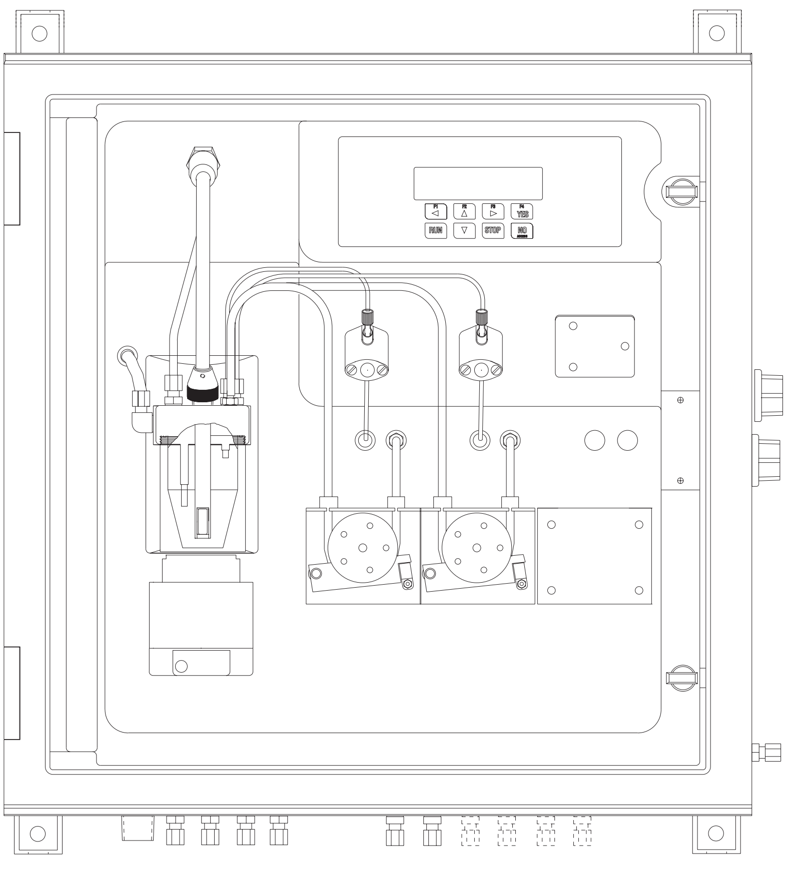
Orion Model 2030

Silica Analyzer

Reference Manual



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Foreword

About this Manual

This Reference Manual provides the information necessary to obtain the maximum benefits from the Orion Model 2030 Silica Analyzer. All operating instructions, functional descriptions, illustrations, and other relevant information are contained in this manual. Descriptions of the system hardware and user-interface software (the control panel) are included, as is an overview of the analytical techniques employed in the analyzer. Step-by-step instructions guide you through all operating procedures and field programming.

The Orion Model 2030 Series Analyzer has been designed to be very easy to use. Each analyzer in this family runs in a fully automated mode for routine, day-to-day monitoring. The need for operator interaction is minimal. Accordingly, the information required by the routine operator of this analyzer is modest, and that information is provided in Chapter 6, Routine Operation, of this manual. **Do not operate your Orion Model 2030 Silica Analyzer until you have read Chapter 6.**

What to Read

Table 1.1 provides assistance in determining which chapter(s) of this manual to read or scan, depending upon your intent.

Table 1.1 Guide to the Reference Manual

If you wish to...	Refer to Chapter(s)
Learn how to use this Reference Manual	Foreword
Learn to use the analyzer in routine operation	6
Change the analyzer's operating characteristics or run tests	7
Place the analyzer in service for the first time	4, 5, 6
Determine maintenance requirements	8
Troubleshooting operating problems	9
Learn about the analyzer's methods and components	2
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After reading or scanning the appropriate chapters of this manual, you will find the supplied Quick Reference Guide to provide a useful summary of system capabilities and operating procedures. The Quick Reference Guide was shipped with your analyzer, and should be kept handy.

Starting Out

If you are placing your Orion Model 2030 Silica Analyzer in service for the first time, you must read through Chapter 4 (Installation) and Chapter 5 (Analyzer Startup). Follow the step-by-step instructions provided. You may discover a need for additional expert help at your site as you step through these procedures. You can also contact your regional Orion Research, Inc. representative or Orion's Customer Service for assistance in properly installing and starting up your Orion Model 2030 Silica Analyzer.

After installing and starting up your analyzer, you should read Chapter 6 and insure that all operators at your site read it, too. You may then find it helpful to read or scan Chapters 7, 3, and 8.

NOTE: You cannot damage the Orion Model 2030 Silica Analyzer by pressing the "wrong" key on its control panel. While you may not achieve the result you expected and the outcome may cause a minor inconvenience, the analyzer always recovers intact. Pressing the **[STOP]** key ends the current procedure, leaving all values unchanged.

Manual Contents

Information in this manual is organized as follows:

Chapter 1, Overview, provides an overview of the Orion Model 2030 Silica Analyzer, including a description of the analyzer's features and functions (measurement process and modes of operation), a review of colorimetric analysis in general and the dual-wavelength colorimetric technique employed by the Orion Model 2030 Silica Analyzer in particular, and identification of the analyzer's three major assemblies and four subsystems and available options.

Chapter 2, Hardware Description, identifies and describes the three main physical assemblies of the Orion Model 2030 Silica Analyzer (swing panel, sample manifold, and electronics enclosure) and the four major functional analyzer subsystems (fluidics, optics, electronics, and control panel).

Chapter 3, Control Panel Description, explains how to use the control panel. Specific topics include: controlling the analyzer; explaining analyzer functions; navigating the control panel menus; and understanding sequences.

Chapter 4, Installation, supplies these procedures to help you in unpacking and installing your Orion Model 2030 Silica Analyzer: inspecting and unpacking the analyzer; preparing for physical installation; mounting the analyzer; and performing electrical installation.

Chapter 5, Analyzer Setup, furnishes procedures you need to help start up the Orion Model 2030 Silica Analyzer for the first time and bring it into on-line service. These procedures include: installing the startup kit; preparing solutions; connecting the fluidics; powering up the analyzer; priming the fluidics; checking and adjusting the sample flow rate; checking and adjusting the time and date; calibrating for the first time; and placing the analyzer into service.

Chapter 6, Routine Operation, describes the routine operation of the analyzer. Topics discussed in this chapter include: accessing routine functions; stopping the analyzer; choosing a function; performing a function (running a calibration, validating a calibration standard, running an analysis, selecting standby operation, printing parameters, and setting the user access level); performing startup functions (purging the fluidics lines, checking the flow rate, setting the time and date); and restarting the analyzer.

Chapter 7, Advanced Operation, details the advanced functions available to an authorized user of the Orion Model 2030 Silica Analyzer, functions that go beyond those typically encountered in routine operation (see Chapter 6). Advanced functions fall into three categories: setup functions; calibration/analysis functions; and diagnostics functions.

Chapter 8, Maintenance, provides the maintenance procedures applicable to the Orion Model 2030 Silica Analyzer. Maintenance procedures covered here fall into three categories: scheduled maintenance procedures; miscellaneous maintenance procedures; and shutdown and restart procedures.

Chapter 9, Troubleshooting, contains troubleshooting information, including an easy-to-use troubleshooting chart to diagnose and correct many common system problems.

Appendix A, Parts Lists, supplies part numbers for the Orion Model 2030 Silica Analyzer.

Appendix B, Customer Service Information, provides Customer Service and Technical Service telephone and fax numbers.

Appendix C, List of Relay Functions, furnishes a list of relay functions.

Appendix D, Reports, supplies examples of the various reports produced by the Orion Model 2030 Silica Analyzer.

Appendix E, General Specifications, lists the general specifications of the Orion Model 2030 Silica Analyzer.

Appendix F, Warning, Alarm, and Fault Messages, lists the types of warning, alarm, and fault messages and the appropriate corrective actions for each.

The **INDEX** is an alphabetical, hierarchical (multi-level) listing of all headings, sub-headings, and important topics contained in this manual.

Design Change Notice

Due to design changes and product improvements, information in this manual is subject to change without notice. The manufacturer reserves the right to change hardware and/or software design at any time, which may subsequently affect the contents of this manual.

The manufacturer assumes no responsibility for any errors that may appear in this manual. The manufacturer will make every reasonable effort to ensure that this Reference Manual is up to date and corresponds with your shipped Orion Model 2030 Silica Analyzer.

Reproduction Notice

Typographic Conventions

Levels of Headings

Headings and sub-headings are arranged both by decimal numbering and typographic sizing. This is so you can delineate topic subordination and can find cross references conveniently. These heading levels are used, in descending order: Chapter Head (Chapter Number: Title), Head 1 (1.1, 2.1, etc.), Head 2 (1.1.1, 2.1.1, etc.), and Head 3 (A, B, C, etc.).

Chapter Titles/Headings in Header

To make it easier for you to identify your place in the manual, a running header at the top of each page notes the appropriate chapter number and chapter title. In addition, to identify the specific major topic on each page, the first level heading is also included in the page header.

Control Panel Entries

Whenever you are instructed to make an entry on the control panel, the keys you must press are printed in boldface type enclosed in brackets. For example, the "RUN" (bottom leftmost) key on the control panel (see Figure 3-1) is referenced as:

[RUN]

In certain situations, the top row of keys on the control panel performs special functions as indicated on the bottom line of the display. Such *soft keys* are represented as upper case characters enclosed in brackets. For example, the top leftmost key in Figure 3-1 ([**F1] or [**LEFT]) performs **the SETUP** function, and is referenced as:

[SETUP]

Control Panel Prompts

System prompts (requests for information or explanatory displays) appearing on the control panel are printed in a Courier typeface, on separate lines, indented—to distinguish them from other text. An example follows:

```
This is a sample system prompt
```

Types of Messages

Three types of messages may appear in this manual: Warnings, Cautions, and Notes.

Warnings

Warnings indicate situations that could result in the injury of a human operator or bystander. Warnings are printed in all uppercase characters in boldface type, between two heavy horizontal rules, as in the following example:

WARNING: NEVER INSTALL OR OPERATE THE Orion Model 2030 Silica Analyzer WHILE STANDING IN WATER. YOU MAY BE ELECTROCUTED!

Cautions

Cautions indicate situations that could damage the Orion Model 2030 Silica Analyzer. Cautions are printed in mixed case characters in boldface type, between two heavy horizontal rules, as in this example:

Caution: Failure to connect the Orion Model 2030 Silica Analyzer to the proper electrical voltage as specified herein could result in damage to the analyzer.

Notes

Notes indicate miscellaneous information. Notes are printed in mixed case characters, in normal type, within a centered box, as in this example:

> **NOTE:** For details on Orion customer service policies, refer to Appendix B.

Orion Services

Orion Research Incorporated's products provide customers with the finest solutions to their on-line wet chemistry problems. Orion's Customer Service is available weekdays from 9:00 am to 5:00 pm Eastern time. The Customer Service telephone number is (800) 225-1480. Technical assistance is also available from regional offices.

This is Revision Number 002 of the *Orion Model 2030 Series Reference Manual*, Orion Document Number 228620-001, with an effective date of June 1998.

Chapter 1: Overview

Chapter 1 provides an overview of the Orion Model 2030 Silica Analyzer. Specific information supplied in this chapter includes:

- A description of the Analyzer's features and functions, including measurement process and modes of operation
- A review of colorimetric analysis in general and the dual-wavelength colorimetric technique employed by the Orion Model 2030 Silica Analyzer in particular
- Identification of the Orion Model 2030 Silica Analyzer's three major assemblies and four subsystems and available options

1.1 Analyzer Description

The Orion Model 2030 Silica Analyzer, illustrated in Figure 1-1, is a precision industrial analyzer that performs silica analysis of one or more fluid sample streams using an established chemistry and dual-wavelength colorimetry.

Important standard analyzer capabilities include:

- Sampling the process stream automatically
- Calculating silica concentration in your sample and reporting it in units of concentration
- Recalibrating automatically at preprogrammed intervals to compensate for any changes in captured sample volume, pump flow rates, lamp intensity, and reagent composition
- Cleaning automatically at preprogrammed intervals to prevent precipitation build-up, coating of the optics or bacterial/fungal growth

The Orion Model 2030 Silica Analyzer is easy to use, and provides walk-away automation for routine operation. It is designed for long life under continuous, rigorous use. The analyzer brings colorimetric laboratory precision to the real world of unattended process and environmental instrumentation.

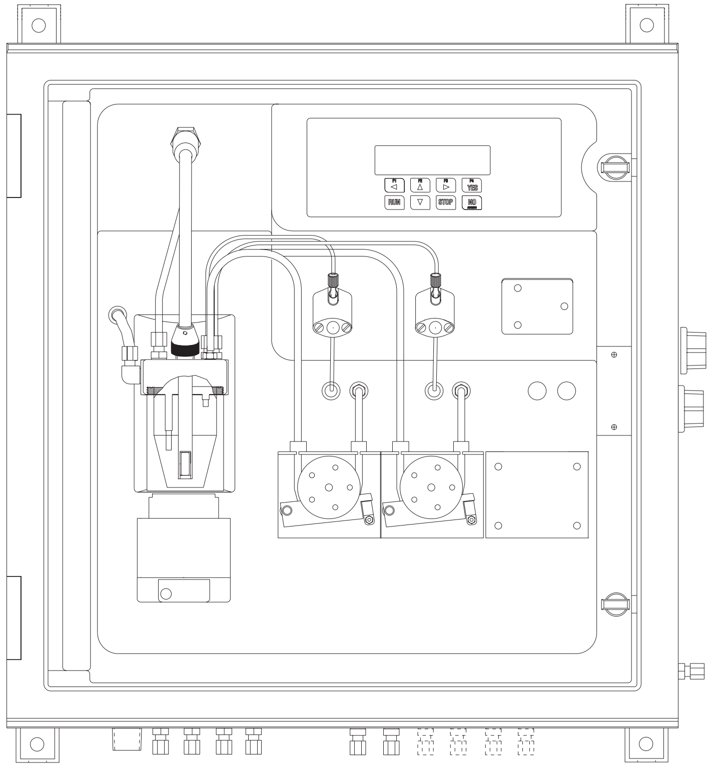

Figure 1-1 Orion Model 2030 Analyzer, Front View (Front Door Not Shown)

1.2 Features and Functions

All parameters that initialize and control the analyzer are entered, or changed, by the operator via the control panel keypad (for details, see Chapter 3). Once set up, the analyzer retains these parameters in non-volatile memory so that the analyzer need not be reprogrammed after a power failure or system shutdown.

1.2.1 Sample Analysis and Analyzer Calibration

Sample analysis and analyzer calibration can be controlled manually in response to control panel keypad input or automatically according to preprogrammed timers. Digital input lines allow the analyzer to be managed by an external controller, by relays, or by remote switches. The digital inputs can be used to remotely control the analyzer, directing it to perform a single sample analysis, a calibration, or switch it to the standby mode.

The Orion Model 2030 Silica Analyzer is configured at the factory to accept commands via as RS-232C serial port. The RS-232C ports can be used to report to a printer, a remote computer, or other serial data communication device.

The Orion Model 2030 Silica Analyzer reports the results of each sample measurement and calibration on the control panel display and printer port, and it signals any alarm conditions that occur. Analysis results are reported over an isolated 4-20 mA current loop for driving a recorder or other analog device. Results are reported in ppb (parts per billion) silica.

The analyzer retains in its memory the time, date, and result of the last 25 calibrations and the last 120 sample measurements. These stored results can be called up at any time from the control panel keypad and shown on the display or output via the serial port.

The fluids used in the analyzer are directed throughout the system by a series of pumps and valves under microprocessor control.

1.2.2 Analysis Cycle

In a typical analysis cycle:

- Fluid from the sample stream is used to wash out the reaction cell by exchanging several volumes of fluid.
- The sample is captured using a siphon method that assures volume repeatability better than 1%.
- 1.5 mL of Reagent 1 is added and stirred for four minutes.
- 1.5 mL of Reagent 2 is added and stirred for one minute.
- A blank absorption measurement is taken.
- 1.5 mL of Reagent 3 is added and stirred for 2.5 minutes.
- Optical absorption of the conditioned sample is measured, the concentration of the silica in the sample is calculated, and the results are reported.

1.2.3 Calibration Cycle

A calibration cycle proceeds similarly using a calibration standard solution in place of the sample stream.

1.2.4 Cleaning Cycle

The cleaning sequence is a timed event whose frequency and scope is user defined. Each step of the sequence allows you to specify the fluidics device, the volume to add, and the time to stir after volume addition. Any device available on the system can be used in the cleaning sequence.

The action taken when the fluid is added depends upon the volume of fluid. If the volume is less than 20 mL, the fluid simply gets added to the cup. If the volume is between 20 and 60 mL, the reaction cell is pressurized, the cell siphoned, and the remaining volume added. If the volume is greater than 60 mL, the cell is pressurized and siphoned, and then washed by exchanging the volume.

1.3 Colorimetric Analysis

Colorimetry has been practiced in laboratories for decades. It has evolved from simple comparisons of a colored sample solution to standard color filters or standard color solutions to more sophisticated methods of spectrophotometry. Table 1-1 reviews common definitions and principles pertaining to spectrophotometric practice.

Modern computer-aided spectrophotometric devices like the Orion Model 2030 Silica Analyzer measure the absorbance or optical density of a colored solution, usually in the visible region of the electromagnetic spectrum: 400 to 850 nanometers (nm), specific to silica. They use optical band-pass filters to select one or more wavelengths of light in order to measure light absorption by a solution containing the silica of interest.

Table 1-1. Spectrophotometry Definitions* and Principles

Term	Definition
Absorbance (A)	The logarithm (base 10) of the reciprocal of the transmittance (T).
Absorption band	A region of the absorption spectrum in which the absorbance passes through a maximum.
Absorption coefficient	A measure of the absorption of radiant energy from an incident light beam as it traverses an absorbing medium according to Bouguer's Law (more frequently referred to as Lambert's Law), $P/P_o=e^{ab}$.
Absorption spectrum	A plot of absorbance against wavelength.
Absorptivity (a)	The absorbance divided by the product of the concentration of the silica and the sample path length.
Beer's Law	The absorbance of a homogenous sample containing an absorbing substance is directly proportional to the concentration of the absorbing substance.
Bouguer's Law (Lambert's Law)	The absorbance of a homogenous sample is directly proportional to the thickness of the sample in the optical path, the path length.

* Reference: ASTM E131-90a

1.3.1 Dual Wavelength Colorimetry

Optical absorbance is measured simply by comparing light intensity or power (I or P) transmitted through the sample to the incident intensity or radiant power [I_o or P_o]. From a strictly theoretical standpoint, measuring incident and transmitted levels at a single, relevant wavelength yields accurate results.

However, in practical terms, a single-wavelength measurement is affected by two phenomena that are difficult to control:

- It is difficult to measure the incident intensity or power at the point where the light enters the sample.
- Real world solutions, especially process streams, exhibit cloudiness or turbidity.

A. Turbidity

While turbidity usually does not exhibit any characteristic absorption, it reduces the radiant power being transmitted through the medium. In a single-wavelength measurement, it is impossible to discriminate between the effects of turbidity and the absorbance of the colored complex. The effects of turbidity on single- and dual-wavelength methods are illustrated in Figure 1-2.

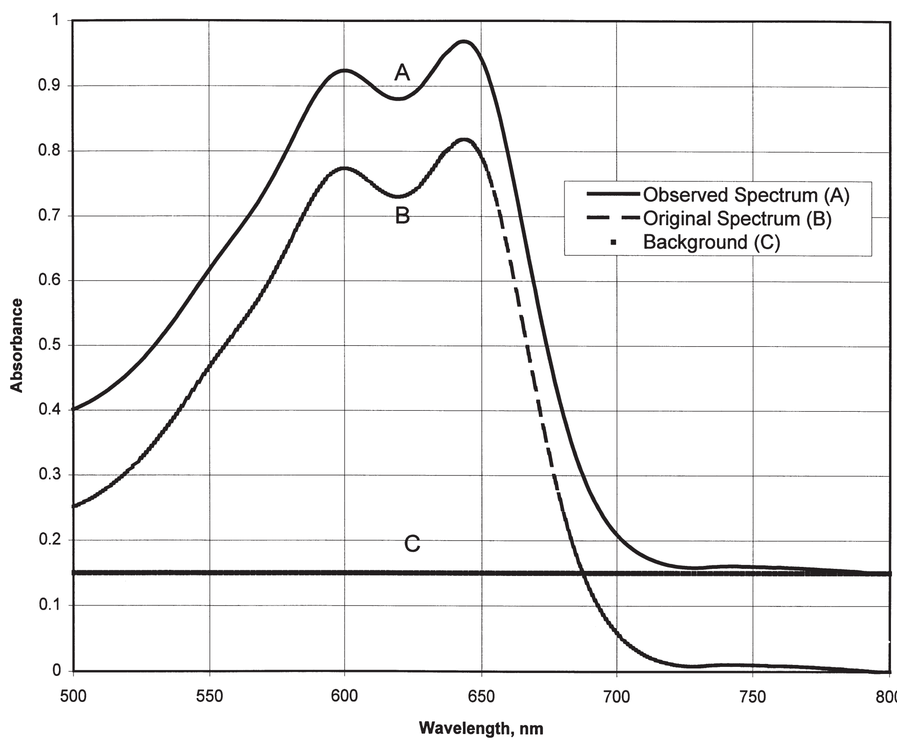

Figure 1-2 Effects of Turbidity

B. Second Reference Measurement

In the dual-wavelength technique, one employs a second *reference* measurement, taken at a wavelength that lies outside the absorption bands of the species under test. This method automatically eliminates the incident intensity or power term from the measurement equation while also compensating for turbidity. The result is an accurate measurement of absorption at the characteristic wavelength of the colored complex formed with the silica.

In the Orion Model 2030 Silica Analyzer, light passes through the sample twice. The light path begins at the incandescent source lamp. Incident light travels through the fiberoptic bundle to the probe window, then through the sample to a reflector. Reflected light travels back through the sample, back into the probe, through the fiberoptic bundle, then back to the detectors.

C. Optical Fibers in Probe

There are actually two groups of optical fibers inside the probe; half the fibers in the bundle carry incident light to the probe, the other half carry collected light back to the photodetectors. At the photodetectors, the reflected-light fibers are again split into two groups, and the light from each group is coupled through an optical (color) filter and into the photodetector for measurement. A real-time analog signal from each photodetector is digitized and passed to a microprocessor for the calculation of absorbance.

1.4 Major Components

Figure 1-3 depicts a typical configuration for the Orion Model 2030 Silica Analyzer. Callouts identify key components; Chapter 2 describes these in more detail.

1.4.1 Main Assemblies

Physically, the Orion Model 2030 Silica Analyzer consists of these three main assemblies:

- Swing Panel
- Sample Manifold
- Electronics Enclosure

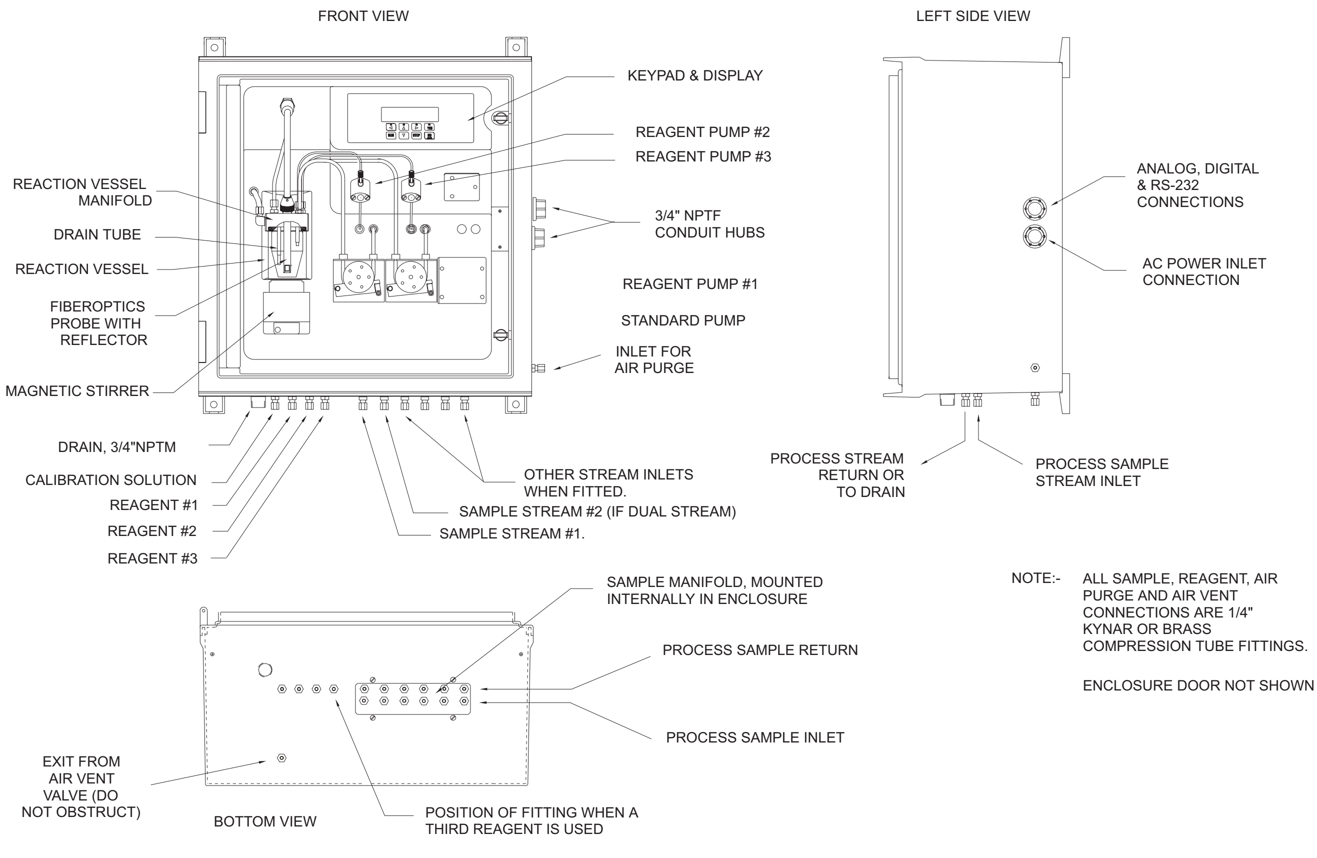

Figure 1-3 Major Components

For more information about these three main assemblies, see Chapter 2.

1.4.2 Main Subsystems

Functionally, the Orion Model 2030 Silica Analyzer is composed of these four main subsystems:

- Fluidics
- Optics
- Electronics
- Control Panel

For more information about these four main subsystems, see Chapter 2; the operation of the control panel is explained in Chapter 3.

1.5 Options

- Flow sensor [The Orion Model 2030 Silica Analyzer is programmed to interface to a specific flow sensor. The sensor is installed on the 1/4" O.D. Teflon tubing of the drain line on the back of the fluidics panel, and is typically connected to digital input 1 (J17-1).]
  – WIRING: BE SURE TO WIRE THE SENSOR CORRECTLY, OTHERWISE THE SENSOR WILL BE DAMAGED. THIS SENSOR IS NOT WATERPROOF.

BROWN (+24 VI)	J15-1	Power Supply HI
BLUE (- COM)	J15-3	Power supply LO
BLACK (OUT)	J17-1	Digital input 1

Default switch settings: LOW, D-ON.

- Level sensor (For detecting reagent or calibration standard levels, this sensor may be used to connect to the digital alarm inputs; a sensor with dry contact closure-type is recommended.)
- Remote Control software (For availability, consult Orion.)

Chapter 2: Hardware Description

Chapter 2 identifies and describes:

- The three main physical assemblies of the Orion Model 2030 Silica Analyzer (swing panel, sample manifold, and electronics enclosure)
- The four major functional analyzer subsystems (fluidics, optics, electronics, and control panel)

2.1 General

The Orion Model 2030 Silica Analyzer is housed in a single fiberglass enclosure that is designed to be mounted on a wall or similar sturdy vertical surface. The front cover of this enclosure is hinged along its left edge to permit operator access for routine functions. An interior swing panel can also be opened by releasing two fasteners along its right edge to expose internal parts requiring less frequent access.

Various fluid inlet, fluid drain, and air vent connections are made through bulkhead attachments located along the bottom surface of the analyzer.

For a visual reference of the analyzer, refer to Figure 1-3.

2.2 Main Physical Assemblies

Physically, the Orion Model 2030 Silica Analyzer consists of these three main assemblies:

- Swing Panel
- Sample Manifold
- Electronics Enclosure

2.2.1 Swing Panel

The Swing Panel contains the components that require access for routine operation, including the control panel and certain fluidics components. The swing panel contains most of the fluidics components. Chemical-handling pumps, valves, the sealed magnetic stirrer assembly, and all plumbing are located on the front surface of the swing panel; electrical connections to these components are confined to its rear surface. Electrical connections to these devices are made through quick-disconnect plugs located on the back side of the swing panel.

A fiberoptic bundle feeds through the swing panel from front to rear, then on to the electronics enclosure where the optical source and detectors are housed.

2.2.2 Sample Manifold

The Sample Manifold contains one or more fluid valves, multiplexed onto a single block and individually switched so as to present one sample at a time for analysis.

2.2.3 Electronics Enclosure

The Electronics Enclosure contains all the control electronics components in a sealed environment physically separated from the fluidics.

Caution: The inside of the electronics enclosure should be accessed only by qualified service personnel.

NOTE: When replacing the electronics cover, secure the captive screws firmly, using a torque wrench at a 100 oz/inch setting.

2.3 Main Functional Subsystems

Functionally, the Orion Model 2030 Silica Analyzer consists of these four main subsystems:

- Fluidics
- Optics
- Electronics
- Control Panel

The following subsections (2.3.1-2.3.4) furnish detailed descriptions of these subsystems.

2.3.1 Fluidics Subsystem

A functional illustration of the Fluidics Subsystem is presented in Figure 2-1, a physical depiction in Figure 2-2.

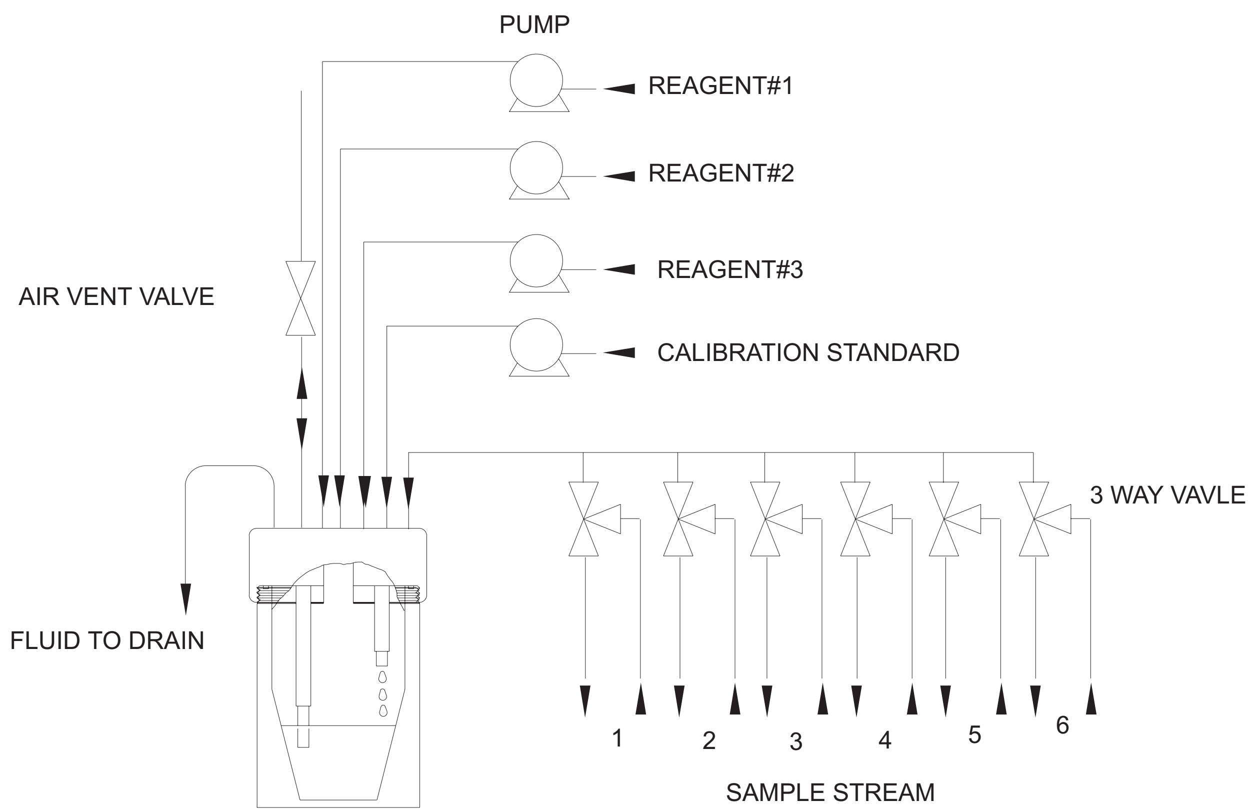

Figure 2-1 Fluidic Path (Functional)

Figures 1-3 and 2-2 depict the major components or assemblies that are described in subsections A-P to follow.

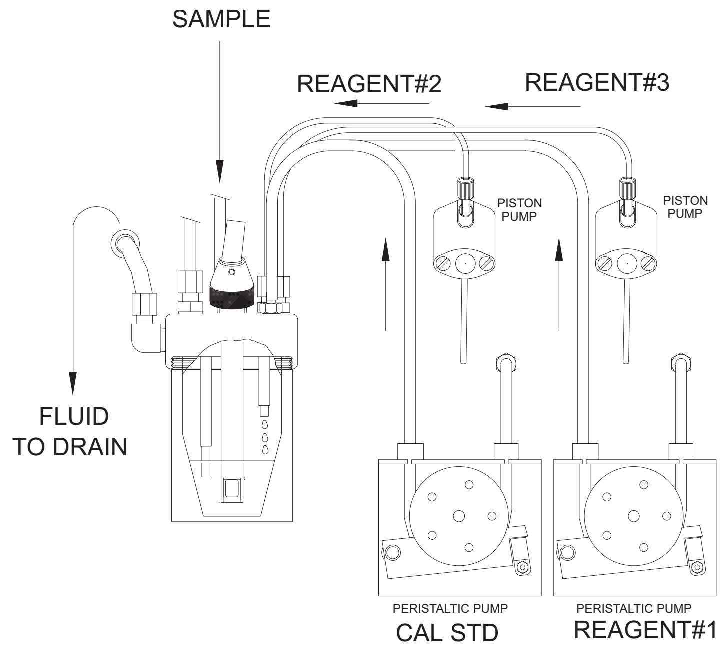

Figure 2-2 Fluid Handling Components

A. Air Purge Fitting

The Air Purge Fitting (1/4" brass compression fitting) is used for positive-pressure gas purging of the electronics enclosure when the analyzer is operating in the presence of a corrosive or combustive atmosphere.

B. Air Vent Fitting

The Air Vent Fitting (1/4" brass compression fitting) functions as an atmospheric vent for siphon/drain tasks during capture of sample or standard.

Caution: Do not block the air vent.

C. Drain Fitting

The Drain Fitting (3/4" MNPT connector) **must** be attached to a drain open to the atmosphere.)

Caution: The length of Teflon tubing connected to the elbow fitting on the manifold (Figure 2-2) is set at the factory. Changing this length may affect analyzer operation adversely.

D. Inlet Fitting (reagent)

The Inlet Fitting (reagent) is a compression fitting for the line from a reagent reservoir; it requires 1/4" OD tubing. The number varies between one and four depending upon the number of reagents configured.

E. Inlet Fitting (sample)

The Inlet Fitting (sample) is a compression fitting for the input line from the sample stream; it requires 1/4" OD tubing. Inlet specifications call for a pressure of 0 - 45 psig (3-way valve) and for a flow rate in the range 30 - 500 mL/minute. There is one such fitting for each sample stream.

Caution: Do not exceed 15 psig back pressure on any valve.

F. Outlet Fitting (sample)

The Outlet Fitting (sample), when plugged, configures the inlet valve as a 2-way valve. It is a compression fitting for the return line to the sample stream, and requires 1/4" OD tubing.

G. Inlet Fitting (standard or calibration solution)

The Inlet Fitting (standard or calibration solution) is a compression fitting for the line from a standard solution reservoir; it requires 1/4" OD tubing.

H. Inlet Valve Assembly

The Inlet Valve Assembly is a three-way valve that controls the introduction of sample into the reaction cell assembly. It operates at 24 VDC. The Inlet Valve Assembly can be a single-valve or the sample manifold (for multiple streams)

I. Outlet Fitting (manifold)

When more than one stream on the analyzer is equipped with a sample manifold, the outlet of the manifold is connected to the reaction cell.

J. Pump Assembly (piston)

The Pump Assembly (piston) works as a metering pump with positive-displacement piston action to add reagent to the sample. Compression tube fittings (1/8" Kynar) and Teflon tubing are used for fluid transport.

K. Pump Assembly (peristaltic)

The Pump Assembly (peristaltic) operates as a peristaltic pump to add reagent standard solution and transport samples to the reaction cell.

L. Quick Reference Guide

The Quick Reference Guide is a summary of operating parameters and procedures. It should be stored in a plastic envelope mounted on the inner surface of the outer door.

M. Reagent Reservoirs

The Reagent Reservoirs are 5-liter containers used for storing reagent solutions. Containers holding 20 liters and more can also be provided for extended use.

Caution: The distance from a bulkhead connector to a reservoir should be minimized; it should not exceed 6 feet.

N. Reaction Cell Assembly

The Reaction Cell Assembly holds the sample during analysis and calibration. Figures 2-3 and 2-4 provide illustrations of this assembly.

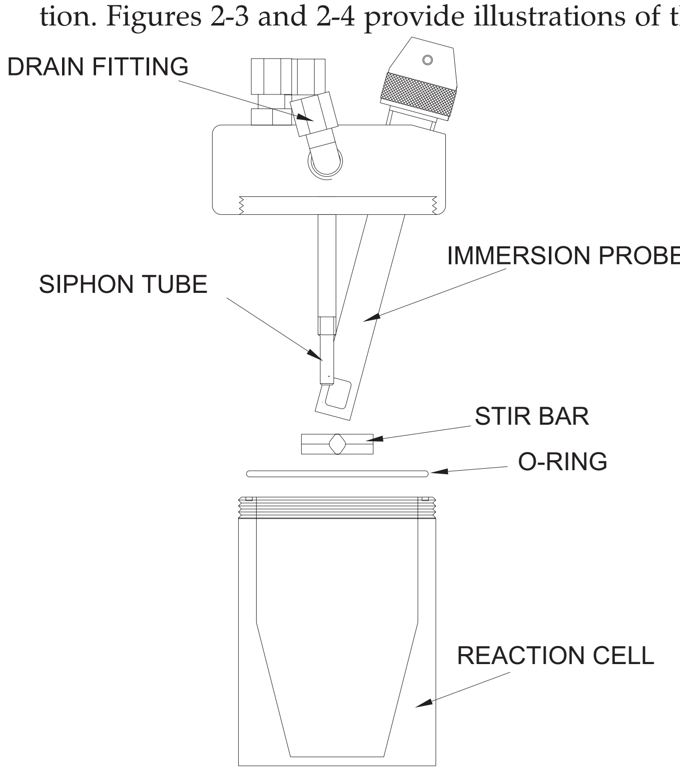

Figure 2-3 Reaction Cell Assembly

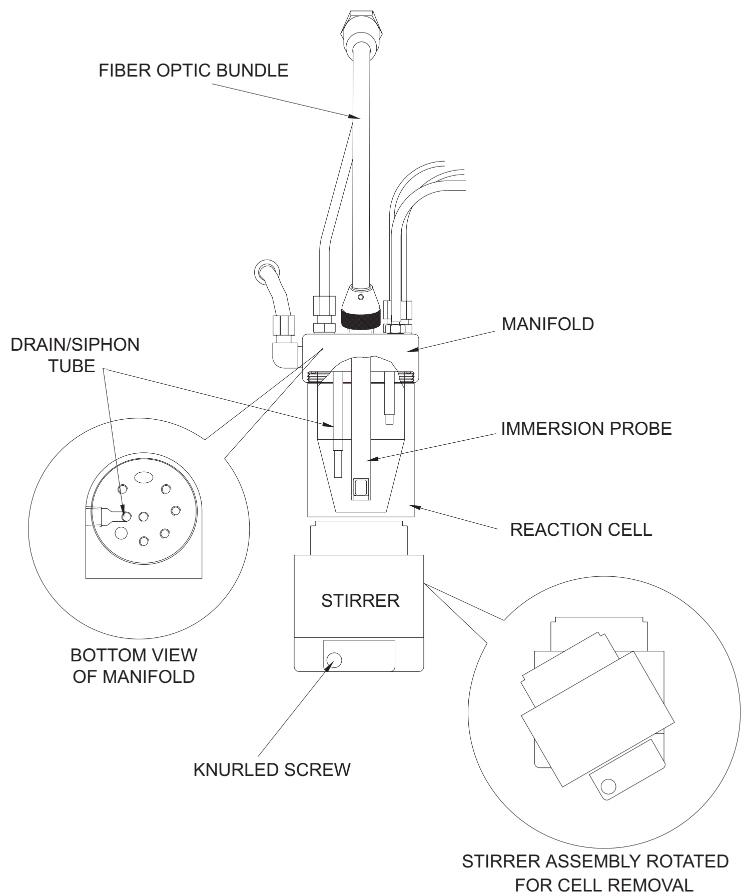

Figure 2-4 Detailed Reaction Cell and Manifold

This assembly consists of:

- **Block manifold**, which attaches to the swing panel. It holds the fiberoptic immersion probe and routes all fluids through to the reaction cell.
- **Reaction cell**, which is screwed into the bottom of the manifold.

