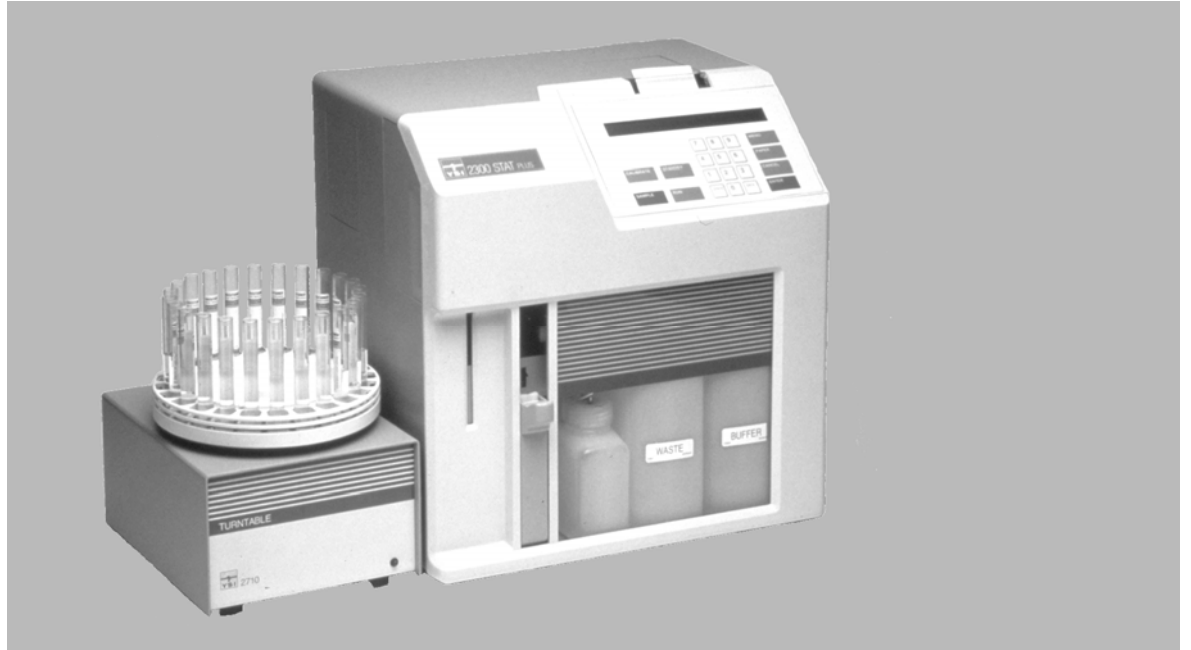




Y S I Life Sciences



User's Manual
YSI 2300 STAT PLUS
Glucose & L-Lactate Analyzer

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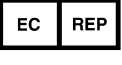






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1. Safety

1.1 Explanation of Symbols

	WARNING	Warning indicates that misuse of the instrument could result in death or serious injury to a person.
	CAUTION	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.
		Biological Risks
		Manufacturer
		Authorized Representative in the European Union
		In Vitro Diagnostic Medical Device
	2747	Catalog number
	03A6549	Lot number
	YEAR-MO	Date of manufacture
	YEAR-MO	Use by Date
		Temperature Limitation

1.2 Notes on Safety

Electrical Precautions

1. BEFORE connecting the power cord, check the line voltage selector and confirm that the selected voltage matches the local power supply (Section 3.5).
2. Use ONLY the line power cord supplied with the instrument. Connect the plug to a matching three-pronged wall receptacle.
3. Use ONLY fuses of the type supplied (Section 7.9). Replacement power cords and fuses can be obtained from YSI, or your Dealer Representative.
4. Do NOT use an extension cord without protective grounding.
5. Do NOT remove rear cover. There are no user serviceable parts inside.
6. Repairs are to be performed only by trained and approved personnel.
7. This instrument must be connected to a protectively grounded (earthed) outlet.
8. The following notices are provided in compliance with IEC1010 Part 1 1990.
 - 8.1 Fuses F1–F7 on the main circuit board are type: Subminiature (F) to UL 198G Standard. Rating: F1–F5, 1A; F6–F7, 2A. These fuses are NOT operator replaceable.
 - 8.2 See Appendix A for mains plug wiring and fusing instructions.
9. If the equipment is used in a manner not specified by YSI, the protection provided by the equipment may be impaired.



WARNING: For auxiliary connection, refer to section *10.2 Setup, Cable Connection*. Use with the YSI 2710 Turntable only.



WARNING: For remote connection, equipment should be EN 61010 or EN 60950 approved only.

10. 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.

2. Introduction

2.1 Description

The YSI 2300 STAT PLUS Glucose and Lactate Analyzer is a laboratory instrument intended for use in clinical care and sports medicine applications. It provides quick measurements of glucose in whole blood, plasma or serum; and of L-lactate in whole blood, plasma, or cerebrospinal fluid (CSF). In whole blood or plasma, glucose and L-lactate can be measured simultaneously.

Your YSI 2300 STAT PLUS may also be configured with the YSI 2710 Turntable. Refer to Section 10 for a description of this accessory.

2.2 Standard Features

- Microprocessor-control.
- Menu-driven setup with battery backed memory.
- Alpha-numeric liquid crystal display.
- Built-in data printer.
- RS-232 serial port installed.
- Turntable interface port installed.
- Complete diagnostic software.
- Automatic calibration.
- Programmable calibration protocol.
- Selectable performance modes.
- Selectable concentration units: mmol/L, mg/dL, mg/L.
- Direct measurement of glucose in whole blood, plasma and serum.
- Direct measurement of lactate in whole blood, plasma and CSF.
- Sample aspiration of only 25 microliters.
- Sample tube holder for "hands off" sampling.
- Manual sampling station for aspirating small volumes.
- Conversion of whole blood to plasma glucose values (user enters hematocrit value at keypad).

2.3 Specifications

Sample size:	25 microliters (aspirated volume)
Response Time (from Test Tube Holder station):	
Normal Mode:	Displayed/printed result in 65 seconds Sample to sample interval is 100 seconds
Screen Mode:	Displayed/printed result in 45 seconds Sample to sample interval is 70 seconds
Linear Range:	
Normal Mode:	
Glucose:	to 50.0 mmol/L (900 mg/dL or 9000 mg/L)
Lactate:	to 30.0 mmol/L (267 mg/dL or 2670 mg/L)
Screen Mode:	
Glucose:	to 27.8 mmol/L (500 mg/dL or 5000 mg/L)
Lactate:	to 15.0 mmol/L (134 mg/dL or 1335 mg/L)
Calibration point:	
Glucose:	10.0 mmol/L; 180 mg/dL; 1800 mg/L
Lactate:	5.00 mmol/L; 45 mg/dL; 445 mg/L
Enzyme membrane working life (typical):	
Glucose:	21 days (YSI 2365)
Lactate:	14 days (YSI 2329)
Precision:	
Glucose:	±2% of the reading or 2.5 mg/dL (25 mg/L, 0.2 mmol/L), whichever is larger
Lactate:	±2% of the reading or 0.1 mmol/L (1 mg/dL, 10 mg/L), whichever is larger
Resolution:	
Glucose:	1 mg/dL (1 mg/L, 0.1 mmol/L)
Lactate:	0.1 mmol/L (1 mg/L, 1 mg/dL)

NOTE: YSI makes no performance claims for sampling whole blood using the YSI 2710 Turntable.

Working environment:	
Ambient temperature:	15° to 35° Celsius
Relative humidity:	10% to 90% (noncondensing)
Power requirement:	110–120 VAC ¹ , 1A or 220–240 VAC, 0.5A 50–60 Hz 50 Watts nominal
Instrument dimensions:	25.4 x 35.6 x 35.6 centimeters 10.0 x 14.0 x 14.0 inches
Instrument weight:	11.4 kilograms 25 pounds
Regulatory Compliance:	CSA, CE, FDA Registered Class II (862.1345) Pollution degree 2 Installation Category 2 Altitude 2000m Indoor use only

¹ Mains supply voltage fluctuations not to exceed ±10% of nominal supply voltage.

2.4 How To Use This Manual

This manual is organized in such a way as to give you the quickest possible start in operating the instrument. However, it cannot be stressed too strongly that informed and safe operation is more than just a matter of knowing which buttons to push. An understanding of the principles of operation and potential chemical interferences is necessary for the wisest interpretation of results. Thorough precautions regarding the handling of biological samples are also essential for the safety of operators and patients.

The early parts of this manual will teach you how to get the instrument running. Additional topics are included to help you understand the science it employs, how to use it most effectively and safely, and how to keep it operating correctly.

Later sections of the manual include instructions for operation and maintenance of the optional YSI 2710 Turntable.

3. Initial Setup

We recommend that your dealer representative or YSI regional representative assist with initial setup and orientation. YSI warranty and product performance claims, however, are not dependent upon installation by factory or dealer personnel.

3.1 Unpacking

Remove the instrument from the shipping container and inspect all assemblies and components for damage. In the event of damaged or missing parts, contact YSI Customer Service or your Dealer Representative immediately.

Note that reagents for the 2300 STAT PLUS Analyzer are not packaged in the same carton as the instrument. These materials must be ordered separately as starter supplies and will arrive in a separate package.

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

If you ordered the 2300 STAT PLUS with the 2710 Turntable, first set up the 2300 STAT PLUS. Once the 2300 STAT PLUS is operating properly, refer to Section *10 Turntable Operation and Maintenance*.

3.2 Major Component Identification

Referring to Figure 3.1 and Figure 3.3, read through the following descriptions and familiarize yourself with the major components.

NOTE: In maintenance kits, service manuals and part lists the "Sipper" may be referred to as the Sipper Needle or Sipper Tube.

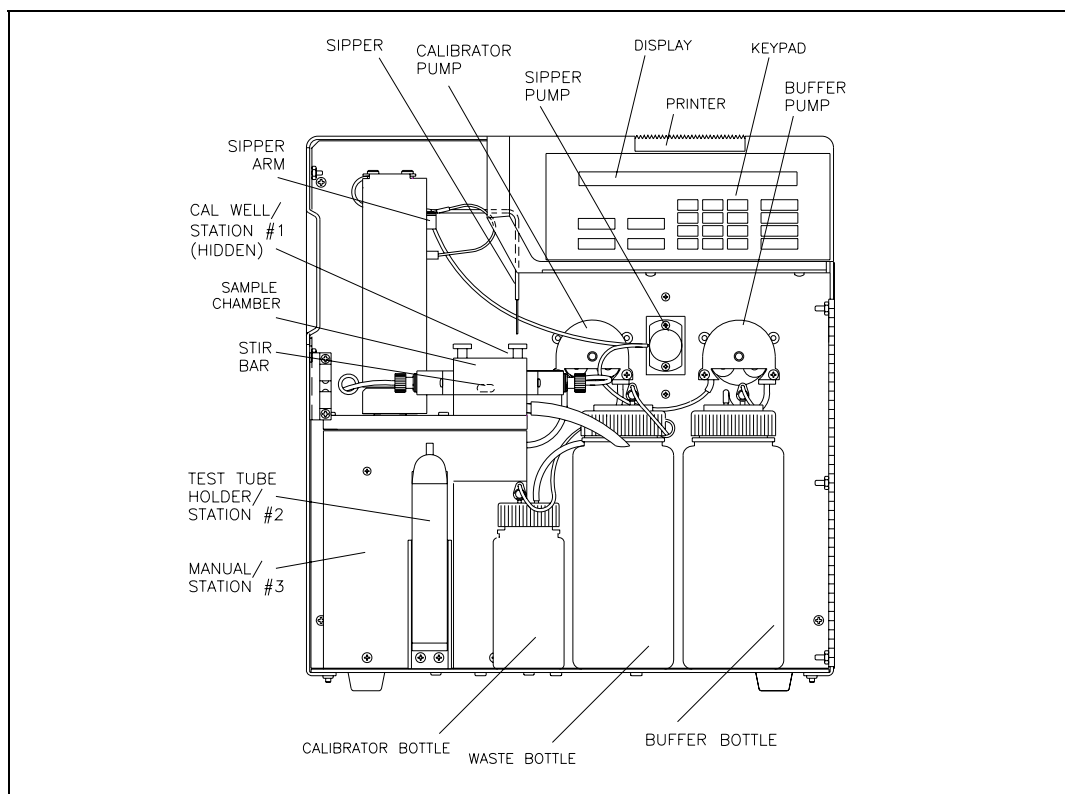


Figure 3.1
Inside Front View of the 2300 STAT PLUS

The **Buffer Pump** draws buffer from its bottle, pumps it through the Sipper Pump body and the Sipper, and flushes the Sample Chamber.

The **Calibrator Pump** draws the appropriate standard solution from the Calibrator Bottle and fills the Calibrator Well in the Sample Block.

The **Sipper Pump** retracts its piston to draw in standard from the Calibrator Well or sample from a tube or container. It extends its piston to dispense standard or sample into the Sample Chamber.

The **Sipper Arm** is raised or lowered by one motor, and moved horizontally to its various positions by another motor. The positions are: Calibrator Well (Station #1), Sample Chamber ("home"), Test Tube Holder Station (Station #2), Manual Station (Station #3), and Turntable Station (Station #4). The Sipper capacitively senses fluid to control immersion depth and detect errors.

The **Stir Bar** is a plastic encapsulated magnet. It is activated by a motor housed below the Sample Chamber. It provides thorough mixing inside the chamber.

The **Buffer, Waste and Calibrator Bottles** are visible through the front door window for easy monitoring of fluid levels. A stainless steel shaft projecting into each bottle terminates with a connector on the lid, providing a signal used to halt operations when the Buffer or Calibrator Bottles are empty, or when the Waste bottle is full.

The **Sample Chamber** is made of clear acrylic plastic. White and black holders for the sensor probes are screwed to either side. The immobilized enzyme membranes on the sensor probes are mounted on O-rings which act as fluid seals on each side of the Sample Chamber. A reference or auxiliary electrode is housed in the temperature probe and positioned at the back of

the Sample Chamber. It is held in place by a retainer that threads directly into the Sample Block. A small black O-ring slips over the temperature probe/electrode to provide the seal. The Calibrator Well is located behind and to the right of the Sample Chamber entry port.

The **Test Tube Holder** pivots out to allow insertion or removal of several common size test tubes.

The **Display** is a 2 line by 40 character liquid crystal display.

The **Printer** provides a hard copy record of sample results, calibration currents and errors. It uses 56 mm (2 1/4 inch) wide thermal paper.

The **Keypad** is a 20 key membrane switch. It has 0–9 numeric keys, SPACE and BACK keys and 8 function keys.

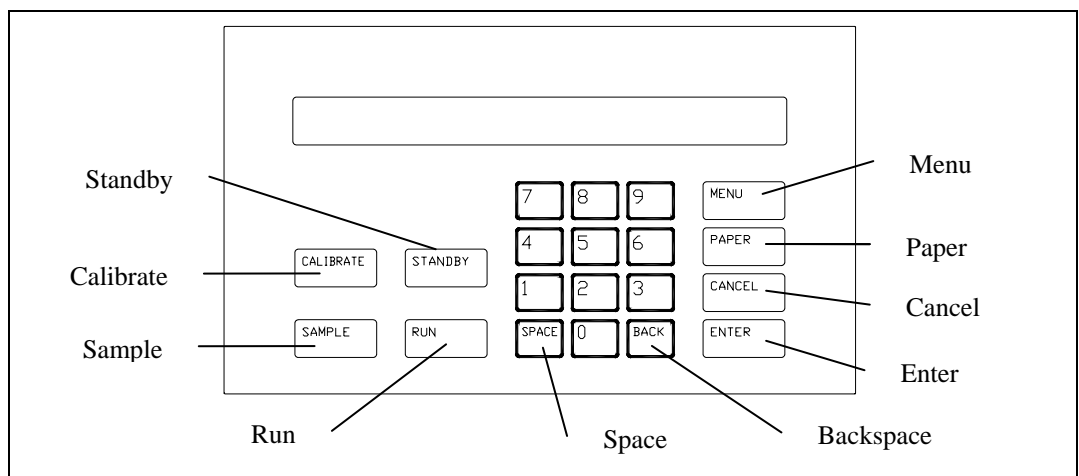


Figure 3.2
2300 Stat Plus Keypad

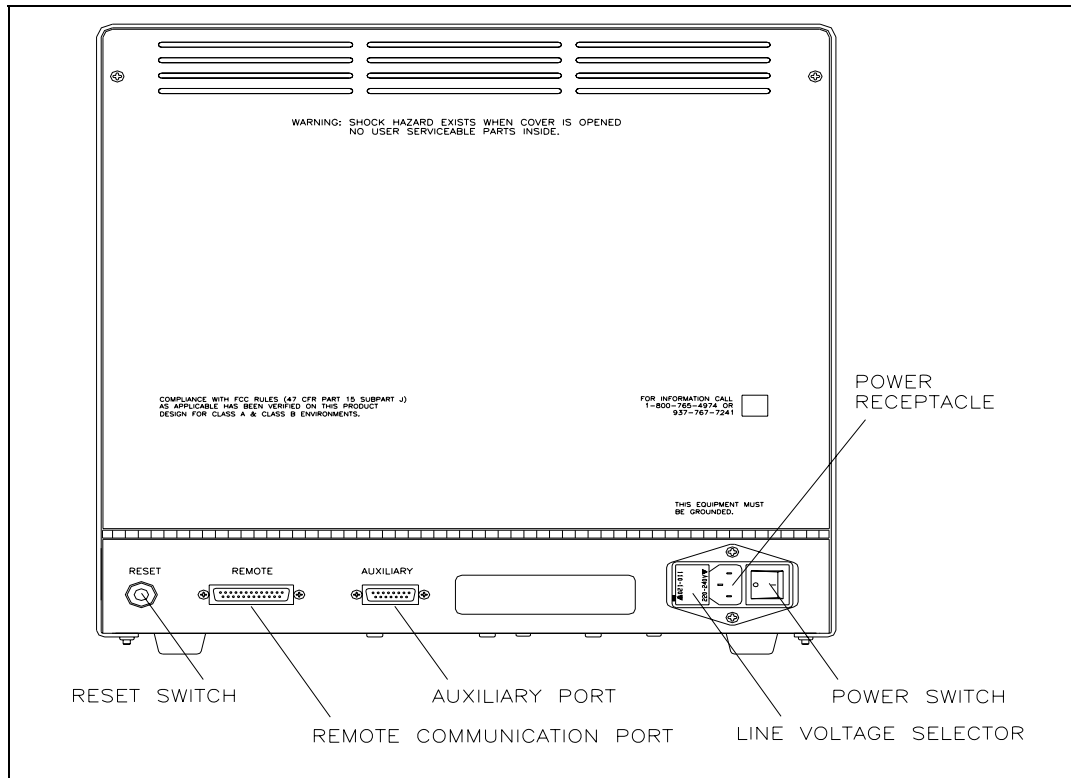


Figure 3.3
Back View of the 2300 STAT PLUS

The **Reset Switch** is located on the back of the instrument. It is used to hard reset the operating system.

The **Remote Communication Port** is an RS-232 serial port. It is used to interface with host computers or other laboratory instruments.

The **Auxiliary Port** is used to interface with the YSI 2710 Turntable.

The **Line Voltage Selector** selects either 110–120 or 220–240 volt operation. It houses the fuses and pulls out of the case for fuse replacement.

The **Power Receptacle** is a power inlet. The power cord plugs into it and an electrical outlet.

The **Power Switch** is an on/off toggle switch (0-off and I-on). It is located on the back of the instrument.

3.3 Reagent Preparation

Prepare the supply buffer and fill the buffer bottle. YSI 2357 buffer is included in the starter supplies. YSI 2357 is recommended for use with all YSI Enzyme Membranes unless otherwise stated.

- » Place about 500 mL of reagent water (distilled and/or deionized) into a one liter flask, or other clean container. Add two packages of YSI 2357 Buffer Concentrate and stir.
- » If cell lysing is desired (See Appendix K.), add two packets of YSI 1515 Cell Lysing Agent.
- » Add more reagent water until the total volume of solution is between 900 and 1000 mL.
- » Stir as necessary, until the buffer chemicals have completely dissolved.
- » Disconnect the electrical lead from the level sensor and remove the bottle lid.

IMPORTANT: When adding fresh buffer to the Buffer Supply Bottle or when installing a new bottle of Calibrator Solution, make every effort to avoid contamination of the lid and level sensor assemblies.

- » Pour the prepared buffer into the supply bottle, replace the lid, and reconnect the lead.

Next install the bottle of calibrator solution. This must be YSI 2747 Standard containing D-glucose (dextrose) and L-lactate.

- » Unplug the electrical lead from the level sensor in the lid of the empty calibrator bottle and remove the lid.
- » Mark the date of installation on the new bottle of YSI calibrator solution.
- » Screw the lid and level sensor assembly onto the new bottle and place it in the instrument compartment. Reconnect the electrical lead.

IMPORTANT: The level sensor cables should not touch the instrument housing. It is best to keep the cable connector on the bottle lid pointed toward the front. False messages concerning fluid levels may result if the bottles are not installed inside the fluid compartment and the cables routed as shown in Figure 3.4.

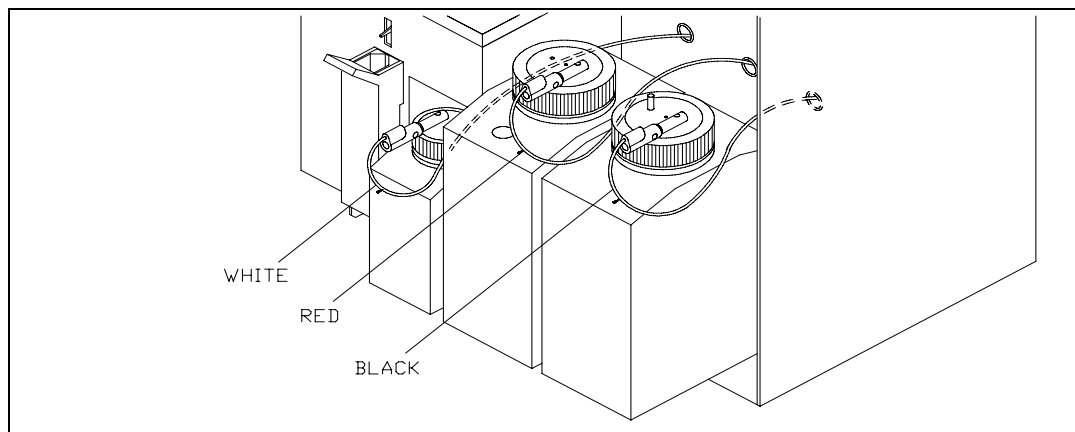


Figure 3.4
Bottles and Level Sensor Cables

3.4 Enzyme Membrane Installation

Each active probe installed in your instrument is fitted with a protective "shipping membrane" which must be removed and replaced with a new membrane from the starter supplies.

The Sample Chamber is color coded to assist you in membrane installation and setup (see Figure 3.5). The left side of the chamber has a black probe housing, and the right side has a white probe housing. (Throughout this manual, whenever we refer to the "black" or "white" probe, the reference is to the "black" or the "white" side of the sample chamber.)

One or more packs of YSI Immobilized Enzyme Membranes is provided in the starter supplies. Each pack contains four membranes. Enzyme Membrane O-rings are color-coded for each type of chemistry. For dual channel configurations it is important that you note which probe, black or white, you use to install specific membranes. It will be necessary to assign chemistry to probe during instrument parameter programming.

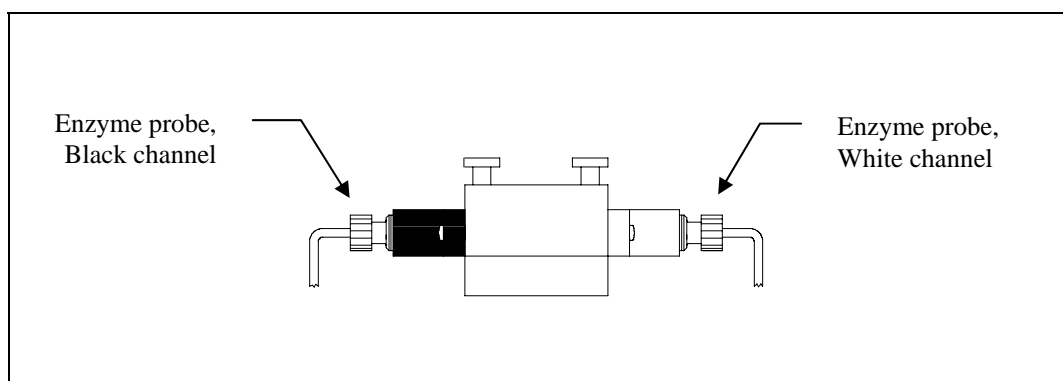


Figure 3.5
Sample Chamber/Sensors

To install a membrane, first unscrew the appropriate probe retainer and gently pull the probe out of the block. Remove the existing O-ring membrane assembly from the end of the probe. A toothpick or pointed tool may be needed to unseat the old membrane. Be careful not to scratch the probe face.

Examine the probe surface and remove any pieces of membrane that remained. Open a cavity of the plastic membrane holder and rinse the membrane inside with a few drops of salt solution (YSI 2392 or equivalent). Place one drop of salt solution on the probe face. Using the plastic membrane holder, press the O-ring membrane assembly gently onto the probe face (Figure 3.6). Wipe excess salt solution from the probe body, then return the probe to the sample chamber. Finger tighten the probe retainer so that the O-ring seals the probe in place. Repeat this procedure for the second probe.

Return the membrane holder to the foil pouch and refrigerate it. Note the expiration date on the membrane package. It is advisable 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 (see Section 1.2).

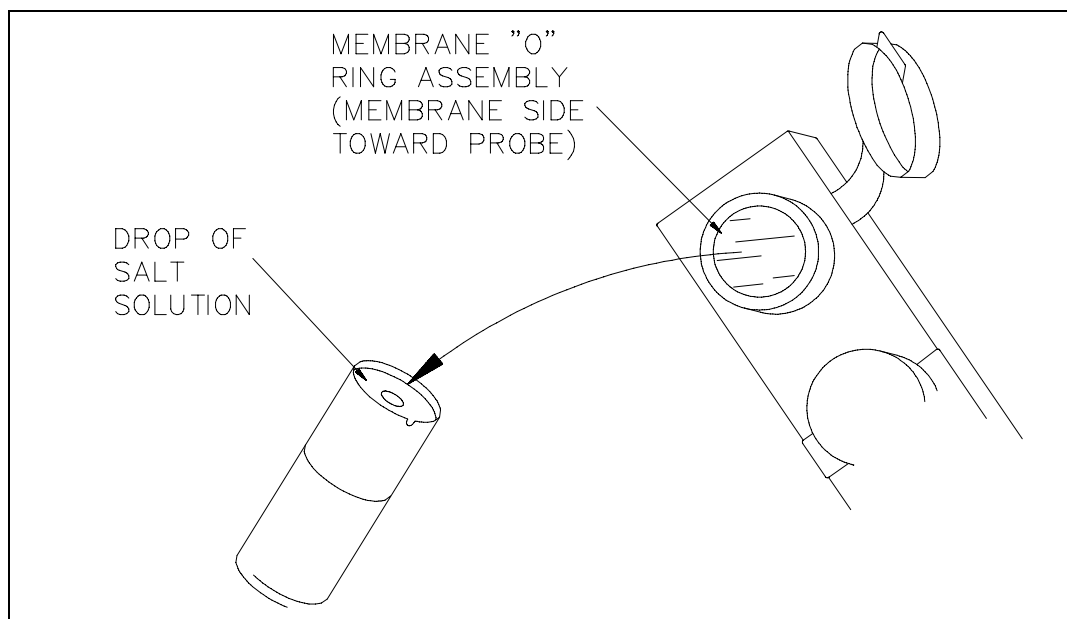


Figure 3.6
Enzyme Membrane Installation

3.5 Power Up Procedures

BEFORE YOU PLUG IN THE POWER CORD, inspect the Line voltage selector on the back of the instrument (See Figure 3.7). Be certain the correct voltage is selected. The arrowhead on the power selector must be pointing to the small rectangle on the housing, as shown.

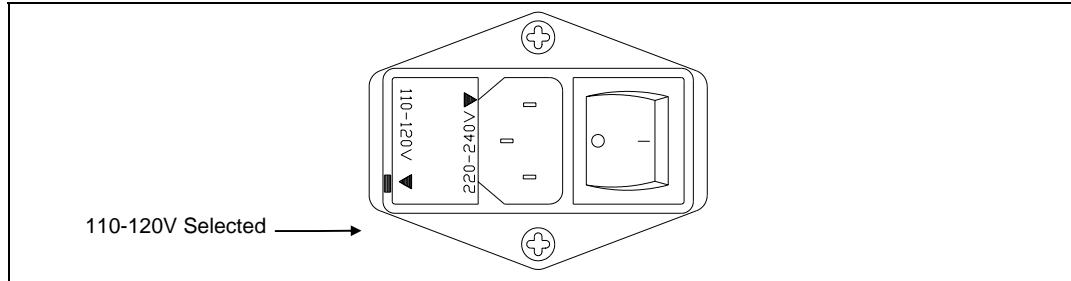


Figure 3.7
Line Voltage Selector

If the voltage selection is incorrect, review Section 7.9 for correct voltage selection and fuse requirements or contact YSI Customer Service or your Dealer Representative.

If the voltage selection is correct, plug in the unit using the power cord packaged with the instrument.

Set the power switch to ON. (0-off and I-on).

Correct Power-up operation is confirmed by observing **either** of the following displays:

Main Menu Display

Please select instrument mode:
[RUN] [STANDBY] [MENU]

Default Parameters Display

***Warning: instrument parameters have
been set to default. Press any key to set up.

The instrument will normally arrive with parameters, including date and time, set from the factory. However, if the backup rechargeable batteries have run down, you will see the Default Parameters message. This message will also appear if you ever need to change batteries in the future.

If you see the Default Parameter message, press any key to access the Setup Menu, then press [MENU] to return to Main Menu as displayed above. Specific instructions to set date, time, and other parameters are described below.

If the Main Menu Display does not appear immediately or after you have tried the procedures above, reset the instrument by pressing the **reset** switch on the back panel or by turning the power off, waiting about 20 seconds, then turning the power back on.

3.6 Fluid System Priming

Since it may take an hour or more to initially stabilize the probes when setting up for the first time, now is a good time to prime the fluid system. You have already reconstituted the appropriate buffer and transferred it to the Buffer Bottle. You have also installed the appropriate calibrator solution and installed the appropriate Enzyme Membrane(s) in the Sample Chamber.

With the Main Menu displayed (see below), press [MENU], then press [1] for Service.

Please select instrument mode
[RUN] [STANDBY] [MENU]

Select instrument function
1-Service 2-Setup 3-Diagnostic

Select service: 1-Sipper 2-Buffer 3-Cal
4-Stir speed 5-Turntable

You are now ready to align the Sipper, prime the fluid pumps and adjust the stirring. Since the adjustments were made prior to shipment, this procedure will likely be just a check. You should ignore all reference to "Turntable" in the displayed menus. Turntable setup, if required, is described in Section 10.

IMPORTANT: The front door must remain open to carry out this procedure.



WARNING: Keep hands clear of the sipper arm and sipper while the instrument is in operation. Service the sipper only when the instrument is in the service mode, not in the run mode or standby mode.

To make certain the Sipper Arm and attached Sipper are correctly aligned, follow the instructions below.

Press [1] for Sipper. The Sipper Arm will move to the "home" position. The tip of the Sipper should be centered over the large hole on the top of the Sample Chamber (see Figure 3.8). If necessary, loosen the adjustment screw and position the Sipper. The adjustment tool (hex key) is included in the preventive maintenance kit that is packed with your instrument. Retighten the adjustment screw.

Adjust sipper then select
0-Exit 1-Lower sipper for fine alignment

Press [1] for Lower sipper for fine alignment. The Sipper will move closer to the small opening in the stainless steel cone.

Fine align sipper then select
0-Exit 1-Test sipper position

The tip of the Sipper should be exactly centered above this opening. If necessary, loosen the adjustment screw again and position the Sipper exactly. Retighten the adjustment screw.

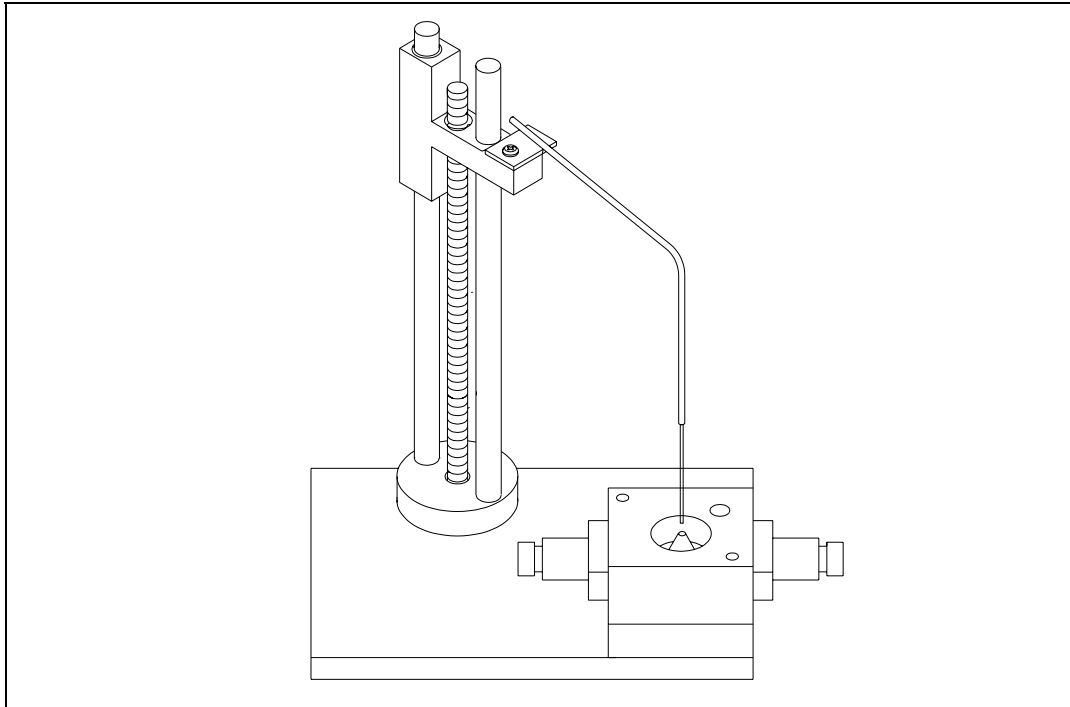


Figure 3.8
Sipper Adjustment Position

Press [1] for Test Sipper position. The Sipper will descend into the Sample Chamber. The Sipper should not contact the stainless steel cone. If the Sipper position is still not exactly right, press [1] and readjust it once more, as described above. **IT IS VERY IMPORTANT THAT THE SIPPER BE ACCURATELY ADJUSTED.**

Select 1 to restart check sipper cycle
0-Exit 1-Home sipper position

After adjustment is complete, press [0] to exit and return to the Select Service menu level.

Select service: 1-Sipper 2-Buffer 3-Cal
4-Stir speed 5-Turntable

Press [2] for Buffer. The Sipper will enter the Sample Chamber and the Buffer Pump will begin to prime the fluid system with buffer solution. The fluid system is completely primed when buffer flows from the steel cone at the top of the sample chamber. Press [2] again, if necessary.

Select service: 1-Sipper 2-Buffer 3-Cal
4-Stir speed 5-Turntable

Press [3] for Cal. The Calibrator Pump will begin to pump calibrator through the calibrator line into the Calibrator Well in the Sample Chamber. If necessary, press [3] again until calibrator flows out of the tube in the cal well.

Select service: 1-Sipper 2-Buffer 3-Cal
4-Stir speed 5-Turntable

Press [4] for Stir Speed. The menu message shown below will appear. The stir bar has two operating speeds; normal speed, at which the stir bar rotates smoothly in the chamber, and accelerated speed, at which the stir bar loses synchronization with the motor housed below, and jumps. This jumping action helps clear the Sample Chamber of air bubbles during a flush cycle.

Adjust until stir bar jumps
1-Increase speed 2-Decrease speed

Adjust the speed until the stir bar jumps or is set to maximum. Next press [0] to return to the Select service menu level.

Select service: 1-Sipper 2-Buffer 3-Cal
4-Stir speed 5-Turntable



CAUTION! Do not enter the 5-turntable submenu unless the turntable is installed and the left access plate is removed. You may seriously damage the sipper arm assembly.

When all adjustments are complete, press [MENU] to return to Main Menu level.

Please select instrument mode
[RUN] [STANDBY] [MENU]

3.7 Printer Paper Installation

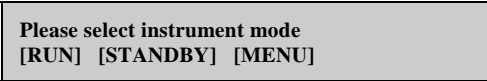
Open the paper cover on top of the instrument. Insert the loose end of the paper into the slot on the printer. The outermost side of the paper on the roll should be facing down. Press [PAPER] to advance the paper through the printer.

3.8 Instrument Parameter Programming

The 2300 STAT PLUS setup is menu driven. Once set up, the system parameters are maintained in memory. In the event of power loss, the 2300 STAT PLUS has a battery backup to maintain its memory. Follow the procedure below to program your instrument parameters.

IMPORTANT: You move through the 2300 STAT PLUS menus by selecting options on the display. Refer to Figure 5.1 for an overview of the menu structure. You can press the MENU key to get back to the Main Menu, and the 0 key to back up to the previous display. However, it may be necessary to confirm a response by pressing [ENTER] before continuing to use the MENU or 0 keys.

The Main Menu display is shown below.



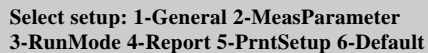
Please select instrument mode
[RUN] [STANDBY] [MENU]

From the Main Menu, press [MENU]. The following display will appear:



Select instrument function
1-Service 2-Setup 3-Diagnostic

Press [2] for Setup. The instrument now displays 6 categories as shown below.



Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default

During normal operation you will seldom need to enter the Menu Mode, but it is important to familiarize yourself with the menu locations of the various parameters over which you have control. See Section 5.3 for complete details of menu options.

Press [5] for PrntSetup. The data printer will print the instrument setup parameters. This will take less than a minute and use approximately 18 centimeters (7 inches) of printer paper. The hard copy of the current parameters setup should help you as you work through this menu.

Each category of the Setup Menu is briefly described below. For now, study the Setup categories. A step-by-step set of instructions that leads you through an example setup will follow.

Press [1] for General. The display will read:

General setup: 1-Date/Time 2-Contrast
3-RS-232 4-Radix 5-Serial# 6-Level 7-Beep

1-General. In this menu you may confirm or change the date, set date format, adjust the display contrast, define communication parameters, select the radix to express decimal numbers, confirm or enter the instrument serial number and select whether to deactivate the bottle level sensor system.

Press [0] to back up, then press [2] for MeasParameter. The display will read:

Measurement parameter setup
1-Mode 2-Black 3-White

2-MeasParameter. "MeasParameter" is an abbreviation for measurement parameters. From this menu you will choose the performance mode in which you prefer to operate. You will also confirm or change two specific parameters dealing with the black and white probes. These parameters are chemistry assignment and units of concentration.



WARNING: It is essential that probe chemistry assignments be made correctly. An incorrect probe assignment can result in patient misdiagnosis. In Section 4.4 Daily Operational Checks, you will see that incorrect probe assignments can be detected by checking linearity using the appropriate YSI linearity check standards.

NOTE: YSI has assigned default values for each of these parameters, but provides the flexibility for the user to change some measurement parameters. **During initial setup, YSI recommends that you use the default settings for the chemistries you choose.**

Press [0] to back up, then press [3] for RunMode. The display will read:

RUN mode setup: 1-SampleProtocol
2-AutoStandby 3-AutoCal

3-RunMode. In this menu you select parameters related to sampling protocol, set parameters that control automatic switching to standby mode, and select parameters that will trigger auto-calibrations. In Sample Protocol, you can select the sample station (position), activate multi-sampling and sample identification systems, set the position to which the Sipper descends when sampling at the Manual Station, and set turntable parameters, if appropriate.

Press [0] to back up, then press [4] for Report. The display will read:

Select sample report format: Brief
1-None 2-Brief 3-Detail

4-Report. In this menu you select the level of detail you desire for the printed sample and calibration reports. You probably would reserve detail reporting for troubleshooting a suspected problem. Press [ENTER] to confirm brief sample report format.

Select cal report format: Brief
1-None 2-Brief 3-Detail

Press [ENTER] again to confirm brief cal report format.

Press [5] for PrntSetup. The display will read:

Printing instrument setup... Please wait

5-PrntSetup. This is an abbreviation for "print setup". Once you have selected your setup parameters, you may record these choices by printing them on the data printer. You have already been instructed to print this to learn about the 2300 STAT PLUS menu.

Press [6] for Default. The display will read:

Reset all system parameters? No
1-No 2-Yes

6-Default. In this menu you have the option to reset all default parameters, i.e., those set in the software to serve your needs for all standard applications. Using this command also requires that you reset date, time, and all other general parameters. Press [ENTER] to confirm "No" and return to Select Setup menu.

Now press [MENU] to return to Main Menu display:

Please select instrument mode
[RUN] [STANDBY] [MENU]

3.9 Initial Setup Example: Step-By-Step

Next we will show a step-by-step instrument programming procedure to illustrate the flexibility you have with the 2300 STAT PLUS. For illustration purposes, we will demonstrate initial setup for simultaneous determination of glucose and L-lactate on a dual channel 2300 STAT PLUS.

Follow along by pressing keys on your 2300 STAT PLUS. This exercise should be a good learning tool if you are unfamiliar with the instrument.

EXAMPLE: Set up the YSI 2300 STAT PLUS to measure D-glucose (dextrose) and L-lactate, simultaneously in the "normal" performance mode. Let us assume you have installed a YSI 2329 Lactate Membrane on the black probe and a YSI 2365 Glucose Membrane on the white probe. YSI 2357 buffer has been reconstituted and poured into the Buffer Bottle and YSI 2747 Standard (1.80 g/L = 10.0 mmol/L glucose and 0.45 g/L = 5.00 mmol/L L-lactate) has been installed into the Calibrator Bottle position. The instrument has been powered and the printer paper installed.

Let us also assume that you have your sample in a test tube and want to program the unit to run the sample three times in succession (triplicate). You would also like to identify the sample by an identification number to be printed with the result. To conserve printer paper you would like the "brief" report version of sample and calibration results. As recommended for Initial Setup, you will use all default measurement parameters.

In Section 3.8 you became familiar with the 6 categories in the Setup Menu, and you were last instructed to press MENU to display Main Menu. This is the level in the menu where we want to start.

At this time you may want to refer to Figure 5.2, Menu Flow Chart.

Main Menu:

Please select instrument mode
[RUN] [STANDBY] [MENU]

Press [MENU].

Select instrument function
1-Service 2-Setup 3-Diagnostic

Press [2] for Setup.

Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default

Press [1] for General.

**General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-Level 7-Beep**

Press [1] for Date/Time. Use the number keys to change entries. Press [ENTER] to confirm each entry.

**Enter date and time as required
Year> 03**

Enter year.

**Enter date and time as required
Month> 2**

Enter month.

**Enter date and time as required
Date> 14**

Enter day.

**Enter date and time as required
Hour> 17**

Enter hour.

**Enter date and time as required
Minute> 22**

Enter minute.

**Select date format: MM/DD/YY
1-MM/DD/YY 2-DD/MM/YY**

Select and/or confirm the format you desire for printed dates: (month/day/year);
(day/month/year).

With the entry of the date format you will return to the previous menu level, General setup.

**General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-Level 7-Beep**

Press [2] for Contrast.

**Adjust the display contrast
1-Raise contrast 2-Lower contrast**

Use the appropriate number key to adjust the LC display contrast for comfortable viewing. When finished, press [0] to return to General setup.

**General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-Level 7-Beep**

Press [3] for RS-232.

**RS-232 setup
1-Baud 2-DataLength 3-Parity 4-Handshake**

This menu is used to set communication parameters. Press [0] to return to General setup or explore these parameters, remembering to press [ENTER] to move through each choice and back to RS-232 setup.

**General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-Level 7-Beep**

Press [4] for Radix.

**Select radix mark: "."
1-" ." 2-" , "**

In some parts of the world a "," is preferred to express decimal numbers. Example, 2.00 = 2,00. Confirm your choice by pressing [ENTER] to return to the General setup.

**General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-Level 7-Beep**

Press [5] for Serial#.

Enter instrument serial number
03 01234

The serial # of your instrument is recorded on the serial plate, lower rear of case. You will find it helpful to record this number in memory. It will be printed in the detailed report format and will be very useful if technical assistance or repair is required. Since YSI uses alpha-characters in the serial #, we recommend that you use a space for these characters. Example: 03B01234AB can be entered as 03 01234.

You will find the number in memory since it is entered prior to shipment and should be preserved by battery backup. Press [ENTER] to confirm and return to General setup.

General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-Level 7-Beep

Press [6] for LevelSensor.

Activate bottle level sensors? Yes
1-No 2-Yes

Choosing Yes maintains level sensing in the Buffer, Calibrator, and Waste bottles. Press [ENTER] to return to General setup.

General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-Level 7-Beep

Press [7] for "Beep".

