



WIZ



OPERATING MANUAL

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Production ,Sales and Service:

Via Paduni, 2A – 03012 Anagni (FR) – Tel.: +39 0775 776058 Fax: +39 0775 772204

e mail: anagni@systea.it

Web site: <http://www.systea.it>



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SYSTEAL SpA

WIZ Probe USER MANUAL Ver. 1.0beta

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1. INTRODUCTION

WIZ Probe is an innovative automatic chemical analyser for “in-situ” long term measurements, based on a new analytical technology, named μ LFA* (micro Loop Flow Analysis);

WIZ allow to analyse sequentially **up to four nutrients**, can be installed on a buoy or any other floating support and can be submerged down to 8 m depth.

It is also designed for hydrology applications where the probe can be used as a portable field analyzer for on site measurements.

The basic WIZ configuration allows to measure NH_3 , NO_2+NO_3 , NO_2 , PO_4 in water or seawater ; other parameters are available on request.

Possible configurations are:

- WIZ-1: single parameter
- WIZ-2: two parameters
- WIZ-3: three parameters
- WIZ-4: four parameters



Basic WIZ includes :

- **Analytical reactor**, with a miniaturised valves manifold, the pump and the flow cell connected to the light sources and the detector through optical fibers.
- **Electronic** compartment, with power supply board, PC 104 CPU board, preamplifier board and detector etc.

WIZ is delivered as standard with a Reagents Canister containing the a series of bags to store reagents, calibrant, water and wastes.

The Reagent Canister is connected to WIZ analytical reactor trough a 10 positions connector allowing fast connection/disconnection of the whole canister.

(*) Patent pending



1.1 Analytical cycle

WIZ can run sequentially one or more analytical cycles (chemistries) ; the necessary steps to complete an analytical cycle are:

1. Sample introduction in the analytical reactor.
2. Sample blank measure and storage (OD Blank)
3. Reagents injection with proper sequence and timing.
4. Sample and reagents mixing.
5. Heating if needed.
6. Reaction time
7. Reaction Optical Density measure (OD End) and storage
8. Calculation of the sample concentration using the stored calibration factor

The analytical cycle during monitoring is repeated for the next active method, up to four times.

1.1Calibration cycle

The mixed concentrated calibrant is a solution including all the analytes to be detected. It is placed inside the Reagent Canister in a 50mL bag and is automatically diluted, during calibration cycles.

A calibration cycle replicates exactly the Analysis cycle steps introducing in the analytical reactor a diluted calibration solution instead of the sample.

Calibration cycle is repeated for each method and the calibration factor is automatically calculated and stored.



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1.2 WIZ technical data

<p>Technical data</p> <p>Measured parameters: 4 Standard: NH_3, NO_3+NO_2, NO_2, PO_4 (other methods available on request)</p> <p>Detectors:</p> <ul style="list-style-type: none"> multi-beam fiber optic colorimeter with silicon detector Fluorimetric: excitation 370 nm, emission 420 ÷ 470 nm, 1 cm <p>Type of analysis: sequential batch</p> <p>Analysis interval: programmable</p> <p>Measuring time: 30 minutes for a full 4 parameters cycle</p> <p>Number of parameters: up to 4</p> <p>Maximum in-situ depth: -10 m</p> <p>Body material: PVC</p> <p>Operating temperature: 4°-40 °C</p> <p>Hydraulic connections: std. 3.2x1.6 mm</p> <p>Waste: directly discharged in water; toxic wastes collected in a separate bag located inside the canister.</p> <p>Reagent expiring: min. 4-6 weeks depending on the method</p> <p>Autonomy: up to one 45 days, depending on analysis frequency</p> <p>Hardware: industrial PC-104 CPU, externally programmable by serial communication port.</p> <p>Data output : RS232 serial port</p>	<p>Programming functions: provided by the external WIZ control panel software.</p> <p>External connections: 6-pole submergible cable for serial data communication and 12 Vdc power supply.</p> <p>Power supply: 12 Vdc, provided through the main connecting cable.</p> <p>Power absorption: 3W in stand by, 8 W mean during analysis.</p> <p>Weight in air: 8 Kg</p> <p>Dimensions: 140 mm diameter x 520mm height(analytical unit); 70mm diameter x 200mm height(reagents canister)</p> <p>Environmental requirements: WIZ should be operated with the ambient temperature ranging from 4 °C to 40 °C. A temperature near 0 °C may freezes the reagents and the calibrant; a temperature over 30 °C will reduce the reagents stability and life.</p> <p>Standard package includes:</p> <ul style="list-style-type: none"> - analytical and electronic units - reagents canister - 5 m submergible cable - WIZ panel software start-up kit. <p>Optional accessories:</p> <ul style="list-style-type: none"> - Additional Reagent canister
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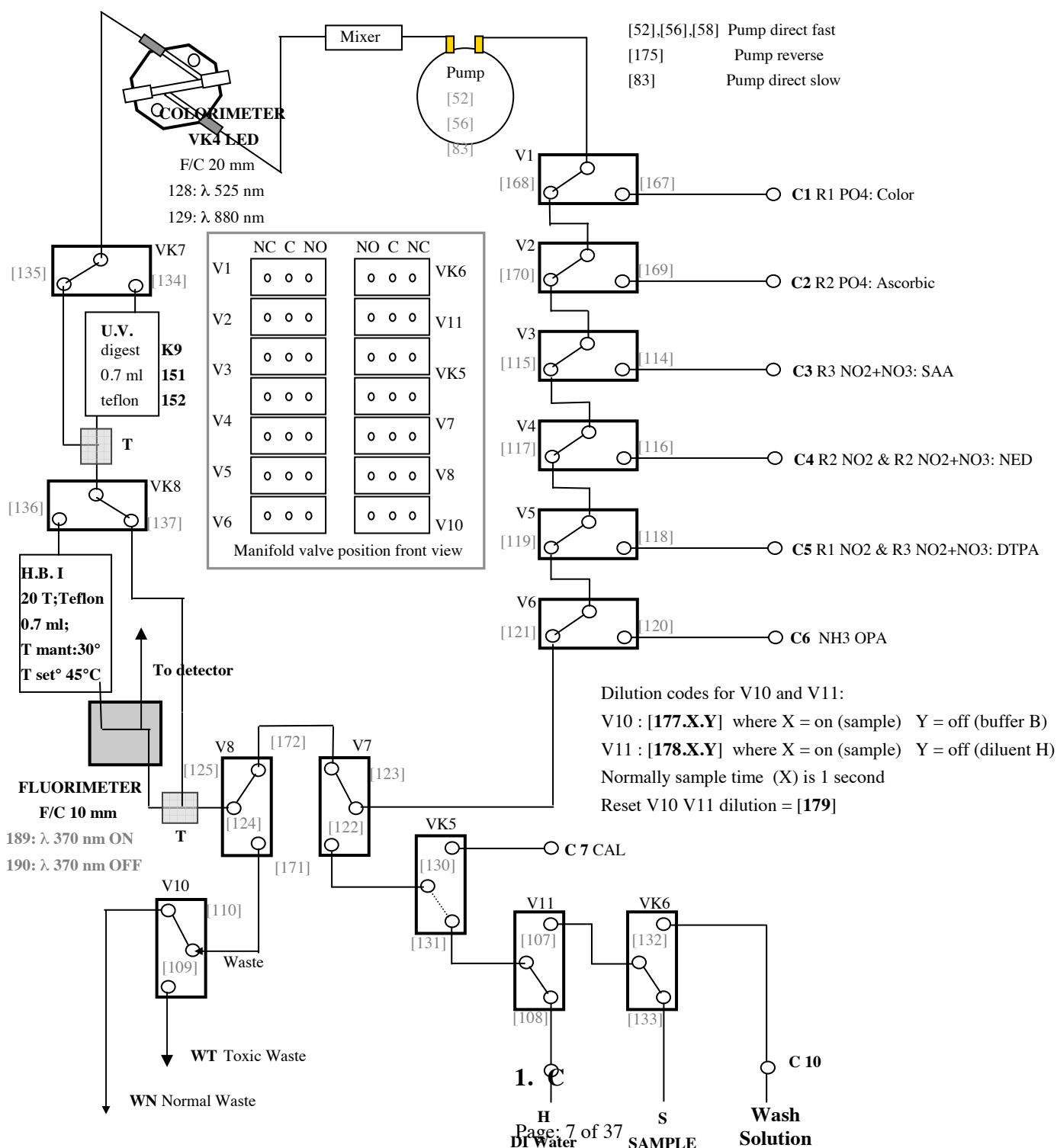
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1.3 FlowChart (Standard Nutrients version)