The fiberoptic reflectance probe is screwed in through the top of the manifold.

O. Stirrer Assembly

The Stirrer Assembly consists of an electrical motor and rotating magnet assembly. The motor spins a magnetic stirrer located inside the reaction cell. The stirrer assembly is positioned adjacent to the bottom of the reaction cell. Loosening the knurled screw on the bottom of the stirrer assembly allows the stirrer assembly to rotate counterclockwise and downward for removal and installation of the reaction cell.

P. Vent Valve Assembly

The Vent Valve Assembly controls draining of the reaction cell during capture of sample or standard, during a wash cycle, and when the reaction cell is being emptied. This assembly operates at 24 VDC. It is made of a polypropylene body with Viton seals; 1/4" OD tubing is used for proper venting.

2.3.2 Optics Subsystem

The Orion Model 2030 Silica Analyzer optics subsystem, shown in Figure 2-5, consists of the following assemblies:

- Immersion probe assembly
- Fiberoptic bundle assembly
- Detector block assembly
- Source block assembly

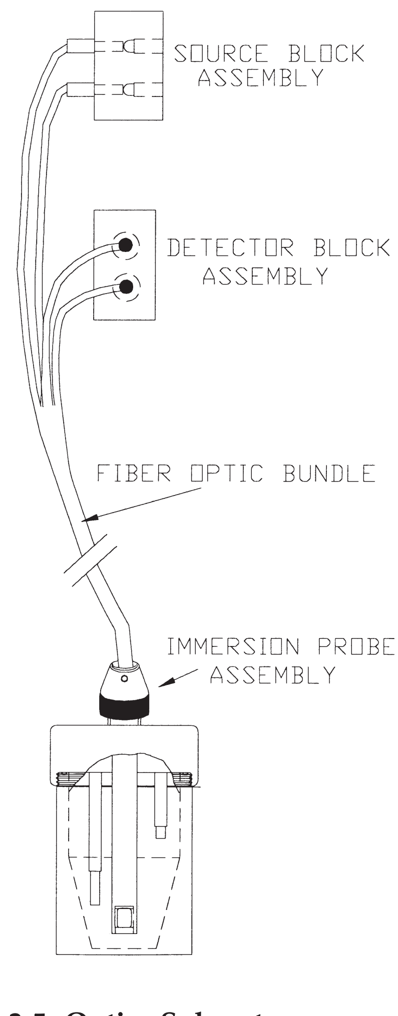

Figure 2-5 Optics Subsystem

A. Immersion Probe

The Immersion Probe is used for dual-wavelength measurement of light absorption of the sample in the reaction cell. It couples incident light into the sample solution and collects the transflected light returned through the sample. The probe is inserted through the top of the reaction cell manifold. The Immersion Probe Assembly is illustrated in Figure 2-6.

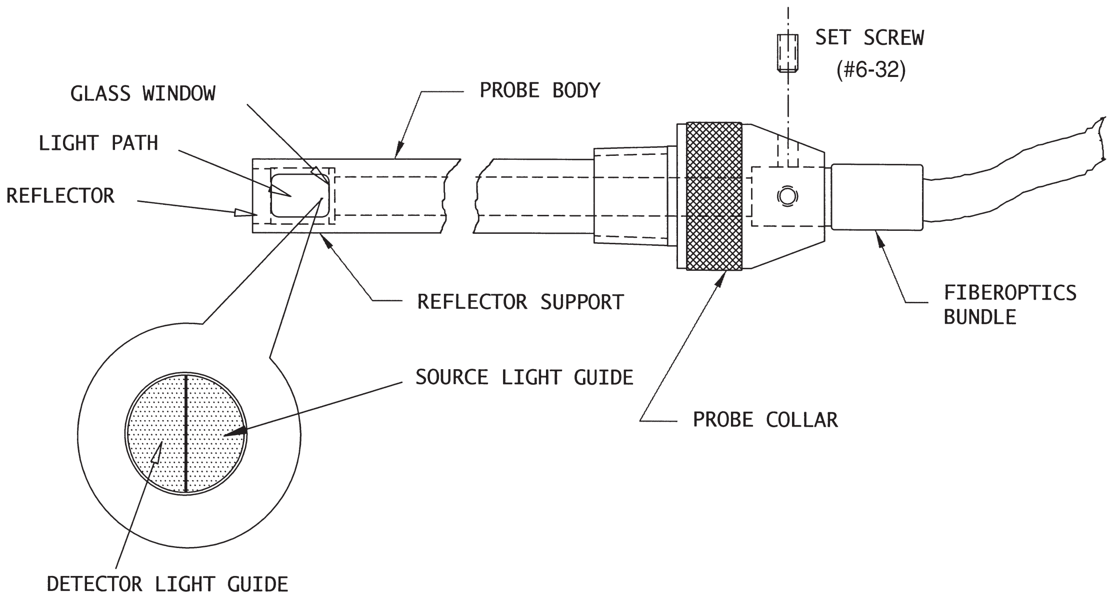

Figure 2-6 Immersion Probe Assembly

The Immersion Probe includes these components:

- **Probe Collar**, which is a knurled knob that provides a handhold for screwing the probe into or out of the reaction cell manifold. Two set screws (#6-32) on the collar secure the fiberoptic bundle inside the probe.
- **Probe Body**, which is a Kynar shaft screwed into the probe collar.

Caution: Do not grasp the flexible portion of the fiberoptic bundle or force it to twist or bend sharply while inserting or removing the probe through the reaction cell manifold.

- **Glass Window**, which isolates the polished epoxy surface of the fiber optic bundle from the chemicals present in the reaction cell.
- **Reflector Supports**, which consist of three struts extending past the probe window on which the reflector mounts. Their open structure allows for adequate sample mixing and fluid flow through the light path.

– **Light Path through Sample**, which extends from the glass window of the probe to the reflector and then back to the probe window.
– **Source Lightguide**, which is a semicircular area of the fiberoptic bundle that couples light into the sample. When the source lamp is on, this area appears brightly lit.
– **Detector Lightguide**, which is the semicircular area of the fiberoptic bundle that couples reflected light from the sample into the fiber then on to the detectors. This area appears dark even when the source lamp is on.
– **Reflector**, which couples light from the source lightguide to the detector lightguide.

B. Fiberoptic Bundle Assembly

The Fiberoptic Bundle Assembly transmits light bi-directionally between the immersion probe and the electronics enclosure. Its components are described below and illustrated in Figure 2-7.

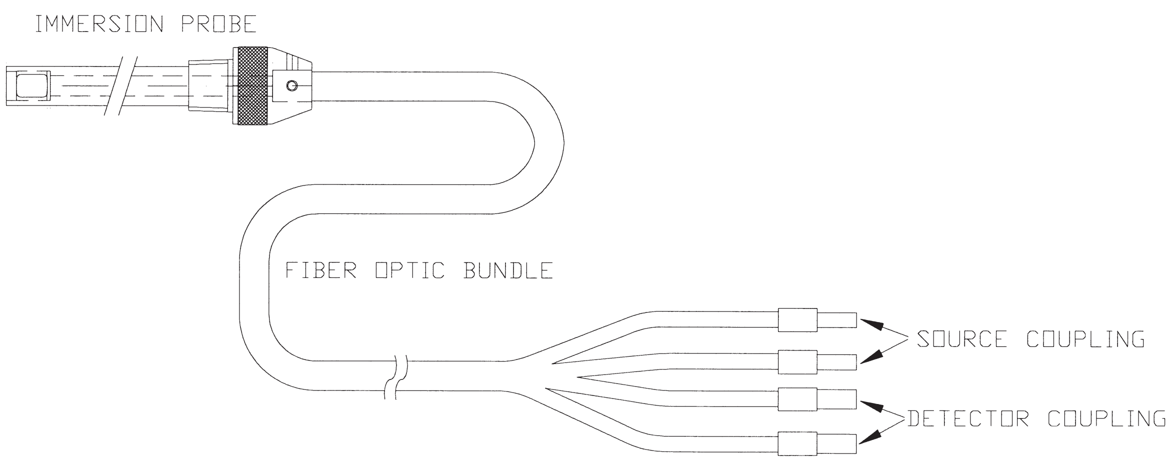

Figure 2-7 Fiberoptic Bundle Assembly (400-303.1)

– **Detector Fiberoptic Couplings**, which are located at two ends of the fiberoptic bundle, and couple light passing from the fiber bundle into the detectors.
– **Source Fiberoptic Couplings**, which are located at both ends of the fiberoptic bundle, and couple incident light from the source block into the fiberoptic bundle.
– **Immersion Probe**, which couples incident light into the sample solution and collects the transflected light returned through the sample.

C. Detector Block Assembly

The Detector Block Assembly couples light returning from the probe to the detectors. It is illustrated in Figure 2-8.

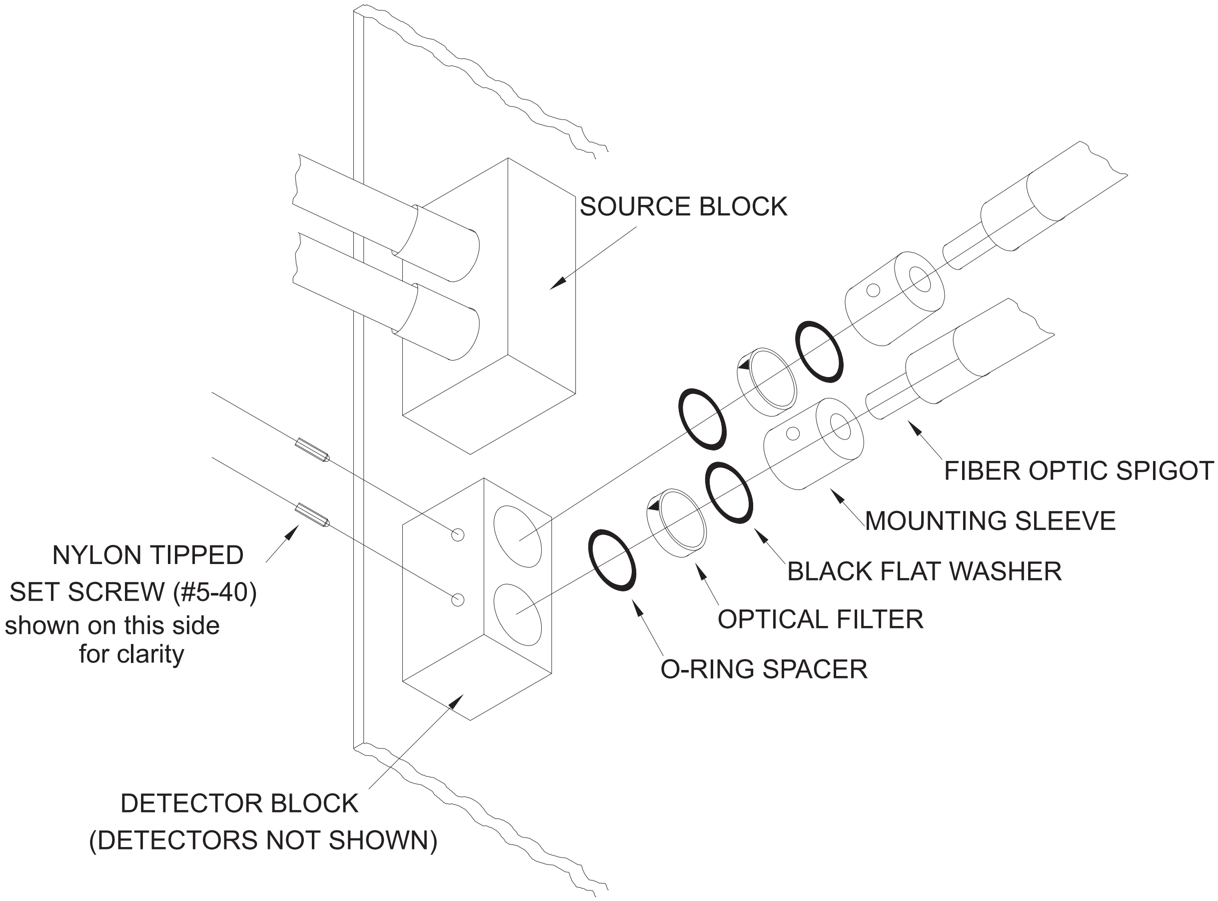

Figure 2-8 Detector Block Assembly

Caution: Access to the detector block requires removal of the electronics cover. The inside of the electronics enclosure should be accessed only by qualified service personnel.

NOTE: When replacing the electronics cover, secure the captive screws firmly, using a torque wrench at a 100 oz/inch setting.

Detector Block Assembly components include:

– **Temperature Sensor,** which measures the temperature of the detector block (embedded inside the assembly).

- **Detector Block Heater**, which is made up of two transistors attached to the detector block; it heats the block to a specified temperature.
- **Fiberoptic Mounting Sleeves**, which hold the color filters in place and align the fiberoptic couplings and optical filters with the detectors.
- **Nylon-tipped Set Screws**, which secure the detector fiberoptic couplings and mounting sleeves to the detector block.
- **Black Flat Washers**, which mechanically isolate the mounting sleeve and the optical filter.

Caution: Do not overtighten these Nylon-tipped set screws.

- **O-ring Spacers**, provide cushioned support for optical filters while keeping them perpendicular to the light axis. The size and number of O-rings are adjusted according to the thickness of the filter.
- **Optical Bandpass Filters,** which select narrow bands of light at the wavelengths of interest for dual-wavelength colorimetric analysis.

NOTE: The optical filters have an anti-reflective surface that should be positioned facing the fiberoptic coupling. Some filters are marked with an arrow on the rim of the filter to denote the preferred direction of light travel. These filters should be mounted so that the arrow points toward the photodetector. Filters not marked with an arrow should be mounted so that the mirrored side of the filter faces the fiberoptic coupling.

- **Detector**, which measures the filtered light intensity after it passes through the sample (twice), converting it to an electrical signal that is amplified in the electronics.

D. Source Block Assembly

The Source Block Assembly couples light from the lamp(s) into the fiberoptic bundle. It is illustrated in Figure 2-9.

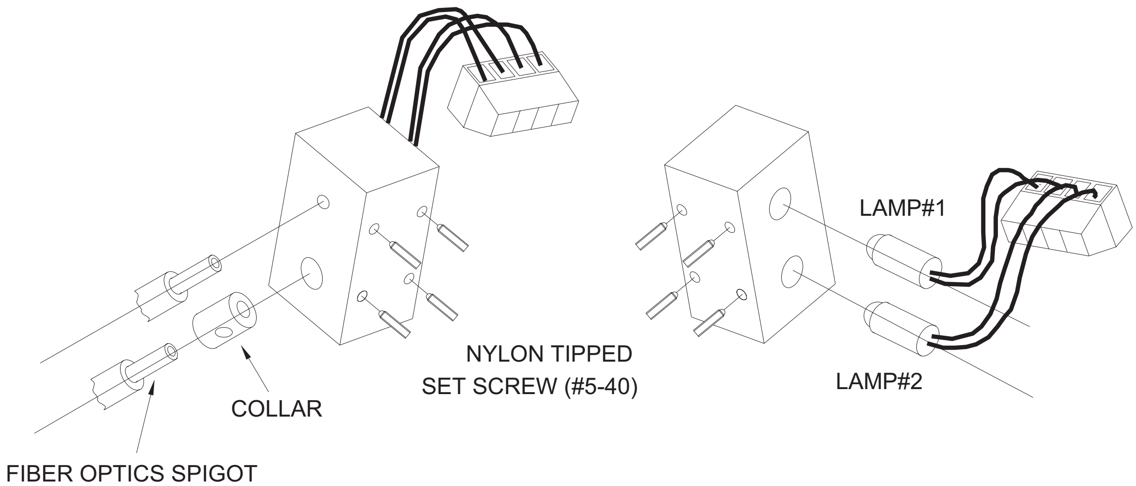

Figure 2-9 Source Block Assembly

Source Block Assembly components include:

- **Source Lamps**, which are two incandescent lamps operating at approximately 5 VDC; these provide source light for the optics subsystem. In most cases, only one lamp is illuminated, while the second lamp is employed when greater intensity is required.
- **Mounting Sleeves** (collar), which hold the fiberoptic couplings in alignment with their respective lamps.
- **Nylon-tipped Set Screws**, which secure the source fiberoptic couplings to the source block.

Caution: Access to the source block requires removal of the electronics cover. The inside of the electronics enclosure should be accessed only by qualified service personnel.

NOTE: When replacing the electronics cover, secure the captive screws firmly, using a torque wrench at a 100 oz/inch setting.

Caution: Components may get hot; avoid touching the components when working near the source block in the electronics enclosure. Do not overtighten the nylon-tipped set screws.

2.3.3 Electronics

Figure 2-10 provides an interior view of the electronics enclosure.

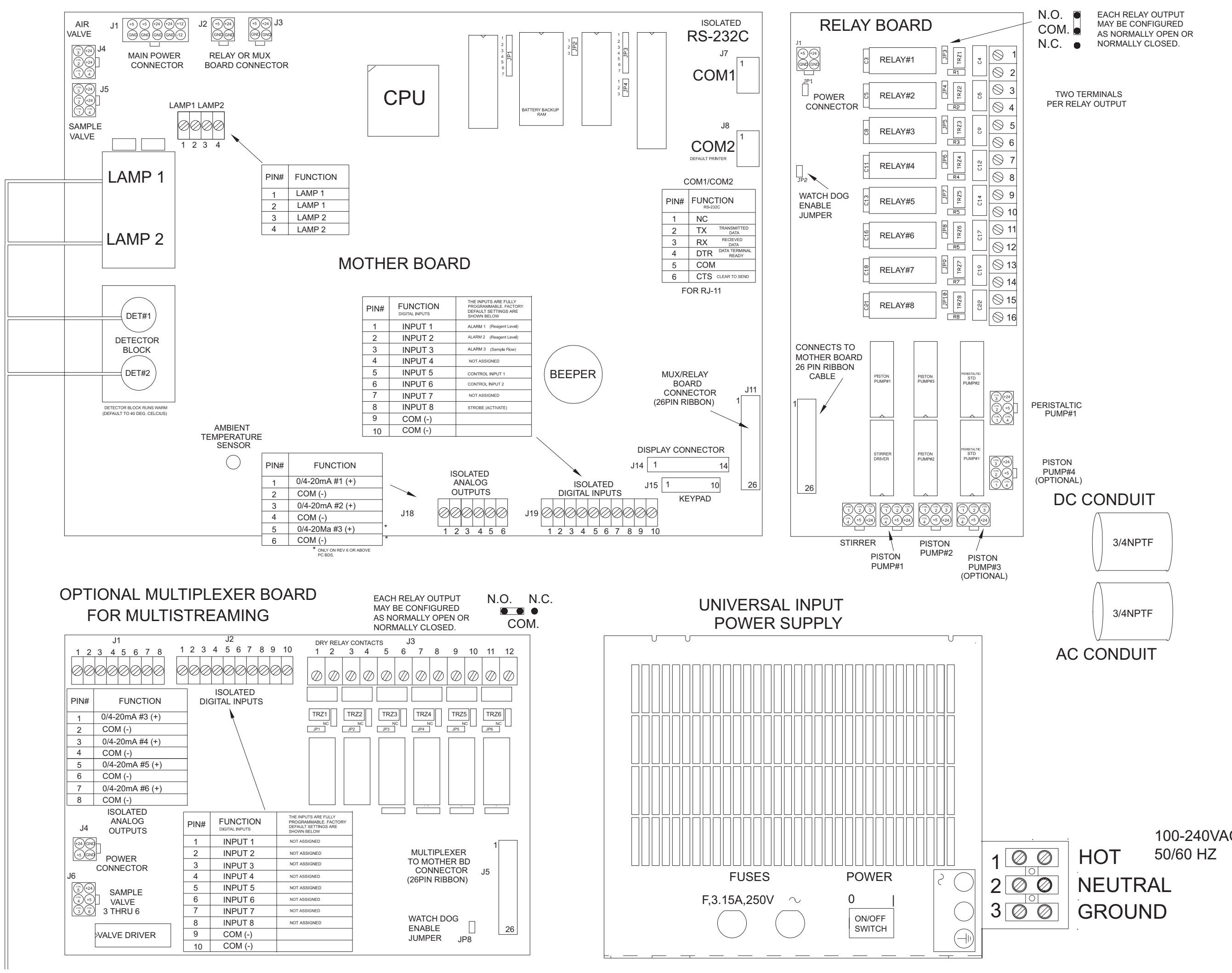

Figure 2-10 Electronics Enclosure

Caution: The inside of the electronics enclosure should be accessed only by qualified service personnel.

NOTE: When replacing the electronics cover, secure the captive screws firmly, using a torque wrench at a 100 oz/inch setting.

Components of the electronics subsystem are described include:

- **AC Fuses**, which are fast-blow fuses that protect the power supply. (**Do not exceed recommended ratings.**)
- **AC Line Terminal Block**, which is connected to the electrical power main operating 100 to 250 VAC, 50/60 Hz.
- **Conduit for AC and Alarm Wiring**, which is 3/4" NPTF and carries grounded electrical power mains and external relay connections.
- **Conduit for DC and Low Voltage Wiring**, which is 3/4" NPTF that runs wires that connect low voltage analog and digital circuits, including the 4-20 mA current loop and RS-232C signals.
- **Fiberoptic Bundle**, which carries light to and from the photonics section of the mother board.
- **Mother Board**, which is the heart of the electronics subsystem. It contains the processor unit and operating software; stores setup parameters along with calibration and sample records; contains the light sources and detectors and controls their operation; includes interfaces for the analog outputs (4-20 mA current loop) and eight isolated, custom-configured digital inputs, which can be used to control certain analyzer operations; and drives two RS-232C outputs to a printer or an external computer. The system is configured at the factory for bi-directional RS-232C operation, enabling remote control from a personal computer (PC).
- **Multiplexer Board**, which contains optional circuitry and connections to support multiple sample streams (up to six).
- **Power Supply**, which provides DC power at + 5 V, ± 12 V, and + 24 V for operating analyzer circuits, pumps, and valves.
- **Power Switch**, which controls all power within the analyzer except that which may be present through external connections to the programmable relays.

Caution: Be sure that all external sources of power—those connected to relay contacts and analog outputs—are turned OFF or disconnected before you attempt to access circuitry in the electronics enclosure.

- **Relay Board**, which contains relays for external alarm and device control and for controlling the analyzer's stirrer and pump motors.
- **RS-232C Connection, COM1 or COM2**, which is a 10-pin connector (or RJ-11 for later versions) that provides for RS-232C serial digital output.

2.3.4 Control Panel

The control panel is the operator's focal point for all programming, routine operations, and fault diagnostics. Two levels of menu access (and menu complexity) are available: (1) Routine and (2) Advanced.

The Orion Model 2030 Silica Analyzer accepts commands and reports results using a control panel mounted on the swing panel. The control panel consists of a display and a keypad; control panel operation is explained in detail in Chapter 3.

NOTE: You cannot damage the Orion Model 2030 Silica Analyzer by pressing the "wrong" key. While you may not achieve the result expected and the outcome may cause a minor inconvenience, the analyzer always recovers intact.

Chapter 3: Control Panel

Chapter 3 explains how to use the control panel. Specific topics include:

- Describing the Control Panel
- Controlling the Analyzer
- Explaining Analyzer Functions
- Navigating the Control Panel Menus
- Understanding Sequences

3.1 Describing the Control Panel

The Orion Model 2030 Analyzer accepts commands and reports results using a control panel mounted on the swing panel. The control panel consists of a display and a keypad, and is shown in Figure 3-1.

Figure 3-1 Control Panel

The control panel is the operator's focal point for all programming, routine operations, and fault diagnostics. Two levels of menu access (and menu complexity) are available: (1) Routine (see Chapter 6) and (2) Advanced (see Chapter 7).

The display contains two lines of 20 characters each. Generally, the first line provides information or asks a question (also called a "prompt"), while the second line labels one or more of the four function keys of the keypad below it.

The keypad consists of eight sealed membrane switches, some of which have dedicated functions and others are soft keys, meaning that the functions are context-dependent.

Whenever you press a key, you hear a "beep," and the display usually changes; however, if you press a key that is inactive in the present context, it is not recognized, and no action occurs; the key is simply ignored.

NOTE: You cannot damage the Orion Model 2030 Silica Analyzer by pressing the "wrong" key. While you may not achieve the result expected and the outcome may cause a minor inconvenience, the analyzer always recovers intact.

3.1.1 Keypad

The keypad consists of eight keys, which are described in Table 3-1.

Table 3-1. Keypad Keys

Key	Description
[F1] or **[LEFT]**	A dual-function key. When it is labeled above in the display, the labeled function applies. Otherwise, this key causes the menu selection to back up (move up) one step.
[F2] or **[UP]**	A dual-function key. When it is labeled above in the display, the labeled function applies. Otherwise, this key causes the menu selection to back up (move up) one step.
[F3] or **[RIGHT]**	A dual-function key. When it is labeled above in the display, the labeled function applies. Otherwise, this key causes the menu selection to move forward (move down) one step.
[F4] or **[YES]**	A dual-function key. When it is labeled above in the display, the labeled function applies. Otherwise, this key enters an affirmative response to the question posed in the first line of the display.
[RUN]	This key initiates the auto-analysis mode.
[DOWN]	This key causes the menu selection to move forward (move down) one step.
[STOP]	This key stops the operation in progress.
[NO] or **[ACCESS]**	A dual-function key. When a question is posed in the first line of the display, this key enters a negative response to the question. At the top menu level (reached when you press the **[STOP]** key), this key allows you to change the access level, using a passcode.

3.2 Controlling the Analyzer

The Orion Model 2030 Silica Analyzer can be operated three ways: (1) by an operator using the control panel, (2) by an external process controller via digital input lines, or (3) remotely through a serial (RS-232 or RS-485) data link. From the control panel, an operator has access to all system functions. A small subset of analyzer functions can be invoked via the digital input lines.

3.2.1 Dedicated Functions/Directional Keys

The keypad offers certain dedicated functions which are always available: **[RUN]**, **[STOP]**, **[YES]**, and **[NO].**

Many other functions are available using the four function keys: **[F1]**, **[F2]**, **[F3]**, and **[F4]**. Their functions depend upon the context, that is, where you are in the menu structure.

You navigate through the analyzer's menu structure to gain access to the desired function by observing the contents of the top line of the display (typically a question) and responding to each message by pressing the **[YES]**, **[NO]**, and/or the directional keys.

> **NOTE:** While the Orion Model 2030 Silica Analyzer offers a great number of functions and extensive user programmability, the great majority of actions can be taken with just a few keystrokes. Routine operation of the analyzer is fully automatic and very straightforward (for details, see Chapter 6).

3.2.2 Menu Level Access

The control panel offers two levels of menu access: (1) Operator Level (or "Routine") and (2) Technician Level. The Operator Level is intended for routine operation (for details, see Chapter 6); it offers only a few manual override functions that are the most likely to be needed in day-to-day use.

The Technician Level, which requires entry of a passcode for access, offers these same common functions plus many additional functions used for setting up analyzer operating parameters and running diagnostic tests (see Chapter 7).

> **NOTE:** To change access, press the **[STOP]** key on the control panel followed by the **[ACCESS] [NO]** key. Then navigate through the menu (scrolling **[UP]**/**[DOWN]**) to change the access level.

A. Diagnostics

Diagnostics provide a direct mechanism to turn various pumps and valves on and off for testing or during adjustment. This function also provides a quick check of the power supply, and it permits zeroing and normalization of the optics subsystem.

B. Standby

Standby immediately initiates a wash cycle (if so configured), then suspends analyzer operation in a standby state until the control panel **[RUN] key** is pressed or an external controller reactivates the analyzer.

C. End an Operation

To terminate any operation or any stepwise sequence of menu choices or data entries, press the control panel [**STOP**] key.

This ends the current process and returns the control panel to the main menu.

3.2.3 External Control

The analyzer can be directed to initiate an analysis or calibration cycle or change operating mode under the command of an external controller using the digital input lines. Detailed specifications for controlling the analyzer in this way are given in section 4.4.2; the external control functions are referenced in Table 3-3.

3.3 Explaining Analyzer Functions

The Orion Model 2030 Silica Analyzer performs many of its functions in automated sequences, or cycles, as described in the following sections.

3.3 1 Analysis Cycle

The steps listed below describe the sequence of events in a typical analysis. The same basic cycle is used to:

- Analyze a sample stream and report silica concentration in each sample.
- Calibrate the analyzer using a silica standard solution.

The displayed messages on the control panel accompanying each step are shown at the left.

1. Fill Drain—The drain line is filled with the sample to prepare to siphon. The sample inlet valve is OPENED, the stirrer is turned ON, and the air vent valve is CLOSED, moving 10 mL of sample into the drain line.

During calibration, instead of the sample valve opening or closing as the cycle proceeds, the standard pump turns ON or OFF.

2. Drain Cell—The reaction cell is drained. The sample valve is CLOSED, the stirrer is turned OFF, and the air vent is OPENED for 40 seconds, siphoning the sample until the level drops below the drain tube opening in the reaction cell.

3. Wash Cell—The reaction cell is cleaned by exchanging 8 to 9 volumes, typically. The vent is CLOSED, and the sample inlet valve is OPENED with the stirrer ON.

4. Drain Cell—The cell volume is again set to a target level. The sample inlet valve is CLOSED, and the air vent is OPENED for 20 seconds to siphon.

5. Fill Cell—The cell is filled to a level above the drain tube opening to ensure good siphoning action in the next step. The air vent and sample inlet valve are OPENED for a time calculated (using the parameter SMP FLOW RATE) to allow the space above the end of the drain tube to fill 1/3 to 1/2 full. The air vent is then CLOSED with the sample inlet valve still OPEN, long enough to fill the drain line adequately.

6. Capture Volume—Final volume capture takes place. The sample inlet valve is CLOSED (for the last time in the cycle), the stirrer is turned OFF, and the air vent is OPENED. The sample drains by siphon action to a level established by the end of the drain tube. Repeatability of sample volume capture is better than 1%.

7.1 Add Rgt1—Reagent 1 is added. The air vent is OPENED, the stirrer is turned ON, and reagent pump #1 is turned on for a period of time proportional to the volume being added. The volume of Reagent 1 being and the stirring time are as specified in the setup menu.

7.2 Add Rgt2—Reagent 2 is added. The air vent is OPENED, the stirrer is turned ON, and reagent pump #2 is turned on for a period of time proportional to the volume of Reagent 2 being added. The volume of Reagent 2 being added and the stirring time are as specified in the setup menu.

7.3—A blank absorption measurement is taken.

7.4 Add Rgt3—Reagent 3 is added. The air vent is OPENED, the stirrer is turned ON, and reagent pump #3 is turned on for a period of time proportional to the volume of Reagent 3 being added. The volume of Reagent 3 being added and the stirring time are as specified in the setup menu.

The solution is allowed up to three minutes for the measured absorption to stabilize. Once stable, the analyzer displays on the control panel the word "STABLE," along with the measured absorbance level.

NOTE: If the solution color is shifting or if a precipitate is being formed, the analyzer is not able to establish a stable absorption reading. It indicates this condition by displaying only a portion of the word "STABLE" (that is, S, ST, STA, STAB, STABL). The number of letters displayed is a rough gauge of stability; that is, as more of the word appears, the analyzer is establishing an increasingly stable reading.

Upon establishing a stable absorption reading, or after 3 minutes have elapsed, the analyzer takes a final absorbance reading, then calculates the concentration of the silica according to the following equation:

$$C_s = C_{\_c} \frac{A_s - A_{sb}}{A_c - A_{cb}}$$

where

C_s	=	concentration of silica sample
$C_{\_c}$	=	concentration of silica in standard solution
A_s	=	absorbance measurement of sample (final value)
A_{sb}	=	absorbance blank measurement of sample (A_{sb} = 0 if not using blank measurement).
A_c	=	absorbance measurement of standard (final value)
A_{cb}	=	absorbance blank measurement of standard (A_{cb} = 0 if not using blank measurement).

NOTE: The precision of the measurement depends only on the repeatability of captured sample volume and the reagent addition rates. The repeatability of sample volume is accomplished by a siphoning action at the end of the sampling sequence. The required precision in the addition of reagents is achieved by using precision pumps.

The numerical result is displayed on the control panel, and an analog representation of the result is sent to the 4-20 mA output lines. The result is also sent to the printer, if one is attached to the RS-232C serial port. This completes the cycle.

3.3.2 Manual and Automatic Modes

The analyzer can run in either of two operating modes: manual mode or auto mode. In manual mode, the analyzer completes a single cycle, using either a process sample or a standard, and then pauses and waits for the command to perform another operation. In auto mode, the analyzer repeatedly runs cycles, both sample and calibration cycles, at the frequencies defined during analyzer setup.

The analyzer can switch between auto mode and manual mode under operator control from the control panel or under external control via the digital input lines.

In auto mode, the analyzer automatically schedules when to analyze a sample and when to calibrate. These are setup parameters. Each time the analyzer enters auto mode, it starts two countdown timers — one controls sample analysis, the other controls calibration. When either timer expires, the analyzer first restarts it (in preparation for the next cycle), then it attempts to initiate the appropriate cycle.

If a cycle is already in progress, that cycle finishes the in-progress cycle before beginning the next one. If both timers expire at the same time, the analyzer first calibrates and then immediately performs the sample analysis.

3.3.3 Run/Resume Function

The auto mode can be interrupted by pressing the **[STOP]** key on the control panel. The analyzer then resumes operation (where it left off) when the **[RUN**] key is pressed. (If the [**RUN] key** is pressed twice within two seconds, both timers reset and the analyzer restarts.)

3.3.4 Blank Absorption Measurement

The blank absorption measurement is the method by which the analyzer corrects for background absorption of the sample solution or of the sample combined with reagents. This measurement is taken only when it is known that one or more chemical species in the sample, or the sample combined with the reagents, will have a characteristic absorption at the wavelength of measurement which is not related to silica concentration.

When enabled in the auto blank method, the analyzer takes an absorption measurement during analysis after Reagent 2 is added, then uses the result to correct the final concentration reported.

3.4 Navigating Menus

Read this section if you are not familiar with the analyzer's control panel and menu structure. Figure 3-2 depicts the software's menu levels graphically.

Operator Level	Technician Level *		
	Setup Menu	Calibration Menu	Diagnostics Menu
Run Calibration Validate Cal Std Run Analysis Run Standby Cycle Print Menu Print Calibrations Print Analyses Print Configuration Print Status Set Access Level Prime Fluidics	Set Up Calibration *Select Setup 1-3* Set Cal Std Conc Set Cal Std Abs Set Cal Device Set Cal Method Set Cal Type Set Repeat Alarm Save Cal Setup Recover Cal Setup Set Up Method *Select Method 1-10* Set Pre/ Cell Wash Set Rgt Addition Set Blank Step Set Post Wash Set Stability Select Cal Setup Save Method Recover Method Set Up Pump Info ‡ *Select Cal or Rgt Pump* Change Pump Type ‡ Set Priming Action ‡ Set Viscosity ‡ Set Flow Rate ‡ Save Pump Info ‡ Recover Pump Info ‡ Set Up Stream Info *Select Stream 1-6* Set Analog Output Set Alarm Levels Set Low Alarm Set High Alarm Set Viscosity Set Ext Smp Device Set Flow Rate Modify Cal Curve ‡ Set Conc Offset ‡ Set Conc Gain ‡ Save Stream Info Recover Stream Info Set Up Sequence Edit Stream Seq Set Sample Freq Edit Cal Sequence Set Cal Frequency Edit Cleaning Seq Set Cleaning Freq Save Sequence Recover Sequence *continued in next column ...*	Run Calibration Validate Cal Std Run Analysis Run Cleaning Cycle Exit Cal/Analysis NOTE : *Setup Menu, Continued from previous column* Set Up Outputs Set Time/Date Set Time Set Date Set Relay Functions Set Input Functions Set Special Functn ‡ Set Communications Modify COM1 Setup Modify COM2 Setup Set Printer Port Set Ext Comm Port Save Output Info Recover Output Info Set Up Parameters Set Stdby Wash Set Stdby Wash Vol Set Stdby Timeout Set Stirrer Mode Set Stirring Action Set Display Format Set Motor Action ‡ Set Pass Code Save Parameters Recover Parameters Save Unit Config Recover Unit Config Exit Setup Menu	Print Menu Print Fluidics Info Print Cal Setup Print Methods Print Stream Info Print Sequences Print Output Info Print Parameters Print Configuration Print Status Review Results Review Calibrations Print Calibrations Review Analyses Print Analyses Review Alarms View Active Alarms Print All Alarms Reset All Alarms Hardware Test Reset All Fluidics Control Check Flow Rates Lamp Control Temperature Control Test Relays Test Analog Outputs View Hardware Set Show Det. Out Show Absorbance, T Show Main ADC ‡ Show Power Rails Show Rev Level Adjust HW Settings Automatic HW Setup Manual HW Setup ‡ Cal Main ADC ‡ Cal DAC Outputs ‡ Zero Electronics ‡ Set Detector Range ‡ Set Lamp Drive ‡ Set Detector Gain ‡ Zero Dark Current ‡ Zero Backscatter ‡ Assign Detectors ‡ Normalize Abs,T ‡ Save HW Setup Recover HW Setup Clear/Reset Memory Clear Calibrations Clear Analyses Reset Cal Setup Reset Test Method Reset Clock ‡ Reset Backup ‡ Reset Memory Exit Diag Menu

‡ Accessible only through special access code (default = 12345). Please use extreme caution in this access level.
* Technician level access code (default = 123)

Figure 3-2 Orion Model 2030 Analyzer Menu Structure

Consider the following main points in navigating the Orion Model 2030 Silica Analyzer's various menus:

- The [**RUN]** key always interrupts the current process and initiates the auto analysis mode, as long as the system is calibrated. In other words, the analyzer is always ready for routine operation.
- The **[STOP]** key interrupts the current process, resets the system hardware, and switches the analyzer to its power-up state.
- To change the access level between Technician Level and Operator Level at any time, press the **[STOP]** key on the control panel followed by the **[ACCESS**] (**[NO]** key).
- The most straightforward way to navigate most menus is to answer each question posed in the display's top line by pressing the **[YES]** or **[NO**] key.
- When the display's bottom line labels one or more function keys, the labeled keys are active; the label describes the assigned function. Unlabeled function keys are inactive.
- Once you become very familiar with analyzer's menu structure, you can use the four **directional** keys to navigate through menus quickly.
- Certain displays include a number that can be modified as a means of entering a new value. When such a display appears, you can press **[NO]** to exit the menu without changing the displayed numeric value.

3.4.1 Editing a Value

To edit a value, perform these steps:

1. Move the blinking cursor to each digit you wish to change using the **[LEFT]** and [**RIGHT]** arrow keys.
2. Modify each digit using the **[UP]** and **[DOWN**] keys.
3. To change the sign of a number, position the blinking cursor at the leftmost digit, then press the [**LEFT]** key.
4. Once the correct new value is displayed, press [**YES**] to accept it and move to the next menu.
5. To cancel an edit, press **[NO]** followed by **[YES]**, in response to the prompt "*Exit No Change*" on the second line of the display.

3.4.2 Scroll Menus

Certain other displays reveal scroll menus, which offer several non-numeric choices, such as different units for concentration values. The bottom line of the display gives the current value of the parameter. Use the directional keys to scroll through all the choices, then press **[YES]** to accept the new value. (To leave the scroll menu without changing the parameter choice, press **[NO]**.)

3.5 Describing Sequences

A sequence is a series of steps that are cyclically executed in a pre-determined fashion. The sequences defined in the Orion Model 2030 Silica Analyzer are as follows:

- Test sequence
- Calibration sequence
- Reagent addition sequence
- Post wash sequence

The concepts of modifying a sequence are the same for all these sequences. Consider a generic three-step sequence as shown below:

1) Event 1
2) Event 2
3) Event 3
4) End of Sequence

The functions to set up the sequences have an identical interface. The primary display allows you to navigate through the sequence, whereas a secondary display lets you edit the sequence.

3.5.1 Primary Mode Functions

Functions available while in the primary display include:

- **NEXT**-go to the next step. If at the end of the sequence, go to the first step in the sequence. Always accessed by pressing the **[UP]** (**[F2]**) key.
- **PREV**-go to the previous step. If at the beginning of the sequence (first step), go to the end of the sequence. Always accessed by pressing the **[DOWN]** key.
- **EDIT**-edit the sequence, as described below. Always accessed by pressing the **[RIGHT]** (**[F3]**) key.
- **EXIT**-exit the function. Always access by pressing the **[YES]** (**[F4]**) key.

3.5.2 End Sequence Options

There are always three options available when editing the sequence:

- **ADD**-adds a new step to the sequence.
- **DEL**-deletes a step from the sequence.
- **MODIFY**-modifies a step in the sequence.

Chapter 4: Installation

Chapter 4 supplies these procedures to help you in unpacking and installing your Orion Model 2030 Silica Analyzer:

- Inspecting and Unpacking the Analyzer
- Preparing for Physical Installation
- Mounting the Analyzer
- Performing Electrical Installation

This chapter specifies the steps you must take to properly install the Model 2030 Silica Analyzer at the site where it is to be used.

