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YSI 2700 SELECT

Biochemistry Analyzer

User's Manual

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1. Introduction

1.1 Description

The YSI Model 2700 SELECT Biochemistry Analyzer is a laboratory instrument intended for use in research, food-processing and bioprocessing applications. **THE MODEL 2700 SELECT IS NOT FOR HUMAN MEDICAL DIAGNOSTIC USE OR FOR HUMAN PERFORMANCE EVALUATION.**

The Model 2700 SELECT offers precision and specificity comparable to more time consuming and rigorous methods, but with greater speed, convenience and sensitivity. Many of the conditions which interfere with refractometers, density meters and manual methods are of little concern when using the Model 2700 SELECT. Measurements are virtually unaffected by sample color, turbidity, density, viscosity, pH, volatility, specific gravity, temperature, index of refraction, optical activity, or the presence of proteins or other biochemicals.

The Model 2700 SELECT can be set up to measure a number of different analytes, but switching between them may entail some time and effort. Configured as a single channel unit, the Model 2700 SELECT provides quick measurements of any one of the following analytes:

- D-Glucose (Dextrose)
- L-Lactate
- Sucrose
- Lactose
- Ethanol
- L-Glutamate
- Choline
- L-Glutamine
- Methanol
- Galactose*
- Hydrogen Peroxide*

Configured as a dual channel unit, the Model 2700 SELECT provides quick, simultaneous measurements of combinations of the following analytes:

- Dextrose and L-Lactate
- Dextrose and Sucrose
- L-Glutamate and L-Glutamine

* YSI does not currently offer calibration standards for these analytes.

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Flexibility is an important feature of the product. Within practical limits a large number of measurement parameters can be selected to fit your application. In addition, the default parameters of many system functions can be changed to fit your needs.

Selectable sample size allows you to extend the dynamic range of the analyzer and improves precision and accuracy. The aspirated sample size can be specified from a minimum of 5 microliters to a maximum of 65 microliters.

The Model 2700 SELECT is equipped with automatic self-calibration. However, within limits, the frequency of autocalibration can be programmed to meet your needs.

If instrument calibration is desired upon command only, the self-calibration feature can be disabled and calibration cycles can be initiated manually via the keypad or commanded by the host computer via the RS-232 interface.

YSI provides a full line of reagents to support the most common chemistries.

YSI offers the Model 2710 Turntable for batch sampling of up to 24 tubes or vials. The 2710 Turntable is controlled by the 2700 SELECT software via a control cable (provided). The results of batch sampling are displayed and printed by the 2700 SELECT.

YSI offers the Model 2730 Monitoring and Control Accessory for use in applications where monitoring and control is desired. The Kit contains a peristaltic pump, external sampling chamber, and tubing for delivering a sample to the 2700 SELECT. Purge time and sampling interval are selectable, under control of the 2700 SELECT software. Also included in this accessory are analog outputs representative of analyte concentrations.

The 2700 SELECT has been designed for future additions to allow even greater versatility related to sample handling and the measurement of additional analytes. Therefore, as accessories become available or new chemistries are developed you have a basic instrument upon which to build.

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1.2 STANDARD FEATURES

- Single and dual chemistry configurations.
- Minimal sample preparation.
- Sample aspiration from a variety of tubes.
- Selectable sample aspiration volume (5 to 65 µL).
- Sample results in about one minute.
- Fluid sensing minimizes carry-over.
- Fluid design washes inside and outside of sipper tube.
- Programmable automatic calibration.
- Selectable concentration units, including g/L, mg/L, mmol/L, %(w/v).
- Liquid crystal display and built-in data printer.
- RS-232 serial port.
- Turntable interface circuitry installed.
- User-accessible service and diagnostic menus.

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1.3 General Specifications

Sample size:	Adjustable from 5 to 65 microliters (aspirated volume)
Response Time:	Sample results in 60 seconds, Complete sample-to-sample cycle in 90 seconds (May vary with analyte and sample matrix.)
Power requirement:	110-120 VAC or 220-240 VAC 50-60 Hz 50 Watts nominal
Working environment:	
Ambient temperature:	15° to 35° Celsius
Relative humidity:	10% to 90% (non-condensing)
Instrument dimensions:	10.0 x 14.0 x 14.0 inches 25.4 x 35.6 x 35.6 centimeters
Instrument weight:	25 pounds 11.4 kilograms

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1.4 Chemistry Performance Specifications

Dextrose (D-Glucose)

YSI Membrane:	2365
Detection Range:	0-9 g/L at 25 µL sample size, 0-25 g/L at 10 µL sample size
Calibration Point:	2.50 g/L
Linearity Check Point:	9.0 g/L
Precision (CV,n=10):	2%
Linearity (0 to Cal Point):	±2%
Linearity (Cal to Range Max):	±5%
Typical Membrane Working Life:	21 days
Membrane O-ring Color:	Red

Ethanol

YSI Membrane:	2786
Detection Range:	0-3.2 g/L
Calibration Point:	2.00 g/L
Linearity Check Point:	3.20 g/L
Precision (CV,n=10):	2%
Linearity (0 to Cal Point):	±2%
Linearity (Cal to Range Max):	±5%
Typical Membrane Working Life:	5 days
Membrane O-ring Color:	Green
Potential Substrate Interference:	Methanol

L-Glutamate*

YSI Membrane:	2754
Detection Range:	0-10 mmol/L
Calibration Point:	5.00 mmol/L
Linearity Check Point:	10.0 mmol/L
Precision (CV,n=10):	2%
Linearity (0 to Cal Point):	±2%
Linearity (Cal to Range Max):	±5%
Typical Membrane Working Life:	7 days
Membrane O-ring Color:	Yellow

*User may configure instrument to measure as monosodium glutamate (MSG).

L-Lactate (L-Lactic Acid)

YSI Membrane:	2329
Detection Range:	0-2.67 g/L
Calibration Point:	0.50 g/L
Linearity Check Point:	2.67 g/L
Precision (CV,n=10):	2%
Linearity (0 to Cal Point):	±2%
Linearity (Cal to Range Max):	±5%
Typical Membrane Working Life:	14 days
Membrane O-ring Color:	Gray

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Lactose

YSI Membrane:	2702
Detection Range:	0-25 g/L
Calibration Point:	5.00 g/L
Linearity Check Point:	25.0 g/L
Precision (CV,n=10):	2%
Linearity (0 to Cal Point):	±2%
Linearity (Cal to Range Max):	±5%
Typical Membrane Working Life:	10 days
Membrane O-ring Color:	White

Sucrose

YSI Membrane:	2703
Detection Range:	0-25 g/L
Calibration Point:	5.00 g/L
Linearity Check Point:	25.0 g/L
Precision (CV,n=10):	2%
Linearity (0 to Cal Point):	±2%
Linearity (Cal to Range Max):	±5%
Typical Membrane Working Life:	10 days
Membrane O-ring color:	Blue

Choline

YSI Membrane:	2771
Detection Range:	0-450 mg/L
Calibration Point:	175 mg/L
Linearity Check Point:	450 mg/L
Precision (CV,n=10):	2%
Linearity (0 to Cal Point):	±2%
Linearity (Cal to Range Max):	±5%
Typical Membrane Working Life:	7 days
Membrane O-ring color:	Orange

L-Glutamine*

YSI Membrane:	2735
Detection Range:	0-8 mmol/L
Calibration Point:	5.00 mmol/L
Linearity Check Point:	8.00 mmol/L
Precision (CV,n=5):	4%
Linearity (0 to Cal Point):	±4%
Linearity (Cal to Range Max):	±5%
Typical Membrane Working Life:	5 days
Membrane O-ring color:	Magenta

*Specs shown are for simultaneous measurement of glutamine and glutamate.

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Methanol

YSI Membrane:	2725
Detection Range:	0-2.50 g/L
Calibration Point:	1.00 g/L
Linearity Check Point:	2.50 g/L
Precision (CV,n=10):	2%
Linearity (0 to Cal Point):	±2% or 0.02 g/L, whichever is greater
Linearity (Cal to Range Max):	±5%
Typical Membrane Working Life:	5 days
Membrane O-ring color:	Black
Potential Substrate Interference:	Ethanol

NOTE: For the following chemistries YSI believes that you will be able to measure these analytes for many applications in the ranges specified below. However, YSI makes no claims with respect to precision or linearity. For each analyte below you will need to prepare the calibrator and linearity standards for your application.

YSI also recommends that you confirm that no significant levels of interfering substrates are present in your samples. For example, we know that lactose and galactose in the same sample may interfere if significant concentrations of both exist. Also dextrose will read at a sucrose membrane, however, by using the dual channel approach to dextrose and sucrose, this is automatically accounted for by the software.

Galactose

Membrane:	2702
Detection Range:	0-25 g/L
Typical Membrane Working Life:	10 days
Membrane O-ring Color:	White
User Must Provide:	Calibrator solution
Potential Substrate Interference:	Lactose

Hydrogen Peroxide

Membrane:	2701
Detection Range:	0-600 mg/L
Typical Membrane Working Life:	21 days
Membrane O-ring Color:	Yellow
User Must Provide:	Calibrator solution
	Catalase-free Supply Buffer

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1.5 How to Use this Manual

If your instrument is configured for single channel chemistry, this instruction manual contains more information than you require, but the measurement technology, and the principles and techniques of operation remain the same.

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.

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.

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2. 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.

2.1 Unpacking and Notes on Safety

Remove the instrument from the shipping container. Be careful not to discard any parts or supplies. Check off all items on the packing list 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 2700 SELECT 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 2700 SELECT with the 2710 Turntable, first set up the 2700 SELECT. Once the 2700 SELECT is operating properly, refer to the *YSI 2710 Turntable Operations Manual*.

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 2.5).
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 (Appendix F, G).
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 G 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 the *YSI 2710 Turntable Operation Manual* or the *YSI 2730 Monitor and Control Accessory User's Manual*. Use with the YSI 2710 Turntable or YSI 2730 Monitor/Control Accessory only.

WARNING: For remote connection, refer to section *9. Communications*. 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.

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2.2 Major Component Identification

Referring to Figure 2.1 and 2.2, 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.

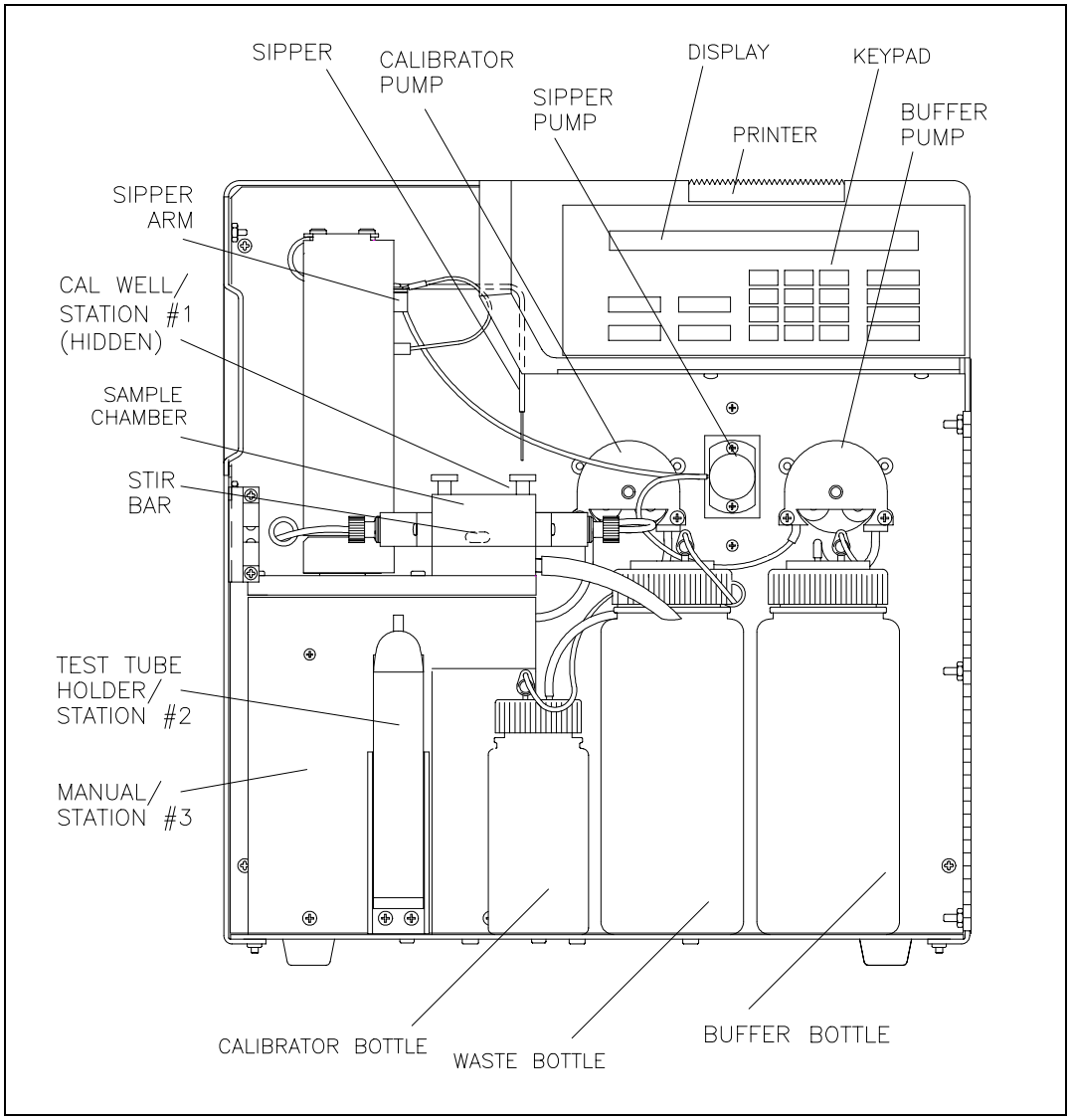


Figure 2.1
Inside Front View of the 2700 SELECT

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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 Chamber.

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 and Sipper Assembly** 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), Turntable Station (Station #4) and Monitor Station (Station #5). 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 2 1/4 inch (56 mm) 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.

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 an interface connector for use with accessories like the YSI 2710 Turntable.

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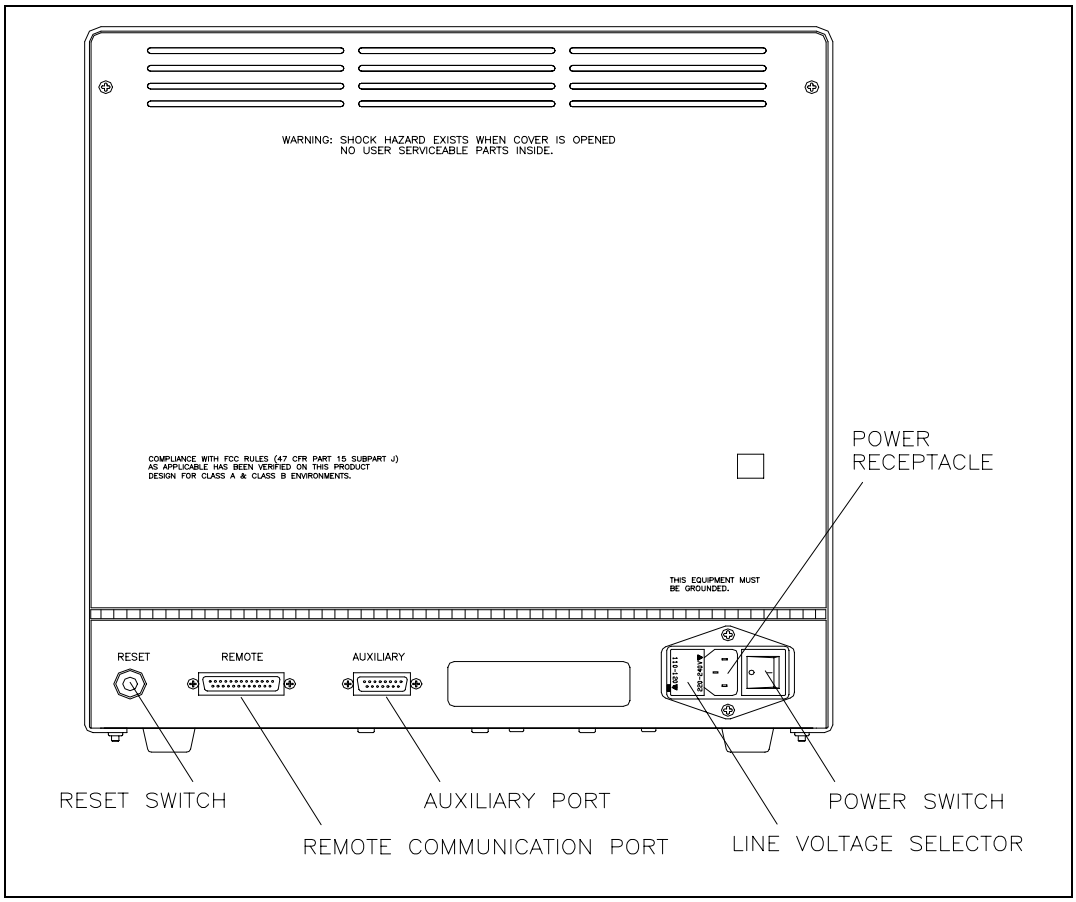


Figure 2.2
Back View of the 2700 SELECT

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. One end of the power cord plugs into this receptacle, while the other end plugs into 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.

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2.3 Reagent Preparation

Prepare the supply buffer and fill the buffer bottle. Powdered buffer concentrate is included in the starter supplies. YSI 2357 is recommended for use with all YSI Enzyme Membranes except YSI 2702 Galactose Oxidase membranes (use YSI 2705), YSI 2786 Ethanol Membranes (use YSI 2787) and YSI 2725 Methanol Membranes (use YSI 1579). All YSI buffers may be ordered separately.

» 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. **NOTE:** YSI 1579 Carbonate Buffer Concentrate (used with 2725 membranes) must be reconstituted as instructed on the bottle.

» 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.

Install the calibrator solution. One or more of the following YSI calibration standards will be provided in your starter supplies, YSI 2776 (Dextrose and L-Lactate), YSI 2780 (Sucrose), YSI 2783 (Lactose), YSI 2772 (Choline), YSI 2755 (L-Glutamate), YSI 2736* (L-Glutamine). YSI calibrators may be purchased separately.

» 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.

* The YSI 2736 Glutamine Calibration Standard must be reconstituted as instructed on the bottle. It is recommended that a sample be poured into a test tube and installed at station #2 for calibration. Refrigerate the bulk solution when not in use.

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 2.3.

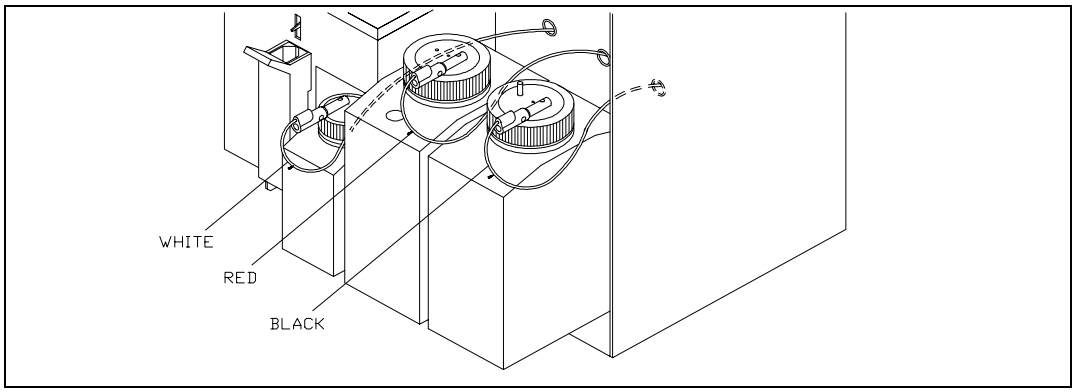


Figure 2.3
Bottles and Level Sensor Cables

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2.4 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. 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.)

The 2700 SELECT is shipped to you already configured as a Single Channel or a Dual Channel unit. For the single channel configuration, the white probe is a blank (see Figure 2.4).

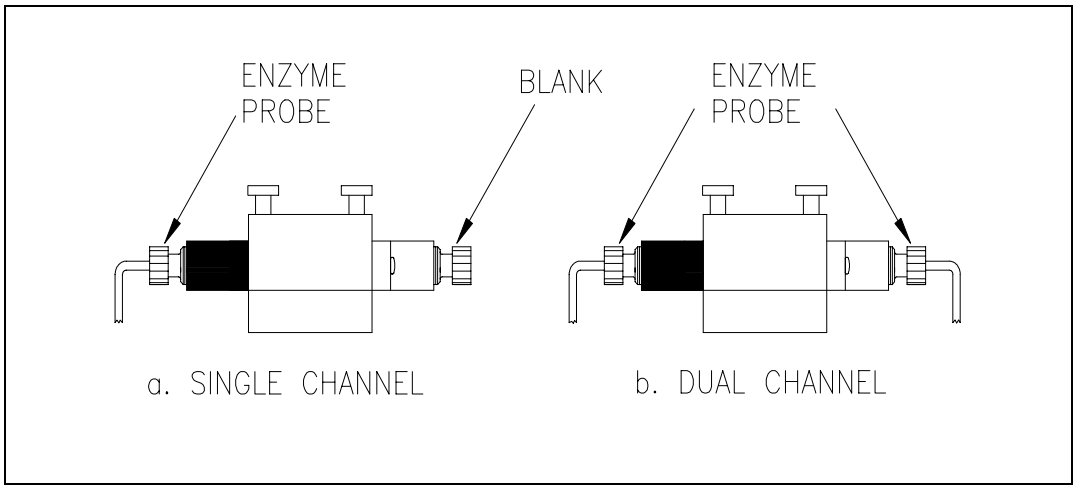


Figure 2.4
Sample Chamber/Sensor Configurations

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.

For single channel configuration the YSI Enzyme Membrane must be installed on the black probe. The blank is sealed in the chamber. You need not remove it.

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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 2.5). 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. Do not overtighten. Repeat this procedure for the second probe if you have a dual channel unit.

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 3.3 for more information).

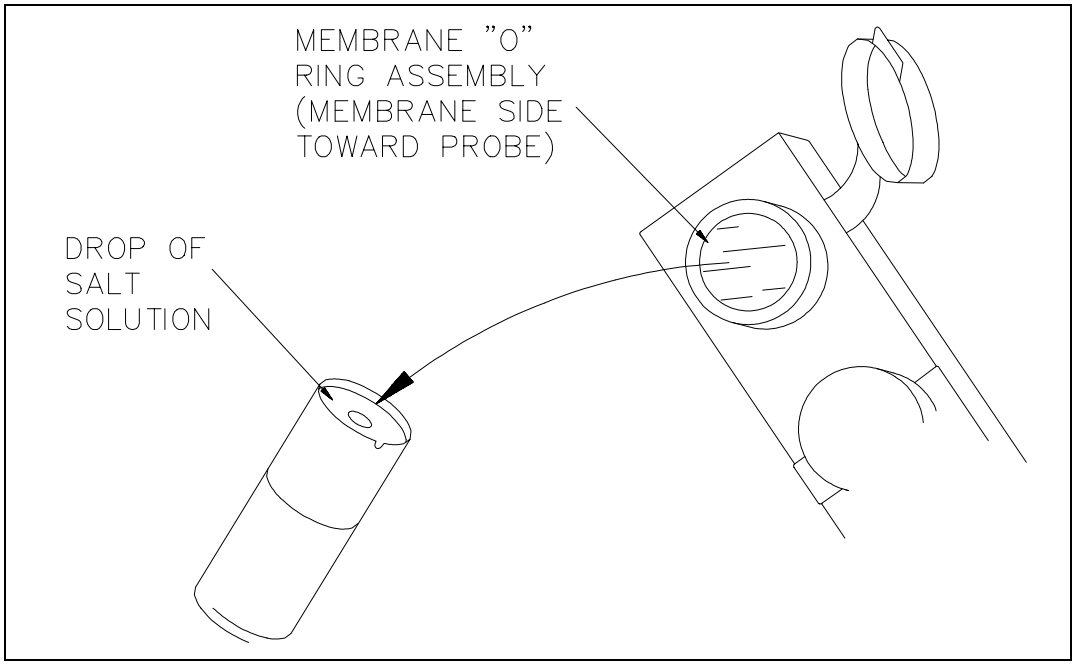


Figure 2.5
Enzyme Membrane Installation

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2.5 Power Up Procedures

BEFORE YOU PLUG IN THE POWER CORD, inspect the Line voltage selector on the back of the instrument (See Figure 2.6). 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.

