **Off**.

e) Repeat the purge cycle for *all* channels of the loading pump (even if they are not used for the application) until all air bubbles are gone.

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

4.6 Column Compartment

4.6.1 Installing a Column Switching Valve

The following column switching valves are available:

Column Switching Valve	Part No.
2-position, 6-port switching valve	6041.0004
2-position, 10-port switching valve	6041.0001

1. Do not touch any metal or plastic parts inside the column chamber while the temperature is higher than 50 °C. Before carrying out any work in the column compartment, wait for the column chamber to cool down.

   To shorten the cool-down time, consider setting a lower temperature and opening the front panel door.

2. A lever is provided on the enclosure bottom of the column compartment for pulling forward the valve actuators. Turn the lever to right and pull it toward the front as far as it goes out.

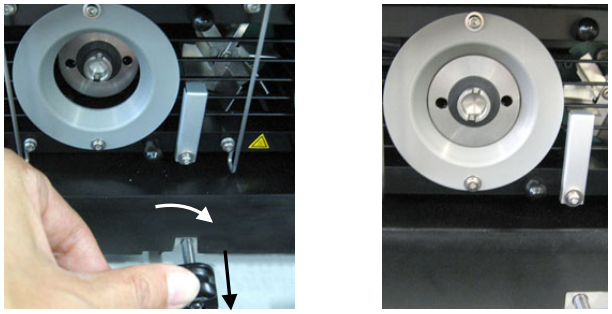


Fig. 35: Pulling the valve actuator forward

Tip: Closing the front panel door will move the lever, and thus the actuators automatically backward.

3. Align the two pins on the back of the valve with the matching openings on the actuator.

Fig. 36: Aligning the valve

4. Push the valve onto the actuator until it locks in place.

   If the valve does not lock in place, the actuator may not be in the correct position. Follow these steps:

   a) Perform the **Catch Head** command for the valve that you want to install:

      In Chromeleon
      Open the **Commands** dialog box for the column oven, select **ColumnOven_Wellness**, and perform the **LeftValveCatchHead** or **RightValveCatchHead** command. The CatchHead commands are available only if a valve type has already been selected in the **Properties** dialog for the NCS-3500RS on the **Oven / Valves** page (→ page 50).

      From one of front panel displays
      On the module, you can perform the command as follows:

      - On the column compartment display from the **Configuration** menu (→ page 106).
      - On the pump display from the **Control** menu of the NC pump or loading pump (→ page 101).

      Select the preferred menu and select **Catch Left Valve Head** or **Catch Right Valve Head**.

   b) The actuator starts turning slowly. Push the valve onto the actuator while the actuator is moving. The valve locks in place as soon as the actuator is in the correct position.

5. In Chromeleon or on column compartment display, check and change the settings for the valve type and installation position if necessary.

   In Chromeleon
   In the Chromeleon Server Configuration program, open the Properties dialog for the module. On the **Oven/Valves** page, specify which valve is installed and in which position (→ page 50).

   On the front panel display (column compartment)
   Select the **Configuration** menu for the column compartment. Under **Left Valve Config** and/or **Right Valve Config**, specify which valve is installed or select None if no valve is installed (→ page 106).

Tip: To prolong the life cycle of the valves, avoid moving the valves dry.

4.6.2 Installing a Separation Column

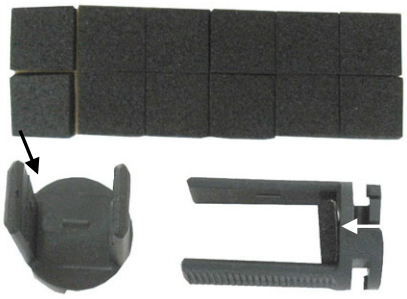
Three column brackets are installed in the column chamber at the factory. Attach the columns to the brackets using the special column clips from the NCS accessories kit.

1. A column clip consists of two pieces. To remove the ring from the bottom part, slightly press the ring in the direction of the arrows.

Press the ring in the direction of the arrows. (The arrows on the ring are printed in black.)

Fig. 37: Two-piece column clip

2. Self-adhesive foam pads are shipped together with the column clips. To protect the column, attach one pad to the inside of each bottom part.



Clip with pad

Fig. 38: Attaching a pad inside the column clip

3. Do not touch any metal or plastic parts inside the column chamber while the temperature is higher than 50 °C. Before carrying out any work in the column compartment, wait for the column chamber to cool down.

   To shorten the cool-down time, consider setting a lower temperature and opening the front panel door.

4. Attach the bottom part of the clip to the bracket and turn it 90° clockwise.

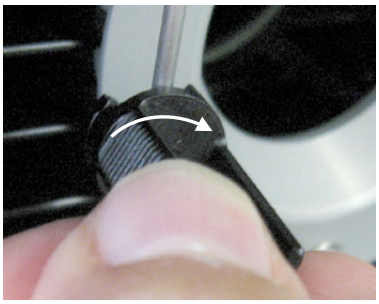


Fig. 39: Installing the bottom part

5. *If you want to use column identification*

   Attach the column ID chip card to the column. Two chip cards are provided in the accessories kit of the module. Wrap the ribbon around the column, pass the shank of the rivet through a hole, and press down to unite the two parts.

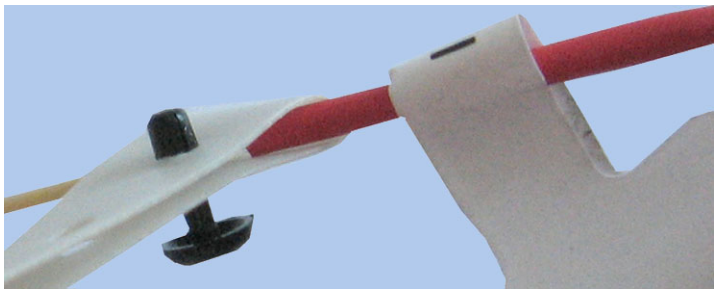
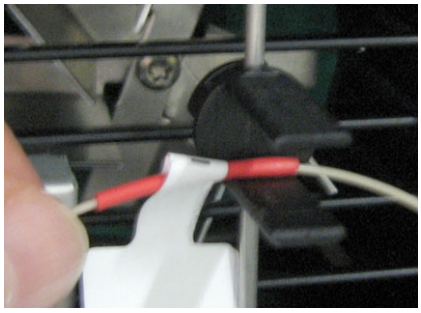


Fig. 40: Attaching the column ID to the column

6. Press the column into the bottom part of the clip and reinstall the ring.



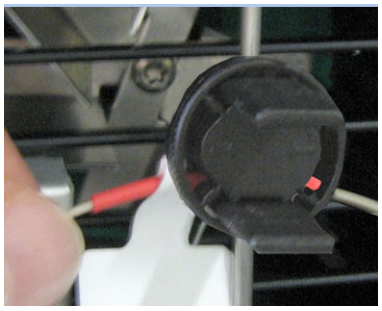


Fig. 41: Installing a column in the clip

7. Connect the capillaries to the column and establish the fluid connections between the separation column and the column switching valve.

   For information about how to connect the capillaries to the valve, see (→ page 80). When connecting the capillaries, observe the general information about how to connect and route the capillaries (→ pages 57 and 60).

8. Activate column identification if applicable (→ page 129).

4.6.3 Installing a Trap Column

Certain applications, for example, preconcentration, require the installation of a trap column. The trap column is connected directly to the column switching valve.

When installing the trap column, observe the direction of flow (indicated by an arrow on the column). Connect the column to the valve in the direction of the nano flow. More information about how to connect the column is shipped with the column. In addition, observe the general information about how to connect capillaries (→ page 57).

4.6.4 Connecting the Components to the Column Switching Valve

1. Do not touch any metal or plastic parts inside the column chamber while the temperature is higher than 50 °C. Before carrying out any work in the column compartment, wait for the column chamber to cool down.

   To shorten the cool-down time, consider setting a lower temperature and opening the front panel door.

2. A plastic cap protects the valve ports during shipment. Remove the plastic cap if it is still present.

3. Connect the capillaries to the column switching valve as required by your application. When connecting the capillaries, observe the general information about how to connect and route the capillaries (→ pages 57 and 60).

4.7 Equilibrating the System

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

Tip: If the module has not been in use for a longer period (> several days), it will take some time until the module is ready for operation again:

- With a Classic flow meter installed, it will take about 60 minutes until the module is ready for operation again. The full accuracy will be reached when the module has been powered on for 24 hours.
- With a ProFlow flow meter installed, it will take about 30 minutes until the module is ready for operation again. The full accuracy will be reached when the module has been powered on for 1 hour.

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

   Loading pump only

   The compression value should remain stable under 100%. The compression value is displayed, for example, on the **Diagnostics** menu for the loading pump (→ page 102).
5. Monitor the detector signal and verify that the baseline signal is at the expected reading for your application and is stable.

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

To equilibrate the system from Chromeleon

- Select and perform the operating commands and parameters from the **Commands** dialog box.
- Create and run an equilibration program to automate the process (→ page 92).

To equilibrate the system from the front panel menus

Select and perform the operating commands and parameters on the front panel menus of the modules. For information about the menus, see section 5.4.2.2 (→ page 98). For information about the menus of other system modules, see the *Operating Instructions* for the respective module.

5 Operation and Maintenance

The module is controlled by the Chromeleon Chromatography Management System. For details, see section 5.3 (→ page 88).

In addition, function keys and menus are available on the front panel displays to facilitate operation during, for example, initial installation, diagnostics, and maintenance, allowing you to perform certain actions directly from the module. For example, you can:

- Perform certain commands (start and stop the flow)
- Set parameters (leak sensor mode, brightness, and contrast of the screen display)
- View and change the module configuration

For details, see section 5.4 (→ page 94).

5.1 Power-Up

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

- For a short time, general information about the module appears on the front panel displays: device type, serial number, and firmware version.
- The module runs a series of internal tests. During these self-diagnostics, all of the main components are checked. When the self test was successful, the status screens appear on the front panel displays (→ page 85).
- If an error is detected, the module or the component for which the error is detected is not ready for analysis. The **Status** LED on the front panel door changes to red and a message appears on the pump display. If the module is operated from Chromeleon, the message is displayed also in the Chromeleon Audit Trail. Turn off the module, take appropriate remedial action (→ page 145), and turn on the module again.

For routine operation, leave the main power switch on. For routine on/off control, use the standby button on the front of the module (→ page 22). Press and hold the button for about one second to allow the module to change the mode. Turn off the main power switch only when instructed to do so, for example, before performing a service procedure.

Tip: Also observe the information in point 3 in section 5.8 (→ page 138).

5.2 Status Screen

When the self test was successful, the status screens appear on the front panel displays. You can adjust the screen brightness or screen contrast to your requirements from Chromeleon or on the front panel displays (→ page 125 for the pump display and page 131 for the column compartment display).

5.2.1 Pump Module

The status screen for the pump module shows the following information:

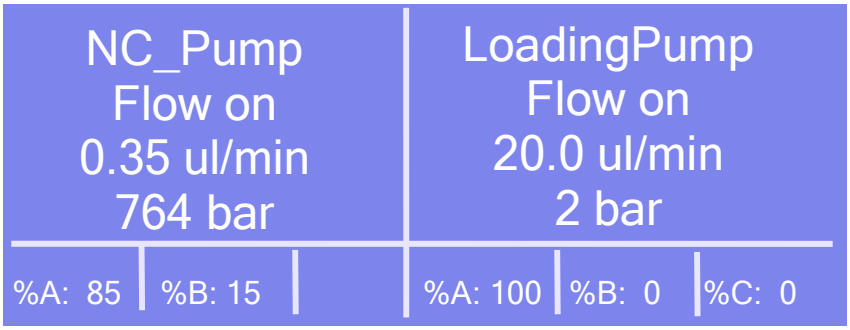


Fig. 42: Status screen (example) (here for the NCS-3500RS)

This information is displayed ...	**Description**
Pump name	The pump name is the name that you specified on the **Pumps** page, under the related **Pump Device Name**, in the **Properties** dialog for the module in the Chromeleon Server Configuration program (→ page 48).
Flow on *or* Flow off *or* Purge	**Flow on** appears when the pump delivers with the specified flow rate. **Flow off** appears when the pump is not delivering. **Purge** appears when a purge cycle is running.
Flow rate	When the pump is pumping, the display always shows the flow rate that the pump is actually delivering. When a flow ramp has been set in Chromeleon, it may take some time until the specified target flow is reached. While is pump is idle, the nominal flow rate is displayed and the flow value is flashing.
Pressure	Shows the pressure in the unit that you specified on the **Limits** page in the **Properties** dialog for the module in the Chromeleon Server Configuration program (→ page 48).
%A, %B or %A, %B, %C	Shows the components of the solvent in percent of the total flow. *Tip:* If the purge cycle for the NC pump is started from Chromeleon, 'Purging' appears on the display. In addition, the component is indicated for which the purge cycle is running

5.2.2 Column Compartment

The picture shows the status screen for the column compartment:

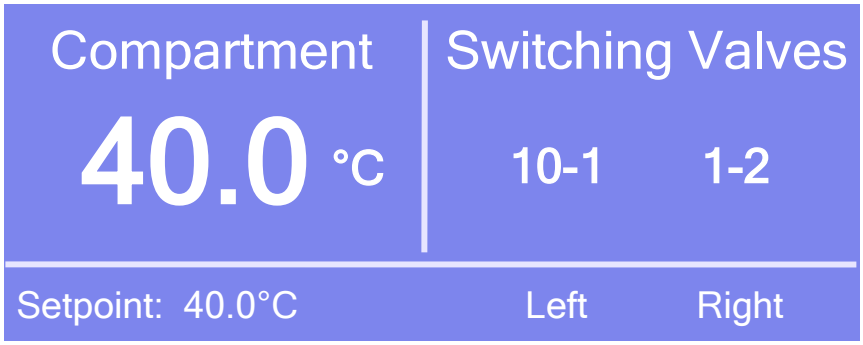


Fig. 43: Status screen (example)

Under ...	**The following information appears …**
Compartment	Current column temperature (in °C)
Setpoint	Target temperature for temperature control (in °C) The temperature value is flashing until the selected temperature is reached. **Off** is displayed when temperature control is disabled.
Switching Valves	Flow path in the column switching valves (if installed).

5.3 Operation from Chromeleon

Before you begin, verify that

1. The Chromeleon software is installed on the computer and the license code is entered.
2. The module is connected to the Chromeleon computer by means of a USB connection.
3. The module is set up in Chromeleon (→ page 43).

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

Two modes of software control are available:

- *Direct control* with the parameters and commands in the **Commands** dialog box (→ page 89) or on a control panel (→ page 90).
- *Automated control* with a control program (PGM) (→ page 92).

5.3.1 Connecting to Chromeleon

1. Start the Chromeleon Server Monitor and the Chromeleon server if they are not yet running (→ page 43).
2. Start the Chromeleon client by clicking the Chromeleon icon  on the desktop. If the Chromeleon icon is not on the desktop, click **Start** on the taskbar, point to **Programs** (or **All Programs**, depending on the operating system), point to **Chromeleon**, and then click **Chromeleon**.
3. Connect the Chromeleon client program to the timebase in which the module is installed. For details about how to do this from the **Commands** dialog box, see page 89. For details about how to do this on a control panel, see page 90.

When the module is correctly connected to Chromeleon:

- The **Connected** LEDs on the front panel doors are green.
- The function keys on the front panel display are *not* available and front panel input is disabled.
- Functions for estimating the lifetime of consumables and monitoring and recording service and (re)qualification information are provided (→ page 132).
- The Standby button on the front of the module remains active.

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

5.3.2 Direct Control

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

To open the Commands dialog box for the module

1. Open a control panel (any panel is possible). To open a control panel, open the Chromeleon Browser and double-click a control panel in the Dionex Templates/Panels folder.

2. Connect the control panel to the timebase in which the module is installed. On the **Control** menu, select **Connect to Timebase**, and then select the timebase on the **Timebase** tab. For more information about the Timebase dialog, click **Help**.

   Tip: The **Control** menu is visible only when a control panel is already open.

3. Press the F8 key or select **Command** on the **Control** menu.

4. Show the parameters and commands for the components of the module. They appear under the names specified for the components in the Properties dialog for the module (→ page 47).

   a) Click the plus sign next to **PumpModule**. Here you see

   - General properties and commands related to the entire pump module, such as the commands and properties for the seal wash system, leak detection, or the degasser in a SRD-3x00 Solvent Rack that is connected to the module.
   - Specific groups of properties and commands for the pumps of the pump module.

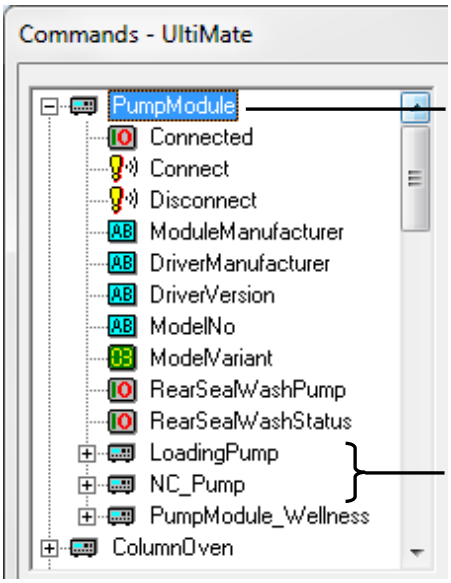


Fig. 44: Commands dialog box (pump module)

b) To see the parameters and commands that are available for the column compartment, click the plus sign next to **ColumnOven**.

5. The commands and parameters available in the dialog box vary, depending on the
   - ♦ Chromeleon version
   - ♦ Options selected for the module in the Properties dialog (→ page 46).
   - ♦ Display filter level (**Normal**, **Advanced**, or **Expert**)
     Change the display filter level if necessary. Right-click in the commands list and select the filter level on the menu.

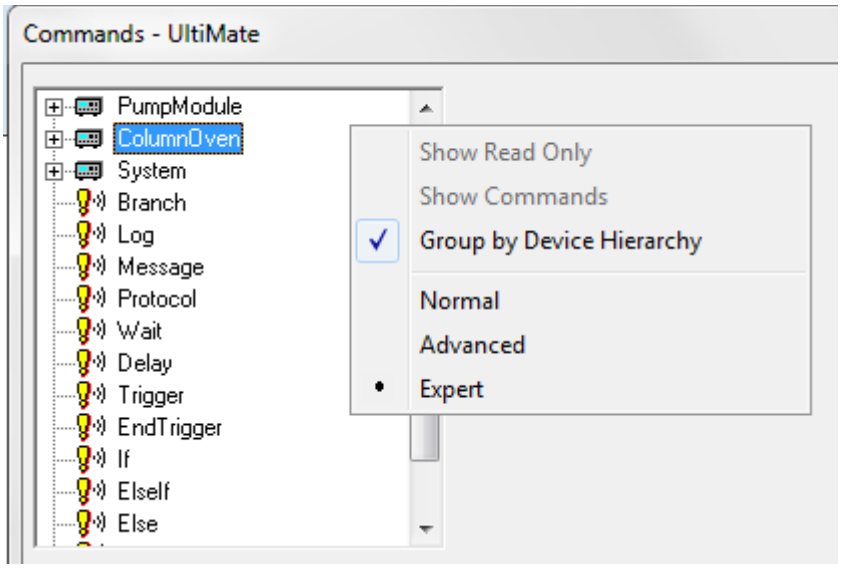


Fig. 45: Changing the display filter level in the Commands dialog box

6. Verify that the module is connected in Chromeleon. If the module is not yet connected, perform the Connect command.

Tip: The **Connect** command is listed under **PumpModule**. When you perform the Connect command, the column compartment is automatically connected, too.

For a list of the commands and parameters that are supported for the module, see the *Chromeleon Help*. In addition to the commands and parameters for this module, the **Commands** dialog box provides also access to all commands and parameters available for any other modules that are installed in the selected timebase.

To open a control panel for the module

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

   Chromeleon creates centralized control panels, called panel tabsets, for all timebases available on the Chromeleon server. A panel tabset provides control panels for the individual instruments in a timebase and, in addition, one or more panels for performing

system-wide functions, for example, creating and running sequences. For more information about panel tabsets, see the *Chromeleon Help*.

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

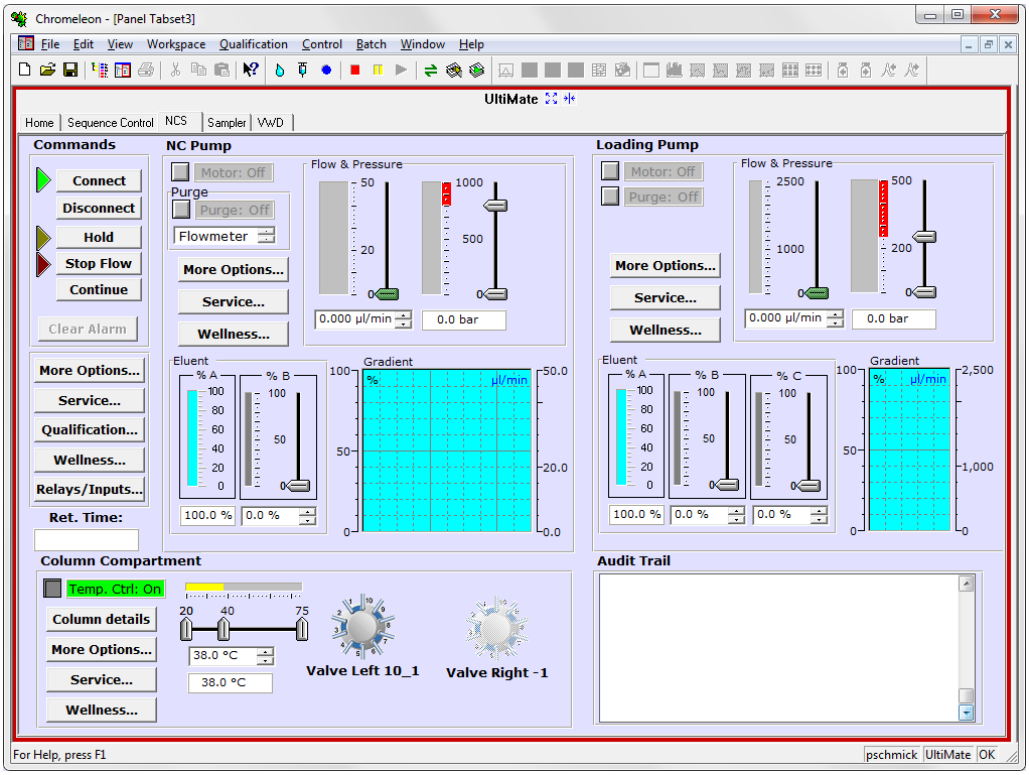


Fig. 46: Control panel (here for the NCS-3500RS)

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

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

5.3.3 Automated Control

With automated control, you create a program file (PGM) for automated operation of the module. You can create programs automatically with the software wizard or manually by editing an existing program. In addition to programs for sample analysis, you can also create programs for special purposes, for example, to automate system shutdown (→ page 141) or to ensure that the system automatically restarts operation as desired after a power failure. For details, see the *Chromeleon Help*.

To create a program with the Program Wizard

1. Open the Program Wizard. On the **File** menu, select **New**, and then select **Program File**.
2. The wizard guides you through program creation. On each wizard page, accept or change the settings as appropriate. For additional information about a page, click **Help**.
3. After you finish the wizard, Chromeleon automatically creates the corresponding program.
4. To start the program, follow the steps below (→ page 93).

To create a program manually

1. Open an existing program.

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

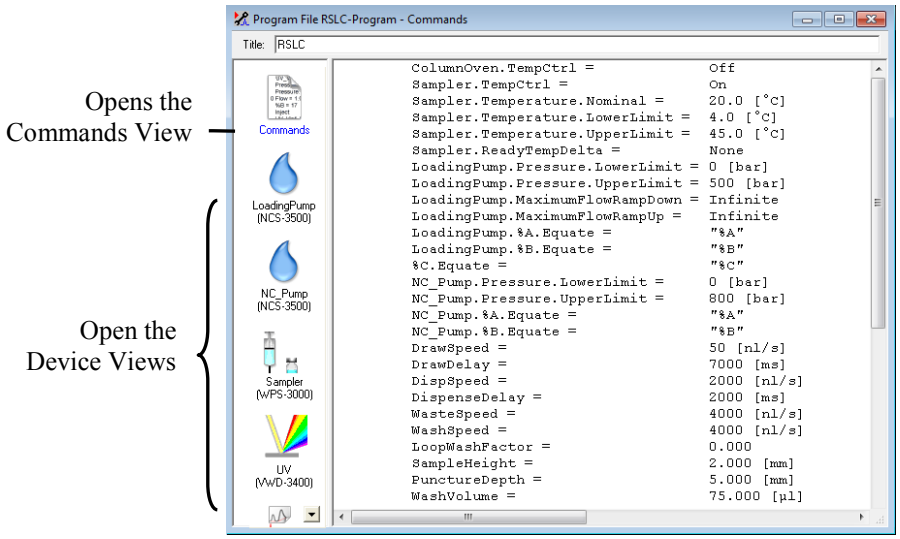


Fig. 47: Chromeleon program (here program shown in the Commands view)

2. Change the program settings as needed.

   The easiest way is to edit a program is to do this in the Device Views (→ Fig. 47). Click a device icon and change the settings on the device pages. Editing the program in the Device Views ensures correct command syntax.

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

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

To start a program

Program for sample analysis

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

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

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

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

Other programs

Add the program to the batch and start the batch.

5.4 Function Keys and Menus on the Display

Function keys and menus are available on the front panel displays. Thus, you can make several settings or execute certain commands directly from the module.

- For information about the function keys, see section 5.4.1 and page 97.
- For information about the menus, see section 5.4.2.2 (→ page 98).

5.4.1 Showing the Function Keys

Four white spots on the front panels mark the positions of the function keys. To show the keys, touch the position of the utmost left spot on the display with the menu pen. The menu pen is included in the shipment.

Fig. 48: Showing the function keys

The function keys replace the information in the bottom line of the status screen. If no key is selected, the bottom line of the status screen is restored after about 5 seconds. When the module is connected in Chromeleon, the function keys (except **Menu**) are *not* available.

The following function keys are available for the pump:

Function Key	Description
Menu	Opens the **Main** menu for the related pump (→ page 100).
Flow on (Flow off)	Has the pump deliver with the specified flow rate. While is pump is idle, the nominal flow rate is displayed and the flow value is flashing. Select **Flow on** to have the pump deliver with the displayed rate. While the pump is delivering with the displayed flow rate, the key name changes to Flow off, the real flow is displayed, and the flow value stops flashing. Select **Flow off** to have the pump stop delivering.

Function Key	Description
Set Flow	*Only NCP-3200RS* Opens the **SetFlow** dialog. You can set the flow rate also on the **Control** menu (→ page 101).
Purge	*Only NCP-3200RS* Opens the **Purge** dialog. Select the component that you want to purge (left and/or right pump head or flow meter). The component is purged for the **Purge Time** specified on the **Preferences** menu (→ page 102). You can access the **Purge** dialog also by selecting **Purge** on the **Control** menu (→ page 101).

The following function keys are available for the column compartment:

Function Key	Description
Menu	Opens the **Main** menu (→ page 105).
Temp	Opens the **Temperature** menu. Under **Temperature Control**, you can turn temperature control on and off. Under **Temperature**, you can set the target temperature
Valve	Opens the **Valves** menu. Under **Left Valve Position** and **Right Valve Position**, you can specify the fluid connections for the related valve.
Leak	Opens the **Leak** menu. Under **Gas Leak Mode** and **Humidity Leak Mode**, you can determine whether leak detection is performed (→ page 106). Under **Leak Alarm Mode**, you can determine in addition whether a beep shall alert you (→ page 106).

5.4.2 Menu

To open the menus for the pump and column compartment, select the **Menu** key on the front panel display. The module type determines which menus and parameters are available.

For an overview of the pump menus, see section 5.4.2.2 (→ page 98). For an overview of the menus that are available for the column compartment, see section 5.4.2.3 (→ page 104).

The general layout and structure is identical for all menus (→ section 5.4.2.1).

5.4.2.1 General Menu Layout and Structure

In general, the menu layout is as follows:

Fig. 49: Menu layout (here Control menu for the pump)

No.	Description
1	Reports the menu name and the number of items on the menu list.
2	The menu items appear on a list and are numbered consecutively. The selected item is underlined.
3	Navigation bar

Select an item with the arrow up or down key—the selected item is underlined. Confirm your selection with **Select**. **Back** returns you to the previous menu level.

The selected menu item or parameter determines which keys appear on the navigation bar:

To …	**Select ...**
Return to the previous entry on a list. If the list contains 5 or more items, you can use the arrow up key to scroll up through the list, after reaching the first line (→ **Key autorepeat**, page 103).	∧
Increment numerical values.	∧
Proceed to the next entry on a list. If the list contains 5 or more items, you can use the arrow down key to scroll up through the list, after reaching the fourth line (→ **Key autorepeat**, page 103).	∨
Decrement numerical values.	∨
Select operating states (for example, the settings for the leak sensor).	∧ *or* ∨
Proceed to the next figure in a number. Any decimal point is skipped.	>
Confirm the selection and activate the input field if applicable. If an item is read-only, the Select key will not be available.	Select
Perform the selected command.	Execute
Return to the previous menu level.	Back
Toggle between two operating states (for example, between On and Off).	Toggle
Confirm the selection or input.	OK
Cancel the action and restore the last value.	Cancel
Note: Depending on the selected option, specific keys may replace these general keys.	

If an error is found, one or more messages appear on the pump display. In this case, the **Prev**, **Next**, and **Clear** keys appear on the navigation bar.

To …	**Select …**
Return to the previous message.	Prev
Proceed to the next message.	Next
Remove a message from the pump display.	Clear

5.4.2.2 Pump Menus

The pump type (NC pump or loading pump) determines which menus, commands, and parameters are available. Fig. 50 provides an overview of the menus for the NC pump. For an overview of the menus for the loading pump, see Fig. 51 (→ page 99).

For information about the commands and parameters that are available in the individual menus, see sections 5.4.2.2.1 through 5.4.2.2.5 (→ page 100 and following pages).
Section 5.4.2.1 provides information about the general menu layout and function keys on the navigation bar (→ page 96).

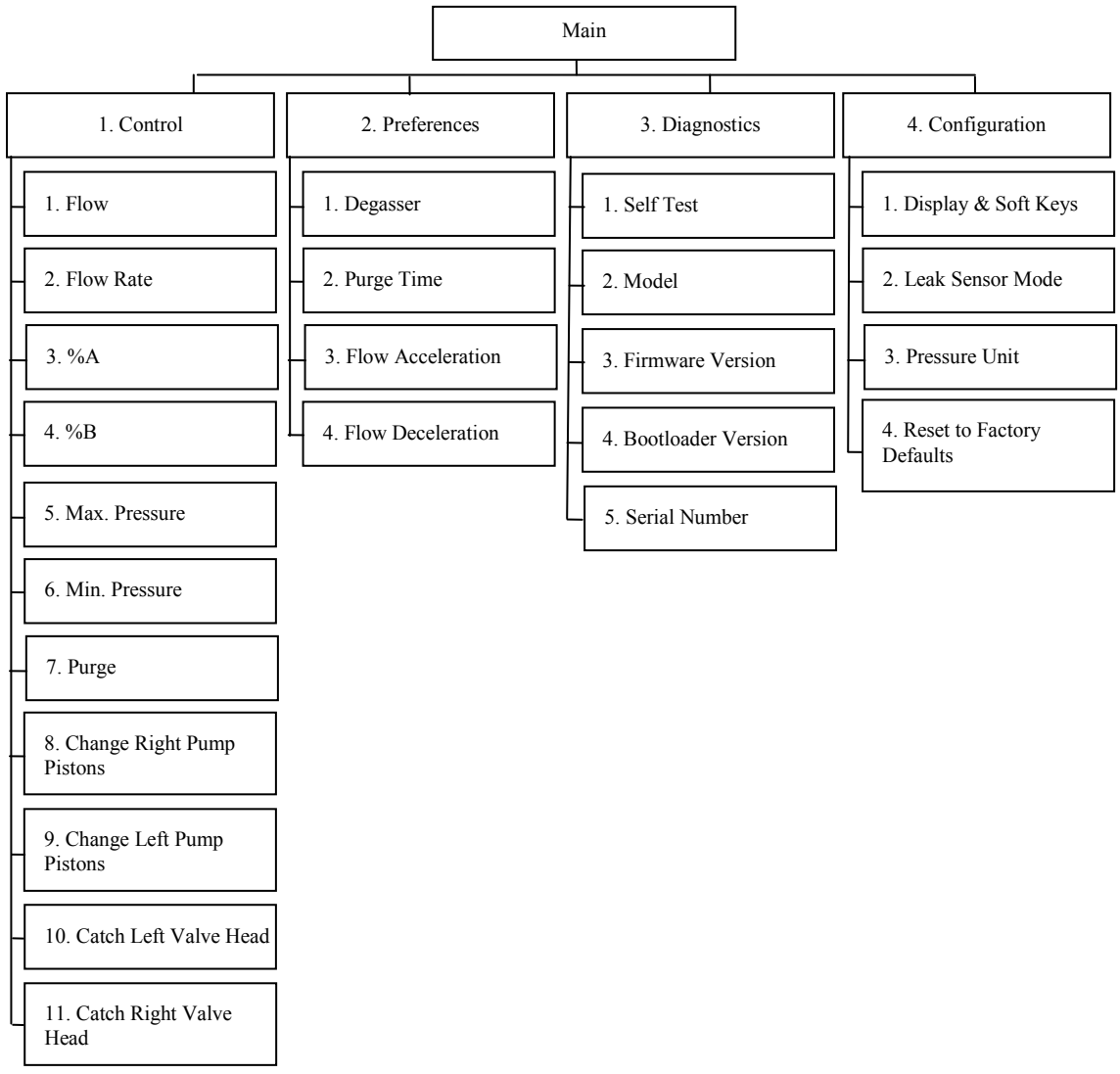


Fig. 50: NC pump menus

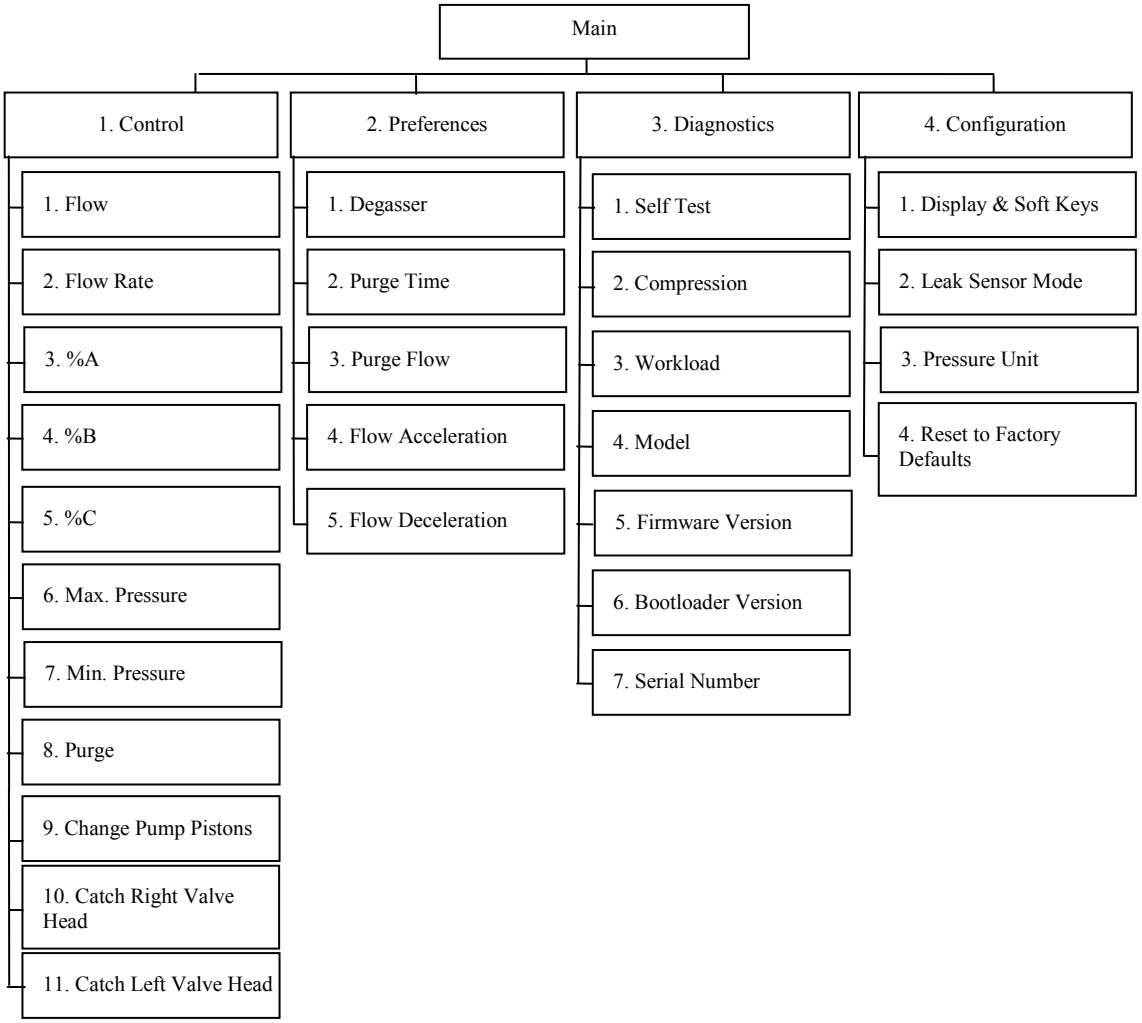


Fig. 51: Loading pump menus

5.4.2.2.1 Main Menu

The **Main** menu provides top-level access to the menu structure. To open the **Main** menu for the related pump, show the function keys and select **Menu** (→ page 94).

