User's Guide

PLC 2050/2250/2500 Purification Systems

GILSON®

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SAFETY

IN THIS CHAPTER:

⚠WARNING **Performing any task not listed in this user's guide will result in loss of warranty and may be dangerous.**

Read this chapter before installing and operating the instrument.

Only trained technical personnel in a laboratory environment may use the instrument for non-medical, liquid handling purposes. For safe and correct use of the instrument, operating and service personnel must follow all instructions contained in this guide when installing, cleaning, and maintaining the instrument. All safety precautions must be observed during all phases of operation, service, and repair of the instrument.

Failure to comply with these precautions or with warnings described in the user's guide violates safety standards of design, manufacture, and intended use of the instrument. Gilson assumes no liability for customers failing to comply with these requirements.

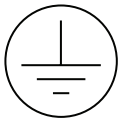
The instrument has been certified to safety standards required in Canada, Europe, and the United States. Refer to the rear panel label on the instrument and the *Declaration of Conformity* document for the current standards to which the instrument has been found compliant.

Read all documentation and safety information for accessories, peripherals, and other instruments that may be used with this instrument before operating the system.

Symbols and Notices

Electrical and Hazard Symbols

The following electrical and hazard symbols may appear on the instrument or in this document:

SYMBOL	EXPLANATION
	Direct Current
	Alternating Current
	Protective Conductor Terminal
|	Electrical Power ON
O	Electrical power OFF
	Caution
	Caution, Risk of Electric Shock
	Caution, Ultraviolet Light, Risk of UV Radiation
	Caution, Two Person Lift Required
	Warning, Corrosive Chemical
	Caution, Hot Surface

Safety Notices

The following safety notices may appear in this document:

⚠WARNING	Indicates a potentially hazardous situation which, if not avoided, may result in personal injury.
⚠CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage.

Chemical Hazards

Any chemicals used for analysis should be handled according to good laboratory practice (GLP). They should also be stored, used, and disposed of in accordance with the manufacturer's specifications, as well as local and national regulations. Potentially hazardous chemicals can be used with the instrument. Use care when handling chemicals and wear appropriate personal protective equipment (PPE), such as safety glasses, gloves, etc.

The responsible individual must ensure that personnel are not exposed to hazardous levels of toxic substances as outlined in the Safety Data Sheets (SDSs), or any documentation provided by local governing bodies such as The Health Protection Agency (United Kingdom) or The Occupational Safety and Health Administration (United States).

Electrical Hazards

Unless specifically instructed, do not remove any protective covers. Detach all sources of voltage from the instrument before the service, repair, or exchange of parts.

Use only the grounded AC cord provided. Ungrounded power cords can result in electrical shock and serious personal injury. Faulty or frayed power cords must be immediately replaced with one of the same type and rating. When it is necessary to use a non-original power cord, make sure the replacement cord adheres to following specifications and local building safety codes: 1) European Union Model; Connector A: Male, Type E or F (Schuko), 16A; Connector B: Female, IEC320/C13, 10A; 250 V~, H05VV-F 3G1.0 mm^2 and 2) United States and Canadian Model; Connector A: Male Type, NEMA 15-5, 15A; Connector B: Female, IEC320/C13, 10A; 125 V~, SVT 3x18 AWG.

NOTICE	Use only approved fuses with the specified current rating. The PLC Purification System must be operated within the voltage specified on the marking plate of the instrument.

Mechanical Hazards

⚠WARNING	The housing of the PLC Purification System must be attached permanently with all screws tightened at 3 N m. Unless specifically instructed, do not remove any protective covers. All protections must be in place before starting the PLC Purification System.

Flammable Solvents

Secure all flammable solvents.

Lifting

The PLC Purification System exceeds the weight one person can lift safely. Two or more people are required to lift the PLC Purification System safely. Always lift the PLC Purification System from the base and follow any unpacking instructions provided with the instrument. For more information, see **Unpacking on page 14.**

Replacement Parts

Be sure to use only replacement parts mentioned in this user's guide.
See **Replacement Parts and Accessories on page 77.**

Signs of Damage

Do not attempt to use the instrument if there are visible signs of damage.

Site Requirements

Do not operate the instrument if site conditions are not within specifications. Refer to **Technical Specifications on page 19** for more details.

Spacing

Allow sufficient spacing around the system for proper cooling and for the connection of power cords, plumbing, injection pump, liquid handler, external detectors, or any other peripherals.

Storage and Movement

Run a clean solvent through the fluid path before storing the PLC Purification System (see **Cleaning and Decontamination on page 56**. Do not leave buffer in the PLC Purification System, as it may cause blockages and damage the seals. Rinse the fluid path and prevent the liquids from flowing out inlets and outlets before moving the PLC Purification System.

Disconnect the PLC Purification System electrically, use the provided plugs for the inlets and outlets, and keep away from collision and moisture in an environment that complies with the **Technical Specifications on page 19**.

When moving the PLC Purification System, use a cart or moving device if it is possible.

Chapter 1

INTRODUCTION

IN THIS CHAPTER:

Description

PLC 2050/2250/2500 Purification Systems are designed for preparative liquid chromatography (PLC) to aspirate mobile phase solvents, form gradients, inject liquid samples, and provide solutions for a preparative column for high performance liquid chromatography (HPLC), centrifugal partition chromatography (CPC), or counter-current chromatography (CCC) applications. A built-in detector measures the absorbance and sends the chromatogram to the on-board control software, GLIDER Software. Fractions are collected with the integrated fraction collector.

Standard Components

The following diagrams provide a general description of the PLC Purification System with standard components.

Figure 1
PLC 2050 Purification System

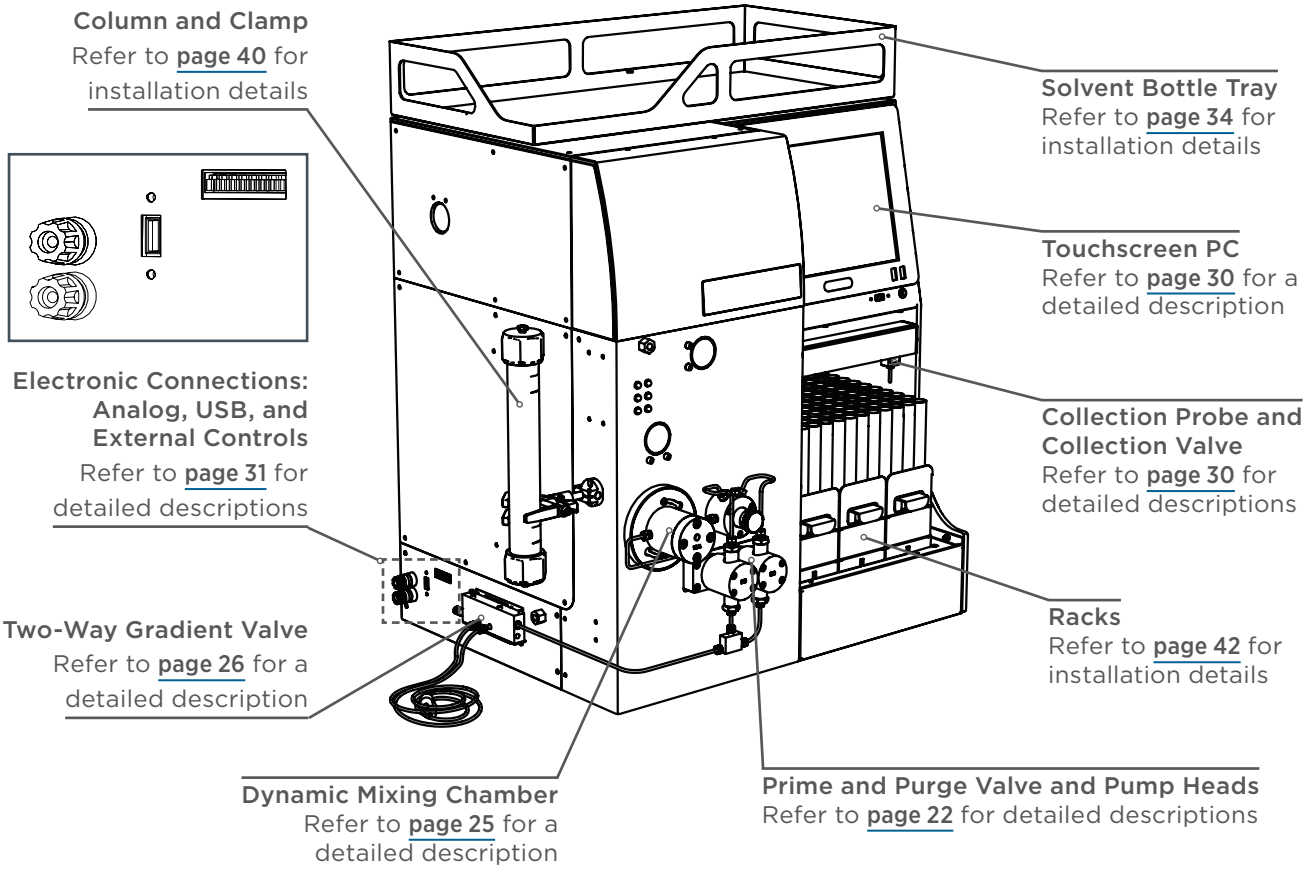


Figure 2
Standard Components for the PLC Purification System (Left and Front View)

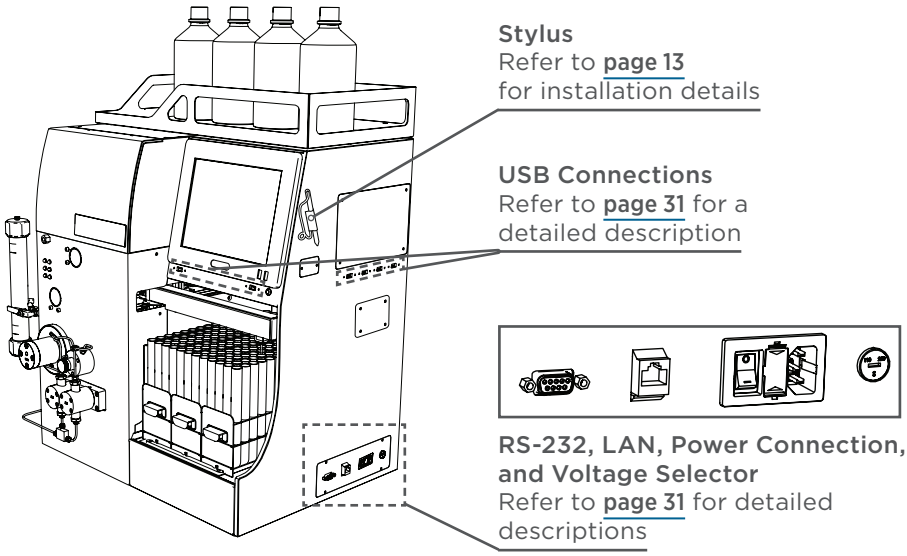


Figure 3
Standard Components for the PLC Purification System (Right and Front View)

Optional Components

The following diagrams provide a general description of the PLC Purification System with optional components.

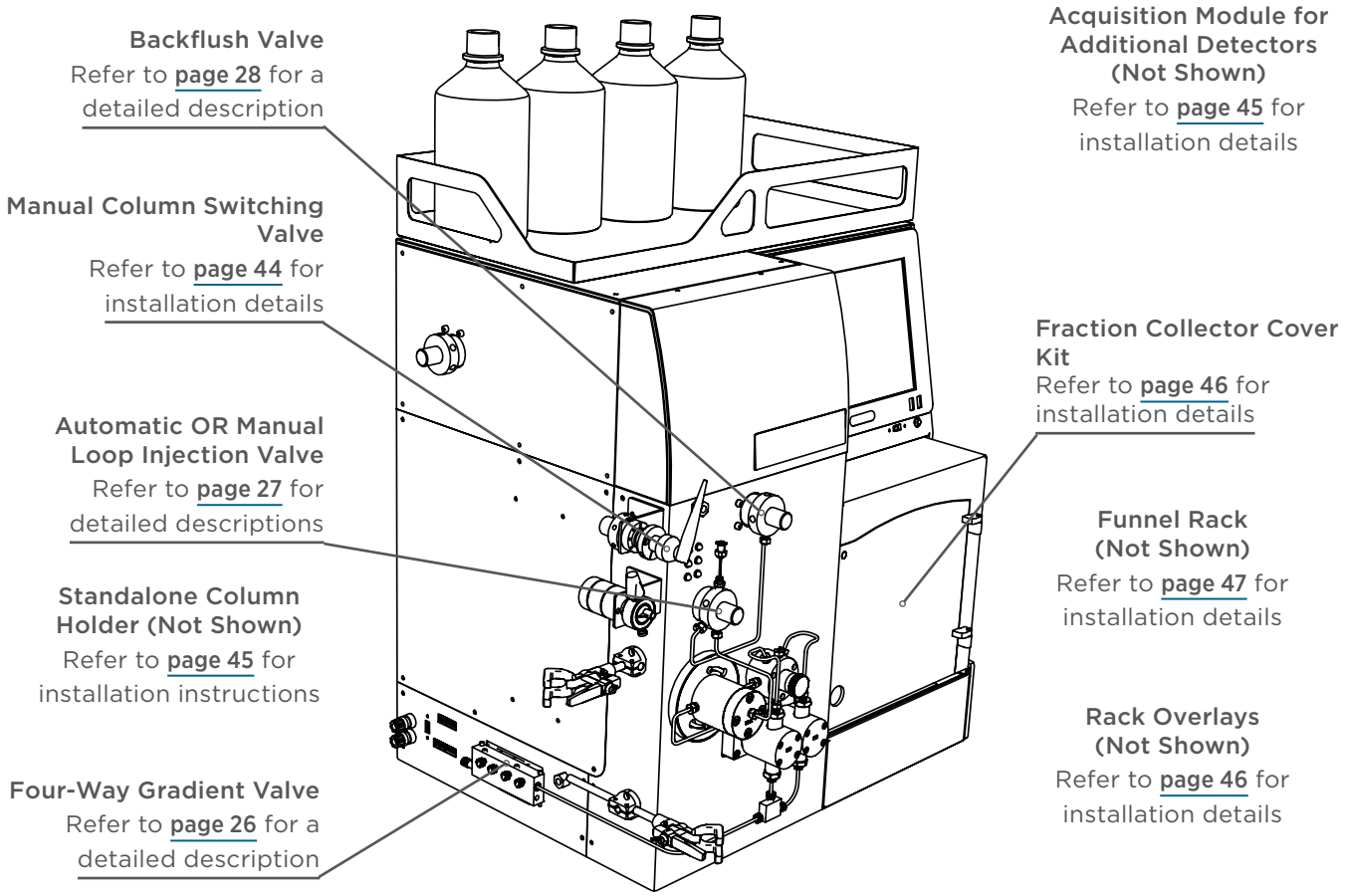


Figure 4
Optional Components for the PLC Purification System (Left and Front View)

GX-241 Liquid Handler Configuration

PLC Purification Systems can be configured with a GX-241 Liquid Handler and VERITY® 4020 Single Syringe Pump for automated sample injections.

GX-241

The optional GX-241 is a compact X/Y/Z instrument designed for automating general liquid handling procedures. For more information, refer to the *GX-241 Liquid Handler User's Guide.*

VERITY 4020 SYRINGE PUMP

The required VERITY 4020 Syringe Pump is equipped with a user-selectable, small- or large-capacity syringe, allowing for a wide range of liquid transfers up to 25 mL in a single stroke. The syringe pump enables automatic, unattended injections on PLC Purification Systems, allowing users to purify more compounds with less manual interaction. For more information, refer to the *VERITY® 4X20 Syringe Pumps User's Guide*.

VERITY® 1920 Mass Spectrometer Configuration

The optional VERITY 1920 MS is a complete, compact, and fully packaged solution for mass spectrometry (MS) purification. For more information, refer to the *VERITY® 1920 Mass Spectrometer User's Guide*.

Other Configurations

PLC Purification Systems can be configured with an external injection pump for high volume injections and additional detectors, such as an evaporative light scattering detector (ELSD). All these optional devices can be controlled with GLIDER.

Unpacking

Upon receipt of the instrument, inspect the exterior of all shipping boxes. All boxes should arrive unopened and undamaged. If examination reveals that damage has occurred in shipment, notify the carrier and Gilson immediately. Refer to Customer Service on page 32.

⚠WARNING

Do not plug in the PLC Purification System if any damage is detected. Powering the PLC Purification System in a damaged state may result in serious injury and may damage internal components of the PLC Purification System.

The PLC Purification Systems are delivered with major components already assembled. Keep the original container and packing assembly so the unit may be shipped safely, if necessary. Carefully unpack the PLC Purification System and its accessories. Verify that all parts are included and undamaged. Do this immediately, even if the system will not be used right away. Many carriers must receive concealed damage claims within seven days of delivery.

⚠CAUTION

A PLC Purification System weighs approximately 65 kg (143 lbs.) and an additional 20 kg (44 lbs.) with packaging. The PLC Purification System is too heavy to be lifted or moved by one person safely. To avoid personal injury and for general safety, if moving or lifting the PLC Purification System, always get another person to assist you. Always follow local health and safety regulations.

Wear appropriate personal protection equipment (PPE), such as safety shoes, when moving the PLC Purification System.

Do not attempt to lift the PLC Purification System from a valve. Always grip it from its base.

To unpack the instrument:

1. Open the box.
2. Remove the carton of accessories.
3. Remove the packing material.
4. Lift the unit out of the box and place it at suitable location, such as a lab bench or cart, and always on a flat, level surface.

NOTICE	
	It is recommended to operate the PLC Purification System inside a fume hood to ensure proper ventilation.
	Allow sufficient spacing around the system for proper cooling and for the different connections.
	Free spaces of at least 20 cm must be kept around the instrument at all times to allow for proper tubing and cable connections and to provide adequate ventilation during operation.

5. Verify that all components from the **Unpacking List on page 15** are included.

Unpacking List

The following items are considered standard equipment and are provided with the PLC Purification Systems. For detailed descriptions and part numbers, refer to **Replacement Parts and Accessories on page 77**.

STANDARD EQUIPMENT

PLC 2050 Purification System and PLC 2250 Purification System

- Inlet/suction, 1/8″ (OD), 2.4 mm (ID), 2 m (qty. 2)
  - PTFE with a 20 cm spring at one end and an SS ballast at the other, and with colored cable ties for identification
  - PEEK nuts and ETFE ferrules for 1/8″ tubing
- Waste outlet, 1/8″ (OD), 1.6 mm (ID), 2 m (qty. 1)
  - ETFE with an SS ballast at one end
  - SS fitting and PEEK nut and ETFE ferrule for 1/8″ tubing

PLC 2500 Purification System

- Inlet/suction, 3/16″ (OD), 1/8″ (ID), 2 m (qty. 2)
  - PFA with an SS ballast at one end with colored cable ties for identification
  - PEEK nuts and ETFE ferrules for 3/16″ tubing
- Waste outlet, 1/8″ (OD), 2.4 mm (ID), 2 m (qty. 1)
  - PTFE with an SS ballast at one end
  - SS fitting and PEEK nut and ETFE ferrule for 1/8″ tubing

All PLC Purification Systems

- Additional collection probes (qty. 2)
  - ETFE Luer Male-to-1/4″-28 (TPI) Male
  - SS probe for 150 mm tubes (6.5 cm)
- Fittings for pump cleaning discs connections (qty. 2)
  - PEEK nuts and ETFE ferrules for 1/8″ tubing
- Tubing kit for column connections
  - SS tubing, 1/8″ (OD), 2.1 mm (ID), 1 m, for column inlet/outlet (qty. 2)
  - SS tubing, 1/16″ (OD), 1 mm (ID), 1 m, for column inlet/outlet (qty. 2)
  - ETFE tubing, 1/8″ (OD), 1.6 mm (ID), 1 m, for column outlet (qty. 1)
  - PTFE tubing, 1/8″ (OD), 2.4 mm (ID), 1 m, for column outlet (qty. 1)
  - PTFE tubing, 1/16″ (OD), 1 mm (ID), 1 m, for column outlet (qty. 1)
  - SS fittings (nuts and ferrules) for 1/8″ tubing (qty. 4)
  - SS fittings (nuts and ferrules) for 1/16″ tubing (qty. 4)
  - Outlet reducer (SS adapter with nut and ferrule for 1/16″ tubing) (qty. 2)
- Column clamp (qty. 1)
  - For columns up to 40 mm (OD)
  - 3 mm Allen wrench
- Detector test cell for service (qty. 1)
- Gradient valve to pump heads tubing assembly (qty. 1)
  - PTFE, 1/8″ (OD), 2.4 mm (ID) with springs
  - PEEK nuts and ETFE ferrules for 1/8” tubing
  - Tee union
- Positioning guide for placing short racks (qty. 1)
- Power cord, based on destination country (qty. 1)
- Purge valve outlet, 1.5 m (qty. 1)
  - ETFE, 1/8” (OD), 1.6 mm (ID) with an SS ballast at one end
  - SS fitting and PEEK nut and ETFE ferrule for 1/8” tubing
- Racks (qty. 3)
  - SS, 18 x 150/80 mm for 18 mm diameter tubes
- Sample loop fittings, unless the sample loop is already supplied (qty. 2)
- Solvent bottle tray (qty. 1)
- Stylus (qty. 1)
  - Adhesive holder
  - M3 fixing screw
- USB drive (qty. 1)
  - Documentation
  - Control software installation file

Documentation

- *PLC 2050/2250/2500 Purification Systems User's Guide*
- *GLIDER Software User's Guide*
- *UV-VIS Detector Service Guide*

OPTIONAL ACCESSORIES

Factory Installed

- Backflush valve, automatic (qty. 1)
  - 4-way, 2-position electric valve for 1/8" tubing, special screws, and cable
  - Control module, power supply, bracket, and cables
  - Tubing kit, 1 mm (ID) (PLC 2050) or 2.1 mm (ID) (PLC 2250 and PLC 2500)
- Column switching valve, automatic (qty. 1)
  - 6-way, 2-position electric valve for 1/8" tubing, special screws, and cable
  - Control module, power supply, bracket, and cables
  - Tubing kit 1 mm (ID) (PLC 2050) or 2.1 mm (ID) (PLC 2250 and PLC 2500)
- Integrated ELS Detector
  - SEDEX FP™ nebulizer
  - Glassware nebulization chamber
  - Chamber shield
  - Accessory kit:
  - Splitter tubing (PEEK), 1/16" (OD) with PEEK fittings, and PEEK union 10-32
    - ▶ Gas tube (PA), 6mm (OD), 3 m
    - ▶ Gas tube (PU), 4 mm (OD), 23 cm
    - ▶ Drain tube assembly (including SS fitting and PTFE seal)
    - ▶ 2 adjustable releasable clips for black exhaust tube
  - Gas regulator with 5 µm filter (ordered separately):
    - ▶ Manometer
    - ▶ Fittings
    - ▶ Set of two side mounting brackets
- Loop injection valve, automatic (qty. 1)
  - 6-way, 2-position electric valve for 1/8" tubing, special screws, and cable
  - Control module, power supply, bracket, and cables
  - Tubing kit 1 mm (ID) (PLC 2050) or 2.1 mm (ID) (PLC 2250 and PLC 2500)
- Quaternary gradient system 1/8" (PLC 2050 and PLC 2250) or 3/16" (PLC 2500) (qty. 1)
  - 4-way gradient valve
  - Inlet/suction tubing with fittings (qty. 4)

Aftermarket Options

- Acquisition module for external detectors (qty. 1)
  - USB cable (qty. 1)
  - USB drive with drivers and installation procedure (qty. 1)
- Loop injection valve, manual (qty. 1)
  - 6-way, 2-position manual valve for 1/8″ tubing, and bracket
  - Tubing kit 1 mm (ID) (PLC 2050) or 2.1 mm (ID) (PLC 2250 and PLC 2500)
  - Hardware and installation procedure
  - Accessory kit
    - ▶ Large-bore syringe needle (qty. 1)
    - ▶ Needle port cleaner (qty. 1)
    - ▶ Allen wrenches (qty. 2)
    - ▶ Open-end spanner, 1/4”—5/16” (qty. 1)
    - ▶ Operating instructions (qty. 1)
- Fraction collector cover kit (qty. 1)
  - Cover with hinges and transparent door
  - Outlet adaptor
  - Clamp ring
  - Installation procedure
- Funnel rack with holder, 16 outlets (qty. 1)
  - Tubing with fittings, PTFE, 1.5m, 1/4″ (OD), 4.75 mm (ID) (qty. 16)
  - SS probe for Funnel Rack (5.3 cm)
  - Stickers for outlet tubes identification
  - Installation procedure
- Manual column switching valve (qty. 1)
  - 6-way, 2-position manual valve for 1/8″ tubing and bracket
  - Tubing kit, 1 mm (ID) (PLC 2050) or 2.1 mm (ID) (PLC 2250 and PLC 2500)
- Standalone column holder for LC and flash columns (qty. 1)
  - ETFE or PTFE tubing kit 1/8” (OD)

Technical Specifications

Please be aware of the following before operating the instrument.

NOTICE **Changes or modifications to the instrument not expressly approved by Gilson could void the factory-authorized warranty.**

This instrument complies with part 15 of the Federal Communications Commission (FCC) rules. Operation is subject to the following two conditions: (1) this instrument may not cause harmful interference, and (2) this instrument must accept any interference received, including interference that may cause undesired operation.

Shielded cables must be used with the instrument to ensure compliance with the FCC Class A limits.

PLC 2050/2250/2500 Purification Systems

SPECIFICATION	DEFINITION
Collection Options	Several rack options available. Refer to **Fraction Collector on page 79** in the **Replacement Parts and Accessories** appendix. Rack overlays for easy tube identification (optional). Refer to **Install the Rack Overlays on page 46**. Funnel rack with 16 outlets for large and variable collection volume in external high-capacity containers (optional). Refer to **Install the Funnel Rack on page 47**. Fraction collector cover kit (optional). **Install the Fraction Collector Cover Kit on page 46**.
Column Holder	Built-in column clamp (standard). 40 mm maximum (OD) for columns. Refer to **Column Setup on page 40**. Additional standalone holder for flash columns. 400 mm maximum height. 115 mm maximum diameter.
Contact Control	Analog signal input: Two contacts +/- (-1 V ⎓ ; and +1V ⎓, use of 10-bit A/D converter) Two inputs (contact closure, CMOS open drain): Start In and Stop In (5 V ⎓ maximum) Two outputs (static relay contacts): Start Out and Stop Out (5 V ⎓ maximum)
Control	Via integrated touchscreen PC with GLIDER Software. Refer to the *GLIDER Software User's Guide*.

PLC 2050/2250/2500 PURIFICATION SYSTEMS TECHNICAL SPECIFICATIONS CONTINUED ON PAGE 20

PLC 2050/2250/2500 Purification Systems

SPECIFICATION	DEFINITION
Detection	UV monochromator single wavelength detector, 254 nm by default (standard) UV monochromator dual wavelength detector, 254/280 nm by default (optional) UV detector, 4-wavelength DAD, 200–400 nm (optional) UV-VIS detector, 4-wavelength DAD, 200–600 nm (optional) UV-VIS detector, 4-wavelength DAD, 200–800 nm (optional) VERITY 1920 MS (optional). Refer to the **PLC with VERITY 1920 MS Configuration** appendix. Standalone or built-in evaporative light scattering detector (ELSD) (optional). Refer to the **PLC with Integrated ELSD** appendix.
Dimensions (W x D x H)	62 x 59 x 66 cm (24.4 x 23.2 x 26 in.)
Electrical Protection	General: Delayed action fuses 6.3A H 250 V~, T-type (qty. 2) 24 V ⎓ and 5 V ⎓: Delayed action fuses with different ratings, L 250 V~, T-type
Environmental Conditions	**Specification** / **Definition** Environment: Indoor use only Altitude: Up to 2000 m Temperature Range: 5°C to 40°C (41°F to 104°F) Humidity: Maximum relative humidity 80% for temperatures up to 31°C, decreasing linearly to 50% relative humidity at 40°C
External Ports	USB ports Serial port RS-232 (COM4) LAN port
Gradient Former	Binary (standard) Quaternary (optional) Linear response from 2% to 98%
Injection Options	Automatic loop injection valve (optional). Refer to **Loop Injection Valve Options on page 27**. Manual loop injection valve (optional). Refer to **Loop Injection Valve Options on page 27**. Additional injection pump (1–50 mL/min or 5–250 mL/min, optional). Additional GX-241 Liquid Handler (optional). Refer to the **PLC with Configuration** appendix.

PLC 2050/2250/2500 PURIFICATION SYSTEMS TECHNICAL SPECIFICATIONS CONTINUED ON PAGE 21

PLC 2050/2250/2500 Purification Systems

SPECIFICATION	DEFINITION	
Liquid Contact Materials* *Refer to **Materials on page 85** for more information.	**Description**	**Material**
	Gradient valve (gradient former) and collection valve	PEEK and Kalrez®
	Shut-off valve for automatic injection valve	PTFE
	Pressure transducer and seal	Al_2O_3 and Kalrez®
	Manual injection valve	316 SS and PEEK
	Pump heads, check valve housings, purge valve holder, and ballasts	316L SS
	Mixing chamber	316L SS and PTFE
	Pump piston seals	GFP and Hastelloy C
	Pump pistons	Zirconium oxide
	Pump check valves	PCTFE, ruby, and sapphire
	Purge valve	Ketron® CA30 PEEK and Kalrez®
	Tubing, fittings, sample loops, and unions	316/316L SS PEEK, ETFE, PTFE, PFA
	UV detector cell	Fused silica, PTFE, and 316 SS
Racks	Three racks, 18 x 150/180 mm tubes (long) Several rack options (long or short) available. Refer to **Fraction Collector on page 79** in the **Replacement Parts and Accessories** appendix for a complete listing. Possible to combine different rack models.	
Power Requirements	**Specification**	**Description**
	Line Voltage	110–120 / 220–240 V~ (single-phase)
	Line Frequency	50/60 Hz
	Wattage	450 W maximum
	Distribution	TT or TN power system only Transient overvoltages Category II Class 1 equipment

PLC 2050/2250/2500 PURIFICATION SYSTEMS TECHNICAL SPECIFICATIONS CONTINUED ON PAGE 22

PLC 2050/2250/2500 Purification Systems

SPECIFICATION	DEFINITION	
Pump Flow rate (minimum to maximum) Maximum pressure	PLC 2050	50 mL/min (1 to 50 mL/min) 300 bar (4351 psi)
	PLC 2250	250 mL/min (5 to 250 mL/min) 230 bar (3336 psi)
	PLC 2500	500 mL/min (10 to 500 mL/min) 110 bar (1595 psi)
Pump Flow Rate Performance	Accuracy: ±2% (with H_2O degassed at 20°C) Repeatability: Better than 0.5% RSD	
Safety and Compliance	The instrument has been certified to safety standards specified for Canada, Europe, and the United States. Refer to the instrument rear panel label and the Declaration of Conformity document for the current standards to which the instrument has been found compliant.	
Storage	450 GB of hard memory Up to 32 methods in control software memory	
Valve Options	Automatic backflush valve (optional) Manual column switching valve (optional)	
Weight	65 kg (143 lbs.)	