WIZ FlowChart: NH3 OPA, NO3 UV, PO4 & NO2





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2. ANALYTICAL CYCLES DESCRIPTION

2.1 Loop Flow Reactor

WIZ analytical reactor includes all necessary devices (mechanical, hydraulics, optics) sequentially connected to form a ring defined as micro **Loop Flow Reactor**, in short **μLFR**.

The μLFR hydraulic diagram is shown in the previous figure; shown components allows to run up to four chemistries, with the possibility to select two different detectors colorimetric and fluorimetric and on the colorimetric detector 2 different wavelengths.

Valves S/L (V8 and V7) allows to open the loop to allow pumping of sample, standard or blank solution (SAMPLE position) or to keep the loop closed (LOOP position), to allows mixing of reaction product.

The reagents and the calibrant are introduced in the loop by the pump; an effective and fast mixing is ensured by a mixer mounted just after the pump.

2.2 Sampling

With valves S/L open, the pump P is activated; the sample is pumped trough VK6, V11, VK5 and V7 inside the loop, passing through the mixer and the colorimetric flow cell, then it flows out to the waste through V8.

The loop, including the flow cell, is now filled with sample; the system measure and store the Sample Blank value that will be subtracted from the final OD of the reaction product.

2.3 Analysis

Following operations are valid for Sample, Reagent Blank and Calibration.

2.3.1 Reagent injection

Valves S/L are in SAMPLE, then reagent valve connected to the reagent bag is switched on while the pump P is activated, for the programmed time to inject an defined quantity of reagents inside the loop.

2.3.2 Mixing

Valves S/L are positioned in LOOP position, the pump P is activated, to allow a fast mixing of sample and the reagents.

The particular internal layout of the three way injection valves and the mixer allow a fast and effective mixing



2.3.3 Reaction and OD reading

The reaction takes place in the colorimeter flow cell, the software allows the graphic monitoring of the reaction development up to the end point.

If method requires heating, to reach the colour development (i.e. NH_3), the sample is heated in a proper device then moved inside the detector.

As soon the reaction reaches the end point, O.D. is measured and stored.

2.3.4 Calculations

Reagent Blank OD: stored and used to calculate the calibration factor

Calibrant OD: stored and used to calculate the calibration factor

OD Start: Sample Blank OD

OD End: Sample final OD – OD Start

Sample concentration = (OD End - Reagent Blank OD) x Calibration factor

2.3.5 Wash

Valves S/L on SAMPLE, all other valves off, while pump P runs; DI water form V11 enter the loop and comes out form V8. As soon the washing time expire pump P stops and S/L are switched off; the loop remains filled with DI water ready for a new run.

2.4 Calibration cycle

Allows the instrument recalibration and QC check using a concentrated calibrant solution that when diluted match to the calibration span.