1. Follow these instructions carefully to avoid damaging the analyzer and to assure its proper operation in routine service.
2. After completing the steps in Chapter 4, go to Chapter 5 and follow the required analyzer start-up procedures.

4.1 Inspecting and Unpacking the Analyzer

1. When you receive the Model 2030 Silica Analyzer, inspect its shipping container and packaging for visible external damage.
2. If there is obvious physical damage, request that the carrier's agent be present while the analyzer is being unpacked.
3. Do not destroy the shipping container during unpacking so that you can save it for possible future use.

WARNING: DO NOT APPLY ELECTRICAL POWER TO VISIBLY DAMAGED COMPONENTS, AS INJURY OR FURTHER EQUIPMENT DAMAGE MAY OCCUR.

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4. Remove the Model 2030 Silica Analyzer from its packaging and verify that all the components listed on the packing list are present.
5. Examine each of the components for physical damage.

6. If any of the components is damaged, notify the carrier and follow the carrier's instructions for damage claims. In addition, report any shipping problems immediately to Orion Research Incorporated.

4.2 Preparing for Physical Installation

The first task is to properly locate and mount the analyzer at its intended point of use. Take the following steps:

- Select an appropriate vertical surface (for example, a sturdy wall) as a mounting site that is close to the process stream(s) to be monitored.
- Be sure that there is sufficient clearance around the analyzer so that the door and swing panel can open completely and an operator facing the control panel is not subject to physical hazards.
- Ensure that there is sufficient space under the analyzer to place all the required solution containers. The distance from the top of any container to the bottom of the analyzer should not exceed six (6) feet.
- **Make sure the analyzer is mounted vertically.** The height at which the analyzer is mounted **must allow for proper operation** of the gravity drain, easy access to the keypad, and comfortable viewing of the control panel display.

Overall dimensions and locations for AC and DC conduits, mounting holes, drain location, and door panel clearance are shown in Figure 4-1.

Caution: The inside of the electronics enclosure should be accessed only by qualified service personnel. Connections to the power mains must be performed by a qualified electrician.

NOTE: When replacing the electronics cover, secure the captive screws firmly, using a torque wrench at a 100 oz/inch setting.

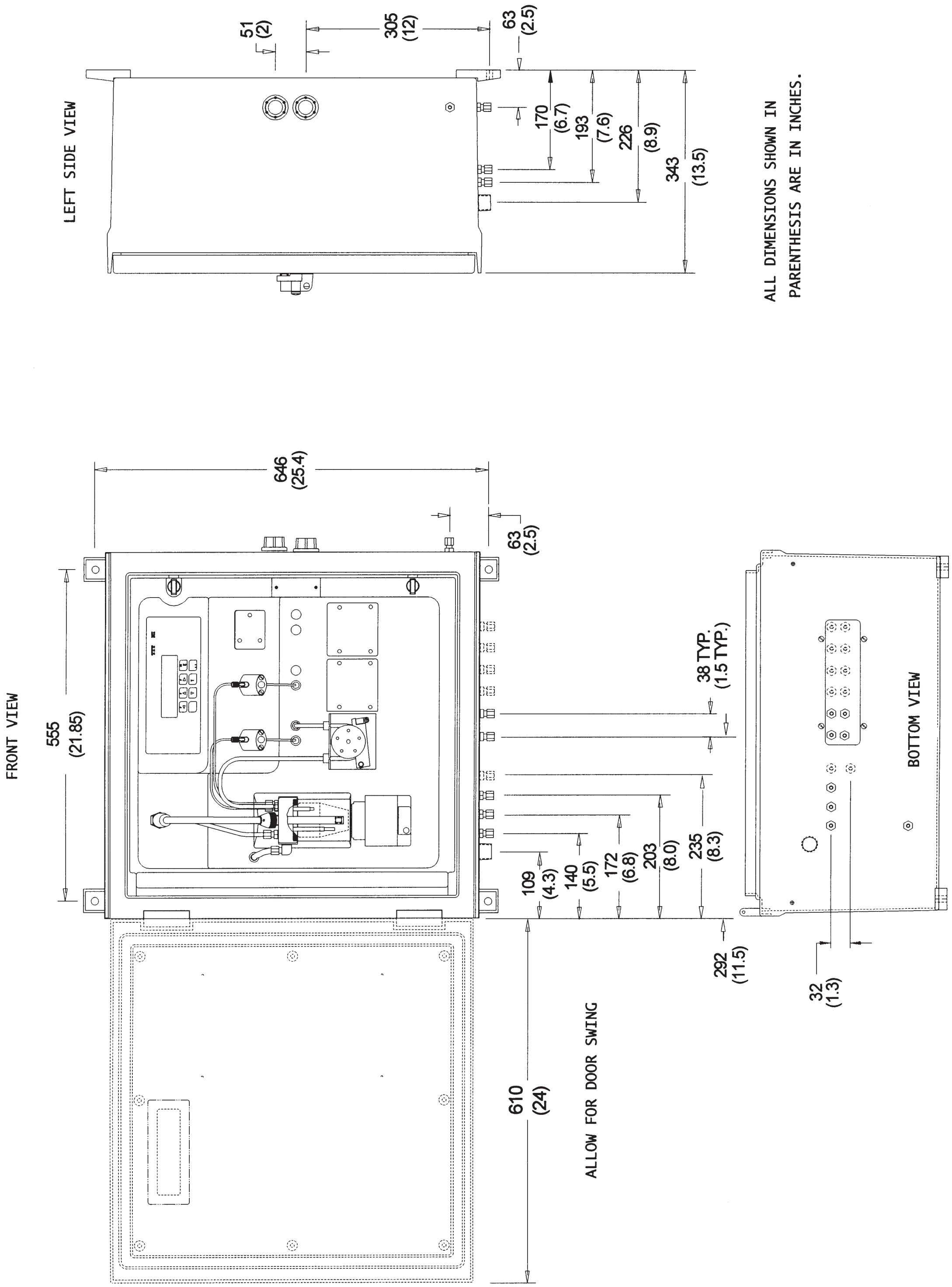


Figure 4-1 Installation Dimensions

4.3 Mounting the Analyzer

Take the following steps to mount the analyzer to the selected vertical surface. (The four (4) mounting feet are shipped in a separate bag. First install them to the back of the enclosure using the appropriate hardware.)

1. Mount the analyzer in an upright position and secure it with four 1/4" or 3/8" bolts through the mounting holes shown in Figure 4-1.
2. Place the reagent and calibration standard solution containers in their proper positions under the analyzer. Do not fill or connect the solution containers at this time.
3. Connect the 3/4" MNPT fitting located at the bottom of the analyzer to an atmospheric drain with the drain line provided. The drain **must** be capable of a flow rate not less than one liter per minute.

> **NOTE:** The reaction cell drain line from the analyzer **must** be unobstructed and open to the atmosphere. Do not replace or lengthen this line, as this may cause errors in analysis.

4. Route the sample stream supply line(s) to the analyzer inlet connector(s). Do not make any sample connections to the analyzer at this time.
5. If the analyzer is configured with a 3-way inlet valve, route a sample stream return line to the sample return connector of the analyzer, but do not connect it to the analyzer at this time.

Caution: A manual shut-off valve should be installed in the sample stream supply line, and also in the sample stream return line if one is present.

4.3.1 Installing the Air Purge

The Model 2030 Silica Analyzer is equipped with an air purge fitting, which purges the electronics enclosure in case of corrosive gases being present at the location of the analyzer. Air purge should also be used in hot environments where the ambient temperature exceeds 40°C. The nitrogen or air used should be free of oil and water. Installation of an air filter is highly recommended before the air purge inlet.

4.4 Performing Electrical Installation

All electrical wiring enters the analyzer through two conduit connectors located along the right side of the analyzer, as shown in Figure 4-1. Both housings are 3/4" FNPT hubs that attach to threaded conduit, or to a threaded male collar on thin-wall conduit.

The upper feedthrough is intended for DC wiring, including digital input lines, analog outputs, and the RS-232C interface. The lower feedthrough is intended for AC circuits, including power mains and connections to alarms or external pumps and devices.

4.4.1 Installing AC Wiring

AC power consumption is less than 200 watts at 110 volts AC. Use #18 AWG to #14 AWG wire for power connections. Analyzer relay ratings for alarms and external pump are 5 amperes maximum; use #18 AWG or #20 AWG for wiring.

NOTE: It is good practice to install a main power cutoff switch near the analyzer.

WARNING: MAKE SURE THE AC POWER MAINS ARE SWITCHED OFF OR OTHERWISE DISCONNECTED BEFORE YOU BEGIN WIRING THE SYSTEM TO AVOID THE POSSIBILITY OF ELECTRICAL SHOCK. IT IS GOOD PRACTICE TO INSTALL A MAIN POWER CUTOFF SWITCH NEAR THE ANALYZER.

Caution: Installing the AC wiring requires removing the electronics cover. The inside of the electronics enclosure should be accessed only by qualified service personnel. Connections to the power mains must be performed by a qualified electrician.

NOTE: When replacing the electronics cover, secure the captive screws firmly, using a torque wrench at a 100 oz/inch setting.

Follow these steps to install the AC wiring:

1. Route the AC power wiring through the lower conduit feedthrough to the power supply assembly, as shown in Figure 4-1, with reference to Table 4-1. Be sure to follow appropriate local codes and practices, and to attach a proper earth ground to the analyzer.
2. Route wiring for external controls to the main mother board appropriate connectors as shown in Figure 4-2, and relay alarms to the relay board as shown in Figure 4-3, with reference to Table 4-2.

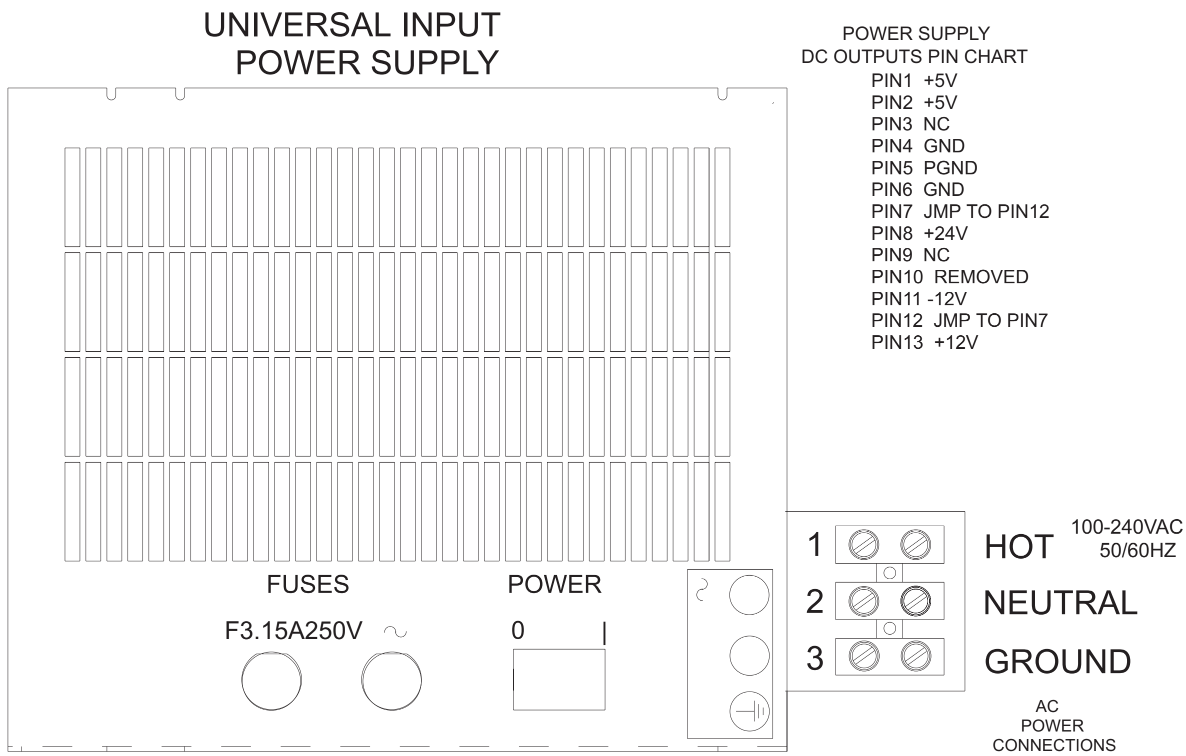


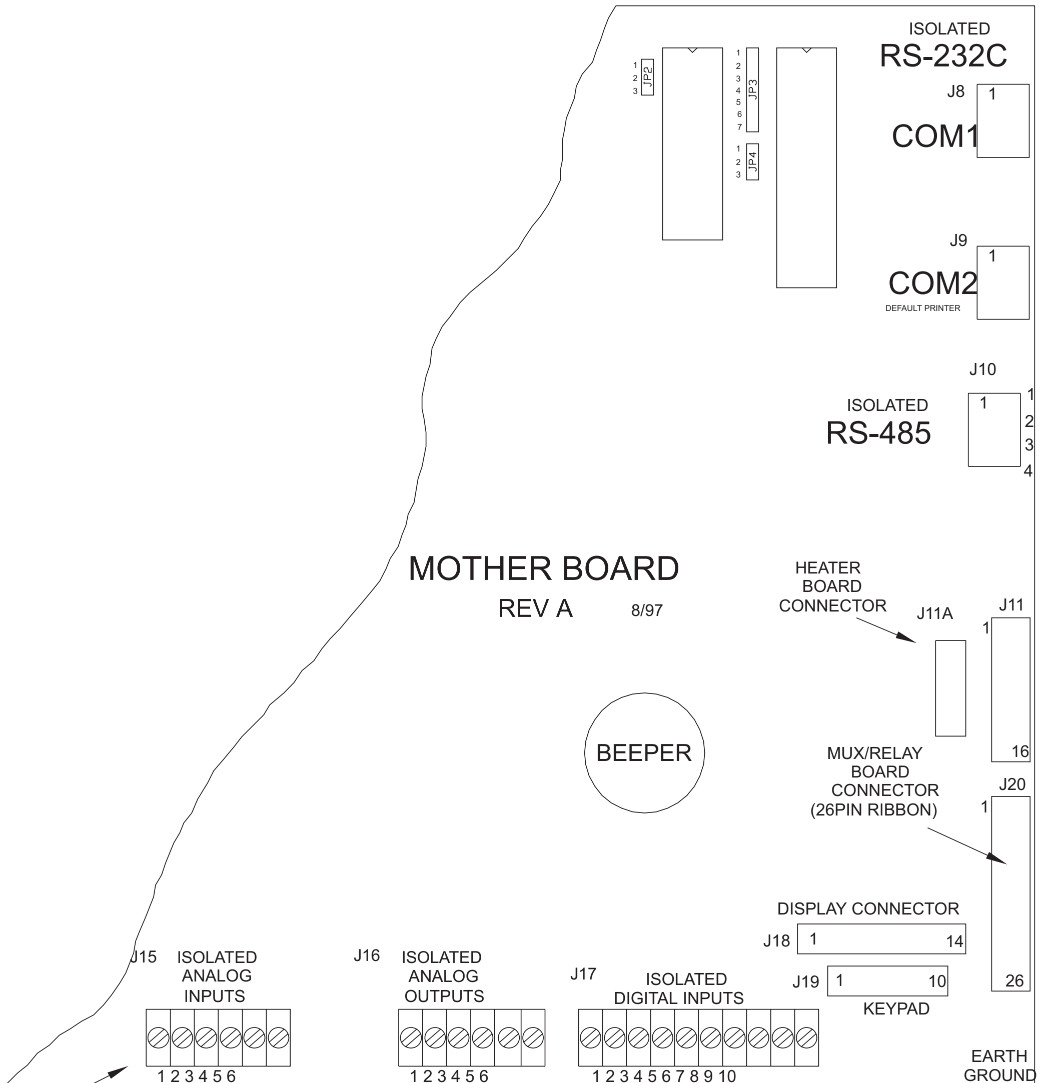
Figure 4-2 Power Supply Assembly

USE APPROPRIATE
CABLE TERMINATION

COM1/COM2

PIN#	FUNCTION (RS-232C)	
1	NC	
2	TX	TRANSMITTED DATA
3	RX	RECIEVED DATA
4	DTR	DATA TERMINAL READY
5	COM	
6	CTS	CLEAR TO SEND

RJ 11 CONNECTOR



PIN#	FUNCTION (RS-485)	
1	DATA(+)	PRIMARY
2	DATA(-)	PRIMARY
3	DATA(+)	SECONDARY
4	DATA(-)	SECONDARY

RJ 11 CONNECTOR

OPTIONAL (CONSULT FACTORY)

PIN#	FUNCTION	
1	24VDC	24VDC TO POWER LOW POWER XTR (4-20 MA)
2	ANALOG INPUT HI (+)	
3	ANALOG INPUT LO (COM -)	
4	24VDC	24VDC TO POWER LOW POWER XTR (4-20 MA)
5	ANALOG INPUT HI (+)	
6	ANALOG INPUT LO (COM -)	

OPTIONAL (CONSULT FACTORY)

PIN#	FUNCTION
1	0/4-20mA #1 (+)
2	COM (-)
3	0/4-20mA #2 (+)
4	COM (-)
5	0/4-20mA #3 (+)
6	COM (-)

PIN#	FUNCTION (DIGITAL INPUTS)	THE INPUTS ARE FULLY PROGRAMMABLE. FACTORY DEFAULT SETTINGS ARE SHOWN BELOW
1	INPUT 1	ALARM 1
2	INPUT 2	ALARM 2
3	INPUT 3	ALARM 3
4	INPUT 4	NOT ASSIGNED
5	INPUT 5	CONTROL INPUT 1
6	INPUT 6	CONTROL INPUT 2
7	INPUT 7	NOT ASSIGNED
8	INPUT 8	STROBE (ACTIVATE)
9	COM (-)	
10	COM (-)	

Figure 4-3 Terminal Blocks on Main Board

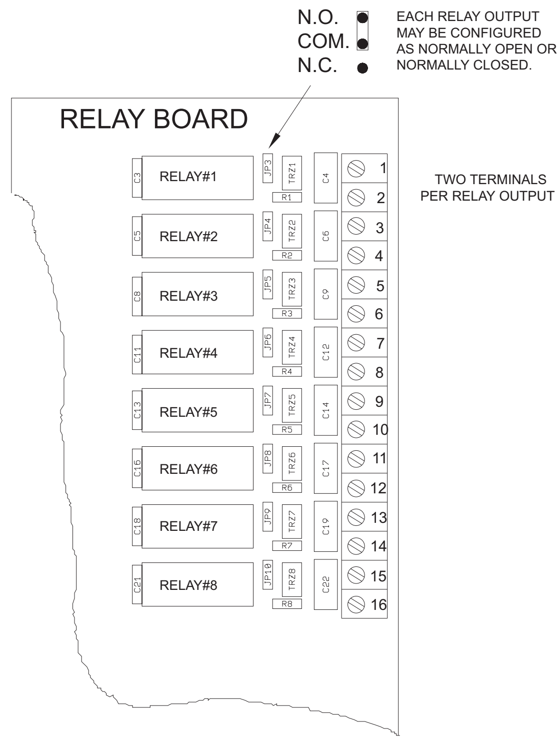
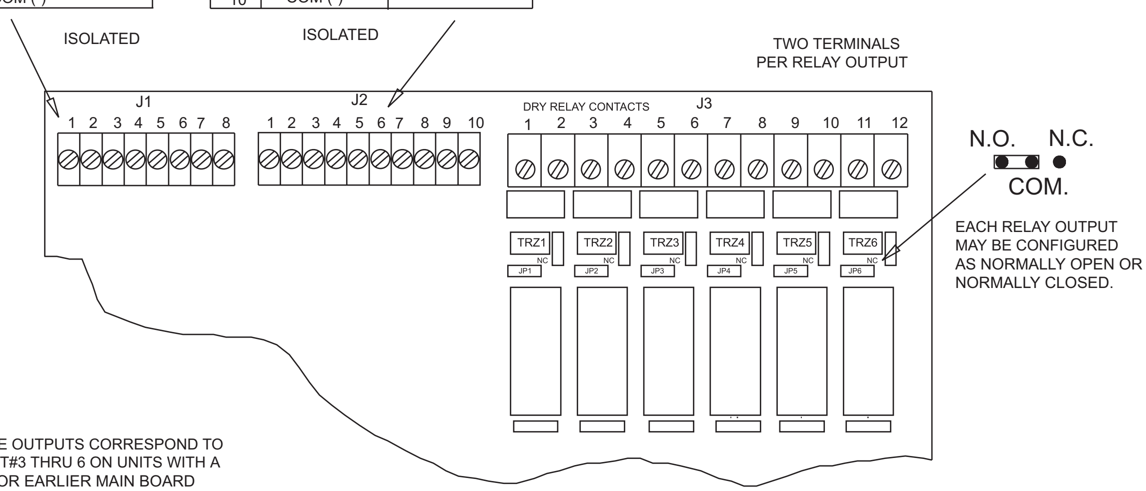


Figure 4-4 Terminal Blocks on Relay Board

	FUNCTION *
1	OUTPUT #4 (+)
2	COM (-)
3	OUTPUT #5 (+)
4	COM (-)
5	OUTPUT #6 (+)
6	COM (-)
7	OUTPUT #7 (+)
8	COM (-)

PIN#	FUNCTION DIGITAL INPUTS	THE INPUTS ARE FULLY PROGRAMMABLE, FACTORY DEFAULT SETTINGS ARE SHOWN BELOW
1	INPUT #9	NOT ASSIGNED
2	INPUT #10	NOT ASSIGNED
3	INPUT #11	NOT ASSIGNED
4	INPUT #12	NOT ASSIGNED
5	INPUT #13	NOT ASSIGNED
6	INPUT #14	NOT ASSIGNED
7	INPUT #15	NOT ASSIGNED
8	INPUT #16	NOT ASSIGNED
9	COM (-)	
10	COM (-)	



* THESE OUTPUTS CORRESPOND TO OUTPUT#3 THRU 6 ON UNITS WITH A REV 5 OR EARLIER MAIN BOARD

Figure 4-5 Optional Multiplexer Board Connections

Table 4-1. AC Power Connections

Terminal		Description	Customer Connection
1	Line (L)	AC hot	100 - 250 VAC, 50/60 Hz
2	Neutral (N)	AC neutral	
3	Ground (G)	Earth ground	

Table 4-2. Alarms Connections

Terminal	Description	Customer Connection
1	Relay #1 *	
2	Relay #1 *	
Two terminals per relay for	Relay 1 through 8	
15	Relay #8 *	
16	Relay #8 *	

* Note jumper configuration for N.O. (normally open) and N.C. (normally closed). Refer to Figure 4-4.

4.4.2 Installing DC Wiring

DC wiring for digital input lines and for the analog outputs should be twisted pair, minimum #24 AWG. Wiring of the RS-232C interface uses a standard cable, which is typically supplied by Orion as part of the startup kit.

Caution: Installing the DC wiring requires removing the electronics cover. The inside of the electronics enclosure should be accessed only by qualified service personnel.

NOTE: When replacing the electronics cover, secure the captive screws firmly, using a torque wrench at a 100 oz/inch setting.

A. Digital Input Lines

There are eight (8) digital input lines by which external commands or alarm input signals can be applied to the analyzer. The lines should be driven by dry contact closures from a programmable logic controller (PLC) or sensors-like Flow or Level. The asserted (ON) state of all the lines is programmable under setup output menus.

Both the main board and the mux board are equipped with digital input lines. The enabled functions on the main board include external control.

Two of the lines, control input #1 (pin #6) and control input #2 (pin #7), are used to encode the four external commands, as shown in Table 4-3. One line is used to strobe the input command. The strobe (pin #8) must be asserted for a minimum of 500 milliseconds in order for the external command to be accepted, as shown in Figure 4-6.

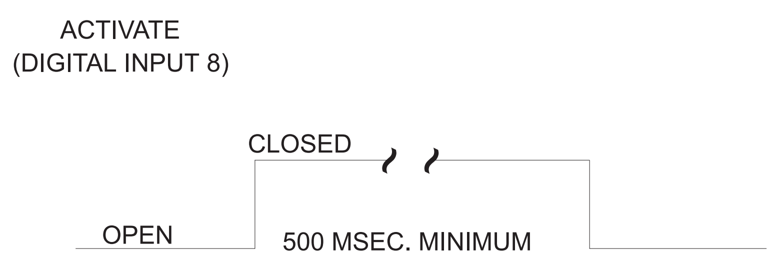


Figure 4-6 ACTIVATE Strobe Signal Timing Diagram

Table 4-3. Encoding of Digital Input Lines

Function	Control Input #1 Pin #6	Control Input #2 Pin #7
Standby	OFF	OFF
Analyze Once *	ON	OFF
Run Auto Mode	OFF	ON
Calibrate Once**	ON	ON

* Runs Method 01 once using Smp1.
** Runs Setup 01 once using Cal1
OFF = open input (HI) ON = closed (LO)

B. Analog Output Lines

Isolated 4-20 mA outputs (source drive) are available. These analog loops are powered from an internal isolated power converter. Both loops are capable of driving load resistances up to 1000 ohms.

Table 4-4. Analog Output Connections (Main Board)

Terminal	Signal	Customer Connection
1	0/4-20 mA Output	#1 (+)
2	Connector	#1 COM
3	0/4-20 mA Output	#2 (+)
4	Common	#2 COM
5	0/4-20 mA Output	#3 (+)*
6	Common	#3 COM*

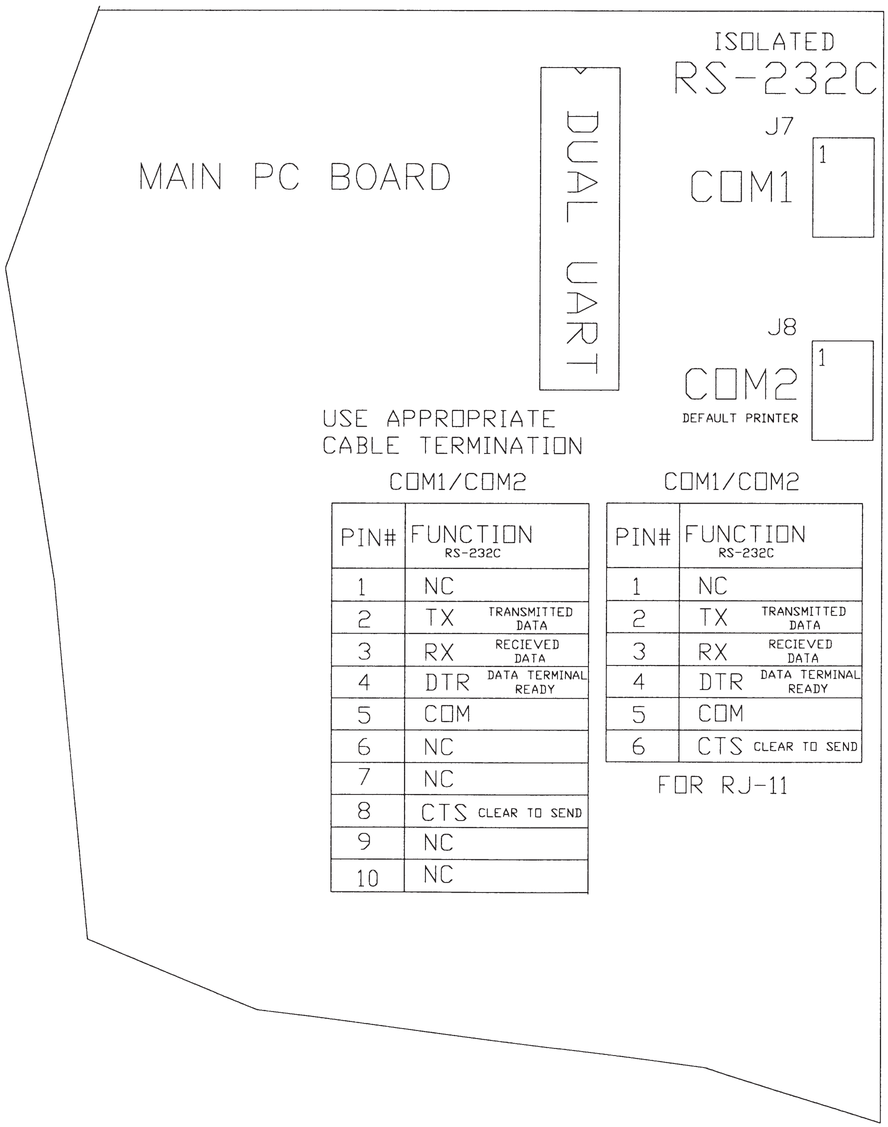
* Rev. A main PC board only.

C. RS-232C Wiring

The analyzer is fitted with two (2) RS-232C interfaces, which can be used to transfer data from the analyzer to a serially interfaced printer or other communications device, such as a modem. The analyzer is configured at the factory for bi-directional transfers through these serial ports, thereby allowing all control panel commands to be entered remotely.

The serial ports are configured for 9600 baud, eight-bit, no parity, one stop bit (8N1), no flow control transmissions operation by default.

The analyzer's internal RS-232C ports are normally cabled (25 feet or 100 feet) to an external connector, a standard D-shell DB-25S, configured for operation as a DCE (Data Communication Equipment) device. Either RS-232C port can be reconfigured as a DTE (Data Terminal Equipment) device through use of an appropriate converter plug. Table 4-5 lists the pinouts at the DB-9 (external) female connector.



PIN#	FUNCTION RS-232C
1	NC
2	TX TRANSMITTED DATA
3	RX RECIEVED DATA
4	DTR DATA TERMINAL READY
5	COM
6	NC
7	NC
8	CTS CLEAR TO SEND
9	NC
10	NC

PIN#	FUNCTION RS-232C
1	NC
2	TX TRANSMITTED DATA
3	RX RECIEVED DATA
4	DTR DATA TERMINAL READY
5	COM
6	CTS CLEAR TO SEND

Figure 4-7 Connecting the RS-232C Cable

Table 4-5. Pinouts at the RS-232C External Connector

Refer to Figure 4-2 a visual reference.

DB25S Pin	DB9S Pin	Signal	Description
3	2	Transmit data	Output from analyzer. This is the line on which data is transmitted to the printer or external communication device.
2	3	Receive data	Input to analyzer. This is the line on which data is transmitted to the analyzer.
5	8	DTR (Data Terminal Ready)	Flow control input to analyzer. In the hardware flow control mode, this line is asserted to enable data output from the analyzer. In no flow control mode, this line can be left unconnected.
7	5	Signal ground	Signal ground for both transmit and receive data.
4	7	CTS (Clear to Send)	Output from analyzer to indicate that the analyzer is ready to receive data. Used in hardware flow control.

Chapter 5: Analyzer Startup

Chapter 5 furnishes procedures you need to help start up the Orion Model 2030 Silica Analyzer for the first time and bring it into on-line service. Follow the procedures described in this section after completing all the installation steps in Chapter 4. To set up the Orion Model 2030 Silica Analyzer successfully for the first time, you **must** ensure that these specific procedures are completed:

- Installing the startup kit
- Preparing solutions
- Connecting the fluidics
- Powering up the analyzer
- Priming the fluidics
- Checking and adjusting the sample flow rate
- Checking and adjusting the time and date
- Calibrating for the first time
- Placing the analyzer into service

Each of these required procedures is described in the following sections.

> **NOTE:** Additional setup features that are usually performed later to alter analyzer operating parameters are described in Chapter 7.

5.1 Installing the Startup Kit

The Orion Model 2030 Silica Analyzer is shipped from the factory with a Startup Kit containing several components that **must** be installed before the analyzer is started. The kit also contains a number of spare parts that should be set aside for later use. The components that need to be installed are the magnetic stirrer and the peristaltic pump tubing. All spare fluid-handling lines, the reaction cell O-ring, and spare fuses need to be used only if problems arise.

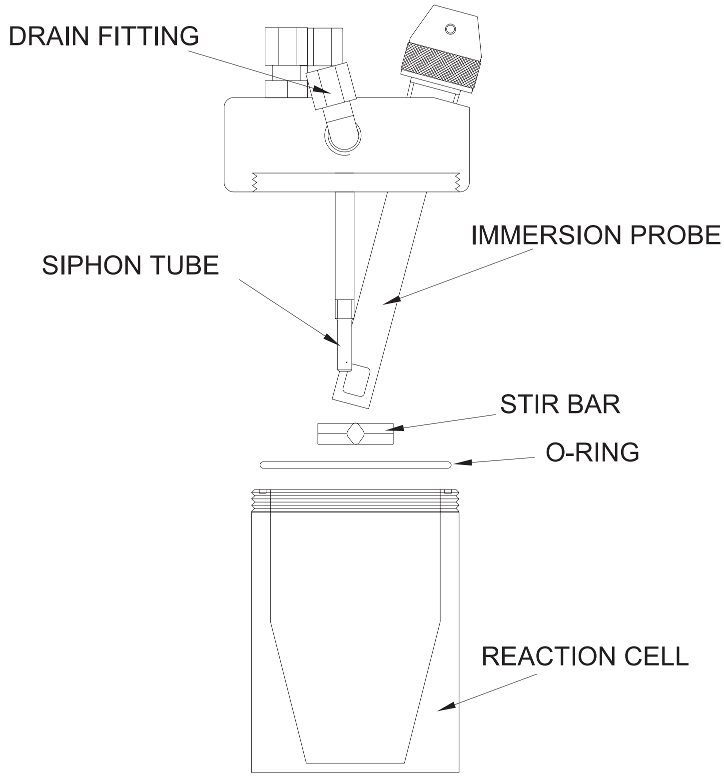


Figure 5-1 Stir Bar Installation and Reaction Cell Detail

5.1.1 Installing the Magnetic Stirrer

To install the magnetic stirrer, follow these steps:

1. Unscrew the knurled fastener located beneath the stirrer assembly, shown in Figure 2-4.
2. Rotate the stirrer assembly downward and to the right.
3. Unscrew the reaction cell, and remove it from the analyzer, as shown in Figure 5-1.
4. Rinse out the cell with de-ionized water, then fill it 2/3 full.
5. Place the magnetic stirrer into the cell, and screw the cell back onto the stirrer assembly.
6. Reposition the stirrer assembly by rotating it back into position. Tighten the knurled fastener by hand.

5.1.2 Installing the Peristaltic Pump Tubing

Refer to Figure 5-3 to establish the correct routing of pump tubing.

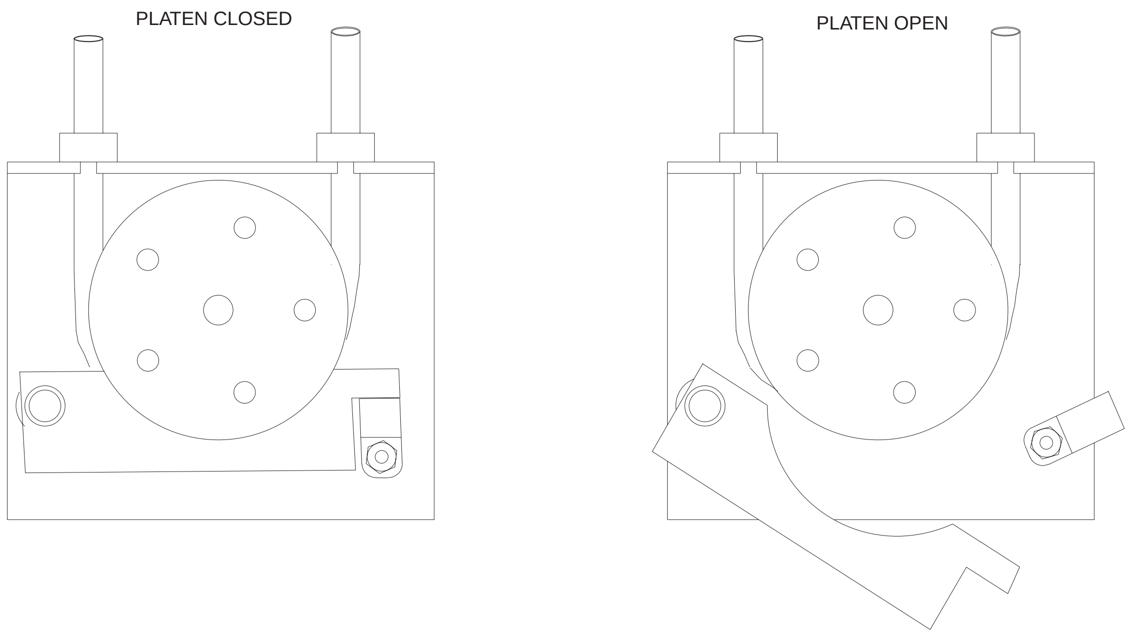


Figure 5-2 Installing Peristaltic Pump Tubing

To install pump tubing on each peristaltic pump, take the following steps:

1. Flip the pump lever to release the pump platen, as shown in Figure 5-2.
2. Open the package containing the pump tubing. Apply a thin film of silicone oil to the length of tubing between the collars.
3. Note that one collar is closer to its end of the tubing than the other. Place the tubing over the pump roller with the shorter tubing connection on the right. Secure both tubing collars above the pump bracket.
4. Attach the longer tubing connection to the barbed fitting on the reaction cell assembly. Attach the shorter tubing connection to the barbed fitting on the swing panel.
5. Flip the pump lever to secure the pump platen against the installed tubing, as shown in Figure 5-2.

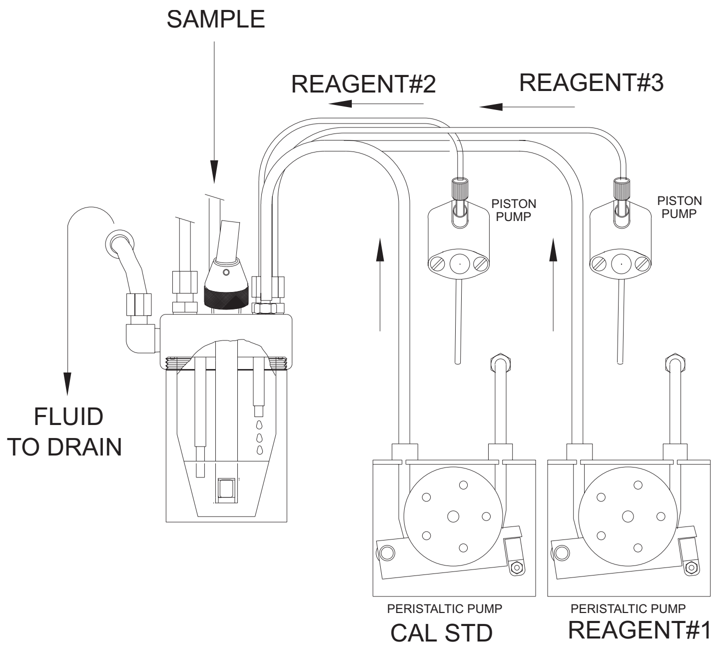
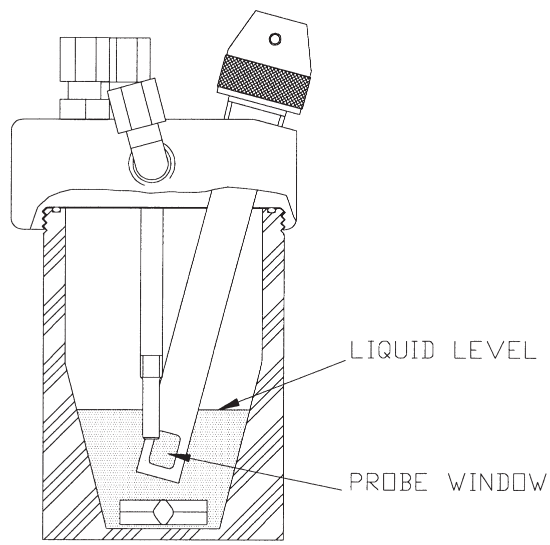


Figure 5-3 Tubing Paths


LIQUID LEVEL
PROBE WINDOW

5.2.1 Installing Reagent Check Valves

When reagents are located below the analyzer on the floor, draining may result between analysis especially when there is a long idle time between cycles. It is recommended that you install check valves (supplied by Orion as part of the startup kit) on the tubing of reagents 2 & 3 as shown in Figure 5-5. These check valves should be changed periodically.

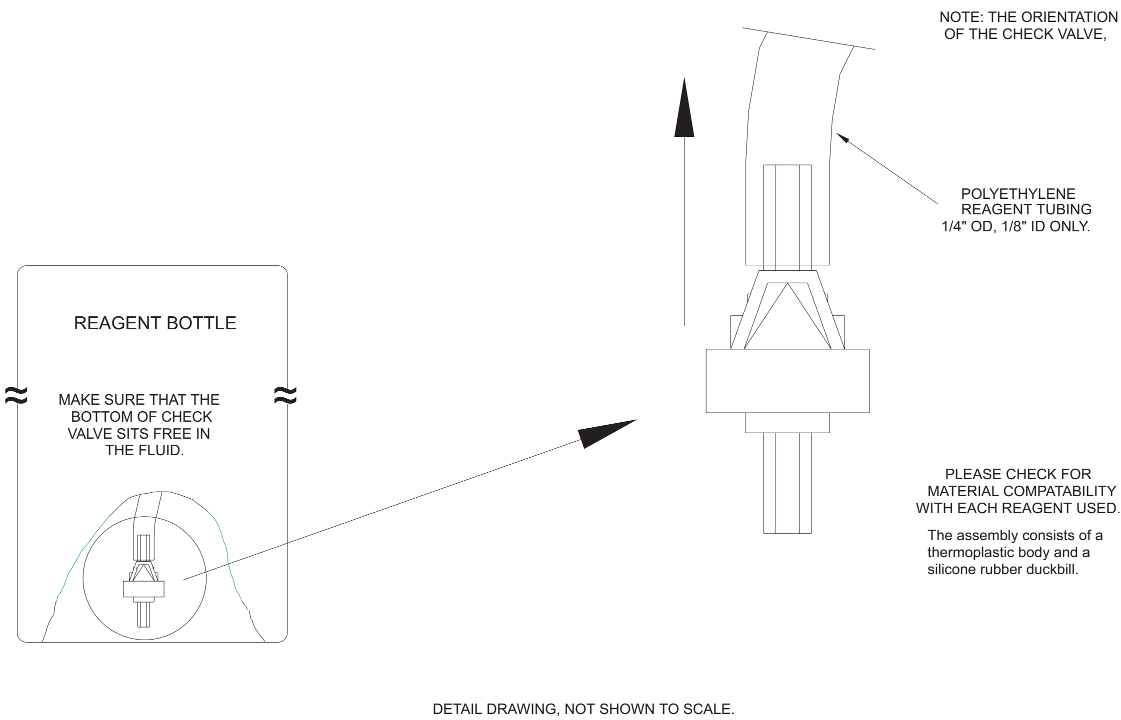


Figure 5-5 Reagent Check Valve Installation

5.3 Connecting the Fluidics

A functional description of Orion Model 2030 fluidics system is shown in Figure 2-1.

