



Operating Manual for PAL Dilutor

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Safety Information

Electrical Hazards

Every analytical instrument has specific hazards, so be sure to read and comply with the following precautions. They will help ensure the safe, long-term use of your PAL Dilutor.

Do not change the external or internal grounding connections. Tampering with or disconnecting these connections could endanger you and/or damage the PAL Dilutor.

The instrument is properly grounded in accordance with CE regulations when shipped. You do not need to make any changes to the electrical connections or the instrument's chassis to ensure safe operation.

Do not turn the instrument on if you suspect that it has incurred any kind of electrical damage. Instead disconnect the power cord and contact a CTC Analytics representative for a product evaluation. Do not attempt to use the instrument until it has been evaluated. Electrical damage may have occurred if the PAL Dilutor shows visible signs of damage, or has been transported under severe stress.

Damage can also result if the instrument is stored for prolonged periods under unfavorable conditions (e.g. subjected to heat, water, etc.).

Always disconnect the power cord before attempting any type of maintenance.

Capacitors inside the instrument may still be charged even if the instrument is turned off.

The instrument includes a number of integrated circuits. These circuits may be damaged if exposed to excessive line voltage fluctuations and/or power surges.

Never try to repair or replace any components of the instrument that is not described in this manual without the assistance of a CTC Analytics representative.



PAL Dilutor Operating Manual

PAL Dilutor Operating Instructions	3
List of Figures	4
How to use this manual	5
1. General System Overview	6
1.1 Specifications	7
1.2 Hardware requirements	7
1.3 Software requirements	7
2. Installation	8
2.1 Unpacking the Components	8
2.2 Assembling the PAL Dilutor	9
2.3 Installing the transfer tubing kit	11
2.4 Installing the Sideport Syringe	13
2.5 Installing the Sideport Syringe Adapter	14
2.6 Removing the Sideport Syringe Adapter	15
2.7 Connecting the solvent bottle tubing	16
2.8 Electrical Connections	17
3. Operation	18
3.1 PAL Dilutor Utility Functions	18
3.2 Cycle Composer Control	20
4. Maintenance	21
4.1 Maintaining the Dilutor Syringe	21
4.2 Maintaining the Sideport Syringe	22
4.3 Replacing the Transfer Tubing Kit	23
Appendices	24
A PAL Dilutor Spare Parts	24
B PAL Dilutor Options	25



List of Figures

Figure 1	PAL Dilutor General System Overview	6
Figure 2	PAL Dilutor Parts	8
Figure 3	Inserting the Dilutor Syringe	9
Figure 4	Attaching the Dilutor to the PAL X-axis	10
Figure 5	Attachment of Mounting Claws	10
Figure 6	Attaching the Transfer Tubing Kit to the Dilutor Module	11
Figure 7	Attaching the Transfer Tubing Kit to the Sideport Syringe Adapter	12
Figure 8	Installing the Sideport Syringe	13
Figure 9	Installing the Sideport Syringe Plunger Holder	14
Figure 10	Installing the Sideport Syringe Adapter	15
Figure 11	Connecting the Solvent Bottle Tubing	16
Figure 12	Electrical Connection	17
Figure 13	Menu Screen PAL Dilutor Utilities	18
Figure 14	Menu Screen Change Dilutor Syringe	21
Figure 15	Exchanging the Sideport Syringe	22
Figure 16	Removing the Transfer Tubing Kit at Dilutor Side	23
Figure 17	Removing the Transfer Tubing Kit at Sideport Syringe side	23



How to Use this Manual

The manual is divided into two sections

PAL Dilutor Operating Instructions

Appendices

The "PAL Dilutor Operating instructions" are intended for frequent PAL users or new users that are experienced in using automated systems to perform existing analytical methods.

note !

The HTS PAL or CombiPAL must be installed and set up properly before the PAL Dilutor Operating Instructions can be used.

The Appendices provide information about the PAL Dilutor Options and it's Spare Parts.



PAL Dilutor Operating Manual

1. General System Overview



Figure 1. PAL Dilutor General System Overview



1.1 Specifications

Article Number:	PAL Dilutor
Dilutor Syringe:	2.5ml (optional 1ml, 5ml and 10ml)
Volume Range:	0.25ml – 2.5ml
Flow Rate Range:	10 μ l/min – 300 μ l/min
Side Port Syringe:	80 μ l with removeable needle (optional 20 μ l)
Flow Rate Range:	1 μ l/min – 200 μ l/min
Transfer tubing kit:	2 pcs. PTFE tubes ID 0.787mm / OD 1.58mm , 620 μ l including connection fittings and guiding wire
Solvent reservoir:	1000ml borosilicate glass including 10 μ m PEEK solvent filter
Control:	Via Cycle Composer Software Vers. 1.4 or higher
PAL Firmware:	Version 2.3 or higher
Piston/Valve Drive:	Stepper motor with independently operated solenoid valve
Wetted parts:	All liquids compatible with borosilicate glass, PTFE, Kel-F, FEP
Dimensions: (Dilutor module)	Width 47 mm Depth 67 mm Length 217 mm
Weight:	980 g

1.2 Hardware requirements

The PAL dilutor option can be used with any HTS PAL or CombiPAL equipped with a side slitted Injection unit. 1 AUX port must be available for Dilutor control.

1.3 Software requirements

The PAL dilutor option can be operated with PAL firmware 2.3 or higher and Cycle Composer software 1.4 or higher. It can not be used on standalone PAL instruments without Cycle Composer software.