Calibration solution is pumped inside the loop while is diluted by modulating the calibrant valve VK5 between calibrant and DI water.

After filling the loop with the diluted calibrant the calibration cycle runs same steps as described in 2. Analysis.



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3. WIZ OVERVIEW

3.1 External overview



WIZ consists of PVC canisters.

1) WIZ Probe including:

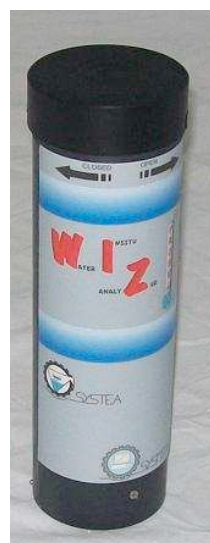
- a) hydraulic manifold
- b) electronic boards
- c) Detectors
- d) Etc.

2) Reagent Canister including

- Reagent and calibrant bags
- Water bags
- Toxic Waste bag
- Multireagent connector



Wiz top view

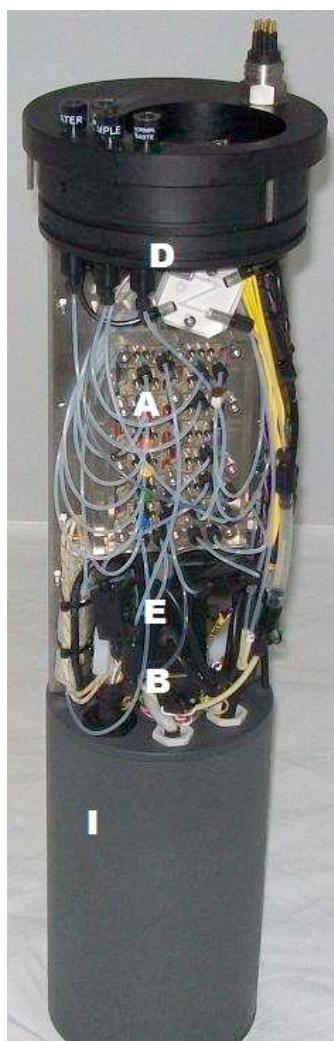


Reagent Canister



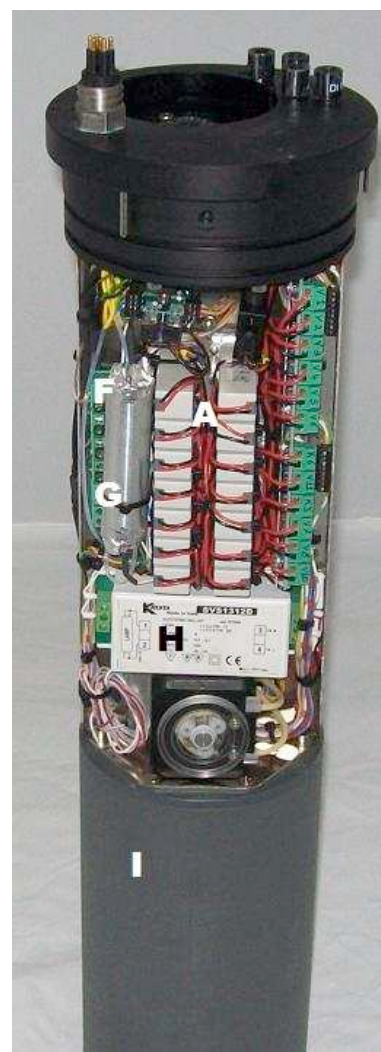
3.2 Analytical and electronic, internal view

3.2.1 Analytical internal view



Front side

- A:** Manifold & valves
- B:** Pump Motor
- C:** Pump Head
- D:** Colorimeter; Flowcell assy
- E:** Fluorimeter: Flowcell assy
- F:** Heating bath
- G:** UV Digestor
- H:** UV Digestor ballast
- I:** Electronic Enclosure



Back Side

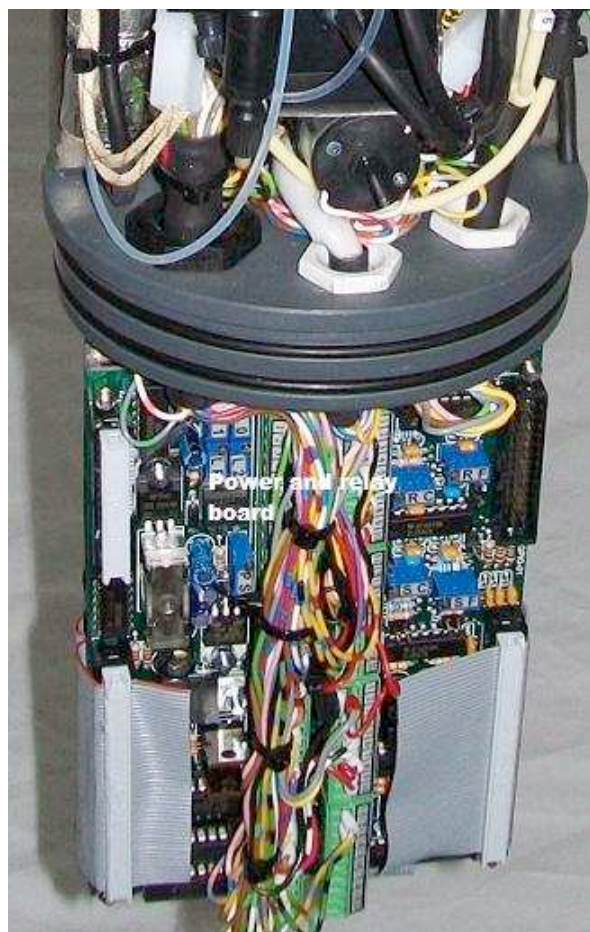


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3.2.2 Electronic compartment internal view





4. SETUP

4.1 General check

WIZ probe is delivered fully tested with the Electronic and Analytical module properly sealed and specifically tested under water pressure.

