



WORLD
PRECISION
INSTRUMENTS

LWCC Continuous Flow Injection System

Instruction Manual

89372-2

Serial No. _____

www.wpi-europe.com

190622

CONTENTS

ABOUT THIS MANUAL 3

INTRODUCTION 4

 Warnings and Cautions..... 4

INSTRUMENT DESCRIPTION 5

 Parts List 5

 Parts for Connecting to the LWCC 5

 Unpacking..... 5

 Description 6

 Front Panel 6

 Injection Valve Schematic..... 7

OPERATING INSTRUCTIONS..... 8

 Setting up the LWCC-INJECTION-SYS 8

 Calculating the Volume of the Sample Loop 10

 Injecting a Sample in the LWCC..... 11

INSTRUMENT MAINTENANCE..... 13

 Cleaning the System 13

ACCESSORIES 14

SPECIFICATIONS..... 14

WARRANTY 15

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ABOUT THIS MANUAL

The following symbols are used in this guide:



This symbol indicates a CAUTION. Cautions warn against actions that can cause damage to equipment. Please read these carefully.



This symbol indicates a WARNING. Warnings alert you to actions that can cause personal injury or pose a physical threat. Please read these carefully.

NOTES and TIPS contain helpful information.



Fig. 1 – LWCC-INJECTION-SYS

INTRODUCTION

The LWCC-Injection-SYS, together with a pump and liquid waveguide capillary cell (LWCC) or UltraPath cell, provides an efficient, continual flow for injecting a sample through the LWCC. This system minimizes contamination and the formation of tiny bubbles that interfere with spectroscopic data recording. The pump provides a constant flow rate and pressure for the sample delivery.

Warnings and Cautions



Flowing liquids containing particles through the LWCC-INJECTION-SYS may result in blockage of your flow system. WPI recommends filtering particles through a 0.2µm or smaller filter



DO NOT USE THE FOLLOWING CHEMICALS WITH THIS SYSTEM: bases, nitric acid, sulfuric acid, halogenated acids (like hydrofluoric acid, hydrobromic acid, and hydroiodic acid) or pure halogenated gasses.

Methylene chloride, THF and DMSO may cause tubing to swell. Use with caution. Refer to Table 1 (below) for details.



The pump must always pull from the solution bottles and send solution into Port 6 of the Injection Valve. Plumbing the pump backwards can contaminate your solutions.



DO NOT USE SCISSORS OR A DULL BLADE TO CUT PEEK TUBING. To avoid crimping the tubing, use only a PEEK cutting tool, a new razor blade or X-acto knife.

Table 1: Wetted Materials Compatibility Chart

<i>Solvent</i>	<i>Vespel®</i>	<i>Teflon®/PFA</i>	<i>PEEK®</i>
<i>Aromatics</i>	R	R	R
<i>Chlorinated</i>	R	R	M
<i>Ketones</i>	R	R	R
<i>Aldehydes</i>	R	R	R
<i>Ethers</i>	R	R	M
<i>Amines</i>	M	R	R
<i>Aliphatic Solutions</i>	R	R	R
<i>Organic Acids</i>	M	R	M
<i>Inorganic Acids</i>	M	R	M
<i>Bases</i>	NR	R	R
<i>Sulfonated Compounds</i>	M	R	M

M: Some solvents are not acceptable. See the caution above.

R: Recommended

NR: Not recommended

INSTRUMENT DESCRIPTION

Parts List

- LWCC-INJECTION base unit
- Start-up kit, including
 - Flangeless fittings
 - Tubing (PEEK and PFA) already cut to length
 - 2 x 250 mL Reservoir bottles for reference solution and waste
 - 4 x 20 mL Vials for cleaning solutions and samples
 - 4m natural PFA tubing for Sample Loop

Parts for Connecting to the LWCC

The following parts are needed to set up this system, but are not included:

- Peristaltic Pump
TIP: The MiniStar (WPI #MINISTAR) or PeriStar Pro (WPI #PERIPRO) are recommended.
- Sample Cell (WPI #LWCC, #ULTRAPATH or cuvettes)
- Spectrophotometer or a light source and spectrometer

If using the LWCC-5100AF or LWC-5200AF it is recommended that you order the wider 1.6mm ID sample loop (WPI# LOOP-5ML) which includes a 2.5m sample tubing loop and connectors to fit the sample loop to the LWCC Injection System.