Detailed Description

Two-Head Pump and Purge Valve

The two-head pump can deliver mobile phases at flow rates up to 500 mL/min (depending on model) with low residual pulsation. PLC Purification Systems utilize high performance, dual piston, reciprocal pumps. The pump generates suction through a system of pulleys, belt, and a stepper motor, which drives the cams and pistons. For plumbing connections, refer to the table on page 24.

A manual valve at the outlet (black knurled knob) allows users to easily purge or prime the pump; the valve is associated with a pressure transducer, which monitors the pressure in the system.

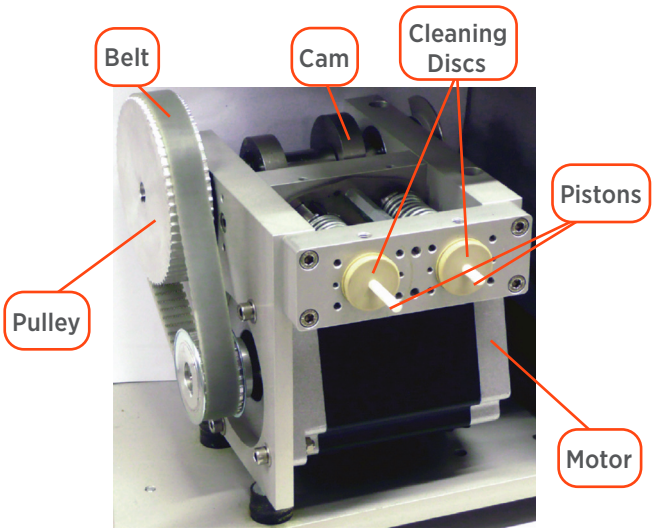


Figure 5
Interior View of Pump

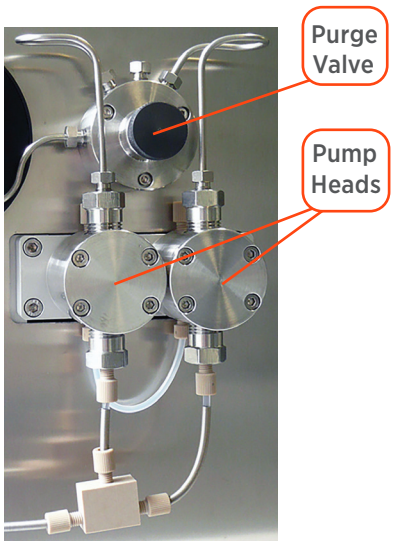


Figure 6
Pump Heads and Purge Valve

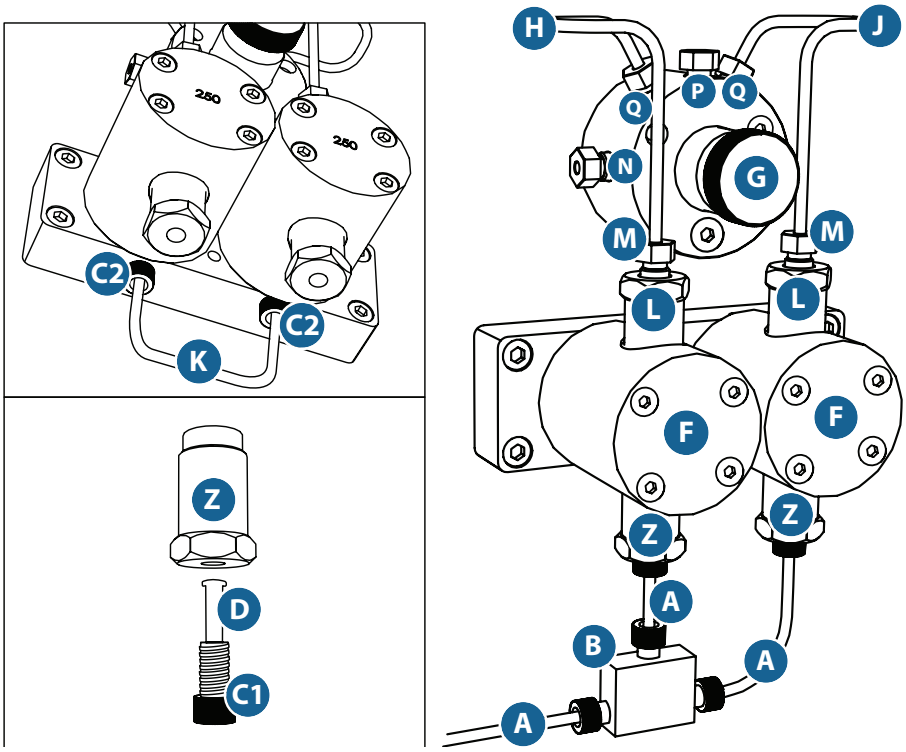


Figure 7
Component and Connection Diagram for the Pump Heads and Prime/Purge Valve

Pump and Purge Valve Components and Connections

COMPONENT	DESCRIPTION	COMPONENT	DESCRIPTION
A	PTFE tubing, 1/8″ (OD), 2.4 mm (ID) with springs (PN 21040137) for PLC 2050 and PLC 2250 PFA tubing, 3/16″ (OD), 1/8″ (ID) (PN 21040139) for PLC 2500	J	SS, preformed tubing, 1/8” (OD), 1 mm (ID) (PN 21040121) for PLC 2050 SS, preformed tubing, 1/8” (OD), 2.1 mm (ID) (PN 21040117) for PLC 2250 and PLC 2500
B	PEEK tee union, 1/4″-28, 2.4 mm bore (PN 21040201) for PLC 2050 and PLC 2250 PEEK Y assembly, 5/16″-24 to 10-32 (PN 4957515) for PLC 2500	K	ETFE junction tubing for cleaning discs
C1	PEEK nuts Long for 1/8″ tubing (PN 21040195 for PLC 2050 and PLC 2250) Standard for 3/16″ tubing (PN 49040132 for PLC 2500)	L	Outlet check valve housings Check valves (PN 21040103)
C2	PEEK short nuts for 1/8″ tubing (PN 21040194)	M	SS nut for 1/8″ tubing (PN 21040199) SS ferrule for 1/8″ tubing (PN 21040200)
D	ETFE ferrules 1/8” tubing (PN 21040193) for PLC 2050 and PLC 2250 3/16” tubing (PN 490410133N) for PLC 2500	N	Outlet
F	Pump heads	P	Purge valve outlet (waste) Purge valve outlet tubing (PN 21040168)
G	Prime and purge valve	Q	Pump head outlets
H	SS, preformed tubing, 1/8” (OD), 1 mm (ID) (PN 21040122) for PLC 2050 SS, preformed tubing, 1/8” (OD), 2.1 mm (ID) (PN 21040118) for PLC 2250 and PLC 2500	Z	Inlet check valve housings Check valves (PN 21040103)

Dynamic Mixing Chamber

Located at the outlet of the pump, the dynamic mixing chamber utilizes a motor-driven magnetic agitator to thoroughly mix solvents and ensure smooth gradients at high flow rates.

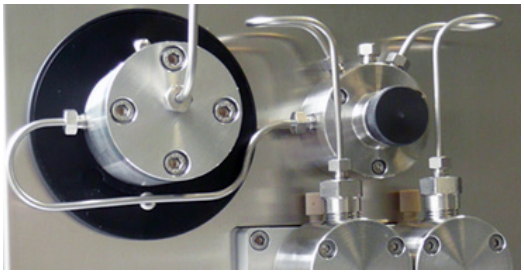


Figure 8
Dynamic Mixing Chamber

Mixing volume depends on pump model installed:

- 4 mL for a 50 mL/min pump (PLC 2050)
- 12 mL for a 250 mL/min pump (PLC 2250)
- 16 mL for a 500 mL/min pump (PLC 2500)

Refer to the diagram below for components and connections to the dynamic mixing chamber.

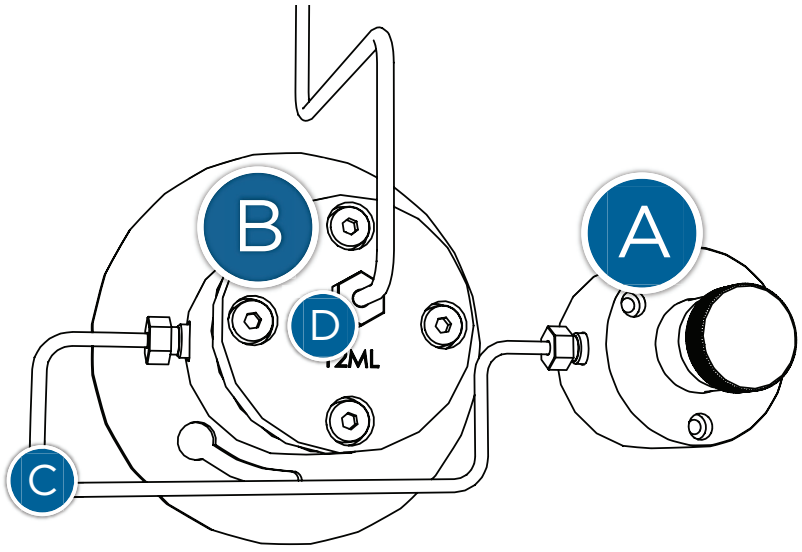


Figure 9
Component and Connection Diagram for the Mixing Chamber

Dynamic Mixing Chamber Components and Standard Connections

COMPONENT	DESCRIPTION	COMPONENT	DESCRIPTION
A	Prime and purge valve	C	SS, preformed tubing, 1/8" (OD), 1 mm (ID) (PN 21040123) for PLC 2050 SS, preformed tubing, 1/8" (OD), 2.1 mm (ID) (PN 21040119) for PLC 2250 and PLC 2500
B	Dynamic mixing chamber	D	SS nut for 1/8" tubing (PN 21040199) SS ferrule for 1/8" tubing (PN 21040200)

Two- or Four-Way Gradient Valve

A two- (standard) or four-way (optional) low pressure valve, located on the left side of the instrument, permits users to perform binary or quaternary elution gradients. The low pressure valve accommodates up to four solvents. The binary gradient valve comes standard with PLC 2050/2250/2500 Purification Systems. The optional quaternary gradient valve (PN 21040001 for PLC 2050 and PLC 2250; PN 21040002 for PLC 2500) is also available. For plumbing connections, refer to Gradient Valve to Pump Heads on page 37.

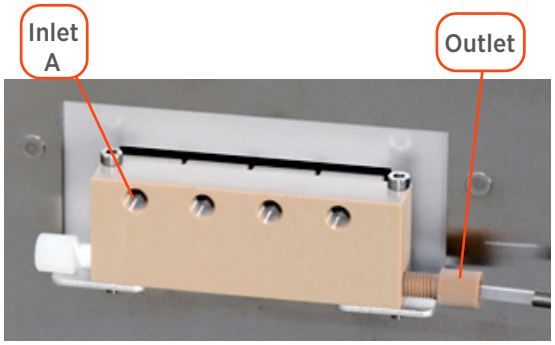


Figure 10
4-Way Gradient Valve

Binary and Quaternary Low Pressure Valves Service Parts

PART NUMBER	BINARY VALVES	PART NUMBER	QUATERNARY VALVES
21040143	1/8" with cable, PLC 2050/2250	21040145	1/8" with cable, PLC 2050/2250
21040144	3/16" with cable, PLC 2500	21040175	3/16" with cable, PLC 2500

INLET TUBING

Inlet tubing connects the gradient valve to the solvent reservoirs. Use the two (standard) or four (optional) inlet lines supplied. Each inlet line has a fitting and spring on one end and an SS ballast on the other end.

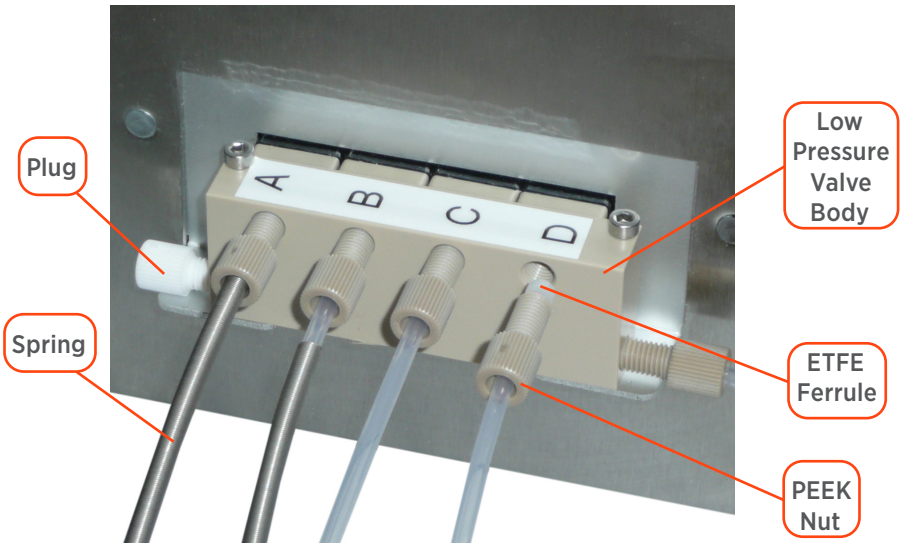


Figure 11
Inlet Tubing Connections

Loop Injection Valve Options

AUTOMATIC LOOP INJECTION VALVE

The six-way automatic loop injection valve allows users to load a sample into the sample loop while the system is running. The sample can be automatically injected into the column by switching the valve via GLIDER.

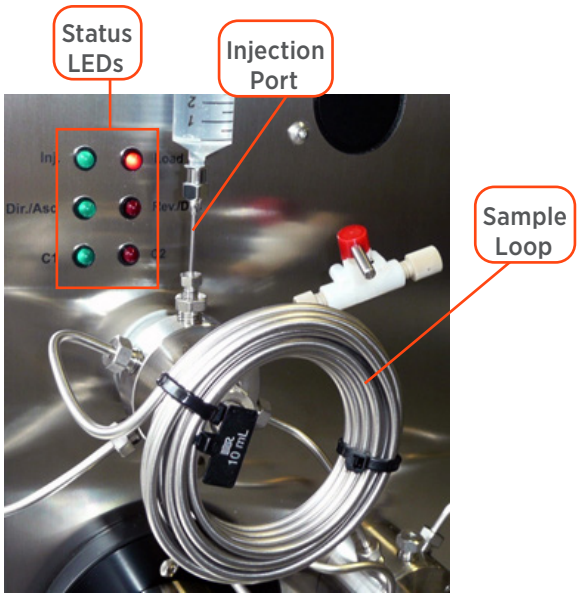


Figure 12
Automatic Loop Injection Valve

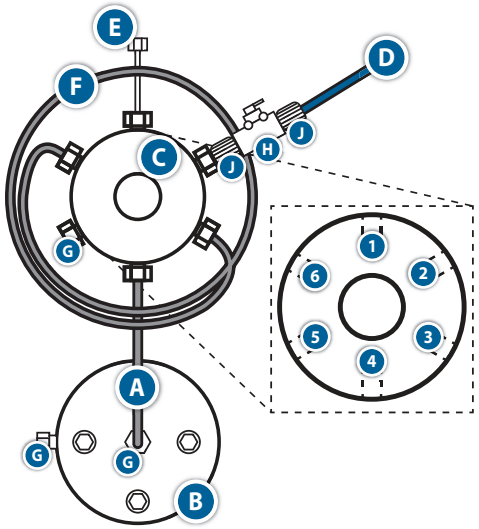


Figure 13
Component and Connection Diagram for the Automatic Loop Injection Valve

Automatic Loop Injection Valve Components and Connections

COMPONENT	DESCRIPTION	COMPONENT	DESCRIPTION
A	SS, preformed tubing, 1/8" (OD), 1 mm (ID) (PN 21040124) for PLC 2050 SS, preformed tubing, 1/8" (OD), 2.1 mm (ID) (PN 21040120) for PLC 2250 and PLC 2500	F	Sample loop, preformed SS, 1/8" (OD), 2.1 mm (ID). Refer to **Sample Loops on page 82** for a complete listing.
B	Dynamic mixing chamber	G	SS nut for 1/8" tubing (PN 21040199) SS ferrule for 1/8" tubing (PN 21040200)
C	Automatic loop injection valve	H	Shut-off valve, PLC, 1/8" (PN 21040172
D	Shut-off valve outlet tubing, 1/8" (OD), 1.6 mm (ID) (PN 21040169)	J	PEEK short nuts for 1/8" tubing (PN 21040194) ETFE ferrules for 1/8" tubing (PN 21040193)
E	Injection port (PN 21040163)		

MANUAL LOOP INJECTION VALVE

Mounted on the left side of the system, the six-way manual loop injection valve allows users to load a sample into the sample loop while the system is running. The sample can be manually injected into the column by switching the valve.

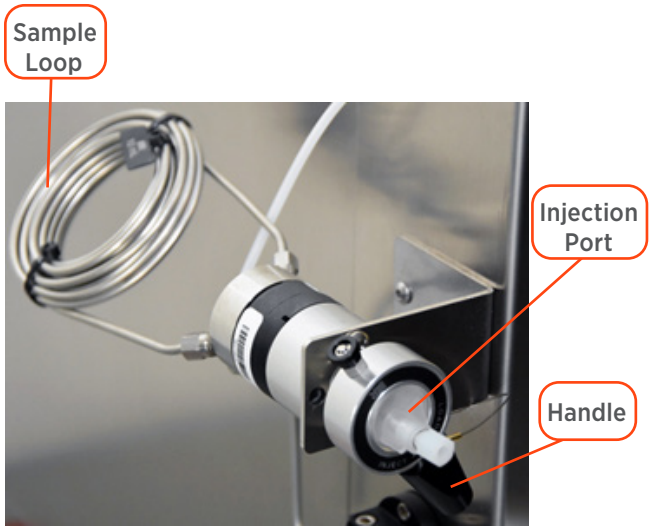


Figure 14
Manual Loop Injection Valve

BACKFLUSH VALVE

The four-way automatic backflush valve allows users to change the pumping direction (elution mode) into the connected column at any time while the system is running:

- Direct 'Dir' / Reverse 'Rev', for a HPLC column
- Ascending 'Asc' / Descending 'Dsc', for a CPC column

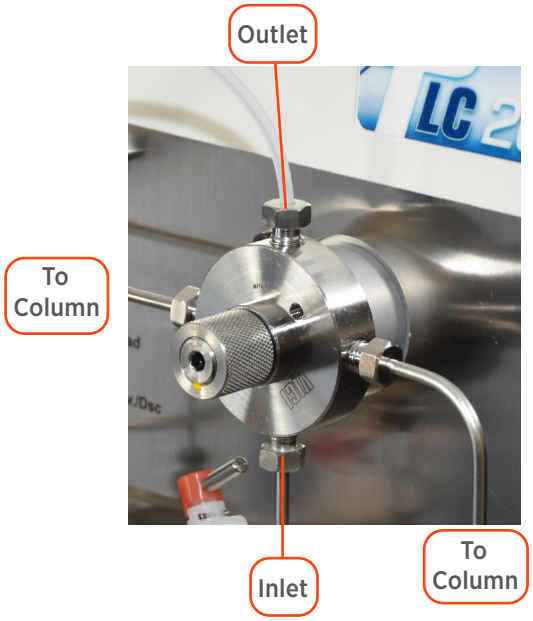


Figure 15
Backflush Valve

UV Detector

The standard UV detector is equipped with a deuterium lamp and monochromator to monitor desired wavelength. The optional DAD (UV or UV-VIS) models monitor a large range of wavelengths. With DAD, the control software can acquire signals issued from four different wavelengths simultaneously. In addition, a continuous scan allows the acquisition of a full spectrum, which is displayed on the main screen.

UV AND UV-VIS DAD OPTIONS

- UV, monochromator, 254 nm by default (standard)
- UV, dual wavelength, 254/280 nm by default (optional)
- UV detector, four-wavelength; DAD, 200–400 nm (optional)
- UV-VIS detector, four-wavelength; DAD, 200–600 nm (optional)
- UV-VIS detector, 4-wavelength; DAD, 200–800 nm (optional)

Fraction Collector

After detection of the signal (chromatogram), the results obtained at the outlet of the column (peaks) can be directed to tubes in racks. A three-way collection valve located on the dispense arm allows users to direct fractions to collection tubes or to waste.

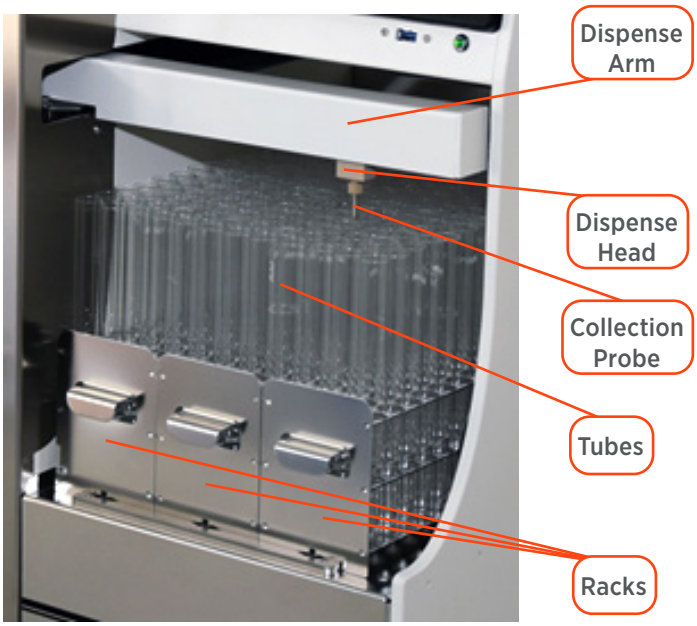


Figure 16
Fraction Collector with Standard Racks

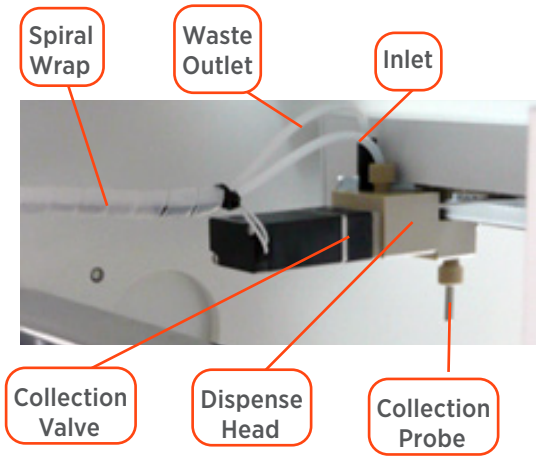


Figure 17
3-Way Collection Valve

COLLECTION PROBES

Different models of collection probes can be connected to the dispense head of the fraction collector. The installed probe is SS, 35 mm (PN 21040159). A second probe, SS, 65 mm is supplied to collect fractions in 150 mm tubes. An additional probe is available, which is shorter, but with a smaller outlet diameter for a fine and accurate dispense.

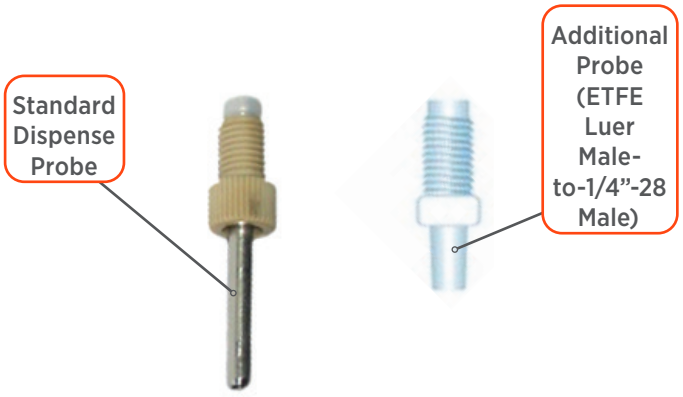


Figure 18
Collector Probes

Back Pressure Regulator

An in-line back pressure regulator 20 psi (1.4 bar) (PN 49041121) is mounted on the collector inlet tubing to prevent air bubbles in the detector flow cell.

NOTICE

For the PLC 2500, the back pressure regulator is replaced by a simple union because it creates too much back pressure at high flow rates. The back pressure regulator is supplied as an accessory.

You can install and use the back pressure regulator 20 psi on PLC 2500 if you are working with flow rates less than 300 mL/min.

Racks

The integrated collector is provided with three SS racks (standard, PN 21040019) designed for 18 mm diameter tubes, accommodating up to 192 tubes and a maximum volume of 6.1 L. Refer to Fraction Collector on page 79 for a complete list of rack options.

Integrated Touchscreen PC

The PLC Purification System is controlled by GLIDER Software that runs on an integrated touchscreen PC, which allows the user to create methods and run the PLC Purification System. Seven USB ports are available, two in the front of the PLC Purification System, below the screen, four on the right side, and one more on the left side of the PLC Purification System. USB cables and all other external connections should not exceed two meters (6.5 ft.).

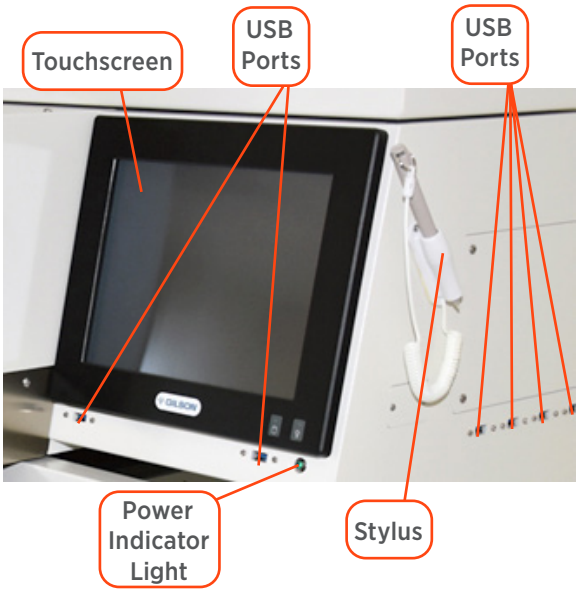


Figure 19
Touchscreen PC

External Connections

Additional external connectors, such as an RS-232 serial communication port (COM4), LAN port, analog signal input, and input/output ports can be used to connect external devices to the PLC Purification System.

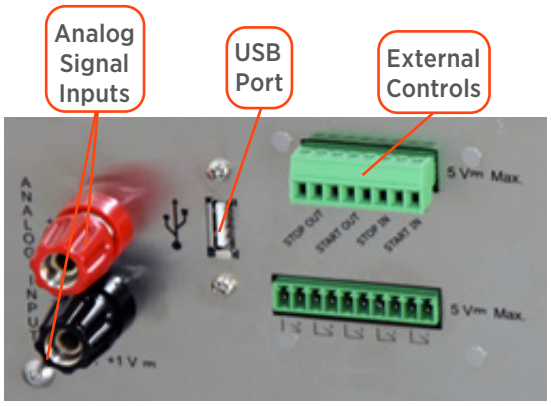


Figure 20
Analog Inputs, USB Port, and I/O Ports (Left Side)

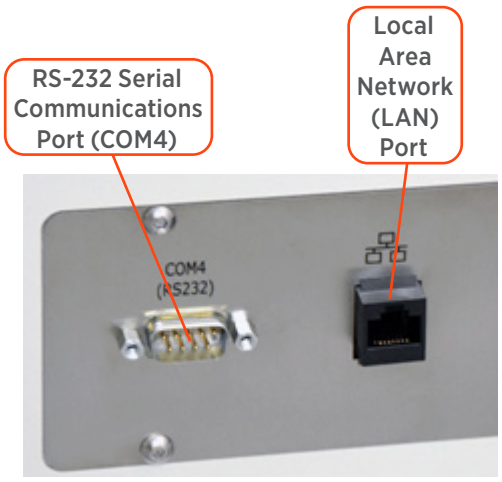


Figure 21
RS-232 and LAN Ports (Right Side)

RS-232 (COM4) PORT

The RS-232 port can be used to control an external device via serial communication with GLIDER, such as a VERITY® CPC System, the GX-241 Liquid Handler, or an additional detector.

USB PORTS

The USB ports can be used to connect any USB peripherals (keyboard, mouse, USB drive, printer, etc.) or optional acquisition module for additional detectors, or to control the VERITY 4020 Syringe Pump.

LAN PORTS

The LAN port can used to make direct data transfer to a private server.

ANALOG SIGNAL INPUTS

The analog input connectors (red +, black -) can be used for signal acquisition of additional detectors (-1 V⎓ ; +1V⎓). A 10-bit A/D converter on an electronic board allows to convert the analog signal to digital signal for the plotting in GLIDER.