1. Position all solution containers, each filled to the desired volume with the required reagent or calibration standard.
2. Connect the necessary tubing connections appropriate to your application using minimum lengths of 1/4" OD polypropylene tubing, or the equivalent, to the fittings on the bottom of the analyzer, as illustrated in Figure 1-3.

   Specifically, connect:

   – All reagent lines.
   – Calibration standard line(s)
   – The sample stream supply lines.
   – The sample stream return lines, if required. The return lines can be plugged if no fast loop is desired.
   – The fluidics drain (3/4" MNPT tubing).

NOTE: The reaction cell drain line from the analyzer **must** be unobstructed and open to the atmosphere. Do not replace or lengthen this line, as this can cause errors in analysis. The drain **must** be capable of a flow rate not less than 1000 mL/min.

WARNING: IN MANY CHEMICAL ANALYSIS METHODS, THE REAGENTS MAY BE TOXIC OR OTHERWISE HARMFUL TO HUMAN HEALTH. OBSERVE APPROPRIATE PRECAUTIONS WHEN HANDLING AND DISPOSING THE REAGENTS. REVIEW THE APPROPRIATE PUBLISHED MATERIAL SAFETY DATA SHEETS REGARDING THE SAFE HANDLING AND DISPOSAL OF ALL REAGENTS.

NOTE: Connecting an Optional Purge Line—For details, refer to section 4.3.1.

5.4 Powering Up the Analyzer

1. Open the swing panel and power-up the analyzer by turning ON the power switch.
2. Allow the analyzer's electronics and optics subsystems to stabilize for at least five (5) minutes before priming the fluidics.

   When the analyzer is turned on, it goes through a power up sequence which resets the hardware and refreshes the software configuration.

The Orion Model 2030 Silica Analyzer is equipped with non-volatile random access memory (NVRAM) and electronically erasable/programmable read-only memory (EEPROM), where the analyzer configuration is stored. NVRAM can be thought of as a scratch pad on which the analyzer's operating parameters are stored; it is referred to, in this manual, as the active memory, or simply the memory.

EEPROM contains a replica of information critical to the analyzer's operation; it is referred to, in this manual, as the backup memory, or simply the backup.

Upon power up, the integrity of the memory and backup are checked first. If both check out fine, the following message appears on the control panel display:

```
Memory .. OK
Backup .. OK
```

If either the memory or backup is corrupted, the "`OK`" gets replaced by a "`Corrupt`" message. See Section 9.2 for further details.

The analyzer then proceeds with updating its configuration from memory. While the update is in progress, the numbers 1 through 9 display sequentially on the control panel's bottom line.

As each number displays, it means that a corresponding section of Orion Model 2030 hardware or software has been successfully updated. For example, the following message displays at step 6 of the power-up sequence :

```
System Startup ..
1.2.3.4.5.6.
```

After completing the update, the analyzer flashes the ready message as shown below:

```
— ORION RESEARCH
Model 2030 Silica
```

The following message now appears on the display:

```
12:00 AM Jan 01, 1999
Hit a Key to Proceed
```

This message corresponds to the bootup screen for the Operator access level. The analyzer is now ready to prime the fluidics.

> **NOTE**: The Orion Model 2030 Silica Analyzer has various access levels that protect key operations from unauthorized use. It is shipped from the factory at the “Operator” level, and powers up for the first time in this level. Subsequent power cycles leave the analyzer in the same level as it was prior to the power cycle. For further details on access levels, please refer to Chapter 7.

5.5 Priming the Fluidics

Before running chemistry, the fluid lines **must** be primed, that is, purged of entrapped air and filled with target fluids. This is accomplished with the “Prime Fluidics” function in the Operator menu. For details, please see Chapter 7.

> **NOTE:** The reagent pump seals are installed and properly seated at the factory. However, they should be re-seated if the analyzer has not been run for several weeks after being shipped from the factory. To re-seat the pump seals, follow the procedure described in Chapter 8.

5.6 Checking and Adjusting Sample Flow Rate

As shipped from the factory, the Orion Model 2030 Silica Analyzer is set up for an assumed sample-stream flow rate of 200 mL per minute. The analyzer functions properly as long as the sample flow rate remains within ± 10% of this value. If the actual flow rate is below this range, insufficient sample is drawn into the reaction cell during analysis. If the actual flow rate is above this range, the reaction cell overflows.

The easiest way to check the sample flow rate is to measure it in the sample stream outside the Orion Model 2030 Silica Analyzer. Note that only a moderately accurate measurement is needed. If an independent measurement cannot be made, follow the procedure described in the "Prime Fluidics" function in the Operator menu (see Chapter 7 for details).

5.7 Changing the Time and Date

The time and date can be modified through the "Prime Fluidics" function in the Operator menu. Please refer to Chapter 7 for details.

5.8 Calibrating for the First Time

When it left the factory, your Orion Model 2030 Silica Analyzer was thoroughly wet-tested and calibrated, the calibration factors were backed up and stored in memory, and the system readied to begin analyzing sample streams. The results of this activity were recorded in a Quality Control Report shipped to you with the analyzer and located on the inner side of the door panel.

Since the elapsed time between factory calibration and your startup process is unpredictable, it is important that you calibrate the analyzer again before you place it in service for the first time.

Please refer to Chapter 6 for instructions on calibrating the Orion Model 2030 Silica Analyzer. It is best to run three (3) calibrations. This takes 20-45 minutes; a result displays and prints (if a printer is installed) as each calibration is completed.

The reported result of a calibration is a number equal to the optical absorbance measured by the analyzer when presented with a calibration standard solution. The particular value of this number is not important, but it should be within ± 5 % of the corresponding value in the Quality Control Report. If so, you can be confident that all subsystems of your analyzer are working properly.

5.9 Placing the Analyzer into Service

Your Orion Model 2030 Silica Analyzer is now ready for routine operation. To place the analyzer in routine service, press the control panel **[RUN]** key. For more information on the actual analysis sequence, refer to Chapter 3.

The analyzer typically runs unattended, analyzing sample streams and calibrating itself at regular intervals. All relevant parameters were programmed at the factory based upon your application. Consequently, the analyzer is fully prepared for routine operation once you complete these startup procedures.

A qualified and authorized user can change a great many of Orion Model 2030's operating parameters through the password-protected "Technician Level" menu as explained in Chapter 7.

Chapter 6: Routine Operation

Chapter 6 describes the routine operation of the Orion Model 2030 Silica Analyzer. Routine operation is very straightforward, since the analyzer is designed to run automatically most of the time. Topics discussed in this chapter include:

- Accessing routine functions
- Stopping the analyzer
- Choosing a function
- Performing a function (running a calibration, validating a calibration standard, running an analysis, selecting standby operation, printing parameters, and setting the user access level)
- Performing startup functions (purging the fluidics lines, checking the flow rate, setting the time, and setting the date)
- Restarting the analyzer

The Orion Model 2030 operations described in this section appear on the *Operator Level* menu, one of two user access levels. The other user access level is the *Technician Level,* which offers many more detailed analyzer functions dealing with setting operating parameters and running diagnostic tests. You can access these additional functions only by entering a pass code, as described on page 6-7.

NOTE: If you are unfamiliar with the control panel, refer to Chapter 3 for an overview of the panel's display and keypad functions.

The Orion Model 2030 Silica Analyzer is usually running in automatic mode, sampling one or more fluid streams, measuring the concentration of silica in the sample fluid, reporting, and storing these results. The measurements are made at regular, programmed time intervals. In addition, the analyzer can calibrate itself automatically, also at regular intervals.

Routine operation consists of the following functions:

- Monitoring the Orion Model 2030 Silica Analyzer's automatic operation, checking to see if it is operating properly with no problems evident, such as empty containers, fluid leaks, errors reported in the display, etc.
- Interrupting this normal automatic state to perform routine maintenance
- Manually calibrating or analyzing samples

6.1 Accessing Routine Functions

The Operator Level menu accesses the routine functions listed in Table 6-1.

Table 6-1. Functions Available in Routine Operation

Displayed Message	Description
`Run Calibration ?`	Run one or more calibration cycles.
`Validate Cal Std ?`	Check the accuracy of a calibration standard or run an analysis on a grab sample.
`Run Analysis ?`	Run an analysis of a sample stream now.
`Run Standby ?`	Leave the analyzer in a controlled, inactive state.
`Print Menu ?`	Print stored calibrations, analysis results, system operating parameters, and/or system status.
`Set Access Level ?`	Change to Technician Level menu.
`Prime Fluidics ?`	Purge the fluidics lines of trapped air, then set up parameters required to put the analyzer into operation for the first time.

To perform any of these functions, refer to the appropriate subsection below. If you need to perform a function not listed in Table 6-1, first set the user access level to *Technician Level*, as described on page 6-7, then consult Chapter 7 of this manual.

Follow these steps to perform any of the functions listed in Table 6-1:

1. Stop the analyzer.
2. Choose the desired function.
3. Perform the desired function.
4. Re-start the analyzer.

6.2 Stopping the Analyzer

At any given time, the Orion Model 2030 Silica Analyzer might be active (analyzing a sample stream or calibrating) or inactive (idle or in standby mode). If it is active, to stop it, you must either wait until the present operation is completed or interrupt that operation.

To stop the analyzer, press the **[STOP]** key on the control panel.

The following message then displays:

```
12:00 Jan 01, 1999
Hit a Key to Proceed
```

6.3 Choosing a Function

Once the analyzer is stopped, the list of functions in Table 6-1 can be accessed in the same order as shown in the table by repeatedly pressing the **[NO]** key on the control panel. This sequence of choices repeats indefinitely.

6.4 Performing a Function

When the message corresponding to the desired function displays on the screen, that function can be executed using the **[YES]** key on the control panel. The actions taken on each of the functions are detailed in the following sections.

6.5 Running a Calibration

Although the Orion Model 2030 Silica Analyzer is usually set up to calibrate on a regular schedule, you may wish to execute a calibration cycle on command to assure that the analyzer is fully calibrated right now. This function runs a specified calibration setup without initiating the automatic mode. A number of calibrations can be run one after the other. Results are stored in the calibration buffer, and the analyzer proceeds to the *Validate Cal Std* menu when finished.

When this function is entered, you are first asked to specify the mode of analyses through the following display:

```
Calibration Mode =
  Auto Analysis
```

There are two modes of analysis:

Auto Analysis - The calibration cycle executed is identical to that of an automatic calibration; the sample capture and analysis procedure described in section 3.3.1 is executed using the device and method specified in the calibration setup; the results are printed and alarm conditions reported as in the automatic mode. When this mode is selected, the calibration setup and the repeat count need to be specified as shown in Table 6-2.

Table 6-2. Running an Auto Calibration

Description	Range	Default Value
Select the calibration	Setup to run.	
`Select Calibration =` `Setup 01 (S01)`	Setup 01 Setup 03+	Setup 01
Select the number of times to run this setup		
`Num of Cals to Run =` `1`	1 to 9	1

* Only setups previously established through the *Technician Level* menu are prompted.

Grab Analysis - This mode is useful if you wish to conserve standard solution, or bypass the normal wash cycle. You fill the cup 2/3 full with the standard. The analyzer then tries to capture the sample directly, rather than going through the six-step clean-and-capture procedure described in section 3.3.1. Details on the Grab Analysis procedure are found in section 6.5.1. When this mode is selected, you are first asked to specify whether you wish to measure and update the absorbance of only one calibration standard, through the following question:

```
Run Single Point
Calibration ?
```

If you press **[YES]** in response to this question, a variety of information needs to be provided, as shown in Table 6-2A. If you press **[NO]**, you are asked if you wish to measure and update the absorbance of two calibration standards through this question:

```
Run Dual Point
Calibration ?
```

For both options, you must specify the Calibration Setup to be updated. If you select the single-point option, you must specify the standard on which the calibration is to be run (Std1 or Std2), and the associated standard concentration. The standard concentration does not have to match the concentration specified in the calibration setup. Instead, once the new calibration curve has been determined, the analyzer updates the absorbances in the calibration setup to correspond to the concentration values stored in the setup.

After specifying the value, you are asked to remove the reaction cell, wash it, and fill it approximately two-thirds with the prepared standard, and then reattach the cup securely, through the following question:

```
Wash Cup & Fill With
000.00 Std ?
```

Upon pressing **[YES]**, the analyzer now executes the Grab Analysis sequence (as described in section 6.5.1). After the sample has been captured, reagents are added in the manner specified by the calibration method, and an absorbance is measured. This absorbance is associated with the specified standard (Std1 or Std2). Thus, if the low-point (Std1) is selected, the manual calibration works exactly like a Cal on Std1, whereas if the high-point (Std2) is selected, if functions exactly like Cal on Std2. All alarms, repeat limits, and actions, etc. are enforced.

> **NOTE:** the 000.00 in the above prompt is replaced by the standard concentration value supplied by the user.

Table 6-2A. Running a Single-Point Grab Calibration

Description	Range	Default Value
Select the calibration setup to update `Cal to Update = Setup 01 (S01)`	Setup 01 Setup 03*	Setup 01
Select the point that the measured absorbance is going to modify. `Calibration Point = Std1 (low point)`	Std1 (low point) Std2 (high point)	Std1 (low point)
Specify the standard concentration. `Cal Std1 Conc = +000.00`	† Max Conc Value (see Set Display Format for details)	Value specified in the calibration setup, entered at the Technician Level

* Only setups previously established through the *Technician Level* menu are prompted.

If you select the dual-point option, you must specify both standard concentrations after specifying the Calibration Setup. The Orion Model 2030 Silica Analyzer runs the single-point procedure as described above, first on the low point (the standard with the lower concentration value), followed by the high point. The new slope and offset are calculated only after both measurements are made, and all limits and alarms are tested at the end of the second calibration.

6.5.1 Running a Grab Analysis

The *Grab Analysis* option allows you to run a calibration, validation, or analysis without having to wash the cell using a standard pump or sample valve. It executes an analysis cycle very different to the once described in section 3.3.1, one that reduces the six-step sample capture procedure to one step. However, it is the user's responsibility to ensure that the cup is cleaned and filled with the correct fluid prior to executing the cycle.

Prior to beginning the grab analysis cycle, you are asked to remove the reaction cell, wash it, and fill it approximately two-thirds with fluid, and then reattach the cup securely. In most situations, the act of screwing on the reaction cell generates enough pressure to fill the drain and pressurize the cell. Thus, when the air vent is opened, siphoning takes place and the correct sample volume is captured. To ensure proper siphoning, the cell is allows to drain for 30 seconds. This siphon time is a function of the calibration pump's viscosity; if you wish to reduce the drain time, you need to modify the CalPump1 viscosity under Setup|Set Pump Info as a super user. Then reagents are added in the manner specified in the method, and an absorbance is reported. In the case of a "grab analysis" calibration, the absorbance is used to calculate the new calibration curve; for a "grab analysis" validation or analysis, the absorbance is used to calculate the reported concentration.

If the flow sensor is enabled, it is used to determine if siphoning occurs. First, the flow sensor checks to see if fluid is present in the drain tube. If no fluid is present, the analyzer siphons for 3 seconds. This is done in order to move any bubbles that may be trapped around the flow sensor. If still no fluid is detected, the 3 second siphon is repeated.

If fluid is still not detected, and the calibration pump is enabled, the air vent is opened and the calibration pump is pumped in reverse for a time corresponding to the time required to pump 8 mL of fluid. This pumps back the standard and fills the line with air. The air vent is then closed and the calibration pump is pumped forward for a time corresponding to the time required to pump 8 mL of fluid, effectively pressurizing the cup using air. After these "Evacuate" and "Fill" steps, if there is still no fluid detected, an "*Unable to Siphon*" error message displays and the cycle is aborted.

NOTE: The "Evacuate" and "Fill" steps are executed only if CalPump1 is available (enabled) on your system. These steps and the two 3-second siphon steps are executed only if the flow sensor is enabled.

If fluid is detected in any one of the aforementioned steps, the analyzer proceeds to do the 30-second siphon to capture the sample, add reagents, make measurements, etc.

6.5.2 Validating a Calibration Standard

You can check the Orion Model 2030 Silica Analyzer's calibration accuracy at any time using this function. Validation consists of running a single calibration cycle and reporting the result in concentration. This reported result can then be compared to the expected value, which is the known concentration of the calibrating solution, to determine the accuracy of calibration.

Running a validation is identical to running an analysis on the calibration device: the results are printed, alarm conditions are tested, and the analog outputs are exercised if the setup references a sampling valve (stream).

The advantage of using this function over the Run Analysis function is that prior knowledge of the device and method is not required as you must provide only the setup you wish to run. A number of validations can be run one after the other. Results are stored in the analysis buffer.

Table 6-3. Validating a Calibration Standard

Description	Range	Default Value
Select the analysis cycle to use when validating (see section 6.5.1). `Validation Mode = Auto Analysis`	Auto Analysis Grab Analysis	Auto Analysis
Select the calibration setup to validate. `Select Calibration = Setup 01 (S01)`	Setup 01 Setup 03	Setup 01
Select the number of times to run this setup. `Num of Validations = 1` **NOTE:** This final step is not executed in case of a grab analysis.	1 to 9	1

+ Only setups previously established through the *Technician Level* menu are prompted.

6.6 Running an Analysis

Although the Orion Model 2030 Silica Analyzer is usually set up to analyze sample streams on a regular schedule, you may wish to execute an analysis on command to obtain an immediate result. This function allows you to run multiple analyses on a sample without requiring that the automatic mode be initiated. The analyzer then runs the specified number of analyses, tests for alarm conditions, exercises the analog outputs, and prints the results exactly as if it were in the automatic mode.

Table 6-4. Running an Analysis

Description	Range	Default Value
Select the cycle (mode) to use when analyzing (see section 6.5.1). `Analysis Mode = Auto Analysis`	Auto Analysis Grab Analysis	Auto Analysis
Select the stream to analyze. `Stream to Analyze = Sample1`	Sample 1-6 + CalPump1	Sample 1
Select the analysis method. `Select Method = Method 01 (M01)`	Method 01 through Method 10*	Method 01 through Method 10
Select the number of times to run this analysis. `Num of Analyses = 1`	1 to 9	1
NOTE: This final step is not executed in case of a grab analysis.		

+ Only setups previously established through the *Technician Level* menu are prompted.
* Only methods previously set up through the *Technician Level* menu are prompted.

NOTE: This function does not initiate the auto analysis mode. To accomplish this, press the **[RUN]** key on the control panel after this function is completed.

6.6.1 Selecting Standby Operation

Standby operation is recommended during long periods of inactivity. During standby operation, all fluidics devices are shut down and the analyzer goes into a standby mode in which the pumps are primed on an hourly basis to prevent degradation of pump seals or pinching of the peristaltic pump tubing.

When you choose this function, the analyzer may first execute a wash cycle if programmed to do so. For details on setting up the Standby Wash, please refer to Chapter 7.

The Orion Model 2030 Silica Analyzer automatically goes into standby operation after half an hour (30 minutes) of inactivity when not in automatic operation. This standby timeout is user-configurable; for details, refer to Chapter 7.

6.6.2 Printing Parameters

There are four sub-functions to the Print Menu, as shown in the table below.

Table 6-5. Print Menu Sub-functions

Displayed Message	Description
`Print Calibrations?`	Print all stored calibration results, exactly like Print Calibrations in the Technician level. See Chapter 7 for details.
`Print Analyses?`	Print all stored analysis results, exactly like Print Analysis in the Technician level. See Chapter 7 for details.
`Print All Params?`	Print the analyzer configuration, exactly like Print All Params in the Technician level. See Chapter 7 for details.
`Print Status ?`	Print the system hardware status, exactly like Print Status in the Technician level. See Chapter 7 for details.

To perform any one of these functions, navigate to the Print Menu function as shown in Table 7-17, press **[NO]** on the control panel until you reach the appropriate message, then press [**YES**].

6.6.3 Setting the User Access Level

Access to functions beyond those described in this section of the manual requires switching to the *Technician Level* menu. You can change the menu only by entering a pass code, a security device to inhibit unauthorized access.

> **NOTE:** Do not attempt to access Orion Model 2030's *Technician Level* menu if you are not authorized to do so. Obtain authorization first from the appropriate person at your facility, then learn the pass code before proceeding.

When you select this function, the following message displays:

```
Change Access Level
to Technician ?
```

1. To change the access level, press the **[YES]** key on the control panel; the following message displays:

   ```
   passcode = *****
   ```

2. Enter the passcode as you would any other number. A passcode can be any length up to five digits. Only one digit can be viewed at a time.

   As each digit is entered, a minus sign (-) appears in that position. Any digit can be reviewed by navigating the cursor to the digit in question using the **[LEFT]** and [**RIGHT]** keys.

   When all the digits are set, press the **[YES]** key on the control panel.

   If the pass code was entered properly, the main menu of the Technician Level displays:

   ```
   12:00 AM Jan 01, 1999
   SETUP  CAL  DIAG  STDBY
   ```

   Otherwise, the following message displays on the screen:

   ```
   passcode = *****
   * Invalid Passcode *
   ```

   You are then provided another chance to enter the passcode at this stage. The Orion Model 2030 Silica Analyzer remembers the original digits entered, and allows you to modify them. Pressing the **[NO]** key at any time during passcode entry takes you back to the operator level.

6.7 Performing Startup Functions

6.7.1 Priming the Fluidics

1. Press the **[YES]** key on the control panel and the following message appears on the display:

   ```
   Connect Tubing and
   Press YES when Ready
   ```

2. Verify that the tubing is properly connected and press **[YES]**.

   The analyzer now prompts whether you wish to prime the piston pumps by displaying this question:

   ```
   Prime Piston Pumps ?
   ```

3. Press **[YES]** or **[NO]** as appropriate.

   If you press **[YES]**, all piston pumps get turned on and a five-minute countdown initiates. The following message appears on the display while the pumps are being primed:

   ```
   Priming Pumps 4:59
   Press YES when Ready
   ```

   The countdown is based on the time it would take for a piston pump to purge six feet (6′) of reagent line.

4. To stop priming at any time during the countdown, press the **[YES]** key on the control panel.

   If the pumps do not get primed within the five-minute interval, you must repeat the Priming the Fluidics procedure.

   After priming the piston pumps, the analyzer prompts you whether you wish to prime the peristaltic pumps by displaying this question:

   ```
   Prime peristaltic
   Pumps ?
   ```

5. Press **[YES]** or **[NO]** as appropriate.

   Pressing **[YES]** now turns on all peristaltic pumps for one minute. As is the case for priming piston pumps, repeat the Priming the Fluidics procedure; a one-minute interval is insufficient to prime the peristaltic pumps.

   You can now test for flow on each one of the sample streams on your analyzer as described in the next section.

6.7.2 Checking the Flow Rate

```
Test Smp1 Flow ?
```

1. Rotate the stirrer assembly downward and to the right.
2. Unscrew the reaction cell, and remove it from the analyzer.
3. Secure a graduated laboratory cylinder or other calibrated vessel at the cell location, in effect temporarily replacing the cell.
4. Press the **[YES]** key on the control panel to initiate the measurement. In this step, the analyzer turns the sample valve on for one (1) minute.

NOTE: You may not have a sufficiently large graduated cylinder for larger sample flow rates. In such a situation, go to step 5.

5. Measure the volume in the graduated cylinder. This is the effective flow rate.

   If the measured flow rates are within ± 10% of the default 200 mL/min, there is no need to reset programmed flow rates. Any flow rate that does not lie within these limits should be reset at the next prompt.

   Enter it through the following display message:

   ```
   Set Smp1 Flow Rate ?
   (curr. 200 mL/min)
   ```

6. As this was the amount of water that flowed through the valve during one minute, it is the effective flow rate in.
7. If more than one sample stream has been set up, repeat this procedure for each stream to determine each flow rate.
8. Remove the calibrated vessel. Fill the reaction cell 2/3 full with deionized water and then re-install.

6.7.3 Setting the Time and Date

To set the time and date, follow the prompts appearing on the control panel and enter the required parameters.

6.8 Restarting the Analyzer

Once the desired function has been completed, press the **[RUN]** key on the control panel to resume normal, automatic operation.

6.8.1 Purging the Fluidics Lines

To purge the fluidics lines, you can use Hardware Test, Fluidics Control menu, or Priming the Fluidics under the Operator menu (see section 6.7.1).

6.9 Describing Display Results

You can now review stored analysis and calibration results, as well as active alarms, while the analyzer is in the auto run mode. This feature can be activated during auto analysis by pressing any key, other than the **[STOP]** and **[RUN]** keys. The following message then appears on the display:

```
Display Previous :
CAL RSLT ALARM EXIT
```

Key	Description
[CAL]	View all stored calibration results, using key strokes identical to those in *Diagnostics|Review Calibrations* (see page 7-54)
[RSLT]	View all stored analysis results, using key strokes identical to those in *Diagnostics|Review Analyses* (see page 7-55)
[ALARM]	View all active alarm conditions, using key strokes identical to those in *Diagnostics|View Active Alarms* (see page 7-56)
[EXIT]	Return to displaying messages as seen during automatic analysis; this occurs automatically after two (2) minutes of inactivity

When you press [RSLT], the analyzer prompts you to answer the following question:

```
Keep Latest Result
On Display ?
```

If you press **[NO]**, in response to this question, you can review stored analysis results as you would under *Diagnostics|Review Results|Review Analyses*. If you press **[YES]**, in response to this question, the analyzer continuously displays the latest result as long as the analyzer is in automatic operation. The analyzer retains this display mode even through a power cycle. If you press **[STOP]** to terminate automatic operation, the analyzer continues in this display mode after you restart automatic operation. This display mode terminates if you press any key other than **[RUN]** or **[STOP]** while the latest result is being displayed. In this situation, you are back in the "Display Results" mode, and you can continue to review stored analyses, calibration, and alarms while the analysis is in progress.

Chapter 7: Advanced Operation

Chapter 7 details the advanced functions available to an authorized user of the Orion Model 2030 Silica Analyzer, functions that go beyond those typically encountered in routine operation (see Chapter 6). These functions fall into three categories:

- Setup functions
- Calibration/Analysis functions
- Diagnostics functions

The functions associated with these three categories are described in detail in corresponding subsections.

The large number of available advanced functions allow for a great deal of flexibility in Orion Model 2030 Silica Analyzer applications, customizing the analyzer's performance to your precise needs.

7.1 Accessing Advanced Functions

The Technician Level menu is typically accessed from the Operator Level menu by entering a pass code, as described in Chapter 6. The power-up message for the technician level is shown below:

```
12:00AM Jan 01,1998
SETUP CAL DIAG STDBY
```

The three function categories can be reached by pressing any one of the function keys (**[F1]**, **[F2]**, **[F3]**, or **[F4]**) as described in Table 7-1.

Table 7-1. Advanced Operation Function Keys

To Access ..	Press ..	Which ..
SETUP	**[F1]**	Accesses the Setup Menu. Through this menu, you can .. – Modify a Calibration Setup – Modify an Analysis Method – Modify Stream Information – Modify the Analysis and Calibration Sequences – Modify Alarm and Relay Outputs – Modify Miscellaneous Parameters
CAL	**[F2]**	Accesses the Calibration/Analysis Menu. Through this menu, you can .. – Run a manual calibration – Run a validation – Run a manual analysis
DIAG	**[F3]**	Accesses the Diagnostic Menu. Through this menu, you can .. – Print various sections of memory and the hardware status – Review and print active alarms – Review and print stored calibration and analysis results – Perform hardware tests – View detector levels, the absorbance, power rails, and the software revision – Calibrate the electronics – Clear and reset sections of memory
STDBY	**[F4]**	Puts the analyzer into Standby Operation. See *Standby Operation* (section 7.1.3) for details.

> **NOTE**: Do not attempt to access the analyzer's *Technician Level* menu if you are not authorized to do so. Obtain authorization first from the appropriate person at your facility, and learn the pass code, before proceeding.

7.1.1 Returning to the Operator Level

At any point in the Technician Level, to return to the Operator Level, on the control panel, press the **[STOP**] key and then **[ACCESS]** (**[NO]**). This results in the following message displaying:

```
Change Access Level
to Operator ?
```

Pressing the **[YES]** key returns you to the Operator Level.

7.1.2 Explaining Standby Operation

This is a power save mode during which all fluidics devices are shut down, but primed on a per-hour basis to prevent degradation of the piston pump seals or pinching of the peristaltic pump tubing. When going into standby mode, the Orion Model 2030 Silica Analyzer may perform a standby wash if programmed to do so.

7.1.3 Saving and Recovering

Because analyzer operation is user-programmable to a large degree, the integrity of analysis results, calibration data, and setup data is of great importance. For this reason, each setup function has the option of saving a replica of all related parameters to the backup memory. Note that this save should be done only when absolutely necessary, as the save overwrites the current information in backup memory.

You may also recover all related parameters from the backup memory on command for each setup function. Take care when doing so, as the recover overwrites the current information in active memory.

> **NOTE**: Take care when saving and recovering as these commands overwrite the current information in the backup and active memories, respectively. As there is no undo feature, once overwritten, this information is lost forever.

> **NOTE**: Writes to backup memory are initiated only upon user command. It is the user's responsibility to ensure that all modifications to the factory configuration have been backed up properly.

7.2 Defining a Calibration Setup

The Orion Model 2030 Silica Analyzer uses a two-point calibration technique when calculating concentrations from a measured absorbance. Each point associates a known concentration with a known absorbance. Information regarding the measurement and calculation of a calibration curve is stored in the calibration Setup. Specifically, a calibration Setup consists of the following parameters:

- Standard 1 Concentration
- Standard 2 Concentration
- Standard 1 Absorbance
- Standard 2 Absorbance
- Calibration Device
- Calibration Method
- Calibration Type
- Calibration Repeat Alarm

Up to three (3) separate calibration Setups can be defined. Each calibration Setup has an up to 9-character identifier (filename) associated with it. References to the calibration Setups are abbreviated as "S01" through "S03." These tags are used to identify the calibration Setup during setup and automatic operation. Setup 01 is always defined.

The parameters associated with calibration Setups can be modified through the Set Up Calibration menu, which is accessible from the *Technician Level* by following the procedure described in Table 7-2.

Table 7-2. Set Up Calibration Menu

Displayed Message	Press ..	Explanation
`12:00AM Jan 01,1997` `SETUP CAL DIAG STDBY`	[SETUP]	Select Setup menu.
`Set Up Menu ?`	[**YES**]	Confirm Setup menu selection.
`Set Up Calibration ?`	[**YES**]	Select Calibration Setup.
`Select Calibration =` `Setup 01 (S01)`		Select the Calibration Setup to be modified. Use arrows to scroll through the Setups and [**YES**] to select the Setup. [**NO**] aborts this function and displays the next function (Set Up Method).

> **NOTE:** When a new setup is being defined, the Orion Model 2030 Silica Analyzer prompts you to confirm creation of the new calibration Setup through the following display:

```
Defining New Setup.
Are you sure ?
```

Note that Calibration Setup 01 is always defined. After pressing **[YES]**, the first message displays as shown in Table 7-3.

The functions available under the Set Up Calibration menu are outlined in Table 7-3.

Table 7-3. Set Up Calibration Menu Functions

Displayed Message	Description
`Set Cal Std Conc ?`	Set the calibration standard concentrations and units.
`Set Cal Std Abs ?`	Set the absorbance values corresponding to the two calibration standard concentrations.
`Set Cal Device ?`	Select the fluidics device to use for providing the calibration standard for this setup.
`Set Cal Method ?`	Select the pre- and cell-wash volumes, reagent addition, and post wash sequences and stability criterion to be used for this setup by specifying an analysis method with the same parameters.
`Set Cal Type ?`	Select the type of calibration.
`Set Repeat Alarm ?`	Set up the calibration repeat alarm for this Setup.
`Save Cal Setup ?`	Save the calibration Setup to backup memory.
`Recover Setup ?`	Recover the calibration Setup from backup memory into active memory.

To perform any one of these functions, navigate to the Set Up Calibration menu as shown in Table 7-2, press the **[NO]** key on the control panel until you reach the appropriate message, then press **[YES]**.

A detailed description of the functions available in Table 7-3 is provided in subsections 7.2.1-7.2.8.

7.2.1 Set Calibration Standard Concentration

Set the concentrations corresponding to the two standards selected for the calibration curve. When this function is entered, the following message displays:

```
Std1 = 000.00
UNITS SET  STD2 EXIT
```

Or

```
Std2 = 200.00
UNITS SET  STD1 EXIT
```

Table 7-4. Calibration Standard Concentrations

Key	Description	Range	Default Value

[UNITS]	Select the analyzers to be used when reporting concentrations. The analyzers, once set, remain the same for both standards.
	`Conc Units =`
	`none`
		none
		ppm
		ppb
		%
		mol
		gm/l
		mg/l
		ug/l
			ppb

[SET]	Set the specified calibration standard (Std1 or Std2) concentration.
	`Cal Std1 Conc =`
	`+000.00`
	Note that the analyzer allows you to set two equal concentrations; see Warning Messages below.
		± Max Conc Value (see **Set Display Format** for details)	Std1 = 0.00
			Std2 = 200.00

[STD1] [STD2]	Switch between displaying Std1 and Std2 concentrations.	Initially always shows the Std1 concentration.	
[EXIT]	Exit to Set Cal Std Abs		

Warning Messages	Message Description
`Std1 = 00.000` `** Check S01 Conc **`	The two standard concentrations for calibration Setup 01 are equal.
`Std1 = 00.000` `** Check S01 Abs **`	The two standard absorbances for calibration Setup 01 are equal.

7.2.2 Set Calibration Standard Absorbance

Set the absorbance values corresponding to the standard concentrations. When this function is entered, the following message displays:

```
Std1 Abs = 0.000
      SET  STD2 EXIT
```

Or

```
Std2 Abs = 0.000
      SET  STD1 EXIT
```

Table 7-5. Calibration Standard Absorbance

Key	Action/Description	Range	Default Value

[SET]	Set the specified standard (Std1 or or Std 2) absorbances.
	`Cal Std1 Abs =`
	`+0.000`
	Note that the analyzer allows you to set two equal absorbances; see Warning Messages below.
		± 3.000	Abs1 = 0.000
			Abs2 = 0.210

[STD2] [STD1]	Switch between displaying Std1 and Std2 absorbance.	Initially always shows the Std1 absorbance.	
[EXIT]	Exit to Set Cal Device		

Warning Messages	Message Description
`Std1 = 0.000` `** Check S01 Conc **`	The two standard concentrations for calibration Setup 01 are equal.
`Std1 Abs = 0.000` `** Check S01 Abs **`	The two standard absorbances for calibration Setup 01 are equal.

7.2.3 Set Calibration Device

There is only one calibration pump on the Orion Model 2030 Silica Analyzer, which is typically used to pump deionized water. If additional standards are needed during automatic operation, they must be delivered via a sample valve. An external pump can be configured to deliver the calibration standard through a sample valve (see Set Ext Smp Device for details).

Description	Range	Default Value

Select the device to be used for delivering the calibration standard.
 	
`Calibration Device =`
`      CalPump 1`
	CalPump1
	Sample 1
	
	:
	Sample 6 †
		CalPump1

† Only those devices available on your system are prompted.

7.2.4 Set Calibration Method

Each method contains information regarding the execution of the analysis cycle. By specifying the method to be used during a calibration, you are indicating the wash volumes, reagent addition sequence, blanking, post wash sequence, and stability rate criteria to be used during the calibration.

Description	Range	Default Value

Select the method to be used for while running a calibration.
 	
`Select Method =`
`Method 01 (M01)`
	Method 01
	:
	
	Method 10 †
		Method 01

† Only methods previously set up through the Set Up Method menu are prompted.

Warning Messages	Message Description
`Select Method =` `* No Other Methods *`	Only one method has been defined in Setup Menu and is used by default.

7.2.5 Set Calibration Type

There are three calibration types from which to choose:

1. **Cal on Std1**: The measured absorbance is associated with calibration standard 1 concentration (Std1), for this setup.
2. **Cal on Std2:** The measured absorbance is associated with calibration standard 2 concentration (Std2), for this setup.
3. **Cal on 1 Update 2:** The measured absorbance is associated with calibration standard 1 concentration (Std1), for this setup. In addition, the standard 2 absorbance (Std2 Abs) is modified so that the span, defined as the difference between the two standard absorbances, remains the same.

Description	Range	Default Value
Select the type of calibration device.		
`Calibration Type =` `Cal on Std 2`	Cal on Std 1 Cal on Std 2 Cal on 1 update 2	Cal on Std 2

7.2.6 Set Calibration Repeat Alarm

The Calibration Repeat Alarm is triggered when the measured absorbance has drifted significantly from the original value. The measured absorbance is compared against the absorbance value of the appropriate calibration standard (stored in this calibration Setup). If the new calibration absorbance is not within a specified percentage of the allowed tolerance, a Calibration Fault is registered, and the specified fault action is taken. When this function is entered, the following message displays:

```
Rpt = 5%, rel, C+C
RELAY SET  MODE EXIT
```

The above display represents calibration repeat limit of 5% relative to the previous calibration result, with an action of clear and continue in case of a fault. The two repeat references are defined as follows:

1. **Relative (rel):** The previous recorded calibration result using this setup is used as the basis for calculating the difference (which is compared against the calibration repeat limit).
2. **Absolute (abs):** A user-specified value is used as the basis for calculating the difference.

There are three repeat actions, described below:

1. **Save & Continue (S+C):** If the measured absorbance is outside the calibration repeat limit, the analyzer flags an error but stores the measured absorbance in the calibration Setup and uses it as a valid point in the calibration curve.

2. **Clear & Continue (C+C):** If the measured absorbance is outside the calibration repeat limit, the analyzer flags an error and discards the measurement.
3. **Save & Halt (S+H):** If the measured absorbance is outside the calibration repeat limit, the analyzer flags an error, stores the measured absorbance in the calibration Setup, uses it as a valid point in the calibration curve, and halts the analyzer if it is in automatic operation.

Note that the measured absorbance and associated alarms are always stored in the Calibration result buffer, regardless of the calibration fault action.

Key	Description	Range	Default Value
[RELAY]	Select the relay to be used for reporting this alarm condition.		
	`S01 Repeat Alarm = Not Assigned`	Any Free Relay †	Not Assigned
[SET]	Set the calibration repeat limit.		
	`S01 Repeat Limit = 005 %`	2-100%	5%
	Select the repeat reference		
	`Repeat Reference = Relative`	Relative Absolute	Relative
	If the repeat reference is specified as absolute, confirm the value being referenced.		
	`Ref Abs = 0.000 Are you sure ?`		
	To change the absolute reference value, answer **[NO]** to the above question and enter the appropriate value:		
	`Ref Abs = +0.000`	± 3.000	0.000

Key	Description	Range	Default Value
[MODE]	Select the action to take when the calibration is outside its repeat limits. `S01 Repeat Action = Clear & Continue`	Disabled Save & Continue Clear & Continue Save & Halt	Save & Continue
[EXIT]	Exit to Save Cal Setup		

† Only those relays available on your system not being used for driving external devices or exclusive alarms are prompted.

7.2.7 Save Calibration Setup

Save the current calibration information to backup memory. Information stored in the backup can be recovered by clearing memory during a Wild-Card reset, or in the Clear Memory menu in the Diagnostics section. A "`Please Wait ..`" message displays while the save is in progress; the save typically takes 1-5 seconds, during which all control panel keys, including the [RUN] and [STOP] keys, are disabled. Disabling the keys ensures that a partial save does not corrupt the setup when recovered later.

NOTE: Save only when it is absolutely necessary. Once the save is initiated, the current backup memory gets overwritten, so the calibration information for a previously saved setup is erased. As there is no undo feature, this data is lost permanently.

7.2.8 Recover Calibration Setup

Recover the data from the backup memory. As is the case in Save Cal Setup, the "`Please Wait ..`" message displays, and the [RUN] and [STOP] keys are disabled during the recovery. The recover permanently alters any information associated with the current setup stored in the active memory. After recovering, the analyzer performs checking to make sure that the data recovered is still valid. In case of invalid data, the following messages appears:

Warning Messages	Message Description
`S01 refers to M03.` `Change to M01 ?`	The calibration references a method (Method 03) that has since been cleared. The analyzer automatically resets the method to Method 01, which is always defined. If this is acceptable, press **[YES]**, otherwise, the method must be assigned from the list of currently defined methods.