Unpacking

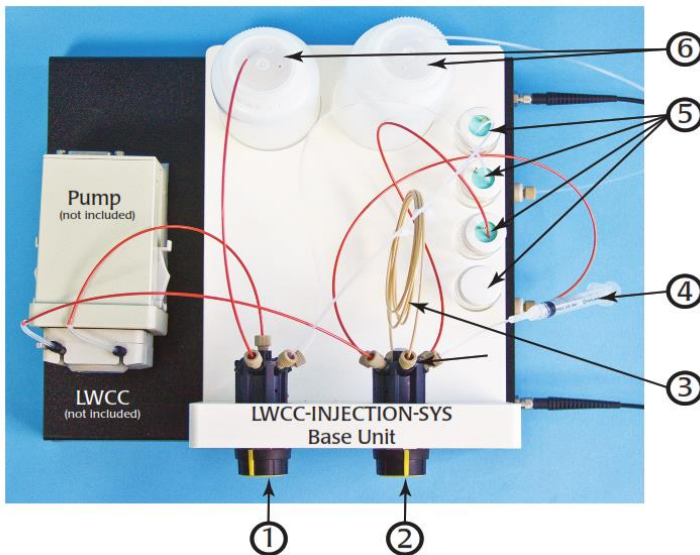
Upon receipt of this instrument, make a thorough inspection of the contents and check for possible damage. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed damage should be reported at once to the carrier and an inspection requested. Please read the section entitled “Claims and Returns” on page 15 of this manual. Please contact WPI Customer Service if any parts are missing.

Returns: Do not return any goods to WPI without obtaining prior approval (RMA # required) and instructions from WPI’s Returns Department. Goods returned (unauthorized) by collect freight may be refused. If a return shipment is necessary, use the original container, if possible. If the original container is not available, use a suitable substitute that is rigid and of

adequate size. Wrap the instrument in paper or plastic surrounded with at least 100mm (four inches) of shock absorbing material. For further details, please read the section entitled “Claims and Returns” on page 15 of this manual.

Description

- 1 **Selection Valve** dial lets you choose one of up to six liquids to move through the system.
- 2 **Injection Valve** dial controls whether the system is loading the sample loop or injecting the selected fluid.
- 3 Sample Loop is a measured length of tubing that holds three to five times the liquid volume of the Sample Cell (LWCC).
- 4 Induction Syringe used to draw an adequate volume of sample solution into the Sample Loop, ensuring that the Sample Loop is full and bubble-free.
- 5 20 mL Glass Vials (4) hold cleaning or sample solutions that can be run through the system.
- 6 250 mL Plastic Reservoir Bottles hold the reference solution and waste liquid.



Front Panel

The front panel of the LWCC-INJECTION-SYS has two knobs. The one on the left is the Selection Valve, and it determines which solution (cleaning or reference) is pumped through the system. The one on the right is the Injection Valve, and it is used to introduce a sample into the fluid

stream for analysis. While the plumbing of your own experiment depends on your requirements and preferences, "Setting up the LWCC-INJECTION-SYS" on page 8 describes the suggested set up.

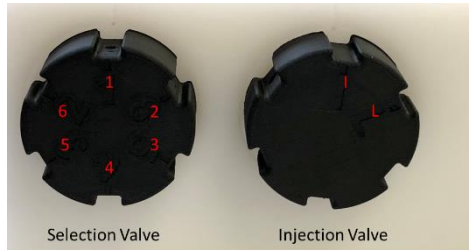


Fig. 3 – System Front Panel

Injection Valve Schematic

Fig. 4 shows the system schematic highlighting the two modes of the Injection Valve. (See Fig. 5 for a system plumbing diagram.) In Load mode the pump continually runs the selected solution (usually reference) through the Sample Cell only. In this mode the syringe can be used to draw sample solution into the Sample Loop, loading the Sample Loop so that it is ready for introduction into the fluid flow path. In inject mode the Sample Loop is included in the fluid flow path, and the pump pushes solution through the Sample Loop and the Sample Cell.