Activate keyboard annunciator? Yes
1-No 2-Yes

Press [1] for No if you prefer to turn off the audible signal for keypad confirmation. After your choice, press [ENTER] to return to Select setup menu level.

You have now completed General setup. Press [0] to return to Select setup menu level.

Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default

Press [2] for MeasParameter.

Measurement parameter setup
1-Mode 2-Black 3-White

Press [1] for Mode. You use this menu to choose one of two instrument performance modes. You may refer to Sections 2 and 11 for descriptions of the basic differences between these modes. Basically, the difference between Normal and Screen mode is that Screen mode provides a faster response (result) and faster cycle time. The compromise for quickness may be linear range, precision and accuracy. Refer to Section 11 for Typical Performance Data.

Select performance mode: Normal
1-Normal 2-Screen

Press [ENTER] to confirm Normal mode.

Press [2] for Black. At this level you will choose chemistry and other black probe measurement parameters.

Select BLACK chemistry: L-Lactate
0-Backup 1-Next chemistry [ENTER]-Accept

Press [1] for Next chemistry. Use this key to scroll through the choices in the menu (glucose, L-lactate, none). For our example, choose L-Lactate, then press [ENTER] to confirm and move on to the next parameter.

Select BLACK unit of measurement: mmol/L
1-mmol/L 2-mg/L (ppm) 3-mg/dL

Press the appropriate number to change the default setting, if necessary.

NOTE: If you choose a concentration unit other than mmol/L, the value automatically changes. That is, 5.00 mmol/L becomes 450 mg/L or 45 mg/dL.

When the desired unit of measurement is selected, press [ENTER] to confirm and return to the Measurement parameter menu.

Measurement parameter setup
1-Mode 2-Black 3-White

Press [3] for White. Now set the same parameters for the White probe that you set for the Black probe.

Select WHITE chemistry: Glucose
0-Backup 1-Next chemistry [ENTER]-Accept

Press [ENTER] to confirm.

Select WHITE unit of measurement: mmol/L
1-mmol/L 2-mg/L (ppm) 3-mg/dL

Press [ENTER] to confirm. The display now shows Measurement parameter setup.

Measurement parameter setup
1-Mode 2-Black 3-White

Press [0] to return to the Select setup level.

Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default

Press [3] for RunMode.

RUN mode setup: 1-SampleProtocol
2-AutoStandby 3-AutoCal

Press [1] for SampleProtocol.

Sampling protocol setup: 1-SipperHeight
2-Multi 3-ID 4-Station# 5-TTable 6-Hct

Press [1] for SipperHeight.

Select manual sipper height: Medium
1-Low 2-Medium 3-High

This specifies to what vertical position the Sipper descends when sampling at the Manual Station. For example, with long test tubes and the fluid level near the bottom of the test tube, use "Low" setting. For now choose Medium level, then press [ENTER] to confirm and return to Sampling protocol setup.

Sampling protocol setup: 1-SipperHeight
2-Multi 3-ID 4-Station# 5-TTable 6-Hct

Press [2] for Multi.

Prompt multiple cycle? No
1-No 2-Yes

Since our example setup requests triplicate analysis of the sample, we must activate multiple cycle. Press [2].

Prompt multiple cycle? Yes
1-No 2-Yes

Press [ENTER] to confirm and return to Sampling protocol setup.

Sampling protocol setup: 1-SipperHeight
2-Multi 3-ID 4-Station# 5-TTable 6-Hct

Press [3] for ID.

Prompt sample ID? No
1-No 2-Yes

Again, our example setup requests that we use sample identification. Press [2].

Prompt sample ID? Yes
1-No 2-Yes

Press [ENTER] to confirm and return to Sampling protocol setup.

Sampling protocol setup: 1-SipperHeight
2-Multi 3-ID 4-Station# 5-TTable 6-Hct

Press [4] for Station#.

Enter Sample Station #
> 2

The default station is Station #2 which is where our test tube will be held. Press [ENTER] to confirm and return to Sampling protocol setup.

Sampling protocol setup: 1-SipperHeight
2-Multi 3-ID 4-Station# 5-TTable 6-Hct

Press [0] to return to Run mode setup.

RUN mode setup: 1-SampleProtocol
2-AutoStandby 3-AutoCal

Press [2] for AutoStandby.

Enter autostandby time in hour
0 to disable 4

This entry defines the number of hours the unit will continue to update calibration and be ready to sample. The default setting is "4". Note that you would press [0], then [ENTER] to disable autostandby which maintains the unit in a "sample ready" mode indefinitely. For now, press [ENTER] to confirm four hour autostandby and return to the Run mode setup.

RUN mode setup: 1-SampleProtocol
2-AutoStandby 3-AutoCal

Press [3] for AutoCal.

Autocal setup:
1-Time 2-Sample

The two parameters in this menu level can be used to alter the conditions which trigger autocalibrations. The maximum time between autocalibrations is 240 minutes. The maximum number of samples is 200, or you may enter [0] to disable sample as a parameter. For now, simply explore each menu parameter.

Before you exit this menu level, return settings to the default values:

Time between autocal = 15 minutes
Number of samples between autocal = 5



WARNING: When using autocalibration parameters other than values described in section 11 of this manual, the precision claims may be compromised. It is your responsibility as a user to verify performance through appropriate quality assurance testing.

Press [ENTER] to confirm the default settings and return to the Autocal setup.

Autocal setup:
1-Time 2-Sample

When you have completed this level, press [0] to return to Run mode setup.

**RUN mode setup: 1-SampleProtocol
2-AutoStandby 3-AutoCal**

Press [0] again to return to Select setup.

**Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default**

Press [4] for Report.

**Select sample report format: Brief
1-None 2-Brief 3-Detail**

The default setting is "brief" report. Press [ENTER] to choose brief Sample report, then press [ENTER] again to choose brief Cal report. See Appendix J for example printouts of each type of report.

**Select cal report format: Brief
1-None 2-Brief 3-Detail**

The Select setup menu is again displayed.

**Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default**

Press [5] for PrntSetup.

Printing instrument setup... Please wait

The instrument will print the setup information. The information is an itemized list of the key parameters that you have entered into memory for running the 2300 STAT PLUS. See Appendix I for an example of this report.

When finished, the display again shows the Select setup menu.

**Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default**

Press [6] for Default.

**Reset all system parameters? No
1-No 2-Yes**

This menu allows you to reset all system parameters to the default settings, that is, those that would appear if you were to unpower the instrument (including backup battery power). **Do not select 1-Yes now.** Instead, press [ENTER] to confirm "No" to resetting system parameters. The instrument will return to the Select setup menu.

Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default

YOU HAVE NOW COMPLETED THE INITIAL SETUP EXAMPLE.

As you learn more about the 2300 STAT PLUS you will gain greater familiarity with the menu system. If you would like to revisit levels of the Select setup menu, press the appropriate number(s). If not, press [0] to return to Select instrument function.

Select instrument function
1-Service 2-Setup 3-Diagnostic

Now press [0] again to return to Main menu.

Please select instrument mode
[RUN] [STANDBY] [MENU]

HINT: Use the Print Setup option to confirm that you have correctly setup your instrument. Remember, "PrntSetup" can be accessed from Main Menu by pressing [MENU], then [2] for Setup and then [5] for PrntSetup. Again, refer to Figure 5.2, Menu Flow Chart for an overview.

3.10 Probe Baseline Check

You were previously instructed to prime the fluid system. Since then, you have been learning about the menu selections. Now it is time to check the probe baseline current to determine if the installed enzyme membrane sensor(s) and probe(s) have equilibrated and are stable enough to initiate calibration.

From the previous instructions your instrument should be displaying Main Menu.

Please select instrument mode
[RUN] [STANDBY] [MENU]

If your instrument display shows another message, press [MENU] on the keypad. The instrument should display the message above. If you inadvertently entered the Run Mode or Standby Mode, you will need to exit to return to the Main Menu. See instructions in Section 4.1 regarding entering and exiting these modes.

Press [MENU] to display instrument function options.

Select instrument function
1-Service 2-Setup 3-Diagnostic

Press [3] for Diagnostic.

Select diagnostic
1-Motor 2-Pump 3-Probe 4-I/O 5-Sensor

Press [3] for Probe.

B:LAC 4.23 nA W:DEX 3.10 nA
1-Flush 2-Calibrator 3-Sample

Observe the probe current values. If they are above 6 nA (nA = nanoamp), check to see if they are decreasing in value. Check the Sample Chamber; it should be full of buffer. If necessary, press [1] for Flush. The Buffer Pump will turn on and flush buffer through the Sample Chamber. Watch the baseline nA values to see if they are decreasing during the flush.

NOTE: Other options in this mode (2-Calibrator and 3-Sample) are used to observe the probe current after injection of calibrator and sample solutions, respectively. You should not need to use these probe diagnostics at this point.

Once the baseline currents are below 6 nA and reasonably stable, press [MENU] to return to Main Menu. You may need to allow an hour or more to establish stability when initially setting up the 2300 STAT PLUS.

Please select instrument mode
[RUN] [STANDBY] [MENU]

Once the installed membranes and probes are equilibrated, the probe current typically runs below 2 nA. This equilibration may take a day or two and does not usually affect operation during the first day since autocalibrations compensate for probe current drift.

When enzyme membrane replacements are required in the future, stabilization will occur much more rapidly, usually within several minutes of installation, if there has been no power disruption to the instrument.

4. Basic Operation

4.1 Main Menu

When you power on or reset your 2300 STAT PLUS the Main Menu appears on the instrument display.

Please select instrument mode
[RUN] [STANDBY] [MENU]

From Main Menu you may enter any of three modes by pressing the appropriate function key. The modes are RUN, STANDBY and MENU. You may also transfer from one mode to another using the function keys, however, there are limits to what submenus you can access. Refer to Figure 3.1.

If you press [RUN] from Main Menu, the instrument initializes and self-calibrates. Once calibrated it maintains a "sample ready" status. If 4 hours pass without a sample being processed, the unit automatically transfers to STANDBY Mode, where reagents are conserved. (In Section 4 you will learn how to change this 4 hour threshold value to better fit your application.)

If you press [STANDBY] from Main Menu, the instrument flushes buffer through the Sample Chamber that houses the Enzyme Electrodes. It then continues to flush buffer once an hour to maintain fresh solution in the Sample Chamber. If you transfer from STANDBY to RUN Mode, a calibration is initiated to update the calibration reference value stored in memory.

If you press [MENU] from Main Menu, you enter a series of submenus that allow you to reconfigure your setup parameters, perform service functions and utilize diagnostic routines. You will learn about MENU selections in Section 4.

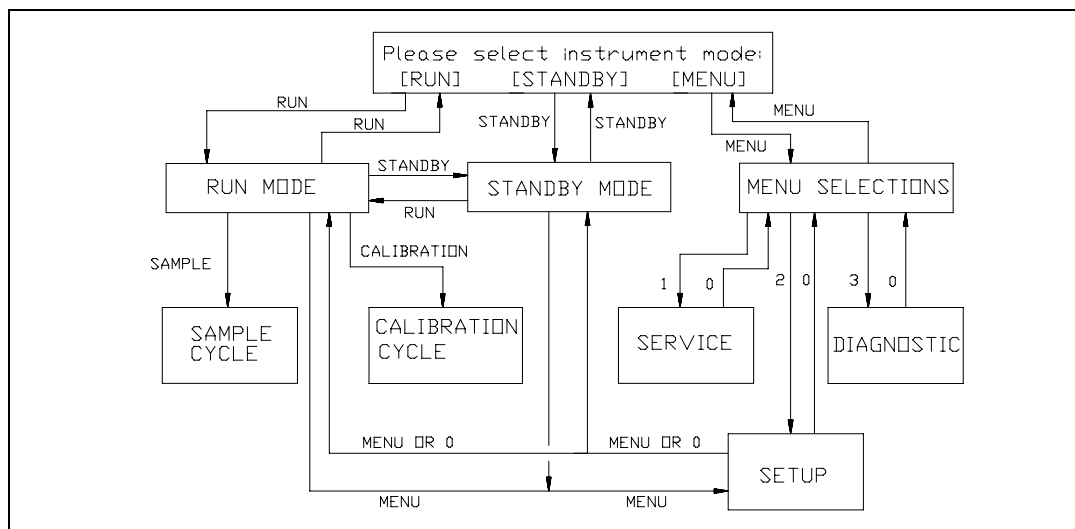


Figure 4.1
2300 STAT PLUS Software Structure

IMPORTANT: The RUN and STANDBY keys act as toggle keys:

You **enter** RUN Mode by pressing [RUN] and you **exit** RUN Mode by pressing [RUN].

You **enter** STANDBY Mode by pressing [STANDBY] and you **exit** STANDBY Mode by pressing [STANDBY].

In each action above you must confirm your intention by pressing [2] or [1] for yes or no, respectively, then press [ENTER] to confirm your choice.

4.2 Run Mode

To enter Run Mode, follow the instructions below.

If required, return to the Main Menu by pressing [MENU] or by exiting RUN or STANDBY Mode. The display must read as follows:

Please select instrument mode
[RUN] [STANDBY] [MENU]

Press [RUN] to enter Run Mode. The Buffer Pump will operate through two cycles and the instrument will "initialize the baseline current" which means it will ready itself to calibrate. Two or more calibration cycles will be run automatically. The Sipper moves out of the Sample Chamber and enters the Calibrator Well. Calibration standard is aspirated into the Sipper, which then returns to the Sample Chamber and dispenses the standard. After the measurement, the Buffer Pump flushes the standard from the chamber.

The following display messages will appear during initialization:

Entering RUN mode, please standby
Initializing mechanism...

Entering RUN mode, please standby
Stabilizing baseline current...

Entering RUN mode, please standby
Stabilizing calibration...

NOTE: In Run Mode, the unit calibrates itself every 15 minutes or every 5 samples. It will sometimes self-calibrate several times until a stable calibration is established. In Section 4 you will learn to change some default calibration parameters to better fit your application.

Once a stable calibration is established, the following display will appear:

Ready to sample at Station #2 HH:MM:SS

You are now ready to run a sample.

In the status block (upper right hand corner of display) there is a running countdown timer showing time to next autocalibration. This status block does not indicate number of samples between calibrations. For example, if 5 samples are run before 15 minutes expire, then an autocalibration will be triggered on sample number, and time will reset to 15 minutes.

Instructions for changing autocalibration parameters are described in Section 5. For example, you may disable the "samples per calibration" parameter and autocalibrate on time alone (up to 240 minutes between autocalibrations). At any time you may press [CALIBRATE] and initiate a calibration update, which resets the countdown timer.

There are two stations at which a sample may be presented: Station #2 (Test Tube Holder Station) and Station #3 (Manual Station). If your instrument is configured with a YSI 2710 Turntable, refer to Section 10 for operation instructions.

See Figure 4.2. The Test Tube Holder accepts tubes from 9 to 16 millimeters in diameter and 50 to 100 millimeters long. Any container other than a tube with the dimensions indicated should be presented at the Manual Station (Station #3).

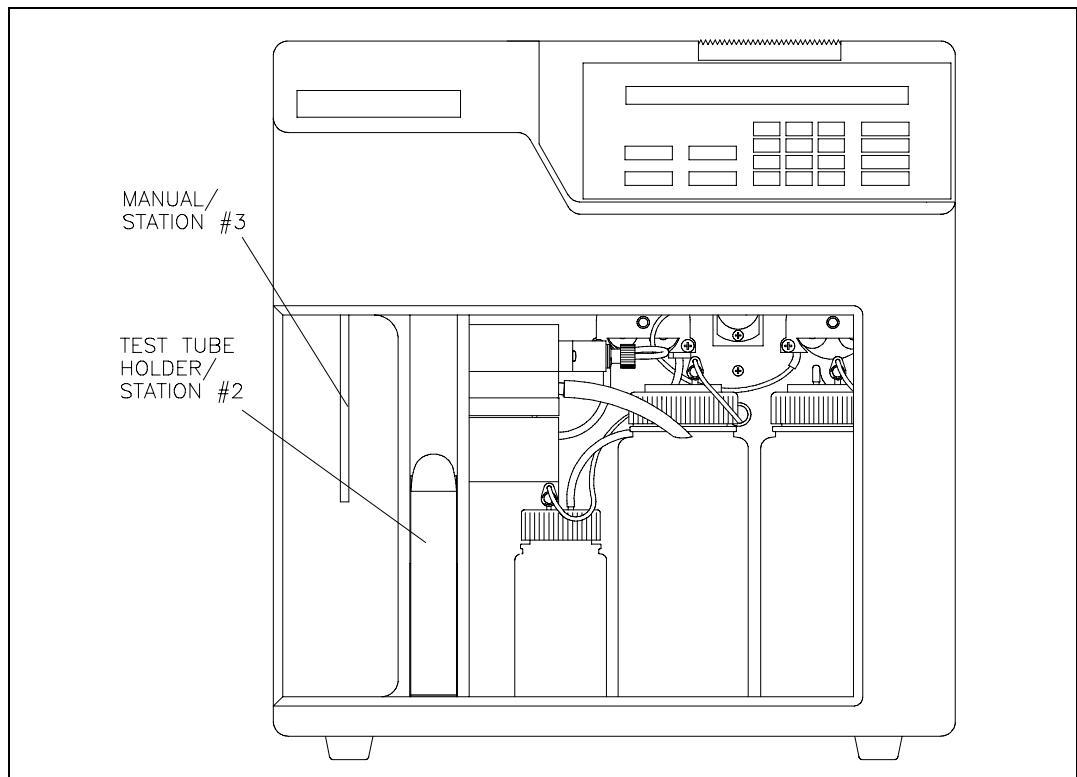


Figure 4.2
Sampling Stations

Operation At The Test Tube Holder Station

For the purposes of demonstrating basic operation, choose a standard for the chemistry you are set up to run. For example, if you have installed a YSI 2365 (glucose oxidase) membrane, calibrate with YSI 2747 standard and use another standard containing glucose to run as a sample.

Using this standard, fill a test tube about half full. The Test Tube Holder is hinged at the bottom. Pull the top out, as shown in Figure 4.3. Place the tube in the holder. The Sipper is not designed to pierce septa, but can be used for some flexible evaporator covers that are pre-slit.

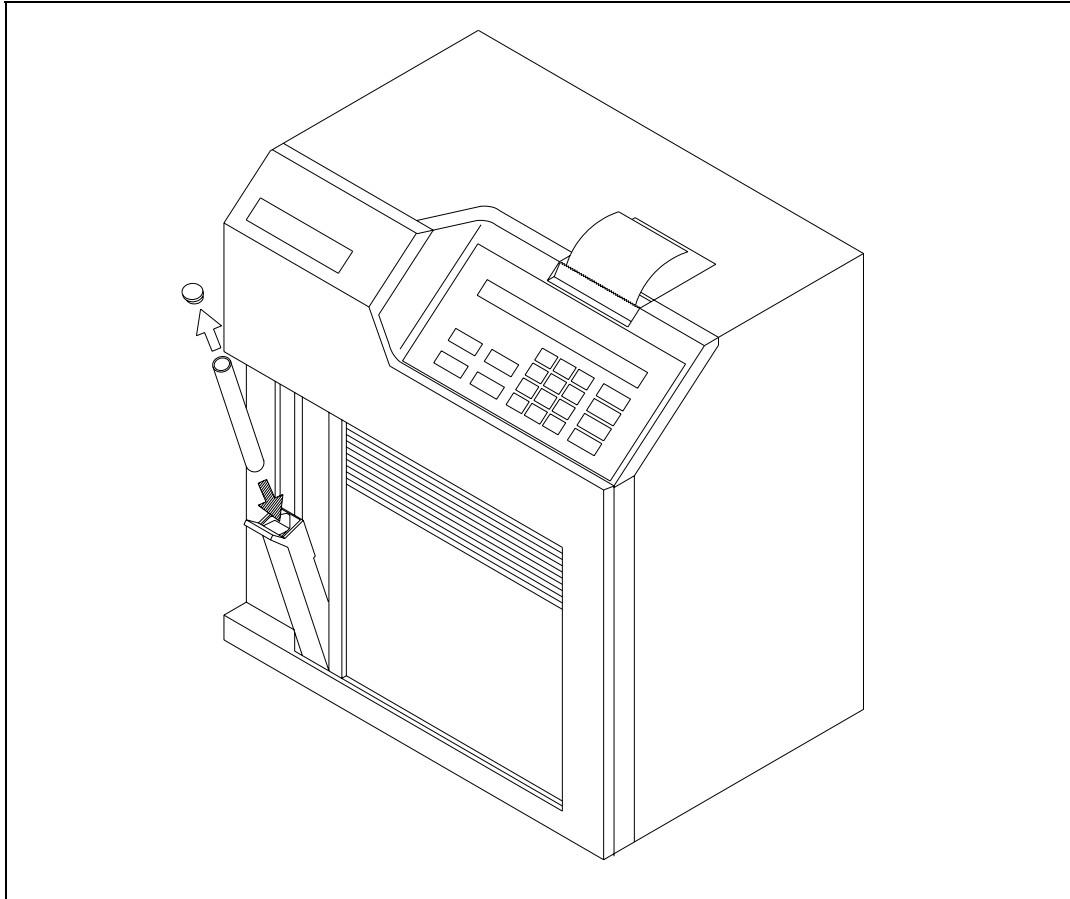


Figure 4.3
The Test Tube Holder Pivoted Out

Push the holder back into place. Press [SAMPLE]. The 2300 STAT PLUS will do the rest. The Sipper moves to the sample test tube and travels about 3 millimeters below the surface of the fluid.

The Sipper Pump Piston retracts and draws in 25 microliters of sample. The Sipper moves back to the Sample Chamber, the Sipper Pump Piston extends and the sample is dispensed. In about one minute the sample's analyte values are displayed and printed. An example of the display format is shown below. Notice that the results are shown on the bottom line, while the "sample ready" message for the next analysis and the calibration countdown timer are on the top line.

Ready to sample at Station #2 HH:MM:SS
B:LAC 0.002 mmol/L W:GLU 49.8 mmol/L

The printer format can be configured to express sample ID, date, time, temperature, instrument serial number, probe currents and more. See Appendix J for example printouts.

Compare the displayed/printed value with the expected value. If the reading differs significantly, your instrument calibration may not yet be stable. Initiate a calibration by pressing [CALIBRATE]. After recalibration repeat the analysis described above. If your result is still outside the expected range, proceed for now with the operation demonstrations. Later in this section, specific actions for linearity checks will be described.

Operation At The Manual Station

Remove the tube from the Test Tube Holder. Rotate the Tube Holder back into place. Next press [3] on the keypad. Note the change in Station # on the LC display. Alternatively, rotate the Test Tube Holder out to trigger the switch that senses a test tube. The Sipper will automatically go to Station #3 (Manual).

With the door fully closed, press [SAMPLE]. The display reads:

Manual sample pause moving MS

Wait for the Sipper to come to a stop at the Manual Station, then bring the sample up to the Sipper so the tip is **just** immersed, about 3 millimeters below the fluid surface (See Figure 4.4). **If the Sipper dips too deeply into the sample, future measurements may be contaminated by carry-over of excess sample on the outside of the Sipper.**

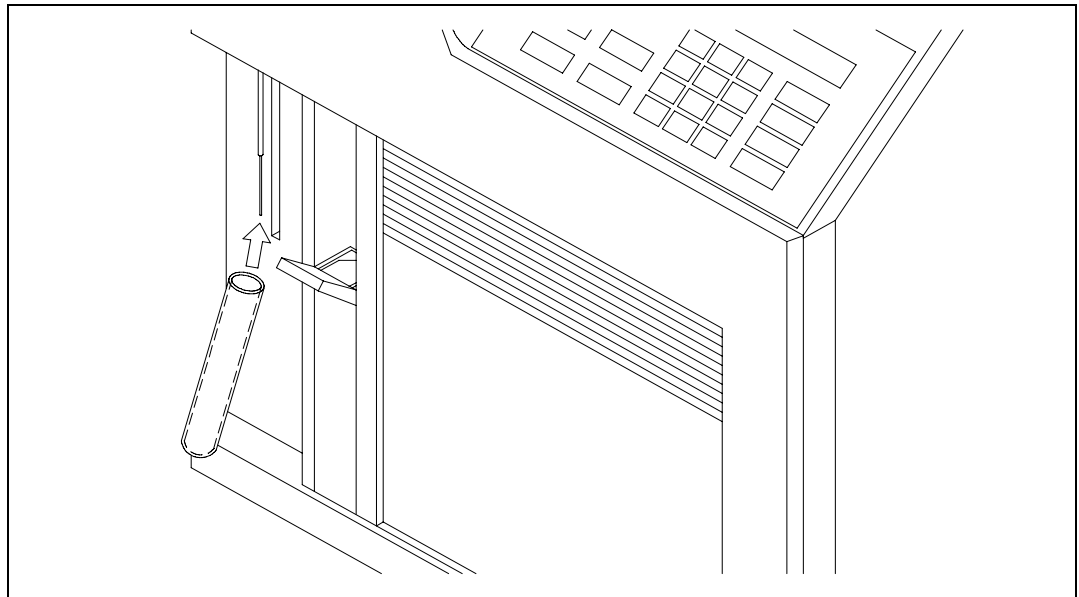


Figure 4.4
The Manual Station

Be very careful not to jar or push on the Sipper during manual operation. You could disturb its critical alignment.

The display now reads:

**Present sample to sipper and
press [SAMPLE] to aspirate**

Press [SAMPLE]. The sample will be aspirated and the Sipper will return to the Sample Chamber. Do not move the sample container until the Sipper has returned to the Sample Chamber.

Aspirating sample...

The results are then displayed and printed as shown above.

4.3 Standby Mode

If no sample is processed for 4 hours, the 2300 STAT PLUS automatically exits RUN Mode and enters STANDBY Mode. In STANDBY Mode, the unit conserves reagents. It does not self-calibrate; it only freshens the Sample Chamber with buffer, using less than 1 milliliter every hour.

You can manually enter STANDBY Mode from either RUN Mode or the Main Menu by pressing the [STANDBY] key.

The 4 hour default for entering STANDBY Mode can be changed to better fit your application. If you have not yet done so, press [MENU]. The following menu should appear.

**Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default**

Press [3] for RunMode.

Then press [2] for AutoStandby. The following display will appear.

**Enter autostandby time in hour
0 to disable > 4**

If you would like your 2300 STAT PLUS never to leave Run Mode, press [0] and it will continually self-calibrate and maintain a "sample ready" status. Otherwise, enter the number of hours (0 to 30,000) you would like to maintain a "sample ready" status before reverting to STANDBY Mode. Press [ENTER], then [MENU] to return to the Main Menu.

4.4 Daily Operational Checks

To ensure that your 2300 STAT PLUS is operating properly, perform the following operational checks on a daily basis.

It is advisable 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. In the log book you may want to paste a printed record of your operational checks.

Membrane Integrity Test

Use YSI 2363 Potassium Ferrocyanide (FCN) Standard to determine if your membranes are structurally intact. This standard is packaged in your starter supplies or may be ordered separately. The test is semiquantitative, but should offer useful information on "membrane leakage".

Place your instrument in RUN Mode. When the unit is ready, the following display will appear.

Ready to sample at Station #2 HH:MM:SS

Pour a small amount of FCN Standard (1000 mg/dL) into a tube or cup and run it as a sample at either the Manual or Test Tube Holder Station. Listed below are the recommended limits for the FCN reading when calibrated with the YSI 2747 standard (glucose and L-lactate).

2365 DEXTROSE (GLUCOSE) SENSOR:

FCN readings greater than 0.3 mmol/L (5 mg/dL) after a stable calibration with YSI 2747 may indicate membrane structural problems.

2329 L-LACTATE SENSOR:

FCN readings greater than 0.6 mmol/L (5 mg/dL) after a stable calibration with YSI 2747 may indicate structural problems within the membrane.

NOTE: If any readings exceed the limits, recalibrate and repeat the FCN test. If they are still high, refer to Section 8 Troubleshooting.

Linearity Test

Use the appropriate YSI linearity standard to test the linear range of the chemistry.

Calibrate using YSI 2747 Dual Standard, which contains 10.0 mmol/L glucose and 5.00 mmol/L L-lactate. These concentrations in mg/dL are 180 and 45, respectively.

Check glucose linearity using YSI 1531 Glucose Standard (50.0 mmol/L or 900 mg/dL) for NORMAL Performance Mode setup.

Check glucose linearity using YSI 2356 Glucose Standard (27.8 mmol/L or 500 mg/dL) for SCREEN Performance Mode setup.

Check L-lactate linearity using YSI 1530 L-Lactate Standard (30.0 mmol/L or 267 mg/dL) for NORMAL Performance Mode setup.

Check L-lactate linearity using YSI 2328 L-Lactate Standard (15.0 mmol/L or 134 mg/dL) for SCREEN Performance Mode setup.

Place your instrument in RUN Mode. When the unit is ready, the following display will appear.

Ready to sample at Station #2 HH:MM:SS

Pour a small amount of linearity standard into a test tube or cup and run it as a sample at either the Manual or Test Tube Holder Station.

YSI specifies linearity to be better than +/-5% from the calibration concentration to the detection range limit. The acceptable values depend on the performance mode you have chosen. The modes are referred to as NORMAL and SCREEN. The acceptable ranges for both modes are shown below in two commonly used concentration units.

Normal Mode:

Glucose: 47.5 to 52.5 mmol/L or 855 to 945 mg/dL
Lactate: 28.5 to 31.5 mmol/L or 254 to 280 mg/dL

Screen Mode:

Glucose: 26.9 to 29.2 mmol/L or 475 to 525 mg/dL
Lactate: 14.2 to 15.8 mmol/L or 126 to 141 mg/dL

NOTE: If any reading is outside of the specified tolerance limits, recalibrate and repeat the linearity test. If it is still out of tolerance, refer to Section 8 Troubleshooting.

Above Linear Range

The acceptable 2300 STAT PLUS limits for the linear range of glucose and L-lactate are stated above. However, results above the linear range are reported up to specific limits, above which results are not reported. The reason for displaying and printing any results above the linear limits of the 2300 STAT PLUS is to provide information for diluting samples appropriately for retest.

Normal Performance Mode

For millimolar expression in the Normal Performance Mode, the warning message "ABOVE LINEAR RANGE" is displayed and printed (with results) for glucose from 53 to 90 mmol/L, and for lactate from 32 to 40 mmol/L.

For milligram/deciliter expression in the Normal Performance Mode the warning message "ABOVE LINEAR RANGE" is displayed and printed (with results) for glucose from 945 to 1500 mg/dL, and for lactate from 284 to 350 mg/dL.

Above these ranges the message "OVER RANGE" is displayed and printed and no results are presented.

Screen Performance Mode

For millimolar expression in the Screen Performance Mode the warning message "ABOVE LINEAR RANGE" is displayed and printed (with results) for glucose from 30 to 50 mmol/L, and for lactate from 16 to 40 mmol/L.

For milligram/deciliter expression in the Screen Performance Mode the warning message "ABOVE LINEAR RANGE" is displayed and printed (with results) for glucose from 525 to 900 mg/dL, and for lactate from 142 to 350 mg/dL.

Above these ranges, the message "OVER RANGE" is displayed and printed; and no results are presented.

IMPORTANT: YSI performance claims must not be assumed to be valid for results displayed and printed with the "Above Linear Range" message.

Clinical Controls

Use clinical controls on a daily basis to verify that the YSI 2300 STAT PLUS is operating properly. Clinical controls are available from most laboratory and hospital supply distributors. Both normal value and elevated value controls should be used.

Pour a small amount of the control into a container and run it as a sample at either the Manual or Test Tube sample station. Results should compare to the stated value for the control.

5. Menu Selections

5.1 Introduction

In this section you will learn about the specific commands required to move through the 2300 STAT PLUS menu structure. You should begin by studying Figure 5.1 below, recognizing that the instrument has two operating modes and a menu mode. Also refer to Figure 5.2, next page.

The operating modes are RUN Mode and STANDBY Mode. In RUN Mode the instrument calibrates, samples or simply remains ready to sample. In STANDBY Mode the instrument remains powered to keep the probes polarized, and periodically freshens the buffer to the sample chamber. When entering RUN Mode, the unit will automatically update its calibration as required.

In MENU Mode there are three submenu levels: Service, Setup and Diagnostics. Notice that you may move from RUN Mode or STANDBY Mode to limited menus in Setup. However, to fully access MENU Mode you must exit RUN or STANDBY modes.

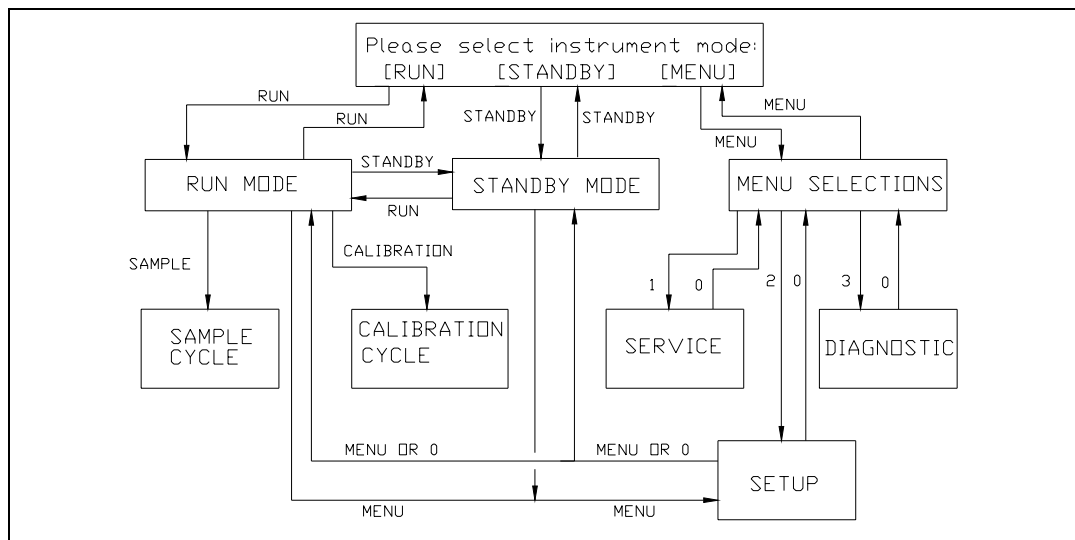


Figure 5.1
2300 STAT PLUS Software Structure

To exit RUN Mode press [RUN], then confirm your exit by pressing [2] for Yes, then [ENTER]. The instrument will next display the message shown below.

To exit STANDBY Mode press [STANDBY], then confirm your exit by pressing [2] for Yes, then [ENTER]. The instrument will also display the message shown below.

The display message shown below is referred to as Main Menu display. This is where we will begin.

Please select instrument mode
[RUN] [STANDBY] [MENU]

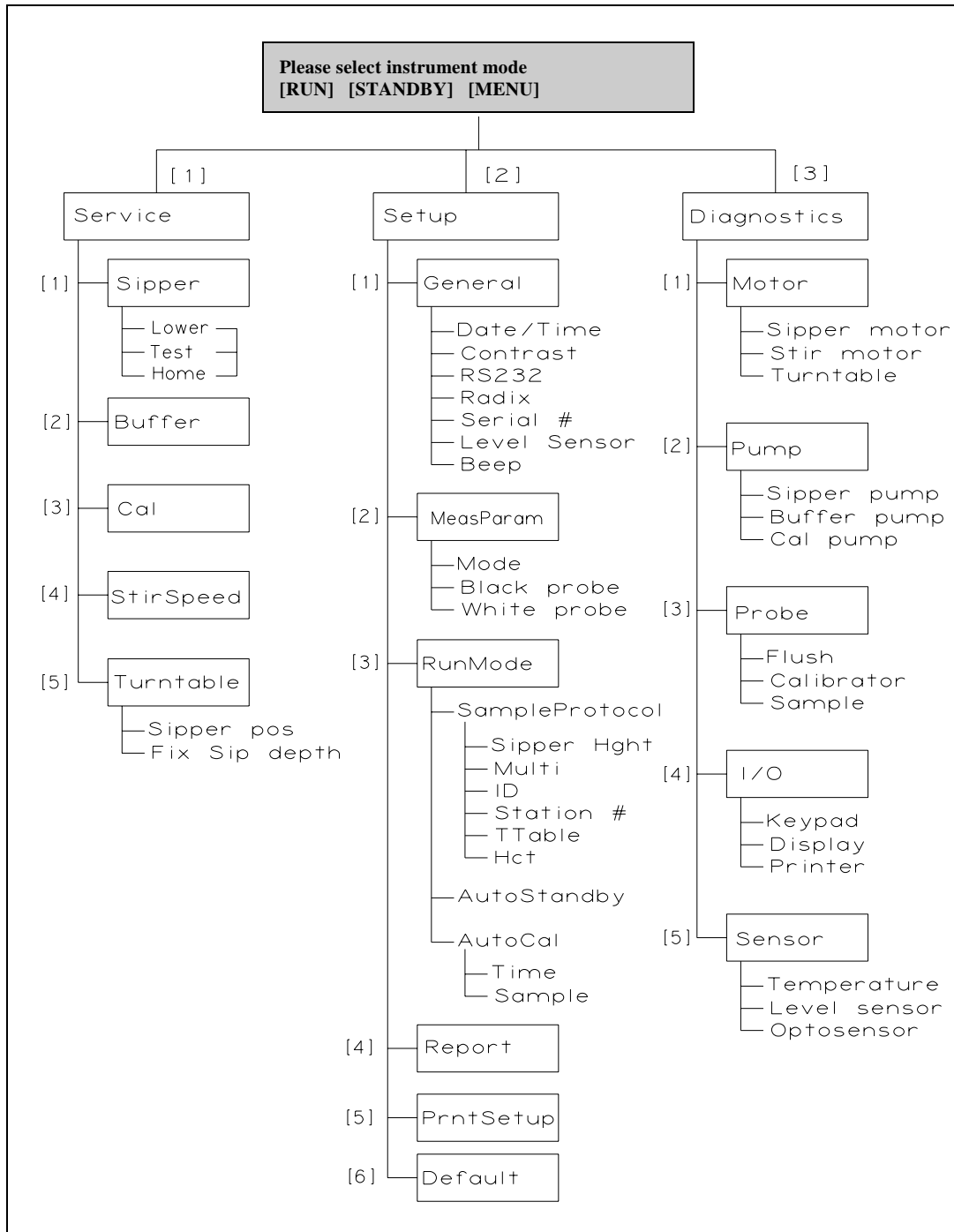


Figure 5.2
YSI 2300 STAT PLUS Menu Flow Chart

REMEMBER: You move through the 2300 STAT PLUS menus by selecting options on the display. You can press [MENU] to get back to the Main Menu, and [0] to back up to the previous display. However, it may be necessary to confirm a response by pressing [ENTER] before continuing to use the [MENU] or [0] keys.

5.2 Service Selections

Service functions are primarily used during initial setup and anytime reagent changes are made. Both Cal Pump and Buffer Pump can be primed using this menu level. In addition, Sipper alignment and Stir Bar speed adjustment can be performed from this level. Use the display messages and text below to learn the service functions.

Main Menu display:

Please select instrument mode
[RUN] [STANDBY] [MENU]

From Main Menu press [MENU] to display instrument functions.

Select instrument function
1-Service 2-Setup 3-Diagnostic

Press [1] for Service to display service functions.

Select service: 1-Sipper 2-Buffer 3-Cal
4-Stir speed 5-Turntable

Press [1] for Sipper to initiate Sipper alignment. This procedure was used during initial instrument setup. Refer to Section 3.9 for more information.

The Sipper Arm Assembly will move to the home position. Loosen the adjustment screw that holds the Sipper flange to the arm to center the Sipper over the Sample Chamber injection port. The display messages will guide you through the procedure. It is very important that the Sipper be accurately adjusted.

Adjust sipper then select
0-Exit 1-Lower sipper for fine alignment

Fine align sipper then select
0-Exit 1-Test sipper position

Select 1 to restart check sipper cycle
0-Exit 1-Home sipper position

Adjust sipper then select
0-Exit 1-Lower sipper for fine alignment

When completed, press [0] for Exit to return to service selections.

Select service: 1-Sipper 2-Buffer 3-Cal
4-Stir speed 5-Turntable

Press [2] for Buffer to initiate a 15-second cycle of the Buffer Pump. This selection allows you to prime the buffer system. Use it after replenishing the buffer bottle or replacing tubing. Also use it to troubleshoot problems or find leaks.

Select service: 1-Sipper 2-Buffer 3-Cal
4-Stir speed 5-Turntable

Press [3] for Cal to initiate a 10-second cycle of the Cal Pump. This selection allows you to prime the calibrator system. Use it after changing the calibration solution or replacing tubing. Also use it to troubleshoot problems or find leaks.

Select service: 1-Sipper 2-Buffer 3-Cal
4-Stir speed 5-Turntable

Press [4] for Stir Bar to adjust the stir bar speed. During RUN Mode operation the stir bar has two operating speeds: normal speed, at which the stir bar rotates smoothly in the chamber and accelerated speed, at which the stir bar loses synchronization with the motor housed below and jumps. This jumping action helps clear the sample chamber of air bubbles during a flush cycle.

Adjust until stir bar jumps
1-Increase speed 2-Decrease speed

Using the 1-Increase and 2-Decrease choices adjust the Stir Bar. Lower the speed to observe synchronous rotation, then increase the speed until the stir bar "jumps" and loses synchronous rotation. At this point release the [1] key. If jumping does not occur, adjust the Stir Bar speed to the maximum setting.

Press [0] to exit the stir bar menu level.

Select service: 1-Sipper 2-Buffer 3-Cal
4-Stir speed 5-Turntable



CAUTION! Do not enter the 5-turntable submenu unless the turntable is installed and the left access plate is removed. You may seriously damage the sipper arm assembly.

If you **press [5] for Turntable** you will access two functions used to align the YSI 2710 Turntable. Refer to Section 10 on operation and maintenance of the turntable for details.

Press [0] two times to backup to the instrument function selections.

Select instrument function
1-Service 2-Setup 3-Diagnostic

You have now completed the Service menu selections.

5.3 Setup Selections

Setup menu is where you will enter system parameters that define the specific information required to run the 2300 STAT PLUS for your particular application. You will set general information such as date, time, display and print formats. You will enter specific information related to chemistry selection, concentration units, calibration and sampling protocols, communication parameters, and other features. Once set, the parameters are maintained in memory. In the event of power loss, the 2300 STAT PLUS has battery backup to preserve this information.

NOTE: When first powered, the instrument will contain most of the general information you need. Some information is set prior to delivery and preserved by battery; and other information will be set as default values which are appropriate for many standard applications. Use the display messages and text below to learn the flexibility you have in setting up your 2300 STAT PLUS.

You may find it helpful to use the Menu Flow Chart (Figure 5.2), to follow the menu levels.

Main Menu display:

Please select instrument mode
[RUN] [STANDBY] [MENU]

From Main Menu press [MENU] to display instrument functions.

Select instrument function
1-Service 2-Setup 3-Diagnostic

Press [2] for Setup to display setup selection categories.

Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default

Press [1] for General. The display will read:

General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-Level 7-Beep

In General setup menu, you may confirm or change the date, set date format, adjust the display contrast, define communication parameters, select the radix to express decimal numbers, confirm or enter the instrument serial number, select whether to deactivate the bottle level sensor system and to deactivate the keypad annunciator.

Press [1] for Date/Time. Use the number keys to change entries. Press [ENTER] to confirm your selection. You will see the display messages below, leading you through the complete date entry sequence.

Enter date and time as required
Year> 03

Enter date and time as required
Month> 2

Enter date and time as required
Date> 14

Enter date and time as required
Hour> 17

Enter date and time as required
Minute> 22

Select and/or confirm the format you desire for printed dates; (month/day/year) or (day/month/year).

Select date format: MM/DD/YY
1-MM/DD/YY 2-DD/MM/YY

When you press [ENTER], you will return to the General setup level.

General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-Level 7-Beep

Press [2] for Contrast. Use the appropriate number key to adjust the LC display contrast for your comfort. When finished, press [0] to return to General setup level.

Adjust the display contrast
1-Raise contrast 2-Lower contrast

General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-Level 7-Beep

Press [3] for RS232. Use this menu to set communication parameters if you are using the serial interface port. See Section 9 for detailed information on communications. Below are the display messages showing default settings and your options. Press [ENTER] to confirm your choices for each parameter.

If you are not using the serial port, you need not worry about setting these parameters. They will not interfere with other parameter settings.

**RS-232 setup 1-Baud 2-Data 3-Parity
4-Stop 5-Handshake 6-Configuration**

**Select baud rate: 9600
1-9600 2-4800 3-2400 4-1200 5-600 6-300**

**Select number of data bits: Seven bits
1-Seven bit 2-Eight bit**

**Select parity: Odd
1-None 2-Even 3-Odd 4-Low 5-High**

**Select number of stop bits: One bit
1-One bit 2-Two bits**

**Select handshaking type: RTS/CTS
1-RTS/CTS 2-XON/XOFF 3-NONE**

If you choose XON/XOFF, you will go one menu level deeper to enter or confirm XON and XOFF values.

**Enter XON character
> 17**

**Enter XOFF character
> 19**

Press [ENTER] to confirm and return to RS-232 setup.

**RS-232 setup 1-Baud 2-Data 3-Parity
4-Stop 5-Handshake 6-Configuration**

**Select configuration: Non-multidrop
1-Non-multidrop 2-Multidrop**

The default configuration is Non-multidrop. If you press [2] for Multidrop, you will see the following.