Upon receipt check for any visual and/or external damages taking care to check the conditions of all electrical and hydraulics connections.

WIZ Reagent Canister is delivered fully assembled

To setup WIZ:

- a) Fill all bags
 - Fill all reagents bag or only the reagent bags for the active methods
 - Fill the Calibrant bag
 - Fill the water bag
- b) Connect the Reagent canister on the WIZ and open the reagents connector
 - Connect the water line and the toxic waste line
 - Connect the sample line
- c) Power on the WIZ (12 V DC)
- d) Wait for booting
- e) Connect laptop to the serial port
- f) Run WIZ control Panel (See the software manual for details)
- g) For first setup run twice a Reagent Prime, after reagent changeover one prime is enough
- h) Run a Wash
- i) Run Reagent blank, check stored OD Blank against the OD Blank reported on the factory test
- j) Run Calibration check stored OD cal against the OD Blank reported on the factory test

WIZ is now ready for deployment or any other use.



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4.2 Reagents Canister Set up

4.2.1 Reagents Canister description

Extracts the reagent bags frame from the PVC cylinder have access to the bags. Each bag is numbered has two ports one is used to connect the bag to the connector trough a Teflon tube and one is closed and is used to refill the bag trough a syringe.

Bags numbering match the reagents number as reported in the hydraulic layout



- A:** Reagent canister guard
- B:** Reagent bags and frame
- C:** Reagent Canister cap
- D:** Fixing screw
- E:** Reagent Connector
- F:** Open/Close key



Bottom Details



4.2.2 Reagent and Calibrant bags filling

To fill the reagents & calibrant bags use the filling tool delivered with the WIZ, as for following procedure:

- Extract the reagent frame from the canister guard (take care that when delivered the frame has a safe lock on the bottom that has to be removed before frame extraction)
- Mount the frame on the filling tool
- Open the reagent connector
- Remove the cap from the line inlet
- Open the Roll On stopper of the line # to be filled
- Connect a 50mL syringe with DI filled with Di water
- Wash the bag with DI water, repeat twice.
- Connect a 50mL syringe filled with 25mL of reagent
- Prime the bag, with all 25mL then empty the bag and waste the reagent used for priming
- Refill the syringe with 50mL of reagent then fill the bag with 40/45mL
- Close the Roll On stopper & remove the syringe
- Repeat for all lines
- Close the reagent connector
- Remove the frame from the filling tool
- Insert the frame in the canister guard taking care do not pinch any tube

a) Extract Reagents frame

To extract reagent frame take care to remove the safety lock on the bottom of the Reagent Canister.

Then:



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a.1) Remove the canister cap



Bags frame extracted

a.2) Extract the Reagent bags frame by pulling up the Fixing screw.

Help extraction by pushing gently from the bottom the reagent connector out coming form the canister guard .



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Bottom part to push gently

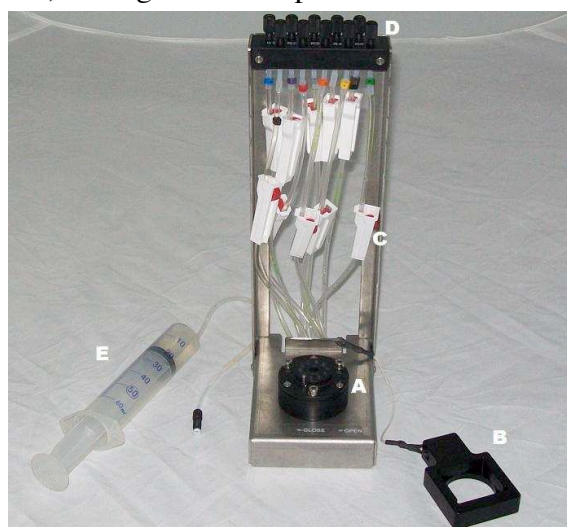


Pull up the fixing screw



b) Mount the frame on the filling tool

b.1) Filling tool description



- A:** Reagent connector
- B:** Reagent connector arm (close/open)
- C:** Roll On stoppers
- D:** Reagent Inlets
- E:** Filling Syringe (use dedicated syringe for each reagent)

b.2) Frame mounting



b.2.1) Be sure all Roll on stopper are closed

b.2.3) Identify the male pin on the filling tool and female pin on the bottom of the reagent frame.



b.2.4) Insert the reagent connector arm that allow to open/close the reagent connector for filling



