xylem

USER MANUAL
525021

YSI 2500 Biochemistry Analyzer

OPERATIONS AND MAINTENANCE MANUAL

YSI

a xylem brand

Table of Contents

1 Introduction

1.1 Description

The 2500 Biochemistry Analyzer is a laboratory instrument intended for use in research, food-processing and bioprocessing applications. **THE 2500 Analyzer IS NOT FOR HUMAN MEDICAL DIAGNOSTIC USE OR FOR HUMAN PERFORMANCE EVALUATION.**

The 2500 Analyzer can be set up to measure glucose and/or lactate in a sample.

User Features

Slim modular design	Easily expand analytes or chemistries Multiple units use much less bench space
Proprietary enzyme electrode	Fast, accurate, and analyte-specific results
Uses biological separation technology	No hazardous chromatography solvents to dispose of
Icon-driven user interface with touchscreen	Easy to learn
Data download options	Save data on a USB drive, send it over the network, or access it in a searchable database anytime
Onboard FAQs	Minimizes operator learning curve

1.2 General Specifications

Sample size ..... Adjustable from 10 to 50 microliters (aspirated volume), per module

Response time ..... Enzyme Sensors

- Sample results in 60 seconds (average)
- Complete sample-to-sample cycle in less than 2 minutes (May vary with analyte and sample matrix.)

Output signals:

Serial ..... USB and RS232

⚠ Power requirement ..... 100–240 VAC ±10%
50–60 Hz ±5%
42 Watts nominal

Working environment:

Ambient temperature ..... 15–35°C

Relative humidity ..... 10–75% (non-condensing)

Regulatory compliance ..... ETL, CE, RoHS
61010-1 compliance:

- Pollution degree 2
- Installation category 2
- Altitude 2000m
- Atmosphere 75 KPa to 106 KPa
- Indoor use only

Instrument dimensions ..... 12" wide x 20.5" deep x 15.75" high (30.5 cm x 52.1 cm x 40 cm)

Instrument weight ..... 30.5 pounds (13.9 kilograms)

2 Safety

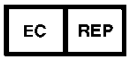
2.1 Important Safety Instructions

DO NOT PLUG THE INSTRUMENT IN AT THIS TIME. You should apply power only when directed to do so in the setup instructions.

1. Use ONLY the line power cord supplied with the instrument. When directed to, connect the plug to a matching three-pronged wall receptacle.
2. Use ONLY fuses of the type supplied. Replacement power cords and fuses can be obtained from YSI, or your Dealer Representative.
3. Do NOT use an extension cord without protective grounding.
4. Do NOT remove rear cover. There are no user serviceable parts inside.
5. Repairs are to be performed only by trained and approved personnel.
6. This instrument must be connected to a protectively grounded (earthed) outlet.
7. The following notice is provided in compliance with IEC 61010-1:2010.
   See Appendix for mains plug wiring and fusing instructions.
8. If the equipment is used in a manner not specified by YSI, the protection provided by the equipment may be impaired.

   WARNING: For RS232 or USB connection, equipment should be EN/CSA/UL 61010 or EN/CSA/UL 60950 approved only.
9. The mains (power) switch is for functional purposes ONLY. To disconnect the instrument from the mains supply, unplug the mains power cord from the back of the instrument.
10. Personal protective equipment (PPE) recommended—protective gloves and safety goggles or glasses.

2.2 Explanation of Symbols

	WARNING AVERTISSEMENT	Warning indicates that misuse of the instrument could result in death or serious injury to a person. Un avertissement indique qu'une mauvaise utilisation de l'instrument peut entraîner la mort ou une blessure grave chez une personne.
	CAUTION ATTENTION	Caution, consult accompanying documents. Caution indicates that misuse of the instrument could result in mild or serious injury to a person and/or damage to equipment. Attention, consulter la documentation jointe. Cette mise en garde indique qu'une mauvaise utilisation de l'instrument peut entraîner une blessure légère ou grave chez une personne et/ou un endommagement du matériel.
		Biological Risks Risques biologiques
		Chemical Irritant Irritant chimique
		Manufacturer Fabricant
		Authorized Representative in the European Union Représentant agréé dans l'Union européenne
	2776	Catalog number Numéro de référence
	18A100549	Lot number Numéro de lot
	YEAR-MO	Date of manufacture Date de fabrication
	YEAR-MO	Use by Date Date limite d'utilisation
		Temperature Limitation Limite de température

3 Getting Started

3.1 Unpacking

When you unpack your new 2500 Analyzer for the first time, check the packing list to make sure you have received everything listed. Note that reagents for the 2500 Analyzer are not packaged in the same carton as the instrument. If there is anything missing or damaged, call the dealer from whom you purchased the 2500 Analyzer. If you do not know which of our authorized dealers sold the system to you, call YSI Life Sciences Customer Service at 800 659-8895 or 937 767-7241, and we'll be happy to help you.

1. After removing the instrument from the shipping box, tilt the display to the full upright position.

Figure 3-1

2. Grasp the hand hold in the right side cover of the instrument and pull up and out to remove the cover.
   NOTE: Leave the cover off the instrument until you have aligned the sipper and installed the membranes as described in the following sections.
3. Carefully cut the tie strap holding the sipper.

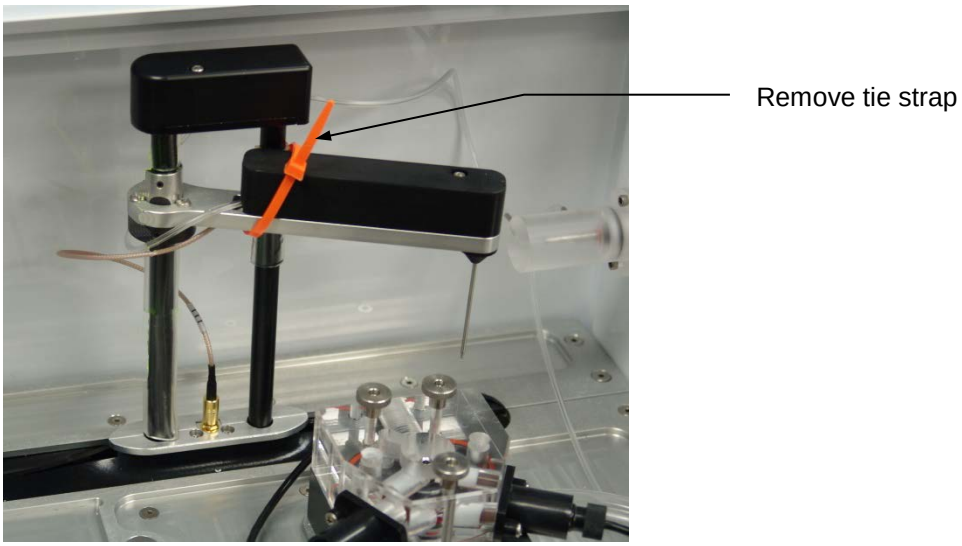


Figure 3-2

3.2 Warranty Card

Please complete the Warranty Card or register your purchase online at www.ysi.com/customer-support/warranty-card . This will record your purchase of this instrument in our computer system. Once your purchase is recorded, you will receive prompt, efficient service in the event any part of your 2500 Analyzer should ever need repair.

3.3 What You Need

Several things are needed in order to analyze samples using the 2500 Analyzer. The following list shows the basic items required.

- 2500 Instrument (with AC Power Cord)
- Bottle Rack with Reagent Level Sensing
- YSI 2357 Buffer
- YSI Calibrator Standard (YSI 2776 or 2747)
- YSI Linearity Standard(s)
- YSI Membrane(s) (YSI 2365 Glucose, 2329 Lactate)
- YSI 2901 Printer (optional)

3.4 Major Components

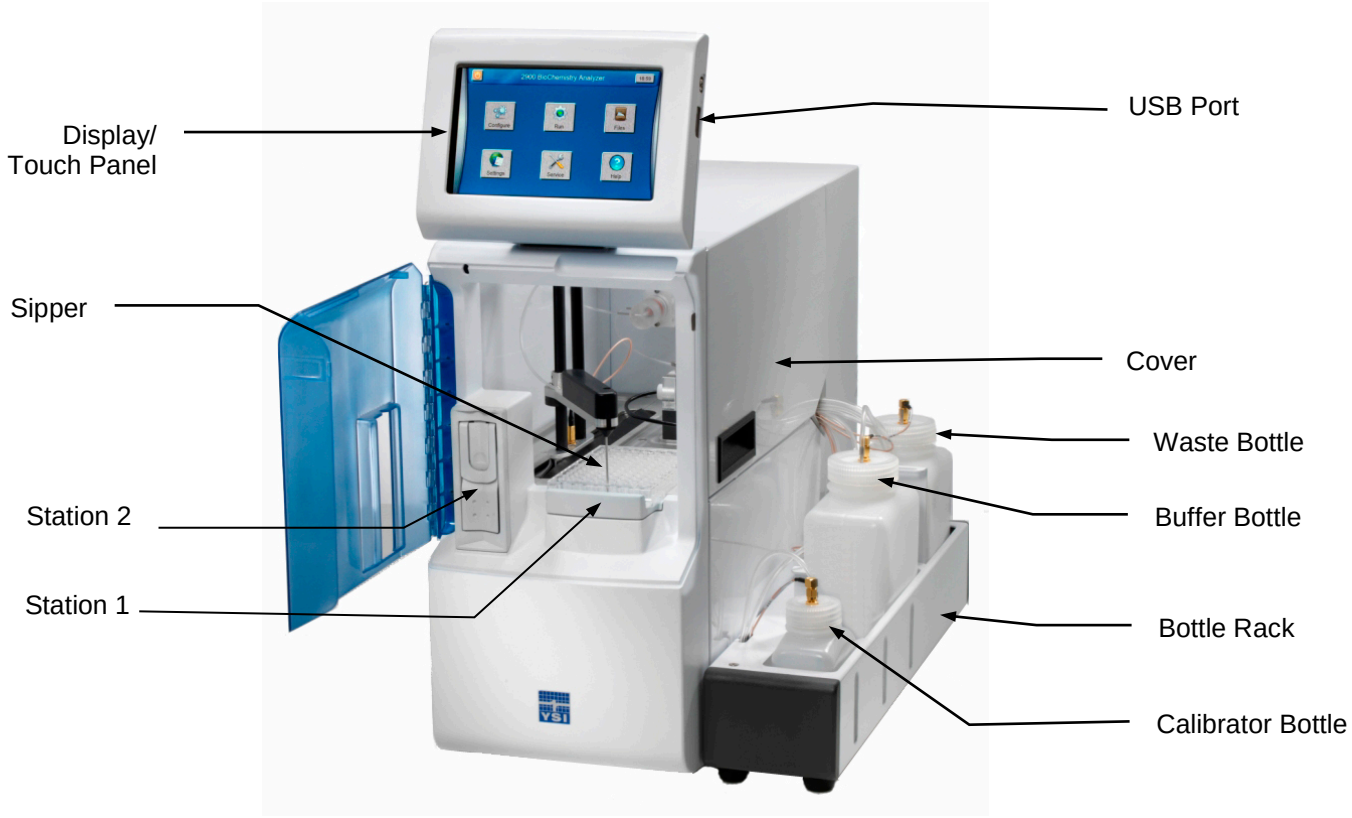


Figure 3-3

Display	Graphical color LCD covered by a touch screen
USB ports	The USB ports allow a flash drive to be connected to the 2500 Analyzer to download sample results or upgrade the instrument's software. A USB port is located on the right side of the display. An additional USB port is located on the rear of the instrument.
Sipper	Can be raised, lowered, rotated, and moved horizontally to its various positions. The positions are: Calibrator Well, Sample Module, and Stations 1 and 2. The Sipper senses fluid level to control immersion depth and detect errors.
Station 1	Plate and rack holder accepts most standard plates/racks for batch sampling of up to 96 samples.
Station 2	Test tube holder for manual sampling.
Buffer Pump	Draws buffer from the buffer bottle, pumps it through the Sipper Pump and the Sipper, and flushes the Sample Module.
Calibrator Pump	Draws the standard solution from the Calibrator Bottle and fills the Calibrator Well.

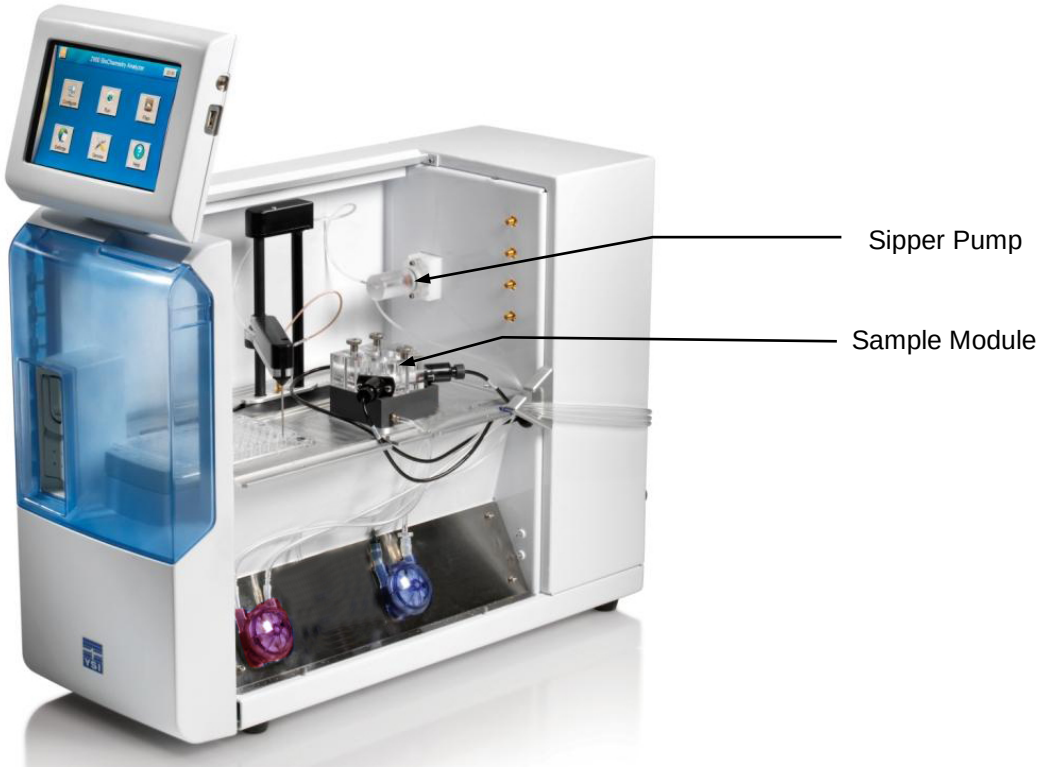
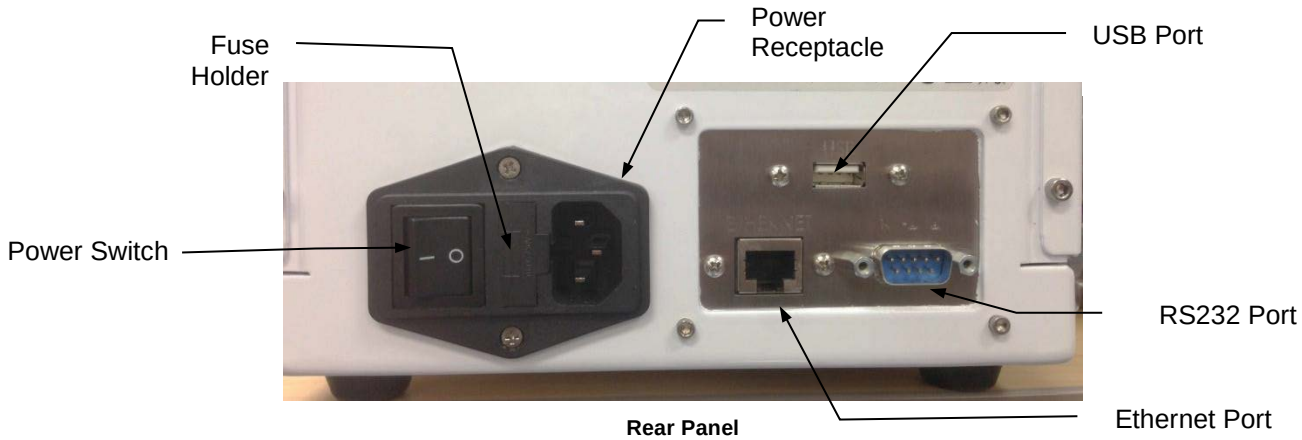


Figure 3-4

Sipper pump	It retracts its piston to draw standard from the Calibrator Well or sample from the sample stations. It extends its piston to dispense standard or sample into the sample module.

Sample module	Made of clear acrylic plastic. Sensor probes are screwed into either side of the module. The immobilized enzyme membranes are mounted on O-rings which act as fluid seals. A reference or auxiliary electrode is housed in the temperature probe and positioned at the back of the Sample module.
Stir Bar *(not shown)*	Plastic encapsulated magnet activated by a motor housed below the sample module. Provides thorough mixing inside the sample module.
Buffer, Waste and Calibrator Bottles	Are conveniently located for maintenance. Fluid levels are monitored by sensors. Operation is automatically halted when the Buffer or Calibrator Bottles are empty, or when the Waste bottle is full.



Rear Panel
Figure 3-5

Power Switch	The main power switch is an on/off rocker switch (0-off and I-on) located on the back of the instrument
Fuse Holder	The fuse holder houses the power line fuse and opens up for fuse replacement.
Power Receptacle	One end of the power cord (supplied) plugs into this receptacle, while the other end plugs into a properly grounded electrical outlet. The instrument will automatically adjust the voltage as needed.
Ethernet Port	It allows connection to a network or router via an RJ45 Ethernet port.
RS232 Serial Port	The RS232 connection is a standard DB9F connector. It is used to interface with the YSI 2901 Printer.

4 Basic Setup

The following list describes the basic steps necessary for sampling with the 2500 Analyzer.

1. Install Bottle Rack
2. Connect Printer (optional)
3. Connect AC Power
4. Align Sipper
5. Prepare and Install Buffer solution
6. Install Calibrator Solution
7. Prime the Fluid System
8. Install Membrane(s)
9. Configure Instrument Chemistries
10. Check Probe Currents

4.1 Install Bottle Rack

1. Install the Bottle Rack with Reagent Level Sensing onto the right side of the instrument by sliding the slots in the tray over the pins on the side of the instrument.

2. Then remove the packing material holding the tubing to the right side of the instrument.
3. Next, connect bottle tubing and cables
    a. Insert the large diameter waste tube into the hole in the waste bottle.
    b. Connect one end of a short cable to the threaded fitting on the waste bottle cap and connect the other end to the Waste (top) fitting on the instrument.
    c. Connect the tubing marked “B1” and one end of a short cable to the fittings on the buffer bottle cap and connect the other end of the cable to the Buffer (2nd) fitting on the instrument.
    d. Connect the tubing marked “C1A” and one end of a long cable to the fittings on the calibrator bottle cap and connect the other end of the cable to the CAL (bottom) fitting on the instrument.

Figure 4-1

4.2 Connect Printer

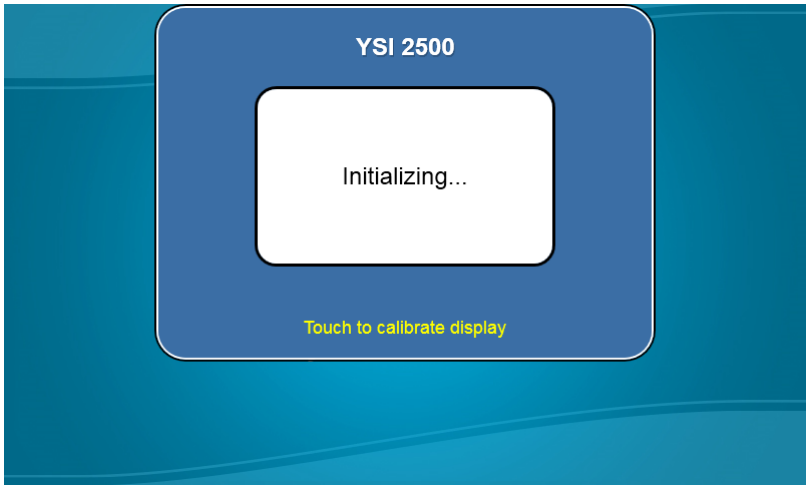
Connect the optional YSI 2901 Printer to the 2500 Biochemistry Analyzer using the data cable provided. The small RJ12 connector plugs into the bottom of the printer and the large DB9 connector plugs into the RS232 port on the back of the analyzer. Refer to the instruction sheet included with the printer for details of printer operation.

4.3 Connect AC Power

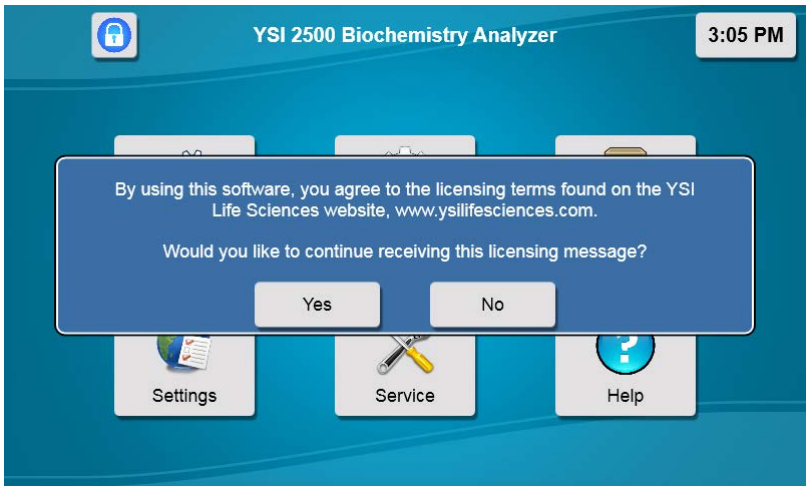
1. Plug the power cord (included with the 2500 Analyzer) into the power receptacle on the back of the instrument, then into a properly grounded electrical outlet provided with a 15 or 20 Amp circuit breaker. The instrument will automatically adjust the voltage as needed.
   If you are located outside the United States, see *Appendix D – Line Power Cord and Plug Wiring* for Line Power Cord and Plug Wiring.

WARNING: Keep your hands clear of the sipper while the instrument is in operation.

2. Turn the instrument on with the main power switch on the rear panel. After about 30 seconds, the Initializing window should appear.

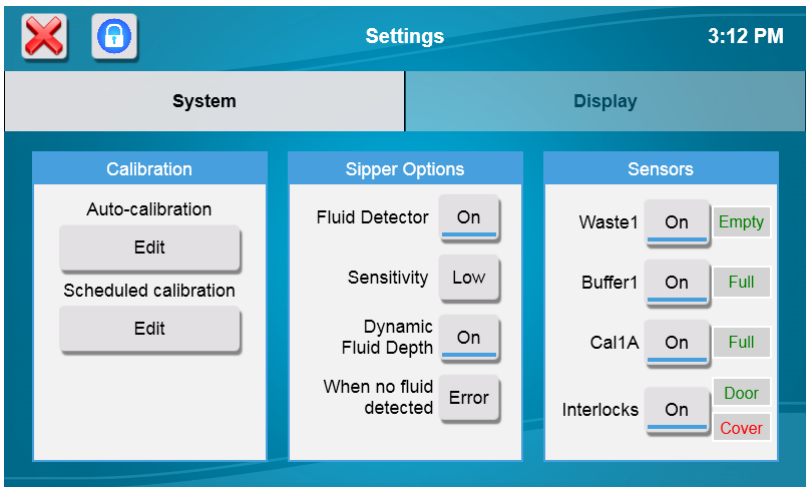


3. The first time the instrument is powered up, the software license window will appear. Touch [No] to prevent the license screen from appearing each time the instrument is turned on.

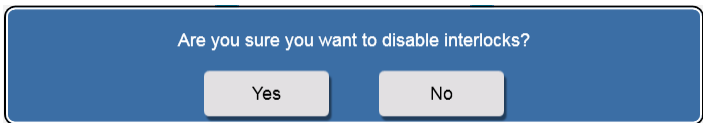


4. Since the top cover of the instrument is removed, the message below will appear.

5. Touch [OK] to confirm, then touch the **Settings** icon.



6. Touch the Interlocks [On] button.



7. Touch [Yes] to confirm and disable the safety interlocks.

8. Touch [X] in the top left of the screen to return to the main display.

4.4 Align Sipper

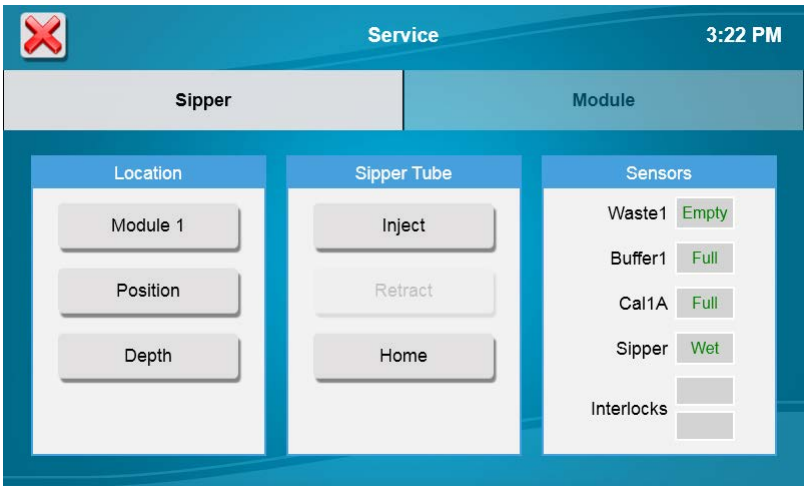
It is very important that the sipper be accurately adjusted.

WARNING: Keep your hands clear of the sipper while the instrument is in operation.

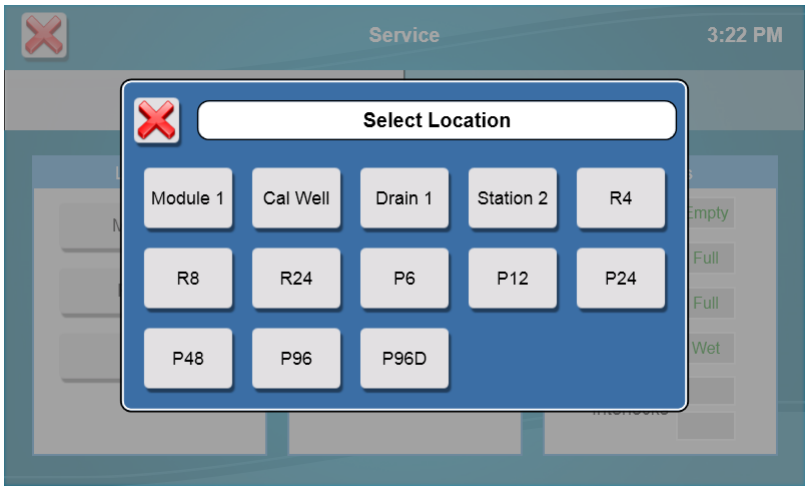
1. Touch the **Service** icon.

2. From the Sipper tab of the Service screen, touch [Home].

3. Once the sipper has moved to the home position, touch [Module 1].

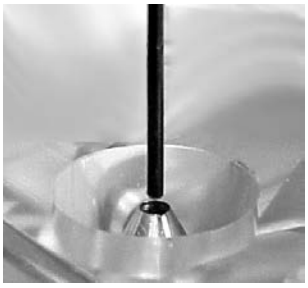


4. The Select Location screen will appear. Select [Module 1]. The sipper will move to sample module 1 and should be centered above the cone shaped opening in the top of the module.
If the sipper does not move, make sure the packing material was removed.



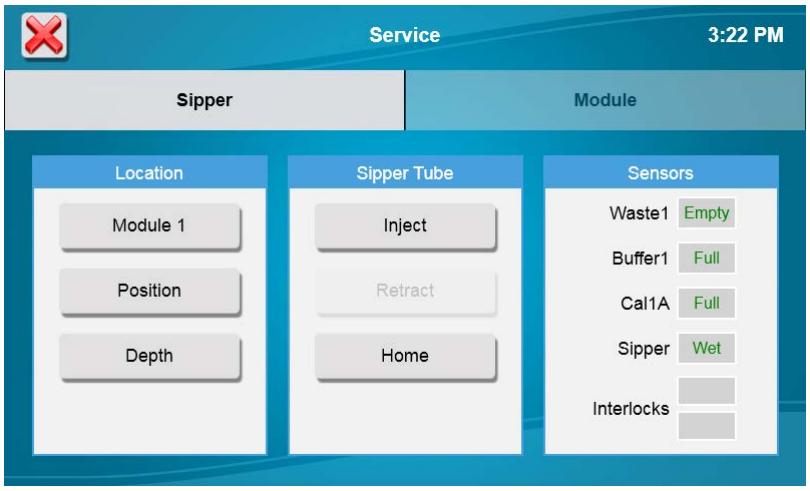
5. If the sipper is not centered, touch [Position] and use the arrow buttons to center the sipper.

6. Make certain the Sipper is centered, then touch [Save] at the bottom of the adjustment window.

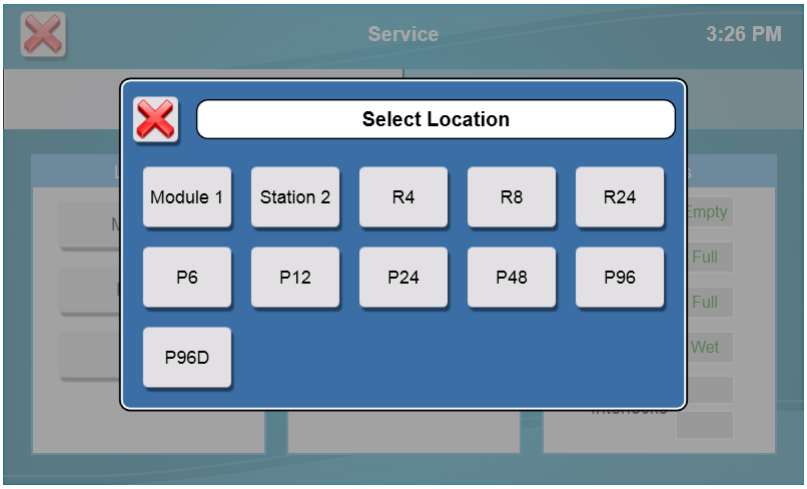


Sipper Adjustment Position
Figure 4-2

7. To test the alignment of the sipper, Touch [Inject] to lower the sipper, then touch [Retract] to raise the sipper back up. If necessary, touch [Position] and repeat the adjustment.



8. Once the sipper enters the sample module without hitting the cone, touch [Depth] to set the sipper depth. The Select Location screen will appear.



9. Select [Module 1]. The tip of the sipper should be right at the top of the module. Use the arrow buttons to lower or raise the sipper until the tip of the sipper is even with the top of the module.
10. Touch [Save] at the bottom of the adjustment window.

11. Check the sipper alignment at the Cal 1A and Drain 1 locations and adjust the position if necessary.

12. Once you have aligned the sipper properly and set the depth, sipper alignment for the Module is complete.
13. Check the sipper alignment for any rack or plate you intend to use at Station 1 (see *6.2.1 Sipper*).
14. Touch [X] at the top left of the screen to return to the main display.

After you have aligned the sipper with the module, return to the Settings screen and touch the Interlocks button and change it back to [On] to enable the safety interlocks.

4.5 Prepare and Install Buffer Solution

Caution: To prevent possible damage due to an electrostatic discharge, do NOT touch the metal tips of the connectors located at the ends of the bottle leads. Handle only the insulated section of the connectors.

4.5.1 Prepare Buffer

1. Place about 500 mL of reagent water (distilled or deionized) into a 1000 mL flask or other clean container.
2. Add two packages of YSI 2357 powder buffer concentrate and stir.
3. Add more reagent water until the total volume of solution is between 900 and 1000 mL.
4. Stir as necessary until the buffer chemicals have completely dissolved.

