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Catalog Number 60000-18

Series 5000 Silica Analyzer

Model 6000

Instrument Manual

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Safety Precautions

Please read this entire manual before unpacking, setting up, or operating this instrument. Pay particular attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To ensure the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that which is specified in this manual.

Use of Hazard Information

If multiple hazards exist, this manual will use the signal word (Danger, Caution, Note) corresponding to the greatest hazard.

DANGER
Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTE
Information that requires special emphasis.

Precautionary Labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.



This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.



This symbol, if noted on the product, indicates the need for protective eye wear.

Specifications are subject to change without notice.

Range: 0.00 to 5000 µg/L as SiO_2

Accuracy (typical): 0.00–500 µg/L: ± 1.0 µg/L or ± 5% of reading, whichever is greater; 500–5000 µg/L: ± 7% of reading

Minimum Detection Limit: Less than 0.5 µg/L

Precision: ± 0.5 µg/L or ± 1.0% of reading, whichever is greater

Step Response Time (sample temperature dependent): 8.8 minutes for 30 to 50 °C, 15 minutes for 5 to 40 °C, (field adjustable)

Ambient Operating Conditions: 10 to 45 °C, 5 to 95% non-condensing humidity. Suitable for general purpose, clean, indoor environments (not suitable for outdoor use).

Analyzer Sample Requirements: Regulated to 5 ± 3 psig (34.5 ± 20.7 kPa). Flow rate from 100 to 300 mL/minute. Sample temperature between 5 and 50 °C. A sample pressure control kit is provided.

Sample Inlet Fitting: ¼-inch OD stainless steel compression tubing fitting

Recorder Outputs: Selectable for 0–0.01 V, 0–0.1 V, 0–1 V, or 4–20 mA. Output span programmable over any portion of the 0–5000 µg/L range

Serial I/O: RS232 and 20 mA current loop

Alarms: Four programmable relays, two sample concentration alarms, analyzer system warning and analyzer system shutdown alarms each equipped with an SPDT relay, two with contacts rated for 1 A resistive load at 30 VAC and 42 VDC and two with contacts rated for 5 A resistive load at 240 VAC.

Power Requirements: 115/230 VAC, 50/60 Hz, switch selectable; 52 VA, 32 W maximum

Reagent Pressure Source: 20 to 60 psig regulated (137.9 to 413.7 kPa); nitrogen, instrument quality air or compressed air. Filter and regulator are supplied with analyzer.

Reagent Pressure Inlet Fitting: ¼-inch OD stainless steel compression tubing fitting

Sample Drain Fitting: ¾-inch NPT PVC female

Air Purge (optional): 15-scfh (standard cubic feet per hour) instrument-quality air, ¼-inch OD stainless steel compression tubing fitting

Reagents: 2.9 L Molybdate 3 (Cat. No. 1995-03), 2.9 L Citric Acid/Surfactant (Cat. No. 23470-03), 2.9 L Amino Acid F (Cat. No. 23531-03), 2.9 L Silica Standard Solution, SiO_2, 500 µg/L (Cat. No. 21008-03) (250 mL required for standardization)

Reagent Consumption: 2.9 L of each reagent per month with 8.8 minute cycle time; 2.9 L of each reagent per seven weeks with 15-minute cycle time

Enclosure: Molded ABS plastic NEMA 4X/I.P. 65 cabinet with gasketed doors (for indoor use)

Dimensions: 856.5 mm (33.72 inches) high x 563.75 mm (22.2 inches) wide x 419 mm (16.5 inches) deep

Mounting: Bench top or panel mounting only

Shipping Weight: 36.7 kg (81 lb)

Operation

DANGER

Handling chemical samples, standards, and reagents can be dangerous. Review the necessary Material Safety Data Sheets and become familiar with all safety procedures before handling any chemicals.

DANGER

La manipulation des échantillons chimiques, étalons et réactifs peut être dangereuse. Lire les Fiches de Données de Sécurité des Produits (FDSP) et se familiariser avec toutes les procédures de sécurité avant de manipuler tous les produits chimiques.

PELIGRO

La manipulación de muestras químicas, estándares y reactivos puede ser peligrosa. Revise las fichas de seguridad de materiales y familiarícese con los procedimientos de seguridad antes de manipular productos químicos.

GEFAHR

Das Arbeiten mit chemischen Proben, Standards und Reagenzien ist mit Gefahren verbunden. Es wird dem Benutzer dieser Produkte empfohlen, sich vor der Arbeit mit sicheren Verfahrensweisen und dem richtigen Gebrauch der Chemikalien vertraut zu machen und alle entsprechenden Materialsicherheitsdatenblätter aufmerksam zu lesen.

PERICOLO

La manipolazione di campioni, standard e reattivi chimici può essere pericolosa. La preghiamo di prendere conoscenza delle Schede Techniche necessarie legate alla Sicurezza dei Materiali e di abituarsi con tutte le procedure di sicurezza prima di manipolare ogni prodotto chimico.

Section 1 General Information

1.1 Instrument Description

The Series 5000 Silica Analyzer is a continuous reading, wet-chemical, colorimetric analyzer for determining silica concentration in water. It has automatic decimal point positioning to provide optimum resolution over the total analysis range of 0 to 5,000 micrograms per liter (µg/L or ppb) silica (SiO_2). Chemical analysis utilizes the heteropoly blue method (also called the molybdenum method) adapted from *Standard Methods for the Examination of Water and Wastewater*.

The analyzer provides semicontinuous analysis of a water sample stream by measuring discrete samples on a regulated cycle. Measurement cycles take either 8.8 or 15 minutes per sample, depending on sample temperature. A programmable, fully automatic calibration system is provided to assure continuous accuracy.

Two independent, programmable, set-point alarms, a 4–20 mA analog-recorder output signal, and an RS232 serial interface are built into the analyzer.