EXTERNAL CONTROLS

The inputs 'Start In' and 'Stop In' can be used to start or stop the pump via a pulse (with 10 mA current limitation) or a closure of a NO/NC contact (O>C) coming from an external device (max. 5 V⎓). The outputs are static relay contacts (max. 5 V⎓). 'Start Out' induces a short closure of a contact NO/NC (Open>Close) at each starting of the pump (Run/Resume). 'Stop Out' induces a short closure of a contact NO/NC at each stop of the pump (Stop/Pause).

Terms and Abbreviations

ACRONYM	DESCRIPTION	ACRONYM	DESCRIPTION
AC	Alternating current	MS	Mass spectrometry
CPC	Centrifugal partition chromatography	NC	Normally closed
CCC	Counter-current chromatography	NO	Normally open
CMOS	Complementary metal–oxide–semiconductor	OD	Outer diameter
DAD	Diode array detector	PC	Personal computer
DMF	Dimethylformamide	PCTFE	Polychlorotrifluoroethylen
DMSO	Dimethyl sulfoxide	PEEK	Polyether ether ketone
ELSD	Evaporative light scattering detector	PFA	Perfluoroalkoxy alkane
EMC	Electromagnetic compatibility	PLC	Preparative liquid chromatography
ETFE	Ethylene tetrafluoroethylene	PPE	Personal protective equipment
FCC	Federal Communications Commission	PTFE	Polytetrafluoroethylene
FEP	Fluorinated ethylene propylene	RSD	Repeatability standard deviation
GFP	Graphite fiber-reinforced PTFE	SS	Stainless steel
GLP	Good laboratory practice	TPI	Threads per inch
HPLC	High performance liquid chromatography	USB	Universal serial bus
ID	Inner diameter	UV	Ultraviolet
IPA	Isopropyl alcohol	UV-VIS	Ultraviolet–visible
LAN	Local area network	WEEE	Waste electrical and electronic equipment

Customer Service

Gilson, Inc. and its worldwide network of authorized representatives provide customers with the following types of assistance: sales, technical support, applications, and instrument repair.

If you need assistance, please contact your local Gilson representative. Specific contact information can be found at **www.gilson.com**. To help us serve you quickly and efficiently, please refer to **Before Calling Us on page 73**.

Chapter 2

INSTALLATION

IN THIS CHAPTER:

⚠WARNING **The installation must be performed only by qualified personnel.**

A PLC Purification System and its components should be set up and installed in order per the instructions in this chapter.

Place the Solvent Bottle Tray

Place the solvent bottle tray on top of the PLC Purification System. Gripped feet allow it to stay in place. It is designed to minimize leakage risks and avoid bottle falls.

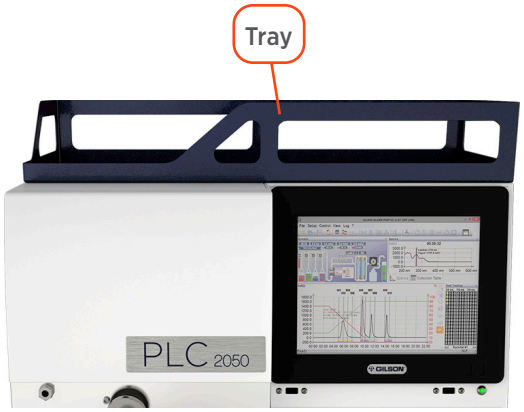


Figure 22
Solvent Tray

Plumbing Connections

⚠CAUTION **Wear appropriate personal protection equipment (PPE) according to the solvent pumped.**

The pump is shipped with high-pressure stainless steel tubing connected, and with plugs on the inlets and outlets. Remove the plugs before connecting any tubing.

Inlet Tubing

Inlet tubing connects the gradient valve to the solvent reservoirs. Use the two (standard) or four (optional) inlet lines supplied. Take care not to kink the inlet tubing. Each inlet line has a fitting and spring on one end and an SS ballast on the other end.

For each inlet line, place the ETFE ferrule into the PEEK body of the gradient valve and screw on the PEEK nut, finger tight, and slide the spring to place its end in the knurled part of the PEEK nut. Springs are used to prevent the tubes from bending. Colored cable ties are provided to easily identify the tubing (A=red, B=green, C=blue, and D=yellow).

Put the ends of the tubing with ballasts into the appropriate solvent reservoirs.

An adjustable, releasable clip on the left side of the system allows users to properly guide the tubing into the bottles positioned on the solvent tray atop the system.

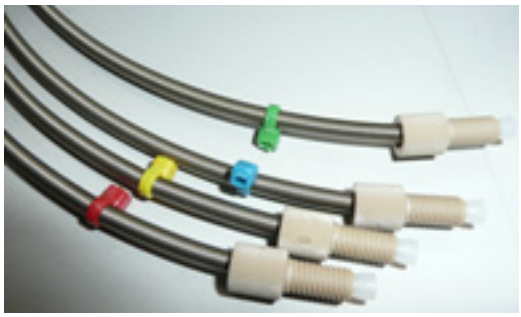


Figure 23
Springs and Colored Cable Ties

Figure 24
Inlet Tubing Ballasts

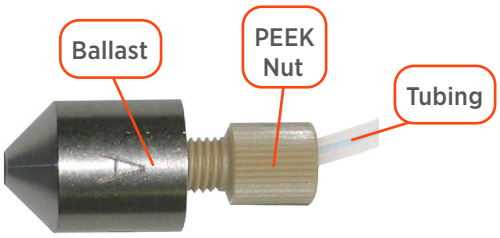


Figure 25
Close Up of Ballast and Fitting

TUBING CONNECTIONS AND COMPONENTS DIAGRAM

Refer to the following diagram and table before connecting the inlet tubing.

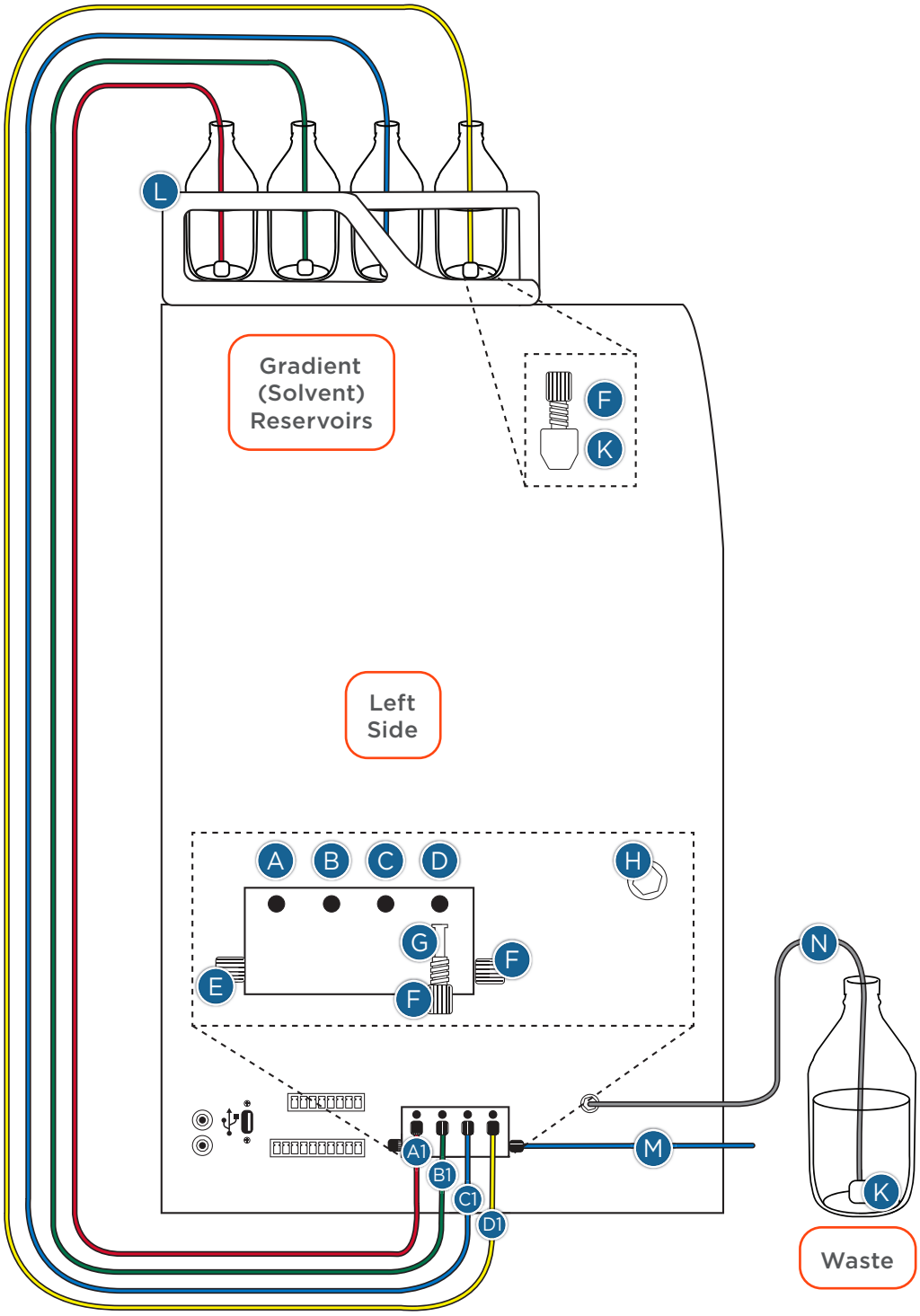


Figure 26
Component and Connection Diagram for the Gradient Valve and Waste Tubing

Gradient Valve Components and Connections

Component	Description	Component	Description
A, B, C, and D	Gradient valve ports • Binary (standard) • Quaternary (optional)	H	Waste outlet bulkhead union for 1/8″ (OD) tubing (PN 21040164)
A1, B1, C1, and D1	Solvent inlet tubing assembly • Binary (qty. 2) • Quaternary (qty. 4) • PTFE tubing, 1/8″ (OD), 2.4 mm (ID) with a 20 cm spring, PEEK nut, and ETFE ferrule (PN 21040101) for PLC 2050 and PLC 2250 • PFA tubing, 3/16″ (OD), 1/8″ (ID) with PEEK nut, and ETFE ferrule (PN 21040102) for PLC 2500	K	SS ballast
E	Plug • PN 49041019 for PLC 2050 and PLC 2250 • PN 21040196 for PLC 2500	L	Solvent bottle tray
F	PEEK nut • PN 21040194 (short) and PN 21040195 (long) for PLC 2050 and PLC 2250 • PN 49040132 for PLC 2500	M	Gradient valve to pump heads tubing assembly • PTFE tubing, 1/8″ (OD), 2.4 mm (ID) with springs, PEEK nuts, ETFE ferrules, and tee union for PLC 2050 and PLC 2250 • PFA tubing, 3/16″ (OD), 1/8″ (ID) with PEEK nuts, ETFE ferrules, and Y assembly for PLC 2500
G	ETFE ferrule • PN 21040193 for PLC 2050 and PLC 2250 • PN 490410133N for PLC 2500)	N	Waste outlet tubing assembly • ETFE tubing, 1/8” (OD), 1.6 mm (ID) with SS nut and ferrule (PN 21040115) for PLC 2050 and PLC 2250 • PTFE tubing, 1/8” (OD), 2.4 mm (ID) with SS nut and ferrule (PN 21040116) for PLC 2500

Gradient Valve to Pump Heads

The gradient valve to pump heads tubing assembly connects the gradient valve outlet to the two pump heads via a tee union. The tubing is equipped with protective springs. Take care not to kink the tubing.

To make the connections:

1. Screw two PEEK nuts into the check valve housings beneath the pump heads without fully tightening them.
2. Screw the PEEK nut into the gradient valve outlet on the left side of the PLC Purification System.
3. Finger-tighten the three fittings, and then ensure that the three fittings on the tee union are fully tightened.

Figure 27
Gradient Valve to Pump Heads Connections

Stainless Steel (SS) Fittings Assembly

1. Slide the nut and ferrule onto the tubing in the order shown on the figure.
2. Insert this assembly into the fitting body, screwing the nut in two or three turns by hand.
3. Push the tubing all the way forward into the body so that it seats firmly. This is essential for a proper zero dead volume connection.
4. Manually turn the nut into the body until it is finger tight.
5. Using the appropriate open end wrench, turn the nut 1/4 turn (90°) past the point where the ferrule first starts to grab the tubing. The amount of force required can vary considerably due to the friction between the nut and the threads and the composition and wall thickness of the tubing used. Because of these variables, a torque specification is unreliable.

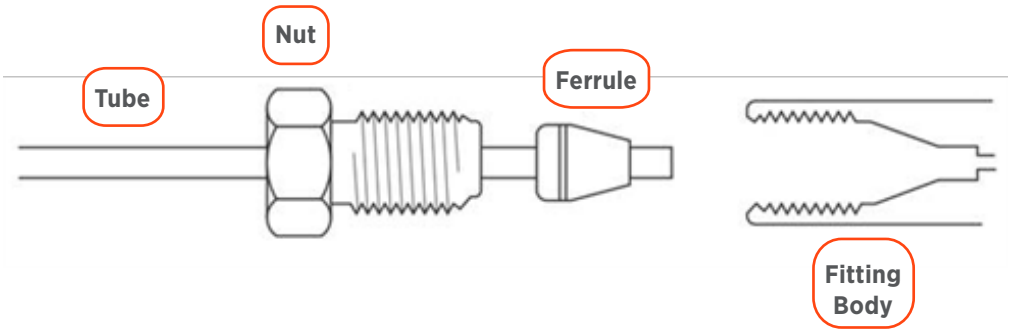


Figure 28
Outlet Tubing Assembly

Waste Outlet Tubing

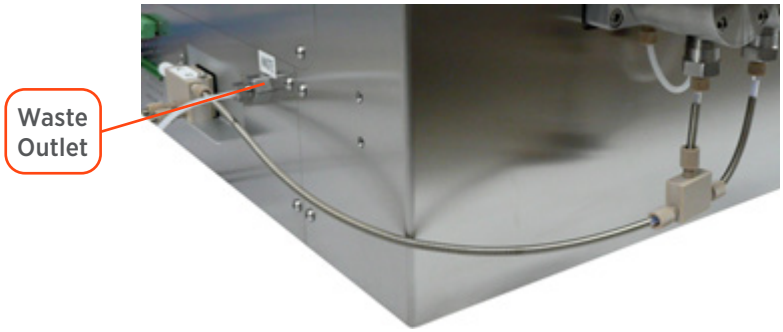


Figure 29
Waste Outlet

The waste tubing (PN 21040115 for PLC 2050 and PLC 2250; PN 21040116 for PLC 2500) connects the waste outlet to a waste reservoir. There is an SS fitting at one end and an SS ballast on the other end.

Connect the tubing to the SS bulkhead union labeled 'Waste', located on the left side of the system. Tighten the SS nut with a 3/8" spanner, and then place the other end in suitable waste receptacle.

Purge Valve Outlet Tubing

The purge valve outlet tubing (PN 21040168) connects the pump valve outlet to a waste reservoir. There is an SS fitting at one end and an SS ballast on the other end.

Connect the tubing to the purge valve outlet, tighten the SS nut with a 3/8” spanner, and then place the other end into suitable waste receptacle.

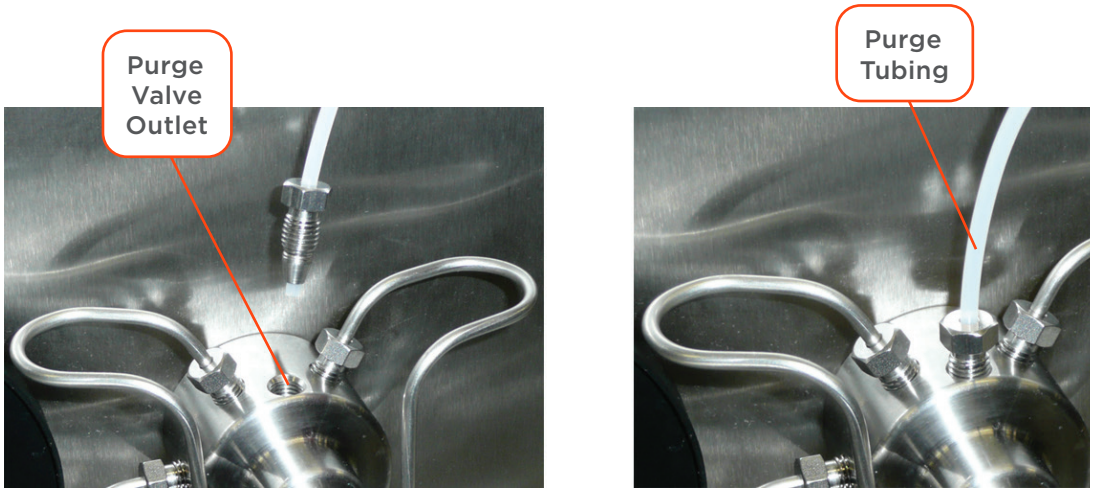


Figure 30
Purge Valve Outlet

Sample Loop

NOTE Most PLC Purification Systems come with the sample loop pre-installed at the factory; however, for custom orders, please follow the instructions below.

To make the sample loop connection:

- Connect a sample loop to Port 3 and Port 6 of the automatic loop injection valve.
- Connect a sample loop to Port 1 and Port 4 of the manual loop injection valve. The manual loop injection valve is mounted on a bracket on the left side of the system.

NOTE The sample loop must be equipped with SS nuts for 1/8” tubing (5/16"-24 UNF model) and SS ferrules for 1/8” tubing. Use a 3/8” or 5/16” spanner to tighten the nuts and properly crimp the ferrules.

Injection Valve Waste Outlet

NOTE Used only for the automatic loop injection valve.

The injection valve waste outlet (PN 21040169) tubing connects the waste outlet of the injection valve to a waste reservoir. There is a fitting at one end and an SS ballast on the other end. Connect the tubing to the shut-off valve outlet and finger-tighten the PEEK nut. The shut-off valve is connected to port 2 of the automatic loop injection valve.

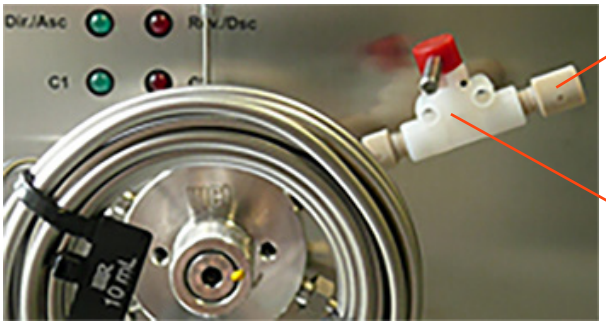


Figure 31
Injection Valve Waste Outlet

Column Setup

A wide range of columns can be used with PLC Purification Systems, including normal- or reverse-phase columns and those with an overall external diameter up to 40 mm. The device used to install the column is a clamp with vinyl coating. The clamp is mounted on the black holder on the left side of the PLC Purification System.

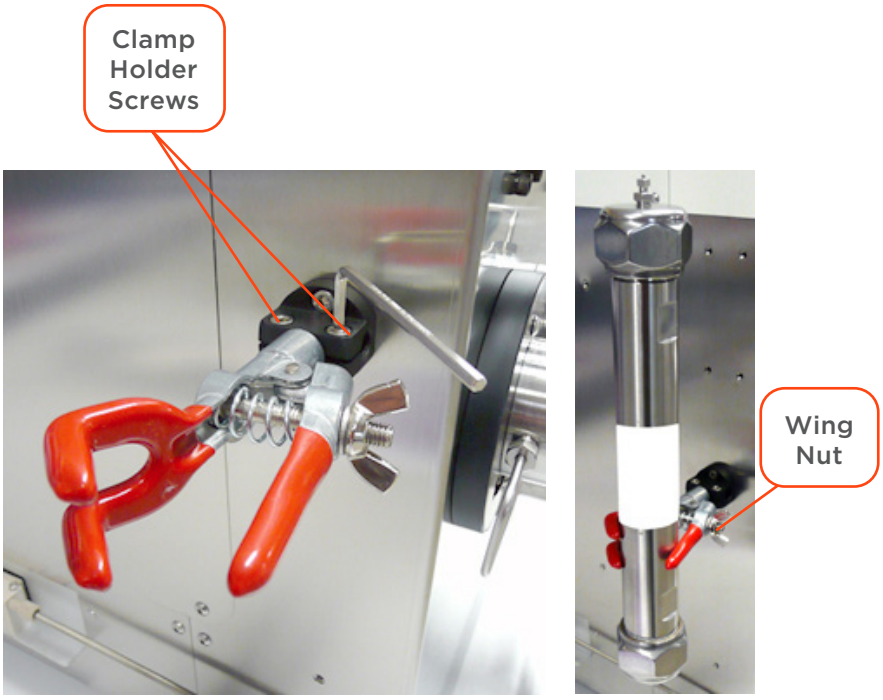


Figure 32
Column Positioning

To install the clamp:

1. Slide the rod horizontally into the black holder. Tighten the two cylindrical-head screws with the 3 mm Allen wrench supplied.
2. To install the column, loosen the wing nut, and then slide the column inside the clamp. Securely tighten the clamp.
3. Connect the column inlet to the loop injection valve outlet (manual or automatic).
   - Port 5 for the automatic loop injection valve
   - Port 3 for the manual loop injection valve
4. Connect the column outlet to the bulkhead union detector Inlet.

NOTE **If additional valves are installed, such as the automatic backflush valve (PN 21040005 for PLC 2050; PN 21040006 for PLC 2250 and PLC 2500) or manual column switching valve (PN 21040013 for PLC 2050; PN 21040014 for PLC 2250 and 2500), proceed as indicated on the system.**

5. Use a 3/8” spanner to tighten the nuts and crimp the ferrules.

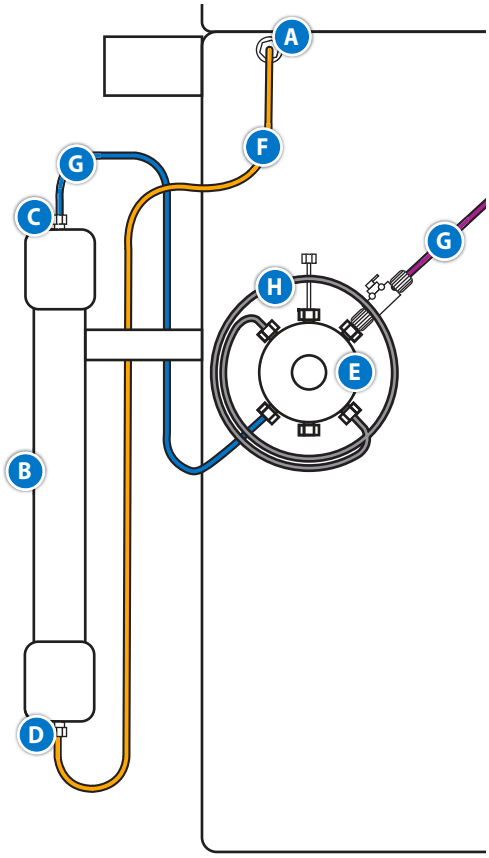


Figure 33
Column Connections to Automatic Loop Injection Valve

Column Connections to the Automatic Loop Injection Valve

Component	Description	Component	Description
A	Bulkhead union detector inlet	E	Automatic loop injection valve
B	Column	F	Column tubing, from column outlet to bulkhead union detector inlet
C	Column outlet/inlet	G	Column tubing, from automatic loop injection valve (Port 5) to column inlet
D	Column outlet/inlet	H	Sample loop

Install the Racks

PLC Purification Systems accommodate three racks. The standard, supplied rack set (PN 21040019) consists of three SS racks with 192 tubes, 180 mm high with a total collection volume of 6.1 L.

NOTE Remove the black cable tie which holds the collector arm during transport by manually loosening it. Keep this cable tie, it is reusable.

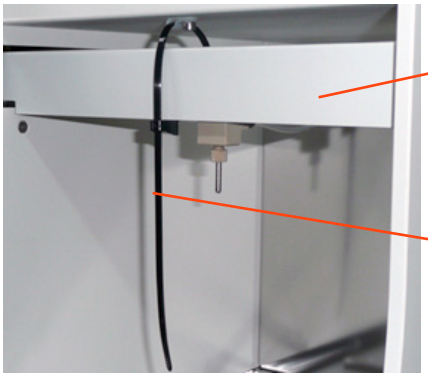


Figure 34
Collector Arm Cable Tie

To install the racks:

1. Place the tubes in the rack holes, and then place the racks on the collector plate.
2. Locate the middle slot in the rear of the rack. Slide the slot over the back positioning guide mounted on the collector plate.
3. Fit the middle slot on the front of the rack over the positioning guide in front of the collector plate.

NOTE When using short racks, use the additional positioning guide supplied and place it in appropriate holes.

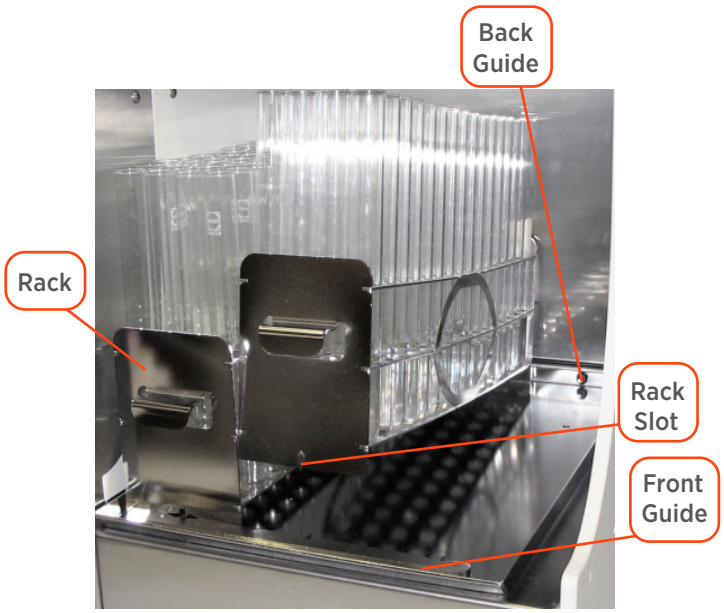


Figure 35
Rack Installation

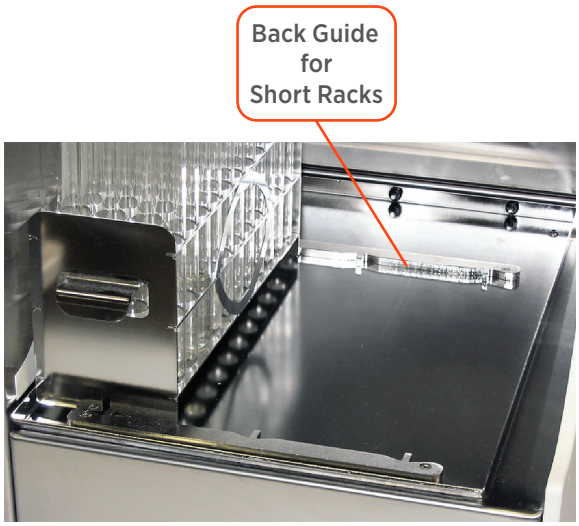


Figure 36
Short Racks Guide

Install the Stylus

Use the supplied stylus to make software selections on the touchscreen. A fixed holder is provided for the stylus and its extendable cord. The stylus holder is installed with the supplied screw on the right side of the PLC Purification System through the threaded hole.

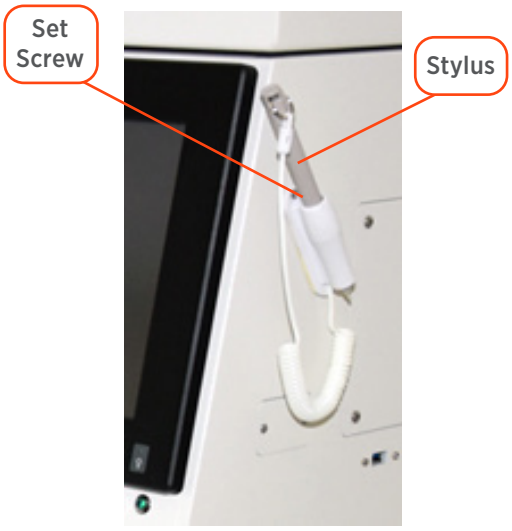


Figure 37
Stylus and Holder

Make the Power Connection

The PLC Purification System is supplied with the appropriate fuses and is ready to operate at the line voltage of the destination country. A voltage selector located near the power receptacle allows users to adjust the input voltage of the system. Check that the position of the voltage selector corresponds to the voltage of the mains.

NOTICE

Never use any cabling not supplied or recommended by Gilson. Use of unspecified cabling may lead to improper operation or failure to comply with safety or EMC regulations.

⚠CAUTION

When operating the PLC Purification System, it must be possible to disconnect it from mains supply at any time. In the event of an emergency, the power connector of the instrument must be easily accessible and removable.

The PLC Purification System must never be operated from a power outlet that has no ground connection. The absence of a ground connection can lead to electric shock or short circuit.

The PLC Purification System is designed for use with liquids; however, liquid contact with external equipment may lead to the risk of electric shock or short circuit. Ensure that fluid connections are not close to ancillary equipment and are checked for leaks prior to use. In the event of a leak, any ancillary equipment not designed for use with liquids must be turned off until the liquid is removed.

To make the power connection, plug in the AC power cord into the power receptacle located on the right side of the PLC Purification System. Then make the connection between the PLC Purification System and the AC power source.

- 110–120/220–240 V~ (single-phase)
- 50/60 Hz
- 450 W max.
- General fuses: T 6.3A H 250 V~ (qty. 2)

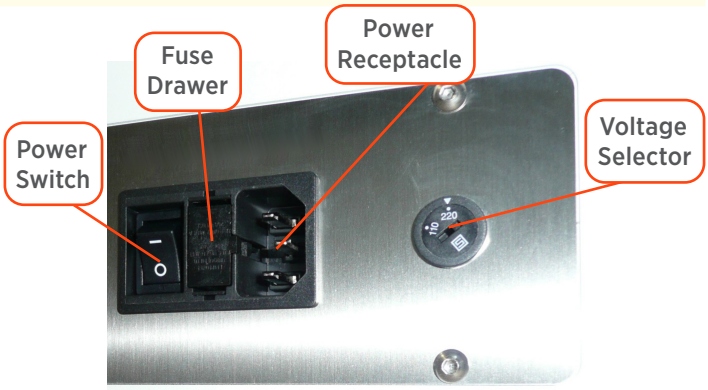


Figure 38
Power Switch and Voltage Selector

NOTE

| indicates that the electrical power is switched on; O indicates that the electrical power is switched off.