b.2.5) Mount the bags frame taking care to match the male and female pins

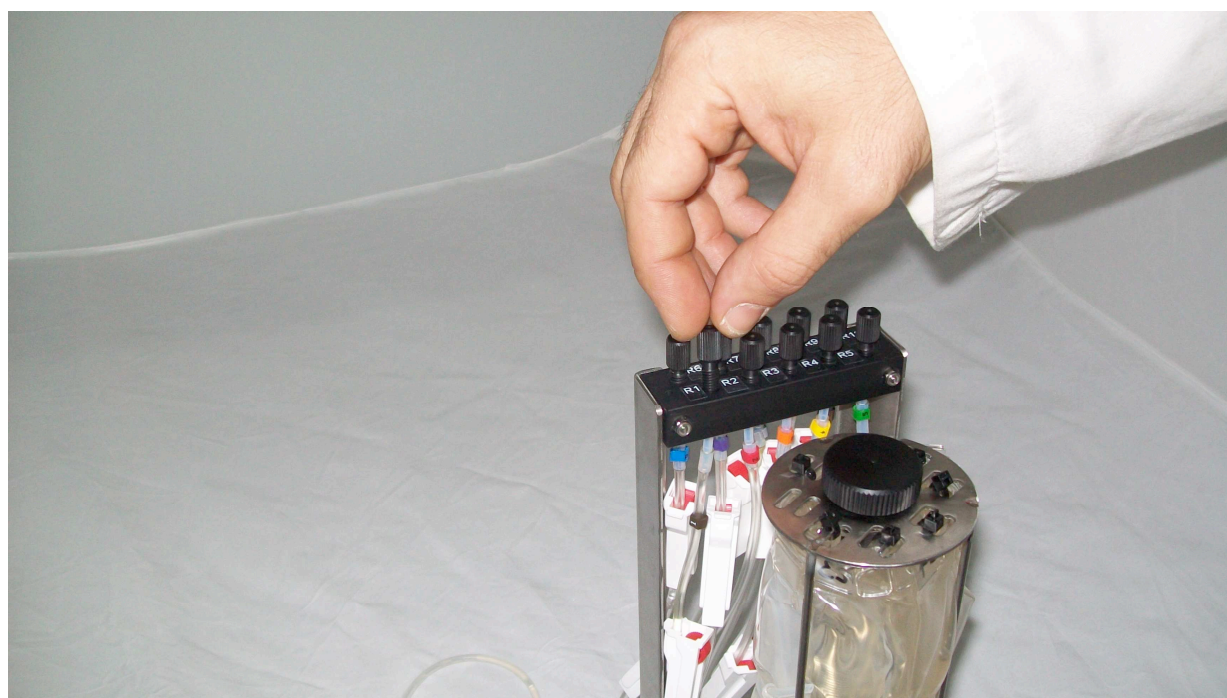
b.2.6) Complete mounting by screwing gently the fixing screw on top of the frame.



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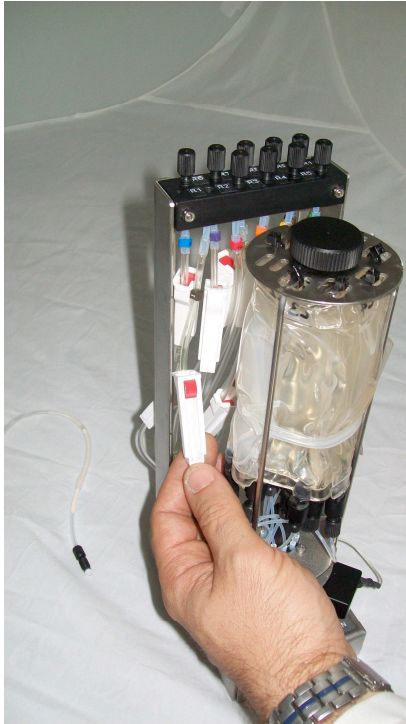
c) Open the reagent connector



d) Remove the stopper from the reagent inlet to be filled



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e) Open the Roll On stopper



f) Connect the filling syringes as for following steps:

- DI water syringe: wash the bag at least twice by injecting 40 mL of DI water, then aspirate back the wash water; discharge the water after each wash and refill the syringe with fresh DI water before next wash. Remove the DI water syringe
- Reagent syringe filled with 25mL of reagent: prime the bag by injecting 25mL of reagent, aspirate back the reagent and discharge.
- Reagent syringe filled with 50mL of reagent: inject 40/45mL of reagent in the bag
- Close the Roll On stopper
- Remove the syringe
- Switch to the next bag



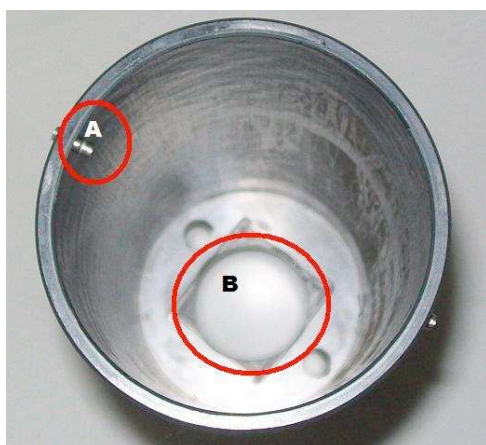
After all bags are filled close the reagent connector then remove the bag frame.

Wash the filling tool by connecting a waste syringe the line and open the roll on stopper while the syringe is aspirating form the tube, to remove the reagents inside the tube.

After all lines are empty wash one by one with DI water syringe, if DI water flow out from the reagent connector dry with paper.

4.2.3 Reagents canister assembly

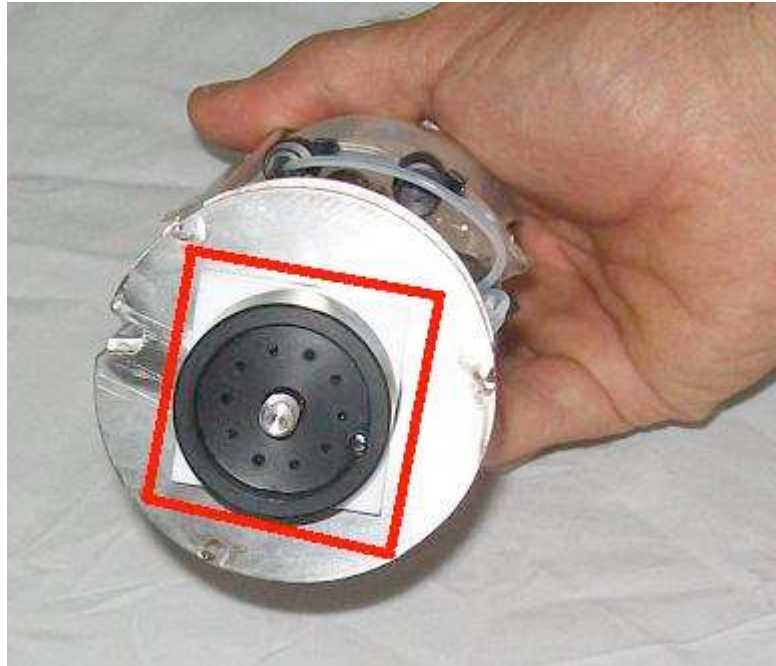
After all bags are filled reagents canister may be mounted and fitted on the WIZ.