From the **Main** menu, you can open the following menus:

- **Control**
  On the **Control** menu, you can make the different settings for pump operation (→ page 101).
- **Preferences**
  On the **Preferences** menu, you can make the basic settings for the related pump (→ page 102).
- **Diagnostics**
  The **Diagnostics** menu provides information for diagnostic purposes (read-only). In addition, you can perform a self-test for the pump module (→ page 102)
- **Configuration**
  The **Configuration** menu provides information about the configuration of the pump module and allows you to make the required settings or perform the related commands (→ page 103).

The pump type (NC pump or loading pump) determines which menus, commands, and parameters are available on the individual menus.

5.4.2.2.2 Control Menu

On the **Control** menu, you can make the different settings for pump operation.

To …	Select …
Start the pump flow with the selected flow rate (on) or to stop the flow (off).	Flow
Set the flow rate.	Flow Rate
Enter the related component of the solvent in percent of the total flow. The total of all components is 100%.	%A , %B, %C
Set the maximum pressure.	Max. Pressure
Set the minimum pressure.	Min. Pressure
Purge the pump. *NC pump* Open the **Purge** dialog. Select the component that you want to purge (left and/or right pump head or flow meter). The component is purged for the **Purge Time** specified on the **Preferences** menu (→ page 102). *Loading pump* The loading pump is purged with the **Purge Flow** and **Purge Time** settings specified on the **Preferences** menu (→ page 102). For more information about how to purge the pumps, see section 4.5.3 (→ page 72).	Purge
Open the **Pump/Maintenance** dialog for piston and piston seal replacement. From this dialog, you can move the pistons into the appropriate position for piston and piston seal replacement. For more information, see section 7.6.2 (→ page 188).	Change Right Pump Pistons Change Left Pump Pistons Change Pump Pistons
Move the actuator for the column switching valve into the correct position for valve installation if necessary. For details, see section 4.6.1 (→ page 78).	Catch Left Valve Head Catch Right Valve Head

5.4.2.2.3 Preferences Menu

On the **Preferences** menu, you can make the basic settings for the related pump.

To …	Select …
Turn the degasser in a SRD-3x00 Solvent Rack that is connected to the module on or off.	Degasser
Set how long the pump (or the flow meter) is purged. For the NC pump, the default purge time is 30 minutes; for the loading pump, the standard purge time is 5 minutes.	Purge Time
Loading pump only Set the flow rate for purging the loading pump. The standard setting is 2 mL/min.	Purge Flow
Set the upper value for the flow rate acceleration. For details, see page 119.	Flow Acceleration
Set the upper value for the flow rate deceleration. For details, see page 119.	Flow Deceleration

5.4.2.2.4 Diagnostics Menu

The **Diagnostics** menu provides information for diagnostic purposes (read-only). In addition, you can perform a self test for the pump module.

To …	Select …
Perform a self test. *Tips:* ♦ Before performing the command, open the purge valves to reduce any pressure and to avoid that pressure builds up. ♦ The self test is performed for *all* pumps of the pump module, independent of whether you perform the command from the NC pump menu or loading pump menu. If an error or mechanical fault is detected, the Status LED on the pump door changes to red and a message appears on the pump display.	Self Test
See the model.	Model
Loading pump only See the compression value of the last stroke of the pump head. The value is indicated in percent. For more information about the compression for the loading pump, see page 174.	Compression

To …	Select …
Loading pump only See the workload of the related pump head since the pump has been operated for the first time. The workload is calculated from the flow rate, pressure, and time.	Workload
See which firmware version is installed in the module.	Firmware Version
See the bootloader version.	Bootloader Version
See the serial number of the module:	Serial Number

5.4.2.2.5 Configuration Menu

The **Configuration** menu provides information about the configuration of the pump module and allows you to make the required settings or perform the related commands.

To …	Select …
Set the display and function key parameters: **Brightness**—sets the screen brightness. (The input is in percent.) **Contrast**—sets the screen contrast. (The input is in percent.) **Key sound**—sets whether a beep sounds when you select a function key. **Key autorepeat**—sets whether the keystroke is automatically repeated when you remain on the key for a longer period, for example, to change a value quickly.	Display & Soft Keys
Turn leak detection off if necessary and on again: **Disabled**—turns leak detection off. **Enabled**—turns leak detection on. Leak detection is enabled as a standard. For more information about how operate the pump with leak detection, see page 124.	Leak Sensor Mode
Set the pressure unit.	Pressure Unit
Restore the factory settings for the pump module. In the **Reset to factory defaults?** dialog box, select **OK** to confirm the restore the factory settings or select **Cancel** to keep your settings. *Tip:* The command restores the factory settings for *all* pumps of the pump module, independent of whether you perform the command from the NC pump menu or loading pump menu.	Reset to Factory Defaults

5.4.2.3 Column Compartment Menus

Fig. 52 provides an overview of the menus that are available for the column compartment. For information about the commands and parameters that are available in the individual menus, see sections 5.4.2.3.1 through 5.4.2.3.4 (→ page 105 and following pages). Section 5.4.2.1 provides information about the general menu layout and function keys on the navigation bar (→ page 96).

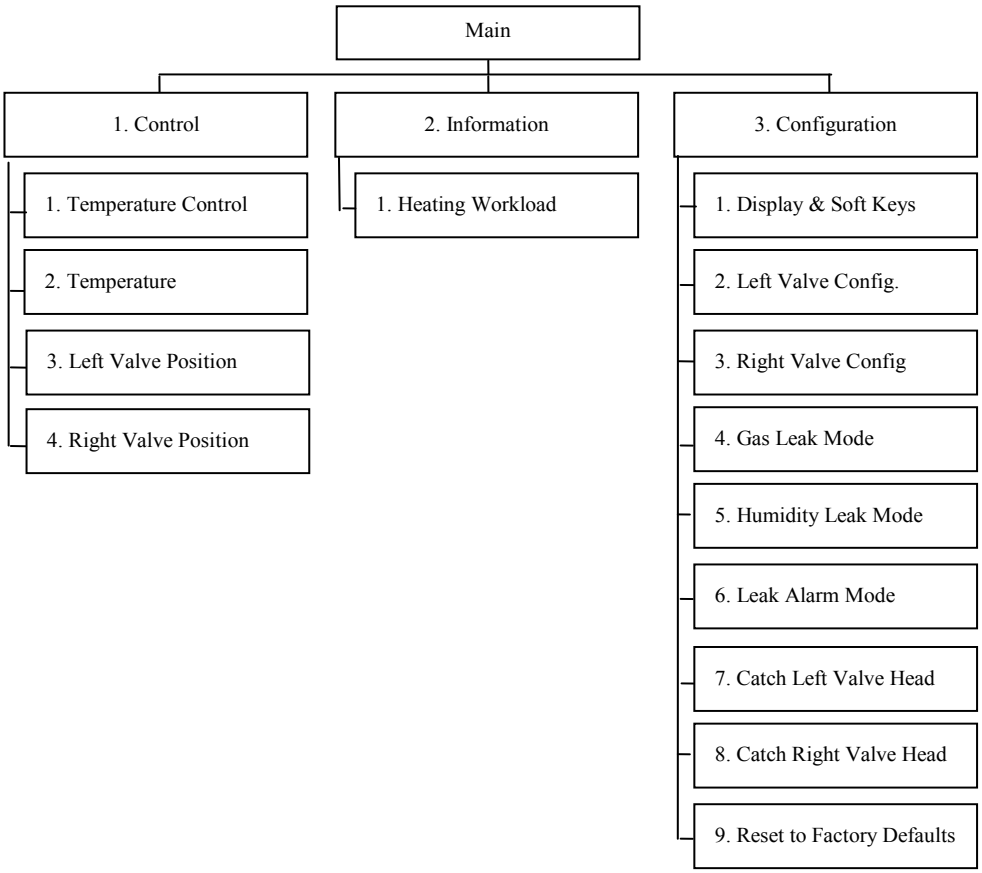


Fig. 52: Column compartment menus

5.4.2.3.1 Main Menu

The **Main** menu provides top-level access to the menu structure. To open the **Main** menu, show the function keys and select **Menu** (→ page 94).

From the **Main** menu, you can open the following menus:

- **Control**
  On the **Control** menu, you can make the settings for temperature control and valve control (see further down).
- **Information**
  The **Information** menu provides information for diagnostic purposes (see further down).
- **Configuration**
  The **Configuration** menu provides information about the configuration of the column compartment and allows you to make the required settings or change the settings (→ page 106).

5.4.2.3.2 Control Menu

From the **Control** menu, you can turn temperature control on and off and set the target temperature. In addition, you can specify the switching position of the valves.

To …	Select …
Turn temperature control on or off.	Temperature Control
Set the target temperature.	Temperature
Set the switching position for the left valve (= liquid flow path through the valve).	Left Valve Position
Set the switching position for the right valve (= liquid flow path through the valve).	Right Valve Position

5.4.2.3.3 Information Menu

The **Information** menu provides information for diagnostic purposes (read-only). **Heating Workload** shows the workload of the heat exchanger.

General information about the module, such as the serial number and firmware version, are available on the Diagnostics menu of the pump (→ page 102).

5.4.2.3.4 Configuration Menu

The **Configuration** menu provides information about the configuration of the column compartment and allows you to make the required settings or change the settings.

To …	Select …
Set the display and function key parameters: **Brightness**—sets the screen brightness. (The input is in percent.) **Contrast**—sets the screen contrast. (The input is in percent.) **Key sound**—sets whether a beep sounds when you select a function key. **Key autorepeat**—sets whether the keystroke is automatically repeated when you remain on the key for a longer period, for example, to change a value quickly.	Display & Soft Keys
Specify which valve is installed in the left and/or right position.	Left Valve Config Right Valve Config
Determine whether leak detection is performed and how you are alerted in case of an alarm. Select the sensor and set the sensitivity: **Low**, **Standard**, or **High**—turns leak detection on and sets the sensitivity with which the sensors respond to excessive gas or humidity. When a sensor is activated, a message appears on the pump display and a beep alerts you (when set under **Leak Alarm Mode**). **Off**—turns leak detection off.	Gas Leak Mode Humidity Leak Mode
Determine whether a beep alerts you when the gas and/or humidity sensor is activated, in addition to the message on the pump display (audible = yes, silent = no).	Leak Alarm Mode
Move the actuator for the column switching valve into the correct position for valve installation if necessary. For details, see section 4.6.1 (→ page 78).	Catch Left Valve Head Catch Right Valve Head
To restore the factory settings for the column compartment. In the **Reset to factory defaults?** dialog box, select **OK** to confirm the restore the factory settings or select **Cancel** to keep your settings.	Reset to Factory Defaults

5.5 Information for Operating the Pump

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

To learn more about ...	See page ...
Choosing the solvents	108
Interdependency of column pressure and maximum flow rate (NC pump)	110
Establishing and saving the solvent viscosity (NC pump)	114
Setting the flow rate, flow acceleration, and flow deceleration	119
Setting the pressure limits	120
Recording the pump pressure	121
Rear seal washing	121
Purging the pumps	124
Detecting liquid leaks in the pump module	124
Adjusting the screen brightness or contrast	125
Operating the degasser of a SRD-3x00 Solvent Rack	125

Section 5.6 (→ page 127) provides information that should be considered for operating the column compartment. For information about special Chromeleon functions, see section 5.7 (→ page 132).

Tip: To have an optimally running system, observe the recommendations in section 5.8 (→ page 138).

5.5.1 Choosing the Solvents

Observe the following precautions for solvent selection:

- Observe the precautionary statements in section 1.2.2 (→ page 5).
- The pump is primed with 2-propanol. During initial operation of the module, make sure that the solvents used are miscible with 2-propanol. Otherwise, follow the appropriate intermediate steps.
- Use only LC-MS grade water (0.2 µm, filtered).

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

  For information about the wetted parts in the module, see the Technical Information section (→ page 235). For information about the wetted parts in the other UltiMate 3000 system modules, refer to the 'Technical Information' section in the operating instructions for the modules.
- Make sure to use special (highly pure) solvents. They are usually labeled accordingly by the vendor.
- Mind the special properties of the solvents, such as viscosity, boiling point, UV absorption (UV/VIS detector), refractive index (refractive index detector), and dissolved gas (degasser).
- pH range: 2 - 10
- Do not operate the module with solvents that at the same time have very low pH and high Chloride concentration (for example, 0.1M HCl + 1.5M NaCl).
- The pump is shipped with reversed phase main piston seals (RP).

  Keep in mind that using chloroform, trichlorobenzene, methylene chloride, tetrahydrofuran, or toluene as solvents chemically damages the UHMW-PE seals. Chemical reactions may also occur when using tetrachloromethane, diethyl ether, di-isopropyl ether, ketones, ammonium hydroxide, toluene, methylcyclohexane, and monochlorobenzene. If you use these solvents, contact the Thermo Fisher Scientific sales organization for Dionex HPLC Products.
- If the UltiMate 3000 system includes a SRD-3x00 Solvent Rack, observe also the solvent compatibility of the degasser.

  Whenever possible, avoid using the following solvents: hexafluoroisopropanol, solvents containing hydrofluoric acid, perfluorinated solvents, and freons.

- In an UltiMate 3000 system, some components are made of PEEK. This polymer has superb chemical resistance to most organic solvents.

  However, it tends to swell when in contact with trichlormethane ($CHCl_3$), dimethyl sulfoxide (DMSO), or tetrahydrofuran (THF). In addition, it is attacked by concentrated acids, such as, sulfuric acid and nitric acid or a mixture of hexane, ethyl acetate, and methanol. In both cases, capillaries may start leaking or they can burst. Swelling or attack by concentrated acids is not a problem with brief flushing procedures. For more information about the chemical resistance of PEEK, see the table in section 12.1 (→ page 247).

- Before switching from buffer to organic solution, rinse the pump thoroughly with deionized water.

- When switching to another solvent, ensure that the new solvent is miscible with the one contained in the pump. Otherwise, the pump can be damaged; for example, by flocculation.

- When replacing solvents, make sure that the solvents are miscible. Mix immiscible solvents with an intermediate solvent (for example, isopropanol) to replace them step-by-step.

- After operation, rinse out buffers and solutions that form peroxides.

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

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

5.5.2 Interdependency of Column Pressure and Maximum Flow Rate

5.5.2.1 NC Pump with a ProFlow Flow Meter

Overview

Each flow channel of the ProFlow flow meter comprises a closed control loop that includes the pump (nos. 1a and 1b) and a thermal flow sensor (nos. 5a and 5b). The flow sensors measure the current flow rates and the pump speeds are controlled so that the flow rates match the set values. Both partial flows are mixed in a microfluidic Y piece (no. 6) at the flow meter outlet.

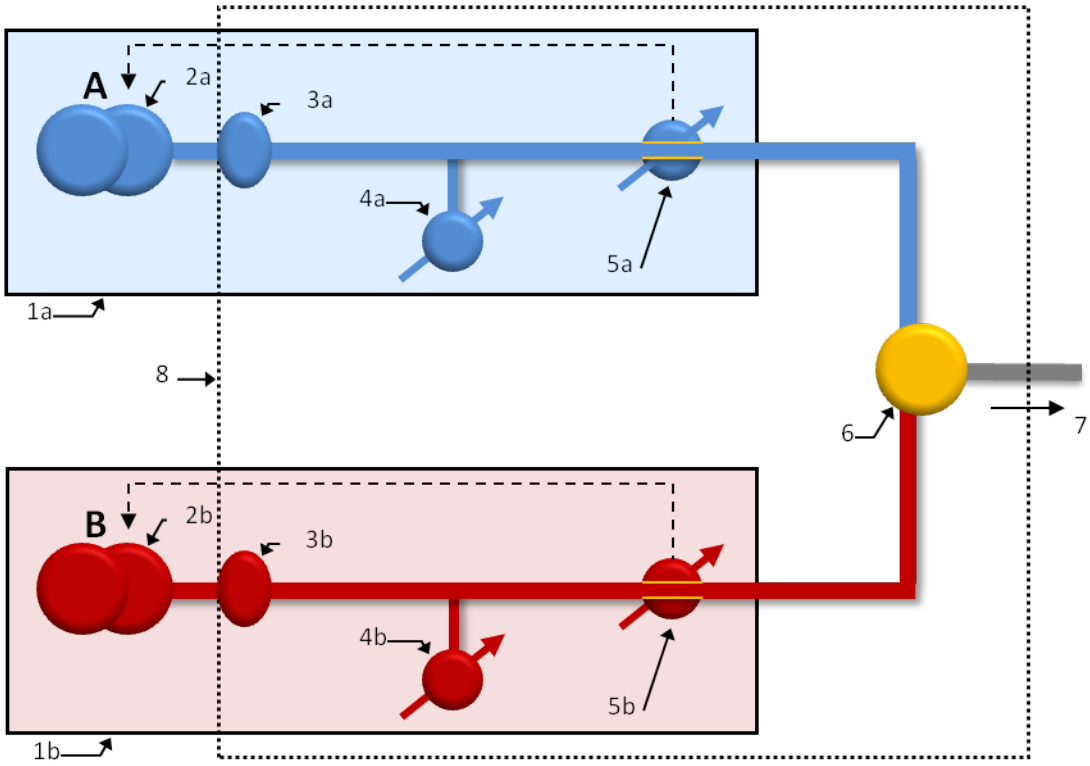


Fig. 53: Functional blocks of the NC pump with ProFlow flow meter

No.	Element
1a / 1b	Flow-controlled pump, left (A) and right (B)
2a / 2b	Dual-piston pump, left / right
3a / 3b	Filter unit, left / right
4a / 4b	Primary pressure transducer, left / right
5a / 5b	Thermal flow sensor, left / right
6	Y piece
7	Flow meter outlet, capillary connection to the other modules of the HPLC system
8	Flow meter module

ProFlow flow meter: Interdependency of column pressure and the maximum flow rate

The maximum column pressure depends on the solvent that is used in solvent channel B and the flow rate. The table below shows which column pressures can be delivered at the given flow rates for a number of solvents:

	Maximum possible column pressure at flow rate				
Solvent (%B)	**1500 nL/min**	**1250 nL/min**	**1000 nL/min**	**750 nL/min**	**500 nL/min**
100 % acetonitrile	900 bar	900 bar	900 bar	900 bar	900 bar
80:20 acetonitrile/ water	890 bar	900 bar	900 bar	900 bar	900 bar
100 % methanol	890 bar	900 bar	900 bar	900 bar	900 bar
100 % water	830 bar	850 bar	880 bar	900 bar	900 bar
100 % isopropanol	610 bar	680 bar	740 bar	800 bar	870 bar

Tip: Pressures above 860 bar delivered by the pump may cause problems with the column switching-valves. Make sure that you observe the maximum pressure limit for the column switching valves.

Example:

If you use 100 % water in solvent channel A and acetonitrile/water (80:20) in solvent channel B at a flow rate of 1500 nL/min, check the table entry for acetonitrile/water (80:20) above; a maximum column pressure of 890 bar is possible with the pump.

The Ready Check checks if the selected flow rate can be delivered reliably at the selected maximum column pressure. If this is not possible, a message appears. If the upper limit for the column pressure is set to a value that is considerably higher than the actually expected column pressure, a message may appear too although no problem has occurred. In this case, reduce the upper limit as required.

If it is required to work at very high column pressures and the selected flow rate cannot be delivered, reducing the flow rate and pressure limit slightly will usually be sufficient to remedy the situation. The maximum expected column pressure decreases with the flow rate.

During operation, the pump continuously monitors whether the selected flow rate is delivered. If it is not, a message appears and the batch or sequence will be aborted. A number of factors determine whether this situation will actually occur, such as the selected gradient.

5.5.2.2 NC Pump with a Classic Flow Meter

Overview

The NC pump has two transducers for the primary pressure and one transducer for the system pressure. The primary pressures are controlled in such a way that the partial flows through the fluidic resistors (→ Fig. 54, nos. 5a and 5b) result in exactly the desired total flow and solvent composition.

The picture illustrates how the pump operates with a Classic flow meter. For more information about the operating principle of the NC pump, see page 222.

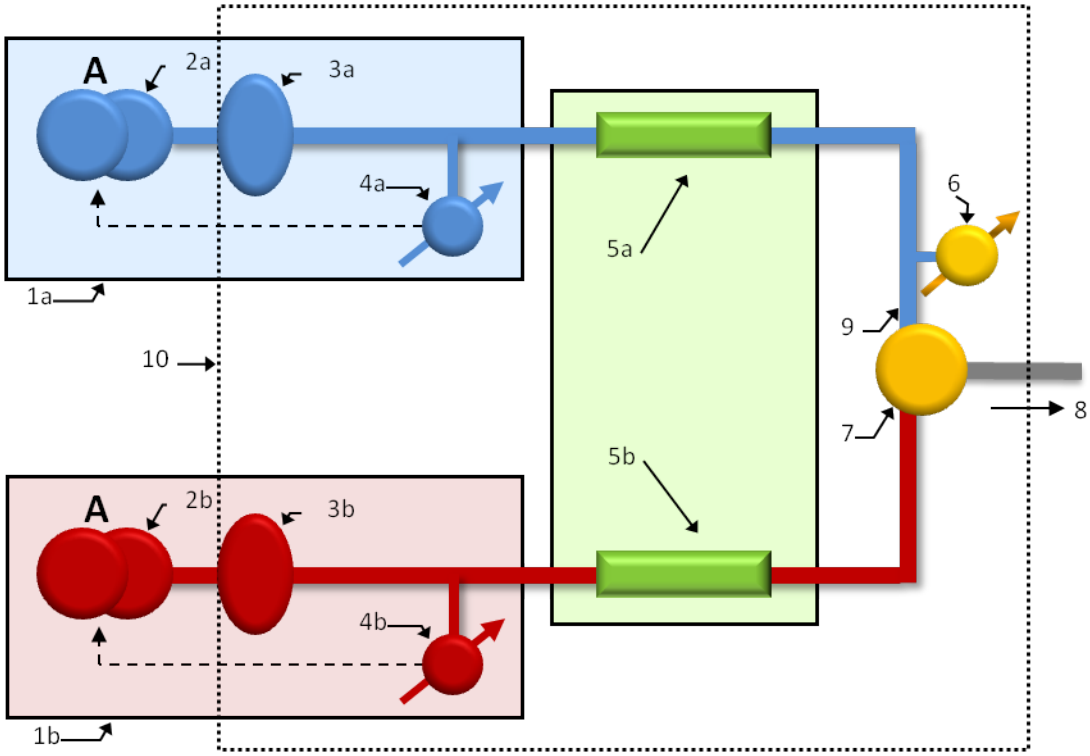


Fig. 54: Functional blocks of the NC pump with Classic flow meter

No.	Element
1a / 1b	Pressure-controlled pump, left (A) and right (B)
2a / 2b	Dual-piston pump, left / right
3a / 3b	Filter unit, left / right
4a / 4b	Primary pressure transducer, left / right
5a / 5b	Flow restrictor, left / right
6	Column pressure transducer
7	Y piece
8	Flow meter outlet, capillary connection to the other modules of the HPLC system
9	Capillary connecting the column pressure transducer to the Y piece
10	Flow meter module

Classic flow meter: Interdependency of column pressure and the maximum flow rate

The pump has been designed for column pressures of up to 80 MPa. This value refers to the nominal flow and solvents with a maximum viscosity of 100 % (equivalent to water). The primary pressures can be up to 100 MPa, but the flow restrictors cause a pressure drop that depends on the selected flow rate, the viscosity of the solvents, and the solvent composition.
Thus, the column pressure that is actually available depends also on these parameters.

The maximum allowed flow rate can be calculated from the expected column pressure P_{max} and the viscosity of the higher-viscosity solvent:

$$Flow_{max} = Nominal\ Flow \cdot \frac{100\%}{Viscosity} \cdot \frac{100MPa - P_{max}}{20\,MPa}$$

Example:

Nominal flow: 500 nL/min
Solvent A = water (viscosity: 100%)
Solvent B = 80% ACN with 20% water (viscosity: 65%)
Maximum expected column pressure: 65 MPa

Solvent B is the lower-viscosity solvent and thus can be ignored. This means:

$$Flow_{max} = 500nL/min \cdot \frac{100\%}{100\%} \cdot \frac{100MPa - 65MPa}{20MPa} = 875nL/min$$

The Ready Check checks whether the selected flow rate can be reliably delivered with the selected maximum column pressure (→ page 120). A message appears if this is not possible. If the upper limit for the column pressure is set to a value that is considerably higher than the actually expected column pressure, the message may appear although the problem does not yet exist. In this case, reduce the upper limit as required.

If you are really working at very high column pressures and the selected flow cannot be delivered, reducing the flow rate and pressure limit slightly will usually be sufficient to remedy the situation, as the maximum expected column pressure decreases with the flow rate.

During operation, the pump continuously monitors whether the selected flow rate is actually delivered. If it is not, a message appears ('Cannot deliver desired flow at this pressure') and the batch will be aborted. A number of factors, for example, the selected gradient, determine whether this situation will actually occur.

5.5.3 Adding Solvents to the Flow Meter Configuration

Relevant only for the NC pump

If the viscosity (Classic flow meters) or type (ProFlow flow meter) for the solvent that you are using is not yet available in Chromeleon, proceed as follows:

- With the ProFlow flow meter, perform a solvent calibration for the solvent to be defined in the flow meter and added in Chromeleon. See section 5.5.3.1 Performing a Solvent Calibration below.
- With Classic flow meters, perform a viscosity measurement for the solvent to be added in Chromeleon. See section 5.5.3.2 Performing a Solvent Viscosity Measurement on page 115.

5.5.3.1 Performing a Solvent Calibration (ProFlow Flow Meter)

Relevant only for NC pump with a ProFlow flow meter

If the type of the solvent that you are using is not yet defined in the flow meter (→ page 69), follow the steps below to calibrate the ProFlow flow meter for this solvent type and add the solvent type to the list in Chromeleon.

Note the following:

- For solvent calibration, the solvent shut off valves need to be installed.
- During solvent calibration, select the respective pump block channel (left/right) of the flow meter for which you want to calibrate the solvent. Solvent types are only available in the block channel for which they are calibrated.
- The solvent calibration coefficients are saved in the flow meter. The coefficients are individual and valid only for the specific flow meter and pump block channel that has been used for the calibration. It is not possible to transfer the calibration coefficients to another ProFlow flow meter or to a different block channel of the flow meter.

Tips: The steps below refer to Chromeleon 6.80.

In Chromeleon 7, perform the solvent calibration from the NC pump **Wellness** page of the ePanel set by clicking **Calibrate Solvent**. The further procedure is similar to the steps below. For more information, see the *Chromeleon Help*.

1. In Chromeleon, open a control panel and connect to the timebase in which the module is installed (→ page 89).

2. On the **Control** menu, select **Diagnostics**, and then select **Solvent Calibration.** A wizard guides you through the procedure. The procedure takes about 60 minutes.

   Tip: During solvent calibration, a nanoViper capillary needs to be connected to the flow meter outlet. A nanoViper capillary with an appropriate inner diameter (0.25 x 155 mm I.D. x L) is provided in the accessories kit of the module. Dispose of any liquid that appears at the free end of the capillary in an appropriate manner or absorb the liquid with a tissue.

3. Solvent calibration includes also diagnostics. Thus, the last wizard page can show the following results:

   - **Success**
     Solvent calibration has been successful. The calibration coefficients have been saved in the flow meter.
   - **Failed** or **Aborted**
     The solvent calibration has been failed or aborted. Follow the instructions provided by the wizard and repeat the procedure.

4. Complete the solvent calibration as instructed in the wizard.
   Make sure that you update the solvent or viscosity list in the device configuration by selecting the **Update** button on the **Flowmeter** page.

5.5.3.2 Performing a Solvent Viscosity Measurement (Classic Flow Meter)

Relevant only for NC pump with Classic flow meters

If the viscosity for the solvent that you are using is not yet known (→ page 69), follow the steps below to establish the viscosity and save the value in Chromeleon.

Tips: It is not possible to calculate the viscosity of premixed solvents from the viscosities and mixing ratio of the components. Therefore, follow the steps below to establish the viscosity.

The viscosity values are relative and refer to water at 42 °C.

The steps below refer to Chromeleon 6.80.

If you operate the module from Chromeleon 7.1 and later, establish the viscosity from the **NC_Pump_Diagnostics** page of the ePanel set by clicking **Run Viscosity Measurement**. The further procedure is similar to the steps below. For more information, see the *Chromeleon Help*.

1. In Chromeleon, open a control panel and connect to the timebase in which the module is installed (→ page 89).

2. On the **Control** menu, select **Diagnostics**, and then select **Viscosity Measurement**; as an alternative, on the tabset panel, in the **NC Pump** group, click **More Options**, and in the **Viscosity Measurement** group, click **Start**. A wizard guides you through the procedure. The procedure takes about 15 minutes.

   Tip: During viscosity measurement, a nanoViper capillary needs to be connected to the flow meter outlet. A nanoViper capillary with an appropriate inner diameter (0.25 x 155 mm I.D. x L) is provided in the accessories kit of the module. Dispose of any liquid that appears at the free end of the capillary in an appropriate manner or absorb the liquid with a tissue.

3. Viscosity Measurement includes also diagnostics. Thus, the last wizard page can show the following results:

   - **Passed**
     Viscosity measurement has been successful. Click **Apply** to save the viscosity to the pump. This value will be used until you save a new value or enter a different value in Chromeleon (for example, in the **Commands** dialog box or on the control panel for the module).
   - **Limited** or **Failed**
     The viscosity measurement has been passed only with limitations or failed. Follow the instructions provided by the wizard and repeat the procedure.

4. Write down the viscosity value if you want to use it later again (see further down) or if you want to add it to the viscosity list in Chromeleon (→ page 116).

Changing the viscosity value stored in the pump

If you change to a different solvent for which the viscosity has already been established as described earlier, follow the steps below to overwrite the value stored in the pump:

1. In Chromeleon, open the **Commands** dialog box for the NC pump (→ page 89).
2. Select **%A_Viscosity** (or **%B_Viscosity**) and type the value as a number in the input box. This value will be used until you establish and save a new value or enter a different value in Chromeleon.

Adding a viscosity value to the list in Chromeleon

If you change solvents frequently, you can add the viscosity to the viscosity list in Chromeleon:

1. Open the Properties dialog for the module in the Server Configuration program (→ page 53).
2. Click the **Viscosities** tab page.

3. Enter the name of the solvent and the viscosity. Note the tips further down in this section.

   - *To add a new entry*
     Click into the line marked by the asterisk (*) in the leftmost column and type the name and viscosity value in this line.
   - *To edit an entry*
     Click the entry that you want to edit and edit the entry as needed. Afterward, click another entry.

   Observe the following:

   - The solvent name can contain any of the following characters a-z, A-Z, 0-9, underscore ('_'), and percent (%).
   - The name must *not* start with a digit.
   - The name *must* be unique.
   - Avoid entries with different names but identical viscosities values. Combine these entries, instead (→ Fig. 55).

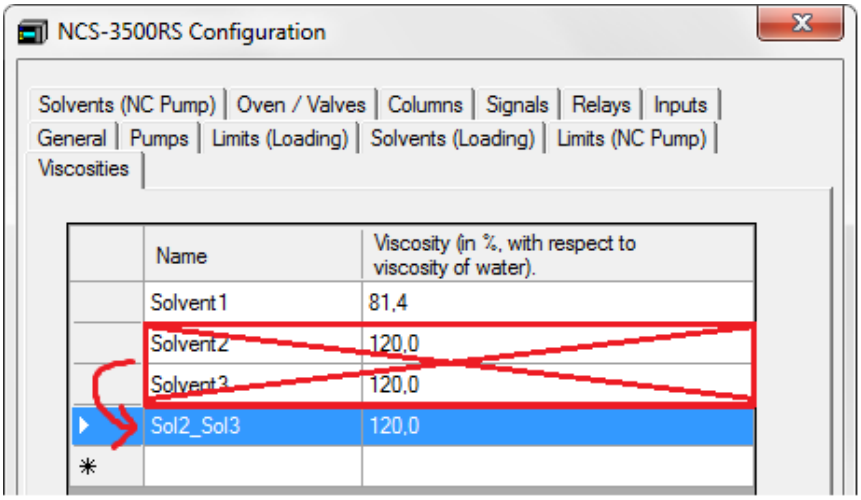


Fig. 55: Entering the viscosity

Chromeleon always uses the entry for a specific viscosity that appears first on the viscosity list (→ Fig. 56). Therefore, if more than one entry exists for a specific viscosity, the Chromeleon report may not show the name of the solvent that is actually used but the name of the solvent with the specified viscosity value found first on the viscosity list.