7.3 Defining an Analysis Method

The Orion Model 2030 Silica Analyzer runs a nine-step analysis sequence as discussed in Chapter 3. Information on how to run an analysis is stored in the Analysis Method. An Analysis Method consists of these parameters:

- Pre-wash volume
- Cell wash volume
- Reagent addition sequence
- Blank step
- Post wash sequence
- Stability
- Referenced calibration curve

Up to ten (10) separate analysis methods can be defined. Each analysis method has an up to nine-character identifier (filename) associated with it. References to the Analysis Methods are abbreviated as "M01" through "M10." The tags are used to identify the method when setting up the test sequence. Method 01 is always defined.

The parameters associated with an Analysis Method can be modified through the Set Up Method menu, which is reached from the Technician Level by following the procedure described in Table 7-6.

Table 7-6. Analysis Method Menu

Displayed Message	Press Key	Explanation
`12:00 AM Jan 01, 1997` `SETUP CAL DIAG STDBY`	[SETUP]	Select Setup menu.
`Set Up Menu ?`	**[YES]**	Confirm Setup menu selection.
`Set Up Calibration ?`	**[NO]**	Do not modify a Calibration Setup.
`Set Up Method ?`	**[YES]**	Modify an Analysis Method.
`Select Method =` `Method 01 (M01)`	**[YES]**	Select the Analysis Method to be modified. Use arrows to scroll through the Method and **[YES]** to select the Method.

NOTE: When a new method is being defined, the analyzer prompts you to confirm creation of the new method through the following display:

```
Defining new Method.
Are you sure ?
```

Note that Method 01 is always defined. After pressing **[YES]**, the first message shown in Table 7-7 displays.

The functions available under the Analysis Method menu are outlined in Table 7-7.

Table 7-7. Analysis Method Menu Functions

Displayed Message	Description
`Set Cell Wash ?`	Set up the pre- and cell-wash volumes.
`Set Rgt Addition ?`	Set up the reagent addition sequence.
`Set Blank Step ?`	Set up the step after which to measure the blank absorbance.
`Set Post Wash ?`	Set up the post wash sequence.
`Set Stability ?`	Set up the stability factor.
`Set Cal Curve ?`	Set up the calibration Setup to reference in order to calculate the concentration.
`Save Current Method ?`	Save the analysis Method to backup memory.
`Recover Method ?`	Recover the analysis Method from backup memory into active memory.

To perform any one of these functions, navigate to Set Up Method as shown in Table 7-6, press **[NO]** until you reach the appropriate message, then press **[YES]**.

A detailed description of the functions available in Table 7-7 is provided in subsections 7.3.1-7.3.8.

7.3.1 Set Cell Wash

Washing the cell consists of two steps: the pre-wash and the cell-wash. The volume specified in the pre-wash is added to the cell after the initial pressurize and siphon step. This allows the sides of the cell to be washed before the exchange of volume. After adding the pre-wash volume, the cell is drained and flushed by circulating the cell wash volume through the cell.

> **NOTE**: Always select a cell wash volume greater than 9-10 capture volumes.

```
Cell Wash = 360 ml
     SET    PRE    EXIT
```

Key	Description	Range	Default Value

[SET]	Set the cell wash volume when displaying the cell wash information.
	`Cell Wash Volume =`
	`360 mL`
		40 - 999 mL	360 mL

[PRE]	Display the pre-wash information (see the next table for details).		
[EXIT]	Exit to Set Rgt Addition.		

The pre-wash fills the reaction cell with the wash fluid before the volume is exchanged such that any residue attached to the upper walls of the cell is removed. This procedure is highly recommended at low level concentration measurements and low capture volumes to minimize volumetric variance and contamination. Another message then displays;

```
Pre Wash = Disables
ENBL  CELL  SET  EXIT
```

Key	Description	Range	Default Value
[ENBL] [DISBL]	Enable or disable the pre-wash by toggling between the two states. Note that ENBL on the display implies that the pre-wash is actually **disabled**.		Pre-wash disabled

[SET]	Set the pre-wash volume, depending upon allocation and capture volume.
	`Pre Wash Volume =`
	`40 mL`
		40 - 130 mL	40 mL

[CELL]	Display cell wash information (see the table above for details).		
[EXIT]	Exit to menu.		

7.3.2 Set Reagent Addition Sequence

The reagent addition volumes and stir times for the specified method are set up through a reagent addition sequence. The default reagent addition sequence for a three-reagent system is shown below.

Table 7-8. Reagent Addition Sequence

Seq #	Device	Volume	Stir Time	Displayed Message
1	Reagent 1	1.5 mL	4.00 min	`1) 1.5 mL of Rgt1` `1) 4.00 min Stir`
2	Reagent 2	1.5 mL	1.00 min	`2) 1.5 mL of Rgt2` `2) 1.0 min Stir`
3	Reagent 3	1.5 mL	2.50 min	`3) 1.5 mL of Rgt 3` `3) 2.50 min stir`

In the above example, 1.5 mL of Reagent 1 (buffering reagent) is added to the cell after the final volume capture. The resulting solution is stirred for 4 minutes. Next, 1.5 mL of Reagent 2 is added and stirred for 1 minute. Then, 1.5 mL of Reagent 3 is added, and the solution is stirred for 2.5 minutes to let the color develop. The absorbance is measured after the third reagent addition.

Up to eight (8) reagent additions can be made using reagent pumps and CalPump1. The latter is allowed only because it may contain deionized water that can be used for dilution. There is no specific order in which devices must be assigned (that is, Reagent 2 can be added before Reagent 1). When this function is entered, the following message displays:

```
1)    1.5 mL of Rgt1
STIR   NEXT   EDIT   EXIT
```

Key	Description
[STIR]	Display the time to stir after adding reagent at this step.
[DOWN]	Display the previous step in the reagent addition sequence.
[NEXT]	Display the next step in the reagent addition sequence.
[EDIT]	Access the modify menu as shown in the next table.
[EXIT]	Exit to Set Blank Step. Upon pressing **[EDIT]**, the following message displays:

```
1)    1.5 mL of Rgt1
ADD   DEL   MODIFY   EXIT
```

Key	Description	Range	Default Value
[ADD]	Add a step to the reagent addition sequence before the currently displayed step. Follow the same procedure as that for [MODIFY] (listed below) to enter the parameters required for the new step.		
[DEL]	Delete the currently displayed step from the reagent addition sequence.		
[DOWN]	Display the previous step in the reagent addition sequence.		
[MODIFY]	Modify the currently displayed step. 1. Specify the fluidics device to use for reagent addition for this step:		
	`Addition 1 Device = Reagent 1`	Reagent 1 through 4 †	Reagent 1
	2. Specify the amount of fluid to add:		
	`Addition 1 Volume = 1.5 mL`	0 to 99.9	5
	3. Specify the time to stir after the fluid has as been added:		
	`Addition 1 Stir = 4.00 min`	0 to 30	00.25
[EXIT]	Exit the modify menu to display menu, as shown in the previous table.		

† Only those devices available on your system are prompted.

If no reagent addition sequence is defined, this message displays:

```
1)    No Addition   Defined
STIR  NEXT   EDIT   EXIT
```

To define a new reagent addition sequence, you need to ADD a new step to the undefined sequence. The analyzer does not let you modify or delete the sequence, as shown in the warning messages on the next page.

Warning Messages	Message Description
`3) End of Sequence` `* Unable to Delete *`	The End of Sequence marker cannot be deleted.
`3) End of Sequence` `* Unable to Modify *`	The End of Sequence marker cannot be modified.
`No Addition Defined` `* Unable to Delete *`	Cannot delete a non-existent sequence. To define a `new` sequence, ADD a new step to the sequence.
`No Addition Defined` `* Unable to Modify *`	Cannot modify a non-existent sequence. To define a new sequence, ADD a new step to the sequence.

7.3.3 Set Blank Step

Blank measurements allow you to reduce the effects of reagent or background color and detector drift by taking an absorbance measurement before color is developed. Blanking is typically done at the step before adding the developing agent.

Note that the blank measurement increases the time of analysis. If an estimate of the background color is known up front, you can specify it as a fixed blank absorbance value. Specifying a fixed blank is not recommended.

Description	Range	Default Value

Select when to take a blank measurement.
`Blank Step =`
`  Disabled`
	Disabled
	Before Addition #1
	:
	Before Addition #8†
	Fixed Blank
		Disabled

If Fixed Blank is selected, you are asked to enter an absorbance value that is to be used as the blank value when recording the absorbance.
`Fixed Blank Abs =`
`    +0.000`
	±1.000	0.000

† Only steps that have been previously defined in the reagent addition sequence are prompted.

Note that a positive fixed blank value results in a negative absorbance shift.

7.3.4 Set Post Wash Sequence

The post wash sequence allows you to clean the reaction cell after a measurement is done. This minimizes any degradation due to chemicals remaining in the reaction cell while the analyzer counts down to the next analysis.

The post wash sequence is set up in the same fashion as the reagent addition sequence; in fact, it has the exact same user interface. The sequence gets executed in the same way as the reagent addition sequence, with one notable exception: how volume is added depends on the amount of volume being added, as outlined in the table below.

If the volume . to be added is greater than ..	but less than ..	Action taken
0 mL	20 mL	The volume is simply added to the reaction cell.
20 mL	60 mL	The reaction cell is pressurized, the cell is drained, and the remaining volume is added.
60 mL	999 mL	The reaction cell is pressurized, the cell is drained, and the cell is washed by exchanging the volume.

The above steps allow enough flexibility in the post wash sequence to deal with various cleaning requirements.

As mentioned earlier, the interface for setting up the post wash is IDENTICAL to that of the reagent addition. When you press **[YES]** in response to Setup Post Wash, the following message displays:

```
1)    1.5 mL of Rgt1
STIR  NEXT  EDIT  EXIT
```

The above soft keys (including **[DOWN]**) are identical in function to those of Set Rgt Addition. Pressing [EDIT] allows you to modify the post wash sequence, through the following display:

```
1)    4.00 min Stir
ADD  DEL  MODIFY  EXIT
```

Again, the only difference in soft key functionality from the reagent addition sequence is the manner in which the parameters required for a new or existing post wash step are modified.

Description	Range	Default Value

1. Specify the fluidics device to use for post washing for this step:
`PostWash 1 Device =`
`Sample 1`
	Reagent 1-4
	CalPump 1
	Stream 1-6
	Cell Wash †
		None

2. Specify the amount of fluid to add:
`PostWash 1 Volume =`
`000.0 mL`
	0-999 mL	0 ml

3. Specify the time to stir after the fluid has been added:
`PostWash 1 Stir =`
`00.25 min`
	0-30 min	0 min

† If cell wash is selected as the post wash device, then the device used during the normal cell wash is also used during this post wash step.

If no post wash sequence is defined, this message displays:

```
No PostWash Defined
STIR   NEXT   EDIT   EXIT
```

In order to define a new post wash sequence, you need to ADD a new step to the undefined sequence. The analyzer does not let you modify or delete the sequence, as shown in the warning messages in the Set Rgt Addition section.

7.3.5 Set Stability Factor

After volume capture and reagent addition, the analyzer takes an absorbance measurement that is used to calculate the concentration. The absorbance may still vary due to bubbles or particulates settling after the stirrer was turned off. For this reason, the analyzer averages the measured absorbances over a five-second window to ensure that the reading is stable, and hence a true measurement. The stability factor determines the bounds on the varying absorbance before it qualifies as an acceptable (stable) measurement. A lower stability factor would accept a less stable reading.

Description	Range	Default Value

Set the stability factor rate for the current analysis method.
`Stability Rate =`
`05`
	1-10	5

7.3.6 Select Calibration Setup

Each Calibration Setup contains a curve that converts measured absorbance to concentration (that is, the calibration curve). By specifying the setup to be used during an analysis, you are indicating the calibration curve to be used when reporting concentration.

Description	Range	Default Value
Set the Setup associated with the current analysis method.		
`Select Calibration = Setup 01 (S01)`	Setup 01 : Setup 03 †	Setup 01

† Only setups previously defined through Set Up Calibration are prompted.

7.3.7 Save Analysis Method

Save the current method parameters to the backup memory, exactly like the Save Cal Setup function.

7.3.8 Recover Analysis Method

Recover the current method parameters from backup memory, exactly like the Recover Cal Setup function.

7.4 Modifying Pump Information

NOTE: Typically, pump parameters set up at the factory do not need to be changed. For this purpose, this menu is accessible by super users only.

The Orion Model 2030 Silica Analyzer uses a number of pumps to add reagents and the calibration standard in to the reaction cell. The parameters associated with each pump are as follows:

- Pump Type
- Priming Action
- Viscosity
- Flow Rate

The parameters associated with the pump can be modified in the *Set Up Pump Info* menu, which can be accessed from the Technician level from the *Set Up Method* menu as shown in the table below.

Table 7-9. Modifying Pump Information

Displayed Message	Press Key	Explanation
`12:00 AM Jan 01, 1997` `SETUP CAL DIAG STDBY`	[SETUP]	Select Setup menu.
`Set Up Menu ?`	**[YES]**	Confirm Setup menu selection.
`Set Up Calibration ?`	**[NO]**	Do not modify a Calibration Setup.
.. and keep pressing **[NO]** until you see the following display:		
`Set Up Pump Info ?`	**[YES]**	Modify a Pump.
`Select Pump =` `CalPump 1`	**[YES]**	**Select the Pump to be modified** Use arrows to scroll through the available pumps and **[YES] to select the Pump.**

The functions available under *Set Up Pump Info* are outlined in the following table.

Table 7-10. Set Up Pump Info Menu Functions

Displayed Message	Description
`Set Pump Type ?`	Select the type of pump (piston or peristaltic). The pump types must reflect the hardware installed on the swing panel.
`Set Priming Action ?`	Enable or disable priming of pumps at the beginning of the analysis cycle
`Set Viscosity ?`	Set the viscosity factor for this pump.
`Set Flow Rate ?`	Set the flow rate of this pump.
`Save Pump Info ?`	Save the pump information from active memory to backup memory.
`Recover Pump Info ?`	Recover the pump information from backup memory into active memory.

To perform any one of these functions, navigate to Set Up Pump Info as shown in Table 7-10, press **[NO]** until you reach the appropriate message, then press **[YES]**. A detailed description of the functions available in Table 7-11 is provided below.

7.4.1 Changing the Pump Type

There are two types of pumps:

1. **Piston:** This type of pump is used to add very accurate volumes.
2. **Peristaltic:** This type of pump is not as accurate as a piston pump, but can deliver fluid much faster (up to 60 mL/min).

Pump type is set at the factory, and should not be changed unless a different pump is installed on the swing panel.

Table 7-10. Set Up Pump Info Menu Functions

Displayed Message	Description
`Set Pump Type ?`	Select the type of pump (piston or peristaltic). The pump types must reflect the hardware installed on the swing panel.
`Set Priming Action ?`	Enable or disable priming of pumps at the beginning of the analysis cycle
`Set Viscosity ?`	Set the viscosity factor for this pump.
`Set Flow Rate ?`	Set the flow rate of this pump.
`Save Pump Info ?`	Save the pump information from active memory to backup memory.
`Recover Pump Info ?`	Recover the pump information from backup memory into active memory.

To perform any one of these functions, navigate to Set Up Pump Info as shown in Table 7-10, press **[NO]** until you reach the appropriate message, then press **[YES]**. A detailed description of the functions available in Table 7-11 is provided below.

7.4.2 Setting the Priming Action

All pumps are primed at the beginning of the analysis cycle to compensate for any backflow on the pump fluid lines. If backflow is not significant on your analyzer, you can disable the priming of pumps through this menu.

Description	Range	Default Value
Enable or disable priming of pumps at the beginning of each analysis cycle. `Priming of Pumps = Enabled`	Disabled	Enabled

7.4.3 Setting Pump Viscosity

The viscosity factor is used in calculating the amount of time required for siphoning. A more viscous sample would require more time to evacuate the cup, and would have a larger viscosity factor value. This value can be set for all pumps, but is useful only in case of calibration standards, as it modifies the siphon time when using the pump during calibration.

Description	Range	Default Value
Set the viscosity factor for the currently selected pump. `Set Viscosity = 1.0`	0.1 - 10.0	1.0 (corresponding to the viscosity of water)

7.4.4 Setting Pump Flow Rate

This function lets you set the speed of the pump. Faster pumping speeds generate a higher rate of flow. Up to five flow rate settings are available. The actual flow rate can be entered only after measuring it in the *Diagnostics|Hardware Test|Check Flow Rates* menu. The five flow rate settings available in this function are scaled accordingly.

Description	Range	Default Value

Set the pump flow rate.
 	
`Cal1 Flow Rate =`
`44.0`
	44.0
	36.7
	31.4
	27.5
	22.0
		44.0

The above example illustrates the available flow rates for the first calibration pump (CalPump1 or Cal1), installed as a peristaltic pump with a measured flow rate of 44.0 mL per minute.

7.4.5 Saving and Recovering

After setting up the pump information in this menu, you can save it to backup memory. Parameters previously saved in backup memory are overwritten (and thus deleted). Since there is no undo feature, the previously saved parameters are permanently lost.

Similarly, the parameters in active memory can be permanently overwritten by recovering previously saved parameters from the backup memory.

7.5 Changing Stream-Related Information

The Orion Model 2030 Silica Analyzer can analyze up to six streams. The following parameters are associated with each stream:

- Analog outputs
- High and low concentration alarm
- Viscosity
- External sampling device
- Flow rate
- Calibration gain and offset (super user only)

The parameters associated with each stream can be modified through the Set Up Stream menu, which is reached from the Technician Level by following the procedure described in Table 7-11.

Table 7-11. Set Up Stream Menu

Displayed Message	Press Key	Explanation
`12:00 AM Jan 01, 1997` `SETUP CAL DIAG STDBY`	[SETUP]	Select Setup menu.
`Set Up Menu?`	**[YES]**	Confirm Setup menu selection.
`Set Up Calibration?`	**[NO]**	Do not modify a Calibration Setup. .. and keep pressing **[NO]** until you see the following display:
`Set Up Stream Info?`	**[YES]**	Modify a Stream.
`Select Stream =` `Sample 1`		Select the Stream to be modified. Use arrows to scroll through the Streams and **[YES]** to select the Stream.

Note that the display shown above does not appear on single-stream analyzers. Only those streams available on your system are prompted.

The functions available under the Set Up Stream menu are outlined in Table 7-12.

Table 7-12. Set Up Stream Menu Functions

Displayed Message	Description
`Set Analog Output ?`	Set up the analog output associated with this stream.
`Set Alarm Levels ?`	Set up the High and Low concentration alarms associated with this stream.
`Set Viscosity ?`	Set the viscosity factor associated with this stream.
`Set Ext Smp Dev ?`	Set an external device to replace or work in conjunction with the sample valve associated with this stream.
`Set Flow Rate ?`	Set the flow rate of this stream.
`Modify Cal Curve ?`	Modify the calibration curve when analyzing this stream. **Note that this is a super user function**, so it does not appear if you are at the Technician level.
`Save Stream Info ?`	Save the stream information from active memory to backup memory.
`Recover Stream Info ?`	Recover the stream information from backup memory into active memory.

To perform any one of these functions, navigate to Set Up Stream as shown in Table 7-11, press **[NO]** until you reach the appropriate message, then press **[YES].** A detailed description of the functions available in Table 7-12 is provided in subsections 7.5.1 - 7.5.10.

7.5.1 Set Analog Output

Each sample stream has exactly one analog output associated with it. Set the range, slope, and mode for the analog output associated with Stream # 1 through the following display:

```
Set   Smpl   Output   :
ACTN   MODE   RANGE   EXIT
```

> **NOTE**: There is currently no provision in the software to change the analog output assignments. Output #1 is always associated with Sample 1, etc. There is also no provision to assign multiple outputs. Hence, on a single-stream system, the second analog output is not available.

The analog output reports the recorded concentration as a milliamp value. The analog output mode determines the physical (milliamp) range of the analog output. There are two output modes: **0 to 20 mA** and **4 to 20 mA**. Each output has a resolution 0.005 mA regardless of the output mode. The concentration resolution depends upon the output range.

The output action determines if 20mA corresponds to the high concentration value or the low concentration value. The two actions are as follows:

1. **Reverse (HI to LO):** The low measurement is reflected by a high analog reading.
2. **Direct (LO to HI):** The low measurement is reflected by a low analog reading.

Output	Description	Range	Default Value

[ACTN]	Set the output action.
	`Output 1 Action =`
	`Direct (LO to HI)`
		Reverse (HI to LO)
		Direct (LO to HI)
			Direct

[MODE]	Set the Analog output mode.
	`Output 1 Mode =`
	`4 to 20 mA`
		0 to 20 mA
		4 to 20 mA
			4 to 20 mA

[RANGE]	Set the high and low endpoint corresponding to the range of concentration reported by the analog output (see description in next table).		
[EXIT]	Exit to Set Alarm Level.		

When setting the analog output range, the following prompts appear:

```
Lo = +000.00
       SET  HI  EXIT
```

or

```
Hi = +200.00
       SET  LO  EXIT
```

Key	Description	Range	Default Value
[SET]	Set the High or Low range value based on the parameter being deleted. `Lo Smp1 Output = +000.00`	± Max Conc Value (see **Set Display Format** for details)	Lo = 0.00 Hi = 200.00
[LO] [HI]	Switch between displaying the Low or High range value.		
[EXIT]	Exit the range menu to output menu, as shown in the previous table.		

7.5.2 Set Alarm Levels

There are two sub-functions to the Set Alarm Levels function, as shown in the table below.

Displayed Message	Description
`Set Low Alarm ?`	Set up the low concentration alarm.
`Set High Alarm ?`	Set up the high concentration alarm.

To perform any one of these functions, navigate to the **Set Alarm Levels** function as shown in above table, press **[NO]** until you reach the appropriate message, then press **[YES]**.

The menus for these two alarms are identical except for the default alarm trigger value and some textual differences in the tags used to identify the alarm. When this function is entered, the following message displays:

```
Lo Alm = +01.000
RELAY  SET  MODE  EXIT
```

Or

```
Hi Alm = +10.000
RELAY  SET  MODE  EXIT
```

The functional keys are described in the following table.

Key	Description	Range	Default Value
[RELAY]	Select the relay to be used for reporting this alarm condition. `Smp1 Low Alarm = Relay #3`	Not Assigned Relay 1 : Relay 14 †	Relay #3 (for both high and low alarm)
[SET]	Set the concentration value below (above) which the alarm should trigger. `Smp1 Low Alarm = +01.000`	± Max Conc Value (see **Set Display Format**)	Lo = 1.00 Hi = 10.0
[MODE]	Enable or disable this alarm by toggling between the two states.	Enabled Disabled	Disabled
[EXIT]	Exit to Set Viscosity.		

† Only those relays available on your system and not being used for driving external devices or exclusive alarms are prompted.

7.5.3 Set Viscosity Factor

The viscosity factor is used in calculating the amount of time required for siphoning. A more viscous sample would require more time to evacuate the cup, and would have a larger viscosity factor value.

Description	Range	Default Value
Set the viscosity factor for the currently selected stream.		1.0 (corresponding to the viscosity of water)
`Viscosity Factor = 1.0`	0.1 - 10.0	

7.5.4 Set External Sample Device

If pressurized sample flow is not easily available, an external device can be triggered using a dry relay contact to provide the appropriate flow. There are three external device modes:

1. **Auxiliary:** The external device relay is turned on/off every time the sample valve goes on/off.
2. **External Enable:** The external device relay is turned on at the beginning of the analysis cycle, and stays on until the volume is captured. The sample valve is turned on/off in the normal fashion.
3. **External Control:** The sample valve is turned on at the beginning of the analysis cycle, and stays on until the volume is captured. The external device is turned on/off when the sample valve is to be turned on/off during the analysis cycle. When this function is entered, the following message displays:

```
Smp1 Ext Dev = None
   MODE  RELAY  EXIT
```

Key	Description	Range	Default Value
[RELAY]	Select the relay to be used for driving the external device. `Smp1 External Dev = Not Assigned`	Not Assigned Relay 1 : Relay 14 †	Not Assigned (that is, no external device)
[MODE]	Select the external device mode: `Ext Device Mode = Auxiliary`	Auxiliary External Enable External Control	Auxiliary
[EXIT]	Exit to Set Flow Rate.		

† Only those relays available on your system and not being used for reporting alarms are prompted.

7.5.5 Set Flow Rate

Description	Range	Default Value
Set the flow rate for current stream. `Smp1 Flow Rate = 200.0 mL/min`	30.0-999.0 mL/min	200.0 mL/min

NOTE: The actual flow rate can be measured using the Cal Flow Rate function in the Hardware Test menu.

7.5.6 Modify Calibration Curve

The calibration curve for each individual sample stream can be directly manipulated by setting a concentration gain and offset value. The modification is done as a straight line fit on the measured concentration:

Reported Concentration = Gain Value x Measured Concentration + Offset Value

Keep in mind that the measured concentration is calculated from the measured absorbance using the calibration curve as specified in the calibration Setup associated with the method being used in the analysis. This features gives you the ability to modify the calibration curve on a per-stream basis. It should therefore be used with extreme caution, and is accessible only through superuser privilege.

There are two sub-functions to the Modify Cal Curve function, as shown in the following table.

Displayed Message	Description
`Set Conc Offset ?`	Set the offset value as described in the above equation.
`Set Conc Gain ?`	Set the gain value as described in the above equation.

To perform any one of these functions, navigate to the **Modify Cal Curve** function as shown above, press **[NO]** until you reach the appropriate message, then press **[YES]**.

7.5.7 Set Offset Value

Description	Range	Default Value
Add a fixed value to the measured concentration for this stream.		
`Conc Offset = +0.000`	± Max Conc Value (see Set **Display Format**)	0.000

7.5.8 Set Gain Value

Description	Range	Default Value
Multiply the measured concentration for this stream by a fixed value.		
`Conc Gain = +01.00`	0.01-100.00	1.00

7.5.9 Save Stream Information

Save the stream information to backup memory. While the save is in progress, the “`Please Wait`” message as shown in Save Cal Setup displays on the display.

7.5.10 Recover Stream Information

Recover the stream information stored in backup memory by overwriting the current test sequence.

7.6 Setting up Sequences

During automatic operation, the Orion Model 2030 Silica Analyzer runs a pre-determined sequence of analysis and calibrations as determined by the Test and Calibration sequences, respectively. The Test Sequence describes the order in which to analyze streams. Each step of this sequence references:

- the stream or fluidics device being analyzed,
- the method to be used for the analysis, and
- the number of counts to repeat the analysis before proceeding to the next step in the sequence.

Each analysis or calibration occurs at fixed intervals as specified by the **Sampling Frequency**. For example, consider the following four-step test sequence:

Step #	Stream Label	Analysis Method	Repeat Count	Displayed Messages
1	Sample 1	Method 01	4	`1) Smp1 use M01x4`
2	Sample 1	Method 02	1	`2) Smp1 use M02x1`
3	Sample 2	Method 01	3	`3) Smp2 use M01x3`
4	Sample 2	Method 03	2	`4) Smp2 use M03x2`
5	End of Sequence			`5) End of Sequence`

When **[RUN]** is pressed for the first time, the Orion Model 2030 Silica Analyzer immediately begins analyzing Sample 1 using the analysis parameters as specified by Method 01, in step #1. After this analysis is complete, the analyzer displays the analysis result and starts counting down to the next analysis. The countdown time depends upon the time it takes to run the analysis and the sampling frequency. For example, if an analysis takes 10 minutes and the sampling frequency is 15 minutes, the analyzer counts down for 5 minutes.

As the repeat count for the first step is four, the next analysis would also analyze Sample 1 using Method 01. The analyzer does not proceed to step #2 until it has analyzed Sample 1 using Method 01 four times, as specified by the repeat count. Similarly, it does not proceed to step #4 from step #3 until it has analyzed Sample 2 using Method 01 three times. It continues to analyze streams in this fashion until it reaches the end of the sequence (step #5), when it wraps the sequence and starts again from step #1. It continues to run analyses at the pre-programmed interval (equal to the sampling frequency) until you press the **[STOP]** key on the control panel.

The default Test Sequence analyzes each stream, sequentially, using Method 01, every 15 minutes. For example, the default Test Sequence for a two-stream Orion Model 2030 Silica Analyzer is shown below:

Step #	Stream Label	Analysis Method	Repeat Count	Displayed Messages
1	Sample 1	Method 01	1	`1) Smp1 use M01x1`
2	Sample 2	Method 02	1	`2) Smp1 use M02x1`
3	End of Sequence			`3) End of Sequence`

The Calibration Sequence similarly describes the order in which to run calibrations. Each step of this sequence references:

- a calibration Setup and
- a repeat count

Details on the device to be used for calibration, calibration method, type, etc. are all picked up from the Setup. For example, the default calibration sequence is shown below:

Step #	Calibration Setup	Repeat Count	Displayed Messages
1	Setup 01	1	`1) Cal 1 use S01x1`
2	End of Sequence		`2) End of Sequence`

Cal1 (CalPump1) is the default calibration device associated with Setup 01.

Each step of the calibration sequence is executed at pre-programmed intervals (equal to the **Calibration Frequency**). Unlike the test sequence, if a repeat count is specified in the calibration sequence, the calibrations are run immediately one after another. Consider an example where calibration frequency is one (1) hour and the following two-step calibration sequence has been defined:

Step #	Calibration Setup	Repeat Count	Displayed Messages
1	Setup 01	3	`1) Cal 1 use S01x3`
2	Setup 02	1	`2) Smp1 use S02x1`
3	End of Sequence		`3) End of Sequence`

One hour after the **[RUN**] key is pressed, the analyzer calibrates using Setup01. The analyzer repeats this calibration three times before proceeding to count down to the next analysis or calibration. Step #2 is run exactly one hour later, and the whole sequence repeats itself until you press the **[STOP]** key, or the analyzer “Save & Halt”s on a calibration fault.

The Calibration and Test Sequences run independently of each other. If an analysis or calibration becomes due while another event is in progress, that event is run immediately after the current event is finished. In the situation when a calibration is due at the same time as a test, the calibration takes precedence. The test runs immediately after the calibration is finished.

The sequences and frequencies can be modified through the Set Up Sequences menu, which is reached from the Technician level by following the procedure described in Table 7-11.

Table 7-13. Set Up Sequence Menu

Displayed Message	Press ..	Explanation
`12:00AM Jan 01,1997` `SETUP CAL DIAG STDBY`	[SETUP]	Select Setup menu.
`Set Up Menu ?`	**[YES**]	Confirm Setup menu selection.
`Set Up Calibration ?`	**[YES]**	Select Calibration Setup. ..and keep pressing **[NO]** until the following message displays:
`Set Up Sequence ?`	**[YES]**	Modifies a Sequence.

The functions available under Set Up Sequence are outlined in Table 7-12.

Table 7-14. Set Up Sequence Menu Functions

Displayed Message	Description
`Edit Stream Seq ?`	Edit the stream (that is, test or analysis) sequence.
`Set Sample Freq ?`	Set the sampling frequency.
`Edit Cal Sequence ?`	Edit the calibration sequence.
`Set Cal Frequency ?`	Set the calibration mode (manual or automatic). If automatic mode is selected, set the calibration frequency.
`Edit Cleaning Seq ?`	Edit the cleaning sequence.
`Set Cleaning Freq ?`	Set the cleaning frequency.
`Save Sequence ?`	Save the sequence information from active memory to backup memory.
`Recover Sequence ?`	Recover the sequence information from backup memory into active memory.

To perform any one of these functions, navigate to Set Up Sequence as shown in Table 7-11, press **[NO]** until you reach the appropriate message, then press **[YES]**.

A detailed description of the functions available in Table 7-12 is provided in subsections 7.6.1 - 7.6.6.

7.6.1 Edit Stream Sequence

When this function is entered, the following message displays:

```
1) Smp1 use M01x1
     NEXT EDIT  EXIT
```

Key	Description
[NEXT]	Display the next step in the test sequence.
[DOWN]	Display the previous step in the test sequence.
[EDIT]	Access the modify menu as shown in the next table.
[EXIT]	Exit to Set Sample Freq.

Once you select [EDIT], the following message displays:

```
1) Smp1 use M01x1
 ADD DEL MODIFY EXIT
```

Key	Description
[ADD]	Add a step to the test sequence before the currently displayed step. Follow the same procedure as that for [MODIFY] (listed below) to enter the parame ters required for the new step.
[DEL]	Delete the currently displayed step from the test sequence.
[DOWN]	Display the previous step in the test sequence.

[MODIFY]	Modify the currently displayed step.
	1. Specify the stream to analyze.
	`Sampling Device =`
	`Sample 1`
	2. Indicate the analysis method.
	`Select Method =`
	`Method 01 (M01)`
	3. Specify the number of times to repeat this step before proceeding to the next step.
	`Repeat Count =`
	`01`
	Note that pressing **[NO]** during any one of the steps above allows you to terminate the setup procedure without modifying the step.

[EXIT]	Exit the modify menu to display menu, shown in the previous table.

Warning Messages	Message Description
`3) End of Sequence` `* Unable to Delete *`	The End of Sequence marker cannot be deleted.
`3) End of Sequence` `* Unable to Modify *`	The End of Sequence marker cannot be modified.

7.6.2 Set Sampling Frequency

This function sets the sampling, or analysis, frequency.

Description	Range	Default Value
Set the sampling, that is, analysis frequency		
`Sampling Frequency = 000.25 hr`	0.02 - 572 hours	0.25 hours - (15 minutes)

7.6.3 Edit Calibration Sequence

This is identical to setting the Stream Sequence. The only difference is when modifying or adding a step. First select the appropriate setup in use if more than one is defined.

Description	Range	Default Value
Modify the currently displayed step.		
1. Indicate the calibration setup.		
`Select Calibration = Setup 01 (S01)`	Setup 01 through Setup 03	Setup 01

NOTE: Note that the Repeat Count function here is different. The analyzer repeats calibration per the Repeat Count before proceeding to the next step.

7.6.4 Set Calibration Frequency

Description	Range	Default Value
Select the Calibration mode:		
`Calibration Mode = Manual`	Manual Automatic	Manual
If automatic mode is selected, the calibration frequency.		
`Calibration Freq = 168.00 hr`	0.02 - 572 hours	168 hours = 1 week

7.6.5 Cleaning Cycle

A five-step cleaning sequence is now available on the Orion Model 2030 Silica Analyzer. This sequence is set up under *Set Up Sequence|Edit Cleaning Seq* in the same fashion as a post-wash sequence (see pg. 7-18). Each step of the sequence allows you to specify the fluidics device, the volume to add, and the time to stir after volume addition. Any device available on the system can be used in the cleaning sequence.

As is the case for the post wash, the action taken when the fluid is added depends upon the volume of fluid. If the volume is less than 20mL, the fluid simply gets added to the cup. If the volume is between 20 and 60 mL, the reaction cell is pressurized, the cell siphoned, and the remaining volume added. If the volume is greater than 60 mL, the cell is pressurized and siphoned, and then washed by exchanging the volume.

The cleaning sequence is a timed event whose frequency is specified in the *Set Up Sequence|Set Cleaning Freq* menu. The cleaning frequency can range between 0.02 hours (1.2 minutes) to 672 hours (one month). The default cleaning frequency is 2 hours. The cleaning cycle can be disabled by deleting the cleaning sequence.

7.6.6 Save Sequence Information

Save the test sequence to backup memory. While the save is in progress, the "`Please Wait`" message displays as shown in the Save Cal Setup.

7.6.7 Recovering Sequence Information

Recover the sequence stored in backup memory by overwriting the current sequence for both calibration and sample analysis.

7.7 Setting up Outputs

The following parameters can be set up under the Set Up Outputs section of the Setup menu:

- System Time and Date
- Relay Functions
- Digital Input Functions
- Special Function
- Communications

The Set Up Outputs menu can be reached from the Technician Level by following the procedure listed in Table 7-15.

Table 7-15. Set Up Outputs Menu

Displayed Message	Press ..	Explanation
`12:00AM Jan 01,1997` `SETUP CAL DIAG STDBY`	[SETUP]	Select Setup menu.
`Set Up Menu ?`	**[YES]**	Confirm Setup menu selection.
`Set Up Calibration ?`	**[YES]**	Select Calibration Setup. ..and keep pressing **[NO] until the following displays:**
`Set Up Outputs ?`	**[YES]**	Modify outputs.

The functions available under Set Up Output are outlined in Table 7-14.

Table 7-16. Set Up Outputs Functions

Displayed Message	Description
`Set Time/Date ?`	Set the system time and date.
`Set Relay Function ?`	Set relay functions.
`Set Input Function ?`	Set digital input functions.
`Set Special Function ?`	Set special function for reporting the general fault condition on the 4-20mA outputs. **This function is accessible only by the super user;** it does not appear if you are at the Technician Level.
`Set Communications ?`	Set communication port functions and associated parameters.
`Save Output Info ?`	Save the output information from active memory to backup memory.
`Recover Output Info ?`	Recover the output information from backup memory into active memory.

To perform any one of these functions, navigate to Set Up Outputs as shown in Table 7-16, press **[NO]** until you reach the appropriate message, then press **[YES]**.

A detailed description of the functions available in Table 7-14 is provided in subsections 7.7.1 - 7.7.8.

7.7.1 Set Time and Date

There are two subfunctions to the Set Time/Date function, as shown below.

Displayed Message	Description
`Set Time ?`	Set the system time.
`Set Date ?`	Set the system date.

To perform any one of these functions, navigate to the Set Time/Date function as shown above, press **[NO]** until you reach the appropriate message, then press **[YES]**.

A. Setting the Time

When this function is entered, the following message displays:

```
        13:01:01
MODE  HOURS  MINS  EXIT
```

Key	Description	Range	Default Value

[MODE]	Set the clock mode, 12 or 24 hour.
	`Clock Mode =`
	`24 Hour`
	For example, two o'clock in the afternoon is 2:00 PM in 12-hour mode and 14:00 in 24-hour mode.
		12 Hour (AM/PM)
		24 Hour
			24 Hour

[HOURS]	Set the hour.
	`Hours =`
	`12`
	If 12-hour mode is selected, specify whether the hour is AM or PM.
	`AM or PM`
	`AM PM`
		1-12 (AM/PM)
		0-23 (24-Hour)
		AM or PM
			12 AM or
			00 hours

[MINS]	Set minutes.
	`Minutes =`
	`00`
		0-59	0

[EXIT]	Exit to Set Date		

B. Setting the Date

This prompt displays once you access the Set Date function.

```
       Jan 01, 1998
MONTH  DAY  YEAR  EXIT
```

Parameter	Description	Range	Default Value

[MONTH]	Set the month.
	`Month =`
	`Jan`
		Jan, Feb, Mar, Apr,
		May, Jun, Jul, Aug,
		Sep, Oct, Nov, Dec
			Jan

Parameter	Description	Range	Default Value
[DAY]	Set the day. `Day = 01`	 1 - 31 Actual maximum depends upon the month and year.	 1
[YEAR]	Set the year. `Year = 1996`	 1995-2050	 1997
[EXIT]	Exit to Set Relay Function.		

7.7.2 Set Relay Function

Each alarm can be assigned a relay for reporting purposes. These assignments can be reviewed and modified under the Set Relay Functions menu. Additional relay functions, such as driving external devices, can also be assigned in this function.

```
Rly1 = General Fault
RLY  NEXTFN  EDIT  EXIT
```

Descriptions for the various relay functions can be found in Appendix C. The following table lists actions taken on specific keys in the Set Relay Functions menu.

Parameter	Description	Range	Default Value
[RLY]	Select the relay whose functions you wish to edit/view.	Relay 1 : Relay 14 †	Always displays Relay #1 the first time through.
[NEXTFN]	Display the next function assigned to the currently displayed relay.		
[DOWN]	Display the previous function assigned to the currently displayed relay.		
[EDIT]	Add or Delete functions from the currently displayed relay (see the next table for details)		
[NO]	Go to the next relay available on your system.		
EXIT	Exit to Set Input Function		

† Only those relays available on your system are prompted.

When the EDIT function is selected, the following soft keys become available.

Key	Description	Range	Default Value
[ADD]	Add a function to the currently displayed relay.	See Appendix C for a complete list	
[DEL]	Delete the currently displayed function from the relay.		
[DOWN]	Display the previous function assigned to the currently displayed relay.		
[EXIT]	Exit the modify menu to display menu, shown in the previous table.		

Multiple alarms can be assigned to each relay. Each relay can be configured normally open (NO) or normally close (NC) via a jumper on the board. Note that a normally open relay has its contacts open when the relay is inactive or unenergized. Not all relay functions can be tied together, see Appendix C for details. The Orion Model 2030 Silica Analyzer does not allow you to assign relays that would generate a conflict; the warning message below displays if you try.

Warning Messages	Message Description
`Add Rly 1 Function =` `** Not Allowed **`	You have tried to tie together two conflicting functions (for example, external device and result ready) on the same relay.

7.7.3 Set Input Functions

The digital inputs on the Orion Model 2030 Silica Analyzer are classified into these three categories:

1. Alarm Inputs
2. Data Inputs
3. Command Inputs

Only the Alarm Inputs can be modified through the Set Input Functions menu. These inputs are typically used for attaching flow and level sensors. Descriptions for the various input functions can be found in Appendix C.

```
Inp1 = Not Assigned
INP  NEXTFN  EDIT  EXIT
```

Key	Description	Range	Default Value
[INP]	Select the input to be used for reporting this alarm condition.	Input 1 : Input 4	Always displays Input #1 the first time through
[NEXTFN]	Display the next function assigned to the currently displayed input.		
[DOWN]	Display the previous function assigned to the currently displayed input.		
[EDIT]	Add or Delete functions from the currently displayed input (see the next table for details).		
[NO]	Go to the next input available as an alarm input on your system.		
[EXIT]	Exit to Set Special Function.		