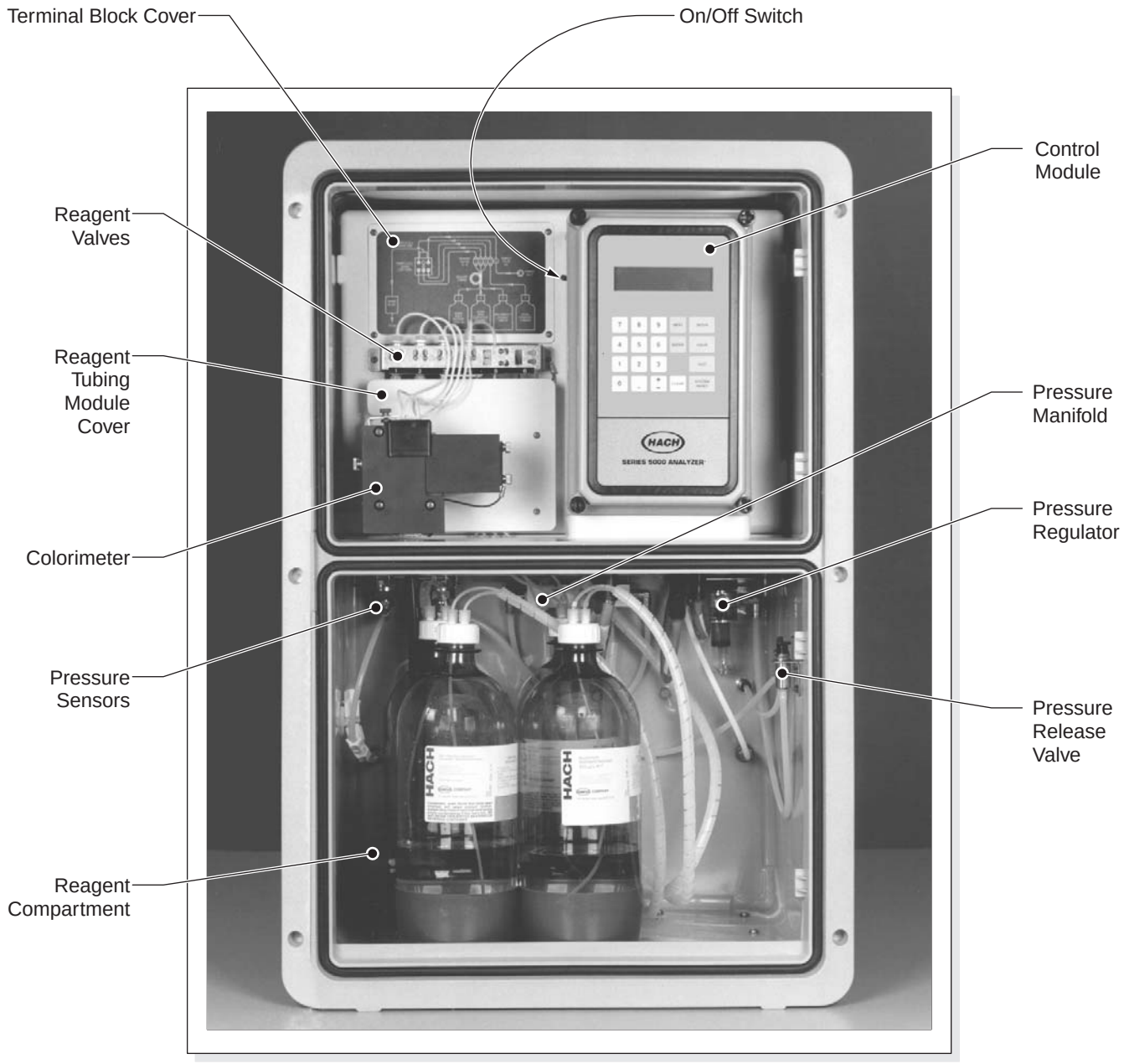
Analyzer components are mounted in a sturdy plastic frame designed for panel or bench-top mounting. Sensitive electronic components are enclosed in an integral gasketed enclosure for environmental protection. The analyzer is suitable for installation in general-purpose, clean, indoor environments.

1.2 Physical Design

The Series 5000 Silica Analyzer is composed of three major modules (see Figure 1).

- Control Module
- Reagent Supply System
- Analysis Module

Figure 1 Key Components



1.2.1 Control Module

The control module (see Figure 2) contains an alphanumeric LCD, a programming keyboard, alarm system relays and a power supply. These components are isolated from the analyzer in a gasketed plastic enclosure. In normal operation, the LCD shows sample silica concentration directly in micrograms per liter as SiO_2. Messages in the display prompt the operator through programming steps and show current operational settings.

All analyzer functions are controlled by microprocessor-based circuits. User-programmed operational settings are stored in memory and protected by a battery backup in the event of a power outage. Analyzer performance is self-monitored continuously, and an alarm system is used to notify the

operator of any conditions affecting analysis. There are two levels of alarms for the analyzer system: a System Warning Alarm indicates a need for operator attention, and a System Alarm indicates a malfunction has shut down the analyzer.

System Warning Alarms (if enabled) are triggered by conditions such as power failures, inability to complete a calibration or a reagent supply nearing depletion. System Alarms result in an automatic shutdown and are caused by conditions such as sample interruption, reagent supply failure or lamp failure.

Figure 2 Control Module



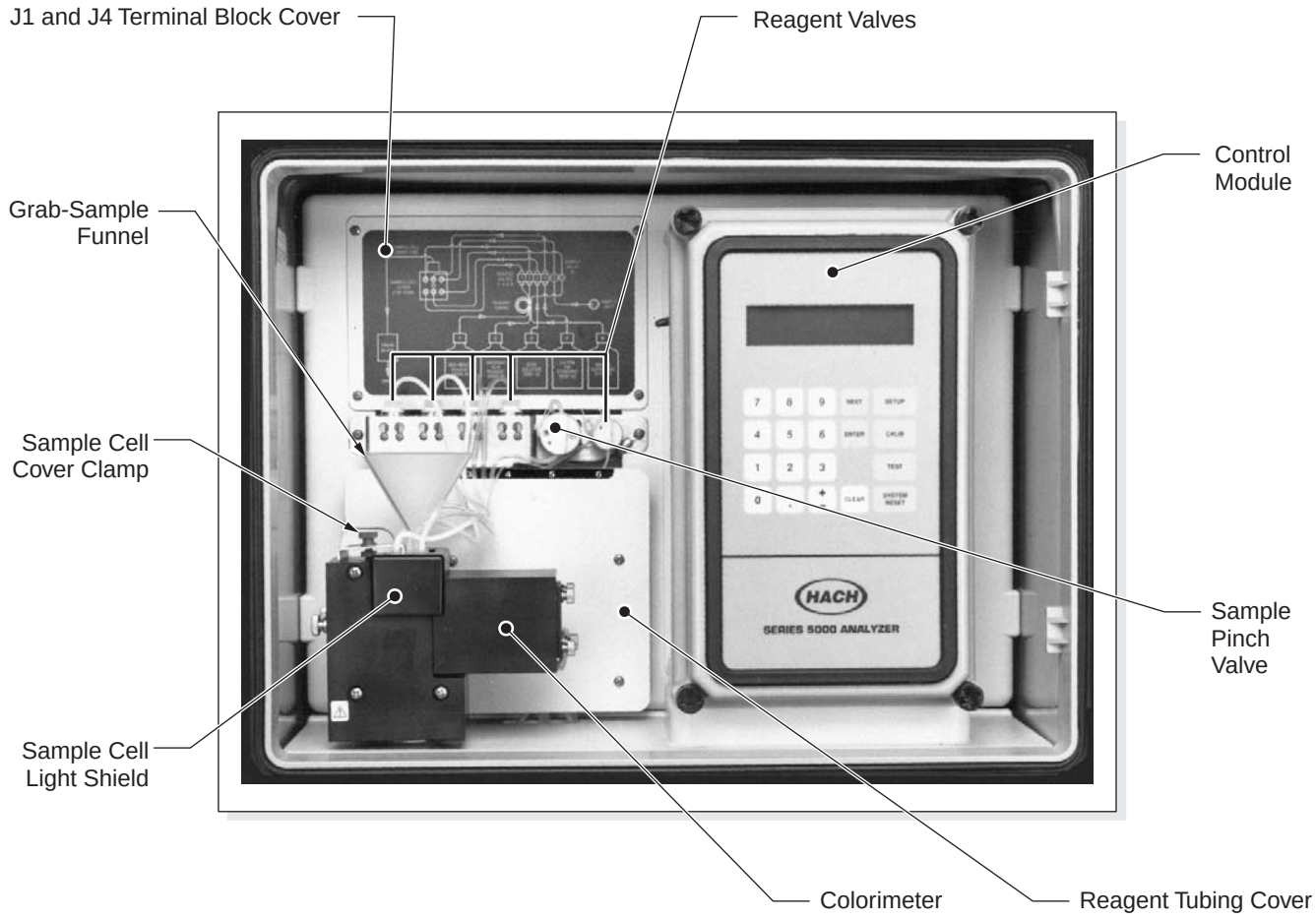
1.2.2 Reagent Supply System

Reagents are supplied to the analysis module by pressurizing the reagent containers and using solenoid valves actuated by the control module to regulate reagent flow volume and timing. Reagent containers are enclosed in a separate reagent compartment. A safety interlock on the compartment door requires reagent depressurization before opening. Reagent system pressure is supplied from an external source.

