Printing History

Edition 1 October 2003 Software Version 2.5.0

The PAL System may be operated with another level of firmware. Details of the current level are given with the leaflet "Firmware Overview" which is placed in the front of this binder.

Safety Information

Declaration of Conformity

See Declaration of Conformity sheet enclosed with the instrument

General Considerations

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The user shall be made aware that if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment my be impaired.

When you use the PAL System, follow the generally accepted procedures for quality control and methods development.

When you use the PAL System in the field of chromatographic analysis and you observe a change in the retention of a particular compound, in the resolution between two compounds, or in peak shape, immediately determine the reason for the changes. Until you determine the cause of a change, do not rely on the separation results.

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 System.

The Installation Category (Over voltage Category) for this instrument is Level II.
The Level II Category pertains to equipment that receives its electrical power from the local level, such as an electrical wall outlet.

Only use fuses of the type and current rating specified. Do not use repaired fuses and do not short-circuit the fuse holder.

The supplied power cord must be inserted into a power outlet with a protective earth contact (ground). When using an extension cord, make sure that the cord also has an earth contact.

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

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

The combination of a PAL System with a LC/MS System does require the safety measure as described by the LC/MS System manufacturer. Detailed instructions for the safety grounding on the LC/MS system are outlined in the corresponding operating/installation manual.
CTC Analytics recommends to use a grounding cable connected on one side at the Injection Valve, Loop or any other suitable direct metallic contact and the other side at an appropriate grounding point at the LC/MS System. This supplementary grounding measure will support the safety strategy of the LC/MS System manufacturer.

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 System shows visible signs of damage, exposure to any liquids 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.).

In any case disconnect the power cord(s) from the power supply or from the different power supplies if optional devices are installed before attempting any type of maintenance.

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

To avoid damaging electrical parts, do not disconnect an electrical assembly while power is applied to the PAL system. Once the power is turned off, wait approximately 30 seconds before you disconnect an assembly.

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.

There are no operator-serviceable or replaceable parts inside the power supply(ies) or in the PAL System. If a power supply is not functioning, contact a CTC Analytics representative.

The power supply for the PAL Instrument has the symbols **I/0** on the label for the power switch to switch ON/OFF.

I = Power ON **0** = Power OFF

If the basic PAL System is installed, than a single power supply is installed only. Turning OFF the power supply or pulling this single power cord in an emergency case will stop the complete PAL System.

It is important that the power supply (ies) are in a location where the power ON and OFF switch is accessible and easy to operate, and where it is possible to unplug the AC power cord from the power supply/wall outlet in case of emergency.

Other Hazards

To avoid injury during PAL System operation, keep your hands away from the syringe.

Do not operate the PAL System without the safety shield. The safety shield must be installed for safe operation.

To avoid injury, observe safe laboratory practice when you handle solvents, change tubing, or operate the PAL System. Know the physical and chemical properties of the solvents you use. See the Material Safety Sheets from the manufacturer for the solvents in use.

Use caution when working with any polymer tubing under pressure:

- Always wear eye protection when near pressurized polymer tubing.
- Do not use polymer tubing that has been severely stressed or kinked.
- Do not use polymer tubing, in particular not PEEK or Tefzel tubing, with Tetrahydrofuran (THF), Dimethylsulfoxid (DMSO), chlorinated organic solvents, concentrated mineral acids, such as Nitric, Phosphoric or Sulfuric acids, or any related compounds to above listings.

Lithium battery

An onboard lithium battery buffers the electronic memories, when the instrument is turned off. Replace it only with the same or equivalent type recommended by the equipment manufacturer.
Battery: Panasonic VL 2330, soldered directly on the electronic board.
Discharged lithium batteries shall be disposed off locally according to national waste disposal regulations for batteries.

There are no operator-serviceable parts on the electronic boards.
If an electronic board fails, contact a CTC Analytics representative.

Commonly Used Symbols

	Caution or refer to User Manual
	Caution, Risk of Needle-Stick Puncture
	Caution, Hot Surface or High Temperature
	Direct Current
	Alternating Current
	Protective Conductor Terminal, Ground
	Fuse
1	Electrical Power ON. Used with Main PAL Power Supply.
0	Electrical Power OFF. Used with Main PAL Power Supply.
	Electrical Power ON for Only Part of the System. Used with Optional Device(s)
	Electrical Power OFF for Only Part of the System. Used with Optional Device(s)
	Caution, Risk of Electrical shock (high voltage)

HTS PAL Operating Manual

General Information

List of Figures

How to Use this Manual

The manual is divided into three major sections

IFC PAL Operating Instructions Section A

IFC PAL Description and Installation Section B

Appendices

The "IFC PAL Operating instructions" in Section A are intended for infrequent PAL users or new users that are experienced in using automated systems to perform existing analytical methods.

note !

The IFC PAL must be installed and set up properly before the Operating Instructions in Section A can be used.

Users who are installing a IFC PAL system, IFC PAL accessories or who need to make adjustments to an installed system should consult "IFC PAL Description and Installation" in Section B.

The Appendices provide useful information such as the Software Flow Chart, Definition of Terms or the IFC PAL Accessories guide.

A. IFC PAL Operating Instructions

The IFC PAL has to operated by a dedicated software, example IFC PAL Software provided by CTC Analytics . The IFC PAL can also be integrated in other manufacturer software.
The IFC PAL can not be operated as a standalone unit.

All functions shown and explained in this Chapter A, “IFC Operating Instructions” have to be considered as an instruction to install, trouble shoot or how to change a syringe as an example.

The general functions of the Control Terminal are exactly the same as described for other PAL Systems.
If the customer wishes to use the Injector side of the IFC PAL system to inject an analytical samples, than all functions like the Method, Job or Job Queue are relevant.

1. Using the Control Terminal

The following procedures present the key steps required to set up and process multiple groups of samples with the IFC PAL. It is intended to provide an overview for new users and a reminder for infrequent users. The IFC PAL and all accessories should be installed and Objects defined correctly. A Syringe of the type called for in any Method to be used should also be installed.

Figure 1 illustrates the PAL Control Terminal and the conventions used to enter, edit, and view information.

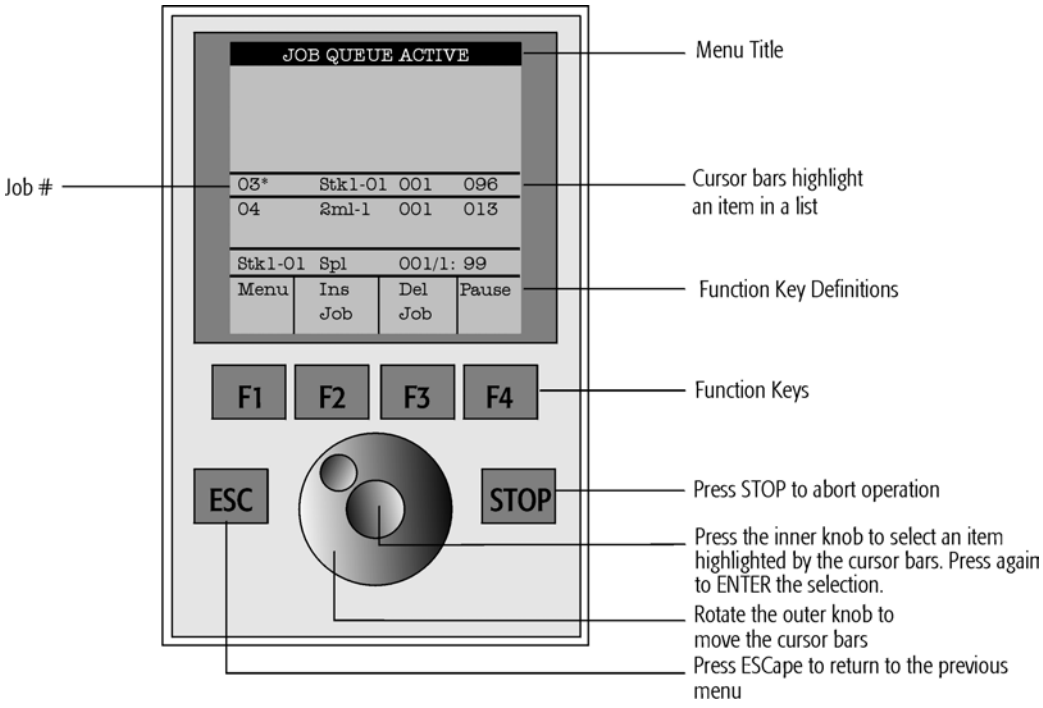


Figure 1. PAL Control Terminal and Conventions

1.1. Menu Screens

Different menu screens are displayed depending on the HTS PAL operating state and the particular function being accessed by the operator. All menu screens have the same basic format. The menu title is displayed at the top of the screen. A list of items is displayed below the title. The date and time or a status is shown in the highlighted area above the Function key labels on the bottom of the screen.

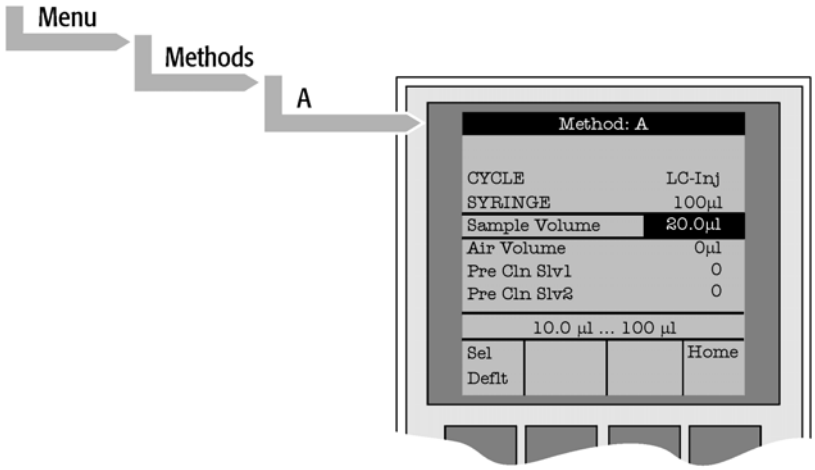


Figure 2. Accessing a Method Screen

1.2 Function Keys

Options for a particular menu are assigned to the corresponding function keys **(F1, F2, F3** and **F4)** directly below each function key label.

Pressing the function key defined as **Home** will always return to the Job Queue menu.

1.3 ESCape and STOP Keys

Press the **ESC**ape key to return to the previous menu. Press the **STOP** key to abort the current Cycle, Job, or Job Queue.

1.4 Scroll Knob and ENTER Button

Rotate the outer knob to scroll through items in a menu list. To select a highlighted item press the central knob (ENTER button). Then use the outer knob to scroll through available options for that item or to change a numeric value. Then press the inner knob again to **ENTER** the displayed option. The inner knob is also used for other operations that require an **ENTER** operation to continue or complete an operation.

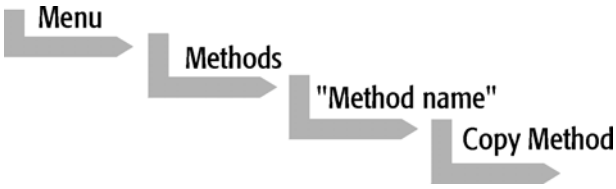
2. Methods

2.1 Creating Methods

Methods can be defined by the user and assigned names up to eight characters in length. Methods can be created, copied, edited, and viewed from the Method menu. Methods can be viewed but not edited from the Job menu.

Methods are created by either copying an existing Method or creating a new Method.

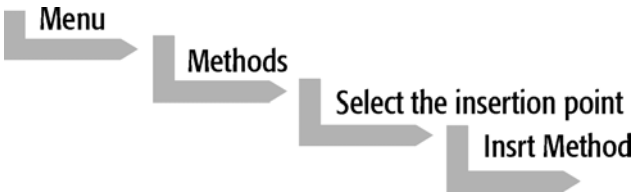
1 To copy a Method, complete the following sequence:



2 You will be prompted to enter a name for the new Method.

Use the scroll knob and the left-right arrow function keys (**F2** and **F3**) to select among alphanumeric characters and spaces. Press the **ENTER** function key (**F4**) to accept the name.

1 To create a new Method, complete the following steps:



2 Assign and enter a new Method name as above.

After a copy of the Method has been created, the Method parameters will be displayed and can be edited. The Cycle and Syringe entries cannot be changed.

3 If the Method is new (i.e. added), select and enter a Cycle that is appropriate for the application.

4 Select the specific Syringe to be used by the Method.

note ! **Once a Method has been created and saved, the Cycle and Syringe can not be changed. To use a different Cycle or Syringe, a new Method must be created.**

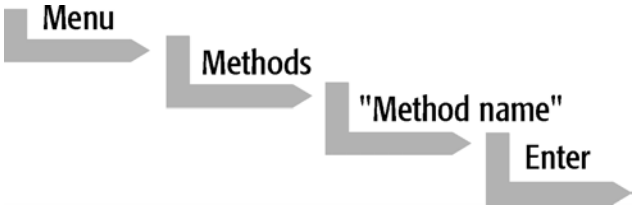
5 Assign Parameter values according to the application requirements. Consult Appendix D "HTS PAL LC-Inj Cycle Parameter" for details of the specific items.

note ! The IFC can be used to inject an analytical sample, no fraction collector mode. Therefore the “HTS PAL Cycle” has to be used.

2.2 Edit / View Methods

Method parameters (excluding Cycle and Syringe) can be viewed and changed from the Method menu as follows:

1



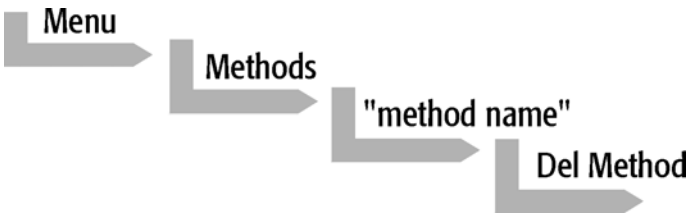
2 Scroll to and select the Parameter to be changed. Assign the new value and press the **ENTER** key.

3 Exit from Parameter List by pressing either the **Home** function key (**F4**) to return to the top-level Job Queue menu or the **ESC**ape key to return to the previous menu.

4 Method contents may be viewed from the Job Queue displays by selecting the desired Job, pressing **ENTER**, and the View Method function key.

2.3 Delete Methods

Methods can be deleted from the Method menu. Methods in use by an active Job cannot be deleted. Complete the following menu selections to delete a Method.



3. Job and Job Queue

3.1. Building and Starting a Job Queue

1 Power up the IFC PAL. The JOB QUEUE screen is displayed.

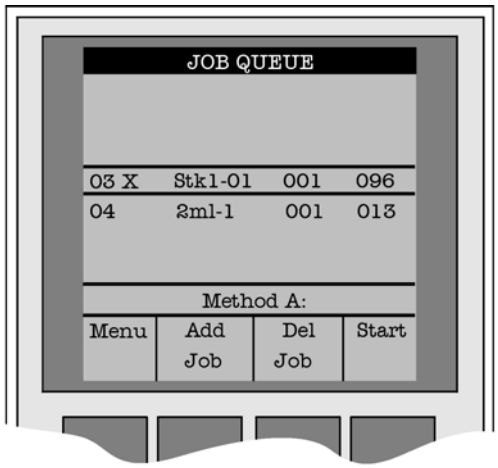


Figure 3. Example Job Queue Screen

2 Load a sample Tray onto an available location in a Tray Holder or Stack. Note the corresponding Tray name.

3 Add a new Job for the Tray. Press the **Add Job** key to bring up the default Job.

4 For **TRAY** select the Tray Name (e.g. Stk1-01) that corresponds to the location of the Tray that was just loaded.

5 Enter the **First** and **Last** sample number for this Job.

6 Select and enter the sample processing **Method** for this Job.

7 Press the **Home** function key (**F4**) to return to the JOB QUEUE screen.

8 To add additional samples to be processed repeat steps 2 - 7.

9 If necessary, replace and/or clean the Syringe. Press the **Menu** key to see the available options for changing (**F1** - **Change Syr**inge) and cleaning (**F2** - **Clean Syr**inge). To completely remove air bubbles, the Syringe should be primed manually (see chapter 8.2, page 32, "Syringe priming")

10 Close all Stack drawers.

11 If only one Job will be processed, select that Job with the scroll knob. Press **Start** key. In the dialog box "Select Job(s) to Process" select one of the following options:
- **All** (Entire Job Queue starting from the top)
- **Selected** (Job selected with the cursor bars)
- **Resume** (Continue with the next Job after the aborted one)

3.2 Aborting a Job Queue

1 Press STOP

2 Select one of the available options
(**Continue, Sample, Job,** or **Job Queue**).

Select **Continue** to resume processing with the current sample.

Select **Sample** to abort processing of the current sample. Processing will resume with the next sample.

Select **Job** to abort processing of all samples in the current Job. Processing will resume with the next Job. The aborted Job is marked with an **X.**

Select **Job Queue** to abort processing of all Jobs. The JOB QUEUE screen will be displayed. The aborted Job is marked with an **X.**

3.3 Restarting an Aborted Job Queue

1 Press the **START** key.

2 Select the option "**Resume**". The job after the last one marked as aborted will be started.

4. Utility Functions

Utility functions, selectable from the **Menu** screen, provide quick access to checking operations and parameters that may need to be changed. These functions are available for the actual Syringe, Trays, Injectors, and Wash Stations. They allow access to key functions without having to set up and execute a Method and Job.

note !

If an item is used in the sample processing cycle, the appropriate Utility value will be overwritten by the Method value.

4.1. Syringes

By pressing a Function Key the following functions are available:

Function Key	Description
F1 Chang Syr	The syringe is moved to a position, where the syringe assembly can be completely lowered to facilitate removal of the syringe adapter. The syringe can then be removed and replaced. A prompt will be displayed to specify the new syringe. The syringe must be installed before pressing **Enter**. (see Chapter 8 "Syringes")
F2 Clean Syr	This Function is used to clean or prime the syringe prior use. After selecting **F2** either Wash1 or Wash2 can be selected.
F3 Set Pos	Set Pos is used to define the Chang Syringe position
F4 HOME	The Injection Unit moves to its HOME position and the Job Queue Menu is displayed.

The following Syringe Parameters may be changed by selecting the particular item:

Item	Description
Actual Id	Indicates the Identification number (ID) of the currently inserted syringe. If the syringe detection system is set to manual, the extension "man" is displayed. This value can not be changed.
Fill Volume	This parameter serves to control the filling of the syringe. It may happen that air bubbles remain below the plunger after the first pull up. If the plunger is moved up and down several times (see Fill Strokes), these air bubbles are worked out. With this operation the syringe may be completely filled even when using very small sample volumes.
Fill Strokes	Number of Fill Strokes. All Fill Strokes, except the last one, use the selected Fill Volume. If the selected Sample volume is higher than the Fill Volume, the Sample Volume is used for all Fill Strokes. If zero is selected the plunger is pulled up only once using the Sample volume value.
Pullup Del	Using this item a delay time between sample pullup and ejection while filling the syringe can be selected. The same delay time is used after the last plunger pullup until the syringe needle is moved out of the sample vial/well. It is only used if more than one Fill Stroke is selected. This feature is especially useful for handling viscous fluids or syringe sizes >100µl.
Fill Speed	Speed of plunger movement used in all syringe filling operations.
Eject Speed	Speed of plunger movement used in all syringe eject operations except sample injection.
Inject Speed	Speed of plunger movement for sample injection.
Plunger Pos	Plunger position during Chang Syringe operation. The syringe plunger is moved to a position, where the syringe can be removed and replaced. The value may be changed for different types of syringes.