Enter node address
>

The node address is only used when networking 2300s in a multi-instrument system. Now press [0] to return to the General setup level.

**General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-Level 7-Beep**

Press [4] for Radix. In some parts of the world, a "," is preferred to express decimal numbers (For example: 2.00 = 2,00). Confirm your choice by pressing [ENTER] to return to the General setup level.

**Select radix mark: "."
1-"," 2-,"**

**General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-Level 7-Beep**

Press [5] for Serial #. The serial # of your instrument is recorded on the serial plate, lower rear of case. Enter this number in memory. It will be printed for certain report formats.

NOTE: YSI uses alpha-characters in the serial number. We recommend that you press [SPACE] for the first alpha-character and omit the last two. Example, 03B01234AB can be entered as 03 01234. This number is normally set prior to delivery, and preserved in memory by battery backup. Press [ENTER] to confirm and return to General setup level.

Enter instrument serial number
03 01234

**General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-Level 7-Beep**

Press [6] for Level Sensor. Choose "Yes" to maintain level sensing in the buffer, calibrator and waste bottles. One reason to inactivate the level sensors would be if you use a non-standard container for buffer or waste.

Activate bottle level sensors? Yes
1-No 2-Yes

Press [ENTER] to confirm and return to General setup level.

General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-Level 7-Beep

Press [7] for "Beep".

Activate keyboard annunciator? Yes
1-No 2-Yes

Press [1] for No if you prefer to turn off the audible signal for keypad confirmation. After your choice, press [ENTER] to return to Select setup menu level.

You have now completed General setup. Press [0] to return to Select setup menu level.

Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default

Press [2] for MeasParameter. The display will read:

Measurement parameter setup
1-Mode 2-Black 3-White

"MeasParameter" is an abbreviation for measurement parameters. In this menu you will select between two performance modes, Normal and Screen modes. You will also assign specific chemistry parameters to the Black and White probes. These parameters are chemistry assignment and units of concentration. YSI has assigned default values for each of these parameters, but provides flexibility so the user can change values to optimize for a particular application. **However, see warning statements in Section 3 (3-13 and 3-22), and additional information in Section 11** Typical Performance Data.

Press [1] for Mode.

Select performance mode: Normal
1-Normal 2-Screen

Use this menu to choose one of two instrument performance modes. Refer to Sections 2 and 11 for descriptions of the basic differences between these modes. Basically, Screen mode provides faster response (result) and faster cycle time than Normal mode. The tradeoff for these faster times may be reduced linear range, precision and accuracy. Refer to Section 11 for data on Typical Performance.

Press [ENTER] to confirm Normal mode.

Press [2] for Black. At this level, you will choose chemistry and other black probe measurement parameters.

Select BLACK chemistry: L-Lactate
0-Backup 1-Next chemistry [ENTER]-Accept

Press [1] for Next chemistry. You use this key to scroll through the choices in the menu (Glucose, L-Lactate, None). Select the appropriate chemistry then press [ENTER] to confirm and move on to the next parameter.

Select BLACK unit of measurement: mmol/L
1-mmol/L 2-mg/L (ppm) 3-mg/dL

Press the appropriate number to change the default setting, if necessary.

NOTE: If you choose a concentration unit other than mmol/L, the value automatically changes. That is, 5.00 mmol/L becomes 450 mg/L or 45 mg/dL.

When the desired unit of measurement is selected, press [ENTER] to confirm and move to the next parameter.

Measurement parameter setup
1-Mode 2-Black 3-White

Press [3] for White. Now set the same parameters for the White probe that you just set for the Black probe.

Select WHITE chemistry: Glucose
0-Backup 1-Next chemistry [ENTER]-Accept

Press [ENTER] to confirm Glucose as the WHITE chemistry.

Select WHITE unit of measurement: mmol/L
1-mmol/L 2-mg/L (ppm) 3-mg/dL

Press [ENTER] to confirm. The display now shows Measurement parameter setup.

Measurement parameter setup
1-Mode 2-Black 3-White

Press [0] to return to the Select setup level.

Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default

Press [3] for RunMode. The display will read:

RUN mode setup: 1-SampleProtocol
2-AutoStandby 3-AutoCal

In this menu, you select parameters related to sampling protocol, set parameters that control automatic switching to standby mode and select parameters that will trigger autocalibrations. In Sampling Protocol, you can select the sample station (position), activate multisampling and sample identification systems, and set the position to which the Sipper descends when sampling at the Manual Station.

Press [1] for SampleProtocol. The display will read:

Sampling protocol setup: 1-SipperHeight
2-Multi 3-ID 4-Station# 5-TTable 6-Hct

Press [1] for SipperHeight. This specifies to what vertical position the Sipper descends when sampling at the Manual Station. For example, with long test tubes and the fluid level near the bottom of the test tube, use "Low" setting.

Select manual sipper height: Medium
1-Low 2-Medium 3-High

Press [ENTER] to confirm and return to Sampling protocol setup.

**Sampling protocol setup: 1-SipperHeight
2-Multi 3-ID 4-Station# 5-TTTable 6-Hct**

Press [2] for Multi (abbreviation for multiple cycles). The default setting is No. The display prompts reflect messages for single sampling and single calibrations. If Yes is confirmed, you will be prompted at the display each time you press [SAMPLE] or [CALIBRATE] to enter how many times the sample or cal solution should be run for that one command. The number that you assign to Multicycle must be between 1 and 99 (samples or calibrations). During RUN Mode, you may cancel the assigned number of cycles by pressing [CANCEL].

As an example, Multicycle allows you to configure your system to run a sample in the Test Tube Holder unattended in duplicate or triplicate. Multicycle also allows you to check calibration stability by assigning some number of consecutive calibrations to be run without requiring repeated key commands of [CALIBRATE].

**Prompt multiple cycle? No
1-No 2-Yes**

Press [ENTER] to confirm and return to Sampling protocol setup.

**Sampling protocol setup: 1-SipperHeight
2-Multi 3-ID 4-Station# 5-TTTable 6-Hct**

Press [3] for ID. If you wish to assign sample identification numbers to each sample, enter [2] for Yes here. When you press [SAMPLE] in RUN Mode, the display will prompt you to enter a sample ID number. You may elect not to assign a number for each sample, in which case the prompt display disappears and the sample is run identified only by time and date.

**Prompt sample ID? No
1-No 2-Yes**

Press [ENTER] to confirm and return to Sample protocol setup.

**Sampling protocol setup: 1-SipperHeight
2-Multi 3-ID 4-Station# 5-TTTable 6-Hct**

Press [4] for Station# to assign the position at which the sample will be aspirated. The default location is Station #2, the Test Tube Holder station. You may also elect to sample from Station #3, the Manual Station.

If you are operating the 2300 STAT PLUS with the 2710 Turntable, you would enter "4" for station #. Refer to Section 10 Turntable Operation and Maintenance for details.

Enter Sample Station#
> 2

Press [ENTER] to confirm and return to Sampling protocol setup.

Sampling protocol setup: 1-SipperHeight
2-Multi 3-ID 4-Station# 5-TTable 6-Hct



CAUTION: Do not press [5] for turntable unless the YSI 2710 Turntable has been installed.

Refer to Section 10 for setup, operation and maintenance of the turntable.

Press [6] for Hct (Hematocrit Correction prompt).

Prompt for Hematocrit? No
1-No 2-Yes

If you select "Yes" to this menu question, the LC display will prompt you each time you press [SAMPLE] for entry of a hematocrit value. Any whole number between 17 and 70 will be accepted. This value converts **ONLY WHOLE BLOOD GLUCOSE TO PLASMA GLUCOSE** (see Appendix D for specific information on the correction equation).

If you do not enter a value within 30 seconds, no correction factor is applied to the glucose result. When you do enter a hematocrit value, the value you enter is printed with the corrected result on the printout. (See Appendix J for example.)

NOTE: Hematocrit correction for whole blood to plasma L-lactate CANNOT be performed with consistency and is not available in the software protocol.

Press [ENTER] to confirm and return to Sampling protocol setup.

Sampling protocol setup: 1-SipperHeight
2-Multi 3-ID 4-Station# 5-TTable 6-Hct

Press [0] to return to RUN mode setup.

RUN mode setup: 1-SampleProtocol
2-AutoStandby 3-AutoCal

Press [2] for AutoStandby to define the number of hours the unit will continue to update calibration and be ready to sample. The default setting is 4. If you press [0] and confirm with [ENTER], AutoStandby is disabled. The instrument then remains "sample ready" indefinitely. You may enter any number between 0 and 99.

Enter autostandby time in hour
0 to disable> 4

Press [ENTER] to confirm and return to RUN mode setup.

RUN mode setup: 1-SampleProtocol
2-AutoStandby 3-AutoCal

Press [3] for AutoCal to define parameters that initiate autocalibrations. Only two menu categories are adjustable, time and sample per calibration. The default settings that initiate calibration are: 1) temperature drift of more than 1°C since last cal, 2) after 15 minutes without cal update, 3) after 5 samples run without a cal update, 4) after a probe current shift of 2% or greater compared to the last cal, and 5) after certain errors are detected in the software.

Autocal setup:
1-Time 2-Sample



CAUTION: The instrument specifications described in Section 2.3 are based on extensive testing, performed under calibration conditions as described in Section 11 Typical Performance Data. Refer to Section 11 before arbitrarily changing calibration parameters, since any changes may compromise precision and/or accuracy.

These selections are provided as part of the overall concept of the 2300 STAT PLUS, flexibility. You may have an application where 5% precision is acceptable if you can guarantee that the instrument will not initiate a calibration at a critical sampling time. This menu allows you to make that possible.

The two displays are shown below, each showing the default value. Near each display block is information related to the range of values that you may enter. Press [ENTER] to confirm and proceed to the next parameter.

Confirm value shown or enter and confirm any number from 1 to 240. The autocal time interval parameter **can not** be disabled. An autocalibration will occur at least once every 240 minutes (4 hours) regardless of how the sample parameter is set.

Enter autocal time interval in minute
> 15

Autocal setup:
1-Time 2-Sample

Confirm value shown or enter and confirm any number of samples from 0 to 200.

Enter number of samples between autocal
0 to disable > 5

Autocal setup:
1-Time 2-Sample

Press [0] to return to RUN mode setup.

RUN mode setup: 1-SampleProtocol
2-AutoStandby 3-AutoCal

You have now completed Run mode setup. Press [0] to return to Select setup menu level.

Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default

Press [4] for Report. The display will read:

Select sample report format: Brief
1-None 2-Brief 3-Detail

Press [ENTER] to confirm sample report format and move to cal report format.

Select cal report format: Brief
1-None 2-Brief 3-Detail

Report Format refers to the information that will be printed each time the 2300 STAT PLUS runs a sample or a calibration. The default settings are "Brief".

Detail report formats are typically used when you want to study probe currents and temperature changes with newly installed reagents or enzyme membranes. You may also elect to choose Detail report for the first few calibrations or samples after a long idle period where no samples or cals are run. If you suspect problems with the instrument, you should run Detail reports to provide more information for troubleshooting.

See Appendix J—Report Formats for example report formats.

Press [0] to return to Select Setup.

Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default

You have completed Report setup.

Press [5] for PrntSetup. The display will read:

Printing instrument setup... Please wait

The instrument will print the setup information you have entered. The information is an itemized list of the key parameters that you have chosen. The printing will take about 45 seconds and use about 15 cm (6 inches) of printer paper. See Appendix I for a sample printout.

When printing is completed the instrument returns to Select setup menu.

Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default

You have completed Print Setup (PrntSetup) level.

Press [6] for Default. The display will read:

Reset all system parameters? No
1-No 2-Yes

This menu allows you to reset all system parameters to the default settings, that is, those that reside in ROM (Read Only Memory) when the instrument is manufactured. **DO NOT DO THIS AT THIS TIME!** If you have been entering setup information for a particular application, resetting to Default will clear some or all of your selections and restore Default system parameters.

You will likely use Default to return to YSI-recommended settings if you have been experimenting with the selections and would like to start at the beginning.

Press [ENTER] to confirm your choice and return to Select setup.

**Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default**

Press [0] to return to Select instrument function.

**Select instrument function
1-Service 2-Setup 3-Diagnostic**

YOU HAVE NOW COMPLETED THE SETUP MENU OF THE SOFTWARE.

As you gain more familiarity with the 2300 STAT PLUS menus, the setup will not seem so complicated. You will learn to "jump in and out" of the menus quickly, sometimes not even needing to exit RUN or STANDBY mode to make a change.

When you have completed Service, Setup or Diagnostic functions press [0] (or [MENU]) to return to Main Menu. From Main Menu you may enter RUN or STANDBY modes.

**Please select instrument mode
[RUN] [STANDBY] [MENU]**

5.4 Diagnostic Selections

Diagnostic menu functions are used primarily during troubleshooting. In this menu, you will learn to gain individual control of components in the instrument. For example, you can turn motors on and off, and even "exercise" motor-controlled devices. You can run pumps to check fluid movement. You can check probe electrical current and even simulate a calibration or sample cycle. You can check I/O (input/output) devices such as display, keypad and printer for proper function. And finally, you can check the status of most sensors in the system. These include the temperature sensor in the Sample Chamber; the level sensors in the reagent and waste bottles; the Sipper capacitance sensing; and the optical sensors that control motors, the Sipper Pump and sense the Test Tube Holder position.

Follow the display prompts and information below to learn about the 2300 STAT PLUS menu diagnostics mode. As before, you will often need to press [0] to return to a previous menu level. Occasionally, the instrument will print diagnostic information.

Refer to Figure 4.3 below to become familiar with major components of the instrument. Additional figures in Sections 4 and 5 may be useful, especially Figure 5.2, Menu Flow Chart.

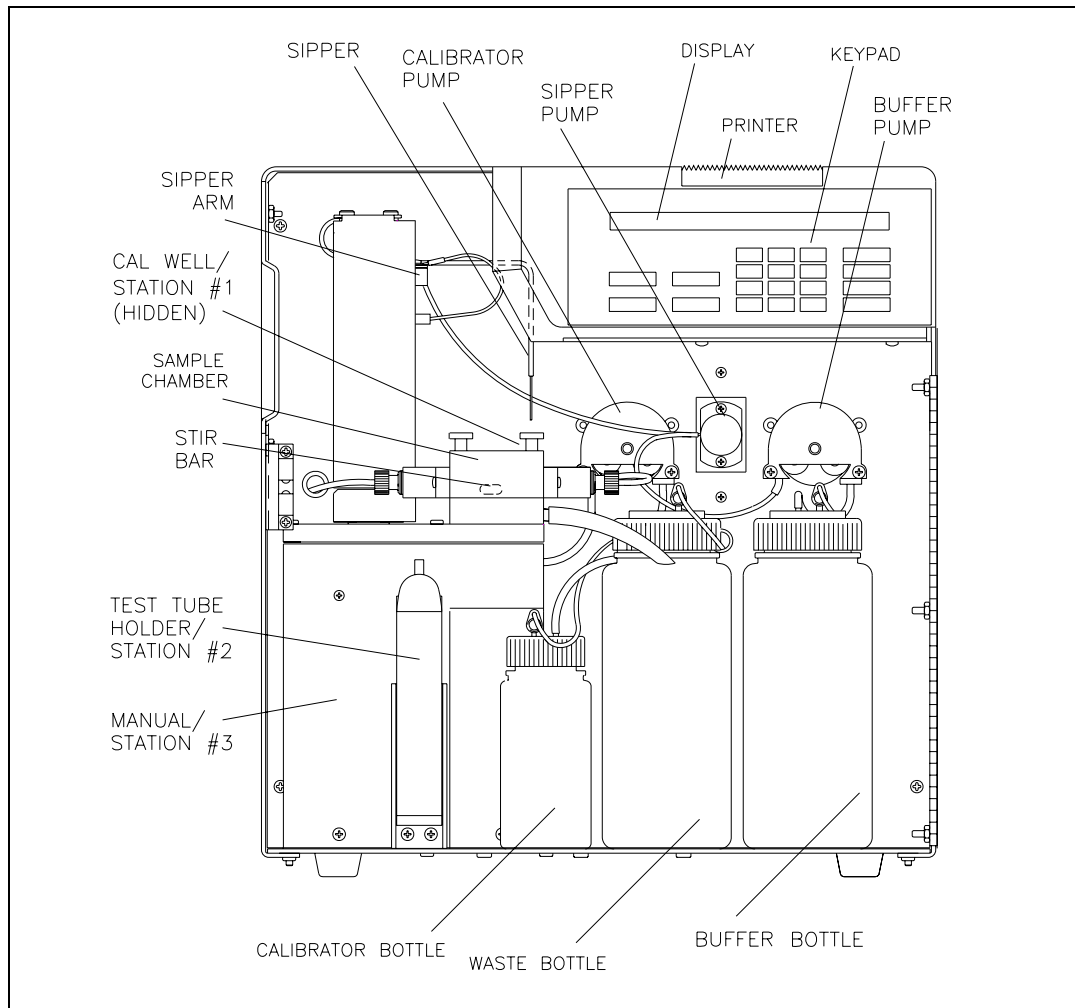


Figure 5.3
2300 STAT PLUS Major Components

As discussed in the Introduction to this section, you must exit RUN Mode or STANDBY Mode to gain complete access to the diagnostic menu functions. To exit Run or Standby modes, press the appropriate key ([RUN] or [STANDBY]), then follow the prompts to exit. You will now be in Main Menu mode and the display will appear as shown below.

Please select instrument mode
[RUN] [STANDBY] [MENU]

Press [MENU], then [3] for Diagnostic to display the five categories of diagnostic selections.

Select instrument function
1-Service 2-Setup 3-Diagnostic

Select diagnostic
1-Motor 2-Pump 3-Probe 4-I/O 5-Sensor

Press [1] for Motor to gain access to two motors, the Sipper Arm assembly (vertical and horizontal motions) and the Stir Motor that turns the magnetic stir bar in the Sample Chamber.

Motor diagnostic
1-Sipper motor 2-Stir motor 3-Turntable

Press [1] for Sipper motor to display the following motion selections.

Sipper diagnostic: 1-Up 2-Down 3-Home
4-Clockwise 5-Counterclock 6-Exercise

When you press one of the keys (1-5), a movement of the Sipper should be observed. Press [1] and the Sipper moves up until the upper limit optosensor is detected. Press [2] and the Sipper moves down into the Sample Chamber or to its limit, if at another station.

In the horizontal plane, press [3] and the Sipper moves to the position directly over the Sample Chamber opening. Press [4] and the Sipper moves horizontally clockwise one station, for example from "home" to Test Tube Holder Station (Station #2). Press [5] and the Sipper moves horizontally counterclockwise one station, for example from Manual Station (Station #3) to Test Tube Holder Station (Station #2).

If the Sipper is "down" and you press a command for horizontal movement, the Sipper first moves up before beginning horizontal motion.



CAUTION: Before you initiate exercise in the horizontal plane, remove the left side access plate to prevent damage if the sipper moves to the turntable position. If you have a turntable installed properly, the access plate will already be removed.

Press [6] to initiate repeated motions in the same plane. We refer to this as "Exercise". The motion (horizontal or vertical) is determined by the last command you choose. The instrument counts the number of cycles and displays them as shown below. When you press a key to terminate the exercise mode, the printer records the activity and number of cycles completed.

Exercising sipper motor
Cycle = 3 Hit any key to stop

Press [0] to return to Sipper diagnostic selections.

Sipper diagnostic: 1-Up 2-Down 3-Home
4-Clockwise 5-Counterclock 6-Exercise

Press [0] again to return to Motor diagnostic selections.

Motor diagnostic
1-Sipper motor 2-Stir motor 3-Turntable

Press [2] for Stir motor to turn on the motor that spins the magnetic stir bar in the Sample Chamber. The bar should spin in "synch", i.e., not "jump" about the chamber as is observed during brief periods of normal operation. The asynchronous motion is used to dispel air bubbles from the chamber wall and probe surfaces.

You turn the Stir Motor off by pressing [2] again. The Stir motor may be activated with the Sipper either in or out of the Sample Chamber.

Motor diagnostic
1-Sipper motor 2-Stir motor 3-Turntable

Press [0] to return to the five diagnostic selections.

Select diagnostic
1-Motor 2-Pump 3-Probe 4-I/O 5-Sensor

Press [2] for Pump to access the Sipper Pump, Calibrator Pump and Buffer Pump.

Pump diagnostic
1-SipperPump 2-Buffer 3-Calibrator

Press [1] for Sipper Pump to begin a sequence of five distinct movements of the plunger rod in the Sipper Pump. Locate the Sipper Pump, a clear plastic cylindrical body mounted between the two peristaltic pumps on the fluid wall. See Figure 7.2. Focus on the metal plunger rod inside this plastic body. Some movements will be brief, so watch closely.

Sipper pump diagnostic
1-Home

Press [1] for Home. You will see a small movement of the plunger, but you will hear a clicking sound that lasts 3 or 4 seconds as the pump motor oversteps to detect "home".

The display will now update to give two new selections as shown below.

Sipper pump diagnostic
1-Home 2-Aspirate separator 3-Exercise

Press [2] for Aspirate separator. A short retraction of the plunger should occur. This simulates the aspiration of an air bubble to isolate sample from the buffer stream. The display updates to read the following.

Sipper pump diagnostic
1-Home 2-Aspirate sample 3-Exercise

Press [2] for Aspirate sample. A longer retraction of the plunger should occur. This simulates the aspiration of sample. The display updates to read the following.

Sipper pump diagnostic
1-Home 2-Dispense sample 3-Exercise

Press [2] for Dispense sample. An extension of the plunger should occur. This simulates dispensing the sample into the Sample Chamber. The display updates to read the following.

Sipper pump diagnostic
1-Home 2-Dispense separator 3-Exercise

Press [2] for Dispense separator. A short extension of the plunger should occur. This simulates dispensing the air bubble into the Sample Chamber after the sample reading at the probe would have occurred. The plunger is now back to "home" position.

Sipper pump diagnostic
1-Home 2-Aspirate separator 3-Exercise

Press [3] for Exercise. All of the plunger movements will occur in the sequence described above.

The complete retraction and extension represents one cycle. The cycle number is displayed.

Exercising sipper pump
Cycle = 3 Hit any key to stop

When you press a key to terminate the exercise mode, the printer records the activity and number of cycles completed. The display returns to Sipper pump diagnostic menu.

Sipper pump diagnostic
1-Home 2-Aspirate separator 3-Exercise

Press [0] to return to Pump diagnostic menu.

Pump diagnostic
1-SipperPump 2-Buffer 3-Calibrator

Press [2] for Buffer to turn on the Buffer Pump. The pump runs until you press [2] a second time. The display does not change messages during this activity. You should hear the pump and see fluid moving through the Sample Chamber and exiting through the opening of the steel cone, then through the Waste Tube to the Waste Bottle.

Pump diagnostic
1-SipperPump 2-Buffer 3-Calibrator

Press [3] for Calibrator to turn on the Calibrator Pump. The pump runs until you press [3] a second time. The display remains as shown below. You should hear the pump, and see fluid moving into the Cal Well of the Sample Chamber Block, and then flowing out through the Waste Tube to the Waste Bottle.

Pump diagnostic
1-SipperPump 2-Buffer 3-Calibrator

Press [0] to return to the five diagnostic selections.

Select diagnostic
1-Motor 2-Pump 3-Probe 4-I/O 5-Sensor

Press [3] for Probe. You will observe a brief display message, as shown below, which then changes to show probe currents. The probe activity is expressed in nA (nanoamperes) of electrical current. A nanoampere is 10^{-9} amperes, which is a very low level of electrical current.

Reading probe current...
Please wait.

B:LAC 0.50 nA W:GLU 0.76 nA
1-Flush 2-Calibrator 3-Sample

NOTE: If you assign "none" for a probe in the Setup (measurement parameters) menu, the display appears as shown below.

B:LAC 0.50 nA W: -Not assigned-
1-Flush 2-Calibrator 3-Sample

Press [2] for Calibrator. The Calibrator Pump turns on as the Sipper moves to the Cal Well and descends. Calibrator solution is aspirated, then moved to the Sample Chamber and dispensed, just as you would observe in a normal calibration cycle.

The display probe current should rise above baseline and within 20 to 30 seconds should level off at some nanoampere value indicative of the particular chemistry you have setup.

B:LAC 11.77 nA W:GLU 23.17 nA
1-Flush 2-Calibrator 3-Sample

Next, press [1] for Flush to clear the calibrator solutions from the Sample Chamber. The flush will take about 30-40 seconds. If the baseline has not returned to levels you previously observed, you may want to initiate a second flush cycle. Baseline values are shown again below.

B:LAC 0.55 nA W:GLU 0.80 nA
1-Flush 2-Calibrator 3-Sample

Press [3] for Sample. The Sipper will move to the assigned sample station and aspirate sample, then move to the Sample Chamber to dispense sample, just as was observed in the calibrator cycle above. Again, you must initiate the flush cycle by pressing [1] for Flush. Probe current values will vary based on concentrations used for sampling.

B:LAC 91.83 nA W:GLU 112.9 nA
1-Flush 2-Calibrator 3-Sample

Press [0] to return to the five diagnostic selections.

```
Select diagnostic
1-Motor 2-Pump 3-Probe 4-I/O 5-Sensor
```

Press [4] for I/O. From this menu level you can run diagnostic tests on the input/output devices of the instrument.

```
I/O diagnostic
1-Keypad 2-Display 3-Printer
```

Press [1] for Keypad. You may now test each of the 20 keys on the keypad. There are 12 numeric keys (including space and backspace) and 8 function keys. To exit the keypad test, press and hold [CANCEL].

```
Hit keys - Hold [CANCEL] to exit
Key>
```

When you press and immediately release a key, we refer to this as a "hit". The following will be displayed (example is [RUN] key).

```
Hit keys - Hold [CANCEL] to exit
Key> [RUN] hit
```

When you press and hold a key down and then release it, the following display messages should be observed.

```
Hit keys - Hold [CANCEL] to exit
Key> [RUN] held down
```

```
Hit keys - Hold [CANCEL] to exit
Key> [RUN] released
```

To exit the keypad test, press and hold down the [CANCEL] key.

```
Hit keys - Hold [CANCEL] to exit
Key> [CANCEL] held down
```

The following message appears after you exit the keypad test.

I/O diagnostic
1-Keypad 2-Display 3-Printer

Press [2] for Display. You should now see 95 different characters (including a blank) appear in each of the 40 segments of the liquid crystal display. The total test takes about 40 seconds. Terminate the test at any time by pressing any key. The first few characters are shown below.

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!  
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

```
.....  
.....
```

```
#####  
#####
```

```
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$  
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
```

I/O diagnostic
1-Keypad 2-Display 3-Printer

Press [3] for Printer. The printer prints the same 95 characters described above in the display test. The printout uses 5 lines and takes about 10 seconds to complete. The display momentarily flashes the message "Printer test", then returns to I/O diagnostic menu.

Printer test

I/O diagnostic
1-Keypad 2-Display 3-Printer

Press [0] to return to the five diagnostic selections.

Select diagnostic
1-Motor 2-Pump 3-Probe 4-I/O 5-Sensor

Press [5] for Sensor. You may select one of three categories of sensors: temperature, fluid level or detection, and optosensors for a variety of motion status signals.

Sensor diagnostic
1-Temperature 2-LevelSensor 3-OptoSensor

Press [1] for Temperature. The display shows the current temperature of buffer in the Sample Chamber. The temperature display is "live", i.e., changes will be updated continuously.

Reading sample chamber temperature...
Please wait

Sample chamber temperature: 25.10 C
Hit any key to exit

Sensor diagnostic
1-Temperature 2-LevelSensor 3-OptoSensor

Press [2] for LevelSensor. You will observe the current status of each of the four level sensors shown below. The Sipper will show "fluid" or "air". The Cal and Buffer will show "OK" or "Empty". The Waste will show "OK" or "Full".

Level sensor status: Sipper:Fluid
Cal:OK Waste:OK Buffer:Empty

Press [0] to return to Sensor diagnostic menu.

Sensor diagnostic
1-Temperature 2-LevelSensor 3-OptoSensor

Press [3] for OptoSensor. Optosensors are used to track horizontal and vertical movement of the Sipper, the movement of the Sipper Pump plunger and the presence of a test tube in the Test Tube Holder.

Opto sensor status: Horiz:OFF Vert:ON
SipperPump:ON TestTube:ON

If the Sipper is positioned at Station #2 or #3, the Horiz message should be OFF; if at "home" or Station #1, the message should be ON.

If the Sipper is down in the Sample Chamber, the Vert message should be OFF; if up, the message should be ON.

If the Sipper Pump plunger is at "home", i.e. extended, the SipperPump message should be ON; if the plunger is in any position other than home, the message should be OFF.

If there is a test tube in the Test Tube Holder and it is in a vertical orientation, the "TestTube" message should be ON; if not, then the message should be OFF.

Press [0] to return to Sensor diagnostic menu.

Sensor diagnostic
1-Temperature 2-LevelSensor 3-OptoSensor

Press [0] to return to the five diagnostic selections.

Select diagnostic
1-Motor 2-Pump 3-Probe 4-I/O 5-Sensor

Press [0] to return to Select instrument function.

Select instrument function
1-Service 2-Setup 3-Diagnostic

Press [0] to return to Main Menu display.

Please select instrument mode
[RUN] [STANDBY] [MENU]

NOTE: You may press [MENU] from most levels of diagnostics to return directly to Main Menu.

You now have had a complete look at the Diagnostic Menu. You may press [RUN] or [STANDBY] to enter an operating mode, or remain in Main Menu indefinitely, however, note that no automatic calibrations or sample chamber flushes will occur in this mode.

6. Principles Of Operation

6.1 Sensor Technology

The sensor technology of the YSI 2300 STAT PLUS 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 in the YSI 23A Blood Glucose Analyzer; then later in the YSI 27 Industrial Analyzer and the YSI 23L Blood Lactate Analyzer. Most recently, the same technology has been employed in the YSI 2700 SELECT Biochemistry Analyzer and the YSI 1500 SPORT Lactate Analyzer.

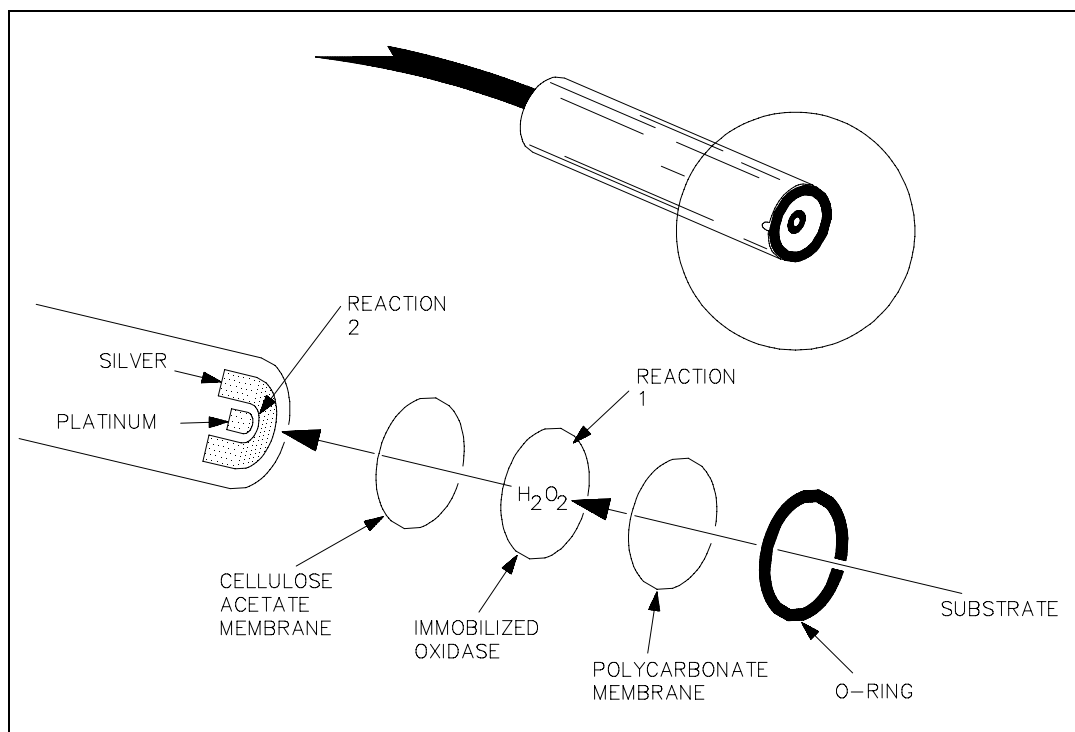
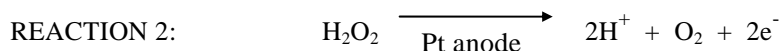
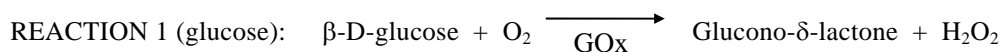


Figure 6.1
Sensor Probe and Enzyme Membrane

Each probe is fitted with a three-layer membrane containing immobilized enzyme in the middle layer. Figure 6.1 shows an exploded view of the membrane and its relationship to face of the probe.

The face of the probe, covered by the membrane, is situated in a buffer-filled sample chamber 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 6.3). The electron flow is linearly proportional to the steady state H_2O_2 concentration and, therefore, to the concentration of the substrate.



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 mercaptans, hydroxylamines, hydrazines, phenols and anilines.

6.2 Fluid System

The 2300 STAT PLUS fluid and electromechanics system is schematically described below in Figure 6.2.

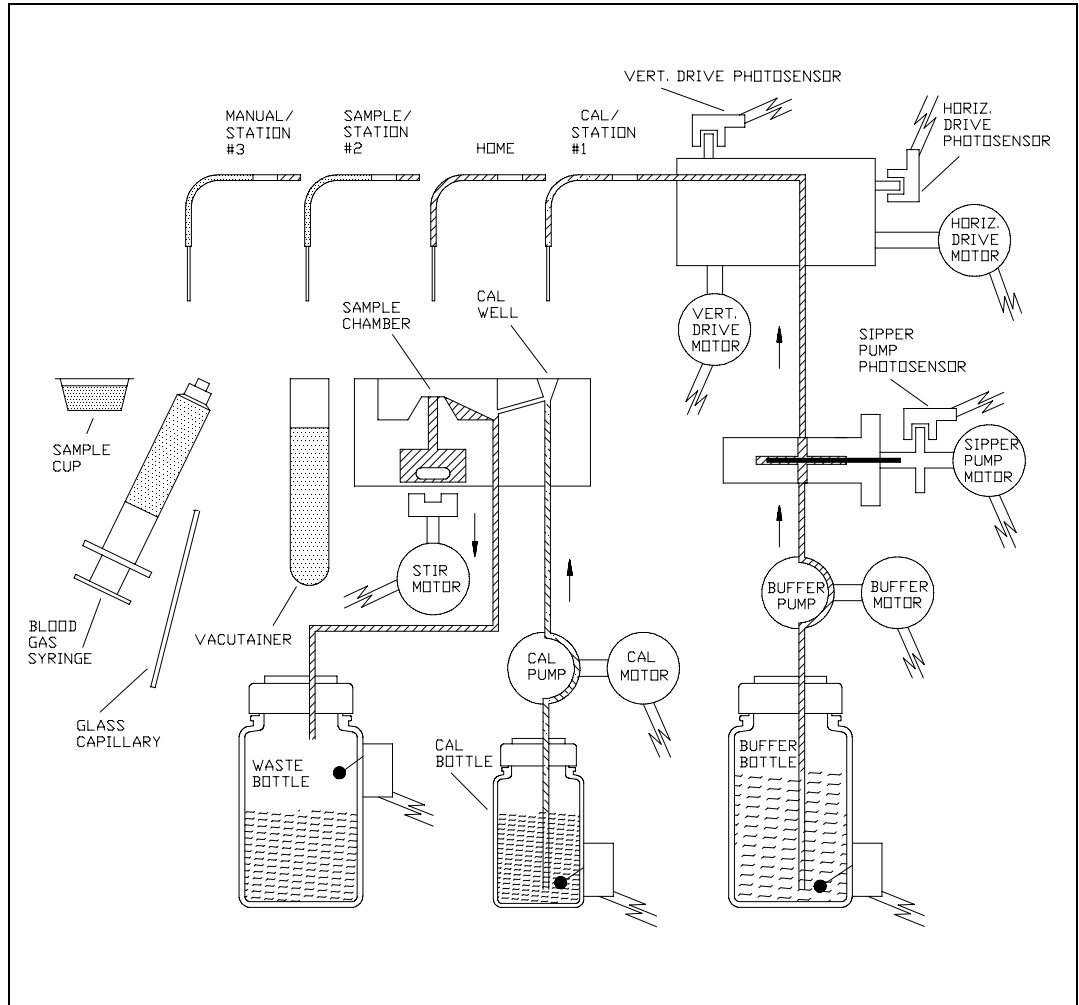


Figure 6.2
2300 STAT PLUS Fluid System

6.3 Measurement Methodology

The 2300 STAT PLUS employs a steady state measurement methodology. A typical sensor response is shown in Figure 6.3.

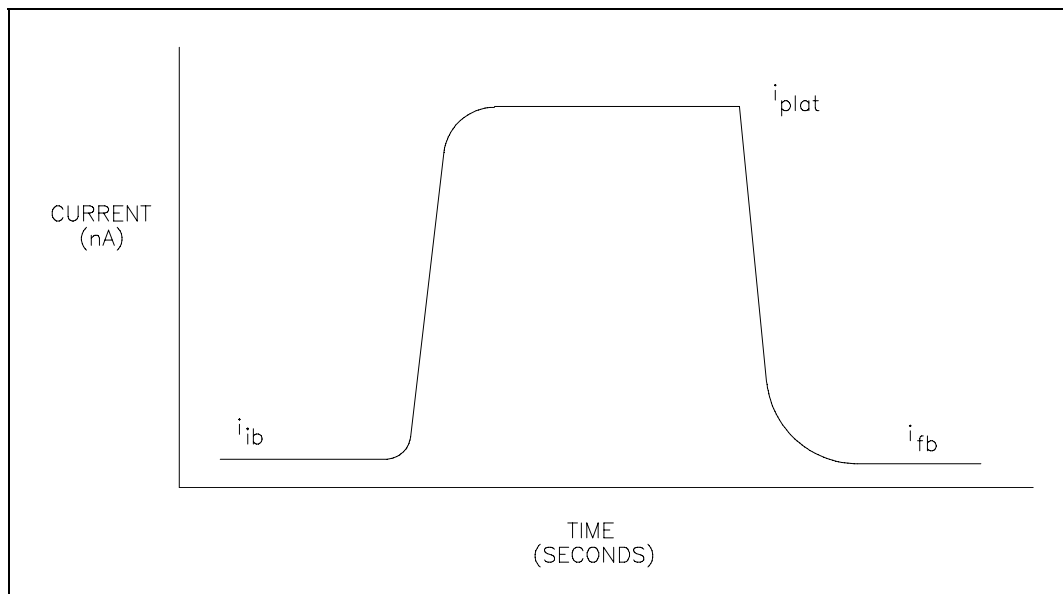


Figure 6.3
Typical Sensor Response

When sample or calibration standard is dispensed into the chamber, it is diluted into 600 microliters of buffer. The sensor response increases and plateaus. After several seconds, the buffer pump flushes the chamber 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 2300 STAT PLUS are between 10 and 25 nA (nanoamps) for YSI calibration solutions. The maximum net probe current is about 500 nanoamps.

6.4 Baseline Stability

The 2300 STAT PLUS monitors the probe baseline current for nA activity and stability. If an unstable baseline is detected, the buffer pump will continue to flush the sample chamber with buffer. When a stable baseline is established, an automatic calibration is initiated.

After every calibration and sample, the final baseline current (i_{fb}) is compared to the initial baseline current (i_{ib}) during the flush cycle. If a significant shift is detected, the buffer pump continues to flush. 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.

6.5 Calibration

To maintain a sample ready status, the 2300 STAT PLUS self-calibrates. Calibrating establishes the sensors' response, in nanoamps of current, to a known concentration of substrate.

The sensors calibration response must be above 5 nA. A response below this value will result in an error.

The 2300 STAT PLUS self-calibrates when entering RUN Mode. While in RUN Mode, it calibrates every 5 samples or 15 minutes. However, default calibration parameters can be altered to tighten or loosen calibration specifications. In RUN Mode a manual calibration can be initiated by pressing [CALIBRATE] or by remote control through an RS-232 interface.

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 currents occurs, the instrument repeats calibration. The sensors' net current for a calibration is displayed and printed. An unstable calibration is displayed and printed as a "cal shift". While establishing a stable calibration, the 2300 STAT PLUS will run 5 calibrations before the error 'unable to calibrate' is displayed.

In summary, by the default calibration settings, recalibration will occur after every 5 samples or 15 minutes, after a calibration shift of 2% or greater, or after a sample chamber temperature drift of more than 1°C. After 5 attempts without successfully calibrating, the instrument displays a calibration error message.

6.6 Linearity

As discussed in Section 6.1, a sensor consists of an electrode and an enzyme membrane. As a membrane ages, its response becomes non-linear (shown in Figure 6.4).

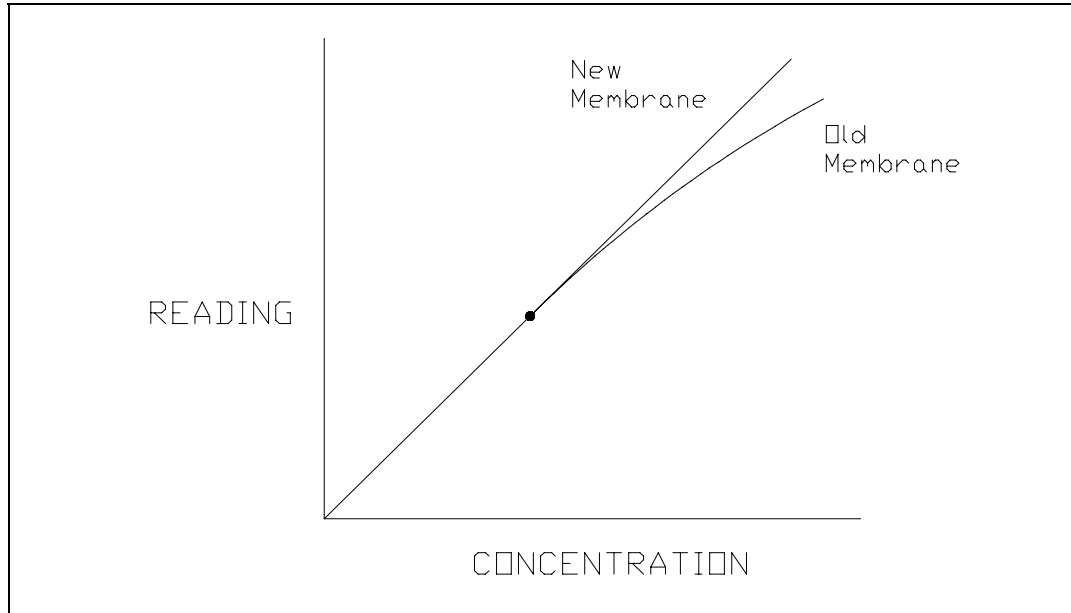


Figure 6.4
Aging Membrane Response

Under optimal conditions the 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. See Appendix E—YSI Supplies and Reagents for product information.

6.7 Temperature Compensation

The sensitivity of the sensors, in the 2300 STAT PLUS, varies with temperature changes. The temperature probe in the sample chamber monitors the fluid temperature very near to the enzyme sensor. The sample results are temperature corrected for the difference in temperature between the sample and the calibration.

6.8 Level Sensing and Sipper Interference

The 2300 STAT PLUS employs capacitive level sensing on the Sipper and in the calibrator, waste and supply bottles.

The Sipper level sensor detects the sample surface at the Test Tube Sample station and then travels into the sample about 3 millimeters. This controlled immersion depth permits the use of sample tubes that are filled to different heights without significant carry-over between samples. This same technique can be employed when using the optional 2710 Turntable (See Section 10).

The Sipper and Arm Assembly should never be touched while the unit is in operation. As an extra safety precaution, the Sipper detects contact with a conductive body, such as a hand. If a conductive body is detected, the Sipper immediately stops, waits for several seconds and then returns to the Sample Chamber.

The calibrator and supply bottles are monitored for low levels and the waste bottle is monitored for high level. The capacitive method depends on close proximity between the bottles and the metal chassis of the 2300 STAT PLUS. The bottles should always rest on the metal floor inside of the instrument. It is also very important that the level sensor cables do not contact the metal chassis.

6.9 Software Structure

The 2300 STAT PLUS has two **operation modes**: **RUN Mode**, where calibration and sample analysis occur and **STANDBY Mode**, where system power is on, but only a few maintenance functions occur. This conserves reagents during extended periods of inactivity.

The 2300 STAT PLUS also has menu selections for service, setup and diagnostics. The Main Menu of the software therefore provides three options: RUN, STANDBY, and MENU.

Figure 6.5 shows you how to move from one mode to another and how to access the different functions within the menu selections and operating modes. The lines of progress are marked with the name or number of the key you press to take that route.

Note that the RUN and STANDBY keys are toggle keys.

You may enter RUN Mode by pressing [RUN] and you may enter STANDBY Mode by pressing [STANDBY]. You may switch back and forth from RUN Mode to STANDBY Mode by using these keys and confirming your choice by pressing [ENTER].