4.5.2 Install Buffer Solution

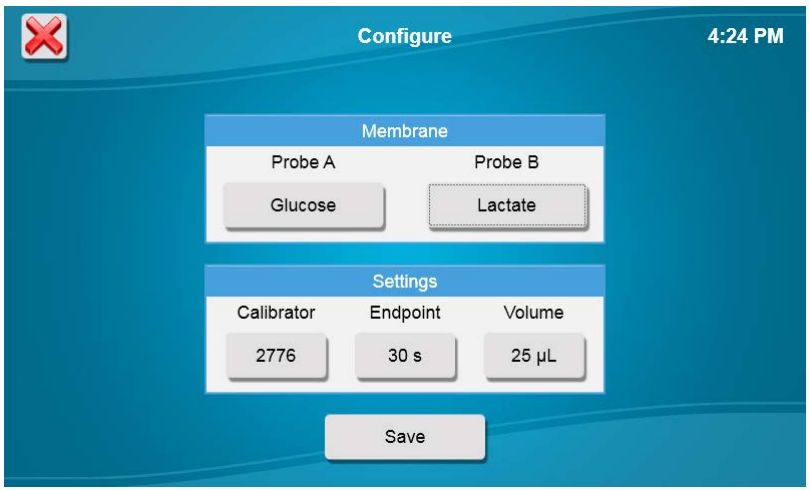
5. Unscrew and remove the lid from the buffer bottle.

IMPORTANT: When adding fresh buffer to the Buffer Supply Bottle, make every effort to avoid contamination of the lid and level sensor assembly.

6. Pour the prepared buffer into the buffer bottle.
7. Install the bottle in the rack.
8. Replace the bottle lid.

4.6 Install Calibrator Solution

Caution: To prevent possible damage due to an electrostatic discharge, do NOT touch the metal tips of the connectors located at the ends of the bottle leads. Handle only the insulated section of the connectors.



1. Unscrew and remove the lid from the empty calibrator bottle.

IMPORTANT: make every effort to avoid contamination of the lid and level sensor assembly.

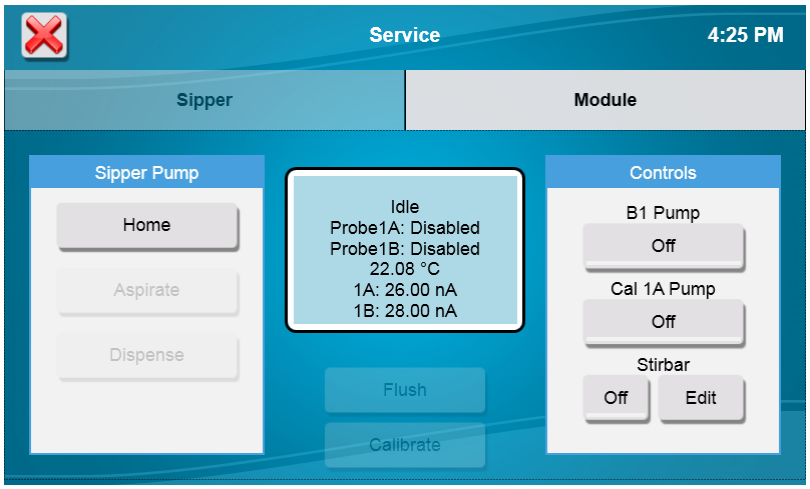
2. Mark the date of installation on the label of the new bottle of YSI calibrator solution (the working life is 30 days).
3. Place the new bottle of YSI 2747 or 2776 calibrator in the bottle rack. Verify that the Calibrator setting in the Configure screen matches the model number of the bottle you install.
4. Screw the lid and level sensor assembly onto it.

4.7 Prime the Fluid System

Please note that it may take from several minutes to more than an hour to initially stabilize the probes when setting up for the **first time** (or after the power has been off for more than a few minutes).

To prime the fluid system:

1. From the Service screen, touch the [Module] tab.



2. Touch the button under B1 Pump to turn the buffer pump on.
3. The instrument will prime the buffer solution.
4. Once buffer flows from the end of the sipper, touch the button under B1 Pump to stop the pump.
5. Touch the button under Cal 1A Pump to turn it on.
6. The instrument will prime the calibrator solution.
7. Once calibrator flows from the calibrator well in the module, touch the button under Cal 1A Pump to stop the pump.

Prime the calibrator bottle daily before calibrating or sampling to remove air bubbles from the tubing.

4.8 Install Enzyme Membranes

Each biosensor probe installed in your instrument is fitted with a protective "shipping membrane" which must be removed and replaced with a new membrane. **Make sure you install the correct membrane for each chemistry you are measuring.**

Enzyme membranes are color-coded, red for glucose and gray for lactate. It is important that you install the specific membrane as indicated on each probe (A or B).

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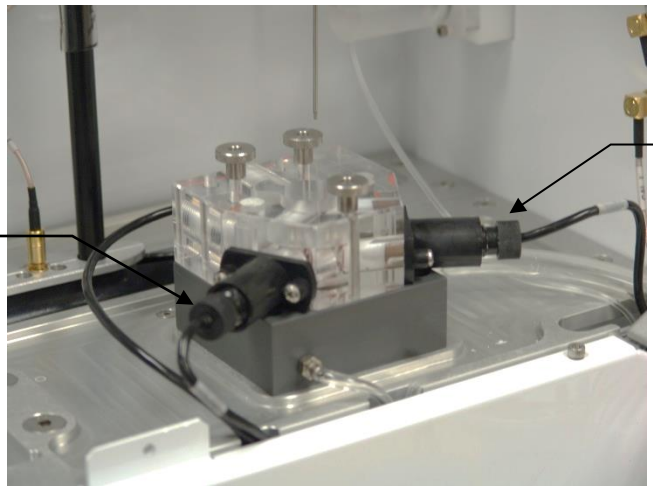


Probe A is on the left when looking in from the side of the instrument
Figure 4-3

To install a membrane:

1. Make sure the top cover is removed from the instrument.
2. Next, unscrew the appropriate enzyme probe retainer and gently pull the probe out of the module.
3. Remove the existing O-ring membrane assembly from the end of the enzyme probe. A lint free tissue or toothpick or pipet tip may be needed to unseat the old membrane. **Be careful not to scratch the enzyme probe surface**.
4. Examine the enzyme probe surface and remove any pieces of membrane that remained.
5. Open a cavity of the plastic membrane holder.
6. Rinse the membrane inside with a few drops of salt solution (YSI 2392).
7. Place one drop of salt solution on the enzyme probe face.
8. Using the plastic membrane holder, press the O-ring membrane assembly gently onto the probe face.

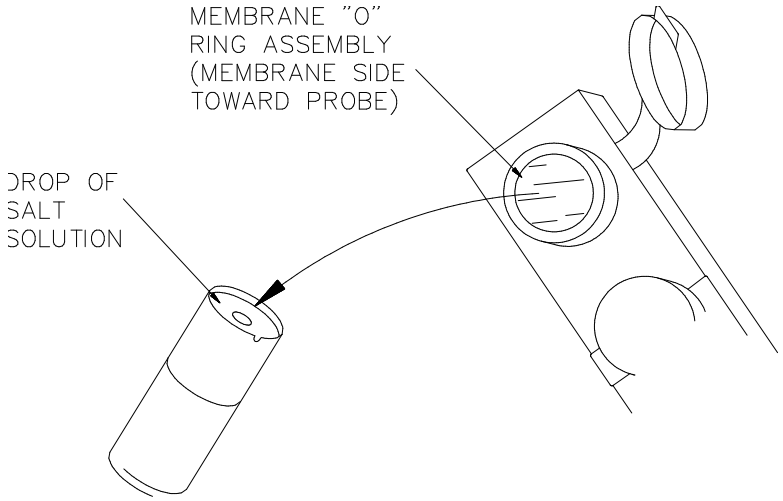


Figure 4-4

9. Wipe excess salt solution from the probe body.
10. Verify there is a stir bar in the module.
11. Then return the enzyme probe to the module.
12. Finger tighten the probe retainer so that the O-ring seals the probe in place. Do not overtighten.
13. Return the membrane holder to the foil pouch and refrigerate it.
14. Note the expiration date on the membrane package.
15. Repeat this procedure for the other enzyme probe.

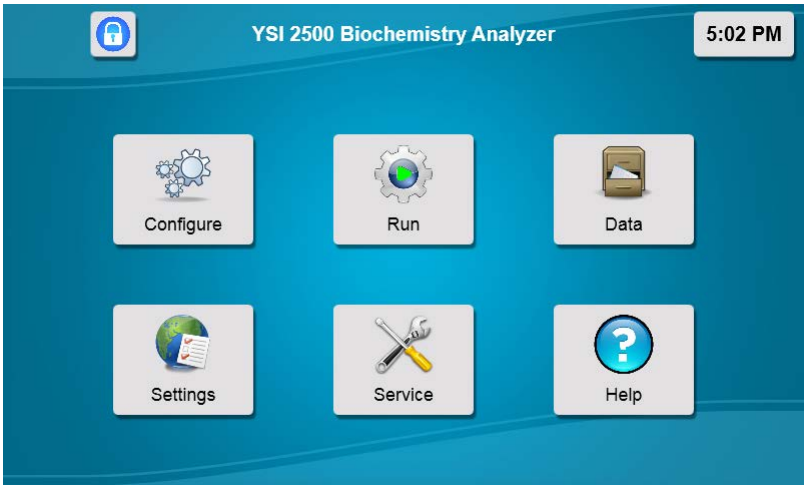
You may want to maintain an instrument log book in which dates and lot numbers of reagents are recorded, along with information from daily operational checks and other relevant information.

4.9 Configure Instrument

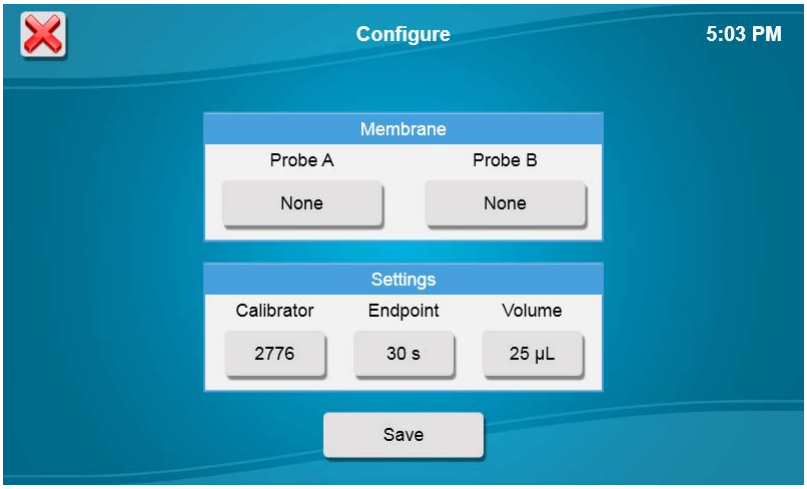
Before operating the 2500 Analyzer, you must set the instrument parameters.

4.9.1 Assign Chemistries to Probes

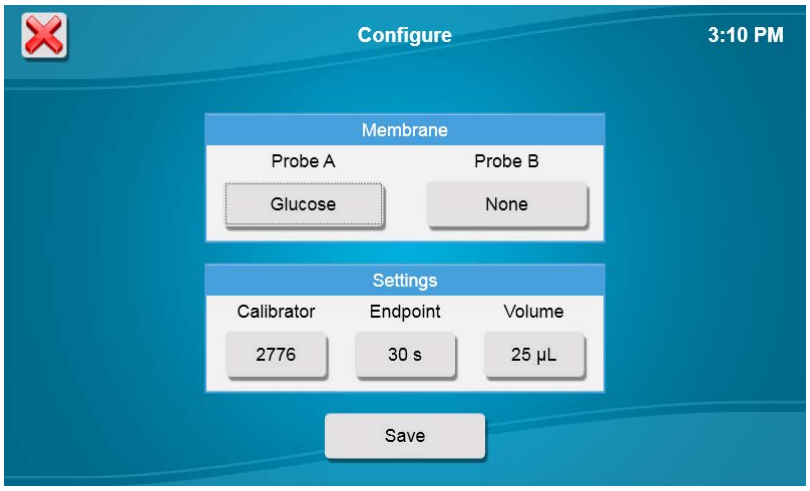
1. From the main display, touch **Configure**.



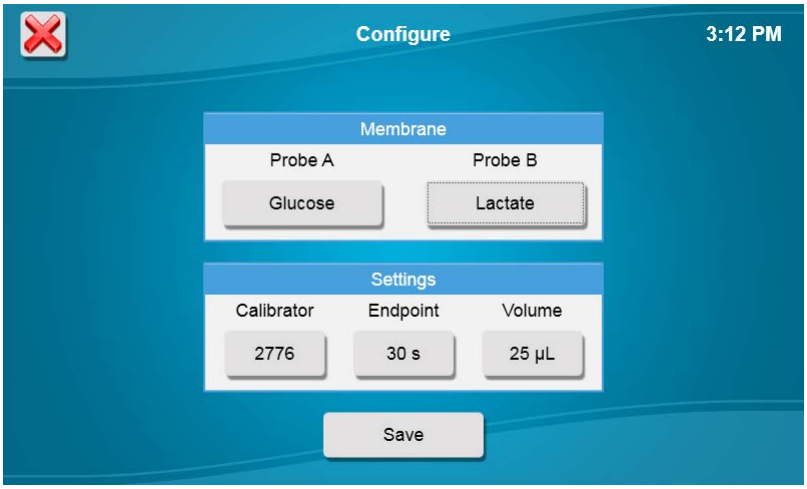
2. Touch the Probe A membrane button to select the chemistry you want to measure.



3. The Probe A Membrane button will now show the chemistry you have selected. The screen also indicates which reagents should be installed.



4. To run a second chemistry in module 1, touch the Probe B membrane button and Select the chemistry you want to measure.



NOTE: The default sample Volume and Endpoint are also displayed. **Use the default settings unless a particular application instruction specifies another value** (see Section *7 Chemistry Setup* for details).

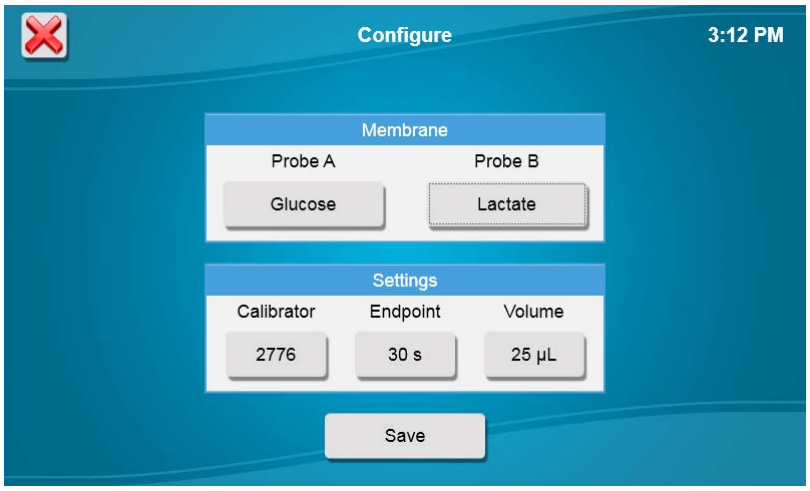
NOTE: Changing chemistry assignments will change the calibrator value back to the default settings.

4.9.2 Buffer

The YSI 2500 always uses YSI 2357 Buffer.

4.9.3 Calibrator

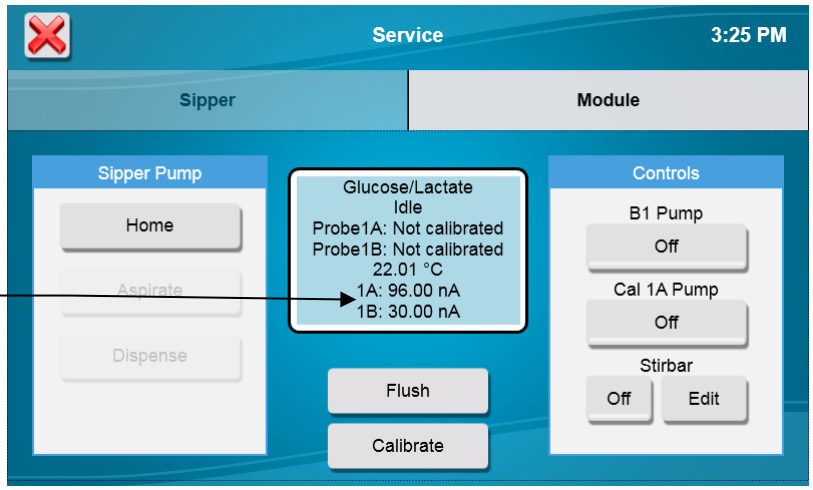
1. Touch the Calibrator button and select the appropriate calibrator, 2776 or 2747.



2. Touch [Save].

4.10 Check Probe Currents

1. From the [Module] tab of the Service screen, touch the [Flush] button to flush the sample module with buffer.



Enzyme Probe Currents

2. Observe the probe current values (baseline). They must be below 6 nA and stable.
3. Check to see if they are decreasing in value.
4. Check the sample module; it should be full of buffer.
5. If necessary, touch the [Flush] Button to flush the sample module again.

Please note that when the instrument is first powered up, it may take several hours for the baseline currents to drop below 6 nA.

5 Running the Instrument

5.1 Perform Daily Operational Checks

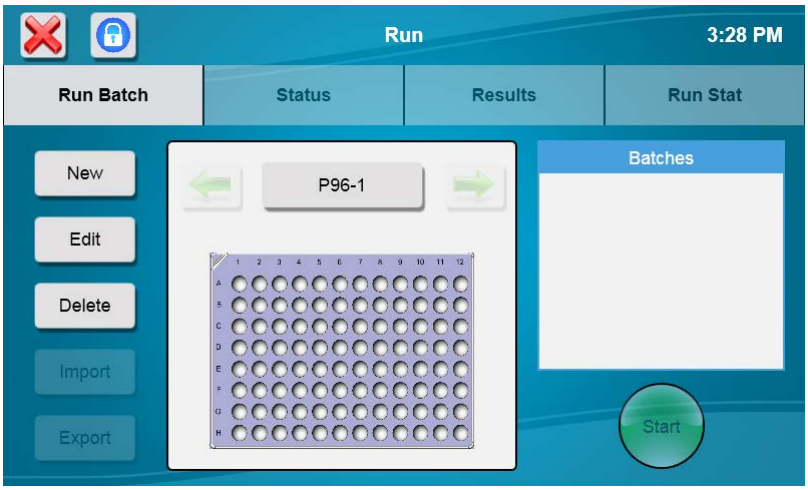
To ensure that your 2500 Analyzer is operating properly, perform the Membrane Integrity and Linearity checks on a daily basis **before running samples**.

5.1.1 Enzyme Membrane Integrity Test

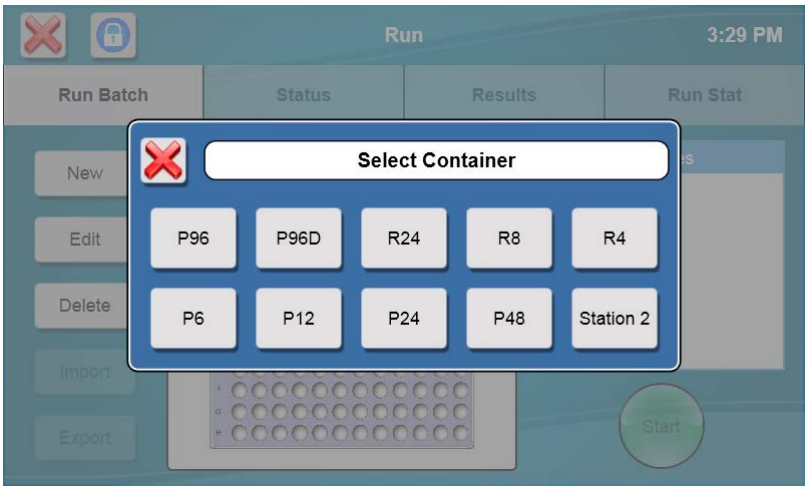
Run YSI 2363 Potassium Ferrocyanide (FCN) Standard as a sample to determine if your enzyme membranes are structurally intact.

1. Pour a small amount of FCN standard (1000 mg/dL) in a test tube or multi-well plate.

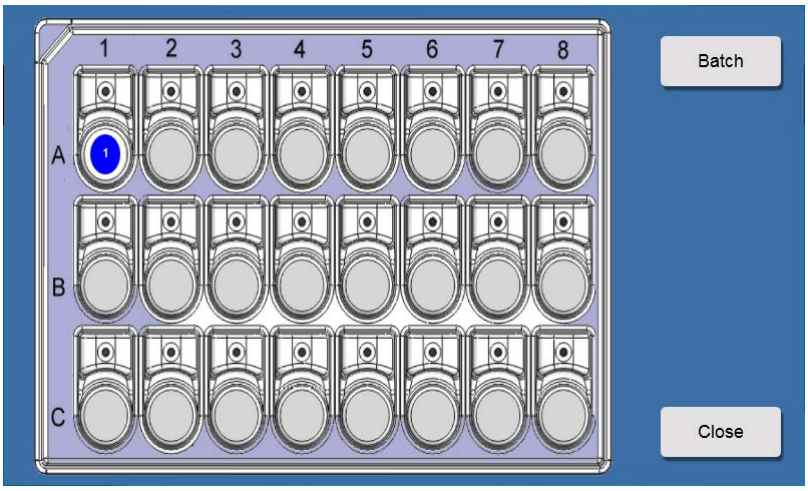
2. From the Run Batch tab, touch [New].



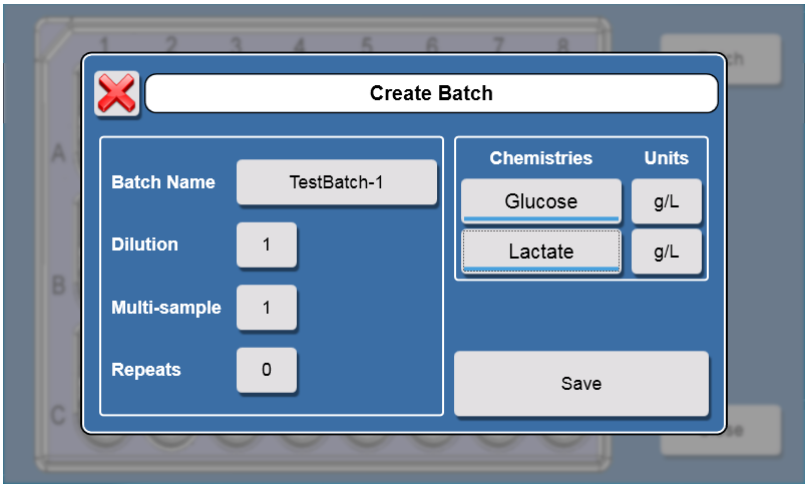
3. Choose from the selection of supported racks and plates.



4. We highly recommend renaming the rack/plate “Daily Checks” by touching its ID to indicate that it contains your daily check batches.
5. After selecting your plate/rack, touch the [Edit] button
6. Touch the location of each sample for the first batch. Selected locations will be blue.

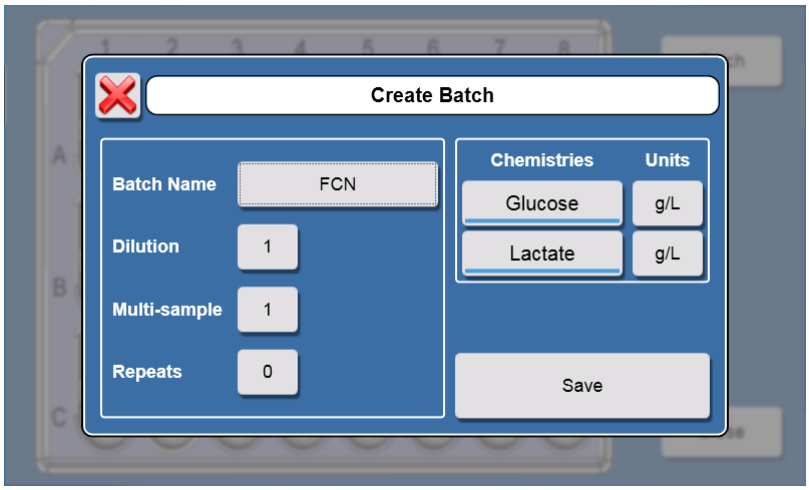


7. Touch the [Batch] button.
8. Select the chemistries that require the FCN test.



9. To change the Batch Name from the default value of TestBatch- #, touch the [TestBatch- #] button. The keypad window will appear.

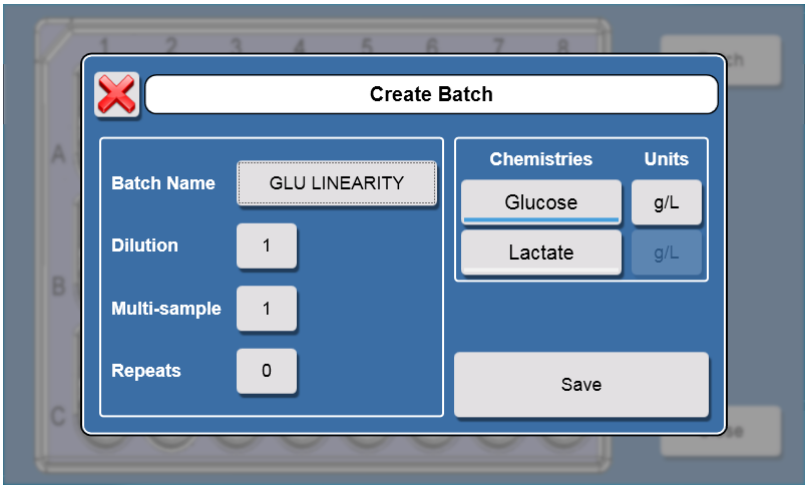
10. Type your new batch name and touch [DONE].



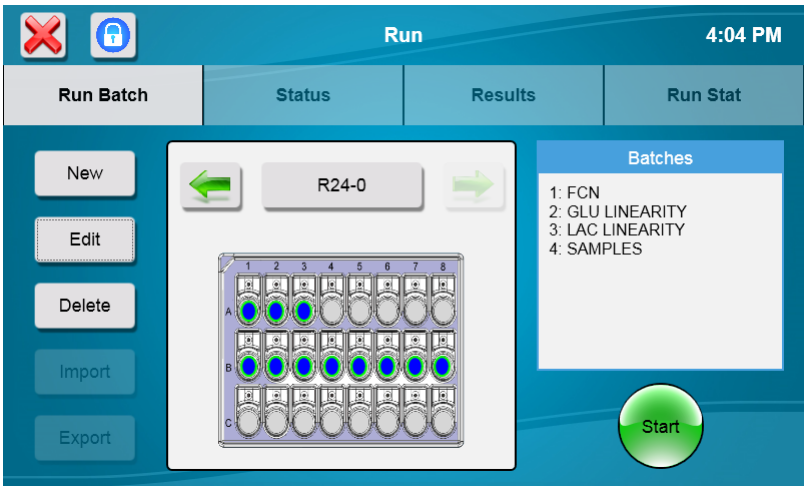
11. Touch [Save] to save the batch.

5.1.2 Linearity Test

12. Pour small amount of each linearity standard in a test tube or multi-well plate.
13. Touch additional sample locations and create new batches for the linearity tests.
14. For the daily linearity checks, select only the chemistry that corresponds to the linearity standard in that sample location.

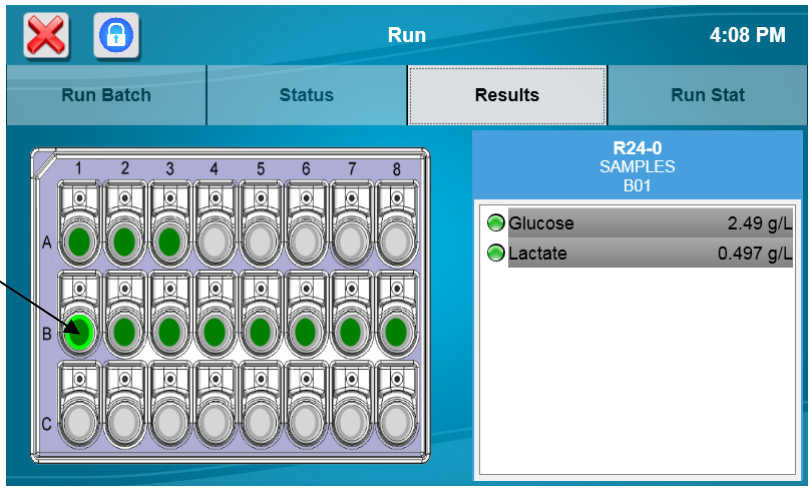


15. Touch [Save] to save the batch.
16. Create batches for each linearity solution.
17. Touch [Close] when all batches are created.
18. Load the plate/rack in the sampling station 1.
19. Touch **(Start)** to run the FCN and the linearity standards as samples.
    The analyzer will calibrate as required and run the batches.

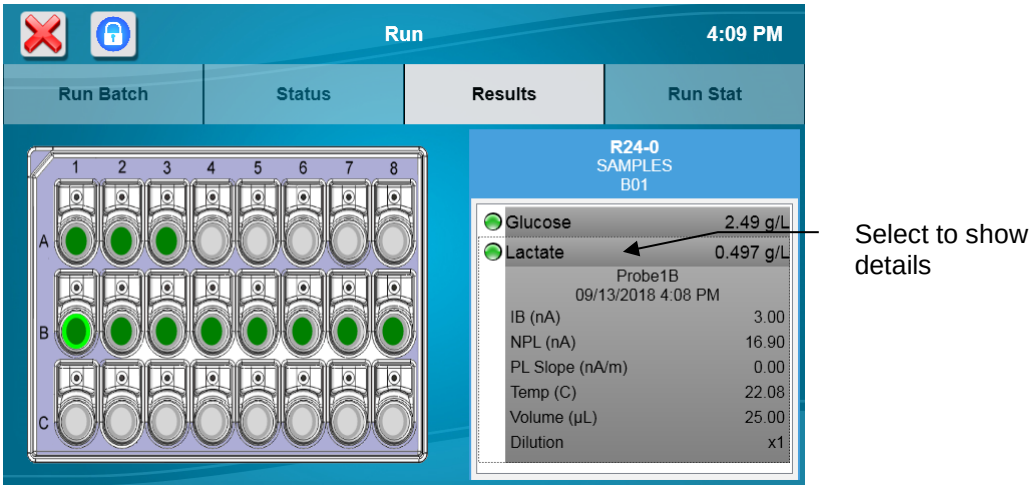


5.1.3 Results

20. Touch the Results tab
21. Select a sample location.



22. Touch a chemistry to show details



23. Listed in table 6-1 below are the recommended FCN limits.
    a. Values less or equal to FCN limits indicate integral membranes
    b. Values greater than FCN limits indicate membrane structural failure
    c. If readings are high, recalibrate and repeat all the steps above to confirm.
    d. If the reading is still out of tolerance, refer to Section *10 Troubleshooting*.

Chemistry	Membrane	Calibration Standard	FCN Limit[1]
Glucose	2365	2776 or 2747	0.05 g/L
L-Lactate	2329	2776 or 2747	0.03 g/L

Table 6-1

24. See the list of acceptable values in table 6-2 below to interpret linearity readings.
    a. Values that are ± 5% of specified tolerance limits indicate good membranes.
    b. Values that are out of tolerance indicate an aging enzyme membrane.
    c. If readings are out of tolerance limits, recalibrate and repeat all the steps above to confirm.
    d. If the reading is still out of tolerance, refer to Section *10 Troubleshooting*.

Chemistry	Calibration Std	Linearity Std	Acceptable Range (g/L)
Glucose	2776 (2.50 g/L)	1531 (9.00 g/L)	8.55 to 9.45
L-Lactate	2776 (0.50 g/L)	1530 (2.67 g/L)	2.54 to 2.80

Table 6-2

5.2 Sample Preparation

A variety of sample types can be analyzed with the 2500 Analyzer. Generally, the only sample preparation that **may** be required is dilution of the sample to bring the substrate concentration within the linear range of the instrument (see Section *7.2 Measurement Parameter Information* for the working range of each chemistry).

Neither color nor turbidity interferes with measurements.