Example:
The viscosity list includes among others the following entries: **Solvent2__120_0%** and **Solvent3__120_0%**. The report will show **Solvent2_120_0%** as solvent name even if you have selected **Solvent3__120_0%** on the viscosity list.

- *To delete an entry*
  Select the entry that you want to delete. To do so, click in the leftmost column and press the **Del** key. A line can be deleted only if the entry has been correct.

4. Click **OK** to transfer the new entries and/or changes to the viscosity list in Chromeleon. Otherwise, click **Cancel** to cancel the action and discard the changes.

   The entries will now appear with the name and viscosity value, for example, in the **Commands** dialog box for the NC pump under **%A_Viscosity** and **%B_Viscosity** (for example, **Solvent1_81_4%**).

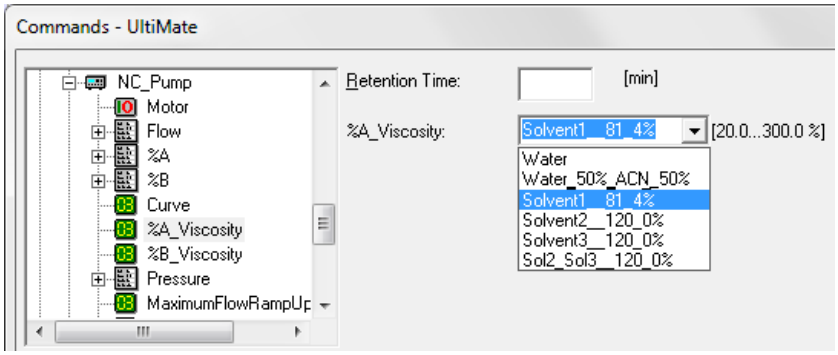


Fig. 56: Showing the viscosity

Observe the following:

- The viscosity list applies to *all* module instances that are installed on the same Chromeleon server.
- Changes and new entries appear only for the module for which you have made them on the **Viscosities** page in the Server Configuration program.
- To make the new entries and changes visible also for the other modules instances, you have to restart the Chromeleon server (→ page 43). As an alternative, restart the drivers for the other module instances. To do so, open the Properties dialog for the related module in the Server Configuration program and click **OK** on one of the tab pages.

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

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

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

Recommendation: Set these parameters to values between 1/3 and factor 3 of the (column) flow rate.

To set the flow rate, flow acceleration, and flow deceleration in Chromeleon

1. In Chromeleon, open the **Commands** dialog box for the pump (→ page 89).
2. Select **Flow** and enter the flow rate in the **Nominal** box.
   The allowed flow rate range is indicated in the Properties dialog for the module (→ page 48). In the Properties dialog box, you can change the upper and lower limit for the flow rate within the allowed range.
3. Under **MaximumFlowRampUp**, check and change the flow acceleration setting if necessary.
   Under **MaximumFlowRampDown**, check and change the flow deceleration setting if necessary.

To set the flow rate, flow acceleration, and flow deceleration on the pump display

1. Select the **Control** menu for the pump.
2. Select **Flow Rate** and enter the preferred value.
3. Select the **Preferences** menu.
4. Under **Flow Acceleration**, check and change the flow acceleration setting if necessary.
   Under **Flow Deceleration**, check and change the flow deceleration setting if necessary.

5.5.5 Setting the Pressure Limits

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

If the pump pressure is outside the specified limits, the related message appears on the pump display. If the module is operated from Chromeleon, the message is displayed also in the Chromeleon Audit Trail. In addition, Chromeleon stops the flow and aborts the batch. Check the Troubleshooting section for a short description of possible causes along with recommended courses of action (→ page 145).

- *Lower pressure limit*
  Helps to prevent the pump, and thus the column, from running dry. A typical setting is 1 MPa.
- *Upper pressure limit*
  Helps to protect the column from too high a pressure. The application and column type determine the setting.
  When setting the upper pressure limit for the NC pump, observe the information in section 5.5.2 (→ page 110).

To set the pressure limits in Chromeleon

A – Pressure range

The range within which the pressure limits can be set and the pressure unit are specified in the in the Properties dialog for the pump (→ page 48). You can set the upper and lower pressure limits only within the specified range.

B – To change the pressure limits for a specific application

1. Open the **Commands** dialog box for the pump (→ page 89).
2. Select **Pressure** and enter the new limits under **LowerLimit** and **UpperLimit**.

To set the pressure limits on the pump display

1. Select the **Control** menu for the pump.
2. Check and change the limits for **Max. pressure** and **Min. pressure** if necessary.

You can change the **Pressure unit** on the **Configuration** menu. When the module is operated from Chromeleon, the pressure unit specified in Chromeleon will be used.

5.5.6 Recording the Pump Signals

On the **Signals** page, the check box for the column pressure of the NC pump and the pressure of the loading pump are selected by default when the module is installed and configured in Chromeleon (→ page 51).

Depending on the flow meter that is installed, observe the following:

- Make sure that the corresponding signals for the flow meters (see table below) are selected to have these signal channels available for recording the pump flow (ProFlow flow meter only) or pump pressure (Classic flow meter only) in Chromeleon.
- *If you exchanged a flow meter type (for example from Classic to ProFlow)*
  Make sure that the signals for the other flow meter type are deactivated (see the example below).

When signals are selected, Chromeleon generates the appropriate channels for recording the signals. The channels are then available in the **Commands** dialog box for the pump. The channel name is generated from the entry in the **Pump Device Name** box on the **Pumps** page (→ page 48).

If a problem occurs, the signals can provide helpful information to identify and eliminate the source for the problem. Therefore, always record the signals of your module.

The signal ... (default name)	**Records the following signal ...**
NC_Pump_Pressure	Column pressure of the NC pump. Selected by default.
LoadingPump_Pressure	Pressure of the loading pump. Selected by default.
ProFlow flow meter only	If a ProFlow flow meter is installed, make sure that these signals are activated.
NC_Pump_Flow_LeftBlk	Flow rate of the left flow cannel (A) of the NC pump. The flow is measured in nL/min.
NC_Pump_Flow_RightBlk	Flow rate of the right flow cannel (B) of the NC pump. The flow is measured in nL/min.
NC_Pump_Flow	Total flow rate from the left and right flow channel flow rates (**NC_Pump_Flow_LeftBlk** and **NC_Pump_Flow_RightBlk**).
Classic flow meter only	If a Classic flow meter is installed, make sure that these signals are activated.
NC_Pump_Press_LeftBlk	The primary pressure of the left or right pump head of the NC pump. If the pressure is above 100 MPa, pumping stops.
NC_Pump_Press_RightBlk	

Example

If a you exchange a ProFlow flow meter with a Classic flow meter, make sure that the **NC_Pump_Flow**, **_LeftBlk** and **_RightBlk** signals are deactivated and the **NC_Pump_Press_LeftBlk** and **_RightBlk** signals for the Classic flow meter are activated on the **Signals** page.

5.5.7 Rear Seal Wash System

Rear seal washing helps avoiding damages to the pistons, piston seals, and support rings, and thus prolongs the seal lifetime. For information about how to set up the rear seal wash system, see page 67.

5.5.7.1 Working with Rear Seal Washing

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

1. Open the **Commands** dialog box for the pump module (→ page 89).
2. Select **RearSealWashPump**. If **RearSealWashPump** =
   Idle, select **Active** to start a wash cycle.
   Active, select **Idle** to stop the running wash cycle.

Observe the following:

- The seal wash solution is directed to waste through the UltiMate 3000 drain system. Therefore, verify that the drain line is properly connected. If it is not, any modules that are located below this module in the UltiMate 3000 system stack may suffer severe damage from the liquid leaving the drain port.
- Always use fresh rear seal wash solution.
- Observe the precautions for the composition of the seal wash solution (→ page 122).
- There will be a warning when the reservoir is empty ("Rear seal wash system has run out of wash solution"). Nevertheless, check the liquid level in the seal wash reservoir at regular intervals.
- Regularly check the volume in the waste container for the seal wash solution. Empty the waste container as needed.

5.5.7.2 Choosing the Seal Wash Solution

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

- Make sure that the liquid used for rear seal washing is miscible with the solvent. This is to avoid impairing the tightness of the pump.
- Make sure that the seal wash solution is compatible with the silicone tubing.
- For reliable detector performance, the seal wash solution must have certain conductivity. Standard HPLC-grade water with 10% methanol is appropriate. (Isopropanol should not be used as an additive.) To increase the conductivity, highly diluted acids can be used.
- If you have to use a liquid other than HPLC grade water due to the miscibility of the delivered solvent, you have to make the liquid slightly conductive by using the appropriate additives. Do not use additives with a high salt content or additives that cause solid residuals upon evaporation. Be sure that with this liquid drops are present in the detector.

5.5.7.3 What happens ….

Correct functioning of the rear seal wash system

During the delivery period of the peristaltic pump, liquid reaches the detector of the rear seal wash system. This means that the seal wash system performs correctly. The tubing is all right and the peristaltic pump works correctly.

Malfunctioning of the rear seal wash system

If no drops reach the detector after maximum five minutes although the peristaltic pump is pumping, this may indicate that the

- Seal wash reservoir is empty.
- Peristaltic tubing is blocked or crimped.
- The seal wash tubing (silicone tubing) is pinched.
- Detector of the system is dirty.

In all cases, the following message appears in the Chromeleon Audit Trail: "Rear seal wash system has run out of wash solution". If the rear seal liquid is not discharged properly to the waste, the following message may appear: "The rear seal leak sensor detects drops constantly".

Take the following remedial action:

- Check the seal wash reservoir level.
- Replace the peristaltic tubing.
- Verify that the liquid can pass the tubing properly. Replace the tubing if required.
- Clean the detector electrodes (→ page 181).

Tip: If the seal wash reservoir is empty, the **RearSealWashDry** property in Chromeleon (**Commands** dialog box) reports **Dry**. To start a batch or set the pump flow nevertheless, set **OverrideRearSealDry** to **Enabled**. However, note that the property will be automatically reset to **Disabled** after each wash cycle.

Possible leakage of the main piston seal

If the message "Piston seal leakage has exceeded the recommended limit" appears, this indicates possible leakage of the main piston seals.

Take the following remedial action:

- Inspect the piston seals for leakage (→ page 186).
- Replace the piston seals (→ page 194).

5.5.8 Purging the Pumps

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

If you observe shifts in retention time for a longer period with the NC pump, the reason may be that you have changed solvents. When the previous solvent has not been removed completely from the pump, shifts in retention time may be observed for a long time.

In these cases, purge the pumps as described in section 4.5.3 (→ page 72).

5.5.9 Detecting Liquid Leaks in the Pump Module

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

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

When the leak sensor reports a leak,

- Locate the source for the leak, eliminate the cause, and dry the leak sensor (→ page 177).
- You can disable the alarm temporarily.
  To do so, open the **Commands** dialog box for the pump and perform the **AlarmOff** command.
  This also turns off the beep and allows you to restart the pump flow.
  If the leak sensor does not report Leak = NoLeak within 30 minutes after you have restarted the flow, another leak alarm will be issued and the pump flow will be stopped again.

You may disable leak detection permanently. (However, it is *not* recommended to do so.) To do so, select one of the following alternatives:

- In Chromeleon, open the **Commands** dialog box for the pump module and set **LeakSensorMode** to **Disabled**.
- On the pump display, select the **Configuration** menu (→ page 103) and set **Leak Sensor Mode** to **Disabled**.

5.5.10 Adjusting the Screen Brightness or Contrast

You can adjust the screen brightness or screen contrast to your requirements from Chromeleon or on the pump display. To do so, select one of the following alternatives:

- In Chromeleon, open the **Commands** dialog box for the pump module. Change the screen brightness under **Brightness** and/or the screen contrast under **Contrast**.
- On the pump display, select the **Configuration** menu (→ page 103) and select **Display & Soft Keys**. Change the screen brightness under **Brightness** and/or the screen contrast under **Contrast**.

5.5.11 Operating the Degasser of a SRD-3x00 Solvent Rack

If a SRD-3x00 Solvent Rack is connected to the module, you can operate the degasser of the solvent rack from the pump module. If the SRD is connected to the module and the module is powered up, the SRD is powered from the module. The degasser is ready for operation.

To turn the degasser on and off from the pump display

Select the **Preferences** menu (→ page 102) and set **Degasser** to **On** or **Off**.

To turn the degasser on and off from Chromeleon

1. In the **Server Configuration** program, open the **Properties** dialog for the module (→ page 53).
2. On the **Pumps** page, verify that **Degasser Control** is set to **External** (→ page 47).
3. Open the **Commands** dialog box for the pump module and set **Degasser** to **On** or **Off**.

   —or—

   Open the **Tabset Panel** for the module (→ page 90) and click **More Options** (the button on the utmost left under Commands). In the **Degasser** group, set **Mode** to **On** or **Off**.

When the degasser is operated in Chromeleon, monitoring of the degasser vacuum and leak detection is performed from the module. The related commands and properties are available in the **Commands** dialog box for the pump module.

Chromeleon Property	Description
DegasserVacuum	Reports whether the degasser has reached the operating vacuum.
SolventRackLeak	Reports whether the leak sensor in the SRD detected a leak.

General Guidelines for Degasser Operation

- Thermo Fisher Scientific recommends always leaving the degasser on while the pump is on.
- Turning off the module to which the SRD is connected also turns off the SRD. The same applies to Standby mode.
- Also, observe the information about the solvent compatibility of the degasser (→ page 108).
- In addition, observe the general information about how to operate the degasser (→ *Solvent Rack manual*).

5.6 Information for Operating the Column Compartment

This section provides specific information about settings and functions that should be considered for operating the column compartment:

To learn more about ...	See page ...
Turning on temperature control	See below.
Activating column identification (column ID)	129
Adjusting the sensitivity of the gas and humidity sensors	130
Recording the temperature signal	131
Adjusting the Screen Brightness or Contrast	131

Section 5.5 (→ page 107) provides information that should be considered for operating the pump module. For information about special Chromeleon functions, see section 5.7 (→ page 132).

5.6.1 Turning On Temperature Control

You can turn temperature control on and off and set the target temperature in Chromeleon and on the column compartment display.

Tip: The column compartment has no active cooling system and thus, the temperature in the compartment cannot be reduced below a temperature resulting from the ambient temperature and self-heating of the module. Therefore, the temperature set point must be at least 7 °C higher than the ambient temperature.

If the temperature set point is too low, the column compartment may not become ready for the next injection (in this case, the Ready property continues to indicate NotReady).

To turn temperature control on in Chromeleon

1. In Chromeleon, open the **Commands** dialog box for the column compartment.
2. Select **ColumnOven**.

3. Select **Temperature** and **Nominal**, and then enter the temperature. Temperature control becomes active and **TempCtrl** is automatically set to **On**.

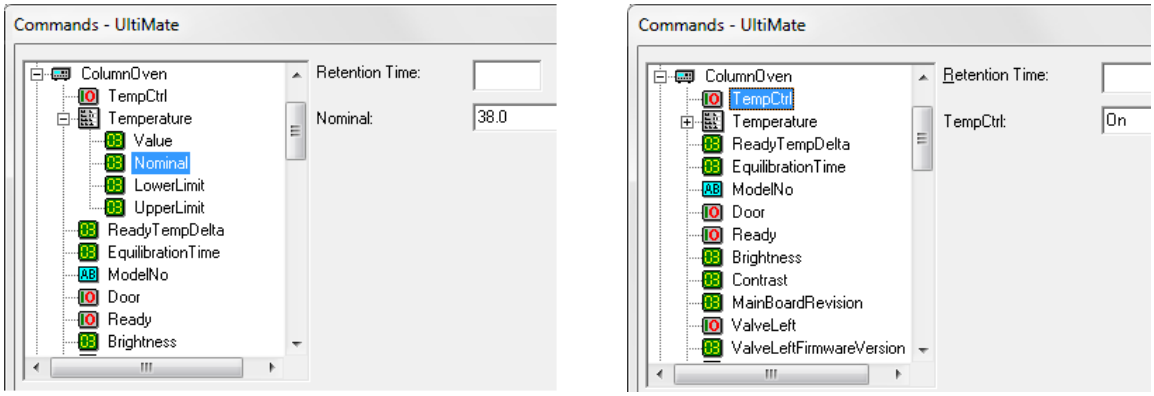


Fig. 57: Turning on temperature control

Set **TempCtrl** to **Off** if you do not want to use temperature control for a certain application.

If you want to use temperature control later again, set **TempCtrl** to **On**. When you change the temperature setting under **Nominal**, Chromeleon sets **TempCtrl** automatically to **On**.

To turn on temperature control on the display (column compartment)

1. Show the function keys and select **Temp** or select the **Control** menu.
2. Select **Temperature** and enter the temperature. Temperature control becomes active and Temperature Control is automatically set to On.

Set **Temperature Control** to **Off** if you do not want to use temperature control.

Set **Temperature Control** to **On** again if you want to use temperature control later again. When you change the temperature setting under **Temperature**, **Temperature Control** is automatically set to **On**.

5.6.2 Activating Column Identification (Column ID)

1. Verify that the column ID chip card is attached to the column (→ page 81).
2. Insert the chip card, with the chip facing down, into one of the four chip card readers (A - D). (The chip card reader at the utmost left is the reader for column A; the chip card reader at the utmost right is the reader for column D.) Four chip cards can be used at the same time. When the chip card is installed correctly, the LED next to the chip card reader is green.

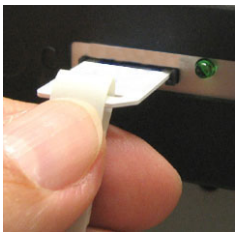


Fig. 58: Inserting a column ID chip card in a chip card reader

3. In the Chromeleon **Server Configuration** program, verify in the **Properties** dialog for the NCS-3500RS that the columns to be monitored are selected by the check box (→ page 51). If a column check box is cleared, no information will be available for the column in Chromeleon.
4. The information on the column ID chip card (see further down) is continuously updated and can be reviewed at any time in Chromeleon (for example, in the **Commands** dialog box for the column oven under **Column_A** (**B**, **C**, or **D**), as long as the column and chip card are installed in the column compartment.

Column Properties

The chip card provides the following types of information:

- **Primary column properties**

  The primary column properties are used for column identification. The information is entered once by the column manufacturer or user and will not be changed during the lifetime of the column. The primary column properties are, for example, the batch number, product ID, serial number, and the date of manufacture.

- **Secondary column properties**

  Secondary properties are entered by the user and can be changed whenever required. The secondary column properties are, for example, the manufacturer and the packing material and particle size of the column, but also temperature, pressure, and pH limits.

- **Operational column properties**
  Chromeleon determines and updates the operational information upon each injection. The operational column properties are, for example, the date of the first injection, the date of the last injection, the maximum flow rate while the column is in use, or the total volume of sample that has been injected onto the column. Operational column properties are read-only.

For a complete list of column properties and for more information about the column identification system, see the *Chromeleon Help*.

5.6.3 Adjusting the Sensitivity of the Gas and Humidity Sensors

You can adjust the sensitivity of the gas or humidity sensor in Chromeleon or on the column compartment display.

To adjust the sensitivity from Chromeleon

1. In Chromeleon, open the **Commands** dialog box for the column compartment.
2. Select **GasLeakSensor** or select **HumidityLeakSensor** and set the sensor sensitivity:
   Select **Low**, **Standard**, or **High**. When the sensor is activated
   - The **Status** LED on the front panel door is red.
   - A message appears in Chromeleon and on the pump display.

   Select **Off** to deactivate leak detection.
3. Select **Leak Alarm Mode** and **Audible** to have a beep alert you in addition to the message you when the sensor is activated. Select **Silent** if no beep shall alert you.

To adjust the sensitivity on the display (column compartment)

1. Select the **Configuration** menu.
2. Select **Gas Leak Mode** or **Humidity Leak Mode**.
3. Select **Low**, **Standard**, or **High** (see further up in this section). To deactivate leak detection, select **Off**.
4. Select **Leak Alarm Mode** and **Audible** to have a beep alert you in addition to the message you when the sensor is activated. Select **Silent** if no beep shall alert you.

5.6.4 Recording the Temperature Signal

On the **Oven / Valves** page, the check box for the temperature channel is selected by default when the NCS-3500RS is installed and configured in Chromeleon (→ page 50). With this setting, Chromeleon generates the **ColumnOven_Temp** channel for recording the temperature signal.

Thermo Fisher Scientific recommends recording the temperature signal in a program. If a problem occurs, the temperature signal channel can provide helpful information to identify and eliminate the problem.

5.6.5 Adjusting the Screen Brightness or Contrast

You can adjust the screen brightness or screen contrast to your requirements from Chromeleon or on the column compartment display. To do so, select one of the following alternatives:

- In Chromeleon, open the **Commands** dialog box for the column compartment. Change the screen brightness under **Brightness** and/or the screen contrast under **Contrast**.
- On the column compartment display, select the **Configuration** menu (→ page 106) and then select **Display & Soft Keys**. Change the screen brightness under **Brightness** and/or the screen contrast under **Contrast**.

5.7 Special Functions in Chromeleon

This section provides a brief overview of some special functions that Chromeleon supports for the module.

To learn more about ...	See page
Predictive performance	See below.
Diagnostics tests	134
Equilibration Time and Ready Temp Delta	136
Using the digital inputs and outputs	137
Operational Qualification and Performance Qualification	137

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

5.7.1 Predictive Performance

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

Open the **Commands** dialog box (→ page 89) and enter the limits for the predictive performance parameters. The predictive performance counters and commands for the components of the module are grouped in Wellness sections (for example, PumpModule_Wellness, LoadingPump_Wellness, and ColumnOven_Wellness).

To keep the predictive performance information up-to-date, perform the following commands (→ table).

Module	After you have …	Perform the following command …
Pump module	Replaced the peristaltic tubing	RearSealWashTubeChanged
Pump module	Serviced the instrument (for example, annual maintenance)	ServiceDone
Pump module	Performed qualification	QualificationDone
Loading pump	Replaced the valve cartridges	CheckValveServiceDone
Loading pump	Replaced the filter frit in the inline filter	MixerFritChanged
Loading pump	Replaced a piston	PistonsChanged
Loading pump	Replaced the main piston seal	SealChanged
Loading pump	Replaced a support ring	SupportRingChanged

Module	After you have …	Perform the following command …
Loading pump	Replaced the entire pump head assembly	CheckValveServiceDone, PistonsChanged, SealChanged, SupportRingChanged
Column compartment	Replaced the rotor seal of the left valve	LeftRotorSealChanged
Column compartment	Replaced the rotor seal of the right valve	RightRotorSealChanged
Column compartment	Replaced the left valve	LeftValveChanged
Column compartment	Replaced the right valve	RightValveChanged
Column compartment	Serviced the instrument (for example, annual maintenance)	ServiceDone
Column compartment	Performed qualification	QualificationDone

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

For a list of the commands and counters that are supported for the module, see the *Chromeleon Help*.

Control Panel

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

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

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

5.7.2 Diagnostics

Chromeleon supports diagnostics functions for checking the performance of certain module components. To perform the tests, the diagnostics toolkit (part no. 6040.3099) is required. The kit includes all materials required for performing the tests.

Tip: The diagnostics functions in Chromeleon provide helpful information in case of problems. The pump flow needs to be interrupted during diagnostics, and thus it may take some runs afterward to reach the optimally stable operating conditions again. Therefore, as long as the system operates properly, you should not perform diagnostics between or shortly before running sample series.

1. On the **Control** menu, select **Diagnostics**. The **Control** menu is visible only when a control panel is open.
2. The **Diagnostics** dialog box lists all tests that are available for the devices in the current timebase. Select a test. A wizard guides you through the test. For more information about a test, see the *Chromeleon Help*.

Pump	To check the …	Run the …
Loading pump	Degasser vacuum in a SRD-3x00 Solvent Rack that is operated from the pump.	Degasser Vacuum Test
Loading pump	Loading pump system (especially the fitting connections) for leakage	General Leak Test*
Loading pump	Valves and seals for leakage. The test provides information about the source for the leak.	Detailed Leak Test*
Loading pump	Pressure pulsation and compressibility compensation.	Performance Test
Loading pump	The permeability of the filter frit in the inline filter.	Mixer Frit Test
NC pump	*Only NC pump with Classic flow meter installed* The pressure transducer offset if you observe a shift in peaks or if the gradients are not correct. Also observe the information about the Pressure Transducer Test on page 172. *Recommendation*: If you want to test the NC pump for tightness by running the Detailed Leak Test, run the Pressure Transducer Test *first*.	Pressure Transducer Test

Pump	To check the …	Run the …
NC pump	The NC pump for leakage (capillary connections, flow meter, pump heads). **Additional Recommendations** *Recommended for NC pumps with Classic flow meter installed:* In addition to the Detailed Leak Test also run the Pressure Transducer Test and Viscosity Measurement in the given order: 1. Pressure Transducer Test 2. Detailed Leak Test 3. Viscosity Measurement *Recommended for NC pumps with ProFlow flow meter installed:* In addition, perform the Zero Balance Test in the given order: 1. Zero Balance Test 2. Detailed Leak Test	Detailed Leak Test
NC pump	*Only NC pump with Classic flow meter installed* The operating ability of the pump and the flow rate accuracy and/or determine the viscosity for the solvents used with the NC pump (→ page 114).	Viscosity Measurement
NC pump	*Only NC pump with ProFlow flow meter installed* The zero balance of the flow sensors and set them to zero if required. See section 6.6.1, page 172. *Recommendation*: If you want to test the NC pump for tightness by running the Detailed Leak Test, run the Zero Balance Test *first*.	Zero Balance Test
NC pump	*Only NC pump with ProFlow flow meter installed* To be used only for configuring new solvents for the flow meter (→ page 114).	Solvent Calibration

* Before running these tests, be sure that the StaticMixer property for the loading pump is set to the correct value (= InlineFilter_10µL). If it is not, the leak tests may not provide reliable results.

If a test fails, check the Chromeleon Diagnostics Messages section for a short description of possible causes along with recommended courses of action (→ page 160).

5.7.3 Ready Temp Delta and Equilibration Time

The **Ready** property indicates whether the column compartment is ready for operation. When the column compartment is in the status **NotReady**, you cannot start the analysis.

Keep in mind that the settings for Ready Temp Delta and Equilibration Time influence the time that the column compartment needs to enter the Ready state:

Setting	Description
ReadyTempDelta	Indicates for how much degrees the current temperature may be above or below the temperature set point. If the current temperature deviates from the temperature set point by more degrees than the value entered here, the column compartment enters the NotReady state and is *not* ready for operation. *Example:* Temperature set point: 45 °C, ReadyTempDelta: 1 °C. The column compartment is ready for operation when the current temperature is between 44 °C and 46 °C. If the current temperature is outside this range, the column compartment enters the NotReady state. If ReadyTempDelta is set to **None**, Chromeleon does not check whether the current temperature deviates from the temperature set point.
Equilibration Time	Indicates for how long the preferred temperature must be in the range specified by the temperature set point and the setting for ReadyTempDelta before the column compartment is ready for operation and the analysis can be started. *Example:* Temperature set point: 45 °C, ReadyTempDelta: 1 °C, EquilibrationTime: 0.5 min The column compartment is ready for operation when the current temperature is between 44 °C and 46 °C *and* has remained in this range for 0.5 minutes. If EquilibrationTime is set to **None**, Chromeleon does not check how long the current temperature remains in the specified range.

The picture illustrates the scenario:

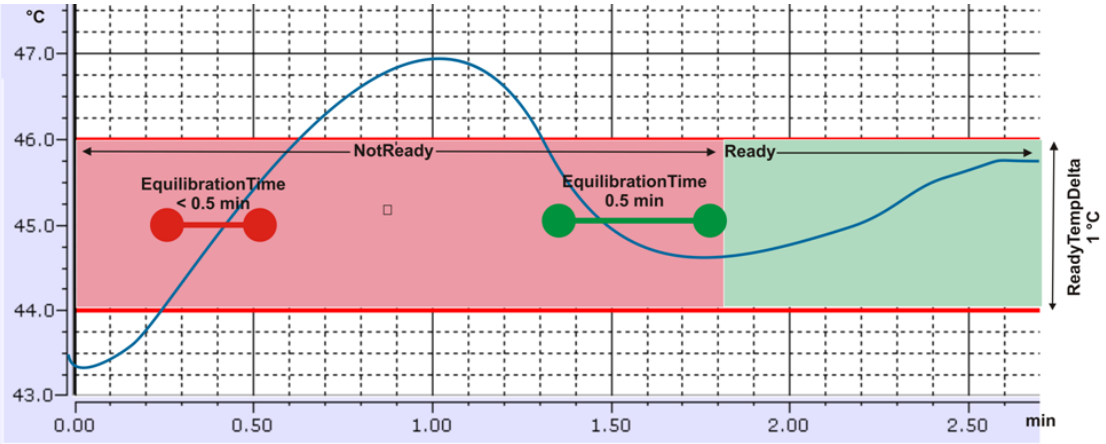


Fig. 59: Interdependencies between ReadyTempDelta, EquilibrationTime, and Ready

Observe the following:

- The smaller the value is for **ReadyTempDelta** and the higher the value is for **EquilibrationTime**, the longer is takes until the column compartment is ready for operation and you can start the data acquisition and/or the analysis.
- Environmental conditions, such as draft or air conditioning, may also extend the waiting period or even prevent the column compartment from entering the Ready state.

5.7.4 Using the Digital Inputs and Outputs (Digital I/O)

Before you begin, verify that

- The device you want to control is connected to the digital I/O port on the rear panel of the module (→ page 42) and that the appropriate signal cable (6-pin Mini-DIN, part no. 6000.1004) is used for the connection.
- The relay outputs and digital inputs you want to use are selected in the Properties dialog for the module (→ page 52).

When these conditions are fulfilled, the relay outputs and digital inputs are available in Chromeleon, for example, in the **Commands** dialog box under **PumpModule**, and can be programmed as required. For information about the functions of the connector pins and pin assignment, see page 255.

5.7.5 Operational Qualification and Performance Qualification

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

5.8 Recommendations for Optimally Running Systems (Best Practice)

The best stability with any chromatographic system is achieved when running the system uninterruptedly.

This is true also for the NC pump that uses extremely precise pressure transducers or thermal flow sensors to control the flow rate and gradients. The best stability is reached when the pressure transducers or thermal flow sensors are always used in the same operating range, as is the case, for example, with gradient runs.

If a Classic flow meter is installed, note the following: When the pump flow has been interrupted or when the pressure has been down to zero, a certain time of operation will be required until the pump has reached full stability again.

However, over time, such sensors can have a small drift. Over time, the drift can change the zero point of the sensors, and thus can cause retention time shifts. With the following tests, you can check and correct the zero points of the sensors:

- If a Classic flow meter is installed, you can check and correct the offset of the pressure transducers if required. To do so, run the **Pressure Transducer Test** (→ page 172).
- If a ProFlow flow meter is installed, you can check and adjust the zero balance of the flow sensors, if required. To do so, run the **Zero Balance Test** (→ page 172).

A drift or shift in retention times can also have other reasons that are not connected to the sensors. For example, you may observe also a drift or shift in retention times when you use pre-mixed solvents. If pre-mixed solvents are not refreshed for a long time, the solvent composition can change due to evaporation of volatile solvent components (for example, ACN, (T)FA)).

Observe the following recommendations:

1. As long as the system provides stable retention times in the expected range, you should *not* interrupt operation unnecessarily by measuring the viscosity, re-calibrating the pressure transducers or flow sensors, or purging the module.
2. For ultimate reproducibility, run the system continuously. For example, use blank runs if the system is not in use for sample analysis. As an alternative, you can run the system at the same flow rate and 50 % of solvent channel B. With nano LC, it is generally not recommended to reduce the flow rate or run the pump at low %B concentrations for a long period of time.

3. If the module was powered off by the power switch for a longer period (≥ 1 day), allow a warm-up period of 1 hour (if a ProFlow flow meter is installed) or 24 hours (if a Classic flow meter is installed) to achieve optimum reproducibility. You can shorten the warm-up period if you set the module to standby mode instead of powering it off completely.

   - If a Classic flow meter is installed, you can shorten the warm-up period to 1 to 2 hours.
   - If a ProFlow flow meter is installed, you can shorten the warm-up period to 15 minutes.

4. Solvents will last several weeks. Replace solvents every 2-4 weeks to avoid large solvent composition changes or bacterial growth. Replace solvents rather than add up and time the replacements to fit in between sample sets.

5. Particularly when using pre-mixed solvents, make sure that the solvents are always fresh and that they have been properly prepared. After preparation, degas the solvents by ultrasonication to remove the excess air that could have introduced from the mixing.

6. *Before* running any calibration routines, perform a purge cycle (→ page 72) to ensure that the pump is properly primed.

7. Flow meter settings:

   - For Classic flow meters:

     Run a viscosity measurement to determine and set the viscosity of *unknown* solvents or solvent mixture (→ section 5.5.3.2, page 115). With *known* solvents, select the known solvent viscosities from the viscosity list (→ section 4.5.2, page 69) rather than repeating the test.

     Viscosity Measurement functions also as a diagnostics test, providing a **Passed**, **Limited**, or **Failed** result. With **Limited** or **Failed**, follow the instructions provided by the wizard and repeat the test.

   - For ProFlow flow meters:

     Run a solvent calibration to calibrate the flow meter for *unknown* solvents (→ section 5.5.3.1, page 114). With *known* solvents, select the known solvent type from the flow meter solvent type list (→ section 4.5.2, page 69) rather than repeating the calibration procedure.

5.9 Shutting Down the Module

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

Tip: Observe the information on this in point 3 in section 5.8 (→ page 138) when resuming module operation.

- For longer periods of inactivity or if saliferous buffers are used, rinse the fluid lines with MS-grade water. This avoids salt crystallization, which may impair the instrument performance.

- If operation is interrupted for a longer period, make sure that neither the module nor the solvent supply lines or solvent reservoirs contain pure water. Use an appropriate additive, for example, 0.1% formic acid, to prevent the growth of algae.

- For longer periods of inactivity (more than one week) or when shipping the module, no water must remain in the fluid passages. This is, for example, to avoid failure of the sealing surfaces of the column switching valve when the temperature falls below 0 °C.

  Rinse out any solvents from the module and fill the pump with methanol or a similar alcohol, such as isopropanol or ethanol. If the solvents in the pump are not miscible with water, use an appropriate intermediate solvent.

  If a buffer is used as a part of the mobile phase, flush the system with several volumes of methanol/water (50:50) before it is shut down. This is to prevent salt buildup inside the unit.

- If pump operation is interrupted for more than 5 days, remove the PharMed tubing from the peristaltic pump. To remove the tubing, slightly press the lever to the right, remove the tubing, and release the lever. This will avoid that the tubing remains compressed and does not relax, thus blocking the wash solution.

- Rinse out buffers or solvents that form peroxides.

- If the pump flow is interrupted for longer periods (> 1 hour), you have to turn off the lamps in any UV or RF detector connected to the module to prevent evaporation in the flow cell.