2. Installation

2.1 Unpacking the Components

The PAL dilutor option is shipped in one single box. Check for the completeness for following items:

1. Dilutor module
2. PTFE Dilutor Syringe Washer (2pcs.)
3. Dilutor Syringe
4. Dilutor Syringe Screw
5. Sideport Syringe Plunger
6. Plunger Sealing Screw
7. Perfluor O-Ring
8. Sideport Syringe with removeable Needle
9. Sideport Syringe Plunger Holder
10. Sideport Syringe Adapter
11. Solvent bottle transfer line including PEEK solvent filter 10 μ m
12. Solvent bottle with cap
13. Transfer tubing kit
14. Dilutor module connection cable

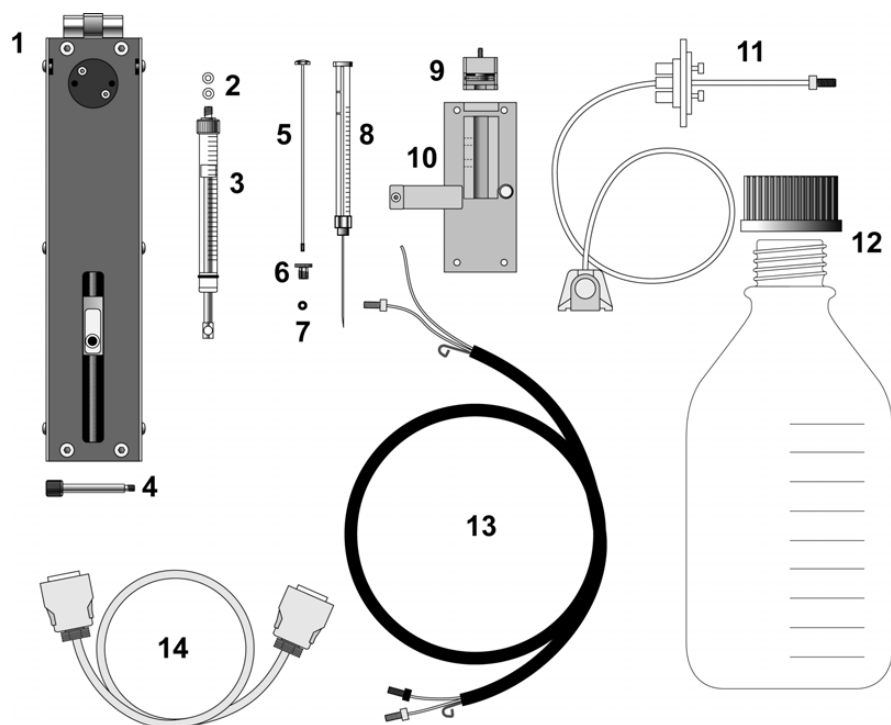


Figure. 2 PAL Dilutor parts



2.2 Assembling the PAL Dilutor

Before beginning the assembling process, determine approximately where the PAL dilutor should be placed. It must be positioned near the left end of the PAL X- axis.

- 1 Before attaching the dilutor module unit to the PAL X-axis, turn it upside down and insert one PTFE washer into the lower dilutor solenoid valve port.
- 2 Carefully screw the dilutor syringe into the lower solenoid valve port and tighten it firmly.
- 3 Insert the dilutor syringe screw into the syringe barrel hole, and screw it into the dilutor plunger holder.

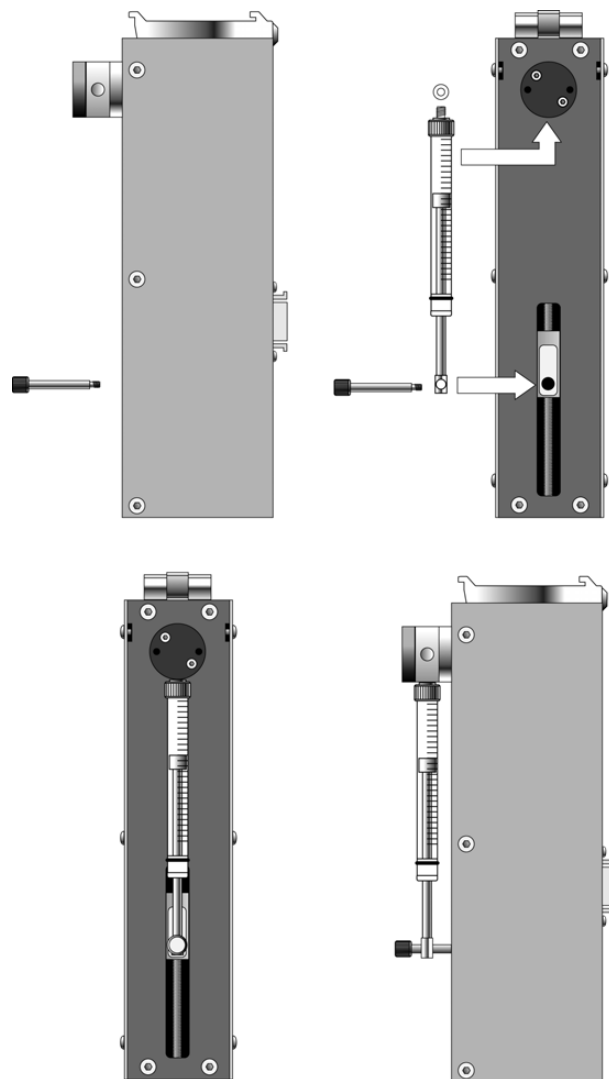


Figure 3 Inserting the dilutor syringe

- 4 Install the PAL dilutor module with the mounting clamp teeth fitting into the grooves on the bottom of the X-axis. The dilutor must be mounted at the left end of the PAL X-axis. Be sure that the clamp fits completely into the grooves. Tighten the Torx screw until the mounting clamp is firmly in place.