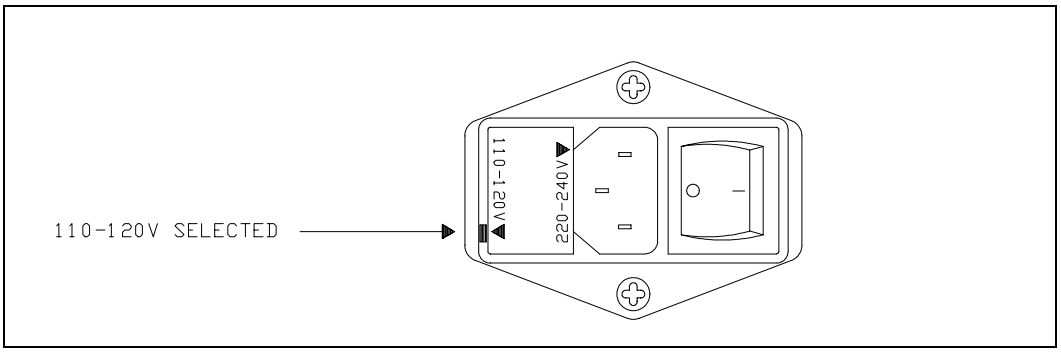


Figure 2.6
Line Voltage Selector (110-120V Position)

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. Hit 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.

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2.6 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-Monitor 6-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.

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

WARNING: Keep your 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 2.7). 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

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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.

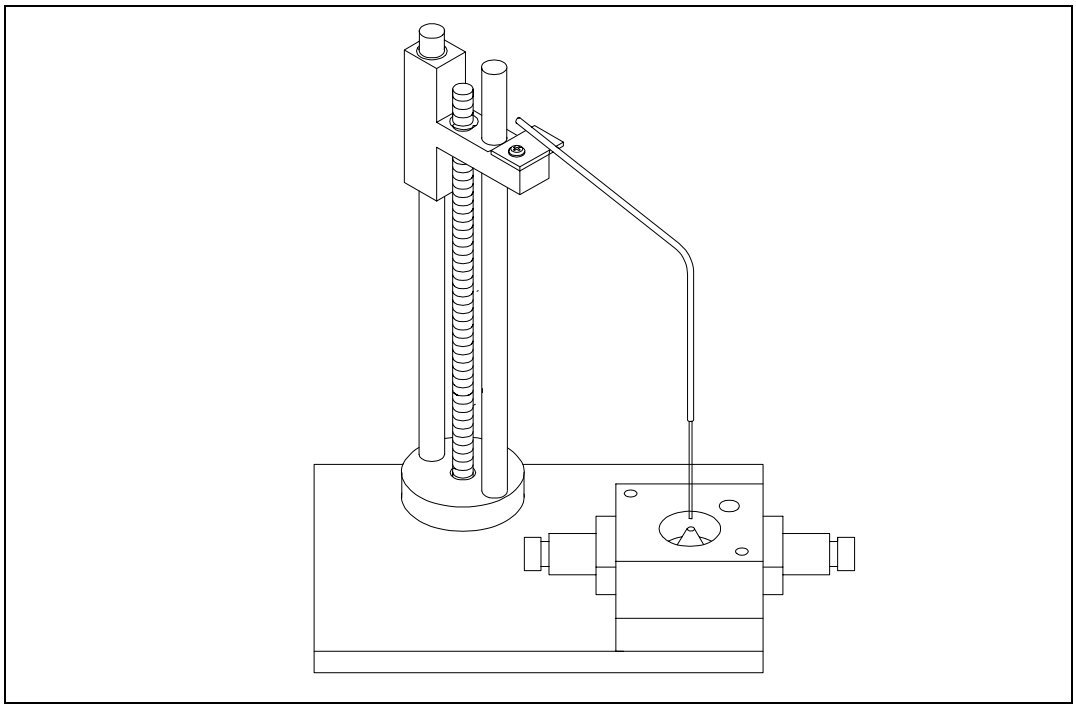


Figure 2.7
Sipper Adjustment Position

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-Monitor 6-Turntable

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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-Monitor  6-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-Monitor  6-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-Monitor  6-Turntable
```

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

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

2.7 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.

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2.8 Instrument Parameter Programming

The 2700 SELECT setup is menu driven. Once set up, the system parameters are maintained in memory. In the event of power loss, the 2700 SELECT has a battery backup to maintain its memory. Follow the procedure below to program your instrument parameters.

IMPORTANT: You move through the 2700 SELECT 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 8 inches (20 centimeters) 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-LevelSensor
```

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.

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

```
Measurement parameter setup
1-SampleSize 2-CalMethod 3-Black 4-White
```

2-MeasParameter. "MeasParameter" is an abbreviation for measurement parameters. From this menu you may select the sample size (5-65 microliters). You may also specify the locations (station #) of calibrator solutions, which is especially useful in certain dual chemistry applications. From this menu, you will also confirm or change specific parameters dealing with the black probe (single channel unit) or black and white probes (dual channel unit). These parameters include chemistry assignment, calibration value, units of concentration, and time to endpoint of reaction.

NOTE: YSI has assigned default values for each of these parameters, but provides the flexibility for the user to change values to optimize a particular application. **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  4-Monitor
```

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 replicate sampling and sample identification prompts, 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 2700 SELECT menu.

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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]

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2.9 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 2700 SELECT. For illustration purposes, we will demonstrate initial setup for simultaneous determination of dextrose and L-lactate on a dual channel 2700 SELECT.

NOTE: If you have a single channel unit, this example has more information than you need. However, it will cover all pertinent information to set up a single channel unit.

This is a straight-forward setup utilizing one calibration solution to perform simultaneous chemistries. Follow along by pressing keys on your 2700 SELECT. This exercise will be a good learning tool. After completing the exercise, you will be directed to parts of the manual related to your specific chemistry interests.

EXAMPLE: Set up the YSI 2700 SELECT to measure D-glucose (dextrose) and L-lactate, simultaneously. 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 2776 Standard (2.50 g/L dextrose and 0.50 g/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 2.8 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. If you have entered Run Mode or Standby Mode, see page 3-1 for instructions to exit either mode.

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
```


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Press [1] for General.

```
General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-LevelSensor
```

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> 98
```

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-LevelSensor
```

Press [2] for Contrast.

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


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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-LevelSensor
```

Press [3] for RS-232.

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

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-LevelSensor
```

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-LevelSensor
```

Press [5] for Serial#.

```
Enter instrument serial number
98  12345
```

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: 98B12345AB can be entered as 98 12345.

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-LevelSensor
```

Press [6] for LevelSensor.

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


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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-LevelSensor
```

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-SampleSize 2-CalMethod 3-Black 4-White
```

Press [1] for SampleSize.

```
Enter sample size in microliter
> 25
```

The default setting is 25 microliter (µL). The options range from 5 to 65 µL. If you enter a number outside of this range, the display will show you the limits. Press [ENTER] to confirm 25 µL and return to the Measurement parameter setup menu level.

```
Measurement parameter setup
1-SampleSize 2-CalMethod 3-Black 4-White
```

Press [2] for CalMethod.

```
Select calibration method:  One Station
1-One Station  2-Two Stations
```

Press [ENTER] to confirm One Station, since both dextrose and L-lactate are in one calibrator bottle and reside in one location.

```
Enter Cal Station #
>  1
```

Press [ENTER] to confirm that the calibrator solution (YSI 2776) is installed at Station #1 (Cal Well of the Sample Chamber). The display now returns to the Measurement parameter setup menu level.

```
Measurement parameter setup
1-SampleSize  2-CalMethod  3-Black  4-White
```


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Press [3] 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. For our example, choose L-Lactate, then press [ENTER] to confirm and move on to the next parameter.

```
Select BLACK unit of measurement:  g/L
1-mmol/L  2-mg/L (ppm)  3-g/L  4-% (w/v)
```

Press [1] for mmol/L. This changes the ‘g/L’ default setting.

```
Select BLACK unit of measurement:  mmol/L
1-mmol/L  2-mg/L (ppm)  3-g/L  4-% (w/v)
```

Press [ENTER] to confirm and move to the next parameter.

```
Enter Black calibration value in mmol/L
>  05.62
```

The value you observe (5.62 mmol/L) is equivalent to 0.50 g/L, the concentration stated on the YSI 2776 calibrator label.

NOTE: If you are using the default values and you choose a concentration unit other than g/L, the value automatically changes. That is, 0.50 g/L becomes 5.62 mmol/L or 500 mg/L. When non-standard calibration values are used, however, the appropriate numbers must be entered whenever the measurement unit is changed.

ALWAYS VERIFY THAT THE CORRECT CALIBRATION VALUE IS ENTERED! Use the information in Appendix A to make the necessary unit conversions for calibration entry.

Press [ENTER] to confirm and move to the next parameter.

```
Enter BLACK end point in seconds
>  30
```

Press [ENTER] to confirm the 30 second endpoint parameter. The options range from 15 to 125 seconds. The display now shows the Measurement parameter setup menu level.

```
Measurement parameter setup
1-SampleSize 2-CalMethod 3-Black 4-White
```

Press [4] for White. Now set the same parameters for the White probe that you set for the Black probe.

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


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Press [ENTER] to confirm Dextrose.

```
Select WHITE unit of measurement:  g/L
1-mmol/L  2-mg/L (ppm)  3-g/L  4-% (w/v)
```

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

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

```
Enter White calibration value in g/L
>  02.50
```

ALWAYS VERIFY THAT THE CORRECT CALIBRATION VALUE IS ENTERED! Use the information in Appendix A to make the necessary unit conversions for calibration entry.

Press [ENTER]to confirm and move to the next parameter.

```
Enter White end point in seconds
>  30
```

Press [ENTER]to confirm the 30 second endpoint parameter.

```
Measurement parameter setup
1-SampleSize 2-CalMethod 3-Black 4-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  4-Monitor
```

Press [1] for SampleProtocol.

```
SamplingProtocol setup: 1-SipperHeight
2-Replicates  3-ID 4-Station#  5-Turntable
```

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.

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```
SamplingProtocol setup: 1-SipperHeight
2-Replicates  3-ID 4-Station#  5-Turntable
```

Press [2] for Replicates.

```
Prompt replicate cycle? No
1-No 2-Yes
```

Since our example setup requests triplicate analysis of the sample, we must activate replicates. Press [2] for Yes.

```
Prompt replicate cycle? Yes
1-No 2-Yes
```

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

```
SamplingProtocol setup: 1-SipperHeight
2-Replicates  3-ID 4-Station#  5-Turntable
```

Press [3] for ID.

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

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

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

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

```
SamplingProtocol setup: 1-SipperHeight
2-Replicates  3-ID 4-Station#  5-Turntable
```

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.

```
SamplingProtocol setup: 1-SipperHeight
2-Replicates  3-ID 4-Station#  5-Turntable
```

Press [0] to return to Run mode setup.

```
RUN mode setup: 1-SampleProtocol
2-AutoStandby  3-AutoCal  4-Monitor
```


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Press [2] for AutoStandby.

```
Enter autostandby time in hour
0 to disable >  2
```

This entry defines the number of hours the unit will continue to update calibration and be ready to sample. The default setting is "2". 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 two hour autostandby and return to the Run mode setup.

```
RUN mode setup: 1-SampleProtocol
2-AutoStandby  3-AutoCal  4-Monitor
```

Press [3] for AutoCal.

```
Autocal setup:  1-Temperature  2-Time
3-Sample  4-Cal shift  5-Sample error
```

Each parameter in this menu level can be used to alter the conditions which trigger autocalibrations. For now, simply explore each menu parameter. Access each parameter by pressing the number. Press [ENTER] to confirm the default setting and return to the Autocal setup. See Section 5.3 for more information.

WARNING: When using autocalibration parameters other than the default values described in this manual, you may compromise precision and/or accuracy. It is your responsibility as a user to verify performance through appropriate quality assurance testing.

```
Autocal setup:  1-Temperature  2-Time
3-Sample  4-Cal shift  5-Sample error
```

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

```
RUN mode setup: 1-SampleProtocol
2-AutoStandby  3-AutoCal  4-Monitor
```

Press [0] again to return to Select setup.

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


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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 D 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 2700 SELECT. See Appendix C 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 2700 SELECT 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.

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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]

Now refer to Section 4 to learn about the recommended system parameters for your particular chemistry application. Next use this information to setup the 2700 SELECT as we have demonstrated above.

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.

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2.10 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 5.1 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 2700 SELECT.

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


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Once the installed membranes and probes are equilibrated, the probe baseline 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.

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3. Basic Operation

3.1 Main Menu

When you power on or reset your 2700 SELECT 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 2 hours pass without a sample being processed, the unit automatically transfers to STANDBY Mode, where reagents are conserved. (In Section 5 you will learn how to change this 2 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 5.

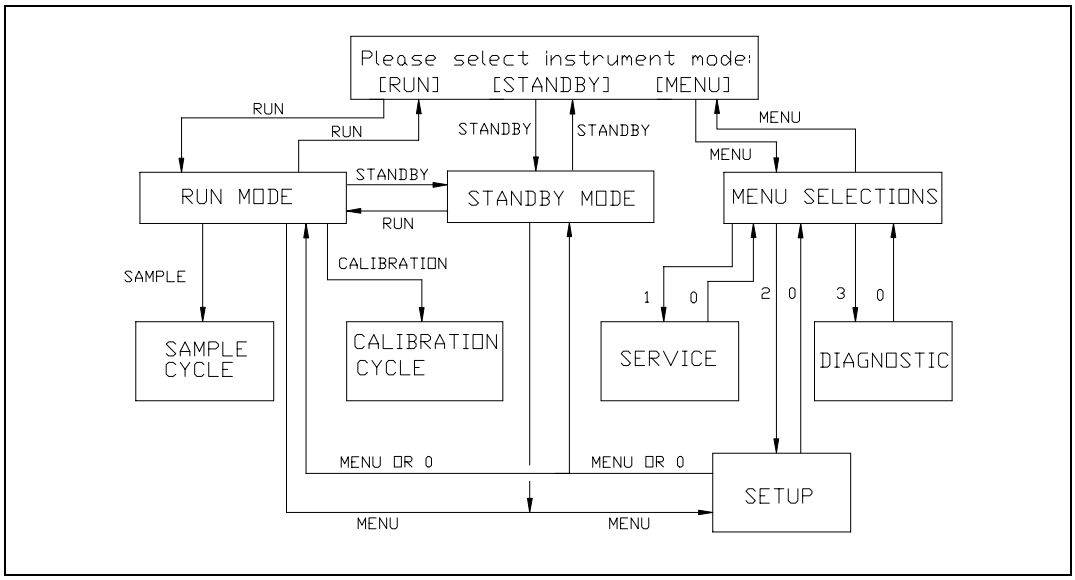


Figure 3.1
2700 SELECT Software Structure

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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.

3.2 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 or other preset calibrator station. 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 5.3 you will learn to change some default calibration parameters to better fit your application.

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

Ready to sample at Station #2

You are now ready to run a sample.

You may present a sample at any one of several stations: Station #2 (Test Tube Holder Station), Station #3 (Manual Station), Station #4 (with optional 2710 Turntable), or Station #5 (with optional 2730 Monitor and Control Accessory). When the **"Ready to sample...."** screen first appears, the sample station entered at the Run Mode Setup menu is selected. However, you may temporarily assign sampling to an alternate station; simply press the number key corresponding to the number of the station you want to sample from. For example, press the '3' key to change the prompt from the previous display to **"Ready to sample at Station #3"**. The 2700 will sample from the alternate station until you re-assign sampling or leave the **"Ready to sample...."** screen.

Note that if an alternate sampling station is selected when you leave the **"Ready to sample...."** screen, the alternate setting will be lost, and the station # stored at the Run Mode Setup menu will automatically be selected the next time you return. To permanently assign sampling to a different station, you must enter the Run Mode Setup menu and store a new station # in memory.

Operation at the Test Tube Holder Station (#2)

The Test Tube Holder (See Figure 3.2) 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). Some double-wall plastic tubes may prevent the fluid detection from working properly. These tubes should also be presented at the Manual Station.

For the purposes of demonstrating basic operation, choose the high level 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 2776 standard and use YSI 1531 standard (containing 9.00 g/L dextrose) to run as a sample.

Using the appropriate standard from your starter supplies, fill a test tube about half full. The Test Tube Holder is hinged at the bottom. Pull out the top as shown in Figure 3.3. Place the tube in the holder. The Sipper is not designed to pierce septa, but can be used with some flexible evaporator covers that are preslit. Alternatively, you may use a smaller container and sample from the Manual Station (#3) to conserve linearity standard solution.

Push the holder back into place. The Test Tube Holder Sensor, located above the holder, detects the presence of a tube. If a tube is detected, the Sipper will sample from this station; if no tube is present, it will move to the Manual Station (Station #3). Press [SAMPLE]. The 2700 SELECT will do the rest. The Sipper moves to the sample test tube and immerses itself about 3 millimeters (1/8 inch) below the surface of the fluid.

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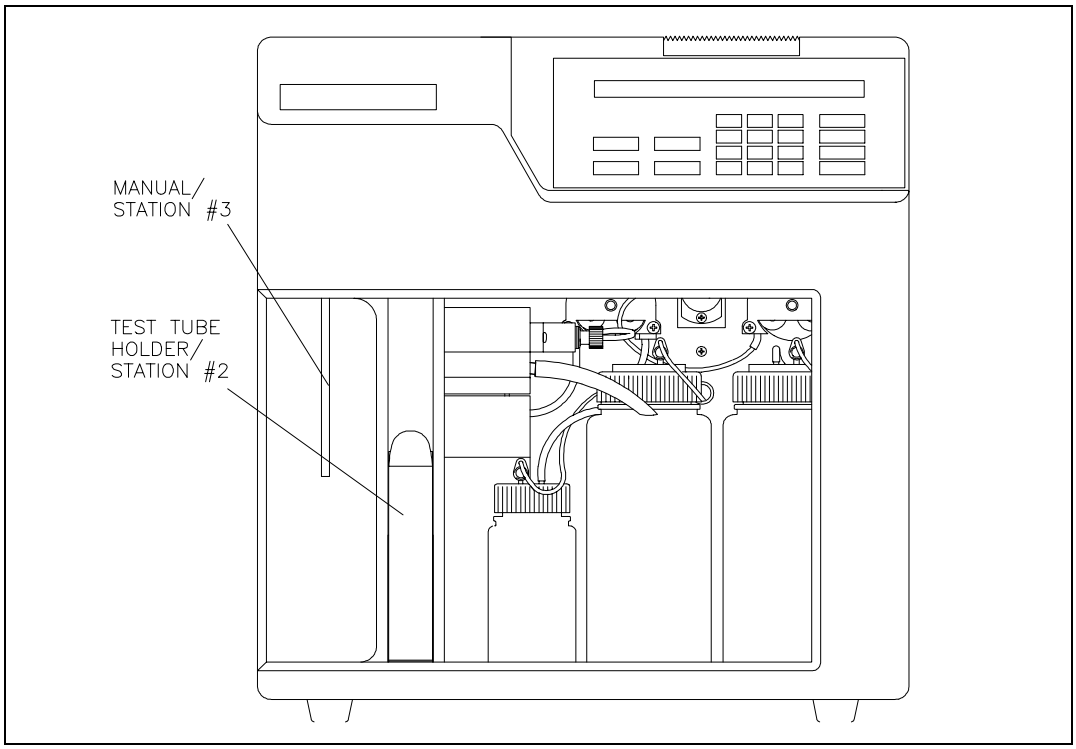


Figure 3.2
Sampling Stations

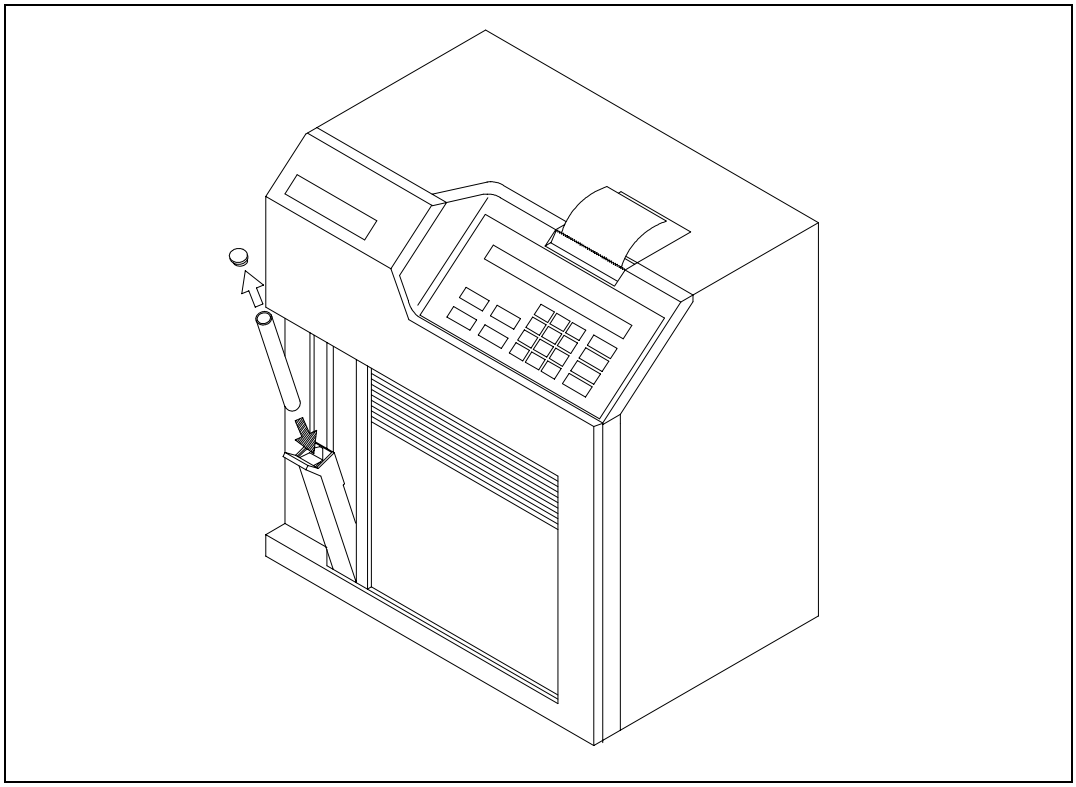


Figure 3.3
The Test Tube Holder Pivoted Out

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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 less than a minute, the analyte values for the sample are displayed and printed. An example of the display format is shown below. Notice that the results are shown in line 2, while the **"Ready to sample...."** message for the next analysis is in line 1.