1.2.3 Analysis Module

The analysis module contains the solenoid valves controlling sample and reagent flow and the colorimetric measuring system (see Figure 3). A sample-measurement cell (sample cell) is placed between a light source and a photodetector and filtered to measure light at 810 nm. Sample and reagents enter the cell through fittings in the cell cover, which prevents external contamination. A magnetic stirrer is activated during reagent additions to mix sample and reagents thoroughly.

Figure 3 Analysis Module



1.3 Method of Analysis

The heteropoly blue method is used to measure molybdate-reactive silica. Molybdate 3 Reagent, an acidic molybdate solution, is added to the sample to react with any silica and phosphate present to form molybdosilicic and molybdophosphoric acids.

Then, Citric Acid/Surfactant Reagent is added. Citric acid masks any molybdophosphoric acid present and reacts with excess molybdate. This prevents molybdate from producing an interfering blue-colored compound. The surfactant, a wetting agent, minimizes air bubble formation on the sample-cell walls. Light absorbance through this solution is measured to determine a sample blank reference absorbance. Color formed at this point is identical to the final color of a 0 µg/L silica sample. This provides a zero reference and compensates for any background turbidity and color inherent in

the sample, changes in colorimeter lamp output or contamination of the sample-cell walls.

Amino Acid F Reagent is added to reduce molybdosilicic acid to a blue-colored solution. The amount of color formed is directly proportional to the silica concentration of the sample. Light absorbance through the solution is measured at 810 nm. This absorbance is compared to the sample-blank reference absorbance, and the silica concentration is calculated.

1.4 Principle of Operation

Operation of the Series 5000 Silica Analyzer is semi-continuous where discrete portions of sample are captured and analyzed in a timed sequence. When an analysis is complete, new sample flow purges the sample cell, and the analysis cycle repeats automatically. If the sample is maintained at an inlet temperature of 30 to 50 °C by normal use or by a sample heater, set the measurement cycle time to 8.8 minutes to take advantage of the faster reaction time at this temperature.

Otherwise, when the sample temperature is in the range of 5 to 40 °C, set the measurement cycle time to 15 minutes to ensure adequate reagent/sample reaction times.

Figure 4 is a flow diagram of the Series 5000 Silica Analyzer. A constant flow of sample is directed through a two-way valve to the sample cell. To keep fresh sample available to the analyzer on a continual basis, a sample pressure conditioning kit is provided with an adjustable needle valve for bypass flow eliminating dead-lags. A sample-inlet pressure of 5 ± 3 psig (100 to 300 mL/min) is required to ensure adequate flow. At the beginning of each measurement cycle, incoming sample flow is directed to the sample cell. The sample cell is filled 10-times. The excess sample flows through an overflow weir to a drain. A precise sample volume is maintained by the overflow weir. Reagents are stored in containers pressurized at a nominal 12 ± 3 psig. By monitoring reagent pressure and temperature, the analyzer can dispense reagents accurately by timing the opening of the solenoid valves. Once the sample cell has been filled, reagents are added in the sequence described in Section 1.3 Method of Analysis.

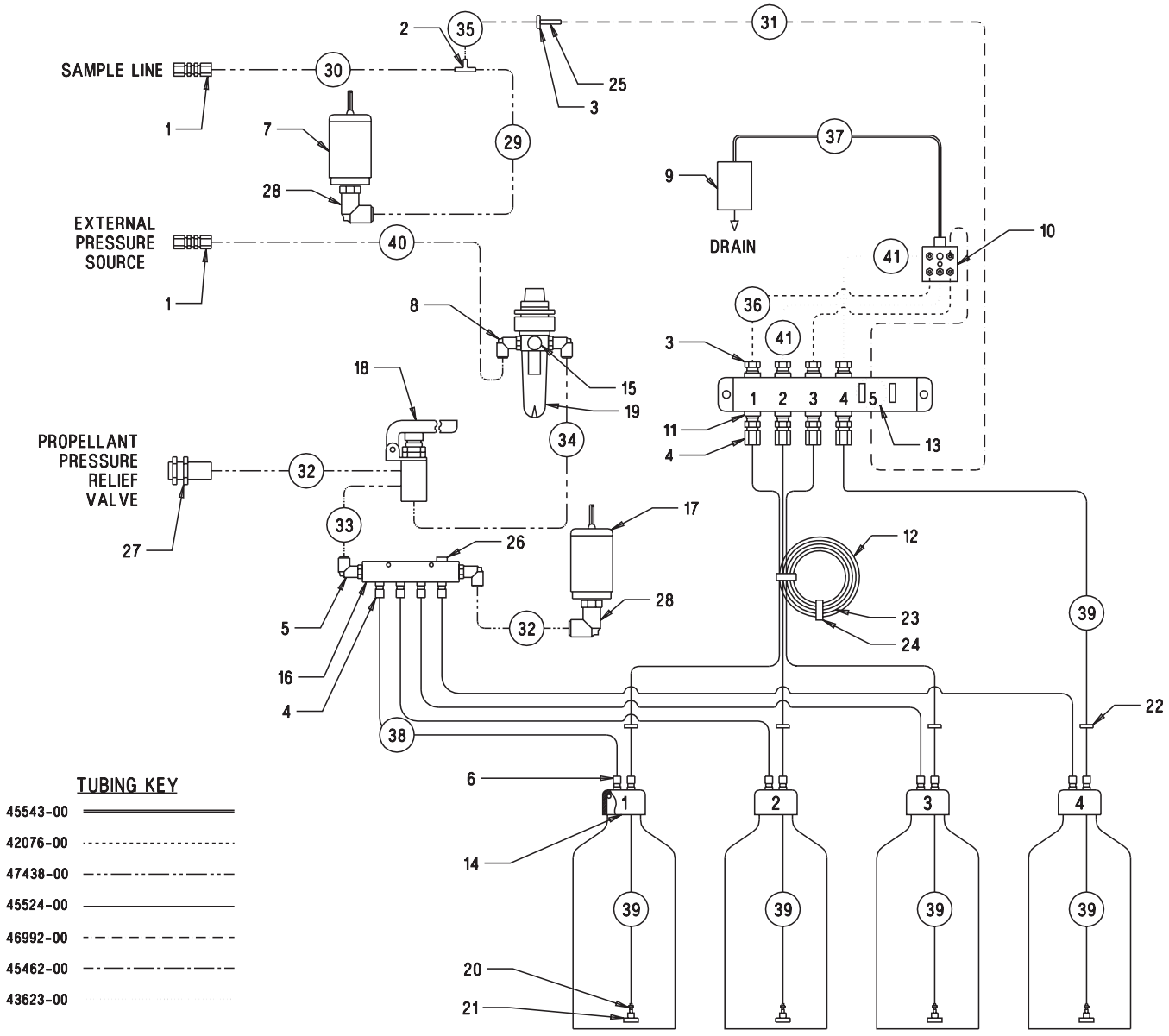
Note: *The reagent pressure regulator is factory set at 12 psig. This setting is required for proper instrument operation.*

A magnetic stirring motor is activated after reagents are added to ensure good mixing. It is turned off to allow sample to stabilize and air bubbles to rise before taking color measurements.