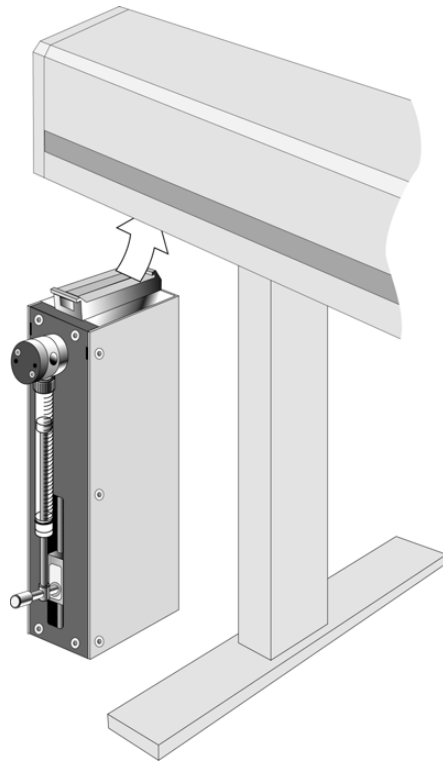


Figure 4 Attaching the Dilutor to the PAL X-axis

- 5 Double check if the PAL dilutor mounting clamp is correctly attached to the PAL X-axis (see Figure 5, page 10)

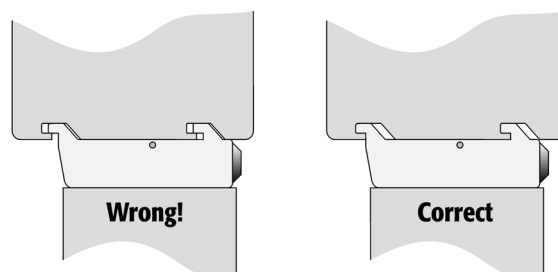


Figure 5 Attaching PAL objects to the PAL X-axis

2.3 Installing the transfer tubing kit

- 1 Unscrew the left top dilutor cover Torx screw.
- 2 Locate the transfer tubing kit end with 1 connection fitting.
- 3 Insert the transfer tubing guiding wire into the left cover slit.
- 4 Adjust the guiding wire in a 90° angle to the dilutor cover and tighten the cover Torx screw back again firmly.
- 5 Connect the white connection fitting to the **left** hand port of the dilutor solenoid valve.

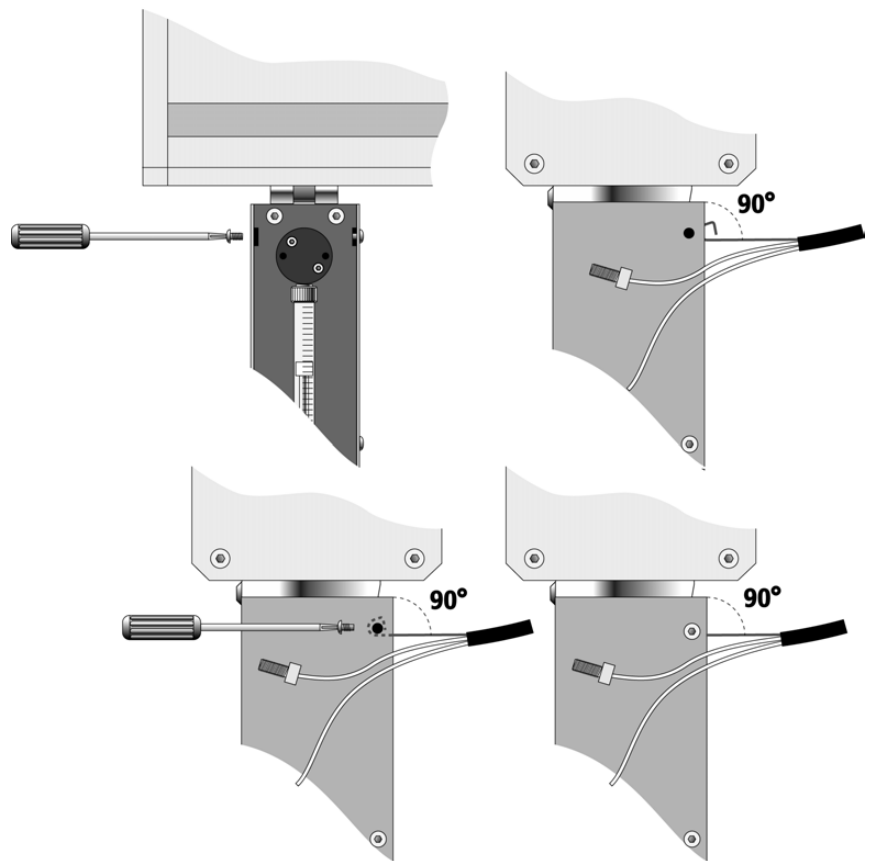


Figure 6 Attaching the transfer tubing kit to the dilutor module



- 5 Open the Torx screw at the guiding bracket of the sideport syringe adapter.
- 6 Locate the transfer tubing kit end with 2 connection fittings
- 7 Insert the transfer tubing guiding wire into the guiding bracket slit.
- 8 Adjust the guiding wire in a 90° angle to the bracket and tighten the Torx screw firmly.