- If you want to ship or move the module to a new location, no liquid must remain in the waste line of the rear seal wash system.

  The waste line is routed on the module bottom to the drain port at the bottom right of the module. If necessary, lift and tilt the module from the left side of the enclosure and wait until no more liquid leaves the waste line.

- Ship the NCS-3500RS always *without* valves. To protect the valve drives, reinstall the foam inserts that were installed upon shipment of the NCS.

- Ship the module only in the original shipping container and observe the packing instructions.

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

  Shipping the module in any other packaging automatically voids the warranty.

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

Standby Program

A standby program sets the HPLC system into standby mode. The main program steps are:

- At the end of the program, the program automatically reduces the flow.
- The program reduces temperature of all temperature-controlled modules in the system.

From the standby mode, you can reactivate the application very quickly.

Shutdown Program

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

- At the end of the program, the program automatically reduces the flow.
- The program turns off certain system components and functions (for example, detector lamps, temperature control).

To create a standby or shutdown program

Select one of the following alternatives:

- Select and perform the operating commands and parameters from the **Commands** dialog box (→ page 89).
- Create and run a corresponding program to automate the process (→ page 92).

5.10 Maintenance, and Maintenance and Calibration Intervals

5.10.1 General Information

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

- *Internal Maintenance*

  Every six weeks, the loading pump automatically performs an internal maintenance procedure when you initiate a purge cycle. While internal maintenance is running, the purge valve must remain open. When internal maintenance is complete, the purge cycle starts automatically.

  If no purge cycle is initiated after another 6 weeks, a message appears in the Chromeleon Audit Trail, reminding you to start a purge cycle.

- *NC pump*

  When the fluid components of the NC pump are filled with liquid and the solvent reservoirs are located above the pump outlet during pump operation, the hydrostatic pressure in the system may cause eluent to escape when you open a fluid connection in the NC pump. *Before* you open a fluid connection, position the reservoirs below the connection to be opened. Empty the solvents lines. If solvent shut off valves are installed on the solvent lines, you can close the shut off valves instead.

- *Predictive Performance and Diagnostics*

  Chromeleon supports functions for estimating the lifetime of consumables and diagnostic tests to check the performance of certain module components (→ pages 132 and 134).

5.10.2 Maintenance Intervals

To ensure optimum performance and maximum uptime of the module, perform the maintenance procedures listed in the table at regular intervals. The exact maintenance schedule depends on a number of factors.

Frequency	What you should do...
Daily	Before you start operating the pump, inspect the fluid lines for air bubbles and degas the solvent. Degas the solvent.
	Check the fluid lines for indications of leakage.
	Check the fluid connections for indications of salt deposits.
	If the eluent is pure water, replace the eluent in the reservoir on a daily basis.
	Check the liquid level in the seal wash reservoir.
	Regularly check the liquid level in the waste containers for the drain liquid and seal wash solution. Empty the containers as needed.
	When using buffer solutions, flush the system thoroughly after use. Use a solvent that does not contain buffers or salts.
Regularly	Inspect the tubing for indications of damage, such as cracks, nicks, cuts, or blockage.
	Fill the seal wash reservoir, by using fresh liquid. Observe the precautions for the composition of the seal wash solution on (→ page 122). When using buffer solutions, inspect the pump for leakage at least once a month (→ page 186).
	Check the filter frits in the solvent supply line filters for permeability. Replace the filter frits in regular intervals. This is especially important with aqueous solvents. Aqueous solvents may contaminate the filters with algae and other microorganisms that deposit on the filter frits. Therefore, use fresh the solvents at regular intervals. Rinse the reservoirs thoroughly before filling them.
	Drain tubing is connected to the drain ports on the bottom right of the module. Verify that the tubes are unclogged and routed below the drain ports. Empty the waste container as needed.
	Inspect the electrodes of the seal wash detector for contamination. Clean the detector electrodes if required (→ page 181). *Classic flow meters:* Calibrate the pressure transducers if required (→ page 172). *ProFlow flow meters:* Perform a zero balance of the flow sensors if required (→ page 172). Check the permeability of the filter frit in the inline filter of the loading pump (→ page 208).
	Clean the column chamber, by using a lint-free cloth. Use paper to absorb any humidity in the column chamber. The cleaner the column chamber is, the better the sensors are at detecting excessive gas or humidity. Inspect the seal installed in the front panel door. A defective door seal impairs the performance of the column compartment. If the seal is defective, contact Thermo Fisher Scientific Service for Dionex HPLC Products.

Frequency	What you should do...
Annually	*Recommended:* Have authorized Service personnel perform preventive maintenance once a year.

5.10.3 Calibration Intervals

Relevant only for the NC pump

The main reason for performing calibration is to correct shifts in retention time that may develop over time. The NC pump uses extremely precise pressure transducers or thermal flow sensors to control the flow rate and the gradients. Over time, such sensors can have a small drift. When the drift is large enough, a small shift in retention times can be observed.

This does not mean that the instrument is broken. However, mind the following for the pressure transducers and thermal flow sensors:

- If a Classic flow meter is installed, you should check and correct the offset of the pressure transducers if required. To do so, run the **Pressure Transducer Test** (→ page 172).
- If a ProFlow flow meter is installed, you should check and adjust the zero balance of the flow sensors, if required. To do so, run the **Zero Balance Test** (→ page 172).

As long as the retention times are stable and in the expected range, you should *not* interrupt pump operation by recalibrating the pressure transducers or thermal flow sensors.

6 Troubleshooting

6.1 Overview

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

- **Status LEDs**

  - The status LEDs (light emitting diodes) on the front panel provide a quick visual check of the operational status of the module. They indicate whether the module is turned on, connected in Chromeleon, and operating properly (→ page 22).
  - The status LED that is located on the interior front panel above the pump head of the loading pump indicates the operational status of the pump block (→ page 146).

- **Messages**

  If a fault or error is detected during the operation of the module, a message appears on the pump display. For information about the possible causes along with recommended courses of action, see page 147 and the following pages. If the module is operated by Chromeleon, a message is also displayed in the Chromeleon Audit Trail.

  Tip: For information about operating problems that might occur during the operation of an UltiMate 3000 system, see Operating Problems (→ page 163).

- **Diagnostics Tests**

  If the module is connected in Chromeleon, Chromeleon provides several diagnostic tests allowing you to check the performance of certain module components (→ page 134). If a test fails, the diagnostics panel and/or the Chromeleon Diagnostics Messages section provide a short description of possible causes along with recommended courses of action (→ page 160).

If you are unable to eliminate a problem following the instructions given here, contact Thermo Fisher Scientific Service for Dionex HPLC Products.

6.2 Pump Block Status Indicator (Loading Pump)

The status LED that is located on the interior front panel above the pump head of the loading pump indicates the operational status of the pump block (→ Fig. 91, page 226):

LED	Operational Status
The LED is dark.	The pump head is not delivering (no flow).
The LED is green.	The pump head is delivering.
The LED flashes green:	
In normal operation	In addition, the message 'Compression limit reached' appears in the Chromeleon Audit Trail. The compression value was 100% during each of the past three strokes. If the compression value is lower than 100% for several strokes afterward, the message 'Compression back to normal' will appear in the Audit Trail. For more information about the compression values, see section 6.7 (→ page 174).
During pump maintenance	The pistons are in the appropriate position for piston (seal) replacement.
The LED flashes red.	The pistons are *not* in the appropriate position for normal operation (for example, after piston (seal) replacement) or an error occurred during internal maintenance (→ page 142). In both cases, the following message appears on the pump display "Undock err., open purge valve". A similar message appears in the Chromeleon Audit Trail. To resolve the problem: 1. Open the purge valve. 2. Perform the **Dock Pistons** command. 3. Close the purge valve.

6.3 Messages on the Pump Display

Each time a fault or error occurs during the operation of the module, the **Status** LED on the front panel door changes to red and one or more messages appear on the pump display. In this case, the **Prev**, **Next**, and **Clear** keys appear on the navigation bar.

To …	Select …
Return to the previous message.	Prev
Proceed to the next message.	Next
Remove a message from the pump display.	Clear

These keys are active also when the module is connected in Chromeleon.

When the module is connected in Chromeleon

- The error is also displayed in the Chromeleon Audit Trail. The Audit Trail may also provide additional information.
- Messages on the pump display can be removed also by performing the **ClearDisplayError** command in Chromeleon.

The table lists module-related messages along with appropriate remedial actions. The component to which the message relates may appear in front of the message text. In addition to the messages listed in the table, other messages may appear. If you cannot eliminate the problem, note the exact wording of the message. Contact Thermo Fisher Scientific Service for Dionex HPLC Products.

Message	Remedial Action
(x) autozero flow failed. Drift was too high.	*(where x specifies if left or right flow sensor)* Wait until the module is equilibrated and repeat the autozero.
(x) counts deviation in zero position	*(where x is the exact deviation from the zero position.)* Turn the module off and on again by pressing the power switch on the rear of the module. If the message appears more often, contact Service.
Air in system. Please purge the flow meter.	During solvent calibration with the ProFlow flow meter, air bubbles were detected in the flow path. Purge the pump (→ page 72).
All flows need to be stopped before servicing the pistons.	You tried to move the pistons of the loading pump into the position for piston or piston seal replacement although the flow rate was not yet down to zero. Set the pump flow rate to 0. Wait until the system pressure is down to zero.

Message	Remedial Action
Calibration procedure failed. Cannot build up and hold pressure.	The message appears when you performed the **CalibrateWP** command from Chromeleon and calibration failed. Possible causes are: - The purge valves are open. Close the valves. - Check that the fitting plug is installed correctly. - There may be a leak in the system. Find and eliminate the source for the leak and tighten leaking connections if necessary. Afterward, perform the command again.
Can't do this when the flow is on.	You tried to perform a self test for the pump although the flow rate was not yet down to zero. Set the pump flow rate to 0 and repeat the command.
Can't reset pressure sensor. Pressure is not constant.	The pump pressure is not down to zero during the self test. Wait until the pressure is down and repeat the test. Verify that the cable for the system pressure transducer is properly connected to the P-Sys connector for the loading pump on the interior front panel. Open and close the purge valve if necessary to reduce the pressure.
Can't reset pressure sensor. Pressure is out of range.	The pump pressure is not down to zero during the self test. Wait until the pressure is down and repeat the test. Verify that the cable for the system pressure transducer is properly connected to the P-Sys connector for the loading pump on the interior front panel. Open and close the purge valve if necessary to reduce the pressure.
Can't start pump while alarm is on.	An alarm has occurred, for example, a leak alarm. You can restart the pump flow only after having acknowledged the alarm, for example, by performing the **AlarmOff** command in Chromeleon.
Cannot deliver desired flow at this pressure	The internal limit for the primary pressure has been reached, resulting in that the set flow rate could not be delivered for a short period. If the problem occurs during an analysis, shifts in retention times may be observed. The problem appears when the column pressure increases to a level at which the pump can no longer deliver the set flow rate. Verify that the column pressure is within the normal range. If it is, reduce the flow rate to avoid the problem. For more information, see section 5.5.2 (→ page 110).
Cannot deliver flow. Something may be clogged.	During solvent calibration with the ProFlow flow meter, clogging was detected in the flow path. Purge the pump (→ page 72).
Cannot pressurize system due to inlet valve failure or air in the system. —or— Cannot pressurize (x) block due to open purge or inlet valve failure or air in system.	*(where x specifies left or right block)* Pressure buildup failed. Possible causes are: - There are air bubbles in the system. Purge the pump (→ page 72). - The inlet valve is defective. Replace the valve cartridge (→ page 182). - The solvent reservoir is empty. Fill the reservoir. Purge the pump (→ page 73).

Message	Remedial Action
Cannot regulate flow	One or both solvent channels of the NC pump cannot build up sufficient pressure to deliver the selected flow rate. Possible causes are: - The solvent reservoir is empty. Fill the reservoir. - The pump may not have been purged sufficiently. Purge the pump (→ page 73). - There may be leakage in the system. Find and eliminate the source for the leak. Tighten leaking connections. - The frit in the solvent supply line filter is clogged. Replace the frit. - The inlet valve is blocked. Replace the cartridge (→ page 182).
Chip card *x* data inconsistent.	*(with x = chip card A, B, C, or D)* The data on the chip card (column ID) are inconsistent. Verify that the chip card is installed properly. The chip card may be defective. Use a new chip card if necessary.
Configuration error: Found *x* ID chips and *y* pump blocks.	*(where x and y are numbers)* The pump block of the loading pump may be defective. Contact Service.
Could not deliver desired flow for more than 30 seconds	The message appears when the internal limit for the primary pressure has been reached and the set flow rate could not be delivered for a longer period. In this case, batch processing will be aborted. For details, see section 5.5.2 (→ page 110).
Degasser malfunction	The vacuum level monitoring function of the degasser in the Solvent Rack was activated. The vacuum level is insufficient. The Solvent Rack may not be connected properly to the module. Verify that the Solvent Rack is properly connected to the module. Turn the Solvent Rack off and on again by pressing the standby button on the front panel. The degassing module may be defective and should be replaced by your Service representative.
Flow calibration failed due to plugged outlet.	During solvent calibration with the ProFlow flow meter, the fitting plug was not removed when instructed to do so. Remove the fitting plug and repeat the calibration.
Flow calibration failed. Implausible measurement results.	During flow calibration of the ProFlow flow meter, a mismatch between solvent and the sensor selected for calibration was detected. Repeat the flow calibration with the solvent or change the solvent. Contact Service.
Flow calibration operation on reserved table index (x).	*(where x is the solvent table position)* During solvent calibration with the ProFlow flow meter, you tried to overwrite one of the first 5 solvent type entries. These entries cannot be overwritten. Select a different table position for saving the calibration.
Flow meter (x) inlet filter or capillary clogged.	*(where x defines the left or right inlet of the flow meter)* The filter frit of the inline filter in the ProFlow flow meter may be clogged. Replace the filter frit. See section 7.9.3 (→ page 209). The capillary that is connected between pump head and flow meter may be clogged. Check the capillary and replace it if required.

Message	Remedial Action
Flow meter data read failure	The data on the flow meter EEPROM could not be read. Verify that the flow meter is installed properly and perform a self test.
Flow meter failure	Invalid values are reported for one or more pressure transducers of the flow meter. Verify that the flow meter is installed properly.
Flow meter missing	Communication with the flow meter failed. Verify that the flow meter is installed properly.
Flow meter recently changed. Please use the zero balance test and then calibrate both working pressure transducers.	After installing the ProFlow flow meter, **Zero Balance Test** and the **CalibrateWP** command have not been performed. 1. Perform the **Zero Balance Test** (→ page 172). 2. From Chromeleon, perform the **CalibrateWP** command for both pump heads.
Flow meter recently changed. Please calibrate (x) working pressure transducer.	*(where x specifies which pressure transducer is affected)* After installing a Classic flow meter, the **Pressure Transducer Test** and **CalibrateWP** command have not been performed. 1. Run the **Pressure Transducer Test** (→ page 172). 2. From Chromeleon, perform the **CalibrateWP** command for the pump head.
Flow meter temperature out of range	The temperature of the flow is outside the allowed range. The flow meter may be defective. Replace the flow meter (→ page 202).
Flow meter data version mismatch	The firmware installed in the module does not support the full functionality of the flow meter. You should update the firmware (→ page 217).
Flow selector changed. Please use the pressure transducer test and perform calibration.	Calibration has not been performed after the Classic flow meter or flow selector has been replaced. Perform calibration by running the **Pressure Transducer Test** (→ page 172).
Flow selector missing	The flow selector in the Classic flow meter may not be installed or the installation may not be correct. Verify that the flow selector is installed properly.
Flow selector version mismatch	The firmware installed in the module does not support the full functionality of the flow selector in the Classic flow meter. You should update the firmware (→ page 217).
Gas leak detected! Absolute threshold exceeded. —or— Gas leak detected! Relative threshold exceeded. —or— Gas leak detected! Gradient threshold exceeded.	The gas sensor detected excessive gas in the column chamber. Eliminate the cause. Tighten leaking connection and vent the column chamber.

Message	Remedial Action
Hardware error during flow calibration. (x)	*(where x provides details on the hardware error)* Turn the module off and on again by pressing the power switch on the rear of the module. Repeat the solvent calibration of the ProFlow flow meter.
Humidity leak detected! Absolute threshold exceeded. —or— Humidity leak detected! Relative threshold exceeded. —or— Humidity leak detected! Gradient threshold exceeded.	The humidity sensor reports an increased concentration of humidity in the column chamber. Eliminate the cause. Tighten leaking connection and vent the column chamber.
I2C device *xx* does not work	*(where xx is a number indicating the device. The number is important for servicing.)* Turn the module off and on again by pressing the power switch on the rear of the module.
Implausible column pressure —or— Implausible left primary pressure —or— Implausible right primary pressure	The pressure values established during the self test are not plausible. Turn the module off and on again by pressing the power switch on the rear of the module. Contact Service if the message appears again. Depending on the flow meter that is installed, proceed as follows: *ProFlow flow meter:* Perform the **Zero Balance Test** (→ page 172) and repeat the self test. *Classic flow meter:* Run the **Pressure Transducer Test** (→ page 172) and repeat the self test.
Implausible left working head pressure —or— Implausible right working head pressure	The pressure values established during the self test for the working pressure of the left and/or right pump head of the NC pump are not plausible. The cable for the related pressure transducer may not be connected properly. Verify that the cable properly connected. If the message appears after you have installed a *replacement* pump head, the head may not have been calibrated properly. Follow steps 8 a) through e) to install a replacement pump head (→ page 192) and purge the flow meter (→ page 75).

Message	Remedial Action
Implausible left working cylinder pressure. Check pressure plug. —or— Implausible right working cylinder pressure. Check pressure plug.	The pressure values established during pump operation for the working pressure of the left and/or right pump head of the NC pump are not plausible. The cable for the related pressure transducer may not be connected properly. Verify that the cable properly connected. Perform the following sequence of actions: 1. *ProFlow flow meter:* Perform the **Zero Balance Test** (→ page 172). *Classic flow meter:* Run the **Pressure Transducer Test** (→ page 172). 2. Purge the pump head for which the message appears (→ page 73). 3. Close the flow meter outlet with a Viper fitting plug (included in the accessories kit of the module) and verify that the purge valves are closed. 4. From Chromeleon, perform the **CalibrateWP** command for the pump head. 5. Purge the flow meter (→ page 75). Replace the pump head (→ page 188).
Implausible left working cylinder calibration. Check pressure plug. —or— Implausible right working cylinder calibration. Check pressure plug.	The calibration values established during pump operation for the left and/or right pump head of the NC pump are not plausible. The cable for the related pressure transducer may not be connected properly. Verify that the cable properly connected. Perform the following sequence of actions: 1. *ProFlow flow meter:* Perform the **Zero Balance Test** (→ page 172). *Classic flow meter:* Run the **Pressure Transducer Test** (→ page 172). 2. Purge the pump head for which the message appears (→ page 73). 3. Close the flow meter outlet with a Viper fitting plug (included in the accessories kit of the module) and verify that the purge valves are closed. 4. From Chromeleon, perform the **CalibrateWP** command for the pump head. 5. Purge the flow meter (→ page 75). Replace the pump head (→ page 188).
Internal pump maintenance is due, please open purge screw and purge	Internal maintenance of the loading pump is overdue and has not been performed for more than 45 days. Open the purge screw and initiate a purge cycle.
Leak detected	*When this message appears, the flow is automatically turned off after 180 seconds.* The leak sensor in the pump module has reported a leak. Find and eliminate the source for the leak. Dry the leak sensor and tray (→ page 177).
Left valve no head found.	While the Catch Head command has been performed, no valve has been found. Repeat the command and push the valve onto the actuator (→ page 78).

Message	Remedial Action
Left valve moving to position timeout.	The left valve did not reach the specified position within a certain time. There may be no valve installed or the valve is not configured properly. Check and change the valve type in Chromeleon or on the oven display (→ page 50 or page 106) if required and switch the valve again. Contact Service if the message appears again.
Left valve position error.	The left valve did not reach the specified position. The valve may not be configured correctly or may be blocked. Check and change the valve type in Chromeleon or on the oven display (→ page 50 or page 106) if required, verify that the valve is not blocked, and switch the valve again. Contact Service if the message appears again.
Left valve header with wrong number of ports configured	When being switched, the left valve recognized that the number of ports configured for the valve does not match the actual number of valve ports. Check and change the setting as necessary (→ page 79).
Left equilibration piston drive sensor remains dark	Drive initialization failed for the left equilibration piston of the NC pump. Turn the module off and on again by pressing the power switch on the rear of the module. Contact Service if the message appears again.
Left working piston drive sensor remains dark	Drive initialization failed for the left working piston of the NC pump. Turn the module off and on again by pressing the power switch on the rear of the module. Contact Service if the message appears again.
Motor current too large	The motor current is too high when the loading pump is running. The flow path before the transducer for the system pressure may be blocked. Make sure that neither the capillary from the working cylinder to the equilibration cylinder nor the capillary to the purge unit is blocked. Replace the capillaries if necessary. Verify that the check valve cartridges of the loading pump are installed in the direction of flow (→ page 182). Inspect the purge valve of the loading pump for indications of blockage. Replace the purge valve screw if necessary (→ page 210). The motor may be defective. Contact Service.
No abortable command was executing	An attempt was made to perform an Abort command. However, no action or command was being executed that can be aborted.
NC drive initialization error	The drive of the NC pump could not be initialized within 30 seconds. Turn the module off and on again by pressing the power switch on the rear of the module.
New flow meter found. Please use the zero balance test and then calibrate both working pressure transducers.	The message is for information only, indicating that a ProFlow flow meter has been installed. Make sure that you perform the required steps for the ProFlow flow meter after installation (→ page 202).

Message	Remedial Action
New flow meter found. Please use the pressure transducer test and then calibrate both working pressure transducers.	The message is for information only, indicating that a Classic flow meter has been installed. Make sure that you perform the required steps for the Classic flow meter after installation (→ page 202).
New flow selector found.	The message is for information only, indicating that a flow selector for a different flow range has been installed in the Classic flow meter.
Outlet valve leak detected in (x) block	*(where x specifies left or right block)* The outlet valve is defective. Replace the valve cartridge (→ page 182).
Position error	A position error is reported for the loading pump. Turn the pump off and on again by pressing the power switch on the rear of the module. Contact Service if the message appears again.
Pressure buildup during maintenance operation. Please open the purge valve.	A pressure of more than 5 MPa built up during piston and/or piston seal maintenance for the loading pump. Open and close the purge valve to reduce the pressure. If the message appears during the internal maintenance procedure for the loading pump (→ page 142), perform an additional purge cycle for the loading pump (→ page 76).
Pressure fallen below lower limit	The solvent reservoirs are empty. Fill the reservoirs and purge the pump (→ page 72). There are air bubbles in solvent supply line. Check the filter frits and purge the system (→ page 72). The system is leaking. Find and eliminate the source for the leak. Tighten loose connections. One of the check valves is defective. Check and replace the valve cartridges as appropriate (→ page 182). Purge the system (→ page 72). The lower pressure limit cannot be reached for the specified flow. The main task of the lower pressure limit is to monitor the system for leakage. Leakage may occur especially at the fittings and or screw joints, the switching valve in the autosampler, or the piston seals. *Loading pump* The solvent emits gas when mixing. Degas the solvent. Check the degasser.
Pressure sensor malfunction	The pressure transducer for the system pressure reported a pressure under 0 MPa. Verify that the cable for the system pressure transducer is properly connected to the P-Sys connector on the interior front panel.
Pump not tight. The purge valve might be open.	During solvent calibration with the ProFlow flow meter, a leakage was detected. Make sure that both purge valves are closed.

Message	Remedial Action
Purge pressure limit exceeded	During the purge cycle, a pressure of more than 5 MPa built up. *If the message appears during the purge cycle for a pump head* Verify that the purge valve for the pump head is open. If it is not, open the purge valve to reduce the pressure. *If the message appears during the purge cycle for the flow meter* Be sure that the correct capillary is connected to the flow meter outlet (nanoViper capillary, 0.25 x 155 mm I.D. x L, MP35N, e.g., from the accessories kit of the module). Verify that the other end of the capillary is open. In any case, check the flow path for indications of blockage (also, see "Upper pressure limit exceeded").
Quiescent current too large	The motor current is too high when the loading pump stops. Turn the pump off and on again by pressing the power switch on the rear of the module.
Reducing flow didn't reduce the pressure. Something may be clogged.	During solvent calibration with the ProFlow flow meter, clogging was detected in the flow path. Purge the pump (→ page 72).
Right valve no head found.	While the Catch Head command has been performed, no valve has been found. Repeat the command and push the valve onto the actuator (→ page 78).
Right valve moving to position timeout.	The right valve did not reach the specified position within a certain time. There may be no valve installed or the valve is not configured properly. Check and change the valve type in Chromeleon or on the oven display (→ page 50 or page 106) if required and switch the valve again. Contact Service if the message appears again.
Right valve position error.	The right valve did not reach the specified position. The valve may not be configured correctly or may be blocked. Check and change the valve type in Chromeleon or on the oven display (→ page 50 or page 106) if required, verify that the valve is not blocked, and switch the valve again. Contact Service if the message appears again.
Right valve header with wrong number of ports configured	When being switched, the right valve recognized that the number of ports configured for the valve does not match the actual number of valve ports. Check and change the setting as necessary (→ page 79).
Right equilibration piston drive sensor remains dark	Drive initialization failed for the right equilibration piston of the NC pump. Turn the module off and on again by pressing the power switch on the rear of the module. Contact Service if the message appears again.
Right working piston drive sensor remains dark	Drive initialization failed for the right working piston of the NC pump. Turn the module off and on again by pressing the power switch on the rear of the module. Contact Service if the message appears again.

Message	Remedial Action
Self test failed: xx	*(where xx = additional text)* *This message usually appears together with another message indicating which failure occurred during the self test.* Refer to this message for recommended remedial actions.
Solvent rack leak detected	The leak sensor in the Solvent Rack has reported a leak. The Solvent Rack may not be connected properly to the module. Verify that the Solvent Rack is properly connected to the module. There is a leak in the system or a fluid connection is loose. Find and eliminate the source for the leak. Tighten leaking connections and dry the leak sensor (→ *Solvent Rack manual*).
The cam position is yet unknown. It is necessary to run at least 2 revolutions.	The position of the cam is unknown after the piston of the loading pump has been replaced. Turn on the flow and have the pump run for two revolutions to establish the position.
The maximum possible flow for this solvent is (x). Please reduce the flow rate.	*(where x specifies the maximum flow rate)* The maximum flow rate for this solvent has been exceeded. Reduce the flow rate.
The piston seal leakage has exceeded the recommended limit.	Inspect the piston seals for leakage (→ page 186). Replace the piston seals (→ page 194).
The pressure exceeded the absolute limit.	The pressure has exceeded the absolute pressure limit. This message appears when pressure builds up extremely fast. *NC pump* Each pressure transducer of the NC pump can cause this message. First, verify that the pressure transducer cables are properly connected on the flow meter. Disconnect and reconnect the cable. Then, make sure that the pressure transducers are properly calibrated. To do so, perform the **CalibrateWP** command for both pump heads from Chromeleon. Reduce the set flow. If the message is extend by 'Please run the self test', you have to run the self test before you can continue. *Loading pump* This may happen, for example, when the pump delivers at a high flow rate while the pump outlet is closed with a fitting plug. Take appropriate remedial action and retry.
The primary pressure exceeded the limit during calibration.	During solvent calibration with the ProFlow flow meter, the primary pressure exceeded the limit. The flow meter may be clogged. Purge the flow meter (→ page 75).
The pump drive is still in maintenance position.	An attempt was made to start the pump while the pump is still in maintenance position, for example, during piston replacement or piston seal replacement. Return the pistons into the position for normal operation (→ page 191) and retry. If the message appears during the internal maintenance procedure for the loading pump (→ page 142), perform an additional purge cycle for the loading pump (→ page 76).

Message	Remedial Action
The rear seal leak sensor detects drops constantly.	Verify that the pump is installed in a horizontal position and that the seal wash solution can run properly to the waste. Remove the detector of the seal wash system (→ page 181). Verify that the detector seat is dry, for example, by using a lint-free cloth or tissue. Inspect the electrodes of the seal wash detector for indications of contamination. Clean the detector electrodes if required (→ page 181).
The rear seal wash system has run out of wash solution	Rear seal washing is enabled and the peristaltic pump is running, but no liquid reaches the detector of the seal wash system. Verify that wash solution is present in the seal wash reservoir. Initiate another Wash cycle manually. To do so, set **RearSealWashPump** to **Active** (→ page 122). Verify that the seal wash tubing is connected properly (→ Fig. 6, page 29) and check the tubing for permeability. Replace the seal wash tubing *and* the tubing connectors as necessary. The peristaltic tubing may be blocked or draws air. Replace the tubing if necessary (→ page 180). Inspect the rear seal wash tubing for indications of leakage (→ page 179). Replace the seal wash tubing *and* the tubing connectors as necessary. Verify that the lever of the peristaltic pump (→ Fig. 29, page 67) is not blocked. Inspect the electrodes of the seal wash detector for indications of contamination. Clean the detector electrodes if necessary (→ page 181). Make sure that the seal wash solution is sufficiently conductive (→ page 122).
The WP calibration could not finish. Release pressure and calibrate again right now!	The working pressure transducer calibration failed. Open and close the purge valve to reduce the pressure (→ page 72). Check that the fitting plug is installed correctly. Perform **CalibrateWP** command again.
Undock err., open purge valve	The pump pistons are not in the appropriate position for normal operation (for example, after piston (seal) replacement) or an error occurred during internal maintenance (→ page 142). Open the purge valve, perform the **Dock Pistons** command, and close the purge valve. *Tip*: When the message appears for the loading pump, usually also the pump block status LED for the loading pump flashes red.

Message	Remedial Action
Upper pressure limit exceeded	*NC pump* The message appears when the column pressure exceeds the set upper pressure limit. In this case, the flow of the NC pump will be stopped. Too high a column pressure may be caused not only by the column itself but also by other components in the flow path of the NC pump (depending on the application). *Loading pump* Check whether the flow path after the purge unit is blocked. To do so, open the purge valve. If the flow path is blocked: - The trap column may be contaminated. Rinse or replace the column. - The autosampler may be blocked. Find and eliminate the source for the blockage. If the flow path is *not* blocked: - Check the permeability of the filter frit in the inline filter. Replace the filter frit if necessary (→ page 209). - The switching valve in the column compartment may not have switched properly. In this case, an additional message will appear for the valve.
Zero position not found during the last revolution.	Turn the module off and on again by pressing the power switch on the rear of the module. Contact Service if the message appears more often.
Zero position not found during the last 3 revolutions.	Turn the module off and on again by pressing the power switch on the rear of the module. Contact Service if the message appears more often.

When the module is operated from Chromeleon and if communication between Chromeleon and the module cannot be established, messages may appear in the Chromeleon Audit Trail. The wording of the messages in the table refers the NCS-3500RS; however, the messages apply in the same way to the NCP-3200RS.

Message	**Remedial Action**
NCS-3500USB-1610103 - Device not found on the USB	The USB connection between the module and the Chromeleon server may be interrupted. Check the USB connection. The power supply to the module may be interrupted. Check the power supply connection of the module. Restart the Chromeleon Server Monitor and/or the Chromeleon server.
Error opening NCS-3500 @USB-1610103 – The System cannot find the file specified	The USB connection between the module and the Chromeleon server may be interrupted. Check the USB connection. The power supply to the module may be interrupted. Check the power supply connection of the module.
Error issuing control request to NCS-3500@USB-1610103	The USB connection between the module and the Chromeleon server may be interrupted. Check the USB connection. Check the power supply connection of the module. Remove the module specified in the message from the server configuration or else, select a different module from the list of available modules in the server configuration program.
Error reading from NCS-3500 @USB-1610103 Data error (cyclic redundancy check)	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. Replace defective USB cables. Replace a defective USB hub.
Error reading from NCS-3500 @USB-1610103	The USB connection between the module and the Chromeleon server may be interrupted. Check the USB connection. The power supply to the module may be interrupted. Check the power supply connection of the module.

6.4 Chromeleon Diagnostics Messages

If the module fails a diagnostics test, perform the instructions given here and repeat the test. If the module fails the test again, contact Thermo Fisher Scientific Service for Dionex HPLC Products.

General Leak Test failed

Probable Cause	Remedial Action
The pressure drop has been too high.	Check the fitting plug on the pump outlet for tightness. Visually inspect all fluid connections for liquid droplets. Check all fluid connections for indications of leakage. Replace the valve cartridge (inlet check valve) (→ page 182). If you still suspect there is a leak, run the detailed leak test.
The pressure level has not been reached in time.	
The initial pressure has not been reached within the first minute.	
The pressure drop during relaxation has been too high.	

Detailed Leak Test failed

Probable Cause	Remedial Action
The capillary connections are leaking.	Check all fluid connections for indications of leakage. Find and eliminate the source for the leak. Tighten leaking connections. If the leakage continues, replace the capillaries. *Capillaries with Viper fitting connections* Perform this sequence of actions: Remove the capillary, carefully clean the capillary ends by using a cloth or tissue wetted with isopropanol, and reinstall the capillary. If the connection continues to leak, install a new capillary.
The check valve is leaking.	Replace the valve cartridge (outlet check valve) (→ page 182) and repeat the test. Replace the valve cartridge (inlet check valve) (→ page 182) and repeat the test.
The piston seals are leaking.	Replace the piston seals (→ page 194).
NC pump	If the NC pump fails test after the flow selector (in a Classic flow meter) has been replaced, take the following steps: 1. Retighten the four capillary connections of the flow selector (→ Fig. 79, page 204) as tight as possible with your hand. 2. Retighten the connections from the pump heads to the flow meter. Clean the capillary ends.

Viscosity Measurement failed (Classic Flow Meter only)

Probable Cause	Remedial Action
After the piston seals have been replaced, the new seals do not yet seal sufficiently tight.	Purge the flow meter for another 30 to 60 minutes (→ page 75). Afterward, repeat the test. If the test fails, information about possible causes and suggested remedial actions are provided also on the last page of the wizard guiding you through the test. Follow these instructions and repeat the test.

Solvent Calibration failed (ProFlow Flow Meter only)

Probable Cause	Remedial Action
After the piston seals have been replaced, the new seals do not yet seal sufficiently tight.	• Perform a detailed leak test (→ page 134). Afterward, repeat the solvent calibration. If the test continues to fail, information about possible causes and suggested remedial actions are provided also on the last page of the wizard guiding you through the test. Follow these instructions and repeat the test. • The purge screw may be open. Close the purge screw. • The piston seals may be worn out. Perform a detailed leak test (→ page 134). Replace the piston seals (→ page 194). • The capillary between pump head and flow meter may be leaking. Check the capillary and replace it, if required. • The fitting plug in the pump head may not be tight. Tighten the plug.

Mixer Frit Test failed

Probable Cause	Remedial Action
The backpressure has exceeded the limit. The filter frit in the inline filter may be blocked.	Replace the filter frit (→ page 209).