During a calibration cycle, standard solution stored in a reagent bottle is added to the sample cell in place of the normal sample. The standard solution is analyzed, exactly as a sample would be, and the result is used to calculate the slope of the calibration curve. This slope factor is used in all future measurements to calculate sample concentration as shown in the following formula:

$$SiO_2 = \text{slope} \times \log\left(\frac{\text{reference}}{\text{sample}}\right)$$

Figure 4 Flow Diagram



Installation/Maintenance

DANGER

Some of the following manual sections contain information in the form of warnings, cautions and notes that require special attention. Read and follow these instructions carefully to avoid personal injury and damage to the instrument. Only personnel qualified to do so, should conduct the installation/maintenance tasks described in this portion of the manual.

DANGER

Certains des chapitres suivants de ce mode d'emploi contiennent des informations sous la forme d'avertissements, messages de prudence et notes qui demandent une attention particulière. Lire et suivre ces instructions attentivement pour éviter les risques de blessures des personnes et de détérioration de l'appareil. Les tâches d'installation et d'entretien décrites dans cette partie du mode d'emploi doivent être seulement effectuées par le personnel qualifié pour le faire.

PELIGRO

Algunos de los capítulos del manual que presentamos contienen información muy importante en forma de alertas, notas y precauciones a tomar. Lea y siga cuidadosamente estas instrucciones a fin de evitar accidentes personales y daños al instrumento. Las tareas de instalación y mantenimiento descritas en la presente sección deberán ser efectuadas únicamente por personas debidamente cualificadas.

GEFAHR

Einige der folgenden Abschnitte dieses Handbuchs enthalten Informationen in Form von Warnungen, Vorsichtsmaßnahmen oder Anmerkungen, die besonders beachtet werden müssen. Lesen und befolgen Sie diese Instruktionen aufmerksam, um Verletzungen von Personen oder Schäden am Gerät zu vermeiden. In diesem Abschnitt beschriebene Installations- und Wartungsaufgaben dürfen nur von qualifiziertem Personal durchgeführt werden.

PERICOLO

Alcune parti di questo manuale contengono informazioni sotto forma d'avvertimenti, di precauzioni e di osservazioni le quali richiedono una particolare attenzione. La preghiamo di leggere attentivamente e di rispettare quelle istruzioni per evitare ogni ferita corporale e danneggiamento della macchina. Solo gli operatori qualificati per l'uso di questa macchina sono autorizzati ad effettuare le operazioni di manutenzione descritte in questa parte del manuale.

Section 2 Analyzer Operation

This section covers procedures required to initiate analyzer operation or to restart the analyzer after an extended shutdown. The analyzer will operate with factory installed programming and calibration settings (default settings); see Table 1.

Table 1 Default Settings

Alarm 1	0.00 µg/l (LOW)
Alarm 2	5000 µg/l (HIGH)
Automatic Calibration	Disabled
Cycle Time (fixed)	Long (15 minutes)
Date	01/01/88
Day	Sunday
Keyboard	Unlocked
Reagent Blank	0.00 µg/L
Reagent Supply	100%
Recorder Maximum	5000 µg/L
Recorder Minimum	0.00 µg/L
Standard Concentration	500 µg/L
Standard Supply	100%
Time	00:00

2.1 Unpacking Analyzer

2.1.1 Check for Damage

Remove packing and lay carton down. Slide the analyzer carefully out of carton. Thoroughly inspect the instrument for damage that may have occurred in shipment. Freight carriers contracted for shipment are responsible for any such damage. If damage is observed, notify the carrier immediately to initiate a claim to cover the repair cost. Contact the Hach Service Center to arrange for repairs.

2.1.2 Contents of Installation Kit

The following items are included in the installation kit provided with the analyzer:

Strain relief bushing (4) for electrical wiring	43794-00
Seal for strain relief (4)	10338-14
Locknut for strain relief (4)	10596-12
Funnel, powder, reagent	22644-72
Tubing, ¾ inch ID, 6 feet for drain	13201-00
Fuse, ½ amp, for 230 VAC (2)	44592-00
Stir bar, for sample cell	44936-00
Sample Conditioning Kit	46991-00
Manual	60000-18
Quick Reference Card	60000-44
Fitting Spacer Gauge	45548-00

2.1.3 Initial Reagent Supply

Note: *Please refer to the MSDS for comprehensive safety information essential for safety training and safe handling. File the MSDS for future reference.*

One three-liter bottle of each chemical reagent is supplied with every analyzer purchased:

- Amino Acid F Reagent
- Citric Acid/Surfactant Reagent
- Molybdate 3 Reagent
- Silica Standard Solution

Reagents must be stored at temperatures above 10 °C (50 °F). Reagents are packed in separate containers in accordance with Federal Department of Transportation regulations with the Material Safety Data Sheets (MSDS) enclosed.

2.2 Start Up

2.2.1 Installing Stir Bar

Note: *The analyzer will not function properly unless the stir bar is installed.*

The stir bar (Cat. No. 44936-00) is supplied in the installation kit. It must be installed in the sample cell in order for the analyzer to function.

Install the stir bar as follows:

1. Remove the sample cell light shield.
2. Remove the sample cell hold-down clamp by turning the knurled hold-down screw counterclockwise (see Figure 3 on page 14).
3. Lift the sample cell cover straight up.
4. Drop the stir bar into the sample cell.
5. Replace the sample cell cover. Make sure the gasket is seated properly and the cover fits flush on the sample cell.
6. Replace the sample cell hold-down clamp and finger tighten the hold-down screw.
7. Replace the sample cell light shield.

2.2.2 Preparing Reagents

The Series 5000 Silica Analyzer uses three chemical reagents and a silica standard solution. Molybdate 3 Reagent, Citric Acid/Surfactant Reagent, Amino Acid F Reagent and Silica Standard Solution, 500 µg/l are factory-prepared and ready to use. Amino Acid F reagent is supplied in two parts to ensure a long shelf life: a 3-liter bottle of Amino Acid F Solution and a bottle of Amino Acid F Reagent powder. Amino Acid F Reagent powder must be added to the solution immediately before installation in the analyzer (see Section 2.2.2.1). A powder funnel is included in the installation kit for this purpose.

2.2.2.1 Amino Acid F Reagent Preparation

WARNING
To familiarize yourself with handling precautions, dangers and emergency procedures, always review the Material Safety Data Sheets prior to handling containers, reservoirs, and delivery systems that contain chemical reagents and standards. Protective eye wear always is recommended when contact with chemicals is possible.