4.2 Tray

After selecting the particular Tray to be accessed, the following Functions are available:

Function Key	Description
F3 Movto nnn	This function serves as a quick check to determine if the XYZ coordinates are defined correctly for the selected Tray. To use this utility the selected Tray including the sample vials or Microplate must be present. After pressing "Movto 001" the Injection Unit moves to sample position no.1. This procedure can be repeated for the last sample position in the first row and the last sample position in the last row.
F4 HOME	The Injection Unit moves to its HOME position and the Job Queue Menu is displayed.

The following Tray Parameters may be changed by selecting the particular item:

Item	Description
Needle Penetr	Needle penetration depth into the sample vial. The stored default values for each Sample Tray Type are approx. 2mm above the sample vial/Microplate bottom. The needle penetration depth for the selected Tray may be changed by entering the desired value.
Tray Type	The Tray Type, which is selected for the Tray, is shown. If the Tray enables use of different Tray Types, it can be changed here. (Alternate use of Microtiter or Deepwell plates in a Stack)

4.3 Injector

After selecting the particular Injector to be accessed, the following Functions are available:

Function Key	Description
F1 Rinse Inj	After pressing **F1**, either Wash1 or Wash2 may be used to clean the LC injection valve port without running a Job.
F2 Act Valve	F2 switches the LC injection valve between the Load and Inject position. It may be used to test the valve drive function or to perform manual injections.
F3 Movto Inj	The Injection Unit moves to the injection valve position. By selecting the Parameter "Needle Penetr" on the same screen the Injection Valve Needle Penetration value may be checked or changed. (see chapter 9.3)
F4 HOME	The Injection Unit moves to its HOME position and the Job Queue Menu is displayed.

The following Injector Parameter may be changed by selecting the particular item:

Item	Description
Needle Penetr	By selecting the Parameter "Needle Penetr" the Injection Valve Needle Penetration value may be checked and/or changed. To ensure reproducible sample injection and minimize carryover it is critical that the needle penetration depth is set accurately. (see chapter 9.3 Injection Valve Needle Penetration)

4.4 Wash Station

After selecting the specific Wash Station, the following Functions are available:

Function Key	Description
F2 Act Valve	F2 switches the selected Wash Station valve between the Open and Close position. It may be used to check the valve function or to prime the wash solvent lines.
F4 HOME	The Injection Unit moves to its HOME position and the Job Queue Menu is displayed.

The following Wash Station Parameter may be changed by selecting the particular item:

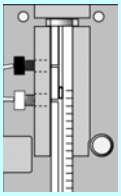
Item	Description
Rinse Time	"Rinse Time" may be used to expand the solvent flow time through the wash station glass liners after the last wash stroke is performed and the needle is retracted. If "Rinse Time" is set to 0, the wash station valve is closed immediately after the last wash stroke.

4.5 Dilutor

The Dilutor functions are used for the Side-port syringe from the IFC PAL Collector side. 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.

IFC PAL Description and Installation

5. General System Overview

5.1 IFC PAL Used for Analytical Flow Rate Range (Typically 1 ml/min or less)

Figure 4. IFC PAL - Major System Components for Analytical Version

The IFC PAL configuration can include a Microplate Stack, Peltier cooled or not cooled,a 6-port LC Injection Valve and a Fast Wash Station.
In addition, a second valve drive, two additional Microplate Stacks or Vial Tray Holders can be added.

5.1.1 Specifications for IFC PAL Analytical Version

General Specifications

Sample capacity	98 x 2ml vials per Tray 200 x 1ml vials per Tray 32 x 10ml / 20ml vials per Tray 6 Deepwell- or Standard Microtiterplates in a 3 drawer Stack 12 Standard Microtiterplates in a 6 drawer Stack (up to 4 Stacks, Injector and Collector side, may be configured, max. 24 plates for each side)
Thermostatted Sample Tray	Optional, 4°C – 70°C
Injection volume range	5, 10, 25, 100, 250, 500, 1000, 2500 and 5000 µl syringes are available. Down to 0.5µl with solvent sandwich injection. Down to 0.5µl with optional 4-port internal loop configuration. Up to 5000µl with optional larger loop and syringe.
Replicate injections	1 - 99 from one vial
Wash Station	2 different wash solvents
Precision	Typically < 0.5% RSD of peak area from 10 µl – 100 µl Typically < 1.0% RSD of peak area from < 10 µl
Carryover	Typically < 0.1% See specific Specification Data Sheet
Collector Syringe Volume	2, 20, 80, 200 and 800 µl syringes available. Dead Volume for changes “Collect/Waste” in µl-range.
Injection cycle time	Typically 20 - 60 sec. depending on plunger speeds, injection volume and wash cycles

5.2 IFC PAL Used for Preparative Flow Rate Range (Typically 1 to 100ml/min)

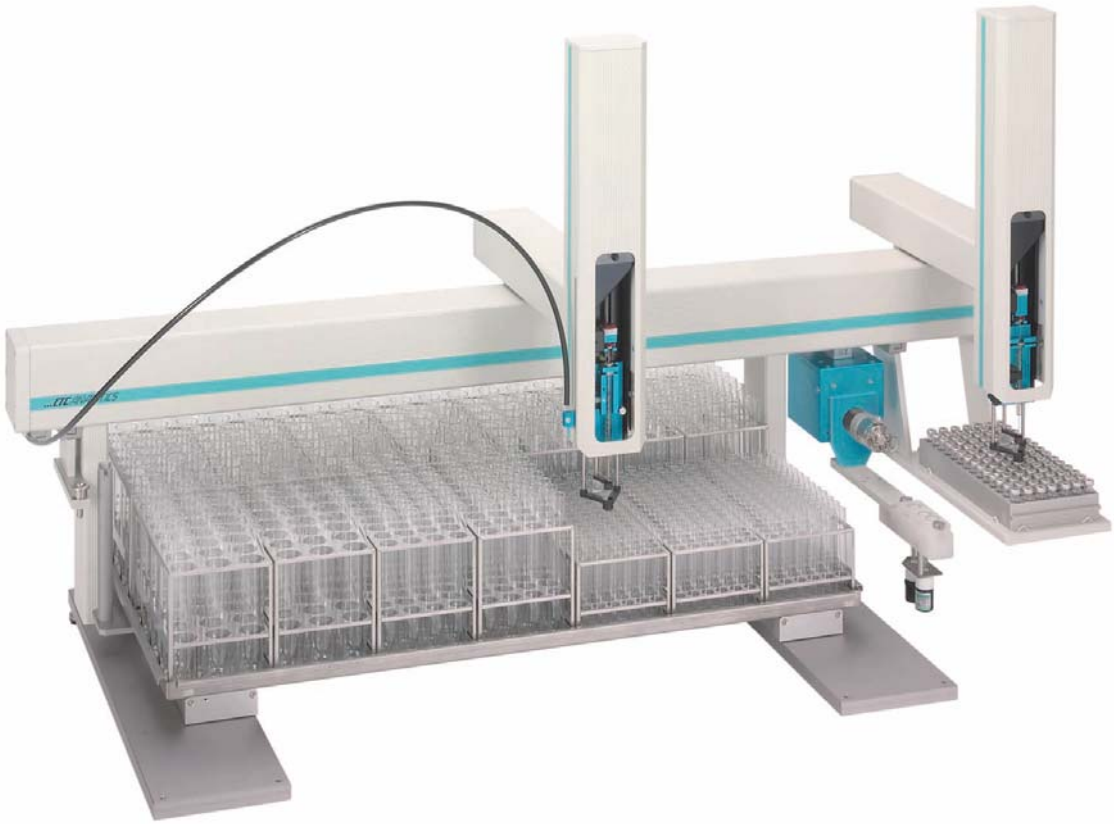


Figure 5. IFC PAL - Major System Components for Preparative Version

The IFC PAL configuration can include at the Injector side a Trayholder, Microplate Stack, Peltier cooled or not cooled, a 6-port LC Injection Valve (prep range) and a Fast Wash Station.
At the Collector side can various types of Trayholders be installed to keep reagent tubes from 13 to 25 mm OD.
In addition a second valve drive (analytical range) can be added.
An optional slider is available to hold standard racks designed for a Gilson System.

5.2.1 Specifications for IFC PAL Preparative Version

General Specifications

Sample Capacity Injector Side	98 x 2ml vials per Tray 200 x 1ml vials per Tray 32 x 10ml / 20ml vials per Tray
Thermostatted Sample Tray	Optional, 4°C – 70°C
	6 Deepwell- or Standard Microtiterplates in a 3 drawer Stack 12 Standard Microtiterplates in a 6 drawer Stack
Injection volume range	100, 250, 500, 1000, 2500 and 5000 µl syringes are available. Maximum injection volume 20 ml, 4 x 5ml
Loop Volume Range	Loops up to 20 ml are available.
Replicate injections	1 - 99 from one vial
Wash Station	2 different wash solvents
Precision	Typically < 1.0% RSD of peak area
Carryover	Typically < 0.1%
Sample Capacity Collector Side	14 standard Trays to hold reagent tubes with various volumes Tube OD 25 mm, holding 55 ml, 21 Tubes per Trayholder, total 294 tubes Tube OD 20 mm, holding 35 ml, 39 Tubes per Trayholder, total 504 tubes Tube OD 18 mm, holding 27 ml, 50 Tubes per Trayholder, total 700 tubes Tube OD 16 mm, holding 16 ml, 50 Tubes per Trayholder, total 700 tubes Tube OD 13 mm, holding 09 ml, 78 Tubes per Trayholder, total 1092 tubes (Volume given for tubes with 1500 mm height. Trayholders for tubes with 100 mm height are available.)
Collector Syringe Volume	2, 20, 80, 200 and 800 µl syringes available. Dead Volume for changes “Collect/Waste” in µl-range.
Injection cycle time	Typically 1 to 3 minutes depending on plunger speeds, injection volume and wash cycles

5.3 Electrical Specifications

Parameter	Requirement
Protection Class[a]	Class I
Over Voltage Category[b]	Category II
Pollution Degree[c]	2
Moisture Protection[d]	Normal (IPXO)

a: Protection Class I:

Protection class describes the insulating scheme used in the instrument to protect the user from electrical shock. Class I identifies a single level of insulation between live parts (wires) and exposed conductive parts (metal panels), in which the exposed conductive parts are connected to a grounding system. In turn this grounding system is connected to the third pin (ground pin) on the electrical power plug.

b: Over Voltage Category II:

Over Voltage category II pertains to instruments that receive their electrical power from a local level such as an electrical wall outlet.

c: Pollution Degree2:

This is a measure of pollution on electrical circuits that may produce a reduction of the dielectric strength or surface resistivity.
Degree 2 refers to normally only non-conductive pollution.
Occasionally, however, a temporary conductivity caused by condensation must be expected.

d: Moisture Protection:

Normal (IPXO) – IPXO means that there is NO Ingress Protection against any type of dripping or sprayed water. The X is a place holder to identify protection against dust if applicable.

Electrical Specifications (Continued)

Parameter	Requirements
PAL System	
Input Voltage	36 VDC
Input Current	3.2 A
Fuse	T6.3 A/250 V
PAL System Power Supply	
Input Line Voltage	Grounded AC, 100 to 240 V
Input Line Frequency	50/60 Hz
Input Power	4 A
Output Voltage	36 VDC
Output Current	4.16 A
PAL Single Valve Module (Serial Control) PAL Single, 2-Valve, 3-Valve Module (Optional Devices)	
Input Voltage	36 VDC
Input Current	3.2 A
Fuse	T6.3 A/250 V
PAL Valve Module Power Supply (Serial control) Single, 2-Valve, 3-Valve Module (Optional Devices)	
Input Line Voltage	Grounded AC, 100 to 240 V
Input Line Frequency	50/60 Hz
Input Power	4 A
Input Fuse	36 VDC
Output Voltage	4.16 A
Output Current	Grounded AC, 100 to 240 V
Stack Cooler DW, MT or Tray Cooler (Peltier Element) (Optional Devices)	
Input Voltage	24 VDC
Input Current	2.7 A
Power Supply for Stack Cooler DW, MT or Tray Cooler (Peltier Element) (Optional Devices)	
Input Line Voltage	Grounded AC, 100 to 240 V
Input Line Frequency	50/60 Hz
Input Power	2 A
Output Voltage	24 VDC
Output Current	4.5 A
Output Fuse	T3.15 A/250 V

Electrical Specifications (Continued)

PAL IFC-Box Interface Box for Fraction Collector, A/D Converter (Optional Device)	
Input Voltage	24 VDC
Input Current	2.7 A
Power Supply for PAL IFC-Box Interface Box for Fraction Collector, A/D converter (Optional Device)	
Input Line Voltage	Grounded AC, 100 to 250 V
Input Line Frequency	50/60 Hz
Input Power	0.7 – 0.35 A
Output Voltage	5 VDC +15 VDC - 15 VDC
Output Current	1.0 A 0.4 A 0.4 A
Output Fuse	N/a

5.4 Physical Specifications

Parameter	Requirements
IFC PAL Systems Analytical Version	
Height	648 mm (25.5 in)
Depth	385 mm (14.1 in.)
Width	1428 mm (56.2 in.) incl. Control Terminal on both sides
Weight	20 kg (44 lbs) without accessories
IFC PAL Systems Preparative Version	
Height	668 mm (26.3 in)
Depth	892 mm (35.1 in.)
Width	1428 mm (56.2 in.) incl. Control Terminal on both sides
Weight	30 kg (66 lbs) without accessories

5.5 Operating and Environmental Requirements

Parameter	Requirements
Operating Temperature Range	4 to 40 °C (39 to 104 °F)
Maximum Relative Humidity	75%, non-condensing
Bench Space	At least 16 cm (6 in.) at the rear, space for fluid waste container below the instrument and solvent containers next to the instrument. Access to power switch(es) and power cord(s). Clean, level and smooth surface. Solid bench plate.
Vibration	Negligible
Static electricity	Negligible

6. Installation

6.1 IFC PAL System Analytical Version

6.1.1 Unpacking the Components

A IFC PAL System is shipped at least in two boxes. One box contains the X/Y Crossrail assembly, the injection unit, the keypad terminal, standalone supports, connecting cables, power supply, syringe kit, the injection valve, fast wash station assembly, safety guard and miscellaneous parts. The other box will typically contain Microplate Stacks and/or Trayholders.

1 Open the large box containing the X/Y Crossrail. First, remove the Injection Units and the accessory boxes before attempting to remove the X/Y Crossrail assembly.

2 Remove any loose foam packing around the X/Y Crossrail. Carefully lift the X/Y Crossrail and remove it from the box. Hold the Y Crossrail in place as the assembly is removed from the box. Set the X/Y Crossrail assembly on a bench and remove the foam pieces from each end.

3 Unpack the remaining small boxes and any other containers.

4 Place the IFC PAL onto a stable surface. Make sure that no objects will interfere with either the Y Crossrail or Injection Unit throughout the entire range of potential movements.

6.1.2 Assembling

note ! The assembling steps are described as an example for a single injection unit. Apply the same steps if a second unit is required for the IFC PAL System as well.

Before beginning the assembly process, determine approximately where the LC injection valve will be located. The 2 control terminals will be mounted on either side of the X Crossrail.

1 If a Stack (a Trayholder with multiple drawers) was shipped with the IFC PAL, loosen the Torx screws on the two mounting clamps located on top of the stack.

2 Move the Y Crossrail to the center of the X Crossrail and temporarily place the X Crossrail assembly on top of the stack with the mounting clamp teeth fitting into the grooves on the bottom of the X Crossrail. The stack should be near the center of the Crossrail.

note ! **For IFC PAL's without a Stack, support the Crossrail in a suitable manner (a sturdy cardboard box can be used) before attempting to install the legs.**

3 Install the legs near the ends of the X Crossrail. Loosen the Torx screws on the mounting clamps and then fit one leg into the grooves in the X Crossrail. Be sure that the clamps fit completely into the grooves. Tighten the Torx screws until the legs are firmly in place.

4 Double check if the legs and stack claws are correctly attached to the X Crossrail (see Figure 6, following page).

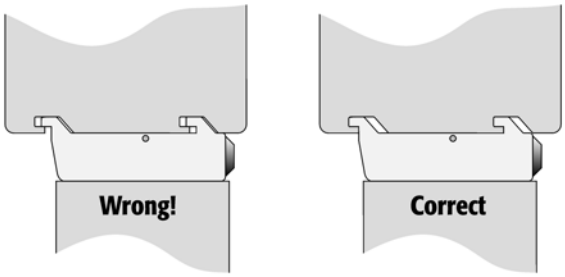


Figure 6. Attachment of Mounting Claws

Installing the Injection Unit

note !

Installation of the Injection Unit should be done carefully. When installing it for the first time, have someone hold it in place while the mounting screws are inserted (see Figure 8).

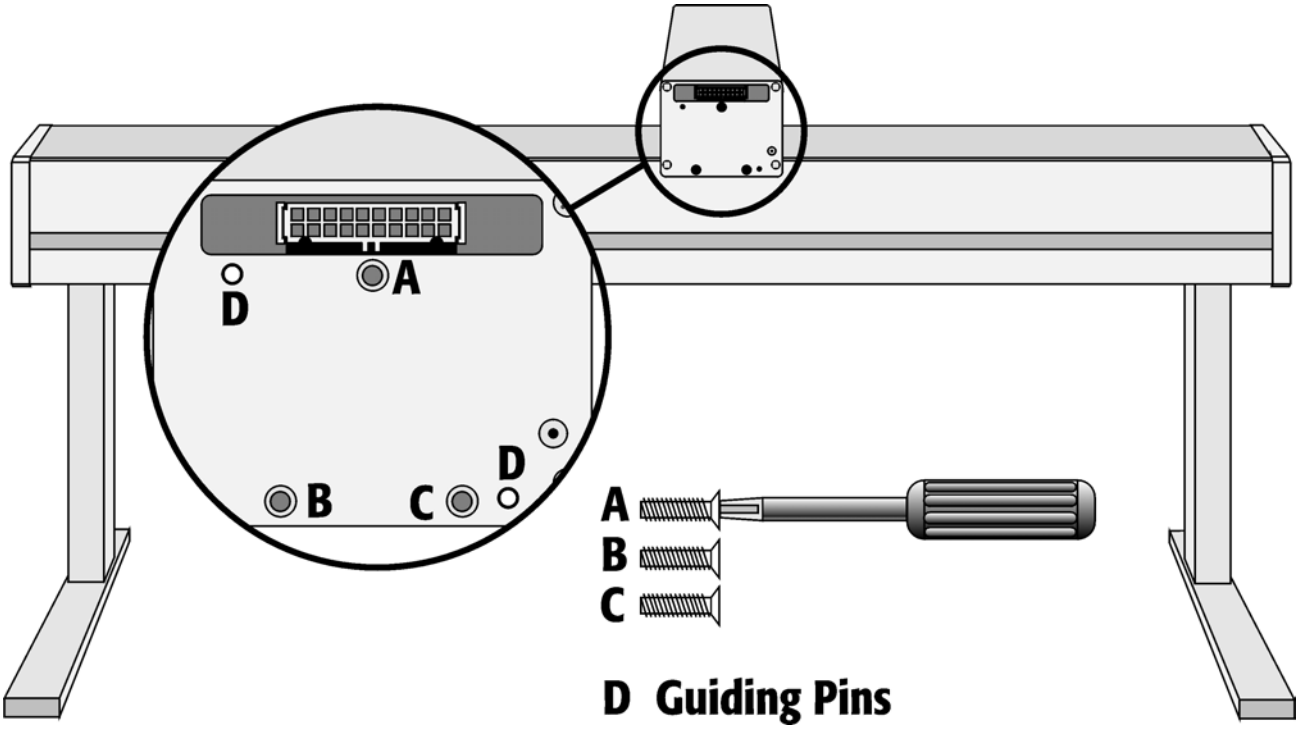


Figure 7. Attaching the PAL Injection Unit

1 Remove the 3 Torx mounting screws **A, B** and **C** that will be used to fix the Injection Unit to the Y Crossrail. Place one of the screws onto the end of the supplied Torx driver. Slide the clear plastic cover on the Injection Unit all the way to the top.