Degasser Vacuum Test failed

Probable Cause	Remedial Action
The degasser module did not reach the appropriate operating vacuum.	Check the tubing of the vacuum system and the degasser module and repeat the test. If the test fails again, the degasser module may be defective. Contact Service.

Performance Test failed

Test Result	Probable Cause	Remedial Action
The pressure/% compression was outside specification!	Eluent may not have been degassed correctly.	Degas the solvent.
	It is likely that the wrong eluent was chosen in test step 1 (Prepare Pump).	Repeat the test. Make sure that the correct eluent is chosen.
	There may be air bubbles in the pump head.	Purge the pump (→ page 72).
	The check valves may not be working correctly.	Replace the cartridges (→ page 182).
	The piston seals are leaking.	Replace the piston seals (→ page 194).
	Backpressure may have fluctuated due to problems with the restrictor. The restrictor may be blocked.	Replace the restrictor.
The pressure was outside specification.	The pressure was outside the upper and lower pressure limits.	Repeat the test with changed flow settings.
The % compression value was over the limit!	There are air bubbles in the pump.	Purge the pump (→ page 72).
	The flow may have been too high.	Repeat the test with reduced flow.
The % compression value was below the limit!	The flow may have been too low.	Repeat the test with increased flow.
	The purge valve may not be closed completely.	Close the purge valve.
Pressure ripple was too high.	There may be a mechanical fault.	Repeat the test. If the test fails again, contact Service.

6.5 Operating Problems

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

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

Problem	Probable Cause	Remedial Action
No information appears on the front panel display.	The module is not connected to the mains.	Connect the power cord.
	The power is turned off.	Turn on the power to the module.
	The module is in standby mode.	Press the Standby key on the front panel.
	The screen brightness or contrast is not adjusted correctly.	Adjust the brightness and/or contrast (→ pages 125 and/or 131).
	The fuses blow.	Replace the fuses (→ page 212).
	Replacement fuse blows immediately.	Contact Service.
	An error occurred in the electronic system.	Contact Service.
The module does not work correctly when controlled by Chromeleon.	There is no connection between the module and the Chromeleon computer.	Check the USB cable and connection to the computer.
	The USB port on the computer is not ready for operation.	Check the USB port on the computer.
The rear seal wash system is leaking.	The tubing of the seal wash system is not connected properly; the tubing is damaged by bending or is blocked.	Check the seal wash tubing (→ Fig. 6, page 29). Replace the tubing if required.
The degasser of a SRD-3x00 Solvent Rack that is connected to the module cannot be turned on from the module.	The degasser is not configured in the Properties dialog for the module.	In the Chromeleon **Server Configuration** program, verify on the **Pumps** page of the Properties dialog for the module that **Degasser Control** is set to **External** (→ page 47).

Problem	Probable Cause	Remedial Action
The degasser of a SRD-3x00 Solvent Rack that is connected to the module does not work (the Vacuum and Status LED on the Solvent Rack are off).	The Solvent Rack is not connected properly to the module and/or the degasser is not configured in the Properties dialog for the module.	In the Chromeleon **Server Configuration** program, verify on the **Pumps** page of the Properties dialog for the module that **Degasser Control** is set to **External** (→ page 47).
	The degasser is turned off.	Turn on the degasser.
	A first generation SRD-3x00 Solvent Rack is connected to the module.	Contact Service.
The system has very high backpressure.	One or more capillaries in the system are blocked.	Check the capillaries in the system systematically from the detector to the pump. Replace the capillaries if needed.
	A column switching valve (if installed) or the injection valve is blocked.	Check and replace the valve if necessary.
	The column is contaminated or blocked.	Rinse or replace the column.
The loading pump has very high backpressure.	The filter frit on the high-pressure side of the loading pump is dirty.	Replace the filter frit (→ page 209).
High baseline drift	The column is contaminated.	Clean or replace the column.
	The system is not sufficiently equilibrated.	Flush the system until equilibration. If equilibration cannot be reached, purge the NC pump (→ page 73).
	The eluents are degraded or inhomogeneous.	Before you start an analysis, be sure that the eluents are already homogenized in the reservoirs. Use fresh solvent and check the eluent filter frits. In aqueous solvents, growth of microorganisms is possible.
	The environmental conditions are unstable.	Make sure that the temperature and the humidity are constant. Avoid draft. Verify on the detector that the lamp and flow cell covers are in proper position and that the front panel door is closed.
	For additional causes, refer to the operating instructions for the detector.	→ *Detector manual*

Problem	Probable Cause	Remedial Action
Shifts in retention time for a longer period	When changing solvents, the previous solvent has not been removed completely from the NC pump.	Purge the NC pump (→ page 73).
	Periods of inactivity (interruption of operation) or changed operating conditions	When pump operation was interrupted (periods of inactivity) or when the operating conditions have been changed, it can take some time until the system has reached the optimally stable operating conditions again.
Retention time outside the expected range	The thermal flow sensors or pressure transducers may have a small drift.	*ProFlow flow meter:* Perform a zero balance test for the thermal flow sensors (→ page 172). *Classic flow meter:* Calibrate the pressure transducers (→ page 172).
	The solvent settings are incorrect.	Check and correct the settings for the solvents in Chromeleon.
	Solvents were pre-mixed and not used for a longer period of time.	Purge the pump (→ page 72).
	Pre-mixed solvents are too old.	Use fresh eluent. Use fresh and appropriate solvents (MS-grade). Purge the pump (→ page 72).
High noise level, non-periodic baseline fluctuation	The eluent is degraded or of poor quality/purity.	Use fresh eluent. Use fresh and appropriate solvents (MS-grade).
	For additional causes, refer to the operating instructions for the detector.	→ *Detector manual*
Pressure pulsation or inconstant pressure	The solvent is not degassed sufficiently.	Degas the solvent.
	The solvent is degraded.	Use fresh solvent.
	There are pressure fluctuations from the pump.	Purge the pump (→ page 72).
	There are pressure fluctuations from the loading pump.	Check the compression values. Perform the remedial actions (→ page 174).
	There are air bubbles in the system.	Purge the pump (→ page 72).

Problem	Probable Cause	Remedial Action
Pressure pulsation or inconstant pressure *(Cont'd)*	After a maintenance procedure (replacement of pump head, piston, or piston seal) the pistons are not in the appropriate position for normal operation.	Remove and reinstall the pistons (→ pages 188 and 190).
	Loading pump The filter frit on the high-pressure side of the pump is dirty.	Replace the filter frit (→ page 209).
Peak tailing	Too large extra column volume.	Use short capillaries with an appropriate inner diameter (Nano LC: 20 µm; Cap LC: 50 µm; Micro LC: 75µm).
	There are poor capillary connections.	Replace the capillaries. Consider using Viper capillaries.
Peak Broadening, increased dead time	The inner diameter of the capillary to the detector is too large.	Use a capillary with an appropriate inner diameter.
	The filter frits on the solvent supply lines are clogged.	Check the filter for permeability. Replace the filter frit if necessary (→ page 62). With the NC pump, the message 'Cannot regulate flow' appears on the pump display.
	The capillaries are clogged or there a poor capillary connections.	Replace the capillaries. Consider using Viper capillaries.
	The sample loop is clogged.	Replace the sample loop (→ *Autosampler manual*).
	The column is overloaded or contaminated.	Clean or replace the column.
	The eluent has changed.	Use fresh solvent.
	A fused silica capillary with poorly installed peek sleeve is used.	Use an appropriate Viper capillary instead.

Problem	Probable Cause	Remedial Action
Either no peaks or only few, poorly resolved peaks appear in the chromatogram.	With direct injection or preconcentration: The solvent contains too much organic, the solvent does not contain enough organic in the solvent, or the mobile phase is wrong.	Optimize the chromatographic parameters.
	With preconcentration: The trap column is too short, the flow rate of the loading pump is too high, and/or the loading time is too long. The three items interact: If the trap column is too short, peaks may be lost because they are not retained. If the loading time is too long or if the loading flow is too high, hydrophilic peaks may be lost. This also affects the reproducibility because the proteins are transported a long way into the trap column.	Consider the following: Use a longer trap column, reduce the flow rate from the loading pump, and/or reduce the loading time.
Reproducible ghost peaks in the chromatogram.	The degassing channels are contaminated.	Rinse the degassing channels (→ *Solvent Rack manual*).
	The eluents are degraded, dirty or of poor purity/quality.	Use fresh solvent. Use fresh and appropriate solvents (MS-grade).
	Contamination occurs somewhere in the system.	Flush the system with an appropriate solvent.
Additional peaks appear in the injection peak.	With gradients, the equilibration time after the flush cycle is too short.	Extend the equilibration time.
	There is excessive dead volume.	Eliminate any dead volume.
Triangular peaks	The column is overloaded (the concentration of the sample is too high).	Dilute the sample.
Spikes	There is electrical interference from other modules.	Isolate the electrical circuit from strong current consumers. Consider installing an uninterruptible power supply (UPS).
	For additional causes, refer to the operating instructions for the detector.	→ *Detector manual*
Negative peaks	Sample solvent and mobile phase differ in composition.	Dissolve the sample in the mobile phase.

Problem	Probable Cause	Remedial Action
Poor peak area precision	The capillary connections are not installed properly or they are leaking.	Check and tighten the capillary connections. Consider using Viper capillaries.
	There are dead volumes in the capillary connections.	Replace the conventional (non-Viper) fitting connections. Make sure that the capillaries are connected correctly. Consider using Viper capillaries.
	There are air bubbles in the pump heads and/or flow meter.	Purge the pump (→ page 72).
	After changing solvents, the previous solvent has not been flushed out completely.	Purge the pump (→ page 72).
	The gradient is irreproducible.	The pressure transducer offset may not be correct. Check the offset and calibrate the pressure transducers if required (→ page 172).
	The sample is unstable and decomposes.	Use new sample or change the conditions. Cool the sample in the autosampler if possible.
	Baseline fluctuations	See the remedial actions provided in the related baseline sections further up in this table.
	The environmental conditions are unstable.	Make sure that the temperature and the humidity are constant. Avoid draft. Consider using the thermostatted column compartment.
	Contamination occurs somewhere in the system.	Flush the system with an appropriate solvent.
	For additional causes, see the Autosampler manual.	→ *Autosampler manual*
	If the problem is observed while the module is used together with a mass spectrometer, the nanoESI emitter may be the cause.	→ *Instrument manual*

Problem	Probable Cause	Remedial Action
No flow	The system is leaking.	Find and eliminate the leak.
	The eluents are degraded, dirty or of poor purity/quality.	Use fresh solvent. Use fresh and appropriate solvents (MS-grade).
	Contamination occurs somewhere in the system.	Flush the system with an appropriate solvent.
	One or both valve cartridges are not installed correctly (not in the direction of flow) or are defective.	Install the cartridges in the direction of flow or replace the cartridges if necessary (→ page 182).
	There are air bubbles in the eluent or in the pump head.	Purge the pump (→ page 72) and check the degasser.
	The filter frit in the inline filter may be blocked.	Replace the filter frit in the inline filter (→ page 209).
	There is an air bubble in the flow path.	Perform a wash cycle. Non-degassed wash solution is used. Degas the wash solution (→ *Autosampler manual*).
	After a maintenance procedure (replacement of pump head, piston, or piston seal) the pistons are not in the appropriate position for normal operation.	Remove and reinstall the pistons (→ pages 188 and 190).
NC pump with Classic flow meter: Flow fluctuation, flow is too low poor gradients	The flow selector is clogged (partially or completely).	Purge the entire NC pump (both channels) by using water (→ page 73) and perform the Viscosity Measurement (→ page 114). The result must be >95 % for both solvent channels. If the result is considerably higher for one or both channels, the flow selector is clogged. Replace the flow selector (→ page 204).
Loading pump: Flow fluctuation	The inlet path is blocked.	Check the inlet lines, filter of the pump, proportioning valve etc. for signs of blockage.
	There is air in the inlet path.	Purge the pump (→ page 72) and check the degasser.
	The check valves are dirty or defective.	Clean the check valves or replace the valve cartridges (→ page 182).

Problem	Probable Cause	Remedial Action
Loading pump: Flow fluctuation *(Cont'd)*	The piston does not contact the magnet holder.	Check whether the piston is installed correctly. Reinstall the piston if needed (→ page 197).
	The piston seals are leaking.	Replace the piston seals (→ page 194).
Injection volumes are too small and or of poor precision. Air bubbles are visible in the syringe.	The connection between the buffer loop and the syringe valve is loose.	Retighten the connection and flush the syringe (→ *Autosampler manual*).
	Non-degassed wash solution is used.	Degas the wash solution (→ *Autosampler manual*).
Poor degassing (loading pump)	The capillaries or solvent supply lines are leaking.	Inspect the capillary and solvent supply line connections for leakage; tighten loose fitting connections.
	The degasser is not working properly.	Inspect the degasser for indications for leakage. Check the degasser vacuum.
	The flow rate is too high.	Reduce the flow rate.
UV signal drift during the gradient	In applications with TFA, the TFA concentration is incorrect. If the signal drifts upward, solvent B contains too much TFA and vice versa.	Increase or reduce the TFA concentration as needed.
After switching from the loading pump flow to the nano flow, there is a drop in the UV signal, and the signal does not return to the initial level fast enough.	The trap column is defective.	Replace the trap column.
	There is excessive dead volume.	Eliminate any dead volume.
Degasser noise	The vacuum pump of the degasser is running at high speed.	Fill and degas *all* channels (even if they are not used for the application).
The temperature in the column chamber does not change for some time although the temperature set point has not been reached.	The ambient temperature is too high or the set point is lower than the specified difference to the ambient temperature.	Select a higher set point or reduce the ambient temperature (for example, by ventilating the room).
	The ventilation slots on the NCS are obstructed.	Make sure that the ventilation slots are not obstructed in any way.
	The compartment door is not completely closed.	To close, push the door upward forcefully if necessary.

Problem	Probable Cause	Remedial Action
The temperature in the column chamber does not change for some time although the temperature set point has not been reached. *(Cont'd)*	The capillaries are placed in such a manner that ambient air can enter the column chamber.	Verify that the capillaries are routed correctly through the guides on the sides of the column chamber and/or rest flat on the edge of the enclosure (→ section 4.2.2, page 60).
	Temperature control is turned off. (The following information appears on the status screen: Setpoint: Off.)	Check and change the temperature control setting (→ page 127).
	The seal of the compartment door is damaged.	Contact Service.

6.6 Flow Sensor / Pressure Transducer Diagnostics (NC Pump)

6.6.1 Performing a Zero Balance Test (ProFlow Flow Meter)

Relevant only for the NC pump with a ProFlow flow meter installed

To ensure an accurate flow rate and solvent composition, the zero balance of the thermal flow sensors and pressure transducers of the ProFlow flow meter must be calibrated from time to time. Perform the **Zero Balance Test** to set the flow sensors and pressure transducers to zero.

To perform the test, navigate to the **Control** menu, select **Diagnostics** and then select the **Zero Balance Test**. In Chromeleon 7, run the test from the NC pump **Wellness** page of the ePanel set by clicking **Adjust Zero Balance**. A wizard guides you through the procedure.

6.6.2 Calibrating the Pressure Transducers (Classic Flow Meter)

Relevant only for the NC pump with a Classic flow meter installed

The NC pump generates the flow rate by applying a corresponding pressure drop at the flow selector. To ensure an accurate result, the pressure transducers must be synchronized very well. Run the **Pressure Transducer Test** to verify that the pressure transducer offset is still correct. If it is not, calibrate the pressure transducers.

Before you begin: Observe the *Tips and Information* for performing the test further down in the section.

1. In Chromeleon, open a control panel and connect to the timebase in which the module is installed (→ page 89).
2. On the **Control** menu, select **Diagnostics** and then select **Pressure Transducer Test** (in Chromeleon 7, run the **Pressure Transducer Test** from the ePanel, by clicking **Check Pressure Transducers** on the **NC_Pump_Diagnostics** tab).
3. A wizard guides you through the procedure. Observe the following:
   - ♦ When you run the **Pressure Transducer Test** after you have installed a *new* pump head, you have to select the **Calibrate Anyway** check box in step 2 of the test (even if calibration is *not* explicitly recommended).
   - ♦ After calibration, the new value is stored automatically as the current value.

Tips and recommendations

- The pump will have the best stability when it has been powered on by the main power switch for at least 24 hours.

  Recommendation: Run the **Pressure Transducer Test** or perform pressure transducer calibration after 24 hours or repeat the test or calibration after this period.

  After shorter interruptions of the power supply (less than 8 hours), it is sufficient to wait at least 1 hour.

- The **Pressure Transducer Test** *must* be performed when the following components have been replaced:
  - Pump head
  - Flow meter
  - Flow selector
- As long as the retention times are stable and in the expected range, you should *not* interrupt pump operation by recalibrating the pressure transducers.
- You should check also the offset of the pressure transducers:
  - *Before* you test the NC pump for leakage by running the diagnostics functions from Chromeleon. Observe the recommended order of tests (→ page 134).
  - If you observe a shift in peaks or if the gradients are not correct.

6.7 Checking the Compression Values (Loading Pump)

Relevant only for the loading pump

Tip: The following applies only when the loading pump has backpressure.

The compression value of the pump head can provide valuable information for troubleshooting. If you observe pump pulsation and/or shifts in retention times, check the compression values:

- On the pump display, select the **Diagnostics** menu and **Compression**.
- In Chromeleon, open the **Commands** dialog box for the loading pump and select **LoadingPump_Wellness_RightBlock** and **Compression**.

The values are indicated in percent; they show the compression of the last stroke. The compression value should be lower than 100% and remain stable. If the value is close to 100%, the required precompression may not be reached and pulsation may occur.

The table shows guides values for some solvents:

Solvent	Compression*
Acetonitrile	70 % ± 10 %
Methanol	75 % ± 10 %
Water	50 % ± 10 %

* with 100 % of degassed solvent delivered at 40 MPa, pump purged and stable for some time The values are linear to the pressure.

- If the compression value is lower than indicated in the table, the valve cartridge (outlet check valve) may be defective. Replace the cartridge (→ page 182).
- If the compression value is *higher* than indicated in the table
  - The piston seals may be defective. Replace the piston seals (→ page 194).
  - The valve cartridge (inlet check valve) may be defective. Replace the cartridge (→ page 182).
- If the compression is very high and the pressure is low, there may be air bubbles in the system. Purge the loading pump (→ page 76).

7 Service

7.1 General Notes and Safety Precautions

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

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

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

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

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

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

- For all service and repair procedures, observe all precautionary statements provided in these operating instructions.
- *NC pump*
  When the fluid components of the NC pump are filled with liquid and the solvent reservoirs are located above the pump outlet during pump operation, the hydrostatic pressure in the system may cause eluent to escape when you open a fluid connection in the NC pump. *Before* you open a fluid connection, position the reservoirs below the connection to be opened. Empty the solvents lines. If solvent shut off valves are installed on the solvent lines, you can close the shut off valves instead.
- *Column Compartment*
  Do not touch any metal or plastic parts inside the column chamber while the temperature is higher than 50 °C. Wait for the chamber to cool down before you carry out any work in the column chamber. To shorten the cool-down time, consider setting a lower temperature and opening the front panel door.

- Use only the original spare parts authorized for the device by Thermo Fisher Scientific.
- Before returning the module for repair, contact Thermo Fisher Scientific Service for Dionex HPLC Products.

  An RMA (Return Material Authorization) number is required to track your module. Always use the original packaging and observe the packing instructions when shipping the module. Shipping the module in anything other than the original packaging voids the warranty.

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

For instructions on shutting down the module, see page 140.

7.2 Eliminating Leakage in the Pump Module

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

1. Wait until the pressure is down to zero.
2. Inspect the fluid connections in the pump for signs of leakage. Tighten or replace leaking connections if necessary.
3. With a cloth or tissue, absorb all liquid that has collected in the tray. Be careful; do not bend or damage the sensor.

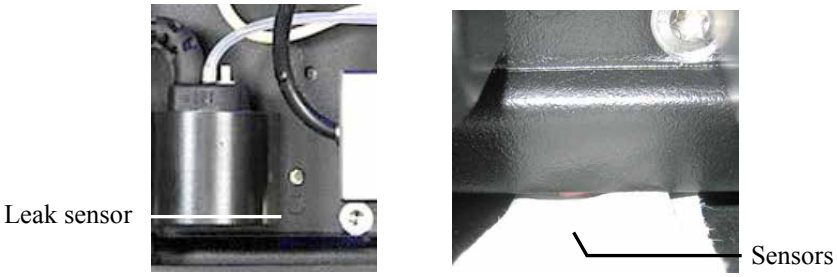


Fig. 60: Drying the leak sensor

4. Allow the sensor to adjust to the ambient temperature for a few minutes. The red sensor LED should now be dark. (The yellow LED may be dark or illuminated; this LED does not indicate errors.)
5. If no errors are reported, you can resume operation.
6. *Loading pump only*
   Test the loading pump for leakage after you have carried out maintenance or repair work on the fluid connections (→ page 211).
   NC pump only
   Visually check the NC pump for leakage while pressure builds up. If leakage occurs for the NC pump, the message 'Cannot regulate flow' will appear on the pump display (→ page 149).

Tip: If the sensor is not dry, the **Status** LED for the pump module remains red. If a message appeared on the front panel display, select **Clear** on the navigation bar to remove the message from the display.

7.3 Removing Gas and Humidity from the Column Compartment

When a certain concentration of gas or humidity is reached inside the column compartment (while the door of the column chamber is closed), the related sensor is activated and the **Status** LED on the front panel door changes to red.

1. Find and eliminate the leak (wearing appropriate protective clothing).
2. Beeping stops for the current alarm when you open the front panel door.
3. Ventilate the interior of the column chamber thoroughly; only then, close the front panel door.
4. If the sensor is not activated again after the door has been closed, you can resume operation.

Tip: The **Status** LED for the column compartment remains red as long as the sensor is exposed to gas or humidity. If a message appeared on the front panel display, select **Clear** on the navigation bar to remove the message from the display.

7.4 Rear Seal Wash System

7.4.1 Inspecting the Rear Seal Wash System for Leakage

1. Remove the seal wash tubing from the detector.

Fig. 61: Detector of the seal wash system

2. Draw seal wash solution into a syringe at the open end of the tubing. Press the lever of the peristaltic pump to the right so that the liquid can easily pass the system.
3. Press the lever of the peristaltic pump firmly onto the tubing, and then press liquid into the seal wash system from the syringe.
4. Inspect the tubing and connections of the seal wash system for indications of leakage. Tighten or replace leaking connections as necessary.
5. Connect the seal wash tubing to the *inner* port (→ Fig. 61). The outer port has no function.

7.4.2 Replacing the Peristaltic Tubing

Description	Part No.
Peristaltic tubing (= PharMed tubing, white) from the Tubing Kit for the Rear Seal Wash System	6040.9502

1. First, remove the seal wash tubing from the seal wash reservoir to avoid liquid spill.
2. Remove the peristaltic tubing from the peristaltic pump. Press the lever to right, remove the tubing from the pump, and release the lever.

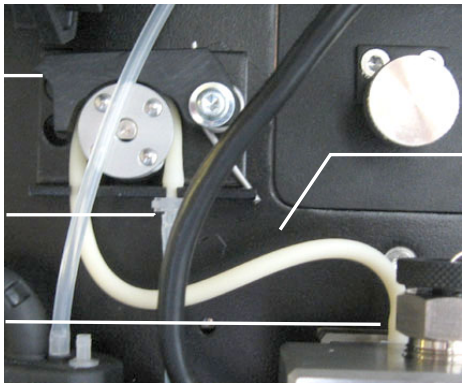


Fig. 62: Peristaltic pump

3. Disconnect the peristaltic tubing from the connection port on the pump head.
4. Disconnect the other end of the peristaltic tubing from the seal wash tubing (clear tubing).
5. Locate the PharMed tubing (white tubing) in the Tubing Kit for the Rear Seal Wash System and cut the tubing to the required length.
6. Connect the replacement tubing to the connection port on the pump head and to the tubing from the seal wash reservoir.
   Push the PharMed tubing onto the connector as far as it goes on (a small collar should be visible).
7. Engage the tubing in the peristaltic pump. Press the lever to right, place the tubing in the pump, and release the lever.
8. Update the service information in Chromeleon. Perform the **RearSealWashTubeChanged** command (→ page 132).

7.4.3 Cleaning the Detector Electrodes

The detector electrodes can be contaminated by deposits impairing the correct functioning of the seal wash system.

1. Remove the seal wash tubing from the detector (→ Fig. 61).
2. Remove the detector from the drain port of the seal wash system by pulling the detector upward. (The detector cable remains connected in the pump.)
3. Clean the electrodes with distilled water and wait until they are dry. The electrodes in the detector are critical for proper operation. Therefore, be careful not to bend or otherwise damage them during cleaning.

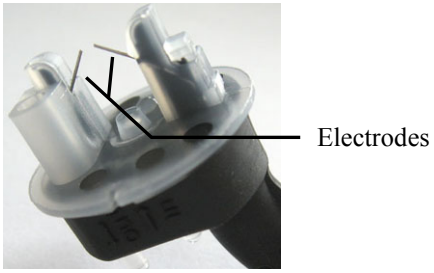


Fig. 63: Detector of the seal wash system

4. Reinstall the detector.
5. Connect the seal wash tubing to the *inner* port (→ Fig. 61). The outer port has no function.

7.5 Replacing the Check Valve Cartridges

Two check valves are installed in the pump head: inlet check valve and outlet check valve (→ Fig. 65, page 184, nos. 11 and 13).

Description	Part No.
Check valve cartridge, ceramics, for the NC pump and loading pump (the cartridge is the same for both the inlet and outlet valve)	6041.2301
Check valve cartridge, sapphire, for the NC pump and loading pump (the cartridge is the same for both the inlet and outlet valve)	6041.2300
Valve nut kit (inlet check valve nut and outlet check valve nut) for NC pump and loading pump	6042.7007

1. If necessary, purge the pump to remove harmful solvents.
2. Set the pump flow rate to 0.
   Open the related purge valve to the stop to reduce the pressure down to zero.
3. Put on a pair of clean room gloves to prevent contamination on the valve parts. Even minute particles may cause damage to the system and result in poor pump performance.
4. Disconnect *all* tubing connections from the inlet and outlet check valves. Observe the information about the different fitting connections on page 57.

   To remove the capillary on the outlet valve nut, consider disconnecting the other end of the capillary (on the rear (lower) connection port) first to facilitate the procedure.
5. Loosen the check valve nuts, by using an open-end wrench (size 13), and remove them from the pump head.
6. Hold the nuts over your hand and turn them upside down, allowing the cartridges to drop into your hand.
7. Insert a new cartridge into the check valve nut. Make sure that you insert the cartridge in the direction of solvent flow, as indicated by the arrow on the cartridge.
8. Screw the valve into the pump head and tighten the check valve (recommended torque: 10 Nm). Do not overtighten; this will crush the cartridge.
   Note the following:

   NC pump

   Optional: Installation of the inlet check vale may be easier while the pump head is removed. For information about how to remove and reinstall a pump head, see section 7.6.2 (→ page 188).

   Tighten the inlet check valve hand-tight and turn the bottom part so that the inlet opening points to the back right. Then, use an open-end wrench (size 13 mm) to tighten the nut until the inlet opening is on the front left (→ Fig. 64, page 183).

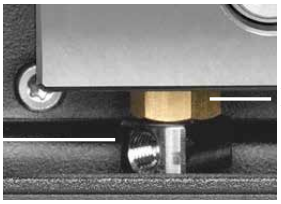


Fig. 64: Inlet check valve NC pump

Loading pump

Tighten the inlet check valve hand-tight and turn the bottom part so that the inlet opening points toward the back. Then, use an open-end wrench (size 13 mm) to tighten the nut until the inlet opening is on the left (about one-quarter turn; → Fig. 91, page 226).

9. Reconnect the tubing connections to the inlet and outlet check valve. Observe the following:

   Inlet check valve

   When you attach the solvent supply line to the inlet valve, take care to avoid cross-threading. If the valve leaks, you may tighten the fitting a little more.

   Outlet check valve

   Tighten the Viper fitting connection. Observe the information about the different fitting connections on page 57.

10. To prevent contaminants from entering the HPLC system, thoroughly rinse the pump (→ page 72).

11. *Loading pump only*
    Test the pump for leakage (→ page 211). Tighten leaking connections.
    NC pump only
    Visually check the NC pump for leakage while pressure builds up. If leakage occurs for the NC pump, the message 'Cannot regulate flow' will appear on the pump display (→ page 149).

12. Update the service information in Chromeleon (→ page 132).

7.6 Pistons and Piston Seals

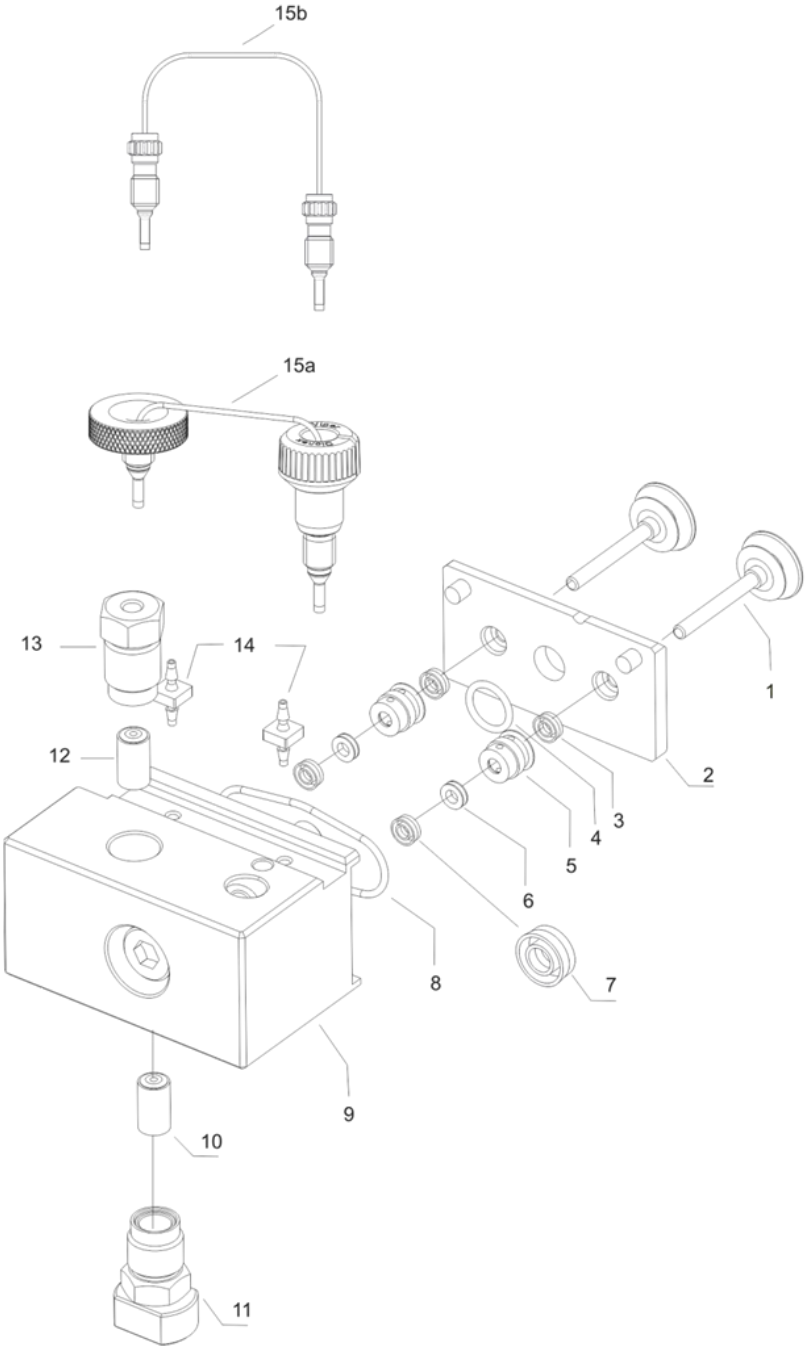


Fig. 65: Pump head, pistons, and piston seals

Depending on the pump version, the representation of a part may be different from the real part. However, the position of the parts is the same for all pump versions.

No.	Description	Part No.	
		NC pump	**Loading pump**
	Pump head, entire assembly, with:	6041.1901A	6041.1902
1	Piston (sapphire)	6040.0042 (= 2 pistons)	
2	Plate of the rear seal wash system	N.a.	
3	Piston seal (in plate of seal wash system) (normal phase)	6040.0306 (= 2 seals)	
4	Seal ring (rear seal wash system)	Included in 6040.2208	
5	Rear seal wash body (pump head bushing)	N.a.	
6	Support ring for the main piston seal	6040.0012	
7	Main piston seal (reversed phase)	6266.0305 (= 2 seals)	
8	Seal ring (rear seal wash system)	Included in 6040.2208	
9	Pump head	N.a.	
10	Valve cartridge (same as no. 12)	6041.2301	
11	Valve nut (inlet check valve)	Included in 6042.7007	
12	Valve cartridge (same as no. 10)	6041.2301	
13	Valve nut (outlet check valve)	Included in 6042.7007	
14	Tubing connector for the seal wash tubing	Included in 6040.9502	
15	Capillary from working cylinder to equilibration cylinder (U-tube)	Included in	Included in
	15a NC pump (nanoViper)	6041.3002	N.a.
	15b Loading pump	N.a.	6041.3001

7.6.1 Visually Inspecting the Pump for Piston Seal Leakage

You can inspect the pump visually for liquid leaks from the piston seals.

1. Flush the rear seal wash system with the seal wash solution.
   a) Remove the seal wash tubing from the detector.

Fig. 66: Tubing connection on the seal wash detector

   b) Draw seal wash solution into a syringe at the open end of the tubing. Press the lever of the peristaltic pump to the right so that the liquid can easily pass the system.
2. Remove some of the liquid by shaking the tube.
3. Follow the appropriate steps for the pump for which you want to perform the test:
   - NC pump: See further down on this page
   - Loading pump: See page 187.

NC pump

4. If you want to perform the test for the NC pump, make sure that the following conditions are fulfilled:
   - The loading pump is not delivering.
   - The pressure of the loading pump is down to zero.
5. Purge the flow meter (→ page 75).
6. To evaluate possible leakage, observe the air/liquid level in the silicone tube. Finish the observation before a new seal wash cycle starts.
   - If the level remains unchanged, the piston seals seal tightly.
     Proceed with the next step.
   - A rising level indicates leakage from one or more piston seals. Follow these steps:
     a) On the right pump head, remove the seal wash tubing connecting the left pump head to the right pump head.
     b) Repeat the observation.
     c) If the level rises again, replace the piston seals in the left pump head (→ page 194) and repeat the test starting with step 1. If the level does not rise, replace the piston seals in the right pump head and repeat the test starting with step 1.
     d) Reconnect the seal wash tubing to the right pump head.

7. Reconnect the seal wash tubing to the detector.
   Be sure to connect the tubing to the *inner* port (→ Fig. 66). The *outer* port has no function.