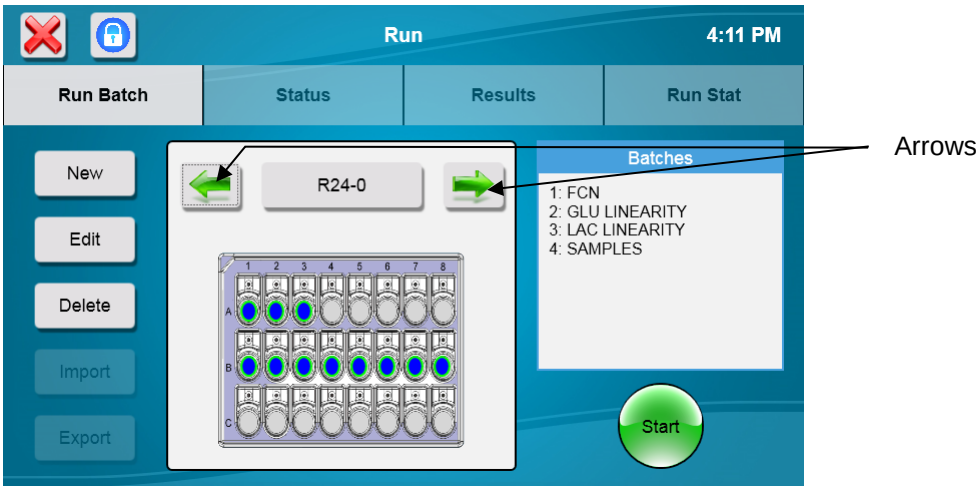
Small particles do not affect the reaction in the sample module that houses the probes, but samples with particles large enough to clog the sipper should be avoided.

5.3 Run Batch

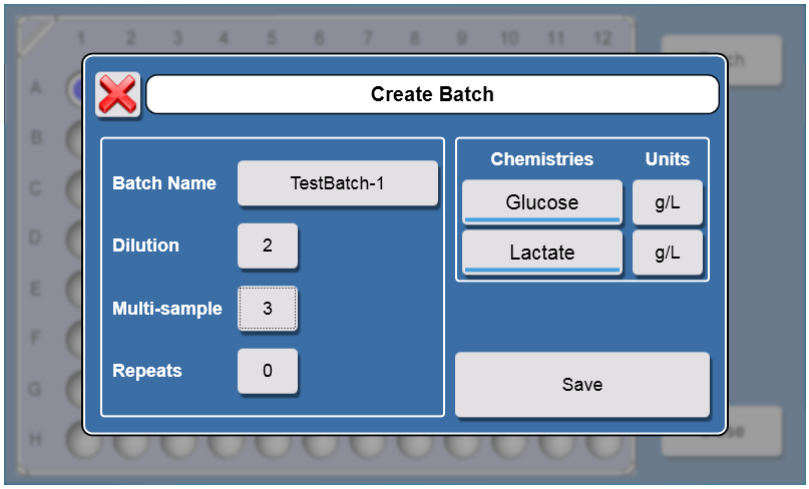
5.3.1 Create Batches

1. From the Run Batch tab of the Run screen, select a sample rack/plate and create batches for your samples.

[1] If you are using units other than g/L for the FCN test, refer to *Appendix B – Concentration Unit* Conversion for conversion values.



2. Touch [New] and choose from the selection of supported racks and plates. Alternatively, use the arrows to scroll through the saved racks and plates until you find the type that you are using.
3. You may rename the rack/plate by touching its ID.
4. After selecting your plate or rack, touch the [Edit] button.
5. Touch the location of each sample for the first batch (selected locations are blue).
6. Touch [Batch].
7. Select the chemistries to run in this batch.

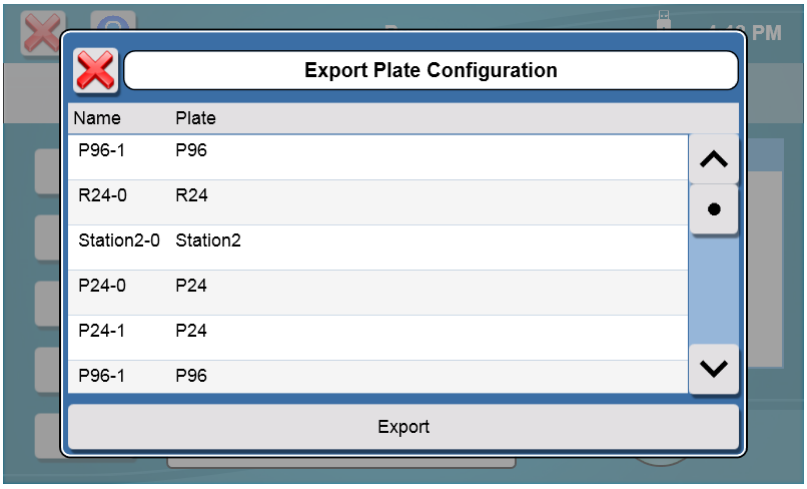


8. Enter any optional parameters, such as Batch Name (separate name for this batch), Dilution factor, Units, Multi-Sample (multiples of each sample location in this batch), or Repeats (multiples of the entire batch).
   Please note that the instrument does not automatically dilute samples.
9. If you diluted your samples:
   a. Touch the Dilution [1] button.
   b. Enter your dilution factor then touch [OK].
10. To change the number of sample replicates:
    a. Touch the Multi-sample [1] button.
    b. Enter the number of times each sample in the batch should be run, then touch [OK].
11. To repeat the entire batch:
    a. Touch the Repeats [0] button
    b. Enter the number of times the entire batch should be repeated, then touch [OK].
12. Touch [Save] to save the batch.

13. You may also create one or more batches for samples. Alternatively, you may create a separate rack for sample batches.
14. Touch [Close] when all batches are created.

5.3.2 Export

1. To save your plate configurations to a flash drive, touch [Export].



2. Select the plates you want to export, and then touch [Export].
3. Previously exported plates can be imported later using the [Import] button.

NOTE: Importing a plate with the same name overwrites an existing plate.

5.3.3 Load Samples

5.3.3.1 R24 and P6-P96 Racks/Plates

1. Open the front door of the instrument

2. Insert the plate/rack (end marked A1 first) into the instrument. Slide the front edge of the plate/rack in until it stops.

Figure 5-1

3. Gently lower the rear of the plate/rack and push it down into position.

Figure 5-2

5.3.3.2 R4 or R8 Tube Racks

1. Open the front door of the instrument.
2. Insert the R4 or R8 tube rack into the cavity just inside the front door.
3. Insert your sample tubes into the tube rack you installed.

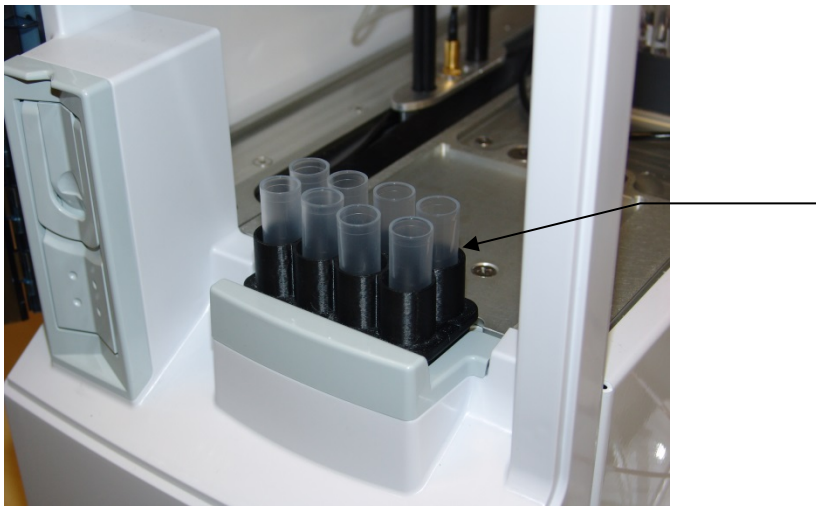


Figure 5-3

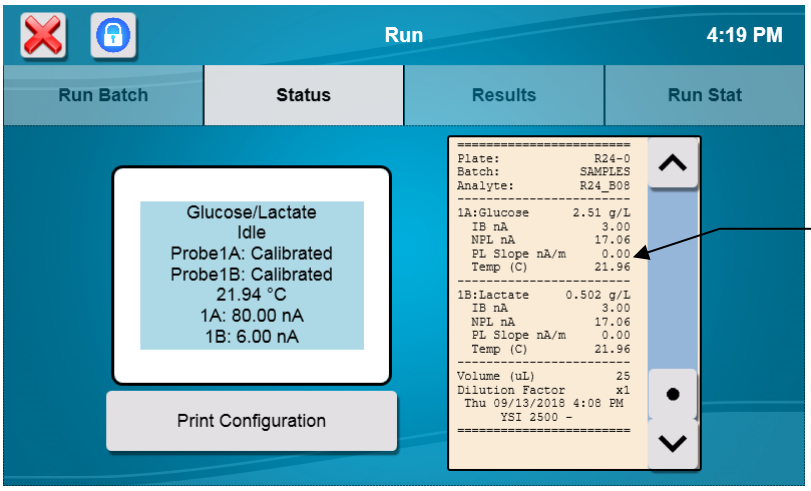
5.3.4 Run Samples

Touch **(Start)** to run the current batches.

The 2500 Analyzer will calibrate as required and run the batches.

5.3.5 Status

1. Touch the Status tab.



2. The virtual printer window displays details of previous samples and calibrations.
3. Use the arrow buttons to scroll the printer window.
4. Touch [Print Configuration] to send the current analyzer setup to the printer.

5.4 Run Stat

A Stat sample at Station 2 runs without stopping a plate analysis that is in progress.
NOTE: The Sipper is not designed to pierce septa.

1. Touch the Run Stat tab
2. Place the Stat sample in Station 2:
    a. Insert your sample tube into the tube holder (Station 2) from below the spring clip
    b. Slide it up all the way until it rests below the notch at the top.

    The test tube holder accepts tubes sizes up to 16x100mm.
    Any container other than this should be sampled manually by holding the sample at Station 2.
    For a Syringe sample, wait until you are prompted to present the sample.

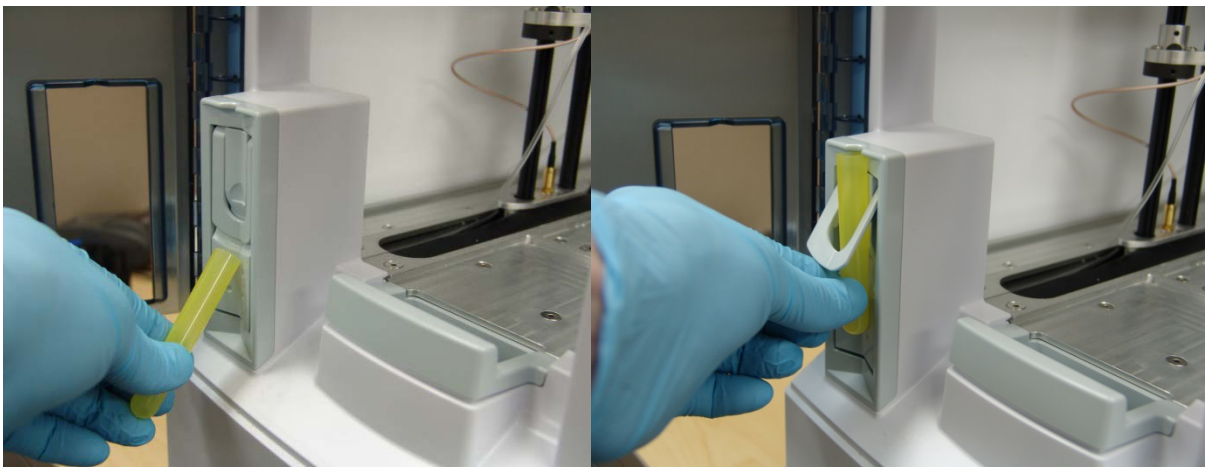
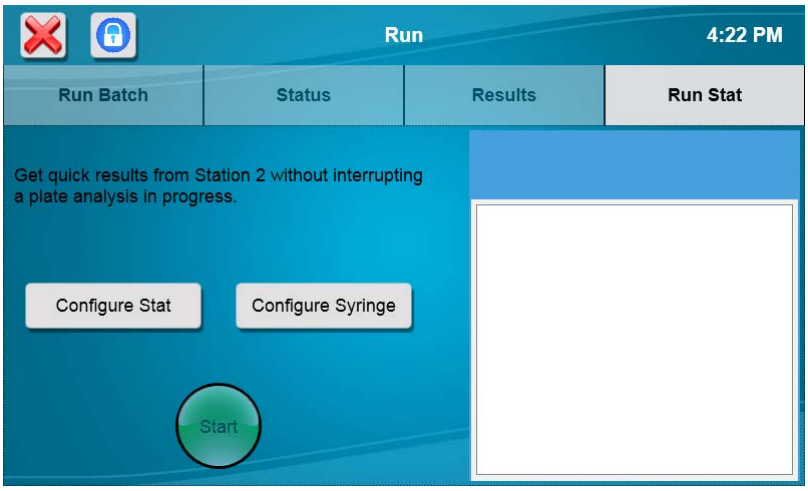
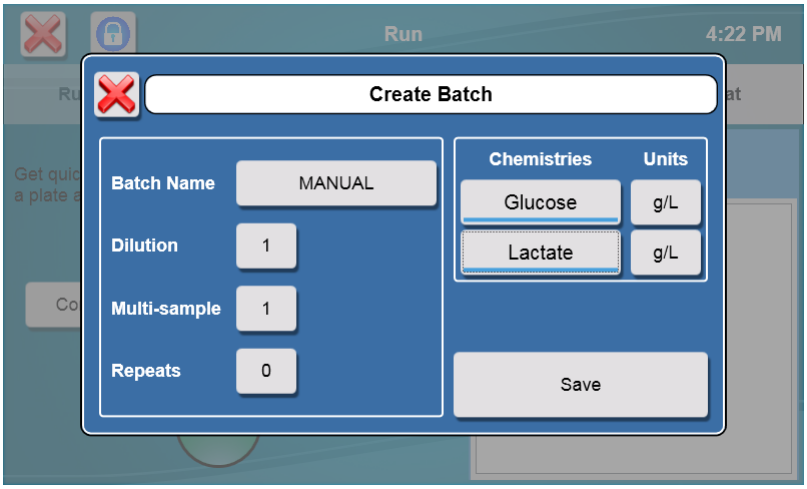


Figure 5-4

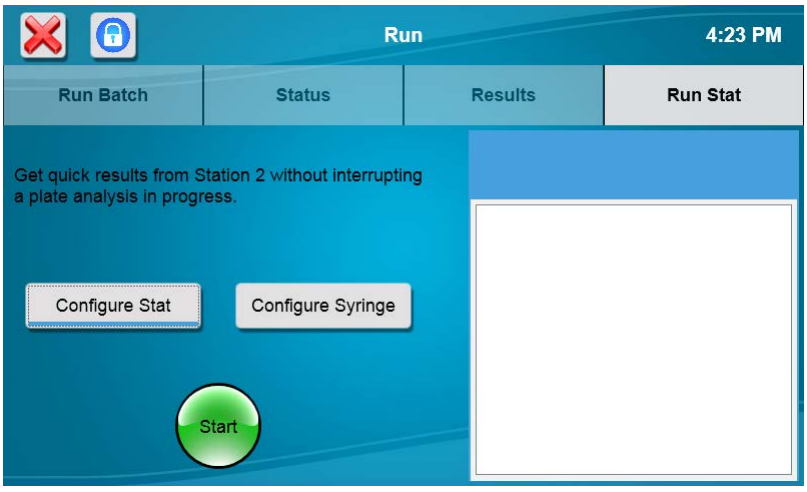
3. Touch [Configure Stat] to setup a Stat sample or [Configure Syringe] to setup a Syringe sample. For a Syringe sample, the analyzer will wait and allow time for the user to carefully immerse the tip of the sipper into the sample.



4. Select the chemistries and units for the sample.

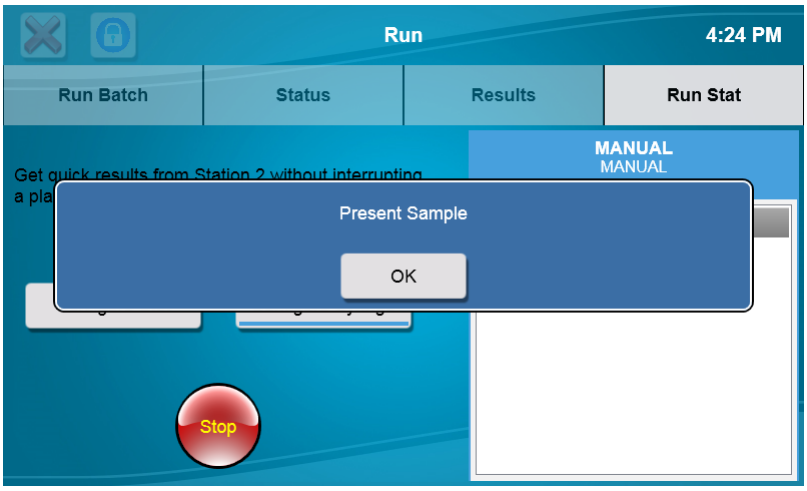


5. Touch [Save] to return to the Run Stat screen. The type of sample you configured will be underlined.

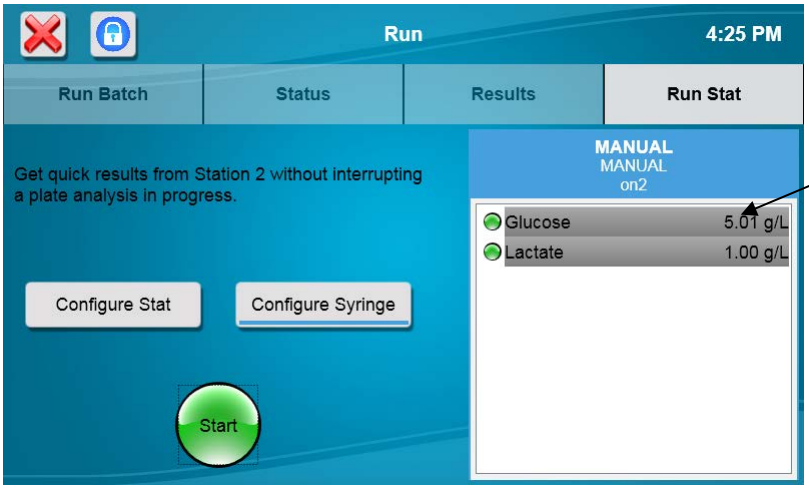


6. Touch **(Start)** to run the highlighted (Stat or Syringe) sample at Station 2.
   If a Station 1 batch is in progress, the Stat sample will run as soon as the current sample is finished.

7. If you configured a Syringe sample, present the sample to the sipper then touch [OK] to run the sample.



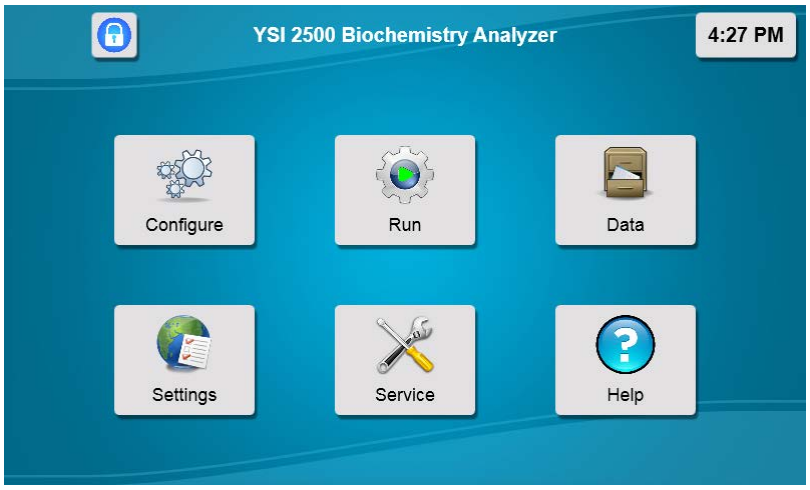
8. The Stat sample results are displayed on the Run Stat tab.



6 Advanced Functions

6.1 Settings

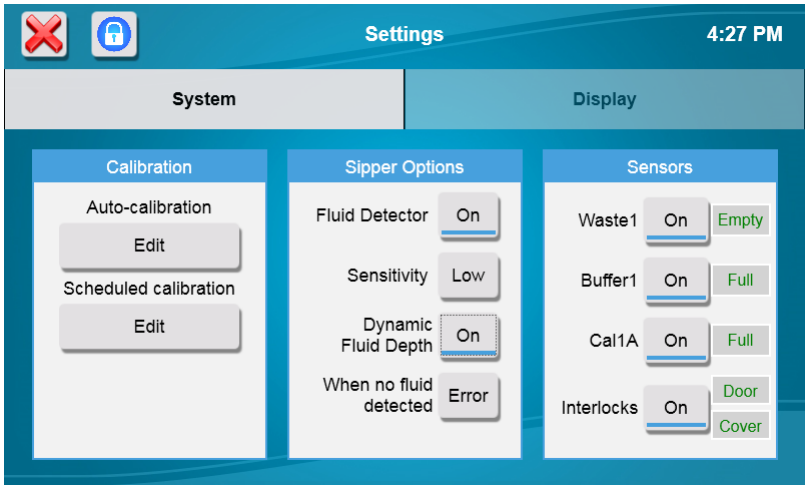
Touch [Settings] to display the settings screen as shown below.



The Settings screen includes System and Display tabs.

6.1.1 System

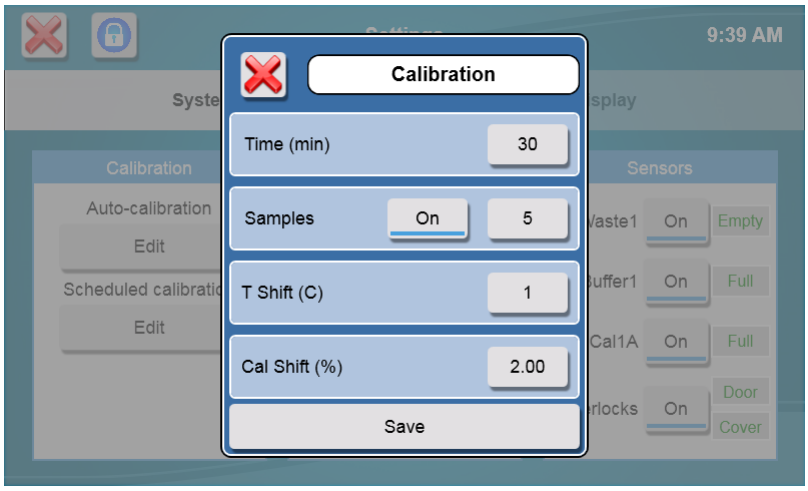
Touch the [System] tab (if not already selected). The System tab is used to adjust calibration settings, enable sipper and bottle fluid detection, and interlocks.



6.1.1.1 Calibration

Auto-Calibration

Touch the Auto-calibration [Edit] button to display the Calibration settings.



The default Auto-calibration settings are shown above. You may alter any of these parameters to suit your application, however, **you may compromise precision and/or accuracy** when doing so. YSI's stated specifications are based on the default settings. These selections are provided as part of the overall concept of the 2500 Analyzer flexibility.

To change the value of a Calibration parameter, simply touch the value to open the numeric keypad. Enter the new value, then touch [OK].

To disable the number of Samples parameter, touch the [ON] button and change it to [OFF].

NOTE: When the analyzer is NOT in the Configure or Service screen, it will continue to calibrate at the time interval entered until it has been idle for 2 hours AND the Screensaver is active. It will then calibrate every 4 hours (performing a maximum of 3 calibration attempts each time to preserve reagent use).

If the Screensaver is disabled (Off), the analyzer will continue to calibrate at the Autocal time interval (default value of every 30 minutes) indefinitely, unless the Screensaver is activated manually (Lock button is pressed) and the analyzer has been idle for 2 hours.

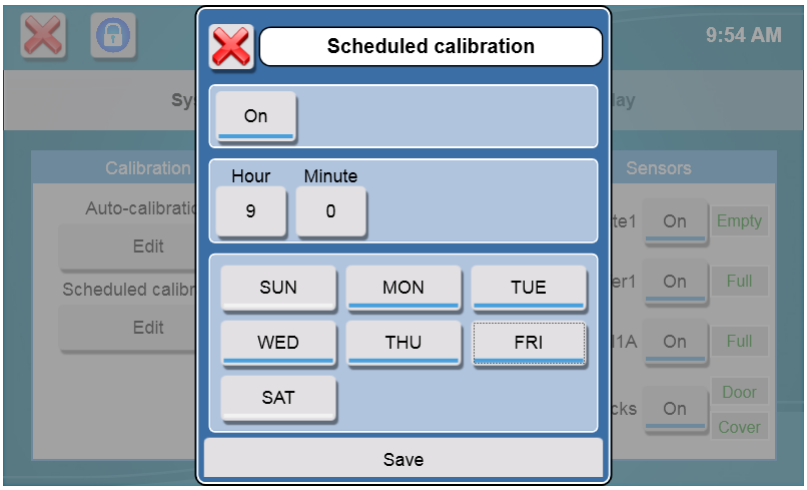
Touch [Save] to save your changes.

Scheduled Calibration

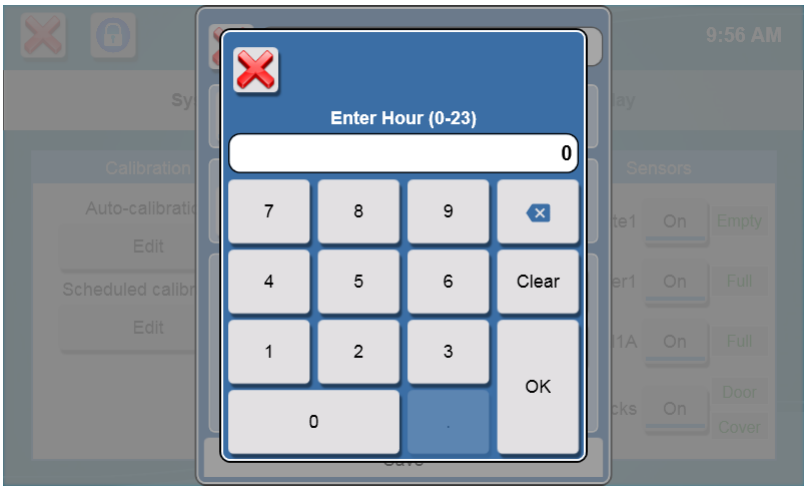
The 2500 Analyzer can be set to automatically calibrate at a specific time of day, such as the start of each workday.

Touch the Scheduled calibration [Edit] button to display the settings

Touch the Scheduled calibration [OFF] button and change it to [ON]. Touch any days to select them. Days of the week that the scheduler is enabled are underlined blue.



Touch the Hour button:



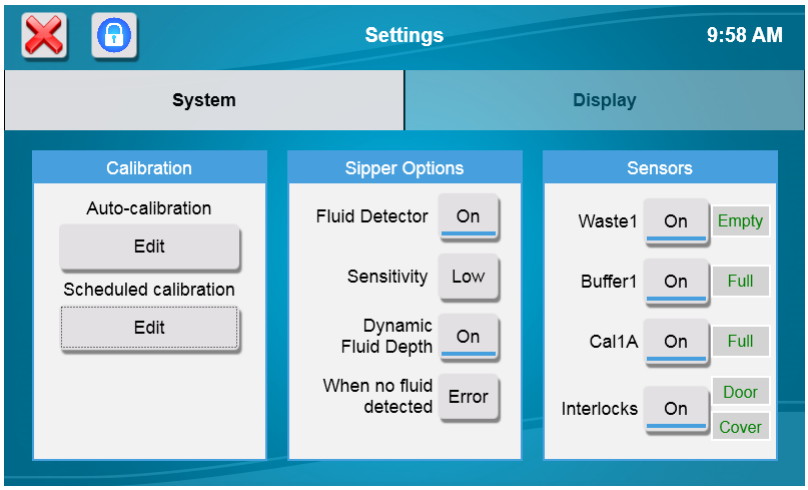
Enter the Hour each day that the instrument should calibrate in 24 hour format (0–23), then touch [OK].

Touch the Minute button [0] and enter the Minutes. Touch [OK].

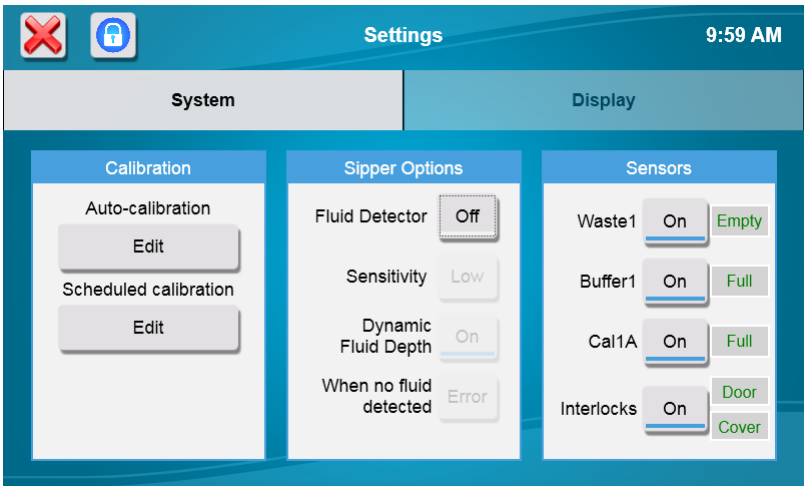
After you have finished making your changes, touch the [Save] button.

6.1.1.2 Sipper Options

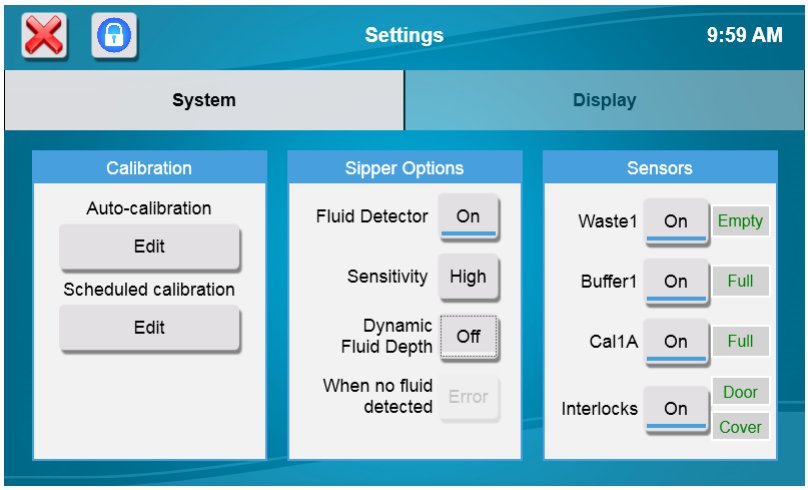
Touch the Sensitivity [High] button and change it to [Low] for samples with high conductivity.



Touch the Fluid Detector [On] button and change it to [Off] to completely disable sipper fluid detection at all locations, including the calibrator wells.



Touch the Dynamic Fluid Depth [On] button and change it to [Off] to disable sipper fluid detection and use fixed depth at sample stations.



Touch the “When no fluid detected” button and select the sample fluid detection mode you prefer:

[Error] Produce an error when no sample is detected (no sample result).

[Warn] Use fixed depth when no sample is detected (report a sample result).

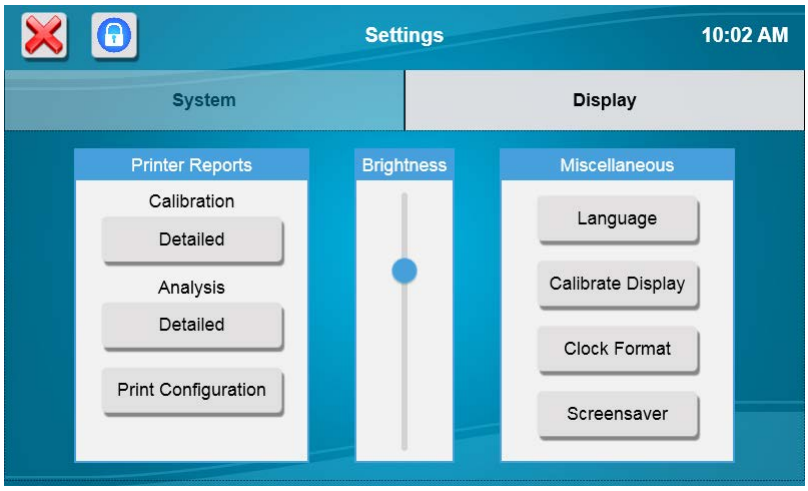
6.1.1.3 Sensors

To change bottle Fluid Detection, touch the button for the bottle you wish to change.