Install Aftermarket Options

Install the Manual Column Switching Valve

The manual column switching valve (PN 21040013 for PLC 2050; PN 21040014 for PLC 2250 and PLC 2500) connects two columns to a single flow path; e.g., a column installed on the standard column clamp and an additional column. Secure the additional column with a second column clamp or use a standalone column holder (PN 21040015).

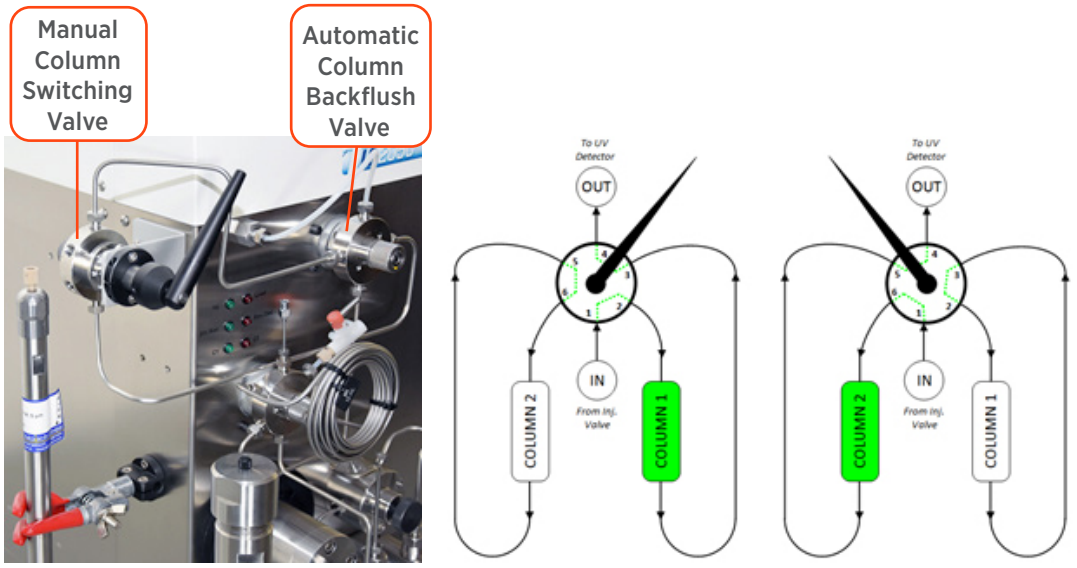


Figure 39
Column Switching Valve with Flow Diagrams

To install and plumb the manual column switching valve:

1. Secure the manual column switching valve (already mounted on its bracket) to the two dedicated holes located on the left side of the PLC Purification System with the two domed-head screws supplied with a 3 mm Allen wrench.
2. Connect the manual column switching valve inlet (Port 1) to the loop injection valve outlet.
3. Connect the column switching valve outlet (Port 4) to the bulkhead union detector inlet.
4. Connect the columns inlets to the column switching valve:
   - To Port 2 for the Column 1 inlet
   - To Port 6 for the Column 2 inlet
5. Connect the columns outlets to the column switching valve:
   - To Port 3 for the Column 1 outlet
   - To Port 5 for the Column 2 outlet
6. Use a 3/8” spanner to tighten the nuts and properly crimp the ferrules.
7. Switch the manual switching valve to the right to direct flow to the Column 1. Switch the valve to the left to direct flow to Column 2.

NOTICE

Do not switch the manual column switching valve while the pump is running as internal damage may occur due to a sudden overpressure.

Install the Standalone Column Holder for LC Columns

When flash chromatography columns are used with the system, use the standalone column holder (PN 21040015) for LC Columns. It is equipped with low-pressure Luer connections and fittings for easy injection on top of the column. The maximum overall external diameter is 115 mm and the maximum overall height is 400 mm.

Figure 40
Standalone Column Holder

Install the Acquisition Module for Additional Detectors

The system is equipped with a built-in analog input to acquire the signal from an additional detector. To improve the quality of the external detection and increase the number of signals acquired, the acquisition module for additional detectors can be used. It allows users to plot more precise curves and acquire up to four signals simultaneously with GLIDER.

Follow the procedure supplied with the module to install the requested drivers, connect it to the system (via a USB port), and then to the analog output(s) of external detector(s).

Figure 41
Acquisition Module

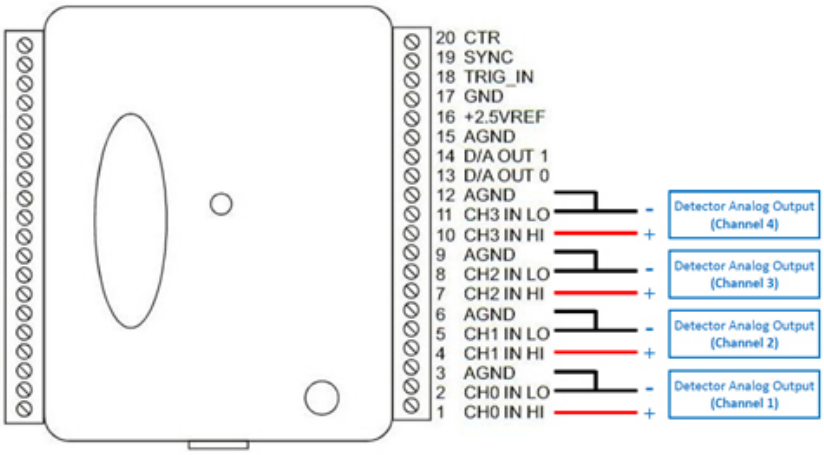


Figure 42
Acquisition Module Connections

Install the Fraction Collector Cover Kit

This option can be mounted on PLC Purification Systems placed outside of a fume hood to allow the extraction of fraction collector vapors. The transparent door is secured with a magnet. An adaptor, located on the right side of the PLC Purification System, is used to affix a pipe (not supplied) with a metallic clamp. The pipe should then be connected to an external air extractor.

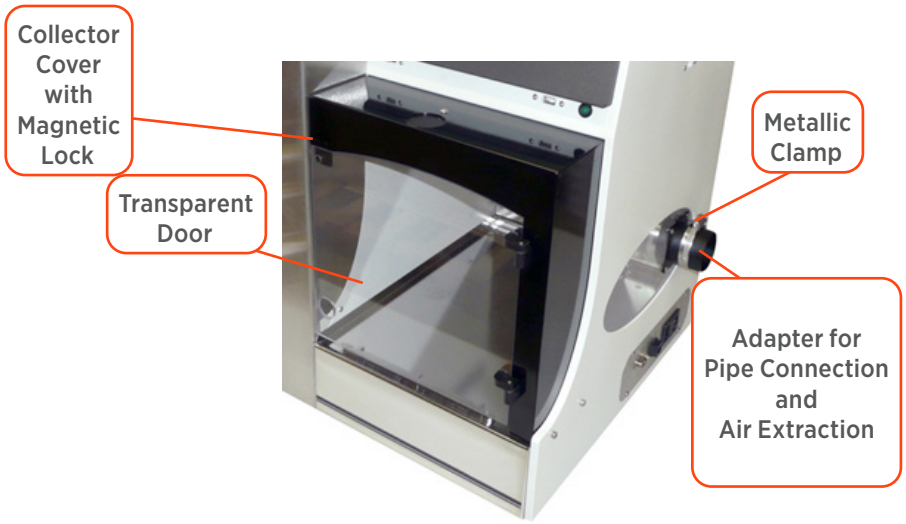


Figure 43
Fraction Collector Cover

Install the Rack Overlays

Rack overlays for 18/16 mm tubes and 13/12 mm tubes are designed for glass tubes identification. They correspond to the default collection probe trajectory called 'Alternating Vertical' in GLIDER.

The characters inscribed on the front correspond to number order, whereas those on the back are related to the physical position of tubes in the rack (n° of rack + n° of tubes in the rack).

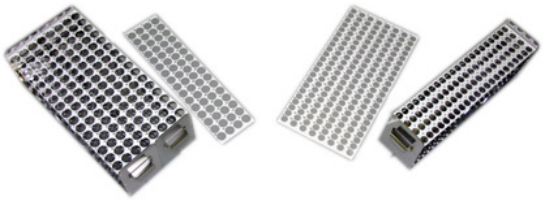


Figure 44
Collector Racks with Overlays

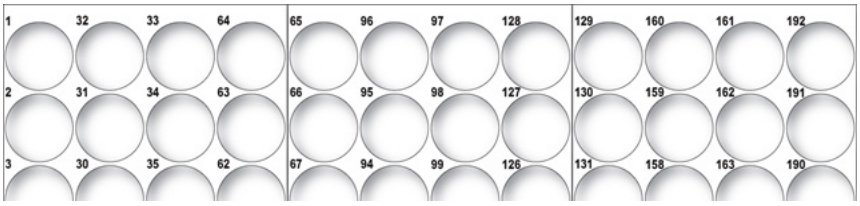


Figure 45
Overlays for Racks 18 mm Tubes (Front Side Numbering)

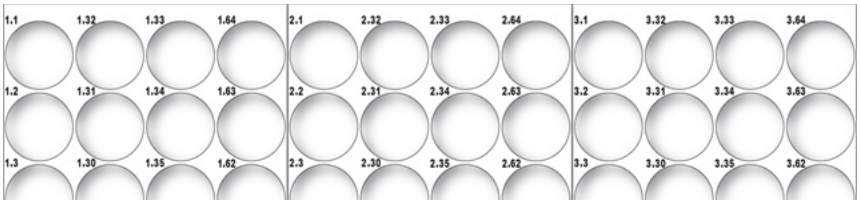


Figure 46
Overlays for Racks 18 mm Tubes (Back Side Numbering)

Install the Funnel Rack

The 16-outlet funnel rack accommodates large and variable collection volume in external high-capacity containers. The funnel rack is installed directly on the collector tray at the front of the PLC Purification System and replaces the standard racks.

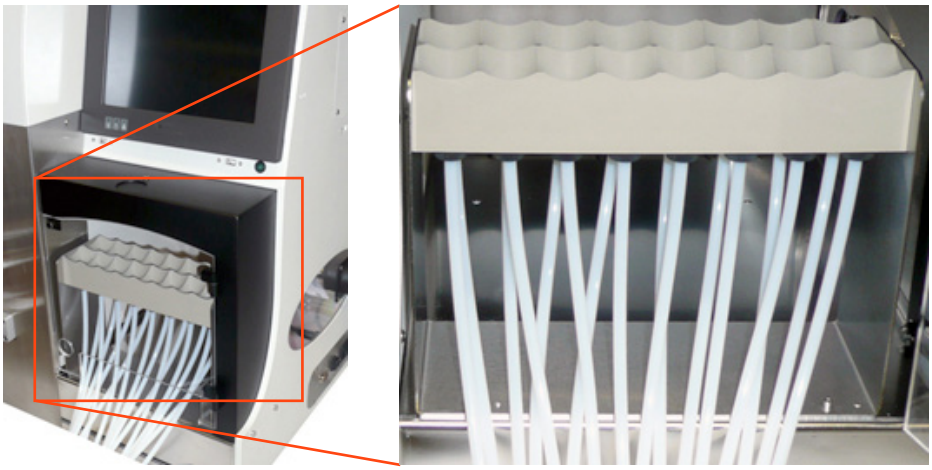


Figure 47
Funnel Rack

To install the funnel rack:

1. Use a 2.5 mm Allen wrench to remove the two cylindrical-head screws from the front positioning guide.
2. Remove the front positioning guide from the tray.
3. Place the funnel rack on the tray and fix it with the two cylindrical-head screws previously removed. Tighten the two screws with the 2.5 mm Allen wrench.
4. Connect the 16-outlet tubing and securely tighten the black nuts.

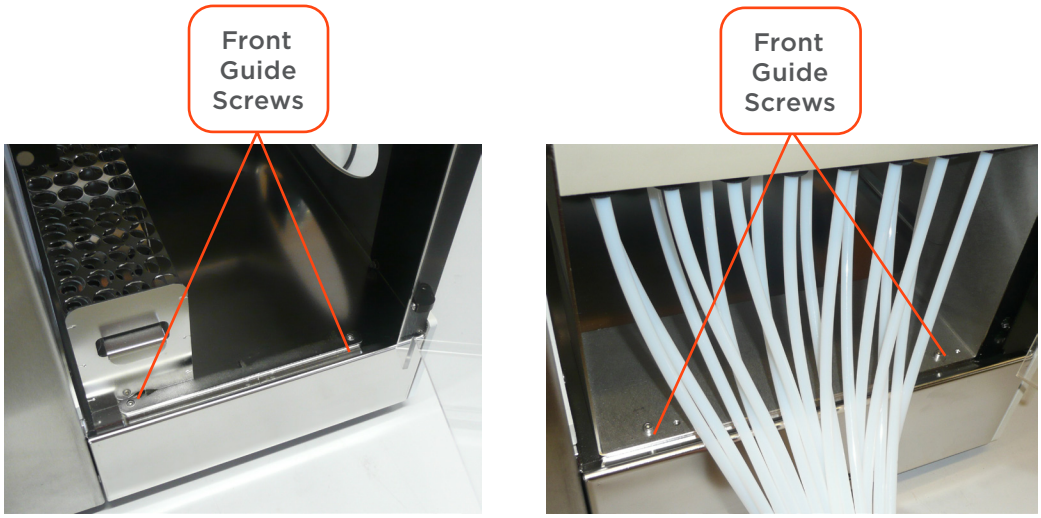


Figure 48
Funnel Rack Installation

Chapter 3

OPERATION

IN THIS CHAPTER:

Start Up

To start the PLC Purification System:

1. Turn the power on using the switch on the side panel (Refer to External Connections on page 31).
   - The power indicator light below the touchscreen on the front panel illuminates.
   - The fan starts.
   - The automatic valve(s) status LEDs on the front panel illuminates according to the position of the valve(s).
   - The system initializes as the fraction collector arm goes to home position.
   - The PC starts as the green 'Power Indicator' light on the screen frame illuminates, and the red 'Hard Drive Activity' light flashes to indicate that the storage device is being used.
   - The screen switches on and displays the Microsoft® Windows® logo. After one minute, the Windows desktop appears.
2. Wait for GLIDER Software to load.
   - The software user interface opens and communication is established with devices.
   - The automatic valve(s) switch to suitable positions.
   - The UV-VIS detector lamp turns on, and the two rear fans of the detector start.
   - Once the software is loaded, several graphics will appear, displaying in real time the status of the instrument and related components. Refer to the *GLIDER Software User's Guide* for more information.

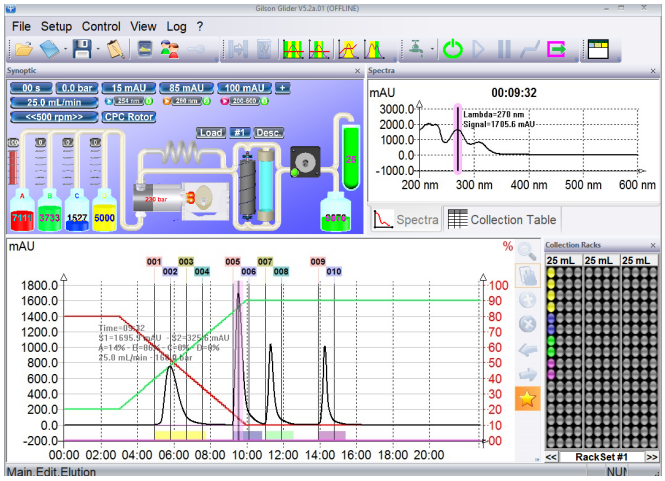


Figure 49
GLIDER Software Control Screen

NOTICE Do not use sharp tools to touch the screen. Use the stylus or your fingers.

Prime the Pump

When tubing is empty and the pump is unprimed, it may be difficult to pump new solvent into the system. To ease this process:

1. Launch the **Purge Mode** in GLIDER. (Refer to the *GLIDER Software User's Guide*.)
2. Loosen the knurled knob (one-half turn counter-clockwise) of the purge valve located above the pump heads.
3. Once solvent has flowed through the purge outlet tubing, stop the pump and tighten the knurled knob (clockwise) to close the purge valve.

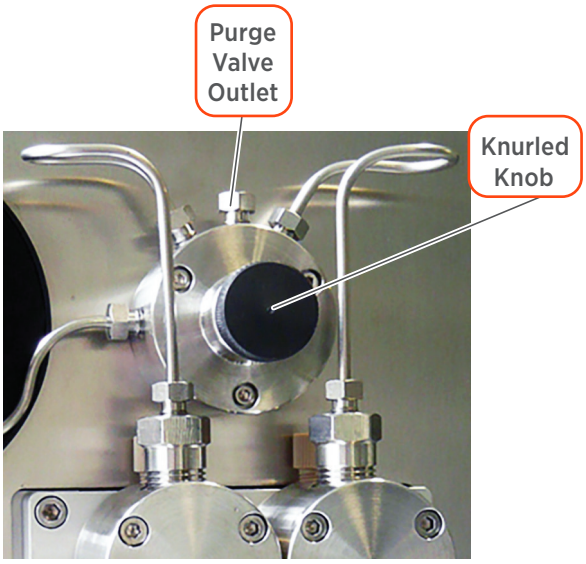


Figure 50
Purge Valve Knurled Knob

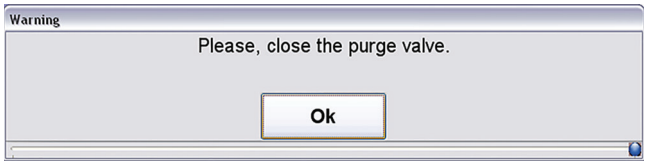


Figure 51
Close Purge Valve Message

NOTICE For best results, elevate the solvent containers for priming the pump. Or, connect a large volume syringe to create a slight vacuum at the outlet.

Loop Injection with Automatic Valve

Use the six-way automatic loop injection valve to manually load the sample in the sample loop and inject it automatically in the column. Refer to PLC with Configuration on page 89 when using the GX-241 Liquid Handler as an autosampler.

The sample loop should be loaded when the PLC Purification System is stopped or during an equilibration phase. In both cases, the red LED **Load** light will illuminate.

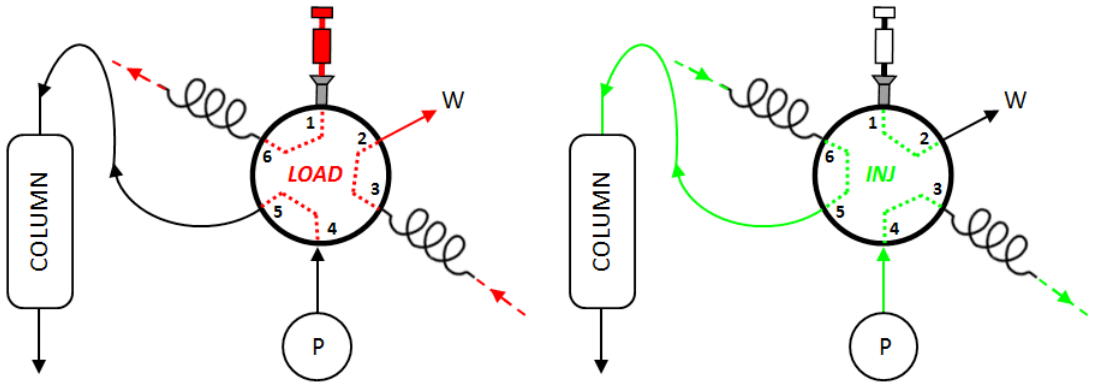


Figure 52
Automatic Load and Injection Diagrams

To inject the sample in the column:

1. Fill a syringe with the desired volume of sample.
2. Place the syringe in the Luer female fitting in the top position of the injection valve (Port 1).
3. Load the sample into the sample loop. Any surplus will flow through the waste tubing (Port 2).
   - When the injection mode **Valve Injection** is selected in the method edition (refer to the *GLIDER Software User's Guide*), the sample is automatically injected before the elution phase starts, as indicated by the green LED **Inj**. light. The sample is pushed into the fluid path and is pushed into the chromatography column by the solvents used.

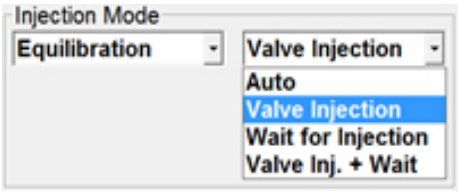


Figure 53
Injection Mode Setting

Loop Injection with Manual Valve

Use the six-way manual loop injection valve to manually load the sample into the sample loop and manually inject it into the column. This action can be done at any time while the pump is running.

⚠CAUTION	**Mobile phase spray from the needle port may occur when the valve is turned from the INJECT to LOAD position. Use the needle port plug, attached to the handle assembly, to shield yourself from this potential spray.**
NOTICE	**Rinse the valve with water after using buffer solutions to prevent crystals from forming, which can cause scratches on the rotor seal of the valve.**

The sample loop should be loaded when the system is stopped or during an equilibration phase.

To inject the sample into the column:

1. Rotate the manual injection valve handle to the LOAD position.
2. Fit the large-bore syringe needle (supplied) on a syringe and fill it with the desired volume of sample.
3. Pull the locking pin to unlock and remove the needle port plug.

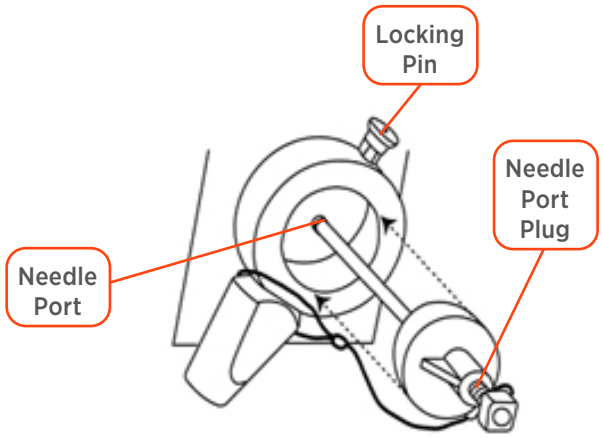


Figure 54
Manual Injection Valve - Needle Port

4. Insert the syringe with the needle into the needle port and load the sample into the sample loop. Any surplus will flow through the waste tubing (Port 6).

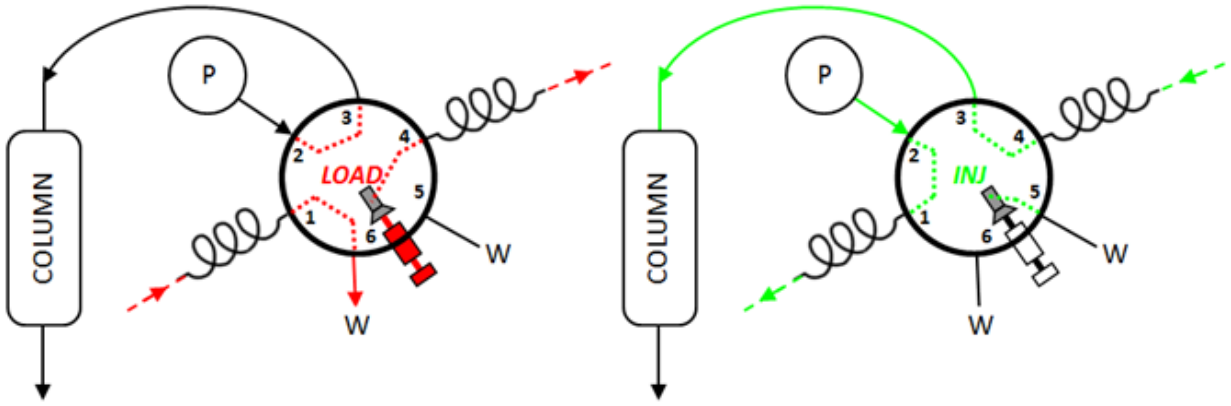


Figure 55
Manual Injection - Load and Inject Diagrams

5. Switch the valve from the LOAD to INJECT position with a 60° rotation of the handle.
   - The sample is pumped into the fluid path and pushed into the chromatography column via the mobile phase used.
   - When the injection mode **Wait for Injection** is selected in the method edition (refer to the *GLIDER Software User's Guide*), the elution phase will start upon user confirmation that the valve has been manually switched.

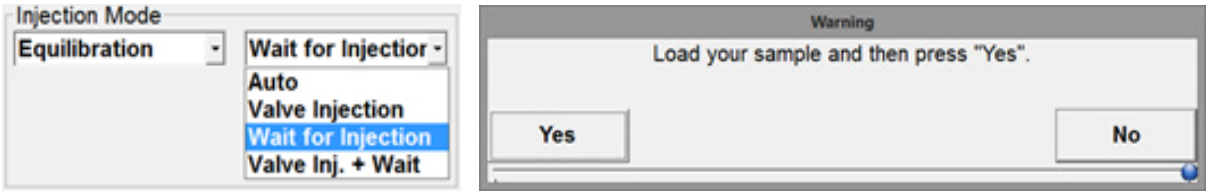


Figure 56
Injection Mode Setting - Wait for Injection Message

Power Down

1. Stop the pump and the running method.
2. Close GLIDER.
3. Turn off the PC and wait for the touchscreen to turn off.
   - The UV-VIS detector lamp will remain on.
4. Switch the main power switch to '0'. Refer to External Connections on page 31.
   - All indicator lights turn off.
   - The UV-VIS detector lamp switches off.
   - The fans stop.

Chapter 4

MAINTENANCE

IN THIS CHAPTER:

This chapter describes actions that should be performed on a routine basis to ensure the long term safe and trouble-free operation of the PLC Purification System. The frequency of the maintenance activities is dependent on the nature of the application, such as the solvents used, the volume of the mobile phases delivered by the pump, the level of cleanliness of the facility, etc. The PLC Purification System has been designed for reliability and needs very little routine maintenance when operated correctly.

When performing the maintenance described in this chapter, use good laboratory practice (GLP), including, but not limited to, wearing protective clothing and preparing the maintenance space for service. Only qualified personnel can perform the maintenance. After completing the maintenance operation, verify the safe and good working order of the part and PLC Purification System.

Three models of pump are available in the range (50 mL/min, PLC 2050; 250 mL/min, PLC 2250; and 500 mL/min, PLC 2500). Parts of the heads kit are different according to the pump model (seals, pistons, cleaning discs, heads, etc.).

Reduced accuracy of the pump may be caused by seal wear or by a fault in the check valves. This chapter contains information and procedures for replacing consumable parts and maintaining the PLC Purification System.

⚠WARNING

Do not open the PLC Purification System or attempt to perform any maintenance other than the ones described in this chapter, failure to comply with this directive will void the warranty and may be potentially dangerous.

Before performing any maintenance, make sure that the PLC Purification System is unplugged and that the fluid paths are flushed and decontaminated according to the cleaning procedure.

NOTICE

Follow local regulations when discarding any used fluidic parts.

Helpful Hints

To keep the system at optimal performance, Gilson recommends the following:

- Follow the preventative Maintenance Schedule on page 58.
- Do not start the pump without fluid in the system as this may prematurely wear the seals.
- Do not leave buffer in the system. Doing this may cause blockages and wear the seals.
- Run a clean and appropriate solvent through all fluid paths before storing the system.
- Clean the valves if the system has not been used for a while.
- Wipe up all spills immediately.
- Allow liquids to equilibrate to room temperature before running them through the system; cold liquids may cause leakage.

Cleaning and Decontamination

Liquids emitted by the pump (spills or grease) must be collected according to GLP. Holes at the bottom of the pump housing allow the recovery of liquid.

Exterior

The instrument should be cleaned occasionally, using a dry, clean cloth. If necessary, use a cloth dipped in water. If liquid is accidentally spilled on the instrument, wipe it up immediately. If a contamination is suspected, the external surfaces of the instrument should be wiped down with a laboratory detergent (alkaline) and rinsed with water and then with a 10% ethanolic (or IPA) aqueous solution (v/v) to remove any residue.

⚠WARNING	**Beware of splashes when cleaning the fluidic panel. Wear appropriate PPE.**
⚠CAUTION	**Do not to use a detergent that will damage the paint or pollute the work environment.**

Fluid Path

Depending upon your use of the PLC Purification System, it may be necessary to flush the entire fluid path. It is important to clean the fluid path if the pump will not be used a while, for weekend or longer storage, or if a solution with a high salt concentration was used for a wash or as a diluent. Refer to the instructions below:

1. Prime the fluid path with distilled or deionized water, or with a solution adapted to the use of the instrument.
2. Flush the fluid path with an alcohol/water mixture, ratio between 30/70 up to 100/0 (v/v).

NOTICE

Before running an application, prime and flush the fluid path with the solvents of this application.

After having run an application, flush the fluid path with the suitable mixture and let those clean solvents in the fluid path. Alcohol prevents bacterial development.

Only use water and ethanol to clean the system so not to damage the seals, cables, tubing and all the plastic parts.

⚠WARNING

Potentially hazardous chemicals can be used with the system. Use care when handling chemicals and wear appropriate PPE. Handling toxic, flammable, and hazardous chemicals can lead to health and safety risks.

The pump pistons can also get dirty and interfere with the fluid path, refer to Clean the Pump Pistons on page 64.

Maintenance Schedule

Gilson recommends performing periodic inspection and maintenance of components of PLC 2050/2250/2500 Purification Systems to ensure operational performance. The recommended inspection and maintenance periods are listed below, but are only general guidelines. The frequency of the maintenance will vary depending on the system usage and type of sample injected.