2 Connect the flat ribbon cable A protruding from the front end of the Y Crossrail to the corresponding connector on the Injection Unit (see Figure 8).

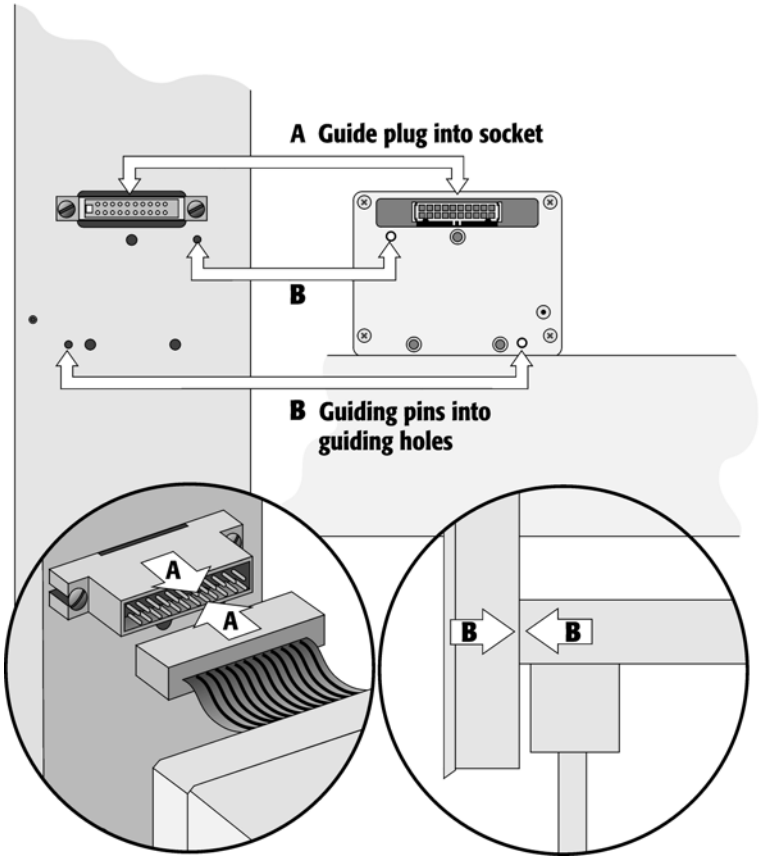


Figure 8. Connecting the Injection Unit Flat Cable

3 Hold the Injection Unit in place against the Y Crossrail. Make sure the two locating pins on the Y Crossrail fit into the two guiding pin holes on the Injection Unit.

4 Locate the three large holes in the black anodized frame attached to the Z Crossrail inside the Injection Unit. Slide the frame upwards until the top hole is centered on the top threaded hole in the end of the Y Crossrail. Insert and securely tighten the Torx screw **A** (see Figure 9).

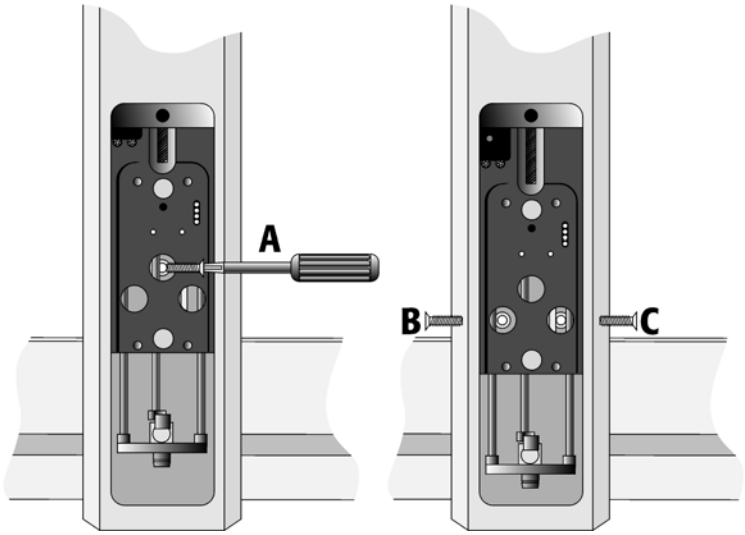


Figure 9. Inserting the Injection Unit Mounting Torx Screws

5 Install the two remaining Torx screws **B**, **C** in the left and right mounting holes, respectively. It may be necessary to move the elastic cord slightly to the left to insert the Torx screw **C** into the right-hand hole.

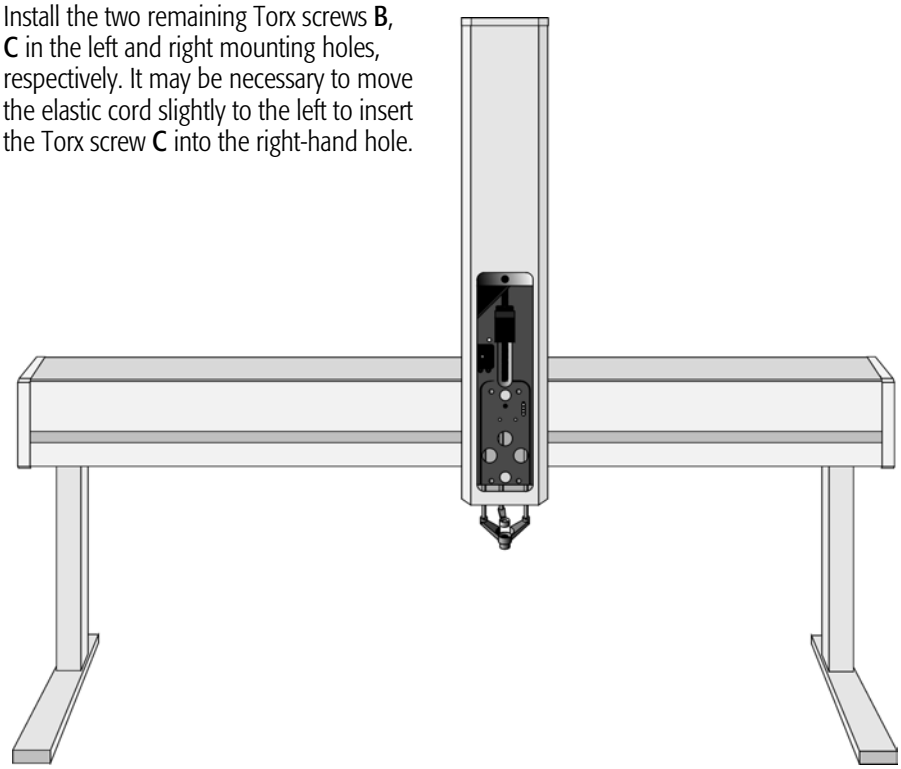


Figure 10. IFC PAL with Injection Unit and Standalone Supports (only 1 injection unit shown)

Installing the Keypad Terminals and Safety Shield

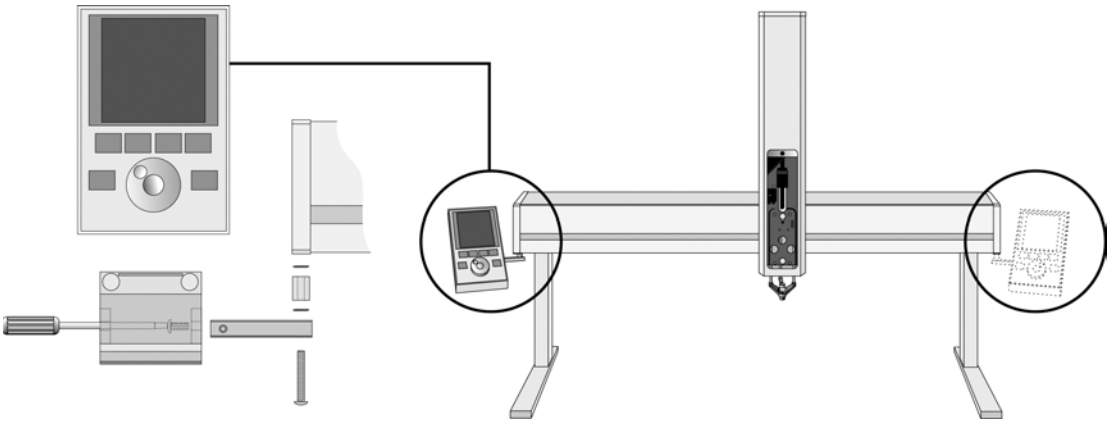


Figure 11. Installing Keypad Terminals

1 Install the Safety Shield on the left and right sides to the outside of the X-Axis.

2 Install the Keypad mounting brackets on the right and left side of the X Crossrail.

3 Connect one end of the white coiled cables (Part SS8J-700) to the Keypad and the other end to the two **SER3** interfaces jack on the rear side of the X Crossrail.

4 Place the Keypad terminals onto it's mounting brackets.

Installing the Power Supply

1 Locate the power supply, the DC power cables (Part RS3M-2000), and the AC power cable.

2 Set the power supply switch to the **OFF** position.

3 Connect one end of the DC power cables to the power supply in the connector "PAL" and "AUX" and the other ends to the **POWER** connectors at the rear side of the X-Crossrail.

4 Connect the female end of the AC power cable to the power supply. Then connect the male end to an AC power outlet.

5 Set the switch on the power supply to the **ON** position.

6 Observe the Keypads display. The model name "IFC PAL Injector" and "IFC PAL Collector" will be displayed along with the software version number. The Job Queue menu screen will then be displayed.

note ! **Before proceeding with the remaining steps, switch OFF power to the IFC PAL.**

Installing the LC Injection Valve

1 Locate the blue, valve drive. It will have one clamp that is identical to other object clamps. Loosen the clamp as above (see Figure 12).

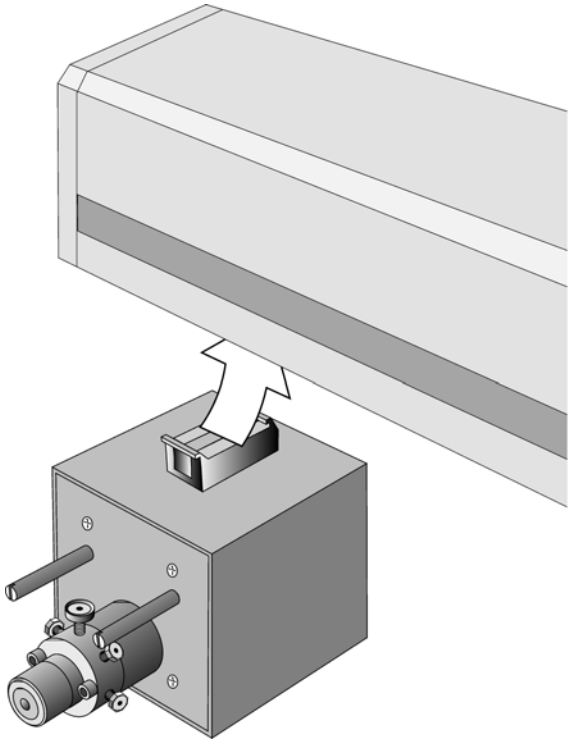


Figure 12. Installing the Injection Valve Drive

2 Attach the valve drive to the X Crossrail and tighten the mounting screw.

note ! **To avoid unnecessary delay volume between sample injection point and detection, the injection valve should be located near the detection device.**

3 Connect the control cable from the valve drive to **AUX1 at the rear of injector IFC PAL side**.

4 The injection valve and rotor is pre-installed on the valve drive.

Installing the Fast Wash Station

1 Attach the Wash Station assembly to the Solvent bottle holder.

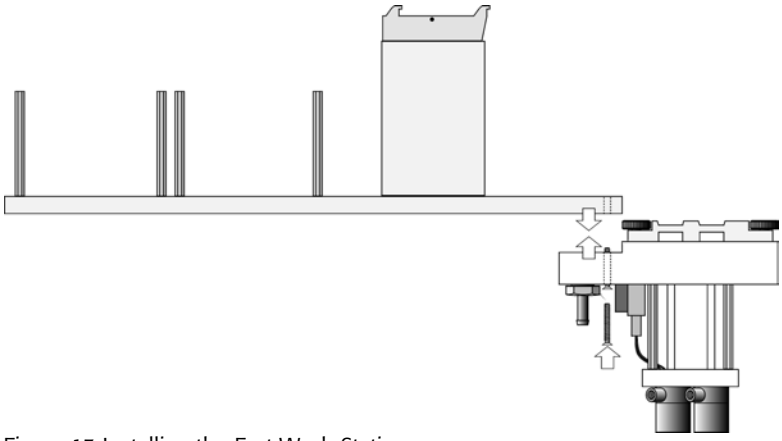


Figure 13 Installing the Fast Wash Station

2 Loosen the screw on the Fast Wash Station mounting clamp.

3 Attach the Fast Wash Station to the X Crossrail as close as possible to the Injection Valve. This will minimize the time required to move between the two positions.

4 Tighten the mounting screw .

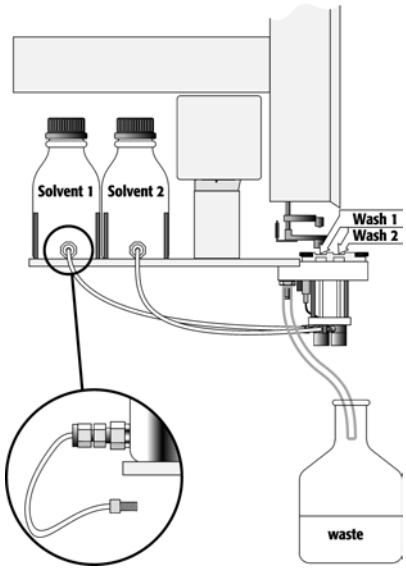


Figure 14. Fast Wash Station Assembly

5 Locate the white Teflon fittings and two lengths of Teflon tubing that connect the Wash Station valves to the wash solvent reservoirs.

6 Place the reservoirs onto their holders and attach the tubing and fittings.

7 Attach one end of the supplied transparent Polyethylene tubing to the Wash station waste port. Place the other end of tubing into a waste reservoir (not supplied), which is **lower** positioned than the Wash station assembly. Stretch the Polyethylene tubing to make sure that no used wash solvent is trapped before the Waste Reservoir.

note !

The waste reservoir MUST be placed in a lower position than the Wash Station assembly.

8 Connect the control cable to the connector "Wash Station" at the rear side, Control Board, and the four-pronged connector located on the Fast Wash Station assembly.

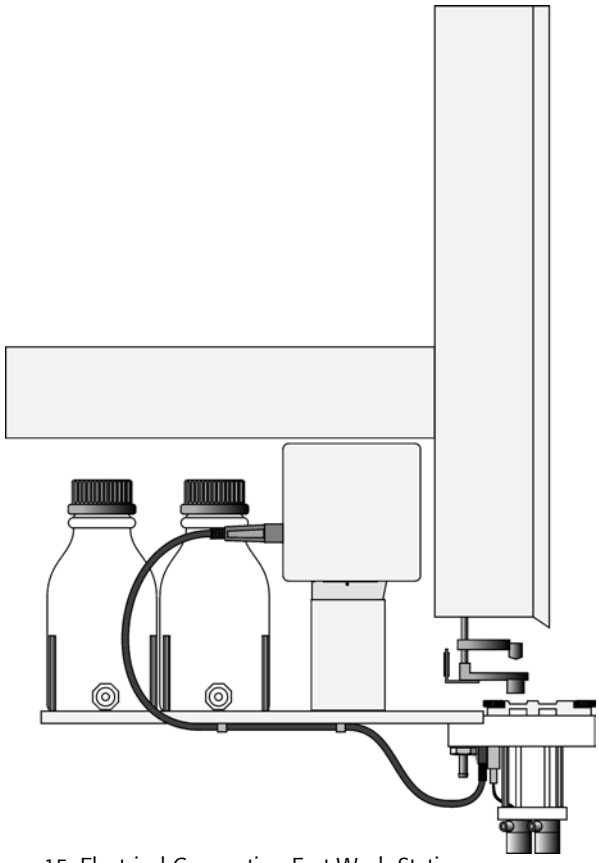


Figure 15. Electrical Connection Fast Wash Station

Installing a Microplate Stack

note !

Installation and operation of a Stack or Tray Cooler (Peltier Version) is described in the Addendum, supplied with every unit.

1 If a Stack (a Trayholder with multiple drawers) was shipped with the IFC PAL, loosen the two Torx screws on the two mounting clamps located on top of the Stack.

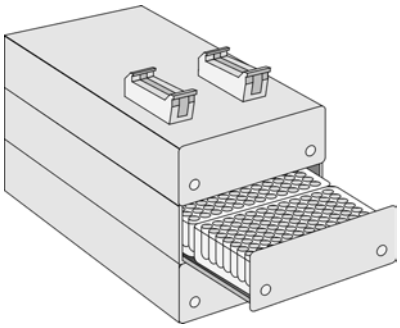


Figure 16. Installing a Microplate Stack

2 Carefully lift the X Crossrail assembly on top of the stack with the mounting clamp teeth fitting into the grooves on the bottom of the X Crossrail.

3 Be sure that the clamps fit completely into the grooves. Alternately tighten the two Torx screws until the two mounting clamps are firmly in place.

4 Double check if the Stack clamps are correctly attached to the X Crossrail (see Figure 6).

Installing a Trayholder

1 If a Trayholder was shipped with the IFC PAL, loosen the two Torx screws on the two mounting clamps located on top of the Trayholder legs.

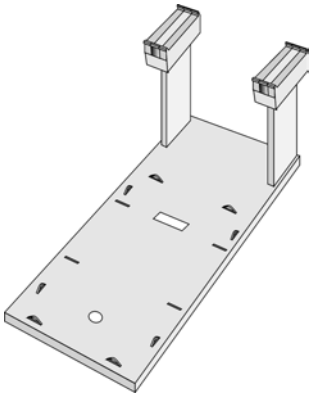


Figure 17. Installing a Trayholder

2 Install the Trayholder with the mounting clamp teeth fitting into the grooves on the bottom of the X Crossrail. The Trayholder should be near the center of the X Crossrail.

3 Be sure that the clamps fit completely into the grooves. Alternately tighten the two Torx screws until the two mounting clamps are firmly in place.