NOTE: When bottle sensors are off, check bottle fluid levels regularly to prevent waste fluid from backing up into sample modules and overflowing.

6.1.2 Display

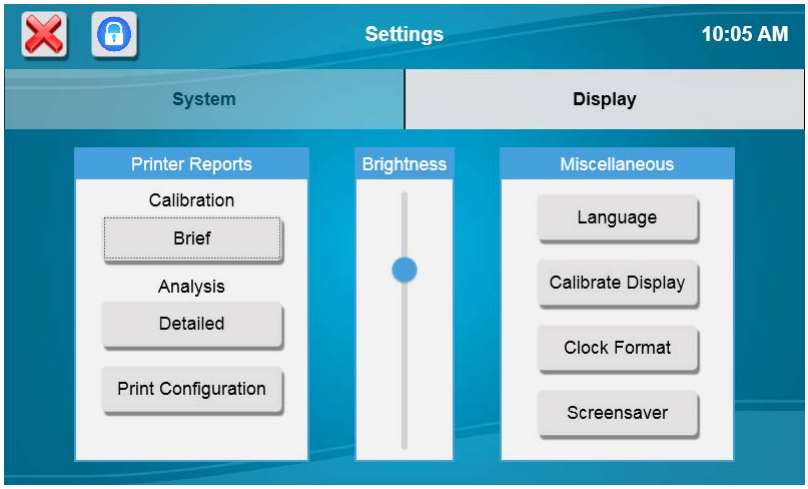
From the Settings screen, touch the [Display] tab.



The Display tab is used to select the type of sample and calibration reports, print the configuration, adjust the display brightness, select your language, calibrate the touch screen, select the clock format, and enable/disable the screensaver.

6.1.2.1 Printer Reports

To change the Analysis or Calibration Reports, touch the button below it to cycle through the selections— Brief, Detailed, or None.



6.1.2.2 Print Configuration

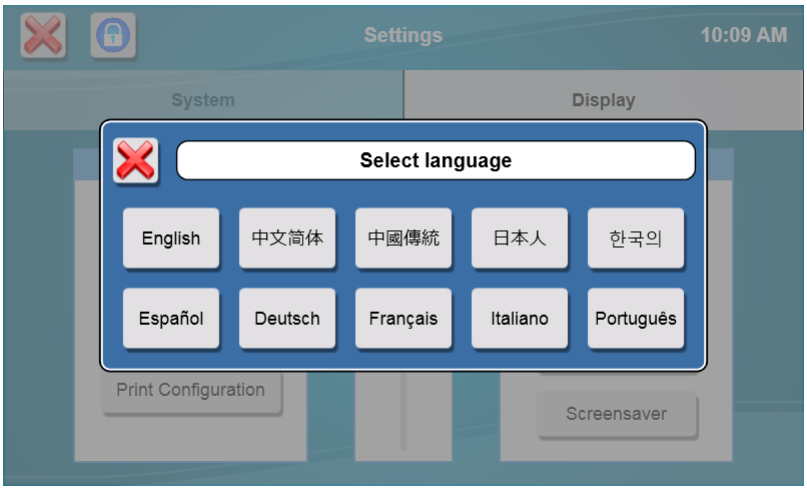
Touch the [Print Configuration] button to send the current instrument configuration to the printer. The configuration is also sent to the virtual printer displayed on the Run screen, Status tab.

6.1.2.3 Brightness

Adjust the display brightness moving the slider up or down.

6.1.2.4 Language

To change the displayed language, touch the [Language] button.



Select your language from the available choices.

6.1.2.5 Touch Screen Calibration

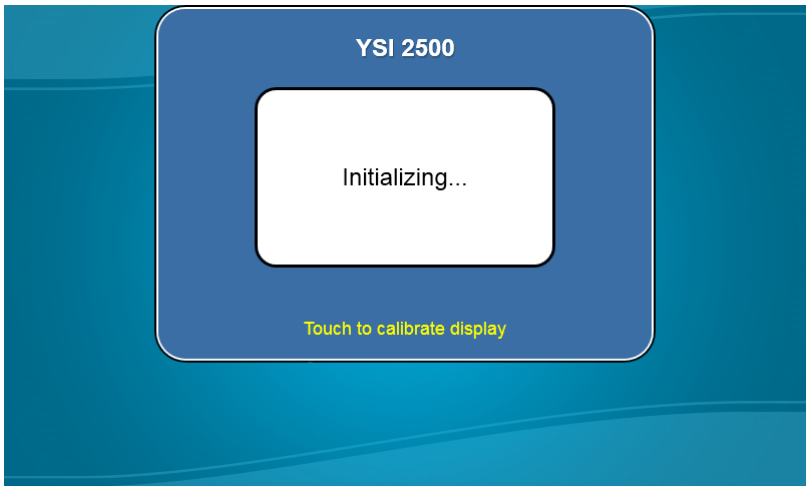
The touch screen is calibrated at the factory and should not require user calibration.

Touch the [Calibrate Display] button to enter touch screen calibration.

Using a stylus, touch and hold the **center** of the red flashing that appears at each corner of the display until OK appears.

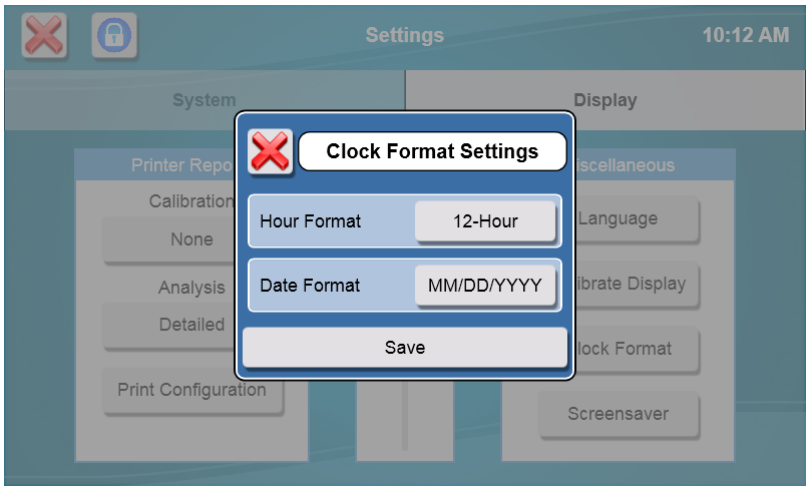
After you have held the in all four corners, the touch panel is calibrated.

Touch screen calibration can also be initiated by touching anywhere on the Initialization screen while the instrument is initializing.



6.1.2.6 Clock Format

Touch the Clock Format button.



Touch the Hour Format button and select [12-hour] or [24-hour] clock format.

Touch the Date Format button and select [DD/MM/YYYY] or [MM/DD/YYYY] date format.

Touch the [Save] button to save your changes.

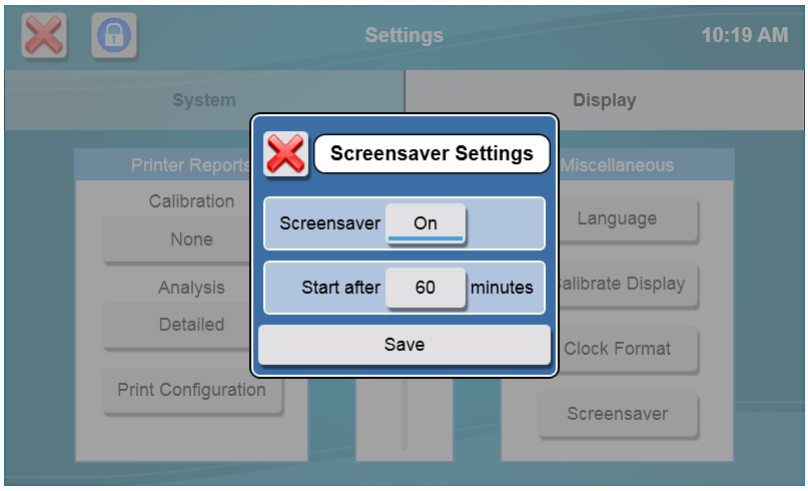
6.1.2.7 Screensaver

Touch the [Screensaver] button.

Enable the Screensaver function by touching the [OFF] button and changing it to [ON].

NOTE: The Screensaver must be enabled (On) to allow the analyzer to conserve reagents by only calibrating every 4 hours (performing a maximum of 3 calibration attempts each time).

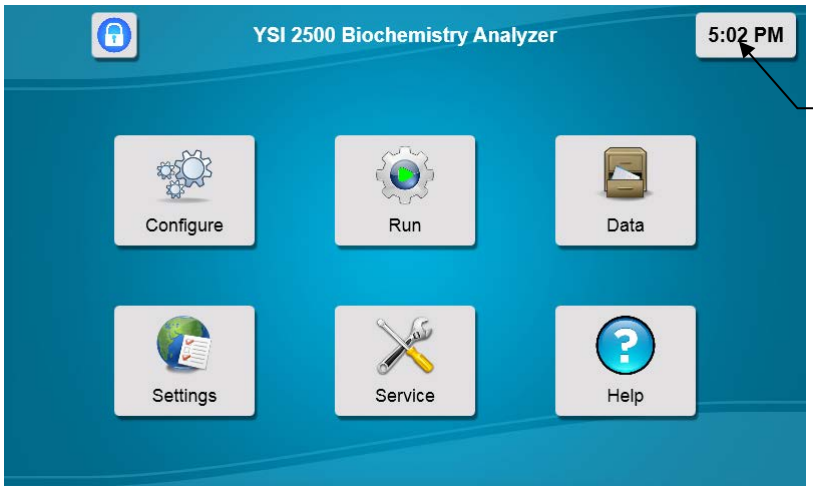
If the Screensaver is disabled (Off), the analyzer will continue to calibrate at the Autocal time interval (default value of every 30 minutes) indefinitely, unless the Screensaver is activated manually (Lock button is pressed) and the analyzer has been idle for 2 hours.



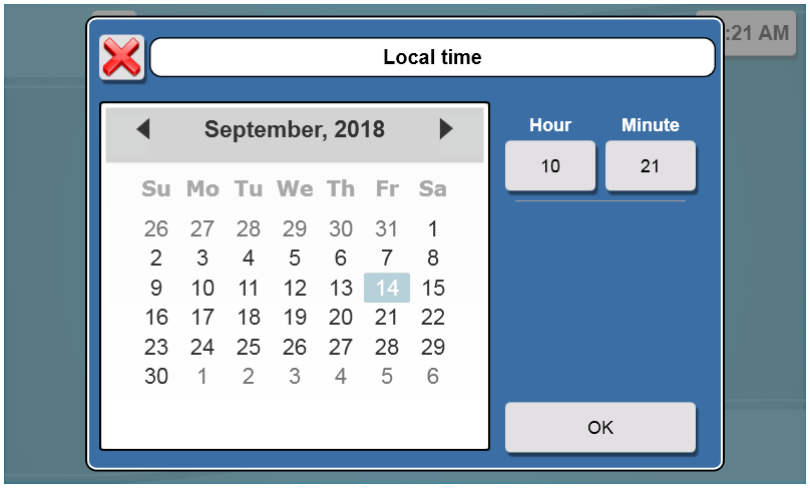
Touch the number of Minutes button [60] next to “Start after.” Enter the number of minutes that the instrument should remain idle before enabling the screensaver, then touch [OK].

Touch the [Save] button.

6.1.3 Date/Time



To set the date/time, touch the time button on the main screen.



Touch the current date on the calendar to select it.

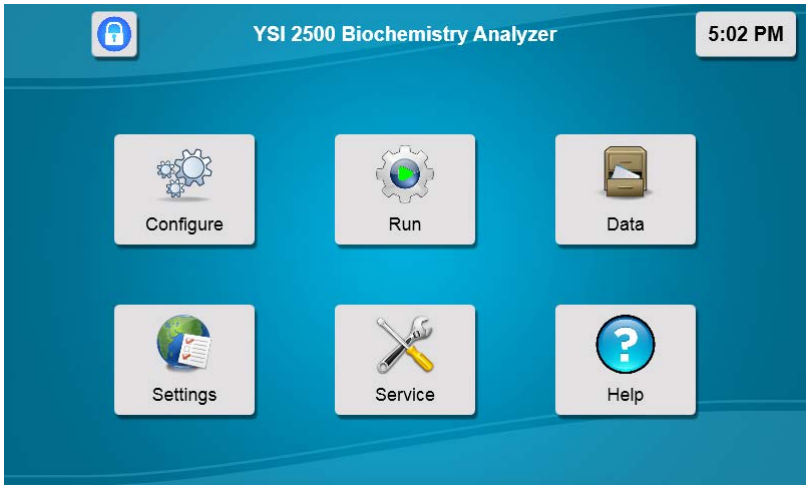
Touch the Hour button and enter the current hour in 24 hour format (0–23), then touch [OK].

Touch the Minute button and enter the current minute, then touch [OK].

When you have finished entering the date and time, touch [OK] to return to the main display.

6.2 Service

Touch [Service] to display the Service menu.



6.2.1 Sipper

See Section 4.4 Align Sipper for details on aligning the sipper with the sample module.

Always [Home] the sipper before performing alignment.

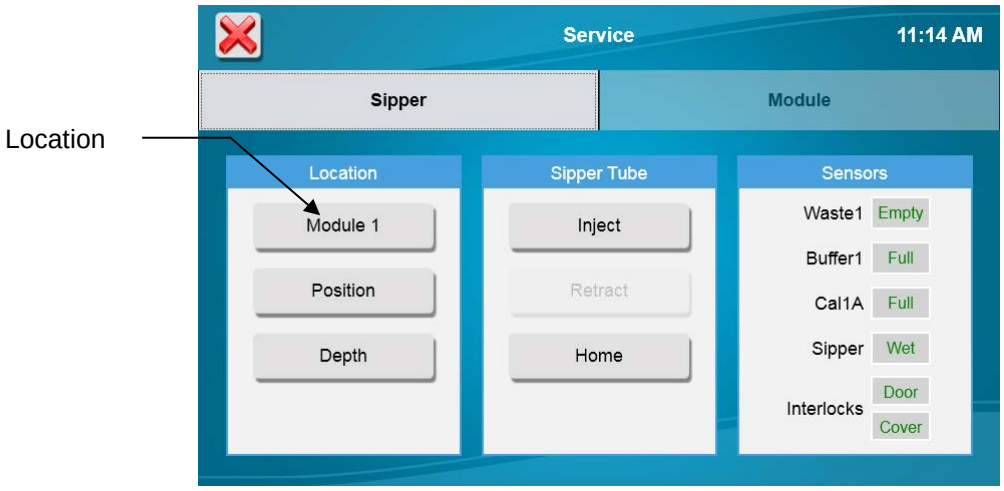
If necessary, the sipper can also be aligned with Station 2, the different types of racks/plates used at Station 1, and the calibrator well.

6.2.1.1 Interlocks

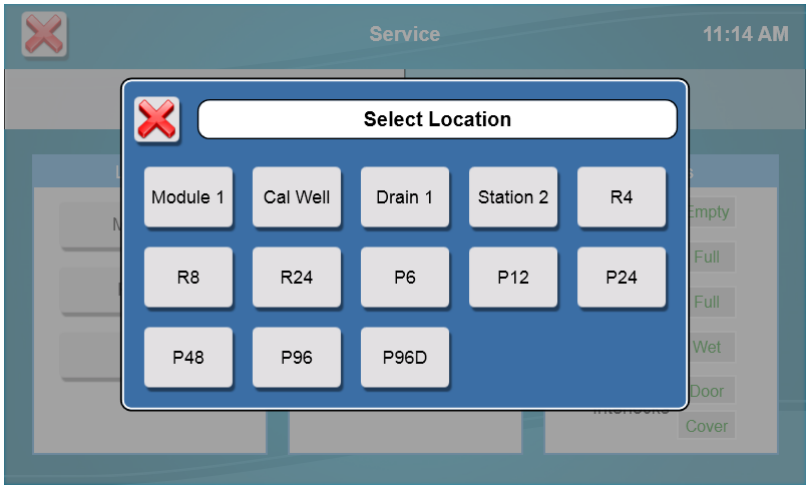
From the Settings screen, System tab, touch the Interlocks button and change the status to [Off] to disable the interlock switches on the front door and side panel when aligning the sipper.

WARNING: Keep your hands clear of the sipper while the instrument is in operation.

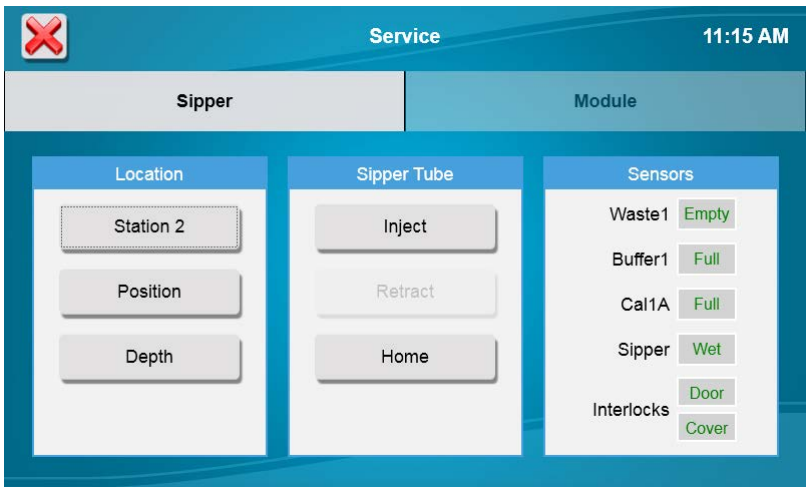
Always turn the Interlocks back [On] before operating the instrument!



To align the sipper at other locations, touch the button under Location.



Touch the button for your location, [Station 2] for example.



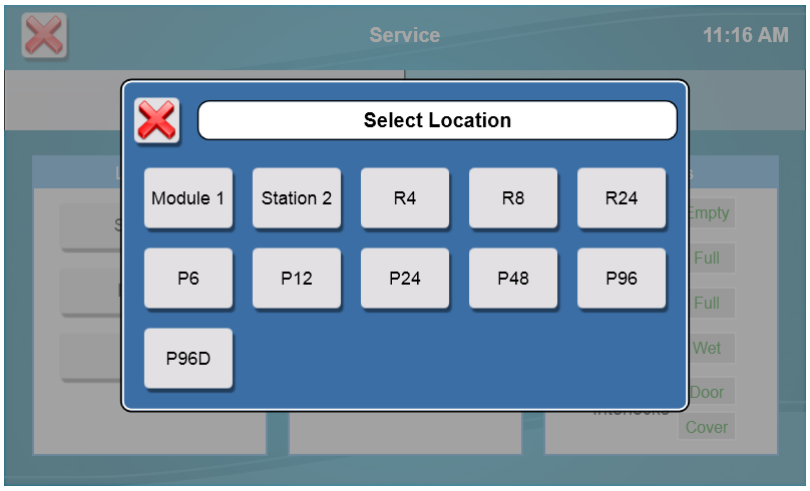
Touch the [Position] button and use the arrow buttons to align the sipper with the selected location.

Touch [Save] to save the position.

Touch [Inject] to lower the sipper and test the alignment, then touch [Retract] to raise the sipper back up. If necessary, touch [Position] and repeat the adjustment.

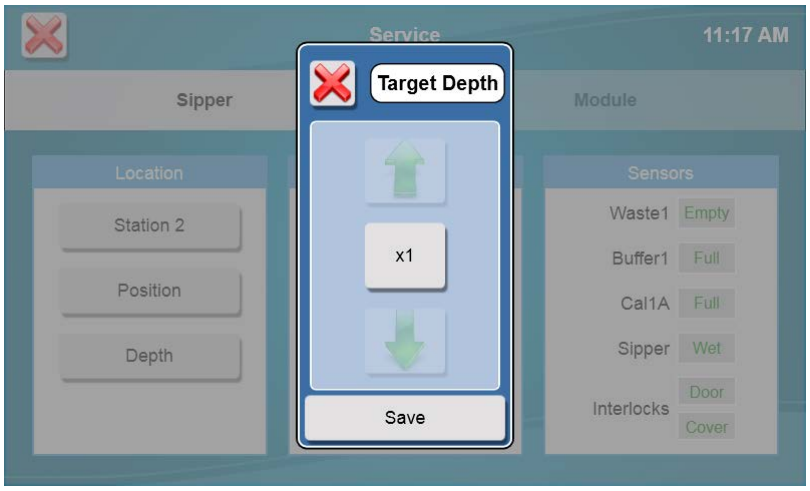
6.2.1.2 Depth

Touch [Depth] and select the location. The sipper will move to the selected location.



Sample Module: use the up and down arrows to set the tip of the sipper even with the top of the Module. Refer to Section *4.4 Align Sipper* for details.

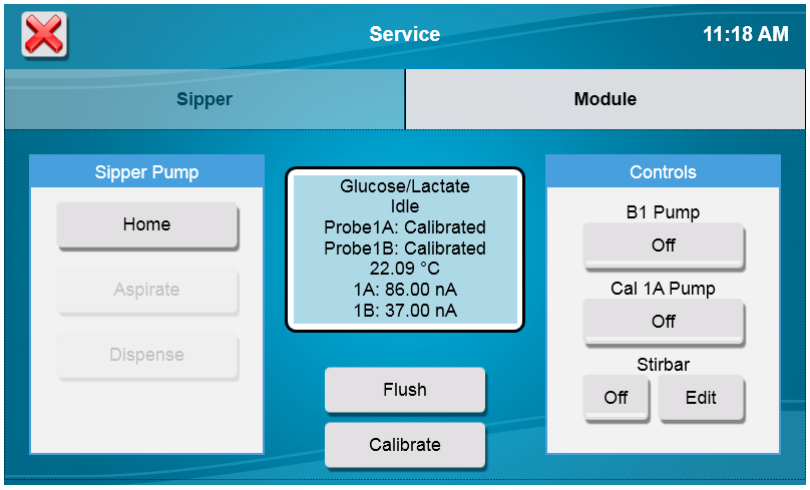
Sample Locations: use the up and down arrows to set the maximum depth the sipper will travel at that sample location. Note that your sample fluid level must be above the maximum depth setting.



Touch [Save] to confirm the position.

6.2.2 Module

From the Service menu, touch the [Module] tab.



The Module tab displays the status of the probes, probe current for each enzyme probe, and the temperature. The probe current is expressed in nA (nanoamperes, 10^{-9} amperes), a very low level of electrical current.

6.2.2.1 Sipper Pump

Home

Touch the [Home] button to Home the sipper pump plunger. The pump plunger will extend fully, then retract slightly.

Aspirate

Touch the [Aspirate] button. The pump plunger will retract about half way as it does when it aspirates a sample. Note that the actual distance depends on the sample size setting.

Dispense

Touch the [Dispense] button. The pump plunger will extend about half way as it does when it dispenses a sample into the sample module.

When you have finished testing the sipper pump, touch the [X] button to return to the main display.

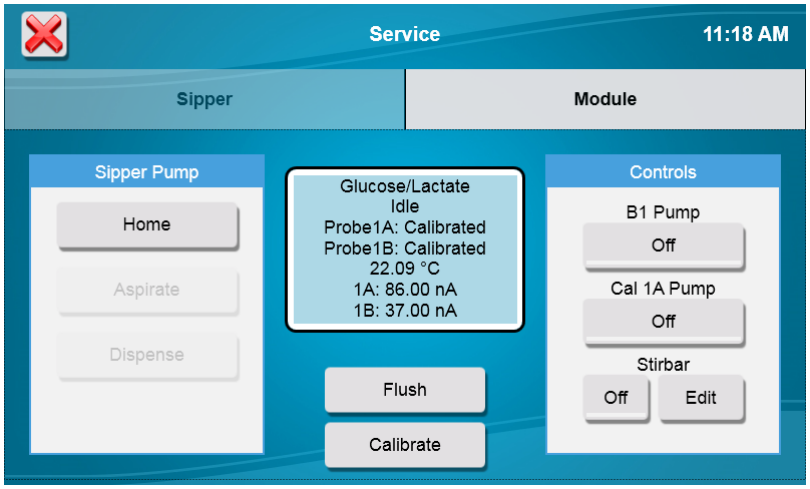
6.2.2.2 Flush

Touch the [Flush] button to flush the sample module with buffer. Observe the probe current values (baseline). If they are above 6 nA, check to see if they are decreasing in value. Check the sample module; it should be full of buffer. If

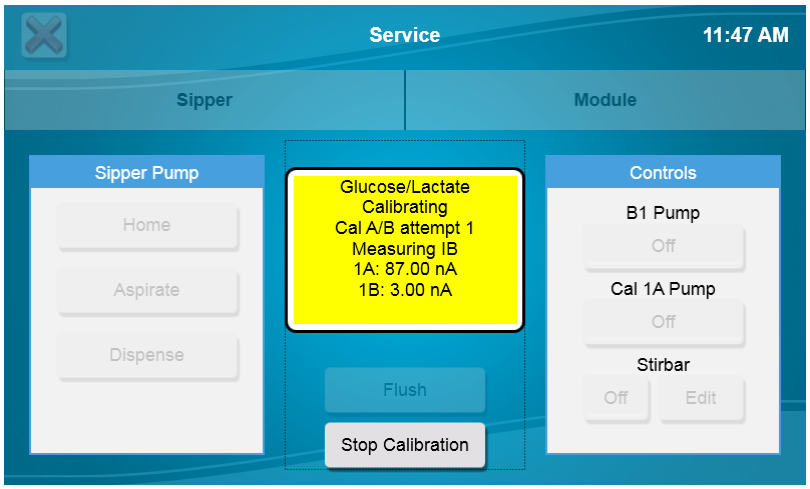
necessary, touch the [Flush] button to flush the sample module again. Note that when the instrument is first powered up, it may take several hours for the baseline currents to drop below 6 nA.

6.2.2.3 Calibrate

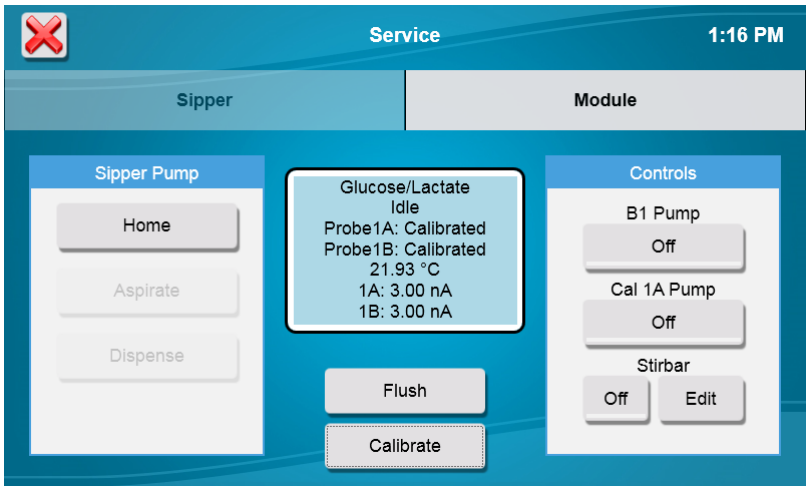
The 2500 Analyzer will automatically calibrate before running a sample batch. You may initiate manual calibration from the [Modules] tab of the Service screen by touching the [Calibrate] button.



Calibration status is displayed on the screen.



The instrument attempts to calibrate each active probe up to 5 times before aborting calibration. If calibration fails, see Section *10 Troubleshooting*.



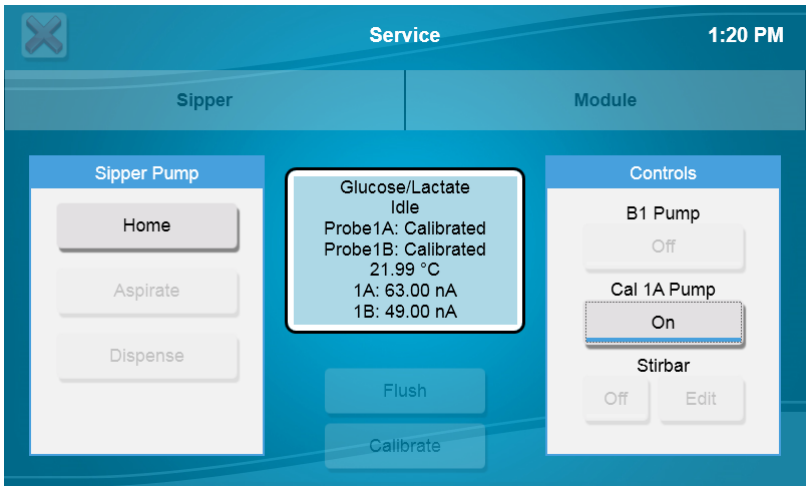
6.2.2.4 Controls

Buffer Pump

Touch the [ON] button under B1 pump. The buffer pump will run. Touch the [OFF] button to stop the pump.

Calibrator Pump

Touch the [ON] button under Cal 1A Pump. The calibrator pump will run.



Touch the [OFF] button under the pump to stop it.

NOTE: Prime the calibrator bottle daily to remove air bubbles from the tubing and deliver fresh calibrator to the cal well!

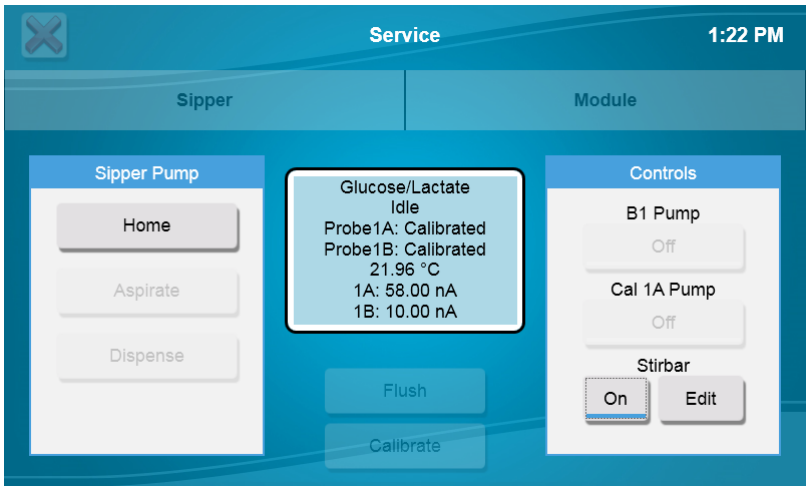
When you have finished priming the fluid pumps, touch the [X] button to return to the Main display.

Stirbar

The StirbBar screen is used to adjust the speed of the stir bar.

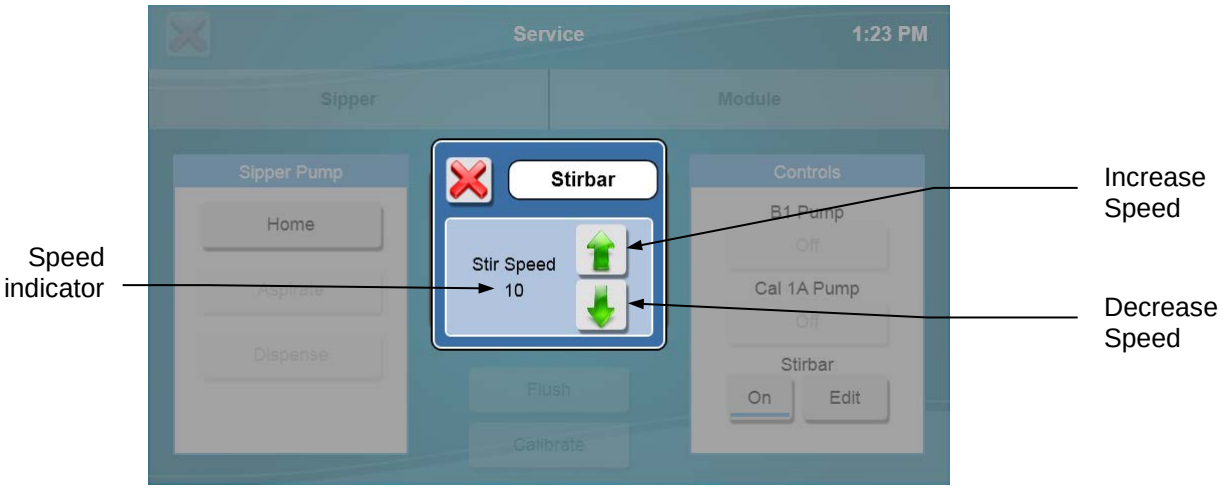
Note: The sample module must be full of buffer when adjusting stir speed. To fill the module with buffer, see *6.2.2 Module*.