```
Ready to sample at Station  #2
B:LAC   0.00 g/L   W:GLU   8.98 g/L
```

The printer format can be configured to express sample ID, date, time, temperature, sample size, instrument serial number, probe currents and more. See Appendix D for example print-outs.

For the purposes of learning basic operation, compare the instrument value with the labeled value of the YSI standard. The 'linearity' standard should be within ±5% of the label value. For example, if you calibrated the 2700 SELECT at 2.50 g/L dextrose using YSI 2776 as the calibrator solution, YSI 1531 (9.00 g/L) should read between 8.55 g/L and 9.45 g/L dextrose. If the reading falls outside these limits, recalibrate the instrument by pressing [CALIBRATE]. After recalibrating, repeat the analysis as directed above. If your reading is still outside this range, proceed for now. Later in this section, specific actions for nonlinearity will be addressed.

Operation at the Manual Station (#3)

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 (1/8 inch) below the fluid surface (See Figure 3.4). **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.**

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 needle and hit
[SAMPLE] to aspirate
```

Press [SAMPLE].

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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 the Sample Chamber.

Aspirating sample...

The results are then displayed and printed as shown above.

Again compare the value reported by the instrument with the value on the label of the YSI 1531 Standard (9.00 g/L dextrose). Repeat calibration and sampling if the result is not within specified tolerance limits of ±5% as described above. If your reading is still outside this range, refer to Linearity Test below.