1) Identify inside the canister guard the pin A and the bottom squared holder B



2) Identify on the bags frame the two cuts that have to be matched with the pin A



3) Identify on the bottom of the frame the squared white plastic part that allow to open close the reagent flow



d) Insert the bags frame inside the canister taking care to match the reference points as showed in 1 and 2.

If 1 and 2 match correctly the bottom squared white plastic showed on 3 match the square holder B of the canister guard.

During insertion may be necessary rotate slightly the frame to fit perfectly.

Take care to avoid tube and bags pinch during assembly.



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Correct mounting allow the reagent connector to come out from the canister bottom for few millimetres, if not mounting is not correct and the squared white plastic did not match the holder on the bottom of the canister.



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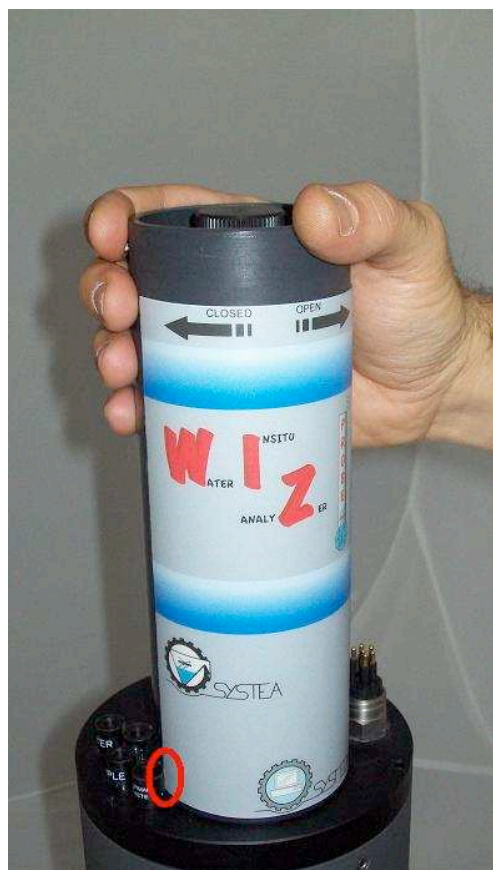


Reagent canister is now ready to be fitted on the WIZ

4.2.4 Reagents Canister mounting



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1) Insert the reagent canister on the proper holder on the top of the WIZ, taking care to match the driving pin located on the left side.

Push gently until the connector fit completely



2) Fix the cylinder by screwing firmly the top screw then open the reagent connector rotating CCW the cylinder body, to allow reagents to flow inside the probe..

4.2.5 External canister for DI water and toxic waste

DI water and toxic waste are contained in 2 external bags 600 mL each. External bags are inserted in an external canister the connected to the WIZ from top connectors.

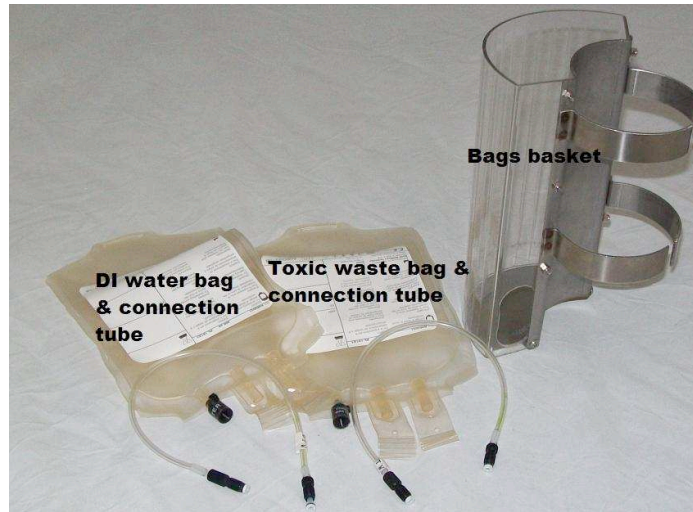


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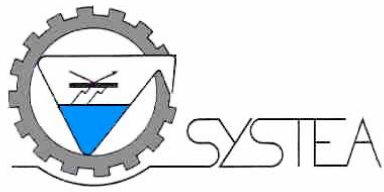
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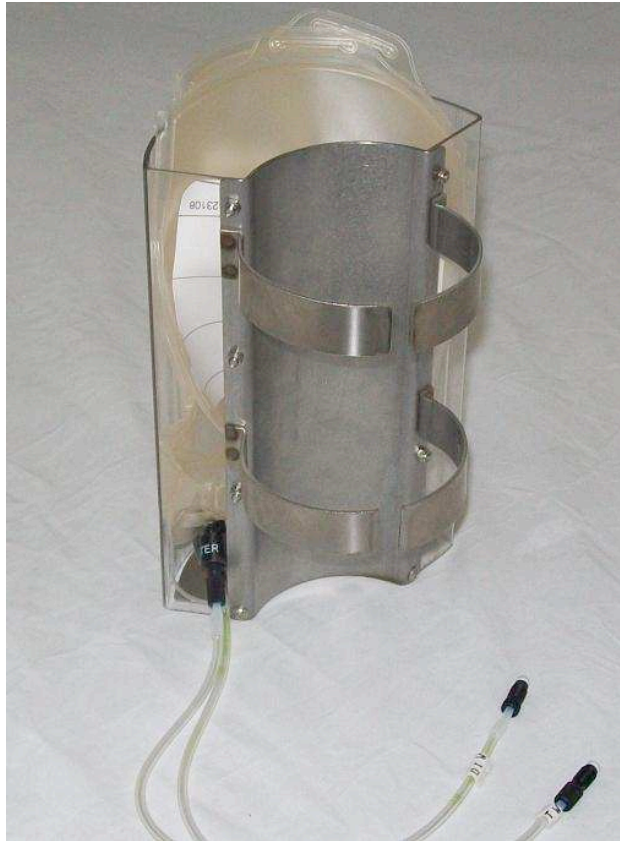