Touch the [Off] button under Stirbar1 to change it to [On]. Verify the stir bar is rotating smoothly, but not jumping.



If the stir bar is jumping, touch the [Edit] button and use the Down Arrow Button to decrease the stir speed until the stir bar is spinning smoothly.

NOTE: Set the stir speed as high as possible without causing the stir bar to jump!



Touch the [X] to return to the Service screen.

Touch the Stirbar [On] button to change it to [Off]. The stir bar will stop.

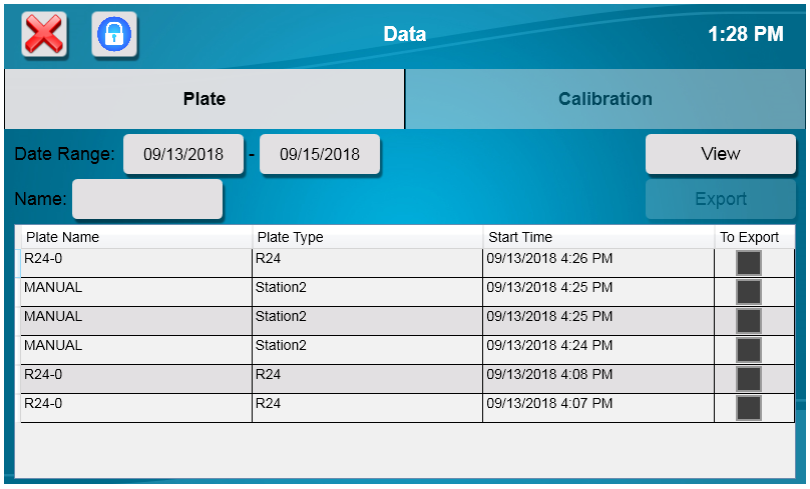
Touch the [Off] button again. Verify the stir bar is spinning smoothly and not jumping. If necessary, reduce the stir speed until the stir bar is not jumping.

Touch the [On] button to stop the stir bar.

After you have adjusted the stir speed, touch the [X] button to return to the Main display.

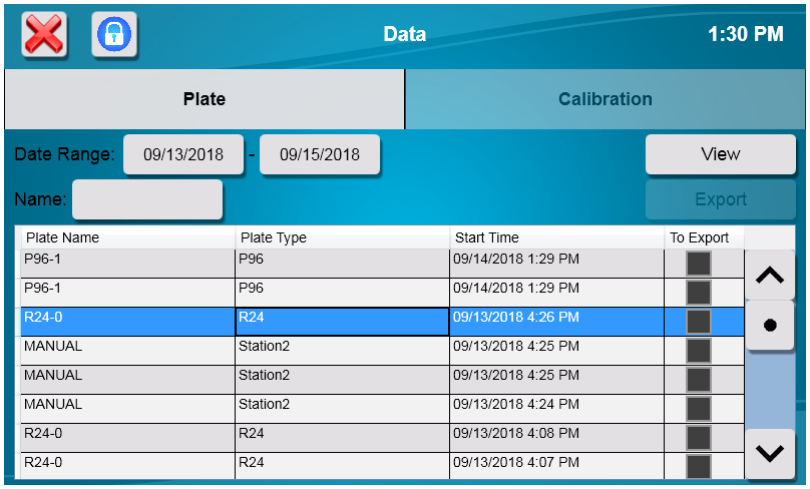
6.3 Data

From the Main display, touch [Data].

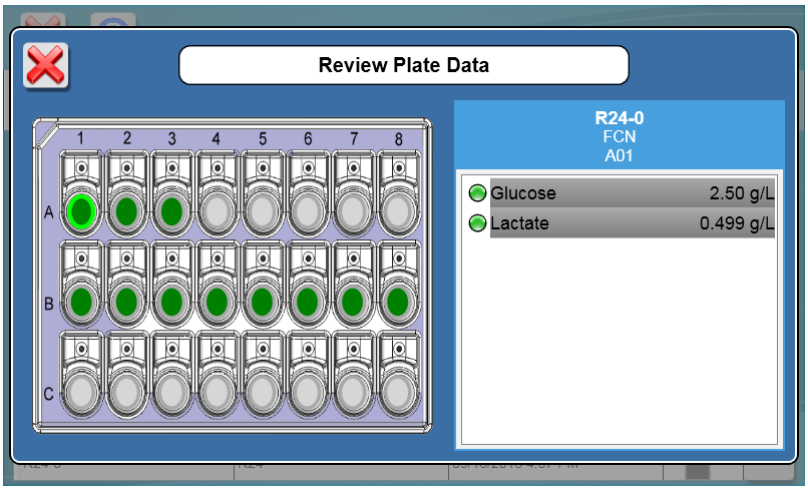


6.3.1 Plate

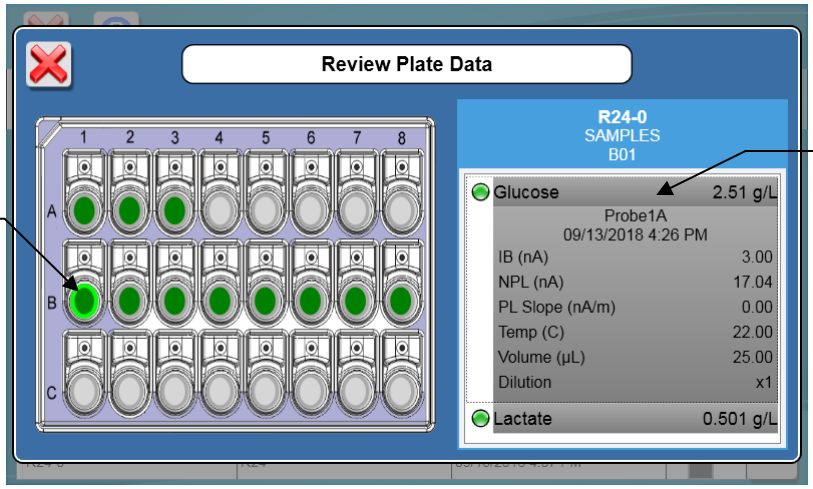
Historical plates of sample data are displayed under the Plate tab. Touch the scroll buttons to page through plates. Touch a specific plate to highlight it, then touch [View] to display the sample data for the selected plate.



Sample data for the first sample in the batch is displayed.



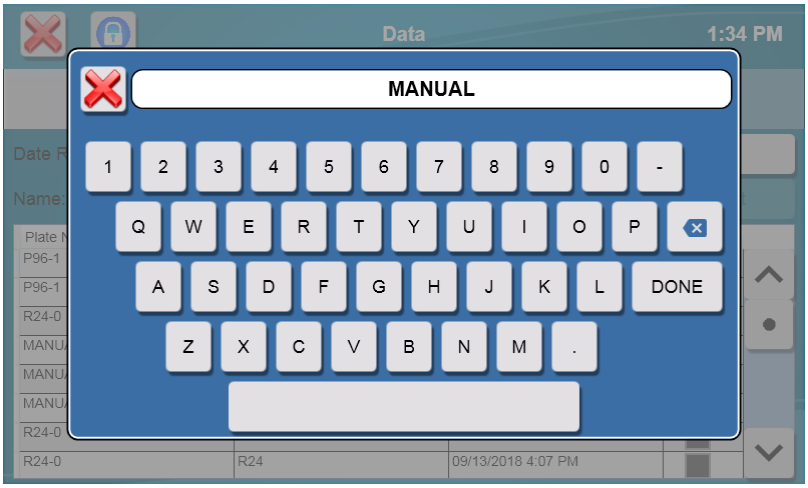
Touch any other sample location to display the sample data. Touch the sample result to show details.



Touch [X] to return to the Data screen.

6.3.1.1 Plate Name Filter

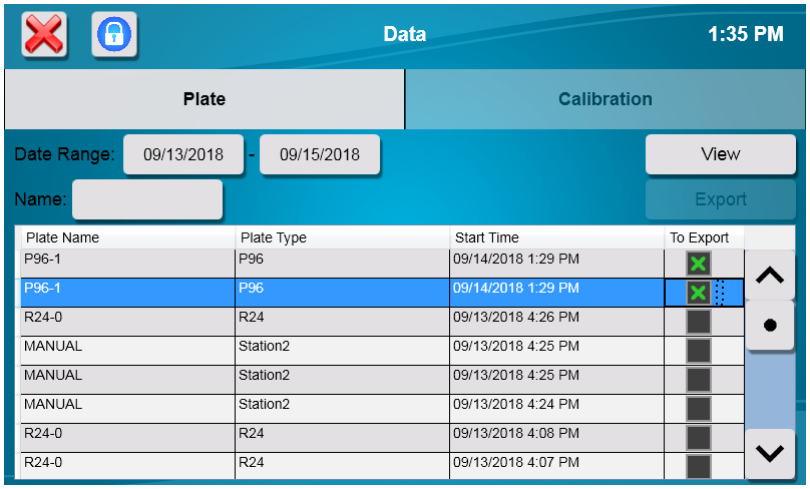
Touch the Name button and enter a plate name to filter the data.



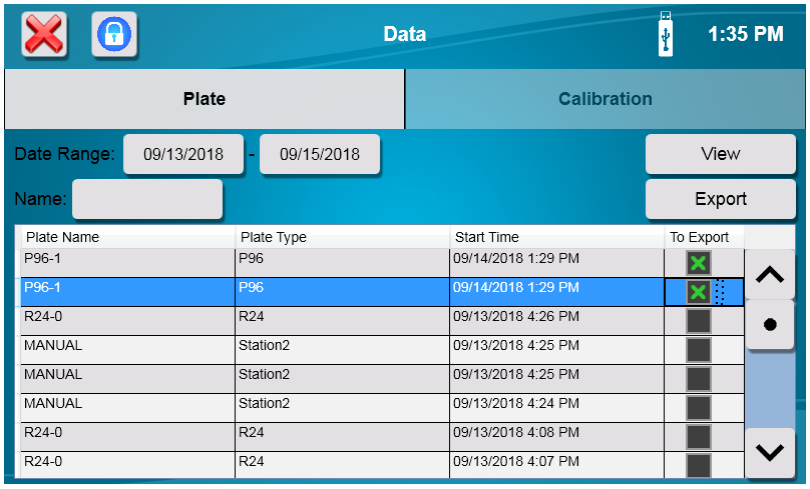
Only plates that begin with that name will be displayed.

6.3.1.2 Export

Check the To Export box for each batch that you would like to export to a flash drive.



Plug a flash drive into the 2500 Analyzer' USB port. An icon in the top right of the display indicates a flash drive is installed.



Touch the [Export] button to send the selected sample results from memory to the flash drive.

When you have finished exporting data, touch the [X] button to return to the Main screen.

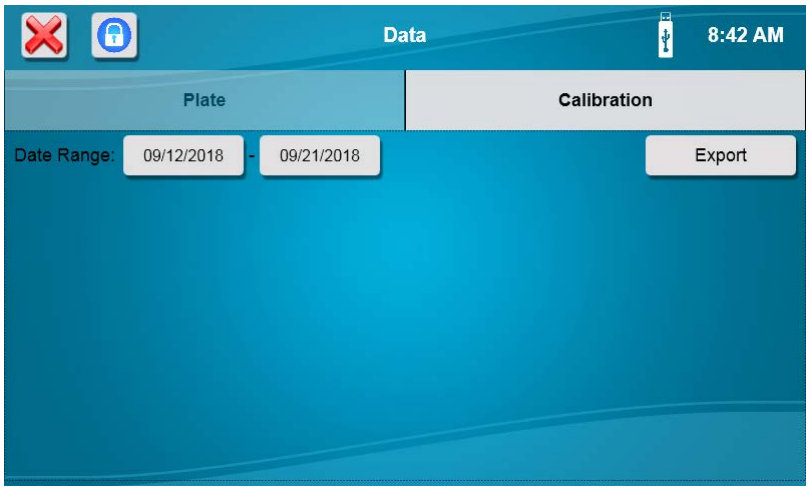
A folder named YSI\BiochemistryAnalyzer will be created on the flash drive. Sample data files are copied to the Data subfolder. The sample data file name will contain the instrument's Machine ID along with the date and time.

Example Sample Data File:

PlateSequenceName	BatchName	LocalCompletionTime	CompletionState	WellId	ChemistryId	ProbeId	Concentration	Units	Endpoint	SampleSize	InitialBaseline	Plateau	FinalBaseline	NetPlateau	NetPlateauTempAdj	CrossNetPlateau	CrossNetPlateauTempAdj	PlateauSlope	Temperature	Errors
Station2-0	MANUAL	9/14/2018 14:52	Complete	Station2	Glucose	Probe1A	2.4886	g/L	0:00:30	25	2.27	19.35	2.27	17.08	16.92			-0.022	22.08	
Station2-0	MANUAL	9/14/2018 14:52	Complete	Station2	Lactate	Probe1B	0.4977	g/L	0:00:30	25	0.52	11.41	0.89	10.52	10.92			0.268	22.08	
P96-1	TestBatch-1	9/14/2018 13:29	Complete	P96_A01	Glucose	Probe1A	2.5053	g/L	0:00:30	25	2.39	19.445	2.42	17.03	16.93			-0.042	21.97	
P96-1	TestBatch-1	9/14/2018 13:29	Complete	P96_A01	Lactate	Probe1B	0.5011	g/L	0:00:30	25	0.501	11.41	0.89	10.52	10.92			0.158	21.97	
P96-1	TestBatch-1	9/14/2018 13:29	Complete	P96_A02	Glucose	Probe1A	2.5088	g/L	0:00:30	25	2.27	19.5	2.42	17.08	16.92			-0.015	21.93	
P96-1	TestBatch-1	9/14/2018 13:29	Complete	P96_A02	Lactate	Probe1B	0.5018	g/L	0:00:30	25	0.52	11.41	0.89	10.52	10.92			0.268	21.93	
P96-1	TestBatch-2	9/14/2018 13:29	Complete	P96_A03	Glucose	Probe1A	1247.4	mg/dL	0:00:30	25	2.272	7.648	2.4	5.248	5.284			-0.042	22.09	
P96-1	TestBatch-2	9/14/2018 13:29	Complete	P96_A04	Glucose	Probe1A	1251.7	mg/dL	0:00:30	25	2.271	7.688	2.42	5.268	5.286			-0.042	21.95	

6.3.2 Calibration

Touch the Calibration tab.



Plug a flash drive into the 2500 Analyzer' USB port. Select a date range, then press the [Export] button to send calibration data to the flash drive.

When you have finished exporting data, touch the [X] button to return to the Main screen.

A folder named YSI\BiochemistryAnalyzer will be created on the flash drive. Calibration data files are copied to the Data subfolder. The calibration data file name will contain the instrument's Machine ID along with the date and time.

Example Calibration File:

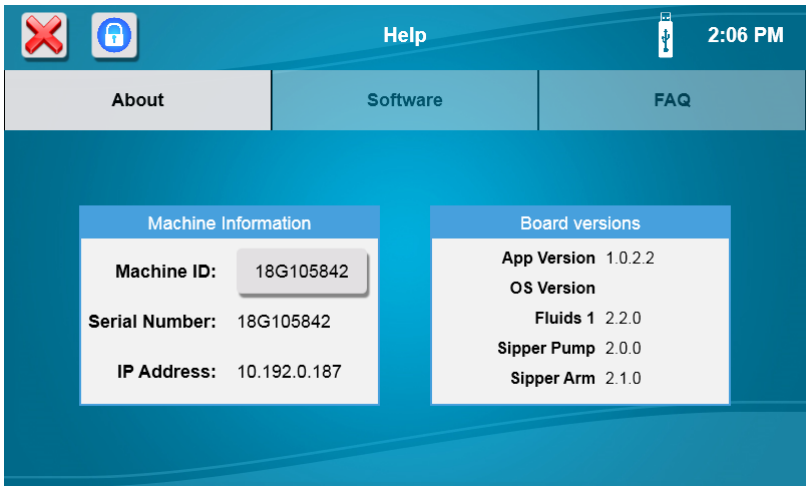
ProbeId	LocalCalibratedTime	ChemistryId	ReagentNumber	Concentration	Units	EndPoint	SampleSize	InitialBaseline	Plateau	FinalBaseline	NetPlateau	CrossNetPlateau	ProbeSlope	Temperature	Errors
1A	8/1/2018 10:12	Glucose	2747	1.8	GramsPerLiter	0:00:30	25	1.038	7.416	1.019	6.378	NaN	-0.0233	23.62	
1B	8/1/2018 10:12	Lactate	2747	0.45	GramsPerLiter	0:00:30	25	2.141	12.71	2.193	10.57	NaN	0.03509	23.62	
1A	8/1/2018 10:32	Glucose	2747	1.8	GramsPerLiter	0:00:30	25	0.266	7.484	0.282	7.218	NaN	0.01806	23.79	
1B	8/1/2018 10:32	Lactate	2747	0.45	GramsPerLiter	0:00:30	25	1.804	14.11	1.878	12.31	NaN	0.27766	23.79	
1A	8/1/2018 10:32	Glucose	2747	1.8	GramsPerLiter	0:00:30	25	0.266	7.484	0.282	7.218	NaN	0.01806	23.79	
1B	8/1/2018 10:32	Lactate	2747	0.45	GramsPerLiter	0:00:30	25	1.804	14.11	1.878	12.31	NaN	0.27766	23.79	
1A	8/1/2018 10:44	Glucose	2747	1.8	GramsPerLiter	0:00:30	25	0.143	7.767	0.199	7.623	NaN	0.371	23.88	
1B	8/1/2018 10:44	Lactate	2747	0.45	GramsPerLiter	0:00:30	25	1.603	14.18	1.692	12.57	NaN	0.22466	23.88	
1A	8/1/2018 10:56	Glucose	2747	1.8	GramsPerLiter	0:00:30	25	0.097	8.027	0.132	7.93	NaN	-0.155	23.93	
1B	8/1/2018 10:56	Lactate	2747	0.45	GramsPerLiter	0:00:30	25	1.535	14.3	1.632	12.77	NaN	0.51949	23.93	

6.4 Help

Touch the [Help] icon to display the Help selections as shown below.

6.4.1 About

Touch the [About] tab to display the About screen. This screen provides information about the analyzer's ID and serial number, the current software (App) version, hardware, and IP address.



6.4.1.1 Machine ID

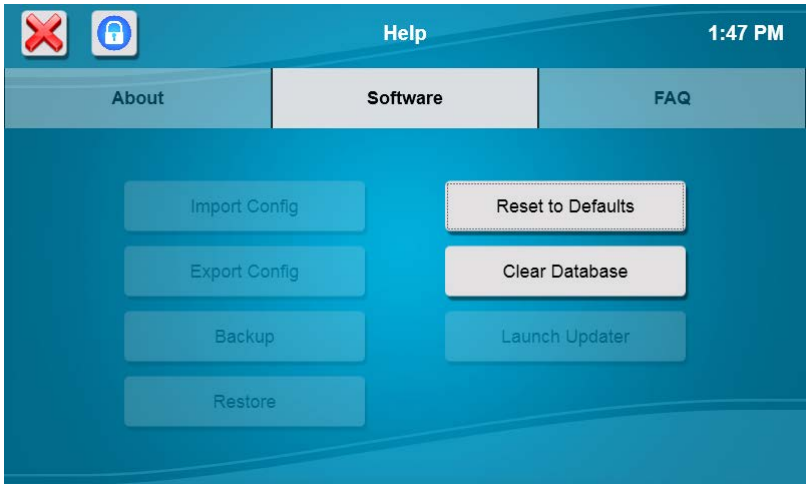
The default Machine ID is the instrument serial number. Touch the Machine ID button to enter a custom ID for this instrument. Enter the new ID and touch [Done].

NOTE: The Machine ID is used as the folder name and file name for data files.

The 2500 Analyzer software can be updated via a flash drive inserted into the USB port. See the YSI web site at www.ysi.com for available updates. Install the update as shown below.

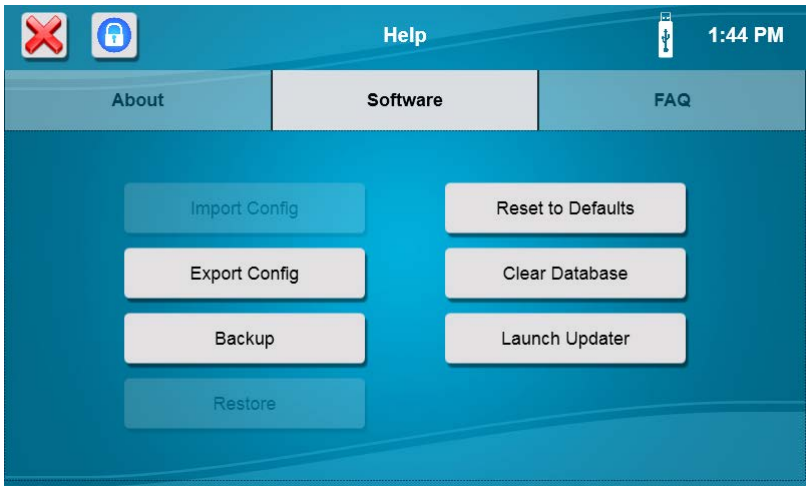
6.4.2 Software

From the Help menu, touch the [Software] tab to display the Software screen.



6.4.2.1 Export Configuration

Insert a flash drive and wait for the Flash drive icon to appear at the top right of the display.



Press [Export Config] to save the current instrument configuration to the flash drive.

NOTE: The configuration file can be imported at a later date to restore the instrument configuration.

6.4.2.2 Backup

Press [Backup] to backup the current instrument setup, database, and log files to the flash drive.

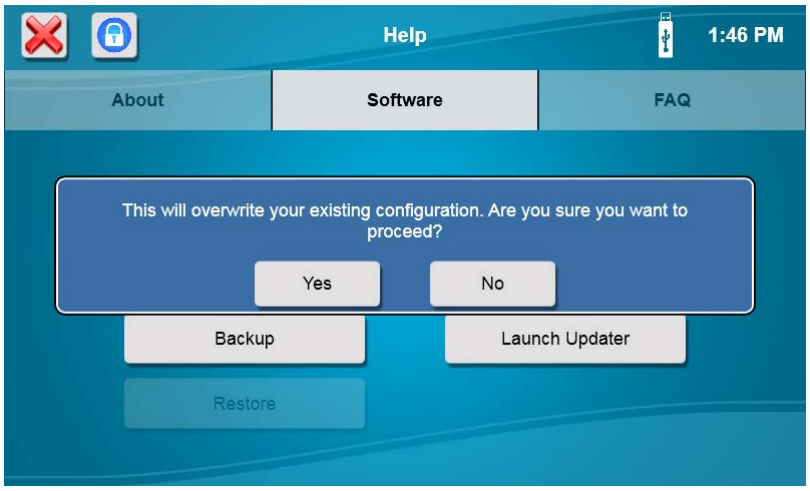
6.4.2.3 Restore

Press [Restore] to restore a previous backup file for this analyzer from a flash drive.

6.4.2.4 Default

To default all instrument settings to the factory values, touch [Reset to Defaults].

NOTE: After resetting the instrument to default settings, the sipper must be realigned with ALL locations to prevent sipper damage.



6.4.2.5 Clear Database

NOTES: Make sure all sample data and calibration data have been exported before clearing the database!

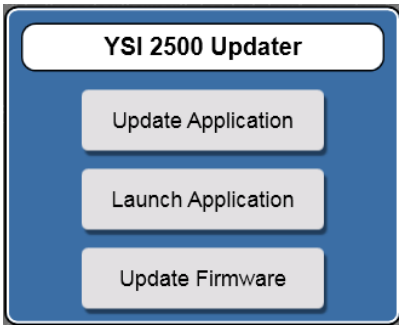
Press [Clear Database] to clear all saved sample and calibration data. Clearing old data from the database will reduce the amount of time required to export and save sample data.

6.4.2.6 Update Software

From the Help screen, Software tab, insert the flash drive containing the software update in the instruments' USB port.

After the Flash Drive icon appears, touch the [Launch Updater] button.

The YSI 2500 Updater will be displayed.



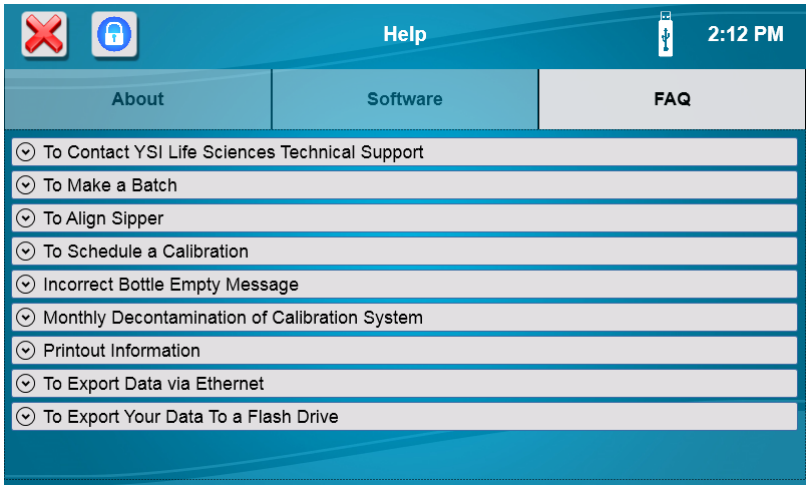
Touch the [Update Application] button to install the new software.

When the Installation is complete, the analyzer will reboot. Remove the flash drive.

NOTE: Updating the software will clear all sample data. After updating the software, the sipper must be aligned with all positions.

FAQ

From the Help menu, touch the [FAQ] tab to display frequently asked questions and answers.



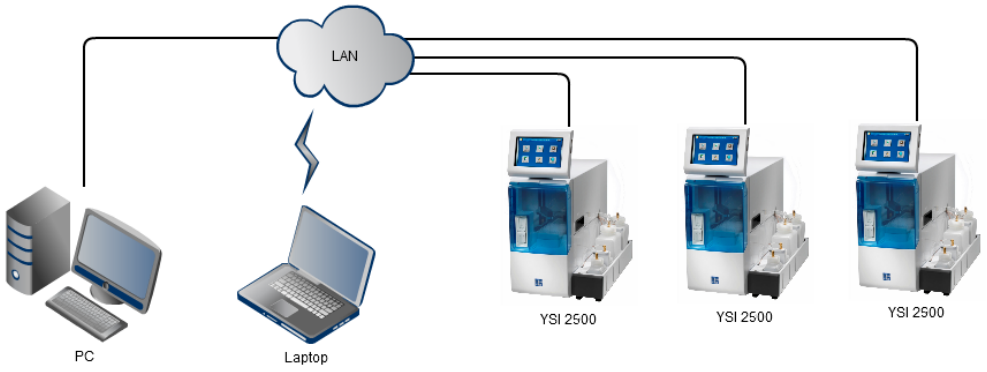
6.5 Connectivity

6.5.1 Ethernet Port

Connect one or more 2500 Analyzer instruments to a LAN or router via the RJ45 Ethernet port.

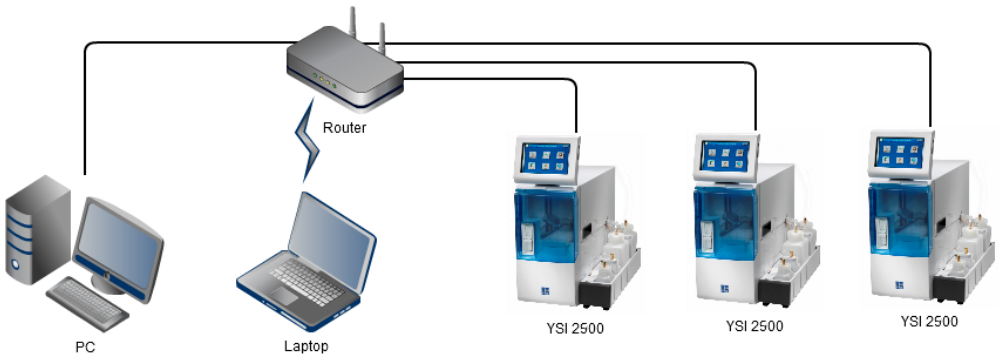
LAN (Shared Network Connection)

Connect one or more 2500 Analyzer instruments to a LAN via the RJ45 Ethernet port.



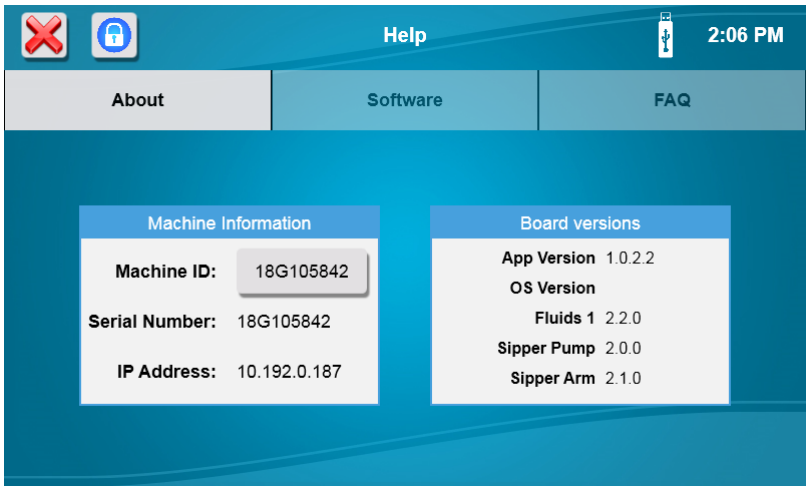
Router (Private Network Connection)

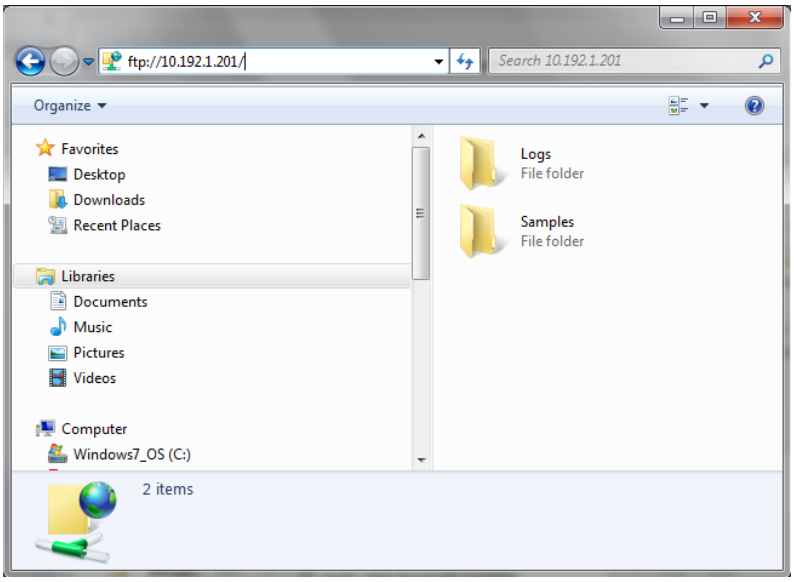
Connect one or more 2500 Analyzer instruments to a router (DHCP server) via the RJ45 Ethernet port.



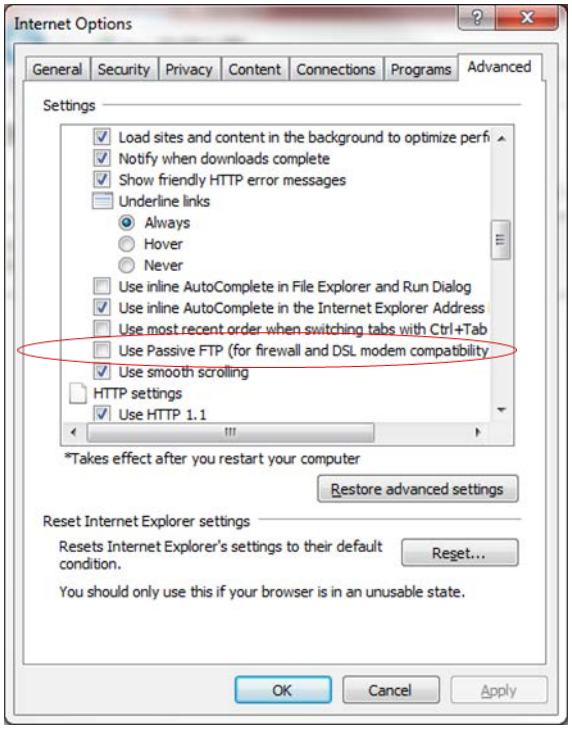
Accessing Stored Data

Access the data stored in a 2500 Analyzer connected to a LAN or router via ftp. See *6.4.1 About* to view the instrument's current IP address.