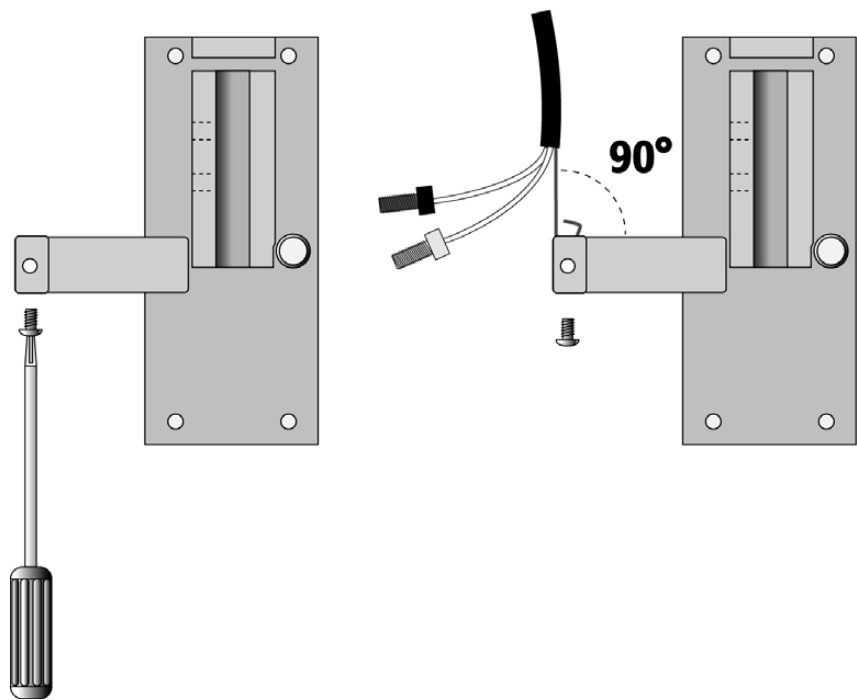


Figure 7 Attaching the transfer tubing kit to the Sideport Syringe Adapter

2.4 Installing the Sideport Syringe

- 1 Insert the sideport syringe without plunger into the syringe adapter. Make sure the syringe side holes are adjusted to the left side.
- 2 Locate the black connection fitting and screw it into the upper connection thread.
- 3 Locate the white connection fitting and screw it into the lower connection thread
- 4 Put the plunger sealing screw over the syringe plunger.
- 5 Put the black Perfluor O-ring over the syringe plunger.
- 6 Insert the plunger into the sideport syringe and carefully screw the plunger sealing screw into the syringe adapter bracket.

note !

Do not overtighten the plunger sealing screw. Check the plunger friction by manually moving the plunger up and down. Loosen the plunger sealing screw if too much friction is applied.

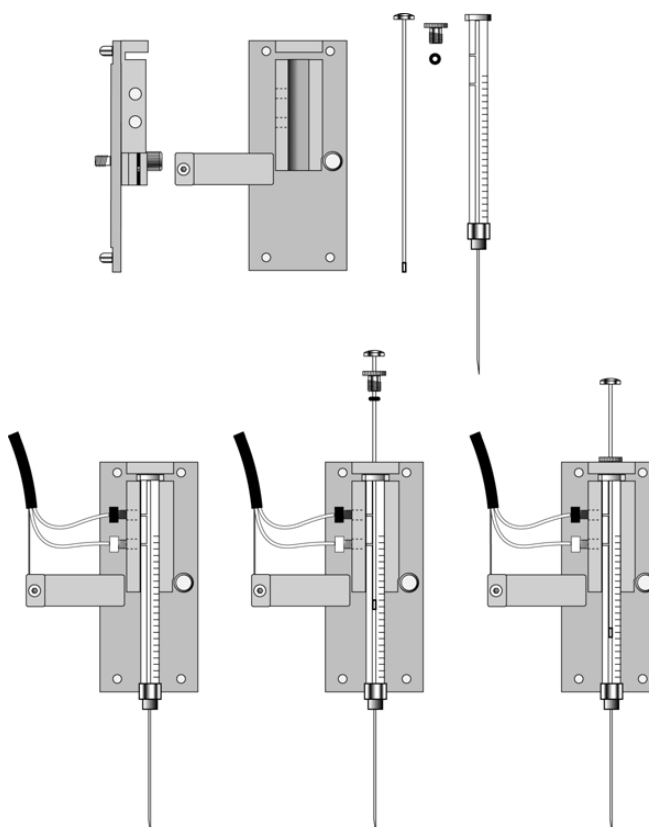


Figure 8 Installing the Sideport Syringe

2.5 Installing the Sideport Syringe Adapter

- 1 Make sure the tubing kit connection fittings and it's guiding wire are attached properly to the sideport syringe adapter. Also the syringe plunger must be inserted in the sideport syringe.
- 2 Turn **OFF** the PAL power supply
- 3 Screw on the sideport syringe plunger holder into the black Injection unit slider.

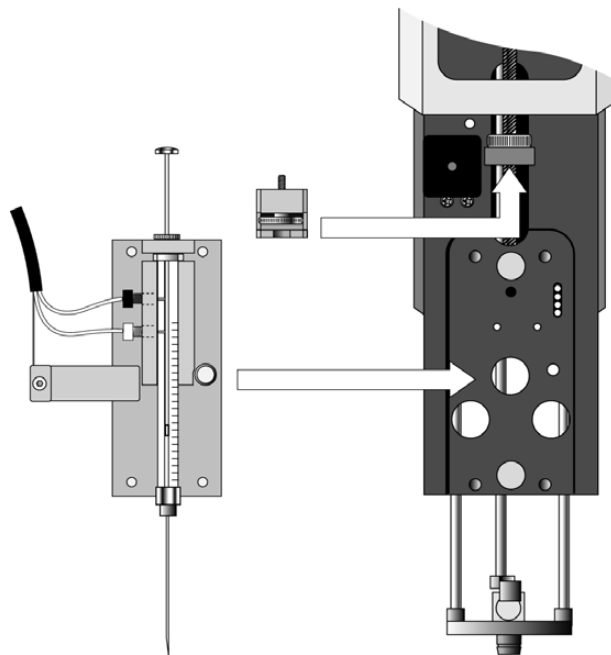


Figure 9 Installing the Sideport Syringe plunger holder

- 4 Place the syringe in the appropriate syringe adapter (see 2.4 Installing the Sideport syringe, page 13). Pull out the plunger to approximately 20% of it's length.
- 5 If necessary, loosen the plunger retaining screw in the plunger holder