To return to the Main Menu to have access to the full Menu options of Service, Setup and Diagnostics, you must exit RUN Mode or STANDBY Mode by pressing [RUN] to exit RUN Mode or pressing [STANDBY] to exit STANDBY Mode.

You have limited access to Setup options by pressing [MENU] from the RUN or STANDBY modes. This enables you to correct the time or date, change report format or turn on a special feature without leaving the operating mode. The only Setup selections not accessible from RUN or STANDBY mode are "MeasParameter" and "Default", both of which allow you to change parameters that could affect sample results leading to erroneous data.

For detail on menu selections see Section 5. For an overview see Figure 5.2, Menu Flow Chart.

2300 STAT PLUS Software Structure

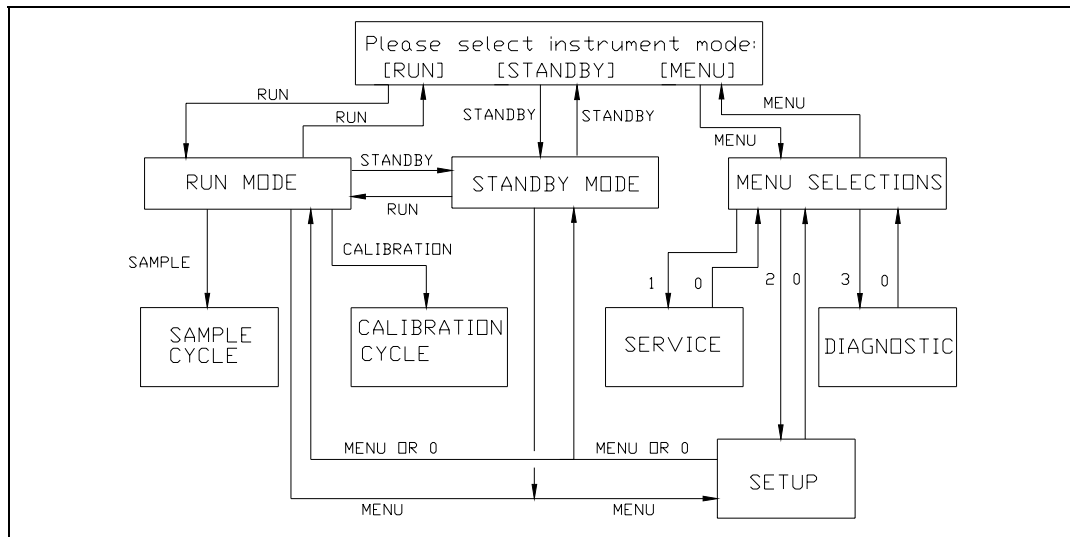


Figure 6.5
2300 STAT PLUS Software Structure

7. Maintenance

Before performing maintenance on the 2300 STAT PLUS, **always** exit RUN or STANDBY Mode. While in these modes, the unit periodically calibrates or flushes. Servicing the fluid system in either RUN or STANDBY Mode can lead to spills or air in the tubing.

To exit RUN Mode, press [RUN] and confirm your intent to exit by pressing [2] for Yes and then [ENTER]. The Main Menu display will appear.

To exit STANDBY Mode, press [STANDBY] and confirm your intent to exit by pressing [2] for Yes and then [ENTER]. The Main Menu display will appear.

Main Menu display:

Please select instrument mode
[RUN] [STANDBY] [MENU]

Preventive Maintenance

The YSI 2788 Preventive Maintenance Kit contains all supplies necessary to keep your 2300 STAT PLUS operating properly. Perform the Calibration Pumping System Maintenance detailed in Section 7.2 at least once every month. Perform the maintenance procedures in Sections 7.3 to 7.11 every 6 months or as necessary. Section 7.9 Fuse Replacement is not preventive maintenance, and obviously requires attention only when fuses fail. Section 7.5 Probe Cleaning is not recommended unless problems related to the enzyme sensor system are indicated.

7.1 Daily Maintenance

Empty the Waste Bottle



Dispose of the waste bottle contents in a manner suitable for biohazardous waste. The reagents used in the 2300 STAT PLUS are non-toxic and, unless otherwise specified, consist of a phosphate salt buffer with small amounts of preservatives. Refer to reagent bottle labels and Material Safety Data Sheets for more information.

Check the Calibrator Bottle

If the fluid level is low or the bottle has been in the instrument longer than 30 days, install a new bottle of calibrator solution. Follow the instructions in Section 3.3 Reagent Preparation.

After installation, prime the Calibrator Well. From Main Menu, press [MENU]. See menu information displayed below. Next press [1] for Service, then press [3] for Cal to initiate a 10 second run of the Cal pump.

Please select instrument mode
[RUN] [STANDBY] [MENU]

Select instrument function
1-Service 2-Setup 3-Diagnostic

Select service: 1-Sipper 2-Buffer 3-Cal
4-Stir speed 5-Turntable

Make certain that all air bubbles are out of the calibrator tubing when the new calibration solution is pumped to the Calibrator Well. You may need to initiate a second run to insure the delivery of calibrator solution to the Calibrator Well.

If the calibrator bottle cap assembly needs cleaning, make sure it is thoroughly rinsed and dried before it is attached to a fresh bottle of calibrator solution.

Check the Buffer Bottle

Replace the buffer if the bottle is low or the buffer has been in the instrument longer than 1 week. Follow the instructions in Section 3.3 Reagent Preparation. 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 it in a clean bottle with cap. You should store it at room temperature.

After a buffer change, prime the buffer system. From Main Menu, press [MENU]. See menu information displayed above. Next press [1] for Service, then press [2] for Buffer to initiate a 15 second run of the Buffer pump. Make certain that all air is out of the buffer tubing. Buffer should be exiting the Sipper inside the Sample Chamber and overflowing to waste. You may need to initiate a second or third run of the buffer pump to complete the priming process.

Remember: The fluid level sensor cables should not contact the instrument housing. See Figure 3.3 for proper cable routing.

Check the Printer Paper

Open the Paper Cover on the top of the instrument and check to see that there is sufficient paper. Replace the paper roll as necessary. See Appendix E for replacement part number. Use the [PAPER] key to advance paper into the printer.

Check for Leaks

Examine the tubing for leaks. Also, check for large air bubbles in the tubing. These are caused either by loose connections or worn pump tubing. Refer to Section 7.6 if tubing replacement is needed.

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.

If there is any evidence of salt build-up around the base of the sample chamber, follow the procedure in Section 7.3 to disassemble the chamber and clean the base. Check that the drain tube fits tightly over the fitting at the bottom of the chamber. If loose, replace the tubing.

Daily Operational Checks

To verify proper instrument performance, perform the daily operational checks described in Section 4.4.

7.2 Calibration Pumping System Maintenance

Perform this procedure at least once a month, to minimize the possibility of contamination. The most convenient time to perform this maintenance is before installation of a new bottle of calibration standard at Station #1.

Exit Run or Standby Mode to prevent autoflushing and autocalibrations. This also allows you to access Service Menu from the keypad.

Press [MENU], then [1], for Service.

Prepare about 100 mL of a nominal 1% solution of hypochlorite (1 part commercial bleach with 3 parts deionized or distilled water) and place this solution in a clean 250 mL bottle that has threads compatible with the Cal Cap Assembly at Station #1.

Attach the Cal Cap Assembly, tighten, and shake gently to insure thorough washing of the inside of the cap assembly.

From the Service Menu, initiate cal priming to flush hypochlorite solution through the pump tubing and steel tubes to the Sample Chamber Waste Bottle. Repeat this flush cycle 3 times, wait 10 minutes, then flush one more time.

Remove and discard the hypochlorite solution, then rinse the bottle thoroughly with water. Next, add deionized or distilled water to the bottle, reattach the Cal Cap Assembly at Station #1, and shake gently to thoroughly rinse the inside of the cal cap.

From the Service Menu, initiate 3 flushes to rinse the tubing and steel tubes with water.

Remove the Cal Cap Assembly, flush one time with air, and wipe the cal cap and steel tubes with a clean laboratory tissue.

Install a new bottle of calibration standard and mark the installation date on the bottle as described in Section 3.3 Reagent Preparation.

From the Service Menu, initiate 3 Cal flushes to prime the Calibration Pumping System. You are now ready to re-enter Run Mode.

7.3 Sample Chamber Cleaning

It is necessary to periodically clean both the sample chamber and the base plate it sets on.

Move the Sipper to the manual sample position. From the Main Menu press [MENU]. Next press [3] for Diagnostic, then press [1] for Motor, then press [1] for Sipper motor. Press [1] for Up, to raise the Sipper from the Sample Chamber, then press [4] for Clockwise to move the Sipper over to the Manual Sample position. Note: You must press [4] (Clockwise) twice to reach the manual position. See the menu displays below to better understand this sequence of events.

Please select instrument mode
[RUN] [STANDBY] [MENU]

Select instrument function
1-Service 2-Setup 3-Diagnostic

Select diagnostic
1-Motor 2-Pump 3-Probe 4-I/O 5-Sensor

Motor diagnostic
1-Sipper motor 2-Stir motor 3-Turntable

Sipper diagnostic: 1-Up 2-Down 3-Home
4-Clockwise 5-Counterclock 6-Exercise

Unscrew and remove all three probes from the sample chamber. If your membranes are in good condition (that is, if they pass the tests in Section 4.4) it is not necessary to replace them. It is important that the membranes do not dry out. If the chamber is to be disassembled from the instrument for more than 15 minutes, the membranes should be replaced.

Unscrew the two thumb nuts on top of the sample chamber. Remove the sample chamber and waste chamber from the base plate (see Figure 7.1).

You will need to disconnect the calibrator well tube and the drain tube. Be careful not to discard the small magnetic stir bar. An extra one is supplied in your maintenance kit. Clean the chambers with the appropriate disinfecting agent. After cleaning, flush the chambers with copious amounts of warm water, then rinse with distilled water to remove any traces of the disinfecting agent.

Clean up any salt deposits or fluid on the base plate. Be sure that the base plate and all other parts are dry. Refer to Figure 7.1 and reassemble the chamber. Remember to return the stir bar to the chamber and be sure to install the chamber seal O-ring. Insert the probes into the chamber, installing new membranes (see Section 3.4) or O-rings as necessary. Extra O-rings are supplied in your Preventive Maintenance Kit. Connect the calibrator well tube and drain tube. Refer to Section 3.6 to check the Sipper alignment and prime the buffer and calibration systems.

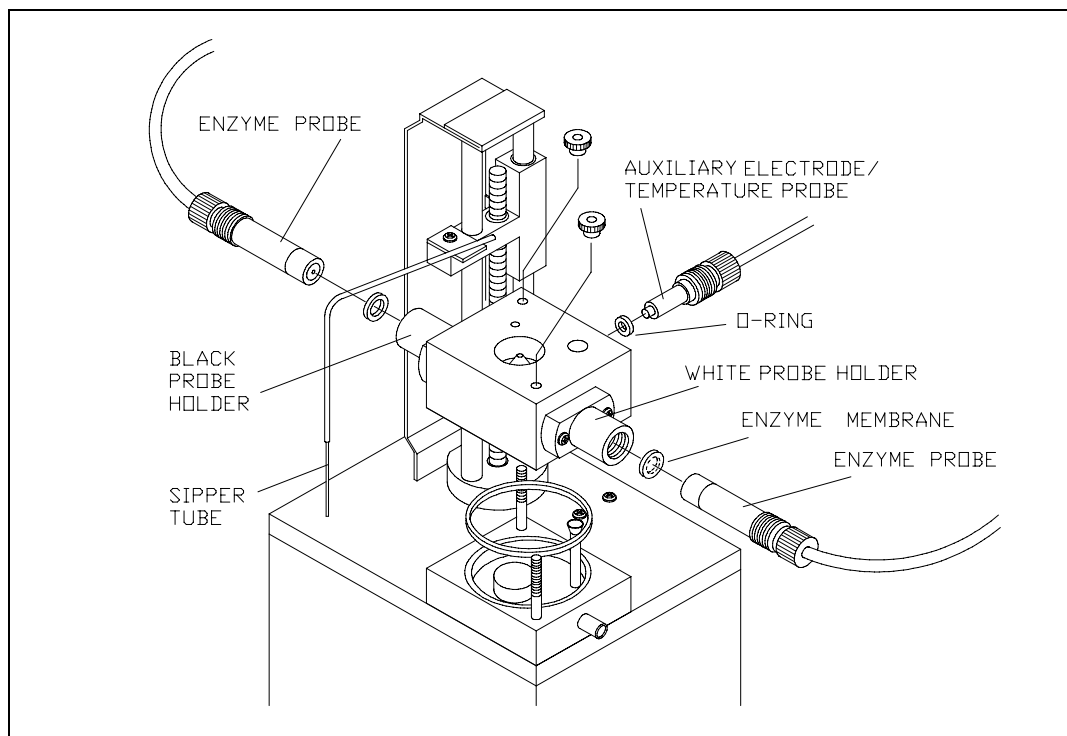


Figure 7.1
Sample Chamber Illustration

7.4 Membrane Replacement

To assure proper performance and prevent unexpected down-time, check membrane integrity and linearity on a daily basis. Refer to Section 4.4 Daily Operational Checks for details. When enzyme membrane installation is required, refer to Section 3.4 Enzyme Membrane Installation.

The typical working life of an enzyme membrane is three weeks for 2365 and two weeks for 2329. You may want to use the expected life as a guideline for scheduling replacement.

7.5 Probe Cleaning

With normal use, enzyme sensors may become fouled and cease to operate in a normal mode. A fouled sensor's output current will decrease and calibration may become unstable. Since the severity of fouling will vary, listed below are methods of cleaning which should be matched to the cleaning needs. Follow the steps carefully and in order.

Sensor Maintenance

It is necessary to maintenance the enzyme sensor when the 2788 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 sensor with reagent grade water and return the sensor to normal service.

Sensor Cleaning and Reconditioning

The following procedure is recommended to be used only when the enzyme sensor stops operating normally and the above maintenance procedure is ineffective. This is not a routine maintenance procedure.

1. With the membrane removed, immerse the sensor in a 14% solution of ammonia for 3 minutes.
2. Immediately after soaking, rinse the sensor with reagent grade water for 3-5 minutes. It is important that all the residual ammonia is removed.
3. Prepare a small amount of 0.5% sodium hypochlorite solution.
4. Immerse the sensor in the solution for 30–45 seconds. Check periodically...sensor should darken, but do not allow it to become black.
5. Remove the sensor and immediately rinse it with reagent water for at least 2 minutes.
6. Install a new membrane and return the probe to service.

The procedure below is only recommended as a last resort for revitalizing a sensor after the above cleaning procedure has been unsuccessfully attempted.



WARNING: The following procedure may cause permanent damage to the enzyme sensor.

1. Using a clean new pencil eraser, carefully, rub the center electrode (platinum) of the sensor. Do not rub the epoxy between the two electrodes or the outer silver electrode.
2. To remove any eraser dust or residual, rinse sensor with 70% isopropyl alcohol and then reagent grade water.
3. Prepare a small amount of 0.5% sodium hypochlorite solution.
4. Immerse the sensor in the solution for about 45 seconds.
5. Remove the sensor and immediately rinse it with reagent grade water for at least 2 minutes.
6. Install a new membrane and return the probe to service.

Note: Several hours may be required for the sensor to stabilize after cleaning.

7.6 Tubing Replacement

The buffer and calibrator pumps in the 2300 STAT PLUS are peristaltic tubing pumps. The tubing life depends on instrument usage. The pump tubes should be replaced at least every 6 months, more frequently if necessary. Other tubes become loose at the fittings and should also be replaced every 6 months.

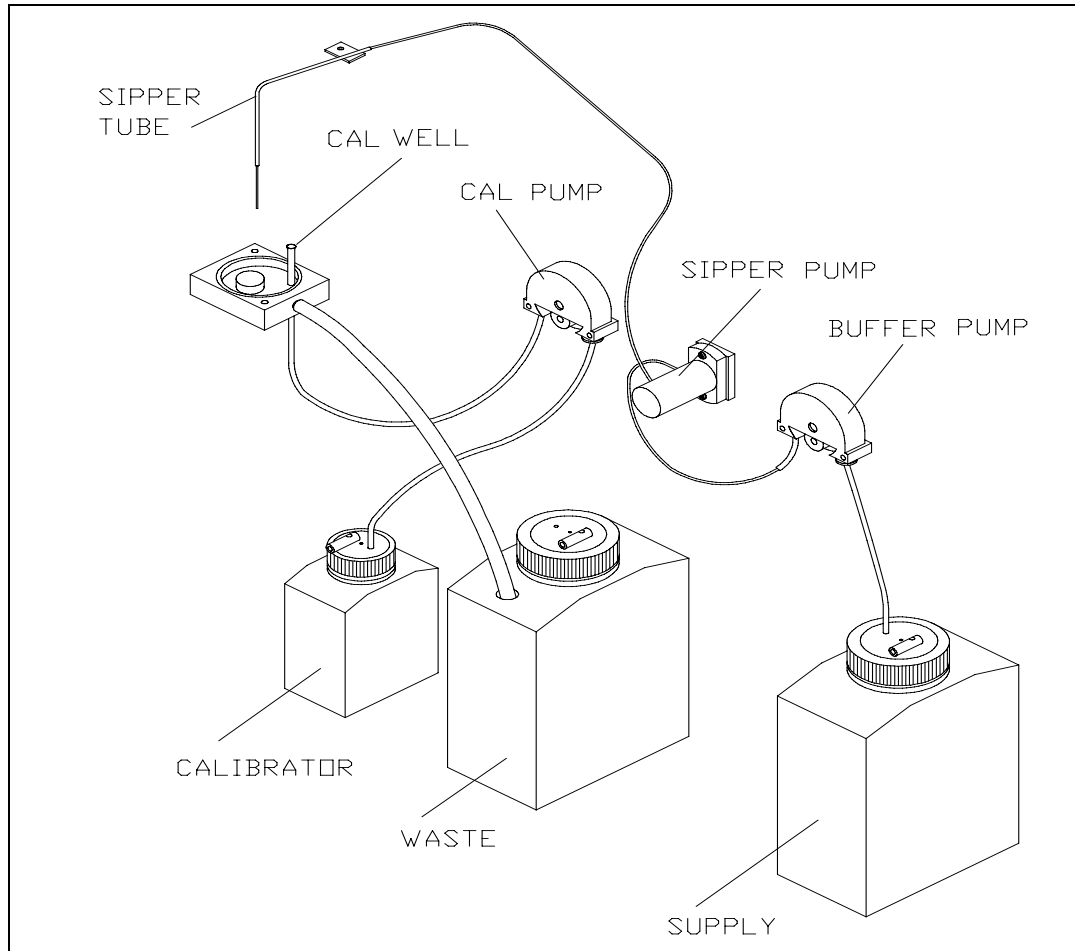


Figure 7.2
Tubing Connections

Remove the screws holding the buffer and calibrator pumps to the instrument wall and remove the pumps. Remove the front housing from each pump by pulling it out at the bottom. Remove the roller assembly and tubing from each pump. Disconnect and remove all the instrument tubing. New tubing is supplied in the Preventive Maintenance Kit. Connect the new tubing as shown in Figure 7.2.

When installing new pump tubing, insert the roller assembly into the rear pump housing (rollers facing out). Starting on one side, place the tubing between the pump housing and roller as shown in Figure 7.3.

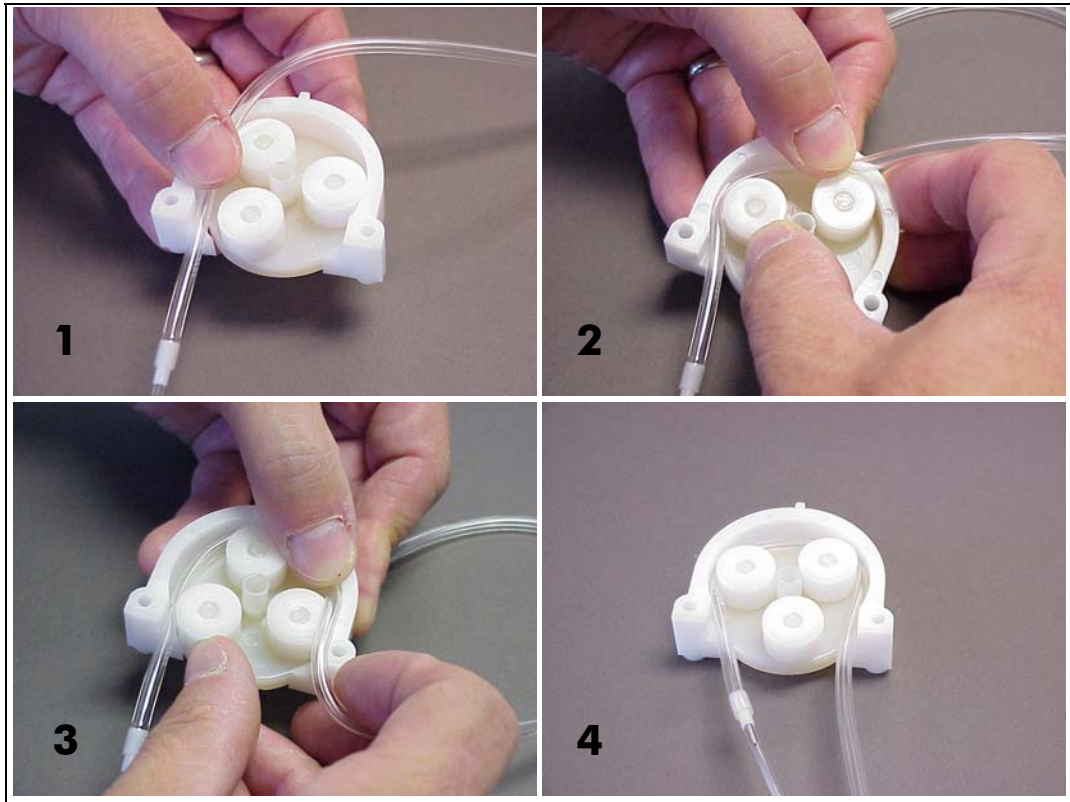


Figure 7.3
Pump Tubing Installation

Make sure that the correct length of tubing is sticking out of the pump (1 to 1½" [2.5 to 3.5 cm] of the large diameter tubing on the left side of the buffer pump), then rotate the roller assembly while pushing the tubing down into the pump ahead of the roller. Once the tubing is installed in the pump, insert that tab on the rear pump housing into the slot at the top of the front pump housing (see Figure 7.4). Lower the front pump housing while guiding the tubing into the slots at the bottom. Gently squeeze the two housings together, while pushing up on the roller assembly.

Align the slot in the rear of the pump with the motor shaft, then slide the pump onto the shaft. Remount the pump to the instrument wall using the mounting screws (pull up on the pump to ease installation of the screws).

Remember to install the tube bushing on the right side of the pump.

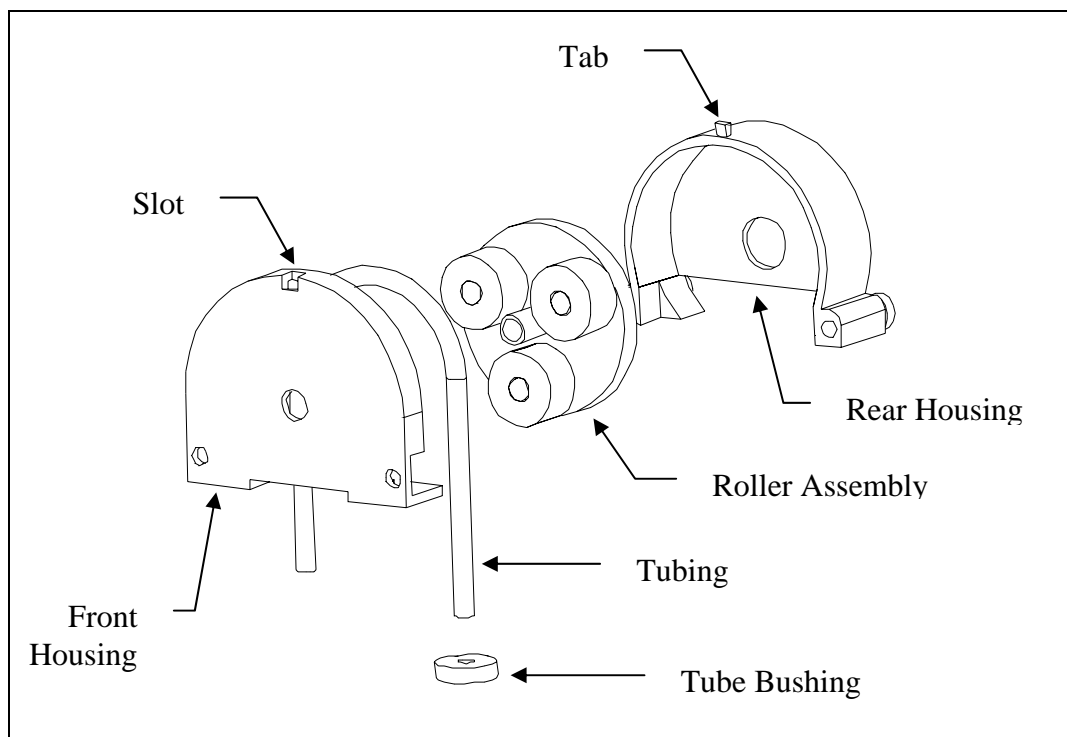


Figure 7.4
Pump Assembly

When all tubes are properly connected, see Section 3.6 to readjust the Sipper and prime the calibrator and buffer systems.

7.7 Sipper Replacement

The Sipper can be damaged if it is not properly aligned or if its alignment is disturbed. If your Sipper needs replaced, remove the screw that mounts it to the sipper arm, disconnect the tubing and remove the Sipper. Install the new Sipper. Reconnect the Sipper ground cable and tubing to the new sipper. Refer to Section 3.6 to readjust the Sipper.

7.8 Sipper Ground Cable

The Sipper Ground Cable flexes with every sample. After several thousand samples, the cable may break. To prevent unexpected down time, replace this cable every 6 months. Extra cables are supplied in the Preventive Maintenance Kit.

Pull the connector out of the printed circuit board on the Sipper Arm. Remove the terminal end of the cable from under the Sipper mounting screw. Install a new cable. Refer to Section 3.6 to readjust the Sipper.

7.9 Fuse Replacement

It may be necessary to replace the fuses in the 2300 STAT PLUS. 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.



WARNING: UNPLUG THE INSTRUMENT FROM THE MAINS SUPPLY.

Using a small screwdriver, pry open the fuse holder on the power receptacle (see Figure 7.5).

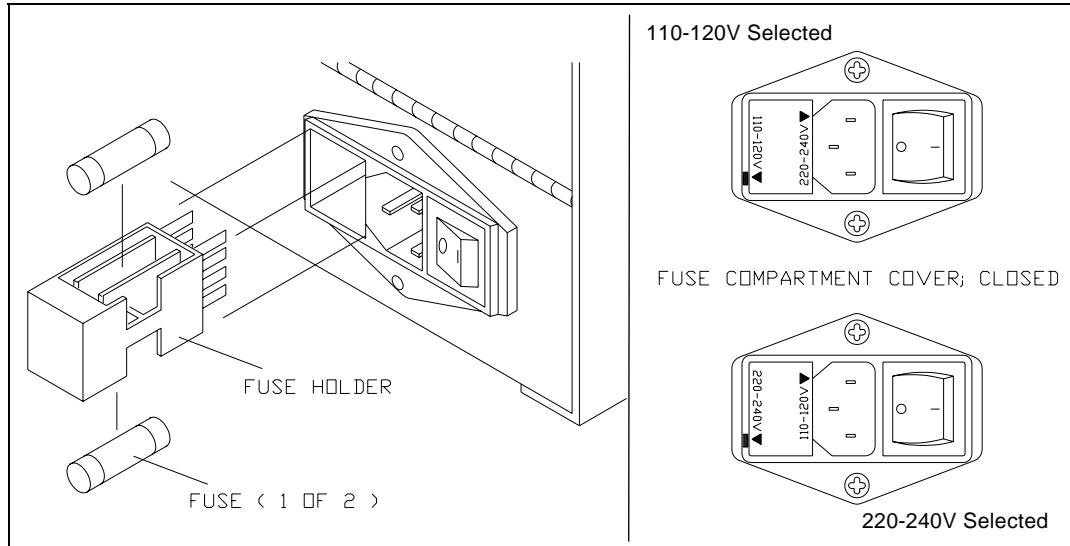


Figure 7.5
Fuse Replacement

Fuse Requirements

Fuse Type: 110-120 VAC Operation -- 1 Amp (YSI #062443, Fast acting)
3AG, 250 volt, 0.25D x 1.25L inches

For Europe and UK use fuse type:

220-240 VAC Operation -- 1/2 Amp (YSI #019722)
Anti-surge(T), 250 volt, 5mm x 20mm (L), IEC127 & BS4265

Install new fuses in place of the old ones and return the fuse holder to the power receptacle. Be certain the correct voltage is selected. The arrowhead on the power selector must be pointing to the small rectangle on the housing, as shown (inset).

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 3.5 Power Up Procedures to confirm correct power up response.

7.10 Sipper Pump Seal Replacement

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

Disconnect the tubings to the Sipper Pump. Remove the Sipper Pump head from the instrument wall (see Figure 7.6).

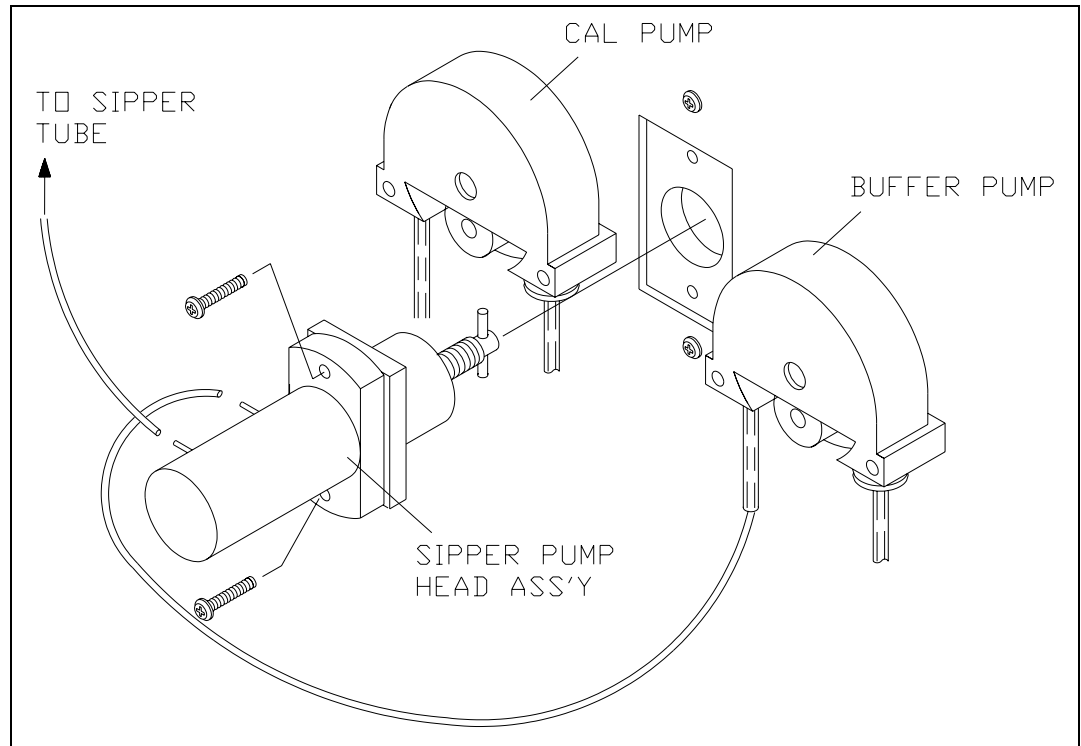


Figure 7.6
Sipper Pump Head Removal

Pull the white pump base from the clear pump housing. If salt deposits have formed on the parts, wash them off with warm water. Replace the seals as shown in Figure 7.6. Extra seals are supplied in the Preventive Maintenance Kit.

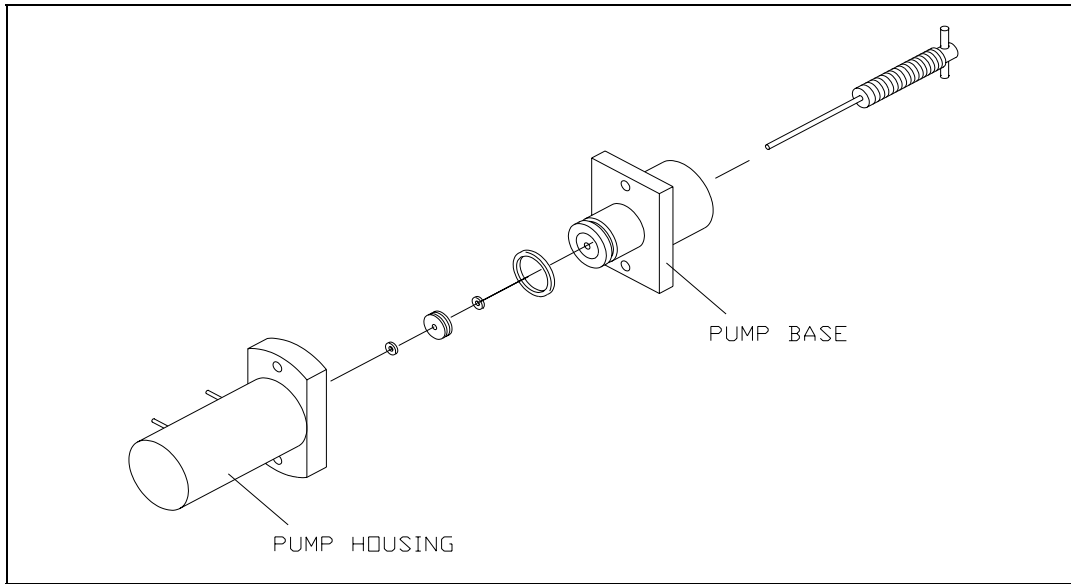


Figure 7.7
Sipper Pump Seal Replacement

Reassemble the pump, position the plunger as shown in Figure 7.8 and install it back on the instrument.

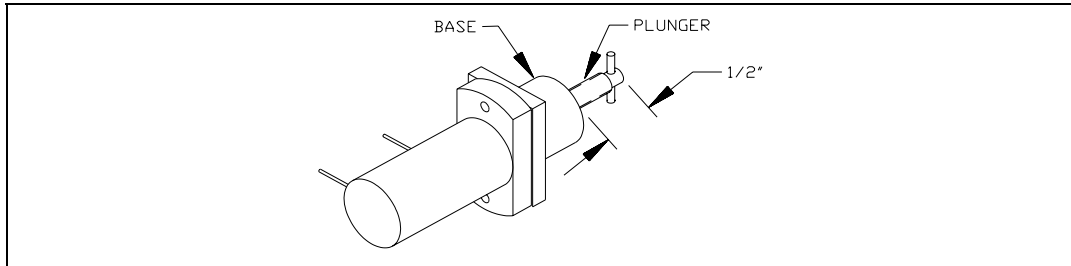


Figure 7.8
Sipper Pump Plunger Position



WARNING: When re-installing the pump head assembly, the plunger **MUST** extend at least $\frac{1}{2}$ " from the base of the pump (see Figure 7.8). This will assure proper alignment between the pump head and the drive hub.

7.11 Sipper Mechanism Lubrication

The sipper mechanism needs only occasional cleaning and lubrication. If the acme screw and guide rods are reasonably clean and have a thin film of lubricant on them, no further maintenance is required. If the screw or either rod has a dirt build-up, or if the mechanism squeaks or jams, then clean the screw and guide rods with a lint-free towel. Apply Lubriplate 105 grease (supplied in YSI 2788 Preventive Maintenance Kit) to two or three threads of the Acme screw. Normal operation will distribute the grease along the length of the screw. Lubricate each guide rod with a drop of light machine oil. Wipe off any excess lubricant promptly.

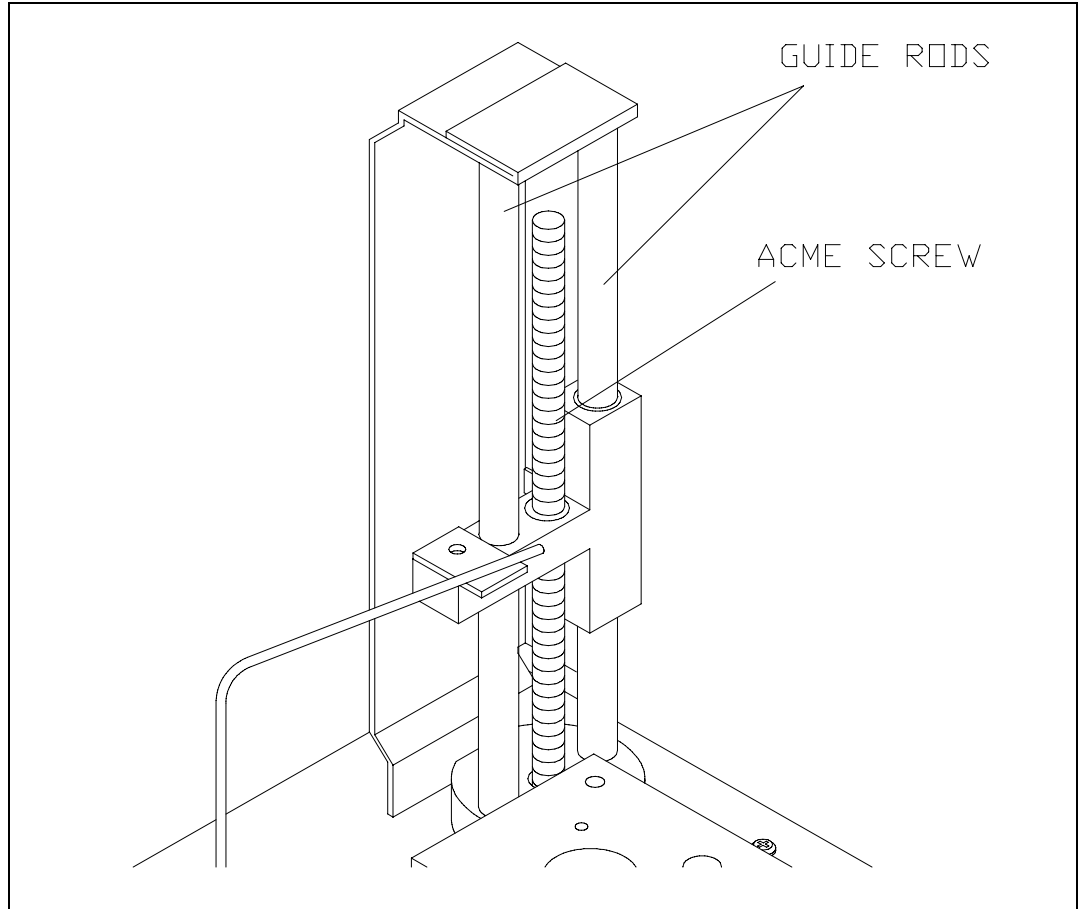


Figure 7.9
Sipper Mechanism Drive Screw and Guide Rods

8. 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 the printed reports for trends in data and errors. Use the detailed format, if possible, 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 chamber, loose connections, noisy components, etc.).
- » Review Section 5.4 Diagnostic Selections to learn more about how you can test individual components of the 2300 STAT PLUS.
- » 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 Customer Service (address and phone information in Appendix F–Warranty and Shipping Information). When communicating with service personnel, please indicate the serial number of the instrument. If writing or transmitting a FAX for assistance, please include a thorough description of the problem and copies of printouts, if possible.

8.1 Printout Information

Refer to Appendix J—Report Formats to learn more about report format options for the 2300 STAT PLUS. 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 both the black and white probes, as well as the temperature probe, is included.

You may access the report format level without exiting RUN or STANDBY modes. Press [menu] on the keypad to display the Select setup menu level. Press [4] for Report to change or confirm sample and calibration formats.

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

Sample Report (Detail)

```
-----Sample Report-----  
ID:      123456789-05-03  
B:L-Lactate 4.82 mmol/L  
  IB current   2.11 nA  
  PL current   118.65 nA  
  Slope        4.6 nA/min  
  End Point    35 Sec  
W:Glucose   8.3 mmol/L  
  IB current   0.88 nA  
  PL current   58.96 nA  
  Slope        2.39 nA/min  
  End Point    35 Sec  
Temperature  26.28 °C  
Sample size   25 uL  
Fri 02/22/03 08:12:34  
YSI 2300D - 03 01234  
-----
```

Calibration Report (Detail)

```
==CALIBRATION REPORT==  
B:Lactate * Unstable *  
  IB current   1.79 nA  
  PL current   11.63 nA  
  FB current   1.51 nA  
*Base shift   -2.65 %  
  Slope        1.42 nA/min  
  End Point    35 Sec  
*Cal shift    3.64 %  
W:Glucose   10.0 mmol/L  
  IB current   0.88 nA  
  PL current   5.81 nA  
  FB current   0.76 nA  
  Base shift   -1.95 %  
  Slope        0.09 nA/min  
  End Point    35 Sec  
Cal shift    -0.10 %  
Temperature  26.33 °C  
Sample size   25 uL  
Thu 02/22/03 14:55:10  
YSI 2300D - 03 01234  
=====
```

IB current (Initial Baseline Current). The initial baseline current is monitored before a sample or calibration and while stabilizing baseline current upon entering RUN Mode. To successfully enter RUN Mode, the IB current must be stable and below 6 nA.

PL current (Plateau Current). The minimum acceptable plateau current is 5 nA. The maximum plateau current is 500 nA. A plateau current larger than this will be printed as a string of asterisks '*****'.

FB current (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.

Base 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 can not adequately flush the chamber.

Slope (Slope of the plateau). See Figure 6.3. 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 chamber until the instrument reads the probe signal. The default value is 35 seconds (Normal Mode). The Screen Mode value is 15 seconds. This value 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.

Cal 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 2300 STAT PLUS performs another calibration. Up to 5 successive calibration shifts are permitted before the 'Unable to calibrate' error is displayed. Excessive calibration shifts may be caused by faulty membranes, newly-installed membranes or air in the sample chamber.

Temperature (Sample Chamber Temperature) The sample chamber temperature is measured during a calibration and a sample. The results of a sample are temperature corrected. The 2300 STAT PLUS works at sample chamber temperatures between 15° and 35°C. The 2300 STAT PLUS only measures and displays temperatures between 10° and 40°C. If the temperature is outside this range, a string of asterisks '*****' will be printed.