4 Double check if the two Trayholder clamps are correctly attached to the X Crossrail (see Figure 5, page 19).

6.1.3. Electrical connections

Before defining the IFC PAL object positions, make sure the LC Injection Valve, Fast Wash Station and the two Control Terminals are correctly connected to the IFC PAL X-axis rear side.

note ! The most common Objects for the IFC PAL System, like Injection valve, Fast Wash Station and one Control Terminal are connected to the IFC Injector side, Control Board.
To the IFC Collector side is typically only the second Control Terminal connected (CPU and MOTIO Board).

note ! **Always switch OFF the PAL power supply before connecting or disconnecting any IFC PAL accessories cable!**

6.2 IFC PAL System Preparative Version

6.2.1 Unpacking the Components

A ITS PAL System is shipped at least in two boxes. One box contains the X/Y Crossrail assembly, the injection unit, the keypad terminal, standalone supports, connecting cables, power supply, syringe kit, the injection valve, fast wash station assembly, safety guard and miscellaneous parts. The other box will typically contain Microplate Stacks and/or Trayholders and Trays to hold reagent tubes for collection.

1 Open the large box containing the X/Y Crossrail. First, remove the Injection Units and the accessory boxes before attempting to remove the X/Y Crossrail assembly.

2 Remove any loose foam packing around the X/Y Crossrail. Carefully lift the X/Y Crossrail and remove it from the box. Hold the Y Crossrail in place as the assembly is removed from the box. Set the X/Y Crossrail assembly on a bench and remove the foam pieces from each end.

3 Unpack the remaining small boxes and any other containers.

4 Place the IFC PAL onto a stable surface. Make sure that no objects will interfere with either the Y-Crossrail or Injection Unit throughout the entire range of potential movements.

6.2.2 Assembling

note ! The assembling steps described are for the specific preparative parts of the IFC PAL system. Assembling of the support legs for the slider plate.

The assembling with standard objects, like the Injection valve, Fast Wash Station, Trayholder , Stacks, etc., is described above under point 6.1 in the section for the analytical version.

note ! It is important that the IFC PAL for the preparative application is mounted on a solid bench plate. The bench has to be leveled and has to have a smooth surface.

Installing the Support and Slider Assembly

1 Open the transport locking screw using the supplied Allen Key.
See Figure 18.

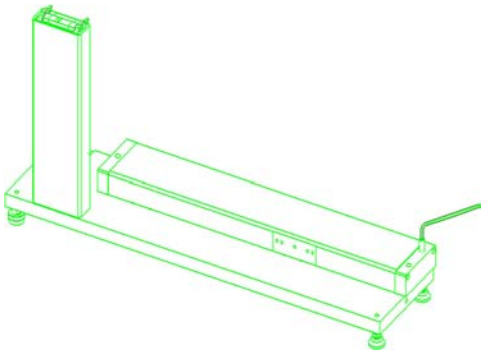


Figure 18. IFC PAL Support Leg Transport Lock

2 Position the two support legs parallel to each other on the table with approximately 57 cm distance in-between the two legs.
The support leg with the sensor cable installed at the back side has to be on the left side.

3 Position the two straining pieces in-between the two support legs. Adjust the distance in-between as perfect as possible to ensure that the support legs are running parallel to each other.

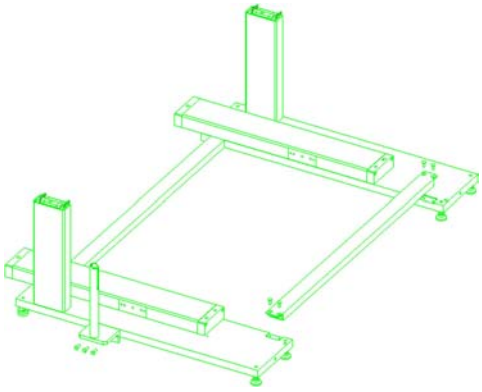


Figure 19. IFC PAL Straining of Support legs

4 Screw the straining pieces together with the screws supplied. Leave all screws a little **loose,** try to lift the straining pieces into the final position and start tightening all screws over-cross. This procedure does ensure that the support legs are positioned parallel.

5 Level out the IFC PAL frame by measuring the distance to the bench plate or by using a water level device. If necessary make the required corrections with the adjustable legs from the supports.

note ! **It is important that the frame is perfectly leveled out. It will affect the gliding friction of the slider assembly.**

6 Mount the follower pin for the slider assembly at the left side of the slider device as shown in Figure 20.

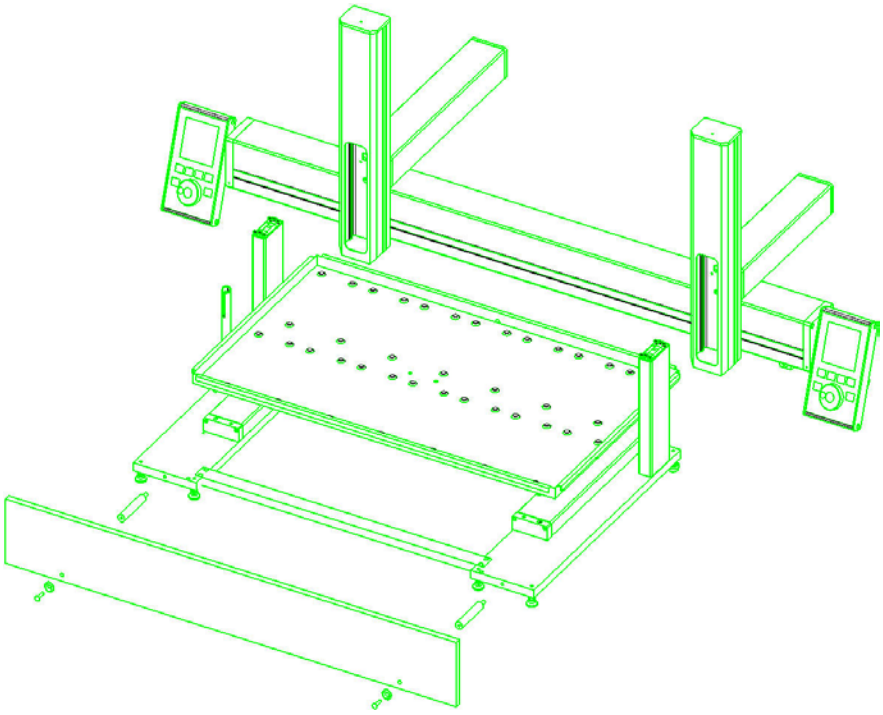


Figure 20. IFC PAL Assembling Tray Pan and X-/Y-Axis

7 Mount the X-Y –Axis on the support legs. The same principle applies as described under point 6.1.2 “Assembling the IFC PAL”.

8 Install the two Injection units as described under point 6.1.2 “Assembling the IFC PAL”.

9 Install the two Keypad Terminals as described under point 6.1.2 “Assembling the IFC PAL”.

10 Install the Tray Pan starting from the left side where the holes are exactly machined for the diameter of the of the pins.
The holes at the right side are wider to accept a certain dimension tolerance.

Move the slider assembly manually back and forth to ensure that the bearings are moving without any friction.

11 Install the safety shield in front of the slider assembly as shown in Figure 20.

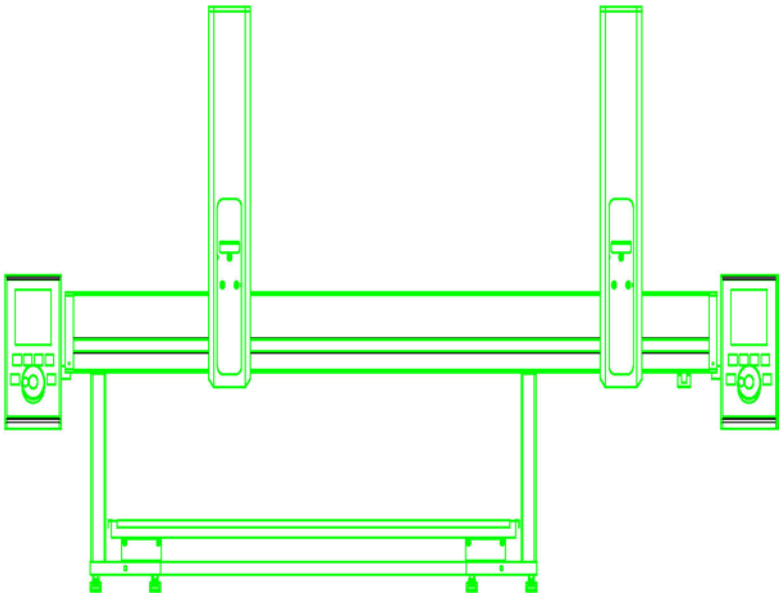


Figure 21. IFC PAL Assembly Front View

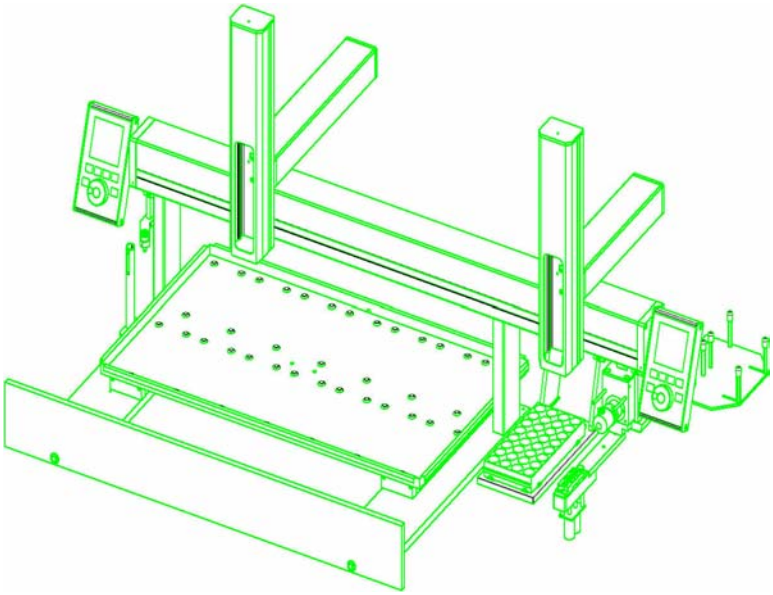


Figure 22. IFC PAL Assembly as an example configuration

7. IFC PAL Object Positions

7.1 Defining Object Reference Positions

note !

Remove the Syringe Adapter from the Injection Unit before performing the following steps.

The objective is to define the Reference Positions for standard IFC PAL Objects. Make sure the Trayholder(s), Valve(s) and Fast Wash Station are properly mounted to the PAL X-axis. The following description is an example how to teach the Reference Position for a Trayholder. The described procedure is common to all IFC PAL Objects.

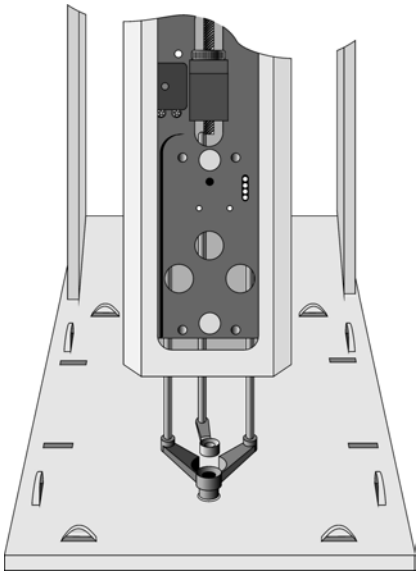


Fig. 23 Object Reference Position

For Trayholder, the **Reference Position** is a hole (slightly larger than the lower needle guide) in the base plate of the Holder. The lower needle guide should be centered in the hole with the bottom of the needle guide flush with the bottom of the base plate.

1 Switch ON the IFC PAL power supply. When the "Job Queue" menu is displayed, complete the following sequence (common to all objects):

Menu → Setup → Objects → Tray Holders → *"Named Tray Holder"*

where "Named Tray Holder" represents a predefined Trayholder (e.g. THldr1 or Stack1).

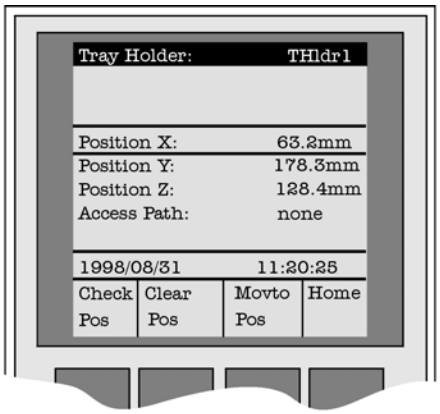


Figure 24. Menu Screen Object Trayholder

2 After selecting "Named Tray Holder" (e.g. THldr1 or Stack1), the **X Y Z** positions for the selected object will be displayed (see Figure 24).

3 Highlight the item **Position X** with the cursor bars and press ENTER. The Injection Unit will move to the previous defined X-axis position.

4 Rotate the outer knob to adjust the X- axis position to the Trayholder **Reference Position** (see Figure 23).

5 Press the inner knob to ENTER the **Position X** value.

6 Repeat steps 3-5 for **Position Y** and **Position Z**.

7 Press the **F3** button "Moveto Zero". The Injection Unit will move to the **HOME** position.

8 Verify the defined **X Y Z Positions** by pressing **F1** "Check Pos".

7.2 Description of Object Reference Positions

Trayholder (e.g. THldr1)

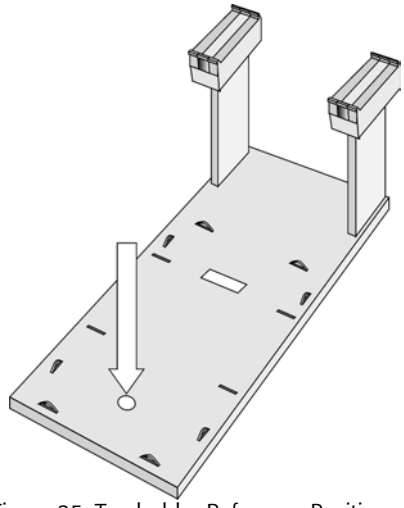


Figure 25. Trayholder Reference Position

For Trayholder, the **Reference Position** is a hole in the base plate of the Holder. The lower needle guide should be centered in the hole with the bottom of the needle guide flush with the bottom of the base plate.

Trayholder with six or three drawers (e.g. Stack1)

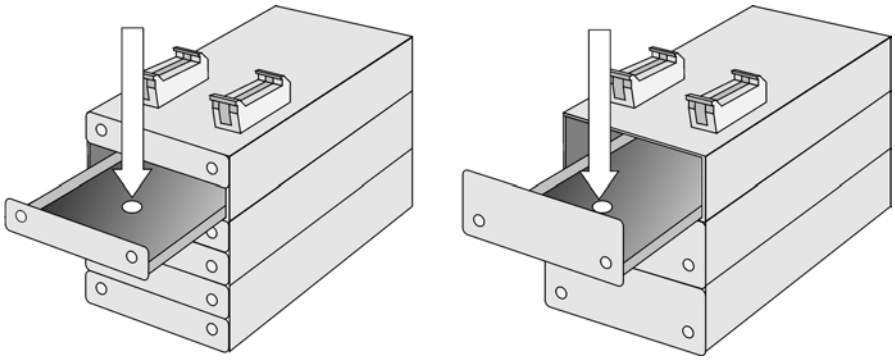


Figure 26. Stack Reference Position

For a six drawer Stack the reference position is a hole located in the **second** drawer (see Figure 26). For a three drawer Stack the reference position is in the **first** (top) drawer (see Figure 26). The lower needle guide must be centered in the hole with the bottom of the needle guide flush with the bottom of the drawer.
The same logic applies as well to Stack or Tray Coolers. For details see the specific manual, Addendum supplied with every unit.

Fast Wash Station (e.g. Wash1 or Wash2)

Figure 27. Fast Wash Station Reference Positions

For a Fast Wash Station the reference positions are two holes above the Wash Station glass liners (see Figure 27, Wash1 and Wash2). The lower needle guide should be centered in these holes with the bottom of the lower needle guide lightly touching the surface of the Wash Station assembly.

note ! **The Waste position represents an "Injector" within the PAL software. It is defined in the Object class "Injectors" (see Fig. 28).**

Injectors (e.g. LC Vlv1 or Waste)

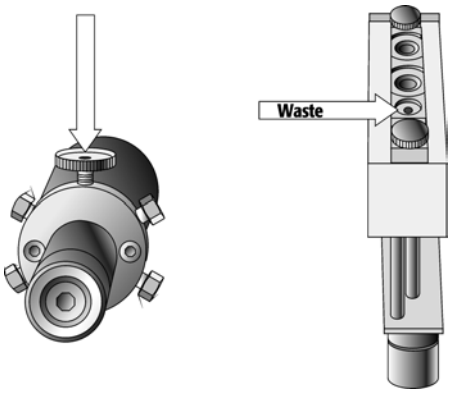


Figure 28. LC Valve and Waste Reference Position

For an **LC Valve** the reference position is the valve needle guide fitting mounted on the top valve port (see Figure 28). The lower needle guide of the Injection Unit should be centered in the valve needle guide fitting. Adjust the Z Position that the bottom of the lower needle guide is just touching the surface of the valve needle guide fitting. **Then reduce the value by 2.0 mm.**
For the **Waste Port** the reference position is a hole (slightly larger than the needle guide) in front of Wash2 (see Figure 27). The lower needle guide should be centered in this hole with the bottom of the lower needle guide lightly touching the surface of the Wash Station assembly.

note ! **To adjust the Valve Needle Penetration value, see chapter 9.3.**

Follower Pin for Slider Assembly) Preparative Version

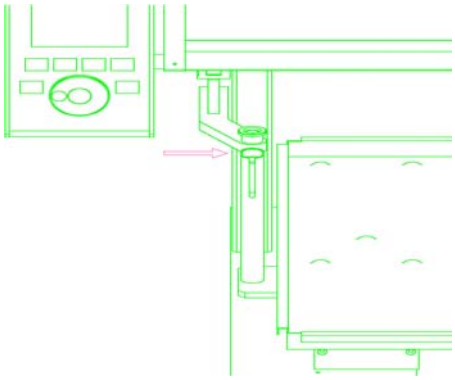


Figure 29. Follower Pin for Slider Assembly, Preparative Version

The reference position for the Follower Pin of the Slider Assembly is the hole at the top of the tube. See Figure 29.
Adjust the Z-Position of the lower needle guide such that it does enter into the hole. The higher rim at the back side of the tube has to be in contact with the lower needle guide. The cut-out in the front of the Follower Pin is reserved for the needle. If longer needles are used, the cut-out has to be mechanical changed.

Waste Position for Slider Assembly) Preparative Version

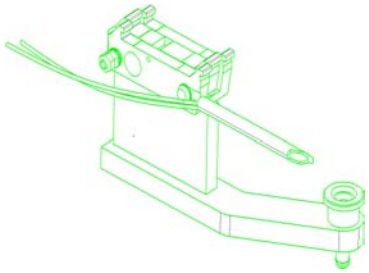


Figure 30. Waste Position for Slider Assembly, Preparative Version

For the **Waste Port** the reference position is a hole (slightly larger than the needle guide) in front of Wash2 (see Figure 30). The lower needle guide should be centered in this hole with the bottom of the lower needle guide lightly touching the surface of the Wash Station assembly.
This waste port is used for clean-up procedures at a stop or abort action.
The wire of the transfer tubing is connected to the screw at the front of the clam.