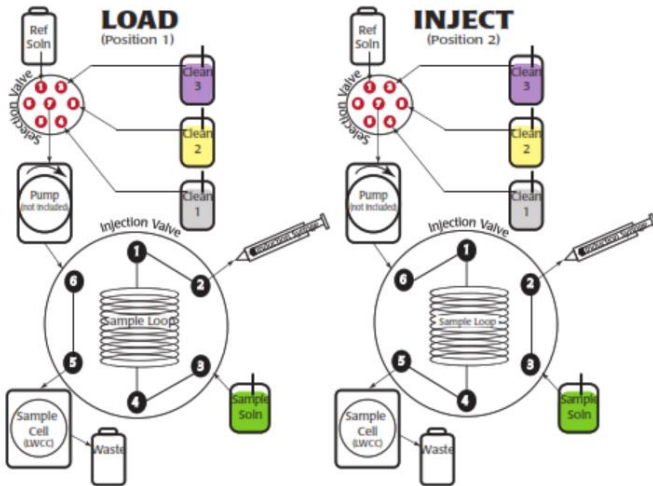


Fig. 4 – Injection Valve Schematic

OPERATING INSTRUCTIONS

Setting up the LWCC-INJECTION-SYS

For ease of set up, the base unit is shipped with most of the tubing (with flangeless fittings assembled) pre-installed. To set up the LWCC-INJECTION-SYS, simply insert the open end of the tubing in the appropriate places as described on the next page. All the Selection and Injection Valve ports are labelled with numbers. The numbers are raised, black symbols located on the back of the valve near the position of each connection. The numbers on the front of the base unit correspond with the numbers embossed on the back of the Selection Valve.

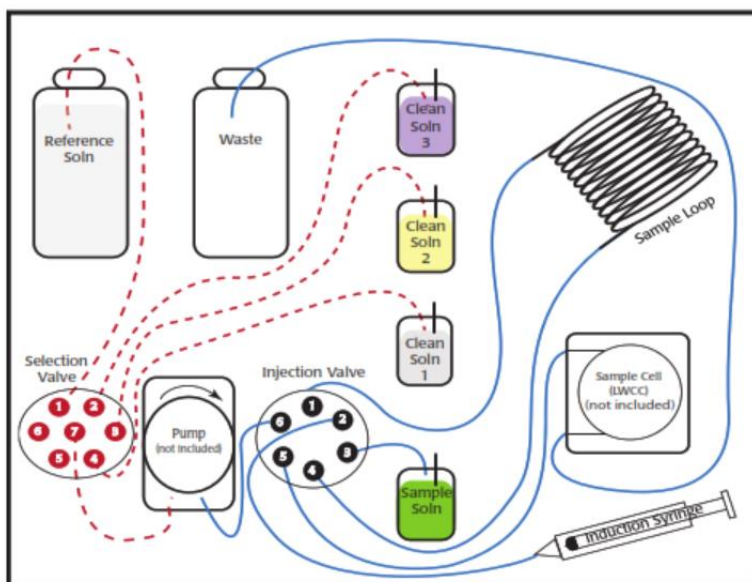


Fig. 5 - Plumbing connections of LWCC-INJECTION-SYS. Red, dashed lines indicate Selection Valve connections. Blue, solid lines indicate Injection Valve connections.



CAUTION: The pump must always pull from the solution bottles and send solution into Port 6 of the Injection Valve. Plumbing the pump backwards can contaminate your solutions.

Refer to Figure 5 when making connections.

NOTE: The setup instructions refer to the embossed numbers printed on the valves.