ATTENTION
Pour se familiariser avec les précautions à prendre lors de la manipulation, les dangers et les procédures d'urgence, toujours lire les Fiches de données de sécurité des Produits avant de manipuler les récipients, les réservoirs et les systèmes de distribution contenant les réactifs chimiques et les solutions étalons. Il est toujours recommandé de porter des lunettes de protection lorsqu'un contact avec les produits chimiques est possible.

ADVERTENCIA
Para familiarizarse con las precauciones de manipulación, los peligros y los procedimientos de emergencia, siempre estudie las Hojas de Datos de Seguridad de los Materiales antes de manipular recipientes, depósitos y sistemas de entrega que contengan reactivos y patrones químicos. Siempre se recomienda el uso de protectores oculares cuando sea posible el contacto con productos químicos.

WARNHINWEIS
Es wird dringend empfohlen, die Sicherheitsdatenblätter vor der Handhabung von Behältern, Tanks und Zufuhrsystemen, die chemische Reagenzien und Standardsubstanzen enthalten, aufmerksam durchzulesen, damit Sie sich mit den beim Umgang mit diesen Chemikalien notwendigen Vorsichtsmaßnahmen, Risiken und Notfallschutzmaßnahmen vertraut machen, Es wird empfohlen, in allen Situationen, in denen mit einem Kontakt mit Chemikalien zu rechnen ist, eine Schutzbrille zu tragen.

ADVERTÊNCIA
Para familiarizar-se com as precauções de manipulação, riscos e procedimentos de emergência, examine sempre o Folheto de Dados de Segurança antes de manipular os recipientes, tanques e sistemas de distribuição que contenham reagentes químicos e outros elementos padronizados. Se recomenda sempre o uso de protetores para olhos, quando possa acontecer contato com os produtos químicos.

Remove the caps from the Amino Acid F Reagent powder bottle and solution bottle and carefully pour the powder into the solution bottle. Recap the solution bottle tightly. Shake to mix and dissolve the powder. The resulting solution has a shelf life of at least two months. If the analyzer is shutdown for more than three weeks, prepare and use fresh reagents on restart.

2.2.3 Installing Reagents

CAUTION
Wear eye protection whenever the reagent compartment door is open, even though the system is not pressurized.

PRUDENCE
Porter des lunettes de protection lorsque la porte du compartiment des réactifs est ouverte, même si le système n'est pas pressurisé.

PRECAUCION
Use protección para los ojos siempre que el compartimiento para reactivos esté abierto, aunque el sistema no esté a presión.

VORSICHT
Wenn die Tür des Reagenzienfachs offen ist, muß immer ein Augenschutz getragon warden, auch wenn das System nicht unter Druck steht.

PRECAUÇÃO
Use proteção aos olhos sempre que a porta do compartimento dos reagentes estiver aberta, ainda que o sistema de pressurização esteja desligado.

Reagents and standard are installed in the bottom of the analyzer in the reagent tray. Pressure and reagent lines through the reagent bottle caps are used to connect the bottles with the analyzer.

Note: *Reagent bottle caps must be tightened securely to avoid propellant pressure loss.*

Reagent bottle caps in the analyzer are numbered to match caps with the correct reagents (see Figure 4 on page 16). Insert the reagent take-up lines into the appropriate reagent bottles and fasten the caps tightly by rotating the reagent bottle to prevent twisting the tubing.

2.2.4 Reagent Blank

Molybdate 3 Reagent contains a small amount of silica that produces a positive interference with the analysis. A reagent blank for each lot of reagent is measured carefully at the factory and noted on the reagent label. Note the reagent blank value. It is entered during start-up to correct for the reagent blank concentration.

2.3 Operation

2.3.1 Power Up

Place the power switch in the ON position (see Figure 5). The analyzer display will show momentarily the analyzer model and the software version number. Press one of the following number keys on power up to select an alternative menu language: 1 for English, 2 for German, 3 for French, or 4 for Spanish.

Figure 5 Power Switch



2.3.2 Keyboard Display Description

Table 2 describes the function of each key and indicator (see Figure 6).

Table 2 Keyboard Description

Key	Description
Display	An alphanumeric display shows silica concentration in µg/L. Decimal point is positioned automatically. Also used as a programming display.
NEXT	Use the **NEXT** key to advance the display to the menu option immediately following it or to select a new value for an existing parameter.
SETUP	Use the **SETUP** key to change or review the analyzer settings.
ENTER	Use the **ENTER** key to store selected options into the analyzer memory for use during normal operating cycles or to begin a submenu.
CALIB	Use the **CALIB** key to change or review analyzer calibration settings.
TEST	Use the **TEST** key to verify proper instrument and peripheral device operation.
CLEAR	Use the **CLEAR** key to clear number entry or return to normal display.
SYSTEM RESET	Resets system alarms, system warnings, and sample alarms. Restarts analysis at the beginning of a measurement cycle.
Numeric	Used to enter data.

Figure 6 Keyboard



2.3.3 Using the Menus

The user controls the operation of the Series 5000 Silica analyzer through three menus. These menus, corresponding to instrument setup, calibration and testing functions, guide the operator in adapting the instrument to the user's application. Each menu is initiated by pressing the **SETUP**, **CALIB** or **TEST** keys, respectively. For menu programming information, refer to Section 2.5 on page 29.

Note: *The following menu selections also restart the analysis at the beginning of a measurement cycle:*

- SAMPLE PRESSURE
- REAGENT PRESSURE
- AUTO-SET CURRENT
- AUTO-SET VOLTAGE

2.3.4 Checking Reagent Pressure

Reagent supply system pressure must be between 8 and 18 psig (55.2 to 124.1 kPa) for proper operation. An internal pressure regulator/relief valve is built in to ensure proper system pressurization. The system also includes a pressure sensor. An analyzer system alarm actuates if reagent pressure is outside of acceptable limits. Pressurize and check the reagent supply system as follows:

1. Supply an external pressure source such as nitrogen or air between 20 and 60 psig.

2. Make sure the door to the reagent compartment is closed and turn the reagent pressure interlock valve to the ON position.

3. Press the **TEST** key to call up the test menu:

ALARM TEST **NEXT OR ENTER**

4. Use the **NEXT** key to advance to:

REAGENT PRESSURE **NEXT OR ENTER**

5. Press the **ENTER** key. The display shows the actual reagent system pressure:

REAG P = 8 to 18 psi **CLEAR TO CANCEL**

If the pressure is below 8 psi, refer to Section 4.3 on page 87.

2.3.5 Setting Sample Pressure

Sample must be supplied to the analyzer at a pressure between 2 and 8 psig (13.8–55.2 kPa) to ensure adequate sample flow into the system. The analyzer contains a built-in sample pressure sensor and will show sample pressure on the display. Sample inlet pressure can be checked as follows:

1. Press the **TEST** key:

ALARM TEST **NEXT OR ENTER**

2. Use the **NEXT** key to advance to:

SAMPLE PRESSURE **NEXT OR ENTER**

3. Press the **ENTER** key to display actual sample pressure:

SMP P = 2.00 to 8.00 psi **CLEAR TO CANCEL**

4. Sample pressure display responds to any changes in sample pressure. Adjust sample pressure to achieve a sample pressure reading of 5 ± 3 psi.