Safety Warning !

The IFC PAL System used for preparative application has to be grounded with special care. Organic solvents can be electrostatic charged, resulting sparks can start a fire hazard.
The screw-connection mounted at the rear side of the clam is used for electrical grounding. The grounding cable from laboratory has to be connected to this point.

8. Syringes

8.1 Selecting Syringes

Recommended Syringe for the IFC PAL for analytical application (Injection Side)

1 PAL SyrLC100µl Kit LC Syringe 100µl for HTS PAL,
consisting of:
1 pc syringe adapter
1 pc plunger holder
2 pc syringe SYRC G100-22S-3

The SYRC G100-22S-3 gastight Syringe for IFC PAL, equipped with 22S gauge needle, is appropriate for injection into the standard CTC injection valve. However, certain applications may require different syringe sizes or needle ID. Consult the PAL Accessories Catalog.

Recommended Syringe for the IFC PAL for preparative application (Injection Side)

1 PAL SyrPrep5000µl Kit LC Syringe 5.0 ml for IFC PAL,
consisting of:
1 pc syringe adapter
1 pc plunger holder
2 pc syringe SYRC G5000-19-3

The SYRC G5000-19-3 gastight Syringe for IFC PAL, equipped with 19 gauge needle, is appropriate for injection into the CTC prep injection valve. However, certain applications may require different syringe sizes or needle ID. Consult the PAL Accessories Catalog.

Note !

The Needle Dimension for Gauge 19 is: OD 1.07, ID 0.69 mm.

The needle guides (hole for needle) from the injection are adjusted with new delivered units. Existing units in the field may have to be upgraded.

The Fast Wash Station (P/N MM 01-04F) has to have glass liners with an internal diameter of 1.50 mm.

Needle Guide and Needle Seal from the injection valve have to be adapted to Gauge 19. See Chapter 9.

Recommended Syringe for the IFC PAL for Collector Side, Analytical Version

1 PAL SyrLCSP20µl, Kit Dilutor Syringe for IFC PAL,
consisting of:
1 pc sideport syringe adapter
1 pc sideport plunger holder
1 pc sideport syringe plunger sealing Screw
1 pc sideport syringe 20µl SYRC Sp20-R
3 pc needles gauge 22S for sideport syringe,Ndl S-22S-3

The sideport syringe is used to divert the effluent flow from the HPLC column-detector to "Collect" or "Waste".
The needles are replaceable. The recommended needle, is appropriate for injection into the CTC injection valve. However, certain applications may require different syringe sizes or needle ID. Consult the PAL Accessories Catalog.

Recommended Syringe for the IFC PAL for Collector Side, Preparative Version

1 PAL SyrLCSP80µl, Kit Dilutor Syringe for IFC PAL,
consisting of:
1 pc sideport syringe adapter
1 pc sideport plunger holder
1 pc sideport syringe plunger sealing Screw
1 pc sideport syringe 80µl SYRC Sp80-R
3 pc needles gauge 19 for sideport syringe,Ndl L-193

The sideport syringe is used to divert the effluent flow from the HPLC column-detector to "Collect" or "Waste".
The needles are replaceable. The recommended needle, is appropriate for injection into the CTC prep injection valve. However, certain applications may require different syringe sizes or needle ID. Consult the PAL Accessories Catalog.

8.2. Syringe Priming

It is critical that syringes be primed before beginning sample preparation. Prime the syringe by using the Utility function **"Clean Syr"**. For fixed needle syringes, priming may also be achieved by using an adequate number of filling strokes in a IFC PAL Method, using the commands from the local terminal.
Gas-tight syringes must be primed manually. Remove the plunger and fill the syringe from the top of the barrel until solvent either overflows or forms a "bead" at the top of the syringe. Then insert the plunger.

8.3 Installing a Syringe for the IFC PAL Injector Side

1 Select Menu and press **F1/Chang Syr**. The Injection Unit will move to a location that will facilitate installation of the syringe.

2 Place the syringe in the appropriate syringe adapter. Pull the plunger out to approximately 20% of it's length.

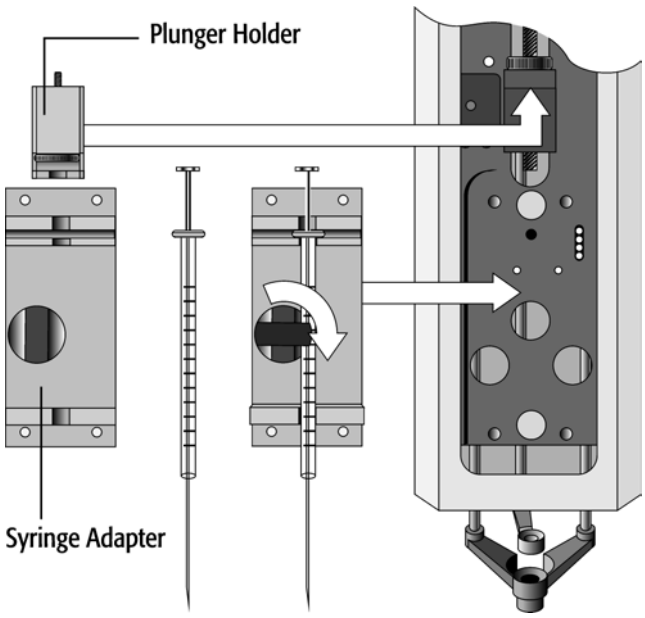


Figure 31. Syringe and Syringe adapter for IFC PAL Injector Side

3 If necessary, loosen the plunger retaining screw in the plunger holder (see Figure 32).

4 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.

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 Press "Home".
The plunger moves down until it hits the mechanical stop. This position is stored as the syringes zero volume position. Then the Injection Unit returns to the **HOME** position.

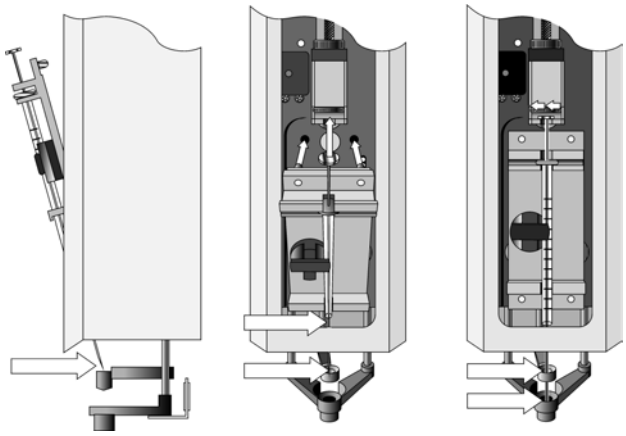


Figure 32. Installing and Removing a Syringe from the PAL IFC Injector Side

note ! **After replacing a syringe, always check the needle penetration in the LC valve (see chapter 9.3, Injection Valve Needle Penetration).**

8.4 Removing a Syringe

1 Select "Menu" and **press F1/Chang Syr**. The Injection Unit will move to a location that will facilitate removal of the syringe.

2 Loosen the plunger retaining screw. Move the plunger slightly out of the plunger holder.

3 Pull the syringe adapter out and then carefully up to remove the syringe adapter with the syringe from the Injection Unit.

8.5 Installing a Sideport Syringe for the IFC PAL Collector Side

8.5.1 Installing the transfer tubing kit for IFC PAL Collector Side

1 Open the Torx screw at the guiding bracket of the sideport syringe adapter.

2 Locate the transfer tubing kit end with 2 connection fittings

3 Insert the transfer tubing guiding wire into the guiding bracket slit.

4 Adjust the guiding wire in a 90° angle to the bracket and tighten the Torx screw firmly.

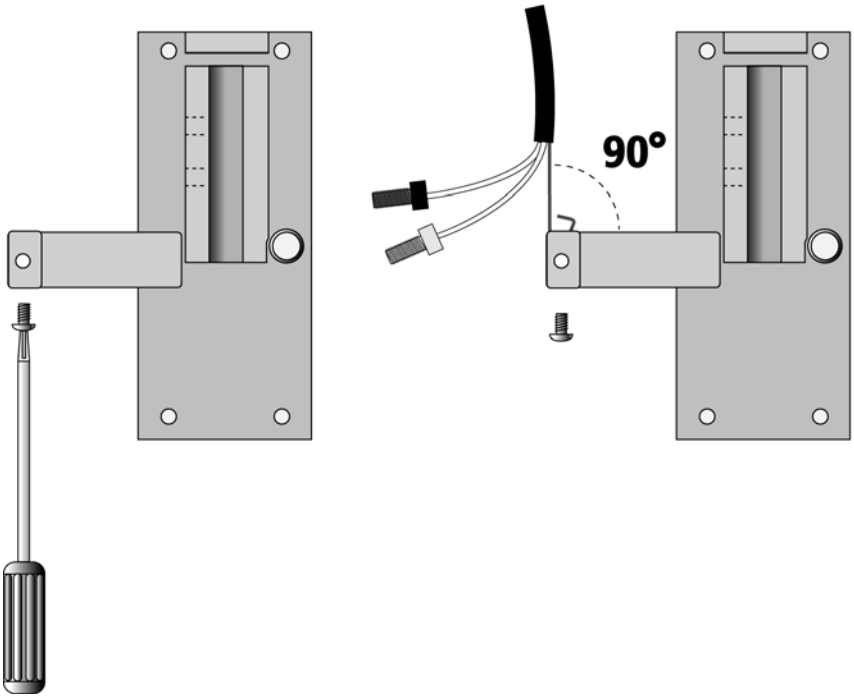


Figure 33. Attaching the transfer tubing kit to the Sideport Syringe Adapter

8.5.2 Installing the Sideport syringe for IFC PAL Collector Side

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 !

It is important to follow the instructions step-by-step. The sideport connections have to be tightened first to allow the syringe glass barrel to fell into the correct (sealing) position. After this step one can continue with the step 4 as described above.

Do not over tighten 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.

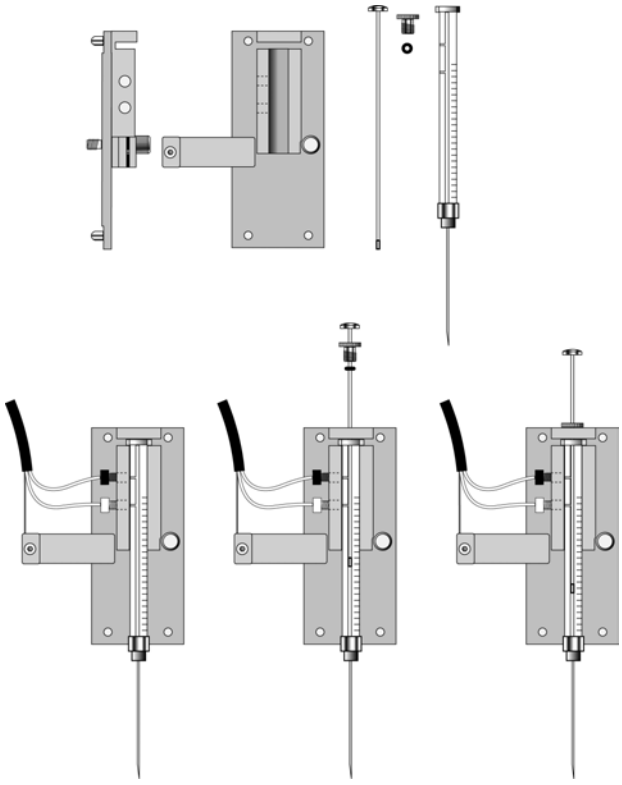


Figure 34. Installing the Sideport Syringe for IFC PAL Collector Side

7 Ensure that 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.

8 Turn **OFF** the PAL power supply

9 Screw on the sideport syringe plunger holder into the black Injection unit slider.

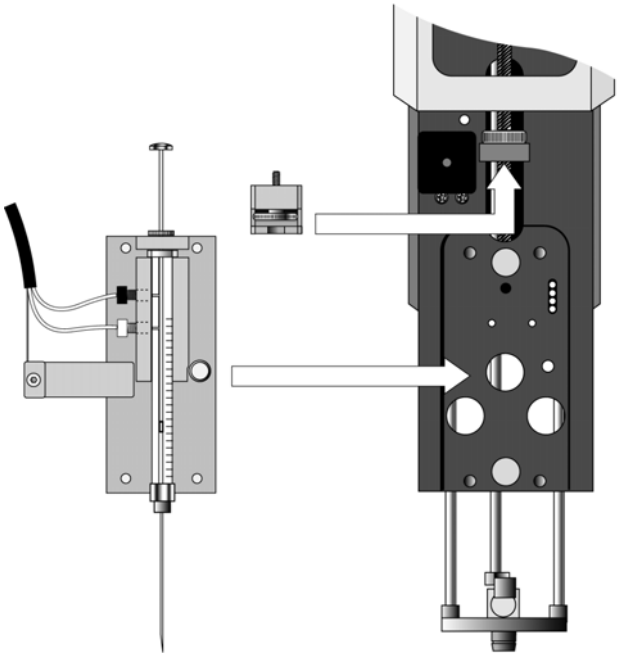


Figure 35. Installing the Sideport Syringe plunger holder for IFC PALCollector Side

10 Pull out the plunger to approximately 20% of it's length.

11 If necessary, loosen the plunger retaining screw in the plunger holder

12 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.

13 Guide the syringe adapter side bracket through the left hand Injection unit slit

14 Place the plunger button into the plunger holder. Allow the syringe adapter to "dick" into place by magnetic force, against the syringe carrier.

15 Tighten the plunger retaining screw against the plunger button.

16 Tighten the sideport syringe adapter screw against the black Injection unit slider

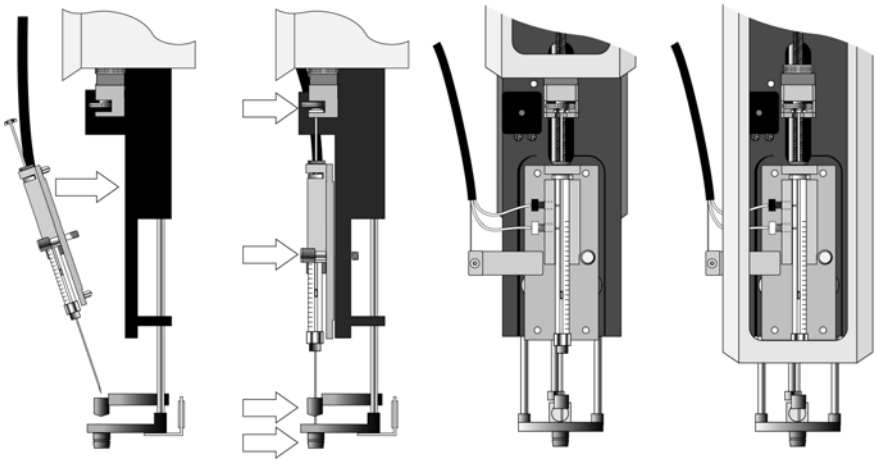


Figure 36. Installing the Sideport Syringe Adapter for IFC PAL Collector Side

17 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 IFC PAL System, always check the plunger position as described in Utilities Functions "Syr Dilut Pos".**

8.6 Removing the Sideport Syringe Adapter for IFC PAL Collector Side

Repeat steps 1 – 17 in chapter 8.5 in reverse order.

9. Injection valve

The IFC PAL can be equipped with different LC Injection valve types.
The recommended valve type for the IFC Pal is the Valco/Vici Cheminert Type Valve.
In the Cheminert product range are valve types for specific applications available.

The Cheminert valve body is available made out of stainless steel or PEAK material (PEEK related polymer).

For the various ranges of the flow rate are following bore sizes recommended:
- Flow rate range 100 to 500 µl/min : Bore 0.25 mm
- Flow rate range 500 to 20 ml/min : Bore 0.40 mm (standard)
- Flow rate range 20 + ml/min : Bore 0.75 mm

These numbers shall be used as an orientation. The valve selection depends also on the expected back pressure from the complete HPLC system.

All 3 valve types are delivers with standard Valco 1/16 inch connections.
It is important to use original Valco Ferrules and Nuts to maintain a leak tight connection.

For the PEAK Valve only PEEK Ferrules can be used. Stainless Steel Ferrules are too hard, one can crack the PEAK Valve Stator by using the wrong ferule material.

The standard rotor material shipped is Valcon H with all valves made out of Stainless steel. The PEAK-Valve is equipped with a rotor made out of PEEK/Teflon. For special applications is also a Vespel (Polyimide) rotor available. This material is harder and the expected life time is therefore shorter.
The selection of the rotor material depends directly from the application.

On customers demand CTC Analytics can also supply the Valco W-Type valve.
This type is only available in stainless steel with a standard bore of 0.40 mm.

The injection loops are available in a wide range from 10 to 5000 µl. All loops have a 1/16 inch tubing at the connection point. The 2 loops for 2.5 and 5 ml have 1/16 inch connections but the tubing is widened-up to 1/8 inch to eliminate a too high back pressure.

9.1. Injection Valve Flow Path

9.1.1 Injection Valve Flow Path for Valco/VICI Cheminert Valve Type

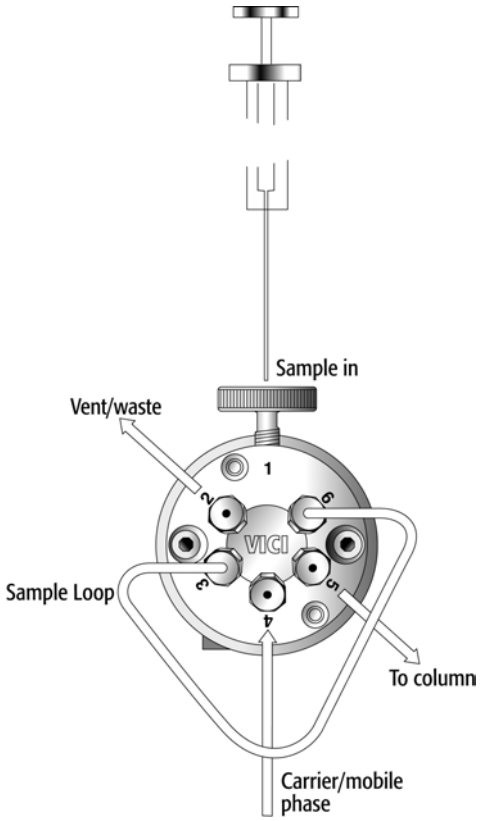


Figure 37. Standard LC Injection Valve Flow Path, Valco / VICI Cheminert Valve

The standard LC Injection Valve is a 6-port two way switching Valve with a special needle guide.