1. Make connections to the Selection Valve. Insert the tubing from the Selection Valve ports into the designated positions according to the chart below:

Port #1	Reference Solution Bottle
Port #2	Cleaning Solution 3
Port #3	Cleaning Solution 2
Port #4	Cleaning Solution 1
Port #5	For Future Use
Port #6	For Future Use
Port #7 (centre)	Peristaltic Pump input

2. Assemble the Sample Loop of natural PEEK tubing (0.040" ID).
 - Determine the appropriate length of sample loop tubing. The volume of the sample loop should be between three and five times the volume of the LWCC sample cell. It is best to start with the largest volume and make it smaller if experimentation with the sample yields satisfactory results with a shorter coil. NOTE: See "Calculating the Volume of the Sample Loop" on page 8 for information on choosing an appropriate length for the Sample Loop
 - Cut the tubing to the appropriate length with a razor blade, leaving a square cut face and a burr-free edge. Coil the tubing and secured it with a zip tie.



DO NOT USE SCISSORS OR A DULL BLADE TO CUT PEEK TUBING. To avoid crimping the tubing, use only a PEEK cutting tool, a new razor blade or X-acto knife

- Instal a flangeless fitting on each end of the tubing by sliding the nut over the tubing (with the nut threads facing the end of the tubing to be connected). Then, slip the ferrule over the tubing (with the tapered portion of the ferrule facing towards the nut). (Fig. 6)



Fig. 6 - Installing a flangeless fitting

- Make connections to the Injection Valve. Insert the tubing from the Selection Valve ports into the designated positions according to the chart below:

Port #1 & 4	Sample Loop (Screw the flangeless fitting into the ports.)
Port #2	Induction Syringe
Port #3	Sample Solution
Port #5	LWCC Sample Cell
Port #6	Peristaltic Pump Output

Calculating the Volume of the Sample Loop

The Sample Loop should contain a volume that is three to five times the volume of the LWCC sample cell. This ensures a stable plateau of the sample absorption spectrum. To determine the volume of the Sample Loop, use the following equation:

$$V_{Loop} = \frac{d^2 \pi}{4} L$$

V_{Loop} = volume of the Sample Loop
 d = inside diameter of the tubing (0.040"=1.016mm)
 L = length of the Sample Loop

If $d=1.016\text{mm}$, the formula shows that the tubing contains $8.1\mu\text{L}$ of volume for each centimetre of length.

$$V_{Loop} = L * 8.1 \mu\text{L}/\text{cm} \qquad L = V_{Loop} / 8.1 \mu\text{L}/\text{cm}$$

To determine the length (cm) of the Sample Loop needed, multiply the sample cell volume by 5 and divide the answer by 8.1. The volume of the Sample Loop and the corresponding length of the Sample Loop for a variety of LWCCs are recorded in the table above.

$$V_{Loop} = V_{LWCC} \times 5$$

$$L = \frac{V_{LWCC} \times 5 \mu\text{L}}{8.1 \mu\text{L} / \text{cm}}$$

The LWCC sample cells have the following volumes:

Sample Cell	Pathlength	V_{LWCC} (μL)	V_{LOOP}(μL)	Loop ID	L
<i>LWCC-5005</i>	5cm	40	200	1.016mm	24.7cm
<i>LWCC-5010</i>	10cm	80	400	1.016mm	49.4cm
<i>LWCC-5025</i>	25cm	200	1000	1.016mm	1.2m
<i>LWCC-5050AF</i>	50cm	400	2000	1.016mm	2.5m
<i>LWCC-5100AF</i>	100cm	800	2400	1.6mm	1.2m
<i>LWCC-5200AF</i>	200cm	1600	1800	1.6mm	2.4m

For 1.016mm V_{LOOP} calculated at x5; For 1.6mm V_{LOOP} calculated at x3

For example, if you are using a LWCC-5050AF, which has a volume of 400μL, your Sample Loop should contain five times that amount (2000μL) and your Sample Loop should be 2.47m long (2000/8.1 = 246.9 cm).