- 6 Move the syringe, installed in the syringe adapter, partially into the Injection Unit. Guide the needle first into the upper needle guide and then into the lower needle guide.
- 7 Guide the syringe adapter side bracket through the left hand Injection unit slit
- 5 Place the plunger button into the plunger holder. Allow the syringe adapter to "dick" into place by magnetic force, against the syringe carrier.
- 6 Tighten the plunger retaining screw against the plunger button.
- 7 Tighten the sideport syringe adapter screw against the the black Injection unit slider

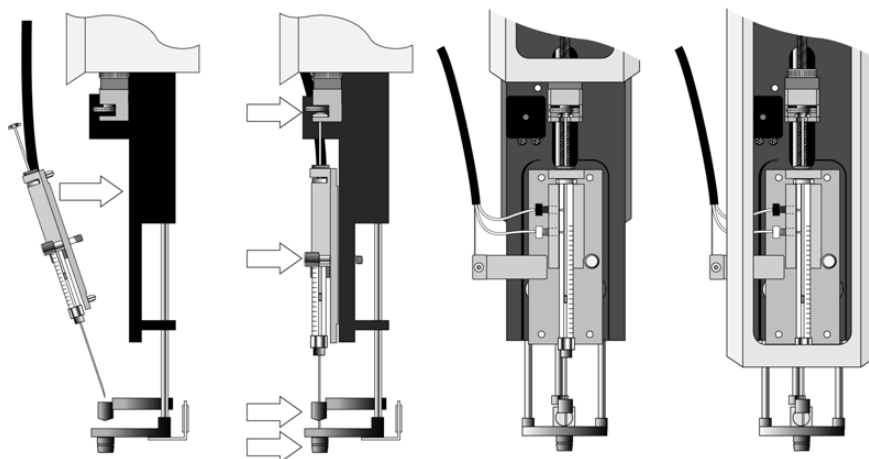


Figure 10 Installing the Sideport Syringe Adapter

- 8 Turn **ON** the PAL power supply. During the syringe initialization process, the plunger moves down until it hits the mechanical stop. This position is stored as the syringes zero volume position

note !

After replacing a sideport syringe in a HTS PAL System, always check the needle penetration in the LC valve (see HTS PAL manual, chapter 9.3, page 36, Injection Valve Needle Penetration)

2.6 Removing the Sideport Syringe Adapter

Repeat steps 1 – 8 in chapter 2.4 in reverse order

2.7 Connecting the solvent bottle tubing

- 1 Attach the PEEK solvent filter to the solvent transfer line and insert the filter into the solvent bottle.
- 2 Connect the other end of the solvent line to the **right** hand port of the dilutor solenoid valve.
- 3 Fill up the solvent bottle with solvent
- 4 Close the solvent bottle with the supplied blue cap.
- 5 Adjust the solvent filter close to the solvent bottle bottom.

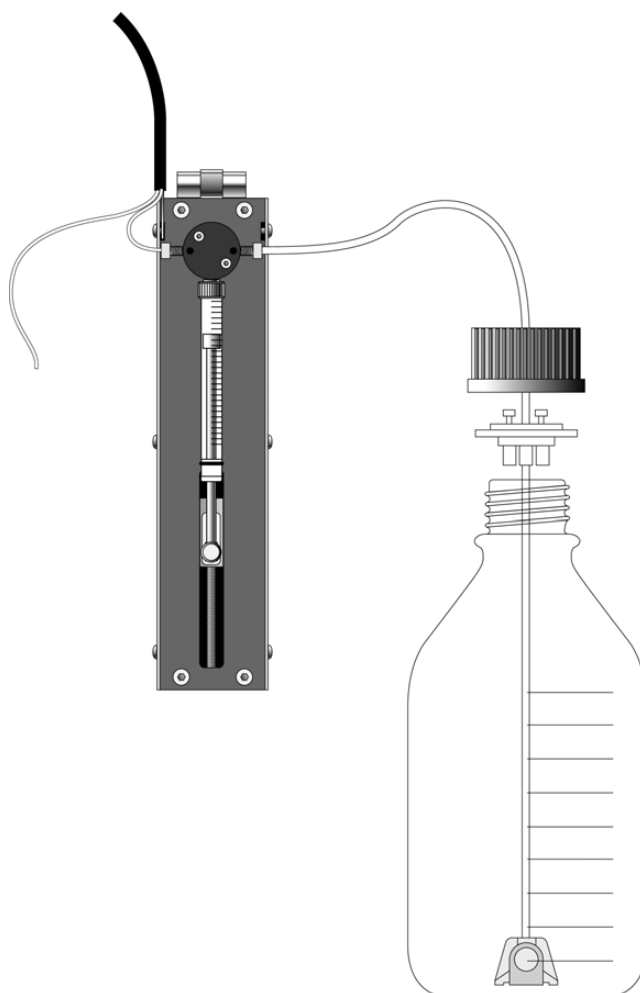


Figure 11 Connecting the solvent bottle tubing

2.8 Electrical connection

note !

Always switch OFF the PAL power supply before connecting or disconnecting the PAL dilutor option or any other PAL accessory cable!