Valco / VICI Cheminert Flat Plate Rotary Valve

Stator Material:	Stainless steel 316
Rotor Material:	Valcon H (inert mix-polymer), standard, can be replaced by other material
Port Size:	1/16 inch
Fittings:	Valco 1/16 inch Ferrules and Nuts
Actuator:	Micro-Electric Actuator

9.1.2 Injection Valve Flow Path for Valco Valve Type W

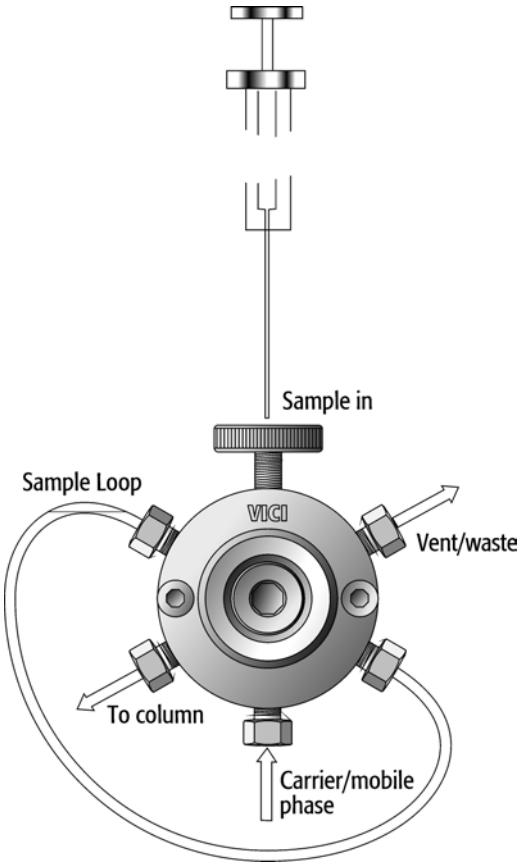


Figure 38. LC Injection Valve Flow Path for Valco Valve Type W.

The LC Injection valve, Valco Type W, Conical Rotary Valves
6-port two way switching valve with the special needle guide.

Stator Material:	Stainless steel 316
Rotor Material:	Valcon H (inert mix-polymer) standard, can be replace by other material
Port Size:	1/16 inch
Fittings:	Valco 1/16 inch Ferrules and Nuts
Actuator:	Micro-Electric Actuator

note ! **Sample loops of the two different valves are not interchangeable**

9.2 Valve Needle Guide and Needle Seal

The two valves are equipped with a special valve needle guide fitting. This fitting has a wide diameter to mate with the syringe needle guide on the injection unit. The valve needle guide also has a countersunk hole to facilitate insertion of the syringe needle into the injection port.

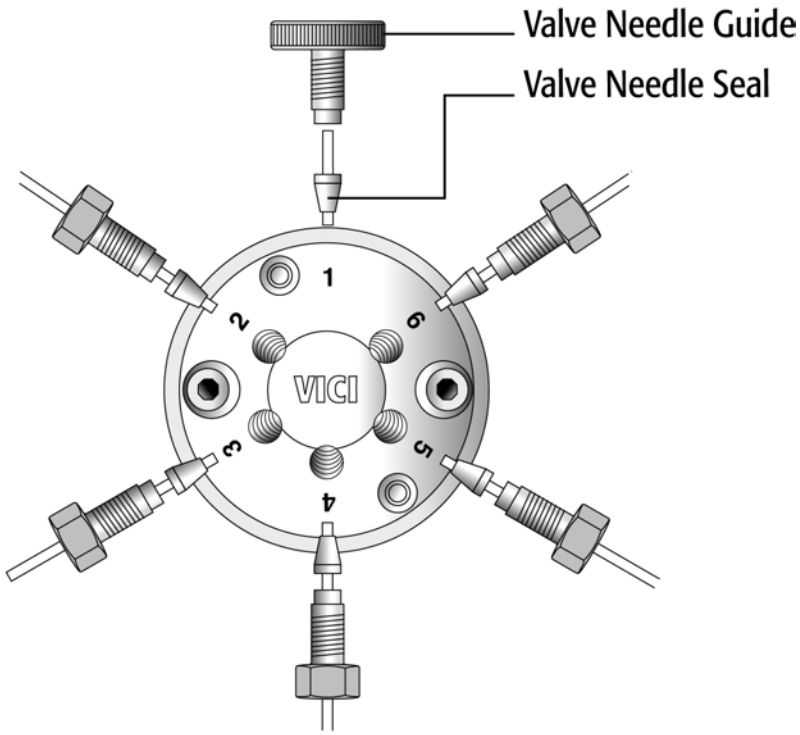


Figure 39. Valve Needle Guide and Valve Needle Seal
Example: Valco/VICI Cheminert Valve
(Needle Guide and seal for Valco Valve type W is identical).

Following Needle Guides are available:

- P/N MV 30-12 Needle Guide stainless steel for Gauge 22 needles
- P/N MV 30-16 Needle Guide PEEK for Gauge 22 needles
- P/N MV 30-52 Needle Guide stainless steel for Gauge 19 needles (marked with a groove at outer rim)

The valve needle guide holds the needle seal. The needle seal, which is a short length of Teflon® tubing, forms the seal around the syringe needle. A stainless steel ferrule is tightened around the Teflon® sleeve to ensure a leak-proof fit.

Following Needle Seals are available (package of 10 seals):

- P/N PAL NdlSeal	Teflon tube with stainless steel ferrule for Gauge 22 needles standard Seal for valve bore 0.25 and 0.40 mm, Teflon transparent
- P/N PAL NdlSealP	Teflon Tube with PEEK ferrule for Gauge 22 needles Seal for PEAK Valve bore 0.40 mm, Teflon transparent
- P/N PAL NdlSeal-19	Teflon Tube with stainless steel ferrule for Gauge 19 needles Seal for Prep-Valve, Bore 0.75 mm. Teflon blue color.

note !

For the PEAK Valve it is crucial that all ferrules used (for any connection) are made out of PEEK. Stainless steel ferrules are too hard. One does risk to crack the PEAK valve stator using a steel ferrule.

note !

To ensure reproducible sample injection and minimize carryover it is critical that:

- **The valve needle guide and the valve needle seal are installed properly.**
- **The valve needle seal is changed every 1500-2000 penetrations.**
- **The needle penetration depth is set accurately (see chapter 9.3, Injection Valve Needle Penetration).**

9.3 Injection Valve Needle Penetration

note !

Before performing the following steps, make sure the Object Position X Y Z for LC Vlv1 (LC Vlv2) are properly defined and a syringe adapter including a syringe is inserted in the Injection Unit (see chapter 7.2 and 8.3).

Complete the following steps to define the Valve Needle Penetration Depth:

1 In the Object Class "Injectors" choose the Object LC Vlv1. The following screen is displayed:

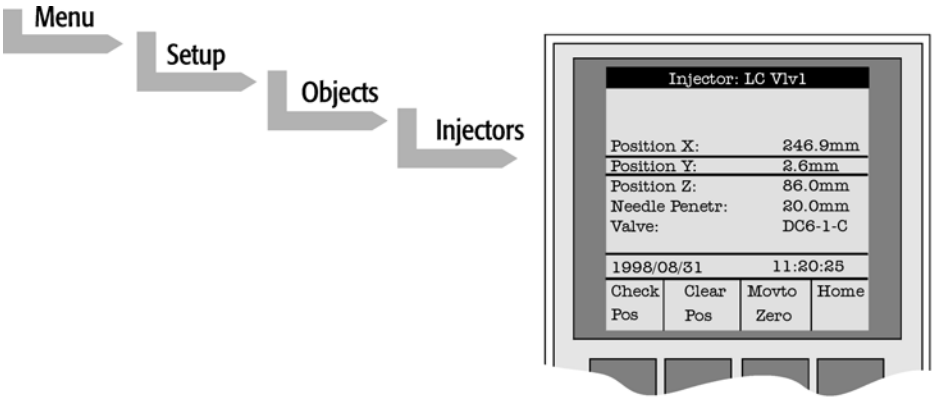


Figure 40. Menu Screen Valve Needle Penetration Depth

2 Press the **F1** button "Check Pos". The Injection Unit moves to the previous defined LC Vlv1position.

3 Highlight the item **Needle Penetr:** with the cursor bars and press ENTER.

4 **Slowly** rotate the outer knob to adjust the Needle Penetration Depth. The syringe moves down stepwise into the Injection port.

5 When the syringe needle tip enters the valve needle guide, **slow down** the Z movement again. Always observe the syringe needle during this operation step.

6 Move single step wise down until you notice a **"click"** sound inside the Injection Unit. **STOP** immediately the Z down movement.

7 Rotate the outer knob **two steps** in the opposite direction and press **ENTER** to save the Needle Penetration Depth value.

8 Press **F3** "Movto Zero".

9 Verify the defined Needle Penetration Depth value by repeating Step 2 and 3.

note !

After all positions have been set and the Valve Needle Penetration has been adjusted perform a backup of the existing configuration. (see Chapter 11 PAL Loader Program)

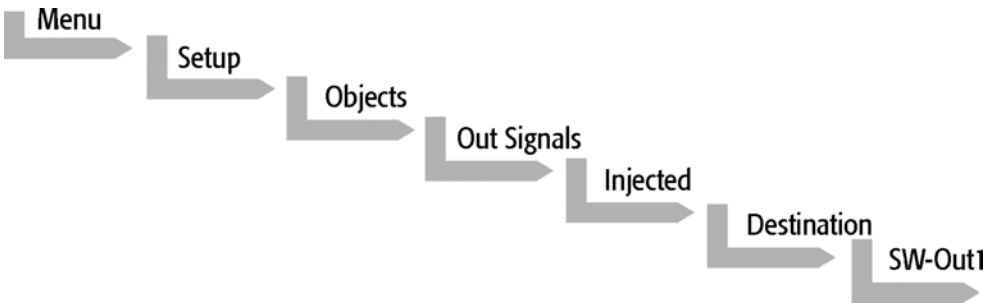
10. Interfacing the IFC PAL to Other Devices

10.1. Synchronization and Output Signals

Synchronization Signals **(Sync Signals)** are inputs that tell the HTS PAL when to wait or proceed with a sample processing step. Output Signals **(Out Signals)** are sent from the PAL to external devices to indicate status or completion of particular processing steps. These signals are classified as Objects. Physical Events (e.g.TTL-In1) are also Objects and may be assigned to named signals. PAL Cycles require that certain signals such as **"Start"**, **"Inject"**, and **"Injected"** be defined. See Table below for the PAL Events and signal assignments associated with the standard PAL **"LC-Inj"** Cycle (can be used for the IFC PAL System or for an "isolated" injection cycle).

The Synchronization Signal shall be set at the IFC PAL Injection Side only. The dedicated IFC PAL-Software will start the Collector side accordingly.

To assign a physical Event (e.g. SW-Out 1) to an existing signal Object ("Injected") complete the following menu selections:



PAL's are shipped with all Cycle events pre-defined as shown in the table below. If a different physical signal needs to be used, then it will be necessary to assign a new Event to the signal Object.

If a signal is to be ignored, then it's corresponding Event must be set to **"Immediat"**.

Standard Assignment for IFC PAL Injection Cycles	Description	Default Events	INTERFACE1 Pin #
Start (Sync Signal)	Start a cycle (Input from LC or data system)	TTL-In1	7 8(GND)
Inject (Sync Signal)	Inject READY to INJECT	Immediat (Ignore)	
Injected (Out Signal)	Is activated at the moment when the sample has been injected	SW-Out1	3 4
Running (Out Signal)	Active as long as the Job Queue is being processed and the PAL is not in an error state	Off	

11. PAL Loader Program

The following procedures require a PC with Windows 95/98/NT/2000/XP Operating System, the supplied PAL Loader program (Version 1.1 or higher), the supplied gray cable (Part RS9B-3000), and the correct version of the PAL firmware to be loaded.

11.1. Backing Up the PAL Control Program

note !

The following procedure should be performed after the installation of a new PAL System is completed. Furthermore, periodically System backups ensures that an updated configuration of the PAL is available any time.

Recommended practice is to create the following directory structure to store PAL firmware updates and backups:

Directory Path	Contents
C:\ProgramFiles\PAL\Loader\Backup\	Full backup files of current and previous PAL configurations; includes firmware and parameter settings; maintained for archival purposes
C:\ProgramFiles\PAL\Loader\Update\	Extracted "Update" files in Loader format (*.sss); may include firmware only or firmware and parameter settings

1 Shut off power to the PAL and the computer. Connect the supplied gray cable between the PAL **(SER1)** and a PC serial port.

2 Switch on power to the PAL. When the PAL Job Menu is displayed, start up the computer.

3 Double-click the PAL Loader icon, the PAL Loader screen appears.

Figure 41. PAL Loader menu screen

4 Click the "Backup" button. A dialog box entitled "Backup Target Memory" will be displayed. The path (storage location) and file name to be assigned to the new backup will be shown. A customized path and/or filename may be entered.

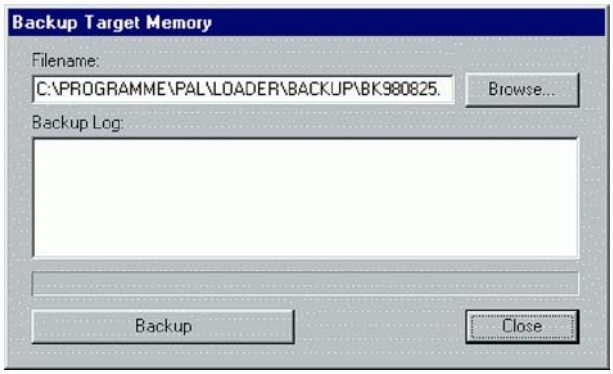


Figure 42. PAL Loader Backup Target Memory

5 Click the "Backup" button.

6 Backup will proceed and information on the backed up components will be displayed in the "Backup Log:" window. The process will take several minutes. The message **"Backup of Target Memory succeeded"** indicates a successful backup.

7 Click the "Close" button to exit the "Backup" dialog box. Click the **"Start PAL"** button to terminate control by the Loader program. On the Keypad terminal, the Job Queue screen is displayed.

8 Disconnect the RS-232 cable from the PAL.

11.2 Reloading a Backup

note !

This operation can potentially overwrite existing parameter settings. Methods created by the user will be overwritten.

The firmware file to be loaded must reside on the PC hard drive. The file cannot be loaded from a floppy drive. A full update (including parameter settings) will not fit on a single floppy diskette in the PAL Loader format. It must be transferred to the PC hard drive in compressed (*.zip) format and extracted into the "*.sss" file, which is the PAL Loader format.

Complete the following steps to reload a PAL backup:

1 Shut off power to the PAL and the computer. Connect the grey null modem cable between the PAL (SER1) and a PC serial port.

2 Switch on power to the PAL. When the PAL Job Menu is displayed, start up the computer.

3 Double-click the PAL Loader icon, the PAL Loader screen appears.

4 Click the "Update" button.

6 Click the "Browse" button and select the appropriate .sss backup file.

7 Click the "Open" button. The "Update Flash Memory" window will be displayed. The path and filename for the update file will be shown in the "Filename:" entry box.

8 Click the "Update" button to load the new firmware. The process will take several minutes. If the update is successfully completed, the message. **"Update of target memory succeeded"** will be displayed.

9 Click the "Close" button to exit the "Backup" dialog box. Click the **"Start PAL"** button to terminate control by the Loader program. On the Keypad terminal, the Job Queue screen is displayed.

10 Disconnect the RS-232 cable from the PAL.

12. Troubleshooting

note !

The HTS PAL represents always one of several components in a chromatography system. The following Troubleshooting Guide is limited to the HTS PAL only.

Symptom or Error Message	Possible Cause	Recommended Action
No or very low detector signal is observed.	The valve needle guide and / or needle seal are not properly installed.	Check valve needle guide and seal (see chapter 9.2, Valve Needle Guide).
	The valve ports are not plumbed correctly to the pump and/or detection system.	Check plumbing connections (see chapter 9.1, Injection valve flow path).
	Wrong valve type specified.	Check valve type by pressing Menu/Setup/Objects/Injectors/LC Vlv1/Valve.
	Clogged syringe.	Remove syringe and aspirate/dispense liquid manually. Clean syringe.
	Bent needle.	Inspect and/or change syringe.
	No sample liquid is injected.	Check and/or adjust Needle penetration into sample vial (see chapter 4.2).
	Sample volume too low.	Increase sample volume.
Mobile phase and/or sample flows out of the wrong ports on the LC injection valve.	The valve rotor is reversed (180° out of alignment).	Remove the rotor and reinstall in the correct position. Look for a letter (e.g. "H") stamped on the rotor. The letter must be on the lower half of the rotor (see chapter 13.3, Valve Rotor).
Sample is backing up on the valve needle guide.	Syringe needle OD too small.	Check the syringe needle for gauge 22.
	Valve needle seal leaks.	Change Valve needle seal (see chapter 9.2, Valve needle Guide).
	The needle penetration depth for the injection valve is not set correctly.	Adjust the Injection Valve Needle Penetration (see chapter 9.3).
	The Syringe Plunger Speed is too high resulting in excessive pressure in inlet.	Reduce Inject Speed in method.
Poor reproducibility	Syringe pressure differences when filling the syringe.	Increase Pullup Delay value.
	Vacuum created in sample vial.	Reduce sample volume in sample vial.
	High volatile solvent.	Use gastight syringe and sample tray cooling. Increase Pullup Delay value. Reduce Filling Speed in method.
	Not properly crimped vials.	Check vial cap by attempting to rotate by hand. Loose caps may cause selective loss of lighter components from sample. Adjust crimping tool correctly
Excessive carryover between samples	Dirty syringe and/or valve injection port.	Increase Pst Inj Slv1 and or/ Vlv Cln Slv1 values in method. Use PreClnSlv1 and PreClnSpl.
	Waste tubing I.D. at Injection valve is too small causing waste liquid to be pulled back, by capillary action, into the rotor groove.	Replace the waste tubing with larger I.D. tubing.
	Damaged or grooved valve rotor.	Replace valve rotor (see chapter 13.3, Valve Rotor).
	Valve needle seal leaks. Inappropriate wash solvent.	Change Valve needle seal (see chapter 9.2, Valve needle Guide). Use appropriate wash solvent.
Unexplained chromatographic peaks	Air is being introduced into the injection loop. Needle penetration depths may be inadequate causing air to be pulled into syringe.	Check and/or adjust Needle Penetration into sample vial (see chapter 4.2). Make sure the "Air Volume" Method parameter is set to zero.

Unexplained collisions of the Injection Unit	Object(s) not defined correctly.	Define Object(s) correctly (see chapter 7.1, Defining Object Positions).
Error Message "Object" Not Detected (Object e.g. Tray1, LCVlv1, Stk1-01)	Incorrect Z value for the affected Object (e.g. LC Vlv1, Tray1 or Stack1-01).	Redefine Z value for the affected Object (see chapter 7.1, Defining Object positions).
	Missing sample vial Deepwell or Microplate.	Insert sample vial, Deepwell or Microplate.
Error Message "Object" Collision before Z Tolerance ("Object" e.g. Tray1, LCVlv1, Stk1-01)	Incorrect Z value for the affected Object (e.g. LC Vlv1, Tray1 or Stack1-01).	Redefine Z value for the affected Object (see chapter 7.1, Defining Object positions).
Error Message Motor AUX1(AUX2) failed	Injection valve drive not connected.	Switch OFF PAL and check connection between PAL and LC Vlv1 (see chapter 6.3).
	Defective LC Vlv1 Connection cable	Change connection cable
	MOTIO Board defective.	Replace MOTIO Board (see chapter 13.1, MOTIO Board).