8.2 Troubleshooting Chart

SYMPTOM:	ERROR: Baseline
POSSIBLE CAUSE:	Pinched, leaking or disconnected tube.
ACTION:	Fix or replace tubing.
SECTION:	7.6
POSSIBLE CAUSE:	Sipper misaligned.
ACTION:	Check Sipper alignment.
SECTION:	3.6
POSSIBLE CAUSE:	Buffer pump not operating properly.
ACTION:	Replace tubing.
SECTION:	7.6
POSSIBLE CAUSE:	Stir bar not in chamber.
ACTION:	Disassemble chamber and reinstall stir bar.
SECTION:	7.3
POSSIBLE CAUSE:	Newly installed enzyme membrane.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	3.6
POSSIBLE CAUSE:	Newly installed probe.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	3.6
POSSIBLE CAUSE:	Power disruption.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	3.6
POSSIBLE CAUSE:	Failing enzyme membrane.
ACTION:	Perform daily operational checks and replace membrane(s) if necessary.
SECTION:	4.4, 3.4
POSSIBLE CAUSE:	Enzyme Probe surface(s) fouled.
ACTION:	Clean probe surface(s).
SECTION:	7.5
POSSIBLE CAUSE:	Temperature Probe (auxiliary electrode) fouled.
ACTION:	Clean probe surface.
SECTION:	7.5
POSSIBLE CAUSE:	Sample may contain an interfering substance.
ACTION:	Attempt to confirm interference.
SECTION:	Appendix C—Effects of Selected Substances

SYMPTOM:	ERROR: Empty Buffer Bottle
POSSIBLE CAUSE:	Low buffer level.
ACTION:	Refill the buffer.
SECTION:	3.3

SYMPTOM: **ERROR: Empty Buffer Bottle (Continued)**
POSSIBLE CAUSE: Level sensor cable not plugged in.
ACTION: Plug in cable.
SECTION: 3.3

SYMPTOM: **ERROR: Empty Calibrator Bottle**
POSSIBLE CAUSE: Low calibrator level.
ACTION: Install new calibrator.
SECTION: 3.3
POSSIBLE CAUSE: Level sensor cable not plugged in.
ACTION: Plug in cable.
SECTION: 3.3

SYMPTOM: **ERROR: Full Waste Bottle**
POSSIBLE CAUSE: High waste level.
ACTION: Empty bottle.
SECTION:
POSSIBLE CAUSE: Level sensor cable in contact with instrument housing or another conductive body.
ACTION: Reroute cables.
SECTION: 3.3

SYMPTOM: **ERROR: Motor Failure**
POSSIBLE CAUSE: One of the motors is jammed.
ACTION: Enter motor diagnostics and cycle the suspected motor.
SECTION: 5.4
POSSIBLE CAUSE: Dirty drive screw on sipper mechanism.
ACTION: Clean and lightly oil.
SECTION: 7.11
POSSIBLE CAUSE: Worn sipper pump seals.
ACTION: Replace seals.
SECTION: 7.10

SYMPTOM: **ERROR: Overrange**
POSSIBLE CAUSE: Sample concentration too high, resulting in high probe nA.
ACTION: Dilute sample and repeat.
SECTION:

SYMPTOM: **ERROR: Printer Failure Detected**
POSSIBLE CAUSE: Printer paper or roll jam.
ACTION: Open paper well and clear obstruction. Reset instrument, if required.
SECTION: 3.6

SYMPTOM:	ERROR: Sample Chamber Temperature Out of Range
POSSIBLE CAUSE:	Ambient temperature too cold or hot.
ACTION:	Operate at ambient temperatures between 15 and 35 degrees C.
SECTION:	
SYMPTOM:	ERROR: Sipper Interference or Fault in Fluid Level Detector
POSSIBLE CAUSE:	Sipper detects a conductive body.
ACTION:	Repeat sample.
SECTION:	
SYMPTOM:	ERROR: Test Tube Interference
POSSIBLE CAUSE:	Sample tube holder not in position.
ACTION:	Reposition and repeat sample.
SECTION:	
SYMPTOM:	ERROR: Unable to Calibrate
POSSIBLE CAUSE:	Pinched, leaking or disconnected tube.
ACTION:	Fix or replace tubing.
SECTION:	7.6
POSSIBLE CAUSE:	Sipper misaligned.
ACTION:	Check Sipper alignment.
SECTION:	3.6
POSSIBLE CAUSE:	Stir bar not in chamber.
ACTION:	Disassemble chamber and reinstall stir bar.
SECTION:	7.3
POSSIBLE CAUSE:	Newly installed enzyme membrane.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	3.6
POSSIBLE CAUSE:	Newly installed probe.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	3.6
POSSIBLE CAUSE:	Calibrator solution out of spec: contaminated or installed for more than 30 days.
ACTION:	Install new calibrator.
SECTION:	3.3
POSSIBLE CAUSE:	Net calibration current (PL current) below 5 nA.
ACTION:	Replace enzyme membrane and check calibrator solution.
SECTION:	3.4

SYMPTOM:	ERROR: Unable to Calibrate (Continued)
POSSIBLE CAUSE:	Failing enzyme membrane.
ACTION:	Perform daily operational checks and replace membrane(s) if necessary.
SECTION:	4.4, 3.4
POSSIBLE CAUSE:	Probe surface fouled.
ACTION:	Clean probe surface.
SECTION:	7.5
POSSIBLE CAUSE:	Temperature Probe (auxiliary electrode) fouled.
ACTION:	Clean probe surface.
SECTION:	7.5

SYMPTOM:	ERROR: Undetectable Fluid
POSSIBLE CAUSE:	Low calibrator solution.
ACTION:	Install new calibrator.
SECTION:	3.3
POSSIBLE CAUSE:	Pinched, blocked, leaking or disconnected tube.
ACTION:	Fix or install new tubing.
SECTION:	7.6
POSSIBLE CAUSE:	Calibrator pump not operating properly.
ACTION:	Replace tubing.
SECTION:	7.6
POSSIBLE CAUSE:	Low sample level.
ACTION:	Run sample at manual position.
SECTION:	

SYMPTOM:	Blank Printout
POSSIBLE CAUSE:	Printing on wrong side of paper.
ACTION:	Install paper correctly.
SECTION:	3.7
POSSIBLE CAUSE:	Using wrong type of paper.
ACTION:	Install correct thermal paper (YSI 2751).
SECTION:	3.7

SYMPTOM:	Fail FCN Test
POSSIBLE CAUSE:	Damaged or old membrane.
ACTION:	Replace membrane.
SECTION:	3.4

SYMPTOM:	Fail Linearity Test
POSSIBLE CAUSE:	Probe assignment incorrect.
ACTION:	Make correct assignment.
SECTION:	3.8
POSSIBLE CAUSE:	Damaged or old membrane.
ACTION:	Replace membrane.
SECTION:	3.4
POSSIBLE CAUSE:	Contaminated or old calibration or linearity standard.
ACTION:	Repeat test with new standards.
SECTION:	4.4

SYMPTOM:	Keypad Disabled
POSSIBLE CAUSE:	Instrument in Remote Control Mode.
ACTION:	Switch communications mode or reset.
SECTION:	9.3
POSSIBLE CAUSE:	Faulty keypad or cable.
ACTION:	Check keypad in I/O diagnostics.
SECTION:	5.4

SYMPTOM:	Printer Does Not Advance
POSSIBLE CAUSE:	Paper or roll jammed.
ACTION:	Open paper well and clear obstruction. Reset instrument if necessary. If printer still does not advance, turn instrument off for 30 seconds, then back on.
SECTION:	

SYMPTOM:	Sipper Does Not Enter Chamber
POSSIBLE CAUSE:	Sipper misaligned.
ACTION:	Check alignment.
SECTION:	3.6

9. Communications

This section describes the communications protocol between the 2300 STAT PLUS and a host computer. The 2300 STAT PLUS has an RS-232 serial port. When you install the appropriate hardware interface (e.g., shielded NULL modem cable), the 2300 STAT PLUS communicates in ASCII over this interface.

The protocol used by the 2300 has been designed to be compatible with most computer database applications and most computer interface protocols. The 2300 STAT PLUS can be configured to communicate in **Result Reporting** mode or **Remote Control** mode.

The communications module also provides networking capability. You may configure a 2300 STAT PLUS to operate in either multidrop or non-multidrop environments. Multidrop refers to networking several 2300s and/or other controllers to a host, while non-multidrop (point-to-point) refers to a single 2300 connected to a host/controller. Multidrop is targeted primarily to the bioprocessing marketplace and would rarely be used in a hospital clinical setting.

In sections below you will learn about communications handshaking, software setup, command structure, communication modes and data base format.

Note: The term "2300 STAT PLUS" has been shortened to "2300" in many sentences and figures below. They are synonymous.

9.1 Communications Protocol

The 2300 communicates with a host computer through its RS-232 serial port, acting as a DTE. The handshaking can be hardware or software configured. The method is user-selectable. Figure 9.1 shows the RS-232 signal descriptions and directions with respect to the 2300.

Pin Number	Signal Name	2300 Direction	Signal Function
1	PGND	---	Protective shield ground
2	TXD	Output	Transmit data
3	RXD	Input	Recieve data
4	RTS	Output	Request to send
5	CTS	Input	Clear to send
6	DSR	Input	Data set ready
7	SGND	---	Signal return ground
8	DCD	Input	Data carrier detect
20	DTR	Output	Data terminal ready

Figure 9.1
RS-232 Signal Description and Direction

Hardware Handshaking Signals. The four handshaking signals used to control the data flow are RTS/CTS and DTR/DCD. The 2300 drives RTS when it wishes to transmit and waits for CTS before transmitting each character. Likewise, the 2300 asserts DTR when it is ready to receive data and receives only when DCD is asserted. DSR is not used.

Software Handshaking Signals. In the XON/XOFF handshaking protocol, RTS and DTR are always asserted and CTS and DCD are always ignored.

Since the 2300 acts as a DTE, it requires a shielded NULL modem cable to connect to another DTE, such as the PC. Figure 9.2 and Figure 9.3 show possible NULL modem cable connections.

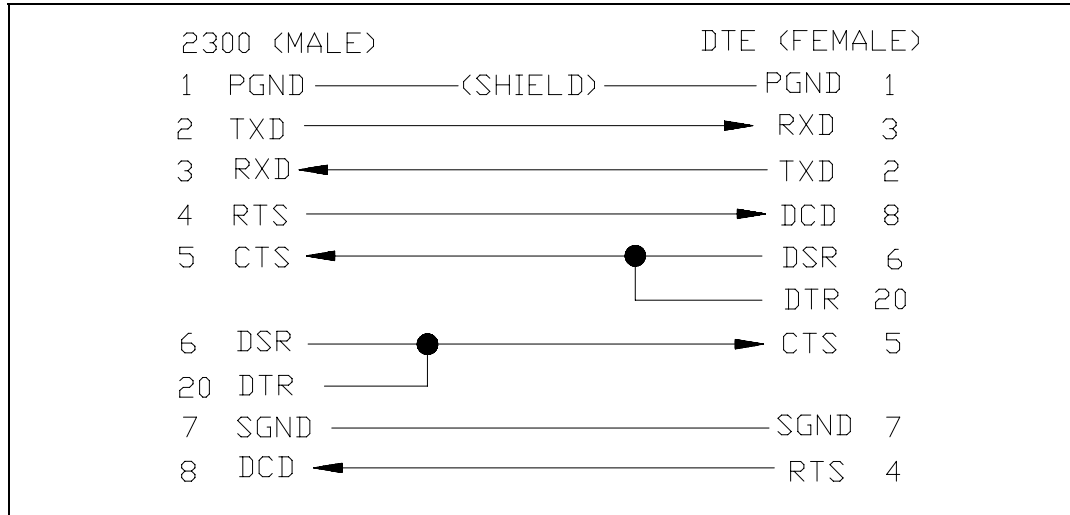


Figure 9.2
Full Handshaking DTE Interface

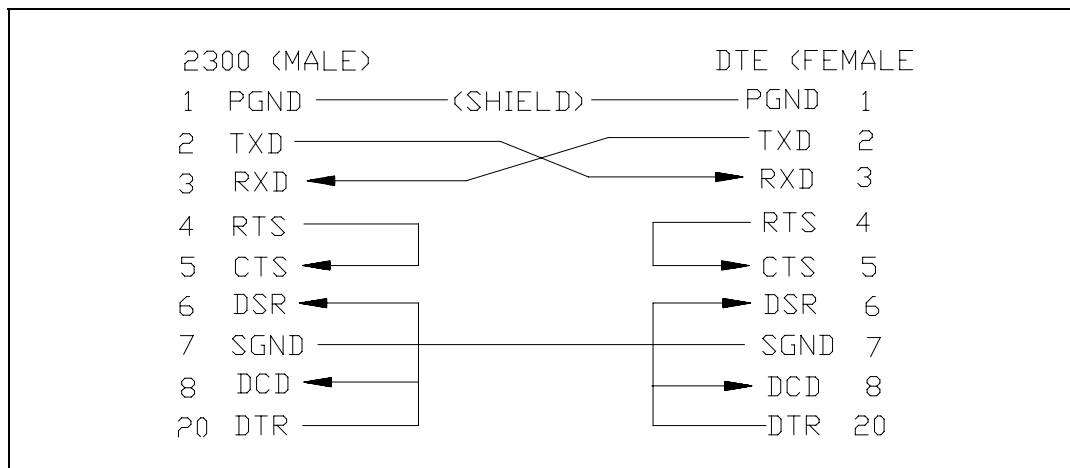


Figure 9.3
Three Wire DTE Interface

You can select the 2300 handshaking protocol, RTS/CTS or XON/XOFF. In addition, you can select baud rate, data length (bits per character), parity, stop bit, and configuration (multipoint or point-to-point). For information on communications setup, see Section 5.3 Setup Selections. The communications menu is a submenu of General setup.

Listed below are the default settings and options for each communications parameter mentioned above. The default value is listed first. The options are in parentheses.

Baud rate:	9600	(4800, 2400, 1200, 600, 300)
Data Length:	7	(8)
Parity:	Even	(odd, low, high, none)
Stop Bit:	1	(2)
Handshake:	RTS/CTS	(XON/XOFF, None)
Configuration:	non-multidrop	(multidrop)

Data and Command Format. The 2300 behaves like a "slave" to the host computer. It never talks to the host unless in response to a command from the host. The 2300 will respond with an ASCII < BEL> followed by the display of an error code, or "?" for an illegal command.

A command is defined to be a string of printable upper case ASCII characters. Blanks are ignored.

Command Grammar. The command grammar is shown below. Abbreviations include ESC (escape), cmd (command), addr (address), arg (argument) and cr (carriage return).

< ESC> &< cmd> [arg]< cr> (non-multidrop)

< ESC> < addr> < cmd> [arg]< cr> (multidrop)

In this grammar, < addr> is a single byte (binary) node address that you assign to the 2300 STAT PLUS. You make the assignment via the instrument keypad. The 2300 STAT PLUS only responds to commands with the < addr> field that matches the assigned address.

A command may require one or more arguments. If multiple arguments are given, they must be separated by a semicolon (;). Two consecutive semicolons indicate a NULL argument, in which case, depending on the command, a default parameter is supplied.

The 2300 responds to a legal command with a status acknowledgment (A), or an error code (1,2,6,7,8 or 9) The interpretations of the status characters are discussed under Communications Commands, Remote Control Commands.

Error Codes

Code 1 indicates that the 2300 is not in remote control mode.

Code 2 indicates that the 2300 is busy in RUN mode.

Code 6 indicates that the assignment of station # is out of range ($s < 1$ or $s > 4$).

Code 7 means that Station #5 was requested. Station #5 is not available in the 2300 STAT PLUS software.

Code 8 indicates a zero turntable position number ($t, n = 0$ or default $t, n = 0$).

Code 9 may mean that sample or calibration results were not found when requested or it may mean that the 2300 is not in RUN mode. You may need to check 2300 status to determine the exact meaning of the error. See Section 9.3 Communications Commands for more information.

The internal receiver buffer in the 2300 is 80 characters long. A string longer than 80 characters without the terminating CR., will cause this buffer to overflow. When this occurs, the 2300 will reset the receiver buffer, ignore the previous 80 characters and start to receive the new command. Most commands are 2 or 3 characters long. Thus, there is no real restriction with this buffer size.

9.2 Communications Modes

The 2300 can be placed in one of two communications modes: Result Reporting Mode or Remote Control Mode. The selection between modes is made by the remote host. The default mode at power-up is Result Reporting Mode.

2300 Data Base. The 2300 keeps a data base of 32 sample results and 1 calibration result in its battery-backed RAM (random access memory). Only the most recent sample or calibration result is shown on the instrument display. However, a remote host can ask for any of these results at any time. This data base can be cleared by the host in Remote Control Mode (see Section 9.3 Communications Commands).

Result Reporting Mode. Result Reporting Mode is designed for use with a computer system that gathers sample results from various analyzers and records the results in a central data base. In this mode, the host can always talk to the 2300 and get the result records.

The host requests the results by either sending the sample ID number and getting the result record or by querying the unit for any untransmitted result in the data base.

Remote Control Mode. Remote Control Mode is designed primarily for industrial and research applications where process control may be an important consideration.

In Remote-Control mode, the instrument is in RUN Mode and under control of the host computer. The instrument keypad is disabled; thus, the operator can not run a sample or calibration locally at the 2300.

The host tells the 2300 to run a sample or a calibration. The samples are typically assigned to run at Station #2 (Test Tube Holder), but may be assigned to Station #4 for turntable sampling.

9.3 Communications Commands

Data Transmission Records. The data report format from "2300 to HOST" is transmitted as shown in the example below. Information includes:

- » time
- » date
- » temperature (sample chamber)
- » node address (re: multidrop mode; instrument identification)
- » ID (sample identification number)
- » chemistry (assigned to probe)
- » value (sample or calibration reading)
- » unit of concentration (nA current for calibrations)
- » error codes

Notes:

A "-1" in the ID column specifies calibration report.

A "-2" in the ID column specifies STAT-interrupt report.

A "-3" in the ID column specifies parameter information request.

A back-slash "\" in the column preceding the carriage return < CR> indicates that more information from that reading continues on the next line.

If two lines of information are combined, the first is black probe data, the second is white probe data. In single channel units, this will not be a concern.

Time	Date	Temp	ID Chem	Value	Unit	Err
10:00:11	02/12/90	25.05	-1 LAC	-123.45	nA	0001\ < CR> < LF>
10:02:35	02/12/90	25.01	-1 GLU	201.23	nA	0000 < CR> < LF>
10:06:59	02/12/90	25.15	12345 LAC	12345.67	mmol/L	0000\ < CR> < LF>
10:06:59	02/12/90	25.15	12345 GLU	1234	mmol/L	0000 < CR> < LF>
10:07:10	02/12/90	25.15	0 LAC	23	mg/L	0000\ < CR> < LF>
10:07:10	02/12/90	25.15	0 GLU	1234	mg/L	0000 < CR> < LF>
10:00:11	02/12/90	25.05	-1 LAC	123.45	nA	0000\ < CR> < LF>
10:02:35	02/12/90	25.02	-1 GLU	201.23	nA	0000 < CR> < LF>
10:07:10	02/12/90	25.15	123 GLU	1234	mg/L	010F\ < CR> < LF>

Figure 9.4
2300 STAT PLUS Data Report Format

NOTE: The specific information above is not intended to appear realistic, but rather to account for all characters and spaces in the report format. See Figure 9.5 for specific field location information.

123456789| 123456789| 123456789| 123456789| 123456789| 123456789| 123456789| 12345
 11:11:11 22/22/22 33333 444 555555555 6666 77777777 88888888 9999\ < cr> < lf>
 11:11:11 22/22/22 33333 444 555555555 6666 77777777 88888888 9999 < cr> < lf>

FIELD NO.	OFFSET COLUMN	WIDTH (BYTE)	DESCRIPTIONS
01	01	08	Time
02	10	08	Date
03	19	05	Temperature
04	25	03	Node Address
05	29	09	Sample ID: 0 = no ID -1 = Cal Report -2 = STAT-interrupt Report -3 = Information Report
06	39	04	Probe Chemistry Assignment: None*** no chemistry GLU Glucose LAC L-Lactate
07	44	08	Sample or Calibration Result
08	53	08	Sample or Calibration Concentration Unit
09	62	04	Error Code (hexadecimal)
10	66	01	Continuation character: '\ more data follows <space> end of record

Figure 9.5
Report Format Field Information

Command Description. For quick reference, the communications commands are divided into five functional groups: process, report database, database management, control, and report system information. For details on process commands, see "Remote Control Commands", later in this section.

PROCESS

PC	Process calibration
PS1	Process sample from calibration well (Station #1)
PS2	Process sample from test tube holder (Station #2)
PS4	Process turntable batch (Station #4)

REPORT DATABASE

RC	Report calibration result
RS	Report sample result
RS#	Report sample result with sample ID number
RY	Report status of instrument
RX	Report last transmission

DATABASE MANAGEMENT

RZ	Clear database memory
----	-----------------------

CONTROL

TR0	Turn remote control off
TR1	Turn remote control on
TP0	Turn 2300 printer off
TP1	Turn 2300 printer on
PA	Abort Turntable Sampling

REPORT SYSTEM INFORMATION

V0	Report instrument model number
V1	Report software version number
V2	Report software revision date
RM	Report system time, date and measurement parameters
RI	Report instrument setup information

Common Commands. The commands below can be invoked in either Remote Control Mode or in Result Reporting Mode, unless otherwise stated. Available commands are those in Report Database and Report System Information categories above.

When **Report Status (RY)** is invoked, the command obtains the 2300 status. The status includes communications mode, sample result status, calibration result status, machine status and remote command status. Below is a summary of responses and the interpretations.

Host to 2300:	RY	Report status of instrument
2300 to Host:		
Communications mode	R	Result reporting mode
	C	Remote control mode
	—	Unknown
Sample status result	U	Results exist not sent to host
	N	No unsent results
Calibrate status result	U	Last cal not sent to host
	N	No unsent calibration results
Machine status	I	Idle in Run Mode
	S	Processing sample
	C	Processing calibration
	A	Processing autocalibration
	M	Processing manual sample
	F	Flushing and aborting error cycle
	B	Stabilizing baseline current
	K	Stabilizing calibration current
	E	Stabilizing motors
	H	Aborting Run Mode
Remote command status	R	In Run Mode
	S	In Standby Mode
	D	In Main Menu Mode
	I	Idle, no pending command
Remote command status	S	Sam command recvd. Pending
	C	Cal command recvd. Pending
	—	Unknown

An example status line may appear as follows:

CNUII

The information stated is that the 2300 is under remote control (C), no sample results are in memory (N), calibration results remain unsent (U), the 2300 is idle in Run mode (I) and there are no remote commands pending (I).

When **Report Last Transmission (RX)** is invoked, the last transmission of the 2300 is sent to the host. It is used when the response received by the 2300 contains an unknown character, is not in the correct format, or whenever in doubt due to communications error.

Host to 2300:	RX	Report last transmission
2300 to Host:		[last transmitted record]

When **Report Calibration Result (RC)** is invoked, the 2300 sends back time, date, chamber temperature, probe chemistry and probe current from the last calibration cycle. The calibration cycle may be a user-activated calibration cycle, a computer-demanded cycle or an autocalibration cycle. If no result is found, the 2300 sends back error code "9".

Host to 2300:	RC	Report last calibration result
2300 to Host:	[cal result]	(see format Fig 8.4)

When **Report Sample Result (RS)** is invoked, the 2300 sends back the last sample processed. When combined with an ID number, the 2300 searches its database and sends back the most recent matching ID result. After the result has been transmitted, its entry in the database is marked as sent. Another request for the same sample ID result will cause the 2300 to send the next most recent result for the matching ID result. If no result is found, the 2300 sends back error code "9".

If the host has received the result in error due to a data transmission error, it should request retransmission using the RX command.

Host to 2300:	RS	Report last sample result
2300 to Host:	[sam result]	(see format Fig 8.4)
Host to 2300:	RS< ID>	Report sam ID result (max = 9 digits)
2300 to Host:	[sam result]	(see format Fig 8.4)

Remote Control Commands. The commands outlined above in the "Process" category can be invoked **only** in Remote Control Mode. If the system is not in the Remote Control Mode, you must first invoke the **Turn Remote Control On (TR1)** command.

Host to 2300:	TR1	Turn on remote control mode
2300 to Host:	A	Acknowledge. 2300 switched to Remote Control. This must be done when 2300 is in Run mode, idle.
	2	2300 busy in Run Mode.
	9	2300 is not in Run Mode.

Note: For each command from Host to 2300, the 2300 sends back an acknowledgment (A) or an error code (2 or 9). Codes 2 and 9 require invoking the Report Status (RY) command to gain further information on machine status.

In a similar manner, you can invoke the **Turn Remote Control Off (TR0)** command to return to Result Reporting Mode.

In the Remote Control Mode you may elect to invoke the **Turn 2300 Printer Off (TP0)** command. The 2300 responses are outlined below.

Host to 2300:	TP0	Turn 2300 printer off
2300 to Host:	A	Acknowledge. 2300 printer turned off.
	1	2300 is not in Remote Control Mode.

In a similar manner you may use TP1 to turn the 2300 printer on.

The calibration and sample process commands are outlined below. The process sample commands are described together, the only difference between the commands being the location from which to sample (1, 2 or 4).

When you invoke the **Process Calibration (PC)** command, the Host commands the 2300 to run a calibration cycle. If the 2300 is running an autocalibration, calibration stabilization or baseline stabilization, the command is acknowledged and the sample is processed as soon as the instrument finishes the existing task.

Host to 2300:	PC	Process calibration
2300 to Host:	A	Acknowledge. Calibration in process or pending upon completion of current task.
	1	2300 is not in Remote Control Mode.
	2	2300 is busy processing last PC or PS command.

When you invoke the **Process Sample (PS)** command, the Host commands the 2300 to sample from one of three locations depending on the specific command (PS1, PS2 or PS4). If the 2300 is running an autocalibration, calibration stabilization or baseline stabilization, the command is acknowledged and the sample is processed as soon as the instrument finishes the existing task.

Host to 2300:	PS	Process sample at PS1, PS2 or PS4.
2300 to Host:	A	Acknowledge. Sample in process or pending upon completion of current task.
	1	2300 is not in Remote Control Mode.
	2	2300 is busy processing last PC or PS command.
	9	For PS2 command, Test Tube Holder switch is off.

The PS command may take three optional arguments:

PS[s][;t][;n]

In these arguments **s** is the station number from which to sample. If **s** is not given, or NULL, the currently assigned sample station is used.

The character **t** is the turntable starting position, which is only valid when **s** = 4. Remember, station #4 is the turntable sampling position. If **t** is not provided or NULL, the default starting position will be used.

The character **n** is the number of turntable positions to be sampled, which also is only valid when **s** = 4. If **n** is not given or NULL, the default value will be used.

When the **Clear Database Memory (RZ)** command is invoked, all of the sample results maintained by the 2300 database are cleared. It is useful when the remote host is first switched to Remote Control Mode and wants to "forget" all previous samples that have been taken by an operator.

Host to 2300:	RZ	Clear 2300 database memory
2300 to Host:	A	Acknowledge. Result data cleared.
	1	2300 is not in Remote Control Mode.

When you invoke the **RM command** the instrument reports to you the current system time, date and measurement parameters. For ease of deciphering this information, the report format is almost identical to that of the sample and calibration reports. The only difference is that the Error Field, beginning at column 62, contains additional information about the calibration parameters.

Figure 9.6 shows you the report format. The first line is basically a ruler. The second and third lines identify each field by an upper case letter (A,B,C,etc.). The number of characters in each field is the field width.

```
123456789|123456789|123456789|123456789|123456789|123456789|123456789|12345
```

```
AA:AA:AA BB/BB/BB CCCCC DDD EEEEEEEEE FFFF GGGGG.GG HHHHHHHH II J\  
<cr><lf>
```

```
AA:AA:AA BB/BB/BB CCCCC DDD EEEEEEEEE KKKK LLLLL.LL MMMMMMMM NN O  
<cr><lf>
```

In the fields above the characters represent the following:

- A: current system time (hh:mm:ss, 24 hour clock)
- B: current system date (mm/dd/yy or dd/mm/yy, depends on format)
- C: not used. Always *****.
- D: comm node address if multidrop. Blank for point-to-point.
- E: measurement parameter report ID. Always "-3".

- F: black channel chemistry abbreviation
- G: black channel calibration standard value
- H: black channel calibration concentration unit
- I: black channel calibration endtime (always 35)
- J: black channel calibration station number (always 1)

- K: white channel chemistry abbreviation
- L: white channel calibration standard value
- M: white channel calibration concentration unit
- N: white channel calibration endtime (always 35)
- O: white channel calibration station number (always 1)

Figure 9.6
RM Command Report Format

When you invoke the **RI command**, the instrument uploads the instrument setup that is not reported by the RM command, except communications and local control parameters. The information reported by this command is coded to conserve space. You must know the codes listed in Figure 9.7 to understand these setup parameters. The report is divided into five categories similar to "PrntSetup" (Print Setup) in the 2300 STAT PLUS menu option. Note, all fields in this report are right-justified.

```
123456789|123456789|123456789|123456789|123456789|123456789|123456789|123456789|  
a b c dd e f g hh iiiii jjjjj kkk lllll mmm nnn o p qqqqq rrrrr sssss ttttt <cr>
```

Interpretation:

General

a: radix (0 for ".", 1 for ",")
b: date format (0 for mm/dd/yy; 1 for dd/mm/yy)
c: bottle level sensor flag (0 for off; 1 for on)
d: sample size, uL (always 25)
e: sample station (2 to 4)
f: calibration method (always 0 for single)

Autocal

g: autocal on sample error flag (always 1 for on)
h: temperature shift between autocals, °C (always 1)
i: time interval between autocals, minutes (0 to 240)
j: number of samples between autocals (0 to 200)
k: cal shift allowed between calcs, % (always 2)

RunMode

l: autostandby time, hours (0 to 30000)
m: default starting turntable position (0 to 255)
n: default number of turntable test tubes loaded (0 to 255)
o: turntable fluid detection flag (0 for off; 1 for on)

Note: p, q, r, s, and t field information is not relevant to the 2300 STAT PLUS, Software.

Figure 9.7
RI Command Report Format

10. Turntable Operation and Maintenance

10.1 Description and Specifications

The YSI Model 2710 Turntable is a laboratory instrument intended for use as an accessory to the YSI Model 2300 STAT PLUS Glucose and L-Lactate Analyzer.

The YSI 2710 provides batch sampling and multiple sampling when under control of the YSI 2300 STAT PLUS. The results of sampling are displayed and printed by the YSI 2300 STAT PLUS. The results are also stored in a 32 place sample memory buffer and can be retrieved via an RS 232 link between the 2300 STAT PLUS and a computer.

The YSI 2710 contains a 24 position sample wheel that rotates to bring each sample position to an area where the 2300 STAT PLUS Sipper automatically descends to aspirate a sample.

The Sample Wheel accommodates tubes or vials that range in size from 10 to 16 millimeters in diameter and from 20 to 100 millimeters high. To minimize carry-over, the YSI 2710 was designed to employ the same unique fluid level detection scheme found on the 2300 STAT PLUS. Alternatively, a fixed-depth aspiration protocol may be employed.

A loaded sample wheel may be given a batch identification number. Each sample is identified by position number, date and time of analysis. For a given batch, multiple sampling can be specified for each position. For example, you may program every position to be sampled in duplicate, triplicate and so on, up to 99 samples per position.

Features

- Sturdy 24-position aluminum alloy sample wheel
- Accommodates a variety of tubes or vials
- Fluid sensing or fixed-depth fluid aspiration
- Removable sample wheel for easy loading and cleaning
- Compact (occupies about 500 cm² or 0.5 ft² of bench space)
- Power and control through interconnect cable to 2300 STAT PLUS
- Batch and sample identification capability
- Programmable multisampling scheme for every position
- Batch interrupt without interfering with turntable run
- Turntable service, setup and diagnostic menus

Specifications

Size:

Case: 23.5 x 20.3 x 12.7 cm (9.3 x 8.0 x 5.0 in)
Sample wheel: 19.1 dia x 1.9 cm (7.5 dia x 0.75 in)

Weight:

2.5 kilograms (5.5 pounds)

Power requirements:

15 VDC, 1 ampere maximum (via interconnect cable from 2300)

Sample container:

Diameter: 10 to 16 millimeters
Height: 20 to 100 millimeters

Note: Automatic fluid sensing works with single wall glass containers and most plastic containers. Fixed-depth aspiration works with all sample containers having dimensions described above.

10.2 Setup

Preliminary Preparation

Remember, the YSI 2710 Turntable is an accessory product. You can only operate the 2710 Turntable while it is connected to a YSI 2300 STAT PLUS Analyzer. The 2300 STAT PLUS has supportive electronics and software necessary for power and control of the turntable.

If you have received your new 2300 STAT PLUS and 2710 Turntable together, first take time to set up the 2300 STAT PLUS. Refer to the 2300 STAT PLUS operation sections of the manual for setup instructions. Once you are familiar with the 2300 STAT PLUS operation, proceed with the 2710 installation.

Unpacking

After you remove the instrument and accessories from the shipping container, be careful not to discard any parts or supplies. Check off all items on the packing list and inspect all components for damage. If any parts are damaged or missing, contact YSI Customer Service or your dealer representative immediately.

DO NOT DISCARD THE SHIPPING CONTAINER.

If it becomes necessary to return the instrument to YSI or your dealer representative, we recommend that the original shipping container be used. This container was custom-designed to protect the instrument and accessories during transportation.

Refer to Appendix F—Warranty and Shipping Information for specific information about returning a product to YSI or other dealer representative.

Component Identification

In this section you will learn about major parts of the YSI 2710 Turntable. Figure 10.1 and Figure 10.2 identify the parts. Information about the function of each part follows.

SAMPLE WHEEL. The Sample Wheel holds up to 24 sample tubes/vials. It is indexed onto the drive hub and you can easily remove it without the use of tools. This feature makes loading tubes and cleaning very convenient.

POWER ON INDICATOR. The Power On Indicator is an LED (light emitting diode) that confirms the turntable is powered up and ready.

RESET PUSH-BUTTON. The Reset Push-button is used to reset the microcontroller within the 2710 turntable. Note that the 2300 STAT PLUS analyzer has a reset switch that resets the entire 2300/2710 system.

HOLDING SPRING. The Holding Spring is a garter spring that holds all sample tubes/vials securely in the Sample Wheel. There are two slots that run the circumference of the Sample Wheel. These slots are cut to different depths. The Holding Spring may be positioned in either slot. The position of the spring in a particular slot determines how easy it is to insert a sample container into the wheel and also the holding force of the spring. Generally, you use the upper slot with sample containers ranging in size from 13 mm to 16 mm diameter. You use the lower slot with sample containers ranging in size from 10 mm to 13 mm in diameter.

INTERCONNECT CABLE. The Interconnect Cable is a 15 conductor shielded cable that carries all power and control signals between the 2300 STAT PLUS and the 2710 Turntable.

INDEXING FIXTURE. The Indexing Fixture is a plate that assures correct positioning of the 2300 STAT PLUS to the 2710 Turntable.

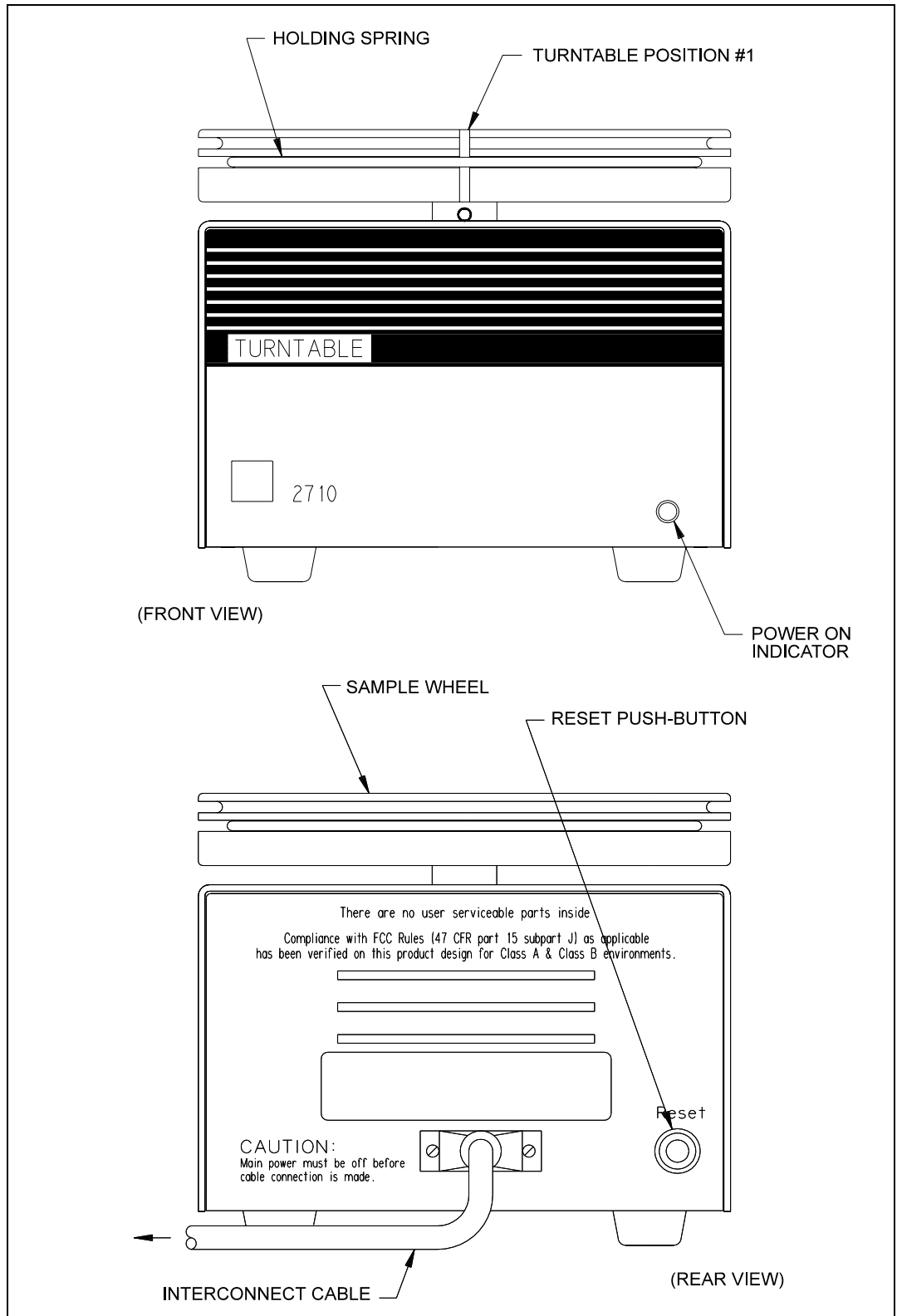


Figure 10.1
2710 Turntable Major Components

Installation

Next you will learn how to install the 2710 Turntable to a 2300 STAT PLUS. This process involves indexing the two instruments together and then aligning the 2300 STAT PLUS Sipper to the 2710 Sample Wheel home position. The following subsections lead you through the process step-by-step.

NOTE: You **must** begin with the 2300 STAT PLUS power off. If you have not already done so, use the power switch on the rear of the 2300 STAT PLUS case to **turn instrument power off**.

Remember, the 2710 Turntable has no line power cord. Power is delivered through the Interconnect Cable.

Indexing the Turntable

Clear a flat surface at least 61 centimeters (24 in) wide by 38 centimeters (15 in) deep to set up your 2300/2710 system.

Refer to Figure 10.2, Instrument Indexing, for proper orientation of the instruments and the indexing fixture. Follow these steps:

- » Place the Indexing Fixture on the flat surface, for example, a benchtop.
- » Lower the 2300 STAT PLUS into the fixture, capturing both the left front and left back feet in their respective holes.
- » Lower the 2710 Turntable into the fixture capturing both the right front and right back feet in their respective holes.

Cable Connection

Connect the Interconnect Cable into the back panel of the 2710 Turntable and then into the Auxiliary connector on the back of the 2300 STAT PLUS. Secure both connectors using the screws provided.



CAUTION: Failure to remove the Access Panel will likely result in damage to the Sipper when it moves toward the turntable sampling position. Check and confirm that the Access Panel has been removed from the side of the 2300 STAT PLUS. This will require a small adjustable wrench, or an 8 mm (5/16 in) wrench. Refer to Figure 10.2 for location.

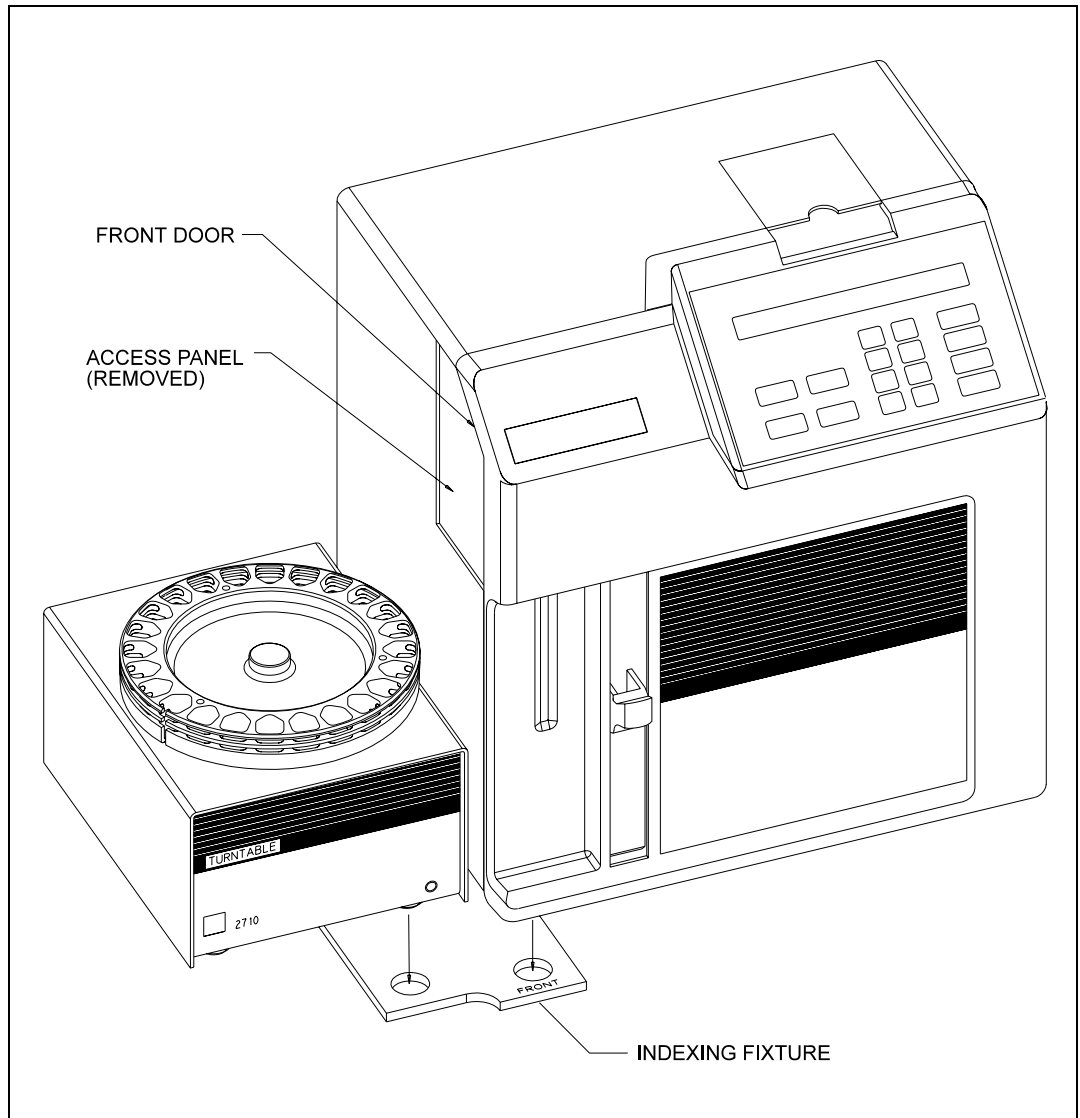


Figure 10.2
Instrument Indexing

Power Up

Before you continue with the 2710 Turntable setup, follow steps described in Section 3.5 Power Up Procedures. Once you have turned on power to the 2300 STAT PLUS, the 2710 Power Indicator LED should illuminate. If the LED does not illuminate, check to make certain that the Interconnect Cable is correctly engaged. If everything appears to be connected correctly and the LED still does not illuminate, unplug the turntable from the 2300 STAT PLUS and contact YSI Customer Service for assistance. See Appendix F for contact information.

Aligning The Turntable

There are provisions in the 2300 STAT PLUS software that allow you to fine-adjust the Sipper in order to better align the Sipper to the sampling position (home position) of the turntable.

NOTE: If a single turntable is being used alternately between two or more 2300 STAT PLUS instruments, you may need to use this alignment procedure whenever you move the turntable to another 2300 STAT PLUS unit. You may also need to use this procedure whenever you replace a Sipper.

We recommend that you align the two instruments with the front door of the 2300 STAT PLUS open. This way you can view the Sipper movements and detect any potential positioning problems.

Follow the step-by-step procedure described below. Since you just powered the 2300 STAT PLUS, the Main Menu should appear on the display.

Please select instrument mode:
[RUN] [STANDBY] [MENU]

Press [MENU]. The display reads:

Select instrument function:
1-Service 2-Setup 3-Diagnostic

Press [1]. The display reads:

Select service: 1-Sipper 2-Buffer 3-Cal
4-Stir speed 5-Turntable

Press [5]. The Sample Wheel rotates searching for "home" position. The home position is turntable position 1 and is clearly identified by the vertical slot in the edge of the wheel. Once located, the wheel stops and the display reads:

Select turntable service
1-Sipper position 2-Fixed sipper depth

Press [1]. The Sipper rotates out through the access opening and stops above the turntable "home" position. The display reads

Finetune turntable sipper position
0-Exit 1-Clockwise 2-CClockwise 3-Test

Visually check to see that the Sipper centers above the "home" position (turntable position 1). YSI sets this position during manufacturing, however, if the turntable stops at a position other than position 1, the turntable must be realigned manually. For manual realignment instructions refer to Section 10.5 Maintenance.

If the turntable stops in the correct position, but the Sipper does not center directly above "home position", you need to fine-adjust using software menu selections described below.

Press [1] or [2] to rotate the Sipper in either clockwise or counterclockwise preset increments. Press the appropriate key as required to set the Sipper position.

Once satisfied that the Sipper is correctly aligned (centered), press [3] to test the location. The Sipper rotates back into the 2300 STAT PLUS, stops directly over the Sample Chamber, then rotates back out through the access opening and stops at the previously chosen location. You do this to visually confirm that the alignment is correct.

When you complete the alignment procedure, press [0]. The Sipper rotates back into the 2300 STAT PLUS and the display reads

Select turntable service
1-Sipper Position 2-Fixed sipper depth

At this point you need to decide whether to use the automatic fluid sensing feature or, alternately, set the Sipper to a fixed point depth. If you decide to use automatic sensing, you need not continue reading. Press [MENU].

NOTE: Additional information on the use of fluid detection is described in Section 10.3 Operation.

If you decide to establish a fixed-point depth for retrieving a sample, press [2]. The Sipper rotates through the access opening and stops above the turntable "home" position at the system default height. This height is about 3 centimeters above the Sample Wheel. The display reads:

Set turntable fixed sipper depth
0-Exit 1-Up 2-Down 3-Test

You press [2] to drive the Sipper down a preset increment, or press [1] to drive it up. Press it again and it moves up or down depending on the key you press. Repeat this process until the Sipper is at the desired height. Once at the desired height press [3] to test the setting. The Sipper rotates back into the 2300 STAT PLUS, stops directly over the Sample Chamber, then rotates back out through the access opening and stops at the previously chosen location. Perform this test to visually confirm that your setting is correct.