TIP: Order the optional LOOP-5ML if you are using the LWCC5100AF, LWCC-5200AF or UltraPath 2. This includes connectors to connect the sample loop with the valves on the LWCC injection system.

Injecting a Sample in the LWCC

To prepare a sample to be introduced into the LWCC, it must first be loaded into the Sample Loop. The solution is drawn into the Sample Loop by a vacuum created when the plunger of the syringe is slowly drawn back. Therefore, select a syringe that holds at least twice the volume of the Sample Loop to ensure that the Sample Loop is full of a pure sample solution.

1. Turn on the pump and set the pump flow rate to approximately 1mL/min. Let the pump run continuously throughout the analysis process.
TIP: If you are using the MiniStar pump, 1mL/min. Is approximately 50% of the maximum setting.
2. Set the Selection Valve to Position 1 (Reference Solution).
3. Set the Injection Valve to Load (Position 1).
4. Run the reference solution through the system until a stable baseline is observed. Let it run for at least 30 seconds after the baseline is established.
5. Attach a syringe that holds at least twice the volume of the Sample Loop to Port 2 of the Injection Valve. The table below shows recommended syringe sizes.

<i>Sample Cell</i>	$V_{LWCC} (\mu\text{L})$	$V_{LOOP} (\mu\text{L})$	$2 \times V_{LOOP} (\mu\text{L})$	$2 \times V_{LOOP} (\text{mL})$	Syringe
<i>LWCC-5005</i>	40	200	400	0.4	1 mL
<i>LWCC-5010</i>	80	400	800	0.8	3 mL
<i>LWCC-5025</i>	200	1000	2000	2.0	3 mL
<i>LWCC-5050AF</i>	400	2000	4000	4.0	10 mL
<i>LWCC-5100AF</i>	800	4000	8000	8.0	20 mL
<i>LWCC-5200AF</i>	1600	8000	16000	16.0	50 mL

6. Slowly draw back the syringe plunger until you have extracted at least twice the volume of the Sample Loop. The sample is now loaded into the Sample Loop.
TIP: If the syringe is drawn back too quickly, air bubbles may be introduced into the system
7. Set the Injection Valve to Inject (Position 2). The sample solution is pushed through the system into the Sample Cell where it is analyzed.
TIP: If you are using an LWCC-5100AF and the flow rate is 1mL/minute, and you inject the sample 30 seconds after the baseline is established, the total scan time of the analysis is about 4 minutes.

INSTRUMENT MAINTENANCE

Cleaning the System

Use WPI's Waveguide Cleaning Kit (WPI #501609) to clean the system. Follow the procedure for pumping solution through the system.

1. Verify that all the tubing is properly connected according to the chart below and the open end of each tube is immersed in its solution.

Setting Solution

1	Reference Solution
2	Cleaning Solution 3
3	Cleaning Solution 2
4	Cleaning Solution 1

NOTE: If the injection system is set up in this manner, the Selection Valve finishes step 7 in Position 1, ready for the next analysis session.

2. Turn the pump on and let it run continuously throughout the cleaning process.
3. Set the Injection Valve to the Inject (Position 2).
4. Set the Selection Valve to 4 (Cleaning Solution 1) and allow it to run through the system for 30 seconds.
5. Set the Selection Valve to 3 (Cleaning Solution 2) and allow it to run through the system for 30 seconds.
6. Set the Selection Valve to 2 (Cleaning Solution 3) and allow it to run through the system for 30 seconds.
7. Set the Selection Valve to 1 (Reference Solution) and allow it to run through the system until a stable baseline is observed, about 2-5 minutes