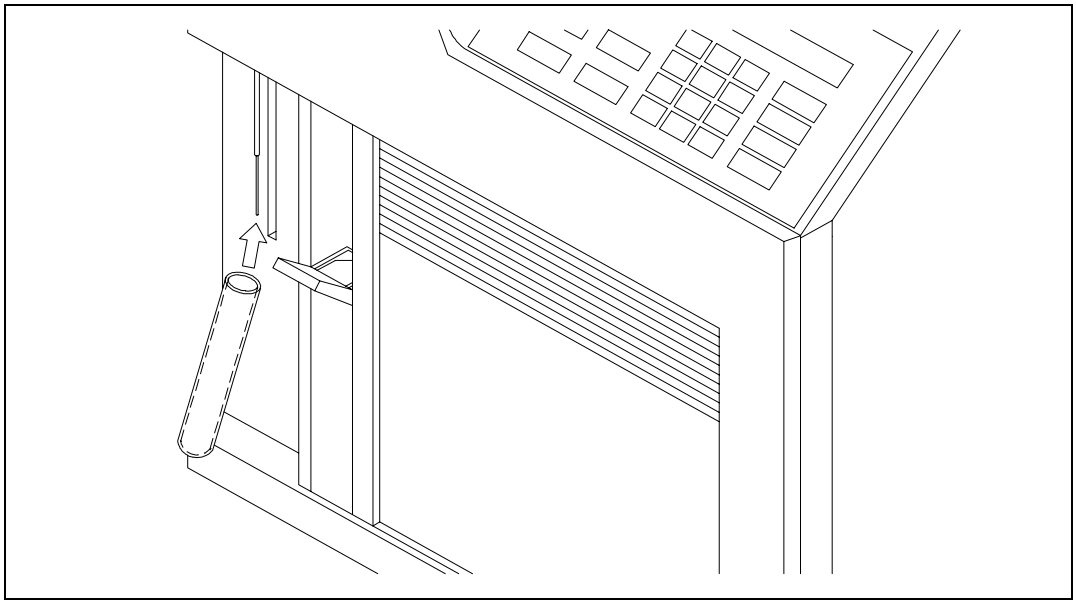


Figure 3.4
The Manual Station

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3.3 Standby Mode

If no sample is processed for 2 hours, the 2700 SELECT 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 2 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> 2
```

If you would like your 2700 SELECT 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 65,535) you would like to maintain a "sample ready" status before reverting to STANDBY Mode. Press [ENTER], then [MENU] to return to the Main Menu.

3.4 Daily Operational Checks

To ensure that your 2700 SELECT 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".

NOTE: This test is recommended for all YSI Enzyme Membranes **except** Galactose Oxidase Membranes (YSI 2702). In these membranes FCN is a component of the supply buffer. High baseline error messages may provide similar information regarding the structural integrity of the installed membrane.

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

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Ready to sample at Station #2

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. The maximum allowable values for FCN readings after calibrating with YSI standards are listed below.

Chemistry	Membrane	Calibration Standard	FCN Limit
Dextrose	2365	2776, 2747 or 2355	0.05 g/L*
Ethanol	2768	2790 (@ 2.00 g/L)	0.05 g/L*
L-Glutamate	2754	2755	0.06 g/L*
L-Lactate	2329	2776, 2747 or 2327	0.03 g/L*
Sucrose	2703	2780	0.10 g/L*
Choline	2771	2772	0.02 g/L*
L-Glutamine	2735	2736	0.06 g/L*
Methanol	2725	2726 (@ 1.00 g/L)	0.05 g/L*

After a stable calibration with the recommended YSI calibration standard, FCN readings greater than the limit may indicate membrane structural failure. Recalibrate and repeat the FCN test. If readings are still high, refer to Section 8, Troubleshooting.

* If you use units other than g/L for the FCN test, refer to Appendix A for conversion values.

Linearity Test

Use the appropriate YSI linearity standard to test the linear range of the chemistry or chemistries you have chosen. See the list below to be certain you are testing with the correct standard solution.

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

Ready to sample at Station #2

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. NOTE: If there is no test tube in the Test Tube Holder, the sipper will automatically move to the Manual Station (#3) for aspiration.

Acceptable linearity values for YSI standards are ±5%. See the list of acceptable values below.

Chemistry	Calibration Std	Linearity Std	Acceptable Range (g/L)*
Dextrose	2776 (2.50 g/L)	1531 (9.00 g/L)	8.55 to 9.45
Ethanol	2790 (2.00 g/L)	2790 (3.20 g/L)	3.04 to 3.36
Lactose	2783 (5.00 g/L)	2784 (25.00 g/L)	23.75 to 26.25
L-Glutamate	2755 (0.73 g/L)	2756 (1.46 g/L)	1.39 to 1.53
L-Lactate	2776 (0.50 g/L)	1530 (2.67 g/L)	2.54 to 2.80
Sucrose	2780 (5.00 g/L)	2778 (25.00 g/L)	23.75 to 26.25
Choline	2772 (0.175 g/L)	2773 (0.450 g/L)	0.43 to 0.47
L-Glutamine	2736 (0.73 g/L)	2737 (1.17 g/L)	1.11 to 1.23
Methanol	2726 (1.00 g/L)	2726 (2.50 g/L)	2.38 to 2.63

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If you are setting up to measure galactose or hydrogen peroxide using one of the YSI Enzyme Membrane Sensors, see Section 4 for more information.

* If you use units other than g/L for the linearity test, refer to Appendix A for conversion values.

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

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4. Chemistry Setup

The YSI 2700 SELECT has been designed to provide considerable flexibility with respect to how it may be configured. This allows you to use the instrument for analyses other than the standard configurations mentioned previously. This flexibility also makes it possible for YSI to develop and introduce new chemistry analyses in the future without significant instrument changes.

In this section, you will learn about each of the chemistry measurements that have been developed for the 2700 SELECT. First, we will briefly discuss the principle of using immobilized oxidase enzymes. Secondly, we will focus on each standard chemistry setup for single channel and then dual channel configurations.

4.1 Principle

You may want to use Section 6.1 to help understand the information presented below regarding immobilized enzyme sensor technology. You may find Figure 6.1 especially useful.

YSI's enzyme sensor technology employs one or more enzyme catalyzed reactions to ultimately produce hydrogen peroxide. Hydrogen peroxide (H_2O_2) is electrochemically oxidized at the platinum anode of an electrochemical probe. This produces a probe signal current.

In many procedures utilizing enzymes, the enzyme is discarded with the sample after the analysis is made. YSI's technology allows preservation of the enzyme by immobilizing it in a patented membrane structure.

The enzyme membrane is coupled with an electrochemical probe and housed in a sample chamber where sample delivery and flushing occur. The life of the enzyme membrane is measured in days or weeks, and is not dependent on the number of samples analyzed. If used frequently, you may measure hundreds of samples with a single enzyme membrane before its function is compromised.

In the sections below, each of the chemistries available by this technology will be discussed. In enzymology, the terms **substrate** and **product** are commonly used to describe a reaction. An enzyme is a protein molecule with great specificity that catalyzes the conversion of one or more substrates to one or more products. In the YSI technology, an oxidase enzyme is always involved since one product of an oxidase reaction is hydrogen peroxide. Hydrogen peroxide is required to produce a meaningful signal current at the electrochemical probe.

A substrate, like dextrose, enters the sample chamber and is stirred and diluted. The substrate then diffuses through a thin polycarbonate membrane material. The rate of the chemical reaction shown below is limited primarily by diffusion. This results in improved linearity, calibration stability and freedom from enzyme inhibition errors.

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Once past the polycarbonate membrane, the substrate encounters an extremely thin layer of the appropriate oxidase enzyme. There the following reaction occurs:

$$\text{Substrate} + O_2 \xrightarrow[\text{oxidase}]{} H_2O_2 + \text{Byproduct}$$

Although oxygen is consumed in this reaction, the buffer is not seriously depleted of oxygen, nor is the rate of enzyme reaction very sensitive to small changes in oxygen concentration. Therefore, it is not necessary to measure or control the oxygen content in the sample chamber.

Hydrogen peroxide diffuses toward the platinum anode in the probe assembly. This gives rise to the probe signal current.

The platinum anode is protected from other oxidizable substances by a thin layer of cellulose acetate. This makes the anode specific for hydrogen peroxide. Low molecular weight, reducing compounds can interfere. Typical interferences include phenols, hydrazine, hydrogen sulfide and mercaptans.

4.2 Sample Preparation

A variety of sample types can be analyzed with the 2700 SELECT. Generally, the only sample preparation that **may** be required is dilution of the sample to bring the substrate concentration within the linear range of the instrument. (see Section 1.4 for the working range of each chemistry).

Neither color nor turbidity interferes with measurements.

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

Further information and specific procedures for determining the concentration of chemical analytes in many products or specimens are available in YSI Application Notes. If you would like to discuss your application or inquire about other uses for the 2700 SELECT, contact YSI Technical Support (address and phone information on the back cover of this manual).

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4.3 Measurement Parameter Setup Information

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

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

Once you make the above determinations, you can decide whether one of the standard setups described below will be appropriate or whether you will need to customize your setup. In either case, the Measurement Parameter section of the instrument Setup Menu lists four submenus in which you must confirm or assign appropriate parameters. These are **sample size, calibration method, black probe parameters** and **white probe parameters**. If you have a single channel unit, white probe parameters do not appear in the menu choices.

You may want to access the print setup command in your 2700 SELECT menu. From Run or Standby mode, press [MENU], then select [5] for PrntSetup. From Main Menu display, press [MENU], select [2] for Setup, then select [5] for PrntSetup. In either case, the instrument printer will print a complete list of system parameters.

See Appendix C for more detail on accessing “PrntSetup” and also to review the sample print-outs of a single channel unit set for dextrose and a dual channel unit set for simultaneous dextrose and L-lactate analyses. The parameters you see in these printouts are default values. For many applications, the default settings will be appropriate for you.

Now enter the Measurement Parameter menu (press [2] for MeasParameter). Within this menu level you will confirm or change the parameter settings that define the chemistry or chemistries of interest.

Sample Size (1-SampleSize). The default setting is 25 µL. The range of choices is 5 to 65 µL. You may enter any integer value. Remember, however, this is a nominal volume. The instrument does not depend on an accurate absolute value, but rather reproducible aspirations. This allows the calibrator probe signal to be stored in memory and provide a reference value used to internally calculate sample readings.

For each chemistry described, a sample size (usually 25 µL) will be recommended. Some of the reasons for changing that sample size are listed below.

- » The calibrator probe signal plateau current might be less than 10 nA. Refer to Appendix D. You may want to increase the sample size to increase the probe signal.
- » Probe plateau current is high enough, but you would like to improve the linear range. For example, you might decrease sample size from 25 µL to 12 µL. Calibration current might drop from 20 nA to 10 nA, but accuracy and precision at the upper end of your concentration range should improve.
- » You may want to measure low concentrations of a particular analyte. For example, you might prepare a 500 mg/L dextrose calibrator for a particular application. If the dextrose calibrator produces probe signal plateau currents significantly below 10 nA, you could increase the sample size from 25 to 50 µL (or more) to bring the plateau current into a reasonable range.

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Calibration Method (2-CalMethod). In most chemistry setups, you will select “One Station”, and the calibration station # will be “Station #1” (Calibration Well). However, you have options to configure this in other ways.

- Select One Station, but assign Cal Station #2. Station #2 is the Test Tube Holder Station. For example, you may place a 500 mg/L dextrose solution in a test tube and calibrate in this manner. If you choose this option, the sampling position is normally Station #3 (Manual Station). With accessories, Station #4 (Turntable), or Station #5 (Monitor) may be used.
- If you are running a dual chemistry where a potential interference is involved, you may select “Two Station”. You will then be prompted to assign calibration stations for both black and white probes. For example, you could install a sucrose membrane on one probe and a dextrose membrane on the second probe. You could place sucrose calibrator in the test tube position (#2) and dextrose at the Cal Well (#1). In this setup, the instrument is programmed to measure the “dextrose reading” at the sucrose membrane and automatically subtract it.

Black Probe Parameter (3-Black). In this menu you choose parameters that correspond to the chemistry of interest at the Black Probe. Be certain that you install the correct enzyme membrane type. The selections include:

- Chemistry (10 selections, plus “none”)
- Unit of Concentration (g/L, mg/L, mmol/L, %(w/v))
- Calibration value (must correlate to units chosen)
- End Point (basically, the reaction time in the sample chamber)

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

White Probe Parameter (4-White). In this menu, you choose parameters that correspond to the chemistry of interest at the White Probe. Be certain that you install the correct enzyme membrane type. The selections include:

- Chemistry (10 selections, plus “none”)
- Unit of Concentration (g/L, mg/L, mmol/L, %(w/v))
- Calibration value (must correlate to units chosen)
- End Point (basically, the reaction time in the sample chamber)

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

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4.4 D-Glucose (Dextrose)

This is a direct reading of dextrose in solution at the enzyme sensor. The enzyme Glucose Oxidase is immobilized in the YSI Dextrose Membrane.

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

System Buffer	YSI 2357
Calibrator Std	YSI 2776 (2.50 g/L dextrose)
Linearity Std	YSI 1531 (9.00 g/L dextrose)*
Black Probe	YSI 2365 (Dextrose Membrane)
White Probe	n/a **
Sample Size	25 µL
Cal Station	Station #1 Cal Well

Black Probe Parameters	
Chemistry	Dextrose
Unit of Conc	g/L
Cal value	2.50
End Point	30 sec

Note: See Appendix A if concentration unit conversion is required.

* For applications requiring linearity performance to 25.0 g/L, YSI 2777 (25.0 g/L dextrose) may be used as a linearity standard provided the sample size is 10 µL.

** If you have a dual channel unit, either Black or White, or both Black and White probes can be configured for this chemistry.

Special Considerations:

- If sample dilution is required, use reagent water or 2357 buffer.
- If a solution must be prepared from solid dextrose, use the following diluent and allow about 15 minutes before measuring the sample. This is required for dextrose, which must equilibrate alpha and beta anomers (mutarotational equilibrium). If your reading is lower than expected, you may need to wait slightly longer for equilibration.

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

Both heat and the presence of phosphate accelerate mutarotational equilibration.

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4.5 L-Lactate

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

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

System Buffer	YSI 2357
Calibrator Std	YSI 2776 (0.50 g/L L-Lactate)
Linearity Std	YSI 1530 (2.67 g/L L-Lactate)
Black Probe	YSI 2329 L-Lactate Membrane
White Probe	n/a *
Sample Size	25 µL
Cal Station	Station #1 Cal Well

Black Probe Parameters	
Chemistry	L-Lactate
Unit of Conc	g/L
Cal value	0.50
End Point	30 sec

* If you have a dual channel unit, either Black or White, or both Black and White probes can be configured for this chemistry.

Note: See Appendix A if concentration unit conversion is required.

Special Considerations:

- If sample dilution is required, use reagent water or 2357 buffer.
- **D-Lactate is not a substrate for L-Lactate Oxidase.** Therefore, the 2700 SELECT cannot directly measure D-Lactate. If you have a known racemic mixture of lactates, the L-Lactate value multiplied by 2 should give you the total lactate value.

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4.6 Sucrose

This is a direct reading of sucrose in solution at the enzyme sensor. Three enzymes are co-immobilized in the YSI Sucrose Membrane: Invertase, Mutarotase, and Glucose Oxidase.

$$\text{Sucrose} + H_2O \xrightarrow[\text{Invertase}]{} \alpha\text{-D-Glucose} + (\text{Fructose})$$

$$\alpha\text{-D-Glucose} \xleftrightarrow[\text{Mutarotase}]{} \beta\text{-D-Glucose}$$

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

Through this chain of reactions the moles of hydrogen peroxide liberated is directly proportional to the moles of sucrose.

System Buffer	YSI 2357
Calibrator Std	YSI 2780 (5.00 g/L Sucrose)
Linearity Std	YSI 2778 (25.0 g/L Sucrose)
Black Probe	YSI 2703 Sucrose Membrane
White Probe	n/a *
Sample Size	25 µL
Cal Station	Station #1 Cal Well

Black Probe Parameters	
Chemistry	Sucrose
Unit of Conc	g/L
Cal value	5.00
End Point	30 sec

* If you have a dual channel unit, either Black or White, or both Black and White probes can be configured for this chemistry.

Note: See Appendix A if concentration unit conversion is required.

Special Considerations:

- » If sample dilution is required, use reagent water or 2357 buffer.
- » The sample must be **dextrose-free**, or at least contain levels low enough not to interfere with the sucrose reading. Since the sucrose membrane contains glucose oxidase, dextrose will produce a probe signal. See Section 4.16 to measure dextrose and sucrose simultaneously.

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4.7 Lactose

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

$$\text{Lactose} + O_2 \xrightarrow[\text{Gal Oxidase}]{} H_2O_2 + \text{Galactose Dialdehyde Derivative}$$

System Buffer	YSI 2705
Calibrator Std	YSI 2783 (5.00 g/L Lactose)
Linearity Std	YSI 2784 (25.0 g/L Lactose)
Black Probe	YSI 2702 Galactose Oxidase Membrane
White Probe	n/a *
Sample Size	25 µL
Cal Station	Station #1 Cal Well

Black Probe Parameters	
Chemistry	Lactose
Unit of Conc	g/L
Cal value	5.00
End Point	30 sec

* If you have a dual channel unit, either Black or White, or both Black and White probes can be configured for this chemistry.

Note: See Appendix A if concentration unit conversion is required.

Special Considerations:

- If sample dilution is required, use reagent water.
- The sample should be galactose-free. Galactose and other galactosides such as raffinose and stachyose are substrates for galactose oxidase. They may interfere by producing artificially high lactose readings.
- The enzyme membrane integrity test involving the use of YSI 2363 Potassium Ferrocyanide solution is not informative since ferrocyanide exists in the 2705 system buffer.

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4.8 Ethanol

This is a direct reading of Ethanol in solution at the enzyme sensor. The enzyme Alcohol Oxidase is immobilized in the enzyme membrane.

$$\text{Ethanol} + O_2 \xrightarrow[\text{Alcohol Oxidase}]{} H_2O_2 + \text{Acetaldehyde}$$

System Buffer	YSI 2787
Calibrator Std	YSI 2390 (Solution A, 2.00 g/L)
Linearity Std	YSI 2390 (Solution B, 3.20 g/L)
Black Probe	YSI 2786 Alcohol Oxidase Membrane
White Probe	n/a *
Sample Size	10 µL (for best linearity)
Cal Station	Station #2 Test Tube Holder **

Black Probe Parameters	
Chemistry	Ethanol
Unit of Conc	g/L
Cal value	2.00 g/L
End Point	45 sec

* If you have a dual channel unit, either Black or White, or both Black and White probes can be configured for this chemistry.

** You may use Station #1 (Cal Well), but evaporation through plastic components may be a problem. See the evaporation control information in special considerations.

Note: See Appendix A if concentration unit conversion is required.

Special Considerations:

- The linear range of ethanol is quite limited. If you are concerned about linearity, monitor the upper range of concentration on a regular basis. You may benefit by preparing and using a calibrator with an ethanol concentration close to your sample concentration .
- If you prepare your own ethanol calibrator, prepare a solution with ionic strength. Level sensing at Station #2 (Test Tube Holder) depends on a conductive solution. A 0.1% K_2EDTA solution as a diluent acts as both a conductive solution and a preservative. Normal saline solution (0.9%) is also an acceptable diluent.
- **Your sample should be methanol-free.** Methanol can be a significant interference, since it is a good substrate for Alcohol Oxidase. Propanol and butanol are very weak substrates of Alcohol Oxidase and usually do not present an interference problem.
- Controlling evaporation of ethanol from both sample and calibrator is important. The use of some type of test tube cover (eg., prepunctured film) will help. Frequently replacing the calibrator solution with fresh solution will also minimize the effects of evaporation on measurement integrity.

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4.9 Starch

This is an indirect reading of starch by measuring dextrose liberated from the hydrolysis of starch. To use the method described, **your sample must be dextrose-free**. If free dextrose is present, see Special Considerations below.

First, dissolved starch is hydrolyzed externally by the enzyme Amyloglucosidase to produce dextrose. Dextrose is read at the enzyme sensor. The enzyme Glucose Oxidase is immobilized in the YSI Dextrose Membrane.

$$\text{Starch} + H_2O \xrightarrow[\text{Amyloglucosidase}]{} \beta\text{-D-Glucose (dextrose)}$$

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

System Buffer	YSI 2357
Calibrator Std	YSI 2776 (2.50 g/L dextrose)
Linearity Std	YSI 1531 (9.00 g/L dextrose)*
Black Probe	YSI 2365 Dextrose Membrane
White Probe	n/a **
Sample Size	25 µL
Cal Station	Station #1 Call Well

Black Probe Parameters	
Chemistry	Dextrose
Unit of Conc	g/L
Cal value	2.50 g/L
End Point	30 sec

* For applications requiring linearity performance to 25.0 g/L, YSI 2777 (25.0 g/L dextrose) may be used as a linearity standard provided the sample size is 10 µL.

** If you have a dual channel unit, either Black or White, or both Black and White probes can be configured for this chemistry.

Special Considerations:

- An amyloglucosidase enzyme such as Sigma # A7420 works with many samples.
- Solubilizing starch is key to obtaining reproducible results. A variety of methods are in the literature. YSI has documented a couple of methods in YSI Application notes.
- Prepare a starch solution using the diluent described below, add 1 to 2 mg amyloglucosidase per mL of starch solution. Allow at least 20 minutes for the enzyme to react, and the liberated dextrose to reach mutarotational equilibrium, before measuring the sample. If your reading is higher than expected, you may need to wait slightly longer, or re-evaluate the possibility of free-dextrose in the sample.

  Diluent: 40 g/L NaH_2PO_4, 10 g/L Na_2HPO_4, in reagent water.
- If free-dextrose is a concern, first measure free dextrose. Then externally hydrolyze the starch, and measure the total dextrose after hydrolysis. Subtract the free-dextrose from the total dextrose and multiply by 0.9 to account for water of hydrolysis.

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4.10 Choline

This is a direct reading of choline in solution at the enzyme sensor. The enzyme Choline Oxidase is immobilized in the YSI Choline Membrane.

$$\text{Choline} + 2O_2 \xrightarrow[\text{Chol Oxidase}]{} 2H_2O_2 + \text{Betaine}$$

System Buffer	YSI 2357
Calibrator Std	YSI 2772
Linearity Std	YSI 2773
Black Probe	YSI 2771(Choline Oxidase Membrane)
White Probe	n/a *
Sample Size	25 µL
Cal Station	Station #1 Cal Well

Black Probe Parameters	
Chemistry	Choline
Unit of Conc	mg/L
Cal value	175
End Point	30 sec

* If you have a dual channel unit, either Black or White, or both Black and White probes can be configured for this chemistry.

Note: See Appendix A if concentration unit conversion is required.

Special Considerations:

- » If sample dilution is required, use reagent water or 2357 Buffer.
- » Although the YSI 2772 Choline calibrator solution is prepared using choline bitartrate, the concentration is expressed as mg/L of choline cation. If you prefer to express the sample as a salt of choline, you must enter an “adjusted” calibration value when configuring your instrument measurement parameters.

  For example, to express results as a choline hydroxide value, program the calibrator value as 204 mg/L when using the YSI 2772 Choline Standard calibrator solution. Your results will now reflect the concentration of choline hydroxide in the sample. Assumptions and calculations are as follows:

  choline hydroxide FW = 121.2
  free choline FW = 104.2
  (121.1 ÷ 104.2) x 175 mg/L = 203.55 = 204 mg/L (rounded up)

  Equivalent values for other choline salts may be calculated in a similar manner.

Potential Interferences. Tests with equimolar concentrations of various vitamins, and other ingredients of nutritionals, showed little or no interference. On a scale where Choline = 100%, those substances that produced more than 0.5% response were Riboflavin (1.1%), Pyridoxine (1.5%), Ascorbic Acid (0.8%), and Thiamine (1.3%). Vanillin, an artificial flavor ingredient, may produce interference levels exceeding 10% (mole/mole), and should be tested separately for your individual formulations if known to be present.

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4.11 Galactose

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

$$\text{Galactose} + O_2 \xrightarrow[\text{Gal Oxidase}]{} H_2O_2 + \text{Galactose Dialdehyde Derivative}$$

System Buffer	YSI 2705
Calibrator Std	n/a *
Linearity Std	n/a *
Black Probe	YSI 2702 Galactose Oxidase Membrane
White Probe	n/a **
Sample Size	25 µL
Cal Station	Station #1 Cal Well

Black Probe Parameters	
Chemistry	Galactose
Unit of Conc	g/L
Cal value	user's choice (recommend about 2 g/L)
End Point	30 sec

* YSI does not currently offer galactose standard solutions.

** If you have a dual channel unit, either Black or White, or both Black and White probes can be configured for this chemistry.

Note: See Appendix A if concentration unit conversion is required.

Special Considerations:

- » If sample dilution is required, use reagent water.
- » The sample should be lactose-free. Lactose and other galactosides such as raffinose and stachyose are substrates for galactose oxidase. They may interfere by producing artificially high galactose readings.
- » The enzyme membrane integrity test involving the use of YSI 2363 Potassium Ferrocyanide solution is not informative since, ferrocyanide exists in the 2705 system buffer.

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4.12 Hydrogen Peroxide

This is a direct electrochemical reading of hydrogen peroxide at the enzyme probe. A structure similar in appearance to an enzyme membrane is used at the probe surface. This membrane contains immobilized nonenzymatic protein to produce diffusion properties similar to those exhibited by YSI Enzyme Membranes.

The electrochemical reaction, which is common to all YSI Enzyme Sensors, is the following:

$$H_2O_2 \xrightarrow[\text{Platinum anode}]{} 2H^+ + O_2 + 2e^-$$

System Buffer	YSI 2357 (see note below regarding catalase)
Calibrator Std	n/a *
Linearity Std	n/a *
Black Probe	YSI 270l Blank Membrane
White Probe	n/a**
Sample Size	25 µL
Cal Station	Station #2 Test Tube Holder

Black Probe Parameters	
Chemistry	Peroxide
Unit of Conc	mg/L
Cal value	user's choice (recommend about 30 mg/L)
End Point	30 sec

* YSI does not currently offer hydrogen peroxide standard solutions.

** If you have a dual channel unit, either Black or White, or both Black and White probes can be configured for this chemistry.

Note: See Appendix A if concentration unit conversion is required.

Special Considerations:

- Since hydrogen peroxide is typically used to calibrate the YSI Blank Membrane, the enzyme **catalase** is a concern. Catalase destroys hydrogen peroxide. Catalase occurs naturally and may be in the sample you are testing. If so, it can also accumulate in the 2700 SELECT sample chamber. A small amount of sodium azide added to the system buffer will inactivate the catalase. Concentrations around 5 mg/L sodium azide are appropriate.
- If you have a dual channel 2700 SELECT and suspect an electrochemical interference (as opposed to an enzymatic interference), you may want to use one channel to **qualitatively** monitor for an interference effect.

Typical electrochemical interferences include phenols, mercaptans, hydroxylamine, hydrazine and analines. If you suspect a particular substance, you may want to configure one of your probes with a blank membrane and calibrate it as described above under Hydrogen Peroxide. Then run your sample and check for activity at the Blank Membrane. It is not quantitative, but may provide useful information about your sample.

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4.13 L-Glutamate (L-Glutamic Acid)

This is a direct reading of L-glutamate in solution at the enzyme sensor. The enzyme L-Glutamate Oxidase is immobilized in the YSI Glutamate Membrane.

$$\text{L-Glutamate} + O_2 \xrightarrow[\text{Glut Oxidase}]{} H_2O_2 + \alpha\text{-Ketoglutarate} + NH_3$$

System Buffer	YSI 2357
Calibrator Std	YSI 2755 (5.00 mmol/L glutamate)
Linearity Std	YSI 2756 (10.00 mmol/L glutamate)
Black Probe	YSI 2754 (Glutamate Oxidase Membrane)
White Probe	n/a *
Sample Size	25 µL
Cal Station	Station #1 Cal Well

Black Probe Parameters	
Chemistry	Glutamate
Unit of Conc	mmol/L
Cal value	5.00
End Point	30 sec

* If you have a dual channel unit, either Black or White, or both Black and White probes can be configured for this chemistry.

Note: See Appendix A if concentration unit conversion is required.

Special Considerations:

- If sample dilution is required, use reagent water or 2357 Buffer.
- If you want to measure MSG (monosodium glutamate, monohydrate) and express the results as mmol/L of MSG, the calibration parameters listed above are all appropriate. If you want to express results as a w/v measurement, such as mg/L MSG, then correction for the sodium and water components is necessary.

  To express results as an MSG value, change the glutamate units to a w/v expression, and enter one of the following: 936 mg/L, 0.936 g/L, or 0.094 %. Use YSI 2755 Calibrator Standard (5.00 mmol/L Glutamate) to calibrate the instrument. Sample results will then reflect MSG concentration.

Potential Interferences. Tests with equimolar concentrations of other amino acids and related substances showed little or no interference. On a scale where Glutamate = 100%, those substances that produced more than 0.5% response were L-Aspartate (0.7), L-Tyrosine (1.4), L-Histidine (0.7), and L-Glutamine (1.1). Glutamate cannot be ruled out as a contaminant in the Glutamine solution.

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4.14 L-Glutamine

This is a direct reading of glutamine in solution at the enzyme sensor. Two enzymes are co-immobilized in the YSI Glutamine Membrane: Glutaminase and Glutamate Oxidase.

$$\text{L-Glutamine} \xrightarrow[\text{Glutaminase}]{} \text{L-Glutamate} + NH_3$$

$$\text{L-Glutamate} + O_2 \xrightarrow[\text{Glut Oxidase}]{} H_2O_2 + \alpha\text{-Ketoglutarate} + NH_3$$

Through this chain of reactions the amount of hydrogen peroxide liberated is directly proportional to the amount of glutamine.

System Buffer	YSI 2357
Calibrator Std	YSI 2736 (5.00 mmol/L)
Linearity Std.	YSI 2737 (8.00 mmol/L)
Black Probe	YSI 2735 Glutamine Membrane
White Probe	n/a *
Sample Size	20 µL
Cal Station	Station #2

Black Probe Parameters	
Chemistry	Glutamine
Unit of Conc	mmol/L
Cal value	5.00
End Point	30 sec

* If you have a dual channel unit, either Black or White, or both Black and White probes can be configured for this chemistry.

Note: See Appendix A if concentration unit conversion is required.

Special Considerations:

» If sample dilution is required, use reagent water or 2357 buffer.

The sample must be **glutamate-free**, or at least contain levels low enough not to interfere with the glutamine reading. Since the glutamine membrane contains glutamate oxidase, glutamate will produce a probe signal. See Section 4.17 to measure glutamate and glutamine simultaneously.

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4.15 Methanol

This is a direct reading of Methanol in solution at the enzyme sensor. The enzyme Alcohol Oxidase is immobilized in the enzyme membrane.

$$\text{Methanol} + O_2 \xrightarrow[\text{Alcohol Oxidase}]{} H_2O_2 + \text{Formaldehyde}$$

System Buffer	YSI 1579
Calibrator Std	YSI 2726 (Solution A, 1.00 g/L)
Linearity Std	YSI 2726 (Solution B, 2.50 g/L)
Black Probe	YSI 2725 Methanol Membrane
White Probe	n/a *
Sample Size	15 µL (for best linearity)
Cal Station	Station #2 Test Tube Holder **

Black Probe Parameters	
Chemistry	Methanol
Unit of Conc	g/L
Cal value	1.00 g/L
End Point	30 sec

* If you have a dual channel unit, either Black or White, or both Black and White probes can be configured for this chemistry.

** You may use Station #1 (Cal Well), but evaporation through plastic components may be a problem. See the evaporation control information in special considerations.

Note: See Appendix A if concentration unit conversion is required.

Special Considerations:

- The linear range of methanol is quite limited. If you are concerned about linearity, monitor the upper range of concentration on a regular basis. You may benefit by preparing and using a calibrator with a methanol concentration close to your sample concentration.
- If you prepare your own methanol calibrator, prepare a solution with ionic strength. Level sensing at Station #2 (Test Tube Holder) depends on a conductive solution. A 0.1% K_2EDTA solution as a diluent acts as both a conductive solution and a preservative. Normal saline solution (0.9%) is also an acceptable diluent.
- **Your sample should be ethanol-free.** Ethanol can be a significant interference, since it is a good substrate for Alcohol Oxidase. Propanol and butanol are very weak substrates of Alcohol Oxidase and usually do not present an interference problem.
- Controlling evaporation of methanol from both sample and calibrator is important. The use of some type of test tube cover (eg., prepunctured film) will help. Frequently replacing the calibrator solution with fresh solution will also minimize the effects of evaporation on measurement integrity.

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4.16 Simultaneous Dextrose and L-Lactate

You must have a dual channel version of the 2700 SELECT in order to perform this measurement. Refer to the sections above on DEXTROSE and L-LACTATE for theoretical and special considerations. Then follow the instructions below to set up your instrument for simultaneous determination.

Note: In Section 2 of this manual, the step-by-step procedure for setting up this simultaneous measurement was described.

System Buffer	YSI 2357
Calibrator Std	YSI 2776 (2.50 g/L dex; 0.50 g/L L-lact)
Linearity Std	YSI 1531 (9.00 g/L dex) and YSI 1530 (2.67 g/L L-lact)
Black Probe	YSI 2329 L-Lactate Membrane
White Probe	YSI 2365 Dextrose Membrane
Sample Size	25 µL
Cal Station	Station #1 Cal Well

Black Probe Parameters	
Chemistry	L-Lactate
Unit of Conc	g/L
Cal value	0.50
End Point	30 sec

White Probe Parameters	
Chemistry	Dextrose
Unit of Conc	g/L
Cal value	2.50
End Point	30 sec

Note: See Appendix A if concentration unit conversion is required.

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4.17 Simultaneous Dextrose and Sucrose

You must have a dual channel version of the 2700 SELECT in order to perform this measurement. Refer to the sections above on DEXTROSE and SUCROSE for theoretical and special considerations. Then follow the instructions below to set up your instrument for simultaneous determination.

Since the Sucrose Membrane (2703) utilizes a chain of enzyme reactions and the final reaction is a “dextrose measurement”, free dextrose in a sample will be measured at the Sucrose Sensor. By using the information at the Dextrose Sensor, this free dextrose is automatically subtracted in the instrument software. The algorithm looks basically like this:

(“Total Dextrose” - “Free Dextrose”) x (1.9) = Sucrose

Total Dextrose is the combined sucrose and dextrose probe signal. Free Dextrose is the dextrose not derived from sucrose hydrolysis. The constant 1.9 corrects for the weight of fructose that is not sensed at either probe, and the water of hydrolysis.

System Buffer	YSI 2357
Calibrator Std	YSI 2776 and YSI 2780
Linearity Std	YSI 1531 and YSI 2778
Black Membrane	YSI 2703
White Membrane	YSI 2365
Sample Size	25 µL
Cal Station	Two Station, # 1 (dex), #2 (suc)*

Black Probe Parameters		White Probe Parameters	
Chemistry	Sucrose	Chemistry	Dextrose
Unit of Conc	g/L	Unit of Conc	g/L
Cal value	5.00	Cal value	2.50
End Point	30 sec	End Point	30 sec

* Since sucrose calibrator is at the Test Tube Holder, you must sample at the Manual Station (#3). The Turntable position (#4), and the Monitor Station (#5) may also be used on units equipped with these accessories.

Special Considerations:

- The combined total of dextrose + sucrose cannot exceed 25 g/L. The dextrose concentration cannot exceed 10 g/L if the combined total is near 25 g/L, since a dextrose concentration that high combined with 15 g/L sucrose will saturate the Sucrose probe. If either of these conditions occur, you should dilute your sample to bring it into a reasonable range.
- The ability to select sample size (5 to 65 µL) may help you optimize your system, especially if very high or very low concentrations of one or the other of these substrates is a problem. The optimal probe current for a calibrator is about 10 nA. See Menu Diagnostics, Section 5.4, to learn more about measuring your probe signal before entering Run mode.

Special Considerations continued on other side....

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Special Considerations:(Continued)

» If the dextrose concentration in your sample exceeds the sucrose concentration, the subtraction of a large dextrose “signal” from a smaller sucrose “signal” may result in significant errors in the sucrose reading. An alternative method involves using two different , and appropriate dilutions of the sample to first measure free dextrose, then treat one sample with invertase and analyze for dextrose liberated from the sucrose. Contact YSI Customer Service, or your dealer representative for an application note explaining this approach in detail.

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4.18 Simultaneous L-Glutamate and L-Glutamine

You must have a dual channel version of the 2700 SELECT in order to perform this measurement. Refer to the previous sections on L-GLUTAMATE and L-GLUTAMINE for theoretical and special considerations, then follow the instructions below to set up your instrument for simultaneous determination.

Since the Glutamine Membrane (2735) utilizes a chain of enzyme reactions and the final reaction is a “glutamate measurement”, free glutamate in a sample will be measured at the Glutamine Sensor. By using the information at the Glutamate Sensor, this free glutamate is automatically subtracted in the instruments software. The algorithm looks basically like this:

(“Total Glutamate” - “Free Glutamate”) = Glutamine

Total Glutamate is the combined glutamine and glutamate probe signal. Free Glutamate is the glutamate not derived from Glutamine reaction.

System Buffer	YSI 2357
Calibrator Std	YSI 2755 and YSI 2736
Linearity Std	YSI 2756 and YSI 2737
Black Membrane	YSI 2735
White Membrane	YSI 2754
Sample Size	20 µL
Cal Station	Two Station, #1 (glutamate), #2 (glutamine) *

Black Probe Parameters		White Probe Parameters	
Chemistry	Glutamine	Chemistry	Glutamate
Unit of Conc	mmol/L	Unit of Conc	mmol/L
Cal value	5.00	Cal value	5.00
End Point	30 sec	End Point	30 sec

* Since glutamine calibrator is at the Test Tube Holder, you must sample at the Manual Station (#3). The Turntable position (#4) and the Monitor Station (#5) may also be used on units equipped with these accessories.

Special Consideration:

» The ability to select sample size (5 to 65 µL) may help you optimize your system, especially if very high or very low concentrations of one or the other of these substrates is a problem. The optimal probe current for a calibrator is about 10 nA. See Menu Diagnostics, Section 5.4, to learn more about measuring your probe signal before entering Run mode.

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5. Menu Selections

5.1 Introduction

In this section you will learn about the specific commands required to move through the 2700 SELECT 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.

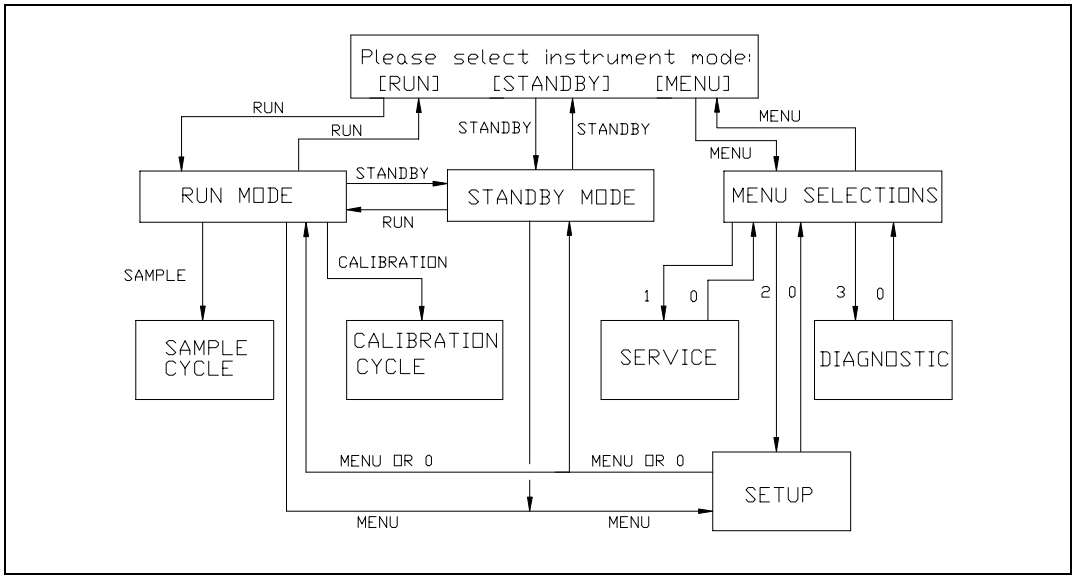


Figure 5.1
2700 SELECT Software Structure

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]

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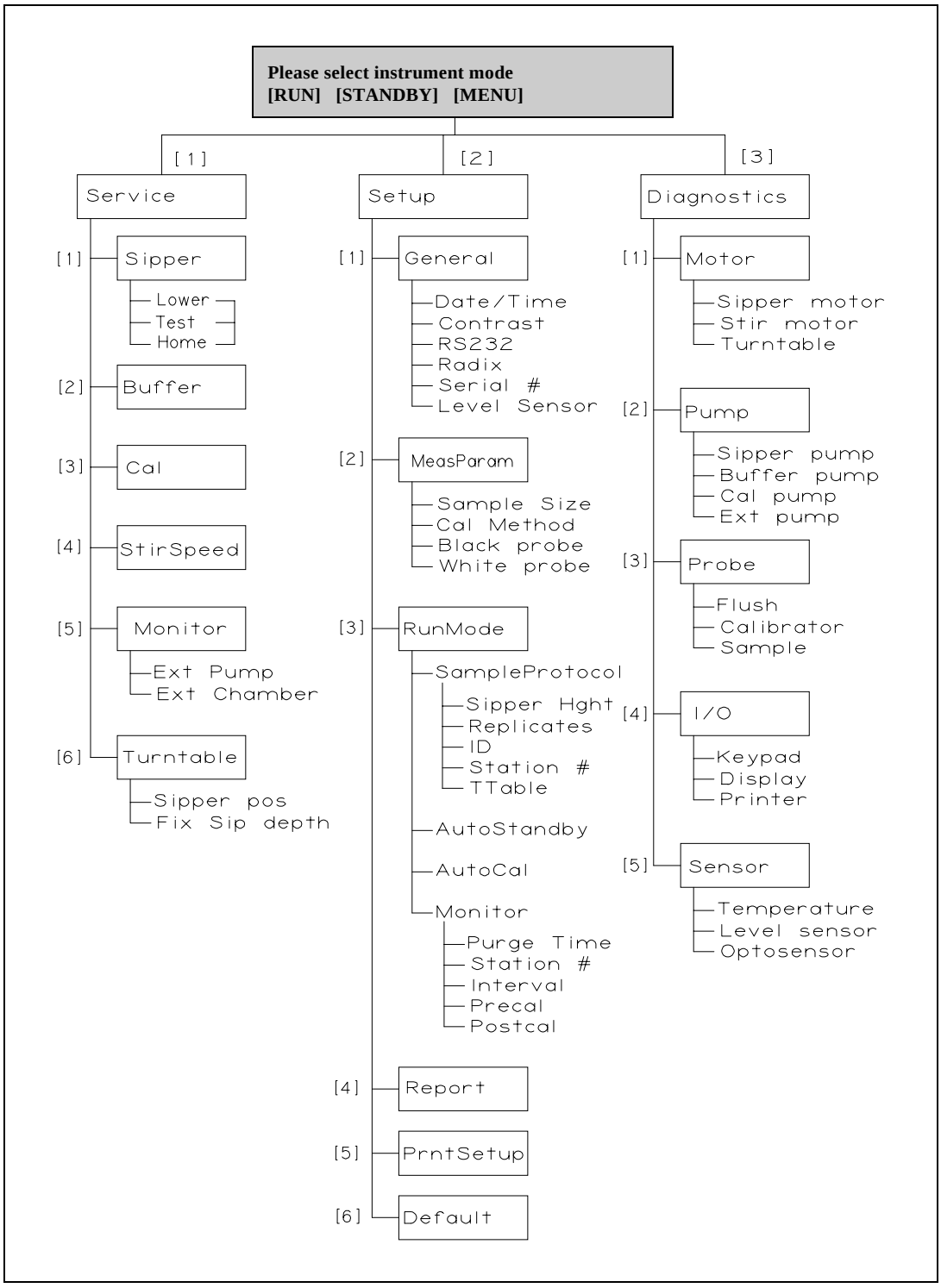


Figure 5.2
YSI 2700 SELECT Menu Flow Chart

REMEMBER: You move through the 2700 SELECT 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.

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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-Monitor  6-Turntable
```

Press [1] for Sipper to initiate Sipper alignment. This procedure was used during initial instrument setup. Refer to Section 2.9 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-Monitor  6-Turntable
```


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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-Monitor 6-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-Monitor 6-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 looses 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 looses 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-Monitor 6-Turntable

CAUTION! Do not enter the 5-Monitor or 6-Turntable submenus unless the monitor or turntable is installed AND the left access plate is removed. You may seriously damage the sipper arm assembly.

If you press [5] for Monitor, you will access the functions used to align and prime the YSI 2730 Monitor and Control Accessory. Refer to the *YSI 2730 Monitor and Control Accessory User's Manual* for details.

If you press [6] for Turntable, you will access the functions used to align the YSI 2710 Turntable. Refer to the *YSI 2710 Turntable Operation Manual* 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.

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5.3 Setup Selections

Setup menu is where you will enter system parameters that define the specific information required to run the 2700 SELECT 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, calibration values, 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 2700 SELECT 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 2700 SELECT.

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-LevelSensor
```

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 and select whether to deactivate the bottle level sensor system.