Press [0]. The Sipper rotates back into the 2300 STAT PLUS and the display reads

Select turntable service
1-Sipper position 2-Fixed sipper depth

Press [MENU] to return to the Main Menu.

Please select instrument mode:
[RUN] [STANDBY] [MENU]

You now have completed alignment of the 2710 Turntable to the 2300 STAT PLUS. This alignment should not change as long as the Indexing Fixture is not removed. For example, if you remove the Sample Wheel, you will not affect the alignment because it is indexed to the drive hub and can only be reinstalled to the same position.

10.3 Operation

In this section we discuss several important topics that are necessary to properly load and operate the 2710 Turntable.

First, we discuss the type and size of test tubes/vials you should use.

Second, we focus on choosing the proper sampling protocol for your application.

Third, we describe how you cancel or interrupt turntable sampling to stop its programmed run.

Fourth, we describe how to interrupt batch sampling to perform a STAT sample at the Test Tube Holder position, and not interfere with the turntable run that was initiated.

In addition, we discuss some special configurations to help you learn to use the turntable most efficiently.

Test Tube and Vial Choices

There are a variety of test tube and vial sizes and types that work with the 2710 Turntable. Make certain that your test tube choice is consistent with dimensions described in Section 10.1 Description and Specifications.

Once you have chosen a particular test tube or vial, you should make sure that you have configured the 2300/2710 system to settings for optimal performance. Review the suggestions below to help you make or confirm your choices. We use the phrase "sample container" below to describe any test tube, vial or other vessel you may choose.

- » Your sample container should be no taller than 100 mm and the bottom of the sample container should be resting on the bottom of the Sample Wheel floor.
- » Sample containers less than 20 mm tall may present some difficulty. You may need to convince yourself they will work by trial and error.
- » If you select Fluid Detection from the Turntable menu, two conditions are important. First, a single wall sample container is normally required. Double wall sample containers and some plastic containers do not work with the 2300/2710 capacitive sensing technique. Second, your sample must be conductive, that is, it must contain ionic species. For example, solutions such as deionized water will not work reliably.
- » To avoid the drawbacks of Fluid Detection, use single wall sample containers whenever possible. Use YSI buffer solution or normal saline solution (without analyte) as a blank in your turntable run.
- » Alternatively, you may turn off Fluid Detection in the 2300 STAT PLUS Setup menu. See Figure 5.2 Menu Flow Chart, to locate the specific submenu Setup, then submenu Turntable. When you turn off Fluid Detection, you must be certain that the Sipper depth is appropriately set at the turntable sampling position. Avoid deep immersion into sample solutions to reduce carry-over errors during sampling. You will find instructions in Section 10.2 Setup that describe how to set Sipper depth.
- » Choose the appropriate position (upper or lower slot) for the garter spring. Generally, for 10-13 mm diameter tubes, use the lower slot. For diameters greater than 13 mm use the upper slot.
- » When in doubt about the proper Sipper depth setting, enter Diagnostics menu, specifically Sipper motor diagnostics, to check your setting. See Figure 5.2, Menu Flow Chart, to locate the proper menu level.
- » If you encounter problems related to finding an appropriate sample container or finding the correct settings for your sample container, contact YSI Customer Service. See Appendix F for phone and FAX information.

Setting Sample Protocol

As we continue describing basic operation, we assume you have followed the 2300 STAT PLUS setup instructions regarding Measurement Parameters. We also assume that all Run Mode selections related to Sample Protocol are currently default settings. See Appendix I, Printed Setup Information, to review the default settings.

If you have entered RUN Mode and the 2300 STAT PLUS is calibrated, the display top line should read:

Ready to sample at Station #2 HH:MM:SS

NOTE: If the 2300 STAT PLUS is not yet calibrated, return to Sections 3 and 4 for setup and operation instructions.

It is important that you understand "stations" at this point. The 2300 STAT PLUS software defines four stations at which aspiration of a sample and/or calibration may occur. The Turntable sampling occurs at Station #4. All station descriptions are outlined below.

Abbreviations used below: CW = clockwise; CCW = counterclockwise

The Sample Chamber (where enzyme probes are housed) is the "home" position.

Station #1 Calibration Well. (one stop CCW to "home")

Station #2 Test Tube Holder. (one stop CW to "home")

Station #3 Manual Sampling. (one stop CW to Station #2)

Station #4 Turntable. (outside left side of instrument case, approximately 180 degrees CW to Cal Well or Station #1)

Now, since we want to sample at the turntable sampling position, press [4] on the 2300 STAT PLUS keypad. The display changes to read

Ready to sample at Station #4 HH:MM:SS

There are several ways to setup turntable sampling protocol. The simplest is described first, followed by an alternative that may be more appropriate for your application.

Setting Sampling Protocol from Run Mode

If your sample containers are loaded and the Sample Wheel properly installed on the turntable hub, you are ready to start.

Press [SAMPLE].

The wheel will rotate counterclockwise until Position #1 is at Station #4 sampling position. The display now prompts you to enter the **starting position** in your run. Position #1 is the default option. The display reads:

```
Enter starting turntable position
>1
```

You may now change the "1" to whatever starting position you desire. Once correct, press [ENTER]. The display now prompts you to enter the **number of samples** in your run. The number "1" is the default option. The display reads:

```
Enter number of samples in run
>1
```

Now enter the number of consecutive positions loaded with sample containers that you want sampled in this run (batch). When correct, press [ENTER].

Turntable sampling now begins and will automatically stop when the programmed number of samples is complete. Note that autocalibrations based on time or number of samples will interrupt sampling as necessary, but will not stop the turntable run.

Each sample result is displayed and printed with turntable position number, date and time. See Appendix J, Report Formats for sample printouts. Batch identification and multicycle options have not been described yet. They will be considered under Special Configurations later in this section.

Setting Sample Protocol from Setup Menu

If you will be running a series of turntable runs (batches) using the same sampling protocol each time, you may want to use Menu setup of sampling protocol. For example, if you plan to use the same starting position and the same number of consecutive samples in several runs, this approach may be more appropriate.

If you choose this approach, you load the Sample Wheel, press [SAMPLE] and the turntable run begins. In this case there will be no prompts regarding starting position or number of samples in the run, as before.

To program the 2300/2710 system to run from Menu setup, start at the Main Menu display and do the following.

Main Menu display:

```
Please select instrument mode:
[ RUN ] [STANDBY] [MENU]
```

From Main Menu, press [MENU].

Select instrument function
1-Service 2-Setup 3-Diagnostic

From Select instrument function, press [2] for Setup.

NOTE: If you are in RUN or STANDBY modes, press [MENU] to go directly to the display shown below.

Select setup:1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default

From Select setup, press [3] for RunMode.

Run Mode Setup:1-Sample Protocol
2-AutoStandby 3-AutoCal

From Run Mode setup, press 1-Sample Protocol

Sampling Protocol Setup: 1-SipperHeight
2-Multi 3-ID 4-Station# 5-TTable 6-Hct

Although Station #4 may already be programmed, you should confirm this. From Sampling Protocol Setup menu, press 4-Station#. The display reads

Enter sample station
>4

If necessary change to "4" by pressing [4], then press [ENTER]. The display again reads

Sampling Protocol Setup: 1-SipperHeight
2-Multi 3-ID 4-Station# 5-TTable 6-Hct

Now you will identify the starting turntable position and the number of positions you want to sample in the run.

Press [5], the display reads

Enter starting turntable position
>1

Enter the desired number (0 to 24, but typically 1), then press [ENTER]. Enter 0 if you want the instrument to prompt you for the starting position each time [Sample] is pressed. The display reads

Enter number of turntable samples
>1

Enter the desired number (0 to 255, but typically 0). Enter 0 if you want the instrument to prompt you for the number of samples each time [Sample] is pressed. Numbers greater than 24 will be explained under Special Configurations. Now press [ENTER]. The display reads

Turn Station #4 Fluid Detection ON: Yes
1-No 2-Yes

Decide whether you wish to use the automatic fluid detection capability described previously. Select On or Off by pressing the appropriate numerical key, then press [ENTER]. The display reads:

Sampling Protocol Setup: 1-SipperHeight
2-Multi 3-ID 4-Station# 5-TTable 6-Hct

Press [MENU] to return to the Main Menu or back to RUN Mode. If the instrument is not yet calibrated, it now reads

Please select instrument mode:
[RUN] [STANDBY] [MENU]

If the 2300 STAT PLUS is calibrated, the display should read

Ready to sample at Station #4 HH:MM:SS

Now, when you press [SAMPLE], the instrument proceeds immediately with the preprogrammed turntable sampling protocol. You will not see display prompts for start position or for number of samples in the run (batch).

How to Cancel a Turntable Run

Once the 2300/2710 system begins a turntable run, it proceeds uninterrupted to completion, as programmed (whether by RUN Mode setup or by MENU Mode setup).

However, for whatever reason, you may halt a turntable run by pressing [CANCEL]. The 2300/2710 system will complete any sample in progress, display and print the results. The turntable run is now complete and the display reads:

Ready to sample at Station #4 HH:MM:SS

NOTE: if you also configured the system to "multicycle", that is, perform multiple samples at each turntable position, you must press [CANCEL] twice. The first press of [CANCEL] disables multicycling. The second press disables the turntable run. More information on multicycling is presented below under Special Configurations.

If you now wish to perform a discrete sample at another station, you have the ability to simply press a numeric key, typically 2 or 3, and run that sample. For example, let us assume you want to sample at the Test Tube Holder position (Station #2). Press [2] and display changes to read

Ready to sample at Station #2 HH:MM:SS

Press [SAMPLE] and the discrete analysis will proceed. When completed the display returns to show

Ready to sample at Station #2 HH:MM:SS

NOTE: Once interrupted by the [CANCEL] command, the turntable cannot resume automatically, nor can it identify where it was interrupted. However, in the next section, a single key interrupt function is described.

Stat Interrupt Of Turntable Run

If you have initiated a turntable run (batch), and do not want to interrupt it, yet have a sample that needs immediate analysis ("STAT sample"), there is a procedure. It works as follows:

- » Press [SAMPLE] to signal a STAT request.
- » The message "STAT sample requested" is briefly displayed.
- » After completion of the turntable sample in progress, the instrument shifts to STAT mode whereby it looks for a sample at the Test Tube Holder position. At this point, the top line of the display indicates turntable sample pause and the word STAT appears. The bottom line of the display indicates the results of the previous sample.

- » The STAT sample is run and the results displayed and printed. The printed result is clearly labeled as a STAT result.
- » The instrument automatically returns to the next "scheduled" sample in the programmed turntable run (batch).

There is a maximum of one STAT interruption per scheduled turntable sample. That is, you cannot perform back-to-back STAT samples. You may, however, interrupt as many samples as necessary in a batch, limited only by the number of positions programmed times the number of replicates per position.

You may, therefore, interrupt in the middle of replicates at a particular position. The instrument will return to the next replicate scheduled.

If several STAT samples show up unexpectedly in your laboratory, then canceling the turntable run makes sense. You can always restart the turntable where you aborted by entering the appropriate starting position and number of positions remaining in the batch.

An example printout (brief format) of a STAT result is shown below:

Sample Report (Brief)

```

-----Sample Report-----
ID:STAT-000000001
B:L-Lactate 2.02 mmol/L
W:Glucose 6.22 mmol/L
Tue 02/22/03 14:36:21
-----

```

Special Configurations

There are a number of features available in the 2300/2710 system that may be of interest in your applications. Three of these features are described below.

Multicycle

Multicycle refers to replicate sampling at each turntable position. You may program your system to make duplicate, triplicate, or up to 99 replicates at each turntable position. The replicates are performed consecutively. For example, for triplicate sampling, Turntable Position #1 would be sampled 3 times, followed by 3 times at Position #2 and so on.

You initiate "multicycle" by selection in the Setup menu, specifically 3-RunMode, then 2-Multicycle. See Figure 5.2, Menu Flow Chart, to locate the option. Once selected, a display prompt requests the number of multicycles (replicates). This prompt appears after pressing [SAMPLE] to initiate a turntable batch.

You may cancel the multicycle function in any turntable run or batch by pressing [CANCEL] **one time**. This only cancels the multicycle function at the position where it is invoked. To cancel or alter multicycle for the entire batch, you must cancel the turntable batch and reprogram.

Turntable Batch Identification (ID)

An identification number (9 digits maximum) may be assigned to a turntable batch. **The number identifies the batch only.** There is no mechanism through the 2300 STAT PLUS keypad to assign an ID number to each sample position in a run. However, the date and time, along with the turntable position number and replicate number permits a unique set of markers for each sample or replicate.

You initiate "ID" by selection in the Setup menu, specifically 3- RunMode, then 3-ID. To locate the option see Figure 5.2, Menu Flow Chart. Once selected, a display prompt requests the entry of an ID number. This prompt appears after pressing [SAMPLE]. You are not required to enter an ID number. Just press enter to continue.

Extending a Turntable Run

There are 24 positions in the Sample Wheel. However, when prompted to **enter the number of samples in a run**, you may enter up to 255. There are at least two situations where this may be of interest to you.

First, you may want to repeat a 24 position run to check whether the analyte concentration of interest has changed with time. In this case you might enter "48" for the number of samples. This permits unattended analyses of the full sample wheel two times in succession.

Second, you may have more than 24 samples to analyze, but would like them all sampled in one report. As earlier positions are analyzed, new samples can be added to these positions by exchange. In this case Position #1 becomes Position #25, then #49 and so on.

To initiate "extension", simply enter the desired number at the prompt asking "number of samples in run". Review Sampling Protocol above for more specific information.

10.4 Diagnostics and Troubleshooting

Diagnostic routines in the 2300 STAT PLUS software provide help in troubleshooting two major components, the turntable motor and position sensing electronics. Instructions below describe how to access the Diagnostics menu and how to use the routines. Refer to Figure 5.2, Menu Flow Chart, for an overview of the diagnostics routines.

Accessing Turntable Diagnostics

You first must return to Main Menu. This may require that you exit RUN Mode or STANDBY Mode.

From the 2300 STAT PLUS Main Menu, which appears as

Please select instrument mode [RUN] [STANDBY] [MENU]

Press [MENU], the display reads

Select instrument function
1-Service 2-Setup 3-Diagnostic

Press [3], the display reads

Select diagnostic
1-Motor 2-Pump 3-Probe 4-I/O 5-Sensor

Press [1], the display reads

Motor diagnostic
1-SipperMotor 2-StirMotor 3-Turntable

Press [3], the display reads

Turntable diagnostic XX
1-Home 2-Goto 3-Step 4-Exercise 5-Reset

Using Turntable Diagnostics

There are three specific functions that you can initiate. In addition, the Sample Wheel may be set to continuously turn (exercise). The XX displayed in the upper right corner of the display identifies position number. The position number counter may need to be reset, since it counts from home position rather than electronically "sensing" position.

Turntable diagnostic XX
1-Home 2-Goto 3-Step 4-Exercise 5-Reset

If you press [1], the turntable wheel rotates to the home position. The display does not update.

If you press [2], this routine allows you to direct the Sample Wheel to a specified position. The display reads

Enter turntable position
> 1

Enter the desired turntable position (1 to 255), then press [ENTER]. The turntable rotates to the selected position and the display returns to the previous screen. The upper right screen should now indicate the Sample Wheel position (1 to 24). If you entered a number greater than 24, the indicator still should agree with the number label on the wheel.

Turntable diagnostic XX 1-Home 2-Goto 3-Step 4-Exercise 5-Reset
--

If you press [3], the Sample Wheel rotates counterclockwise to the next position. The display will not change except for the position indicator in the upper right screen which updates with each step. Note, the wheel moves quickly enough that every position is not displayed on the screen as it moves.

If you press [4], you initiate an exercise routine in which the turntable starts rotating, updating the position indicator as each position is passed. The display now reads:

Exercising turntable XX Hit any key to stop
--

After one complete revolution, a "hesitation" at each position will become obvious. This is not a failure, but rather the software stopping and starting the turntable at each position. It occurs so fast that it is visually imperceptible. Press any key to stop the routine. The display returns to the previous screen.

Turntable diagnostic XX 1-Home 2-Goto 3-Step 4-Exercise 5-Reset
--

If you press [5], the position indicator resets to 00.

To return to the Main Menu, press [MENU].

Please select instrument mode: [RUN] [STANDBY] [MENU]
--

In addition to the 2710 Turntable diagnostic routines, many routines related to the 2300 STAT PLUS are available for better understanding of instrument function, and, if required, to troubleshoot problems.

Troubleshooting

This section provides a simple, but systematic, approach to establishing the cause of the most common turntable malfunctions. Symptoms related to 2710 Turntable problems are somewhat limited. Most often, one of the following may occur. The 2300 STAT PLUS Sipper may miss target or come up with a detection error, or the Sample Wheel may not rotate.

When you consider the 2300/2710 system, the possible problems increase significantly. For this reason you should consider Section 8 Troubleshooting as an extension of this troubleshooting section.

Before taking corrective action related to any problem, be certain to collect as much pertinent data as possible. Try to make use of the 2710 service and diagnostic routines to test potential problem areas.

If you cannot resolve a problem, contact YSI Technical Support for help. When you communicate with service personnel, please indicate the serial numbers of both the 2710 Turntable and the 2300 STAT PLUS with which the turntable is configured. If you are writing or transmitting a FAX, include a thorough description of the problem. Include printouts in the "detail" report format, if possible.

You can find phone, FAX and address information for YSI in Appendix F—Warranty and Shipping Information.

SAMPLE WHEEL ROTATION PROBLEM

DESCRIPTION:	The 2710 Turntable Sample Wheel fails to rotate or rotates improperly.
POSSIBLE CAUSE:	The Interconnect Cable has been disconnected.
ACTION:	Reconnect Interconnect Cable or check the cable connector mounting screws to make sure they are snug.
POSSIBLE CAUSE:	The 2710 Turntable Drive Hub has worked loose.
ACTION:	Tighten the Drive Hub set screws, then re-align the turntable with the 2300 STAT PLUS.

SIPPER ALIGNMENT PROBLEM

DESCRIPTION:	The 2300 STAT PLUS Sipper misses intended sample cup.
POSSIBLE CAUSE:	The 2710 Turntable and the 2300 STAT PLUS have become misaligned because the feet of the instruments have been moved from the Indexing Fixture.
ACTION:	Reinstall the feet into their respective positions, then re-align turntable and 2300 STAT PLUS.
POSSIBLE CAUSE:	The 2710 Turntable and the 2300 STAT PLUS have become misaligned due to a loose turntable Drive Hub.
ACTION:	Tighten the Drive Hub set screws, then re-align the turntable with the 2300 STAT PLUS.
POSSIBLE CAUSE:	The 2300 STAT PLUS and the 2710 Turntable have become misaligned because the 2300 STAT PLUS Sipper has been knocked out of its aligned position.
ACTION:	Re-align the 2300 STAT PLUS Sipper to "home" position (Sample Chamber).
POSSIBLE CAUSE:	The 2300 STAT PLUS fluid detection has been turned off and the fixed point is set too low for the sample container.
ACTION:	Reset the fixed sipper depth setting.

FLUID DETECTION PROBLEM

DESCRIPTION:	Fluid Detection error displayed on 2300 STAT PLUS.
POSSIBLE CAUSE:	The 2300 STAT PLUS fluid detection has failed due to low conductivity of the sample solution.
ACTION:	Verify fluid detection turned on in menu. Check fluid detection function by loading a YSI Standard solution, buffer or saline into a sample container and running it as a sample.

10.5 Maintenance

With normal usage there is little maintenance required of the 2710 Turntable. The drive train inside the case is protected from sample spills and does not require any regular lubrication. All exposed surfaces have protective finishes that prevent corrosion if they are cleaned periodically.

Cleaning

The Sample Wheel is made from an aluminum alloy and has been treated with a protective coating. You can remove the wheel easily, without the use of tools, and take it to a wash station where cleaning is more practical.



CAUTION: When cleaning the Sample Wheel, avoid the use of nonpolar solvents such as acetone. Commonly used laboratory cleaning and disinfecting agents such as detergents, 70% isopropyl alcohol, 0.5% hypochlorite (bleach), and 3% hydrogen peroxide will not harm the protective finish.

To remove the wheel from the 2710 Turntable case, grasp firmly with both hands and raise it straight up. The wheel should become disengaged from the drive hub and slide freely off the shaft. If the wheel seems resistant to disengagement, a slight rocking motion should be sufficient to allow removal.

To re-install the Sample Wheel, simply slide the wheel down over the drive shaft until the wheel stops. Gently rotate the wheel until it drops down into the indexing slot. We recommend that whenever the wheel has been removed and replaced that you visually check to verify that it is still properly aligned. If alignment appears to be a problem, enter Service or Diagnostic menu to check more methodically.

The turntable Drive Hub should be checked occasionally to assure that it is secured tightly. A loose Drive Hub causes the 2710 Turntable to become misaligned with the 2300 STAT PLUS Sipper. This could result in damage to the Sipper. A T-handle allen wrench has been provided with the 2710 Turntable for tightening the Drive Hub should it become loose over time.

To re-align the 2710 Turntable, refer to instructions below and in Section 10.2.

Sample Wheel/Drive Hub Alignment

Remove the Sample Wheel as described above.

Enter the 2300 STAT PLUS Service menu, then proceed to Turntable Diagnostics. Follow the steps described below, if necessary.

2300 STAT PLUS Main Menu:

<p>Please select instrument mode: [RUN] [STANDBY] [MENU]</p>
--

Press [MENU], the display reads

**Select instrument function:
1-Service 2-Setup 3-Diagnostic**

Press [1], the display reads

**Select service: 1-Sipper 2-Buffer 3-Cal
4-Stir speed 5-Turntable**

Press [5]. The Sample Wheel rotates counterclockwise until it reaches the "home" position. The home position is Turntable Position #1 and is clearly identified by the vertical slot on the side of the wheel.

**Select turntable service
1-Sipper position 2-Fixed sipper depth**

Now press [1] to move the 2300 STAT PLUS Sipper into position. The Sipper rotates out through the access opening and stops above the turntable "home " position.

Loosen both set screws in the Drive Hub with the allen wrench that has been provided. Replace the Sample Wheel.

Rotate the Sample Wheel by hand until the #1 position is directly under the 2300 STAT PLUS Sipper. Hold the Sample Wheel securely while tightening the two set screws in the Drive Hub.

Now repeat the turntable alignment procedure described in Section 10.2.

11. Typical Performance Data

Introduction

In 1989 YSI introduced the 2300 STAT Glucose and L-Lactate Analyzer. This analyzer was designed to measure glucose in whole blood, plasma or serum and measure L-lactate in whole blood, plasma or cerebrospinal fluid. Among the 2300 STAT features were (1) fixed-parameter automatic calibration, (2) sample results displayed 65 seconds after sample presentation and (3) glucose linearity to 27.8 mmol/L (500 mg/dL) and L-lactate linearity to 15.0 mmol/L (134 mg/dL).

Fixed-parameter automatic calibration in the 2300 STAT triggered calibrations every 5 samples or 15 minutes, whichever occurred first. This is referred to below as the "5/15" routine. The 2300 STAT PLUS (the STAT's successor) now provides programmable options in the autocalibration routine, but maintains "5/15" as the default autocalibration setting. The autocalibration routine is flexible, but has an upper limit of one calibration update every 4 hours (240 minutes). This would be considered "worst case". This is referred to below as the "0/240" routine.

The 2300 STAT PLUS offers operation in one of two performance modes related to sample cycle time. The user selects the mode. The default mode is referred to as Normal Mode, which uses the same cycle time criteria as the 2300 STAT. Alternatively, the user may choose Screen Mode, which provides results more rapidly reducing sample cycle time by about 30%. However, the user is cautioned that accuracy, precision and/or linearity may be compromised in this mode (see Section 2.3). Data presented below compare these two modes of operation.

Each set of data below is categorized by analyte (glucose or lactate), specimen type (whole blood, plasma, etc.), performance mode (Normal or Screen) and autocalibration routine (5/15 or 0/240). There are twenty sets of information in all.

NOTE: The specified linear limits of the 2300 STAT are 500 mg/dL glucose and 15.0 mmol/L lactate. The specified limits of the 2300 STAT PLUS are 900 mg/dL glucose and 30.0 mmol/L lactate. When glucose or lactate values exceeded the linear limit of the 2300 STAT during testing, samples were diluted 1:1 with normal saline solution and reanalyzed. The adjusted results (multiplied by 2) were then used for statistical analysis in the comparison of the 2300 STAT to the 2300 STAT PLUS.

SET 1: WHOLE BLOOD GLUCOSE
NORMAL MODE
5/15 CAL ROUTINE

Comparison of Glucose Measurements (0-900 mg/dL) done on the 2300 STAT PLUS vs. the 2300 STAT.

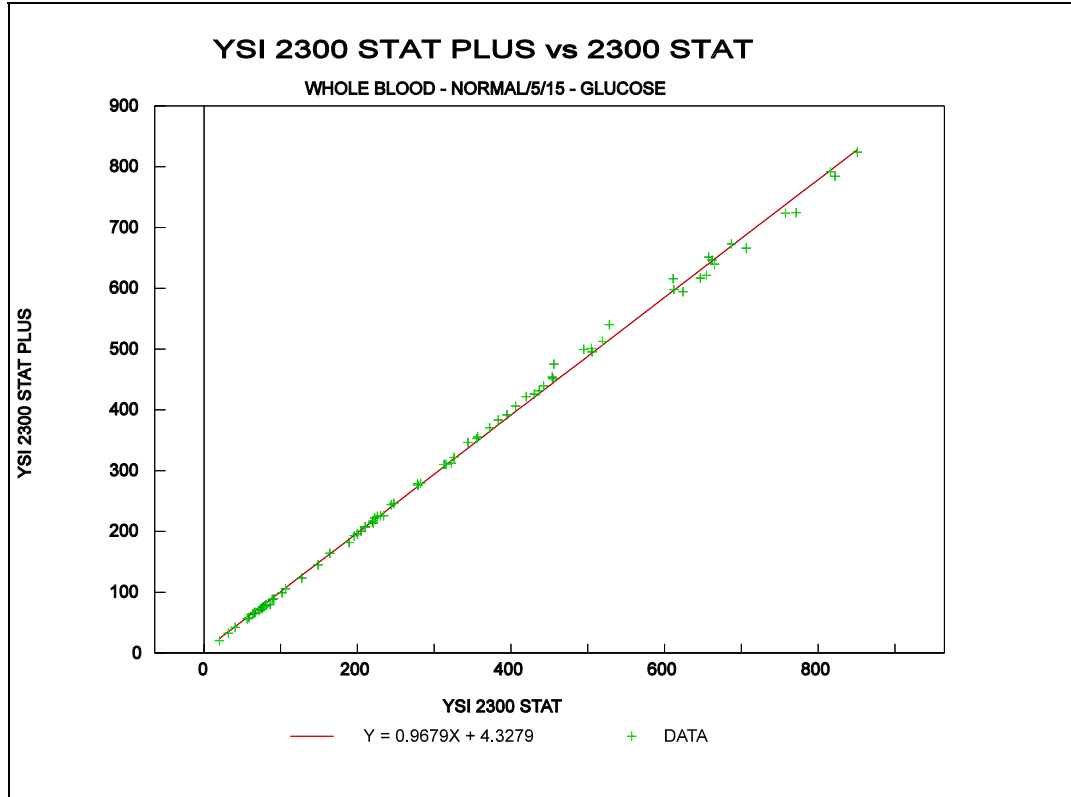


Figure 11.1
Comparison Plot, 0-900 mg/dL

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mg/dL)	Mean Bias (mg/dL)	PESD (mg/dL)
0-150	-1.2 *	0.8
150-300	-3.0 *	1.7
300-500	-1.0 *	2.4
500-900	-20.06	8.67
0-900	-5.85	4.40

Regression Equation (0-900 mg/dL) :

$$2300 \text{ STAT PLUS} = 0.968 (2300 \text{ STAT}) + 4.33$$

Correlation Coefficient (R) = 0.999
n = 83

* Data from 2300 STAT FDA 510k.

SET 2: WHOLE BLOOD GLUCOSE
NORMAL MODE
0/240 CAL ROUTINE

Comparison of Glucose Measurements (0-900 mg/dL) done on the 2300 STAT PLUS vs. the 2300 STAT.

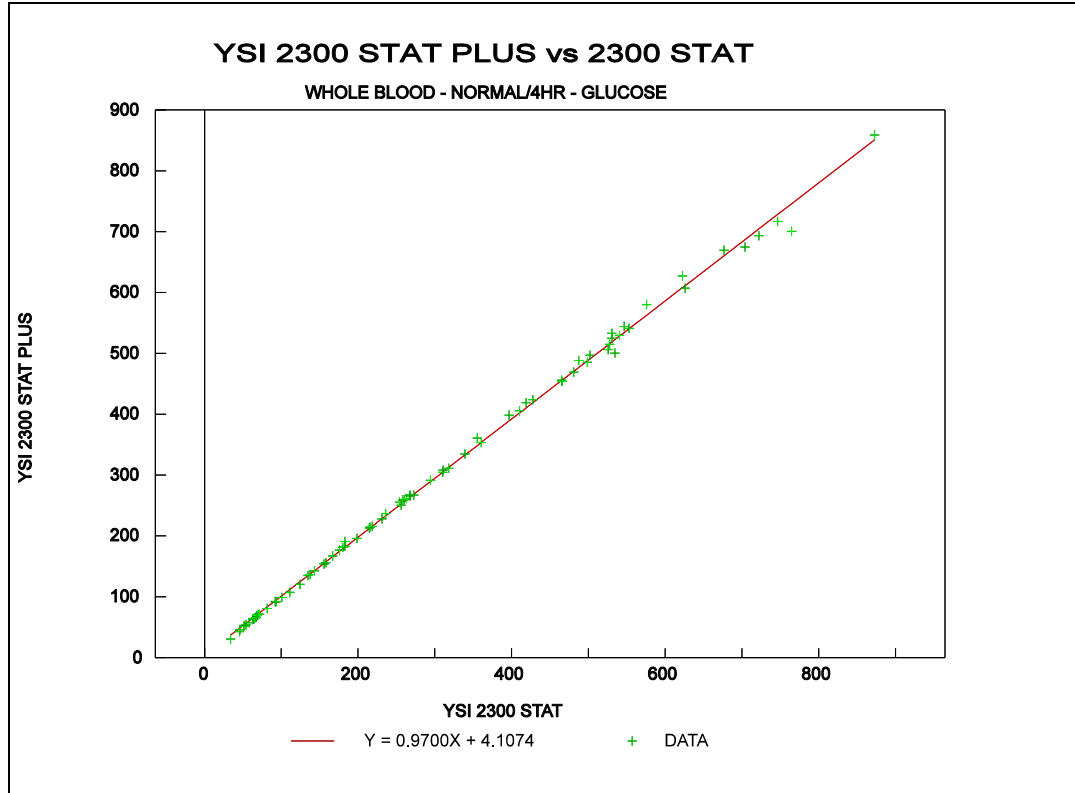


Figure 11.2
Comparison Plot, 0-900 mg/dL

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mg/dL)	Mean Bias (mg/dL)	PESD (mg/dL)
0-150	-0.75	2.27
150-300	-0.90	6.03
300-500	-4.71	5.26
500-900	-15.68	10.69
0-900	-4.89	6.52

Regression Equation (0-900 mg/dL) :

2300 STAT PLUS = 0.970 (2300 STAT) +4.11
 Correlation Coefficient (R) = 0.999
 n = 80

**SET 3: WHOLE BLOOD GLUCOSE
SCREEN MODE
5/15 CAL ROUTINE**

Comparison of Glucose Measurements (0-500 mg/dL) done on the 2300 STAT PLUS vs. the 2300 STAT.

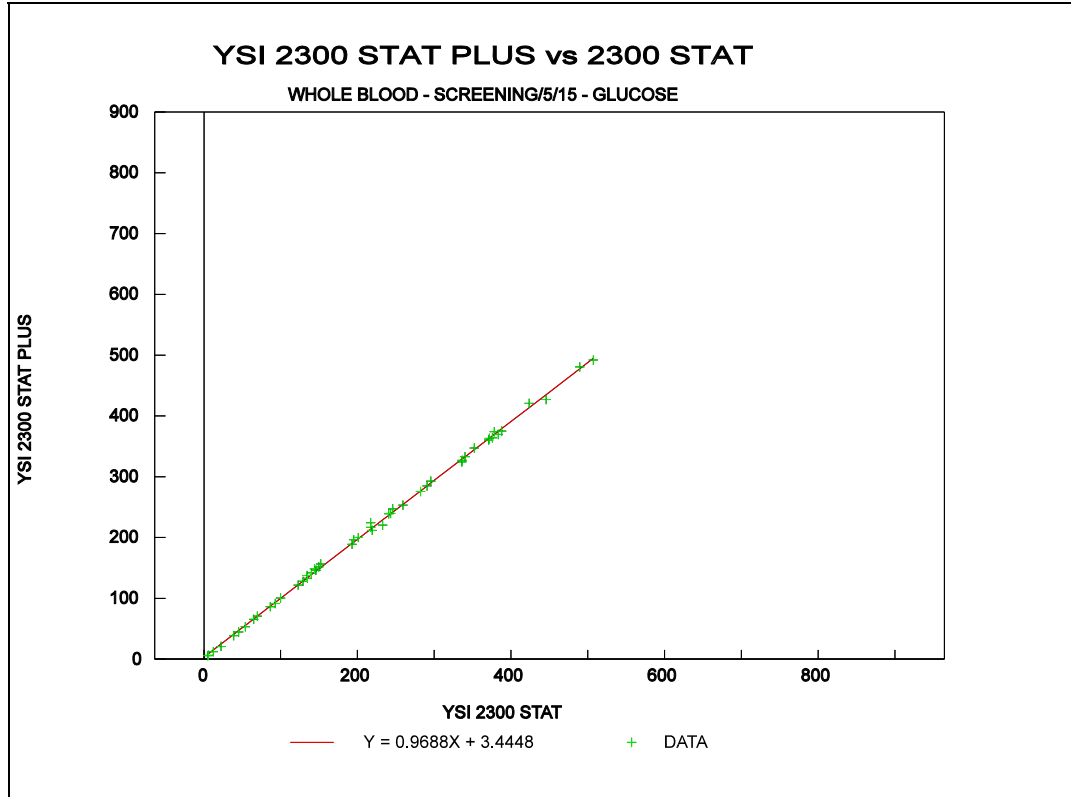


Figure 11.3
Comparison Plot, 0-500 mg/dL

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mg/dL)	Mean Bias (mg/dL)	PESD (mg/dL)
0-150	+0.49	0.92
150-300	-2.35	2.06
300-500	-9.95	4.90
0-500	-3.36	2.92

Regression Equation (0-500 mg/dL) :

$$2300 \text{ STAT PLUS} = 0.969 (2300 \text{ STAT}) + 3.44$$

Correlation Coefficient (R) = 0.999
n = 49

SET 4: WHOLE BLOOD GLUCOSE
SCREEN MODE
0/240 CAL ROUTINE

Comparison of Glucose Measurements (0-500 mg/dL) done on the 2300 STAT PLUS vs. the 2300 STAT.

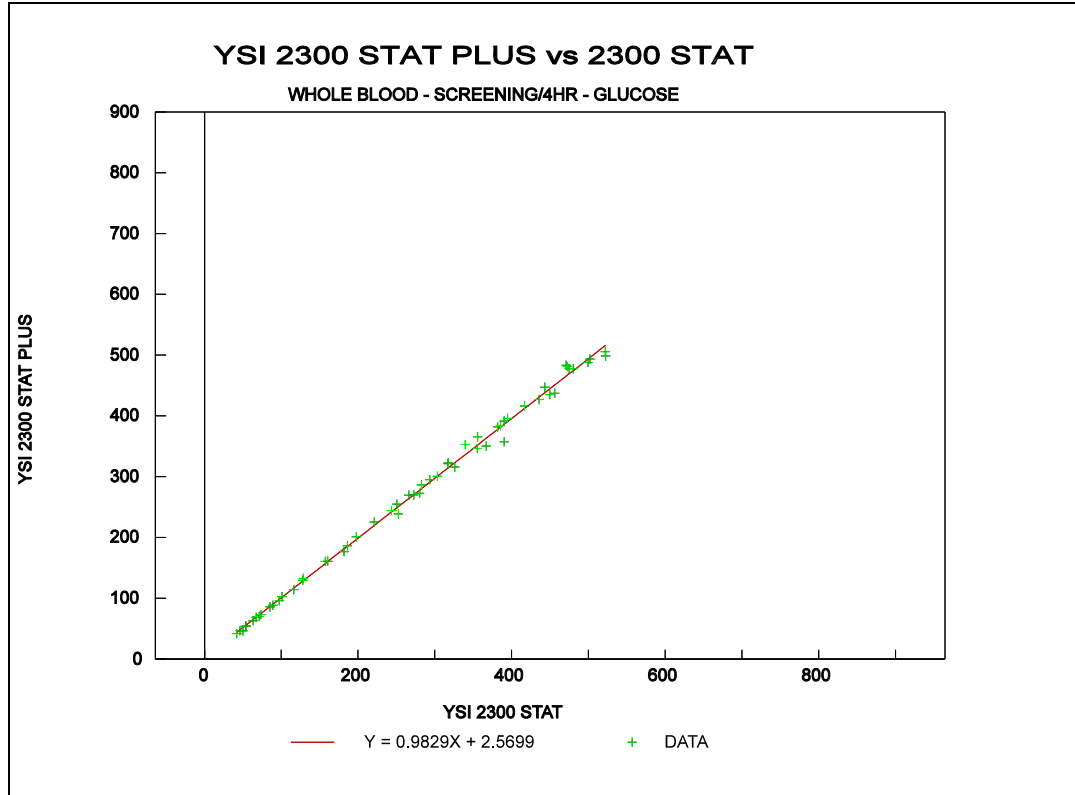


Figure 11.4
Comparison Plot, 0-500 mg/dL

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mg/dL)	Mean Bias (mg/dL)	PESD (mg/dL)
0-150	+0.10	2.04
150-300	-0.20	5.43
300-500	-4.47	10.12
0-500	-2.10	7.49

Regression Equation (0-500 mg/dL) :

$$2300 \text{ STAT PLUS} = 0.983 (2300 \text{ STAT}) + 2.57$$

Correlation Coefficient (R) = 0.999
n = 56

SET 5: PLASMA GLUCOSE
NORMAL MODE
5/15 CAL ROUTINE

Comparison of Glucose Measurements (0-900 mg/dL) done on the 2300 STAT PLUS vs. the 2300 STAT.

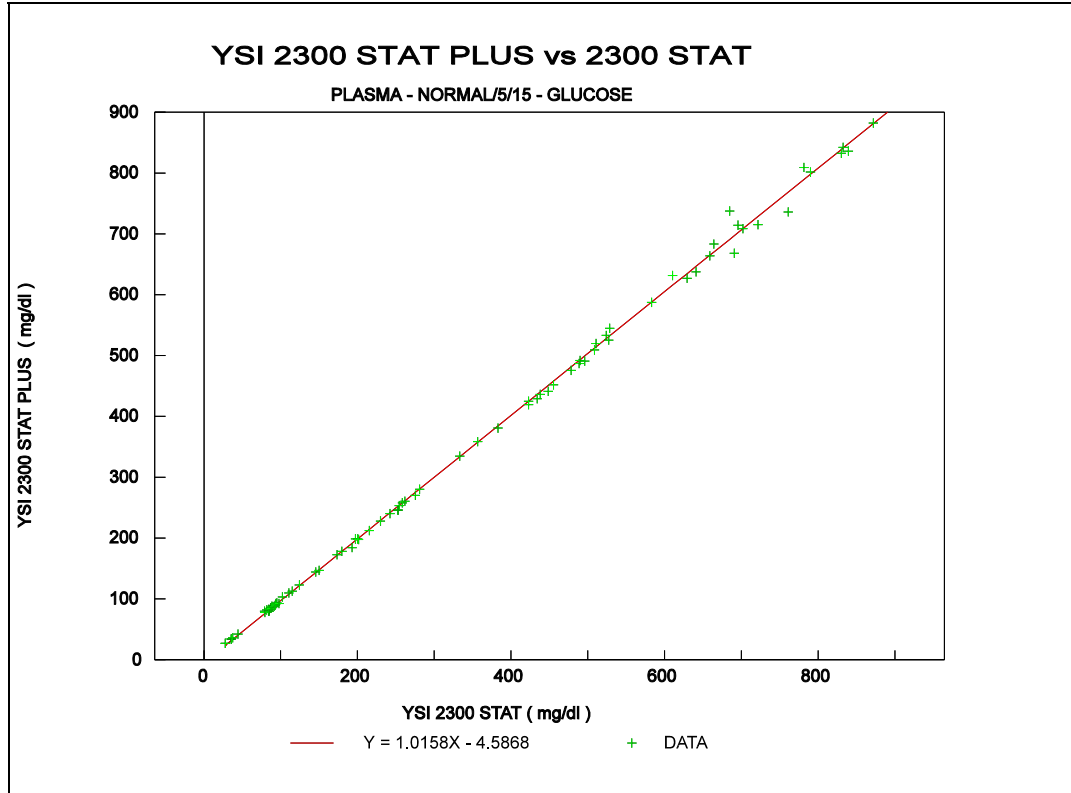


Figure 11.5
Comparison Plot, 0-900 mg/dL

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mg/dL)	Mean Bias (mg/dL)	PESD (mg/dL)
0-150	-1.9 *	0.7
150-300	-2.8 *	2.2
300-500	-1.5 *	2.9
500-900	+8.08	10.41
0-900	+0.86	5.89

Regression Equation (0-900 mg/dL) :

$$2300 \text{ STAT PLUS} = 1.016 (2300 \text{ STAT}) - 4.59$$

Correlation Coefficient (R) = 0.999
n = 82

* Data from 2300 STAT FDA 510k

SET 6: PLASMA GLUCOSE
 NORMAL MODE
 0/240 CAL ROUTINE

Comparison of Glucose Measurements (0-900 mg/dL) done on the 2300 STAT PLUS vs. the 2300 STAT.

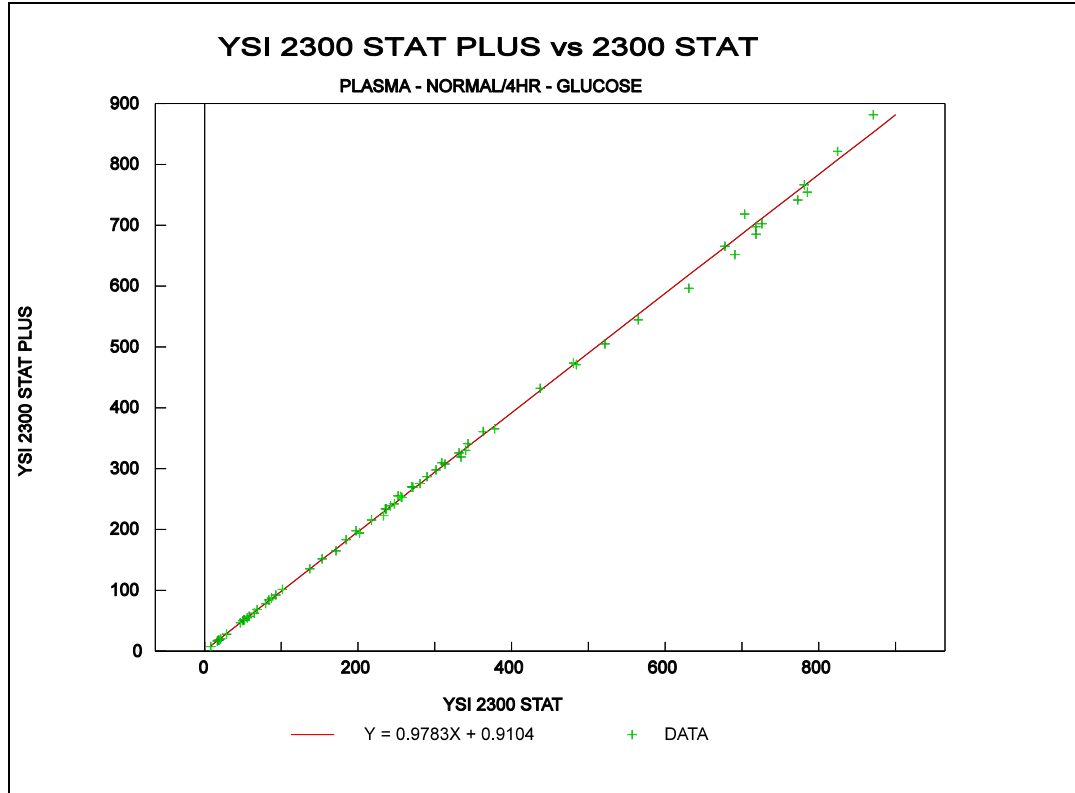


Figure 11.6
 Comparison Plot, 0-900 mg/dL

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mg/dL)	Mean Bias (mg/dL)	PESD (mg/dL)
0-150	-0.35	0.69
150-300	-2.96	2.66
300-500	-6.49	5.70
500-900	-16.86	15.19
0-900	-6.13	7.94

Regression Equation (0-900 mg/dL) :

2300 STAT PLUS = 0.978 (2300 STAT) +0.91
 Correlation Coefficient (R) = 0.999
 n = 67

**SET 7: PLASMA GLUCOSE
SCREEN MODE
5/15 CAL ROUTINE**

Comparison of Glucose Measurements (0-500 mg/dL) done on the 2300 STAT PLUS vs. the 2300 STAT.