ACCESSORIES

Part Number	Part Description
SYR-TB1	1ml Syringe, Plastic Norm Ject Tuberculin Inert
SYR-NJ3LL	3 mL Syringe, Plastic Norm Ject Luer Lock Inert
SYR-GL3LL	3 mL Syringe, Glass with Luer Lock
SYR-NJ10LL	10 mL Syringe, Plastic Norm Ject Luer Lock Inert
SYR-GL10LL	10 mL Syringe, Glass with Luer Lock
SYR-NJ20LL	20 mL Syringe, Plastic Norm Ject Luer Lock Inert
SYR-GL20LL	20 mL Syringe, Glass with Luer Lock
SYR-NJ50LL	50 mL Syringe, Plastic Norm Ject Luer Lock Inert
SYR-GL50LL	50 mL Syringe, Glass with Luer Lock
LOOP-5ML	Sample Loop Kit, 5 mL (2.5m PFA Tubing 1/16" ID x 1/8" OD + 2 x PEEK fittings 1/8" OD Tubing x 1/4"-28 UNF)
MINISTAR	Miniature Peristaltic Pump, 1-channel
PERIPRO-4LS	Peri-star pro, 4-channel, low rate, small tubing

SPECIFICATIONS

Wetted Materials	PEEK®, PFA®, Vespel®, Teflon®
Flow Speed	0-10 mL/minute
Sample Loop Volume	80-5,000 µL (using 0.040" ID tubing)
Tubing OD	0.0625"
Sample Injection Method	Induction syringe / peristaltic pump
Tubing ID	0.020" Orange PEEK 0.040" Natural PEEK 0.020" PFA
Fittings	1/4 - 28 Flangeless Fittings (Selection and Injection Valves) 10 - 32 One-piece, finger-tight PEEK fitting
Maximum Valve Operating Temperature	80° C

WARRANTY

WPI (World Precision Instruments) warrants to the original purchaser that this equipment, including its components and parts, shall be free from defects in material and workmanship for a period of 30 days* from the date of receipt. WPI's obligation under this warranty shall be limited to repair or replacement, at WPI's option, of the equipment or defective components or parts upon receipt thereof f.o.b. WPI, Sarasota, Florida U.S.A. Return of a repaired instrument shall be f.o.b. Sarasota.

The above warranty is contingent upon normal usage and does not cover products which have been modified without WPI's approval or which have been subjected to unusual physical or electrical stress or on which the original identification marks have been removed or altered. The above warranty will not apply if adjustment, repair or parts replacement is required because of accident, neglect, misuse, failure of electric power, air conditioning, humidity control, or causes other than normal and ordinary usage.

To the extent that any of its equipment is furnished by a manufacturer other than WPI, the foregoing warranty shall be applicable only to the extent of the warranty furnished by such other manufacturer. This warranty will not apply to appearance terms, such as knobs, handles, dials or the like.

WPI makes no warranty of any kind, express or implied or statutory, including without limitation any warranties of merchantability and/or fitness for a particular purpose. WPI shall not be liable for any damages, whether direct, indirect, special or consequential arising from a failure of this product to operate in the manner desired by the user. WPI shall not be liable for any damage to data or property that may be caused directly or indirectly by use of this product.

Claims and Returns

Inspect all shipments upon receipt. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed loss or damage should be reported at once to the carrier and an inspection requested. All claims for shortage or damage must be made within ten (10) days after receipt of shipment. Claims for lost shipments must be made within thirty (30) days of receipt of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim is settled. In some instances, photographic documentation may be required. Some items are time-sensitive; WPI assumes no extended warranty or any liability for use beyond the date specified on the container

Do not return any goods to us without obtaining prior approval and instructions from our Returns Department. Goods returned (unauthorized) by collect freight may be refused. Goods accepted for restocking will be exchanged or credited to your WPI account. Goods returned which were ordered by customers in error are subject to a 25% restocking charge. Equipment which was built as a special order cannot be returned.

Repairs

Contact our Customer Service Department for assistance in the repair of apparatus. Do not return goods until instructions have been received. Returned items must be securely packed to prevent further damage in transit. The Customer is responsible for paying shipping expenses, including adequate insurance on all items returned for repairs. Identification of the item(s) by model number, name, as well as complete description of the difficulties experienced should be written on the repair purchase order and on a tag attached to the item.

** Electrodes, batteries and other consumable parts are warranted for 30 days only from the date on which the customer receives these items.*

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