Once the EDIT function is selected, the following message displays:

```
Inp1 = Not Assigned
ADD   DEL   MODIFY   EXIT
```

Key	Description	Range	Default Value
[ADD]	Add a function to the currently displayed input.	See Appendix C for a list.	
[DEL]	Delete the currently displayed function from the input.		

[MODIFY]	Once selected, you can define the fault state as LOW or HIGH levels.
	`Fault State =`
	`Input HIGH (+5V)`		

[DOWN]	Display the previous function assigned to the currently displayed input.		
[EXIT]	Exit the modify menu to display menu, shown in the previous table.		

NOTE: When more than one reagent level needs to be monitored, you may group reagent level sensors on one input and flag a generic out of reagent condition. In such a situation, if any one of the reagent level sensors switches, all reagents assigned to input one are reported as having a low level.

NOTE: You cannot attach the flow sensor and a level sensor to the same input.

NOTE: The Orion Model 2030 Silica Analyzer does not support flow sensors other than those supplied through Orion.

7.7.4 Set Special Function

This option is available under super user access only. Once the general fault is triggered, the analog outputs (all) are maxed to 20 mA for 250 msec and then reduced to 0 mA for 250 msec and then restored to original values. This is done to flag the occurrence of a general fault on the analog outputs. **Use only after consulting the factory**. Use with caution when the analyzer is connected to a PID loop. When the general fault is cleared, the opposite sequence of this cycle occurs (LO for 250 msec and then HI for 250 msec followed by a restore to original output levels).

7.7.5 Set Communications

The Orion Model 2030 Silica Analyzer has two communications ports, labeled COM1 and COM2 on the main board. Both ports support bi-directional RS232C communications. *Their default setting is 9600 baud, 8 data bits, no parity, one stop bit, no flow control.*

This menu can be accessed under the *Set Up Outputs|Set Communications* menu, which is reached following the procedures listed in Tables 7-13 and 7-14. The options under this menu are shown on the next page.

Displayed Message	Description
`Modify COM1 Setup ?`	Modify the communications parameters (baud rate, data bits, stop bits, parity, flow control) associated with COM1, located on the top right hand corner of the main board (see Figure A-1).
`Modify COM2 Setup ?`	Modify the communications parameters associated with COM2, located below COM1 on the main board.
`Set Printer Port ?`	Select the RS232 communications port to be hooked up to the printer.
`Set Ext Comm Port ?`	Select the RS232 communications port to be hooked up to a computer or a modem.

To perform any one of these functions, navigate to the Set Communications menu, press **[YES]** to reach the first function listed above, press **[NO]** until the appropriate message displays, then press **[YES]**.

The last two functions are discussed on page 7-44. The first two functions are new functions. They are identical, modifying the baud rate, data frame and flow control on the specified communications ports (COM1 or COM2). You can modify COM1 parameters through the following display:

```
COM1 =  9600 8N1 No
BAUD DATA FLOW EXIT
```

Key	Description	Range	Default Value
[BAUD]	Select the baud rate `COM1 Baud Rate = 9600`	300 1200 2400 4800 9600 19200	9600
[DATA]	Set the data frame. This consists of setting the number of data (d) bits, stop (s) bits, and the parity. `COM1 Data Frame = 8d,1s,no parity` The example shown above is 8 data bits, 1 stop bit, and no parity.	8d, 1s, no parity 7d, 1s, even parity 7d, 1s, odd parity	8d, 1s, no parity
[FLOW]	Set the flow control. `COM1 Flow Control = None (No)`	None (No) RTS/CTS (HW) XON/XOFF (SW)	None (No)
[EXIT]	Exit this menu		

A. Setting the Printer Port

Description	Range	Default Value
Set the communications port to be hooked up to a computer or a printer.		
`Printer Port = COM2 (Bottom Port)`	COM1 (Top Port) COM2 (Bottom Port)	COM2

NOTE: The printer and external communications can be assigned to the same port. This can be useful if you wish to capture a printout on a computer.

B. Setting the External Communications Port

Description	Range	Default Value
Set the communications port to be hooked up to a computer or modem.		
`Ext Comm Port = COM1 (Top Port)`	COM1 (Top Port) COM2 (Bottom Port)	COM1

NOTE: The external communications port cannot be modified when the Orion Model 2030 Silica Analyzer is under remote control.

7.7.6 Save Output Information

Save the output to backup memory. While the save is in progress, the "`Please Wait`" message, as shown in Save Cal Setup, appears on the display.

7.7.7 Recover Output Information

Recover the output information stored in backup memory by overwriting the current test sequence.

7.8 Setting Up Parameters

The following parameters can be set up under the Set Up Parameters section of the Setup menu:

- Standby Wash Sequence and Timeout
- Stirrer Mode
- Stirring Action
- Display Format and Maximum Concentration Value
- Motor Action
- Pass Code

The Set Up Parameters menu can be reached from the Technician Level by following the procedure listed in Table 7-17.

Table 7-17. Set Up Parameters Menu

Displayed Message	Press ..	Explanation
`12:00AM Jan 01,1997` `SETUP CAL DIAG STDBY`	[SETUP]	Select Setup menu.
`Set Up Menu ?`	**[YES]**	Confirm Setup menu selection.
`Set Up Calibration ?`	[**YES**]	Select Calibration setup. ..and keep pressing **[NO]** until the following displays:
`Set Up Parameters ?`	[**YES]**	Modify miscellaneous parameters.

The functions available under Set Up Parameters are outlined in Table 7-18.

Table 7-18. Set Up Parameters Functions

Displayed Message	Description
`Set Stdby Wash ?`	Set the standby wash and timeout.
`Set Stirrer Mode ?`	Set the stirring mode.
`Set Stirring Action?`	Set the stirring action.
`Set Display Format ?`	Set the displays format and, hence, the maximum concentration value.
`Set Motor Action ?`	Set the motor action. **This function is accessible only by the super user;** it does not appear if you are at the Technician Level.
`Set Pass Code ?`	Modify pass codes.
`Save Parameters ?`	Save miscellaneous parameters from active memory to backup memory.
`Recover Parameters ?`	Recover miscellaneous parameters from backup memory to active memory.

To perform any one of these functions, navigate to Set Up Parameters as shown in Table 7-17, press **[NO]** until you reach the appropriate message, then press **[YES]**.

A detailed description of the functions available in Table 7-18 is supplied in subsections 7.8.1 - 7.8.10.

7.8.1 Set Standby Wash

There are two subfunctions to the Set Standby Wash function, as shown in below.

Displayed Message	Description
`Set Stdby Wash Vol ?`	Set the standby wash volume and device.
`Set Stdby Timeout ?`	Set the time after which the analyzer automatically goes into standby when sitting idle.

To perform any one of these functions, navigate to Set Standby Wash function as shown in Table 7-16, press **[NO]** until you reach the appropriate message, then press **[YES]**.

A. Setting the Standby Wash Volume

Description	Range	Default Value
Set the wash volume. To disable the standby wash, set the wash volume to zero mL. `Stdby Wash Volume = 000 mL`	0 - 999 mL	300 mL
If a non-zero wash volume is set, specify the wash device. `Stdby Wash Device = Sample 1`	Sample 1 through 6 † Calpump 1	

† All available devices.

B. Setting the Standby Timeout Period

Description	Range	Default Value
Set time after which the analyzer goes into standby if left inactive. `Stdby Timeout = 00.50 hr`	0.25 - 6 hours	0.50 hours (30 minutes)

7.8.2 Set Stirrer Mode

There are two stirrer modes:

1. **Stir Btwn Analysis:** Leave the stirrer on while counting down between analyses.
2. **Stop Btwn Analysis:** Leave the stirrer off while counting down between analyses.

Description	Range	Default Value
Indicate whether the stirrer should remain on between analysis.		
`Stirrer Mode = Stop Btwn Analyses`	Stir Btwn Analyses Stop Btwn Analyses	Stop Btwn Analyses

7.8.3 Set Stirring Action

The stirrer motion can be set up as continuous (stirrer rotating constantly in the same direction) or agitating (stirrer reversing its direction every once in a while). The agitating action can be used if trying to eliminate bubbles in the reaction cell. The different times after which the stirrer reverses direction determine the effectiveness of the agitation. For larger volumes, wait longer for the momentum to build up before reversing to get better agitation.

Description	Range	Default Value
Set the stirring action.		
`Stirring Action = Continuous`	Continuous Reverse every 1 second Reverse every 2 seconds Reverse every 5 seconds	Reverse every 5 seconds

7.8.4 Set Display Format

This function controls the decimal point location and the range of allowable numbers to be entered or displayed.

Description	Range	Default Value
Select the format used to display the concentration `Display Format = XXX.XX`	X.XXXX XX.XXX XXX.XX XXXX.X XXXXX	XXX.XX

Note that the maximum value (MaxConcValue) and resolution of the displayed/reported concentration is determined by the display format. See the table below.

Display Format	Resolution (in concentration units)	MaxConcValue (maximum value)
X.XXXX	0.0001	9.0000
XX.XXX	0.001	99.000
XXX.XX	0.01	999.00
XXXX.X	0.1	9999.0
XXXXX	1	99999

7.8.5 Set Motor Action

This function is accessible only by the super user. The pump directions are defaulted. This menu lets you retain modified pumps/directions. Use with caution. For additional details, contact the factory.

7.8.6 Set Pass Code

Set the Security Code (or pass code) for the analyzer. You can modify the pass code of access levels lower than your own. For example, a technician can only modify the technician access code, whereas the super user can modify both the technician's and the super user's access code.

Description	Range	Default Value
Select the access level whose pass code you wish to modify (**super user only**) . `Passcode for Level = Technician`	 Operator Technician SuperUser	 1 123
Set the pass code for the selected access level. `Technician Passcode = 123`	 0 - 99999	 123

7.8.7 Save Parameters

Save the miscellaneous parameters to backup memory. While the save is in progress, the "`Please Wait`" message, as shown in Save Cal Setup, appears on the display.

7.8.8 Recover Parameters

Recover the miscellaneous parameters stored in backup memory by overwriting the current parameters.

7.9 Save Unit Configuration

Save the **entire analyzer configuration** to backup memory. While the save is in progress, the "`Please Wait`" message appears.

7.10 Recover Unit Configuration

Recover the **entire analyzer configuration** stored in backup memory by overwriting the current parameters.

7.11 Printing System Parameters

Because the printout of all parameters on the Orion Model 2030 Silica Analyzer is very long, it has been divided into logical partitions. These are as follows:

- Fluidics Information
- Calibration Setups
- Analysis Methods
- Stream Information
- Sequences
- Output Information
- Miscellaneous Parameters
- Hardware Status

The Print Menu can be reached from the Technician Level by following the procedure listed in Table 7-17.

Table 7-19. Printing System Parameters Menu

Displayed Message	Press Key	Explanation
12:00AM Jan 01,1997 SETUP CAL DIAG STDBY	[DIAG]	**Select Diagnostics menu.**
Diagnostics Menu ?	[**YES**]	Confirm Diagnostics menu selection.
Print Menu ?	[**YES**]	Select Print menu.

The functions available under Print Menu are outlined in Table 7-18.

Table 7-20. Printing Systems Parameters Functions

Displayed Message	Description
`Print Fluidics Info?`	Print all information regarding fluidics devices.
`Print Cal Setup ?`	Print a single or all defined calibration Setups.
`Print Methods ?`	Print a single or all defined analysis methods.
`Print Stream Info ?`	Print all stream-related information, for all streams in a multi-stream analyzer.
`Print Stream Seq ?`	Print the test and calibration sequences and frequencies.
`Print Output Info?`	Print information regarding relay functions, digital inputs, and communications ports.
`Print Parameters ?`	Print miscellaneous parameters.
`Print All Params ?`	Print the entire analyzer configuration; includes all parameters printed in first seven functions listed above.
`Print Status ?`	Print the system hardware status.

To perform any one of these functions, navigate to Print Menu as shown in Table 7-17, press **[NO]** until you reach the appropriate message, then press **[YES]**.

A detailed description of the functions available in Table 7-18 is furnished in subsections 7.11.1 - 7.11.9.

While printing, all control panel keys except for the **[RUN]** and **[STOP]** keys are inactive. While the analyzer is printing, a "`Printing`" message similar to the one below displays.

```
Print Status :
   Printing ...
```

7.11.1 Print Fluidics

Print information about the Fluidics Devices. See Figure D-1 for a sample printout for a system with a single stream, two reagent pump, and one calibration pump.

7.11.2 Print Calibration Setups

Print calibration setups. If more than one calibration Setup has been defined, you are first asked if you wish to print all defined setups through the following display:

```
Print All Setups ?
```

If you wish to print only one setup, press **[NO]** in response to the above question and specify the setup you wish to print through the following display:

```
Select Calibration =
     Setup 01 (S01)
```

See Figure D-2 for a sample printout of the default Setup 01.

7.11.3 Print Methods

Print analysis methods. If more than one method has been defined, you are first asked if you wish to print all defined methods through the following display:

```
Print All Methods ?
```

If you wish to print only one method, press **[NO]** in response to the above question and specify the method you wish to print through the following display:

```
Select Method =
     Method 01 (M01)
```

See Figure D-3 for a sample printout of the default Method 01 for a two-reagent pump, one-calibration pump system.

7.11.4 Print Stream Information

Print information about the streams. On multi-stream systems, you are first asked if you wish to print the information about all streams, through the following display:

```
Print All Streams ?
```

If you wish to print the information for only one stream, press **[NO]** in response to the above question and specify the stream whose information you wish to print through the following display:

```
Print Stream =
    Sample 1
```

See Figure D-4 for a sample printout of the defaults for Stream #1 (Sample 1).

7.11.5 Print Sequences

Print information about the test and calibration sequences and frequencies. See Figure D-5 for a sample printout of the defaults for a six- stream system.

7.11.6 Print Outputs

Print information about the system inputs and outputs. See Figure D-6 for a sample printout of the defaults for a three stream system.

7.11.7 Print Parameters

Print information on the miscellaneous parameters. See Figure D-7 for a sample printout of the defaults for a dual-stream system.

7.11.8 Print All Parameters

Print all information on the analyzer (the *analyzer configuration*), excluding the hardware status. This prints out everything as described in the previous sections as one printout; for that reason, a sample printout is not included.

> **NOTE**: Because of the length of the analyzer configuration printout, it is recommended that the analyzer configuration be printed in sections, using the previously described printing functions.

7.11.9 Print System Status

The analyzer runs a diagnostic test and prints the results as shown in Figure D-8. In order to run this test, the analyzer requires the reaction cell to be filled with distilled water above the probe window. It prompts you to confirm this through the following display:

```
Wash Cup & Fill with
  Distilled Water ?
```

The analyzer then proceeds with its diagnostic routine, during which the following message displays:

```
Print Status :
  Testing ...
```

After completing the diagnostic routine, it begins printing the results, displaying the "`Printing`" message while the print is in progress.

> **NOTE:** A light shield should be installed and the probe window must be covered with deionized water or "zero" sample.

7.12 Reviewing Stored Results

The Review Results menu can be reached from the Technician Level by following the procedure listed in Table 7-21.

Table 7-21. Review Results Menu

Displayed Message	Press Key	Explanation
`12:00 AM Jan 01, 1997` `SETUP CAL DIAG STDBY`	[DIAG]	**Select Diagnostic menu.**
`Diagnostics Menu ?`	[**YES**]	Confirm Diagnostic menu selection.
`Print Menu ?`	[**NO**]	Do not print anything.
`Review Results ?`	[**YES**]	Review test and calibration results.

The functions available under Review Results are outlined in Table 7-22.

Table 7-22. Review Results Menu Functions

Displayed Message	Description
`Review Calibrations ?`	Review stored calibration results on the display.
`Print Calibrations ?`	Print stored calibration results.
`Review Analyses ?`	Review stored analysis results on the display.
`Print Analyses ?`	Print stored analysis results.
`Review Alarms ?`	Review stored alarms on the display. Once selected, submenus allow you to view active alarms, clear alarms, and observe, and/or print the status of all the alarms.

To perform any one of these functions, navigate to Review Results as shown in Table 7-19, press **[NO]** until you reach the appropriate message, then press **[YES]**.

A detailed description of the functions available in Table 7-20 is supplied in subsections 7.12.1 - 7.12.4.

7.12.1 Review Calibration

Review stored calibration results. Up to 25 calibrations are stored in memory. If there are no stored results, the following message displays:

```
Review Calibrations?
*No Stored Results*
```

The latest result is shown first. The time and date of the calibration, the standard it modified, and the measured absorbance are displayed as shown below:

```
12:00 AM Jan 01, 1998
  Abs (1) = 0.123
```

To view the results, use the keys listed in the following table.

Key	Action
[UP]	Go to the previous result
[LEFT]	Go back 10 results
[DOWN]	Go to the next result
[RIGHT]	Go forward 10 results
[YES], [NO]	Exit to Print Calibrations

7.12.2 Print Calibrations

Print the stored calibrations. If no calibration results are available, the "`No Results Stored`" message, as discussed above, appears on the second line of the control panel. The results are printed in ascending order with the oldest result printed first. Refer to Figure D-9 for a sample printout.

If many calibration results are stored, you are first asked if you wish to print all the stored results through the following display:

```
Print All Results ?
```

If you wish to print only the last few results, press **[NO]** in response to the above question and enter the number of results you wish to print through the following display:

```
Print Results =
         10
```

By entering 10 above, you print the last ten (10) results. The Orion Model 2030 Silica Analyzer does not have the capability to print sections of the stored results, other than the last few results. This is true for stored analysis results as well.

7.12.3 Review Analyses

Review stored analyses results. Up to 120 analyses are stored in memory. If no results are stored, the "`No Stored Results`" message as shown in Review Calibrations appears on the second line of the control panel. The navigation through stored results is identical to that discussed in Review Calibrations.

The results are displayed as shown below:

```
12:00 AM Jan 01, 1998
   Conc = 1.234
```

To view the results, use the keys listed in the following table.

Key	Action
[UP]	Go to the previous result
[LEFT]	Go back 10 results
[DOWN]	Go to the next result
[RIGHT]	Go forward 10 results
[YES], **[NO]**	Exit to Print Calibrations

7.12.4 Print Analyses

Print the stored analysis results. This function is identical to the Print Calibrations function, except that it prints all or the last few stored analysis results. Refer to Figure D-9 for a sample printout.

7.13 Reviewing Alarms

The Review Alarms menu can be reached from the Technician Level by following the procedure listed in Table 7-23.

Table 7-23. Review Alarms Menu

Displayed Message	Press Key	Explanation
`12:00 AM Jan 01, 1998` `SETUP CAL DIAG STDBY`	[DIAG]	Select Diagnostic menu.
`Diagnostics Menu ?`	**[YES]**	Confirm Diagnostic menu selection.
`Print Menu ?`	[**NO**]	Do not print anything.
		..and keep pressing **[NO]** until you see the following display:
`Review Alarms ?`	**[YES]**	Review alarms.

The functions available under Review Alarms are outlined in Table 7-24.

Table 7-24. Review Alarms Menu Functions

Displayed Message	Description
`View Active Alarms ?`	View and individually clear all active alarms.
`Print All Alarms ?`	Print the status of all alarms (active or inactive, enabled or disabled).
`Reset All Alarms ?`	Reset all alarms to their power up state.

To perform any one of these functions, navigate to Review Alarms as shown in Table 7-21, press **[NO]** until you reach the appropriate message, then press **[YES]**.

A detailed description of the functions available in Table 7-22 is supplied in subsections 7.13.1 - 7.13.3.

7.13.1 View Active Alarms

This menu lets you view active alarms and clear their state.

7.13.2 Print All Alarms

See Appendix D, figure D-10.

7.13.3 Reset All Alarms

This function resets all the active alarms. Note that the H line alarms retain their active states.

7.14 Testing the Hardware

The Hardware Test menu can be reached from the Technician Level by following the procedure listed in Table 7-25

Table 7-25. Hardware Test Menu

Displayed Message	Press Key	Explanation
`12:00 AM Jan 01, 1997` `SETUP CAL DIAG STDBY`	[DIAG]	Select Diagnostic menu.
`Diagnostics Menu ?`	**[YES]**	Confirm Diagnostic menu selection.
`Print Menu ?`	**[NO]**	Do not print anything. ..and keep pressing **[NO]** until you see the following display:
`Hardware Test ?`	**[YES]**	Test and control the hardware.

The functions available under Hardware Test are outlined in Table 7-26.

Table 7-26. Hardware Test Menu Functions

Displayed Message	Description
`Reset All ?`	Reset all hardware to its default settings, excluding alarm relays.
`Fluidics Control ?`	Turn the fluidics devices ON/OFF and set the pump speeds.
`Check Flow Rates ?`	Check the flow rates of all fluidics devices.
`Lamp Control ?`	Turn the lamps ON/OFF and set the lamp drive.
`Temperature Control ?`	View the temperature of the detector block and that inside the electronics enclosure. Set the detector block temperature.
`Test Relays ?`	Test all available relays by turning them ON/OFF.
`Test Analog Outs ?`	Test all available analog outputs by varying the output mode and action, and setting the output drive as a percentage of the full scale.

To perform any one of these functions, navigate to Hardware Tests as shown in Table 7-23, press **[NO]** until you reach the appropriate message, then press **[YES]**.

A detailed description of the functions available in Table 7-24 is provided in subsections 7.14.1 - 7.14.7.

7.14.1 Reset All

Reset all the hardware. All relays (other than alarm relays), valves, and pumps are de-energized. The lamps are turned off; the temperature and front end control signals are refreshed; and the analog outputs are reinitialized.

7.14.2 Fluidics Control

When you select the Fluidics Control function (by pressing **[YES]**), the following question displays on the control panel:

```
Stirrer Control ?
```

By pressing **[YES]** in response to this question, you can test the stirrer. Other fluidics devices (the reagent and calibration pumps, air vent valve, and sample valves) can be similarly tested by pressing [**NO]** until the appropriate device is highlighted. Note that you are prompted only for those devices available on your system.

Pressing **[YES]** in response to the above question results in the following display:

```
Control Stirrer :
CW   SPEED   ON   EXIT
```

Option	Description	Range	Default Value
CW CCW	Switch the stirrer rotation direction between clockwise (CW) and counterclockwise (CCW). Note that this option is present only for a continuous stirring action.	Note that CCW on the display means the stirrer is actually rotating in a clockwise direction.	CW
SPEED	Vary the stirrer speed.	208, 250, 278, 313, 357 rpm.	250 rpm
ON OFF	Toggle the stirrer on/off.	Note that ON on the display indicates that the stirrer is actually off.	
EXIT	Exit to Control Reagent 1.		

Note that this display is unique to the stirrer. There are two other displays related to controlling fluidics devices, as shown below:

```
Control Reagent 1 :
REV  FLOW  ON  EXIT
```

This display appears when you are attempting to control pumps. The display is identical (except for the device tag) for both reagent and calibration pumps.

Option	Description	Range	Default Value
REV FWD	Switch between pumping into the reaction cell (forward pumping or FWD), and pumping out of the reaction cell (reverse pumping or REV).	Note that REV on the display means that the pump is actually pumping forward (into the reaction cell).	FWD
FLOW	Vary the pump flow rate by altering the speed of the motor driving the pump.	Depends on pump type and flow calibration.	
ON OFF	Toggle the pump on/off.	Note that ON on the display indicates that the pump is a actually off.	
EXIT	Exit to next device		

The display below appears when you are attempting to control valves. The display is identical (except for the device tag) for the air vent and the sample valves:

```
Turn Air Vent :
                ON  EXIT
```

Option	Description	Range	Default Value
ON OFF	Toggle the valve on/off.	Note that ON on the display indicates that the valve is actually off.	
EXIT	Exit to next device		

NOTE: The analyzer does not allow you to turn on more than four (4) devices at the same time, excluding the stirrer.

7.14.3 Check Flow Rates

When the Check (calibrate) Flow Rates function is selected (by pressing **[YES])**, the following message displays:

```
Check Rgt1 Flow ?
```

By pressing **[YES]** in response to this question, you can check (calibrate) the flow rate of Rgt1. Other fluidics devices (the reagent and calibration pumps, and sample valves) can be similarly tested by pressing **NO** until the appropriate device is highlighted. Note that you are prompted only for those devices available on your system.

In order to calibrate the flow rate, the analyzer keeps the specified device on for exactly one (1) minute. You are asked to collect the pumped volume, measure it, and enter it into the system as the calibrated data. The analyzer prompts you at each stage. Thus, it first prompts you to remove the reaction cell and attach a measuring cylinder to the device output port, as shown below:

```
Remove Cup & Attach
Measuring Cylinder ?
```

> **NOTE:** It is up to your discretion to provide a sufficiently large measuring cylinder, large enough to hold one minute's worth of fluid.

You may answer **[NO]** to this question to exit without calibrating. Once you press **[YES],** the analyzer turns on the appropriate device. The keypad (except for **[RUN]** and [**STOP]**) is disabled for this duration. The Orion Model 2030 Silica Analyzer then displays the countdown as shown below:

```
Pumping Reagent 1
  Time left = 1:00
```

Once the analyzer has turned off the device, you are prompted to enter the volume in the measuring cylinder. If you choose **[NO]** at this stage, you can again exit without calibrating the device.

```
Note Down Volume in
Measuring Cylinder ?
```

If you chose **[YES]** to the previous question, you **must** enter the volume in the measuring cylinder through the following display:

```
Measured Rgt1 Vol =
      005.0 mL
```

The device flow rate has now changed. This change is reflected in the analysis cycle, as well as the flow rate choices in Fluidics Control.

7.14.4 Lamp Control

This function is used to set up the lamp drive as a percentage value. 100 % drive corresponds to a 155mA of current through the lamps. Each percentage point changes the current by approximately 1.56mA. The maximum drive is 135 % (200mA) while the minimum drive is 0% (< 0.8mA) in which case the lamp is off. The lamp intensity is directly proportional to the lamp current, which in turn is linearly proportional to the drive percentage over the 0-135% range.

The lamp drive is set up through the following display:

```
Lamp1 set at 100 %
LMP2  SET  ON  EXIT
```

Option	Description	Range	Default Value
LMP1 LMP2	Switch between displaying the lamp drive for Lamp 1 and Lamp 2. Note that this key is not available on systems with a single lamp.		

SET	Set the lamp drive for the lamp being displayed:
	`Lamp1 set =`
	`100 %`
		0 - 135%	120 %

ON OFF	Switch the lamp being displayed on/off.	Note that ON on the display means that the lamp is actually off.	
EXIT	Exit to Temperature Control.		

7.14.5 Temperature Control

The Temperature Control function allows you to set and view the detector block temperature as well as view the ambient temperature. When this function is entered, the following message displays:

```
Blk Temp = 49.7 °C
°C/°F  SET  AMB  EXIT
```

Or

```
Amb Temp = 30.7 °C
°C/°F  SET  BLK  EXIT
```

Option	Description	Range	Default Value
°C/°F	Switch between Fahrenheit and Centigrade units.		
SET	Set the detector block temperature. `Blk Temp = 050.0 °C`	0-72°C (32-158°F)	50°C (122°F)
BLK	Switch between displaying the detector block and ambient temperatures.		
EXIT	Exit to Test Relays.		

> **NOTE**: The detector block cannot be cooled if the block temperature is set below room temperature. The block temperature should be at least 5 °C above the highest ambient temperature expected for proper regulation.

7.14.6 Test Relays

When the Test Relays function is selected (by pressing **YES**), the following question displays:

```
Test Relay #1 ?
```

By pressing **[YES]** in response to this question, you can test Relay #1 by toggling it on and off. Other relays can be similarly tested by pressing **[NO]** until the appropriate relay is highlighted. Note that you are prompted only for those relays that are available on your analyzer.

The most common way of testing the contact closure on the relays is to connect the two terminals to a digital ohmmeter and toggle the relay on and off. Based on the normal state of the relay (normally open or normally closed), the ohmmeter reads a short and an open, respectively.

Pressing **[YES]** in response to the above question results in the following display:

```
Turn Relay #1 :
      ON   EXIT
```

Option	Description	Range	Default Value
ON OFF	Toggle the Relay state on/off.		OFF
EXIT	Exit to Test Analog Out.		

7.14.7 Test Analog Outputs

When the Test Analog Outs function is selected (by pressing **YES**), the following question displays:

```
Test Output #1 ?
```

By pressing **[YES]** in response to this question, you can test Analog Output #1. Other analog outputs can be similarly tested by pressing [**NO]** until the appropriate output is highlighted.

The most common way of testing an analog output is by verifying its output drive, based on a percentage of the full scale. For example, if you set a 0-20mA output to 50% scale, you would expect 10mA between the output terminals.

The Test Analog Outputs function permits you to set the output drive to a known value and thus verify its operation by comparing it against the actual output, as measured on a digital multi-meter. The actual current output depends on the output action and mode and displays on the display for verification purposes, as shown below.

```
Out1 = 0.0mA ( 0%)
ACTN  MODE  VALUE  EXIT
```

NOTE: Once you exit the test analog outputs, the output is restored to its previous value.

Option	Description	Range	Default Value

ACTN	Sets the output action.
	
	`Smp 1 Output Action =`
	`Direct (LO to HI)`
		
		Reverse (HI to LO)
		Direct (LO to HI)
			
			Direct

MODE	Set the Analog output mode.
	
	`Smp 1 Output Mode =`
	`4 to 20 mA`
		
		0 to 20 mA
		4 to 20 mA
			
			4 to 20 mA

VALUE	Set the output drive as a percentage of full scale.
	`Out1 =`
	`100 %`
		
		0-100%
			
			0 %

EXIT	Exit to Adjust HW Settings		

See Setting the Analog Output function description in this Chapter for a description of output actions and modes.

7.15 Viewing Hardware Settings

The View Hardware menu can be reached from the Technician Level by following the procedure listed in Table 7-27.

Table 7-27. View Hardware Settings Menu

Displayed Message	Press Key	Explanation
`12:00 AM Jan 01, 1997` `SETUP CAL DIAG STDBY`	[DIAG]	Select Diagnostic menu.
`Diagnostics Menu ?`	[**YES**]	Confirm Diagnostic menu selection.
`Print Menu ?`	[**NO**]	Do not print anything. ..and keep pressing [NO] until you see the following display:
`View Hardware Set ?`	[**YES**]	Review detector signals and other internal signals plus the serial number and software revision level.

The functions available under View Hardware are outlined in Table 7-28.

Table 7-28. View Hardware Settings Menu Functions

Displayed Message	Description
`Show Det Out ?`	Show the detector signal levels and adjust the gains. Please use extreme caution when adjusting the gains.
`Show Absorbance, T?`	Show the absorbance and transmittance or normalize the detectors.
`Show Main ADC ?`	Show various internal signal levels. **This function is only available to the super user.**
`Show Power Rails ?`	Show the +24, ±12, and +5V rails.
`Show Rev Level ?`	Show the software revision level and analyzer serial number.

To perform any one of these functions, navigate to View Hardware as shown in Table 7-27, press **[NO]** until you reach the appropriate message, then press **[YES]**. A detailed description of the functions available in Table 7-28 is provided in subsections 7.15.1 - 7.15.5.

7.15.1 Show Detector Output

The Show Detector Outputs function allows you to view the output of the light detector levels and verify its operation. After you select the Show Detector Outputs function, this message displays:

```
Det1 = 3750 mV
GAIN   LMPON   DET2   EXIT
```

Option	Description	Range	Default Value
[GAIN]	Adjust the preamplifier or amplifier gain. This is described in further detail in the next table.	See table below.	
[LMPON] [LPOFF]	Toggle the lamp on and off. Note that the LMPON message on the display is indicating that the lamps are off.		
[DET2] [DET1]	Switch between displaying the amp/preamp settings of Detector 1 (Det1) and those of Detector 2 (Det2).		Initially always shows the Detector 1 settings
[EXIT]	Exit to Show Absorbance, T		

After selecting [GAIN], this message displays:

```
Pre1 = 85 Amp1 = 60
PRE   AMP   DET2   EXIT
```

```
T1 = 10    Amp1 = 99%
TIME   AMP   DET2 EXIT
```

In this display, T1 represents the integration time for Detector 1 (in milliseconds), and Amp1 represents the scale factor. A 50% setting would decrease the signal out of the integrating amplifier by half.

Key	Description	Range	Default Value

[TIME]	Set the integration period for the currently displayed detector.
	
	`Det1 Integrate Time =`
	`0010 ms`
		5 - 999 ms	10 ms

[AMP]	Set the scale factor for the currently displayed detector
	
	`Det1 Amplifier Gain =`
	`99 %`
		0 - 99%	99%

[DET2] [DET2]	Switch between displaying Detector 1 and Detector 2 amplifier settings		
[EXIT]	Exit this menu		

The gain of each detector can be increased by a factor of ten by removing the jumpers JP8 and JP9, respectively. Typically, this is done for applications requiring the use of optical band pass filters in the 400-500nm range, due to the low throughput of light at these wavelengths (consult the factory).

Warning Messages	Message Description
`Det1= 5158 mV OVER` `GAIN   LMPON   DET2   EXIT`	The detector is overrange.

7.15.2 Show Absorbance, Transmittance

This function lets you view absorbance and transmittance values. Once you select this function, this message displays:

```
A=  0.000 T= 100.0
RST  NORM  LMPON  EXIT
```

Option	Description	Range	Default Value
[RST]	Reset any prior normalization coefficient to 1.0.		
[NORM]	Normalize the absorbance to 0.000.		
[LMPON] [LMPON]	Toggle the lamp on and off. Note that the LMPON message on the display is indicating that the lamps are off. The system does not allow you to normalize when the lamps are off.		OFF
[EXIT]	Exit to Show Main ADC.		

NOTE: The 'N' on the top right of the display indicates that the analyzer has been normalized

Warning Messages	Message Description
`Abs=0.000 Optics FLT` `RST NORM LMPON EXIT`	Either a lamp has failed or one of the detectors is overrange.

7.15.3 Show Main ADC

The Show Main ADC function shows the signal levels of various internal test points, and is used for hardware diagnostics.

> **NOTE:** This menu is to be used only during troubleshooting and is only available to the super user.

When this menu is accessed, the following message displays:

```
+2.5V = 2497.6 mV
LOG NEXT  EDIT EXIT
```

Key	Description
[LOG]/[STOP]	Toggles data logging ON and OFF. The data is logged by printing the signal value once a second. Each logged data point is printed on one line with a time stamp.
[NEXT]	Displays the next internal signal. The [DOWN] arrow key displays the previous internal signal.
[EDIT]	Changes various signal properties. This leads to the second display as shown below. This secondary menu can be used to enable/disable the FIFO, gain correction and function conversion. The FIFO (First In First Out) is used for data averaging.
[EXIT]	Exits this menu.

```
+2.5V = P0 F6 Raw
 PRI FIFO  CONV EXIT
```

Key	Description
[PRI]	Toggles the priority of the current signal between its nominal state and the top priority state. As the signal automatically gets bumped to top priority within the Show Main ADC function, pressing this key does not have any effect.
[FIFO]	Toggles the fifo. At present, the fifo length is fixed at six. Therefore, pressing this key toggles the fifo length between zero (F0) and six (F6).
[CONV]	This key allows you to toggle between conversion functions available for the signal. By default, the raw signal (Raw) is displayed in Show Main ADC. Pressing CONV once applies the ADC gain correction as measured during the electronics calibration (Corr). Pressing CONV again applies the pre-configured conversion function on the corrected signal (Conv). For example, if the block temperature is changed to Conv, the signal displays in degrees C. If there is no conversion function, the corrected mV reading continues to display.
[EXIT]	Exits this menu.

7.15.4 Show Power Rails

The Show Power Rails function allows you to check the status of the power rails (+ 24V, ± 12V, and + 5V).

7.15.5 Show Revision Level

The Show Revision Level function displays the software revision level and serial number.

7.16 Adjusting Hardware Settings

The Adjust Hardware Settings menu can be reached from the Technician Level by following the procedure listed in Table 7-29. It contains options that let you calibrate the Orion Model 2030 Silica Analyzer's electronics.

Table 7-29. Adjust Hardware Settings Menu

Displayed Message	Press Key	Explanation
`12:00 AM Jan 01, 1997` `SETUP CAL DIAG STDBY`	[DIAG]	Select Diagnostic menu.
`Diagnostics Menu ?`	**[YES]**	Confirm Diagnostic menu selection.
`Print Menu ?`	**[NO]**	Do not print anything. ..and keep pressing [NO] until you see the following display:
`Adjust HW Settings ?`	**[YES]**	Calibrate the electronics.

The functions available under Adjust HW Settings are outlined in Table 7-30.

Table 7-30. Adjust Hardware Settings Menu Functions

Displayed Message	Description
`Automatic HW Setup ?`	Automatically calibrate the electronics using default settings (recommended).
`Manual HW Setup ?`	Manually calibrate the electronics, section by section. **This function is accessible only by a super user;** it does not appear if you are at the Technician Level.
`Save HW Setup ?`	Save the electronics setup from active memory to backup memory.
`Recover HW Setup ?`	Recover the electronics setup from backup memory to active memory.

To perform any one of these functions, navigate to Adjust HW Settings as shown in Table 7-29, press **[NO]** until you reach the appropriate message, then press **[YES].**

A detailed description of the functions available in Table 7-30 is provided in subsections 7.16.1 - 7.16.4.

7.16.1 Automatic Hardware Calibration

Select to recalibrate the optics in case a filter or a lamp was changed. This is an automatic batch file; the calibration may take up to 20 minutes to complete.

7.16.2 Manual Hardware Calibration

The Manual Hardware (electronics) Calibration menu allows you to individually configure sections of hardware, and also allows you to modify the default hardware settings. For this purpose, **this function is accessible only by super users**. There are a number of sub-functions to the **Manual HW Cal** function, as shown in the table below.

Displayed Message	Description
`Cal Main ADC ?`	Allows you to calibrate the main analog to digital converter (ADC) using the internal references or external input references. For factory technician only.
`Cal DAC Outputs ?`	Calibrates the 8-bit digital to analog converter (DAC) used to control temperature/detector offsets.
`Zero Front End ?`	Zero out the preamplifier offset current and detector dark current at maximum preamplifier gain.
`Set Detector Range ?`	Set the detector signal range, over which an overrange condition is reported.
`Set Lamp Drive ?`	Set the lamp intensity.
`Set Detector Gain ?`	Automatically set the detector gains such that both detectors are matched within 50 mV of each other.
`Zero Dark Current ?`	Zero out the preamplifier offset current and detector dark current at operating gains.
`Zero Backscatter ?`	Zeros the backscatter from the probe body.
`Normalize Abs,T ?`	Normalize the absorbance.

The *Zero Electronics* procedure eliminates any offsets related to the detector amplifier electronics. The integrator output is bypassed to ground and the amplifier output is adjusted to read close to 0.0 mV.

The *Set Detector Range* procedure measures the dark current and integrator offsets. A warning message appears if dark signal is exceptionally high (>80mV) during both manual and automatic electronics calibration. In a majority of cases, the high dark current signal occurs if you forget to cover the cell with the light shield during electronics calibration. If this warning appears, you should make sure that the shield is properly installed, and then continue with the range measurement.

In the manual electronics calibration mode, you now have the ability to set the lamp intensity. In the automatic procedure, the lamp intensity as set in the *Diagnostics|Hardware Test|Lamp Control* menu, is used when determining the gain.

The *Set Detector Gain* procedure automatically adjusts the integration times and amplifier settings to generate just over 4000 mV from both detectors. The span value (4000 mV) can be modified in the manual electronics calibration mode. The *Set Detector Gain* procedure first tries to determine the optimal lamp and jumper settings for an integration time of less than 100 ms. In this process, it may end up increasing active lamp intensities to 120%. It also enforces a minimum integration time of 5 ms. If lamps are already set to 120% or more, it permits a maximum integration time of 1000 ms.

The *Zero Dark Current* procedure adjusts the detector signal so that the detectors read exactly 0.0 mV with the lamps off. If the required trim is outside the capability of the electronics, the only way that the detectors can be zeroed is by adjusting the range. If this situation occurs, a warning message flashes and you are asked if the range should be adjusted.

Once the final range is determined, the span value is adjusted such that it is at least 400mV less than the range (to accommodate for any signal drift).

The *Zero Backscatter* procedure (not needed in most cases) can be used to account for the signal contribution due to scatter-off of the immersion probe body. You are asked to remove the mirror and then the signal is measured. Signal levels greater than 200mV with the mirror detached are considered to be too high. As the kynar body reflects insignificant levels of light, this procedure is not recommended during normal operation. (This procedure is only available in the manual electronics calibration mode.)

In the manual mode, you are also able to select which detector to use for the reference signal. The reference detector is set at the factory and should be changed only if optical filters are changed, or the backup is erased.

The *Normalize Abs, T* procedure lets you normalize the detectors such that the absorbance is exactly 0.000. In the automatic procedure, the lamps are left on for 7 seconds and then allowed to stabilize before the normalization takes place.

At the end of a successful automatic calibration, you are given the option of printing the status to confirm the hardware settings. You should save the hardware settings to backup after both manual and automatic electronic calibrations. Once the settings are saved, there is no need to recover them.

NOTE: Due to variations in optical filters, detector efficiencies, fiber transmission, and lamp characteristics, gains may vary substantially between analyzers even with the same applications. Please keep a copy of the hardware setup status (as recorded when you Print Status) with the unit at all times, as a backup of the nominal hardware settings of the analyzer.

A number of error messages can occur and are listed in the following table.