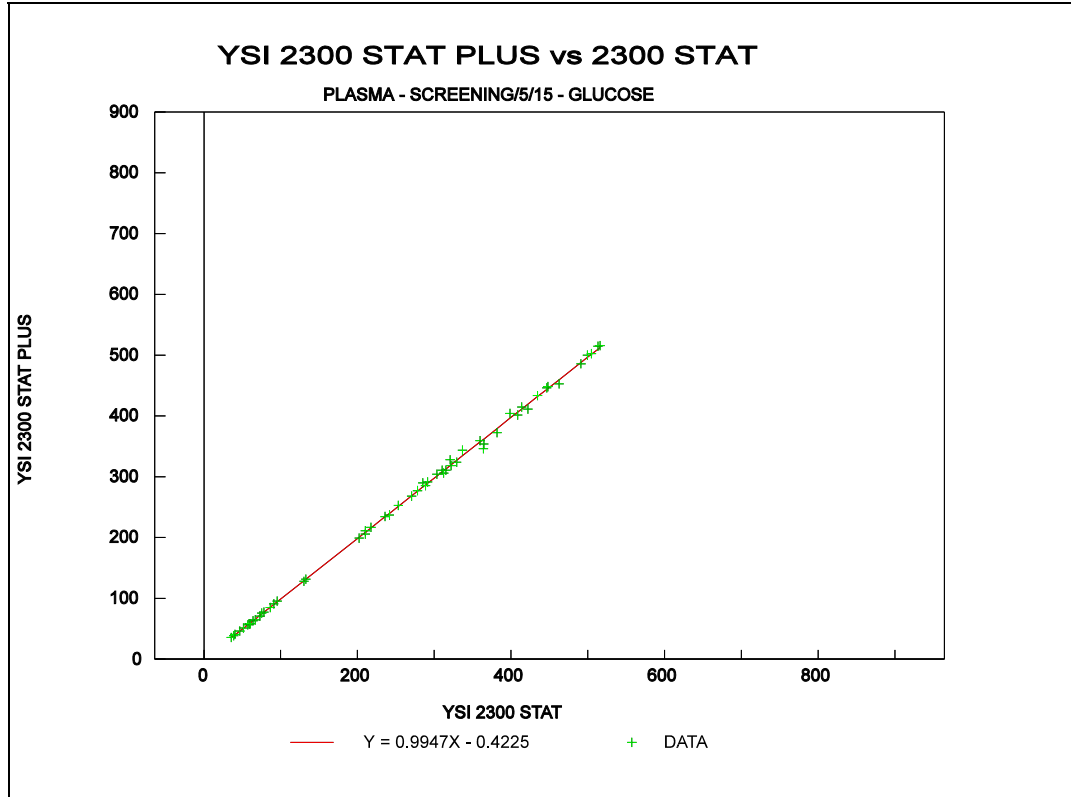


Figure 11.7
Comparison Plot, 0-500 mg/dL

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mg/dL)	Mean Bias (mg/dL)	PESD (mg/dL)
0-150	-0.75	0.84
150-300	-1.24	2.97
300-500	-2.80	5.93
0-500	-1.77	4.22

Regression Equation (0-500 mg/dL) :

$$2300 \text{ STAT PLUS} = 0.995 (2300 \text{ STAT}) - 0.42$$

Correlation Coefficient (R) = 0.999
n = 56

SET 8: PLASMA GLUCOSE
SCREEN MODE
0/240 CAL ROUTINE

Comparison of Glucose Measurements (0-500 mg/dL) done on the 2300 STAT PLUS vs. the 2300 STAT.

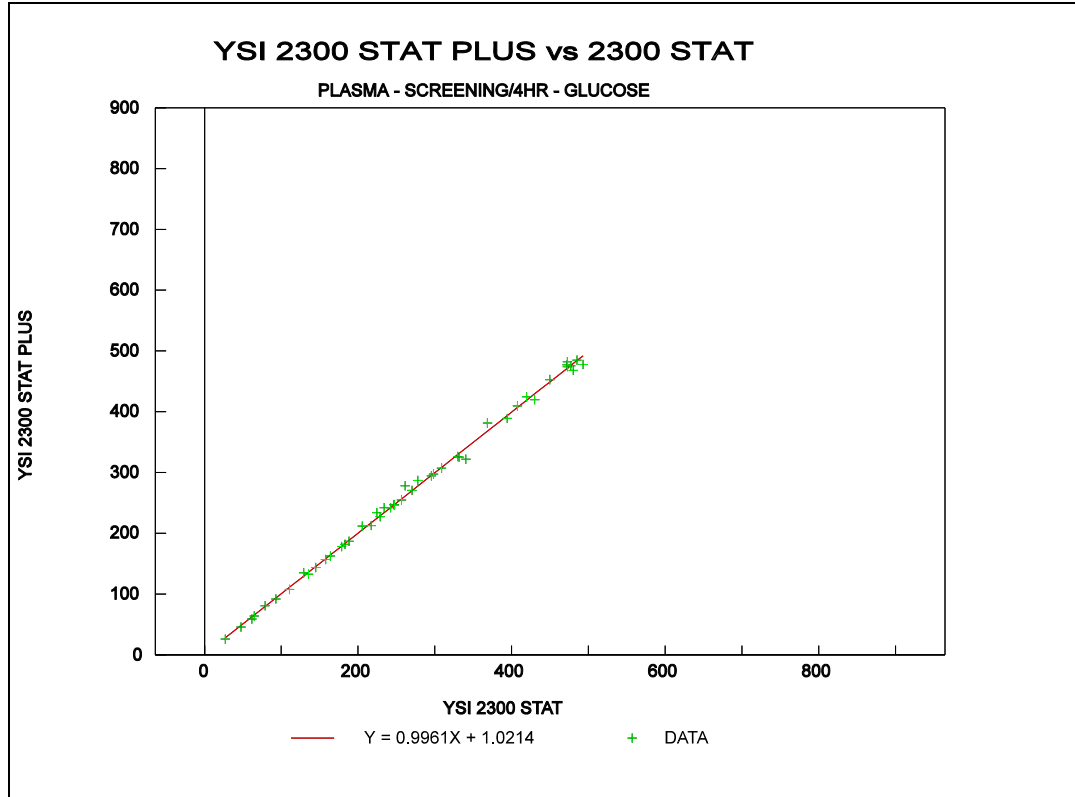


Figure 11.8
Comparison Plot, 0-500 mg/dL

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mg/dL)	Mean Bias (mg/dL)	PESD (mg/dL)
0-150	-0.62	1.77
150-300	+2.00	3.90
300-500	-1.93	6.00
0-500	-0.02	4.50

Regression Equation (0-500 mg/dL) :

$$2300 \text{ STAT PLUS} = 0.996 (2300 \text{ STAT}) + 1.02$$

Correlation Coefficient (R) = 0.999
n = 46

SET 9: WHOLE BLOOD LACTATE
NORMAL MODE
5/15 CAL ROUTINE

Comparison of L-lactate Measurements (0-30 mmol/L) done on the 2300 STAT PLUS vs. the 2300 STAT.

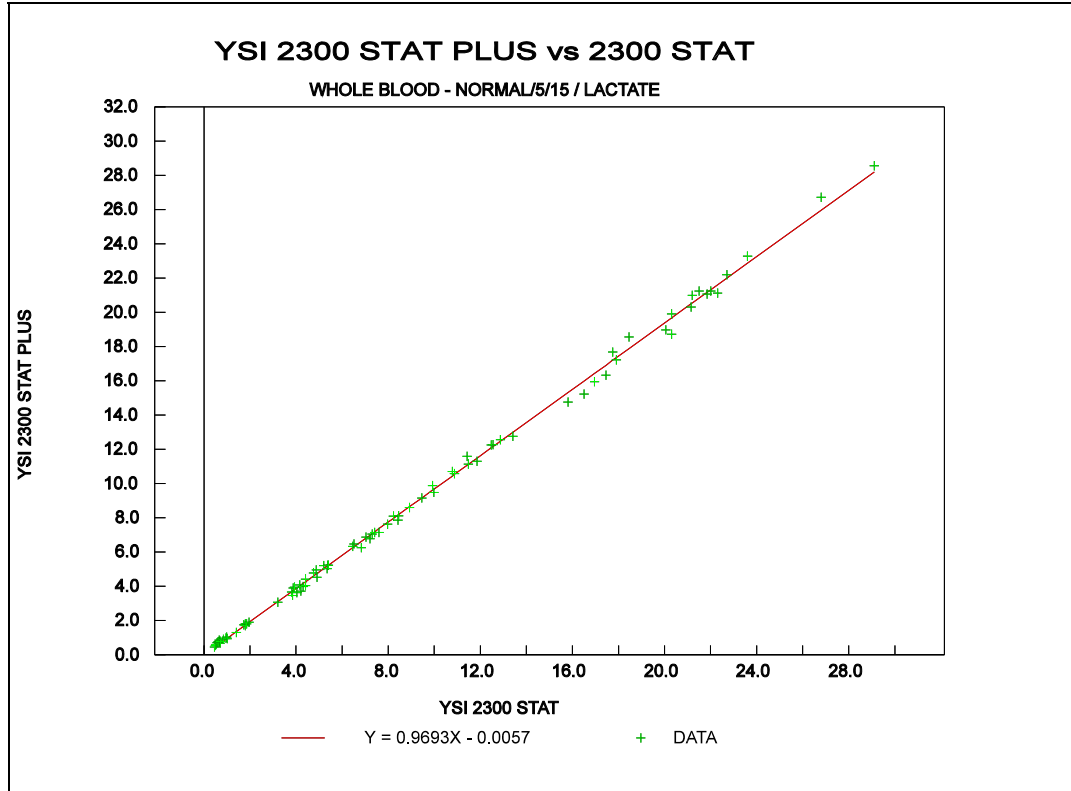


Figure 11.9
Comparison Plot, 0-30 mmol/L

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mmol/L)	Mean Bias (mmol/L)	PESD (mmol/L)
0-5	-0.05 *	0.1
5-10	-0.3 *	0.1
10-15	-0.3 *	0.2
15-30	-0.68	0.31
0-30	-0.28	0.18

Regression Equation (0-30 mM) :

$$2300 \text{ STAT PLUS} = 0.969 (2300 \text{ STAT}) - 0.01$$

Correlation Coefficient (R) = 0.999
n = 85

* Data from 2300 STAT FDA 510k

SET 10: WHOLE BLOOD LACTATE
NORMAL MODE
0/240 CAL ROUTINE

Comparison of L-lactate Measurements (0-30 mmol/L) done on the 2300 STAT PLUS vs. the 2300 STAT.

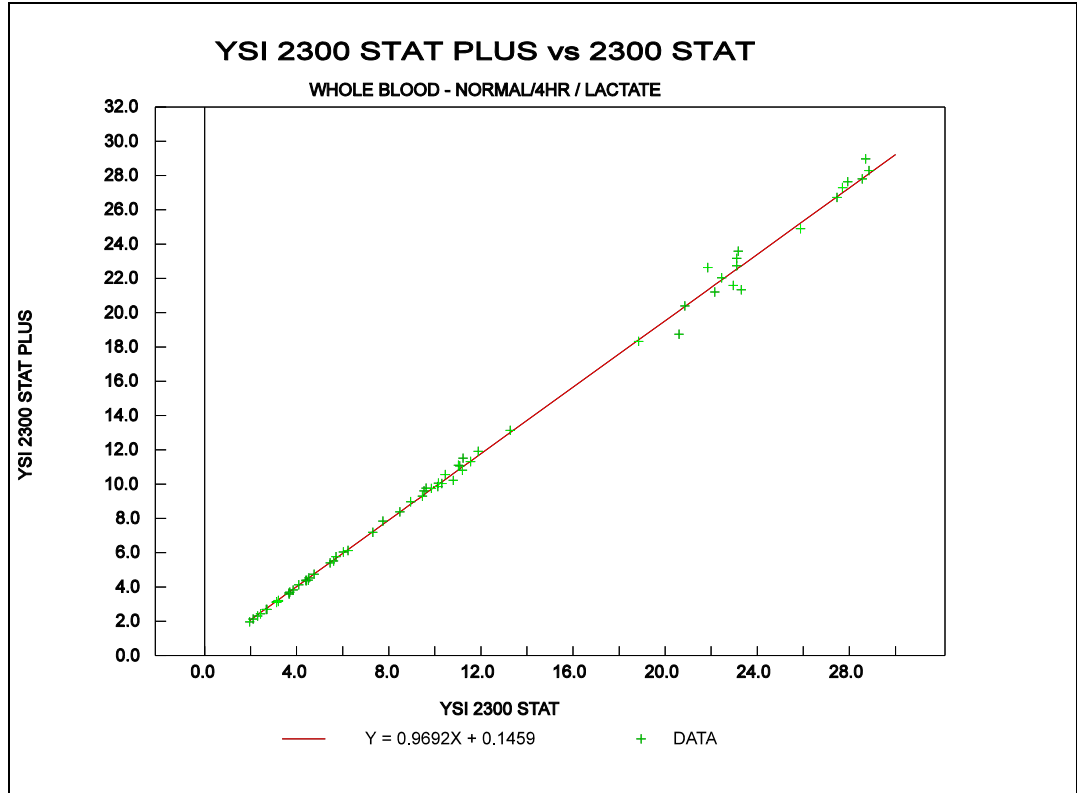


Figure 11.10
Comparison Plot, 0-30 mmol/L

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mmol/L)	Mean Bias (mmol/L)	PESD (mmol/L)
0-5	-0.01	0.05
5-10	-0.02	0.10
10-15	-0.12	0.21
15-30	-0.66	0.71
0-30	-0.23	0.40

Regression Equation (0-30 mM) :

2300 STAT PLUS = 0.969 (2300 STAT) +0.15
Correlation Coefficient (R) = 0.999
n = 66

SET 11: WHOLE BLOOD LACTATE
SCREEN MODE
5/15 CAL ROUTINE

Comparison of L-lactate Measurements (0-15 mmol/L) done on the 2300 STAT PLUS vs. the 2300 STAT.

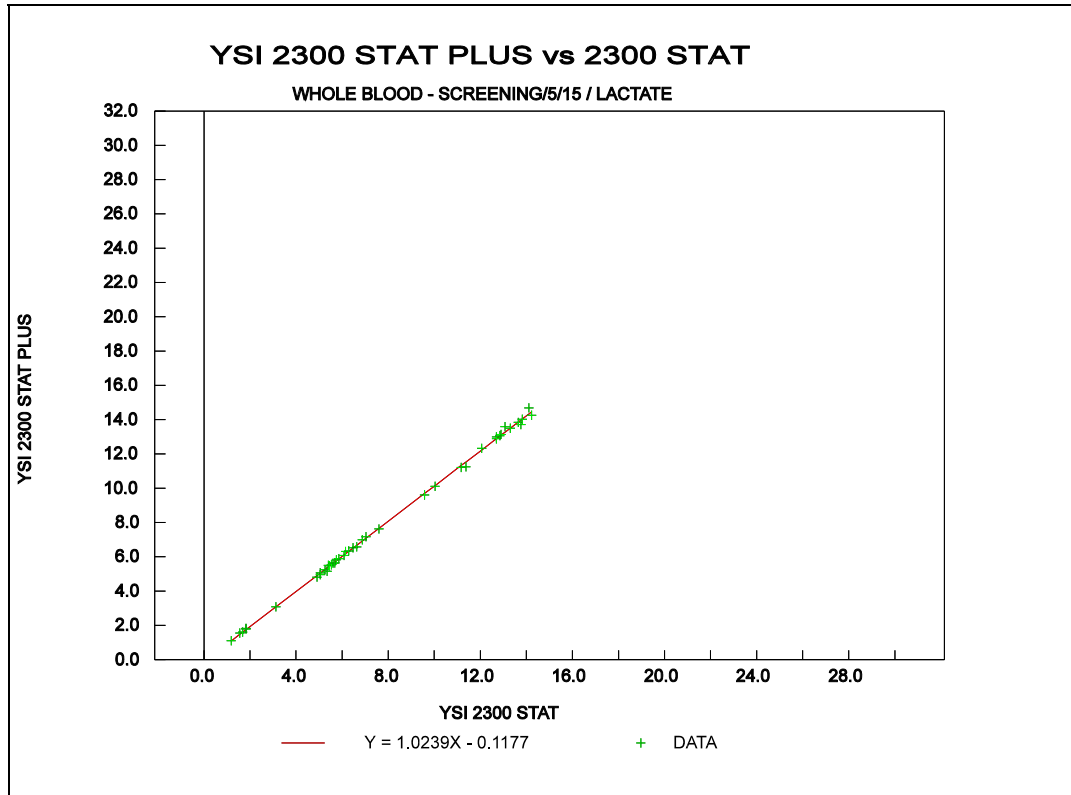


Figure 11.11
Comparison Plot, 0-15 mmol/L

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mmol/L)	Mean Bias (mmol/L)	PESD (mmol/L)
0-5	-0.05	0.04
5-10	+0.02	0.11
10-15	+0.19	0.15
0-15	+0.07	0.12

Regression Equation (0-15 mM) :

2300 STAT PLUS = 1.024 (2300 STAT) - 0.12
 Correlation Coefficient (R) = 0.999
 n = 42

SET 12: WHOLE BLOOD LACTATE
SCREEN MODE
0/240 CAL ROUTINE

Comparison of L-lactate Measurements (0-15 mmol/L) done on the 2300 STAT PLUS vs. the 2300 STAT.

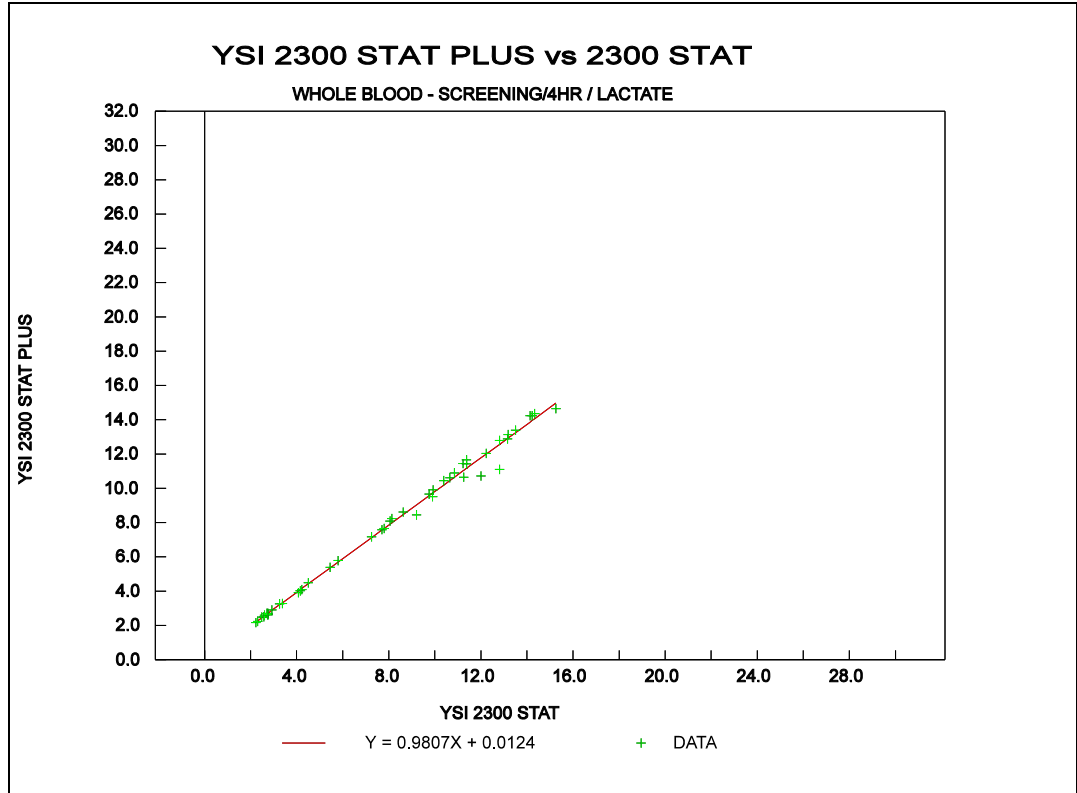


Figure 11.12
Comparison Plot, 0-15 mmol/L

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mmol/L)	Mean Bias (mmol/L)	PESD (mmol/L)
0-5	-0.07	0.10
5-10	-0.13	0.24
10-15	-0.22	0.34
0-15	-0.14	0.25

Regression Equation (0-15 mM) :

2300 STAT PLUS = 0.981 (2300 STAT) +0.01
 Correlation Coefficient (R) = 0.997
 n = 46

SET 13: PLASMA LACTATE
NORMAL MODE
5/15 CAL ROUTINE

Comparison of L-lactate Measurements (0-30 mmol/L) done on the 2300 STAT PLUS vs. the 2300 STAT.

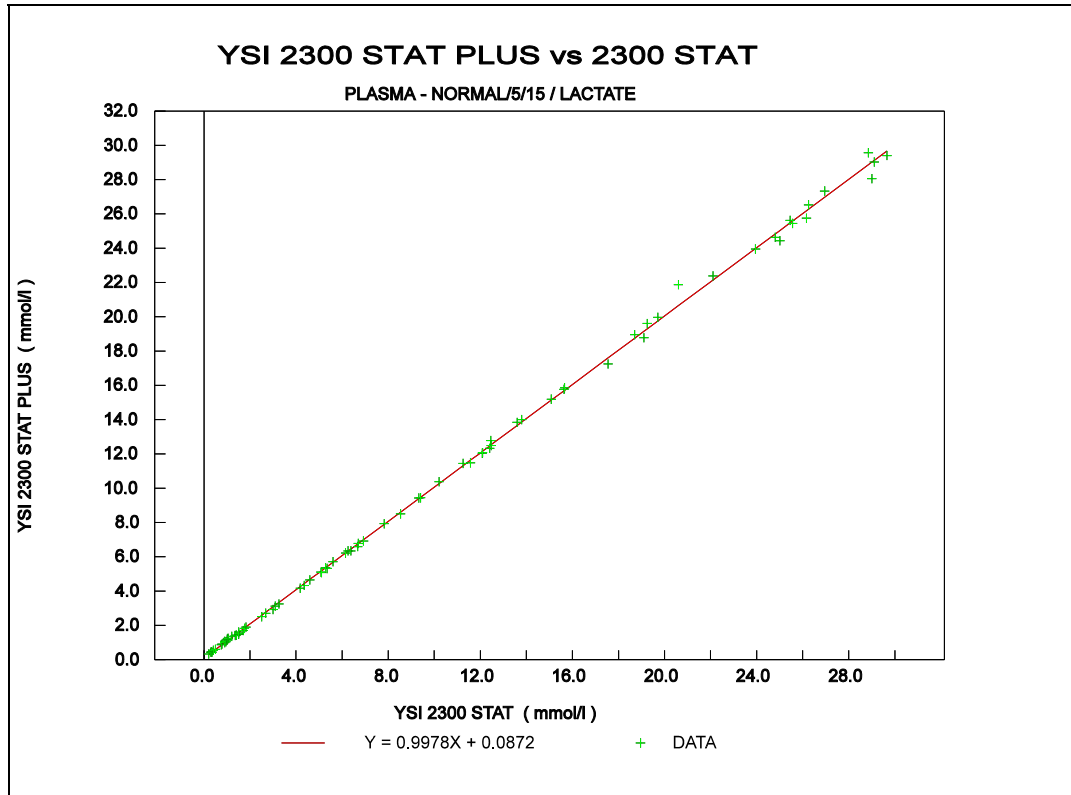


Figure 11.13
Comparison Plot, 0-30 mmol/L

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mmol/L)	Mean Bias (mmol/L)	PESD (mmol/L)
0-5	+0.1 *	0.1
5-10	0.0 *	0.1
10-15	+0.1 *	0.1
15-30	+0.06	0.27
0-30	+0.06	0.16

Regression Equation (0-30 mM) :

$$2300 \text{ STAT PLUS} = 0.998 (2300 \text{ STAT}) + 0.09$$

Correlation Coefficient (R) = 0.999
n = 79

* Data from 2300 STAT FDA 510k

SET 14: PLASMA LACTATE
NORMAL MODE
0/240 CAL ROUTINE

Comparison of L-lactate Measurements (0-30 mmol/L) done on the 2300 STAT PLUS vs. the 2300 STAT.

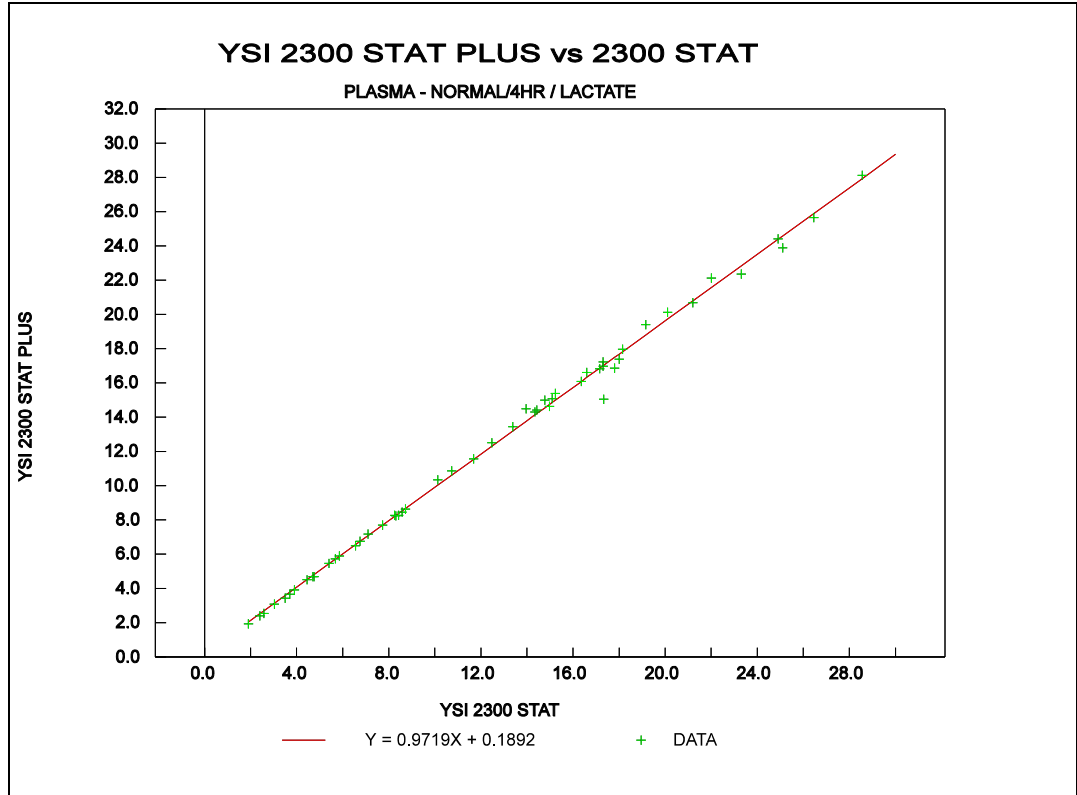


Figure 11.14
Comparison Plot, 0-30 mmol/L

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mmol/L)	Mean Bias (mmol/L)	PESD (mmol/L)
0-5	-0.01	0.04
5-10	-0.02	0.06
10-15	+0.07	0.18
15-30	-0.45	0.39
0-30	-0.17	0.26

Regression Equation (0-30 mM) :

$$2300 \text{ STAT PLUS} = 0.972 (2300 \text{ STAT}) + 0.19$$

Correlation Coefficient (R) = 0.999
n = 53

SET 15: PLASMA LACTATE
SCREEN MODE
5/15 CAL ROUTINE

Comparison of L-lactate Measurements (0-15 mmol/L) done on the 2300 STAT PLUS vs. the 2300 STAT.

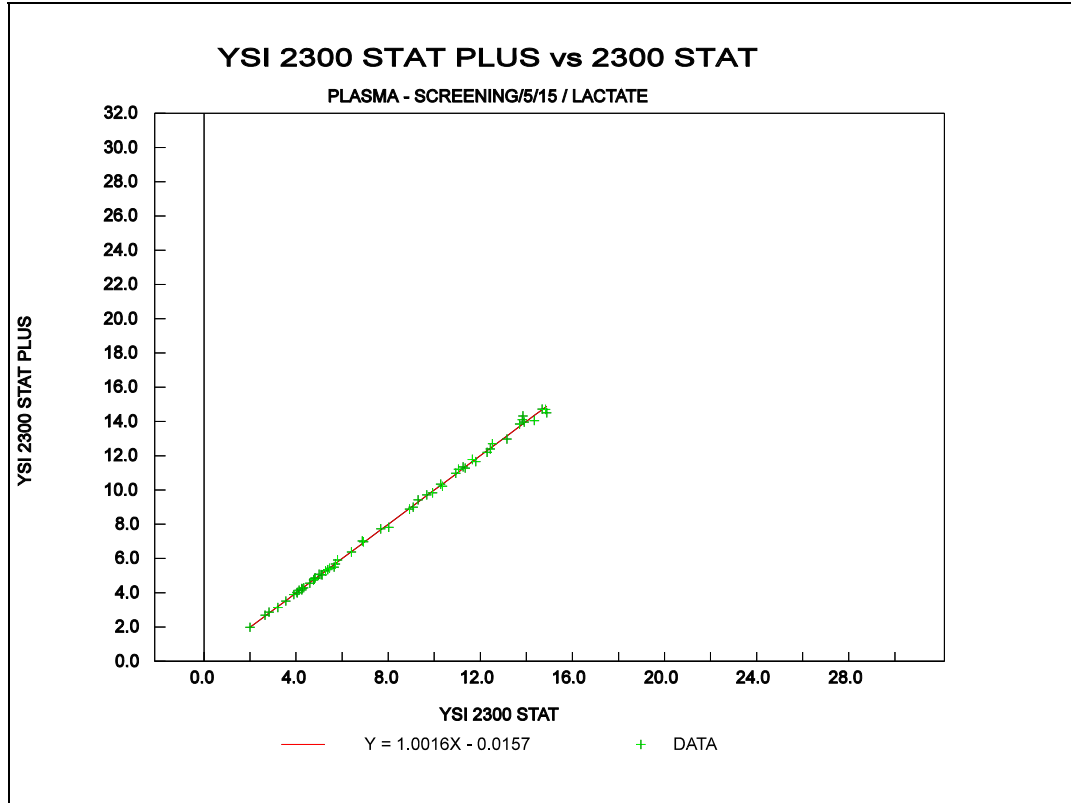


Figure 11.15
Comparison Plot, 0-15 mmol/L

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mmol/L)	Mean Bias (mmol/L)	PESD (mmol/L)
0-5	-0.01	0.06
5-10	-0.01	0.14
10-15	+0.01	0.27
0-15	0.0	0.18

Regression Equation (0-15 mM) :

2300 STAT PLUS = 1.002 (2300 STAT) -0.02
 Correlation Coefficient (R) = 0.999
 n = 57

SET 16: PLASMA LACTATE
SCREEN MODE
0/240 CAL ROUTINE

Comparison of L-lactate Measurements (0-15 mmol/L) done on the 2300 STAT PLUS vs. the 2300 STAT.

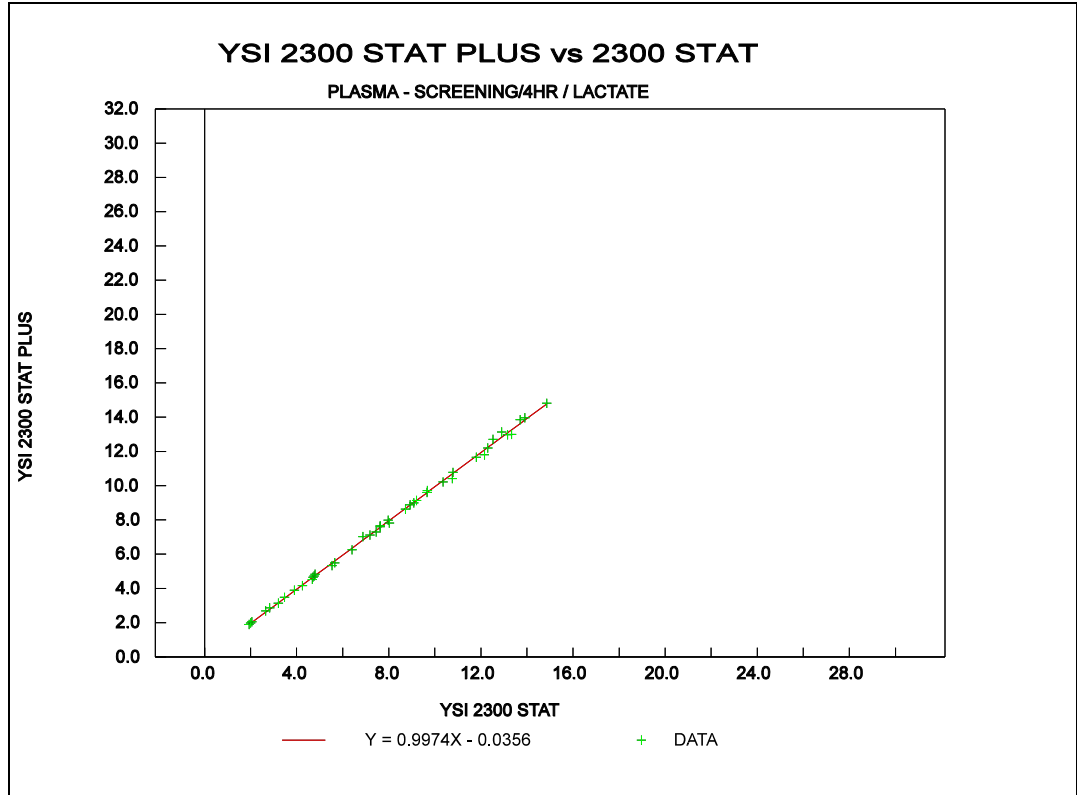


Figure 11.16
Comparison Plot, 0-15 mmol/L

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mmol/L)	Mean Bias (mmol/L)	PESD (mmol/L)
0-5	-0.03	0.07
5-10	-0.06	0.14
10-15	-0.08	0.33
0-15	-0.06	0.21

Regression Equation (0-15 mM) :

$$2300 \text{ STAT PLUS} = 0.997 (2300 \text{ STAT}) - 0.04$$

Correlation Coefficient (R) = 0.999
n = 42

SET 17: CEREBROSPINAL FLUID LACTATE
NORMAL MODE
5/15 CAL ROUTINE

Comparison of L-lactate Measurements (0-30 mmol/L) done on the 2300 STAT PLUS vs. the 2300 STAT.

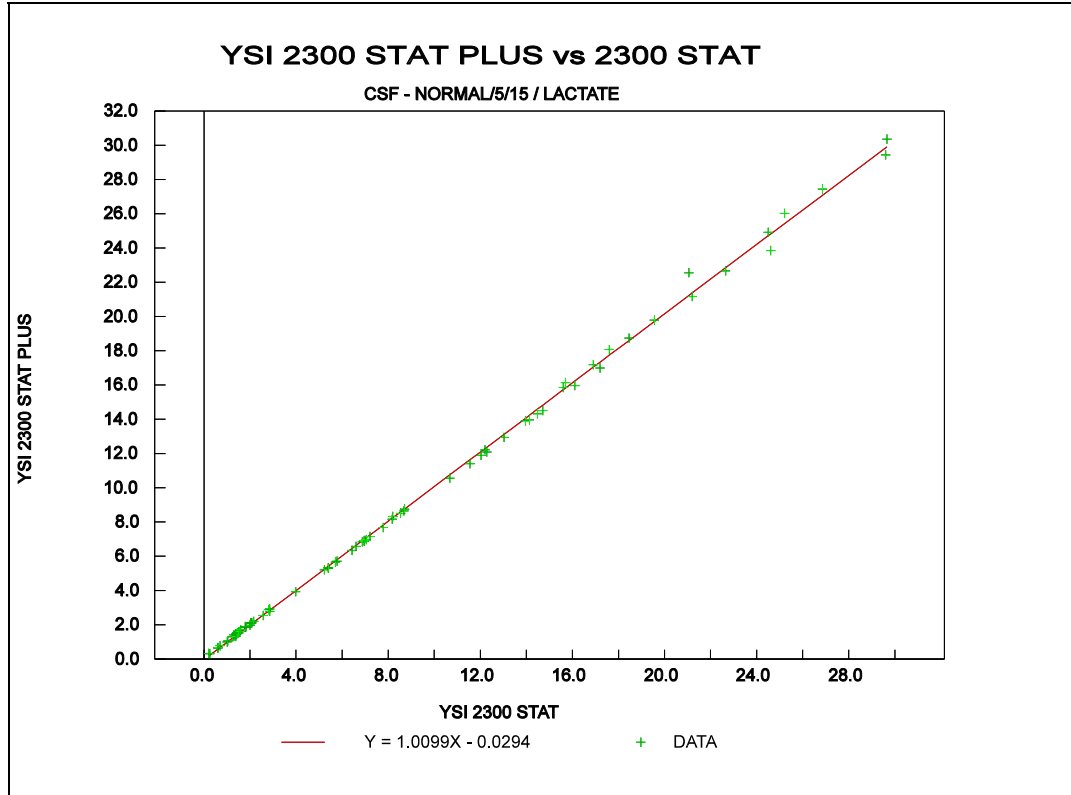


Figure 11.17
Comparison Plot, 0-30 mmol/L

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mmol/L)	Mean Bias (mmol/L)	PESD (mmol/L)
0-5	+0.01 *	0.1
5-10	0.0 *	0.1
10-15	-0.01 *	0.1
15-30	+0.28	0.57
0-30	+0.05	0.27

Regression Equation (0-30 mM) :

$$2300 \text{ STAT PLUS} = 1.010 (2300 \text{ STAT}) - 0.03$$

Correlation Coefficient (R) = 0.999
n = 80

* Data from 2300 STAT FDA 510k

SET 18: CEREBROSPINAL FLUID LACTATE
 NORMAL MODE
 0/240 CAL ROUTINE

Comparison of L-lactate Measurements (0-30 mmol/L) done on the 2300 STAT PLUS vs. the 2300 STAT.

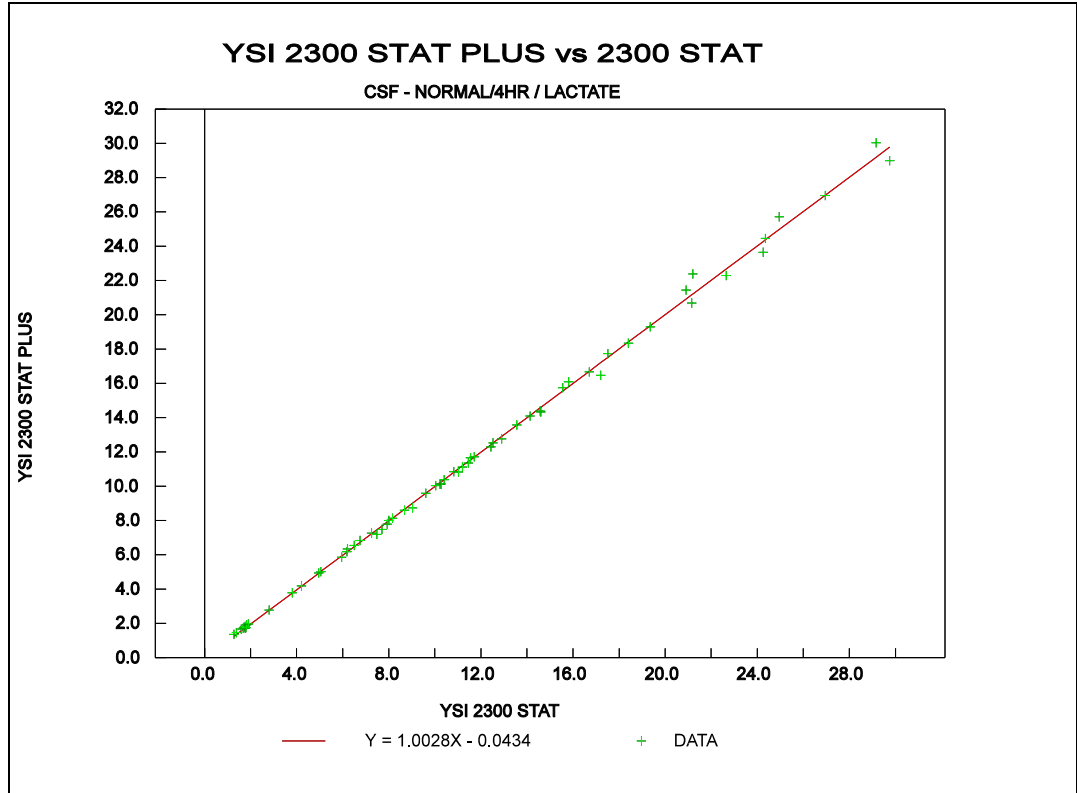


Figure 11.18
 Comparison Plot, 0-30 mmol/L

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mmol/L)	Mean Bias (mmol/L)	PESD (mmol/L)
0-5	+0.03	0.04
5-10	-0.06	0.20
10-15	-0.08	0.20
15-30	+0.07	0.61
0-30	-0.01	0.35

Regression Equation (0-30 mM) :

2300 STAT PLUS = 1.003 (2300 STAT) - 0.04
 Correlation Coefficient (R) = 0.999
 n = 63

SET 19: CEREBROSPINAL FLUID LACTATE
SCREEN MODE
5/15 CAL ROUTINE

Comparison of L-lactate Measurements (0-15 mmol/L) done on the 2300 STAT PLUS vs. the 2300 STAT.

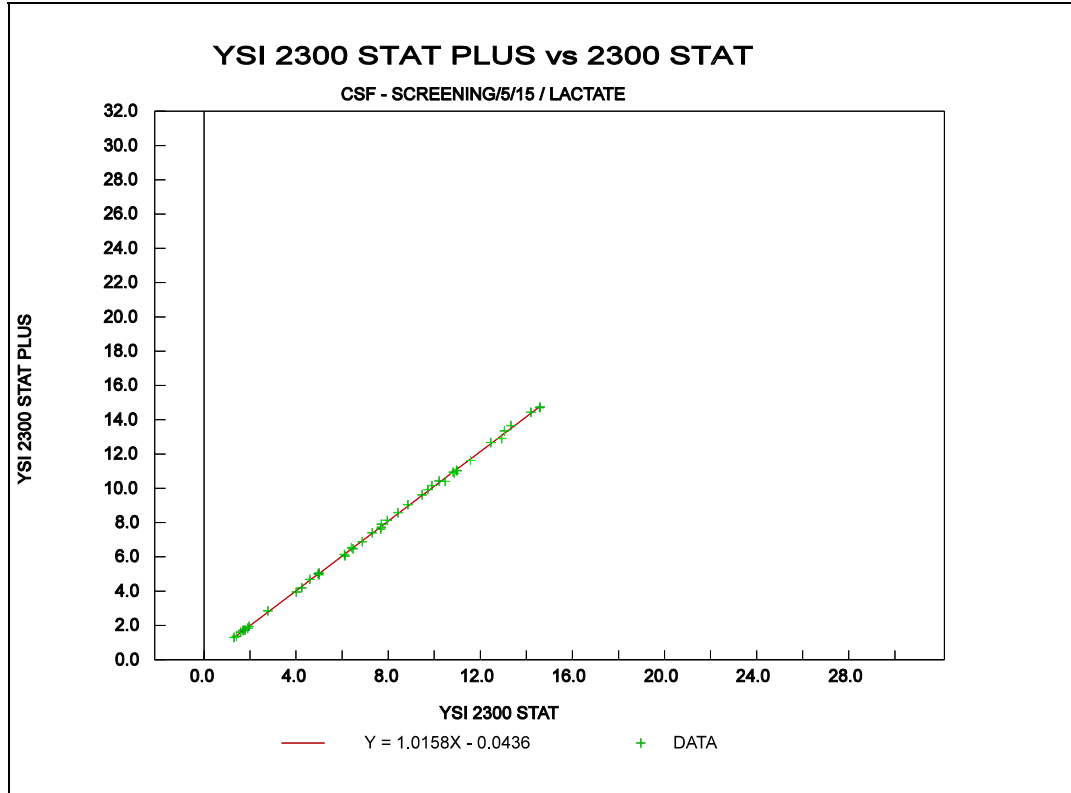


Figure 11.19
Comparison Plot, 0-15 mmol/L

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mmol/L)	Mean Bias (mmol/L)	PESD (mmol/L)
0-5	0.0	0.05
5-10	+0.10	0.09
10-15	+0.13	0.23
0-15	+0.07	0.14

Regression Equation (0-15 mM) :

$$2300 \text{ STAT PLUS} = 1.016 (2300 \text{ STAT}) - 0.04$$

Correlation Coefficient (R) = 0.999
n = 45

SET 20: CEREBROSPINAL FLUID LACTATE
SCREEN MODE
0/240 CAL ROUTINE

Comparison of L-lactate Measurements (0-15 mmol/L) done on the 2300 STAT PLUS vs. the 2300 STAT.