Note: *Pressures greater than 30 psig will damage pressure sensors.*

Note: *When monitoring sample or reagent pressure, normal silica measurement is discontinued. To resume normal measurement, press* **CLEAR**. *If no key is pressed for 60 seconds, the instrument automatically resumes normal operation.*

5. Press the **CLEAR** key to return to normal operation.

2.3.6 Initial Operation

With reagent and sample pressures properly set, initialize analyzer operation as follows:

1. Press the **SETUP** key to enter the setup menu:

ALARMS **NEXT OR ENTER**

2. Use the **NEXT** key to advance to:

REAGENETS **NEXT OR ENTER**

3. Press the **ENTER** key to select reagent options:

RBLANK 0.00 µg/l NEXT OR #KEYS

Key in the reagent blank as listed on the Molybdate 3 bottle using the numeric keys. This value is labeled **Reagent Blank = _____ mg/L SiO2**. With the correct reagent blank value shown in the display, press **ENTER** to accept the value.

RBLANK 0.00 µg/l NEXT OR CLEAR

4. Press the **NEXT** key to advance to:

REAG LEVEL = 0 (to) 100% NEXT OR #KEYS

5. **Reag Level** describes the amount of reagent remaining in the bottles in 1% increments. If starting with new, full reagent bottles, set to 100%. If starting with partially depleted bottles, estimate the amount remaining, and enter the actual level to the nearest 10% using the number keys. When the correct reagent level is shown in the display, press the **ENTER** key:

REAG LEVEL = 100% NEXT OR CLEAR

6. Press the **NEXT** key:

STD LEVEL = 0 (to) 100% NEXT OR #KEYS

7. Standard level is set separately from the reagent level because it is consumed at a different rate. When using new Hach standard solutions, set the standard level to 100%. Or, when using partially filled standard bottles, enter the actual standard level to the nearest 10% using the number keys. When the correct standard level is shown in the display, press the **ENTER** key:

STD LEVEL + 100% NEXT OR CLEAR

8. Press the **NEXT** key:

PRIME REAGENTS NEXT OR ENTER

9. Press the **ENTER** key. Reagent solenoid valves open sequentially to prime the reagent feed lines to the colorimeter cell with fresh reagent.

10. Wait until each of the three reagent valves has opened and closed. The total time required is roughly 2.5 minutes. For initial startup, repeat the priming procedure (*step 9*) three or four times.

2.3.7 Stabilization Time

Operate the analyzer for a short period of time to purge sample system components of any impurities and to fully wet down all system components. Run the analyzer for several hours or until stable, repeatable readings are obtained before calibrating.

2.3.8 Initial Calibration

Series 5000 Silica Analyzers are programmed with a factory default calibration. The auto-calibration system of the analyzer provides a means for fine tuning the calibration of the individual analyzer and assuring continuing analyzer accuracy. When first placing the analyzer into operation, calibrate the analyzer as follows:

1. Press the **CALIB** key to select the calibration menu:

AUTO-CALIBRATION NEXT OR ENTER

2. Press the **ENTER** key:

START CALIB? ENTER OR CLEAR

3. Press the **ENTER** key to initiate the calibration sequence.

(CALIBRATING)

4. Calibration is complete in 15 minutes or 8.8 minutes if the ambient temperature is greater than 30 °C. The analyzer then returns to normal operation.

2.4 Performance Monitoring

Once the analyzer has been started and the operational programming is set as described in the following sections, virtually no operator intervention is required. Visually inspect the analyzer on a regular basis to verify normal operation.

2.4.1 Analysis Verification

Sensitivity and repeatability of the Series 5000 Silica Analyzer is superior to most laboratory analysis methods. However, determining the absolute accuracy of any method at low silica levels is difficult. Automatic calibration as performed by the analyzer is the best assurance of ongoing accuracy. Response of the analyzer to silica concentration is linear throughout its range. Low level accuracy is thus ensured with a standard such as the 500 µg/L standard supplied with the analyzer. The 2.9-liter bottle of standard solution is sufficient for ten calibrations.

2.4.2 Alarm Indications

Analyzer alarms signal either sample silica concentration outside of programmed limits, or a potential problem with the analyzer itself (refer to Section 2.6.1).

If alarm conditions do exist, the alarm relays are actuated and an alarm message, indicating the cause of the alarm, will flash on the second line of the display. For faster operator intervention, connect external annunciators, visual and/or audible, to the alarm system relays.

2.4.3 Tubing Inspection

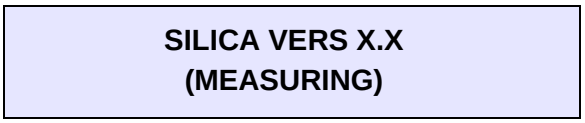
Regularly inspect all tubing and fittings in the analyzer for any indication of leaks, kinks or splitting. Some tubing distortion and discoloration is normal. Any evidence of cracking, splitting or leaking indicates a need for replacement.

Any leaks or tubing problems should be corrected immediately to avoid unexpected failures. Refer to Section 4 Maintenance Requirements for replacement procedures.

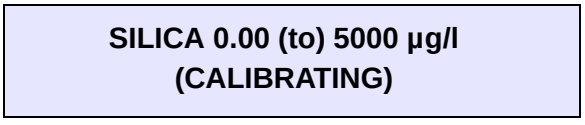
2.4.4 Normal Display of Measured Silica

The display shows the following displays during start-up, calibration and measurement:

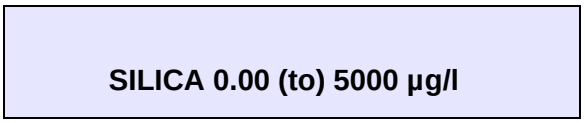
Start-up:



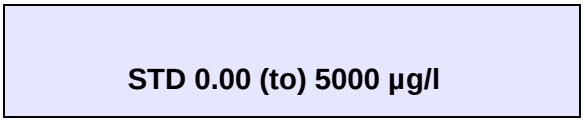
Calibration:



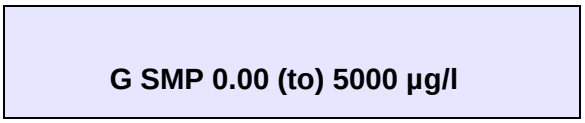
Measurement:



or



or



(Used for grab sample measurements)

The display shows the last measurement until a new sample measurement is made. The display returns automatically to one of the normal displays if no key is pressed for 60 seconds. It returns immediately if **CLEAR** is pressed after a selected option is entered.

The display flashes when warnings or alarms occur (see Section 2.9 on page 60).

2.5 Operational Programming

Operational programming modifies analyzer functions to meet the specific needs of the user. Functions such as alarm set points, recorder output span, reagent status, auto-calibration time and digital interface parameters all are user programmable.

Three programming menus relating to analyzer setup, calibration and testing functions guide the operator in adapting the analyzer to specific applications. Menus are selected by pressing the appropriately labeled keys.

Once a menu key is pressed, the display presents options that the operator can scroll through by pressing the **NEXT** key, or select for programming by pressing the **ENTER** key. At any point, the **CLEAR** key can be pressed to exit a menu and return to normal concentration display. Also, the analyzer automatically exits a menu and returns to normal concentration display if no keys are pressed within 60 seconds.

2.6 Initial Setup

The Setup Menu covers the most common user programmable settings. Pressing the **SETUP** key calls up the Setup Menu starting with Alarms. Repeatedly pressing the **NEXT** key scrolls through the Setup options. At any point, the **CLEAR** key can be pressed to exit the Setup Menu and return to normal concentration display.