13. Replacing Parts

13.1 MOTIO Board

1 Follow the sequence shown in Figure 43 to detach and release the MOTIO board from its position inside the X Crossrail.

2 Carefully pull the two flat cable connectors upwards to free from the board.

3 Install the replacement board in the reverse order.

note ! **After reconnecting the two flat cables to the board ensure that the cables are folded flat and can be slid inside the cross-rail without damage.**

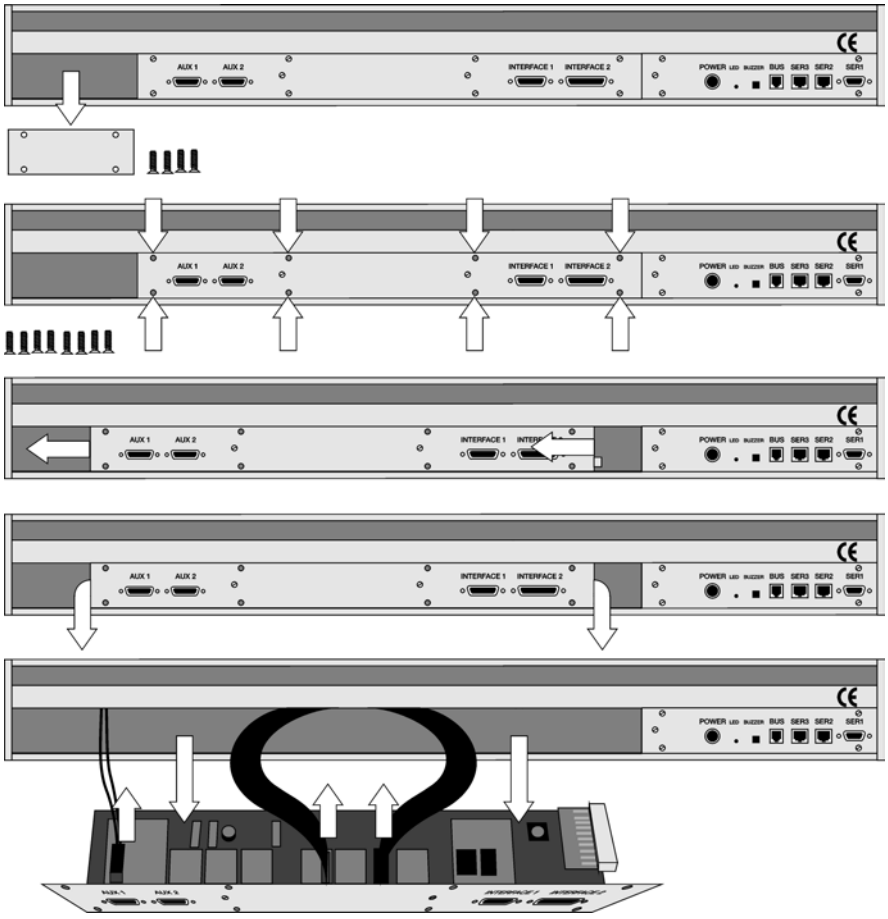


Figure 43 Replacing MOTIO Board

13.2 Control Board

1 Follow the sequence shown in Figure 44 to detach and release the Control board from its position inside the X Crossrail.

2 Carefully pull the two flat cable connectors upwards to free from the board.

3 Install the replacement board in the reverse order.

note ! **After reconnecting the two flat cables to the board ensure that the cables are folded flat and can be slid inside the cross-rail without damage.**

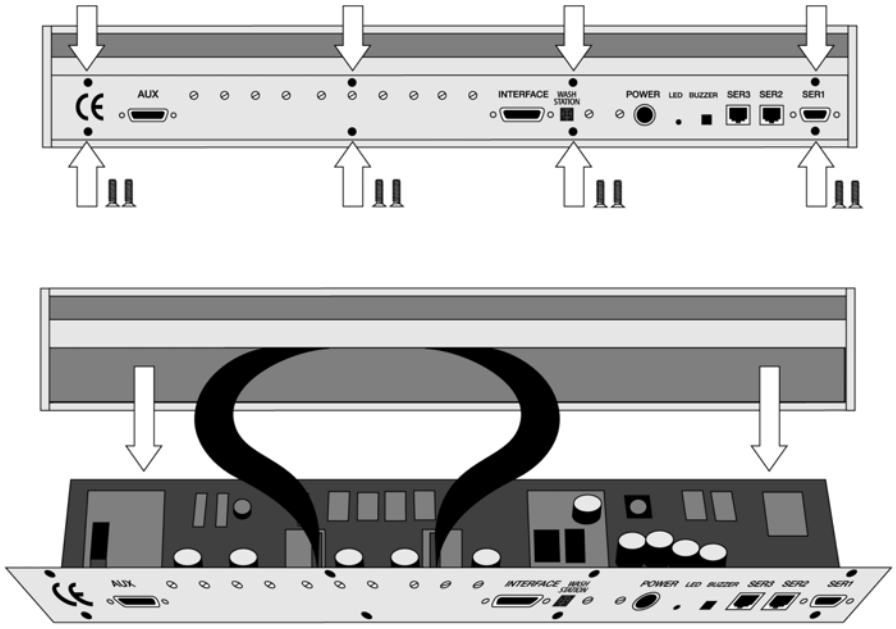


Figure 44. Replacing Control Board

13.3 CPU Board

1 Remove the right end cover of the Crossrail (facing the rear of the chassis).

2 Slide the CPU board out and towards the right end of the Crossrail. This is necessary because the CPU board mates on its left side with a connector on the MOTIO board.

3 Install the replacement board in the reverse order

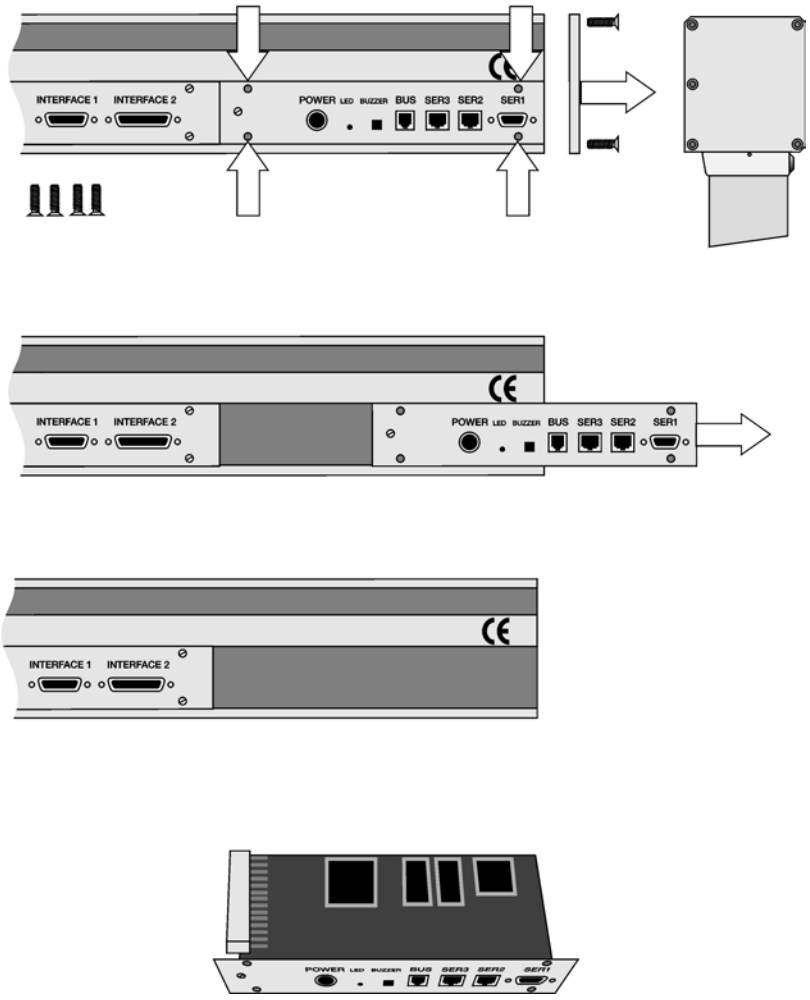


Figure 45 Replacing CPU Board

13.4 Injection Valve and Valve Rotor

13.4.1 Standard LC Injection valve Valco /VICI Cheminert, Flat Plate Rotary Valve.

To replace and/or clean the Cheminert injection valve follow the steps as shown in Figure 46.

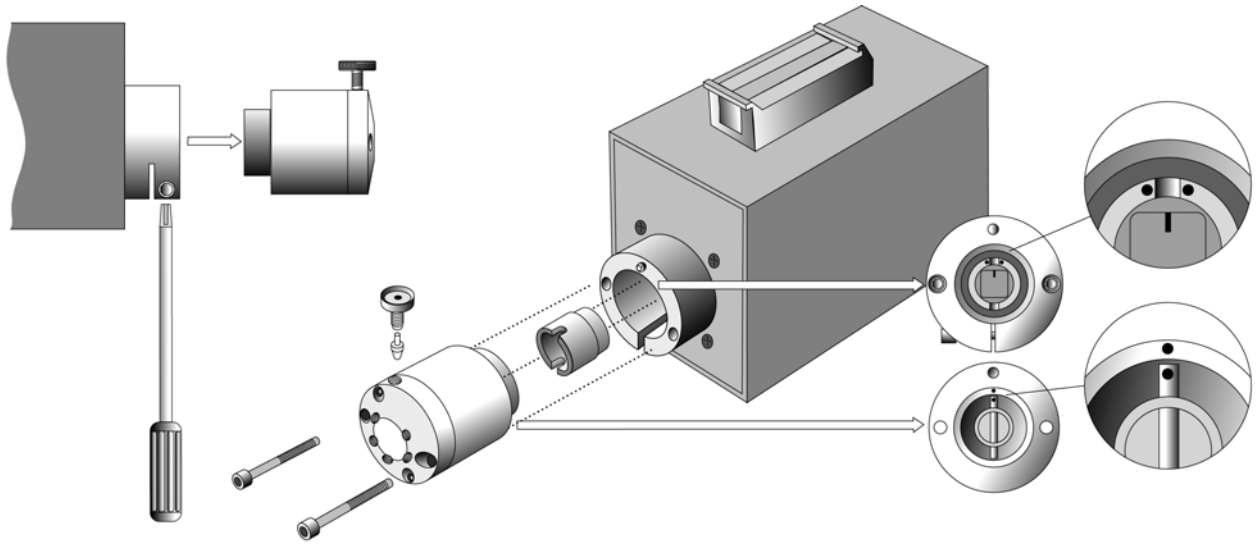


Figure 46. Replacing the Standard LC Injection Valve, Valco/VICI Cheminert

1 Remove the sample loop, needle guide fitting and connection tubes from the valve body. See Figure 35, left picture.
(It is a good practice to label the connection tubes before removal.)

2 Unscrew to the hex screw, which holds the valve to the valve drive

3 Check that the valve guiding pin remains at it's position

4 Install the replacement valve in the reverse order

Valve Rotor LC Standard Valve
Valco/VICI Cheminert, Flat Plate Rotary Valve

To replace and/or clean the Cheminert valve rotor follow the steps shown in Figure 47

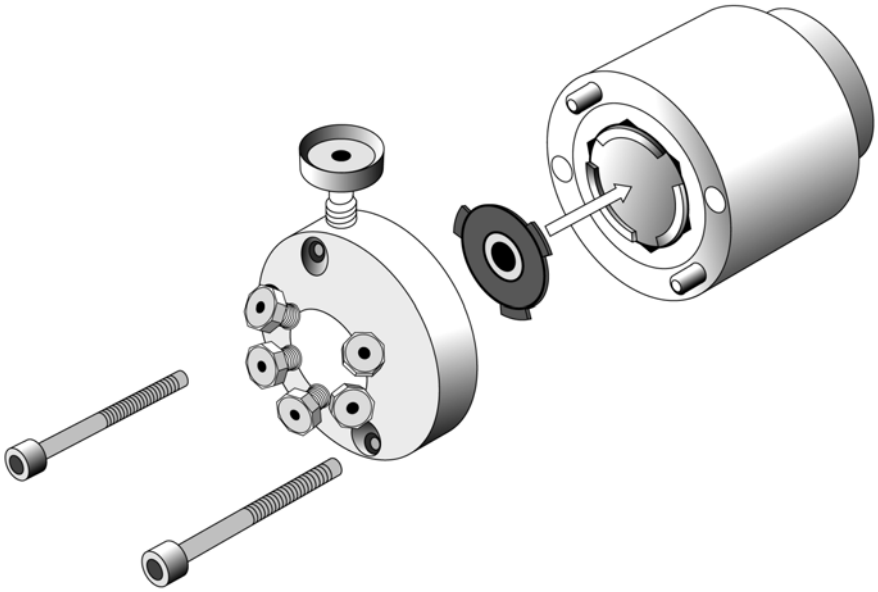


Figure 47. Replacing Cheminert Valve Rotor

1 Unscrew the two hex screws retaining the stator.

2 Remove the old rotor with an appropriate tool.

3 If necessary clean the surfaces without scratching the metal parts.

4 Insert the new rotor, press the polymer disk carefully into position.

5 Put the stator back on, tighten the two hex screws.
The valve is ready for use at the factory-set pressure.

note !

In the event of damage of the stator, replacements or factory refinishing are available.
The rotor material is Valcon H for HPLC use. The type of material is not marked on the valve.

13.4.2Optional Injection Valve Type W and Valve Rotor

Injection valve Type W

To replace and/or clean the injection valve follow the steps shown in Figure 48.

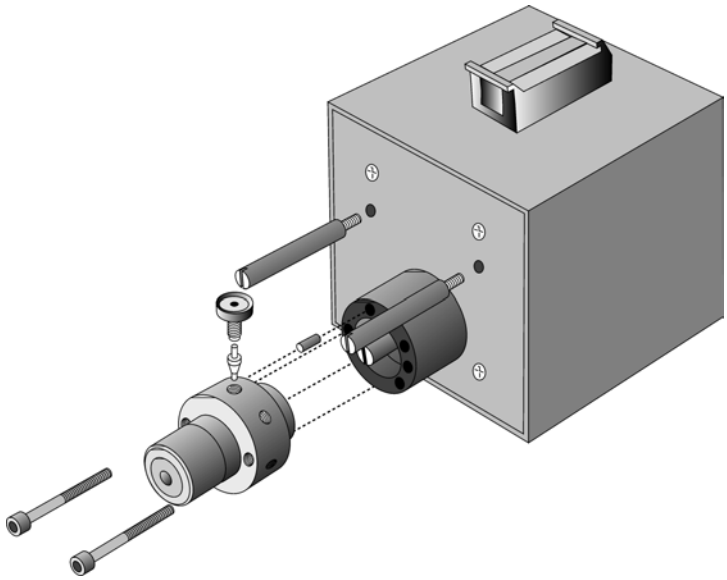


Figure 48 Replacing the Injection Valve, Valco Type W

1 Remove the sample loop, needle guide fitting and connection tubes from the valve body.
2 Unscrew to the hex screws, which hold the valve to the valve drive
3 Check that the valve guiding pin remains at it's position
4 Install the replacement valve in the reverse order

Valve Rotor

To replace and/or clean the valve rotor follow the steps shown in Figure 49

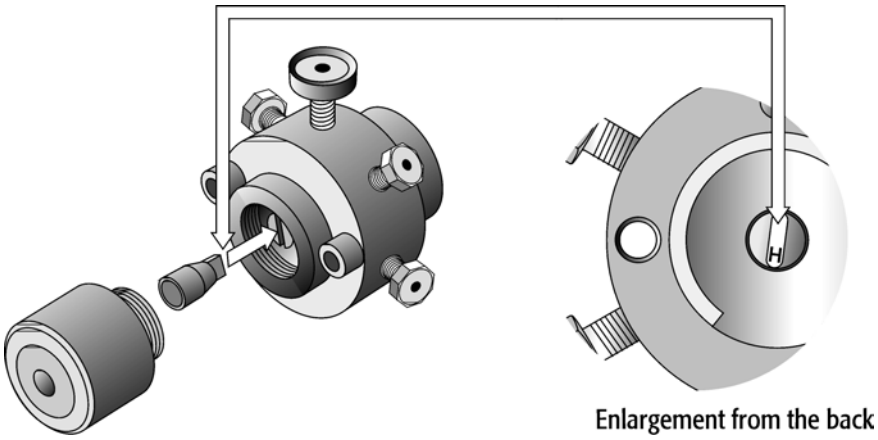


Figure 49 Replacing Valve Rotor, Valco Type W

1 Do not remove the valve from the valve drive or any tubing or the loop
2 Unscrew the knurled pre-load assembly. Do not tamper with the preset socket adjustment screw.
3 Engage the end of the rotor with a magnet or a pair of tweezers.
4 Locate the letter (e.g. "H") stamped on the new or cleaned rotor and orient the letter to the lower half of the valve.
5 Insert the new rotor. Make sure the rotor tab fits into the slot in the valve drive.
6 Replace the knurled pre-load assembly.
7 Tighten the pre-load assembly. It must end up fully bottomed-out.

13.4 Injection Unit

Follow the sequence of steps shown in chapter 6.2 Assembling the IFC PAL.

13.5 Wash Station

Follow the sequence of steps shown in chapter 6.2 Assembling the IFCPAL.

14. Maintaining the IFC PAL System

14.1 General Maintance

Regularly performing maintenance helps ensure accuracy and precision of the PAL System. Suggested intervals for maintenance procedures to ensure uninterrupted operation are given below.
If you use the system heavily (for example, nights and weekends), or if you use aggressive solvents, you may need to perform the maintenance procedure more frequently.

Maintenance Step	Interval
Clean the outside of the instrument. Use only a soft lint-free paper or cloth dampened with mild soap and water.	Weekly or as needed
Clean Instrument, syringe and surfaces	Weekly or as needed.
Replace the valve needle seal	Every 1500 to 2000 penetrations (Check the tightness of the needle in the needle seal)
Replace the valve rotor	Replace the valve rotor: Annually or more a year, depending on the throughput and quality of the sample solution and Mobile Phase.
Replace the syringe plunger	Syringe Plunger has to be replaced on a regular base. The interval is highly dependent on the application, throughput, quality of sample solution(particles, etc.) washing solvent. It is advisable to check the tightness of the plunger on a regular base to gain the experience with the own application.

The other steps are described in the “Preventative Maintenance Procedure”.
Specific kits for the GC or the HPLC techniques are available. The kits include the parts which shall be changed annually.
PM Kit1 for HPLC and PM Kit2 for GC technique.

note ! There are no operator-serviceable or replaceable parts inside the power supply(ies) or the PAL System. In case of any failure, contact a representative of CTC Analytics.

14.2 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 removable 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)

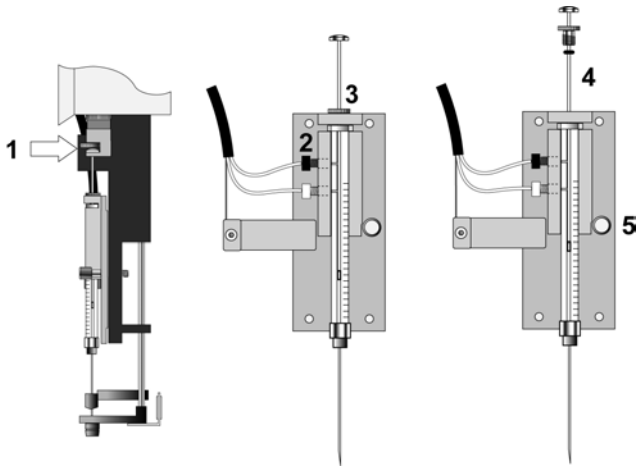


Figure 50 Exchanging the Sideport Syringe

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

Appendices

A. Definition of Terms

Job Queue

A Job Queue is a list of sample processing Jobs. Jobs are executed in the order displayed on the JOB QUEUE menu screens. New Jobs may be added to the queue while samples are being processed.