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> 98
```


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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-LevelSensor

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-LevelSensor

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

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```
Select number of data bits: Seven bit
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
```

Press [ENTER] to confirm.

```
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
```

If you press [6] for Configuration, you will see the following.

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

The configuration option allows operation in either a point-to-point environment or in a multidrop environment with an address (ID) assigned to your 2700 SELECT unit(s). The default configuration is Non-multidrop. If you press [2] for Multidrop, you will see the following.

```
Enter node address
> 38
```

Either enter another address # or accept the default, then confirm with [ENTER]. The node address is only used when networking 2700s in a multi-instrument system. The 2700 responds only to commands prefixed with the ID matching the address assigned from this menu.

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Now press [0] to return to the General setup level.

```
General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-LevelSensor
```

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-LevelSensor
```

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, 98B01234AB can be entered as 98 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
98  01234
```

```
General setup: 1-Date/Time 2-Contrast
3-RS232 4-Radix 5-Serial# 6-LevelSensor
```

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-LevelSensor
```

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
```


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

```
Measurement parameter setup
1-SampleSize  2-CalMethod  3-Black  4-White
```

"MeasParameter" is an abbreviation for measurement parameters. In this menu, you may select the sample size and assign the location of the calibrator solution(s). You will also assign specific chemistry parameters to the Black probe (single channel) or Black and White probes (dual channel). These parameters include chemistry assignment, calibration value, units of concentration, and time to endpoint of the enzyme sensor reading.

NOTE: YSI has assigned default values for each of these parameters, but provides flexibility for the user to change values to optimize for a particular application.

Press [1] for SampleSize. The default setting is 25 microliters. The range is 5 to 65.

```
Enter sample size in microliter
>  25
```

Press [ENTER] to confirm and return to Measurement parameter setup.

```
Measurement parameter setup
1-SampleSize  2-CalMethod  3-Black  4-White
```

Press [2] for CalMethod. The default setting is One station. The Two Station option is required for some dual channel analyses, for example, simultaneous dextrose and sucrose determination.

```
Select calibration method:  One station
1-One station  2-Two stations
```

After pressing [ENTER] to confirm One station, you must specify at which location the calibration solution will be. The default location is Station #1 (Cal Well). The choices are #1 and/or #2. Number 2 is the Test Tube Holder location. With Accessories such as the YSI 2710 Turntable and YSI 2730 Monitor and Control Accessory, stations #4 and #5 are also options.

```
Enter Cal Station #
>  1
```

NOTE: If Two station is selected, you will first be prompted to identify the Black probe cal station #, and then the White probe cal station #.

Press [ENTER] to confirm and return to Measurement parameter setup.

```
Measurement parameter setup
1-SampleSize  2-CalMethod  3-Black  4-White
```

Press [3] 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
```


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Press [1] for Next chemistry to scroll through the choices in the menu. The choices are L-Lactate, Sucrose, Lactose, Galactose, Peroxide, Ethanol, Choline, L-Glutamate, L-Glutamine, Methanol, none, and Dextrose. The Black probe default chemistry is L-Lactate.

Press [ENTER] to confirm and continue to the unit of measurement parameter. The choices are grams/liter (g/L), millimoles/liter (mmol/L), milligram/liter (mg/L), which is often referred to as parts per million (ppm), and percent (weight/volume).

```
Select BLACK unit of measurement:  g/L
1-mmol/L  2-mg/L  3-g/L  4-% (w/v)
```

To confirm, press [ENTER], then choose the calibration value. For L-Lactate the default value is 0.50 g/L. If you change units, default values automatically change to reflect the new units of measurement. If you are not using a calibrator with the default value, you must enter the new value after a change of units. Use Appendix A to convert to the appropriate value.

```
Enter BLACK calibration value in g/L
>  0.50
```

For some numeric entries you may need to lead with a 0. Follow the cursor. For example, if you had 13.89 mmol/L Dextrose entered, and you wanted to change to 1.80 g/L, the calibration value would read “02.50”, with the cursor under the “0”. You would then need to enter 1.80 as 01.80.

To confirm, press [ENTER], and then choose the end point time for the stabilized enzyme sensor reading. The default is 30 seconds. The range is 15 to 125 seconds. Use the default setting unless a particular application instruction specifies another value.

```
Enter BLACK end point time in seconds
>  30
```

Press [ENTER] to confirm and return to the Measurement parameter setup.

```
Measurement parameter setup
1-SampleSize  2-CalMethod  3-Black  4-White
```

If you have a dual channel unit, press [4] for White, and repeat the steps that you performed for the Black probe. The default settings are Dextrose, g/L, 2.50, 30 seconds. All of the setup options for the Black probe are also available for the White probe.

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

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

```
Select WHITE unit of measurement:  g/L
1-mmol/L  2-mg/L  3-g/L  4-%(w/v)
```

```
Enter WHITE calibration value in g/L
>  2.50
```


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```
Enter WHITE end point in seconds
> 30
```

Press [ENTER] to confirm and return to Measurement parameter setup.

```
Measurement parameter setup
1-SampleSize 2-CalMethod 3-Black 4-White
```

You have now completed MeasParameter setup. 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 4-Monitor
```

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 replicate sampling 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-Replicates 3-ID 4-Station# 5-Turntable
```

Press [1] for SipperHeight. This specifies to what vertical position the Sipper descends when sampling at the Manual Station (#3). 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-Replicates 3-ID 4-Station# 5-Turntable
```

Press [2] for Replicates. 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 Replicates must be between 1 and 999 (samples or calibrations). During RUN Mode, you may cancel the assigned number of replicate cycles by pressing [CANCEL].

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

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```
Prompt replicate cycle? No
1-No 2-Yes
```

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

```
Sampling protocol setup: 1-SipperHeight
2-Replicates  3-ID  4-Station#  5-Turntable
```

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-Replicates  3-ID  4-Station#  5-Turntable
```

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 or even Station #1, the Cal well. This last choice would be rarely used, but does give you the flexibility to calibrate from a solution in the Test Tube Holder (#2) and sample from the Cal Well (#1). If you have the YSI 2710 Turntable or YSI 2730 Monitor and Control Accessory, stations #4 and #5 are also available. See the appropriate manual for assignments.

```
Enter Sample Station#
> 2
```

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

```
Sampling protocol setup: 1-SipperHeight
2-Replicates  3-ID  4-Station#  5-Turntable
```

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

Refer to the *YSI 2710 Turntable Operation Manual* for setup, operation and maintenance of the turntable.

Press [0] to return to RUN mode setup.

```
RUN mode setup: 1-SampleProtocol
2-AutoStandby  3-AutoCal  4-Monitor
```


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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 2. 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 999.

```
Enter autostandby time in hour
0 to disable>  2
```

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

```
RUN mode setup: 1-SampleProtocol
2-AutoStandby  3-AutoCal  4-Monitor
```

Press [3] for AutoCal to define parameters that initiate autocalibrations. The five categories are shown in the display below. 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 (eg., baseline instability).

```
Autocal setup:  1-Temperature  2-Time
3-Sample  4-Cal shift  5-Sample error
```

You may alter any of these parameters to suit your application, however, you **may** compromise precision and/or accuracy when doing so. YSI's stated specifications are based on the default settings shown above.

WARNING: When using autocalibration parameters other than the default values described above, you may compromise precision and/or accuracy. It is your responsibility as a user to verify performance through appropriate quality assurance testing.

These selections are provided as part of the overall concept of the 2700 SELECT, 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 5 autocal parameter displays are shown below with their default values. The range of values that may be entered is shown below each display. Press [ENTER] to confirm each parameter and proceed to the next.

Press [1] for Temperature.

```
Enter allowable autocal temp drift in °C
0 to disable> 1
```

Confirm value shown or enter and confirm number of degrees from 1 to 20.

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```
Autocal setup:  1-Temperature  2-Time
3-Sample  4-Cal shift  5-Sample error
```

Press [2] for Time.

```
Enter autocal time interval in minute
> 15
```

Confirm value shown or enter and confirm any number of minutes from 0 to 30000.

```
Autocal setup:  1-Temperature  2-Time
3-Sample  4-Cal shift  5-Sample error
```

Press [3] for Sample.

```
Enter number of samples between autocals
0 to disable> 5
```

Confirm value shown or enter and confirm any number of samples from 0 to 30000.

```
Autocal setup:  1-Temperature  2-Time
3-Sample  4-Cal shift  5-Sample error
```

Press [4] for Cal shift.

```
Enter allowable autocal shift in %
0 to disable>  2
```

Confirm value shown or enter and confirm any number from 0 to 100.

```
Autocal setup:  1-Temperature  2-Time
3-Sample  4-Cal shift  5-Sample error
```

Press [5] for Sample error.

```
Autocal on sample error? Yes
1-No  2-Yes
```

Press [ENTER] to confirm performing an Autocal whenever a sample error is detected, or press [1] for No, then [ENTER] if you do NOT want the 2700 to perform an Autocal after detecting an error.

```
Autocal setup:  1-Temperature  2-Time
3-Sample  4-Cal shift  5-Sample error
```


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Press [0] to return to RUN mode setup.

```
RUN mode setup: 1-SampleProtocol
2-AutoStandby  3-AutoCal  4-Monitor
```

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 2700 SELECT 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 D 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 60 seconds and use about 8 inches (20 cm) of printer paper. See Appendix C for a sample printout.

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

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```
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 2700 SELECT 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]
```


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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 2700 SELECT 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 5.3 below to become familiar with major components of the instrument. Additional figures in Sections 3 and 5 may be useful, especially Figure 5.2, Menu Flow Chart.

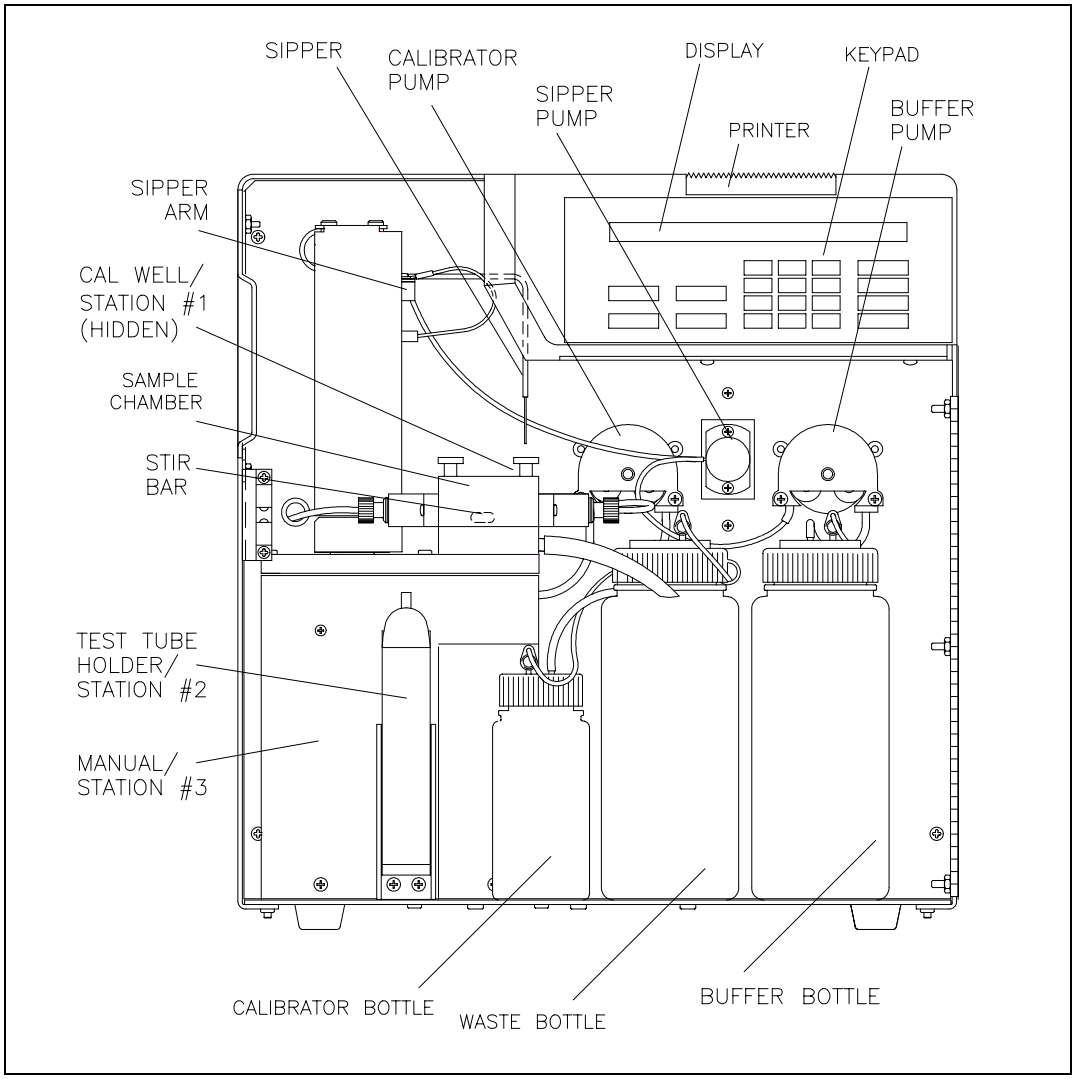


Figure 5.3
2700 SELECT Major Components

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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.

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 or monitor position. If you have a turntable or monitor installed properly, the access plate will already be removed.

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).

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

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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 chose. 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-Cal  4-ExtPump
```

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 5.3. 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".

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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-Cal  4-ExtPump
```


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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-Cal  4-ExtPump
```

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-Cal  4-ExtPump
```

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

NOTE: Unless the 2730 Monitor and Control pump is installed, 4-ExtPump will give no response, Refer to the *YSI 2730 Monitor and Control Accessory User's Manual* for details of external pump operation.

```
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 current(s). You will observe only Black probe current for a single channel unit. 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:DEX  1.76 nA
1-Flush 2-Calibrator 3-Sample
```

NOTE: If you assign "none" for a probe in the Setup (measurement parameters) menu, or you have a single channel unit, 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 and aspiration volume you have setup.

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```
B:LAC  11.77 nA  W:DEX  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:DEX  1.80 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:DEX  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
```


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```
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
```


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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
```