Before operating the PAL dilutor, make sure it is correctly connected to the **AUX 2** connector at the PAL X-axis rear side (see Figure 12).

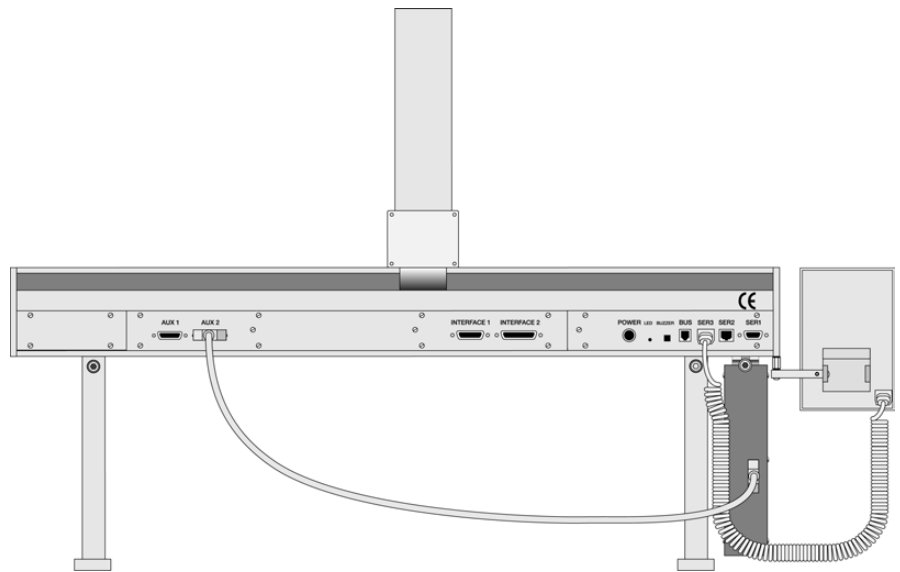


Figure 12 Electrical connection



3. Operation

3.1 PAL Dilutor Utility Functions

The Dilutor Utility functions, selectable from the **Menu** screen, provide quick access to dilutor parameters that may need to be changed (e.g. prime function or syringe plunger speeds).

note ! The PAL Dilutor must be installed and set up properly before the Utility Functions can be used.

Complete the following steps to get access to the PAL dilutor utility functions:

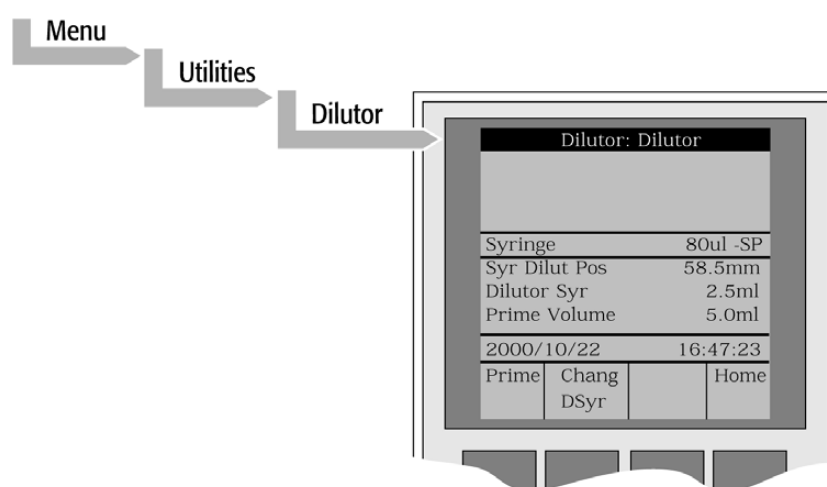


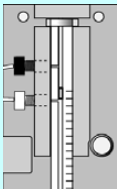
Figure 13 Menu Screen PAL Dilutor Utilities

By pressing a Function Key the following functions are available:

Function Key	Description
F1 Prime	This Function is used to prime the solvent lines between the solvent bottle and the dilutor syringe and the transfer line between the dilutor syringe and the sideport syringe. After selecting " F1Prime " the dilutor syringe aspirates the volume defined in Prime Volume and ejects the solvent to the selected Waste position. It may be that several plunger strokes are needed depending on dilutor syringe size and Prime Volume. The Function is used prior first time use or after every solvent or syringe change.
F2 Change DSyr	The dilutor syringe plunger is moved to a position where the syringe can be removed from the dilutor module (see page 9 "assembling the PAL dilutor"). A prompt will be displayed to specify the new dilutor syringe. The syringe must be installed before pressing Enter .
F3	Not used
F4 Home	The dilutor syringe moves to it's Zero position and the Job Queue Menu is displayed.



The following syringe parameters may be changed by selecting the particular item:

Item	Description
Syringe	Indicates the type of sideport syringe currently used together with the dilutor module.
Syr Dilut Pos	This parameter serves to define the dilute position of the sideport syringe plunger. The position should be adjusted exactly above the lower hole of the sideport syringe. It must be verified after every sideport syringe change. 
Dilutor Syr	Indicates the type (size) of dilutor syringe currently used.
Prime Volume	The volume used to prime the solvent lines between the solvent bottle and the dilutor syringe and the transfer line between the dilutor syringe and the sideport syringe (see page 18, "F1Prime").
Pullup Del	Using this item a delay time between solvent pullup and ejection while filling the dilutor syringe can be selected. This feature is especially useful for handling viscous solvents.
Fill Speed	Speed of dilutor syringe plunger movement used in all syringe filling operations.
Eject Speed	Speed of dilutor syringe plunger movement used in all syringe eject operations.
Eject Delay	Using this item a delay time between solvent eject and next solvent pullup of the dilutor syringe can be selected. This feature is especially useful for handling viscous solvents.