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

Loading pump

4. If you want to perform the test for the loading pump, make sure that the following conditions are fulfilled:
   - The NC pump is not delivering.
   - The pressure of the NC pump is down to zero.
5. Set the flow rate. Arrange the system in such a way that approximately 30 MPa of backpressure is produced.
6. To evaluate possible leakage, observe the air/liquid level in the silicone tube. Finish the observation before a new seal wash cycle starts.
   - If the level remains unchanged, the piston seals seal tightly.
     Proceed with the next step.
   - A rising level indicates leakage from one or more piston seals.
     Replace the piston seals (→ page 194).
7. Reconnect the seal wash tubing to the detector.
   Be sure to connect the tubing to the *inner* port (→ Fig. 66). The *outer* port has no function.

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

7.6.2 Pump Head and Pistons

7.6.2.1 Removing the Pump Head and Pistons

1. Tilt the front cover upward.
2. If necessary, purge the pump to remove harmful solvents.
3. Set the pump flow rate to 0. Open the purge valve and wait until the system pressure is down to zero.
4. Move the pistons into the appropriate position for piston replacement. To do so, perform the command for the pump head that you want to remove.

   - On the pump, perform the **Change Right Pump Pistons** or **Change Left Pump Pistons** command on the **Control** menu for the NC pump or the **Change Pump Pistons** command for the loading pump (→ page 101).

     Wait until the **Pump/Maintenance** screen indicates that the pump head can be removed, before you continue with the next steps.

   —or—

   - In Chromeleon, open the **Commands** dialog box for the NC pump or the loading pump and perform the **UndockPistons** command. (For the NC pump, the command appears under **NC_Pump_Wellness_LeftBlock** and **NC_Pump_WellnessRightBlock**; for the loading pump, the command appears under **LoadingPump_Wellness_RightBlock**.)

     Wait until the **PistonPositionStatus** property reports **Undocked** before you continue with the next steps.

5. *NC pump only*
   Move the pistons of the second pump head into the appropriate position for removal if applicable (**Undock**).
6. *NC pump only*
   Unplug the pressure transducer cable from the P-Work connector on the interior front panel.
7. Disconnect all fluid connections from the pump head. (It is not necessary to remove the U-tube, that is, the capillary from the working cylinder to the equilibration.)
   Observe the information about connecting capillaries and about the different fitting connections on page 57.
8. Loosen the pump head screw with the hexagon wrench (size 6 mm) from the accessories kit of the module.

9. Hold the pump head with one hand in its position, remove the pump head screw, and then remove the pump head toward you.

   NC pump
   The plate of the rear seal wash system and the pistons remain in the pump. If you want to clean or replace the pistons, remove the plate and pistons as described for the loading pump further down in this section. You need not remove the plate and pistons if you want to replace only the main piston seals.

   Loading pump
   The pistons are removed from the pump together with the pump head. Hold down the plate of the rear seal wash system on the pump head and remove the pistons from the head.

   If the plate of the rear seal wash system remains in the pump when you remove the pump head, set the pump head tool to the plate (→ Fig. 67). The pump head tool is provided in the accessories kit of the module. Carefully remove the plate from the pump block. Remove the pistons from the pump if needed.

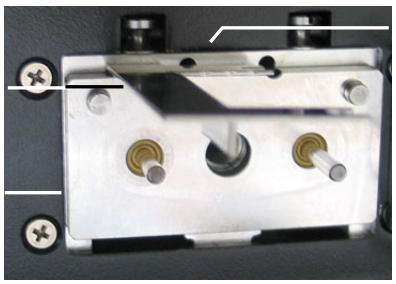


Fig. 67: Pump head tool, hooked in

7.6.2.2 Installing the Pistons and Pump Head

Description	Part No.
Pump head (entire assembly) NC pump Loading pump	 6041.1901A 6041.1902
Piston (2 pistons, sapphire)	6040.0042

1. *If you removed the pistons*

   a) Place the plate of the rear seal wash system onto the pump head.

   b) Inject a few drops of isopropanol into the piston cavities and insert the pistons.

   c) Use the pump head tool (spacing tool) to establish the correct distance between the piston and the plate of the rear seal wash system.

   Place the spacing tool on the plate of the rear seal wash system and push both pistons downward as far as possible. The distance is correct when both pistons touch the spacing tool. Remove the tool.

Fig. 68: Establishing the distance

2. Place the pump head back into the pump and tighten the pump head screw with the hexagon wrench (size 6) from the accessories kit of the module (recommended torque: 10 Nm).

   If both pump heads of the NC pump were removed, be sure not to interchange them during reinstallation. Note the label on the pressure transducer cable: A identifies the left pump head; B identifies the right head.

   Tip: Replacement pump heads have no label. For easy identification for future maintenance, consider marking the replacement pump heads accordingly.

3. Reconnect the fluid connections on the pump head.
   Observe the following:

   Loading Pump

   When installing the capillary from the pump head to the purge unit, make sure that you install the capillary in the direction of solvent flow. Note that one side of the capillary is longer than the other is. Connect the longer side to the pump head.

   NC pump and loading pump

   When you attach the solvent supply line to the inlet valve, take care to avoid cross-threading.

   Observe the information about connecting capillaries and about the different fitting connections on page 57.

4. Follow the appropriate steps for the pump for which you want to install the pump head:

   - NC pump: See further down on this page
   - Loading pump: See page 192.

NC Pump

5. Connect the pressure transducer cable to the P-Work connector on the interior front panel.

   When reinstalling the pump head you removed
   If messages relating to the working pressure appear on the pump display (for example, 'Implausible right working head pressure' or 'Implausible left working head pressure'), verify that the cable of the related pressure transducer is properly connected.

   When installing a replacement pump head
   Messages relating to the working pressure of the pump appear on the pump display. Ignore these messages for the moment. However, verify that the cable of the related pressure transducer is properly connected.

6. Return the pistons into the appropriate position for normal operation. To do so, perform the command for the pump head that you want to install:

   - On the **Pump/Maintenance** screen on the pump display, select **Dock**. Wait until the screen returns to the Main menu before continuing with the next steps.

   —or—

   - In Chromeleon, open the **Commands** dialog box for the NC pump and perform the **DockPistons** command. The command appears under **NC_Pump_Wellness_LeftBlock** and/or **NC_Pump_WellnessRightBlock**.

     Wait until the **PistonPositionStatus** property reports **Operational** before you continue with the next steps.

7. Flush the pump head with seal wash solution (→ step 1 on page 186).
8. *Depends on whether you install the pump head you removed or a new one*

   A—Reinstalling the pump head you removed

   Thoroughly purge the pump (pump heads and flow meter) (→ page 72).

   B—Installing a new pump head

   a) This step depends on the flow meter that is installed:

      - *If a Classic flow meter is installed*
        Run the **Pressure Transducer Test** (→ page 172). In step 2 of the test, always select the **Calibrate Anyway** check box (even if calibration is not explicitly recommended).
      - *If a ProFlow flow meter is installed*
        Run the **Zero Balance Test** (→ page 172).

   b) Purge the pump head (→ page 73).

   c) Close the flow meter outlet with a Viper fitting plug. Appropriate fitting plugs are available in the accessories kit of the module.

   d) Verify that the purge screws are closed.

   e) In Chromeleon, perform the **CalibrateWP** command for the replacement pump head. (The command appears in the **Commands** dialog box for the NC pump under **NC_Pump_Wellness_LeftBlock** and/or **NC_Pump_Wellness_RightBlock**.)

      Execution of the command takes about 30 seconds. A message appears *only if* an error has occurred.

      Note: A primary pressure of 90 MPa builds up during calibration.

   If you have replaced both pump heads, repeat the steps above for the second pump head.
9. Purge the flow meter (→ page 75).
10. Visually check the NC pump for leakage while pressure builds up. If leakage occurs for the NC pump, the message 'Cannot regulate flow' will appear on the pump display (→ page 149).

Loading pump

5. Return the pistons into the appropriate position for normal operation.

   - On the **Pump/Maintenance** screen on the pump display, select **Dock**. Wait until the screen returns to the Main menu before continuing with the next steps.

   —or—

   - In Chromeleon, open the **Commands** dialog box for the loading pump and perform the **DockPistons** command. (The command appears under **LoadingPump_Wellness_RightBlock**.)

Wait until the **PistonPositionStatus** property reports **Operational** before you continue with the next steps.

6. Flush the pump head with seal wash solution (→ step 1 on page 186).
7. To prevent contaminants from entering the HPLC system, thoroughly rinse the pump (→ page 72).
8. Test the pump for leakage (→ page 211). Tighten leaking connections.
9. Update the service information in Chromeleon (→ page 132).

7.6.3 Replacing the Piston Seals

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

Each piston has two piston seals: One main piston seal (reversed phase) in the front part of the pump head (→ Fig. 65, no. 7, page 184) and a piston seal in the plate of the rear seal wash system (→ Fig. 65, no. 3). Use the piston seals only for the positions for which they are intended. The (yellow) piston seals in the plate of the rear seal wash system are not intended for use as main piston seals.

The replacement procedure for the main piston seals in the pump head consists of

1. Removing the pump head and pistons (→ page 188)
2. Disassembling the pump head and removing the pistons seals (→ page 195)
3. Cleaning the pistons (→ page 196)
4. Reassembling the pump head (→ page 197)
5. *Recommended*: Replacing the piston seals in the plate of the rear seal wash system (→ page 199).
6. Installing the pistons and pump head (→ page 190)
7. After replacing the piston seals, observe the recommendations on page 200.

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

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

7.6.3.1 Disassembling the Pump Head and Removing the Piston Seals

1. To remove the pump head, follow the steps in section 7.6.2.1 (→ page 188).

   Tip: Never disassemble the pump head with bare hands and place the components only on a clean surface.

   Put on a pair of clean room gloves to prevent contamination on the pump parts. Even minute particles may cause damage to the system and result in poor pump performance.
2. Remove the plate of the rear seal wash system if required.

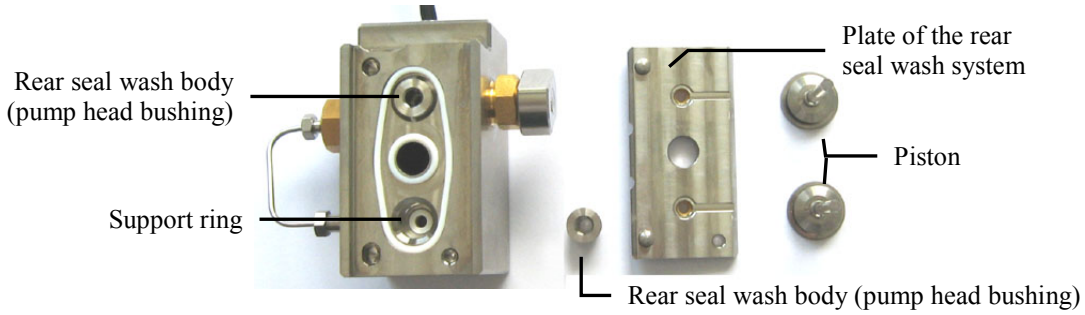


Fig. 69: Pump head removed

3. Remove the rear seal wash body (pump head bushing) from the pump head.
4. First, remove the support ring.
   Tap the pump head on a surface to make the support ring drop out. If this does not remove the support ring, push the seal *insertion* tool into the pump head and remove the tool. The support ring is removed together with the tool.

   Tip: Do *not* use the *seal removal tool* for the support ring because the ring can be removed from the tool only with difficulties.
5. Remove the piston seal from the pump head.
   Push the *seal removal tool* into the pump head as far as it goes in.

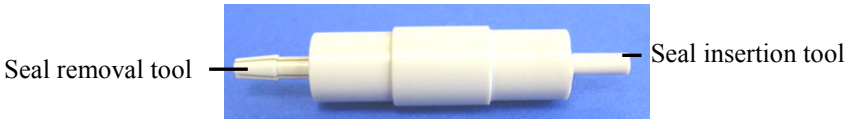


Fig. 70: Piston seal removal and insertion tool

6. Remove the tool from the pump head. The piston seal is removed together with the tool. The piston seal will be destroyed and cannot be reused.

7.6.3.2 Cleaning the Pistons

Cleaning the pistons is required only if you reinstall the pistons you removed. Verify that the pistons are clean and free of damage by using a light. Hold the rear side of the piston into the light. Dirt particles will be enlarged by the refraction of the light.

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

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

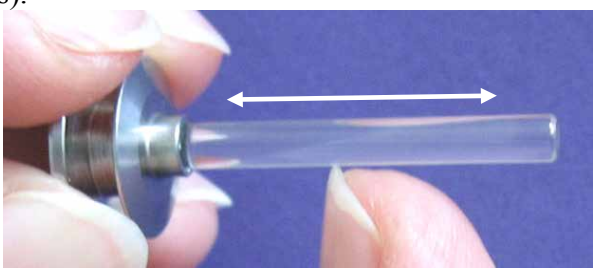


Fig. 71: Fingernail test

1. Carefully rinse the piston (preferably with isopropanol), and then rub it several times with a dry, lint-free tissue.
2. Consider repeating the fingernail test.
3. Inspect the piston for signs of damage. If no damage is visible, reinstall the piston. If the piston is scratched or scored, install a new piston.

7.6.3.3 Installing the Piston Seals and Reassembling the Pump Head

Description	Part No.
Main piston seal (reversed phase) (→ Fig. 65, page 184, no. 7) NC pump and loading pump (2 seals)	6266.0305
Support ring (→ Fig. 65, no. 6) for NC pump and loading pump	6040.0012

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

1. The support ring is *not* a wear part and thus, you need *not* replace the support ring when you replace the piston seal. However, before reinstalling the support ring, you should clean the support ring from the inside and outside, by using isopropanol, a cleaning swab (part no. 6040.0006), and a lint-free cloth or tissue.
2. Pipette a few drops of isopropanol onto the edge in the pump head on which the piston seal will rest.
3. First, slide the support ring, and then slide the piston seal onto the seal insertion tool (→ Fig. 70, page 195). Mind the correct orientation of the seal. The open side of the seal must face away from the tool.

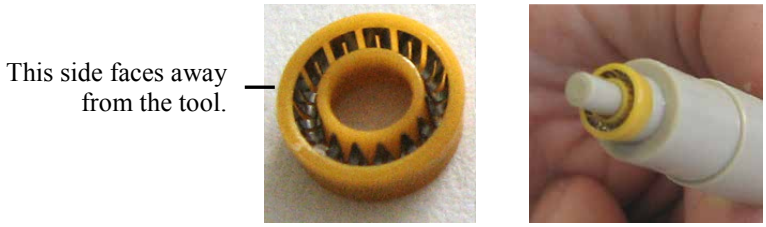


Fig. 72: Correct orientation of the piston seal

4. Push the piston seal tool into the pump head as far as it goes in.

5. Remove the tool from the pump head. The piston seal and the support ring remain in the pump head.

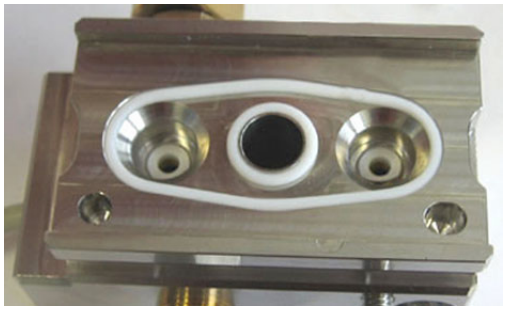


Fig. 73: Seal installed in the pump head

6. Insert the rear seal wash body (pump head bushing). Mind the correct orientation (→ Fig. 74). The even side faces the pump head; the opposite side faces the plate of the rear seal wash system.

Fig. 74: Orientation of the rear seal wash body

7. If required, place the plate of the rear seal wash system onto the pump head as shown in the picture. The channels in the plate are facing you.

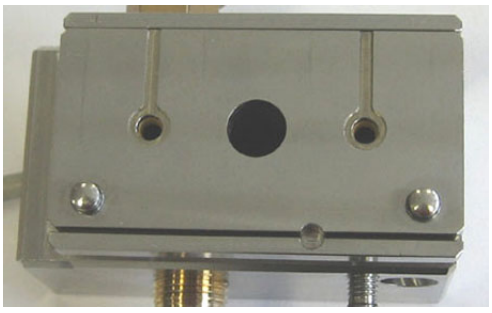


Fig. 75: Plate of the rear seal wash system installed

8. Install the pistons and pump head (→ page 190).
9. After replacing the piston seals, observe the recommendations on page 200.
10. Update the service information in Chromeleon (→ page 132).

7.6.3.4 Replacing the Piston Seals in the Plate of the Seal Wash System

Description	Part No.
Piston seal in plate of seal wash system (→ Fig. 65, page 184, no. 3) for NC pump and loading pump	6040.0033

1. To remove the pump head and pistons, follow the steps in section 7.6.2.1 (→ page 188).
2. Remove the plate of the rear seal wash system.
3. Set the seal insertion tool to the side of the seal (on the low-pressure side of the plate) as shown in the picture and push the seal out of the plate.

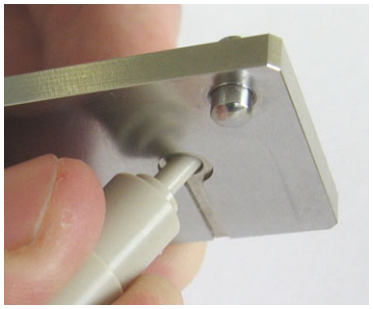


Fig. 76: Removing the seal from the plate of the seal wash system

4. Insert and push the replacement seal into the plate (high-pressure side) with your hand. To prevent contamination, put on a pair of gloves.

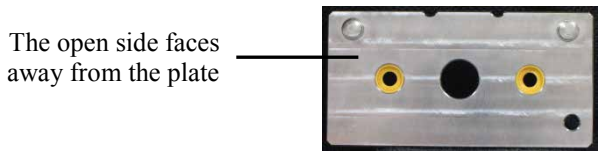


Fig. 77: Inserting the piston seal into the plate of the rear seal wash system

5. Place the plate of the rear seal wash system onto the pump head.
6. Install the pistons and pump head (→ page 190).

7.6.3.5 Recommended Actions after Main Piston Seal Replacement

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

NC pump

1. Purge both pump heads of the NC pump for 15 minutes with isopropanol (→ section 4.5.3.1.1, page 73).
2. Afterward, purge the pump heads with the solvent used for the application. Purge the pump heads for a minimum of 30 minutes to make sure that the isopropanol is completely removed from the pump.
3. Finally, purge the flow meter (→ page 75) with the solvent used for the application (at least for 30 minutes).
4. *Recommended*
   Perform flow meter diagnostic tests depending on the flow meter installed. For test details, see page 134.
   - *For ProFlow flow meter:* Run the following diagnostic tests in the given order:
     1. Zero Balance Test
     2. Detailed Leak Test
   - *For Classic flow meter* Run the following diagnostic tests in the given order:
     1. Pressure Transducer Test
     2. Detailed Leak Test
     3. Viscosity Measurement

     If Viscosity Measurement fails, the new seals may not yet seal sufficiently tight. Purge the flow meter for another 30 to 60 minutes (→ page 75) and repeat the test.

Loading pump

- Never run the pump dry. Damage to the pistons or the piston seals could result.
- Allow new piston seals to run in.
  a) Connect drain tubing to the purge outlet nozzle.
  b) Open the purge valve.
  c) Operate the pump for 15 minutes with isopropanol at a flow rate of 1 mL/min. Do *not* deliver in circles.
  d) Close the purge valve.
  e) On the pump outlet, install a flow resistance, for example, a capillary, that can produce approximately 30 MPa at a flow rate of 1 mL/min.
  f) Have the pump deliver isopropanol at 1 mL/min for another 30 minutes.
  g) Check the permeability of the filter frit in the inline filter (→ page 209).
  h) Remove the capillary from the pump outlet and connect the pump to the system.

- *Recommended*
  Run the **General Leak Test** from Chromeleon (→ page 134).
- In rare cases, new seals may still show an increased leakage rate after several hours of operation.

  If leakage is observed with new piston seals, operate the pump for at least 2 hours at 35 MPa to run in the seals. (It does not help if you tighten the pump head screw more.)

  Tip: If the piston seals do not yet seal sufficiently tight, try the following: Have the pump build up high pressure (→ page 211) and hold the pressure for some minutes.

7.7 Flow Meter

7.7.1 Replacing the Flow Meter

Description	Part No.
ProFlow flow meter, with thermal flow sensors for nano LC (50 – 1500 nL/min)	6041.7850
Classic flow meter, with flow selector for capillary LC (0.5 - 10 µL/min)	6041.7902A
Classic flow meter, with flow selector for micro LC (5 - 50 µL/min)	6041.7903A

⚠ **Important:** To avoid damage from electrostatic discharge, wear appropriate earthing protection for the replacement procedure.

⚠ **Important:** Pour éviter des dommages de décharge électrostatique vous devriez employer la protection à la terre appropriée.

1. Turn off the module by pressing the power switch on the rear of the module.
2. Unplug the pressure transducer cables.
3. Disconnect the capillaries connected to the flow meter inlets and outlet.

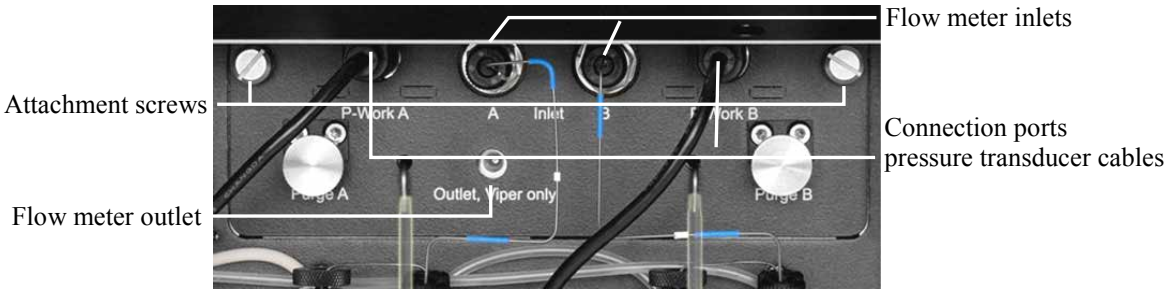


Fig. 78: Flow meter (here: Classic flow meter)

4. Loosen the two screws that attach the flow meter and pull the flow meter out toward the front.
5. *With Classic flow meters only*
   Replace the flow selector if required (→ page 204).
6. Install the replacement flow meter in the reverse order.
   Be careful not to pinch any tubing.
7. Turn on the module by pressing the power switch on the rear of the module.
   Messages relating to the working pressure may appear on the pump display; these messages can be ignored.

8. Purge *both* pump heads of the NC pump (→ page 73).
9. Purge the flow meter (→ page 75).
10. Depending on the flow meter installed
    - *ProFlow flow meter*
      Run the **Zero Balance Test** (→ page 172).
    - *Classic flow meter*
      Run the **Pressure Transducer Test** (→ page 172).
11. Close the flow meter outlet with a Viper fitting plug (included in the accessories kit of the module) and verify that the purge valves are closed.
12. In Chromeleon, perform the **CalibrateWP** command for both pump heads. (The command appears in the **Commands** dialog box for the NC pump under **NC_Pump_Wellness_LeftBlock** and/or **NC_Pump_Wellness_RightBlock**.)
13. *Required only if a ProFlow flow meter was installed*
    Purge the flow meter again (→ page 75).
14. *Recommended for Classic flow meters*
    Repeat the **Pressure Transducer Test** when the module has been operated with the new flow meter for about one day. Allow a warm-up period of 24 hours for the new flow meter to achieve optimum reproducibility.
15. Note the following for the solvent line:
    - *Recommended for the ProFlow flow meter:* Use solvent lines with shut off valves. If you installed a ProFlow flow meter, make sure that solvent lines with shut off valves are connected.

      For instructions on installing shut off valves, see section 7.8 (→ page 206).
    - With a Classic flow meter, a solvent line with or without shut off valve can be used, as applicable.

7.7.2 Replacing the Flow Selector in a Classic Flow Meter

This section applies only for Classic flow meters.

The following flow selectors are available:

Flow selector for	Part No.
Capillary LC (0.5 - 10 µL/min)	6041.0003
Micro LC (5 - 50 µL/min)	6041.0014

Tip: Observe the following precautions:

- Avoid bending or kinking the capillaries.
- Make sure that the connectors are free from contaminants and close the open ends with the black caps. Particles may clog the flow selector.

1. Remove the flow meter (→ page 202).
2. First, remove the screw that attaches the flow selector.

Fig. 79: Flow selector

3. Afterward, remove the capillaries marked a) through d) in the picture (in any order).
4. Remove the flow selector.
5. Install the replacement flow selector in the reverse order. The pump recognizes automatically that a selector for a different flow range has been installed.
6. Reinstall the flow meter and then perform steps 7 through 15 (→ page 202).

7. Observe the following:

   - If the module was powered off by the power switch for a longer period (≥ 1 day), allow a warm-up period of 24 hours to achieve optimum reproducibility.
   - If the module was powered off by the power switch less than one day, allow a warm-up period of 60 minutes to achieve full accuracy.

7.7.3 Replacing the Filter Frit in a ProFlow Flow Meter

This section applies for ProFlow flow meters only.

The flow meter inlets on the ProFlow flow meter accommodate a built-in inline filter each. If a filter frit is clogged, replace the filter frit.

Description	Part No.
Filter frits for inline filter (2 frits, porosity: 2 µm)	6268.0036

To replace the filter frit in an inline filter on the inlet of the ProFlow flow meter, follow these steps:

1. Stop the pump flow.
2. On the ProFlow flow meter, disconnect the capillary from the inlet.
3. Open the inline filter with a wrench (size 13 mm). Remove the filter frit.
4. Pipette a drop of solvent into the frit holder and insert the replacement frit. Close the filter housing. The solvent keeps the frit in the holder during closing.
5. Perform a **Detailed Leak Test** for the flow meter (→ page 134).

7.8 Installing and Removing Solvent Shut Off Valves

Solvent shut off valves enable opening and closing the solvent flow path to the pump heads, for example, to prevent solvent from flowing through the system when you open a flow connection on the low-pressure side.

Tip: *Recommended for ProFlow flow meter:*
Use the solvent shut off valves in the solvent lines. For solvent calibration, the solvent shut off valves need to be installed in the solvent flow path.

Installing Solvent Shut Off Valves

Parts required

- Shut off valve
- Solvent line
- Elbow tubing (shipped with the solvent line)

Follow these steps

1. Stop the pump flow and wait until the pressure is down to zero.
2. Unscrew the cap of the solvent reservoir and remove the solvent line together with the cap from the reservoir.
3. Purge the pump until the solvent line is empty.
4. *Proceed as required*

   - *If the solvent line is to be replaced*

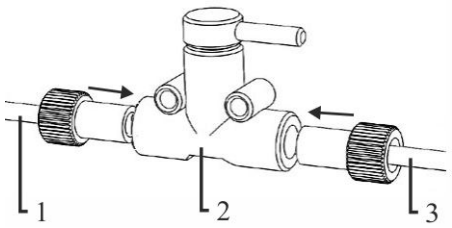
     a) Disconnect the solvent line from the reservoir cap.

     b) Connect the new solvent line to the solvent reservoir. See section 4.3.2.1, page 63.

   - *If the solvent line remains connected to the solvent reservoir*

     Retighten the reservoir cap hand-tight. Verify that the retaining guide remains in the hole in the reservoir cap. If it does not, press the retaining guide into the hole to ensure that the tubing is kept in place in the cap.
5. Connect the shut off valve to the free, flanged end of the solvent line and to one end of the elbow tubing.

6. Connect the other end of the elbow tubing to the pump head inlet.



No.	Description
1	Elbow tubing to pump head
2	Shut off valve
3	Solvent line to solvent reservoir

Fig. 80: Installing a shut off valve in a solvent line

Removing Solvent Shut Off Valves

1. Stop the pump flow and wait until the pressure is down to zero.
2. Close the shut off valve.
3. Disconnect the elbow tubing from the pump head and empty the line into waste.
4. Unscrew the cap of the solvent reservoir and remove the solvent line together with the cap from the reservoir.
5. Empty the solvent line to the reservoir into waste.
6. Disconnect the shut off valve with the elbow tubing from the solvent line to the reservoir.
7. Connect the solvent line between pump head inlet and solvent reservoir.

7.9 Inline Filter (Loading Pump)

7.9.1 Checking the Filter Frit for Permeability

Check the permeability of the frit in the inline filter at regular intervals.

1. Disconnect the capillary on the filter outlet.
2. Have the pump deliver water at a flow rate of 2 mL/min.
   When the pump outlet is open, the pressure should be less than 0.5 MPa.
3. Replace the frit if necessary (→ page 209).
4. Reconnect the capillary to the outlet of the inline filter.
5. Test the loading pump for leakage (→ page 211).

Tip: As an alternative, you can check the permeability of the filter frit in the inline filter also from Chromeleon by running the **Mixer Frit Test** (→ page 134).

7.9.2 Replacing the Inline Filter

Description	Part No.
Inline filter (volume: 10 µL) with filter frit (porosity: 2 µm)	6042.5014
Capillary from purge unit to inline filter	Included in 6041.3001

1. Disconnect the capillaries on the filter inlet and outlet and remove the inline filter from the pump.

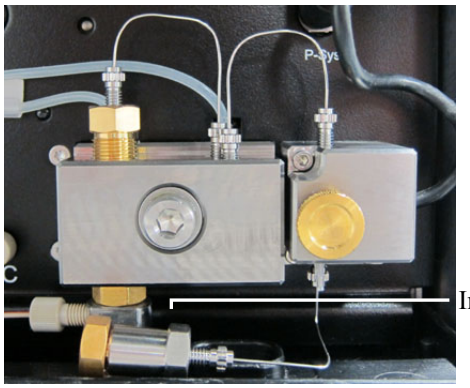


Fig. 81: Inline filter

2. Connect the capillaries to the replacement inline filter (observing the direction of flow through the filter as indicated by an arrow on the filter) and place the filter below the pump head in the pump enclosure.
3. In Chromeleon, verify that the **StaticMixer** property is set to **InlineFilter_10µL**. If the property is not set to the correct value, the leak tests (→ page 134) may not provide reliable results.

7.9.3 Replacing the Filter Frit in the Loading Pump

To replace the filter frit in the loading pump, follow the steps below.

Description	Part No.
Filter frits for inline filter (2 frits, porosity: 2 µm)	6268.0036

1. Remove the inline filter as described in section 7.9.2.
2. Open the inline filter and remove the filter frit.
3. Pipette a drop of solvent into the frit holder and insert the replacement frit. Close the filter housing. The solvent keeps the frit in the holder during closing.
4. Install the inline filter as described in section 7.9.2.
5. Test the loading pump for leakage (→ page 211).
6. After you have replaced the filter frit, update the related service information in Chromeleon. To do so, perform the **MixerFritChanged** command.

7.10 Replacing the Purge Screw (Loading Pump)

Relevant only for the loading pump

Description	Part No.
Purge screw (with integrated cap seal) for loading pump	6040.2035

Replace the purge screw when

- Leakage is observed around the valve screw when the valve is open.
- Leakage is observed on the purge outlet when the valve is closed.

1. If necessary, purge the pump to remove harmful solvents.
2. Set the pump flow rate to 0. Wait until the system pressure is down to zero.
3. Remove the purge screw from the purge unit. Turn the screw counterclockwise all the way and then pull it straight off the purge unit.
4. Before installing the replacement purge screw, clean the hole in the purge unit with a cleaning swab (part no. 6040.0006).
5. Hold the replacement purge screw carefully. You should not hold the screw by the seal end to avoid scratching the seals. These scratches will prevent proper seal and allow leakage.

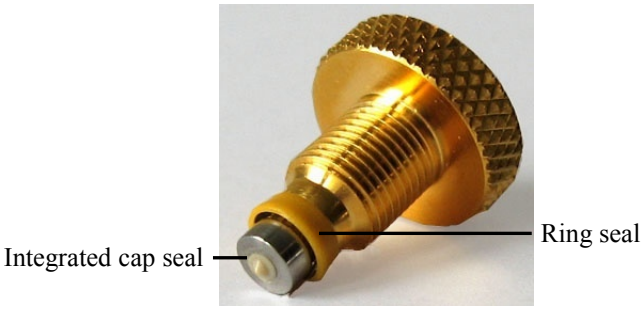


Fig. 82: Purge screw

6. Insert the purge screw into the purge unit, turn the screw clockwise, and tighten fingertight. Tighten with your hand only (use no tool). Overtightening may destroy the purge valve seals.
7. Resume operation and check whether liquid leaves the purge outlet. If it does, the screw may not be tightened enough. Tighten the screw a little more.

7.11 Testing the Loading Pump for Leakage

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

Tips: As an alternative, you can test the loading pump for leakage also by running the diagnostic functions in Chromeleon (→ page 134).

If leakage occurs for the NC pump, the message 'Cannot regulate flow' will appear on the pump display (→ page 149).

1. Close the outlet of the loading pump with an appropriate fitting plug (for example, Viper fitting plug, part no. 6040.2303).
2. In Chromeleon, in the **Commands** dialog box for the loading pump, set the upper pressure limit to 50 MPa under **Pressure > UpperLimit**.
3. In Chromeleon, select a flow rate of, for example, 30 µL/min.
4. Decrease the flow as soon as the pressure builds up, typically between 20 and 30 MPa.
5. Have the pump deliver some µL/min until a pressure of 45 MPa has built up.
6. When this pressure has been built up and when the pump delivers a flow of 1 µL/min, the pressure should increase or remain constant at least. If it does not, this indicates possible leakage.
7. Find and eliminate the cause for the leak, and then perform the test described under this list. Possible sources are:
   - *Capillary connections*
     Inspect them for signs of leakage and tighten leaking connections.
   - *Piston seals*
     - Inspect the piston seals for leakage (→ page 186).
     - Replace the piston seals (→ page 194).
     - If leakage is observed with new piston seals, operate the pump for at least 2 hours at 35 MPa to run in the seals. (In this case, tightening the pump head screw does not help.)
   - *Check valves*
     - Tighten the valve nuts (→ page 182).
     - Remove the valve cartridges (→ page 182) and clean them, for example, in an ultrasonic bath.
   - *Purge valve*
     Inspect the purge screw and purge unit for indications of leakage.

Test

a) Pressure up the pump. This is the best way to identify a leaking connection.

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

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

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

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

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

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

7.12 Column Switching Valve

The column compartment can be equipped with one or two column switching valves (→ page 19).

To ensure optimum operation of the valve, observe the following guidelines:

- To prolong the life cycle of the valves, avoid moving the valves dry.
- Maintenance requirements are kept to a minimum. In most instances, it will be sufficient to clean the valve by flushing all lines with an appropriate solvent. The nature of the solvent to be used depends on the samples and the mobile phases that are used.

  Use a common solvent, such as methanol or acetonitrile, or an 80:20 mixture of methanol or acetonitrile and water.

7.12.1 Replacing the Column Switching Valve

Description	Part No.
2-position, 6-port switching valve*	6041.0004
2-position, 10-port switching valve	6041.0001
* Both valves are suitable for pressures < 86 MPa (12500 psi).	

1. Do not touch any metal or plastic parts inside the column chamber while the temperature is higher than 50 °C. Before carrying out any work in the column compartment, wait for the column chamber to cool down.