2.6.1 Alarms

Sample concentration Alarms 1 and 2 are completely independent set-point alarms. They actuate when sample silica concentration is outside the programmed limit(s). Either alarm can be set to actuate at any point within the 0 to 5,000 μg/L range. Either one also can be set to actuate when silica concentration goes above the set point (high alarm) or below the set point (low alarm).

This allows for a great deal of flexibility in the alarm system. An expected silica range can be bracketed with upper and lower limits. A dual level alarm system can be established with two high alarms. Or, both alarms can be set at the same point making both relays available for annunciation and control.

Alarms 1 and 2 also may be set as rate-of-change alarms. Differences between sequential readings are compared to a rate-of-change alarm setting in terms of μg/L per hour. This alarm can be used to give early warning of a trend approaching process limits.

To check or program the alarm settings:

Press the **SETUP** key to call up the Setup Menu:

ALARMS **NEXT OR ENTER**

Press the **ENTER** key to select the Alarm Settings Menu:

2.6.1.1 Reset Alarms

RESET ALARMS **NEXT OR ENTER**

Pressing **ENTER** clears any existing alarms. However, if the alarm condition persists, the alarm is reactivated on the next measurement cycle.

Press the **NEXT** key to advance to:

2.6.1.2 Enable/Disable Alarms

ALARMS ENABLED (or) DISABLED
NEXT OR ENTER

This option controls alarm activation. If disabled, alarm relays are not be activated if set points are exceeded. Disabling alarms is useful when performing maintenance or troubleshooting the analyzer.

To change the condition displayed, press the **ENTER** key:

ALARMS ENABLED (or) DISABLED
SELECT WITH NEXT

Press the **NEXT** key to change the status:

ALARMS DISABLED (or) ENABLED
NEXT OR ENTER

Then, press the **ENTER** key to accept the new setting

ALARMS ENABLED (or) DISABLED
NEXT OR CLEAR

Press the **NEXT** key to advance to:

2.6.1.3 Alarm Setpoints

L ALM 10.00 (to) 5000 µg/l
NEXT OR # KEYS

This option allows you to review or change the alarm concentration set point. Alarm configuration of high, low or rate-of-change alarms is set in the next option.

The **L** in **L ALM1** indicates Alarm 1 is set as a low alarm at the concentration setting displayed. Use the numerical keys to change the set point, then press the **ENTER** key to accept the new value.

L ALM 10.00 (to) 5000 µg/l
NEXT OR CLEAR

Press the **NEXT** key to advance to:

L ALM 20.00 (to) 5000 µg/l
NEXT OR #KEYS

The **H** in **H ALM2** indicates Alarm 2 is set as a high alarm at the concentration setting displayed. Use the numerical keys to change the set point, then press the **ENTER** key to accept the new value.

H ALM 20.00 (to) 5000 µg/l
NEXT OR CLEAR

Press the **NEXT** key to advance to:

2.6.1.4 Alarm Configuration

ALARM CONFIG
NEXT OR ENTER

This option sets Alarms 1 and 2 as high alarms, low alarms or rate-of-change alarms.

Press the **ENTER** key to review or change configuration:

ALARM 1=LOW (or) HIGH (or) RATE
NEXT OR ENTER

To change the configuration, press the **ENTER** key. Then press the **NEXT** key until the desired configuration is displayed. Press the **ENTER** key to accept the displayed configuration.

ALARM 1=LOW (or) HIGH (or) RATE
NEXT OR CLEAR

Press the **NEXT** key to view or change the Alarm 2 configuration.

Press the **CLEAR** key to exit the Setup Menu.

Press the **NEXT** key to view or change the Power Fail warning status.

POWER FAIL: OFF
NEXT OR ENTER

This option determines if the instrument gives a “System Warning” after a power failure. To change the status, press the **ENTER** key. Then press the **NEXT** key until the desired status is displayed. Press the **ENTER** key to accept the displayed status. Press the **CLEAR** key to exit the Setup Menu.

2.6.1.5 Relay Configuration

This option determines which relay is actuated for each of the alarm functions.

RELAY CONFIG
NEXT OR ENTER

Press the **ENTER** key to review or change configuration:

SYS ALRM: RLY1 (to) RLY4
NEXT OR ENTER

Press the **ENTER** key to change the configuration. Then, press the **NEXT** key until the desired configuration is displayed. Press the **ENTER** key to accept the displayed configuration. Press the **NEXT** key to view or change System Alarm, Alarm 1 and/or Alarm 2 configuration. Press the **CLEAR** key to exit the Setup Menu.

Table 3 Programmable Relay Configuration for Series 5000 Version 2.0

Sub menu	Function	Relay
RELAY CONFIG	SYS ALRM	RLY 1
	SYS WARN	RLY 2
	ALARM 1	RLY 3
	ALARM 2	RLY 4
	MARK END*	NO RLY
	SMP COND	NO RLY

* Does not show up in menu unless enabled.
SMP COND in Phosphate Analyzers only.

2.6.2 Reagents

The Reagent Setup Menu is used anytime analyzer reagents or standard are replaced.

Press the **SETUP** key to enter the Setup Menu, then press the **NEXT** key to advance to:

REAGENTS
NEXT OR ENTER

Press the **ENTER** key to select the Reagent Setup Menu:

2.6.2.1 Reagent Blank

RBLANK 0.00 µg/l NEXT OR #KEYS

Enter the reagent blank as listed on the Molybdate 3 bottle using the numeric keys. This value is labeled **Reagent Blank = _____ mg/L SiO2**. With the correct reagent blank value shown in the display, press the **ENTER** key to accept the value.

RBLANK 0.00 µg/l NEXT OR CLEAR

Press the **NEXT** key to advance to:

2.6.2.2 Reagent Level

REAG LEVEL = 0 (to) 100% NEXT OR #KEY

Reagent Level displays the amount of reagent remaining in the bottle in 1% increments. An analyzer System Warning alarm, **Reagents Low,** is activated when the reagent level is 19% or less. A System Alarm, **Replace Reag**, is activated and the analyzer shuts down when the reagent level reaches 10%.

Use the numeric keys to enter the new reagent level (100% if installing a new bottle), then press the **ENTER** key to accept the new value.

REAG LEVEL = 100% NEXT OR CLEAR

Press the **NEXT** key to advance to:

2.6.2.3 Standard Level

STD LEVEL = 0 (to) 100% NEXT OR #KEYS

Standard Level displays the amount of calibration standard remaining in the bottle in 10% increments. When the standard is replaced, the level must be reset to 100%. Standard consumption is monitored by the analyzer and a System Warning alarm, **Replace Cal Std**, is triggered when the standard level is less than 10%.

Use the numeric keys to enter a new standard level (100% if installing a new bottle) and press the **ENTER** key to accept.

STD LEVEL = 0 (to) 100% NEXT OR CLEAR

Press the **NEXT** key to advance to:

2.6.2.4 Prime Reagents

PRIME REAGENTS NEXT OR ENTER

Prime the reagent lines anytime reagents are installed or replaced. This purges the lines of old reagents and any air bubbles introduced during replacement.

To prime the reagent lines, press the **ENTER** key:

PRIME REAGENTS NEXT OR CLEAR

Priming the reagent lines takes approximately 2.5 minutes. When priming is complete, the analyzer automatically resumes normal operation. “System Reset” and some of the “Test” functions stop the priming function.