List of operations

- Fit both bags inside the canister
- Mount the connection tubes
- Position upside down the Canister and fill the DI water bag with a 50mL syringe
- Pinch the DI water bag tube
- Mount the canister on the WIZ
- Connect both bags to respective positions



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Bags canister assembly front view



Bags canister assembly back view



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Mount the canister on the WIZ



Connect both bags to WIZ



4.3 Power and sample connection

When mounting is completed final assy looks as follows





4.3.1 Power & Sample line connection



Connect the power cable to the power connector located on the top of WIZ, wait for booting, about 45-60 seconds; then connect the sample line

Note that power cable includes also the serial connections. On the power side of the WIZ cable is available as standard an DB9 RS232 connector.

WIZ now is ready for start up as described in following chapters

5. Operation

WSIZ can be controlled and operated through an external software the WIZ Control Panel

a) The WIZ Control Panel:

Running on PC under Windows OS, dialogues with the probe using the RS-232 serial port are available from the external electric connector.

The Control Panel allows to:

- edit/ modify the run settings
- display/graph the real time Optical Density measured by the colorimeter
- display the sample measures stored by the unit
- edit/modify the WIZ monitor settings
- download the memory buffer with measured data in text format

WIZ software allows to manage all the operations normally required by the user during measurements.



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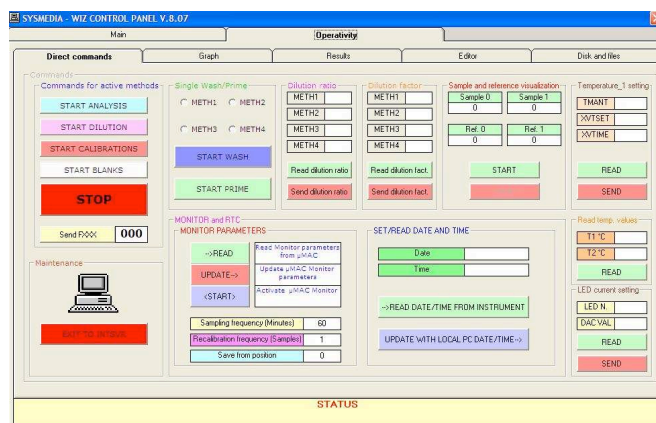
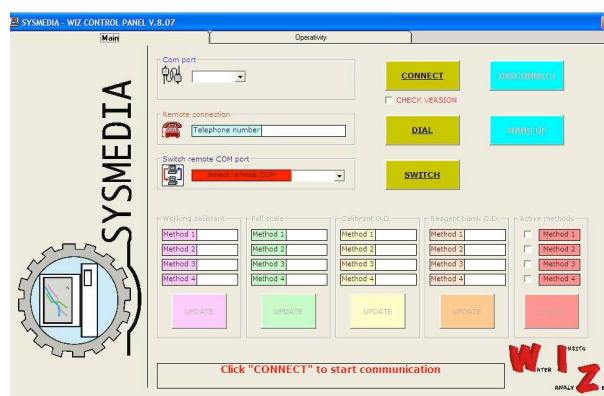
6. Start up

After Setup WIZ can be connected to a 12 V power supply and a PC with the WIZ panel SW installed; PC has to be connected through a serial port to the WIZ.

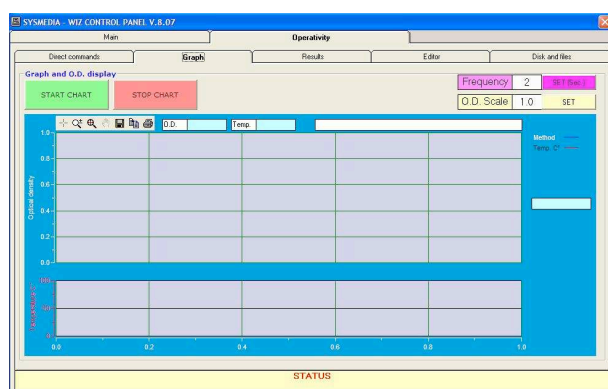
All following steps are given only for Method 1 repeat all steps for all methods included in the WIZ delivery.

Note: following software images may be not updated to the last software revision; use them only as general reference; for more detailed and updated information please use the document WIZ Panel SW manual.