Press any key to return to Sensor diagnostic menu.

```
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.

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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.

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6. Principles of Operation

6.1 Sensor Technology

The sensor technology of the YSI 2700 SELECT is based on the principles conceived by Dr. Leland Clark 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 2300 STAT PLUS Glucose and L-Lactate Analyzer and the YSI 1500 SPORT Lactate Analyzer.

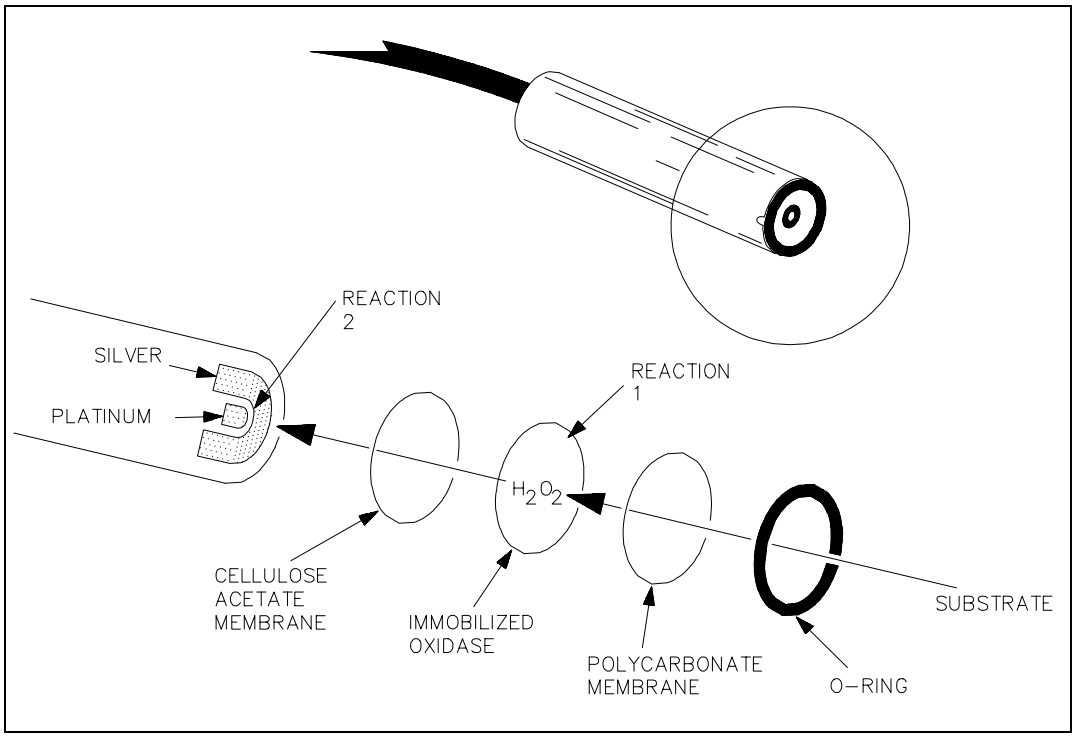


Figure 6.1
Sensor Probe and Enzyme Membrane

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.

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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.

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

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

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

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

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6.2 Fluid System

The 2700 SELECT fluid and electromechanics system is schematically described below in Figure 6.2.

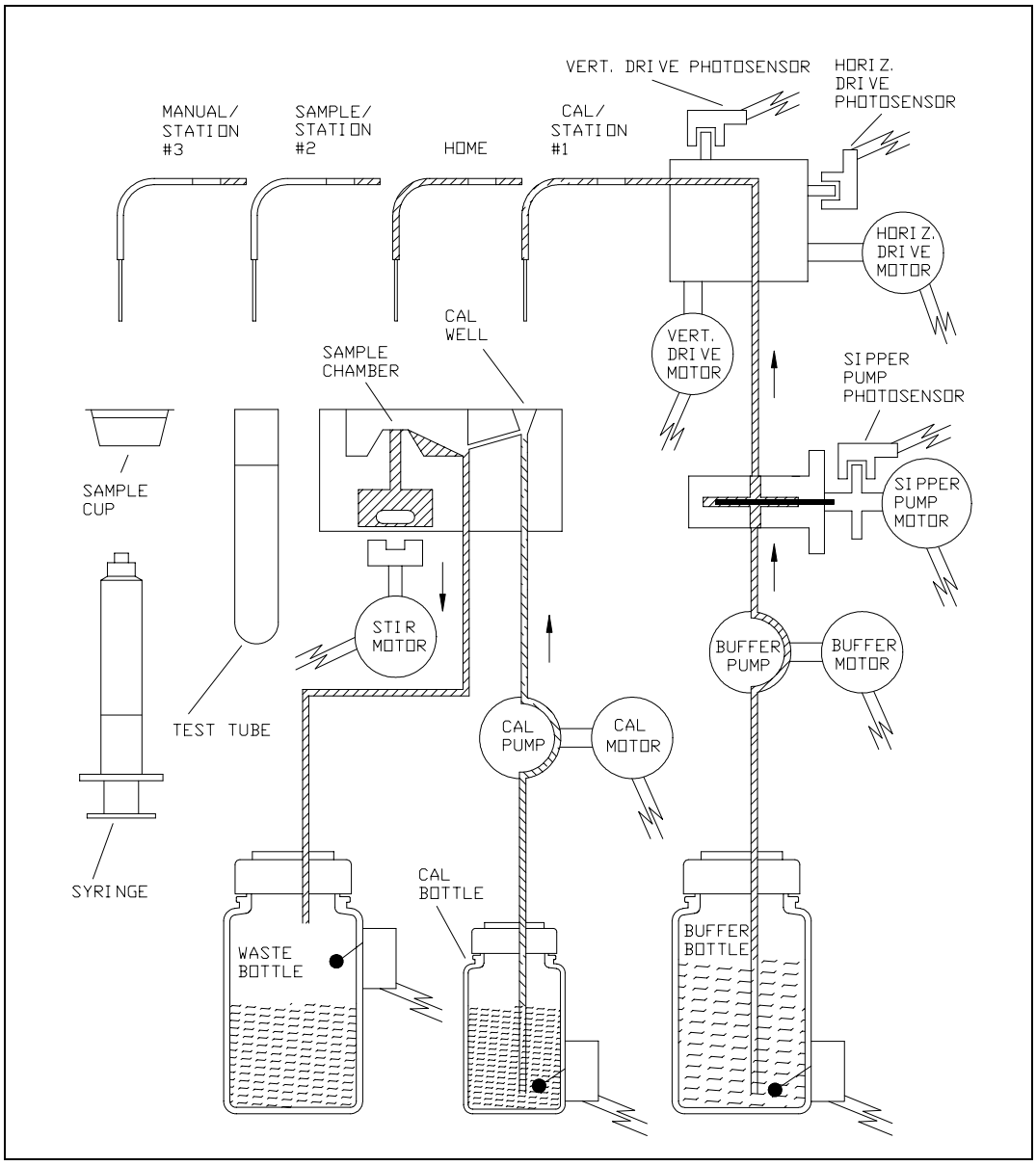


Figure 6.2
2700 SELECT Fluid System

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6.3 Measurement Methodology

The 2700 SELECT employs a steady state measurement methodology. A typical sensor response is shown in Figure 6.3.

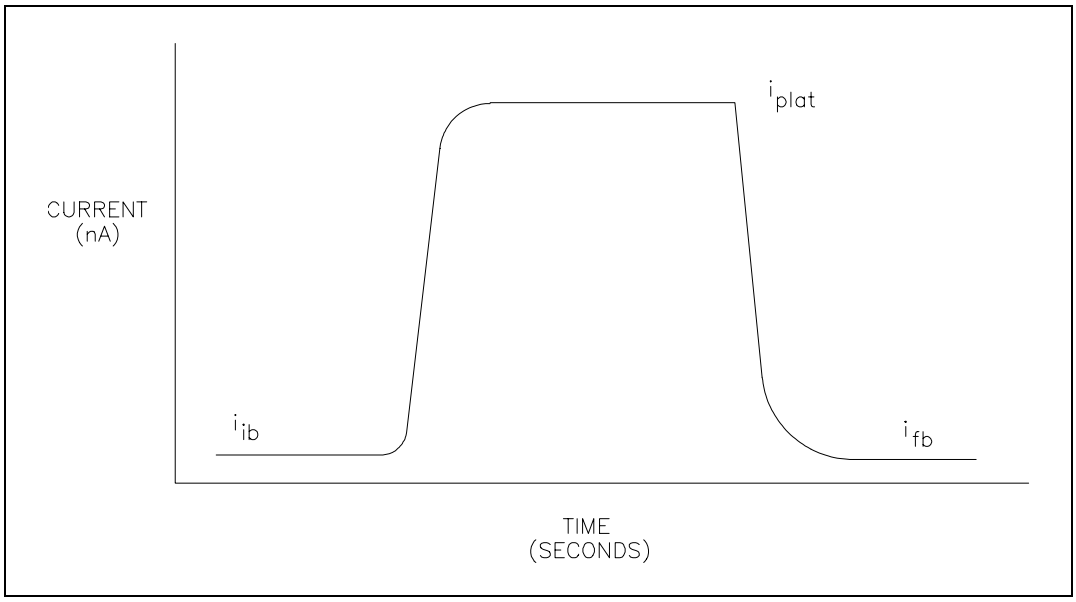


Figure 6.3
Typical Sensor Response

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 2700 SELECT 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 2700 SELECT 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.

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6.5 Calibration

To maintain a sample ready status, the 2700 SELECT 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 2700 SELECT 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% (default setting) 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 2700 SELECT will run 5 calibrations before the error '**unable to calibrate**' is displayed. The flexible parameter selection allows the user to disable this error mode in menu setup.

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).

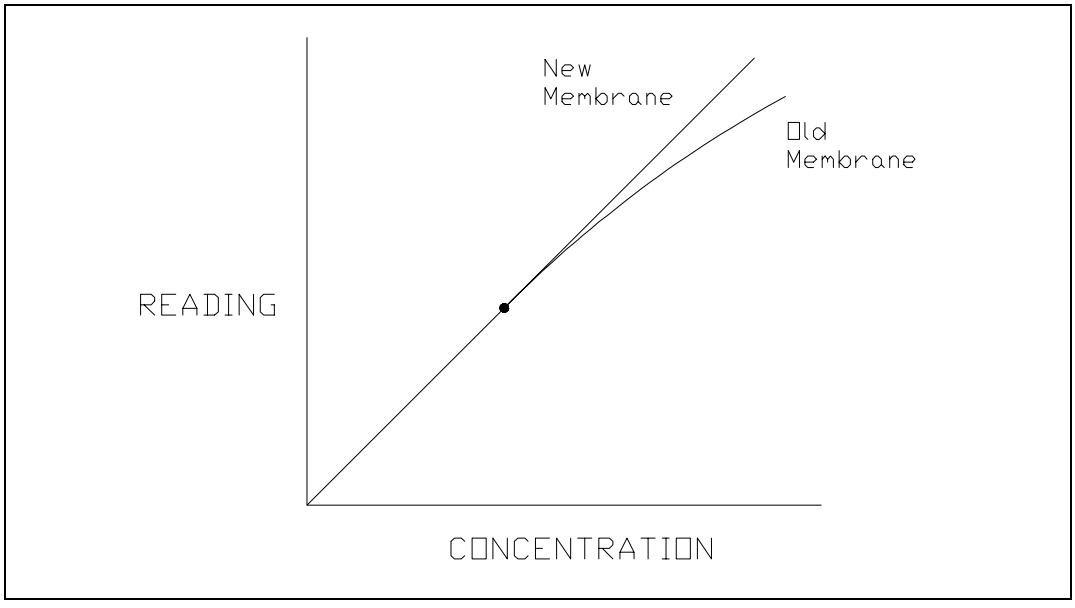


Figure 6.4
Aging Membrane Response

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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 Section 1.4 for details. If you chose to identify your own calibration value and measurement range, keep this failure mode in mind.

6.7 Temperature Compensation

The sensitivity of the sensors, in the 2700 SELECT, 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 2700 SELECT 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 (1/8 inch). 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 the *YSI 2710 Turntable Operation Manual*).

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 2700 SELECT. 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.

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6.9 Software Structure

The 2700 SELECT 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 2700 SELECT 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.

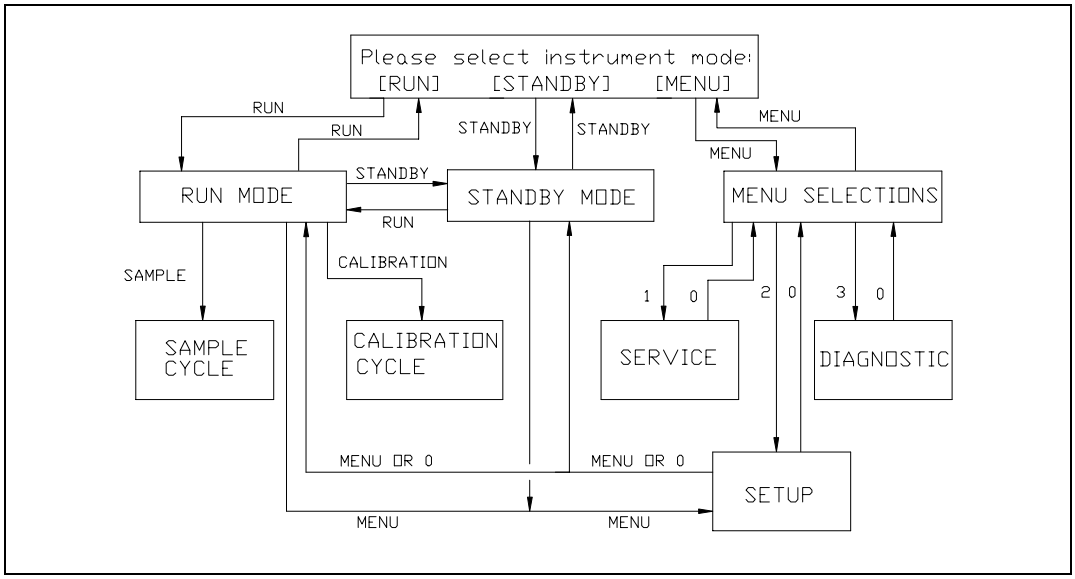


Figure 6.5
2700 SELECT Software Structure

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7. Maintenance

Before performing maintenance on the 2700 SELECT, **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 2700 SELECT 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

If the 2700 SELECT is used for medical research or biological testing, dispose of the waste bottle contents in a manner suitable for biohazardous waste. The reagents used in the 2700 SELECT are non-toxic and, unless otherwise specified, consist of a phosphate salt buffer with small amounts of preservatives. YSI 2705 phosphate buffer also contains Potassium Ferricyanide. 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 2.3 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. 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.

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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-Monitor 6-Turntable

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.

If you are calibrating from a test tube at the Test Tube Holder Station (#2), evaporation is a major concern. Calibrating with calibrator that has experienced any significant evaporation will result cause inaccurate test results. Consider changing calibrator daily, or more often, if required.

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 2.3 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 2.3 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 B 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.

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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 stainless steel fitting at the bottom of the chamber. If loose, replace the tubing. See Appendix B for the part number of the 2700 SELECT preventive maintenance kit.

Daily Operational Checks

To verify proper instrument performance, perform the daily operational checks described in Section 3.3.

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 2.3 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.

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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 3.3) 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.

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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 2.4) 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 2.6 to check the Sipper alignment and prime the buffer and calibration systems.

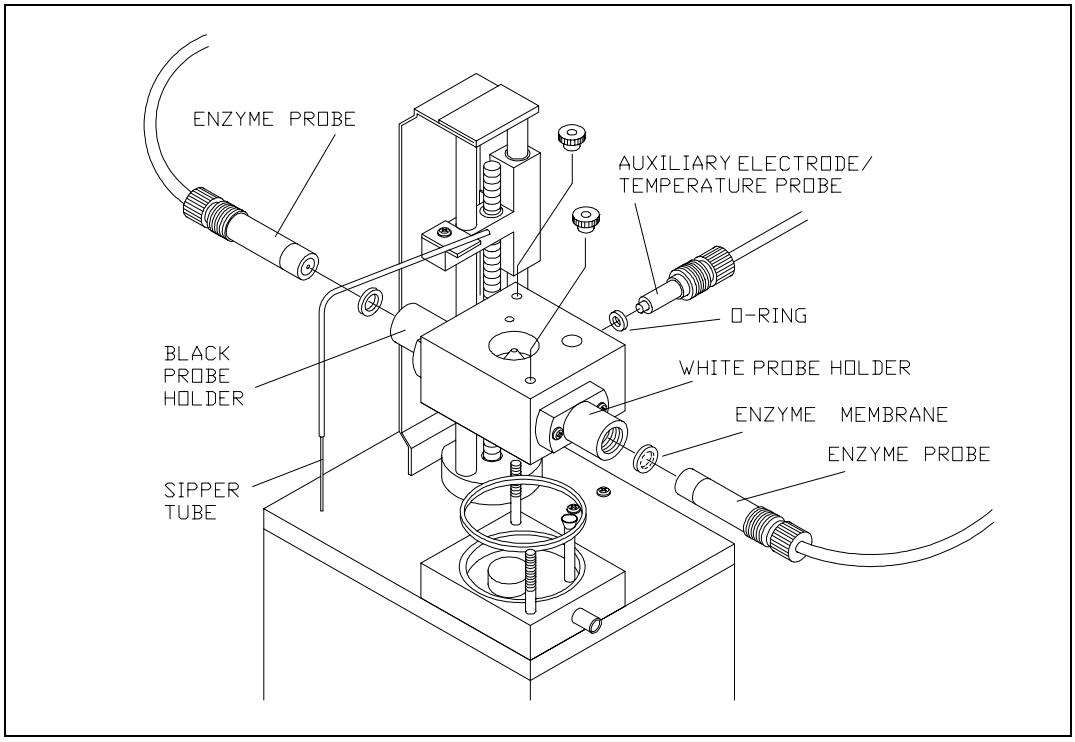


Figure 7.1
Sample Chamber Illustration

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 3.3, Daily Operational Checks, for details. When enzyme membrane installation is required, refer to Section 2.4, replacement procedures.

The typical working life of an enzyme membrane is displayed under Chemistry Performance Specifications, Section 1.4. You may want to use the expected life as a guideline for scheduling replacement.

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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.

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7.6 Tubing Replacement

The buffer and calibrator pumps in the 2700 SELECT 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.

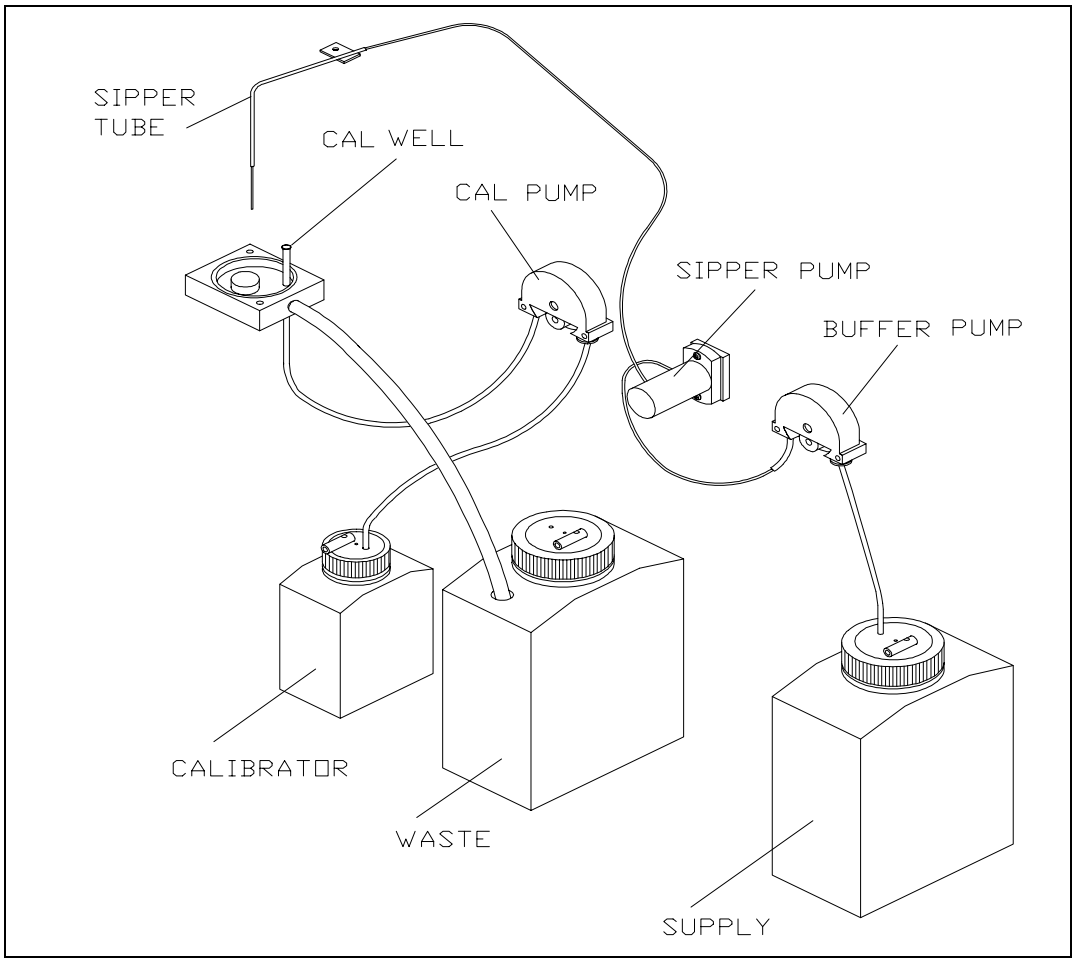


Figure 7.2
Tubing Connections

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.

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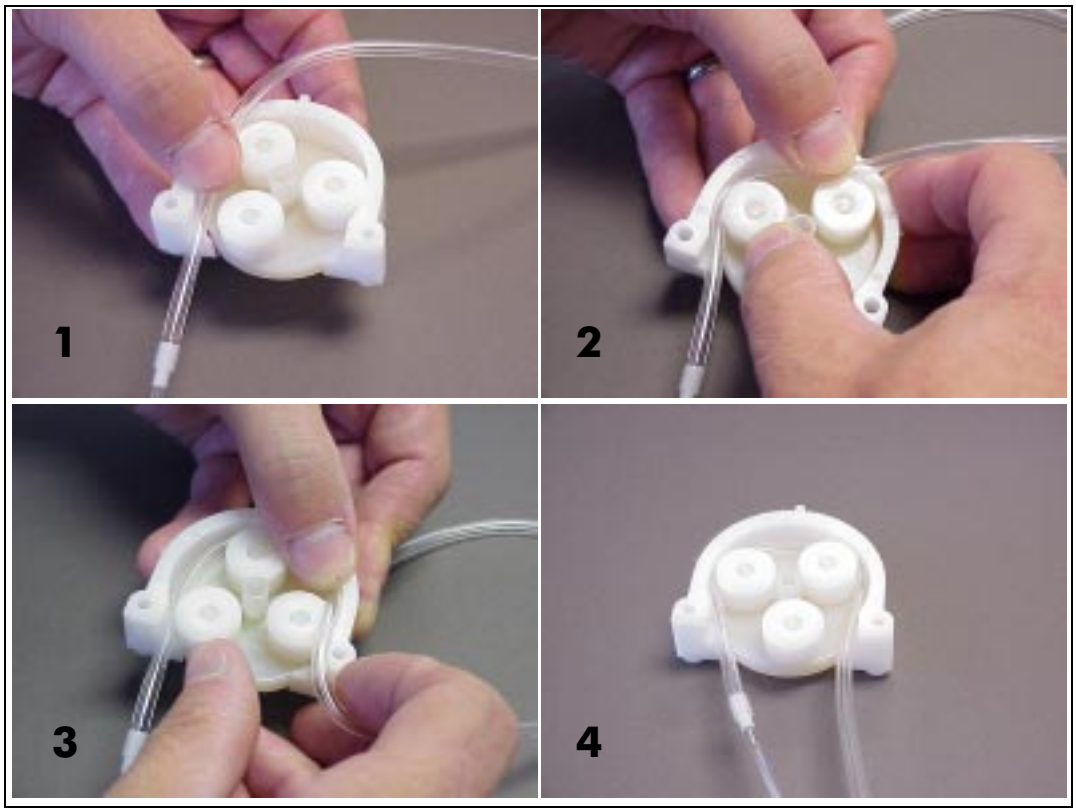


Figure 7.3
Pump Tubing Installation

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.

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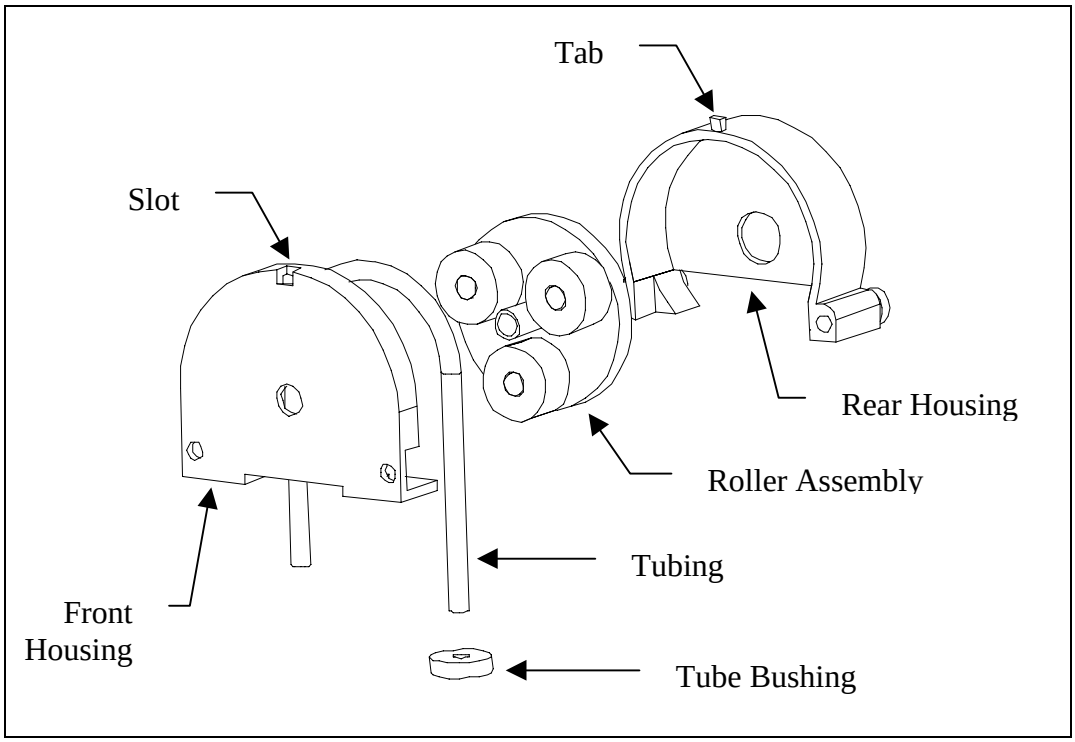


Figure 7.4
Pump Assembly

When all tubes are properly connected, see Section 2.6 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 2.6 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 2.6 to readjust the Sipper.

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7.9 Fuse Replacement

It may be necessary to replace the fuses in the 2700 SELECT. 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.

UNPLUG THE INSTRUMENT FROM THE MAINS SUPPLY.

Using a small screw driver, pry open the fuse holder on the power receptacle (see Figure 7.4).

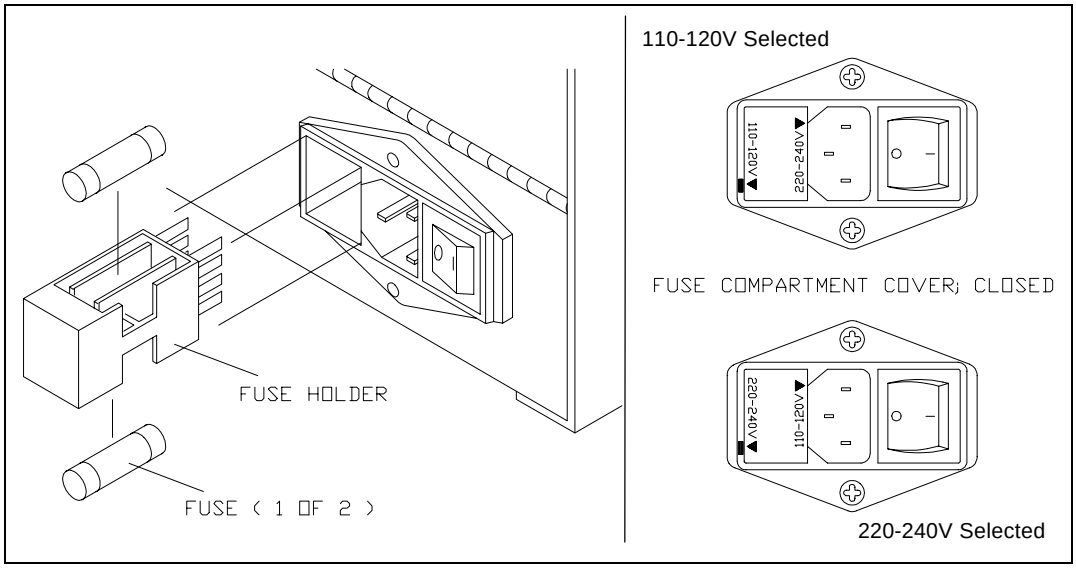


Figure 7.5
Fuse Replacement

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 2.5 Power Up, to confirm correct power up response.

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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 7.5).

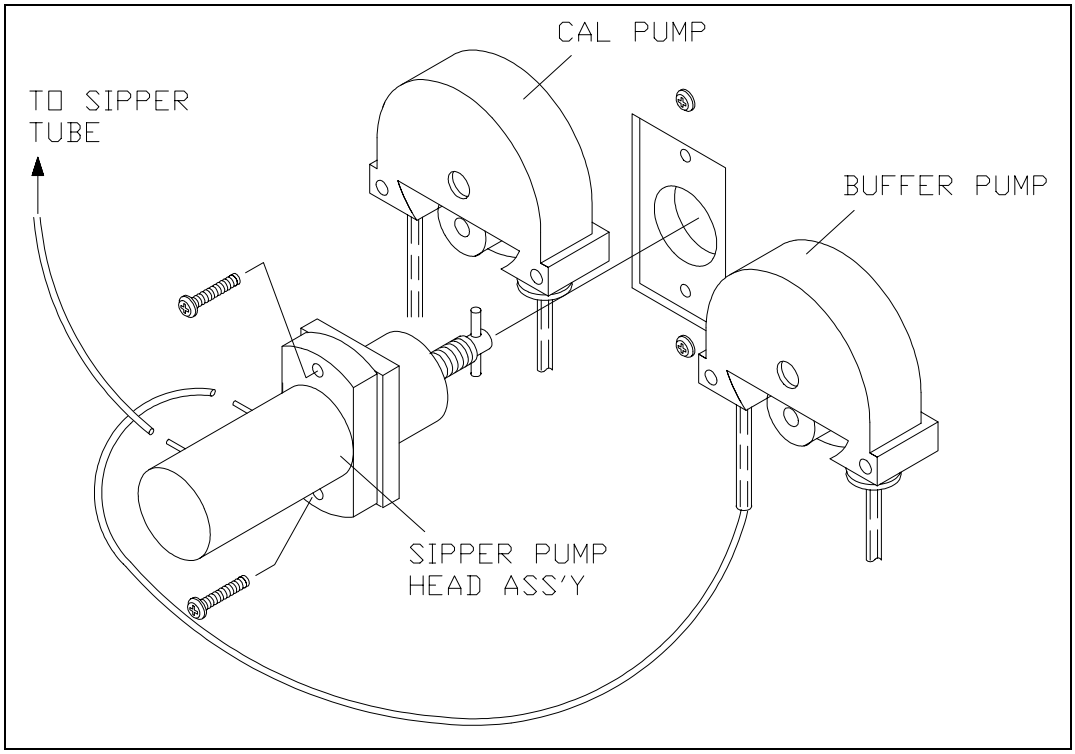


Figure 7.6
Sipper Pump Head Removal

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.

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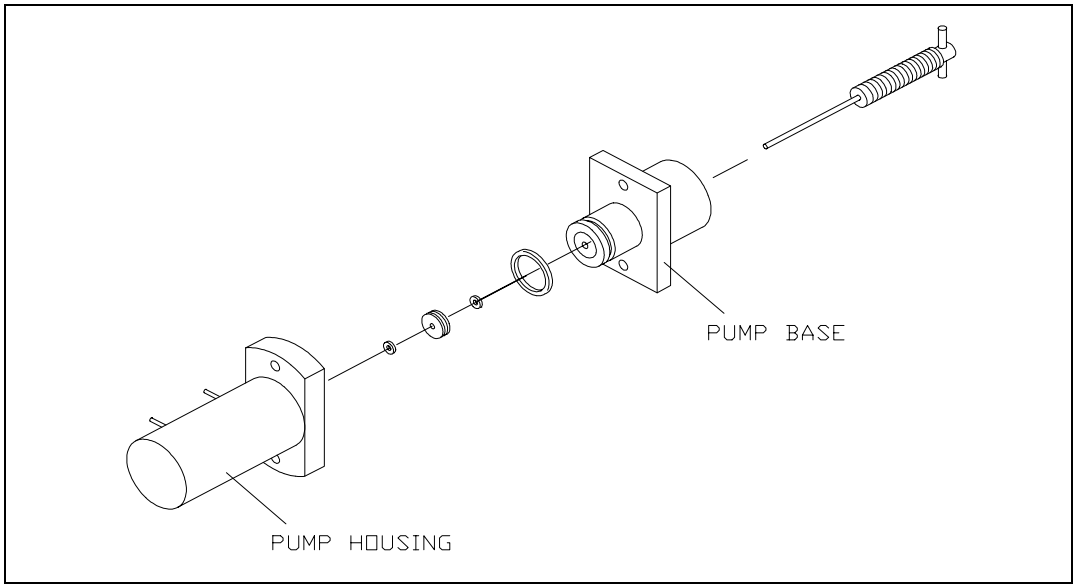


Figure 7.7
Sipper Pump Seal Replacement

Reassemble the pump, position the plunger as shown in figure 7.7 and install it back on the instrument.

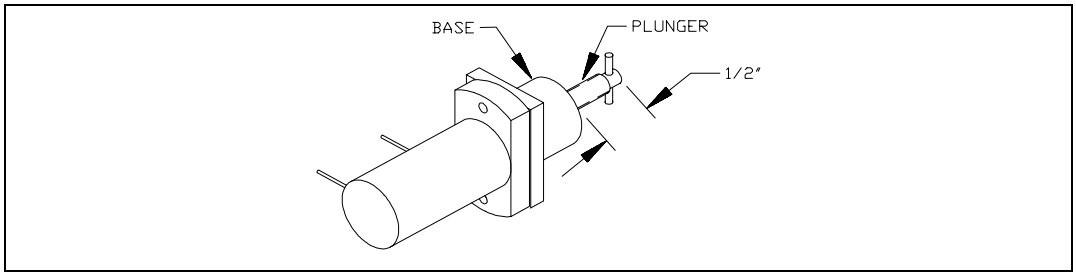


Figure 7.8
Sipper Pump Plunger Position

WARNING: When re-installing the pump head assembly, the plunger <u>MUST</u> extend at least 1/2" from the base of the pump (see Figure 7.7). This will assure proper alignment between the pump head and the drive hub.

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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.

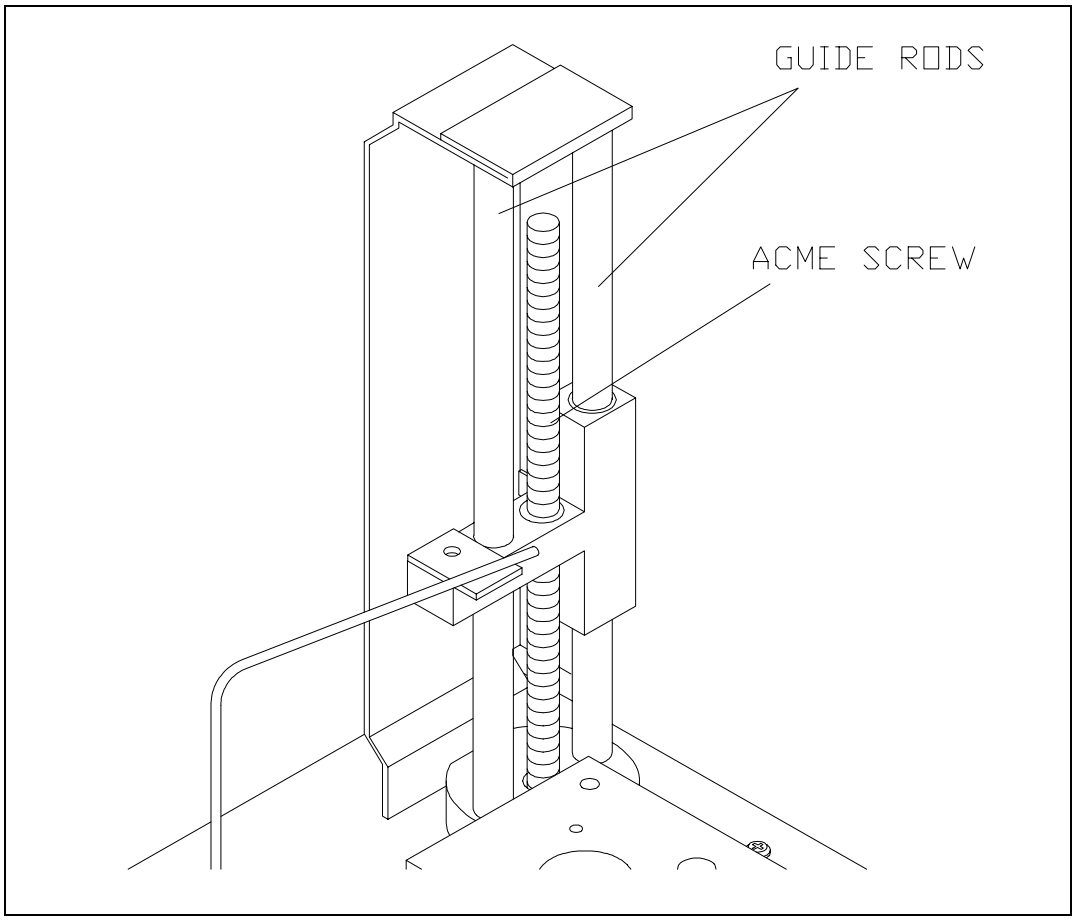


Figure 7.9
Sipper Mechanism Drive Screw and Guide Rods

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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, Menu Diagnostics, to learn more about how you can test individual components of the 2700 SELECT.
- 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). 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.

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8.1 Printout Information

Refer to Appendix D to learn more about report format options for the 2700 SELECT. 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 g/L
 IB current     2.11 nA
 PL current   118.65 nA
 Slope      4.69 nA/min
 End Point       30 Sec
W:Dextrose      8.3 g/L
 IB current     0.88 nA
 PL current    58.96 nA
 Slope      2.39 nA/min
 End Point       30 Sec
Temperature    26.28 °C
Sample size       25 uL
Fri 02/22/98   08:12:34
YSI 2700D - 98 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       30 Sec
*Cal shift       3.64 %
W:Dextrose     10.0 g/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        30 Sec
Cal shift       -0.10 %
Temperature    26.33 °C
Sample size       25 uL
Thu 02/22/98   14:55:10
YSI 2700D - 98 01234
======================
```