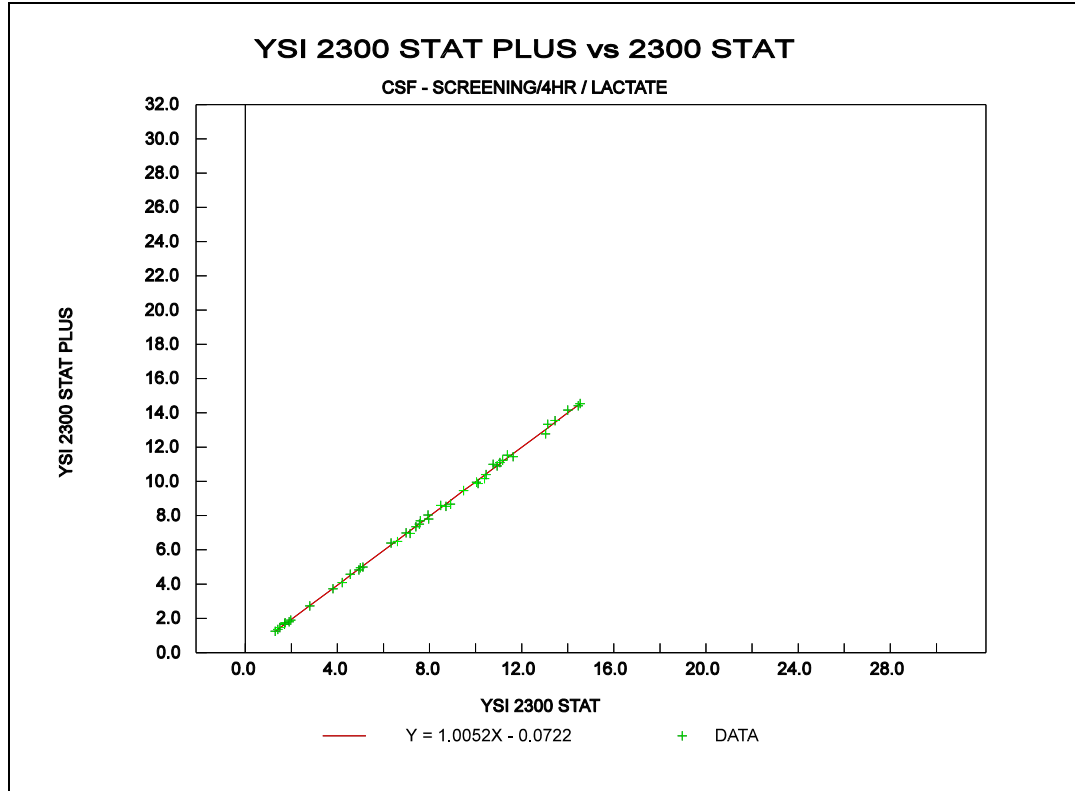


Figure 11.20
Comparison Plot, 0-15 mmol/L

Data Ranges and statistics:

PESD = Pooled Estimate Standard Deviation

Range (mmol/L)	Mean Bias (mmol/L)	PESD (mmol/L)
0-5	-0.05	0.06
5-10	-0.05	0.15
10-15	-0.01	0.17
0-15	-0.03	0.14

Regression Equation (0-15 mM) :

$$2300 \text{ STAT PLUS} = 1.005 (2300 \text{ STAT}) - 0.07$$

Correlation Coefficient (R) = 0.999
n = 45

12. Appendix A—Line Power Cord and Plug Wiring

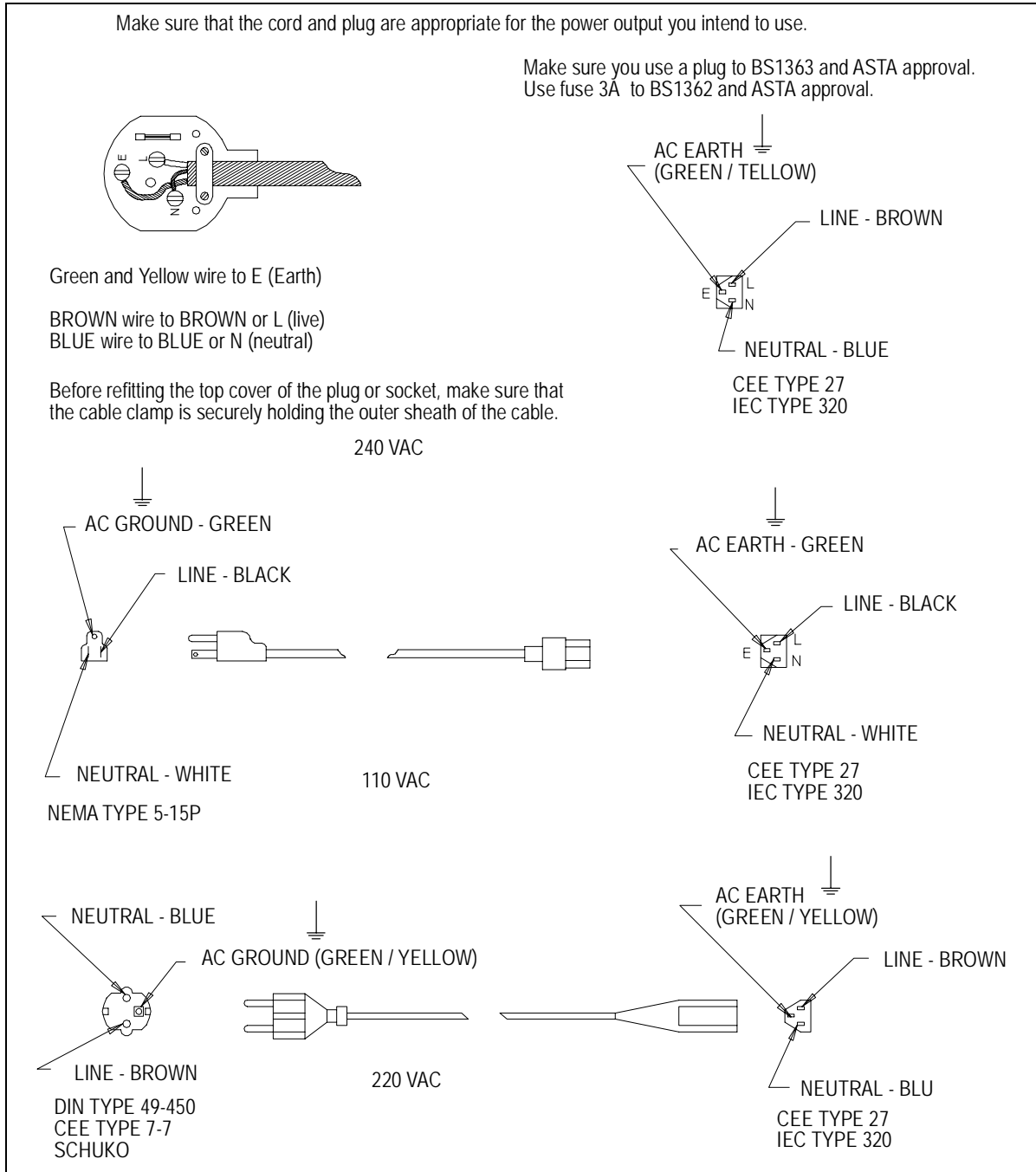


Figure 12.1
Line Power Cord and Plug Wiring

13. Appendix B—Sample Collection and Handling



Proper sample collection and preparation are vital factors in obtaining reliable results with the YSI 2300. This section covers the basic guidelines for collecting and preparing plasma, whole blood, and serum samples.

Much of the Blood Plasma and Blood Serum material is abstracted from "Workshop Manual of Methods for the Determination of Glucose" by Gerald R. Cooper, M.D., Ph.D. published by the Commission on Continuing Education, Council on Clinical Chemistry, American Society of Clinical Pathologists (1966).

B.1 BLOOD PLASMA

Be sure that all collection equipment is sterile and chemically clean. Use aseptic techniques in handling the sample from collection through assay.

During, or immediately after collection, mix the specimen with an anticoagulant and preservative to prevent coagulation, inhibit enzyme activity, and prevent bacterial growth. Separate the red blood cells by centrifugation within 30 minutes of collection. Do not allow plasma to stand on the red cells for long periods at room temperature as this will cause a drop in the glucose level.

If delays between collection and assay are unavoidable, follow one of these procedures:

1. Refrigerate the whole blood at +4°C. This is acceptable for periods up to four hours.
2. Or, refrigerate the plasma with preservatives at +4°C for up to three days. Plasma with preservative left at room temperature may keep up to four hours.
3. Or, freeze the cell-free plasma with preservative at -10°C or colder. Plasma will keep indefinitely at this temperature. Thaw the frozen plasma rapidly at 25°C and analyze promptly. The freeze-thaw cycle should not be repeated. Tubes containing cells should never be frozen.

NOTE: Chilling or freezing may precipitate aggluten or fibrinogen masses which may not redissolve. In such cases, remove them by centrifugation before assay.

Several common anticoagulants are suitable for use with specimens being prepared for assay. These include

- » Potassium oxalate in a concentration of 2 mg/ml of blood.
- » Sodium fluoride in a concentration of 5–10 mg/ml of blood.
- » EDTA in a concentration of 1 mg/ml of blood.
- » Sodium fluoride and potassium oxalate in combination in a total concentration of 2 mg/ml of blood.
- » Heparin (sodium or lithium) as commonly supplied in Vacutainer collection tubes.



WARNING: The YSI 2300 is not suitable for use with samples containing thymol or other phenol preservatives. These are interfering substances.

Oxalate anticoagulants, and particularly the combination of sodium fluoride and oxalate, may produce hemolysis, which can cause disagreement between results from the YSI 2300 and some reference methods.



WARNING: Frozen blood-bank blood, which contains a high percentage of glycerin, is not a suitable specimen for diagnostic work with the YSI 2300.

B.2 WHOLE BLOOD

If more than five minutes will elapse between the time you draw a specimen and analyze it, you should mix the blood with an anticoagulant during or immediately after collection. Analysis of whole blood without an anticoagulant is not recommended. The preferred anticoagulants are EDTA in a concentration of 1 mg/ml of blood, or heparin sodium as commonly supplied in Vacutainer collection tubes.

Other effective anticoagulants which may be used are potassium oxalate in a concentration of 2 mg/ml of blood, sodium fluoride in a concentration of 5–10 mg/ml of blood, or sodium fluoride and EDTA in a concentration of 2.5 mg fluoride and 1 mg EDTA per ml of blood.

These are not known to cause any error in the measurement of whole blood glucose or lactate, but they may cause a reduction of the sample's hematocrit value with or without accompanying hemolysis. This would lead to a slight error in the calculated plasma glucose value. Hemolysis can cause disagreement between readings on the YSI 2300 and some reference methods.

Cell metabolism or microbial growth can cause rapid loss of glucose in the specimen through glycolysis, which will result in erroneously low assay values. Glycolysis is particularly rapid in whole blood specimens, and these should be analyzed within an hour of drawing. Refrigeration at +4°C will retard glycolysis and extend the acceptable delay to four hours. Whole blood specimens must not be frozen. Some authorities recommend the use of chemical preservatives to minimize glycolysis:

- » Fluoride in concentrations of 7.5 mg/ml of blood.
- » Boric acid in concentrations of 8 mg/ml of blood.
- » Sodium iodoacetate; if sodium iodoacetate is used as the antiglycolytic, it must be free of iodide and iodine.

YSI has not evaluated the effects of these antiglycolytics.



WARNING: The YSI 2300 is not suitable for use with samples containing thymol or other phenol preservatives. These are interfering substances.

Before taking a sample from a whole blood specimen, any cells which may have settled out must be resuspended. Invert the collection tube three times, gently enough not to cause frothing, just before sampling. Samples which have settled for more than an hour (particularly if they have been refrigerated) should be placed on a blood rotator for five minutes to break up clumps of cells.

Air bubbles or froth in the sample drawn into the sipper can lead to significant errors in the form of low glucose and lactate readings. Because it is difficult to detect bubbles visually in whole blood specimens, you should exercise great care. Any unexpectedly low glucose or lactate readings may indicate a bubble; if possible, repeat the determination.



WARNING: Frozen blood-bank blood, which contains a high percentage of glycerin, is not a suitable specimen for diagnostic work with the YSI 2300.

B.3 BLOOD SERUM

Draw blood for serum preparation into a dry tube without additives. Silicone-coated tubes and stoppers lubricated with glycerine or silicone are acceptable.

After the specimen stands 15 minutes at room temperature, loosen the clot from the wall of the tube with a sterile glass rod or applicator. Add sterile beads, if desired. Centrifuge the specimen promptly to separate the serum from the clot.

Cell metabolism or microbial growth can cause rapid loss of glucose in the specimen through glycolysis. This will result in erroneously low assay values. Minimize glycolysis by assaying the serum as soon as possible, preferably within four hours.

If delays are unavoidable follow one these procedures:

1. Refrigerate the whole blood at +4°C. This is acceptable for periods of up to 4 hours.
2. Or, prolonged storage, isolate the serum from the clot within 30 minutes of collection and freeze it at -10°C or colder. Serum will keep indefinitely at this temperature. Thaw the frozen serum rapidly at 25°C and analyze promptly. The freeze-thaw cycle should not be repeated. Tubes containing cells should never be frozen.

NOTE: Freezing may precipitate aggluten or fibrinogen masses which may not redissolve. You can remove these by centrifugation before assay.

3. Add a chemical preservative. Preservatives are not commonly used with serum; however, sodium fluoride in concentrations of 7.5 mg/ml of blood, EDTA in concentrations of 1 mg/ml of blood, or boric acid in concentrations of 8 mg/ml of blood will substantially halt glycolysis in most, but not all, specimens. If sodium iodoacetate is used as an antiglycolytic, it must be free of iodide and iodine.



WARNING: The YSI 2300 is not suitable for use with samples containing thymol or other phenol preservatives. These are interfering substances.



WARNING: Frozen blood-bank blood, which contains a high percentage of glycerine, is not a suitable specimen for diagnostic work with the YSI 2300.

14. Appendix C—Effects of Selected Substances



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

Several classes of chemicals can damage the YSI sensor system or cause erroneous readings. Most of these have no place in diagnostic medicines, but may be of scientific interest. Some substances such as triglycerides, which are interferences for photometric sensor systems, do not interfere with the 2300 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 specimens. 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 2300 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-Phenylenediamine
- » 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 2300.

The endogenous substances listed were all tested at levels far higher than can be found in the body, and all 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, and nothing should be added to the specimens except those anticoagulants and antiglycolytics recommended in the section on **Sample Collection and Handling**.

Recent information indicates that some of the exogenous substances listed are now drugs that are abused, that is, ingested at levels much higher than the usually recommended therapeutic doses. In patients with higher than therapeutic levels, there is hazard of gross masking of glucose or lactate concentration by the interfering substance. The YSI 2300 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 2300 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 erythrocyte 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.

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 Iodipamide	1335.02	25000	190
Meglumine Iothalamate	809.13	29000	360
Renografine (Squibb)	mixture	22000	220 gm/l
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
D-Mannose	180.16	29.4	1.63
Melibiose	342.20	250	7.31
2-Mercaptoethanol	78.13	0.8	0.1
Methylene Blue	373.9	370	9.9
3-O-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

INTERFERING SUBSTANCE	FORMULA WEIGHT	INTERFERING LEVELS FOR LACTATE	
		mg/dL	mmol/L
ENDOGENOUS SUBSTANCES:			
DL-a-Glycerophosphate,Disodium salt	216.1	---	---
Glyceric Acid	106.08	100	9.4
Glycolic Acid	76.05	25.9	3.4
B-Hydroxypyruvic Acid,Lithium salt	111.0	---	---
DL-B-Hydroxybutyric Acid,Sodium salt	126.1	---	---
4-Hydroxybutyric Acid,Sodium salt	126.1	---	---
DL-Malic Acid	134.1	---	---
DL-a-Hydroxybutyric Acid	126.1	250	19.8
L-B-Phenyllactic Acid	166.2	51.5	3.1
B-Chlorolactic Acid	124.5	417	33.5
DL-a-Hydroxycaproic Acid	132.2	312	23.6
Oxalacetic Acid	132.07	---	---
DL-a-Hydroxycaproic Acid	132.2	178	13.5
Pyruvic Acid	88.06	---	---
Uric Acid	168.11	---	---
DL-a- Hydroxyisovaleric Acid	118.13	---	---
L-a-Glycerophosphate, Di(monocyclohexyl-ammonium salt)	370.4	---	---
L-a-Hydroxyisocaproic Acid	132.16	96.5	7.3
a-Hydroxyisobutyric Acid	104.10	---	---
Glycerol	92.09	---	---
EXOGENOUS SUBSTANCES:			
DRUGS AND OTHER CHEMICALS:			
Acetaminophen	151.16	12.1	0.8
Metaphosphoric Acid	79.98	---	---
Ethanol	46.07	---	---
Acetylsalicylic Acid	180.16	---	---
Formaldehyde	30.03	625	208.1
Hydrogen Peroxide	34.01	3.4	1.0
D-Penicillamine	149.2	2500	167.5
Salicylamide	137.14	30.2	2.2
Sodium Nitrite	69.01	1000	145.0
Sodium Salicylate	160.10	27.2	1.7
ANTICOAGULANTS:			
Sodium Oxalate	134.01	---	---
Ammonium Oxalate	124.10	---	---
Potassium Oxalate	184.23	---	---
Sodium Heparin	---	---	---
GLYCOLYTIC INHIBITORS:			
Sodium Fluoride	41.98	---	---
Iodoacetic Acid	185.96	---	---

15. Appendix D—Converting Whole Blood Glucose Values

To determine the plasma glucose value of a whole blood sample, you must convert the whole blood glucose reading. You can make this conversion in any of four ways, all of which involve the specimen's hematocrit value:

- » Use of Numerical Calculation.
- » Use of Whole Blood Glucose Factor Chart.
- » Use of Conversion Glucose Nomogram.
- » Use of keypad entry of hematocrit (see Section 5.3)



WARNING: To obtain the stated typical performance, be sure to use the correct hematocrit value. Elevated hematocrits are typical in neonatal specimens.

Numerical Calculation

To convert whole blood values to equivalent plasma glucose values, use the following equation:

$$\text{Equivalent Plasma Glucose Value} = \frac{\text{Whole Blood Reading}}{(1.0 - (2.4 \times 10^{-3} \times H\%))}$$

where H % is the hematocrit percentage in the whole blood sample.

Example: Whole Blood Reading = 85 mg/dL (4.7 mmol/L)
 Hematocrit = 40 %

$$\text{Equivalent Plasma Glucose Value} = \frac{(85)}{(1.0 - (2.4 \times 10^{-3} \times 40))} = 94 \text{ mg/dL (5.2 mmol/L)}$$

Conversion Nomograms (Figure 15.1 and Figure 15.2)

Use a straight-edge to align the whole blood reading and the samples whole blood hematocrit percentage. Then, read the equivalent plasma glucose value where the straight-edge crosses the BLOOD PLASMA column.

Example: Whole Blood Reading = 85 mg/dL (4.7 mmol/L)
 Hematocrit = 40 %

Equivalent Plasma Glucose Value = 94 mg/dL (5.2 mmol/L)

Separate nomograms are included for determining the Equivalent Plasma Glucose Values in both mg/dL and mmol/L.



WARNING: Do not use the equations and nomograms below to convert whole blood lactate values to plasma lactate values. A reliable correlation factor between whole blood and plasma lactate has not been determined for general use.

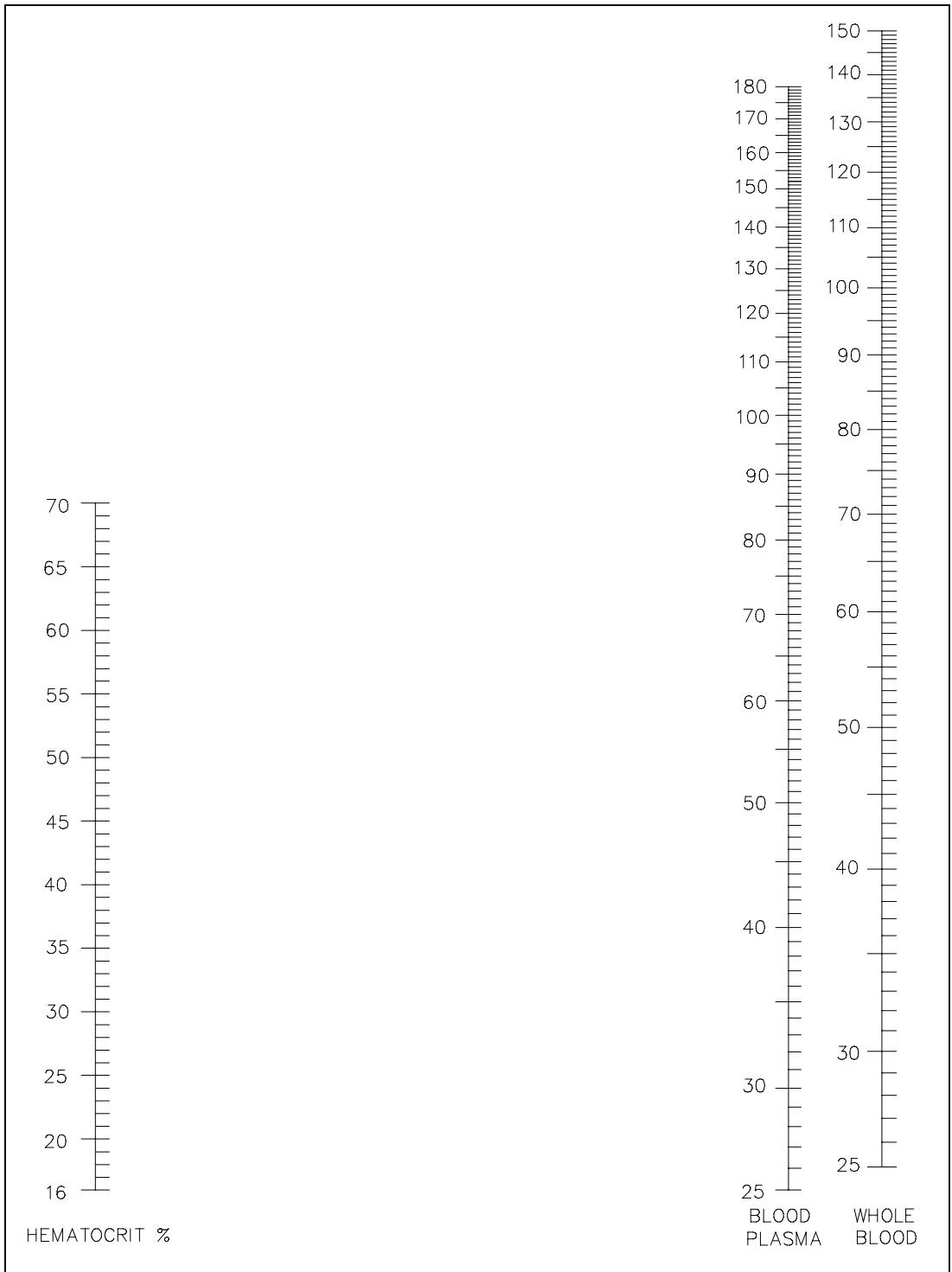


Figure 15.1
Whole Blood Conversion Nomogram (mg/dL)

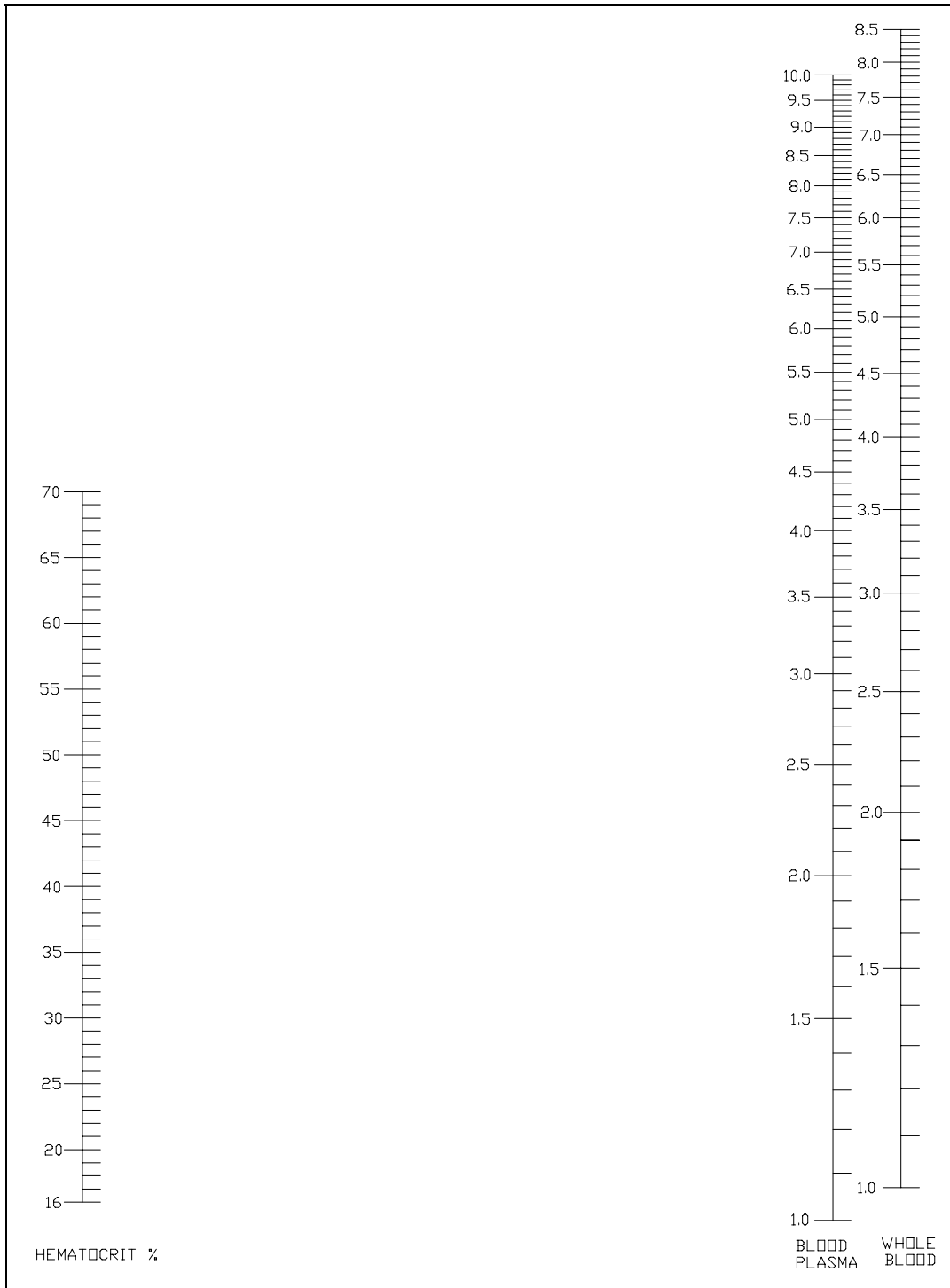


Figure 15.2
Whole Blood Conversion Nomogram (mmol/L)

To convert whole blood glucose values to equivalent plasma glucose values, find the Whole Blood Factor which corresponds to the sample's whole blood hematocrit percentage and then use the following equation:

$$\text{Equivalent Plasma Glucose Value} = (\text{Whole Blood Reading} \times \text{Whole Blood Factor})$$

Example: Whole Blood Reading = 85 mg/dL (4.7 mmol/L)
 Hematocrit = 40 %
 Whole Blood Factor = 1.11

$$\text{Equivalent Plasma Glucose Value} = (85 \times 1.11) = 94 \text{ mg/dL (5.2 mmol/L)}$$

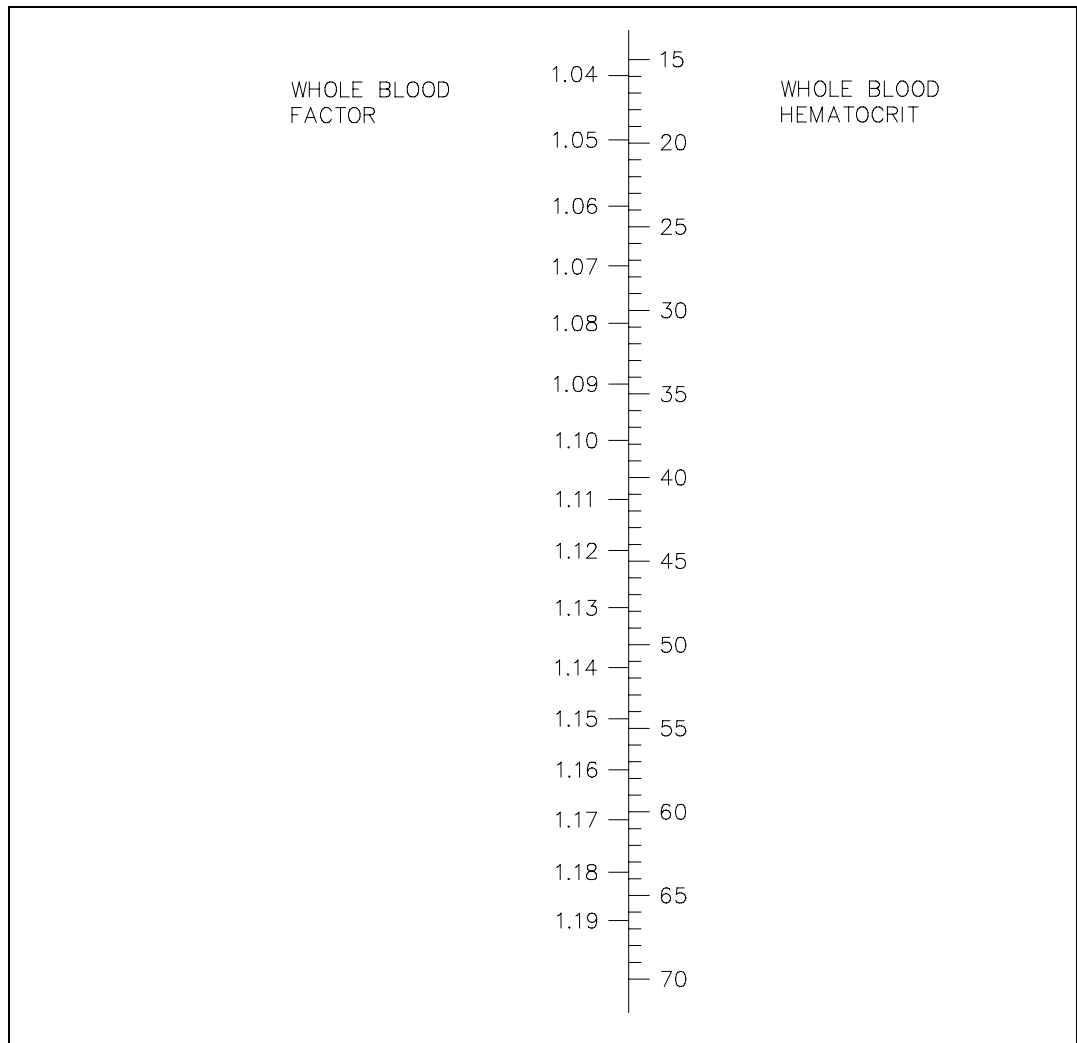


Figure 15.3
Whole Blood Factor Chart

16. Appendix E—YSI Supplies and Reagents

September 2009

ENZYME MEMBRANE KITS

YSI #	PRODUCT DESCRIPTION	QUANTITY
2329	L-Lactate Membrane Kit	4/kit
2365	Dextrose Membrane Kit	4/kit

BUFFER

YSI #	PRODUCT DESCRIPTION	QUANTITY
2357	Buffer Kit (for all membranes listed above)	4 liters*

STANDARDS FOR 2300 STAT PLUS

YSI #	PRODUCT DESCRIPTION	QUANTITY
2747	Dual Standard (glucose/L-lactate) (Glu: 10.0 mmol/L, 180 mg/dL) (Lac: 5.0 mmol/L, 45 mg/dL)	250 mL
2328	L-Lactate Standard, 15.0 mmol/L or 134 mg/dL	125 mL
2356	Glucose Standard, 500 mg/dL or 27.8 mmol/L	125 mL
1530	L-Lactate Standard, 30.0 mmol/L or 267 mg/dL	125 mL
1531	Glucose Standard, 900 mg/dL or 50.0 mmol/L	125 mL

GENERAL REAGENTS AND MISCELLANEOUS SUPPLIES

YSI #	PRODUCT DESCRIPTION	QUANTITY
1515	Cell Lysing Agent	4 Liters*
2363	Potassium Ferrocyanide, 1000 mg/dL	125 mL*
2392	NaCl Solution (sodium chloride)	125 mL*
2751	Printer Paper (5 rolls/box)	1 box
2788	Preventitive Maintenance Kit	1 kit
2399	IQ/OQ Documentation Package	
2340	Data Collection Software	

* Makes specified volume when reconstituted.

Contact YSI or your authorized dealer for more information on ordering supplies and reagents for the YSI 2300 STAT PLUS.

17. Appendix F–Warranty and Shipping Information

The YSI Model 2300 STAT PLUS Analyzer is 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. 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.

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.

YSI Factory Service Centers

United States

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

Europe

YSI (UK) Ltd • 119 Fleet Road • Fleet, Hampshire • GU51 3PD • Phone: 44 1252 819844 • Fax: 44 1252 819544

Japan

YSI (Japan) Ltd • 3Fl., Sakura Building 5-6-13 • Shinjuku • Shinjuku-ku • Tokyo 160 • Phone: 813 5360-3561
• Fax: 813 5360-3565

17.1 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, or with waste water. 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 has 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 Appendix H for cleaning instructions.
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.

17.2 Packing Instructions

1. Clean and decontaminate items to insure the safety of the handler.
2. Complete and include the Cleaning Certificate.
3. Place the product in a plastic bag to keep out dirt and packing material.
4. Use a large carton, preferably the original, and surround the product completely with packing material.
5. 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

18. Appendix G—Required Notice

The Federal Communications Commission defines this product as a computing device and requires the following notice:

This equipment generates and uses radio frequency energy and if not installed and used properly, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class A or Class B computing device in accordance with the specification in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, 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:

- a) reorient the receiving antenna
- b) relocate the computer with respect to the receiver
- c) move the computer away from the receiver
- d) 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, D.C. 20402, Stock No. 0004-000-00345-4.

19. Appendix H—Cleaning, Disinfecting, and Decontamination Procedures



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

Suggested cleaning and disinfecting solutions include:

- » Isopropanol 70%
- » Sodium hypochlorite, 5000 ppm free available chlorine (1:10 solution of household bleach)

Decontamination Procedures

Remove and discard all tubing. New tubing is provided in preventive maintenance kit. Empty waste bottle and wash with disinfecting agent. Remove Sample Chamber, Sipper, Test Tube Holder and probes according to instructions.

Thoroughly clean with disinfecting agent, then rinse with warm water. Remove probes and discard membranes. Clean probes with isopropanol only, rinse with warm water. Clean up all spills, then reassemble.

20. Appendix I—Printed Setup Information

You may print your 2300 STAT PLUS instrument setup anytime by entering the Setup menu. You are not required to leave RUN Mode or STANDBY Mode to access this information.

Main Menu display:

```
Please select instrument mode
[ RUN ] [ STANDBY ] [ MENU ]
```

From Main Menu, press [MENU].

```
Select instrument function
1-Service 2-Setup 3-Diagnostic
```

From Select instrument function, press [2] for Setup.

NOTE: If you are in RUN or STANDBY modes, press [MENU] to go directly to the display shown below.

```
Select setup: 1-General 2-MeasParameter
3-RunMode 4-Report 5-PrntSetup 6-Default
```

From Select setup, press [5] for PrntSetup, to print all of the instrument parameters currently in memory.

If you repowered the instrument, or reset the instrument using the reset button, the printout first shows an instrument identification, including the software version number. Once you command the instrument to "Print Setup", the Instrument Setup prints out on the paper tape. This takes about 45 seconds.

The information on the printout completely describes the system parameters, whether using default settings or settings that you configured for your particular application.

The Instrument Setup printout can be very useful when compiling your daily log or simply to check your system if you suspect a problem.

You can learn about the system parameters by referring to Section 5 Menu Selections. If you have a YSI 2710 Turntable refer to Section 10.

The printout for the 2300 STAT PLUS is shown below. Note, if calibration or sample data are due to print while you are performing PrntSetup, the instrument will interrupt PrntSetup to print results. PrntSetup printing then resumes automatically.

```

          INSTRUMENT SETUP
-----
Sample size      25 uL
SamStation#:    2
Mode            : Normal
BLACK PROBE
Chemistry       : L-Lactate
Unit           : mmol/L
Calibrator      : 5.00
WHITE PROBE
Chemistry       : Glucose
Unit           : mmol/L
Calibrator      : 10.0
AUTOCAL
Time           : 15 Min
Sample         : 5 Sam
RUN MODE
Multicycle     : OFF
Sample ID      : OFF
Sip Height     : Medium
Autostandby    : 4 Hr
TT StartPos   : 0
TT # in Run    : 0
TT FluidDet    : ON
Hematocrit     : OFF
RS-232
Baud rate      : 9600
Data           : Seven bit
Stop           : One bit
Parity         : Even
Handshake      : RTS/CTS
XON char       : 17
XOFF char      : 19
Mode           : Non-multidrop
Address        : 38
GENERAL
Radix mark     : "."
Level sensor   : ON
Cal Report     : Brief
SampleReport   : Brief
DateFormat     : MM/DD/YY
Software revision: 2.25
YSI 2300D
Thu 02/26/03  00:00:48
-----
```

21. Appendix J—Report Formats

When you setup your YSI 2300 STAT PLUS from the Setup Menu, you have the option to print the calibration and sample results in "brief" or "detail" format. You also have the option not to print calibration values. Review Section 5.3 Setup Selections, specifically choice 4-Report in the Setup selection menu.

Below are example printouts of the brief and detail formats. You can learn more about the information on the "detail" printout in Section 8 Troubleshooting.

Sample Report (Detail)

```
-----Sample Report-----
ID:      123456789-05-03
B:L-Lactate 4.82 mmol/L
  IB      2.11 nA
  PL current 18.65 nA
  Slope   4.69 nA/min
  End Point 35 Sec
W:Glucose 5.38 mmol/L
  IB current 0.88 nA
  PL current 15.96 nA
  Slope    2.39 nA/min
  End Point 35 Sec
Temperature 26.28 °C
Sample size 25 uL
Fri 02/22/03 08:12:34
YSI 2300D - 03 01234
-----
```

Sample Report (Brief)

```
From Test Tube Holder
Sample ID: "123456789"
Sample 1 of 3
```

```
-----Sample Report-----
ID:      123456789-03-01
B:L-Lactate 0.82 mmol/L
W:Glucose 5.31 mmol/L
Wed 02/22/03 13:22:56
-----
16.68 nA
```

Calibration Report (Detail)

```
==CALIBRATION REPORT==
B:L-Lactate* Unstable *
  IB current 1.79 nA
  PL current 11.63 nA
  FB current 1.51 nA
*Base shift -2.65 %
  Slope 1.42 nA/min
  End Point 35 Sec
*Cal shift 3.64 %
W:Glucose 10.0 mmol/L
  IB current 0.88 nA
  PL current 5.81 nA
  FB current 0.76 nA
  Base shift -1.95 %
  Slope 0.09 nA/min
  End Point 35 Sec
  Cal shift -0.10 %
  Temperature 26.33 °C
  Sample size 25 uL
Thu 02/22/03 14:55:10
YSI 2300D - 03 01234
=====
```

Calibration Report (Brief)

```
==CALIBRATION REPORT==
      B:L-Lactate

W:Glucose 12.81 nA
Mon 02/22/03 17:12:09
=====
```

Sample Report (Brief)

From Manual position
Sample ID: "123456789"
45% Hct value entered

-----Sample Report-----
ID: MANUAL-123456789
B:L-Lactate 0.82 mmol/L
W:Glucose 5.31 mmol/L
Hematocrit 45
Wed 02/22/03 13:42:50

The example printouts below illustrate the report formats used by the YSI 2300 STAT PLUS when configured for turntable sampling with the YSI 2710 Turntable. Examples of both the brief and detail formats are presented. These examples show results of turntable runs. Note that part of each ID is Txx, where x is a number. The ID: T01-123456789-05-03 in the first example indicates that the third sample of five replicates at Turntable Position #1 has been reported. The number 123456789 is a nine digit ID number that describes the current batch or run. Remember, you can only assign an ID number to a batch. The specific sample is identified by turntable position #, date and time.

**Turntable Sample Report
(Detailed Format)**

-----Sample Report-----
ID: T01-123456789-05-03
B:L-Lactate 0.82 mmol/L
IB current 2.11 nA
PL current 118.65 nA
Base shift 0.91 %
Slope 4.69 nA/min
End Point 30 Sec
W:Glucose 8.30 mmol/L
IB current 0.88 nA
PL current 58.96 nA
Base shift 0.27 %
Slope 2.39 nA/min
End Point 35 Sec
Temperature 26.28 °C
Sample size 25 uL
Fri 02/22/03 08:12:34
YSI 2300D - 03 01234

**Turntable Sample Report
(Brief Format)**

Batch ID: 123456789
Turntable Position #01
Replicate 1 of 3

-----Sample Report-----
ID: T01-123456789-03-01
B:L-Lactate 0.82 mmol/L
W:Glucose 5.31 mmol/L
Wed 02/22/03 13:22:56

**Calibration Report
(Detailed Format)**

==CALIBRATION REPORT==
B:L-Lactate* Unstable *
IB current 1.79 nA
PL current 11.63 nA
FB current 1.51 nA
*Base shift -2.65 %
Slope 1.42 nA/min
End Point 35 Sec
*Cal shift 3.64 %
W:Glucose 10.0 mmol/L
IB current 0.88 nA
PL current 5.81 nA
FB current 0.76 nA
Base shift -1.95 %
Slope 0.09 nA/min
End Point 35 Sec
Cal shift -0.10 %
Temperature 26.33 °C
Sample size 25 uL
Thu 02/22/03 14:55:10
YSI 2300D - 03 01234

**Calibration Report
(Brief Format)**

==CALIBRATION REPORT==
B:L-Lactate 16.68 nA
W:Glucose 12.81 nA
Mon 02/22/03 17:12:09
=====

22. Appendix K—Considerations when Measuring Lactate in Whole Blood

L-lactate is present both inside (**intracellular**) and outside (**extracellular**) red blood cells in a whole blood sample. As lactate production in the body occurs, the intracellular and extracellular lactate concentrations adjust toward equilibrium. However, this process occurs continuously and relatively slowly, possibly leading to situations where intracellular and extracellular lactate levels differ significantly. As a result, lactate measurement methods which measure only extracellular lactate are highly dependent on timing and hematocrit.

To avoid these timing and hematocrit dependencies, a cell lysing system can be used when measuring lactate in whole blood. Cell lysing allows for the measurement of both intracellular and extracellular lactate, giving a **Total Blood Lactate** measurement.

The YSI 2300 STAT Plus has the capability of measuring either extracellular lactate or Total Blood Lactate. YSI 2357 Buffer, used in the instrument, is isosmotic with respect to red blood cells.

EXTRACELLULAR LACTATE MEASUREMENT - NON-LYSING

By using YSI 2357 Buffer and analyzing whole blood samples, a non-lysing system is achieved. When sample is introduced into the sample chamber, the red blood cell membrane acts as a barrier, prohibiting the intracellular lactate from interacting with the YSI measurement sensor. Only the extracellular lactate is detected by the sensor. However, any unintentional cell lysing caused by sample handling can affect extracellular lactate measurements.

TOTAL BLOOD LACTATE - LYSING

YSI offers the 1515 Cell Lysing agent, which is added to the 2357 Buffer. As samples are introduced into the sample chamber containing this agent, the red blood cells are ruptured. The intracellular lactate **and** the extracellular lactate then become accessible to the YSI measurement sensor. This system yields Total Blood Lactate values. Total blood lactate measurements are unaffected by equilibrium issues.

A NOTE ABOUT GLUCOSE

The behavior of glucose under these conditions is quite different than that of lactate. In a non-lysing system, glucose migrates through the red blood cell membrane immediately and quickly upon introduction of the sample into the sample chamber. Glucose measurements, therefore, reflect the total of both the intracellular and extracellular glucose concentrations. And, of course, in a lysing system, the total glucose concentration is also measured. **Glucose results on the YSI 2300 STAT Plus are unaffected by YSI 1515 Cell Lysing agent.**

23. Appendix L–CE Compliance

Important Notice regarding CE standards compliance:

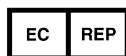
1. Users should not open the front access door during operation, internal components may be susceptible to ESD (electrostatic discharge).
2. Users are cautioned not to touch the sipper needle during operation, as discussed in the users manual. The sipper mechanism is equipped with contact-sensing circuitry for the purposes of fluid detection and human safety. This circuitry may be susceptible to ESD. ESD to the sipper needle may cause instrument malfunction.
3. Users should note that RS232 communications may be susceptible to ESD. Data corruption or serial communications failure may occur. If malfunction occurs, users may restore proper operation by resetting communications parameters under the “General/RS-232” setup menu.



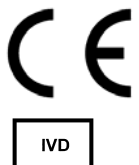
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