If you are unable to connect via ftp, make sure the “Passive ftp” option is **not** checked under Advanced Internet Options on your computer:



Sample and calibration data files are stored in the Samples folder of the 2500 Analyzer. The file names are:

BioSample_Machine ID.csv
BioCalibration_Machine ID.csv

6.5.2 RS232 Port

The RS232 serial port supports the YSI 2901 Printer.

Printer

Connect the optional YSI 2901 Printer to the RS232 port for a hard copy of calibration and sample reports.

7 Chemistry Setup

In this section, you will learn about each standard chemistry setup for single chemistry configurations and then dual chemistry configurations.

In order to configure your instrument to measure a particular chemistry analyte, you need to:

- Approximate the analyte concentration or range of concentrations to be measured.
- Decide if you must dilute your sample, and, if required, determine an appropriate dilution factor and diluent.
- Decide what calibration value(s) is appropriate for the range of concentrations under study.
- If possible, account for any interferences to your reading. Methods to do these corrections are described below.

Once you make the above determinations, you can decide whether one of the standard setups described below will be appropriate or whether you will need to customize your setup.

7.1 Sample Volume

The sample volume range is 10 to 50 μL. However, this is a nominal volume. The instrument does not depend on an accurate absolute value, but rather reproducible aspirations. This allows the calibrator probe signal to be stored in memory and provide a reference value used to internally calculate sample readings.

7.2 Measurement Parameter Information

For most standard applications, specifications and recommended parameter settings are outlined below under each chemistry.

7.2.1 D-Glucose (Dextrose)

This is a direct reading of glucose in solution at the enzyme sensor. The enzyme glucose oxidase is immobilized in the enzyme membrane.

$$\text{Glucose} + O_2 \xrightarrow[\text{Glu Oxidase}]{} H_2O_2 + \text{D-Glucono-}\delta\text{-Lactone}$$

System Buffer	YSI 2357
Calibrator Std	YSI 2776
Linearity Std	YSI 1531
Membrane	YSI 2365
Membrane Color	Dark red
Detection Range	0.05–9.0 g/L at 13, 15 & 25 µL sample size 0.05–18.0 g/L at 10 µL sample size (1.80 g/L Cal Point) 0.05–25.0 g/L at 10 µL sample size (2.50g/L Cal Point)
Calibration Point	1.80 g/L 2.50 g/L
Linearity Check Point	9.0 g/L
Sample Size	25 µL
End Point	30 sec
Precision (CV,n=10)	2% or 0.02 g/L, whichever is greater
Linearity	±2% or 0.02 g/L, whichever is greater (0.05 to Cal Point) ±5% (Above Cal Point to Range Max)
Typical Working Life	21 days

Note: See Appendix B – Concentration Unit Conversion if concentration unit conversion is required.

Special Considerations:

- If sample dilution is required, use reagent water.
- If a solution must be prepared from solid glucose, use the following diluent and allow about 15 minutes before measuring the sample. This is required for glucose, which must equilibrate alpha and beta anomers (mutarotational equilibrium). If your reading is lower than expected, you may need to wait slightly longer for equilibration.

  Diluent: 40 g/L NaH_2PO_4
  10 g/L Na_2HPO_4
  Reagent water

  Both heat and the presence of phosphate accelerate mutarotational equilibration.
- For applications requiring linearity performance to 25.0 g/L, YSI 2777 (25.0 g/L glucose, 2.50 g/L lactate) may be used as a linearity standard provided the calibrator is YSI 2776 (2.50 g/L glucose, 0.50 g/L lactate) and the sample size is 10 µL.
- For applications requiring linearity performance to 18.0 g/L, YSI 2748 (18.0 g/L glucose, 1.78 g/L lactate) may be used as a linearity standard provided the sample size is 10 µL.

7.2.2 L-Lactate

This is a direct reading of L-Lactate (L-Lactic Acid) in solution at the enzyme sensor. The enzyme L-Lactate Oxidase is immobilized in the enzyme membrane.

$$\text{L-Lactate} + O_2 \xrightarrow[\text{L-Lac Oxidase}]{} H_2O_2 + \text{Pyruvate}$$

System Buffer	YSI 2357
Calibrator Std	YSI 2776
Linearity Std	YSI 1530
Membrane	YSI 2329
Membrane Color	Gray
Detection Range	0.05–2.70 g/L
Calibration Point	0.5 g/L
Linearity Check Point	2.67 g/L
Sample Size	25 µL
End Point	30 sec
Precision (CV,n=10)	2% or 0.03 g/L, whichever is greater
Linearity	±2% or 0.03 g/L, whichever is greater (0.05 to Cal Point) ±5% (Above Cal Point to Range Max)
Typical Working Life	14 days

Note: See *Appendix B – Concentration Unit Conversion* if concentration unit conversion is required.

Special Considerations:

- If sample dilution is required, use reagent water.
- D-Lactate is not a substrate for L-Lactate Oxidase. Therefore, the 2500 Analyzer cannot directly measure D-Lactate. If you have a known racemic mixture of lactates, the L-Lactate value multiplied by 2 should give you the total lactate value.

7.2.3 Simultaneous Glucose and L-Lactate

Refer to the sections above on Glucose and L-Lactate for theoretical and special considerations. Then follow the instructions below to set up your instrument for simultaneous determination.

	A Probe	B Probe
Chemistry	Glucose	L-Lactate
System Buffer	YSI 2357	
Calibrator Std	YSI 2776	
Linearity Std	YSI 1531	YSI 1530
Membrane	YSI 2365	YSI 2329
Sample Size	25 µL	
Unit of Conc.	g/L	
Cal Value	2.50	0.50
End Point	30 sec	

Note: See *Appendix B – Concentration Unit Conversion* if concentration unit conversion is required.

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8 Operational Checks and Maintenance

8.1 Cleaning, Disinfecting, and Decontaminating

Proper precautionary lab practices should be followed when handling biological hazards.

Authorized cleaning and disinfecting agents include:

- Sodium hypochlorite, 0.5% free available chlorine
- Isopropanol, 70%
- Ethanol, 70%
- NaOH, 0.5N

Authorized rinsing agents include:

- Deionized (DI) Water
- Distilled Water
- Purified Water
- Water For Injection (WFI)—must be cooled

8.1.1 Touch Panel

Clean the touch panel with glass cleaner or isopropanol. Do not use sodium hypochlorite (bleach).

8.1.2 Decontamination Procedures

Wipe the instrument case with mild soap and water, do not immerse. If necessary, isopropanol may be used.

Remove and discard all tubing. New tubing is provided in the preventive maintenance kit. Empty the waste bottle and wash with authorized disinfecting agent. Remove sample module, Sipper, Test Tube Holders/racks and probes according to instructions.

Thoroughly clean with authorized disinfecting agent, then rinse with authorized rinsing agent (see Section 8.1). Remove probes and discard enzyme membranes. Clean enzyme probes with isopropanol only, rinse with authorized rinsing agent (see Section 8.1). Clean up all spills, then reassemble.

8.2 Daily Maintenance

8.2.1 Empty the Waste Bottle

Carefully pull the waste tube out of the hole in the waste bottle. Unscrew the lid from the waste bottle then lift the waste bottle out of the bottle tray.

If the 2500 Analyzer is used with hazardous samples, dispose of the waste bottle contents in a manner suitable for biohazardous waste. The YSI reagents used in the 2500 Analyzer are non-toxic and, unless otherwise specified, consist of a phosphate salt buffer with small amounts of preservatives. Refer to reagent bottle labels and Safety Data Sheets for more information.

Rinse and dry only the bottom of the waste bottle cap. Ensure the SMA connector is dry. If the SMA connector gets wet, dry thoroughly with a lint-free tissue. For best results, let air dry for 2 hours.

Slide the waste bottle back into the bottle tray and screw the lid back onto the bottle. Insert the waste tube into the hole in the bottle.

8.2.2 Check the Calibrator Bottle

If the fluid level is low or the bottle has been in the instrument longer than the working life (30 days), install a new bottle of calibrator solution.

After installation, prime the calibrator for 60 seconds (see Section *4.7*).

8.2.3 Check the Buffer Bottle

Replace the buffer if the bottle is low or the buffer has been in the instrument longer than 1 week. Clean the buffer bottle and cap with an authorized cleaning solution (see Section *8.1*), then rinse well with authorized rinsing agent (see Section 8.1) before installing fresh buffer. You may find it convenient to make more than one liter of buffer at a time, in order to have it on hand to replenish the buffer bottle. Prepare the buffer in a clean bottle with cap and store any excess at room temperature.

After a buffer change, prime the buffer system (see Section *8.1*). Buffer should be exiting the sipper inside the sample module and overflowing to waste. You may need to initiate a second or third run of the buffer pump to complete the priming process.

8.2.4 Check for Leaks

Examine the instrument for leaks. These are caused either by loose connections or worn tubing.

8.2.5 Clean up Spills

Spills should be cleaned up promptly to prevent biohazard build-up and corrosion. Clean any spills of biological material from the sample area.

8.2.6 Daily Operational Checks

To verify proper instrument performance, perform the daily operational checks described in Section 5.1.1 Enzyme Membrane Integrity Test and 5.1.2 Linearity Test.

8.3 Monthly Maintenance

Perform these procedures at least once a month to minimize the possibility of contamination. Depending on application and use, more frequent cleaning may be required. The most convenient time to perform this maintenance is before installation of a new bottle of calibration standard or buffer.

8.3.1 Calibration Pumping System Maintenance

Prepare about 100 mL of one of the authorized cleaning solutions (see Section 8.1) and place this solution in a clean calibrator bottle. Install the bottle in the calibrator bottle position(s) you use.

From the Service screen, Module tab, touch [Off] to turn on the pump for the calibrator bottle position to flush the cleaning solution through the pump tubing and calibrator well and to the waste bottle. After 3 minutes, touch [On] to turn the pump off. Wait 7 minutes.

Remove and discard the authorized cleaning solution, then rinse the bottle thoroughly with authorized rinsing agent (see Section 8.1). Next, add authorized rinsing agent to the bottle and reinstall the Cal bottle inside the bottle tray.

From the Service screen, Module tab, touch [Off] to prime the calibrator for 3 to 5 minutes to rinse the tubing and cal well. After 3 to 5 minutes, touch [On] to turn the pump off.

Remove the Cal Cap Assembly. From the Service screen, Module tab, touch [Off] to flush the line with air. After 1 minute, touch [On] to turn the pump off. Wipe the cal cap and steel tubes with a lint-free tissue.

Install a new bottle of calibration standard and mark the installation date on the bottle.

From the Service screen, Module tab, touch [Off] to prime the fresh calibrator through the tubing and cal well. After 2 minutes, touch [On] to turn the pump off.

8.3.2 Buffer Pumping System Maintenance

Prepare about 300 mL of one of the authorized cleaning solutions (see Section 8.1) and place this solution in a clean buffer bottle. Install the bottle in the buffer bottle position(s) you use.

From the Service screen, Module tab, touch [Off] to turn on the pump for the buffer bottle position to flush the cleaning solution through the pump tubing and to the waste bottle. After 3 minutes, touch [On] to turn the pump off. Wait 7 minutes.

Remove and discard the authorized cleaning solution, then rinse the bottle thoroughly with authorized rinsing agent (see Section 8.1). Next, add authorized rinsing agent to the bottle, reinstall the Buffer bottle inside the bottle tray.

From the Service screen, Module tab, touch [Off] to prime the buffer pump for 3 to 5 minutes to rinse the tubing. After 3 to 5 minutes, touch [On] to turn the pump off.

Empty the buffer bottle.

Remove the Buffer Cap Assembly. From the Service screen, Module tab, touch [Off] to flush the line with air. After 1 minute, touch [On] to turn the pump off. Wipe the buffer cap and steel tubes with a clean laboratory tissue.

Fill the buffer bottle with fresh buffer.

From the Service screen, Module tab, touch [Off] to prime the fresh buffer through the tubing and sipper. After 2 minutes, touch [On] to turn the pump off.

8.3.3 Bottle Cap Cleaning

Clean the buffer and calibrator bottle caps using one of the authorized cleaning solutions (see Section 8.1). Rinse with authorized rinsing agent and dry the bottle caps. Dry the SMA connector thoroughly with a lint-free tissue. For best results, let air dry for 2 hours.

8.3.4 Sample Module Cleaning

For applications requiring more frequent cleaning of the sample module, including stir bar and O-rings, clean as described in Section *8.4.1 Sample Module Cleaning* below.

8.4 Preventive Maintenance – 6 months or 1000 Hours

Before performing maintenance on the 2500 Analyzer, **ALWAYS** go to the Service screen to prevent the analyzer from attempting to calibrate.

Perform the maintenance procedures in this section every 6 months or 1000 hours sample ready, whichever occurs first. Depending on application and use, more frequent maintenance may be required.

The YSI 2588 Preventive Maintenance Kit contains all supplies necessary.

8.4.1 Sample Module Cleaning

It is necessary to periodically clean the sample modules.

From the Service screen, [Sipper] tab, touch the button under Location. Select [Station 1-P96] to move the sipper away from the sample module.

Grasp the hand hold in the right side cover of the instrument and pull up and out to remove the cover.

Lift the cover off the left side of the instrument.

Unscrew the three thumbnuts on top of each sample module.

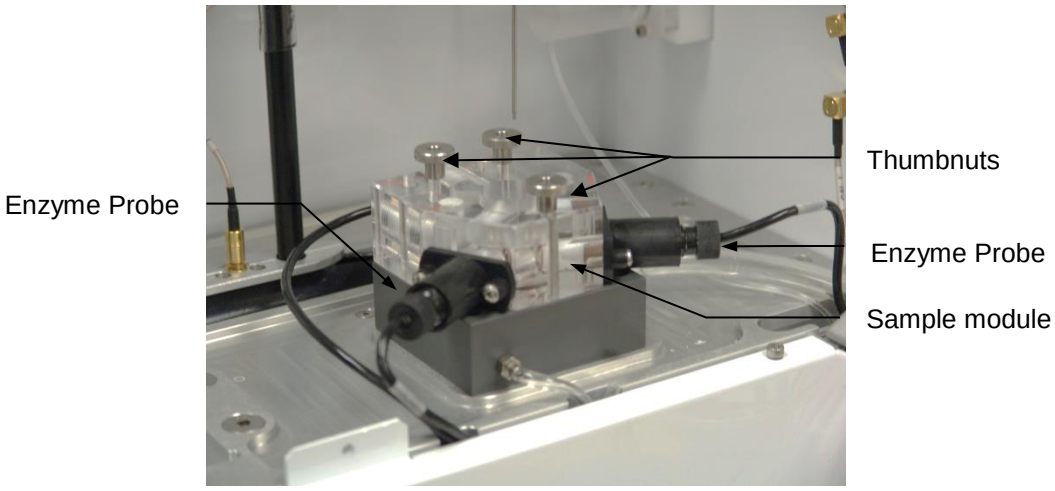


Figure 8-1

Unscrew and remove the enzyme probes and the temperature probe from the sample module.

Remove the sample module. Remove and discard the small magnetic stir bar inside the module. Immerse the module in the authorized disinfecting agent (see Section 8.1) for a maximum of 10 minutes. If soiling or residue is visible, the module may be immersed in a water filled room temperature sonification bath for a maximum of 10 minutes. After cleaning, rinse the module for 3 to 5 minutes with authorized rinsing agent (see Section 8.1). Wipe dry with a lint-free tissue.

8.4.2 Waste Module Cleaning

Unscrew the three hex screws from the top of the waste module. Disconnect the calibrator and waste tubing and remove the waste module from the base plate.

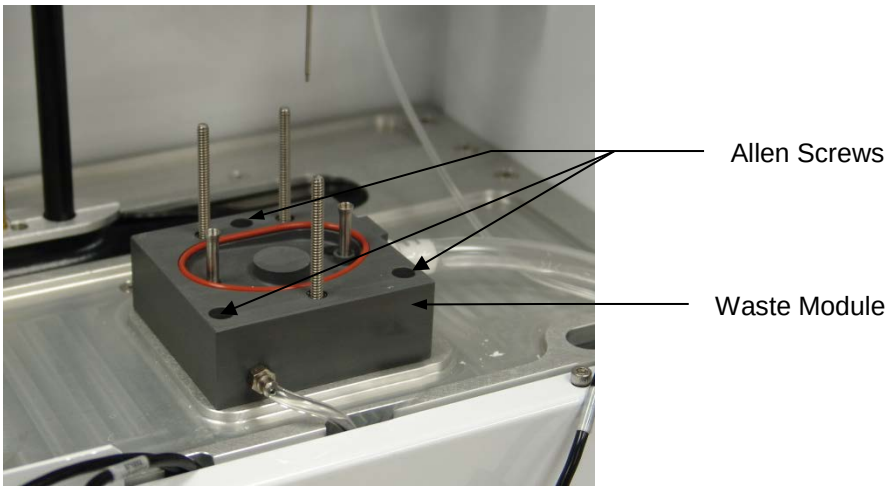


Figure 8-2

Immerse the waste module in authorized disinfecting agent (see Section 8.1). After cleaning, rinse the module for 3 to 5 minutes with authorized rinsing agent (see Section 8.1). Wipe dry with a lint-free tissue.

Remove the O-ring from the base plate. Clean up any salt deposits or fluid on the base plate. Be sure that the base plate and all other parts are dry.

8.4.3 Enzyme Probe Cleaning

With normal use, enzyme sensors may become fouled and cease to operate normally. A fouled sensor's output current will decrease and calibration may become unstable. Follow the steps below to clean the probes.

8.4.3.1 Sensor Maintenance

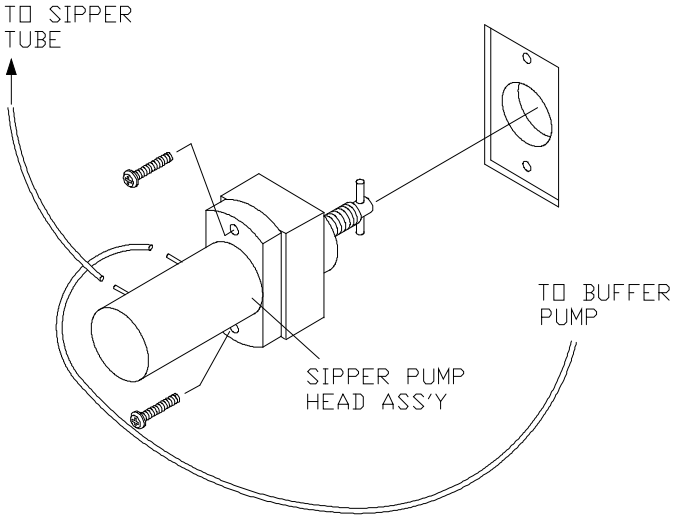
It is necessary to maintenance the enzyme sensors when the PM kit is installed and periodically as needed.

1. Remove the enzyme Membrane and hold the probe with the electrodes facing up.
2. Wad a small portion of a lint free tissue and wet it with 70% isopropyl alcohol.
3. Using your thumb, press the alcohol soaked wad against the probe's surface and rotate the probe back and forth.
4. Rinse the probe with authorized rinsing agent (see Section 8.1).
5. Install a new membrane on the probe (see Section 4.8), then install the probe in the sample module.

8.4.4 Sipper pump Seal Replacement

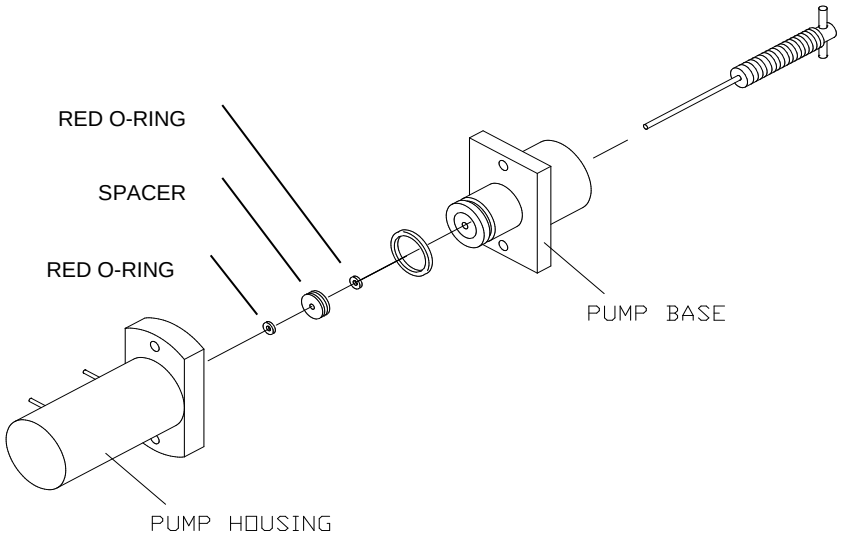
Replace the Sipper Pump seals every 6 months. Heavy usage may warrant more frequent replacement.

Disconnect the tubing from the Sipper Pump. Remove the two hex screws from the Sipper Pump head and remove it from the instrument wall (see Figure 8-3).



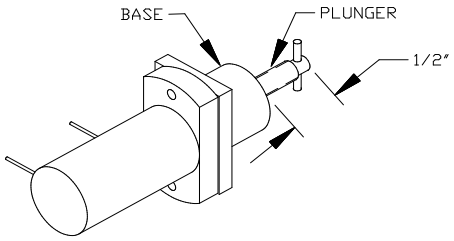
Sipper pump head
Figure 8-3

Pull the white pump base from the clear pump housing. Immerse the clear pump housing in authorized disinfecting agent (see Section 8.1). After cleaning, rinse the pump housing for 5 minutes with authorized rinsing agent (see Section 8.1). Wipe dry with a lint-free tissue. Make sure the metal pipes where the tubing connects are not blocked or restricted. Replace the O-ring seals as shown in Figure 8-4. New seals are supplied in the Preventive Maintenance Kit. Be sure to reinstall the black spacer between the two small red O-rings.



Sipper pump seal replacement
Figure 8-4

Reassemble the pump, position the plunger as shown in Figure 8-5 and install it back on the instrument.



Sipper pump plunger position
Figure 8-5

⚠ WARNING: When re-installing the pump head assembly, the plunger MUST extend at least 1/2″ from the base of the pump (see Figure 8-5). This will assure proper alignment between the pump head and the drive hub.

8.4.5 Bottle Tubing

Disconnect the tubing and unscrew the cable connectors from the buffer, waste and calibrator bottles on each side of the instrument.

Lift the bottle tray on the right side of the instrument up and remove it. Remove the bottles from the tray and clean the bottles and caps with the appropriate disinfecting agent (see 8.1 Cleaning, Disinfecting, and Decontaminating).

Remove the two hex screws holding the pump cover on the right side of the instrument. Lift the cover up and remove it.

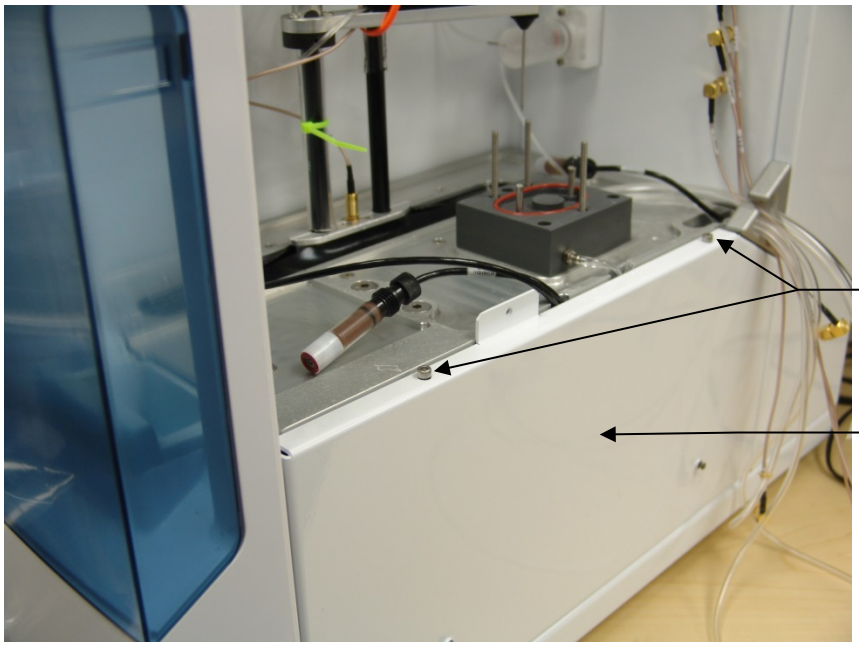
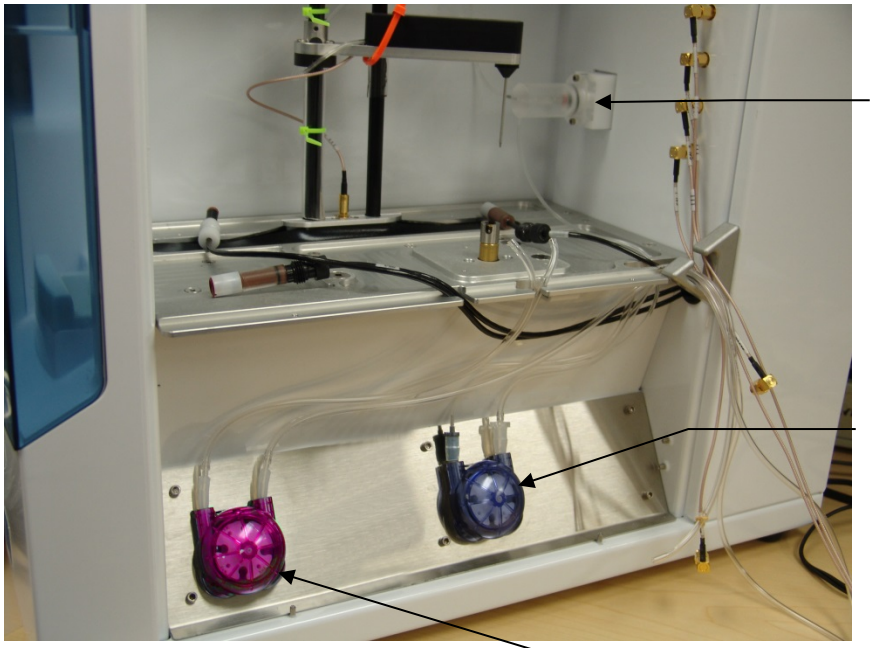


Figure 8-6



Pumps – Right side
Figure 8-7

8.4.6 Pump Tubing Replacement

Tubing life depends on instrument usage. The buffer and calibrator pump tubing should be replaced at least every 6 months or 1000 hours sample ready.

NOTE: The buffer pump tubing and calibrator pump tubing each require a different type of grease. It is important to apply the correct grease to each type of tubing.

8.4.6.1 Buffer Pump Tubing

Pull out firmly on the top edge of each pump head cover. The pump head cover should snap off. See Figure 8-8 and Figure 8-9 below.

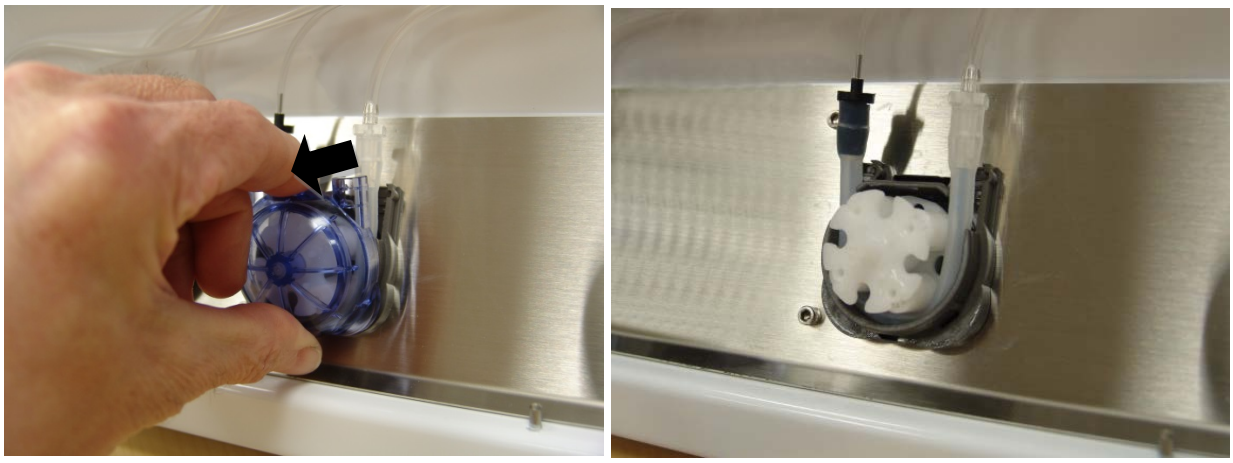


Figure 8-8

Remove the pump tubing from the pump.

Install Buffer Tubing

Apply plenty of buffer grease (included with the new buffer pump tubing) to the new buffer pump tubing. Only apply the grease to the large diameter section of the tubing. Do not apply calibrator pump grease to the buffer pump tubing.

Insert the new pump tubing around the pump roller assembly and into the buffer pump. Make sure the small white fitting with the small diameter tubing is on the left side of the pump.

Place the blue pump head cover onto the buffer pump and press until it snaps into place.

Connect Buffer Tubing

Connect the small diameter tubing from the Buffer Pump to the rear tube of the sipper pump.

8.4.6.2 Calibrator Pump Tubing

Apply plenty of calibrator grease (included with the new calibrator pump tubing) to the larger diameter section of new calibrator pump tubing. Do not apply this calibrator pump grease to the buffer pump tubing.

Insert the new pump tubing around the pump roller assembly and into the calibrator pump. Make sure the short section of tubing is on the left side of the pump. The tubing attached to this fitting connects to the fitting on the waste module.

Place a red pump head cover onto the cal pump and press until it snaps into place.

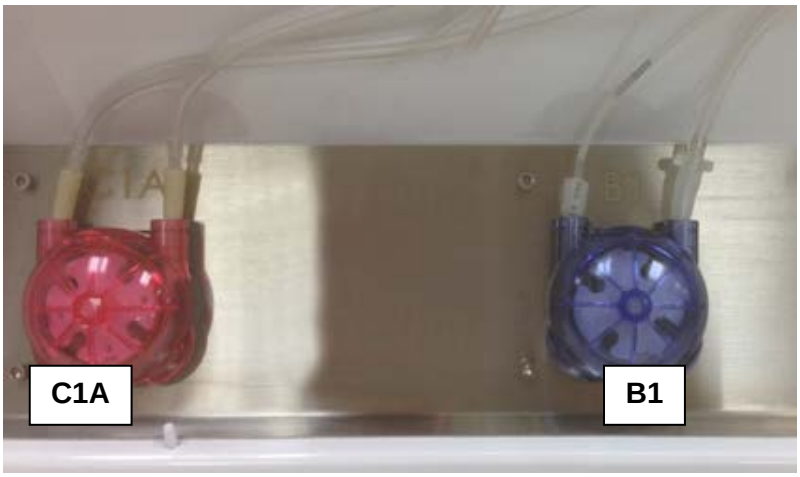
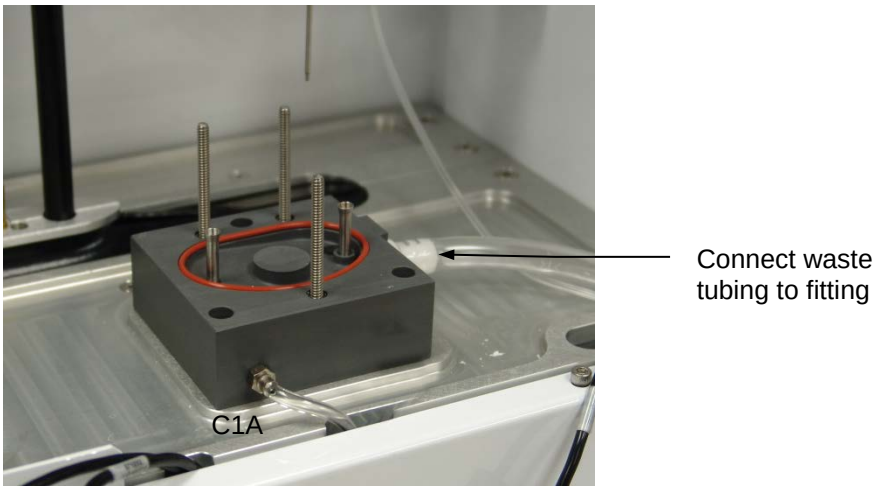


Figure 8-9

8.4.7 Install Waste Module

After cleaning, flush the waste module with copious amounts of authorized rinsing agent (see Section 8.1) to remove any traces of the disinfecting agent. Install new O-rings in the base plate under the waste module. Reinstall the waste module using the three hex screws previously removed. Connect the end of the new calibrator tubing to the fitting on the side of the waste module.