NOTICE **Follow all guidelines listed in this table to avoid damaging the PLC Purification System.**

Maintenance Schedule

OPERATION	FREQUENCY
Verify the cleanliness of all liquid containers.	Daily
• Clean and rinse the gradient valve and all other switching valves with suitable solution. • Perform maintenance any time an aqueous solution with strong buffers is used.	As needed
• Clean all parts in contact with solvents or samples with suitable solutions. Rinse thoroughly using a mix of water and alcohol. • Perform maintenance any time an aqueous solution with strong buffers is used.	As needed
Replace the detector deuterium lamp when efficiency is unreliable. Refer to the *UV-VIS Detector Service Guide*.	As needed
• Check the suitable tightening of fittings and the proper state of tubing (not kinked, damaged, etc.). • Perform maintenance any time solvent leaks or air bubbles are observed.	Weekly
Check that the fan is operational.	Monthly
Clean the pump check valves. Refer to **Clean or Replace a Pump Check Valve on page 62**.	Quarterly
Clean the pump piston rods (manually). Refer to **Clean the Pump Pistons on page 64**. Perform maintenance any time the pump head is disassembled.	Quarterly
• Check the efficiency of the detector deuterium lamp. Refer to the *UV-VIS Detector Service Guide*. • Perform maintenance any time higher noise levels or decreased sensitivity is observed in the chromatogram.	Quarterly
Clean the detector flow cell. Refer to the *UV-VIS Detector Service Guide*.	Quarterly
• Replace the tubing and associated fittings (except the preformed, SS tubing). • Replace damaged tubing and fittings any time damage is observed.	Yearly
Replace the pump seals. Refer to **Replace a Pump Seal on page 59**	Yearly
• Replace the pump check valves. Refer to **Clean or Replace a Pump Check Valve on page 62**. • Perform maintenance any time abnormal pressure, flow rate fluctuation, or noisy baselines occur.	Yearly

Replace a Pump Seal

NOTICE

The lifetime of the seals is dependent on the flow rate, the pressure, and the type and temperature of liquids used, but mostly on the cleanliness of the mobile phase and sample. The presence of micro-particles will cause accelerated wear and tear of the seals. Similarly, any dried buffer particles on the piston will damage the seal.

After performing a maintenance on a fluidic part, check for leakage by running an application and gradually increase the pressure to the maximum.

When disassembling or reassembling the pump, make sure that each component is clean and take care that the system is assembled in a clean environment.

There are four seals: one for each pump head, and one for each cleaning disc.

To disassemble a pump head with cleaning disc, and to replace a seal, follow the instructions below:

Remove the Pump Head and the Cleaning Disc

1. Purge the system with a suitable solvent.
2. Switch off the PLC Purification System and disconnect it from the mains. (Refer to External Connections on page 31).
3. Disconnect the PTFE or PFA inlet tubing by hand (PEEK nut).
4. Disconnect the SS outlet tubing with a 3/8″ spanner (SS nut). When untightening the SS nut, use a second spanner (17 mm) to hold the check valve housing. The tubing must be removed (i.e., disconnect it from the purge valve holder at the other end).
5. Loosen the four M4 screws (counter-clockwise) of the head in an alternating criss-cross pattern with a 3 mm Allen wrench.
6. Hold the pump head and consecutively pull out the four screws.

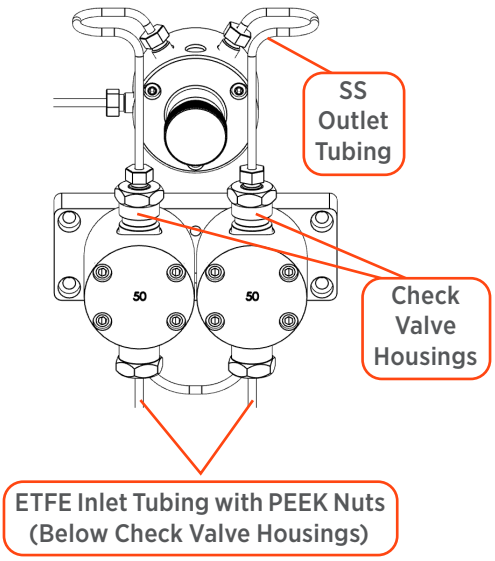


Figure 57
Removing the Outlet and Inlet Tubing

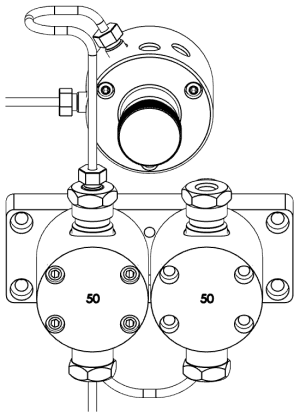


Figure 58
Removing the Head Screws

7. Carefully remove the pump head. The ceramic piston and the cleaning disc (PEEK part) will be visible.

Figure 59
Removing the Pump Heads

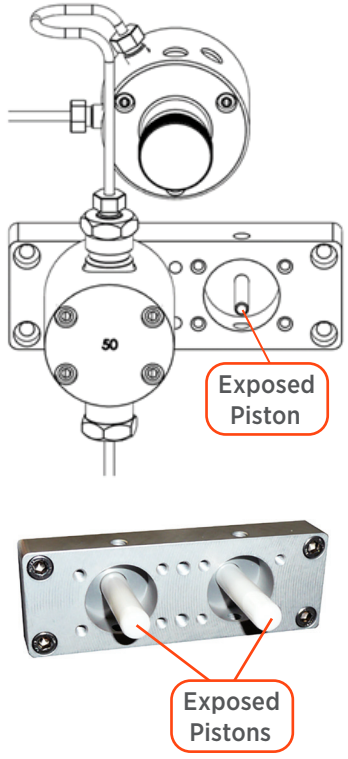


Figure 60
Removing the Cleaning Discs

8. Carefully remove the cleaning disc to fully expose the piston.

> **NOTE** If needed, disconnect the ETFE junction tubing for cleaning discs by hand (PEEK nuts under pump head).

9. Once the part is removed, carefully take out the old seal.

> **NOTICE** Do not score the seat of the seal. If the seat is scored, it is necessary to replace the pump head or the cleaning disc (not under warranty).

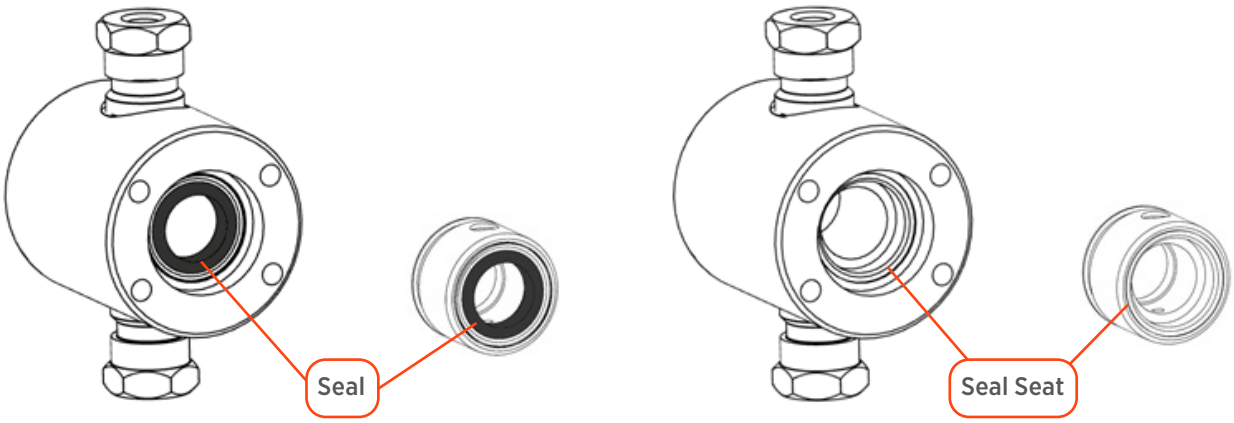


Figure 61
Back Pump Head and Back Cleaning Disc

Replace the Seal

1. Thoroughly clean the seal seat with IPA or ethanol to remove possible worn seal particles, and then plunge the new seal in IPA for lubrication.
2. Align the new seal over the seal seat of the head or cleaning disc.

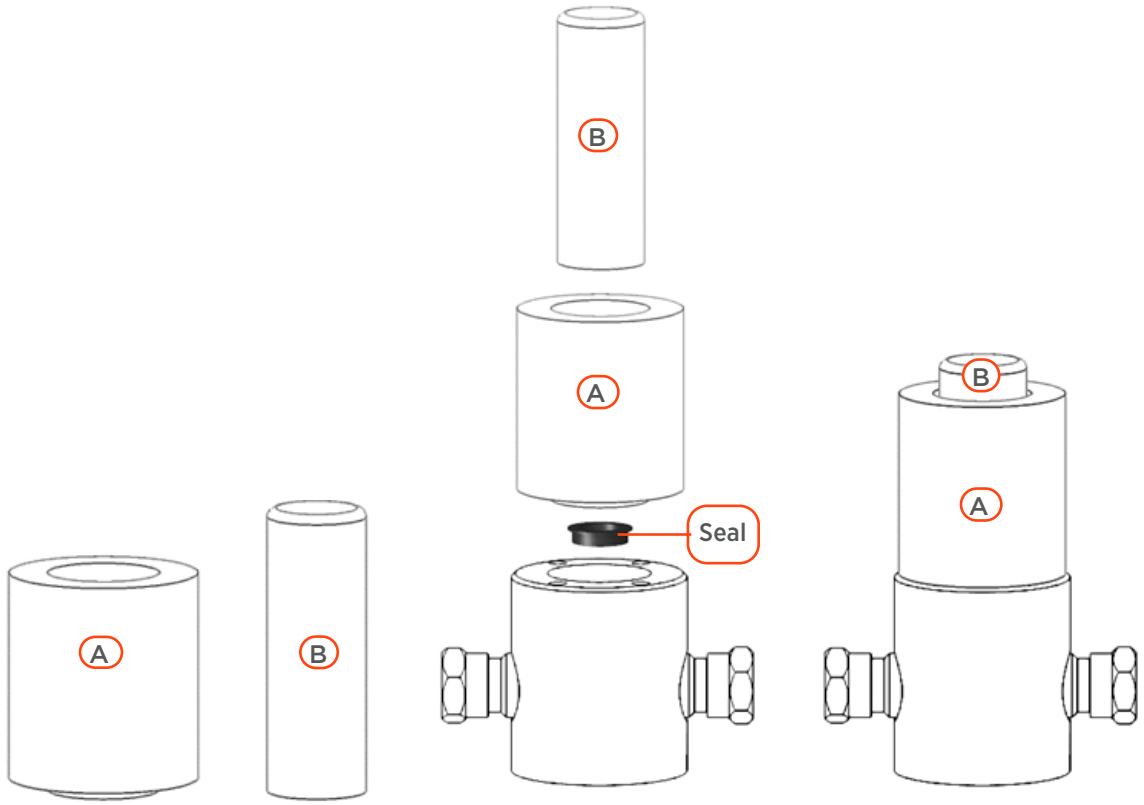


Figure 62
Pump Seal Seating Instructions

3. Use the pump seal insertion tool, A and B, pictured above.
4. Position the part A over the back of the pump head or of the cleaning disc and slip the part B into A.
5. Push briskly the part B with the palm of your hand, inserting the seal into position.
6. Remove the tool and examine the seal to ensure it is properly placed.
7. Clean the piston rod with a lint-free cloth and alcohol to remove possible worn seal particles.
8. Replace carefully the cleaning disc onto the piston and insert it into the head holder. Verify that the alignment between the cleaning disc and the head holder hole is correct.
9. Replace carefully the pump head onto the piston by checking that the outlet check valve housing is on top, and the inlet check valve housing is at the bottom.
10. Insert the four fastening screws. Tighten slowly in an alternating criss-cross pattern with a 3 mm Allen wrench.
11. Reconnect the tubing. When tightening the SS nut on the outlet check valve housing, use a 17 mm spanner to hold the housing and keep the suitable tightening.

Clean or Replace a Pump Check Valve

NOTICE After performing a maintenance on a fluidic part, check for leakage by running an application and gradually increase the pressure to the maximum.

Abnormal pressure fluctuation or the observation of pump noise in the chromatogram data is usually caused by check valve problems. Dirty or damaged check valves do not open and close properly, which can cause pressure fluctuations and irregular flow.

There are four check valves: two per head, one for each inlet, and one for each outlet.

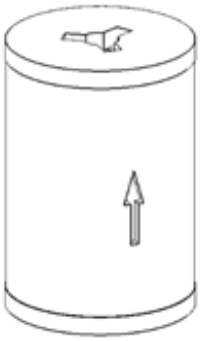


Figure 63
Check Valve

To clean or replace a check valve, follow the instructions below:

1. Purge the system with a suitable solvent.
2. Switch off the system and disconnect it from the mains. (Refer to External Connections on page 31).
3. For an inlet check valve (bottom), disconnect the PTFE or PFA inlet tubing by hand (PEEK nut).
4. For an outlet check valve (top), disconnect the SS outlet tubing with a 3/8″ spanner (SS nut). When untightening the SS nut, use a second spanner (17 mm) to hold the housing. The tubing must be removed (i.e., disconnect it from the purge valve holder at the other end).
5. Once the tubing is removed, unscrew the check valve housing using a 17 mm spanner and remove the check valve. If the check valve is blocked inside the housing, use a small tool to extract it, in this case, the check valve must be replaced.

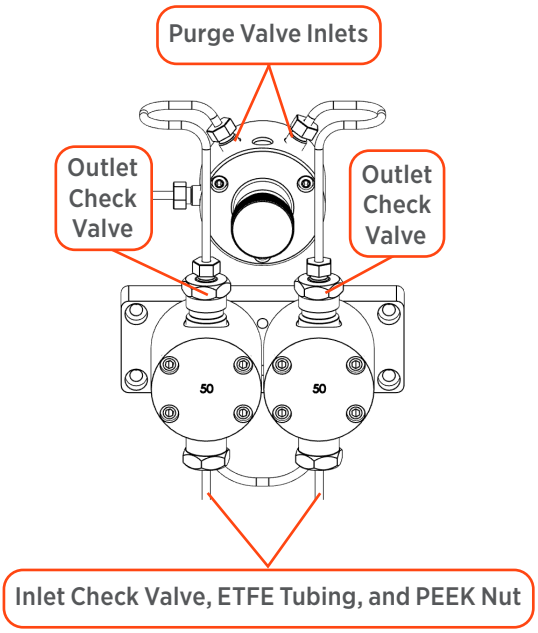


Figure 64
Removing the Outlet and Inlet Tubing

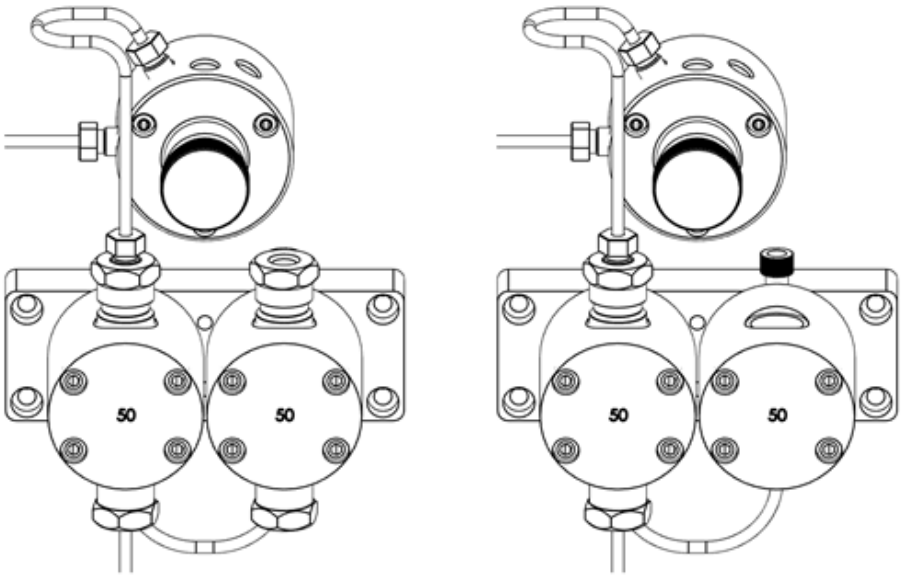


Figure 65
Removing the Check Valve Housing and the Check Valve

6. Clean the check valve or replace the check valve with a new one:
   a. Clean the check valve by placing it in an ultrasonic bath with methanol or acetone for approximately five minutes.

> **NOTICE** Ensure that the arrow on the check valve is directed downwards when it is cleaned in an ultrasonic bath, or damage to the surface quality, the ball and the seat will occur.

   b. Replace the check valve. Whether it is for the inlet or the outlet, make sure the arrow is always directed upwards.

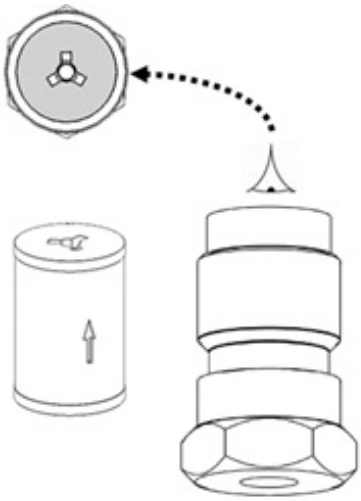


Figure 66
Inlet Valve Housing (Bottom)
Inlet Check Valve Placement

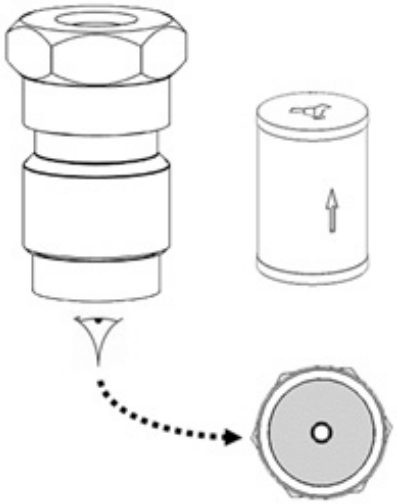


Figure 67
Outlet Valve Housing (Top)
Outlet Check Valve Placement

7. Tighten slowly the valve housing in the pump head by hand until finger tight and tighten the housing with a 17 mm spanner until hearing a little crunch, which means that the new check valve is properly seated.

> **NOTICE** Do not overtighten the valve housing as this could degrade the check valve more quickly. If a liquid leakage or air bubble is detected, tighten slightly to improve the sealing.

8. Reconnect the tubing. When tightening the SS nut on the outlet check valve housing, use a 17 mm spanner to hold the housing and keep the suitable tightening.

Clean the Pump Pistons

NOTICE After performing a maintenance on a fluidic part, check for leakage by running an application and gradually increase the pressure to the maximum.

1. Follow steps 1 through 8 in Remove the Pump Head and the Cleaning Disc on page 59.
2. Thoroughly clean the piston rods with a lint-free cloth and alcohol.
3. Follow the steps 8 through 12 in Replace the Seal on page 61 to reinstall the cleaning discs and pump heads.

Connect the Inlet and Outlet Tubing for the Cleaning Discs

The high pressure heads incorporate a piston washing device called cleaning discs. These are typically used when aqueous buffers are pumped and function to manually wash the buffers from the back of the seals and to prevent early wear of these seals.

1. Fit the 1/8" PEEK nuts and ETFE ferrules (supplied) onto suitable lengths of wide bore 1/8" PTFE tubing.
2. Screw the fittings into the cleaning discs inlet and outlet at the back of the high pressure heads. Both connections are interchangeable, choose one for the inlet, and the other for the outlet.
3. Connect the cleaning discs inlet tubing to a dedicated device (a combination syringe with Luer or another external pumping system).
4. Put the cleaning discs outlet tubing into a waste container.

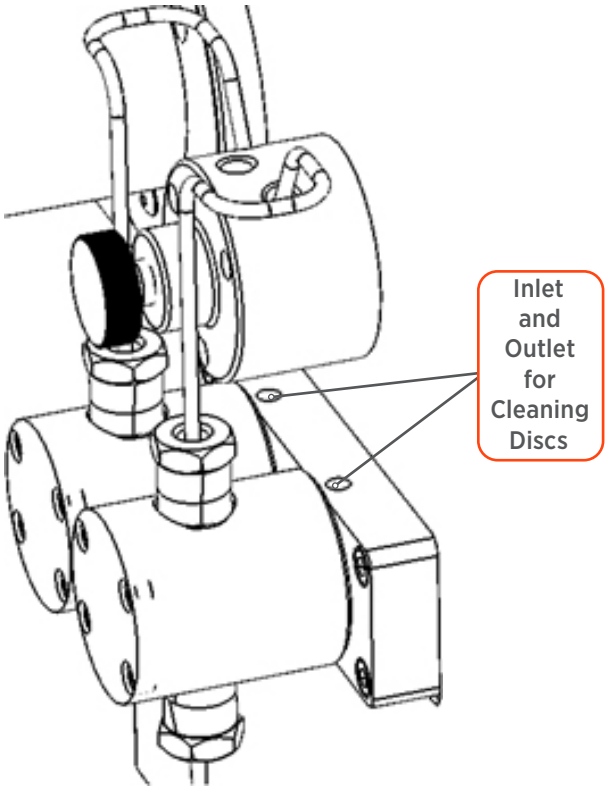


Figure 68
Pistons Cleaning

Replace the Mixing Chamber Piston Seal

NOTICE After performing a maintenance on a fluidic part, check for leakage by running an application and gradually increase the pressure to the maximum.

To replace the seal of the mixing chamber, follow the instructions below:

1. Purge the system with a suitable solvent.
2. Switch off the system and disconnect it from the mains.
3. Disconnect the SS tubing from the chamber outlet with a 3/8″ open-ended spanner (SS nut). The tubing must be removed (i.e., disconnect it from the injection valve inlet at the other end).

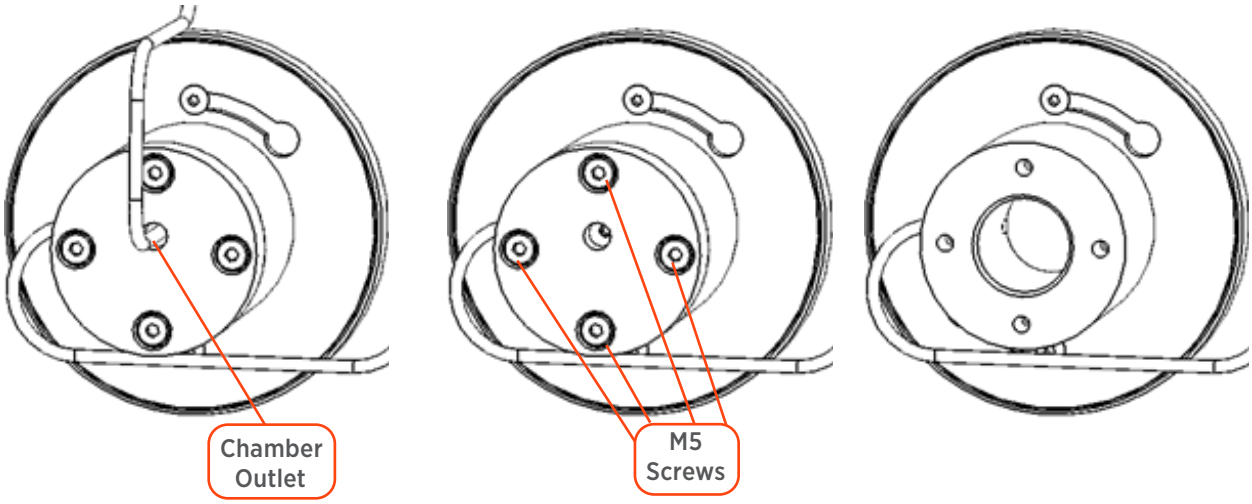


Figure 69
Mixing Chamber Piston Removal

4. Remove the four M5 screws with a 4 mm Allen wrench.
5. Carefully pull the piston to remove it.
6. Remove the worn seal and get a new seal.
7. Insert the seal in the seal seat of the piston.
8. Replace the piston in the mixing chamber with the threaded hole on top.
9. Replace the four fastening screws and securely tighten them.
10. Replace the tubing and securely tighten the SS nuts.

Figure 70
Mixing Chamber Piston

Test and Repair the UV-VIS Detector

Several models of UV detectors are available with the PLC 2050/2250/2500 Purification Systems: UV monochromator single or dual wavelength, UV or UV-VIS PDA detectors (DAD) 4-wavelength with different wavelength ranges (200–400 nm, 200–600 nm or 200–800 nm).

A deuterium lamp is used as a source of light. In versions up to 800 nm, a secondary halogen lamp is used. The efficiency of the lamp and the cleanliness of the flow cell must be checked periodically.

If efficiency of detection is unreliable, detector lamp wear could be to blame. Deuterium lamp life can be checked with GLIDER Software. From the GLIDER main menu, select the **?** icon, and then **Information**.

When disassembling or reassembling the detector, make sure that each component is clean and take care that the system is in a clean environment.

Refer to the *UV-VIS Detector Service Guide* for more information on detector testing, lamp replacement, and flow cell cleaning.

Chapter 5

TROUBLESHOOTING

IN THIS CHAPTER:

Troubleshooting Table

The following table details some basic symptoms, possible causes, and potential solutions for issues related to PLC 2050/2250/2500 Purification Systems. If the problem persists after all remedies have been attempted, contact Gilson customer service. Refer to **Customer Service on page 32**.

Fluidics and Pumping

Symptom(s)	Possible Cause(s)	Remedy	Reference
Leakage or air bubbles.	The fittings are not sufficiently tightened.	Tighten the fittings.	
The pump makes abnormal noises.	• The motor or motor driver is damaged or not properly installed. • The system belt or pulleys are damaged.	• Stop the pump. • Switch off the PLC Purification System.	Refer to **Power Down on page 54.**
• Inaccurate or irregular flow rates. • Lack of solvent suction. • Inaccurate gradient forming.	• The fittings are not sufficiently tightened. • Improper state of tubing or fitting. • The fluid path is partially or totally blocked.	• Tighten the fittings and check the state of the tubing. • Replace the fittings and/or the tubing, if damaged. • Clean the fluid path.	Refer to **page 56**.
	• The piston rods are dirty. • The pump piston seals are worn. • The pump check valves are dirty or damaged.	• Check and/or clean all parts in contact with solvents or samples (gradient valve, piston rods, seals, check valves, etc.). • Replace the consumable parts (seals, check valves, etc.), if damaged.	Refer to **Maintenance on page 55**.
• Abnormal pressure fluctuation. • Noise on the data system.	The pump check valves are dirty or damaged.	Check and/or clean and/or replace the pump check valves.	Refer to **page 62**.
Abnormal overpressure.	• Improper state of tubing or fitting. • The fluid path is partially or totally blocked.	• Determine the overpressure location by isolating different parts of the fluid path. • Check the state of tubing. • Replace the tubing, if damaged. • Clean the fluid path.	Refer to **page 56**.

FLUIDICS AND PUMPING TROUBLESHOOTING CONTINUED ON PAGE 69

Fluidics and Pumping

Symptom(S)	Possible Cause(s)	Remedy	Reference
Leakage near the pump heads or cleaning discs.	Worn pump piston seals.	Replace the pump piston seals.	Refer to **page 59**.
Leakage near the purge valve.	Worn purge valve seal.	• Check the purge valve seal. • Replace the purge valve seal, if damaged.	
• No pressure acquisition. • Leakage near the pressure transducer.	• Damaged pressure transducer. • Worn pressure transducer seal.	• Check the pressure transducer and its seal. • Replace the pressure transducer and its seal if damaged.	
Leakage near the mixing chamber.	Worn mixing chamber piston seal.	• Check the mixing chamber piston seal. • Replace the mixing chamber piston seal if damaged.	Refer to **page 65**.
Leakage near a high-pressure valve.	• The fittings are not sufficiently tightened. • Improper state of tubing or fitting. • The fluid path is partially or totally blocked.	• Tighten the fittings and check the state of the tubing. • Replace the fittings and/or tubing, if damaged. • Clean the valve and the fluid path.	
Leakage near the UV detector flow cell (liquid flow under the system through the detector drain pan tubing).	• The fittings are not sufficiently tightened. • Improper state of tubing or fitting.	Check the tubing and fittings connection to and from the UV cell by removing the plastic panel on the left side of the system.	
	Cracked quartz window inside the UV flow cell.	Replace the UV flow cell.	Refer to the *UV-VIS Detector Service Guide.*

Detection

Symptom(s)	Possible Cause(s)	Remedy	Reference
UV detector does not respond to commands.	• No communication. • Electronic failure.	• Restart the PLC Purification System. If the problem persists, export the **Traces** log files from GLIDER. • Run a basic diagnostic of the detector. • Create a 'Service Report' for the detector.	• Refer to the *UV-VIS Detector Service Guide.* • Refer to the *GLIDER Software User's Guide*.
Noise on UV signals.	• Use of non-degassed solvents. • Unsuitable mixing of solvents pumped.	• Degas solvents pumped. • Increase the backpressure value after the flow cell. • Use GLIDER to make a calculated filtering of the UV signals.	Refer to the *GLIDER Software User's Guide*.
• Higher noise levels or decreased sensitivity on UV signals. • Improper autozero.	• Low UV lamp intensity. • Unreliable efficiency of UV lamp.	• Check the UV lamp for efficiency. • Check for UV noise and drift. • Check the light intensity curve.	Refer to the *UV-VIS Detector Service Guide.*
• No signal during UV acquisition. • UV detector lamp does not switch on.	Worn UV deuterium lamp.	Replace the UV deuterium lamp and perform an intensity recalibration.	Refer to the *UV-VIS Detector Service Guide.*
Low signal during UV acquisition in visible range.	Worn UV halogen lamp.	Replace the UV halogen lamp and perform a scan intensity.	Refer to the *UV-VIS Detector Service Guide.*
Lowered UV light transmission, persistent higher noise levels or decreased sensitivity on UV signals with efficient lamp.	Dirty or contaminated UV flow cell.	Check the UV cell for cleanliness.	Refer to the *UV-VIS Detector Service Guide.*
Peaks detected by UV have a too low intensity whatever the application.	UV flow cell optical path length is too small.	Replace the UV cell with another cell with a higher path length.	Refer to the *UV-VIS Detector Service Guide.*
Peaks detected by UV have a too high intensity (signal saturation) whatever the application.	UV flow cell optical path length is too large.	Replace the UV cell with another cell with a lower path length.	Refer to the *UV-VIS Detector Service Guide.*

Collection

Symptom(s)	Possible Cause(s)	Remedy	Reference
Fraction collector does not respond to commands.	• No communication. • Electronic board firmware failure.	Restart the system. If the problem persists, export the **Traces** log files from GLIDER.	Refer to the *GLIDER Software User's Guide*.
Fraction collector does not go to home position.	Motor(s) or optical sensor(s) are damaged or not properly supplied.	• Check the X and Y movement when system is off. • Check the state and cleanliness of collector sensors.	
Fraction collector does not collect properly into tubes.	• Wrong racks used. • Wrong racks positioning. • Wrong collection parameters.	• Check rack code in the software matches the racks you are using. • Check positioning of racks on the tray. • Check the collection parameters in GLIDER and then adjust if needed. • Check that the collection probe is sufficiently tightened.	Refer to the *GLIDER Software User's Guide*.
	Mechanical blockage.	Check for obstruction to X and Y movement when system is off.	
	Dirty or damaged collection valve.	• Check the collection valve cleanliness. • Check the collection and waste tubing state. • Disassemble the collection valve for cleaning. • Replace the collection valve or tubing if damaged.	