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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 cannot 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 for most chemistry setups is 30 seconds. The value that you have selected in Setup is displayed in the report. Note: This is not through-put time, but rather best thought of as "reaction" time or "probe signal development" time.

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 2700 SELECT performs another calibration. Up to 5 successive calibration shifts are permitted before the 'Unable to calibrate' error is displayed. You may select Cal shift values that better suit your application. See Section 5.3 for details. 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 2700 SELECT works at sample chamber temperatures between 15° and 35°C. The 2700 SELECT only measures and displays temperatures between 10° and 40°C. If the temperature is outside this range, a string of asterisks '*****' will be printed.

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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:	2.6
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:	2.6
POSSIBLE CAUSE:	Newly installed probe.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	2.6
POSSIBLE CAUSE:	Power disruption.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	2.6
POSSIBLE CAUSE:	Failing enzyme membrane.
ACTION:	Perform daily operational checks and replace membrane(s) if necessary.
SECTION:	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:	4.12

SYMPTOM:	**ERROR: Empty Buffer Bottle**
POSSIBLE CAUSE:	Low buffer level.
ACTION:	Refill the buffer.
SECTION:	2.3

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SYMPTOM:	**ERROR: Empty Buffer Bottle** (Continued)
POSSIBLE CAUSE:	Level sensor cable not plugged in.
ACTION:	Plug in cable.
SECTION:	2.3

SYMPTOM:	**ERROR: Empty Calibrator Bottle**
POSSIBLE CAUSE:	Low calibrator level.
ACTION:	Install new calibrator.
SECTION:	2.3
POSSIBLE CAUSE:	Level sensor cable not plugged in.
ACTION:	Plug in cable.
SECTION:	2.3

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:	2.3

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 or adjust sample size down and repeat.
SECTION:	4.3

SYMPTOM:	**ERROR: Printer Failure Detected**
POSSIBLE CAUSE:	Printer paper or roll jam.
ACTION:	Open paper well and clear obstruction. Reset instrument, if required.
SECTION:	2.6

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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:	---
POSSIBLE CAUSE:	Intermittent sipper ground cable.
ACTION:	Replace sipper ground cable.
SECTION:	7.8
POSSIBLE CAUSE:	Intermittent sipper cable.
ACTION:	Replace sipper cable.
SECTION:	See the *2700 SELECT SERVICE MANUAL*

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:	2.6
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:	2.6
POSSIBLE CAUSE:	Newly installed probe.
ACTION:	Enter probe diagnostics and check probe currents.
SECTION:	2.6
POSSIBLE CAUSE:	Calibrator solution out of spec: contaminated or installed for more than 30 days.
ACTION:	Install new calibrator.
SECTION:	2.3
POSSIBLE CAUSE:	Net calibration current (PL current) below 5 nA.
ACTION:	Replace enzyme membrane and check calibrator solution.
SECTION:	2.4

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SYMPTOM:	**ERROR: Unable to Calibrate** (Continued)
POSSIBLE CAUSE:	Failing enzyme membrane.
ACTION:	Perform daily operational checks and replace membrane(s) if necessary.
SECTION:	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:	2.3
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:	Fluid not conductive.
ACTION:	Use saline as diluent.
SECTION:	4.8
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:	2.6
POSSIBLE CAUSE:	Using wrong type of paper.
ACTION:	Install correct thermal paper (YSI 2751).
SECTION:	2.6

SYMPTOM:	**Fail FCN Test**
POSSIBLE CAUSE:	Damaged or old membrane.
ACTION:	Replace membrane.
SECTION:	2.4

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SYMPTOM:	**Fail Linearity Test**
POSSIBLE CAUSE:	Probe assignment incorrect.
ACTION:	Make correct assignment.
SECTION:	4.0
POSSIBLE CAUSE:	Damaged or old membrane.
ACTION:	Replace membrane.
SECTION:	2.4
POSSIBLE CAUSE:	Contaminated or old calibration or linearity standard.
ACTION:	Repeat test with new standards.
SECTION:	3.4
POSSIBLE CAUSE:	Assigned concentration range beyond practical limits.
ACTION:	Redefine measurement parameters. Remake standards.
SECTION:	4.3

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:	2.6

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9. Communications

This section describes the communications protocol between the 2700 SELECT and a host computer. The 2700 SELECT has an RS-232 serial port. When you install the appropriate hardware interface (e.g., shielded NULL modem cable), the 2700 SELECT communicates in ASCII over this interface.

The protocol used by the 2700 has been designed to be compatible with most computer database applications and most computer interface protocols. The 2700 SELECT can be configured to communicate in **Result Reporting** mode or **Remote Control** mode.

The communications module also provides networking capability. You may configure a 2700 SELECT to operate in either multidrop or non-multidrop environments. Multidrop refers to networking several 2700s and/or other controllers to a host, while non-multidrop (point-to-point) refers to a single 2700 connected to a host/controller.

The non-multidrop configurations of software versions higher than 2.40 maintain compatibility with the earlier software version 2.03. The command format and communication protocols are identical for software versions 2.03 and up.

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

Note: The term "2700 SELECT" has been shortened to "2700" in many sentences and figures below. They are synonymous.

9.1 Communications Protocol

The 2700 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 2700.

Pin Number	Signal Name	2700 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

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Hardware Handshaking Signals. The four handshaking signals used to control the data flow are RTS/CTS and DTR/DCD. The 2700 drives RTS when it wishes to transmit and waits for CTS before transmitting each character. Likewise, the 2700 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 2700 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.

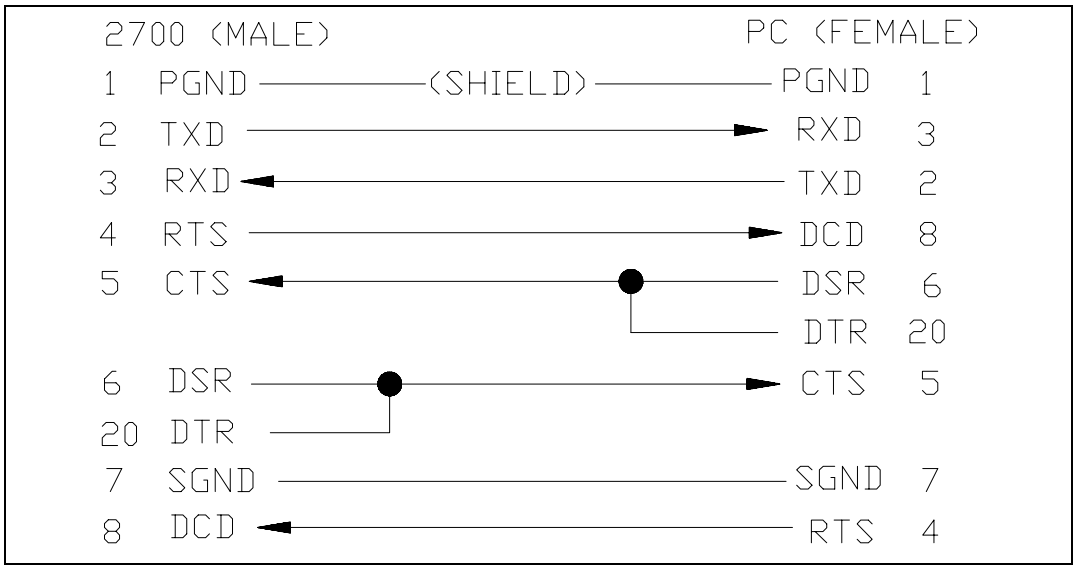


Figure 9.2
Full Handshaking DTE Interface

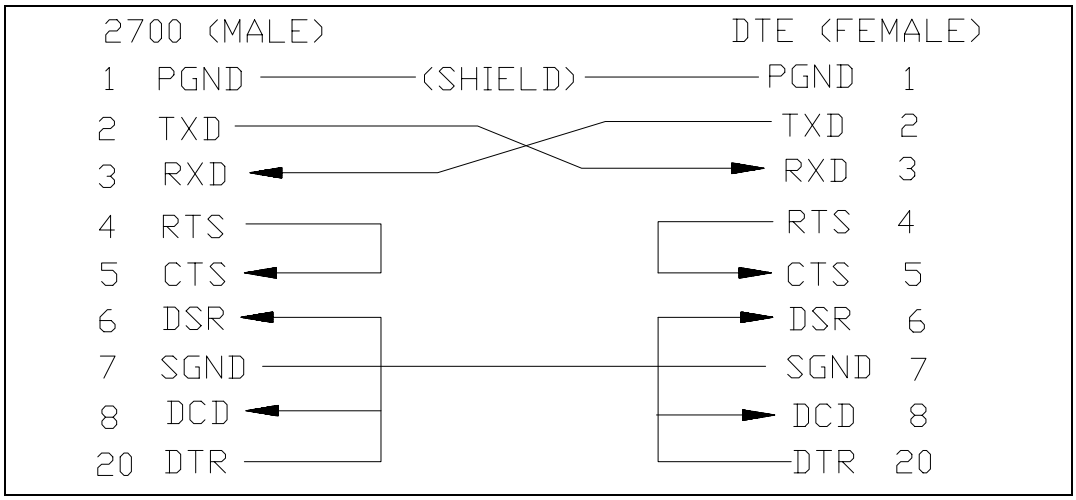


Figure 9.3
Three Wire DTE Interface

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You can select the 2700 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 4.2, Menu Setup. 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 2700 behaves like a "slave" to the host computer. It never talks to the host unless in response to a command from the host. The 2700 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 2700 SELECT. You make the assignment via the instrument keypad. The 2700 SELECT 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 2700 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 (in Section 9.3).

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Error Codes

Code 1

a) 2700 is not in remote control mode. This condition generally indicates that you invoked the TN1 command (enter Run Mode remotely) when the 2700 was not in remote mode. You must first successfully invoke TR1 (turn on remote control mode). You may need to check 2700 status to determine the exact meaning of the error. See Communications Commands (Section 9.3) for more information.

b) 2700 is in remote control mode but not in Run Mode. This condition generally indicates that you requested that the 2700 Sample or Calibrate when the 2700 was not in Run Mode. You must first successfully invoke TN1 command (enter Run Mode remotely).

Code 2

2700 is busy in RUN mode.

Code 6

assignment of station # is out of range (s< 1 or s> 5).

Code 7

purge time of zero is assigned when Station #5 (s=5) is assigned (monitor accessory).

Code 8

zero turntable position number is assigned (t, n = 0 or default t, n = 0).

Code 9

a) sample or calibration results were not found when requested.

b) 2700 is not in RUN mode.

c) 2700 is in “halt condition”. A halt condition can be caused by a cal error, baseline error or other fatal system error.

The internal receiver buffer in the 2700 is 80 characters long. A string longer than 80 characters without the terminating CR., will cause this buffer to overflow. When this occurs, the 2700 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.

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9.2 Communications Modes

The 2700 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.

2700 Data Base. The 2700 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 2700 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 cannot run a sample or calibration locally at the 2700.

The host tells the 2700 to run a sample or a calibration. The samples may be assigned to run at Station #1 (Cal Well), Station #2 (Test Tube Holder), Station #4 (Turntable) or Station #5 (Monitor Accessory). See page 9-14 for more information.

Calibrations are typically assigned to run at Station #1, but may be assigned to Station #2 or even assigned to Stations #1 and #2 together in dual chemistry applications. **The remote host cannot change calibration station assignments; they must be made locally at the 2700 SELECT.**

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9.3 Communications Commands

Data Transmission Records. The data report format from "2700 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 monitor 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.

In Figure 9.4, several examples show how information for a dual channel 2700 SELECT may appear when transmitted. Again, the ruler line is for reference only and does not appear on the record.

The first example shows a multidrop 2700 report with the assigned address of “123”.

The second example shows a non-multidrop 2700 report. Note that the only difference between this and the first example is the node address field.

The third example shows a calibration report. The sample ID field of a cal report is always “-1”.

The fourth example shows a monitor report. Similar to the cal report, the sample ID field in this report is always “-2”.

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```
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345

13:22:34 02/13/98 23.56 123 123456789 H2O2 12345.78 mmol/L 0000\ <cr><lf>
13:22:34 02/13/98 23.56 123 123456789 H2O2 12345.78 mmol/L 0000  <cr><lf>

13:22:34 02/13/98 23.56     123456789 H2O2 12345.78 mmol/L 0000\ <cr><lf>
13:22:34 02/13/98 23.56     123456789 H2O2 12345.78 mmol/L 0000  <cr><lf>

15:12:04 02/13/98 23.56 123        -1 H2O2    45.78 nA     0000\ <cr><lf>
15:12:04 02/13/98 23.56 123        -1 H2O2    15.28 nA     0F01  <cr><lf>

12:02:34 02/13/98 24.86            -2 H2O2 12345.78 mmol/L 0000\ <cr><lf>
12:02:34 02/13/98 24.86            -2 H2O2   345.78 g/L    0000  <cr><lf>
```

Figure 9.4
2700 SELECT 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.

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The fields of the data transmission records are more specifically defined below in Figure 9.5. A ruler line is used simply to help you identify the offset and field widths in the report. We have used the following symbols to depict changes from early 2700 software vs versions 2.41 and higher. The symbol '*' indicates a change. The symbol '**' indicates an addition. The symbol '***' labels the choice NONE to indicate that when this choice is made, the remainder of that line fills with blanks.

Each field is identified by a number series just below the ruler line. These field numbers help you visualize column width.

```
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 = Monitor Sample Report
				-3 = Information Report
06	39	04	Probe Chemistry Assignment:	
			None***	no chemistry
			DEX	Dextrose
			LAC	L-Lactate
			SUC	Sucrose
			LTOS	Lactose
			GAL	Galactose
			H2O2	Hydrogen Peroxide
			ETOH	Ethanol
			MEOH	Methanol
			GLMT	L-Glutamate
			GLMN	Glutamine
			CHOL	Choline
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

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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)
PS5	Process monitor sample (Station #5)

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 2700 printer off
TP1	Turn 2700 printer on
MPt	Change pump purge time
MTt	Change monitor time interval
MRt	Change precal time interval
MOt	Change postcal time interval
MSs	Change monitor station #
PA	Abort Turntable Sampling
TN0	Exit Run Mode; Enter Standby Mode
TN1	Enter Run Mode from any mode (Standby or Menu)

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

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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 the Report Database and Report System Information categories above.

When **Report Status (RY)** is invoked, the command obtains the 2700 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 2700:	RY	Report status of instrument
2700 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
	P	Processing precal cycle
	N	Processing monitor cycle
	T	Processing postcal cycle
	F	Flushing and aborting error cycle
	B	Stabilizing baseline current
	K	Stabilizing calibration current
	E	Stabilizing motors
	H	Aborting Run Mode
	R	In Run Mode
	Y	In Standby Mode
	D	In Main Menu Mode
Remote command status	I	Idle, no pending command
	S	Sam command received. Pending
	C	Cal command received. Pending
	—	Unknown

An example status line may appear as follows:

CNUII

The information stated is that the 2700 is under remote control (C), no sample results are in memory (N), calibration results remain unsent (U), the 2700 is idle in Run mode (I) and there are no remote commands pending (I).

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When **Report Last Transmission (RX)** is invoked, the last transmission of the 2700 is sent to the host. It is used when the response received by the 2700 contains an unknown character, is not in the correct format, or whenever in doubt due to communications error.

Host to 2700:	RX	Report last transmission
2700 to Host:	[last transmitted record]	

When **Report Calibration Result (RC)** is invoked, the 2700 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, computer-demanded cycle or an autocalibration cycle. If no result is found, the 2700 sends back error code "9".

Host to 2700:	RC	Report last calibration result
2700 to Host:	[cal result]	(see format in Figure 9.4)

When **Report Sample Result (RS)** is invoked, the 2700 sends back the last sample processed. When combined with an ID number, the 2700 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 2700 to send the next most recent result for the matching ID result. If no result is found, the 2700 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 2700:	RS	Report last sample result
2700 to Host:	[sam result]	(see format in Figure 9.4)
Host to 2700:	RS< ID>	Report sam ID result (max = 9 digits)
2700 to Host:	[sam result]	(see format in Figure 9.4)

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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.