Job

A Job contains the information needed by the PAL to process multiple samples by the same processing steps. The elements of a Job are a Method and a Tray that defines the location of the samples to be processed. For identification, Jobs are automatically numbered from 01 to 99 and then restarting with 01 when they are added to the Job Queue.

Cycle

A Cycle consist of the specific operations necessary to process one sample. The Cycle operations are repeated for each sample within a Job. Cycles are designed for specific applications. The Standard HTS PAL Cycle is named LC-Inj.

Method

A Method defines how the samples are processed. The elements of a Method are a Cycle, a Syringe and a Parameter List. Methods have names with up to 8 characters and can be edited, copied, and deleted.

Method Parameters

Method Parameters are associated with the Cycle operations. User-assigned Parameter values define how a processing operation is performed. A zero Parameter value will disable a Cycle operation. Cycle parameters are application-specific.

Object

Objects are data structures describing the properties of physical modules. Certain modules (e.g. a Stack) require several objects.

Trayholder

A Trayholder can hold one or more trays. Each Trayholder has a reference position (X, Y, Z co-ordinates) that defines it's location.

Stack

A Stack is a particular type of Trayholder, that is designed to hold micro-plates. A six-drawer Stack holds 12 standard micro-plates two in each drawer. A three-drawer Stack holds six deep-well micro-plates two in each drawer.

Tray

A Tray that holds multiple samples. Trays are defined by designating the Tray Type (see below) and the Trayholder. Tray names are used to identify the sample source within a PAL Job.

Tray Type

A Tray Type defines the pattern and sampling sequence of sample locations within a Tray. Standard Tray Types include shallow and deep-well 96-position Microplates and Trays that hold 1, 2, 10, and 20ml vials.

B. Conventions of Naming

This section recommends standard naming conventions for HTS PAL Trays, Tray Types, and Tray holders. Following these conventions will allow HTS PAL's to be pre-configured for certain applications, will simplify software backups and application development, and will improve technical support and training.

Tray Type	Tray Description
MT96	Standard 96-position microplates
DW96	Deep well 96-position microplates
MT384	High density 384-position microplates
VT200	Vial Tray, 200 positions (10 X 20) for 7mm micro-vials, 1.0 ml
VT98	Vial Tray, 98 positions (7 X 14) for 12mm vials, 2.0 ml
VT78	Vial Tray, 78 positions (6 X 13) for 7mm micro-vials, 1.0ml (opposite side of 98 positions Tray)
VT54	Vial Tray, 54 positions (6 X 9) for 12mm vials, 2.0 ml (6 Trays may be used in Deep-well Stack PAL Stack6DW)
FC21-55	Fraction Collector Vial Tray, 21 positions (3 x 7) for 25 mm OD reagent tubes, 150 mm height , 55 ml
FC39-35	Fraction Collector Vial Tray, 39 positions (3 x 13) for 20 mm OD reagent tubes, 150 mm height , 35 ml
FC50-27	Fraction Collector Vial Tray, 50 positions (5 x 10) for 18 mm OD reagent tubes, 150 mm height , 27 ml
FC50-16	Fraction Collector Vial Tray, 50 positions (5 x 10) for 16 mm OD reagent tubes, 150 mm height , 16 ml
FC 78-09	Fraction Collector Vial Tray, 78 positions (6 x 13) for 13 mm OD reagent tubes, 150 mm height , 9 ml

C. Injection Cycles

HTS PAL "LC-Inj" Cycle

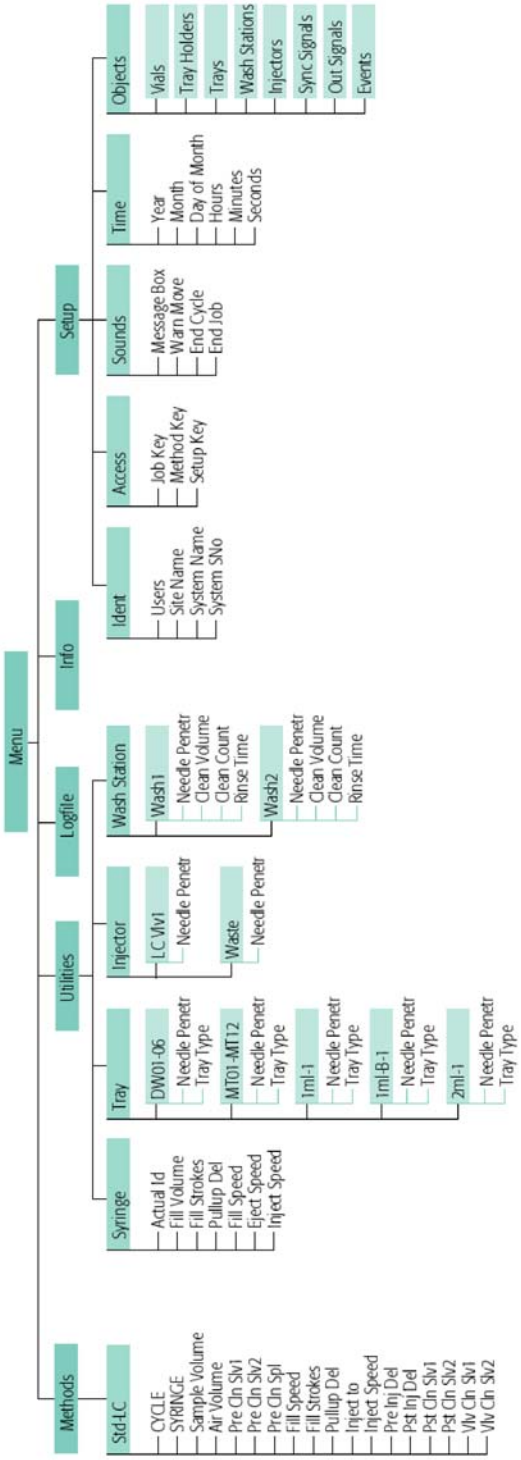
No.	Processing Step	Method Parameter	Object	(Class)	Used Object Value
1	Reference X, Y, Z axis and syringe plunger			(System)	Start Ref = ON
2	Wait for Start signal		Start	(Sync Signals)	
3	Read Barcode if enabled		TRAY	(Tray Type)	Barcode • None
4	Syringe wash strokes with solvent from Wash1	Pre Cln Slv1	SYRINGE Wash1	(Syringes) (Wash Stations)	Fill Speed Eject Speed Needle Penetr Clean Volume Max Fill Speed Max Eject Speed
5	Syringe wash strokes with solvent from Wash2	Pre Cln Slv2	SYRINGE Wash2	(Syringes) (Wash Stations)	Fill Speed Eject Speed Needle Penetr Clean Volume Max Fill Speed Max Eject Speed
6	Rinse syringe with sample selected number of times	Pre Cln Spl Sample Volume Fill Speed Pullup Delay	SYRINGE TRAY Waste	(Syringes) (Tray Type) (Injectors)	Eject Speed Fill Volume Needle Penetr Needle Penetr
7	Fill syringe with sample using several filling strokes; aspirate air outside of vial if Air Volume • 0	Sample Volume Air Volume Fill Speed Fill Strokes Pullup Del	SYRINGE TRAY	(Syringes) (Tray Type)	Eject Speed Overfill Fill Volume Needle Penetr
8	Move to injection valve	Inject to			
9	Wait for Inject signal		Inject	(Sync Signals)	
10	Drive needle to penetration depth	Inject to		(Injectors)	Needle Penetr
11	Delay	Pre Inj Del			
12	Switch valve to Active position				
13	Activate Injected signal		Injected	(Out Signals)	Pulse Time
14	Activate Injectd+Signal				
15	Dispense syringe contents into sample loop	Inject Speed			
16	Delay	Pst Inj Del			
17	Switch valve to Standby position				
18	Retract needle from injector				
19	Clean syringe and needle with solvent from Wash1	Pst Cln Slv1	SYRINGE Wash1	(Syringes) (Wash Stations)	Fill Speed Eject Speed Needle Penetr Clean Volume Max Fill Speed Max Eject Speed

20	Clean syringe and needle with solvent from Wash2	Pst Cln Slv2	SYRINGE (Syringes) Wash2 (Wash Stations)	Fill Speed Eject Speed Needle Penetr Clean Volume Max Fill Speed Max Eject Speed
21	Rinse valve inlet with solvent from Wash1	Vlv Cln Slv1	SYRINGE (Syringes) Wash1 (Wash Stations)	Fill Speed Inject Speed Needle Penetr Clean Volume Max Fill Speed Max Eject Speed
22	Rinse valve inlet with solvent from Wash2	Vlv Cln Slv2	SYRINGE (Syringes) Wash1 (Wash Stations)	Fill Speed Inject Speed Needle Penetr Clean Volume Max Fill Speed Max Eject Speed
23	Move to Home position		Home (Positions)	

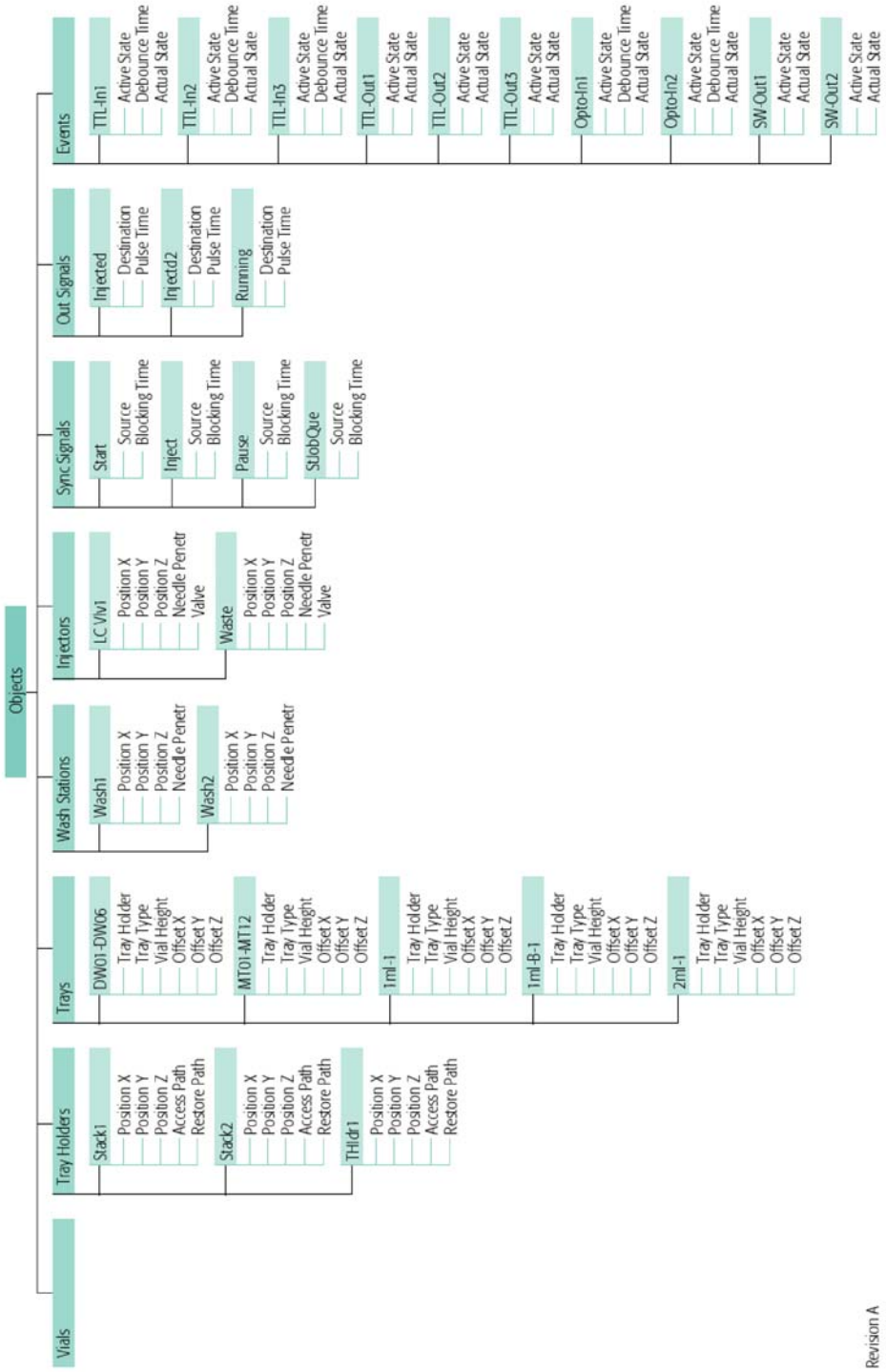
"LC-Inj" Cycle Parameter Description

Parameter	Description
CYCLE	LC-Inj Cycle
SYRINGE	Selected syringe
Sample Volume	Selected sample volume
Air Volume	Volume aspirated after the syringe needle is moved out of the sample liquid
Pre Cln Slv1	Pre injection syringe wash strokes with solvent from Wash1
Pre Cln Slv2	Pre injection syringe wash strokes with solvent from Wash2
Pre Cln Spl	Pre injection syringe rinse cycles with sample
Fill Speed	Speed of plunger movement used to aspirate sample
Fill Strokes	Number of filling strokes to aspirate sample
Pullup Del	Delay time between sample pull-up and ejection
Inject to	Name of Injector used for injection
Inject Speed	Speed of plunger movement used during sample injection
Pre Inj Del	Delay time prior sample injection
Pst Inj Del	Delay time after sample injection
Pst Cln Slv1	Post injection syringe wash strokes with solvent from Wash1
Pst Cln Slv2	Post injection syringe wash strokes with solvent from Wash2
Vlv Cln Slv1	Valve rinse cycles with solvent from Wash1
Vlv Cln Slv2	Valve rinse cycles with solvent form Wash2

D. HTS PAL Software Flow Chart

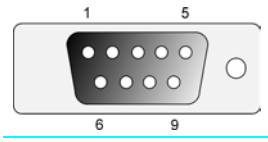


Revision A


Objects
Events
TTL-In1
Active State
Debounce Time
Actual State
TTL-In2
Active State
Debounce Time
Actual State
TTL-In3
Active State
Debounce Time
Actual State
TTL-Out1
Active State
Actual State
TTL-Out2
Active State
Actual State
TTL-Out3
Active State
Actual State
Opto-In1
Active State
Debounce Time
Actual State
Opto-In2
Active State
Debounce Time
Actual State
SW-Out1
Active State
Actual State
SW-Out2
Active State
Actual State
Out Signals
Injected
Destination
Pulse Time
Inject2
Destination
Pulse Time
Running
Destination
Pulse Time
Sync Signals
Start
Source
Blocking Time
Inject
Source
Blocking Time
Pause
Source
Blocking Time
StobQue
Source
Blocking Time
Injectors
LC Vlv1
Position X
Position Y
Position Z
Needle Penetr
Valve
Waste
Position X
Position Y
Position Z
Needle Penetr
Valve
Wash Stations
Wash1
Position X
Position Y
Position Z
Needle Penetr
Wash2
Position X
Position Y
Position Z
Needle Penetr
Trays
DW01-DW06
Tray Holder
Tray Type
Vial Height
Offset X
Offset Y
Offset Z
MT01-MT12
Tray Holder
Tray Type
Vial Height
Offset X
Offset Y
Offset Z
1ml-1
Tray Holder
Tray Type
Vial Height
Offset X
Offset Y
Offset Z
1ml-B-1
Tray Holder
Tray Type
Vial Height
Offset X
Offset Y
Offset Z
2ml-1
Tray Holder
Tray Type
Vial Height
Offset X
Offset Y
Offset Z
Tray Holders
Stack1
Position X
Position Y
Position Z
Access Path
Restore Path
Stack2
Position X
Position Y
Position Z
Access Path
Restore Path
THldr1
Position X
Position Y
Position Z
Access Path
Restore Path
Vials
Revision A

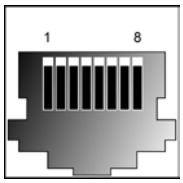
E. External Connectors

Connector SER1



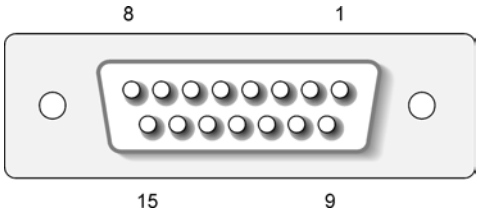
Pin	Signal Name
1	DCD
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI

Connector SER2 / SER3



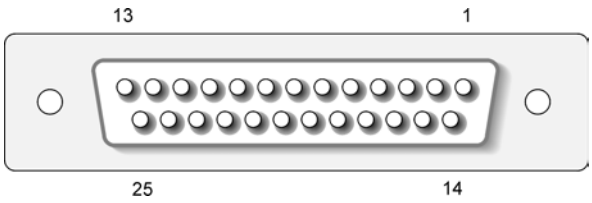
Pin	Signal Name
1	GND
2	RXD
3	TXD
4	RTS
5	CTS
6	+5V
7	reserved
8	reserved

Connector INTERFACE 1



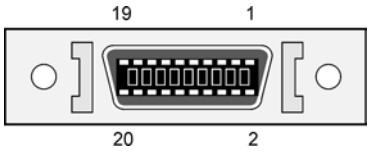
Pin	Signal Name
1	Pwr-Out1 +
2	Pwr-Out2 +
3	SW-Out1 NO
4	SW-Out1 COM
5	SW-Out2 NO
6	Opto-In1 +
7	TTL-In1
8	GND
9	Pwr-Out1 -
10	Pwr-Out2 -
11	TTL-In2
12	SW-Out2 COM
13	TTL-In3
14	Opto-In1 -
15	+5V

Connector INTERFACE 2



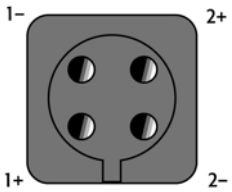
Pin	Signal Name
1	TTL-In1
2	TTL-In2
3	TTL-In3
4	TTL-Out1
5	TTL-Out2
6	TTL-Out3
7	Opto-In1 +
8	Opto-In2 +
9	SW-Out1 NO
10	SW-Out2 NO
11	Pwr-Out1 +
12	Pwr-Out2 +
13	+5V
14-19	GND
20	Opto-In1 –
21	Opto-In2 –
22	SW-Out1 COM
23	SW-Out2 COM
24	Pwr-Out1 –
25	Pwr-Out2 –

Connector AUX1 / AUX2 MOTIO and Control Board



Pin	Signal Name
1,3	Motor A1
2,4	Motor A2
5,7	Motor B1
6,8	Motor B2
10,16,18	GND
11	Temp +
12	Temp –
13	Sens
14	+5V
15,17	Heater
19,20	+36V

Connector WASHSTATION Control Board



Pin	Signal Name
1+	Pwr-Out1+
1-	Pwr-Out1-
2+	Pwr-Out2+
2-	Pwr-Out2-