Communications, Electronics, and Power

Symptom(s)	Possible Cause(s)	Remedy	Reference
The PLC Purification System does not switch on.	The PLC Purification System is not supplied with voltage.	• Check the AC power source. • Try a different AC outlet. • Check the AC power cord. • Check the fuses and replace, if necessary.	
A communication error with GLIDER.	• Incorrect configuration. • Incorrect initialization of an internal device. • No communication with an internal device.	• Restart GLIDER. • Restart the PC. • Restart the system. • Check the **System Configuration** in GLIDER. • If the problem persists, export the **Traces** log files from GLIDER.	Refer to the *GLIDER Software User's Guide*.
GLIDER does not work correctly.	An abnormal malfunction not detected beforehand.	• Export the **Traces** log files from GLIDER. • Upgrade GLIDER to the newest version.	Refer to the *GLIDER Software User's Guide*.
The touchscreen PC does not turn on at the same time the PLC Purification System turns on.	• An unexpected shutting down of the PC or the system. • General outage.	Manually reboot the PC by removing the small trapdoor on the right side of the system and by pressing the built-in push button.	
The stylus points to the wrong place on the touchscreen.	An unwanted modification of touchscreen calibration.	Recalibrate the touchscreen with the calibration tool installed on the PC.	*Refer to the GLIDER Software User's Guide.*
The pump does not respond to commands.	• No communication. • Electronic board firmware failure.	• Restart the system. • If the problem persists, export the **Traces** log files from GLIDER.	Refer to the *GLIDER Software User's Guide*.
The automatic, high-pressure valve (injection, backflush, column switching, etc.) does not respond to commands and does not switch properly.	Defective valve or control module.	• Use GLIDER to manually switch the valve several times. • Check the valve's status LEDs on the front panel. • Check the control module and its LEDs.	Refer to the *GLIDER Software User's Guide*.

Repair and Return Policies

Refer to the following information and then contact your local Gilson representative. Specific contact information can be found at **www.gilson.com**.

Before Calling Us

Your local Gilson representative will be able to serve you more efficiently if you have the following information:

- Serial number and model number of the instruments involved. The serial number is located on the right side of the PLC 2050/2250/2500 Purification System.
- List of concise symptoms.
- List of operating procedures and conditions you were using when the problem arose.
- List of other devices connected to the instrument and a description of those connections.
- List of other electrical connections in the room.

Warranty Repair

Units covered under warranty will be repaired and returned to you at no charge. If you have any questions about applicability, contact your local Gilson representative.

Non-Warranty Repair

For out-of-warranty repairs, contact your local Gilson representative who will discuss service options with you and can assist in making arrangements to return the equipment, if necessary.

Return Procedure

Contact your local Gilson representative to obtain authorization before returning any Gilson equipment. To return a piece of equipment:

- Carefully pack the unit to prevent damage in transit. Check with your local Gilson representative regarding proper method of shipment. No responsibility is assumed by Gilson or your local Gilson representative for damage caused by improperly packaged instruments. Indicate the authorization reference on the carton and on the packing slip.
- Always insure for the replacement value of the unit.
- Include a description of symptoms, your name, address, phone number, and purchase order to cover repair costs, return and shipping charges, if your institution requires it.

Unit End-of-Life

When a unit reaches the end of its useful life, refer to **www.gilson.com** for directives and information on the end-of life policy. This is in accordance with the European Union Directive 2012/19/UE on Waste Electrical and Electronic Equipment (WEEE).

Appendix A

WARRANTY

IN THIS CHAPTER:

General

A PLC Purification System is under warranty to be free from defects in material or workmanship under normal installation, use and maintenance, as described in this user's guide and under conditions given below.

The warranty period is defined in the order/contract and starts from the date of initial shipment of the manufacturer. Note that it does not apply to the instrument if modified by the user or resold without permission from the manufacturer, nor to consumable parts, nor to any failure of lifetime-expired parts. Refer to **Repair and Return Policies on page 73**.

The warranty is void in the following cases:

- Failure due to incorrect installation
- Failure due to using the incorrect AC power supply
- Failure due to mechanical force applied to the unit
- Failure due to improper handling by the user or an individual not authorized to operate the equipment
- Failure due to the use of improper spare parts or hardware
- Damage to the software, data, or hard disk due to a PC virus infection
- Corrosion caused by leakage of solvent or samples
- Corrosion of electronic parts caused by highly corrosive atmospheric gas
- Failure due to the disassembly, modification, relocation, or transport after initial installation
- Failure due to the disconnection of main power without taking the specified normal shutdown procedure
- Failure due to the disregard of safety regulations
- Failure due to not following the maintenance schedule
- Failure due to acts of nature

NOTICE	**Gilson is not responsible for any damage caused by improper use of the system, improper maintenance, unauthorized modifications or failure to comply with the procedures detailed in Gilson documentation.**

Limited Warranty

Fittings and Tubing

TERMS OF USE

- Normal tightening of fittings.
- Use of clean solvents and containers (Filter the solvents to avoid presence of fibers and particles in the pump.)
- Proper positioning, according to the instructions in this guide.

DAMAGES NOT COVERED

- Damaged threads caused by improper tightening.
- Blocked flow paths caused by improper installation or unsuitable mobile phases.
- Bent or cut tubing caused by improper positioning.

Valves

TERMS OF USE

- Normal tightening of fittings.
- Use of clean solvents and containers. (Filter the solvents to avoid presence of fibers and particles in the pump.)
- Preventative maintenance schedule followed.

DAMAGES NOT COVERED

- Damaged threads or crushed internal parts caused by improper tightening.
- Blocked flow paths caused by improper installation or unsuitable mobile phases.

Pump and Detector

TERMS OF USE

- Use of clean solvents and containers (Filter the solvents to avoid presence of fibers and particles in the pump.)
- Preventative maintenance schedule followed.

DAMAGES NOT COVERED

- Damaged threads caused by improper installation, replacement, or the use of unsuitable solvents.
- Blocked flow paths caused by improper installation or unsuitable mobile phases.

Appendix B

REPLACEMENT PARTS AND ACCESSORIES

IN THIS CHAPTER:

⚠CAUTION	**All items listed must only be supplied by Gilson or an agent thereof. Use of alternate parts may lead to improper operation of the system or failure to comply with safety or EMC regulations.**
NOTICE	**The manufacturer's declaration of conformity becomes invalid if the user modifies the original product or installs additional components.**

Couplers and Adapters

PART NUMBER	DESCRIPTION
21040201	TEE, 1/4-28, 2,4 mm BORE, PEEK, PLC 2050/2250
4957515	Y ASSY, 5/16-24, PEEK, PLC 2500
49060022	REDUCER 5/16-24 TO 10-32, 1 mm BORE
21040163	FEMALE LUER ADAPTER TO 1/8" FITTING, SS
21040164	BULKHEAD UNION 1/8", SS, PLC 2250/2500
21040165	BULKHEAD UNION 1/16", SS, PLC 2050
21040166	TEE, 1/8", 2 mm BORE, SS
21040167	TEE, 1/16", 1 mm BORE, SS
490410678	ADPTR, LUER FEMALE TO 1/4-28 MALE, ETFE
21040202	ADPTR, LUER MALE W/LOCK TO 1/4-28 FEMALE
49041120	QUICK-STOP LUER CHECK VALVE
490410675	ADPTR, LUER MALE W/LOCK TO 1/4-28 MALE
21040203	ADPTR, UNION 1/4-28 MALE TO 1/4-28 MALE
49041131	BACK PRES REG, PEEK, 20 psi
21040207	UNION ETFE FEMALE 1/4-28 TO 1/4-28
21040208	ADPTR, LUER MALE TO 1/4-28 MALE

Detector Parts

PART NUMBER	DESCRIPTION
21040113	LAMP DEUTERIUM, PLCA
21040253	LAMP DEUTERIUM, PLCA, V2
21041038	LAMP HALOGEN, PLCA
21040125	FLOW CELL, PLCA, 2.4 mm
21040126	FLOW CELL, PLCA, 1.3 mm
21040127	FLOW CELL, PLCA, 0.3 mm
21040254	DETECTOR TEST CELL FOR SERVICE

Fittings

PART NUMBER	DESCRIPTION
21040193	ETFE FERRULE FOR 1/8" TUBING (X10)
21040194	PEEK NUT, SHORT, FOR 1/8" TUBING
21040195	PEEK NUT, LONG, FOR 1/8" TUBING
490410133N	ETFE FERRULE FOR 3/16" TUBING
49040132	PEEK NUT FOR 3/16" TUBING
49041019	ETFE PLUG, 1/4-28 FOR GRADIENT VALVE, PLC 2050/2250
21040196	PEEK PLUG 5/16-24 FOR GRADIENT VALVE, PLC 2500
49041122	ETFE FERRULE FOR 1/4" TUBING
49041123	PEEK BLK NUT FOR 1/4" TUBING
21040197	SS NUT FOR 1/16" TUBING (X10)
21040198	SS FERRULE FOR 1/16" TUBING (X10)
21040199	SS NUT FOR 1/8" TUBING (X10)
21040200	SS FERRULE FOR 1/8" TUBING (X10)
490410120	F120, FINGERTIGHT FITTING

Fraction Collector

PART NUMBER	DESCRIPTION
21040159	FC PROBE, SS NEEDLE W/ FITTING, PLCA
21040188	NEEDLE, 100 mm TUBES, 11.5 CM, PLCA
21040019	RACK SET 3L, 18x150/180 mm TUBES
21040020	RACK SET 3L, 13x100 mm TUBES
21040021	RACK SET 3L, 16x150 mm TUBES
21040022	RACK SET 3L, 21x150 mm TUBES
21040023	RACK SET 3L, 25x150 mm TUBES
21040024	RACK SET 3L, 28x150 mm TUBES
21040025	RACK SET 3L, 29.5x200 mm TUBES
21040026	RACK SET 3L, 13x73 mm HEMO TUBES
21040191	RACK SET 3L, 12x65 mm TUBES
21040027	RACK FUNNEL, 16 OUTLETS 1/4 OD

FRACTION COLLECTOR CONTINUED ON PAGE 80

PART NUMBER	DESCRIPTION
21040232	COLLECTION PLATFORM 2 DEEP WELL MCRPLT
21040028	RACK OVERLAYS 18 mm TUBES, 3L
21040029	RACK OVERLAYS 13 mm TUBES, 3L
21040189	TEST TUBES, 18x150 mm, 25 mL (X 100)
21040190	TEST TUBES, 18x180 mm, 32 mL (X 100)

Miscellaneous

PART NUMBER	DESCRIPTION
21040015	STANDALONE COLUMN HOLDER - LC COLUMNS
21040177	ADDITIONAL TIGHTENING CLAMP - LC COLUMNS
21040114	MXNG CHMBR PISTON SEAL, PTFE, PLCA
21040156	MIX CHMBR PISTON (4ML) W/ SEAL, PLCA
21040157	MIX CHMBR PISTON (12ML) W/ SEAL, PLCA
21040158	MIX CHMBR PISTON (16ML) W/ SEAL, PLCA
21040161	MIX CHMBR MOTOR W/ MAG AND CBL, PLCA
21040147	PC FAN, W/ CABLE, PLCA
21040148	BACK FAN, W/ CABLE, PLCA
21040149	AXIAL FAN, 60X60 W/ CABLE, PLCA
21040150	FUSE, 6.3 AMP, H, 250 V, PLCA
21040205	GAS REGULATOR W/FILTER 5µ & MANOMETER
21040128	MAIN PCB, PLCA, CM2008
21040129	PUMP BOARD, PLCA, CPU2008-RP
21040130	FC BOARD, PLCA, CF2008-R
21040131	PUMP INTERFACE BOARD, PLCA, CIP2008
21040132	EXTRNL CONN INTRFACE BD, PLCA, CIC2008
21040133	CPU FOR EXT CONNECTIVITY, PLCA, FLEX
21040134	POWER SUPPLY, PLCA, 24V DC, 300W
21040135	POWER SUPPLY, PLCA, 5V DC, 15W
21040136	CENTRAL PROCESS UNIT W/ TOUCH SCRN, PLCA
21040153	CAMSHAFT OPTO-SENSOR W/ CABLE, PLCA

MISCELLANEOUS CONTINUED ON PAGE 81

PART NUMBER	DESCRIPTION
21040154	OPTO-SENSOR DISC, PLCA
21040160	SERIAL RS-232 CABLE FOR COM4 USE, PLCA
21040162	STYLUS WITH ADHESIVE HOLDER, PLCA
21041028	MOTOR SHOCK MOUNT (X4), PLC COLL. MOTOR
21041029	PLC COLLECTOR ARM COVER
21040234	PLC BACK PANEL RIGHT
21040235	PLC COLLECTOR BACK METAL PLATE
21040233	SHIP MTRL PLC, SKID, BOX, FOAMS, ACC BOX
21040206	X-AXIS OPTO-SENSOR W/ CABLE, PLCA
21040243	Y-AXIS OPTO-SENSOR W/ CABLE, PLCA
21041026	X-AXIS BELT FOR PLC COLLECTOR
21041027	Y-AXIS BELT FOR PLC COLLECTOR
21040244	X-AXIS MTR W/ PULLEY, SHCK MNT & CABLE
21040245	Y-AXIS MTR W/ PULLEY, SHCK MNT & CABLE
21040242	BALLAST FOR 1/8" TUBING
21041043	POWER CORD, 110 V
21041044	POWER CORD, 220 V

Pump Parts

PART NUMBER	DESCRIPTION
21040103	CHECK VALVE, 10 mm, PLCA
21040104	SEAL, 4.5 mm, PLC 2050
21040105	SEAL, 10 mm, PLC 2250
21040106	SEAL, 14 mm, PLC 2500
21040107	PISTON ASSY, 4.5 X 65 mm, PLC 2050
21040108	PISTON ASSY, 10 X 65 mm, PLC 2250
21040109	PISTON ASSY, 14 X 65 mm, PLC 2500
21040110	CLEANING DISC, 4.5 mm, PLC 2050
21040111	CLEANING DISC, 10 mm, PLC 2250

PUMP PARTS CONTINUED ON PAGE 82

PART NUMBER	DESCRIPTION
21040112	CLEANING DISC, 14 mm, PLC 2500
21040236	INLET CVH 10mm, 1/8, FLAT, PLC 2050/2250
21040237	INLET CVH 10mm, 3/16, FLAT, PLC 2500
21040238	OUTLET CVH 10mm, 1/8, CONIC, PLCA
21040250	PUMP HEAD ASSY, PLC 2050
21040251	PUMP HEAD ASSY, PLC 2250
21040152	PUMP HEAD ASSY, PLC 2500
21040155	PRESSURE TRANSDUCER V2, 400 BAR, PLCA
21040174	TOOL FOR SEAL INSERTION, PLCA

Sample Loops

PART NUMBER	DESCRIPTION
21040030	SAMPLE LOOP, 1 ML, AUTO, 1/8”
21040031	SAMPLE LOOP, 2 ML, AUTO, 1/8”
21040032	SAMPLE LOOP, 5 ML, AUTO, 1/8”
21040033	SAMPLE LOOP, 10 ML, AUTO, 1/8”
21040034	SAMPLE LOOP, 20 ML, AUTO, 1/8”
21040035	SAMPLE LOOP, 30 ML, AUTO, 1/8”
21040036	SAMPLE LOOP, 40 ML, AUTO, 1/8”
21040037	SAMPLE LOOP, 50 ML, AUTO, 1/8”
21041007	SAMPLE LOOP, 1 ML, MAN, 1/8”
21041008	SAMPLE LOOP, 2 ML, MAN, 1/8”
21041009	SAMPLE LOOP, 5 ML, MAN, 1/8”
21041010	SAMPLE LOOP, 10 ML, MAN, 1/8”
21041011	SAMPLE LOOP, 20 ML, MAN, 1/8”
21041012	SAMPLE LOOP, 30 ML, MAN, 1/8”
21041013	SAMPLE LOOP, 40 ML, MAN, 1/8”
21041014	SAMPLE LOOP, 50 ML, MAN, 1/8”

Tubing

PART NUMBER	DESCRIPTION
21040101	SOLVENT INLET TBNG ASSY, ETFE, PLC 2050/2250
21040102	SOLVENT INLET TBNG ASSY, PFA, PLC 2500
21040247	TBNG ASSY, BIN VLV TO HEADS, PLC 2X50
21040246	TBNG ASSY, QUAT VLV TO HEADS, PLC 2X50
21040248	TBNG ASSY, BIN VLV TO HEADS, PLC 2500
21040249	TBNG ASSY, QUAT VLV TO HEADS, PLC 2500
21040115	WASTE OUTLET TBNG, ETFE, PLC 2050/2250
21040116	WASTE OUTLET TBNG, ETFE, PLC 2500
21040137	ETFE TUBING, 1/8″ OD, 2.4 mm ID, 1 MTR
21040138	ETFE TUBING, 1/8″ OD, 1.6 mm ID, 1 MTR
21040139	PFA TUBING, 3/16″ OD, 1/8″ ID, 1 MTR
21040140	SS TUBING, 1/8″ OD, 2.1 mm ID, 1 MTR
21040141	SS TUBING, 1/8″ OD, 1 mm ID, 1 MTR
21040142	SPRING, 20 CM FOR ETFE 1/8″ TUBING
21040168	PURGE VLV OUT TBNG, SS FTTNG, PLCA
21040169	SHUT-OFF VLV OUT TBNG, PEEK FTTNG, PLCA
21040170	PTFE TUBING, 1/4” OD, 4.75 mm ID, 1 MTR
21040171	SS TUBING, 1/16” OD, 1 mm ID, 1 MTR
21040117	RT HD, TRNSDCR PRFRM TBNG PLC 2250/2500
21040118	LFT HD, TRNSDCR PRFRM TBNG PLC 2250/2500
21040119	TRNSDCR, MIXER PRFRM TBNG PLC 2250/2500
21040120	MXR TO INJ VLV PRFRM TBNG PLC 2250/2500
21040121	RGHT HD, TRNSDCR PRFRM TBNG PLC 2050
21040122	LFT HD, TRNSDCR PRFRM TBNG PLC 2050
21040123	TRNSDCR, MXR PRFRM TBNG PLC 2050
21040124	MXR TO INJ VLV PRFRM TBNG PLC 2050
21040239	MXR TO VLV ASSY TBNG W/TEE, PLC 2250/2500

Valves

PART NUMBER	DESCRIPTION
21040143	BINARY GRAD VLV 1/8 W/ CABLE, PLC 2050/2250
21040144	BINARY GRAD VLV 3/16 W/ CABLE, PLC 2500
21040145	QUAT GRAD VLV 1/8 W/ CABLE, PLC 2050/2250
21040175	QUAT GRAD VLV 3/16 W/ CABLE, PLC 2500
21040146	SOLENOID VLV 1/8, GRAD FORMER, PLC 2050/2250
21040176	SOLENOID VLV 3/16, GRAD FORMR, PLC 2500
21040151	VLV, 6-PORT, 2-POS, 1/8, HEAD RPLCMNT, PLCA
21040173	VLV, 4-PORT, 2-POS, 1/8, HEAD RPLCMNT, PLCA
21041021	CONTROL MODULE FOR AUTOMATIC VICI VALVE
21041022	VLV, 6-PORT, 2-POS, ROTOR SEAL
21040213	VLV, 4-PORT, 2-POS, ROTOR SEAL
21040152	VLV, 3-WAY, 1/8, W/ CABLE, PLCA
21040214	VLV, 3-WAY, 1/8, W/ CABLE, PLCA, V2
21040172	SHUT OFF VLV, INJ VLV OUT, 1/8, PLCA
21041019	NEEDLE, 16GA, SS FOR MAN LOOP INJ VLV
21041020	REBUILT KIT FOR MANU LOOP INJ VLV

Appendix C

MATERIALS

Liquid Contact Materials

The information provided in the following table is accurate to the best of our knowledge and belief, but it is intended for general information only (classified by alphabetical order).

Liquid Contact Materials

MATERIAL	DESCRIPTION
Al_2O_3 Ceramic	Alumina ceramic (Aluminum Oxide or Al_2O_3) is an excellent electrical insulator and one of the most widely used advanced ceramic materials. Additionally, it is extremely resistant to wear and corrosion. Alumina components are used in a wide range of applications such as electronics, pump components and automotive sensors.
ETFE	Ethylene tetrafluoroethylene is the generic name for the material such as Tefzel®. A fluoropolymer used for sealing surfaces, it is resistant to most chemical attack; however, some chlorinated chemicals will cause a physical swelling of ETFE tubing.
Fused Silica, SiO_2 Glass	High purity sand deposits provide the raw material for bulk refractory grade, which is electric arc melted at extremely high temperatures. Optical and general purpose fused silica rods and tubing are drawn from a melt made from high purity chemicals. Fiber optic purity is made by thermal decomposition of high purity gaseous silica containing chemicals. The glass may be clear or translucent, in which case it is often referred to as fused quartz. The glass has very high viscosity, and this property allows the glass to be formed, cooled and annealed without crystallizing. Fused silica glass is a very low thermal expansion material, and so is extremely thermal shock resistant. The material is also chemically inert up to moderate temperatures except to hydrofluoric acid, which dissolves silica. It will devitrify above about 1100°C in the presence of contaminants such as sodium, phosphorus and vanadium, with the formation of cristobalite crystals which destroy the properties of the glass. The dielectric properties are stable up through gigahertz frequencies.
Graphite Fiber-Reinforced Polytetrafluoroethylene (GFP)	GFP is a reinforced graphite fiber PTFE material used in moderate to extreme service conditions. This material has excellent wear resistance in a wide range of speeds, in medium pressures and in high temperatures. GFP performs well in water and other liquid solutions and has limited use in vacuum or inert gas applications. Dynamic surfaces in contact with a seal made from GFP should have a hardness of Rc 40 or higher. GFP is recommended for applications that require good wear in liquids and humid conditions at temperatures from -320°F to +500°F (-196°C to +260°C), such as down-hole logging tools, adhesive, and epoxy dispensing equipment, and chemical and laboratory equipment. GFP has excellent chemical compatibility. This material is compatible with most fluids and gases, except some acids, such as sulfuric, nitric and hydrofluoric acids.

LIQUID CONTACT MATERIALS CONTINUED ON PAGE 86

Liquid Contact Materials

MATERIAL	DESCRIPTION
Hastelloy C	This is the material most often recommended for corrosion resistance. This versatile nickel-chromium molybdenum alloy has excellent resistance to most acids, including strong oxidizers such as ferric and cupric chlorides; nitric, formic and acetic acids; wet chlorine; sea water and brine solutions; and mixtures containing nitric acid or oxidizing acids with chloride ions. The best choice for most special applications where HPLC grade stainless cannot be used, Hastelloy C has excellent resistance to pitting, stress corrosion cracking, and oxidizing atmospheres up to temperatures well beyond any other standard components of the chromatographic system.
Kalrez®	Kalrez® perfluoroelastomer parts (FFKM) resist over 1,800 different chemicals, while offering the high temperature stability of PTFE (327°C). They are used in highly aggressive chemical processing, semiconductor wafer fabrication, pharmaceutical, oil and gas recovery, and aerospace applications. The long-term, proven performance of Kalrez® parts can mean less frequent seal changes, repairs and inspections, increasing process and equipment uptime for greater productivity and yield.
Ketron® CA30 PEEK	Ketron® CA30 PEEK is a polyetheretherketone material with 30% carbon fiber reinforced. The addition of carbon fibers enhances the compressive strength and stiffness of PEEK, and dramatically lowers its expansion rate. It offers designers optimum wear resistance and load carrying capability in a PEEK-based product. This grade provides more thermal conductivity than unreinforced PEEK, increasing heat dissipation from bearing surfaces improving bearing life and capability.
PCTFE	This material is a homopolymer of chlorotrifluoroethylene which has many of the properties similar to other fluoropolymers such as PTFE or FEP, but is mechanically superior in rigidity (does not deform easily), and has very low gas permeability. Its dimensional stability makes it attractive for use as a component of a structural part where the high temperature and chemical resistance of fluoropolymers is required. PCTFE shows high compressive strength and low deformation under load.
PEEK	Considered relatively inert and biocompatible, poly-etheretherketone tubing can withstand temperatures up to 100°C. Under the right circumstances, 0.005”–0.020” (ID) tubing can be used up to 5000 psi for a limited time, and 0.030 to 3000 psi. Larger IDs are typically good to 500 psi. These limits will be substantially reduced at elevated temperatures and in contact with some solvents or acids. Its mechanical properties allow PEEK to be used instead of stainless in many situations and in some environments where stainless would be too reactive. However, PEEK can be somewhat absorptive of solvents and analytes, notably methylene chloride, DMSO, THF, and high concentrations of sulfuric and nitric acid. This tubing is highly prone to «kinking», or sealing off, if held in a sharp bend over time.

LIQUID CONTACT MATERIALS CONTINUED ON PAGE 87

Liquid Contact Materials

MATERIAL	DESCRIPTION
PFA	Perfluoroalkoxy is a fluorocarbon with chemical and mechanical properties similar to FEP. More rigid than either PTFE or FEP. FEP (fluorinated ethylene propylene) is another member of the fluorocarbon family with similar chemical properties. It is generally more rigid than PTFE, with somewhat increased tensile strength. It is typically more transparent than PTFE, slightly less porous, and less permeable to oxygen. FEP is not as subject to compressive creep at room temperature as PTFE, and because of its slightly higher coefficient of friction is easier to retain in a compression fitting.
PTFE	Polytetrafluoroethylene is the generic name for the class of materials such as Teflon®. It offers superior chemical resistance but is limited in pressure and temperature capabilities. Because it's so easy to handle, it is often used in low pressure situations where stainless steel might cause adsorption. PTFE tubing is relatively porous, and compounds of low molecular weight can diffuse through the tubing wall.
Ruby / Sapphire	Synthetic rubies and sapphires are single-crystal aluminum oxides, practically pure for the sapphire (+99,99% Al_2O_3). The color of the ruby is produced by adding a few ppm (parts per million) of chromium oxide (CrO_3). Synthetic rubies and sapphires have a hexagonal-rhombic crystal structure, density of 3.99 g/cm^3 and a water absorption coefficient of 0%. The principal properties of synthetic rubies and sapphires include a hardness and high mechanical strength, excellent resistance to wear, very low friction coefficient, chemically inert, good thermal conductivity, ideal electrical insulation.

LIQUID CONTACT MATERIALS CONTINUED ON PAGE 88

Liquid Contact Materials

MATERIAL	DESCRIPTION
Stainless Steel, Type 316/316L	Stainless Steel 316 is a chromium-nickel based steel that possesses increased levels of resistance against several substances, due to the addition of molybdenum in its composition. The molybdenum allows SS 316 to be more resistance to corrosion overall, with specific resistance against chlorine pitting. SS 316 is also found to be more applicable in areas with high or elevated temperatures compared to other stainless steels. It has more heat resistance than Type 304 but otherwise possesses many of the same general characteristics. 316's corrosion resistance is especially effective against chemicals, such as those used in the paper and textile industries. The metal finds other common applications in food processing equipment, chemical processing, nuts and bolts, and medical implants. While the metal is pliable under hot and cold-working techniques, it cannot be work hardened with heat treatment and in general is considered to have lower weldability compared to the 304 type stainless steels. However, it is still preferred over many other stainless steel grades in terms of workability. Stainless Steel 316L was designed to have a much lower carbon content than its 316 counterpart. As such, 316L is useful in areas where the avoidance of carbon precipitation is desired. The metal is commonly applied in weldments, where its particular carbon content combined with welding guarantees maximum resistance against general corrosion, and also in heavy gauge components. 316L is considered to be more resistant to oxidation than type 316, especially in warm marine environments. Once again, its low levels of carbon protect it against carbon precipitation. The metal also shows resistance in extremely low temperatures, even down to cryogenic levels. In regard to heat, 316L shows better resistance to creep, stress to rupture and overall strength than other stainless-steel grades. Many of the same work practices effective on type 316 may also be employed on 316L, including weldability and work hardening through cold working. In addition, 316 does not require post-work annealing to maximize its corrosion resistance, however annealing may be utilized in certain situations.
Zirconium Oxide	The zirconium oxide or zirconia (ZrO2) has a tetragonal crystal structure with a grain size not exceeding 0.50 microns, density greater than 6,00 g/cm^3, and a Vickers hardness value of about 1200. The principal properties of zirconia ZrO_2 include a high mechanical strength, fracture toughness, extreme hardness, compressive strength, low thermal conductivity, excellent resistance to corrosion and wear, excellent tribological properties and good biocompatibility.