Troubleshooting Guide for Automatic Electronics Calibration

Displayed Message	Description	Action to be taken
ADC Slope Error	Hardware calibration limits exceeded	Consult factory
ADC Offset Error	Hardware calibration limits exceeded	Consult factory
Blk Temp Not Set	The detector block temperature was not at the set point	Wait until the block temperature reaches the set point
DAC Slope Error	Hardware calibration limits exceeded	Consult factory
DAC Offset Error	Hardware calibration limits exceeded	Consult factory
Detx Dark Sig Hi	The dark signal (current generated by the detector with no light present) is too high to be automatically adjusted; this is a warning to the operator and does not adversely affect the operation of the analyzer	Make sure the light shield is installed, and proceed
Detx Offset Hi	Circuit fault	Consult factory
Detx Timed Out	Circuit fault	Consult factory
EPOT Error - U36	Circuit fault	Consult factory
EPOT Error - U40	Circuit fault	Consult factory
EPOT Overrange	Circuit fault	Consult factory
Replace Jumper JP8	The signal measured on Detector 1 requires very short integration times	Install JP8
Replace Jumper JP9	The signal measured on Detector 2 requires very short integration times	Install JP9
Remove Jumper JP8	The signal measured on Detector 1 requires very long integration times	Remove JP8, or set both lamps to 100%
Remove Jumper JP9	The signal measured on Detector 1 requires very long integration times	Remove JP9, or set both lamps to 100%

7.16.3 Save Hardware Setup

Save the hardware (electronics) setup to backup memory. While the save is in progress, the "Please Wait" message as shown in Save Cal Setup displays on the display.

7.16.4 Recover Hardware Setup

Recover the hardware (electronics) setup stored in backup memory by overwriting the current test sequence.

7.17 Clearing Sections of Memory

The Clear/Reset Memory menu can be reached from the Technician Level by following the procedure listed in Table 7-31.

Table 7-31. Clear/Reset Memory Menu

Displayed Message	Press Key	Explanation
12:00 AM Jan 01, 1997 SETUP CAL DIAG STDBY	[DIAG]	**Select Diagnostic menu.**
Diagnostics Menu ?	**[YES]**	Confirm Diagnostic menu selection.
Print Menu ?	**[NO]**	Do not print anything. ..and keep pressing **[NO]** until you see the following display:
Clear/Reset Memory ?	**[YES]**	Clear and reset sections of memory.

The functions available under Clear/Reset Memory are outlined in Table 7-32.

Table 7-32. Clear/Reset Memory Menu Functions

Displayed Message	Description
Clear Calibrations ?	Clear all stored calibration results.
Clear Analyses ?	Clear all stored analysis results.
Reset Cal Setup ?	Set a specified calibration Setups to default values. The reset setup is longer available in any of the setup menus.
Reset Test Method ?	Set a specified analysis method to default values. The reset setup is no longer available in any of the setup menus.
Reset Clock ?	Reset the system clock to 12:00 AM, 01 Jan 1998.
Reset Backup ?	Reset the backup using defaults and load these into active memory on a reboot. **This function is accessible only by the super user.**
Reset Memory ?	Load the analyzer configuration from backup memory into active memory on a reboot.

To perform any one of these functions, navigate to Clear/Reset Memory as shown in Table 7-30, press **[NO]** until you reach the appropriate message, then press **[YES]**.

A detailed description of the functions available in Table 7-31 is provided in subsections 7.17.1 - 7.17.7.

7.17.1 Clear Calibrations

This function clears all stored calibrations.

7.17.2 Clear Test Results

This function clears all stored results.

7.17.3 Reset Calibration Setup

This function permits you to reset any one of the defined calibration Setup(s) to the factory default state.

7.17.4 Reset Test Method

This function permits you to reset any one of the defined analysis Method(s) to the factory default state.

> **NOTE:** When a calibration Setup or an analysis Method is reset, the defined Setup or Method is erased except for Setup 01 or Method 01.

7.17.5 Reset Clock

This function resets the clock to Jan, 01, 1998.

7.17.6 Reset Backup

This function clears backup memory to the power-up factory defaults.

7.17.7 Reset Memory

This function clears RAM and recovers the analyzer configuration from back-up memory.

Chapter 8: Maintenance

Chapter 8 provides the maintenance procedures applicable to the Orion Model 2030 Silica Analyzer. Specific maintenance procedures covered here fall into three categories:

- Scheduled Maintenance Procedures
- Miscellaneous Maintenance Procedures
- Shutdown and Restart Procedures

The scheduled maintenance procedures (section 8.1) are important tasks that must be performed in a timely fashion to maintain the analyzer's availability and performance level. The analyzer will run unattended for long periods of time if these simple procedures are followed regularly.

The Miscellaneous Maintenance procedures (section 8.2) are associated with replacing failed components, so these procedures are unscheduled and they are likely to be infrequent. **The procedures described in this section are those that can be carried out by technicians with appropriate training and tools. If you doubt your ability to perform these procedures, contact Orion for assistance.**

Shutdown and restart procedures (section 8.1) are the recommended steps to take if your Orion Model 2030 Silica Analyzer is inactive for an extended period, that is, more than three days.

First, you should familiarize yourself with all the scheduled maintenance requirements by scanning the next subsection. Then, when a particular scheduled or unscheduled procedure must be performed, find it in the following list and carefully follow the instructions provided.

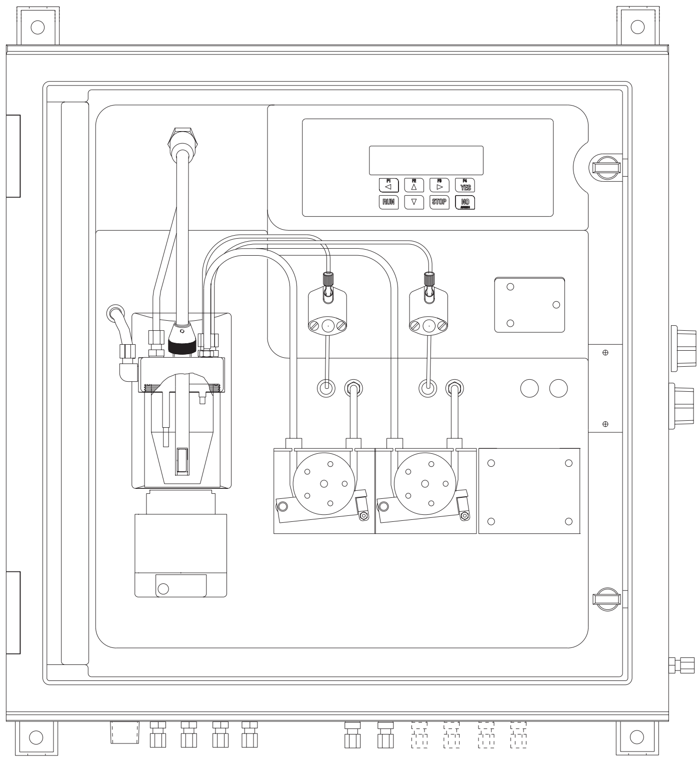


Figure 8-1 Orion Model 2030 Analyzer Front View (Front Door Not Shown)

> **NOTE:** The section on Shutdown Procedures outlines the standard procedures for shutting the Analyzer down for short and extended time periods. These procedures are important to prevent damage to the piston pumps and to prevent material buildup on the optical surfaces of the probe.

8.1 Scheduled Maintenance

Table 8-1 lists the scheduled maintenance procedures for the analyzer. You can adapt this schedule to your particular usage since strong acids, alkalis, and oxidizing agents can destroy pump tubing faster than dilute solutions. Calibration and analysis frequency can also affect the lifetime of seals and pump tubing.

Table 8-1. Maintenance Schedule

Interval	Item	Operation
Daily	Printer	Check paper and ribbon †
	Reagents	Check levels in containers ‡
	Standard	Check levels in container ‡
Weekly	Analyzer	Calibrate
Biweekly	Probe	Clean and inspect
Monthly	Piston pumps	Seat seals
	Piston pumps	Check flow rate and operation
	Peristaltic pump	Check tubing flow rate
	Reaction cell	Wash out cup thoroughly
3 Months	Peristaltic pump	Replace tubing and pump clips
	Piston Pumps	Replace pumps seals
	O-rings	Replace

† Only if printer installed.
‡ Can be automated and reported through contact closure.

The tools required for most procedures are:

- Phillips and Flat Head screwdrivers
- 1/16" and 9/64" Allen wrench (early models of the Orion Model 2030 Silica Analyzer)
- 5/8" open end wrench
- Channel lock pliers
- 10 mL graduated cylinder
- 1/4" nut driver
- Cotton swabs, solvent

8.1.1 Reseating Piston Pump Seals

The seals on the piston pumps need to be reseated monthly under normal conditions and after the analyzer is idle for an extended period.

The procedure can be performed in a few minutes, **but you must take proper precautions to avoid exposure to hazardous chemicals.**

WARNING: IN MANY CHEMICAL ANALYSIS METHODS, THE REAGENTS MAY BE TOXIC OR OTHERWISE HARMFUL TO HUMAN HEALTH. OBSERVE APPROPRIATE PRECAUTIONS WHEN HANDLING AND DISPOSING THE REAGENTS. REVIEW THE APPROPRIATE PUBLISHED MATERIAL SAFETY DATA SHEETS REGARDING THE SAFE HANDLING AND DISPOSAL OF ALL REAGENTS.

A piston pump is controlled by the software via the control panel. During this procedure, you change the direction of flow of the pump, which can only be done using the **[F1]** key to REVERSE DIRECTION.

After you complete the procedure, be sure to leave the pump in the FORWARD position.

A. Flushing Lines with Water

1. Detach all reagent pump supply lines from the reagent containers, and place the inlet end of each tube in a beaker or bottle containing 1-2 liters of distilled or deionized water. To avoid any possible cross-contamination between reagents, use fresh water and a separate, clean, container for each reagent supply line.
   It is good practice to close the reagent container with an appropriate stopper or blank fitting. Make sure that the reagent containers are clearly marked so that there is no confusion when reattaching these containers.

Caution: Be careful not to spill reagent solution or to let it drip on your body or clothes.

---

2. Flush the reagent-handling systems with water by stepping through the procedure given in Table 8-2. As you flush each reagent-handling system, be sure to leave the pump ON until the tubing and pump are thoroughly flushed. This may take up to fifteen (15) minutes.

NOTE: Five seconds or so after water starts flowing into the tubing line, remove the source end of the reagent supply tubing from the water supply just long enough to form a small air bubble in the line, and then reinsert the tubing into the water supply. By waiting for the bubble to traverse the supply line and reach the reaction cell, you can be certain that flushing is complete.

Table 8-2. Piston Pump and Line Flushing

Displayed Message	Press Key	Explanation
`Run Diagnostics ?`	**[YES**]	Enter Diagnostics menu.
`Print Menu ?`	**[NO**]	Now keep pressing **[NO**] until ..
`Hardware Test ?`	[**YES**]	
`Reset All ?`	[**NO**]	
`Fluidics Control ?`	**[YES]**	**Enter Fluidics Control menu.** Now locate the pump to be flushed by using the **[UP]** and **[DOWN]** keys. For example, to locate Reagent Pump 1, keep pressing the **[DOWN]** key until the following message displays:
`Reagent 1 Control ?`		If you go too far, you can always recover by pressing the **[UP]** arrow. Allows you to turn pump ON and OFF.

B. Seating the Pump Seals

Perform the following two steps in turn with each piston pump:

1. Remove the end of the inlet tubing from the water. Plug the end with your finger and turn the pump ON for 20-30 seconds. This seats the seals against a vacuum.
2. Continue to plug the end of the tubing and reverse the pump direction by pressing the [REV] **([F1])** key on the control panel under Fluidics Control. Keep direction reversed for 10-20 seconds.

C. Reconnecting and Refilling Reagent Lines

1. Remove each reagent line from the water container and momentarily turn on each pump so that a 2-3" air column (bubble) forms in the end of each line.
2. Reconnect each reagent supply line to the appropriate reagent container.
3. Refer to Figure 8-2. Double check the plumbing by tracing the tubing paths for each pump in order to ensure that both reagent solutions route through the correct piston pumps.

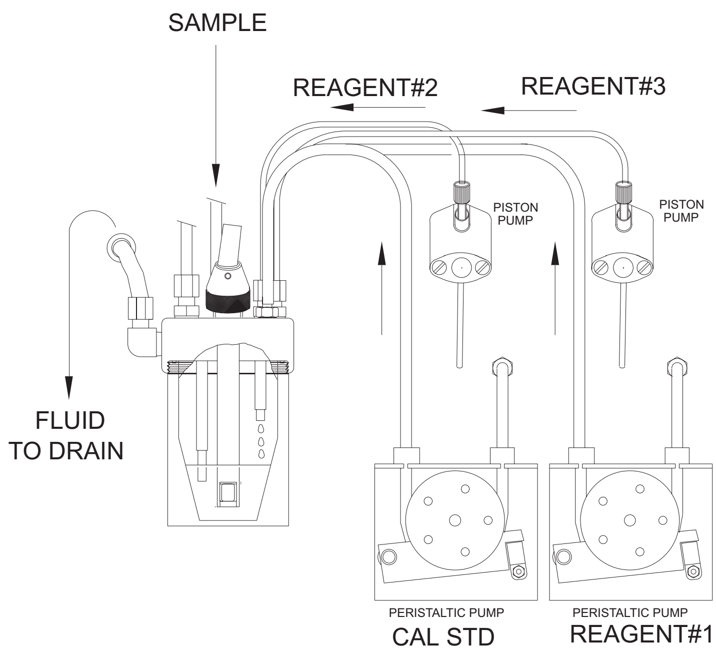


Figure 8-2 Reagent and Standard Tubing Paths

4. Working with one pump at a time: turn the pump ON, then wait for the air bubble to traverse the reagent lines and reach the reaction cell. Then turn it OFF.
5. Turn on Sample 1 for 2-3 minutes to wash out the reaction cell.
6. Remove the reaction cell and rinse it thoroughly with deionized water. Replace the cell, filled 2/3 with the deionized water.

8.1.2 Replacing Piston Pump Seals

The seals on the piston pumps need to be changed quarterly under normal conditions. The most noticeable signs that the seals require changing are air bubbles from the piston pumps and erratic analysis results.

The procedure described below is intended for use in the field, but you can send one or both piston pumps to Orion for servicing if you prefer. We encourage you to learn these procedures and to perform them at proper intervals to assure high-precision operation and excellent reliability of your analyzer. **We recommend that you replace the seals on all piston pumps at the same time.**

You can service the pumps while they remain installed on the analyzer. You might want to have a set of spare pump assemblies available to minimize analyzer downtime.

Be sure to take proper precautions to avoid exposure to hazardous chemicals.

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A piston pump is controlled by the software via the control panel. During this procedure you change the direction of flow of the pump, which can only be done using the **[F1]** key to REVERSE DIRECTION.

After you complete the procedure, be sure to leave the pump in the FORWARD pumping mode.

A. Flushing Lines with Water

1. Detach both reagent supply lines from the reagent containers, and place the inlet end of each tubing in a beaker or bottle containing 1-2 liters of distilled or deionized water. To avoid any possible cross-contamination between reagents, use fresh water and a separate, clean container for each reagent supply line.

   It is good practice to close the reagent container with an appropriate stopper or blank fitting. Make sure that the reagent containers are clearly marked so that there is no confusion when reattaching these containers.

> **NOTE**: Be careful not to spill reagent solution or to let it drip on your body or clothes.

2. Flush the lines and pump in each reagent-handling systems with water by stepping through the sequence given in Table 8-3.

   As you flush each reagent-handling system, be sure to leave the pump on until the tubing and pump are thoroughly flushed. This may take up to fifteen (15) minutes.

> **NOTE:** Five seconds or so after water starts flowing into the line, remove the source end of the reagent supply tubing from the water supply just long enough to form a small air bubble in the line, and then reinsert the tubing into the water supply. By waiting for the bubble to traverse the supply line and reach the reaction cell, you can be certain that flushing is complete.

3. Refer to Table 8-2 to navigate to fluidics control.

B. Removing the Pump Assemblies

1. Press the **[STOP]** key on the control panel**.**
2. Loosen the compression fittings to the inlet and outlet tubing on the top and bottom of the pump.
3. Remove the three mounting screws.
4. Disconnect the electrical connector at the rear of the assembly. It is best to service the pump on a bench or suitable workplace.
5. Perform the following three sets of procedures (disassembling, replacing seals, reassembling) in turn on each pump. By working with one pump at a time, you eliminate the possibility of mixing up the parts.

C. Disassembling the Pump

1. Refer to Figure 8-3. Loosen the two screws that hold the cylinder cap to the base assembly. Begin with the left screw and loosen evenly, until the cylinder cap can be removed. Do not twist or cock the assembly.

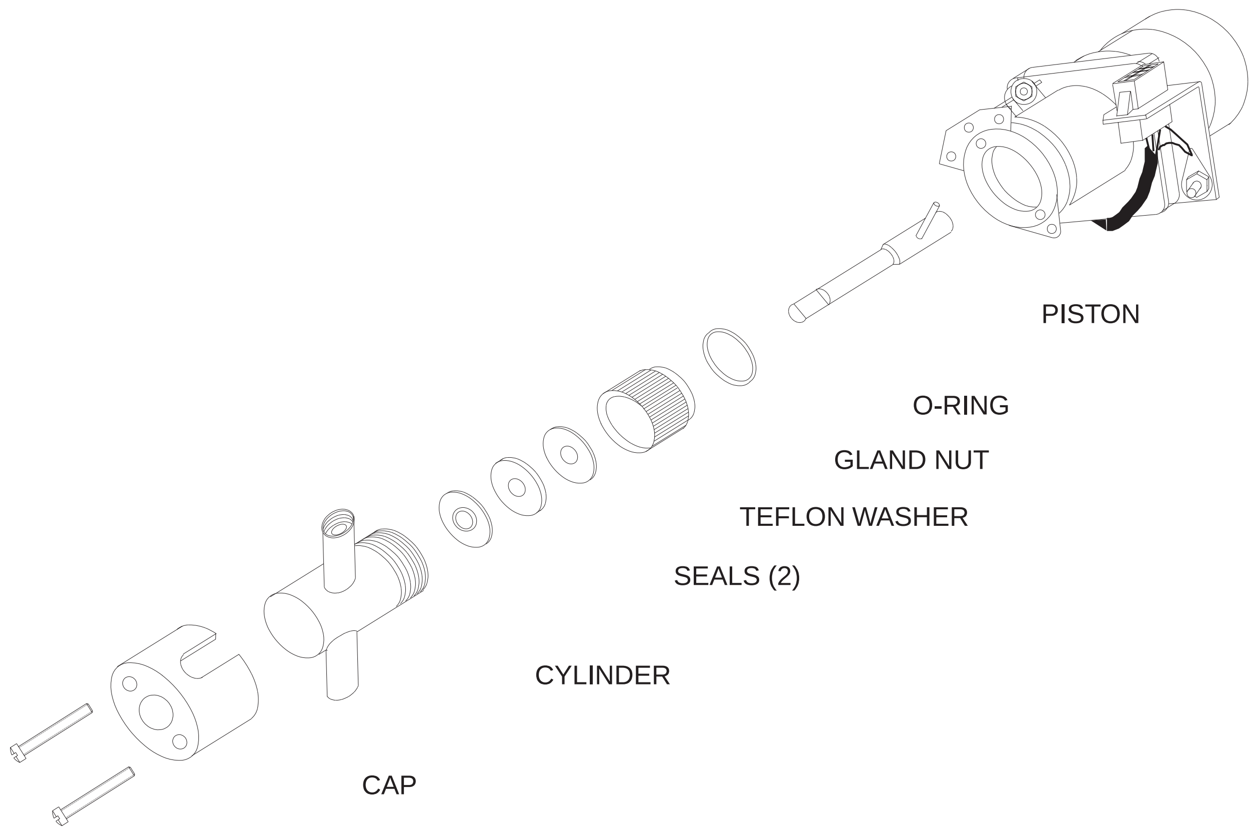

Figure 8-3 Piston Pump, Exploded View

Caution: The piston and cylinder of the pump are ceramic and can be broken easily if improperly handled.

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2. Remove the cylinder cap and remove the piston-cylinder assembly by rotating the assembly as shown in Figure 8-3.
3. Refer to Figure 8-3. Gently loosen the gland nut using a pair of pliers, and remove the inner O-ring, piston, Teflon washer, and seals.
4. Put the piston and cylinder into an ultrasonic cleaner or a water bath and soak it overnight. This removes deposits, thereby helping to reduce seal abrasion and prolonging the life of the pump.
5. Discard the old seals.

Caution: New seals must be handled carefully to prevent tearing and will not work properly if installed incorrectly. Be sure to install the seals exactly as described.

D. Installing New Seals

1. Refer to Figure 8-4. Pre-form the new piston seals by inserting the point of a pencil into the center of the seal and gently sliding the seal down so that it creates an indentation of about 1/16th of an inch. Do not oversize the center of the seal. It expands to fit the piston and cylinder when the seals are installed.

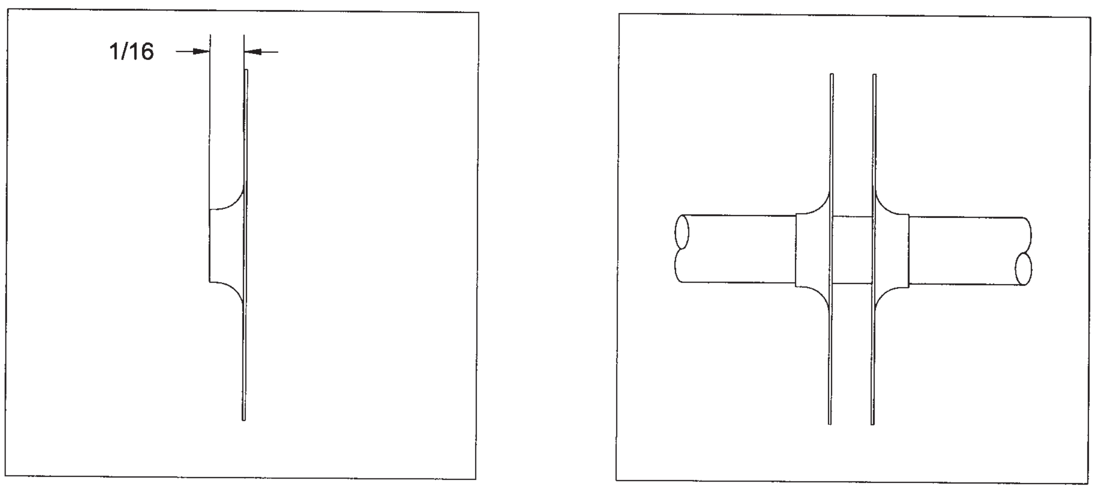

Figure 8-4 Preforming Seals

2. Refer to Figure 8-3. Install the O-ring onto the channel at the end of the gland nut.
3. Slide the gland out, O-ring-end first, onto the piston.
4. Install the Teflon washer onto the piston.
5. Put the first seal over the end of the piston, raised side first, as shown in Figure 8-3, and work it gently past the flat spot in the piston.
6. Install the second seal, **raised side last**, as shown in Figure 8-3, and slide it gently past the flat spot on the piston.
7. Insert the piston end into the cylinder until the seals touch the cylinder end.
8. Making sure that the Teflon washer and seals are aligned and centered, slowly tighten the gland nut by hand onto the cylinder.
9. Refer to Figure 8-3. Tighten the gland nut an additional 1/8 of a turn, using a pair of pliers. Be careful not to damage the O-ring when tightening.

E. Reassembling the Pump

To avoid component damage, it is important that the piston cylinder assembly be gently installed into the base assembly in the orientation shown in Figure 8-3.

1. Pull the piston part way out to facilitate installation.
2. Refer to Figure 8-3. Gently install the pin at the end of the piston into the bearing. Seat the cylinder firmly against the base assembly. Be sure that the compression fittings on the cylinder are positioned vertically.
3. Put the cylinder cap over the cylinder. Insert and tighten the screws finger tight. Tighten the screws alternately 1/2 turn at a time until the cap is snugly pressed against the base assembly.

F. Reinstalling Pump Assemblies

1. Reinstall both pumps in their correct positions on the analyzer.
2. Reconnect the inlet and outlet tubing at each pump.
3. Step through the sequence given previously in Table 8-3. Allow each pump to operate until the lines are filled with water, and then turn it OFF.

G. Seating the Pump Seals

Refer to Pump Set Seals.

H. Reconnecting and Filling Reagent Lines

1. Remove each reagent line from the water container and momentarily turn ON the associated piston pump long enough that a 2-3" air column (bubble) forms in the end of the line.
2. Reconnect both reagent supply lines to the reagent container.

8.1.3 Performing Reagent Pump Flow Rate Calibration

Use the following procedure at least monthly to calibrate the flow rate of the piston pumps; this ensures that the flow rates of the two piston pumps are accurate.

- In the procedure, you first flush **both** reagent lines with deionized water to purge them of potentially hazardous chemicals, and reseat the piston pump seals.
- Then you measure the flow rate using a graduate and second timer.

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8.1.4. Measuring Flow Rate

The Diagnostics Menu, Check Flow Rate, provides you access to the specific control routines to check the flow rate of the various devices. Navigate to the Check Flow Rate menu under Fluidics Control and enable the appropriate device.

8.1.5 Inspecting and Cleaning the Immersion Probe

1. Using several cotton-tipped applicators soaked in deionized water or in a solution that is a solvent to the process chemistry, repeatedly wipe the glass window of the probe and the reflector until there is no sign of deposit on either surface. For convenience, the reflector can be removed using a flat-blade screwdriver in the slot on its back surface. When reinstalling the reflector, do not overtighten.

> **NOTE**: For serious buildup, it is useful to soak the probe and reflector in solvent overnight, or to use an ultrasonic bath. In such an instance, it can be helpful to remove the probe body from the fiber assembly and collar. For details, consult the Replacing Probe Body procedure later in this chapter.

2. Rinse the probe and reflector in distilled or deionized water. Inspect the window and the reflector surface for pitting or scaling. If the reflector surface is not shiny, replace it with a spare.

Additional reflectors may be obtained from Orion. If the window shows sign of deterioration, contact Orion. It may be necessary to replace the probe body.

3. Reassemble the reflector into the probe if it was removed.
4. Screw the probe back into the reaction cell by grasping the knurled collar and slightly rotating the probe into the manifold.

8.1.6 Replacing the Reaction Cell O-ring

Perform this procedure yearly. Refer to Figure 5-1 for details.

1. Place the analyzer on standby or power down the system.
2. Loosen the stirrer assembly using the knurled nut at the bottom of the stirrer assembly and rotate the stirrer assembly down counterclockwise out of the way.
3. Remove and replace the O-rings seated in the top surface of the reaction cell.
4. Install the cup.
5. Reposition the stirrer assembly by rotating it back into position. Tighten the knurled fastener by hand.
6. Place the analyzer back into service.

8.2 Miscellaneous Maintenance

In addition to the scheduled maintenance procedures just described, perform tubing replacement and valve replacement whenever visual inspection or operational deficiencies indicate the need.

8.2.1 Replacing Standard Tubing

A. Flushing the Lines with Water

Detach the standard supply line from the standard container, and place the end of the tubing in a clean beaker or bottle containing 1-2 liters of fresh distilled or deionized water.

It is good practice to close the standard container with an appropriate stopper or blank fitting.

Caution: Be careful not to spill solution or to let it drip on your body or clothes.

B. Replacing the Tubing

1. Make note of where the tubing ends are attached, then remove the tubing. When installing the Standard pump tubing, be sure that the shorter length is on the right.
2. Loop the new tubing over the pump rollers and lock in place by inserting the tubing into the bracket slots so that both tube collars are below the bracket, as previously shown in Figure 5-3.
3. Refer to Figure 8-5. Attach the ends of the tubing to the correct fittings on the Reaction Cell Assembly.

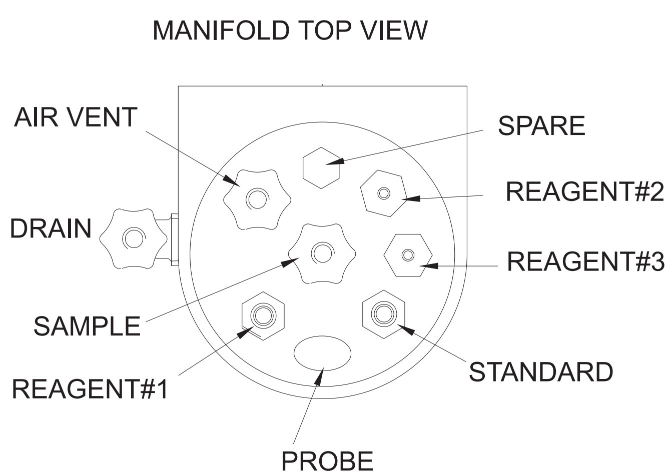

Figure 8-5 Reaction Cell Assembly

C. Replacing the Immersion Probe Body

This procedure describes the removal and replacement of the body of the immersion probe from the fiberoptic bundle. You should perform this procedure if:

- Upon inspection, the glass window shows severe deterioration or cracks.
- The entire fiberoptic assembly must be replaced

For convenience, the probe is to be cleaned using an overnight soak in solvent or ultrasonic bath.

It is good practice to replace the probe reflector at the same time the probe body is replaced (Refer to Figure 8-6 for details). It is necessary to reinitialize the hardware after replacing the probe (Refer to Chapter 7 for details).

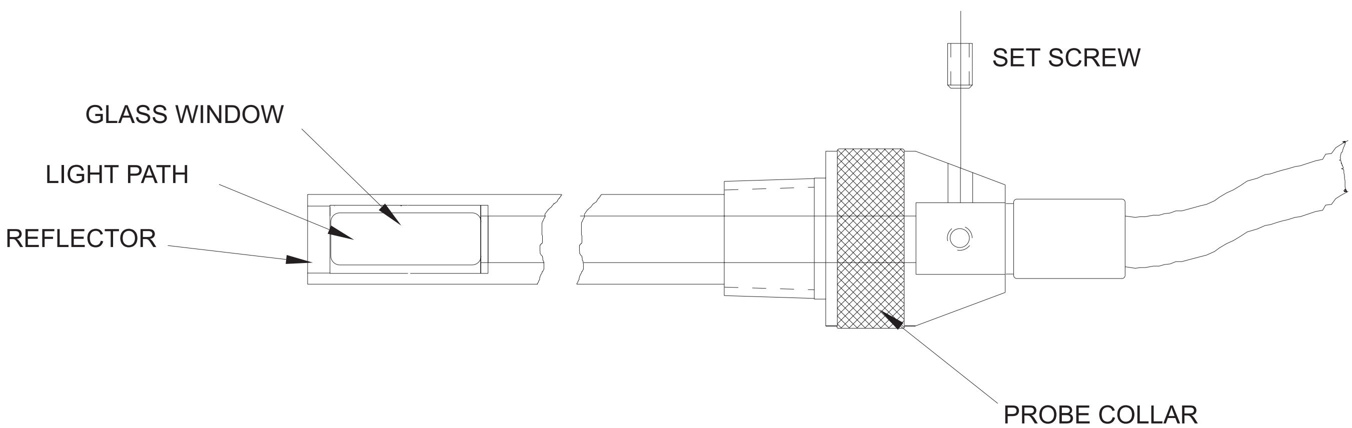

Figure 8-6 Probe Detail

8.2.2 Replacing the Lamp

This procedure is performed if the source bulb burns out. It is necessary practice to reinitialize the hardware and normalize the probe after replacing the bulb. Refer to Figure 8-7 for details.

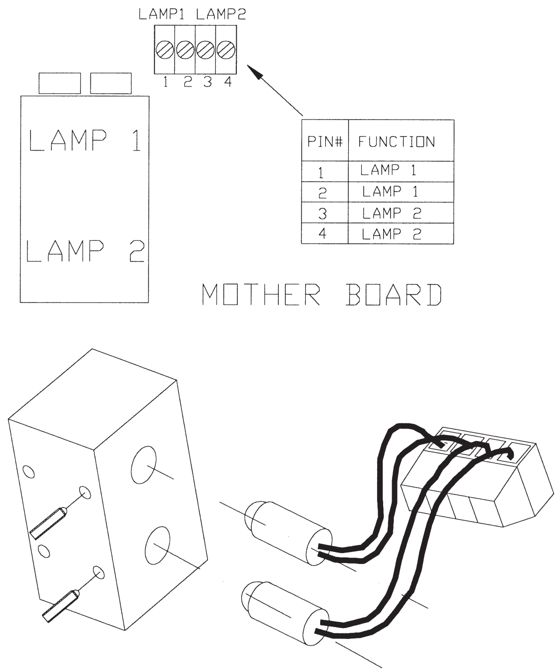

Figure 8-7 Source Block Detail

1. From the keypad, place the analyzer on standby, or power down the system.
2. Locate the source block on the left side of the mother board, and the four set screws visible on the front surface of the block.

Caution: Access to the source block requires removing the electronics cover. The inside of the electronics enclosure should be accessed only by qualified service personnel.

> **NOTE:** When replacing the electronics cover, secure the captive screws firmly, using a torque wrench at a 100 oz/inch setting.

3. Use a 1/16" hex wrench to loosen only the right-hand set screw, which holds the bulbs in position.
4. Slide the bulb out of the block by pulling gently on its pigtail wires.

5. Using a small flat-blade screwdriver loosen the two left-most screws on the terminal block to which the lamp pigtail wires attach. Discard the lamp.
6. Attach the wires from a spare lamp to the terminal block and tighten.
7. Slide the new bulb into its mounting hole until it bottoms out, and finger-tighten the set screw.
8. Follow procedure to reinitialize the hardware (refer to Chapter 7 for details).

8.2.3 Replacing the Optical Filter

This procedure should be necessary only under unusual circumstances and should be performed only under the recommendation of Orion. If both filters are to be changed, it is good practice to work only on one at a time; the procedure is identical for both. Depending on the type of filter that is being replaced, Orion recommends that the hardware get reinitialized.

Caution: **Access to the detector block requires removing the electronics cover. The inside of the electronics enclosure should be accessed only by qualified service personnel.**

NOTE: When replacing the electronics cover, secure the captive screws firmly, using a torque wrench at a 100 oz/inch setting.

1. Open the electronics enclosure by releasing the four (4) screws and removing the electronics cover.
2. Power down the analyzer.
3. Refer to Figure 8-8. Using a 1/16" hex wrench, loosen the nylon-tipped screw that secures a fiberoptic coupling to the detector block and slide the coupling out of the block and out of the way. Remove the screw and retain for reassembly.
4. If necessary, remove the rear O-ring from the cavity using a cotton-tipped applicator, being careful not to damage the photodetector located at the rear of the filter cavity.

NOTE: The thickness of the front and rear O-rings depends on the thickness of the filter itself, and may differ from each other. In some cases, more than one O-ring may be used to achieve correct spacing. If replacing a filter with one of the same thickness, the old O-rings may be re-used, otherwise use the O-rings supplied with the new filter.

5. Slide the rear O-ring into the cavity so that it is vertical and is seated against the photodetector at the back.
6. If the new filter has a small arrow printed on the outside rim, insert the filter so the arrow points down the barrel of the cavity toward the photodetector at the back.
7. If there is no arrow, insert the filter so that the shiny surface faces out of the cavity. Use a clean cotton-tipped applicator to gently push the filter so that it remains vertical, positioned up against the rear O-ring at the back of the cavity.
8. Slide the front O-ring into the cavity so that it is vertical and up against the filter.

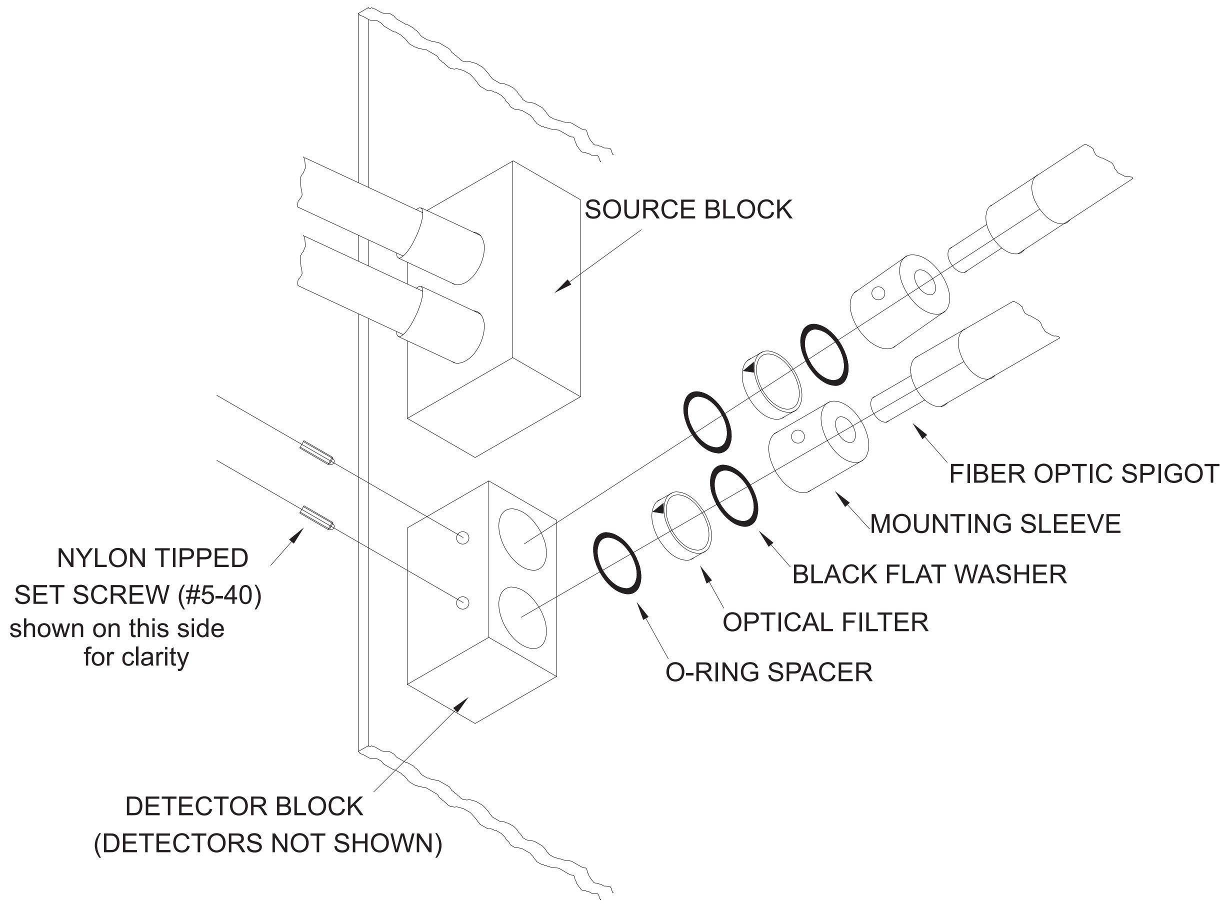

Figure 8-8 Detector Block Detail

9. Position the retaining sleeve so that the hole for the set screw points right, and so that the hole itself is closer to the filter than to the front of the block. Slide the sleeve into the cavity. There should be very slight resistance just before the sleeve snugs up against the O-rings and filter. Do not force the sleeve. If it does not fit flush with the front surface

of the detector block, the filter or one of the O-rings may have fallen out of position.

10. Slide the Allen wrench into the hole for the set screw and use it to make sure the hole in the sleeve aligns with the set screw hole. Next, insert the nylon-tipped set screw into position. It should easily slide into the retaining sleeve and hold it in position. Do not tighten the set screw yet, the tip of the screw must not be visible inside the barrel of the sleeve at this time.
11. Slide the fiberoptic coupling into the sleeve until it bottoms. Then, lightly finger-tighten the set screw to secure the coupling in place.
12. It is necessary to reinitialize the hardware, see Chapter 7, the Adjusting Hardware Settings section.

8.2.4 Resetting the Memory

This procedure is to be used only in the event the system cannot recover proper operation by cycling power off and on. The Wild Card Reset procedure resets the contents of memory to the backup memory values. This action sometimes requires that all parameters be set up to the specified values for the specific application and that a calibration be performed before the analyzer can be used. Refer to Figure 8-9 for details.

1. Open the electronics enclosure, turn the power OFF.
2. Simultaneously PRESS and HOLD the **[F1]** and **[F2]** keys on the control panel while turning the power back on.

   The display powers back up, and this boot sequence message appears:

```
Orion Model 2030
1.2.3.4.5.6.7.8.9.10
```

8.3 Shutdown and Restart Procedures

Since the analyzer contains fluids, extended periods of inactivity require a more complex shutdown process than intermittent overnight shutdown. Section 8.3 describes both procedures, along with restarting procedures for each.

8.3.1 Performing Short-term Shutdown

If the analyzer is going to be shut down overnight or for a weekend, place it into the stand-by mode by pressing the [STANDBY] key on the control panel, in Technician mode, or press **[STOP]**, navigate the menu to Run StandBy, and press **[YES]**.

8.3.2 Restarting After Short-term Shutdown

To restart the analyzer after a short-term shutdown, press the **[RUN]** key on the control panel to resume automatic operation.

8.3.3 Performing Extended Shutdown

If the analyzer is going to be shut down for more than three days, it is important to flush all the fluid lines, clean the reaction cell, and relax the peristaltic pump tubing as noted in subsections A-B to follow.

A. Flushing the Standard Lines

1. Detach the standard supply line from the standard container, and place the end of the tubing in a clean beaker or bottle containing 1-2 liters of fresh distilled or deionized water. Be sure to close the standard container with an appropriate stopper or blank fitting.