Note: For each command from Host to 2700, the 2700 sends back an acknowledgment (A) or an error code. Error codes may require invoking the Report Status (RY) command to gain further information on machine status.

Host to 2700:	TR1	Turn on remote control mode
2700 to Host:	A	Acknowledge. 2700 switched to Remote Control.
	2	2700 busy in Run Mode.
	9	2700 is in a “halt” condition (page 9-4).

You should invoke this command from Standby or Menu mode. If you attempt to enter Run Mode by pressing the RUN key locally, then invoke the TR1 command prior to successful calibration, **you may not successfully enter remote control mode**.

Alternatively, you may enter Run Mode locally by pressing RUN and waiting for successful calibration. Then invoke the TR1 command to enter remote control mode.

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 2700 Printer Off (TP0)** command. The 2700 responses are outlined below.

Host to 2700:	TP0	Turn 2700 printer off
2700 to Host:	A	Acknowledge. 2700 printer turned off.
	1	2700 is not in Remote Control Mode.

In a similar manner, you may use **TP1** to turn the 2700 printer on.

Commands to Exit/Enter Run Mode remotely. You may use the commands described below to enter and exit Run Mode, however, always verify that you are in Remote Control Mode prior to invoking these commands.

When you invoke **TN0 (Exit Run Mode)**, the instrument exits Run Mode and switches to Standby Mode or, if there is a “halt condition”, to Menu Mode. Standby Mode may be used to conserve reagents in certain applications. Menu Mode positions you to remotely recover from most error conditions.

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Host to 2700:	TN0	Exit Run Mode and switch to Standby Mode or Menu Mode.
2700 to Host:	A	Acknowledge. 2700 exits Run Mode.
	1	2700 is not in Remote Control Mode.
	2	2700 is busy in Run Mode.

When you invoke **TN1 (Enter Run Mode)**, the instrument enters Run Mode from Standby or from "Menu Mode". You may use this command to re-enter Run Mode after using the TN0 command or to reinitialize the instrument after a "halt condition" such as an error resulting from unstable calibration or similar problems.

Host to 2700:	TN1	Enter Run Mode from Standby or Menu mode.
2700 to Host:	A	Acknowledge. 2700 switches to Run Mode.
	1	2700 is not in Remote Control Mode.
	9	2700 is not in Run Mode, but is attempting to enter Run Mode from a halt condition.

IMPORTANT: These commands are designed to be used when the 2700 is in Remote Control mode. In writing control programs, verify that the instrument is in Remote Control mode before invoking these commands.

The calibration commands and sample process commands are outlined below. The "process sample" commands are described together, the only difference among the different commands being the station from which the sample is aspirated (#1, #2, #4, #5). Station #3 is theoretically possible, but not practical in remote control mode.

When you invoke the **Process Calibration (PC)** command, the Host commands the 2700 to run a calibration cycle. If the 2700 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 2700:	PC	Process calibration
2700 to Host:	A	Acknowledge. Calibration in process or pending upon completion of current task.
	1	2700 is not in Remote Control Mode.
	2	2700 is busy processing last PC or PS command.

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When you invoke the **Process Sample (PS)** command, the Host commands the 2700 to sample from one of four locations depending on the specific command (PS1, PS2, PS4 or PS5). If the 2700 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 2700:	PS	Process sample at PS1, PS2, PS4 or PS5.
2700 to Host:	A	Acknowledge. Sample in process or pending upon completion of current task.
	1	2700 is not in Remote Control Mode.
	2	2700 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 2700 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 2700:	RZ	Clear 2700 database memory
2700 to Host:	A	Acknowledge. Result data cleared.
	1	2700 is not in Remote Control Mode.

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When you invoke the **RM (Report Parameters)** 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.

Host to 2700:	RM	Report instrument parameters.
2700 to Host:	A	Acknowledge.
	1	2700 is not in Remote Control Mode.

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 (15 to 90 seconds)
J: black channel calibration station number (1 to 5)

K: white channel chemistry abbreviation
L: white channel calibration standard value
M: white channel calibration concentration unit
N: white channel calibration endtime (15 to 90 seconds)
O: white channel calibration station number (1 to 5)

Figure 9.6
RM Command Report Format

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When you invoke the **RI (Report Information)** 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 several categories similar to "PrntSetup" (Print Setup) in the 2700 SELECT 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 (5 to 65µL)
e: sample station (1 to 5)
f: calibration method (0 for single; 1 for dual)

Autocal

g: autocal on chemistry error flag (0 for off; 1 for on)
h: temperature shift between autocals
i: time interval between autocals (0 to 65535 minutes)
j: number of samples between autocals (0 to 30000)
k: cal shift allowed between cals

RunMode

l: autostandby time (0 to 30000 hours)
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)

Monitor

p: monitor station number (1 to 5)
q: monitor time interval (0 to 65535 minutes)
r: monitor precal time (0 to 65535 minutes)
s: monitor postcal time (0 to 65535 minutes)
t: external pump purge time (0 to 65535 minutes)

Figure 9.7
RI Command Report Format

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Additional remote control commands related to changing the external monitoring parameters and aborting a turntable run are described below.

Monitor Parameter Modification Commands (MP, MT, MR, MO, MS). You may use the commands described below to change monitor setup parameters remotely.

MPt	change external pump purge time to t, where t is in seconds
MTt	change monitor time interval to t, where t is in minutes
MRt	change precal time interval to t, where t is in minutes
MOt	change postcal time interval to t, where t is in minutes
MSs	change monitor station number to s

Abort Turntable Sample Command (PA). You may use this command to abort turntable samples in progress. Recall, you initiate the turntable sampling using the PS command. You cannot use the 2700 SELECT [CANCEL] key to abort the run, since the 2700 SELECT keypad is disabled in remote control mode.

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Appendix A

Concentration Unit Conversion

In the YSI 2700 SELECT menu selection procedure you have the option to assign units of concentration. You will find this in the Setup Menu under measurement parameters, black and white probes. There are default values set based on calibration solutions offered by YSI. Below is a table of unit conversions for these calibration solutions and other concentrations of interest.

Chemistry	g/L	mg/L (ppm)	% (w/v)	mmol/L	mw (g/mole)
Choline	0.18	175	0.018	1.68	(104)
Dextrose	2.50	2500	0.25	13.89	(180)
Ethanol	2.00	2000	0.20	43.48	(46)
Galactose*	2.50	2500	0.25	13.89	(180)
L-Glutamate	0.73	731	0.07	5.00	(146)
L-Glutamine	0.73	731	0.07	5.00	(146)
L-Lactate	0.50	500	0.05	5.62	(89)
Lactose	5.00	5000	0.50	14.62	(342)
Methanol	1.00	1000	0.10	31.25	(32)
Peroxide*	0.60	600	0.06	17.65	(34)
Sucrose	5.00	5000	0.50	14.62	(342)

* Denotes that YSI does not currently offer this standard value.

If you are preparing your own standard of a value not listed in the preceding table, refer to the example conversions on the next page to help calculate your unit of choice. If you change units, remember to enter the appropriate numerical value when prompted by the display. Only the default values listed above will be automatically converted by the instrument software.

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Example Conversions

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

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

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

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

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

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Linearity Test. Concentration Unit Conversion

Chemistry	g/L	mg/L (ppm)	% (w/v)	mmol/L	mw (g/mole)
Choline	0.47	473	0.047	4.54	(104)
	0.45	450	0.045	4.32	
	0.43	427	0.043	4.10	
Dextrose	9.45	9,450	0.945	52.5	(180)
	9.00	9,000	0.900	50.0	
	8.55	8,550	0.855	47.5	
Ethanol	3.36	3,360	0.34	73.1	(46)
	3.20	3,200	0.32	69.6	
	3.04	3,040	0.30	66.1	
L-Glutamate	1.54	1,535	0.154	9.5	(146)
	1.46	1,462	0.146	10.0	
	1.39	1,389	0.139	10.5	
L-Glutamine	1.23	1,228	0.123	8.40	(146)
	1.17	1,169	0.117	8.00	
	1.11	1,111	0.111	7.60	
L-Lactate	2.80	2,806	0.281	31.5	(89)
	2.67	2,672	0.267	30.0	
	2.54	2,539	0.254	28.5	
Lactose	26.25	26,250	2.63	76.8	(342)
	25.00	25,000	2.50	73.1	
	23.75	23,750	2.38	69.4	
Methanol	2.63	2625	0.263	82.0	(32)
	2.50	2500	0.250	78.1	
	2.38	2375	0.238	74.2	
Sucrose	26.25	26,250	2.63	76.8	(342)
	25.00	25,000	2.50	73.1	
	23.75	23,750	2.38	69.4	

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

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FCN Membrane Integrity Test. Concentration Unit Conversion

Chemistry	g/L	mg/L (ppm)	% (w/v)	mmol/L	mw (g/mole)
Choline	0.02	15	0.02	0.14	(104)
Dextrose	0.05	50	0.01	0.28	(180)
Ethanol	0.05	50	0.01	1.09	(46)
L-Glutamate	0.06	58	0.01	0.40	(146)
L-Glutamine	0.06	58	0.01	0.40	(146)
L-Lactate	0.03	30	0.01	0.34	(89)
Lactose	----	--	----	----	(342)
Methanol	0.05	50	0.01	1.56	(32)
Sucrose	0.10	100	0.01	0.29	(342)

NOTE: Use the values from the preceding tables only when calibrating with the appropriate YSI calibrator solution: Choline (2772), Dextrose (2776), Ethanol (2790), L-Glutamate (2755), L-Glutamine (2736), L-Lactate (2776), Methanol (2726) and Sucrose (2780).

See Section 3, Basic Operation, Daily Operational Checks for cross references.

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Appendix B

YSI Supplies And Reagents

Enzyme Membrane Kits

YSI #	Product Description	Quantity
2329	L-Lactate Membrane Kit	4/kit
2365	Dextrose Membrane Kit	4/kit
2786	Ethanol Membrane Kit	4/kit
2701	Blank Membrane Kit (hydrogen peroxide)	4/kit
2702	Galactose Oxidase Membrane Kit	4/kit
2703	Sucrose Membrane Kit	4/kit
2725	Methanol Membrane Kit	4/kit
2735	L-Glutamine Membrane Kit	4/kit
2754	L-Glutamate Oxidase Membrane Kit	4/kit
2771	Choline Oxidase Membrane Kit	4/kit

Standards for 2700 Select

YSI #	Product Description	Quantity
2726	Methanol Standard Kit: 1.00 g/L	180mL
	2.50 g/L	120mL
2736	L-Glutamine Standard, 5.00 mmol/L	250mL
2737	L-Glutamine Standard, 8.00 mmol/L	156mL
2755	L-Glutamate Standard, 5.00 mmol/L	250mL
2756	L-Glutamate Standard, 10.0 mmol/L	125mL
2772	Choline Standard, 175 mg/L	250mL
2773	Choline Standard, 450 mg/L	125mL
2776	Dextrose/L-Lactate Standard (Dex: 2.50 g/L; Lac: 0.50 g/L)	250mL
1530	L-Lactate Standard, 30.0 mmol/L (2.67 g/L)	125mL
1531	Dextrose Standard, 9.00 g/L	125mL
2778	Sucrose Standard, 25.0 g/L	125mL
2780	Sucrose Standard, 5.00 g/L	250mL
2783	Lactose Standard, 5.00 g/L	250mL
2784	Lactose Standard, 25.0 g/L	125mL
2790	Ethanol Standard Kit: 2.00 g/L	180mL
	3.20 g/L	120mL

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Other Available YSI Standards

YSI #	Product Description	Quantity
2327	L-Lactate, 5.0 mmol/L (0.45 g/L)	125mL
2328	L-Lactate, 15.0 mmol/L (1.34 g/L)	125mL
2356	Glucose, 500 mg/dL (5.00 g/L)	125mL
2747	Dual Standard (Glucose,1.80 g/L; L-Lactate,0.45 g/L)	250mL
2748	Dual Standard (Glucose,18.0 g/L; L-Lactate,1.78 g/L)	125mL
2777	Dextrose/L-Lactate Standard (Dex: 25.0 g/L; Lac: 2.50 g/L)	125mL

General Reagents And Buffers

YSI #	Product Description	Quantity
2357	Buffer Kit (all membranes **except** 2702, 2725, 2786)	4liters*
1579	Carbonate Buffer Concentrate (use with 2725 membrane)	1liter**
2705	Lactose Buffer Kit (use with 2702 membrane)	4liters*
2787	Ethanol Buffer Kit (use with 2786 membrane)	4liters*
2363	Potassium Ferrocyanide, 1000 mg/dL	125mL*
2392	NaCl Solution (sodium chloride)	30mL*

* Reagent packaged dry. Makes specified volume when reconstituted.
** Reagent concentrated. Makes specified volume when reconstituted.

Miscellaneous Accessories & Supplies

YSI #	Product Description
2710	Turntable
2711	Upgrade pre-1991 YSI 2700's with turntable interface
2730	Monitor and Control Accessory
2731	2730 Preventive Maintenance Kit
2751	Printer Paper (5 rolls/box)
2788	Preventive Maintenance Kit

Contact YSI Incorporated or your authorized dealer representative for more information on ordering supplies and reagents for the YSI 2700 SELECT.

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Appendix C

Printed Setup Information

You may print your 2700 SELECT 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 after replacing batteries, 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 60 seconds.

The information on the printout completely describes the system parameters, whether using default settings or settings that you configured for your particular application.

You can learn about the system parameters by referring to Section 5.3, Setup, in this manual. If you have a YSI 2710 Turntable, refer to Section 3 in the *2710 Turntable Operation Manual*.

Printed Setup Information

The printouts for single channel and dual channel 2700's are shown on the following page. Note, if a calibration or sample data report is due to print while you are performing PrntSetup, the instrument will interrupt PrntSetup to print results. PrntSetup printing then resumes automatically.

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```
   INSTRUMENT SETUP
   ----------------
Sample size       25 uL
SamStation #:   2
Cal Method: One station
BLACK PROBE
 Chemistry   : Dextrose
 Unit        :  g/L
 Calibrator  :   2.50
 End Point   :  30 Sec
 CalStation#:   1
AUTOCAL
 SampleError:  ON
 Temperature:    1 °C
 Time        :   15 Min
 Sample      :    5 Sam
 Cal Shift   :    2 %
RUN MODE
 Replicates  :   OFF
 Sample ID   :   OFF
 Sip Height  :   Medium
 Autostandby:     2 Hr
 TT StartPos:     0
 TT # in Run:     0
 TT FluidDet: ON
MONITOR
 MonStation#:   1
 SamInterval:     0 Min
 PreCal      :     0 Min
 PostCal     :     0 Min
 Purge Time  :     0 Sec
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: 2.56
 YSI 2700S - 98 01234
 Thu 02/26/98  09:20:48
------------------------
```

```
   INSTRUMENT SETUP
   ----------------
Sample size       25 uL
SamStation #:   2
Cal Method: One station
BLACK PROBE
 Chemistry   : L-Lactate
 Unit        :  g/L
 Calibrator  :   0.50
 End Point   :  30 Sec
 CalStation#:   1
WHITE PROBE
 Chemistry   : Dextrose
 Unit        :  g/L
 Calibrator  :   2.50
 End Point   :  30 Sec
 CalStation#:   1
AUTOCAL
 SampleError:  ON
 Temperature:    1 °C
 Time        :   15 Min
 Sample      :    5 Sam
 Cal Shift   :    2 %
RUN MODE
 Replicates  : OFF
 Sample ID   : OFF
 Sip Height  : Medium
 Autostandby:     2 Hr
 TT StartPos:     0
 TT # in Run:     0
 TT FluidDet: ON
MONITOR
 MonStation#:   1
 SamInterval:     0 Min
 PreCal      :     0 Min
 PostCal     :     0 Min
 Purge Time  :     0 Sec
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: 2.56
 YSI 2700D - 98 01234
 Thu 02/26/98   09:22:36
------------------------
```


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Appendix D

Report Formats

When you setup your YSI 2700 SELECT 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, specifically choice 4-Report in the Setup selection menu. For more specific information on the “detail” printout, refer to Section 8, Troubleshooting.

Example printouts of both formats are presented below. These examples show printed results of samples and calibrations. In the first Sample Report, the ID# “123456789-05-03” indicates that the third of five replicates is being reported for the sample identified by the nine digit number “123456789”.

Sample Report (Detail)

```
-----Sample Report-----
ID:     123456789-05-03
B:L-Lactate  4.82   g/L
 IB             2.11 nA
 PL current    18.65 nA
 Slope      0.69 nA/min
 End Point       30 Sec
W:Dextrose   5.38   g/L
 IB current     0.88 nA
 PL current    15.96 nA
 Slope      0.39 nA/min
 End Point       30 Sec
Temperature    26.28 °C
Sample size       25 uL
Fri 02/27/98   08:12:34
YSI 2700D - 98 01234
----------------------
```

Sample Report (Brief)

```
ID# 123456789
Replicate 1 of 3

-----Sample Report-----
ID:     123456789-03-01
B:L-Lactate  0.82   g/L
W: Dextrose  5.31   g/L
Wed 02/25/98   13:22:56
----------------------
```

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       30 Sec
*Cal shift      3.64 %
W: Dextrose  2.50   g/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       30 Sec
 Cal shift     -0.10 %
Temperature    26.33 °C
Sample size       25 uL
Thu 02/26/98   14:55:10
YSI 2700D - 98 01234
======================
```

Calibration Report (Brief)

```
==CALIBRATION REPORT==
B:L-Lactate    16.68 nA
W: Dextrose    12.81 nA
Mon 02/23/98   17:12:09
======================
```


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Appendix E

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:

- reorient the receiving antenna
- relocate the computer with respect to the receiver
- move the computer away from the receiver
- plug the computer into a different outlet so that the computer and receiver are on different branch circuits.

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

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Appendix F

Warranty And Shipping Information

The YSI Model 2700 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 • USA
Phone: 937 767-7241 • Fax: 937 767-9353

Europe

YSI LTD • Lynchford House • Lynchford Lane • Farnborough, Hampshire • GU14 GLT • England
Phone: 441 252 514711 • Fax: 441 252 511855

Japan

YSI (Japan) Ltd • 3Fl., Sakura Building 5-6-13 • Shinjuku • Shinjuku-ku • Tokyo 160 • Japan
Phone: 813 5360-3561• Fax: 813 5360-3565

YSI Authorized Service Centers

California

Fisher Scientific ISD • 2822 Walnut Avenue, Suite E • Tustin, CA • 92681 • Phone: 800 395-5442

Georgia

Fisher Scientific ISD • 2775 Horizon Ridge Court • Suwanee, GA • 30174 • Phone: 800 395-5442

Illinois

Fisher • 1600 West Gleenlake Avenue • Itasca, Ill • 60143 • Phone: 800 395-5442

New Jersey

Fisher Scientific ISD • 52 Fadem Road • Springfield, NJ • 07081 • Phone: 800 395-5442

Pennsylvania

Fisher Scientific ISD • 585 Alpa Drive • Pittsburgh, PA • 15238 • Phone: 800 395-5442

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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. 70% isopropyl alcohol or a solution of 1/4 cup bleach to 1 gallon tap water are suitable for most disinfecting. Instruments used with waste water may be disinfected with .5% Lysol if this is more convenient to the user.
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.

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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

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Appendix G

Line Power Cord and Plug Wiring

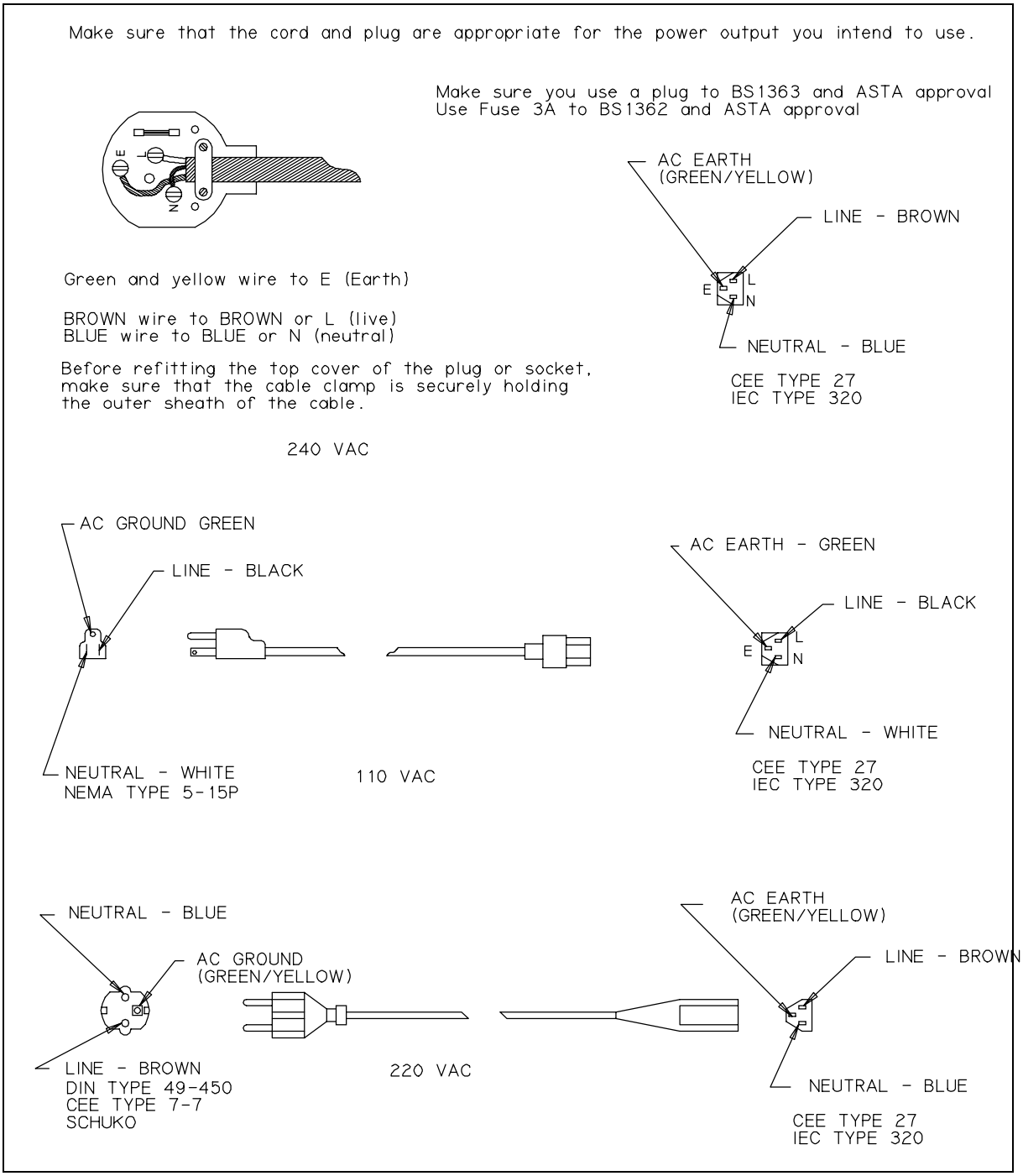


Figure G.1
Line Power Cord and Plug Wiring

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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.

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Appendix I

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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