Trademark Description References

Al_2O_3 ceramic description provided by Elan Technology (www.elantechnology.com)

ETFE, Hastelloy C, PEEK, PFA, and PTFE descriptions provided by Valco Instruments Co. Inc. (www.vici.com)

Fused Silica, SiO2 Glass description provided by Accuratus Corporation (www.accuratus.com)

GFP description provided by Bal Seal Engineering, Inc. (www.balseal.com)

Kalrez® descriptions provided by DuPont (www.dupont.com)

Ketron® CA30 PEEK description provided by Quadrant (www.quadrantplastics.com)

PCTFE description provided by Fluorotherm (www.fluorotherm.com)

Stainless Steel, Type 316 / 316L descriptions provided by Stardust Impex (www.stardustimpex.com)

Ruby/Sapphire and Zirconium Oxide descriptions provided by Ceramaret SA (www.ceramaret.ch)

Appendix D

PLC WITH GX-241 LIQUID HANDLER CONFIGURATION

IN THIS CHAPTER:

Unpack the System

The PLC Purification System, GX-241 Liquid Handler, and VERITY® 4020 Single Syringe Pump are shipped separately.

Upon receipt of each instrument, inspect the exterior of all shipping boxes. All boxes should arrive unopened and undamaged. Report any damage to the shipping carrier and Gilson as soon as possible after receipt. Keep packing materials in case the instrument needs to be shipped in the future.

System Setup

Follow the instructions to set up the GX-241 Liquid Handler and VERITY® 4020 Single Syringe Pump as described in each instrument's user's guide.

> ***NOTE*** **Do not connect the transfer tubing as instructed. This is a system connection that will be described later in this section.**

Connect the Transfer Tubing

Connect the transfer tubing as described in **Transfer Tubing Connection on page 94**.

Control Software

Control of the PLC Purification System with the GX-241 as autosampler with VERITY 4020 Syringe Pump is via GLIDER Software accessed via the touchscreen of the PLC Purification System.

Installation

Install the GX-241 and the VERITY 4020 Syringe Pump as described in each instrument's user's guide. Complete instructions for each step are included in the 'Installation' chapter. The instrument and its components should be set up in the order shown below.

Figure 71
PLC Purification System with GX-241 Liquid Handler

1. Set up the GX-241.
2. Place the GX-241 to the left of the PLC Purification System.
3. Place the 3 x 100 mL solvent reservoir rack (PN SPL-2334-HDW), which must be installed adjacent to the rinse station.
4. Set up the VERITY 4020 Syringe Pump.
5. Place the VERITY 4020 Syringe Pump to the left of the GX-241.
6. Install the syringe. The syringe is ordered separately, according to the PLC sample loop size. Refer to the table for part numbers.

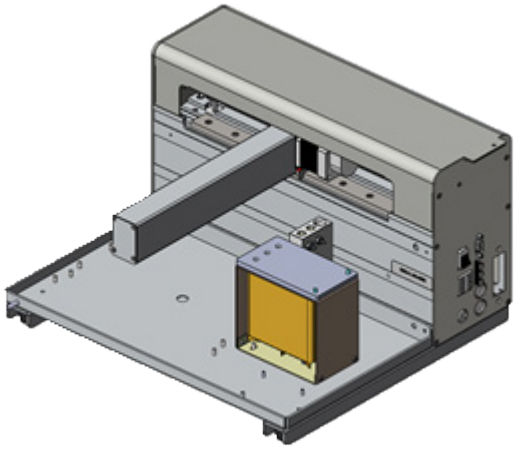


Figure 72
Location of 3 x 100 mL Solvent Reservoir

Syringes

Part Number	Description
25025344	Syringe 5 mL
25025345	Syringe 10 mL
25025346	Syringe 25 mL

Plumbing Connections

Make all connections as described in each instrument user's guide, except the transfer tubing connection, as this is different with the PLC Purification System.

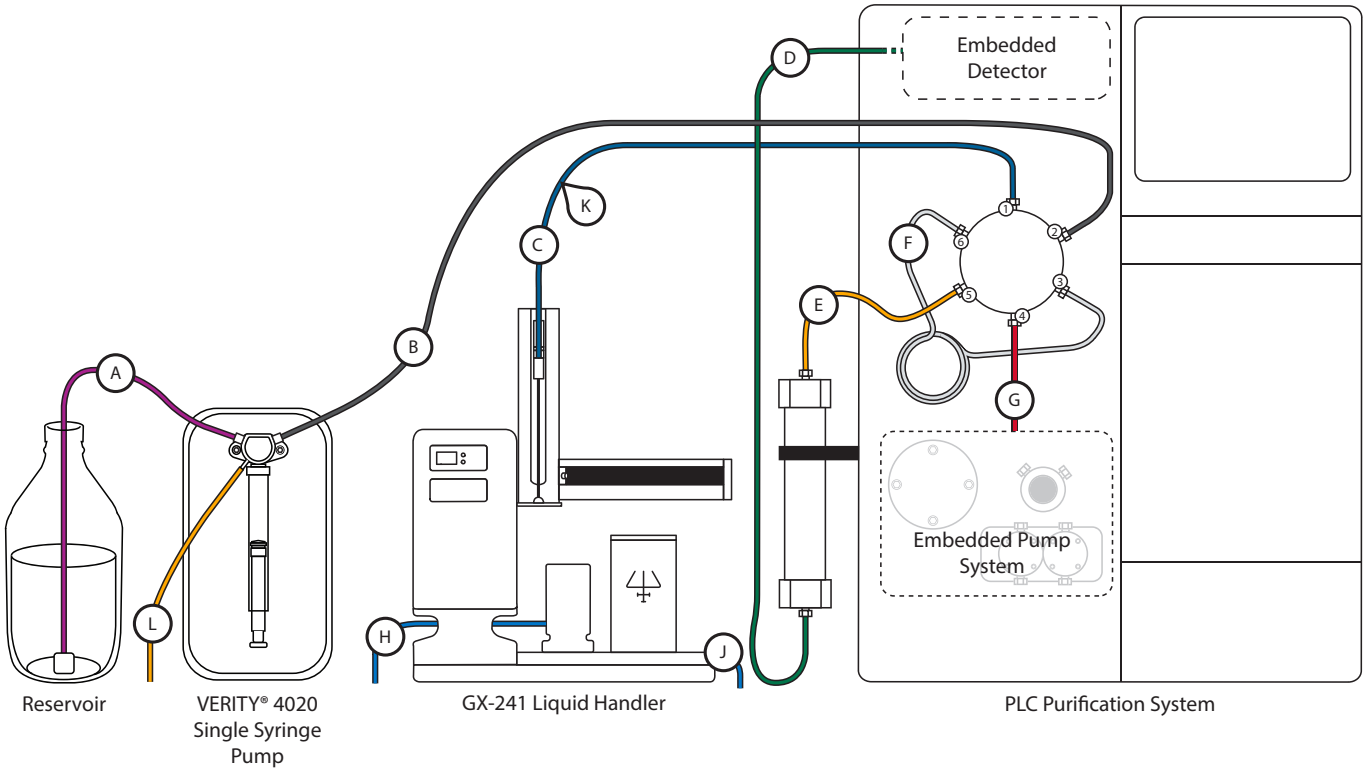


Figure 73
Plumbing Diagram for the PLC Purification System with GX-241 Liquid Handler and VERITY® 4020 Single Syringe Pump

PLC Purification System with GX-241 Liquid Handler Plumbing Connections

Connection			Tubing	Fittings
A	FROM	Reservoir	Solvent inlet tubing assembly • 3 mm (OD), 2 mm (ID) (PN 499484021)	20 µL filter (PN 4957226)
	TO	Syringe pump inlet		PEEK
B	FROM	Syringe pump outlet	Transfer tubing • 5.5 mL for 5 mL syringe (PN 499671112) • 10.5 mL for 10 mL syringe (PN 499474103) • 30 mL for 25 mL syringe (PN 499483602)	PEEK
	TO	Port 2 Automated sample loop injection valve		

PLC PURIFICATION SYSTEM WITH GX-241 LIQUID HANDLER PLUMBING CONNECTIONS CONTINUED ON PAGE 93

PLC Purification System with GX-241 Liquid Handler Plumbing Connections

Connection			Tubing		Fittings
C	FROM	GX-241	1/16" (OD) PTFE probe tubing		1/4"-28 PEEK
	TO	Port 1 Automated sample loop injection valve			10-32 SS
D	FROM	Column	Varies, based on PLC model and connected column		Varies, based on PLC model and connected column
	TO	Detector			
E	FROM	Port 5 Automated sample loop injection valve	Varies, based on PLC model and connected column		Varies, based on PLC model and connected column
	TO	Column			
F	FROM	Port 3 Automated sample loop injection valve	Sample loop tubing		5/16"-24 SS
	TO	Port 6 Automated sample loop injection valve	1/8" (OD)	• 1 mL (PN 21040030) • 2 mL (PN 21040031) • 5 mL (PN 21040032) • 10 mL (PN 21040033) • 20 mL (PN 21040034)	
G	FROM	Embedded pump system (mixing chamber)	1/8" (OD), SS		5/16"-24 SS
	TO	Port 4 Automated sample loop injection valve			
H	FROM	Rinse station	Rinse station assembly (PN 26054000)		Installed
	TO	Waste			N/A
J	FROM	GX-241 locator plate	Tygon® waste tubing (PN 470331206)		N/A
	TO	Waste			
L	FROM	Syringe pump vent	Vent tubing (PN F4420577)		N/A
	TO	Waste			N/A
K	Spiral wrap to contain probe tubing				

Transfer Tubing Connection

The transfer tubing is routed from the syringe pump to the outlet of the automatic loop injection valve of the PLC Purification System. Refer to Plumbing Connections on page 92.

The transfer tubing is ordered separately, according to the syringe size. Refer to the table below for part numbers.

Transfer Tubing

Part Number	Syringe Size	Description
499671112	5 mL	Transfer tubing 5.5 mL
499474103	10 mL	Transfer tubing 10.5 mL
499483602	25 mL	Transfer tubing 30 mL

To install the transfer tubing:

1. Connect one end with 1/4”-28 fitting to the transfer tubing side of the valve of the VERITY 4020 Syringe Pump (right-hand port), and finger-tighten the nut.
2. Connect the other end to the outlet of the shut-off valve, connected to the waste outlet (port 2) of the automatic loop injection valve of the PLC Purification System and finger-tighten the nut.

Rear Panel Connections

Diagram

The following diagram provides a general overview of the connections described in this section.

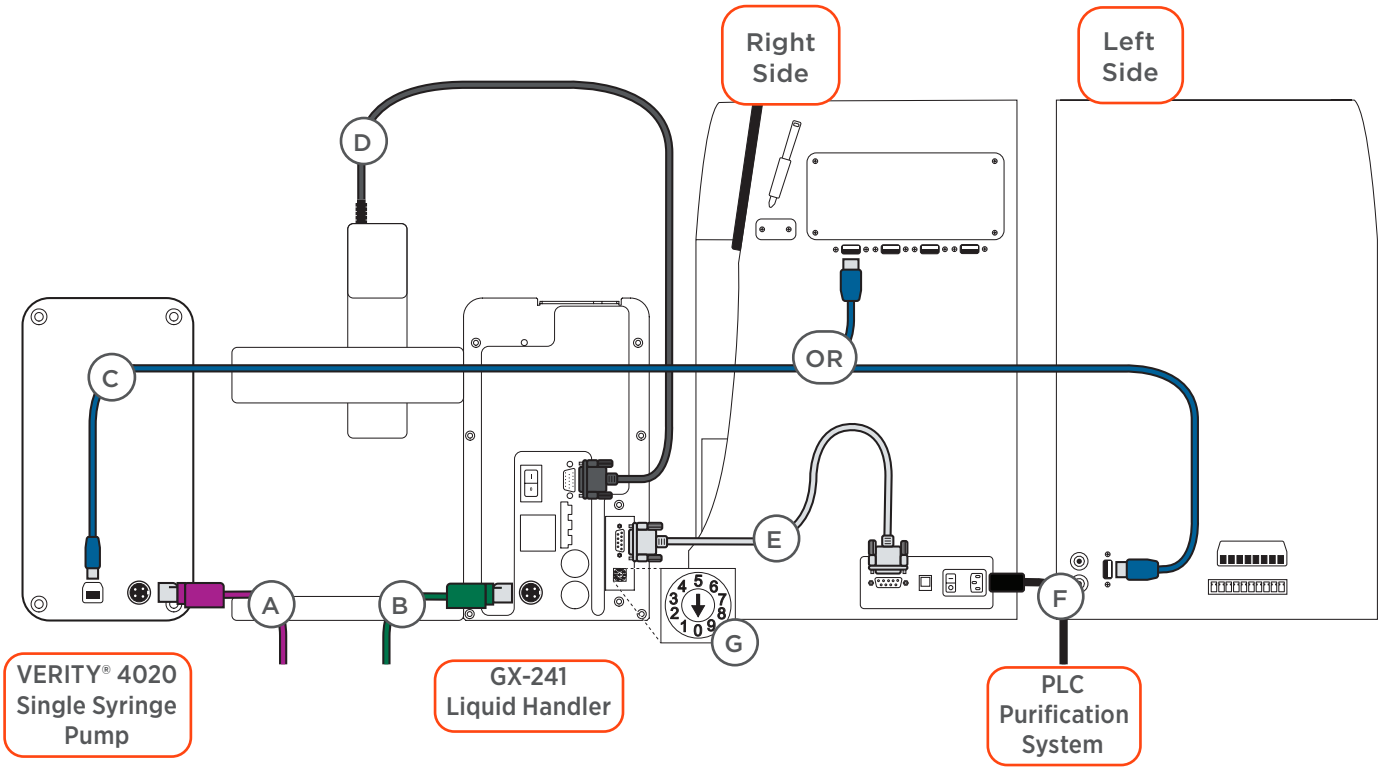


Figure 74
Electrical Diagram for the PLC Purification System with GX-241 Liquid Handler and VERITY® 4020 Single Syringe Pump

GX-241, VERITY 4020 Syringe Pump, and PLC Purification System Electrical Connections

Connection			Description
A	FROM	VERITY 4020 Syringe Pump	External power supply and power cord (appropriate for line voltage)
	TO	External power supply, and then to AC power source	
B	FROM	GX-241	External Power Supply and Power Cord (appropriate for line voltage)
	TO	External power supply, and then to AC power source	
C	FROM	VERITY 4020 Syringe Pump	USB cable, B-type end (square)
	TO	PLC Purification System	USB cable, A-type end (flat)
D	FROM	Z-arm	Z-arm cable* *Ensure power is off before connecting Z-arm.
	TO	GX-241	
E	FROM	GX-241	RS-232 cable
	TO	PLC Purification System	
F	FROM	PLC Purification System	Power cord
	TO	Power outlet	
G	Unit ID		

GX-241

The GX-241 is shipped configured for RS-232 communication with a unit ID of 8, which is the supported configuration in the PLC Purification System.

To make the RS-232 connection between the GX-241 Liquid handler and the PLC Purification System, use the RS-232 cable supplied.

1. Attach the male end of the RS-232 cable to the RS-232 port located on the rear panel of the liquid handler. Tighten the retaining screws.
2. Attach the female end of the RS-232 cable to the RS-232 serial communication port (COM4) located on the right panel of the PLC system. Tighten the retaining screws.

UNIT ID

At the factory, the unit ID on the liquid handler is set to 30. The selector on the rear panel has the arrow aligned with 0. The unit ID is 30 plus the selected number. There is no need to change this number.

Z-ARM CONNECTION

Connect the cable from the Z-arm to the Z-ARM port on the rear panel and then use a small, flat-blade screwdriver to tighten the screws to secure it

VERITY 4020 Syringe Pump

The VERITY 4020 Syringe Pump communicates with GLIDER via USB.

To make the USB connection between the VERITY 4020 Syringe Pump and the PLC Purification System, use the USB cable supplied in the accessory kit. Use the end with the A-type (flat) connector to connect to a USB port of the PLC Purification System, and use the end with the B-type (square) connector to connect to the VERITY 4020 Syringe Pump.

Power Connections

Use the power cord on the external power supply to make the connection between the power receptacle on the GX-241 Liquid Handler and the external power supply.

The connection from the external power supply to the GX-241 Liquid Handler uses a connector with a locking collar. Check the alignment of the pins and then push in until it clicks and locks in place. To disconnect, pull back on the locking collar and then disconnect the cable from the rear panel of the GX-241 Liquid Handler.

Locate the appropriate power cord for the line voltage and then make the connection between the external power supply and the AC power source.

Repeat the previous operation for the power connection of the VERITY 4020 Syringe Pump and its external power supply.

Start Up

Follow all prior instructions to make all rear panel and plumbing connections.

To start the GX-241 Liquid Handler and the VERITY 4020 Syringe Pump:

1. Power on the external supply, and then power on the GX-241 Liquid Handler, using the power switch on the rear panel.
   - The green power indicator light on the front panel illuminates.
   - The two-digit front panel display indicates 0 (no error).
2. Power on the VERITY 4020 Syringe Pump, using the power switch on the side panel.
   - The green power indicator light on the front panel illuminates.
   - The syringe pump initializes. It stops with the valve set to the outlet (transfer tubing) position.
3. Power on the PLC Purification System and wait for GLIDER to start.

Operational Description of the VERITY 4020 Syringe Pump

The VERITY 4020 Syringe Pump has a single syringe and valve. The instrument only dispenses to the GX-241 probe via the automatic loop injection valve of the PLC Purification System.

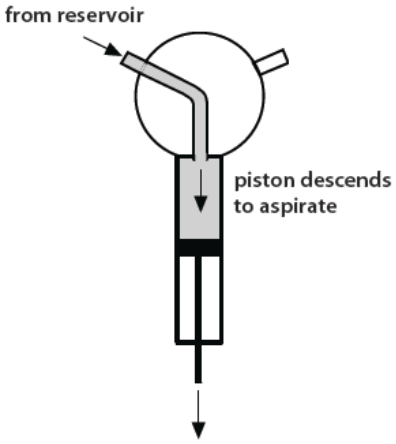


Figure 76
Aspirating from Reservoir

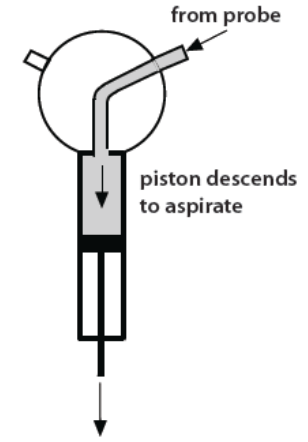


Figure 77
Aspirating from Probe

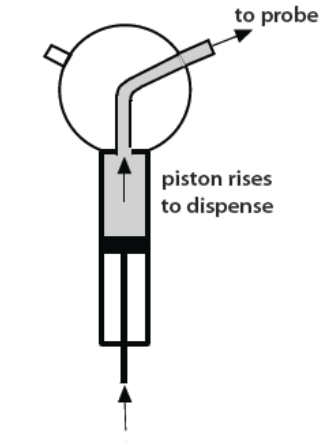


Figure 75
Dispensing

NOTE

It is impossible to dispense to the reservoir.

When aspirating from the probe, it is important to take into account the volume of transfer tubing connecting the pump outlet to the probe. The liquid aspirated from the probe must never enter the valve. The maximum volume of liquid that can be aspirated from the probe is limited to the volume of the syringe, or the volume of the transfer tubing, whichever is smaller.

Appendix E

PLC WITH VERITY 1920 MS CONFIGURATION

IN THIS CHAPTER:

Unpack the System

The components of the PLC Purification System and VERITY 1920 MS system are shipped separately. Follow any unpacking instructions provided with each component when unpacking the system.

Report any damage to the shipping carrier and Gilson as soon as possible after receipt. Keep packing materials in case the component needs to be shipped in the future.

Control Software

Control of the PLC Purification System with VERITY 1920 MS, VERITY 3011 Pump and MRA Splitter is via GLIDER Software accessed via the touchscreen of the PLC Purification System.

System Setup

Install each system component per the instructions provided in each instrument's user's guide and in the site requirements document.

Install the rotary vane pump underneath the bench or fume hood when possible. If a diaphragm pump is used, place it on top of the rotary vane pump, at the back. The MRA Splitter can be stacked on top of the VERITY 3011 Pump.

Position the chromatographic column (HPLC or CPC) between the PLC Purification System and VERITY 1920 MS system.

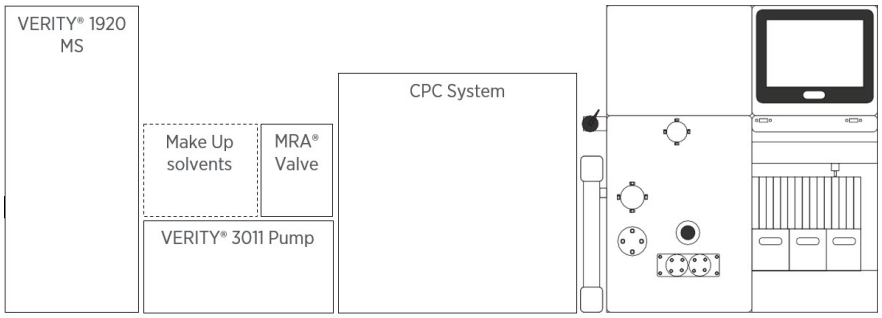


Figure 78
Stacking Diagram

Electrical Connections

The rear panel of the VERITY 1920 MS includes connections for power and nitrogen gas. The front panel includes vacuum exhaust, house exhaust, waste outlet, and a USB communication port.

The rear panel of the VERITY 3011 Pump includes connections for power and communication. The USB port is used for the communication with the PLC Purification System.

The rear panel of the MRA Splitter includes connections for power and communication. The RS-232 port is used for the communication with the PLC Purification System.

Communication Connections

USB

VERITY 1920 MS

The USB port on the VERITY 1920 MS is used for remote control with GLIDER.

To make the USB connection between the VERITY 1920 MS and the PLC Purification System, use the USB cable supplied. Connect the B-type (square) end to the USB port located on the front panel of the VERITY 1920 MS, and then connect the A-type (flat) end to the PLC Purification System.

VERITY 3011 Pump

The USB port on the VERITY 3011 Pump is used for remote control with GLIDER.

To make the USB connection between the VERITY 3011 Pump and the PLC Purification System, use the USB cable supplied. Connect the B-type (square) end to the USB port located on the rear panel of the VERITY 3011 Pump, and then connect the A-type (flat) end to the PLC Purification System.

RS-232

MRA Splitter

The RS-232 port on the MRA Splitter is used for remote control with GLIDER.

To make the RS-232 connection between the MRA Splitter and the PLC Purification System, use the RS-232 gender changer and the USB/RS-232 converter cable supplied. Connect the gender changer to the RS-232 port located on the rear panel of the MRA Splitter and tighten the retaining screws. Connect the male RS-232 end of the converter cable to the gender changer and tighten the retaining screws. Connect the USB A-type end of the converter cable to the PLC Purification System.

Power Connections

Do not turn on the instruments until instructed.

Exhaust Connections

Vacuum Exhaust

The vacuum exhaust tubing is already connected inside the VERITY 1920 MS and goes out from the front left of the instrument. This large, spiral-supported 1.3″ OD- 1″ ID tubing must be connected to the rotary vane pump (clamp connection).

House Exhaust

The house exhaust tubing is already connected inside the VERITY 1920 MS and goes out from the front right of the instrument. This spiral-supported 1″ OD–3/4″ ID tubing must be connected to the Ion Source Exhaust Trap, the 4L bottle with cap and adapters (barbed connection).

Plumbing Connections

After setting up the system, make the plumbing connections as described in each instrument's user's guide.

The flow rates of the PLC Purification System are too high for micro-spray operation with the VERITY 1920 MS; therefore, the analysis of samples with a PLC Purification System can only be carried out using a splitter valve set up with the correct split ratio.

The outlet from the column is directed to the HPLC stream inlet of the MRA Splitter, where the fluid stream is split between the integrated UV detector and the VERITY 1920 MS. The HPLC stream outlet of the MRA Splitter is redirected to the UV detector bulkhead union of the PLC Purification System.

The VERITY 3011 Pump is used as the make-up pump and its outlet is connected to the MS stream inlet of the MRA Splitter. The VERITY 1920 ACTIVE SPLITTER KIT (PN 18005005) includes all necessary tubing to connect the MS stream outlet of the MRA Splitter to the VERITY 1920 MS. Use 1 m of the red PEEK tubing (PN 499500591) to connect the MRA Splitter to the flow injection analysis (FIA) injection valve and use 0.5 m of the same tubing to connect the FIA injection valve to the ion source.

The waste outlet tubing of the VERITY 1920 MS is already connected inside and goes out from the front right of the instrument. Place the end of this Tygon® 3/8"OD-1/4" ID tubing into suitable waste receptacle.

The following diagram shows and the table explains the plumbing connections between system components.

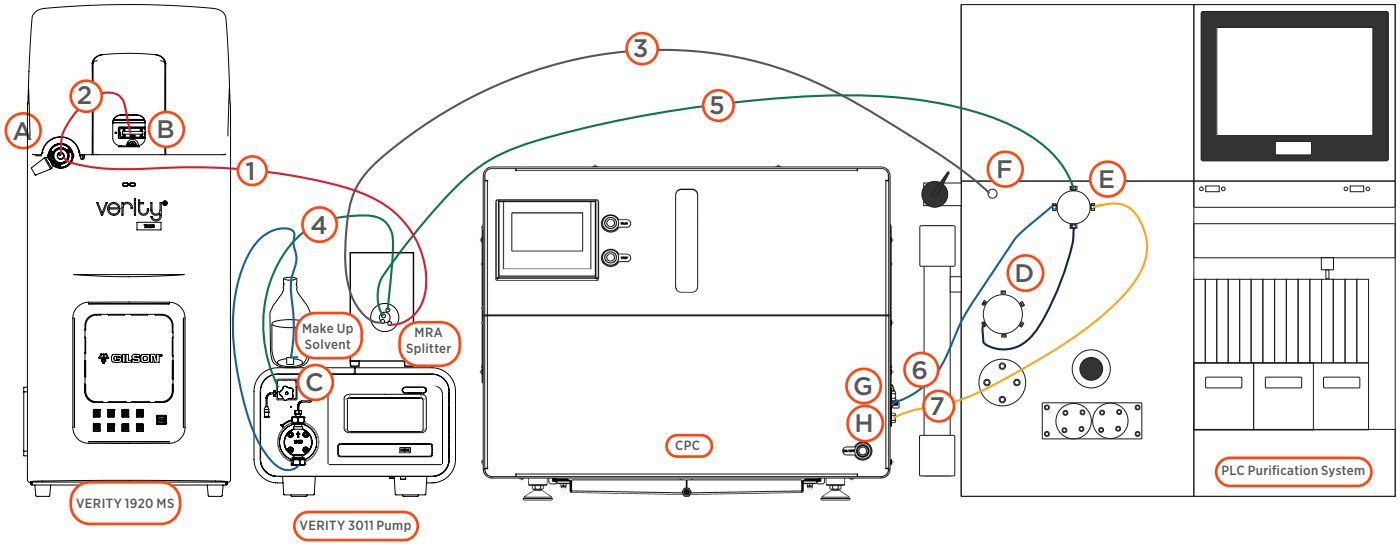


Figure 79
System Plumbing Connections

System Plumbing Connections

ID	DESCRIPTION
Ⓐ	FIA injection valve
Ⓑ	Ion source
Ⓒ	Purge valve of VERITY 3011 Pump (make up pump)
Ⓓ	Automatic loop injection valve
Ⓔ	Automatic backflush ASC/DSC valve
Ⓕ	Detector bulkhead union
Ⓖ	CPC ASC inlet / DSC outlet
Ⓗ	CPC DSC inlet / ASC outlet
①	MRA Splitter to FIA injection valve (port 2) PEEK tubing, red, 1/16" (OD), 0.005"/0.125 mm (ID), 1 m
②	FIA injection valve (port 3) to ion source PEEK tubing, red, 1/16" (OD), 0.005"/0.125 mm (ID), 0.5 m
③	MRA Splitter to integrated UV/VIS detector or DAD in the PLC Purification System Cut the tubing to the appropriate length at installation: PEEK tubing, green, 1/16" (OD), 0.030"/0.75mm (ID), 50 ft/15 m (included in the semi-prep tubing kit PN 18005100) or PEEK tubing, natural, 1/16" (OD), 0.040"/1.0 mm (ID), 50 ft/15 m (included in the prep tubing kit PN 18005101) This tubing corresponds to the "Tubing Kit" in GLIDER.
④	VERITY 3011 Pump (make up pump) to MRA Splitter PEEK tubing, green, 1/16" (OD), 0.03"/0.75 mm (ID)
⑤	Column (through backflush ASC/DSC valve) to MRA Splitter PEEK tubing, green, 1/16" (OD), 0.03"/0.75 mm (ID)
⑥/⑦	Flow to CPC column PEEK tubing, green, 1/16" (OD), 0.03"/0.75 mm (ID)

Start Up

Follow all prior instructions to make all rear panel and plumbing connections.

Power on all system components except the PLC Purification System. Allow each component to initialize and then power on the PLC Purification System and wait for GLIDER to load.

If the PLC Purification System and the different peripherals are properly configured and the communication established, there is no communication error and the system is ready to operate.

For more information about how to control a VERITY 1920 MS and PLC Purification System using GLIDER, refer to the instructions document on the documentation USB drive shipped with the system.

Appendix F

PLC WITH INTEGRATED ELSD

IN THIS CHAPTER:

Technical Specifications

Please be aware of the following before operating the instrument.