3.2 Cycle Composer Control

note !

To operate the PAL Dilutor via Cycle Composer software, it is assumed that the user is familiar with the PAL Cycle Composer control software.

The PAL dilutor can only be used together with the PAL control software Cycle Composer only. Make sure the hard- and software requirements meet with your installation, before operating the dilutor.

(see page 7, 1.2 Hardware requirements / 1.3 Software requirements)

Every PAL dilutor is shipped with a floppy disk containing 3 different dilutor application examples (see table below). These examples may be used to get familiar with the dilutor and might be a good starting point to develop your own applications. Copy these examples to your Cycle Composer method folder using the File Import option of the Cycle Composer.

Method	Method Description	Macro used	Macro Description
Serial Dilute 200ul to 96 vials	Dilute 200ul to a range of samples starting with index set in sample list	Serial Dilute to Tray	Dilute a selectable volume to a sequence of samples. The first sample is specified in the sample list.
Add 50ul Reagent, Dilute with 200ul and Inject	Add reagent to sample and immediately dilute with solvent. Aspirate sample with mixing strokes and inject into valve. Clean syringe and valve inlet by flushing with dilutor.	Add Reagent and Dilute	Put reagent to the vial selected in sample list and add solvent with the dilutor
Inject and Flush Valve with Dilutor	Load sample into syringe, inject to valve and immediately flush syringe and valve with dilutor.	Flush Injector	Flush an injection valve with the dilutor using a selectable volume up to 10ml



4. Maintenance

4.1 Maintaining the Dilutor Syringe

To maintain the dilutor syringe you can:

- Inspect the syringe plunger seal
- Replace the syringe plunger
- Replace the syringe

The dilutor syringe plunger requires periodic replacement. The frequency depends on the duty cycles, the type of solvents being run through the syringe and the size of the syringe. Replace the syringe plunger if it is leaking or damaged. To either inspect or replace the dilutor syringe plunger seal complete the following steps to get access to the dilutor syringe change utility function:

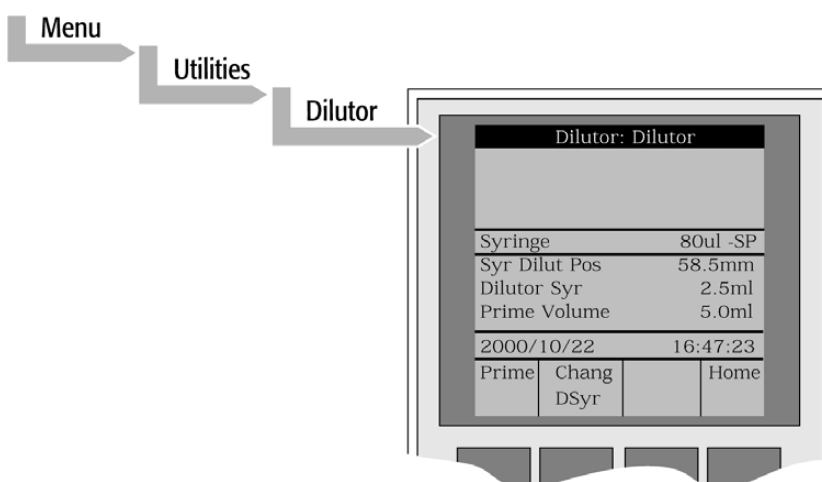


Figure 14 Menu screen Change Dilutor Syringe

- 1 Press F2 "Change DSyr". The dilutor syringe plunger moves to a mid position of the plunger drive.
- 2 Remove the dilutor syringe screw.
- 3 Unscrew the dilutor syringe from the dilutor solenoid valve.
- 4 Inspect or replace the plunger / syringe.
- 5 Carefully screw the dilutor syringe into the lower solenoid valve port again and tighten it firmly.

note !

**Make sure a PTFE dilutor syringe washer is inserted ! (see Figure 3 page 9)
Do not insert a second washer !**

- 6 Rotate the syringe barrel and insert the dilutor syringe screw into the syringe button hole, and screw it into the dilutor drive pin

4.2 Maintaining the Sideport Syringe

To maintain the sideport syringe you can:

- Inspect the syringe plunger seal
- Replace the syringe plunger
- Replace the removeable syringe needle
- Replace the syringe

The sideport syringe plunger requires periodic replacement. The frequency depends on the duty cycles, the type of solvents being run through the syringe and the size of the syringe. Replace the syringe plunger if it is leaking or damaged. To either inspect or replace the sideport syringe plunger, the syringe or the removeable syringe needle complete the following steps:

- 1 Turn **OFF** the PAL power supply
- 2 Move the PAL Injection unit to a clear position within the working space
- 3 Loosen the plunger holder retaining screw **1**
- 4 Unscrew the sideport syringe adapter screw **5** and remove the sideport syringe assembly from the Injection unit.
- 5 Loosen the two transfer tubing connection fittings **2** but do not remove them completely.
- 6 Loosen the plunger sealing screw **3** and lift it up **4** (make sure the black Perfluor O-ring remains in the plunger sealing screw)