   To shorten the cool-down time, consider setting a lower temperature and opening the front panel door.

2. Pull the column switching valves toward the front. To do so, turn the lever for the actuators to the right and pull it toward the front as far as it goes out (→ Fig. 35, page 78).

3. Grasp the valve that you want to replace and pull out firmly to remove the valve from the actuator.

4. Install the replacement valve as described in section 4.6.1, step 3 and following steps (→ page 78).

5. When the valve is replaced, the rotor seal is also replaced. Therefore, in Chromeleon, update the service information for the rotor seal. Perform the **LeftRotorSealChanged** command or **RightRotorSealChanged** command as appropriate.

7.12.2 Replacing the Valve Stator and Rotor Seal

Description	Part No.
Stator for 2-position, 6-port switching valve 2-position, 10-port switching valve	 6041.0007 6041.0005
Rotor seal for 2-position, 6-port switching valve 2-position, 10-port switching valve	 6041.0008 6041.0006

1. Do not touch any metal or plastic parts inside the column chamber while the temperature is higher than 50 °C. Before carrying out any work in the column compartment, wait for the column chamber to cool down.

   To shorten the cool-down time, consider setting a lower temperature and opening the front panel door.

2. Pull the column switching valves toward the front. To do so, turn the lever for the actuators to the right and pull it toward the front as far as it goes out (→ Fig. 35, page 78).

3. Grasp the valve for which you want to replace the stator and/or rotor seal and pull firmly to remove the valve from the actuator.

4. Remove the stator screws, by using a hexagon wrench (size 9/64"). Alternately, loosen all screws in turn until you can remove them.

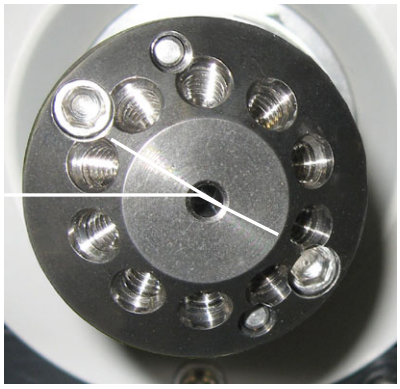


Fig. 83: Stator screws

5. Remove the stator from the valve body. To avoid damage to the sealing surface turn the stator so that it rests on its outer surface.

6. Carefully remove the rotor seal with your hand.

   To avoid scratches on the sealing surfaces, do not use pointed or sharp-edged tools to remove or install a seal. Even minute scratches may result in poor sealing performance of the valve.

7. Inspect the sealing surfaces of the rotor seal and stator for scratches. If scratches are visible, replace the rotor seal and/or stator.
8. Insert the replacement rotor seal.
   - Observe the orientation of the seal: The sealing surface with the engraved flow passages must be facing out. The pattern is asymmetrical to prevent improper placement of the rotor seal.
   - Be careful to avoid contamination on the valve parts. Even minute particles may cause damage to the valve and result in poor sealing performance.
9. Reinstall the stator and tighten both stator screws alternately, each time with approximately one-quarter turn, until they are tightened.

   Avoid overtightening. The screws hold the assembly together and do not affect the sealing force, which is automatically set as the screws close the stator against the valve body.
10. Reinstall the valve as described in section 4.6.1, step 3 and following steps (→ page 78).
11. Test the valve by pressurizing the system. If leakage is observed, replace the valve (→ page 213).
12. Update the service information in Chromeleon. Perform the **LeftRotorSealChanged** command or **RightRotorSealChanged** command as appropriate.

7.13 Replacing the Main Power Fuses

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

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

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

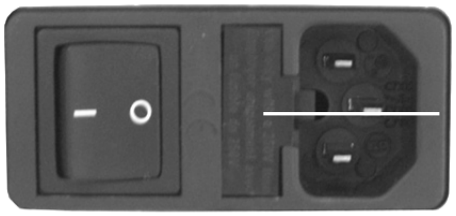


Fig. 84: Fuse cartridge

2. Replace the fuses.

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

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

Description	Part No.
Fuse, slow blow (5 x 20 mm) NCS-3500RS: 4 A NCP-3200RS: 2 A	Included in the Fuses Kit, part no. 6820.0026 For information about the kit, see section 11.3 (→ page 243).

3. Reinstall the fuse cartridge.

4. Reconnect the power cord to its source. Turn on the module.

7.14 Updating the Firmware

The module is shipped with the most recent firmware version. The firmware for the module is also included in Chromeleon.

To check which firmware version is installed in the module and which version is included in Chromeleon:

- *Firmware version in the module*
  - Turn on the module by pressing the power switch on the rear of the module. General information about the module appears on the pump display, including the firmware version.
  - On the pump display, select the **Diagnostics** menu (→ page 102) and select **Firmware version**.
- *Firmware version in Chromeleon*
  - In the **Server Configuration** program, open the configuration pages for the module (→ page 53). On the **General** page, the firmware version is displayed (→ page 46).
  - In the Windows Explorer, locate the **IQReport.log** file in the IQ folder of your Chromeleon installation. In the file, search for NCS3000.hex (also for the NCP-3200RS).

Tip: When updating the firmware in the module from Chromeleon, this information will also be provided during the download (see further down in this section).

Whenever a new firmware version is released for the module, the new version will be provided with the next Chromeleon Service Release and described in the release notes.

The new firmware will *not* be downloaded automatically to the module when you install a Chromeleon Service Release. To update the firmware, follow these steps:

Important: To ensure that the download is successful, make sure that the communication between the module and Chromeleon is not interrupted during the download and that you do not turn off the module.

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

1. Before you begin, verify that
   - The module is connected in Chromeleon.
   - The Chromeleon server is in *running idle* mode. All processes on the Chromeleon server PC and in Chromeleon have been stopped.
   - The pump is unpressurized (for example, the purge valve is open) and the flow is turned off.

2. Start the **Server Configuration** program (→ page 45).
3. Right-click the module in the timebase and click **Properties** on the menu.
4. On the **General** page (→ page 46), the firmware version provided by Chromeleon for the module is displayed in the **Firmware** box. If more than one firmware version is available for the module in Chromeleon, select the version you wish to transfer from the **Firmware** list.
5. Click **Download**. A message displays the firmware version that is currently installed in the module and the version that will be downloaded from Chromeleon.

   Tip: If the module comes with a newer firmware than the version included in Chromeleon, do *not* downgrade the firmware. Older firmware may be incompatible with new hardware revisions.

6. Click **Yes** to start the download. (Click **No** to cancel the action.)

The download may take several minutes. The download is complete when **Firmware download completed successfully** appears in the **Messages Server** window in the Chromeleon Server Configuration program. The message appears also in the Chromeleon Audit Trail.

Immediately after the new firmware has been downloaded from Chromeleon to the module, the module performs a reset. For about 15 seconds, the internal boot loader is updated. Do *not* turn off the module while the boot loader is updating.

If the download from Chromeleon is not successful, the related messages appear in the Audit Trail. In this case, turn the module off and on again. Repeat the download as described above. If the download fails again, contact Thermo Fisher Scientific Service for Dionex HPLC Products.

8 Module-Specific Information

The following sections provide specific information about the components in the module:

8.1 NC Pump

8.1.1 Interior Components (Detailed View)

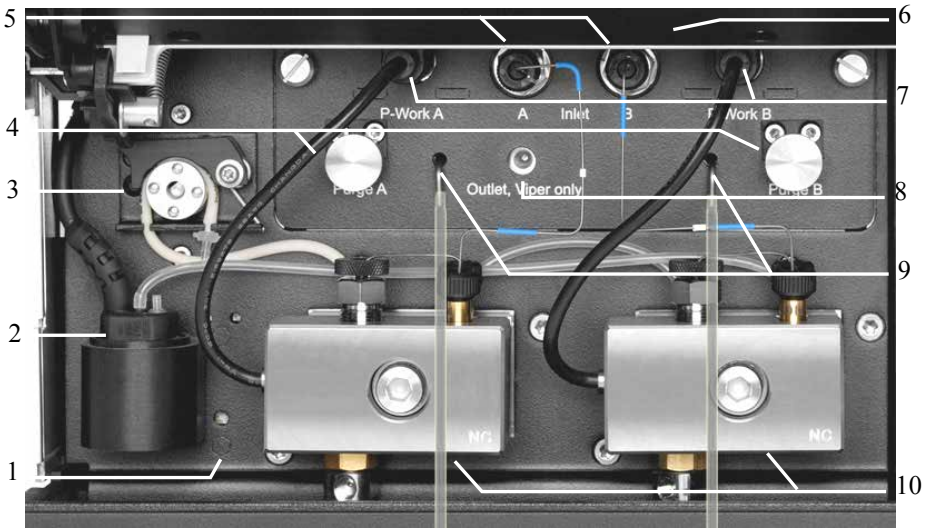


Fig. 85: NC pump with Classic flow meter (detailed view)

No.	Description
1	Leak sensor
2	Detector of the seal wash system
3	Peristaltic pump
4	Purge screw
5	Flow meter inlet
6	Pump lights (here hidden by the front panel door)
7	Connector for the pressure transducer cable (working pressure of the pump head)
8	Flow meter outlet
9	Purge outlet
10	Pump head

8.1.2 Flow Path

The picture illustrates the liquid flow path through the pump.

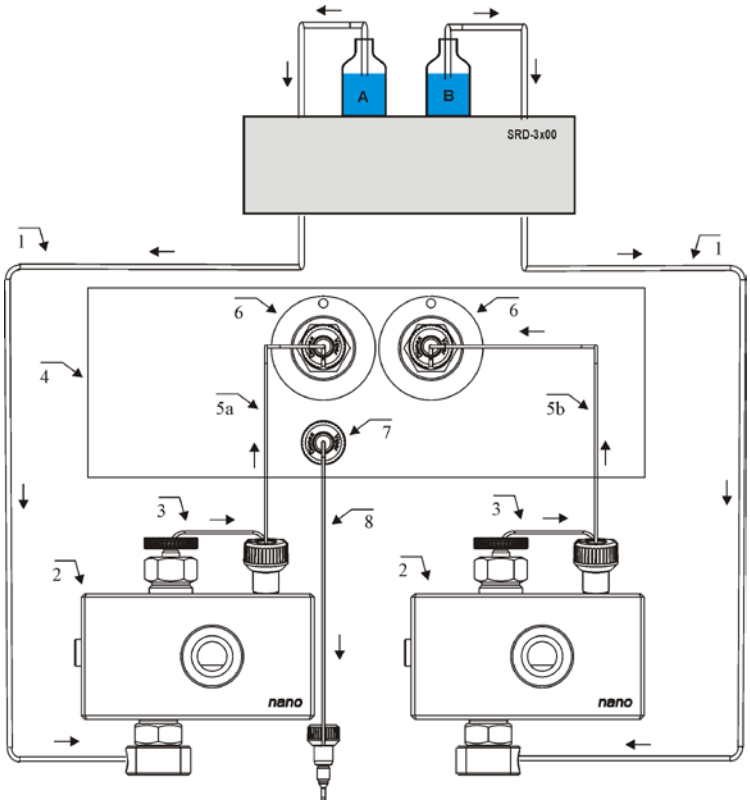


Fig. 86: Flow path through the NC pump (here: Classic flow meter)

No.	Description	Part No.
	SRD-3x00 Solvent Rack	→ page 20
1	Solvent supply line to pump head, depending on the system stack NCS-3500RS (1.0 x 1000 mm I.D. x L) NCP-3200RS (1.0 x 1000 mm ID x L; 1.0 x 1300 mm ID x L)	6041.2540 6041.2540; 6041.2530
2	Pump head with working cylinder and equilibration cylinder (entire assembly)	6041.1901A
3	Capillary from working cylinder to equilibration cylinder (U-tube)	Included in 6041.3002
4	Flow meter	→ page 202
5a	Capillary from left pump head to flow meter	Included in 6041.3002
5b	Capillary from right pump head to flow meter	Included in 6041.3002
6	Flow meter (inlet)	----
7	Flow meter (outlet) (pump outlet)	----
8	Capillary connection (nanoViper)	Depending on the application

8.1.3 Operating Principle

The NC pump provides two essentially identical solvent channels A and B. Each channel has a dual-piston pump that can deliver flow continuously without need for refill cycles. The flow meter module includes several sensors that measure the channel pressures and flow rates, and thus control the pumps such that they meet the set values. At the flow meter outlet, both partial flows are mixed, which results in the desired flow rate and solvent composition.

8.1.3.1 ProFlow Flow Meter

In the ProFlow flow meter, each dual-piston pump (nos. 2a and 2b) is controlled by the associated thermal flow sensor (nos. 5a and 5b). The partial flows of these flow-controlled pumps (nos. 1a and 1b) are mixed in a Y piece (no. 6) at the outlet of the flow meter.

The picture illustrates the functional blocks of the pump with a ProFlow flow meter.

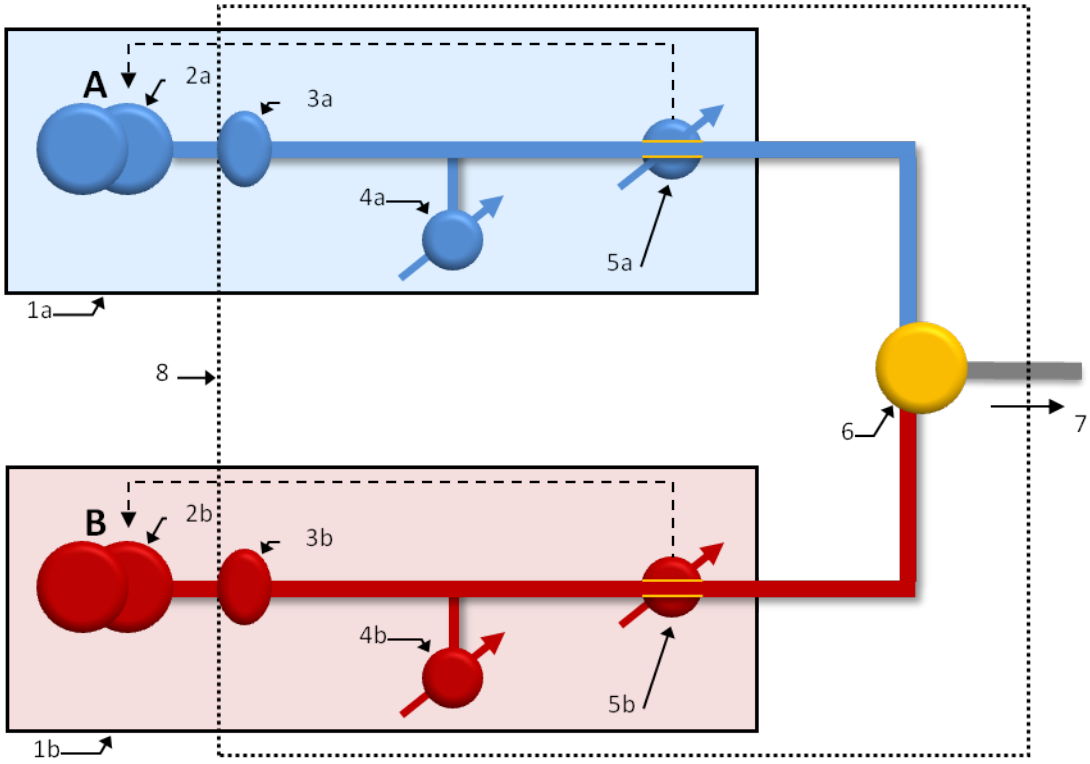


Fig. 87: Functional blocks of the NC pump with a ProFlow flow meter

No.	Element	No.	Element
1a / 1b	Flow-controlled pump, left (A) and right (B)	5a / 5b	Thermal flow sensors, left/right
2a / 2b	Dual-piston pump, left / right	6	Y piece
3a / 3b	Filter unit, left / right	7	Flow meter outlet, capillary connection to the other modules of the HPLC system
4a / 4b	Primary pressure transducer, left / right	8	Flow meter module

Except for the dual-piston pumps (nos. 2a and 2b), all parts shown in the picture are located in a plug-in flow meter module (no. 8).

For a detailed flow meter diagram for the ProFlow flow meter, see section 8.1.3.3, page 224.

8.1.3.2 Classic Flow Meter

In the Classic flow meter, each dual-piston pump (nos. 2a and 2b) is controlled by the associated pressure sensor (nos. 4a and 4b). Each of these pressure-controlled pumps (nos. 1a and 1b) delivers its partial flow through a calibrated flow restrictor (nos. 5a and 5b). Both partial flows are mixed in a Y piece (no. 7). The pressure at the flow meter outlet (no. 8) is measured by the column pressure transducer (no. 6), which is connected to the Y piece (7) by means of a short connection capillary (no. 9).

Both flow restrictors (nos. 5a and 5b) are located in a common flow selector cartridge that can be replaced to select a different flow range.

The picture illustrates the functional blocks of the pump with the Classic flow meter.

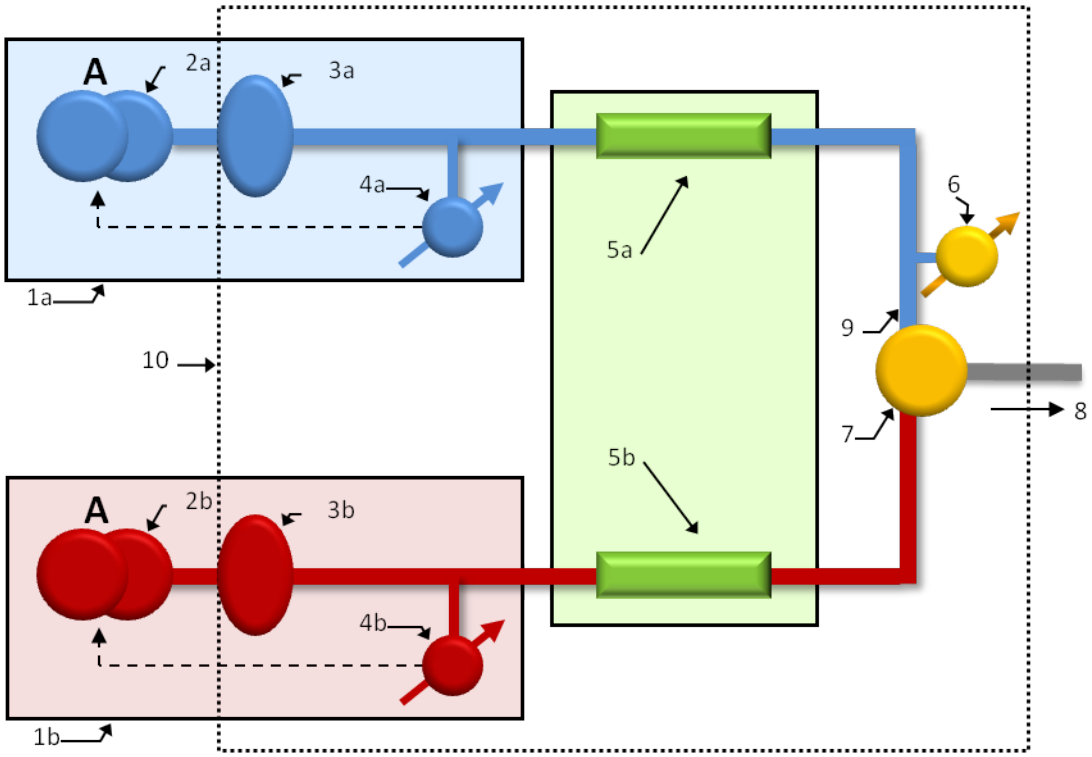


Fig. 88: Functional blocks of the NC pump with a Classic flow meter

No.	Element	No.	Element
1a / 1b	Pressure-controlled pump, left (A) and right (B)	6	Column pressure transducer
2a / 2b	Dual-piston pump, left / right	7	Y piece
3a / 3b	Filter unit, left / right	8	Flow meter outlet, capillary connection to the other modules of the HPLC system

No.	Element	No.	Element
4a / 4b	Primary pressure transducer, left / right	9	Capillary connecting the column pressure transducer to the Y piece
5a / 5b	Flow restrictor, left / right	10	Flow meter module

For a detailed flow meter diagram for the Classic flow meter, see section 8.1.3.3 (→ page 224).

8.1.3.3 Flow Meter Diagrams

The pictures show how the flow and solvent composition are controlled.

The control unit calculates the required partial flow rates, Fl_{Set_A} and Fl_{Set_B}, for both channels from the set total flow rate and the set solvent composition (gradient point).

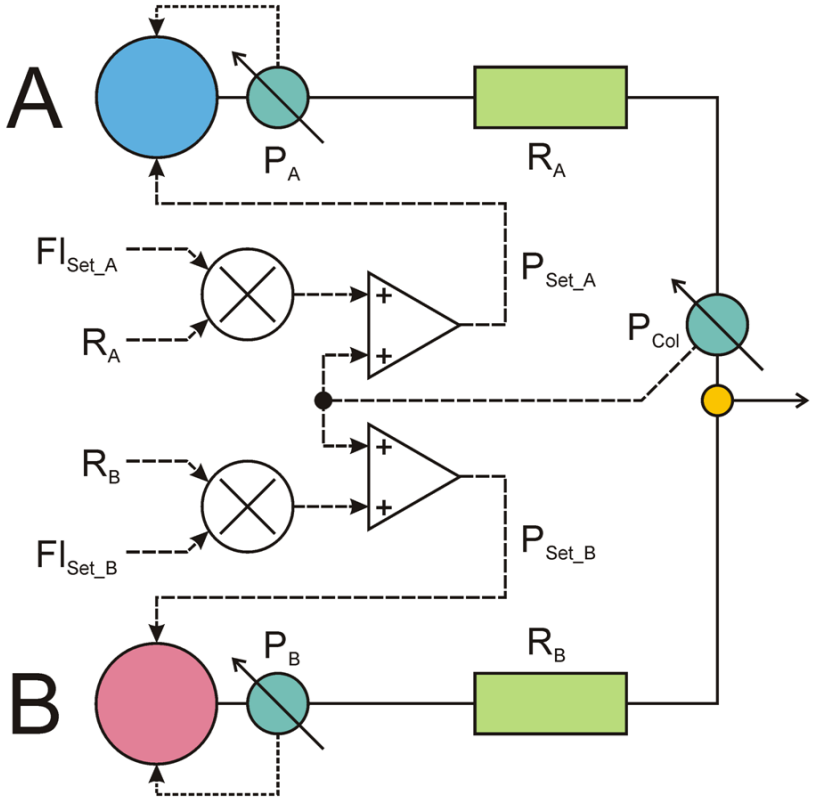


Fig. 89: Operating principle of the pump (Classic flow meter)

In case of the Classic flow meter, Fl_{Set_A} and Fl_{Set_B} are multiplied by the known fluidic resistance R_A and R_B of the corresponding flow restrictor. Then, the column pressure P_{Col} is added to obtain the set primary pressures P_{Set_A} and P_{Set_B}. The constant pressure pumps A and B deliver the related pressures so that exactly the required partial flows pass the restrictors R_A and R_B. Both partial flows are combined at the flow meter outlet so that the desired total flow rate and solvent composition are delivered.

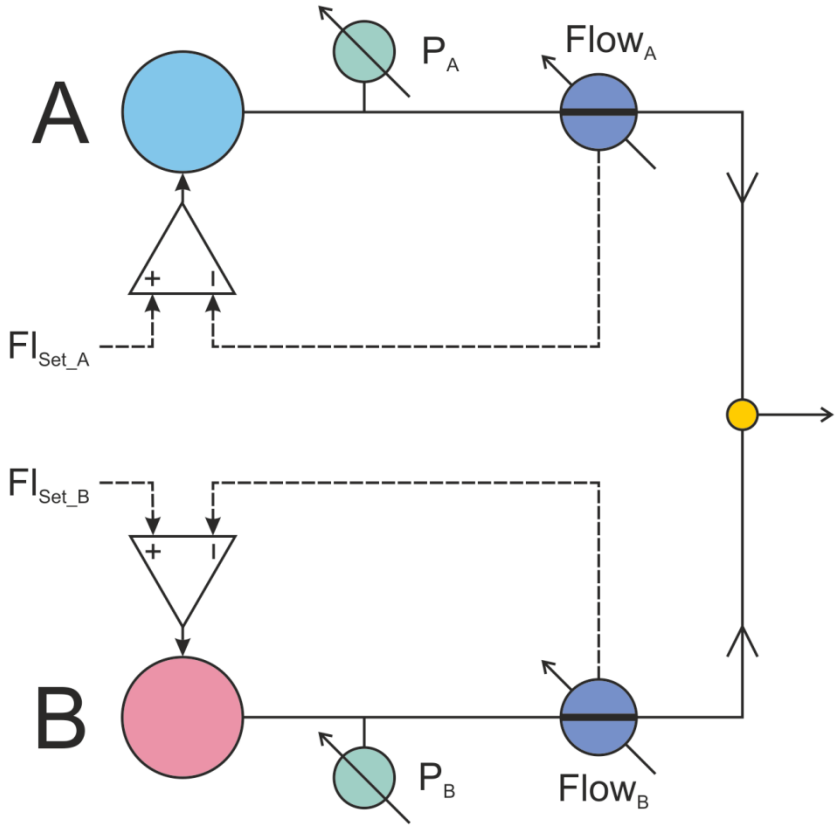


Fig. 90: Operating principle of the pump (ProFlow flow meter)

In case of the ProFlow flow meter, the signals of the flow sensors $Flow_A$ and $Flow_B$ are compared with the set values $F1_{Set\_A}$ and $F1_{Set\_B}$. The pumps A and B are controlled in response to the difference between the set values and the sensor signals.

8.2 Loading Pump (Micro Pump)

8.2.1 Interior Components (Detailed View)

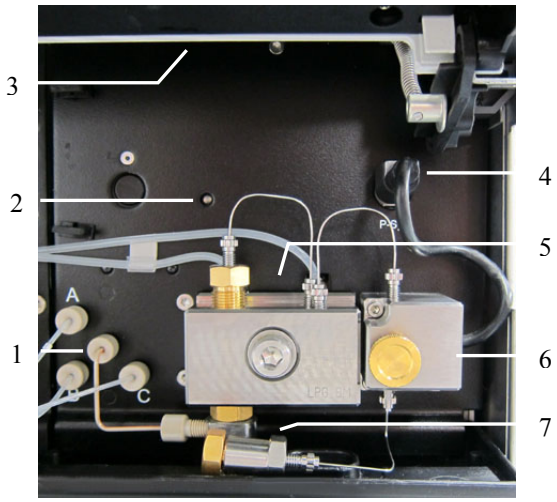


Fig. 91: Detailed view (loading pump)

No.	Description
1	3-channel proportioning valve
2	Pump block status LED (→ page 146)
3	Pump lights (here hidden by the front panel door)
4	Connector for pressure transducer cable (system pressure) from purge unit
5	Pump head with working cylinder and equilibration cylinder
6	Purge unit with purge valve and pressure transducer for the system pressure
7	Inline filter

8.2.2 Flow Path

The picture illustrates the liquid flow path through the pump.

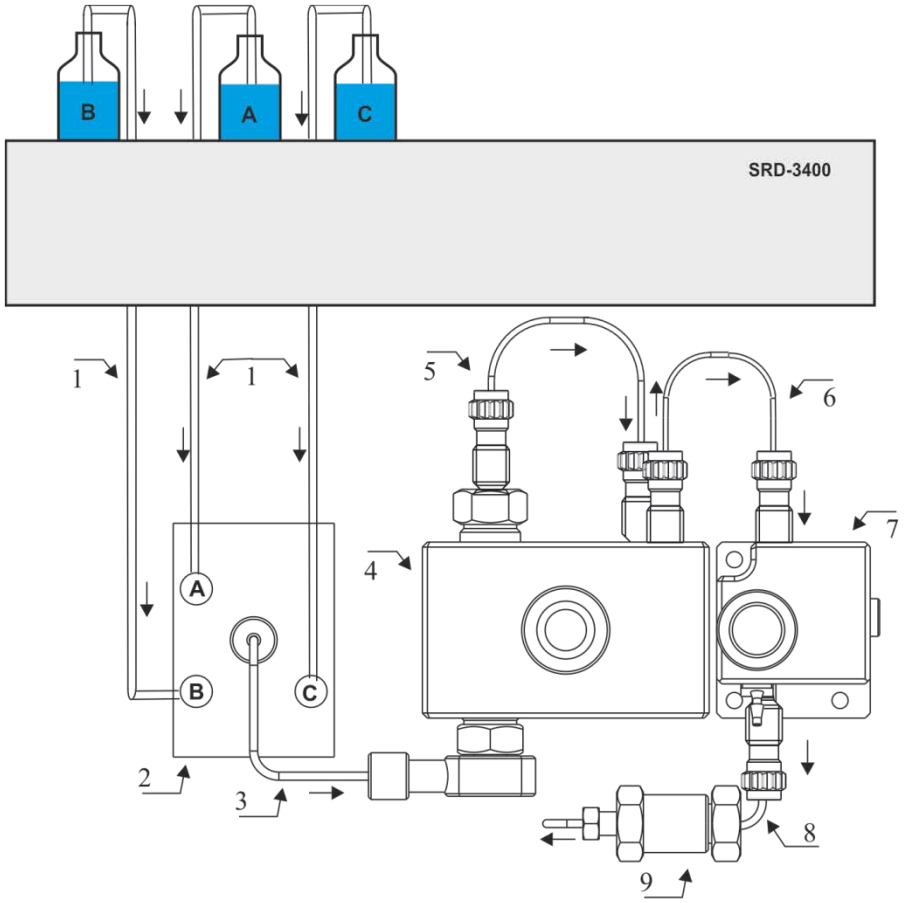


Fig. 92: Flow path through the loading pump

No.	Description	Part No.
	SRD-3x00 Solvent Rack	→ page 20
1	Solvent supply lines from SRD degasser to proportioning valve (pack of 3 solvent supply lines)	6030.2547
2	3-channel proportioning valve	----
3	Tubing from proportioning valve to pump head	6040.3023
4	Pump head with working cylinder and equilibration cylinder (entire assembly)	6041.1902
5	Capillary from working cylinder to equilibration cylinder (U-tube)	Included in 6041.3001
6	Capillary from pump head to purge unit	Included in 6041.3001
7	Purge unit with purge valve and system pressure transducer	----
8	Capillary from purge unit to inline filter	Included in 6041.3001
9	Inline filter	6042.5014

8.2.3 Operating Principle

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

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

The picture illustrates how the pump operates.

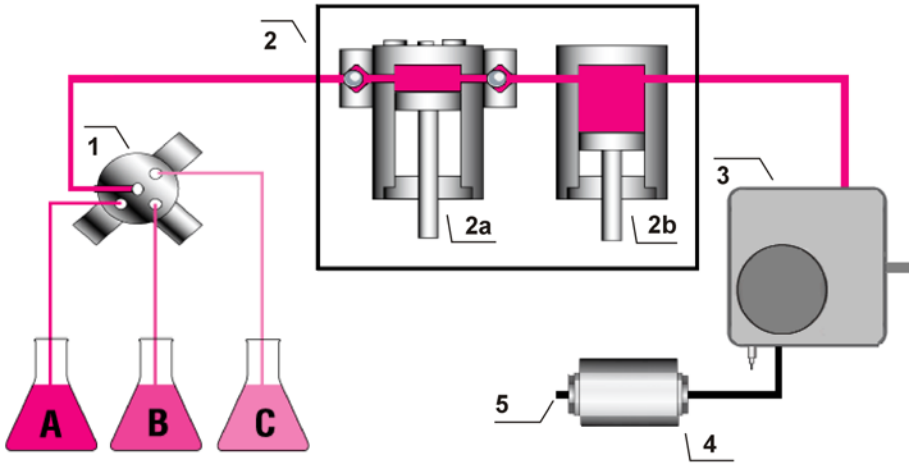


Fig. 93: Operating principle of the loading pump

No.	Element
1	3-channel proportioning valve
2	Pump head with working cylinder (no. 2a) and equilibration cylinder (no. 2b)
3	Purge unit
4	Inline filter
5	Pump outlet

8.3 Column Compartment

8.3.1 Interior Components

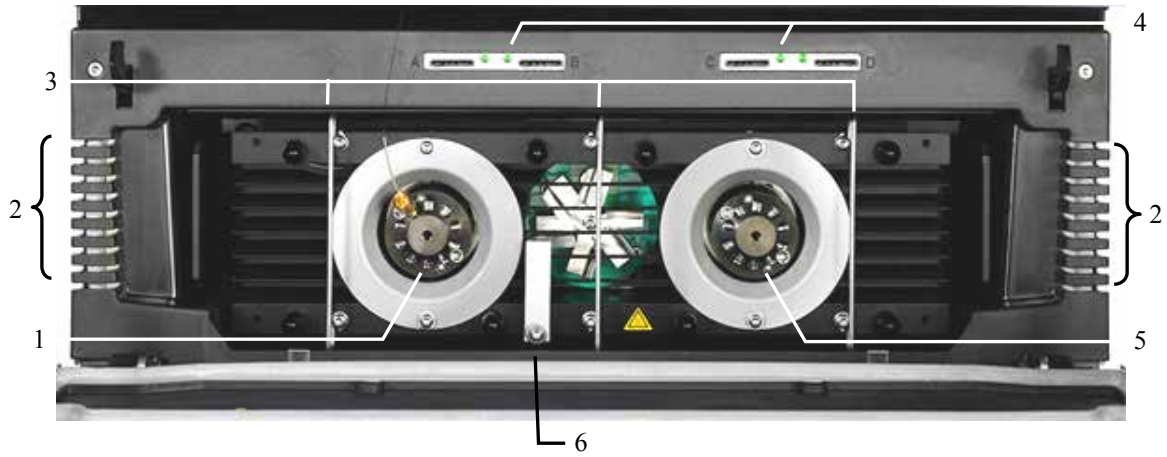


Fig. 94: Interior components (column compartment)

No.	Description
1	Column switching valve It depends on the configuration of the column compartment whether a valve is installed in this position (→ page 19).
2	Capillary guides (→ page 60) Capillaries to be routed to the outside on the sides of the column chamber *have to* be routed through the guides provided on the left and right of the column chamber.
3	Column brackets (→ page 80)
4	Slots for the column ID chip cards (→ page 129)
5	Column switching valve It depends on the configuration of the column compartment whether a valve is installed in this position (→ page 19).
6	Temperature sensor

8.3.2 Operating Principle

The fundamental requirement for a column compartment is the ability to maintain the preset temperature as precisely as possible. Temperature stability plays an important role for temperature equalization. The NCS contains advanced electronic circuitry that maintains the temperature with a precision of ±0.1 °C.

The thermo-optimized design of the column compartment reduces the time required to equilibrate the temperature between the column and the solvent.

Thermoelectric elements heat the column chamber and all internal components to the preferred temperature (settable in 0.1 °C increments). Using a heat exchanger, they allow fast temperature changes and ensure independence from the ambient temperature.

All this ensures that

- The temperature of the stationary phase remains constant over the total column length.
- The column and the solvent have the same temperature during the analysis.

Under these conditions, the analytical separation is performed at the nominal temperature. This minimizes fronting and tailing of peaks, as well as retention time variations.