PLC Purification System with Integrated ELS Detector

Specification	Definition	
Communication	USB (internal)	
Control	GLIDER Software installed on the integrated touchscreen PC	
Data rate	Up to 30 Hz	
Detection	Photodiode with high sensitivity	
Filter	Moving average	
Gain setting	Dynamic gain management: SAGA (SEDEX Automated Gain Adjustment)	
Gas requirements* *For oil-free, dry and filtered gas, nitrogen, or air.	**Specification**	**Definition**
	Pressure	2–4.5 bar (29–67 psi)
	Purity	Gas purity has negligible impact on ELS detector performance
	Tubing	Polyamide (PA), 6 mm (OD)
	Fitting	Stainless steel (SS), 6 mm with push-lock fitting
Light source	Selected high efficiency blue LED (470 mm) with elapsed-time counter	
Nebulizer* *Model SEDEX FP™ (Flash/Prep)	**Specification**	**Definition**
	Flow rate range	100 µL/min to 5 mL/min
Temperature range	Ambient to 100°C	
Weight* *In addition to a standard PLC Purification System	5 kg (11 lbs.)	

Description

The low temperature, evaporative light-scattering (ELS) detector integrated in the PLC Purification System detects compounds in the eluent of the liquid purification chromatography system. It is capable of monitoring eluent flow rates from 100 µL/min. to 5 mL/min.

ELS detection (ELSD) is a nearly universal technique that can detect any analyte less volatile than the mobile phase. Unlike other modes of detection, such as UV, it is not dependent on the absorption of radiation, nor do the absorption characteristics of the solvent affect detection. Thus, solvents which absorb UV radiation can be used. As the solvent is completely evaporated, a gradient can be performed to optimize the separation.

ELSD is a three step process:

1. Nebulization is achieved with a venture nebulizer.
2. Evaporation is achieved with a heated tube. This is an adjustable parameter.
3. Light diffusion detection is measured with a photodiode.

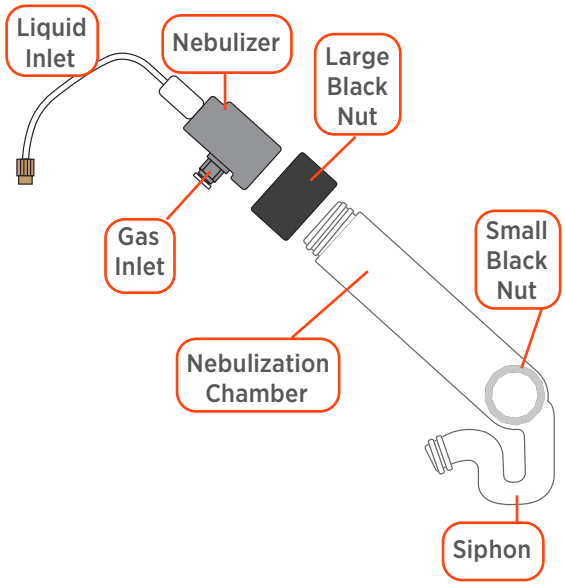


Figure 80
ELSD Components

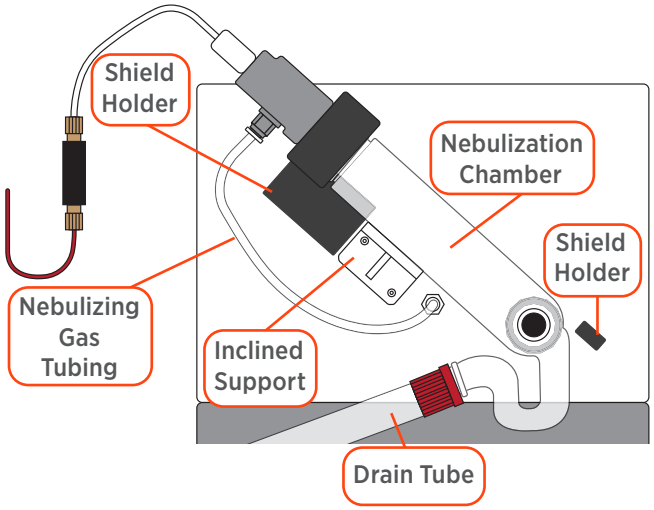


Figure 81
ELSD Installed on PLC

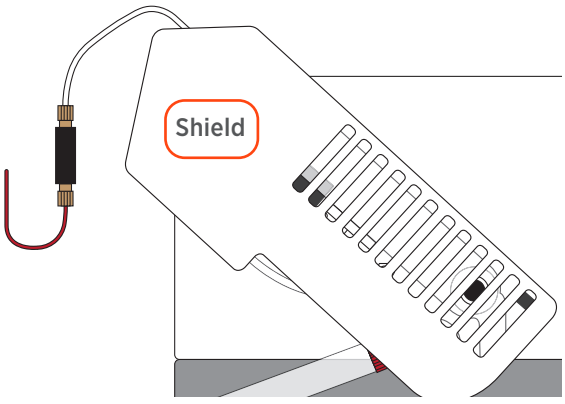


Figure 82
Shield Installed over ELSD Components

Make the Rear Panel Connections

Rear Panel Diagram

The rear panel provides connections for a gas inlet and exhaust outlet. The exhaust outlet evacuates gaseous mobile phase vapor and solute particles from the detector.

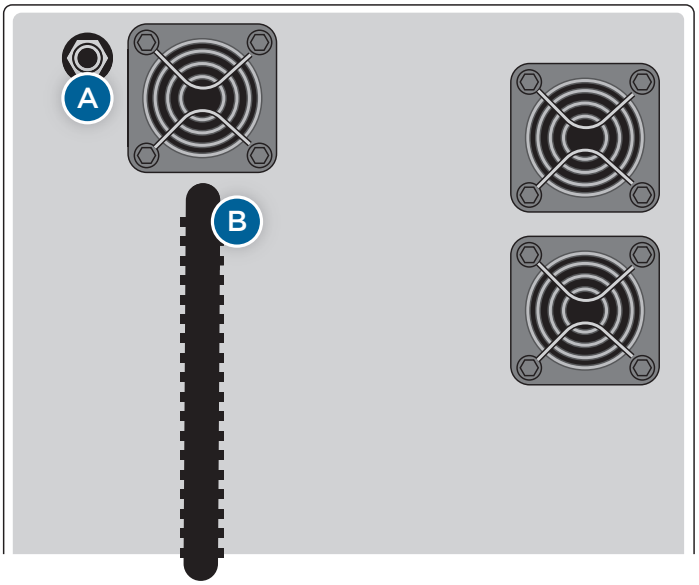


Figure 83
Rear Panel Components Diagram for PLC with ELSD

Rear Panel Components

Part	Description
A	Gas
B	Exhaust

Connect the Gas Supply

A supply of filtered, oil-free, dry, and clean gas (nitrogen or air) is required to operate the ELS detector.

NOTICE

Highly purified gas is not required to operate the ELS detector; however, a good quality of gas is mandatory for high performance detection. The gas should be free from particles (dust) and from oil.

⚠WARNING

Fire and explosion hazard.

Do not use a combustible gas with combustible solvents or analytes.

Inspect the supplied tubing for damage after installation and before use. Any damage to tubing could permit gas to leak into the laboratory.

The gas supply must include a pressure gauge that is stable and regulated by an external manometer. The ELS detector is typically operated with a gas pressure of 2 bar (29 psi) and gas consumption of 3 L/min. A gas regulator (sold separately, PN 21040205) with a 5 µm filter, manometer, and fittings is available for purchase.

To connect the PLC Purification System to the gas supply:

1. Connect a suitable length of clean, 6 mm (OD) tubing from the gas regulator outlet to the gas inlet (Port A).
2. Connect a suitable length of clean, 6 mm (OD) tubing from the gas source to the gas regulator inlet.
3. Insert the tube into the fitting until it reaches the back, and then pull the tube to check engagement of the grab.

NOTICE

Ensure that the gas pressure supplied to the detector is less than 4.5 bar (67 psi). If the pressure increases above 4.5 bar, the pressure sensor may be damaged (not covered by the warranty).

Vent the Exhaust Line

The carrier gas containing volatilized mobile phase and analytes exits the detector through the black exhaust tube. This tube can be cut and should be directed into a fume hood or exhaust vent.

Vent to Fume Hood

Ensure that the fume hood draws gas from the detector, i.e., there is positive pressure between the detector and the fume hood.

NOTICE

Use a moderate vacuum to avoid turbulence in the nebulization chamber siphon or to prevent liquid from spilling into the evaporation tube.

Avoid loops or bends in the black exhaust tubing to avoid condensation traps that can result in poor measurement results.

Negative pressure between the fume hood and ELS detector can introduce contaminants from the fume hood into the ELS detector.

Connect the exhaust tubing to the fume hood. If necessary, use the two adjustable, self-adhesive clips supplied to guide the vent tube.

⚠WARNING

Ensure that the vent tube does not become blocked, bent, or restricted from the detector to the fume hood.

Avoid long tube installations in an upward direction, which can create condensation that flows back into the detector.

NOTE

If an extension line is required because the supplied tubing is not long enough, a suitable length of 3/4” (ID) tubing can be fitted over the exhaust tubing.

Figure 84
Exhaust Tubing and Self-Adhesive Clips

Install the Nebulizer and Nebulization Chamber

NOTICE The nebulizer and the nebulization chamber are fragile. Unpack and handle them with care. Ensure that each component is clean before installation.

To install the nebulizer and nebulization chamber:

1. Remove the yellow cap from the evaporation tube.
2. Remove the paraffin film from the nebulization chamber.
3. Position the nebulization chamber onto the stainless steel (SS) evaporation tube with the siphon directed down. The chamber should be pushed as far as possible.
4. Rest the nebulization chamber on its inclined support, and then tighten the small black nut at the bottom.
5. Place the nebulizer on the top of the nebulization chamber, and then tighten the large black nut with the gas inlet fitting directed down.

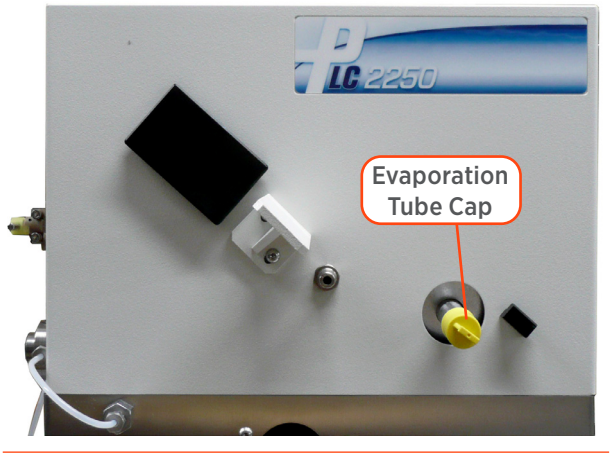


Figure 85
Removing the Evaporation Tube Cap

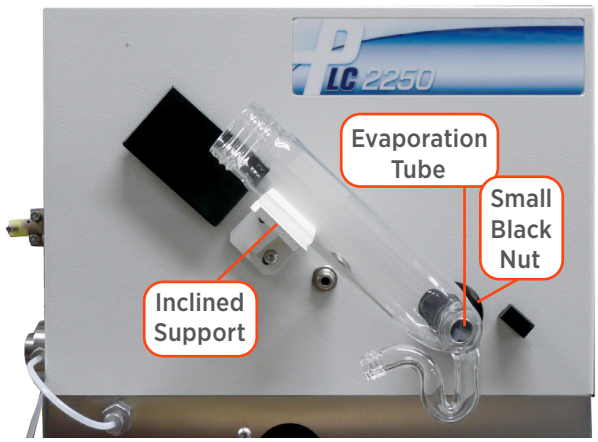


Figure 86
Positioning the Nebulization Chamber

6. Fill the siphon of the nebulization chamber with the mobile phase that will be used for the separation. The liquid should fill the bend in the siphon, but not pool in the evaporation tube. Ensure that no liquid leak could affect the detector performance or create laboratory pollution.

NOTICE If using a volatile solvent (e.g., hexane or dichloromethane), use water to fill the siphon.

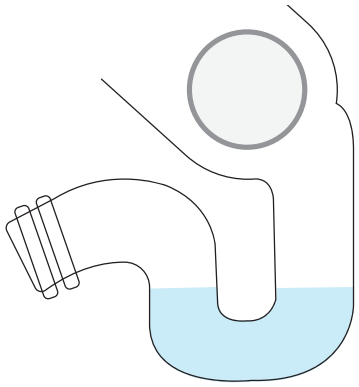


Figure 87
Fill Area for Siphon Overflow

Front Panel Connections

Connect the Siphon Overflow

1. Connect the supplied drain tube assembly to the end of the siphon tube, using the red, tapered hose connector with PTFE seal.
2. Lead the drain tube to waste.

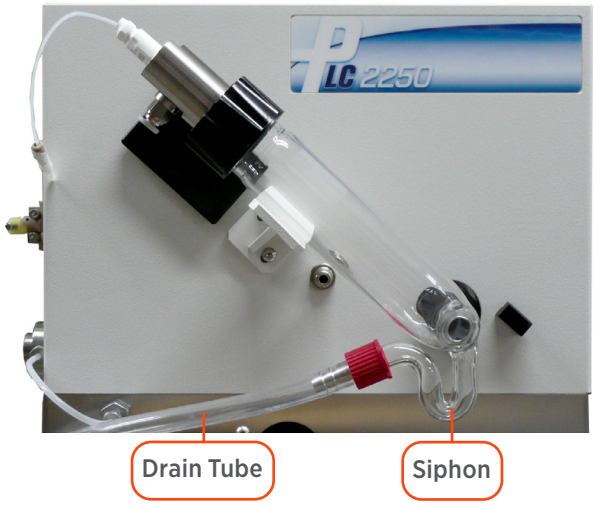


Figure 88
Siphon Overflow Connections

NOTICE

Ensure that the waste container is directly below the siphon outlet and that there are no loops or bends in the drain tubing.

Affix the drain tubing to the inlet of the waste container, so that the end of the tubing never submerges into the liquid.

If the solvent you are using is not compatible with the drain tube, such as tetrahydrofuran (THF), use a piece of PTFE tubing or any material compatible with your solvent in its place. When using this type of tubing, which is generally more rigid, ensure that it is safely installed, so that it will not damage the nebulization chamber (glassware).

Connect the Nebulization Gas Supply

Use the short, 4 mm (OD) gas tubing supplied to connect the gas outlet on the front panel to the gas inlet fitting on the nebulizer.

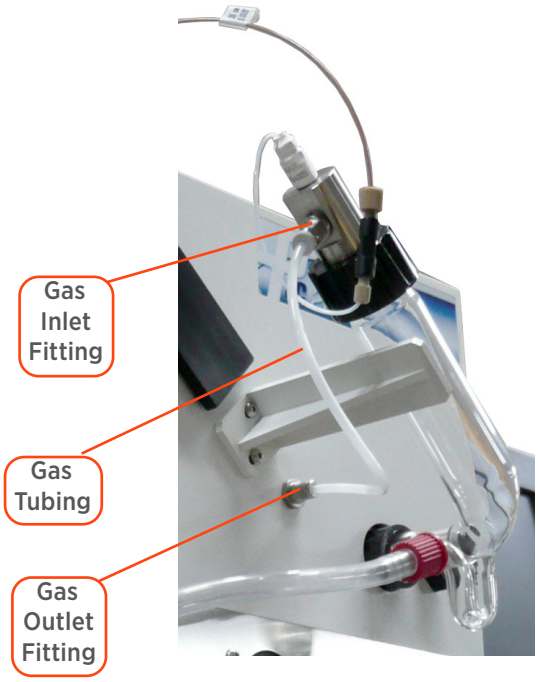


Figure 89
Nebulization Gas Supply Connections

Connect the Splitter Tubing

Since ELS detection is a destructive technique, the PLC Purification System includes a splitter to divert a fraction of the purification flow to the ELS detector while the remainder flows to the UV-VIS detector, and then on to the fraction collector.

Use the supplied, 1/16" (OD) PEEK tubing to connect the splitter outlet to the ELS detector nebulizer, taking care not to kink the tubing.

1. Screw the 1/16" (OD) PEEK fitting of the nebulizer inlet tubing to the black, 10-32 PEEK union on the splitter tubing until it is fingertight.
2. Unscrew the plug from the PEEK shut-off valve located on the top-left side of the system.
3. Screw the other end of the splitter tubing with PEEK fittings into the shut-off valve outlet until it is fingertight.

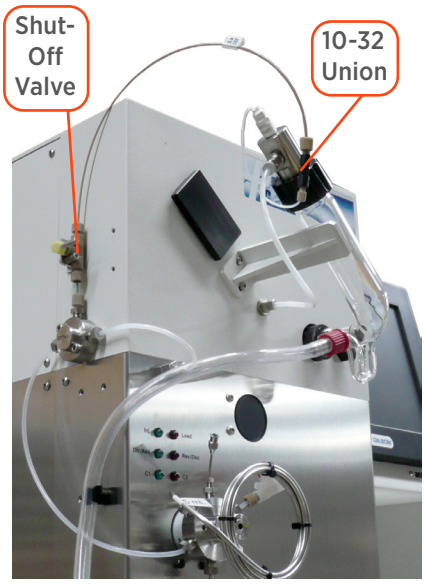


Figure 90
Splitter Tubing Connections

Install the Chamber Shield

The chamber shield encloses the nebulization chamber and is held in place by two black plastic holders in front. The chamber shield is designed to minimize glassware breakage and prevent tubing deterioration. Take care not to damage the splitter tubing, nebulizer, and nebulization chamber, and then slide the shield diagonally downward.

To install the chamber shield slide the chamber shield into the exposed notches of the two shield holders.

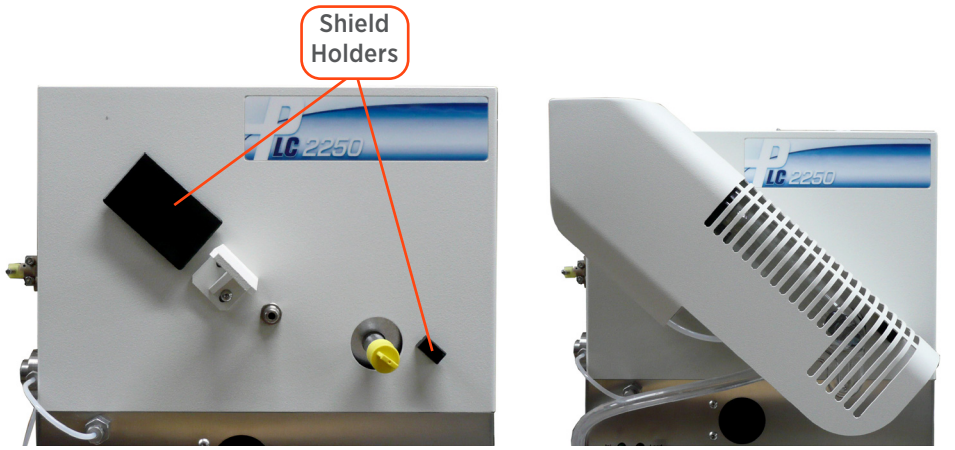


Figure 91
Installing the Chamber Shield

Operation

Start Up

Make all rear and front panel connections before start up.

To use the ELS detector:

1. Open the gas source.
2. Unlock the regulating device of the gas regulator by lifting it to be able to adjust the gas pressure supplied to the system.
3. Turn the regulating device clockwise (+) to set the gas pressure to 2 bar (29 psi) on the manometer.
4. Once the gas pressure is adjusted, lock the regulating device by pressing it.
5. Open the split way by switching the quarter-turn shut-off valve (small handle turned up), that allows to divert a minor fraction of the purification flow to the ELS detector.

6. Ensure that the overflow siphon for the nebulization chamber is filled with the mobile phase that will be used for the separation. If necessary, pump a few milliliters of solvent through the instrument to fill the siphon.

NOTICE	**Ensure that the waste container is directly below the siphon outlet and that there are no loops or bends in the drain tubing.** **Affix the drain tubing to the inlet of the waste container, so that the end of the tubing is never submerged in the liquid.** **Drain tubing that is bent or immersed in the waste container will create pressure fluctuations in the ELS detector and result in poor measurements.** **The liquid level in the siphon must be stable and should be equal at both sides. If the vacuum is too strong, liquid is drawn into the evaporation tube or generate air bubbles from the drain tube and both resulting in bad measurement results.**

7. Power on the PLC Purification System and wait for GLIDER to load.
   - If the PLC Purification System and the ELS detector are properly configured and communication is established, a second detector cell with two green dots appears on the software screen.
   - The ELS detector warms to reach the default temperature selected in the 'System Configuration' window of GLIDER.

Select the Optimum Temperature

There are two factors that should be taken into account when selecting the optimum temperature for the detector:

- Increasing temperature will optimize the evaporation of the mobile phase.
- Decreasing temperature will minimize the decomposition of thermally labile compounds and the volatilization of semi-volatile compounds.

A very reasonable start is to set the temperature to 60°C if an aqueous mobile phase is used and 40°C if an organic mobile phase is used (these temperatures are suggested for a flow rate of 1 mL/min). At higher flow rates, more elevated temperatures may be required to minimize the noise.

If the mobile phase used is not easily volatile, such as DMSO or DMF, temperature should be increased to allow correct evaporation process.

The temperature can be readily adjusted during the method optimization process.

If you suspect that the compound of interest is thermally labile or semi-volatile, a lower temperature could be used to improve the sensitivity by reducing the thermal decomposition or evaporation. For a given flow rate and solvent, there is, however, a point at which the noise in the chromatogram is dramatically increased because not all of the mobile phase is vaporized.

The minimum temperature that can be used is dependent on the flow rate and the nature of the mobile phase.

Pretreat the Sample

If the sample contains any particulate matter, it should be filtered through a 0.2 or 0.45 µm filter before injection.

Treat the Column

The chromatographic column typically contains microparticles which are used to separate the compounds of interest. Under certain conditions, the column packing will undergo chemical and/or mechanical breakdown, this may lead to the introduction of particulate matter into the detector, which may lead to an increase in the noise.

The breakdown of the column packing is dependent on a variety of factors including the particle size, type of column packing, the manufacturer of the column and the nature of the mobile phase (high pH may degrade silica based columns).

When you install a new column, we suggest to pump the mobile phase through it for few minutes before connecting it to the detector. This will flush out the microparticles that remained in the column after its manufacture.

Split Flow Rates and Ratios

The following table provides results of tests performed on a PLC 2250 Purification System (250 mL/min max.) using the 1/16" OD, 0.005" ID, 35 cm PEEK splitter tubing.

Split Flow Rates and Ratios with Acetonitrile (ACN)

Elution Flow Rate (mL/min)	Split Flow Rate in ELSD (mL/min)	Split Ratio (%)
5	0.08	1.62
10	0.29	2.87
20	0.70	3.51
50	1.58	3.15
75	2.04	2.72
100	2.36	2.36
150	3.14	2.09
250	4.77	1.91

Split Flow Rates and Ratios with 90% Water - 10% Acetonitrile (ACN)

Elution Flow Rate (mL/min)	Split Flow Rate in ELSD (mL/min)	Split Ratio (%)
5	0.12	2.32
10	0.24	2.44
20	0.47	2.33
50	0.80	1.60
75	1.01	1.34
100	1.21	1.21
150	1.61	1.07
250	2.35	0.94

Maintenance

The ELSD is designed to require a minimum of maintenance activities. If preventive maintenance activities are followed, the detector should provide high sensitivity measurements without any further intervention by the operator.

General Maintenance Recommendations

- Maintain the ELS detector in a clean laboratory environment.
- If the ELS detector will not be used for one hour, flush out any mobile phase that contains acids, bases, or salts to prevent foreign matter deposits on components or instrument corrosion.
- Only use clean, particle- and oil residue-free gas.

NOTICE

Closing the gas supply while the pump is still running may result in serious nebulizer damage.

If the ELS detector will not be used for one hour, close the shut-off valve on the splitter to avoid clogging the nebulizer or depositing foreign matter into the detector.

After each run and before shutting down the PLC Purification System, the ELS detector should be cleaned to ensure good performance. Follow the preventative maintenance steps below to clean the ELS detector after the final analysis:

1. Allow the mobile phase to continue flowing after analysis to flush any remaining particles from the detector. The mobile phase should not contain any additive or buffer.
2. Incrementally increase the temperature to dissolve any remaining deposits.
3. Stop the mobile phase flow, but allow the gas to flow for at least 30 minutes to prevent particle deposit.
   - If needed, stop the gas flow at the source.
   - If needed, shut down the system.

NOTE

The time required for each step depends on the application, so solvent type and sample concentration should be determined accordingly. Access the inside of the instrument is not required for routine operation. If the suggestions provided in this chapter do not remedy the problem, contact your local Gilson representative. Refer to Customer Service on page 32.

The LED has a long but finite lifetime (5000 hours) and should be replaced periodically by trained personnel. Decreasing light intensity from a failing LED will result in decreasing signal heights. Contact your local Gilson representative to replace the LED.

Troubleshooting

Considering that the operator has already determined that other components of the system are operating in an appropriate way, the following information can help to determine the cause of the problem.

NOTICE **Never disassemble the nebulizer. Disassembling the rear part of the nebulizer (at the level of the white engraved heat-shrinking tubing) will permanently damage it.**

1. Check to ensure that the liquid level in the siphon is appropriate, and there is no liquid pooling close to the evaporation tube inlet.
2. Check that the gas pressure is sufficient and stable. The selected pressure for most applications is 2 bar (29 psi) and gas consumption is 3 L/min. Pressure above 4.5 bar (67 psi) can damage the pressure sensor. The gas filter should be clean and in place. Only use gas free of particle and oil residue.
3. Ensure that the flow rate of the pump is constant and check that there are no leaks in the PLC system.
4. The mist from the nebulizer should be homogeneous. If it is not homogeneous, the nebulizer, the needle or the PTFE tube may be partially obstructed. To remove the obstruction, pump a solvent that can dissolve the foreign material. As an alternative, the nebulizer can be placed in an ultrasonic bath to dissolve the foreign material. Instructions about cleaning of the nebulizer are given on next page.
5. If the sensitivity of the detector is low, ensure that there are no leaks in the system. Make sure you are using a fresh sample and consider running the test using a backpressure loop instead of a column. Alternatively, the light source may need to be replaced or the nebulizer could be obstructed.
6. A decrease in the sensitivity is often caused by the nebulizer (main cause). Clean the nebulizer. If the sensitivity does not return to normal, the nebulizer might need to be replaced. Please note that the root cause might also be in different module, i.e. volumes injected by the autosampler might be too low or dead volumes in capillary connections may cause peak broadening.
7. If the detector signal is saturated or if there is a decrease in the dynamic range of the system, it is possible that a residue is passing through the detector cell. This will lead to an intense signal due to a significant amount of light-scattering. This residue may be a result of the elution of strongly retained materials from the column, or may come from the solvent. To determine the cause of the problem, bypass the column and observe the signal intensity.
   - If the signal returns to normal, strongly retained materials are eluting from the column. Flush the column with a strong solvent to elute all material.
   - If the signal does not return to normal, the solvent contains a too high residue material, after evaporation and is not suitable for use with the detector.
8. If the noise of the detector without solvent is high or if ghost peaks occur, it is possible that foreign material is present in the drift tube. In this situation, increase the temperature to 95°C and pump appropriate solvent at the rate of 2 mL/min, using a gas pressure of 2.0 bar (29 psi). The solvent will be determined by the nature of the samples that were previously analyzed with the detector. If you do not know the nature of the sample, ethanol is a good choice. Do not use solvents that can potentially corrode the instrument. Maintain the flow and temperature during three hours at least.

Clean the Nebulizer

With time, the nebulizer can get clogged by sample and mobile phase materials. A dirty or clogged nebulizer can cause increased baseline noise and decreased sensitivity. The following procedure can be used to clean the nebulizer.

The nebulizer is a consumable component. Nebulizer lifespan depends directly on the conditions of use and care. This section provides general directions for nebulizer maintenance, but if cleaning procedures are ineffective, consider a nebulizer replacement.

NOTICE

Handle the nebulizer carefully, and do not disassemble the rear component protected by a white, heat-shrinking tubing. Improper handling of the nebulizer will permanently damage it.

The nebulizer rear part results from a very tricky setting which must not be disassembled for any reason. If it has been removed or unscrewed, the only solution is to proceed to a nebulizer replacement.

Remove the Nebulizer

1. Switch off the PLC Purification System.
2. Disconnect the PLC Purification System from the mains.
3. Stop the flow of gas to the PLC Purification System.
4. Remove the chamber shield.
5. Disconnect the nebulizer liquid inlet from the splitter tubing.
6. Disconnect the gas inlet tubing from the nebulizer.
   - To remove the tube, apply manual pressure to the white push sleeve to disengage the grab ring, and then withdraw the tube from the fitting.
7. Hold the nebulizer with one hand, and then unscrew the black plastic nut to remove the nebulizer from the glass chamber with the other hand. Do not pull or twist the nebulizer capillary.
8. Remove the gas inlet fitting and the black plastic nut to avoid damaging the seals with the cleaning solvent.

Clean the Nebulizer

1. Fill an ultrasonic bath with water. Fill a beaker (50 or 100 mL) with approximately 2 cm of appropriate solvent. The solvent is dependent on the nature of the material that is present in the nebulizer. In most cases, ethanol is a satisfactory solvent.
2. Place the nebulizer vertically in the beaker. The nebulizer outlet should be placed at the bottom of the bath and the nebulizer inlet liquid tubing should be pointing up. Take care to ensure that the rear component of the nebulizer is not in contact with the solvent.
3. Clean the nebulizer for approximately 30 minutes.
4. Replace the solvent with water and clean for an additional 30 minutes.

Reinstall or Replace the Nebulizer

1. Reinstall the gas inlet fitting and the black plastic nut with seal.
2. Install the nebulizer in reverse order.
3. Install the chamber shield.
4. Test the nebulizer to ensure that it is working properly.

> ***NOTICE*** **Replace the nebulizer if the cleaning and preventative maintenance steps provided are ineffective.**

Decontaminate the Nebulizer

Set the evaporation temperature to 95°C and the gas pressure to 2 bar (29 psi). Pump the appropriate solvent through the system at the rate of 2 mL/min. The solvent will be determined by the nature of the samples that were previously analyzed with the detector. If you do not know the nature of the sample, ethanol is a good choice. Do not use solvents that can potentially corrode the instrument. Maintain the flow and temperature for a minimum of three hours.

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Original Instructions

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