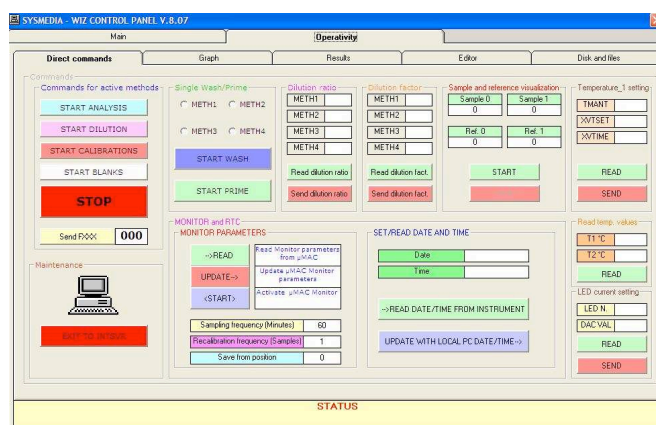
- 1) Turn On the WIZ
- 2) Turn On the PC after booting run the WIZ Panel
- 3) On the Main folder first select the COM# used by the PC then click on Connect
- 4) The bottom message box will prompt the user when connection will be established
- 5) All fields like Working Calibrants, Calibrants OD etc. will be updated with the values stored inside the WIZ. Please check all the values against the test certificate received together the analyzer



- 6) Switch to the Operativity folder
- 7) Select Method 1 then start a first Wash to fill up the WIZ hydraulics with water
- 8) Repeat Start Wash



- 9) Switch to the graph folder and click on Start Graph to check the measured OD; check the value against the Water OD value reported on the test report received with the analyzer (**NOTE:** When the real time display is active, all other commands are ignored; to send any other command, it is necessary first to click on STOP Graph.)
- 10) Repeat from 8 if graphs and consequently OD value is not stable meaning that the hydraulics is not completely filled with DI water.

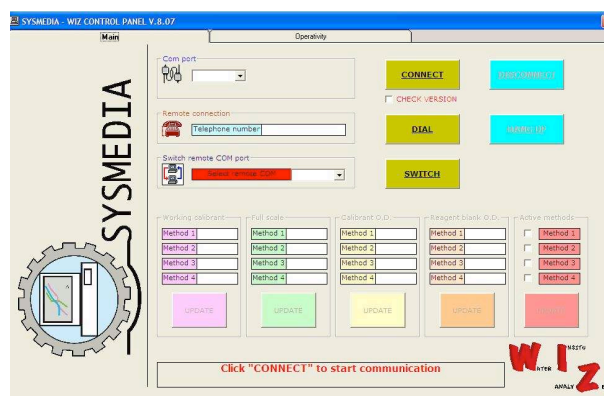


- 11) Switch back to the Operativity folder
- 12) Select Method 1 Start a Prime to fill the Method 1 reagent lines
- 13) Repeat for all methods
- 14) Start blanks
- 15) Switch to Graph folder to follow the OD during the reaction process
- 16) Start calibrations
- 17) Switch to Graph folder to follow the OD during the reaction process

- 18) Go back to the main folder
- 19) Click on Disconnect
- 20) Click on Connect
- 21) The bottom message box will prompt the user when connection will be established
- 22) All fields Working Calibrants, Full scale Calibrants OD, Reagent Blank OD will be updated with the values stored inside the

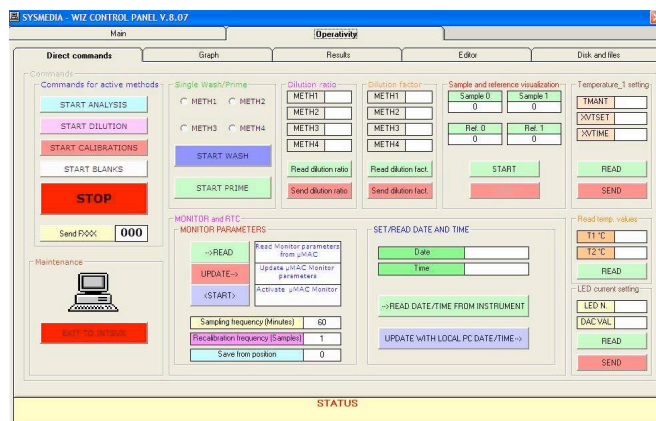


WIZ. Take note of the new Calibrant OD and Reagent Blank OD and check them against the test certificate received together the analyzer



WIZ now is ready for one of following:

6.1 Analyse a spot sample



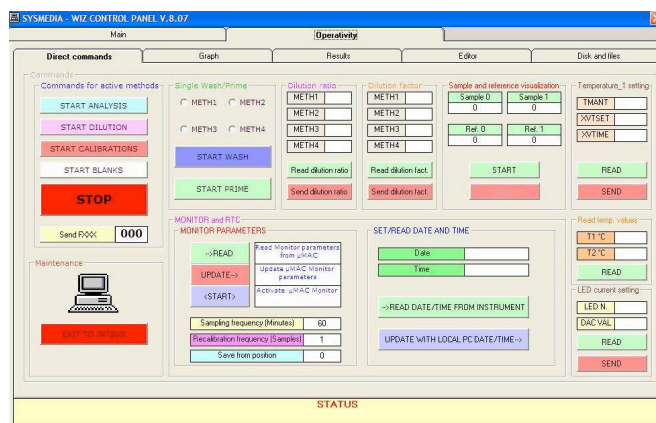
- 1) Switch to Operativity folder
- 2) Insert the sample line in the sample container
- 3) Start Analysis

6.2 Start Monitor

- 1) Switch to Operativity folder
- 2) Click on **Read Monitor Parameters** from μ Mac to update the *Sampling Frequency*, *Recalibration frequency* and *Save from position* fields with the data stored in the NPA PRO memory



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- 3) Check if the data downloaded from the WIZ memory are matching the actual needing, if not change the values and click on **Update** to store the new settings inside WIZ
- 4) Click on **Start** to start monitoring.

Note:

- 1) Before start monitoring WIZ will wait for a time equal to the *Sampling frequency*, to allow the deploy of the probe in water. In case of Laboratory tests where the user may need the first results immediately switch back to the *Operativity* folder and click on *Start Analysis*. WIZ will start immediately then will wait for the next analysis until the *Sampling frequency* time expire.
- 2) After clicking *Start* the WIZ timer counting the elapsed time on the *Sampling frequency* will remain active also if the probe will be shutted down. This is to allow WIZ deploy without PC connection.