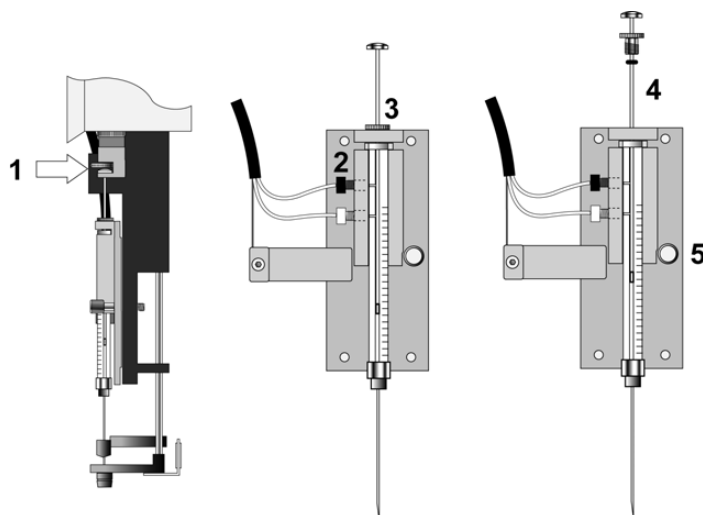


Figure 15 Exchanging the Sideport Syringe

- 7 Inspect the sideport syringe plunger and / or the removeable needle and replace it if necessary.

To install the sideport syringe again, repeat steps 1–7

4.3 Replacing the transfer tubing kit



- 1 Unscrew the white connection fitting at the left hand port of the dilutor solenoid valve.
- 2 Unscrew the left top dilutor cover Torx screw and remove the guiding wire.

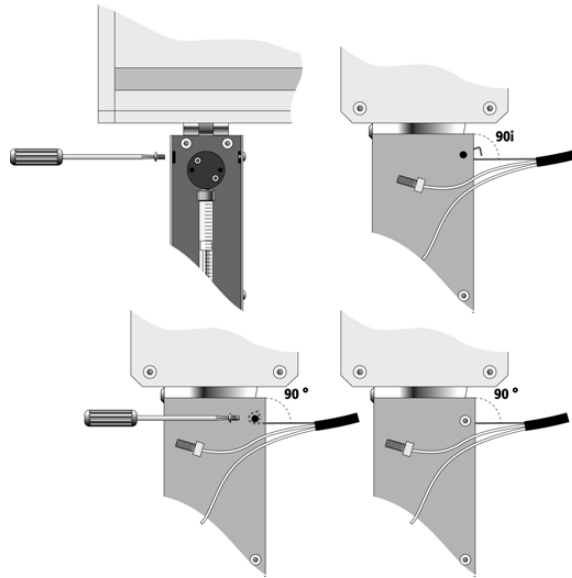


Figure 16 Removing the transfer tubing kit at dilutor side

- 3 Unscrew the two connection fittings at the guiding bracket of the sideport syringe adapter
- 4 Open the Torx screw at the guiding bracket of the sideport syringe adapter.
- 5 Remove the transfer tubing kit

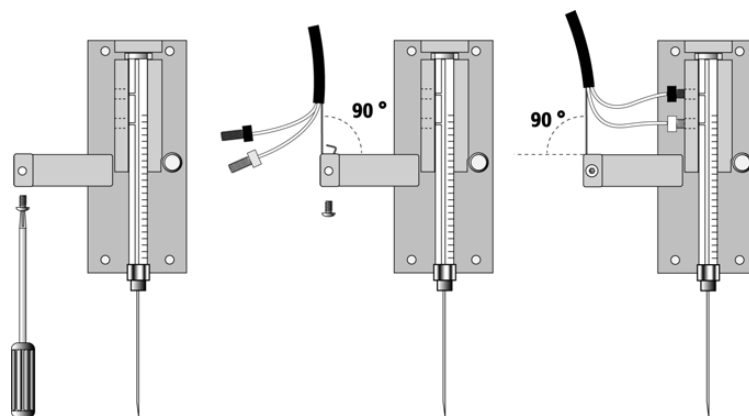


Figure 17 Removing the transfer tubing kit at sideport syringe side

To reinstall the transfer tubing kit repeat steps 1 – 5



Appendices



A. PAL Dilutor Spare Parts

Part no	Item	Description
PLG Dil1.0	Replacement Dilutor Syringe plunger 1ml	
PLG Dil2.5	Replacement Dilutor Syringe plunger 2.5ml	
PLG Dil5.0	Replacement Dilutor Syringe plunger 5ml	
PLG Dil10	Replacement Dilutor Syringe plunger 10ml	
PLG G100	10 pcs. Replacement syringe plunger for 80µl Sideport syringe	
PLG G25	10 pcs. Replacement syringe plunger for 25µl Sideport syringe	
NDL S-22-3	3 pcs. Replacement needles gauge 22 pointstyle 3 for Sideport syringe	
NDL S-22S-3	3 pcs. Replacement needles gauge 22S pointstyle 3 for Sideport syringe	
MM 30-36	Dilutor syringe screw	
DilWasher	1 pc PTFE Dilutor washer	
ORing 1.0x2.0 GA-65	1 pc Perfluor O-Ring	
MSU 30-14	1 pc Sideport syringe screw	
PAL TubeDilutor	Transfer tubing kit	
PAL DilAspKit	FEP Solvent line incl. PEEK solvent filter 10µm	
1000-SV	Dilutor Solvent bottle 1000ml	
Cbl RS20R-760	Cable 20p shielded, MiniRibbon connectors, 760mm long	



B.

PAL Dilutor Options

Part no	Item	Description
SYRC DIL1.0	PAL Dilutor Syringe 1ml	 © ©
SYRC DIL2.5	PAL Dilutor Syringe 2.5ml	
SYRC DIL5.0	PAL Dilutor Syringe 5ml	
SYRC DIL10	PAL Dilutor Syringe 10ml	
SYRC SP80-R22-3	Sideport Syringe 80µl gastight without needle	
SYRC SP20-R22S-3	Sideport Syringe 20µl gastight without needle	