Calibrator and Waste Tubing
Figure 8-10

8.4.8 Waste Tubing

Slide the new waste tubing onto the large fitting on the side of the waste module.

8.4.9 Install Sample Module

After cleaning, flush the sample module with copious amounts of warm water, then rinse with authorized rinsing agent (see Section 8.1) to remove any traces of the disinfecting agent. Install the sample module. Remember to install the stir bar and the module seal O-ring. Secure the sample module using the three thumb nuts. Install a new O-ring on the temperature probe, then install the temperature probe into the sample module.

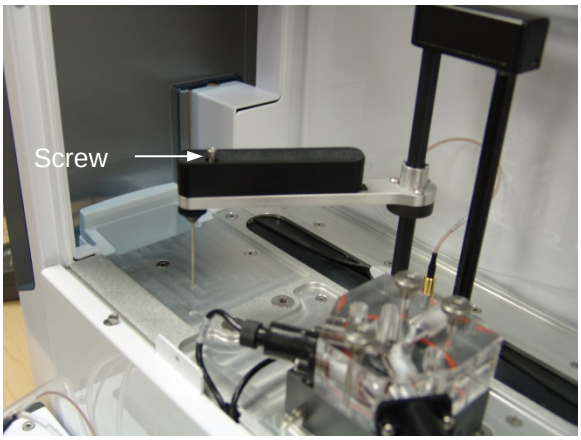
Be sure to clean the enzyme probes before installing them in the sample module.

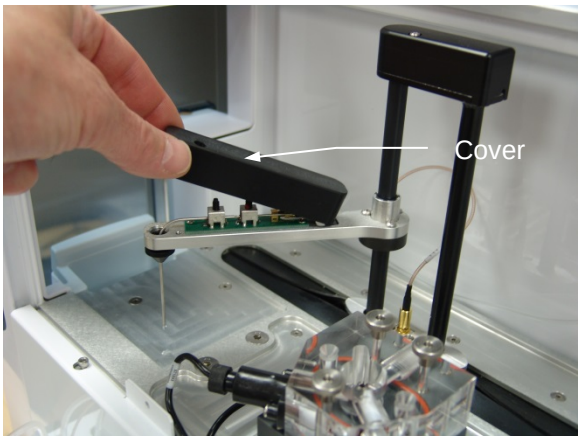
8.4.10 Sipper Replacement

⚠ Caution: Touch a bare metal chassis screw before handling the sipper tube to prevent possible damage due to an electrostatic discharge.

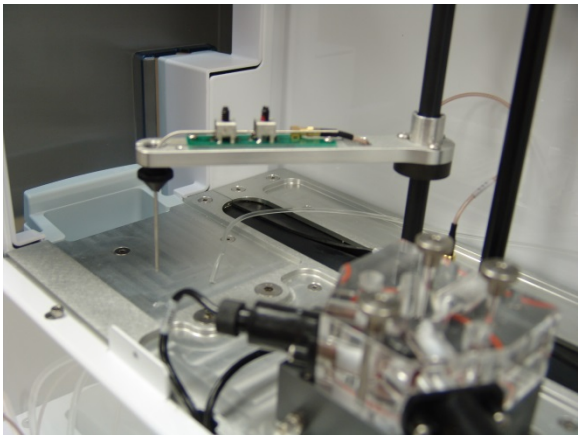
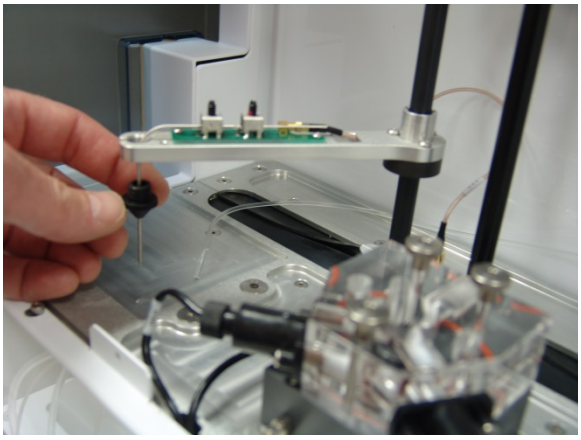
The Sipper can be damaged if it is not properly aligned or if its alignment is disturbed. Inspect the Sipper for straightness and condition of the Teflon jacket separating the two stainless steel tubes. If the Teflon jacket is torn, replacement of the Sipper is required. Follow the steps below to replace the Sipper.

From the Service screen, Sipper tab, move the sipper to Location [Station 1-P96] to allow access to the sipper.

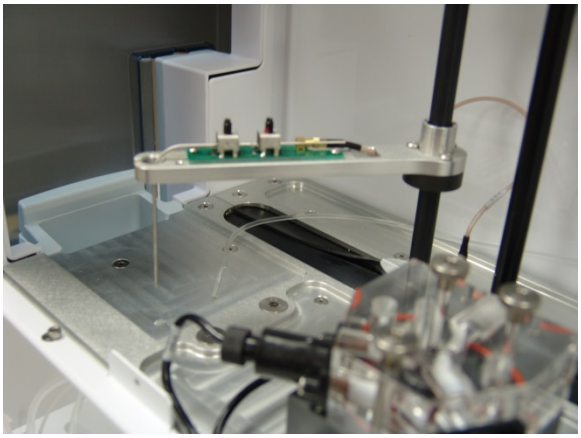
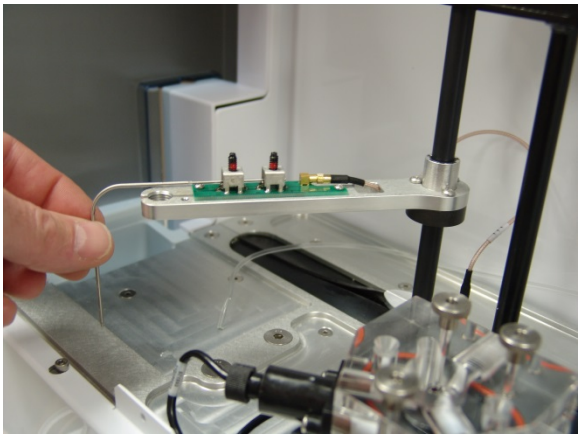




Remove the screw holding the sipper arm cover, then raise the cover up and slide it out of the sipper arm. Disconnect the tubing from the sipper.

Unscrew the sipper cone, slide it down and remove it from the sipper. Loosen the two needle mount screws two turns, then remove the sipper by sliding it straight out of the mounts.

Carefully insert the long thin end of the new sipper and slide it into the mounts. Slide the sipper cone up the sipper and screw it into the sipper arm. Be sure the sipper is centered in both mounts. Tighten the mount screws gently until they contact the sipper, then tighten an additional ¼ turn (**do not over tighten**). Install the sipper arm cover and secure using the hex screw (**do not over tighten**).

Route the new sipper tubing behind the sipper assembly and connect the other end to the front connector of the sipper pump.

8.4.11 Calibrate Sipper

Align the Sipper with the sample module as described in Section *4.4 Align Sipper*.

8.4.12 Install Bottles

Temporarily place the bottle tray next to the instrument and install the bottles. Connect the tubing and cables to the bottles. Be sure to install new reagents in the clean bottles.

8.4.13 Install Membranes

Install new membranes as prescribed (see Section *4.8 Install Enzyme Membranes*).

8.4.14 Prime Fluid System

Prime the buffer and calibration systems (see Section *4.7 Prime the Fluid System*). After checking for any leaks, reinstall the pump cover on the side of the instrument and slide the bottle tray into position.

Calibrate the instrument and run the daily checks to confirm operation (see Section *5.1 Perform Daily Operational Checks*).

8.5 Fuse Replacement

It may be necessary to replace the fuse in the back of the 2500 Analyzer. New fuses may be purchased from YSI or obtained from many local electrical component suppliers. Be sure to obtain the correct fuse rating as indicated below.

⚠ **CAUTION: UNPLUG THE INSTRUMENT FROM THE MAINS SUPPLY**, then unplug the other end of the power cord from the back of the instrument.

Using your fingers, grasp the right edge of the fuse holder and slide it out until it stops, then rotate it to the right to expose the fuse. Only the upper compartment of the fuse holder is used. Carefully slide the fuse out of the fuse holder.

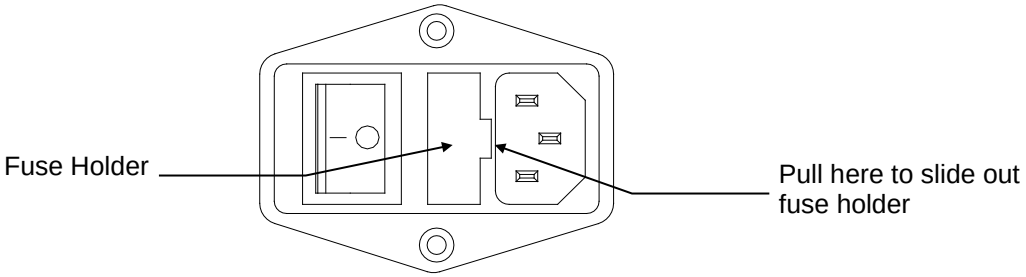


Figure 8-11

8.5.1 Fuse Requirements

Fuse Type: 100–240VAC Operation
2.0 Amp (YSI #571238)
Slow-blow (T Type), 250 volt, 5mm x 20mm

Slide a new fuse into the upper compartment of the fuse holder. Rotate the fuse holder until it is straight, then push it back into the instrument.

With the power switch in the off (O) position, plug the power cord into the instrument and then into the power mains. Refer to Section *1 Basic Setup* to confirm correct power up response.

9 Storage

During normal use, the 2500 Analyzer should be left with the power on at all times. It should also have an adequate supply of buffer. This will keep the enzyme probes polarized and ready for use and prevent the module from drying out.

9.1 Instrument Storage

If the 2500 Analyzer is not going to be used for 2 weeks or longer, remove the buffer and calibrator solutions from the bottles and replace them with authorized rinsing agent (see Section 8.1). Flush the rinsing agent through the system thoroughly, empty the bottles, reinstall them in the instrument and prime the system with air. After all the fluid has been pumped from the system, drain the sample module by temporarily removing one probe. Reinstall the enzyme probes and store the instrument with the membranes in place.

Store the instrument in an environment from 15–35°C, 10–75% humidity (non-condensing).

9.2 Enzyme Membrane Storage

Extra membranes should be refrigerated until use. Once installed, Membranes should remain in 2357 Buffer solution and not allowed to dry out.

9.3 Instrument Handling/Transport

Before transporting, drain all fluids as described above and secure the sipper assembly.

Transporting the instrument may require two people.

10 Troubleshooting

This section provides a systematic approach to establishing the cause of an instrument malfunction. Before taking any corrective action, be certain you have collected as much pertinent information as possible.

To establish probable cause, you should:

- Review any error/warning messages displayed. They should indicate any problems.
- Review the reports for trends in data and errors. Use the detailed format to obtain as much information as possible. An explanation of the report data is covered in this section.
- Check reagent and Membrane installation dates. Compare the elapsed time to the recommended time.
- Look and listen for problems (fluid leaks, salt build-ups, air bubbles in the sample module, loose connections, noisy components, etc.).
- Review Section 6.2, to learn more about how you can test individual components of the 2500 Analyzer.
- Use the troubleshooting chart in this section to assist you in identifying the problem, then use the chart to guide you to a corrective action.

If the problem cannot be resolved, contact YSI Technical Support. When communicating with service personnel, please indicate the serial number of the instrument. If writing or transmitting an email or FAX for assistance, please include a thorough description of the problem and a backup file or copies of printouts, if possible.

10.1 Printout Information

For troubleshooting, or even daily log information, the "detail" report format is preferable. The Detail Report provides a complete description of the sensors for a calibration or sample. Information for all the sensors, as well as the temperature probe, is included.

Listed below are example printouts and explanations of the Detail format information for enzyme sensors.

Sample Report (Detail)

```
======================
 Sample Results Report
======================
Plate:            P96-1
Batch:     Test Batch-1
Analyte         P96_A01
----------------------
1A:Glucose     4.82 g/L
  IB nA            2.11
  NPL nA          32.65
  PL Slope nA/m    0.69
  Temp (C)         25.9
----------------------
Volume (uL)          25
Dilution Factor      x1
Fri 9/9/2018 10:59:37
 YSI 2500 – 15F000025
======================


======================
 Sample Results Report
======================
Plate:            P96-1
Batch:     Test Batch-1
Analyte:        P96_A01
----------------------
1B:Lactate     1.82 g/L
  IB nA            2.11
  NPL nA          32.65
  PL Slope nA/m    0.69
  Temp (C)         25.9
----------------------
Volume (uL)          25
Dilution Factor      x1
Fri 9/9/2018 10:59:37
 YSI 2500 – 18G000025
======================
```

Calibration Report (Detail)

```
======================
   Cal Report [1] *
======================

1A:Glucose     2.50 g/L
  IB nA            1.79
  NPL nA          17.63
  FB nA            1.51
  PL Slope nA/m    0.42
  IB Shift       -0.65%
  NPL Shift       3.64%
  Temp (C)         25.9
----------------------
1B:Lactate     0.50 g/L
  IB nA            0.88
  NPL nA           9.81
  FB nA            0.76
  PL Slope nA/m    0.42
  IB Shift       -1.95%
  NPL Shift       1.64%
  Temp (C)         25.9
----------------------
End Point (sec)      30
Volume (uL)          25
Fri 9/9/2018 10:59:37
   YSI 2500 – 18G000025
======================
```

Sample Report (Brief)

```
======================
 Sample Results Report
======================
Batch:     Test Batch-1
Analyte:        P96_A01
----------------------
1A:Glucose     4.82 g/L
1B:Lactate     1.82 g/L
Fri 9/9/2018 10:59:37
======================
```

Calibration Report (Brief)

```
======================
     Cal Report [2]
======================
1A:Glucose     2.50 g/L
  IB nA            3.24
  NPL nA          17.63
  NPL Shift      -0.64%
----------------------
1B:Lactate     0.50 g/L
  IB nA            2.28
  NPL nA          11.81
  NPL Shift       0.47%
----------------------
 Fri 9/9/2018 10:59:37
======================
```

IB nA (Initial Baseline Current). The initial baseline current is monitored before a sample or calibration. The IB current must be stable and below 6 nA.

NPL nA (Net Plateau Current). This is the peak current minus the baseline current. The minimum acceptable plateau current is 5 nA. The maximum plateau current allowed is 100 nA for calibrations and 625 nA for samples.

FB nA (Final Baseline Current). The final baseline current is printed for calibrations and samples. The baseline current is monitored during the buffer flush and compared to the initial baseline current.

IB shift (Baseline Shift). The final and initial baselines are compared and reported as percent shift. A negative baseline shift is not uncommon with newly-installed Membranes. High concentration samples may yield positive baseline shifts. An excessive positive shift can be an indicator of the presence of an interfering substance. The message 'Final baseline error' is printed when the instrument cannot adequately flush the sample module.

PL Slope (Slope of the plateau). The slope is reported in nanoamps per minute. A newly installed membrane may have an elevated plateau slope. An excessive slope can be an indicator of the presence of an interfering substance.

End Point is the time from dispensing the sample into the sample module until the instrument reads the probe signal. The default value for most chemistry setups is 30 seconds. The value that you have selected in Setup is displayed in the report. Note: This is not through-put time, but rather best thought of as "reaction" time or "probe signal development" time.

NPL shift (Calibration Shift). A calibration result is compared to the previous calibration result and the percent shift is reported. The default setting is 2%. That is, if the shift is greater than 2%, the instrument performs another calibration. Note that the 2500 Analyzer attempts to calibrate each sensor up to 5 times before aborting calibration for that sensor. You may select Cal shift values that better suit your application. Excessive calibration shifts may be caused by faulty membranes, newly installed membranes or air in the sample module.

Temperature (Sample module Temperature). The sample module temperature is measured during a calibration and a sample. The results of a sample are temperature corrected. The 2500 Analyzer works at sample module temperatures between 15° and 35°C. The instrument only measures and displays temperatures between 10° and 50°C.

10.2 Troubleshooting Chart

SYMPTOM:	**MEASUREMENT ERROR: IB Level Error**
POSSIBLE CAUSE:	Pinched, leaking or disconnected tube.
ACTION:	Fix or replace tubing.
SECTION:	*8.4.6 Pump Tubing Replacement*
POSSIBLE CAUSE:	Sipper misaligned.
ACTION:	Check Sipper alignment.
SECTION:	*4.4 Align Sipper*
POSSIBLE CAUSE:	Sipper pump not operating properly.
ACTION:	Replace sipper pump seals.
SECTION:	*8.4.4 Sipper pump Seal Replacement*
POSSIBLE CAUSE:	Stir bar not in sample module.
ACTION:	Install stir bar.
SECTION:	*8.4.1 Sample Module Cleaning*
POSSIBLE CAUSE:	Stir speed too fast or too slow.
ACTION:	Adjust stir speed.
SECTION:	*6.2.2.4* Controls*,* Stirbar
POSSIBLE CAUSE:	Newly installed enzyme Membrane.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	*6.2.2 Module*
POSSIBLE CAUSE:	Newly installed probe.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	*6.2.2 Module*
POSSIBLE CAUSE:	Power disruption.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	6.2.2 *Module*
POSSIBLE CAUSE:	Failing enzyme membrane.
ACTION:	Perform daily operational checks and replace membrane if necessary.
SECTION:	*5.1 Perform Daily Operational Checks, 4.7 Install Enzyme Membranes*
POSSIBLE CAUSE:	Enzyme Probe surface fouled.
ACTION:	Clean probe surface.
SECTION:	*8.4.3 Enzyme Probe Cleaning*
POSSIBLE CAUSE:	Auxiliary electrode fouled.
ACTION:	Clean Auxiliary electrode surface (temperature probe) with isopropyl alcohol.
POSSIBLE CAUSE:	Sample may contain an interfering substance.
ACTION:	Attempt to confirm interference.
SYMPTOM:	**MEASUREMENT ERROR: PL Limit Error**
POSSIBLE CAUSE:	Sipper misaligned.
ACTION:	Check Sipper alignment.
SECTION:	*4.4 Align Sipper*
POSSIBLE CAUSE:	Stir bar not in sample module.
ACTION:	Disassemble sample module and reinstall stir bar.
SECTION:	*8.4.1 Sample Module Cleaning*

POSSIBLE CAUSE:	Newly installed enzyme Membrane.
ACTION:	Enter probe service and check probe currents.
SECTION:	*6.2.2 Module*
POSSIBLE CAUSE:	Newly installed probe.
ACTION:	Enter probe service and check probe currents.
SECTION:	*6.2.2 Module*
POSSIBLE CAUSE:	Calibrator solution out of spec: contaminated or installed for more than 30 days.
ACTION:	Install new calibrator.
SECTION:	*4.6 Install Calibrator Solution*
POSSIBLE CAUSE:	Failing enzyme Membrane.
ACTION:	Enter probe service and check probe currents. Replace Membrane(s) if necessary.
SECTION:	*5.1 Perform Daily Operational Checks*, *4.7 Install Enzyme Membranes*
POSSIBLE CAUSE:	Probe surface fouled.
ACTION:	Clean probe surface.
SECTION:	*8.4.3 Enzyme Probe Cleaning*
POSSIBLE CAUSE:	Auxiliary electrode fouled.
ACTION:	Clean Auxiliary electrode surface (temperature probe) with isopropyl alcohol.
POSSIBLE CAUSE:	Sample concentration too high, resulting in high probe current (nA).
ACTION:	Dilute sample or adjust sample size down and repeat.
SECTION:	*7.1 Sample Volume*

SYMPTOM:	**MEASUREMENT ERROR: PL Slope**
POSSIBLE CAUSE:	Stir speed too fast or too slow.
ACTION:	Adjust stir speed.
SECTION:	*6.2.2.4 Controls, Stirbar*
POSSIBLE CAUSE:	Newly installed enzyme Membrane.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	*6.2.2 Module*
POSSIBLE CAUSE:	Newly installed probe.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	*6.2.2 Module*
POSSIBLE CAUSE:	Failing enzyme membrane.
ACTION:	Replace membrane.
SECTION:	*5.1 Perform Daily Operational Checks*, *4.7 Install Enzyme Membranes*
POSSIBLE CAUSE:	Enzyme Probe surface fouled.
ACTION:	Clean probe surface.
SECTION:	*8.4.3 Enzyme Probe Cleaning*
POSSIBLE CAUSE:	Auxiliary electrode fouled.
ACTION:	Clean Auxiliary electrode surface (temperature probe) with isopropyl alcohol.

SYMPTOM:	**FLUID ERROR: Check Bottles**
POSSIBLE CAUSE:	Low buffer or calibrator level.
ACTION:	Check bottle status at bottom of Sample screen. Refill the appropriate bottle.
SECTION:	*4.5 Prepare and Install Buffer Solution*, *4.6 Install Calibrator Solution*

POSSIBLE CAUSE:	High waste level.
ACTION:	Empty waste bottle.
SECTION:	*8.2.1 Empty the Waste Bottle*
POSSIBLE CAUSE:	Bubbles in buffer or calibrator bottle tubing.
ACTION:	Prime bottle.
SECTION:	*4.7 Prime the Fluid System*

SYMPTOM:	**INTERNAL FAILURE: Unable to Calibrate**
POSSIBLE CAUSE:	Air bubbles in calibrator tubing.
ACTION:	Prime calibrator bottles.
SECTION:	*4.7 Prime the Fluid System*
POSSIBLE CAUSE:	Pinched, leaking or disconnected tube.
ACTION:	Fix or replace tubing.
SECTION:	*8.4.6 Pump Tubing Replacement*
POSSIBLE CAUSE:	Sipper misaligned.
ACTION:	Check Sipper alignment.
SECTION:	4.4 *Align Sipper*
POSSIBLE CAUSE:	Stir bar not in sample module.
ACTION:	Install stir bar.
SECTION:	*8.4.1 Sample Module Cleaning*
POSSIBLE CAUSE:	Stir speed too fast or too slow.
ACTION:	Adjust stir speed.
SECTION:	*6.2.2.4* Controls*,* Stirbar
POSSIBLE CAUSE:	Newly installed enzyme membrane.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	*6.2.2 Module*
POSSIBLE CAUSE:	Newly installed probe.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	*6.2.2 Module*
POSSIBLE CAUSE:	Calibrator solution out of spec: contaminated or installed for more than 30 days.
ACTION:	Install new calibrator.
SECTION:	*4.6 Install Calibrator Solution*
POSSIBLE CAUSE:	Net calibration current (PL current) below 5 nA.
ACTION:	Replace enzyme Membrane and check calibrator solution.
SECTION:	*4.7 Prime the Fluid System*
POSSIBLE CAUSE:	Failing enzyme membrane.
ACTION:	Perform daily operational checks and replace membrane(s) if necessary.
SECTION:	*5.1 Perform Daily Operational Checks*, *4.7 Prime the Fluid System*
POSSIBLE CAUSE:	Probe surface fouled.
ACTION:	Clean probe surface.
SECTION:	*8.4.3 Enzyme Probe Cleaning*
POSSIBLE CAUSE:	Auxiliary electrode fouled.
ACTION:	Clean Auxiliary electrode surface (temperature probe) with isopropyl alcohol.

SYMPTOM:	**ERROR: No Fluid Detected**
POSSIBLE CAUSE:	Low sample level.
ACTION:	Increase sample level in test tube.
POSSIBLE CAUSE:	Sipper Depth set too high at sample station.
ACTION:	Adjust sipper depth.
SECTION:	*4.4 Align Sipper*
POSSIBLE CAUSE:	Calibrator bottle not primed.
ACTION:	Prime calibrator bottle.
SECTION:	*4.7 Prime the Fluid System*
POSSIBLE CAUSE:	Low calibrator solution.
ACTION:	Install new calibrator.
SECTION:	*4.6 Install Calibrator Solution*
POSSIBLE CAUSE:	Pinched, blocked, leaking or disconnected tube.
ACTION:	Fix or install new tubing.
SECTION:	*8.4.6 Pump Tubing Replacement*
POSSIBLE CAUSE:	Calibrator pump not operating properly.
ACTION:	Check pump and tubing.
SECTION:	*8.4.6 Pump Tubing Replacement*
POSSIBLE CAUSE:	Fluid not conductive.
ACTION:	Use saline as diluent.
POSSIBLE CAUSE:	Sipper tip fouled.
ACTION:	Clean tip of sipper with isopropyl alcohol and a lint-free tissue.
POSSIBLE CAUSE:	Sipper mounting screws loose.
ACTION:	Check sipper mounting screws and tighten **gently** if required.
SECTION:	*8.4.10 Sipper Replacement*

SYMPTOM:	**Fail FCN Test**
POSSIBLE CAUSE:	Damaged or old membrane.
ACTION:	Replace membrane.
SECTION:	*4.7 Prime the Fluid System*

SYMPTOM:	**Fail Linearity Test**
POSSIBLE CAUSE:	Probe assignment incorrect.
ACTION:	Make correct assignment.
SECTION:	*4.9.1 Assign Chemistries to Probes*
POSSIBLE CAUSE:	Damaged or old Membrane.
ACTION:	Replace membrane.
SECTION:	*4.7 Prime the Fluid System*
POSSIBLE CAUSE:	Calibrator bottle(s) not primed sufficiently.
ACTION:	Prime each calibrator bottle for 60 seconds.
SECTION:	*4.7 Prime the Fluid System*
POSSIBLE CAUSE:	Contaminated or old calibration or linearity standard.
ACTION:	Repeat test with new standards.
SECTION:	*5.1 Perform Daily Operational Checks*
POSSIBLE CAUSE:	Assigned concentration range beyond practical limits.
ACTION:	Redefine measurement parameters. Remake standards.
SECTION:	*7 Chemistry Setup*

SYMPTOM:	**ERROR: Motor Failure**
POSSIBLE CAUSE:	One of the motors is jammed.
ACTION:	Enter motor service and cycle the suspected motor.
SECTION:	*6.2 Service*
POSSIBLE CAUSE:	Worn sipper pump seals.
ACTION:	Replace seals.
SECTION:	*8.4.4 Sipper pump Seal Replacement*

SYMPTOM:	**ERROR: Temperature**
POSSIBLE CAUSE:	Ambient temperature too cold or hot.
ACTION:	Operate at ambient temperatures between 15 and 35°C.

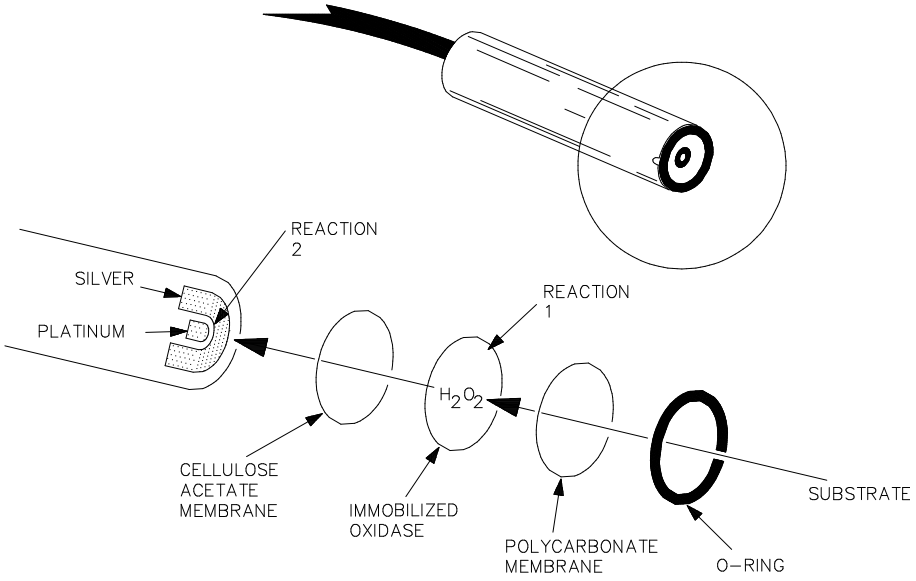
SYMPTOM:	**Printer Does Not Advance**
POSSIBLE CAUSE:	Paper or roll jammed.
ACTION:	Remove paper cover and clear obstruction. If printer still does not advance, turn printer off for 30 seconds, then back on.

SYMPTOM:	**Sipper Does Not Enter Sample module**
POSSIBLE CAUSE:	Sipper misaligned.
ACTION:	Align sipper.
SECTION:	*4.4 Align Sipper*

11 Principles of Operation

11.1 Enzyme Sensor Technology

The enzyme sensor technology of the 2500 Analyzer is based on the principles conceived by Dr. Leland Clark, formerly of Children's Hospital Foundation, Cincinnati, Ohio. The immobilized enzyme membrane was invented by YSI and is covered by U.S. Patent 4,073,713. This sensor technology has been used successfully since 1975.



Sensor Probe and Enzyme Membrane
Figure 11-1

Each enzyme probe is fitted with a three-layer membrane containing immobilized enzyme in the middle layer. Figure 11-1 shows an exploded view of the membrane and its relationship to the face of the probe.

The face of the probe, covered by the membrane, is situated in a buffer-filled sample module into which a sample is injected. Some of the substrate diffuses through the membrane. When it contacts the immobilized oxidase enzyme, it is rapidly oxidized, producing hydrogen peroxide. See Reaction 1, using glucose as an example.

The hydrogen peroxide (H_2O_2) is, in turn, oxidized at the platinum anode, producing electrons (Reaction 2). A dynamic equilibrium is achieved when the rate of H_2O_2 production and the rate at which H_2O_2 leaves the immobilized enzyme layer are constant and is indicated by a steady state response (Figure 11-2). The electron flow is linearly proportional to the steady state H_2O_2 concentration and, therefore, to the concentration of the substrate.

REACTION 1 (glucose): β-D-glucose + O_2 $\xrightarrow[GOx]{}$ Glucono-δ-lactone + H_2O_2

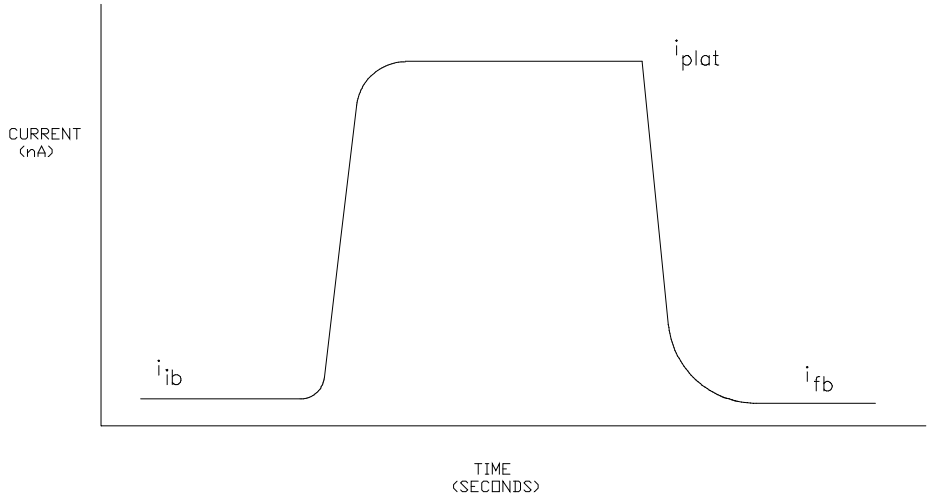
REACTION 2: $H_2O_2 \xrightarrow[Pt\ anode]{} 2H^+ + O_2 + 2e^-$

The platinum electrode is held at an anodic potential and is capable of oxidizing many substances other than H_2O_2. To prevent these reducing agents from contributing to sensor current, the membrane contains an inner layer consisting of a very thin film of cellulose acetate. This film readily passes H_2O_2 but excludes chemical compounds with molecular weights above approximately 200.