Caution: Be careful not to spill solution or to let it drip on your body or clothes.

---

2. Flush the lines and pump in both standard-handling systems with water by stepping through the procedure given in Table 8-3, or by using the Prime Fluidics menu. Be sure to leave the pump on until the tubing and pump are thoroughly flushed. This may take several minutes.

> **NOTE:** Five seconds or so after water starts flowing into the line, remove the source end of the supply tubing from the water supply just long enough to form a small air bubble in the line, and then put the tubing back into the water. By waiting for the bubble to traverse the line and reach the reaction cell, you can be certain that flushing is complete.

B. Cleaning Sample/Reaction Cell and Probe

1. Power down the analyzer.
2. Remove the probe from the reaction cell manifold.

Caution: Do not grasp the flexible portion of the fiberoptic bundle or force it to twist or bend sharply while inserting or removing the probe through the sample cell manifold.

---

3. Using several cotton-tipped applicators soaked in deionized water or a solution that is a solvent to the process chemistry, repeatedly wipe the glass window of the probe and the reflector until there is no sign of deposit on either surface. For convenience, the reflector can be removed using a flat-blade screwdriver in the slot on its back surface.

> **NOTE**: For serious buildup, it is useful to soak the probe and reflector in solvent overnight, or to use an ultrasonic bath. In such an instance, it can be helpful to remove the probe body from the fiber assembly and collar. For details, consult the Replacing Probe Body procedure in this chapter.

4. Rinse the probe and reflector in distilled or deionized water. Inspect the window and the reflector surface for pitting or scaling. If the reflector surface is not shiny, replace it with a spare.

   One spare reflector is supplied with the analyzer; additional reflectors may be obtained from Orion. If the window shows sign of deterioration, contact Orion. It may be necessary to replace the probe body.
5. Reassemble the reflector into the probe if it was removed.
6. Screw the probe back into the reaction cell, by grasping the knurled collar and rotating the probe as it screws into the manifold.

Chapter 9: Troubleshooting

Chapter 9 contains troubleshooting information, including an easy-to-use troubleshooting chart to diagnose and correct many common system problems.

9.1 Troubleshooting

If your Orion Model 2030 Silica Analyzer fails to operate properly, refer to the following steps and the troubleshooting chart BEFORE calling Orion or your authorized dealer for help. These steps are designed to help you isolate and correct many common system problems.

1. Write down the time and date that the problem occurred, or the time and date when you first noticed the problem. Also note what the analyzer was doing, or what it was supposed to be doing, when the problem occurred or was first noticed, including the type of analysis it was running.
2. Note all other relevant information, paying particular attention to recent hardware or software modifications or updates to the Orion Model 2030 Silica Analyzer, new or inexperienced operators, or any recent hardware changes to any connected computer peripheral (printer, modem, programmable logic controller, PLC, etc.).
3. Contact Orion or your authorized dealer for assistance ONLY after following steps 1-2 above. Ensure that you have a written description of the problem before calling for help, including all basic information outlined in steps 1-2 above.

9.2 Corrupt Memory

If the MEMORY is corrupt, the "OK" message on the control panel is replaced by the "Corrupt" message shown below.

```
Memory .. Corrupt !
Backup .. OK
```

During the memory integrity checks, if either a corrupt memory or backup memory is detected, the analyzer automatically resets with an error condition.

If a "Wild Card Reset" is initiated, or memory/backup is corrupt, you have the option of clearing the memory/backup through a series of questions. In either case, the first question prompt is a request to clear memory, as shown below:

```
OK TO RESET Memory ?
```

9.2.1 Initiating a Wildcard Reset

This procedure is to be used only in the event the system cannot recover proper operation by cycling power off and on. The "Wild Card Reset" procedure resets the contents of memory to the default values. This action requires that all parameters be set up to the values required for the specific application and that a calibration be performed BEFORE the analyzer can be used. For details, refer to Figure 8-9.

1. Open the analyzer's fluidics swing panel, turn the power OFF.
2. Simultaneously PRESS and HOLD the **[F1]** and [**F2]** keys on the control panel while turning the power back on.

   The analyzer then allows you the option of resetting memory, displaying this boot sequence message:

   ```
   SYSTEM STARTUP ...
   1.2.3.4.5.6.7.8.9.10
   ```

> **NOTE:** You **must** hold the **[F1]** and **[F2]** keys until the display shows the above message.

9.2.2 What to do if Memory is Corrupt

If you wish to reset the memory as in the above example, press the [**YES]** key on the control panel. The analyzer verifies that you wish to reset memory by prompting you on the second line of the screen:

```
OK TO RESET Memory ?
Are you sure ?
```

Press the **[YES]** or [**NO]** key on the control panel as appropriate.

9.2.3 What to do if Backup is Corrupt

Most reset situations only require a memory reset. Other options during a memory clear or wildcard reset are:

```
OK TO RESET RESULTS ?
```

```
OK TO RESET REMOTE ?
```

(if the analyzer was in remote control)

Both these questions are responded to as for the memory reset request.

At this stage, if the BACKUP is corrupt, you have the option of clearing it. Note that once the BACKUP is cleared, any stored setups are lost. Additionally, the electronics calibration is also lost and the unit MUST be recalibrated (see Hardware Settings).

If the BACKUP is corrupt, there is typically no choice but to clear it. However, there still may be a way to recover data from it. For more details, please refer to the special applications note "Recovering from a corrupt BACKUP."

At this stage, if the MEMORY is corrupt, you are given the option of resetting the clock. In most instances, you do not need to reset the clock.

Also, in most cases, a misbehaving analyzer can be reset by simply resetting MEMORY.

> **NOTE:** The reset request times out after 10 seconds if no answer is provided. A timeout condition then proceeds to the next question without resetting.

9.3 Troubleshooting Chart

This section provides troubleshooting information for the Orion Model 2030 Silica Analyzer. The troubleshooting details are presented in a straightforward form using the problem type as a locator.

- Problem list
- Possible causes for the problem
- Remedies

To use this troubleshooting guide, first locate the problem description in the column labeled "Problem." The adjacent column describes the "Possible Cause" for the problem. Adjacent to the possible causes are listed the "Remedies" that should be tried to eliminate the problem.

If the information in this trouble shooting guide does not help resolve your problem, call Orion's Technical Service Department at 1-800-225-1480.

Before calling Technical Service, please record the following information: Unit Serial Number, range of sample measurement, and current operating parameters. For additional information, refer to Appendix F.

Problem	Possible Cause	Remedy
No Display	Power	Insure that the power switch inside the enclosure is in the ON position and that the light in the switch is illuminated. Check and replace fuses if necessary. **Caution**: **Use only fuses of the same type and rating.**
	Loose connectors	Open the electronics enclosure check power connector and check if all the DC power connector are seated securely. Check if the POWER ON LED on the main mother board is ON.
No Display or Keyboard beeps but no response	Line voltage power "spikes"	Turn analyzer OFF and back ON, if no change, clear memory and see Wild Card Reset procedure.
System continuously resets	Corrupted memory	Turn analyzer OFF and back ON, if no change, clear memory and see Wild Card Reset procedure.
Printer erratic	Incorrect baud rate or bad connection.	Set baud rate and or check cable.

Problem	Possible Cause	Remedy
Can't calibrate	Parameters not set correctly	Check parameters, especially reagent volume additions.
	Reagent tubing not full	Tighten all connections, make sure solution is flowing in line. Purge reagent lines using *Purge Fluidics Operator* menu or *Hardware Test Technician* menu.
	Reagents incorrect or reversed	Insure that the proper solutions are in the proper containers. If necessary perform the analysis manually to check chemicals.
	Probe trouble	Check probe operation under *Hardware Test* submenu in Diagnostics. Turn lamp on and check absorbance readings in a clear solution.
	Incorrect SETUP	Insure that you have selected the appro-priate Setup in case more than one setup was defined.
	Wrong Standard or No Standard	Check the level in the standard reservoir. Fill it if necessary. Insure that the standard pump is functional under *Hardware Test*.
	Probe window not fully covered with solution	Ensure that the solution level in the reaction cell is high enough to cover the probe window. In particular for low volume capture, check reagent addition volumes.
Erratic results	Air in tubing Cell overflows during analysis	Tighten all connections. Locate and seal any leaks. Check flow rates. Adjust if necessary. Check reagent addition.
	Reagents depleted	Refill reagent containers.
	Plugged tubing	Check all tubing using *Hardware Test* and clear any blockage.
	Erratic sample	Insure that the system supplying sample is operating correctly and continuously during sampling sequence. Check and/or verify sample flow rate.
	Reagent decomposition	Insure that the solutions are not outdated or contaminated.
	Stirrer not functioning	Ensure that the stir bar is in the cell and rotates freely.

Appendix A: Parts Lists

Appendix A supplies part numbers and descriptions for the Orion Model 2030 Silica Analyzer.

Maintenance Parts

Part Number	Description
2030MK	Maintenance Kit*
2030RF	Probe Reflector Hastelloy C
2030	LA Source Lamp, tungsten
2030SB	Stirbar, Starburst PTFE

- Maintenance Kit includes: tubing for the peristaltic pump (2), O-ring for the reaction cell (1), Fuses - F3A250VAC (2), Seals for piston pump (2 sets), and checkvalves (2).

Service Parts

Part Number	Description
230807-001	Air vent valve
230808-001	Digital relay PC board assembly
230809-001	Display module
230810-001	Fiber optics bundle assembly
230811-001	Flow sensor
230812-001	Immersion probe
230813-001	Keypad with back plate
230814-001	Main PC Board
230815-001	Multiplexer board
230816-001	Optical filters (810)
230817-001	Optical filters (450)
230818-001	Peristaltic pump assembly
230819-001	Piston pump assembly
230820-001	Power supply for universal input
230821-001	Reaction cell acrylic

Part Number	Description
230822-001	Reaction cell manifold assembly
230823-001	RS232 cable assembly with RJ11 connector
230824-001	Sample inlet valve - single stream
230825-001	Sample valve manifold 2 stream
230826-001	Sample valve manifold 6 stream
230827-001	Siphon tube for 35 mL capture (Model 2030)
230828-001	Solenoid valve for manifold
230829-001	Stirrer assembly

Appendix B: Customer Service Information

Appendix B provides Customer Service and Technical Service telephone and fax numbers.

Orion Customer Service and Technical Service can be reached by calling or faxing the following:

B.1 Telephone Numbers

Toll-free:	800-225-1480 (from U.S.A. and Canada)
Local:	978-922-7673 ext. 2499

B.2 Fax Numbers

U.S.A.:	978-927-3932
International:	978-927-4347

B.3 Warranty

Please refer to the warranty card supplied with your analyzer. if you should require an extra warranty card, please call or fax us at the above numbers.

Appendix C: List of Relay Functions

Appendix C furnishes a list of relay functions.

NOTE: There are two types of alarm modes, “EXCLUSIVE” and “NON EXCLUSIVE.” Exclusive alarms cannot be combined on the same relay. By default, only the Result Ready alarm and the Hardware Alarms are enabled.

Function Tag	Description	Default Relay
Smp1 Conc Lo	Sample 1 low concentration alarm [3]	3
Smp1 Conc Hi	Sample 1 high concentration alarm [3]	3
Cal Fault	Repeat Limit exceeded on calibration	None
Smp1 Gen Fault	Sample 1 general fault [2]	9 [1]
Smp2 Gen Fault	Sample 2 general fault [2]	10 [1]
Smp3 Gen Fault	Sample 3 general fault [2]	11 [1]
Smp4 Gen Fault	Sample 4 general fault [2]	12 [1]
Smp5 Gen Fault	Sample 5 general fault [2]	13 [1]
Smp6 Gen Fault	Sample 6 general fault [2]	14 [1]
Cal Flow	CalPump1 flow alarm [4]	4
Rgt1 Level	Reagent 1 level alarm [2]	4
Rgt2 Level	Reagent 2 level alarm [2]	4
Rgt3 Level	Reagent 3 level alarm [2]	4
Rgt4 Level	Reagent 4 level alarm [2]	4
Cal1 Level	CalPump 1 level alarm	4
Sample Flow	Sample flow alarm [4]	4
Smp1 Flow	Sample 1 flow alarm [3 4]	4
Off Line	Off line condition	None
Result Ready	Result ready condition	2

Function Tag	Description	Default Relay
Smp1 Ext Dev	Sample 1 external device [3]	None
Sensor Fault	Flow Sensor malfunction	None
General Fault	General Fault in the system	1
Lamp1 Failure	Lamp 1 Failure	None
Lamp2 Failure	Lamp 2 Failure	None
Det1 Overrange	Detector 1 overrange condition	None
Det2 Overrange	Detector 2 overrange condition	None
Optics Fault	Optics Fault	None
Power Failure	Power Failure	8
Test In Progress	Analyzer running an analysis	None
Cal In Progress	Analyzer running a calibration	None
In Standby	Analyzer in power down mode	None

[1] only if optional multiplexer board is installed, otherwise assigned to Relay #1.
[2] will be enabled only if these devices are available on your system.
[3] will be replicated for each stream on your system.
[4] see the Level and Flow Alarms section below for details.

C.1 Concentration Alarms

Each stream has a high and a low concentration alarm. The high and low alarms for each stream can be individually configured under the **Set Up Stream** section of the **Setup** menu.

1. **High Alarm** - Alarm is triggered when the reported concentration for a stream is above the high alarm set limit. The following actions are taken when the alarm is triggered:
   (a) A message is sent to the screen.
   (b) If a relay has been assigned to this alarm, it is activated.
   (c) An error message is printed after printing the concentration.

   This alarm is cleared when the reported concentration for that stream falls below the high alarm limit. The following actions are taken when the alarm is cleared:

   (a) If a relay has been assigned to this alarm it is deactivated, as long as other alarm functions attached to this relay are inactive.

2. **Low Alarm** - Alarm is triggered when the reported concentration for a stream is below the low alarm limit. The following actions are taken when the alarm is triggered:
   (a) A message is sent to the screen.
   (b) If a relay has been assigned to this alarm, it is activated
   (c) An error message is printed after printing the concentration.
   This alarm is cleared when the reported concentration for that stream falls above the low alarm limit. The following actions are taken when the alarm is cleared:
   (a) If a relay has been assigned to this alarm it is deactivated, as long as other alarms attached to this relay are inactive.

C.2 Calibration Repeat Alarm

The calibration repeat alarm is active in both manual and automatic modes. If the set limits are exceeded, the alarm is triggered. The following actions are taken:

(a) A message is sent to the screen.
(b) If a relay has been assigned to this alarm, it is activated.
(c) An error message is printed after printing the calibration results.
(d) The system general fault is triggered.

The alarm is cleared when the next calibration falls within the repeat limit. The following actions are taken:

(a) If a relay has been assigned to this alarm, it is deactivated, as long as other alarms attached to this relay are inactive.
(b) The system general fault alarm is informed that this alarm was cleared.

C.3 General Faults

1. **System General Fault** - An alarm is triggered whenever any of the following events occur:
   (a) A General Fault associated with any stream gets triggered.
   (b) Any Flow or Level Alarm gets triggered.
   (c) Lamp Failure, Detector Overrange or Optics Fault detected during any analysis.
   (d) The calibration repeat limit is exceeded.
   (e) Flow sensor malfunctions

   If a relay is assigned to this alarm, it is activated when the alarm is triggered. The alarm is cleared when all the conditions listed above are cleared, in which case the relay assigned to the alarm is deactivated.

2. **Stream General Fault** - An alarm is triggered whenever any one of the following events occur:
   (a) The Sample Flow alarm gets triggered while analyzing this stream.
   (b) The method being used to analyze this stream uses a reagent whose level alarm is triggered.
   (c) Any reagent Level alarm for reagents used to analyze this stream gets triggered.
   (d) Lamp Failure, Detector Overrange or Optics Fault is detected while analyzing this stream.
   (e) Flow sensor malfunctions.

   If a relay is assigned to this alarm, it is activated when the alarm is triggered. The alarm is cleared when all the conditions listed above are cleared, in which case the relay assigned to the alarm is deactivated.

C.4 Level and Flow Alarms

1. **Level Alarm** - Reagent and Standard levels may be monitored using on-off type Level sensors. These sensors are assigned to a digital input and are tested continuously. A fault is flagged as soon as the level sensor reports the alarm condition. The following actions are taken:
   (a) An error message is printed
   (b) If a relay is associated with this alarm, it is triggered.
   (c) The general fault alarm is triggered.
   This alarm is cleared when the level is restored, that is, the reagent container is refilled. The following actions are taken when this alarm is cleared:
   a) If a relay has been assigned to this alarm, it is deactivated, as long as other alarms attached to this relay are inactive.
   b) The system and stream general fault alarms are informed that this alarm was cleared.
2. **Flow Alarms** - There is a single flow sensor used for detecting both sample and calibration standard flow into the reaction vessel. The sensor is assigned to a digital input, and is located on the drain line. The detection of flow is accomplished in the specific steps of pressurize and siphon cycles during the wash sequence of the reaction vessel. When a fault is trapped, the system may decide to extend the cycle to validate the fault. When no flow is validated, the following actions are taken :
   (a) An error message appears on the screen after a long beep.
   (b) An error message is printed.
   (c) If a relay has been assigned, it is activated.
   (d) The appropriate stream general fault is triggered.
   (e) The system general fault is triggered.
   (f) The analysis is terminated.
   This alarm is cleared when the appropriate flow is restored. The following actions are taken when this alarm is cleared:
   a) If a relay has been assigned to this alarm, it is deactivated, as long as other alarms attached to this relay are inactive.
   b) The system and stream general fault alarms are informed that this alarm was cleared.
   3. **Sensor Failure** - As part of checking flow into the reaction cell, the system validates a sensor malfunction. Actions taken on a sensor failure are identical to those for a flow alarm. The alarm is cleared when flow is restored, and the same actions as those for a flow alarm are taken.

C.5 Hardware Alarms

While acquiring absorbance data, a variety of alarms are checked:

1. **Lamp Failure** - When a lamp is turned on, the current through the lamp is tested against a set point determined by the lamp intensity level (lamp drive). The alarm is triggered if the current through the lamp falls outside ± 10% of the set level. The analyzer does not test a lamp if the lamp drive is less than 10%.

   The following actions are taken when this alarm is triggered:

   (a) An error message appears on the screen after a long beep.

   (b) If the unit is performing an analysis,

   (i) An error message is printed.

   (ii) If a relay has been assigned, it is activated.

   (iii) If the unit is analyzing a stream, the appropriate stream general fault is triggered.

   (iv) The system general fault is triggered.

   (v) The analysis is terminated.

   This alarm is cleared when the lamp current falls within limits. The following actions are taken when this alarm is cleared:

   a) If a relay has been assigned to this alarm it is deactivated, as long as other alarms attached to this relay are inactive.

   b) The system and stream general fault alarms are informed that this alarm was cleared.

2. **Detector Overrange** - Before the absorbance is calculated, the detector levels are checked to see if they are overrange. The overrange condition is validated three times before a detector overrange alarm is triggered.

   The following actions are taken when this alarm is triggered:

   (a) An error message appears on the screen after a long beep.

   (b) If the unit is performing an analysis,

   (i) An error message is printed after the reported concentration is printed.

   (ii) If a relay has been assigned, it is activated.

   (iii) If the unit is analyzing a stream, the appropriate stream general fault is triggered.

   (iv) The system general fault is triggered.

This alarm is cleared when the detector levels are within limits. The following actions are taken when this alarm is cleared:

a) If a relay has been assigned to this alarm, it is deactivated, as long as other alarms attached to this relay are inactive.
b) The system and stream general fault alarms are informed that this alarm was cleared.

3. **Optics Failure** - Alarm is triggered if the reference detector is below 15% of its operating condition. This is typically caused by loss of light energy due to either loss of the mirror or heavy coating.

   The following actions are taken when this alarm is triggered:

   (a) An error message appears on the screen after a long beep.
   (b) If the unit is doing an analysis,

   (i) An error message is printed after the reported concentration is printed.

   (ii) If a relay has been assigned, it is activated.

   (iii) If the unit is analyzing a stream, the appropriate stream general fault is triggered.

   (iv) The system general fault is triggered.

   This alarm is cleared when the detector levels are within limits. The following actions are taken when this alarm is cleared:

   a) If a relay has been assigned to this alarm it is deactivated, as long as other alarms attached to this relay are inactive.
   b) The system and stream general fault alarms are informed that this alarm was cleared.

C.6 Other Alarms

1. **Off Line Condition** - "Alarm" is triggered when the analyzer is not in auto analysis mode. If a relay is assigned to this alarm, it is activated. The alarm is cleared when the analyzer goes into auto analysis mode, in which case the relay is deactivated. Note that the Offline alarm is an exclusive relay function, that is, no other function can be assigned to the offline relay.
2. **Result Ready Condition** - When communicating to a control loop or to a computer, a result ready signal is required to tell the receiving device that the last analysis cycle was completed and that the outputs (4-20mA) were updated per the last measurement. This "alarm" is triggered after the outputs are updated, and the assigned relay is activated. The "alarm" is cleared at the beginning of the analysis cycle, in which case the assigned relay is deactivated. Note that the Result Ready alarm is an exclusive relay function, that is, no other function can be assigned to a result ready relay.
3. **Test In Progress** - The assigned relay turns ON at the beginning of the analysis cycle, before the pumps are primed. The relay turns OFF at the end of the analysis cycle, just before starting the countdown to the next analysis.
4. **Cal In Progress** - The assigned relay turns ON at the beginning of the calibration cycle, before the pumps are primed. The relay turns OFF at the end of the calibration cycle, just before starting the countdown to the next scheduled event.
5. **In Standby** - The assigned relay is turned ON when the unit goes into the standby mode. The relay turns OFF when the unit comes out of the standby mode.

Appendix D: Reports

Appendix D contains examples of the various reports available on the Orion Model 2030 Analyer.

```
----------------------------------------
--------- Model 2030 Rev 2.33  ---------
----------  S/N:  980801006   ----------
System Parameters  @ 10:02  Aug 05,1998

========================================
Fluidics Device Information
========================================

Reagent    Pump      Pump   FlowRate
Pump #     Label      Tag   (ml/min)
-------- ---------   -----  --------
    1    Reagent 1    Rgt1    22.0
    2    Reagent 2    Rgt2     5.1
    3    Reagent 3    Rgt3     5.0

Standard   Pump      Pump   FlowRate
Pump #     Label      Tag   (ml/min)
-------- ---------   -----  --------
    1    CalPump 1    Cal1    48.0

Stream    Stream    Stream  FlowRate
Number     Label      Tag   (ml/min)
-------- ---------   -----  --------
    1     Sample 1    Smp1   200.0

----------------------------------------
```

Figure D-1 Fluidics Device Printout

```
---------------------------------------
--------- Model 2030 Rev 2.33  ---------
----------  S/N:  980801006   ----------
System Parameters  @ 10:02  Aug 05,1998

=======================================
Calibration Setup Information
=======================================

[1]  Setup 01 Description
---------------------------------------
Assigned Filename = Setup 01
Addition Device   = CalPump 1
Addition Method   = Method 01
Update Type       = Cal On Std 2
Repeat Alarm      = Enabled, No Relay
Repeat Limit      = 5 %
Repeat Reference  = Relative
Repeat Flt Action = Save & Continue

PARAMETERS ENTERED @   9:48  Aug 05,1998
Abs(1) =  0.000   Std(1) = 000.00 ppb
Abs(2) =  0.210   Std(2) = 200.00 ppb
Equation For Sample Concentration :
  CONC =  0.000 + 952.381 * ABS

---------------------------------------
```

Figure D-2 Calibration Setup Printout

```
---------------------------------------
--------- Model 2030 Rev 2.33  ---------
----------  S/N:  980801006   ----------
System Parameters  @ 10:02  Aug 05,1998
=======================================
Method Information
=======================================

[1]  Method 01 Description
---------------------------------------
Assigned Filename = Method 01
Calibration Curve = Setup 01
Stability Factor  = 5
Cell Wash Volume  = 360 ml
Pre Wash Volume   = Disabled
Blank Measurement = Before Addition #3

Addition  Reagent   Volume  StirTime
 Number    Added     (ml)    (mins)
-------- --------- ------  --------
    1    Reagent 1   1.5     4.00
    2    Reagent 2   1.5     1.00
    3    Reagent 3   1.5     2.50

PostWash   Fluid    Volume  StirTime
 Number    Added     (ml)    (mins)
-------- --------- ------  --------
    1     Sample 1 300.0     0.25

---------------------------------------
```

Figure D-3 Method Printout

```
----------------------------------------
--------- Model 2030 Rev 2.33  ---------
----------  S/N:  980801006   ----------
========================================
Stream Specific Information
========================================

[1] Sample 1
----------------------------------------
Viscosity Factor     = 1.0
Concentration Offset = 0.000 ppb
Concentration Gain   = 1.000
Sample Flow Rate     = 200.0 ml/min
External Sample Dev  = None

Analog Outputs :
----------------
Assigned Device     Output #1
mA Range            4-20 mA
Slope (Action)      LO to HI
Min Value           000.00 ppb
Max Value           200.00 ppb

Alarm     Trig Level    Status
------    ----------    ------
 Low      001.00 ppb    Disabled
 High     010.00 ppb    Disabled
----------------------------------------
```

Figure D-4 Stream Information Printout

```
----------------------------------------
--------- Model 2030 Rev 2.33  ---------
----------  S/N:  980801006   ----------
System Parameters  @ 10:02  Aug 05,1998
========================================
Sequencing Information
========================================

Sampling Frequency = 0.25   hr

Sequence   Sample    Method     Repeat
 Number    Stream     Used      Count
-------- ---------  ---------  --------
   1      Sample 1  Method 01     1

Calibration Frequency = Manual

Sequence   Calibr.    Setup     Repeat
 Number    Device     Used      Count
-------- ---------  ---------  --------
   1     CalPump 1   Setup 01     1
No Cleaning Cycle Defined
----------------------------------------
```

Figure D-5 Sequence Information Printout

```
----------------------------------------
--------- Model 2030 Rev 2.33  ---------
----------  S/N:  980801006   ----------
System Parameters  @ 10:02  Aug 05,1998
========================================
Digital Input/Output Information
========================================

Digital      Input      Active
 Input        Type      State
--------    --------   --------
Input #1    Alarm      Low(+0V)
Input #2    Alarm      Disabled
Input #3    Alarm      Disabled
Input #4    Alarm      Disabled
Input #5    Data       Disabled
Input #6    Command    Low(+0V)
Input #7    Command    Low(+0V)
Input #8    Strobe     HI->LO

Alarm Input Functions
---------------------
Input # 1 =
             Sample Flow
Input # 2 =
             Not Assigned
Input # 3 =
             Not Assigned
Input # 4 =
             Not Assigned


Relay Functions
---------------
Relay # 1 =
             General Fault
Relay # 2 =
             Result Ready
Relay # 3 =
             Smp1 Conc Lo
             Smp1 Conc Hi
Relay # 4 =
             Smp1 Gen Flt
             Cal Flow
             Rgt1 Level
             Rgt2 Level
             Rgt3 Level
             Cal1 Level
             Sample Flow
             Smp1 Flow
Relay # 5 =
             Not Assigned
Relay # 6 =
             Not Assigned
Relay # 7 =
             Not Assigned
Relay # 8 =
             Power Failure

 Communications    COM1       COM2
---------------  --------   --------
Function         Computer   Printer
Baud Rate          9600       9600
# of Data Bits        8          8
# of Stop Bits        1          1
Parity             None       None
Flow Control       None       None
----------------------------------------
```

Figure D-6 Digital Input/Output Information Printout

```
----------------------------------------
--------- Model 2030 Rev 2.33  ---------
----------  S/N:  980801006   ----------
System Parameters  @ 10:02  Aug 05,1998
========================================
Miscellaneous Parameter Information
========================================

Drain Volume     = 10.0 ml
Standby Wash     = 300 ml using Sample 1
Standby Timeout  = 0.50  hr
Stirrer Mode     = Stop Btwn Analyses
Stirring Action  = Reverse every 5s

----------------------------------------
```

Figure D-7 Parameters Information Printout

```
----------------------------------------
--------- Model 2030 Rev 2.33  ---------
----------  S/N:  980801006   ----------
System Status  @ 10:02  Aug 05,1998


 24 V Rail =  24.17 V
 12 V Rail =  11.86 V
  5 V Rail =   5.02 V
-12 V Rail = -11.77 V

Internal Temp   =  27.0 Deg C
Set Block Temp  =  50.0 Deg C
Act Block Temp  =  49.9 Deg C

Det  Detector  Time  Amp  Offset Range
 #    Label    (ms)  (%)   (mV)   (mV)
---  -------- ------ ---- ------ -----
 1   Measure    68    97      0   4500
 2   Reference  87    97      0   4506

 Lamp   State  Setting  Drive
------  -----  -------  -----
   1     Off    120 %   187.3 mA
   2     Off      0 %     0.9 mA

  Lamp     Det1    Det2    Det1    Det2
 State    Signal  Signal  PreAmp  PreAmp
(On/Off)   (mV)    (mV)    (mV)    (mV)
--------- ------- ------- ------- ------
Lamp1 On   3508    3500    3171    3171
Lamp2 On      0       0       0      -5
Both On    3515    3514    3171    3171
Both Off      0       0       0      -7

ADC Gain = 1.0004  ADC Offset =  1.5 mV
DAC Gain = 1.0086  DAC Offset =  0.0 mV

Coefficient of Normalization = 0.999

Det1 Backscatter  =    0.0 mV
Det2 Backscatter  =    0.0 mV

 Relay Board: Enabled & Detected
----------------------------------------
```

Figure D-8 System Status Information Printout

```
--------- Stored Calibrations ----------
Cal Data for CalPump 1 using Setup 1
Cal On Std 2       @ 11:01  Aug 05,1998
Abs1 =  0.000         Std1 = 000.00 ppb
Abs2 =  0.210  *NEW  Std2 = 200.00 ppb
Blank Abs Before Addition #3 = 0.002

Cal On Std 2       @ 11:21  Aug 05,1998
Abs1 =  0.000         Std1 = 000.00 ppb
Abs2 =  0.212  *NEW  Std2 = 200.00 ppb
Blank Abs Before Addition #3 = 0.002

---------------------------------------


----------- Stored Analyses ------------
Test Data for Sample 1 using Method 1
Conc = 02.30 ppb @ 11:06  Aug 05,1998
Measured Absorbance   = 0.002
Blank Abs Before Addition #3 = 0.002

Test Data for Sample 1 using Method 1
Conc = 02.50 ppb @ 11:21  Aug 05,1998
Measured Absorbance   = 0.003
Blank Abs Before Addition #3 = 0.001
---------------------------------------
```

Figure D-9 Stored Calibrations Information Printout

```
---------------------------------------
--------- Model 2030 Rev 2.33  ---------
----------  S/N:  980801006   ----------
System Parameters  @ 10:56  Aug 05,1998

=======================================
Alarm Information
=======================================

   Alarm         State    Status   Relay
-----------    --------  ------- -------
Backflush       Disabled           None
Cal Fault       Enabled   clear    None
Cal Flow        Enabled   clear     #4
Cal In Progress Enabled   clear    None
Cal1 Level      Disabled            #4
Det1 Overrange  Enabled   clear    None
Det2 Overrange  Enabled   clear    None
Clean In Prog   Enabled   clear    None
In Standby      Enabled   clear    None
General Fault   Enabled   clear     #1
Lamp1 Failure   Enabled   clear    None
Lamp2 Failure   Enabled   clear    None
Off Line        Enabled   *SET*    None
Optics Fault    Enabled   clear    None
Power Failure   Enabled   clear     #8
Result Ready    Enabled   clear     #2
Rgt1 Level      Disabled            #4
Rgt2 Level      Disabled            #4
Rgt3 Level      Disabled            #4
Sensor Fault    Enabled   clear    None
Sample Flow     Disabled            #4
Smp1 Conc Hi    Disabled            #3
Smp1 Conc Lo    Disabled            #3
Smp1 Ext Dev    Disabled           None
Smp1 Flow       Disabled            #4
Smp1 Gen Flt    Enabled   clear     #4
Tst In Progress Enabled   clear    None

---------------------------------------
```

Figure D-10 Alarm Information Printout

Appendix E: General Specifications

Appendix E lists the general specifications of the Orion Model 2030 Silica Analyzer.

Component/Feature	Description
Measuring Range	0-500 ppb Silica.
Measured Components	Silica in water using the absorption band at 810 nm with a Reference wavelength at 450 nm.
Measuring Technology	Single beam dual wavelength using fiber-optic probe in the transflection mode.
Measurement Sensitivity	0.5 ppb.
Reproducibility	± 1 ppb or 2% of fullscale (whichever is greater).
Display Resolution	0.01 ppb (software selectable).
Sampling Frequency	Manual or automatic, fully programmable sampling Sequence and interval. Typical analysis interval for Silica is approximately 15 minutes.
Sample Analysis Methods	Fully programmable reagent addition sequence with pre- and post-measurement wash capabilities. Fully programmable auto-zeroing (blanking) capability. Up to 10 methods may be stored for multi-range analysis.
Calibration Setups	Up to 3 calibration setups may be stored.
Calibration Frequency	Manual or automatic. Fully programmable.
Grab Sample Analysis	Manual, using pump feed or direct sample cup fill.

Component/Feature	Description
Data Storage Capacity	Saves last 120 analysis results and last 25 calibration results.
Data Retention	Approximately 5 years.
Display	Alphanumeric, 2 lines of 20 characters each, vacuum fluorescent.
Control Panel	Eight-key membrane keypad, with 3 operational security Access levels. Security codes fully user programmable.
Analog outputs	One output per stream. Isolated 0/4 to 20 mA, fully range Programmable, maximum load 1000 Ohms. Result values are held until the reading is updated.
Digital Outputs	Dual isolated RS-232C for printer and computer interface at user-selected baud rates, with remote control capability. Optional isolated RS485 interface.
Digital Inputs	8 digital inputs with fully programmable functions allowing interface to a PLC and/or interface to voltage free contact from sensors. Expandable to 16 inputs with multiplexer board option.
Relay Contacts	Programmable voltage free contacts (minimum 8 relays Configurable to N.C or N. O), expandable to 14 relays with multiplexer board option. Contact rated at 5A @ 240VAC maximum with a non-inductive load.
Alarms	• Stream-specific High and Low set point alarms • Sample/Standard Flow and Reagent Level Alarms (sensors optional) • Failsafe power failure alarm • General, hardware and stream-specific fault signals • Result ready, test in progress, calibration in progress and other alarm and interface functions (consult manual). Alarms can be assigned in software to voltage free contact relays. Grouping of alarms to relays is fully programmable.

Component/Feature	Description
Number of Sample Streams	One standard up to six (optional).
Sample Flow Rate	50 to 900 mL/minute.
Sample Pressure	2 to 50 psig.
Sample Temperature	5 to 70 Degrees Celsius.
Sample Inlet	¼ inch compression fitting.
Suspended Solids	2% maximum with 0.050 inch maximum size.
Drain	¾ inch MNPT to atmospheric pressure.
Number of Reagents	3 Reagents.
Reagent Inlet	¼ inch compression fitting.
Reagent Consumption	Refer to Application sheet.
Operating Temperature	5 to 45 Degrees Celsius. Vortex air cooler recommended Above 45 Degrees Celsius.
Ambient Conditions	Up to 95% relative humidity, non-condensing.
Power Supply	100 to 240VAC 50/60 Hz.
Power Consumption	200 watts maximum.
Warm Up Time	Approximately 10 minutes at 25 Degrees Celsius.
Mounting	Wall or Panel mount.
Dimensions (W x H x D)	24 x 25 x 13 inches (61 x 64 x 33 cm).
Enclosure ratings	IP65, NEMA 4X (Fiberglass).
Weight	Approximately 80 lb.. (36 kg) when fully equipped.
Agency Compliance	Designed to meet most regulatory agency approvals, Including CE compliance.

***NOTE:** This product should only be used as specified by the manufacturer. If used other than specified, it may impair the safety protection of the system.

Performance specifications are environment-dependent. Certain field conditions, contamination, and sample conditioning will affect performance. To ensure the optimal environment, please consult the User Manual or check with the manufacturer.

Appendix F: Warning, Alarm, and Fault Messages

Displayed Message	Printed Message	Cause	Corrective Action
** Lamp 1 Fail **	** DETECTED - Lamp1 Fail **	Lamp Failure	Check lamp wiring to make sure there is no loose contact in connector J7, if the wiring is OK, replace the lamp.
** Lamp 2 Fail **	** DETECTED - Lamp2 Fail **	Lamp Failure	
** Lamp1&2 Fail **	** DETECTED - Lamp1&2 Fail **	Lamp Failure	
** Unable to Siphon * ** No *device* Flow**	** DETECTED - No Flow Alarm **	Flow Failure	Make sure that the tubing to the reported device is secure and unblocked and that the flow rate is within 30 % of the specified flow rate. If the tubing is OK, check the flow sensor for proper operation. The red light on the top right corner of the flow sensor should be ON when there is no fluid in the drain tub. If the flow sensor is not working, disable it or replace.

Displayed Message	Printed Message	Cause	Corrective Action
** Low Rgt Level **	** DETECTED - Low Rgt Level **	Reagent Level Sensor Alarm or Low fluid level	Check that the fluid level in the Rgt. Bottle is low, and replace with a new bottle. Verify the level sensor is in operation and replace if necessary.
* Bad Device (MO1) * * Bad Device (MO1) *	** DETECTED - Bad Device PW #xx ** ** DETECTED - Bad Device Rgt Add#xx **	Corrupt memory	Recover the corrupted memory through *SETUP/SET UP METHOD/ RECOVER METHOD* and re-analyze using this method. If the analysis cycle still terminated prematurely, note the method parameters, reset the method through *DIAG/ Reset/Clear Memory/ Reset Method*, then re-enter the method parameters through *SETUP/ Set Up Method.*
* Aborted by User*	** Manual Calibration Aborted by User **	Calibration terminated by user	This message is printed and displayed if a manual calibration was prematurely terminated by the user. The measurement is discarded and not stored.

Displayed Message	Printed Message	Cause	Corrective Action
WARNING: UNSTABLE!	** WARNING - Unstable Measurement	Unstable absorbance measurement	This message is displayed and printed if absorbance stability criterion was not met after three minutes of absorption measurement. This may be caused by unstable chemistry, bubbles in the reaction cell. Loose or damaged optical probe, probe window not completely covered with fluid, heavy particulates in the wash solution or precipitate formation. Visually check probe, reaction cell, and tubing. Prime the tubing if necessary and repeat the analysis.

Displayed Message	Printed Message	Cause	Corrective Action
** Smpl Conc Lo** ** Smpl Conc Hi **	** ALARM - Conc Below Low Level** ** ALARM - Conc Above High Level**	Concentration alarm limit	These messages are displayed for a short time and printed when the measured concentration exceeds the concentration alarm limits. See Appendix C, section 1.

Displayed Message	Printed Message	Cause	Corrective Action
STABL o1 STABL 02	** ALARM - Detector 1 Overrange ** ** ALARM - Detector 2 Overrange **	Detector overrange	If the detectors are over-range (greater than 4500 mV, or a user-defined value) the symbols "o1" (overrange - detector 1) and "o2" (ove range - detector 2) appear on top right of the display, as appropriate. If the reference detector is less than 15% of its operating value, the "of" (optics fault) symbol appears. See Appendix C, section 5. The detector signals may vary due to temperature fluctuations; check the ambient temp under *DIAG /Hardware Test/Vary Temperature*. The block temperature should be 5 to 10 degrees Celsius above the ambient temperature. Other possibilities include bubbles in reaction cell, loose or damaged optical probe, probe window not completely covered with fluid, heavy particulates in the wash solution or precipitate formation. If the block temperature is above the ambient temperature, try adjusting the Hardware settings *DIAG/Adjust HW Settings/Auto HW Setup.*

Displayed Message	Printed Message	Cause	Corrective Action
** Limit Exceeded **	** ALARM - Slope/Offset Exceed Limit**	Offset Calibration Curve	This message is printed when the calculated calibration curve slope or offset exceeds factory limits. This usually indicates an improperly entered concentration value in the calibration setup. Check the calibration setup and repeat.
** Over Abs Limit **	** ALARM - Cal Abs Exceeds Limit **	Manual calibration Abs Limit is Exceeded	During manual calibration, the user may enter the calibration standard conc. Values. If the calculated absorbance exceeds the analyzer limit (± 3.000 AU), this message will appear and then be printed with yhe calibration results. Check the setup and repeat.
** Over Rpt Limit **	** ALARM - Cal Outside Repeat Limit **	Calibration Result outside repeat limit	Occurs when the measured absorbance value in a calibration exceeds the repeat limit. See Appendix C, section 2. Default repeat limit is set to 5%.

Displayed Message	Printed Message	Cause	Corrective Action
** SO1 Abs Equal ** ** SO1 Conc Equal ** * SO1 Offset Error * * SO1 Slope Error * * SO1 Recal Error * ** Setup Error **	** SET - Cal Fault** ** Initiating Recalibration **	Equal abs values for 2 calibration pts	These messages are seen if the referenced calibration setup has 2 equal absorbance values, two equal conc. values, or slope/offset that is outside factory limits. The referenced calibration is executed and the new slope/offset are used to report concentration.
** SO1 Never Run **	No printed message	New reference calibration	This message is displayed for a short time at the beginning of an analysis cycle, if referenced calibration setup has never been run. The referenced calibration is executed immediately, and the new slope/offset are used to report the conc. at the end of the cycle.

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