The column compartment has no active cooling system and thus, the temperature in the compartment cannot be reduced below a temperature resulting from the ambient temperature and self-heating of the module. Therefore, the temperature set point must be at least 7 °C higher than the ambient temperature.

9 ProFlow Flow Meter Upgrade

The ProFlow flow meter is designed for the nano LC flow range. In order to modify an NCS-3500RS or NCP-3200RS module with a ProFlow flow meter, follow the steps and guidelines in this chapter.

9.1 Modifying the Module with a ProFlow Flow Meter

Parts required

Description	Part No.
ProFlow flow meter, with thermal flow sensors for nano LC (50 – 1500 nL/min)	6041.7850
Upgrade kit for ProFlow flow meter Including accessories required to modify a NCS-3x00RS or NCP-3x00RS module with the ProFlow flow meter: • Solvent lines, elbow tubes, shut off valves • Capillaries for the NC pump (nanoViper, MP35N) • Chromeleon software DVD • Fitting plugs, Viper	6041.3003
Note: Operation of the module with a ProFlow flow meter requires a suitable firmware and Chromeleon version.	

Preparations

1. Disconnect the module in Chromeleon.
2. Remove the installed flow meter from your module. Follow the removal steps in section 7.7.1 Replacing the Flow Meter, page 202.
3. On the NC pump, disconnect the solvent lines, the capillaries and the U tubes.

Follow these steps

1. Install a suitable Chromeleon version on the computer. Refer to the Chromeleon software version and installation information that is shipped in the Upgrade kit.
2. Unpack the ProFlow flow meter.
3. Install the ProFlow flow meter. Follow the installation steps in section 7.7.1 Replacing the Flow Meter, page 202.

4. Assemble and install the solvent lines with shut off valves. For instructions, see section 7.8, page 206.

   Tip: With the ProFlow flow meter, shut off valves are required during solvent calibration.
   The shut off valves allow you to shut off the solvent flow through the system at the solvent reservoir, for example, to prevent solvent from flowing through the system when the pump flow is zero for a longer period.

5. On the NC pump, replace the capillaries with the capillaries from the Upgrade kit. This includes:

   - Capillaries from working cylinder to equilibration cylinder (U-tube) on both pump heads
   - Capillary from right pump head to flow meter inlet
   - Capillary from left pump head to flow meter inlet

   For an overview of the connections on the ProFlow flow meter, see section 2.8.2 Flow Meter, page 30.

   Tip: The capillaries can also be used with a Classic flow meter.

6. Connect the module in Chromeleon.
7. Make sure that the firmware version that is installed on the module is suitable for the ProFlow flow meter. If required, update the firmware to the firmware shipped in the new Chromeleon version. See section 7.14, page 217.
8. Open the Chromeleon Server Configuration program and adapt the configuration for your module with the ProFlow flow meter.
   Note the following:

   - If you set up a new system configuration, set up your configuration as required.
   - If you import an existing system configuration being set up with an older Chromeleon version, remove the device from the timebase and add it newly to have the new configuration features available.

   a) On the **Flowmeter** page of the module, verfiy that the **Flowmeter Type** is set to **ProFlow**. Solvent lists show the available pre-defined solvents in the flow meter.

   b) On the **Signals** page of the module, verify that the signal channels for the ProFlow flow meter are selected. See section 5.5.6, page 121.

9. To operate the flow meter, set the solvent types. See section 4.5.2 Flow Meter Settings, page 69.
   If the solvent that you use is not available in the solvent type list, perform a solvent calibration for this solvent. See section 5.5.3.1 Performing a Solvent Calibration, page 114.

   Tip: To check that all flow connections are tight, perform a detailed leak test (→ section 5.7.2, page 134).

9.2 Guidelines on Operating the ProFlow Flow Meter

For operation of the ProFlow flow meter, make yourself familiar with the following guidelines:

- Solvent viscosity values that are saved for a Classic flow meter do not apply for the ProFlow flow meter. A list of commonly used solvents is available in the ProFlow flow meter. Unknown solvents need to be calibrated newly for the ProFlow flow meter. See section 5.5.3.1, page 114.
- When purging the flow meter, mind the different purge times for the ProFlow flow meter (→ section 4.5.3.1.2, page 75).
- The ProFlow flow meter includes a built-in inline filter, of which you can replace the filter frit. For replacement instructions, see section 7.7.3, page 205.
- Different diagnostic and calibration procedures apply for the ProFlow flow meter. See section 5.7.2, page 134.
- For details on the operating principle of the NC pump with a ProFlow flow meter, see section 8.1.3, page 222.

10 Technical Information

Pump Module*	**NC pump**	**Loading pump**
Gradient formation:	High-pressure gradient proportioning	Low-pressure gradient proportioning
Flow rate range: **Recommended:** **(Settable:)**	*ProFlow flow meter for Nano LC:* 50 - 1500 nL/min (0 - 1500 nL/min) *Classic flow meter with flow selector for*: *Cap LC:* 0.5 - 10 µL/min (0 - 15 µL/min) *Micro LC:* 5 - 50 µL/min (0 - 50 µL/min)	5 - 2500 µL (0 - 2500 µL) Gradient from 50 µL/min
Flow rate accuracy:	N.a.	± 0.5%
Flow rate precision:	N.a.	< 0.05% RSD or < 0.01 min SD, whichever is greater
Retention time precision:	≤ 0.2% RSD or < 0.1 min SD, whichever is greater for 30 min gradient	N.a.
Pressure range:	*ProFlow flow meter:* 2 – 90 MPa (290 – 13050 psi) *Classic flow meter:* 2 – 80 MPa (290-11600 psi) at nominal flow Nominal flow for: *ProFlow flow meter – Nano LC*: complete flow range *Classic flow meter:* • *Cap LC*: 5 µL/min • *Micro LC*: 25 µL/min	2 - 62 MPa (290 - 9000 psi)
Pulsation:	N.a.	Typically < 1% or < 0.2 MPa, whichever is greater
Proportioning accuracy:	N.a.	± 1.0% of full scale
Proportioning precision:	N.a.	< 0.3% SD
Number of solvent channels:	2	3
Gradient delay volume:	< 25 nL	220 µL
Solvent degassing:	External (optional)	External (optional)
Safety features:	Leak sensor, active rear seal wash system, excess pressure monitoring	

Pump Module*	**NC pump**	**Loading pump**
Wetted parts:	Titanium, PEEK, UHMW polyethylene, PTFE, FEP, sapphire, zirconium oxide, aluminum oxide, fused silica, MP35N *In addition for ProFlow flow meter only:* PCTFE, stainless steel	Titanium, PEEK, UHMW polyethylene, PTFE, FEP, ruby, zirconium oxide, aluminum oxide, perfluoro elastomer (FFKM)
* Typical operating conditions for measurable specifications: NC pump: Nominal flow of the flow meter (see Pressure range above) @ 20 MPa Loading pump: 200 or 300 µL/min @ 17 MPa or 25 MPa		

Column Compartment	
Temperature range:	Ambient +7 °C to 75 °C
Temperature accuracy:	±0.5 °C (measured at 50 °C setpoint)
Temperature stability:	±0.1 °C (measured at 50 °C setpoint)
Temperature precision:	±0.1 °C
Column capacity:	Maximum available width for column plus fittings: 350 mm; coiled columns
Warm up time:	from 35 °C to 65 °C in 12 minutes (typically) at an ambient temperature of 25 °C
Column switching valves:	Up to two 2-position, 10-port or 2-position, 6-port switching valves Port-to-port volume: 10-port valve:114 nL 6-port valve: 91 nL
Wetted parts:	Column switching valves: Nitronic® 60, Valcon E3
Safety features:	Humidity sensor, gas sensor

General Module Information	
User input/display:	Standby button Separately for pump module and column compartment: LCD indicating system parameters 3 LEDs (Power, Connected, and Status) for status monitoring 4 function keys for operation during initial installation and maintenance
GLP features:	In Chromeleon: • Electronic identification system for 4 columns • System Wellness monitoring • All system parameters are recorded in the Audit Trail.

General Module Information	
I/O interfaces:	2 digital inputs, 2 programmable relay outputs 15-pin D-Sub port for connection of a SRD-3x00 Solvent Rack or degasser
Control:	All functions controllable via USB 2.0; Integrated USB hub with three free USB ports
Power requirements:	*NCS-3500RS* 100 - 120 V, 60 Hz; 200 - 240 V, 50 Hz; max. 300 VA max. 2.6A@115V, 1.3A@230V *NCP-3200RS* 100 - 120 V, 60 Hz; 200 - 240 V, 50 Hz; max. 150 VA max. 1.3A@115V, 0.7A@230V
Emission sound pressure level:	< 70 dB(A) in 1-m distance
Environmental conditions:	Range of use: Indoor use Temperature: 10 °C to 35 °C (50 to 95°F) Air humidity: 80% relative humidity, non-condensing Overvoltage category: II Pollution degree: 2
Dimensions (h × w × d):	NCS-3500RS: 36 x 42 x 51 cm NCP-3200RS: 20 x 42 x 51 cm
Weight:	NCS-3500RS: 32 kg (no column switching valves installed) NCP-3200RS: 17.5 kg

Technical information as of January 2016 - All technical specifications are subject to change without notice.

11 Accessories, Consumables, and Spare Parts

Accessories, spare parts, and consumables for the module 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.

11.1 Standard Accessories

The following standard accessories are shipped with the instrument (subject to change without notice). Some parts listed in the following tables are included in one of the spare part kits. For information about the kit content, see section 11.3 (→ page 243).
The part number always refers to the packing unit. Unless otherwise stated, the packing unit is 1 unit. For more information, contact the Thermo Fisher Scientific sales organization for Dionex HPLC Products.

Description	Part No.	Quantity in the kit
Accessories kit of the NCS-3500RS, including:		
Capillary, nanoViper, MP35N (0.25 x 155 mm I.D. x L) To be used, for example, for calibrating solvents with the ProFlow flow meter or establishing the solvent viscosity with the Classic flow meter or for purging the flow meter.	6041.7892	1
Chromeleon software DVD		1
Column ID	Included in 6710.1505	2
Column installation/capillary clips kit, including 6 column clips 2 clips to attach capillaries routed from top to bottom through the column chamber	6041.0011	1
Drain kit for UltiMate 3000 systems: Cable clips (self-adhesive) Y piece T piece Elbow Connecting tube Drain tubing Installation instructions	6040.0005	 4 5 5 12 1 6 m 1
Fitting plug (Viper, titanium, biocompatible)	6040.2303	2
Fuse, 4 A, slow blow (5 x 20 mm)	Included in 6820.0026	2
Installation tool for Viper capillaries with torque toothing	6040.2314	1
Labels for solvent tubing 3.0 mm, both red and green	----	 6
Plastic syringe (12 mL)	Included in 6000.0010	2
Retaining guide (e.g., for seal wash reservoir)	Included in 6000.0042	6

Description	Part No.	Quantity in the kit
Silicone tubing (2.80 mm O.D. x 1.30 mm I.D.)	6007.9100	3 m
Solvent reservoir (250 mL) or Seal wash reservoir (250 mL) (including bottle cap)	included in 2270.0026	3
Solvent supply line (1.0 x 1000 mm I.D. x L) *Tip:* This tube can be also be used to *directly* connect the loading pump to the solvent reservoir. In this case, also install an eluent filter with 10 µm PEEK frit.	6041.2540	1
Solvent supply line filter, including: 1 Filter holder (top and bottom parts) and 1 filter frit (PEEK, porosity: 10 µm) + 2 spare frits	 Included in 6268.0115 Included in 6268.0117	3
Tool kit for UltiMate 3000 RS, SD, BM pumps, and NCS-3500RS/NCP-3200RS, including: 1 open-end wrench (size 1/4" x 5/16") 2 open-end wrenches (size 11 x 13 mm) 1 hexagon wrench (size 6 mm) 1 piston seal removal and insertion tool 1 pump head tool for RS/SD pumps and 1 pump head tool for BM pumps and NCS-3500RS/NCP-3200RS (the tool is required for establishing the distance during piston installation)	6007.9304	1
Tubing connector (straight, for I.D. 1.0 - 2.0 mm)	Included in 6040.9502	5
USB cable, type A to type B, high speed USB 2.0 (cable length: 1 m)	6035.9035	1
USB cable, type A to type B, high speed USB 2.0 (cable length: 5 m)	6911.0002	1

Description	Part No.	Quantity in the kit
Accessories kit of the NCP-3200RS, including:		
Capillary, nanoViper, MP35N (0.25 x 155 mm I.D. x L) To be used, for example, for calibrating solvents with the ProFlow flow meter or establishing the solvent viscosity with the Classic flow meter or for purging the flow meter.	6041.7892	1
Chromeleon software DVD		1

Description	**Part No.**	**Quantity in the kit**
Drain kit for UltiMate 3000 systems: Cable clips (self-adhesive) Y piece T piece Elbow Connecting tube Drain tubing Installation instructions	6040.0005	 4 5 5 12 1 6 m 1
Fitting plug (Viper, titanium, biocompatible)	6040.2303	2
Fuse, 2 A, slow blow (5 x 20 mm)	Included in 6820.0026	2
Plastic syringe (12 mL)	Included in 6000.0010	2
Retaining guide (e.g., for seal wash reservoir)	Included in 6000.0042	6
Silicone tubing (2.80 mm O.D. x 1.30 mm I.D.)	6007.9100	3 m
Solvent reservoir (250 mL) or Seal wash reservoir (250 mL) (including bottle cap)	Included in 2270.0026	3
Solvent supply line (1.0 x 1300 mm I.D. x L)	6041.2530	2
Solvent supply line filter, including: 1 Filter holder (top and bottom parts) and 1 filter frit (PEEK, porosity: 10 µm) + 2 spare frits	 Included in 6268.0115 Included in 6268.0117	2
Tool kit for UltiMate 3000 RS, SD, BM pumps, and NCS-3500RS/NCP-3200RS, including: 1 open-end wrench (size 1/4" x 5/16") 2 open-end wrenches (size 11 x 13 mm) 1 hexagon wrench (size 6 mm) 1 piston seal removal and insertion tool 1 pump head tool for RS/SD pumps and 1 pump head tool for BM pumps and NCS-3500RS/NCP-3200RS (the tool is required for establishing the distance during piston installation)	6007.9304	1
Tubing connector (straight, for I.D. 1.0 - 2.0 mm)	Included in 6040.9502	5
USB cable, type A to type B, high speed USB 2.0 (cable length: 1 m)	6035.9035	1
USB cable, type A to type B, high speed USB 2.0 (cable length: 5 m)	6911.0002	1

11.2 Optional Accessories

Accessories	Description	Part No.
Column Switching Valve	2-position, 6-port switching valve 2-position, 10-port switching valve	6041.0004 6041.0001
Signal cable	6-pin mini-DIN cable for connection to the Digital I/O port of the pump	6000.1004
Mixer kit (mixer volume: 8 µL) for capillaryLC	To reduce the ripple for capillaryLC applications, connect the mixer capillary to the flow meter outlet and, by using the union from the mixer kit, connect the free end of the capillary to the other components of the HPCL system.	6041.7895
Upgrade kit for ProFlow flow meter	Includes all required accessories for modification of a module with a ProFlow flow meter. *Note:* The ProFlow flow meter must be ordered separately.	6041.3003
Application kits for UltiMate 3000 RSLCnano systems The modules of UltiMate 3000RSLCnano system can be arranged in different configurations for various applications. All parts required for the system setups (columns, capillaries, fittings, etc.) are included in the related RSLCnano application kits. For information about how to arrange and set up an RSLCnano System, refer to the "UltiMate 30000 RSLCnano - Standard Applications" system manual. The manual is shipped with the NCS-3500RS and NCP-3200RS.		
	Direct Injection Nano LC Kit	6720.0300
	Direct Injection Capillary LC Kit	6720.0305
	Preconcentration Nano LC Kit	6720.0310
	Preconcentration Capillary LC Kit	6720.0315
	Preconcentration Monolithic LC Kit	6720.0320
	2D Salt Plugs Kit	6720.0325
	Automated off line SCX-RP Peptides Kit	6720.0330
	Automated offline RP-RP Peptides Kit	6720.0340
	Tandem Nano LC Kit	6720.0335
SRD-3x00 Solvent Racks		
SRD-3200	Solvent Rack with analytical 2-channel vacuum degasser	5035.9250
SRD-3400	Solvent Rack with analytical 4-channel vacuum degasser	5035.9245
SRD-3600	Solvent Rack with analytical 6-channel vacuum degasser	5035.9230
SR-3000	Solvent Rack (without vacuum degasser)	5035.9200

11.3 Consumables and Spare Parts

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

Description	Part No.
Bottle cap (4 screw caps) for seal wash and solvent reservoirs	6270.0013
Cap plugs (to close open holes in the reservoir caps), 20 plugs	6000.0047
Cap plugs and retaining guides for reservoir caps, kit including 10 cap plugs (to close open holes in the reservoir caps) and 5 retaining guides (to keep the liquid line in place in the reservoir cap)	6030.9101
Capillaries, capillary kit (with fittings), including 2 capillaries from working cylinder to equilibration cylinder (U tubes) 2 capillaries from pump head to purge unit 2 capillaries from purge unit to inline-filter	6042.3001
Capillaries, capillary kit for loading pump (with fittings), including: 1 capillary from working cylinder to equilibration cylinder (U-tubes) 1 capillary from pump head to purge unit 1 capillary from purge unit to inline-filter	6041.3001
Capillaries, capillary kit for NC pump (nanoViper, MP35N), including: 2 capillaries from working cylinder to equilibration cylinder (U-tubes) 1 capillary from right pump head to flow meter inlet 1 capillary from left pump head to flow meter inlet	6041.3002
Capillary clips (column compartment) → Column installation/capillary clips kit	
Capillary, nanoViper, MP35N (0.25 x 155 mm I.D. x L) To be used, for example, for calibrating solvents with the ProFlow flow meter or establishing the solvent viscosity with the Classic flow meter or for purging the flow meter.	6041.7892
Check valve cartridge, sapphire (the cartridge is the same for both the inlet and outlet valve) for the NC pump and loading pump	6041.2300
Check valve cartridge, ceramics (the cartridge is the same for both the inlet and outlet valve) for the NC pump and loading pump	6041.2301
Check valve nut kit (Ti) for double check valve, including inlet check valve nut and outlet check valve nut (NC pump and loading pump)	6042.7007
Cleaning swabs (10 swabs) (for example, to clean the connection ports on the pump block or purge unit)	6040.0006
Column ID (pack of 5 IDs)	6710.1505
Column installation clips → Column installation/capillary clips kit	
Column installation, column clips → Column clips	
Column installation/capillary clips kit, including	6041.0011

Description	Part No.
6 column clips 2 clips to attach capillaries routed from top to bottom through the column chamber	
Column switching valve 2-position, 6-port valve 2-position, 10-port valve	 6041.0004 6041.0001
Column switching valve, rotor seal → Rotor seal	
Column switching valve, stator → Stator	
Drain kit for UltiMate 3000 systems The kit includes all required components and detailed installation instructions.	6040.0005
Filter frit (PEEK, 10 µm) for solvent supply line filter (10 frits)	6268.0117
Filter frit (titanium, biocompatible, 2 µm, 2 frits) For loading pump inline filter and ProFlow flow meter inline filter.	6268.0036
Fitting plug (Viper, titanium, biocompatible)	6040.2303
Flow meters: ProFlow flow meter for nano LC (50 - 1500 nL/min) Classic flow meter with flow selector for capillary LC (0.5 - 10 µL/min) Classic flow meter with flow selector for micro LC (5 - 50 µL/min)	 6041.7850 6041.7902A 6041.7903A
Flow selector (for Classic flow meters only) for Capillary LC (0.5 - 10 µL/min) Micro LC (5 - 50 µL/min)	 6041.0003 6041.0014
Fuses kit, including: 10 fuses, 4A, slow-blow, 5 x 20 mm (for use in the NCS) 10 fuses, overload protection, 2A, slow-blow, 5 x 20 mm (for use in the NCP) 5 fuses, 4A, slow-blow, 6.3 x 32 mm	6820.0026
Inline filter (with filter frit, porosity: 2 µm) for loading pump	6042.5014
Inline filter, filter frits → Filter frits, inline filter	
Installation tool for Viper capillaries with torque toothing	6040.2314
Installation tool for Viper capillaries with torque toothing → Tool, installation tool for Viper capillaries with torque toothing	
Maintenance kit for NCS-3500RS loading pump—including: 4 solvent supply line filters with filter frits 1.5 m silicone tubing (O.D. x I.D. 2.80 mm x 1.30 mm) 18 cm PharMed tubing (O.D. x I.D. 3.2 mm x 1.6 mm) 3 tubing connectors, straight, for I.D. 1.0-2.0 mm 2 piston seals (reversed phase), main piston seals 2 piston seals, for plate of seal wash system 2 support rings 1 O-Ring seal each (PTFE; 9x1.5 and 32x1.5), for seal wash system 1 filter frit (titanium, biocompatible, 2 µm) for inline filter 1 valve cartridge 1 cap seal for purge screw (to be used *only* for screws *without* integrated cap seal) 5 cleaning swabs	6042.1951
Menu pen	6300.0100

Description	Part No.
Mixer kit (mixer volume: 8 µL) for capillaryLC To reduce the ripple for capillaryLC applications, connect the mixer capillary to the flow meter outlet and, by using the union from the mixer kit, connect the free end of the capillary to the other components of the HPCL system.	6041.7895
Piston (2 pistons, sapphire)	6040.0042
Piston seal (main piston seal), Reversed Phase (2 seals) for NC pump and loading pump	6266.0305
Piston seal removal and insertion tool	6040.7158
Piston seals (in plate of seal wash system) for NC pump and loading pump (2 seals)	6040.0033
Power cord, Australia, China	6000.1060
Power cord, Denmark	6000.1070
Power cord, EU	6000.1000
Power cord, India/SA	6000.1090
Power cord, Italy	6000.1040
Power cord, Japan	6000.1050
Power cord, Switzerland	6000.1030
Power cord, UK	6000.1020
Power cord, US	6000.1001
Pump head, entire assembly, for NC pump Loading pump	 6041.1901A 6041.1902
Purge screw for loading pump	6040.2035
Rear seal wash system reservoir, 0.25L including bottle cap	2270.0026
Rear seal wash system, seals (→ Fig. 65, page 184, nos. 4 and 8) PTFE seals, 9 x 1.5 mm and 32 x 1.5 mm, 5 each	6040.2208
Rear seal wash system, tubing kit, including: silicone tubing (1.5 m, O.D. x I.D. 2.80 x 1.30 mm) PharMed® tubing (18 cm, O.D. x I.D., 3.20 x 1.60 mm) 7 tubing connectors, straight, for tubing I.D. 1.0 - 2.0 mm	6040.9502
Retaining guide (for seal wash reservoir and solvent reservoirs)	6000.0042
Rotor seal for 2-position, 6-port switching valve 2-position, 10-port switching valve	 6041.0008 6041.0006
Screwdriver set, Torx T10 and T20	6040.0010
Seals, rear seal wash system → Rear seal wash system, seals	
Signal cable (6-pin, mini-DIN)	6000.1004
Solvent shut off valve	6036.0010

Description	Part No.
Solvent supply line set, including • Solvent supply line (1.0 x 1000 mm I.D. x L) Used to connect the pump head of the NC pump to the solvent reservoir or to connect the loading pump in the NCS-3500RS directly to the solvent reservoir. • Elbow tubing (1.0 x 100 mm I.D. x L) For use with a shut off valve. For further information, see section 7.8, page 206.	6041.2540
Solvent supply line set, including • Solvent supply line (1.0 x 1300 mm I.D. x L) Used to connect the pump head of the NC pump to the solvent reservoir. • Elbow tubing (1.0 x 100 mm I.D. x L) For use with a shut off valve. For further information, see section 7.8, page 206.	6041.2530
Solvent supply line filter Filter holder (6 holders) Filter frit (PEEK, 10 µm), 10 frits	 6268.0115 6268.0117
Solvent supply line from degasser to proportioning valve, loading pump (Pack of 3 solvent supply lines, fitting connections, and line labels)	6030.2547
Stator for 2-position, 6-port switching valve 2-position, 10-port switching valve	 6041.0007 6041.0005
Support ring for main piston seal (2 support rings) for NC pump and loading pump	6040.0012
Syringe and tubing kit, including: 5 plastic syringes 3m silicone tubing (O.D. x I.D. 2.80 mm x 1.30 mm)	6000.0010
Tool kit for UltiMate 3000 RS, SD, BM pumps, and NCS-3500RS/NCP-3200RS, including: 1 open-end wrench (1/4" x 5/16") 2 open-end wrenches (11 x 13 mm) 1 hexagon wrench (size 6 mm) 1 piston seal removal and insertion tool 1 pump head tool for RS/SD pumps and 1 pump head tool for BM pumps and NCS-3500RS/NCP-3200RS (the tool is required for establishing the distance during piston installation)	6007.9304
Tubing from proportioning valve to pump head, loading pump (pack of 2 tubes with fittings)	6040.3023
Tubing kit, rear seal wash system → Rear seal wash system, tubing kit	
Tubing, silicone tubing (2.80 mm O.D. x 1.30 mm I.D.)	6007.9100
USB cable, type A to type B, high speed USB 2.0 (cable length: 1 m)	6035.9035
USB cable, type A to type B, high speed USB 2.0 (cable length: 5 m)	6911.0002
Valve cartridge, check valve → Check valve, valve cartridge	
Valve nut kit for check valve → Check valve, valve nut kit	

12 Reference Information

12.1 Chemical Resistance of PEEK

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

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

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

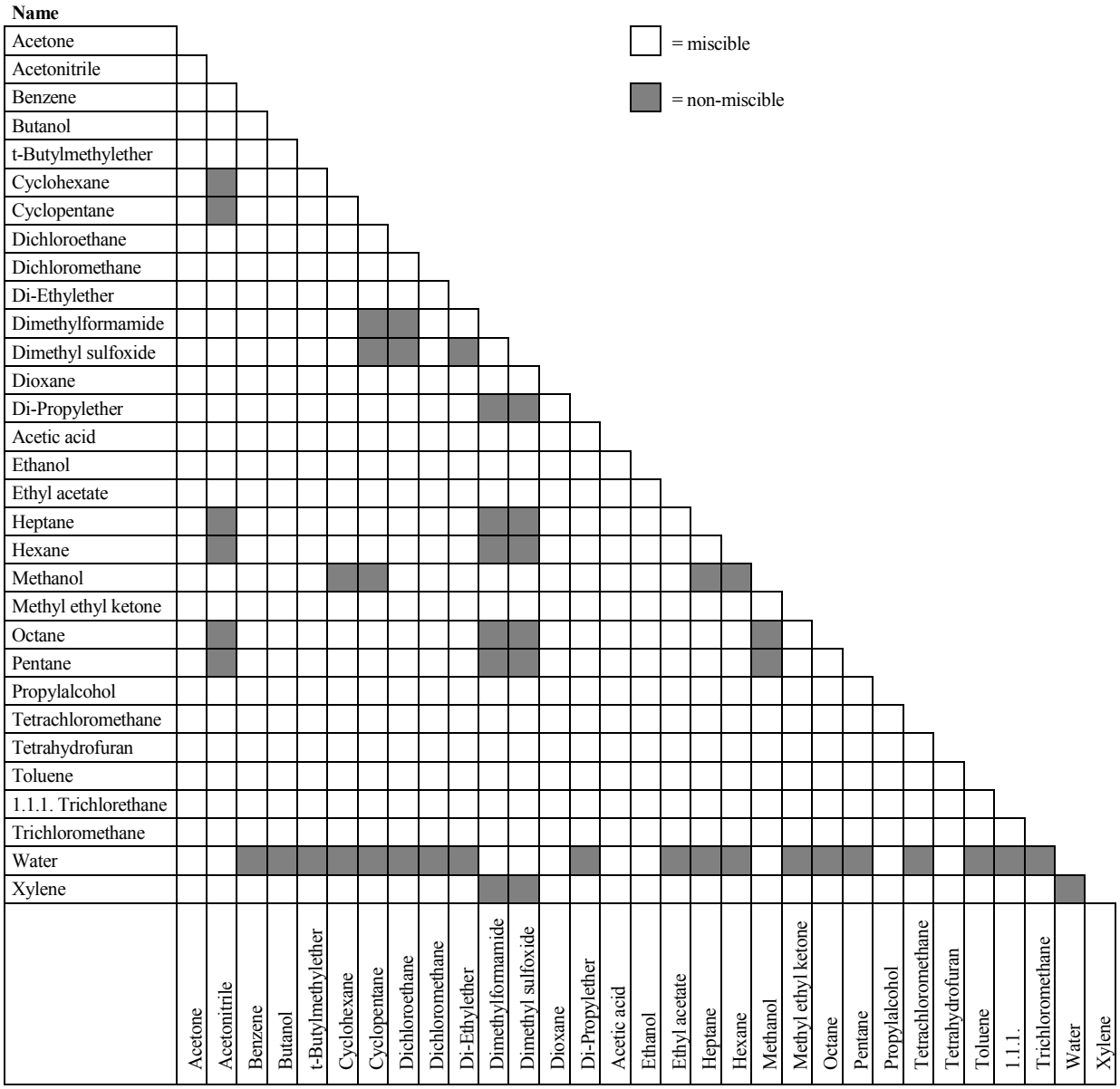
Medium	Concentration [%]	Temperature	Maximum Duration (Days)	Resistance (+ = yes; - = no)
Dimethylformamide	100	23	7	+
Dioctylphthalate		23		+
Dioxane		23		+
Ethanol	96 (Vol.)	23	7	+
Ethyl acetate	100	23		+
Ethylene glycol		23		+
Ferric chloride		23		+
Formaldehyde	30	23		+
Formic acid	95	104	42	+
Glycerin		23		+
Heptane	100	23	7	+
Hydrochloric acid	37	23		+
Hydrofluoric acid		23		-
Hydrogen peroxide	30	23	7	+
Lactic acid		23		+
Magnesium chloride		23		+
Methanol	100	23		+
Methyl ethyl ketone	100	23		+
Methyl isobutyl ketone	100	23		+
Nitric acid	40	23	7	+
Nitric acid	65	23	7	+
Nitrobenzene	100	23		+
Paraffin oil		60		+
Paraffin oil		23		+
Perchlorethylene	100	23		+
Phenol	Diluted	23		+
Phenol	Concentrated	23		-
Potassium dichromate		23		+
Potassium hydroxide		23		+
Potassium nitrate		23		+
Potassium permanganate		23		+
Propane		23		+
Propyl alcohol		100		+
Pure benzene		60		+
Silicone oil		160		+
Sodium chloride		23		+
Sodium hydrogen carbonate		23		+
Sodium hydroxide	40	23	7	+
Sodium hydroxide	30	130		+
Sodium thiosulphate		23		+
Sulphur dioxide		23		+
Sulphur dioxide		23		+

Medium	Concentration [%]	Temperature	Maximum Duration (Days)	Resistance (+ = yes; - = no)
Sulphuric acid	40	130		+
Sulphuric acid	50	23	7	+
Sulphuric acid (dissolved)	98	23		-
Toluene	100	23	7	+
Trichloroethylene	100	23	7	+
Trichlormethane (chloroform)	100	23		+
Water		23		+
Xylene	100	23		+
Zinc chloride		23		+

12.2 Solvent Miscibility

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

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



12.3 Properties of Common Solvents

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

	Acetronitrile	Dichloromethane	n-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 (η) at 20 °C (cP = mPa*s)	0.37	0.44	0.33	2.3	0.60	0.55	1.00
Density (ρ) (g/mL)	0.78	1.32	0.66	0.78	0.79	0.88	0.997
η/ρ (cP*mL/g)	0.47	0.33	0.50	2.9	0.76	0.62	1.00
Compressibility (χ) at 20 °C ($MBar^{-1}$)	99	97	160	100	123	93	46
Critical Flow F_c (mL/min) [1)]	13	9.4	14	83	21	18	28
Linear Drop in Pressure $\Delta p/l$ (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 I.D. tubing
F_C (mL/min) = 113 x 0.25 mm x η (cP) / ρ (g/mL)
F_C is an example of a hydrodynamic calculation.

2) $^{\Delta}p/l$ = linear drop in pressure for 1 mL/min and 0.25 mm I.D. tubing
$^{\Delta}p/l$ (MPa/m) = 6.8 x 10^{-6} x 1 mL/min x 100 cm x ^{h} (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

12.4 Safety Information about Flammable Solvents

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

	Acetonitrile	**Diethyl ether**	**Ethanol**	**Ethyl acetate**	**Heptane**	**Hexane**	**Isopropyl alcohol**	**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]

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

References

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

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

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

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

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

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

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

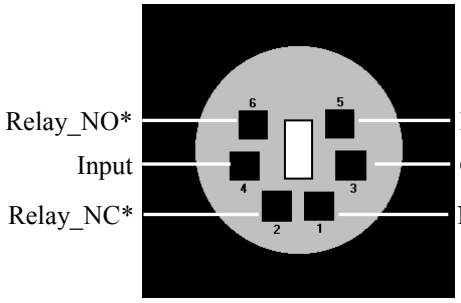
[8] Chemical Safety Sheets, *Working Safely with Hazardous Chemicals*, Kluwer Acad. Publ., Samson Chem. Publ., Dutch Inst. for the Working Environment, and Dutch Chem. Ind. Assoc., 1991

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

13 Appendix

13.1 Digital I/O (Pin Assignment)

The two digital I/O ports provide two digital inputs and two relay outputs that can be used to exchange digital signals with external devices.



* NO = Normally open contact
NC = Normally closed contact

COM is the common contact for NO and NC. If the relay is not activated or if the pump is turned off, the connection is between COM and NC. If the relay is activated, the connection is between Com and NO.

Fig. 95: Mini-DIN Digital I/O port

To connect an external device to a digital I/O port, use the appropriate mini-DIN cable (part no. 6000.1004). The table lists the functions assigned to the connector pins and the color and label of the cable wire connected to each pin (ignore the information on the cable label).

Pin	Wire Color	Signal Name	Signal Level	Remark
1	Pink			Not used
2	Gray	Relay_NC	Potential free	Opening contact
3	Green	GND	Ground	Reference potential
4	Yellow	Input	TTL	Digital input
5	Brown	Relay_COM	Potential free	Common contact for NO and NC
6	White	Relay_NO	Potential free	Closing contact

Fig. 96: Pin assignment (port and cable)

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

The maximum input voltage at the input must not exceed +5 V with reference to ground. The minimum input voltage must not be lower than the ground potential.

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

La tension d'entrée maximale à l'entrée ne doit pas dépasser +5V concernant la terre. La tension d'entrée minimale ne doit pas être inferieur au potentiel de la terre.

🛈 **Tip:** The input has a pull-up resistor.

13.2 Solvent Rack (Pin Assignment)

Pin	Signal Name	Signal Level	Remark
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	+15V_supply	Supply for the solvent rack
7	GND_Degas	Ground_supply	Reference potential for V_Degas
8	VCC		Voltage for logic devices +5V
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	+15V_supply	Supply for the solvent rack
15	GND_Degas	Ground_supply	Reference potential for V_Degas

Fig. 97: 15-pol. Solvent Rack port (female)

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