The cellulose acetate film also protects the platinum surface from proteins, detergents, and other substances that could foul it. However, the cellulose acetate film can be penetrated by such compounds as hydrogen sulfide, low molecular weight reducing compounds, mercaptans, hydroxylamines, hydrazines, phenols and anilines.

11.2 Measurement Methodology

The 2500 Analyzer employs a steady state measurement methodology. A typical enzyme sensor response is shown in Figure 11-1.



Typical Enzyme Sensor Response
Figure 11-2

When sample or calibration standard is dispensed into the sample module, it is diluted into approximately 600 microliters of buffer. The enzyme sensor response increases and plateaus. After several seconds, the sample module is flushed with buffer and the sensor response decreases.

The net response is the difference between the plateau current (i_{plat}) and the initial baseline current (i_{ib}). Typical net responses for the 2500 Analyzer are between 10 and 25 nA (nanoamps) for YSI calibration solutions.

11.3 Baseline Stability

The 2500 Analyzer monitors the probe baseline activity and stability. If an unstable baseline is detected, the instrument will continue to flush the sample module with buffer. When a stable baseline is established, an automatic calibration is initiated.

After every calibration and sample, the final baseline value (i_{fb}) is compared to the initial baseline value (i_{ib}) during the flush cycle. If a significant shift is detected, the sample module continues to be flushed with buffer. As soon as the baseline recovers, buffer flushing ceases and the instrument performs its next command. There is a limit of about 3 minutes, at which time the instrument displays a baseline error message.

11.4 Calibration

To maintain a sample ready status, the 2500 Analyzer self-calibrates. Calibrating establishes the sensors' response to a known concentration of substrate.

The enzyme sensors calibration response must be above 5 nA. A response below this value will result in an error (low PL current).

The 2500 Analyzer self-calibrates enzyme sensors every 5 samples or 30 minutes. However, default calibration parameters can be altered to tighten or loosen calibration specifications. A manual calibration can be initiated from the [Run], [Calibrate] tab.

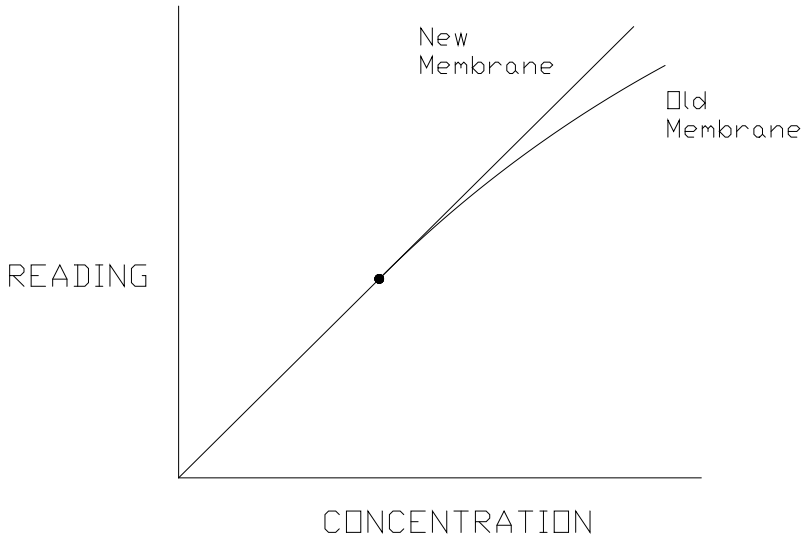
A STABLE CALIBRATION IS IMPORTANT. The instrument re-establishes a calibration reference point after every calibration. If a difference of more than 2% between the present and previous net calibration values occurs, the instrument repeats calibration. The sensors' net value for a calibration (PL) is displayed and printed. An unstable calibration is

displayed and printed as a "PL shift". While establishing a stable calibration, the 2500 Analyzer will run 5 calibrations before aborting calibration for a sensor. The flexible parameter selection allows the user to disable this error mode.

In summary, by the default enzyme sensor calibration settings, recalibration will occur after every 5 samples or 30 minutes, after a calibration shift of 2% or greater, or after a sample module temperature drift of more than 1°C. After 5 attempts without successfully calibrating, the instrument aborts calibration for that sensor.

11.5 Linearity

As discussed earlier, an enzyme sensor consists of an electrode and an enzyme membrane. As a membrane ages, its response becomes non-linear (shown in Figure 11-3 below).



Aging Enzyme Membrane Response
Figure 11-3

Under optimal conditions the enzyme sensor response depends on diffusion limitation of the substrate. When the substrate can diffuse at a greater rate than the enzyme can turnover product, enzyme kinetics defines the response and nonlinearity is a symptom. This occurs as an enzyme membrane ages.

It is necessary to periodically check sensor linearity. YSI offers linearity standards for all of the recommended calibration values.

11.6 Temperature Compensation

The sensitivity of the sensors, in the 2500 Analyzer, varies with temperature changes. The sample module contains a temperature probe that monitors the fluid temperature. The sample results are temperature corrected for the difference in temperature between the sample and the calibration.

11.7 Level Sensing

The 2500 Analyzer employs level sensing on the Sipper and, optionally, in the waste, calibrator and buffer bottles.

The Sipper level sensor detects the sample surface and then travels into the sample about 3 millimeters (1/8 inch). This controlled immersion depth permits the use of sample tubes/plates that are filled to different heights without significant carry-over between samples.

The Sipper and Arm Assembly should never be touched while the unit is in operation.

The calibrator and supply bottles are monitored for low levels and the waste bottle is monitored for high level.

12 Warranty and Repair

YSI 2500 Biochemistry Analyzers are warranted for one year from date of purchase by the end user against defects in materials and workmanship, exclusive of batteries. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

12.1 Limitation of Warranty

This Warranty does not apply to any YSI product damage or failure caused by

(i) failure to install, operate or use the product in accordance with YSI's written instructions,
(ii) abuse or misuse of the product,
(iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure,
(iv) any improper repairs to the product,
(v) use by you of defective or improper components or parts in servicing or repairing the product, or
(vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI's LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.
To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

12.1.1 Shipping Instructions

1. Clean and decontaminate items to insure the safety of the handler.
2. Secure the sipper to prevent damage during shipment.
3. Complete and include the Cleaning Certificate.
4. Place the product in a plastic bag to keep out dirt and packing material.
5. Use a large carton, preferably the original, and surround the product completely with packing material.
6. Insure for the replacement value of the product.

Cleaning Certificate

Organization _____

Department _____

Address _____

City _____ State _____ Zip _____

Country _____ Phone _____

Model No. of Device _____ Lot Number _____

Contaminant (if known) _____

Cleaning Agent(s) used _____

Radioactive Decontamination Certified?

(Answer only if there has been radioactive exposure)

___ Yes ___ No

Cleaning Certified By _____

Name Date

12.1.2 Cleaning Instructions

NOTE: Before they can be serviced, equipment exposed to biological, radioactive, or toxic materials must be cleaned and disinfected. Biological contamination is presumed for any instrument, probe, or other device that has been used with body fluids or tissues, microorganisms or with wastewater. Radioactive contamination is presumed for any instrument, probe or other device that has been used near any radioactive source.

If an instrument, probe, or other part is returned or presented for service without a Cleaning Certificate, and if in our opinion it represents a potential biological or radioactive hazard, our service personnel reserve the right to withhold service until appropriate cleaning, decontamination, and certification have been completed. We will contact the sender for instructions as to the disposition of the equipment. Disposition costs will be the responsibility of the sender.

When service is required, either at the user's facility or at YSI, the following steps must be taken to insure the safety of our service personnel.

1. In a manner appropriate to each device, decontaminate all exposed surfaces, including any containers. See Section 8.1for a list of authorized cleaning agents. Instruments used with wastewater may be disinfected with 0.5% Lysol if this is more convenient to the user. Autoclavable products may be autoclaved.
2. The user shall take normal precautions to prevent radioactive contamination and must use appropriate decontamination procedures should exposure occur.
3. If exposure has occurred, the customer must certify that decontamination has been accomplished and that no radioactivity is detectable by survey equipment.
4. Any product being returned to the YSI Repair Center should be packed securely to prevent damage.
5. Cleaning must be completed and certified on any product before returning it to YSI.

12.2 YSI Factory Authorized Service Centers

United States

YSI Incorporated
Repair Center
1725 Brannum Lane
Yellow Springs, OH 45387
Phone: 937 767-7241
Fax: 937 767-9353

Rochelle Scientific
1966 Tice Valley Blvd., #430
Walnut Creek, CA 94595
Phone: 877 527-8494
Fax: 707 307-7130

RJM Sales
454 Park Avenue
Scotch Plains, NJ 07076
Phone: 800 752-9055
Fax 908 322-2160

Giangarlo Scientific
162 Steuben St.
Pittsburgh, PA 15220
Phone: 412 922-8850
Fax: 412 922-9047

Scimetrics Inc.
19407 Park Row, Ste. 102
Houston, YX 77084
Phone: 281-565-0066
Fax: 281-565-1570

Europe

YSI Life Sciences
Xylem
Longfield Road
Tunbridge Wells
Kent TN2 3EY
UK
Phone: 44 1892 500400
Fax: 44 1892 543115

Asia

Smartec Scientific Corp.
7F-6, No.12, Lane 609
Sec 5, Chung-Hsing Road
San Chung
Taipei
Taiwan
Phone: 886 2 2999-5767
Fax: 886 2 2999-5759

Canada

Mandel Scientific
2 Admiral Place
Guelph, ON U1G 4N4
Canada
Phone: 888-883-3636
Fax: 519-763-2005

13 Notices

13.1 Declaration of Conformity

YSI Incorporated
1725 Brannum Lane, Yellow Springs, OH 45387
Tel +1.937.767.7241 Fax +1.937.767.9353

Declaration of Conformity

Manufacturer:	YSI Incorporated 1725 Brannum Lane Yellow Springs, OH 45387 USA
Product Name:	YSI Model 2900 Series Biochemistry Analyzer
Model Number(s):	YSI 2900D, YSI 2950D-x, YSI 2500
Directives:	EMC Directive 2014/30/EU Low Voltage Directive 2014/35/EU Machinery Directive 2006/42/EC WEEE Directive 2012/19/EU RoHS Directive 2011/65/EU FCC 47 CFR Part 15 Canada ICES-003:2004
Harmonized Standards:	EN 61326-1:2013 EN 61326-2-3:2013 EN 61000-3-2:2006+A1:2009+A2:2009 EN 61000-3-3:2013 EN 61010-1:2010 3rd Edition

YSI Incorporated declares that the instrument specified above conforms to the essential requirements of the Directives and Standards specified above when installed and operated in accordance with specifications as set forth by YSI. This product has been tested to the requirements of CAN/CSA-C22.2 No. 61010-1, third edition, or a later version of the same standard, incorporating the same level of testing requirements.

Gregory W. Popp

Gregory Popp
Quality Manager
937-767-7241 x230
gpopp@ysi.com

13.2 Radio and Television Interference Notice

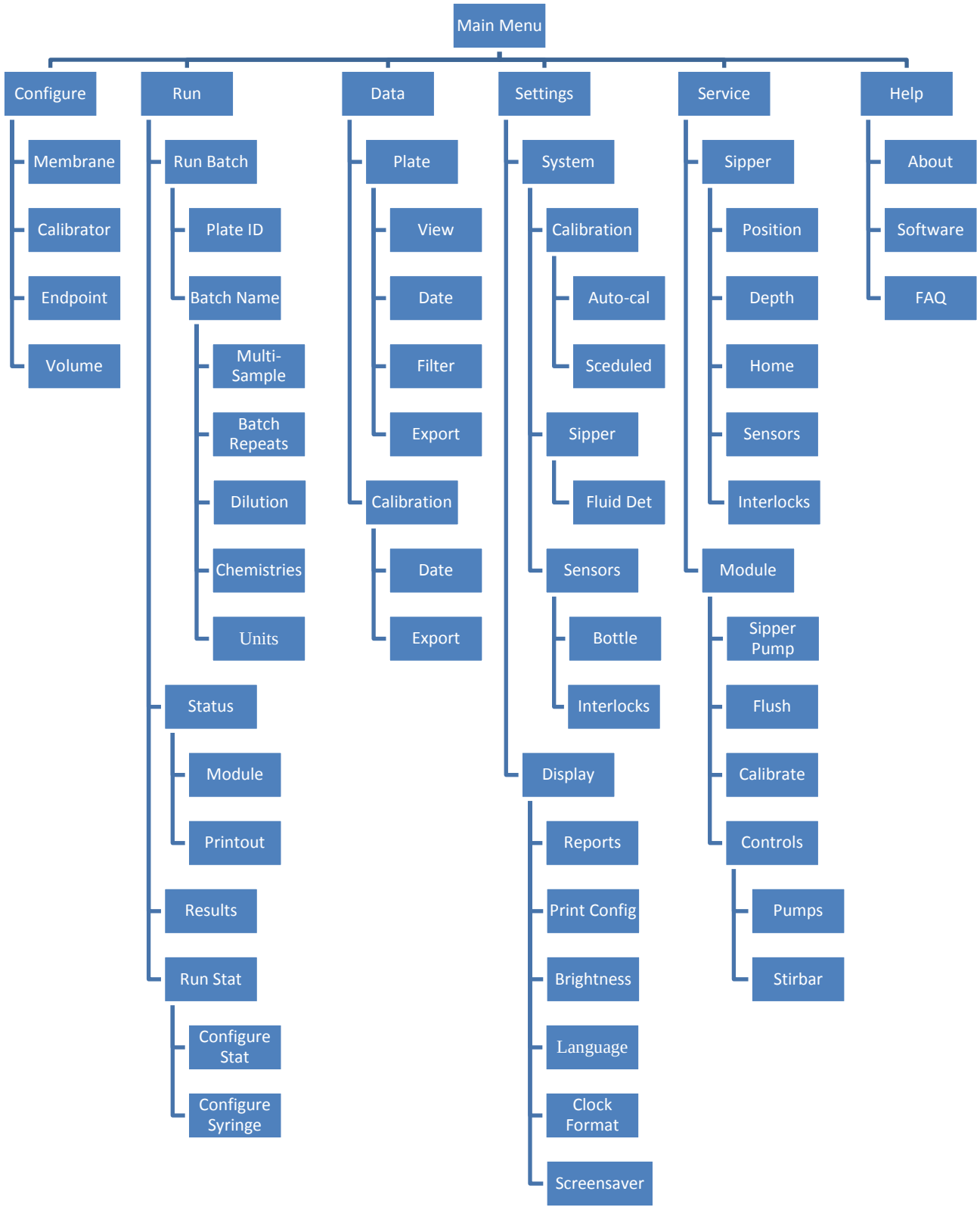
This equipment generates and uses radio frequency energy and if not installed and used properly, may cause interference to radio and television reception. There is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna
- Relocate the computer with respect to the receiver
- Move the computer away from the receiver
- Plug the computer into a different outlet so that the computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet, prepared by the Federal Communications Commission, helpful: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock No. 0004-000-00345-4.

14 Appendix A – Software Flowchart

The software flow chart for the 2500 Analyzer is shown below. The main screen has six icons that control all instrument functions (shown at the top of the flowchart).



15 Appendix B – Concentration Unit Conversion

In the 2500 Analyzer Batch menu, you have the option to assign units of concentration. There are default values set based on calibration solutions offered by YSI. Below is a table of unit conversions for these calibration solutions.

Chemistry	g/L	mg/L (ppm)	mg/dL	% (w/v)	mmol/L	mw (g/mole)
Glucose (Dextrose)	1.80	1800	180	0.18	10.00	(180)
Glucose (Dextrose)	2.50	2500	250	0.25	13.89	(180)
L-Lactate	0.45	450	45	0.045	5.00	(89)

If you are using a standard of a value not listed in the preceding table, refer to the example conversions below to help calculate your unit of choice.

Example Conversions

Beginning with 2.50 g/L glucose, convert this to mg\L, then % and finally to mmol/L:

1. Multiply by unit conversion(s)
2. Cancel units common in “numerator” and “denominator”
3. Multiply numbers

? mg/L = 2.50 g/L
= (2.50 g/L)(1000 mg/g) = (2.50)(1000) mg/L = **2500 mg/L**

? % (w/v) = 2.50 g/L
= (2.50 g/L)(0.1 L/dL) = (2.50)(0.1) g/dL = 0.250 g/dL
= **0.250 %** (Note: g/dL is g/100ml or percent)

? mmol/L = 2.50 g/L
= (2.50 g/L)(1 mole/180 g)(1000 mmole/mole)
= (2.50)(1/180)(1000) mmole/L = **13.89 mmol/L**

15.1 Linearity Test. Concentration Unit Conversion

Chemistry	g/L	mg/L (ppm)	mg/dL	% (w/v)	mmol/L	mw (g/mole)
Glucose (Dextrose)	9.45	9,450	945	0.945	52.5	(180)
	9.00	9,000	900	0.900	50.0	
	8.55	8,550	855	0.855	47.5	
L-Lactate	2.80	2,806	281	0.281	31.5	(89)
	2.67	2,672	267	0.267	30.0	
	2.54	2,539	254	0.254	28.5	

NOTE: The linearity concentration ranges for each chemistry are shown (top to bottom) as upper limit, theoretical, and lower limit for each of five concentration units.

15.2 FCN Membrane Integrity Test. Concentration Unit Conversion

Chemistry	g/L	mg/L (ppm)	mg/dL	% (w/v)	mmol/L	mw (g/mole)
Glucose (Dextrose)	0.05	50	5	0.01	0.28	(180)
L-Lactate	0.03	30	3	0.01	0.34	(89)

NOTE: Use the values from the preceding tables only when calibrating with the appropriate YSI calibrator solution Glucose (2776 or 2747) and L-Lactate (2776).

16 Appendix C – Effects of Selected Substances

⚠ Caution: The following preservatives interfere with the measurement and should not be used: Phenol, Benzalkonium Chloride, Methyl Paraben, Perchloric Acid, Sodium Azide, Thymol, Trichloracetic Acid.

Several classes of chemicals can damage the YSI sensor system or cause erroneous readings. Some substances such as triglycerides, which are interferences for photometric sensor systems, do not interfere with the 2500 electrochemical sensor system.

Side Substrates of Glucose Oxidase

The glucose oxidase used in YSI glucose membranes reacts with beta-D-glucose and with certain analogs differing only at carbon position 2 or 6. A specimen containing these substances would give a falsely elevated reading, but there would be no damage to the sensor nor any effect on readings from other samples. Side substrate response is greatest when the membrane is first installed and declines with use.

Reducing Agents

Many reducing agents would give rise to a false signal current (and falsely elevated reading) if they succeeded in reaching the sensing anode of the YSI 2500 probe. Most of these are excluded from the probe by the cellulose acetate layers of the membrane, However, thymol, phenols, anilines, hydrazines and hydrazides, hydroxylamines, oximes and a few other compounds of molecular weight below 150 which are cationic or uncharged in neutral solution can interfere.

Homologues and isomers may be expected to behave similarly, except that relative response generally declines with increasing molecular (or ionic) bulkiness. Hydrogen Sulfide, Hydrazine, Methylhydrazine, Phenylhydrazine, Oxamic Hydrazide, Hydroxyethylhydrazine, Acetone Oxime, Hydroxylamine and Sodium Borohydride are also known to give a significant relative response. Relative response to reducing agents may vary from membrane lot to membrane lot, and may depend on the service history of the probe and membrane.

The following reducing agents may result in an elevated background current when present at low levels (only a few milligrams per liter):

- Aniline
- Catechol
- Ethyl Carbazate
- Formic Acid Hydrazide
- Guaiacol
- 2-Mercaptoethanol
- Phenol
- Resorcinol
- Thiocarbohydrazide
- Thiourea

The following materials may cause trouble at higher concentrations:

- 2-Amino-4-nitrophenol
- p-Aminophenol
- p-Cresol
- N.N-Dimethylhydroxylamine
- 4-Ethylphenol
- Hydroquinone
- 2-Hydroxybenzyl Alcohol
- Isoniazid
- Methimazole
- Oxalyl Dihydrazide
- p-Phenylenediame
- Pyrogallol
- Sodium Azide
- o-Toluidine

Calibration Shift by Detergents

The sensitivity of the platinum anode of the sensor is affected somewhat by absorption or desorption of material from the buffer which bathes it. In normal operation, such changes are quite gradual and are corrected in the periodic recalibration of the instrument. However, concentrated detergent solutions may have a much more sudden effect. Concentrated anionic detergents can cause readings to be abruptly elevated or depressed; concentrated nonionic detergents generally depress readings. For this reason, concentrated detergent solutions should not be sampled. No problem has been observed from the naturally occurring detergency of specimens.

Endogenous and Exogenous Substances

YSI has tested hundreds of substances to determine whether they have any effect on the sensor system used in the YSI 2500.

The endogenous substances listed were found to be noninterfering at the highest naturally occurring levels. The column headed "Interfering Level" indicates the concentration at which each substance might be expected to cause an error of 1 mmol/l in the lactate reading, or 5 mg/dl in the glucose reading. Certain exogenous substances can interfere with measurements.

The YSI 2500 should not be used to analyze specimens containing any of these substances at or above the listed Interfering Level.

Physical Damage

Never inject concentrated mineral acids, concentrated bases, or strong organic solvents into the YSI 2500 as these may permanently damage the enzyme membranes or the plastic parts of the probe and sample chamber. Do not inject water-insoluble oils or greases, because it may be difficult to clear them from the sample chamber. Blood specimens with excessive content of fats are not a problem.

NOTE: Chlorpromazine, Iodoacetamide, Phloridzin and various mercurials have been reported to inhibit the transport of glucose through erthrocyte membranes in vitro, which could conceivably lead to erroneously low whole blood glucose readings by YSI methods. We have been unable to produce any error in our laboratory with reasonable levels of these materials, but it may nevertheless be prudent to determine glucose in plasma, rather than whole blood, for specimens in which these substances (or any other reported glucose transport inhibitors) are believed to be present.

Glucose Interference

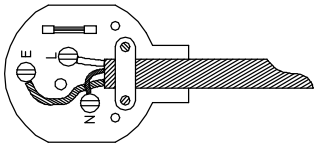
INTERFERING SUBSTANCE	FORMULA **WEIGHT**	INTERFERING LEVELS **FOR GLUCOSE** mg/dL	mmol/L
ANTICOAGULANTS:			
Sodium Oxalate	134.01	69000	5100
Sodium Fluoride	41.99	54000	13000
Heparin Sodium	---	1800U/ml	1800U/ml
Dipotassium EDTA	404.46	5200	129
Sodium Citrate	294.10	31000	1100
PRESERVATIVES:			
2-Iodoacetamide	184.96	900	49
Iodoacetic Acid	185.96	50000	2400
Sodium Iodoacetate,free of iodine and iodide	207.93	8000	385
Sodium Tetraborate Decahydrate	381.37	68000	1700
DO NOT USE:			
Benzalkonium Chloride	396.11	416	10.5
Methylparaben	152.15	691	45.4
Phenol	94.11	4.78	0.51
Sodium Azide	65.01	827	127
Thymol	150.22	54.9	3.66
SUBSTANCES OF PARTICULAR INTEREST IN DIABETES:			
Acetone	58.08	26000	4500
beta-Hydroxybutyric Acid	126.10	14000	1100
L-Leucine	131.20	21000	1600
Sorbitol	182.17	14000	770
Tolbutamide	270.34	2200	81
D-Xylose	150.13	730	49
RADIOPAQUES:			
Meglumine lodipamide	1335.02	25000	190
Meglumine lothalamate	809.13	29000	360
Renografine (Squibb)	mixture	22000	220 gm/1
Sodium Methioda	244.01	9000	370
ENDOGENOUS SUBSTANCES OF GENERAL INTEREST:			
D(-)Adrenaline	183.21	110	6.0
Ascorbic Acid	176.21	1000	57
Billirubin(dissolved in DMSO)	584.70	140	2.4
L(+)Cysteine Hydrochloride	256.63	100	3.9
D(-)Fructose	180.16	5400	300
d-Galactose	180.16	300	17
Gentisic Acid	154.12	110	7.1
D(+)Glucosamine Hydrochloride	215.64	280	13
Glucose 6-phosphate	336.32	3000	89
Glutathione, reduced	307.30	100	3.3
d-Mannose	180.17	170	9.4
Tyrosine	181.20	160	8.8
Uric Acid	168.11	170	9.9
LIPIDS AND RELATED SUBSTANCES:			
Cholesterol (in isopropanol)	386.66	2800	72
Cholesteryl Octanoate(in isopropanol)	512.86	8600	170
Cholic Acid	408.58	16000	390
Nonanoic Acid(in isopropanol)	158.23	2700	170
Octanol(inisopropanol)	130.23	500	38
Silicone Oil (SF-90)(50)(in isopropanol)	---	18000	180 gm/l
Tripalmitin (inisopropanol)	807.30	2100	26

INTERFERING SUBSTANCE	FORMULA **WEIGHT**	INTERFERING LEVELS **FOR GLUCOSE** mg/dL	mmol/L
DRUGS, POISONS, AND MISCELLANEOUS EXOGENOUS SUBSTANCES:			
Acetaminophen	151.16	564	37.3
Acetylsalicylic Acid	180.16	608	34.7
D-Allose	180.16	500	27.8
P-Aminosalicylic Acid	153.13	32.7	2.1
Catechol	110.11	0.3	.03
6-Chloro-Glucose	214.61	29.4	1.37
2-Deoxy-D-Galactose	164.16	500	30.5
2-Deoxy-D-Glucose	164.16	5.0	.31
6-Deoxy-D-glucose	164.16	6.9	.42
Dextran	2000.00	2000	.1
L-3, 4-Dihydro-phenylalanine	197.20	1400	71
2,3-Dimercapto-propanol	124.20	5	.40
Ethanol	46.07	8200	1800
Formaldehyde	30.03	42	14
D-Fructose	180.16	----	----
D-Galactose	180.16	62.5	3.47
Gentiobiose	342.20	250	7.31
D-Glucosamine	179.17	45.5	2.54
Guaiacol	124.14	12.5	1.01
Hydrazine Sulfate	130.12	28	2.15
Hydrogen Peroxide	34.01	0.2	0.05
Hydroquinone	110.11	3.7	0.3
Hydroxylamine Hydrochloride	69.49	0.3	0.04
D-Idose	180.16	167	9.27
Isoniazid	137.15	80	5.83
D-Mannosamine	179.17	125	6.98
Melibiose	342.20	250	7.31
2-Mercaptoethanol	78.13	0.8	0.1
Methylene Blue	373.9	370	9.9
3-0-Methylglucoside	194.18	250	12.9
D-Penicillamine	149.20	18600	1200
P-Phenylenediamine	108.14	1.0	.09
Potassium Cyanide	65.12	1600	250
Potassium Iodide	166.02	4400	260
Potassium Thiocyanate	97.18	36	3.7
Pyridoxine Hydro-chloride	205.70	5900	290
Salicylamide	137.14	62.6	4.56
Sodium Nitrite	69.01	78.7	11.4
Sodium Salicylate	160.10	6400	400
Sodium Sulfide Nonhydrate	240.18	0.4	0.02
D-Talose	180.16	500	27.8
2-Thiouracil	128.15	0.6	.04
Thiourea	76.12	1.4	0.18
o-Tolidine Dihydro-chloride	285.22	2800	97.4
o-Toluidine	107.16	8.3	0.78

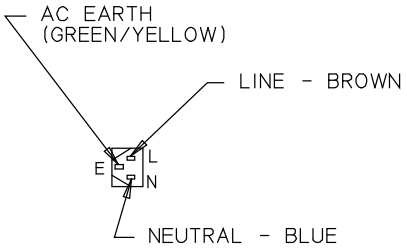
17 Appendix D – Line Power Cord and Plug Wiring

Make sure that the cord and plug are appropriate for the power output you intend to use.

United Kingdom



Make sure you use a plug to BS1363 and ASTA approval
Use Fuse 3A to BS1362 and ASTA approval



Green and yellow wire to E (Earth)

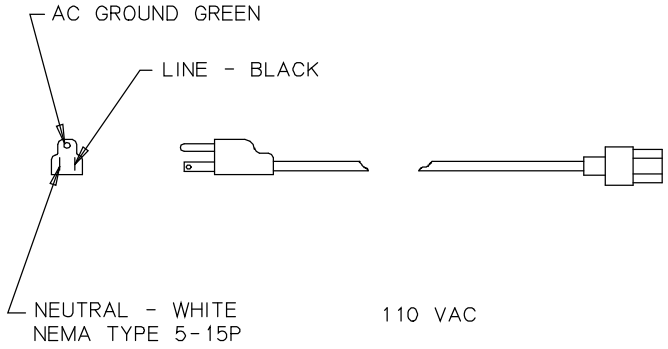
BROWN wire to BROWN or L (live)
BLUE wire to BLUE or N (neutral)

Before refitting the top cover of the plug or socket, make sure that the cable clamp is securely holding the outer sheath of the cable.

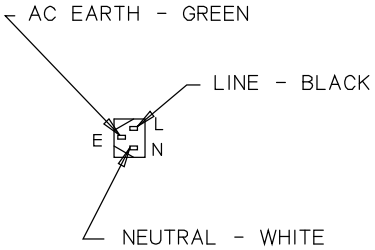
CEE TYPE 27
IEC TYPE 320

240 VAC

United States

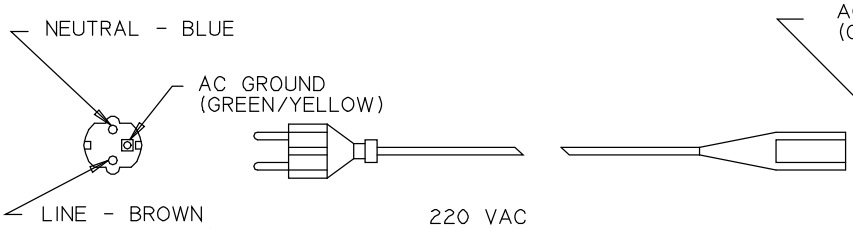


110 VAC

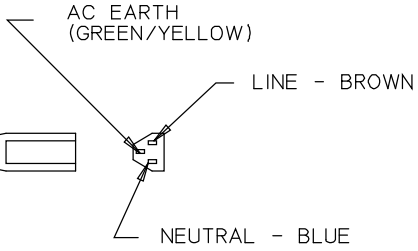


CEE TYPE 27
IEC TYPE 320

Europe



220 VAC



CEE TYPE 27
IEC TYPE 320

18 Appendix E - Reagents and Accessories

YSI Number	Description	Comments
2357	Buffer Kit (8 packs of Buffer Concentrate)	For use with Glucose and L-Lactate membranes.
2392	NaCl Solution	
2329	Lactate Membrane Kit	
2365	Glucose Membrane Kit	
1531	Glucose Standard (9.0 g/L)	
2356	Glucose Standard (500 mg/dL)	
2368	Glucose Standard (25 mmol/L)	
1530	L-Lactate Standard (2.67 g/L)	
2747	Dual Standard (1.80 g/L Glucose, 0.45 g/L L-Lactate)	Calibrator
2748	Dual Standard (18.0 g/L Glucose, 1.78 g/L L-Lactate)	
2776	Dual Standard (2.50 g/L Glucose, 0.50 g/L L-Lactate)	Calibrator
2777	Dual Standard (25.0 g/L Glucose, 2.50 g/L L-Lactate)	
2751	Printer Paper	5 rolls
2901	Printer	Includes power supply and data cable
2938	Bottle Rack, Single Module, Right Side	Includes bottles with caps and fluid detection cables
2941	R24 Capped Vial Tray	24 position
2942	P96 Flat Bottom 96 Well Plates	Case of 100
2943	P96 Round Bottom 96 Well Plates	Case of 100
2944	X-Pierce Films	
2945	R24 12mm Glass Vial Tray	
2947	R8 12mm Test Tube Rack	
2948	R4 16mm Test Tube Rack	
2588	Preventive Maintenance Kit, 2500	Tubing, Sipper, Stir Bar and O-rings for 6 month maintenance

Xylem |'zīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to www.xylem.com

xylem
Let's Solve Water

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