2.6.3 Recorder

The Recorder Setup Menu is used to program the recorder output range and calibrate the current or voltage output span. The recorder output range (in μg/L silica) can be programmed to cover any segment of the 0 to 5000 μg/L analyzer range.

Press the **SETUP** key to call up the Setup Menu and press the **NEXT** key to advance to:

RECORDER TEST NEXT OR ENTER

Press the **ENTER** key to select the Recorder Setup Menu:

2.6.3.1 Output Concentration Range

RECMAX 0.00 (to) 5000 µg/l NEXT OR #KEYS

RECORDER MAXIMUM is used to set the top end of the recorder output range in μg/L silica. If, for example, the recorder maximum is set to 10 μg/L, an analyzer reading of 10 μg/L would drive the recorder to full scale.

Use the numeric keys to key in the desired recorder maximum setting. Press the **ENTER** key to accept the displayed setting:

RECMAX 10.00 µg/l NEXT OR CLEAR

Press the **NEXT** key to advance to:

RECMIN 0.00 (to) 5000 µg/l NEXT OR #KEYS

RECORDER MINIMUM is used to set the bottom end of the recorder output range in µg/L silica. If, for example, the recorder minimum is set to 0.0 µg/L, an analyzer reading of 0.0 µg/L would drive the recorder to zero.

Use the numeric keys to key in the desired recorder minimum setting. Press the **ENTER** key to accept the displayed setting:

RECMIN 0.00 µg/l NEXT OR CLEAR

Press the **NEXT** key to advance to:

2.6.3.2 On Alarm

ON ALARM: HOLD NEXT OR ENTER

This option is used to set the recorder output to **Hold**, **Go Max** or **Go Min** (e.g., a system alarm where the analyzer can no longer continue analysis.) The recorder output can be programmed to go full scale (**Go Max**), zero (**Go Min**), or continue holding (**Hold**) at the output last detected before the system alarm occurred. Press the **ENTER** key to select one of the three options.

Press the **NEXT** key to advance to:

2.6.3.3 4–20 mA Output Calibration

AUTO-SET CURRENT NEXT OR ENTER

Auto-Set Current automatically calibrates the 4–20 mA recorder output span. This option is used only when the 4–20 mA current output is selected for use (see Section 3.3.3 on page 79).

Press the **ENTER** key to execute the **Auto-Set Current**. The display shows the actual output current level in milliamps as it is adjusted to 20 mA for full scale and 4 mA for zero:

REC FS = 20.00 **CLEAR TO CANCEL**

REC ZERO = 4.00 **NEXT OR CLEAR**

Press the **NEXT** key to advance to:

2.6.3.4 Voltage Output Calibration

AUTO-SET VOLTAGE **NEXT OR ENTER**

Auto-Set Voltage automatically calibrates the millivolt recorder output span. This option is used only when a voltage output is selected for use as described in (see Section 3.3.3 on page 79).

Press the **ENTER** key to execute **Auto-Set Voltage**. The display shows the actual output voltage level in volts as it is adjusted to 1.00 volt for full scale and 0.00 volts for zero. Lesser output spans are driven by a 0 to 1 volt signal through a voltage divider:

REC FS = 1.00 **CLEAR TO CANCEL**

REC ZERO = 0.00 **NEXT OR CLEAR**

Press the **NEXT** key to advance to:

2.6.3.5 Manual Output Calibration

MANUAL SET REC **NEXT OR ENTER**

This option manually adjusts the output span limits to drive a recorder to exact full scale and zero. This may be easier than making internal adjustments in the recorder to match it to input currents or voltages.

Press the **ENTER** key to select this option:

INCR FULL SCALE **NEXT OR ENTER**

Press the **ENTER** key and the recorder output is driven to its full-scale setting and gradually increased.

REC F S = XXX
PRESS ANY KEY

When the recorder indicates exactly full scale, or if it indicates over full scale, press any key to freeze the setting.

REC F S = XXX
NEXT OR CLEAR

Press the **NEXT** key to advance to:

DECR FULL SCALE
NEXT OR ENTER

Press the **ENTER** key and the recorder output is driven to its full scale setting and gradually decreased.

REC F S = XXX
PRESS ANY KEY

When the recorder indicates exactly full scale, or if it indicates below full scale, press any key to freeze the setting.

REC F S = XXX
NEXT OR CLEAR

Press the **NEXT** key to advance to:

INCR ZERO
NEXT OR ENTER

Press the **ENTER** key and the recorder output is driven to its zero setting and gradually increased:

REC ZERO = XXX
PRESS ANY KEY

When the recorder indicates exactly zero, or if it indicates above zero, press any key to freeze the setting.

REC ZERO = XXX NEXT OR CLEAR

Press the **NEXT** key to advance to:

DECR ZERO NEXT OR ENTER

Press the **ENTER** key and the recorder output is driven to its zero setting and gradually decreased:

REC ZERO = XXX PRESS ANY KEY

When the recorder indicates exactly zero, or if it indicates below zero, press any key to freeze the setting.

REC ZERO = XXX NEXT OR CLEAR

Press the **NEXT** key if you need to repeat any of the manual adjustments. Or, press the **CLEAR** key to exit the Setup Menu.

2.6.4 Data Communications Format/Setup

Data communications format selections of baud rate, parity, stop bit and word length (other than those established as default settings) may be required for compatibility with peripheral equipment. The selections are made by entering the appropriate value in the Initial Setup menu. The default values are: 1200 baud, no parity, 1 stop bit, and 8 word length.

The Initial Setup menu is used as follows:

1. Press the **SETUP** key to call up the Setup Menu:

2. Use the **NEXT** key to advance to:

INITIAL SETUP NEXT OR ENTER

3. Press the **ENTER** key to review or change the serial I/O setup.

HR:MIN = 00.00 NEXT OR #KEYS

4. Use the **NEXT** key to advance to:

BAUD RATE = 300, 600, 1200, 2400, 4800, 9600 NEXT OR ENTER

5. Press the **ENTER** key to change the baud rate. Press the **NEXT** key to display the proper baud rate. Press the **ENTER** key to select the proper baud rate.

6. Use the **NEXT** key to advance to:

STOP BITS = 1 OR 2 NEXT OR ENTER

7. Press the **ENTER** key to change the number of stop bits. Press the **NEXT** key to display the proper number of stop bits. Press the **ENTER** key to select the proper number of stop bits.

8. Use the **NEXT** key to advance to:

PARITY = ODD, EVEN, OR NONE NEXT OR ENTER

9. Press the **ENTER** key to change the parity. Press the **NEXT** key to display the proper parity. Press the **ENTER** key to select the proper parity.

CHAR LENGTH = 7 or 9 NEXT OR ENTER

10. Press **ENTER** to change the character length. Press the **NEXT** key to display the proper character length. Press the **ENTER** key to select the proper char length.

2.6.5 Print Format

The data print format is set for a 35-column print width. A data header is output to the printer on power-up, system reset, or on command (see Figure 7, A). The data header contains information about the analyzer setup. The data header may be printed at any time by:

1. Press the **SETUP** key.

2. Use the **NEXT** key to advance to:

PRINT SETUP NEXT OR ENTER

3. Press the **ENTER** key.

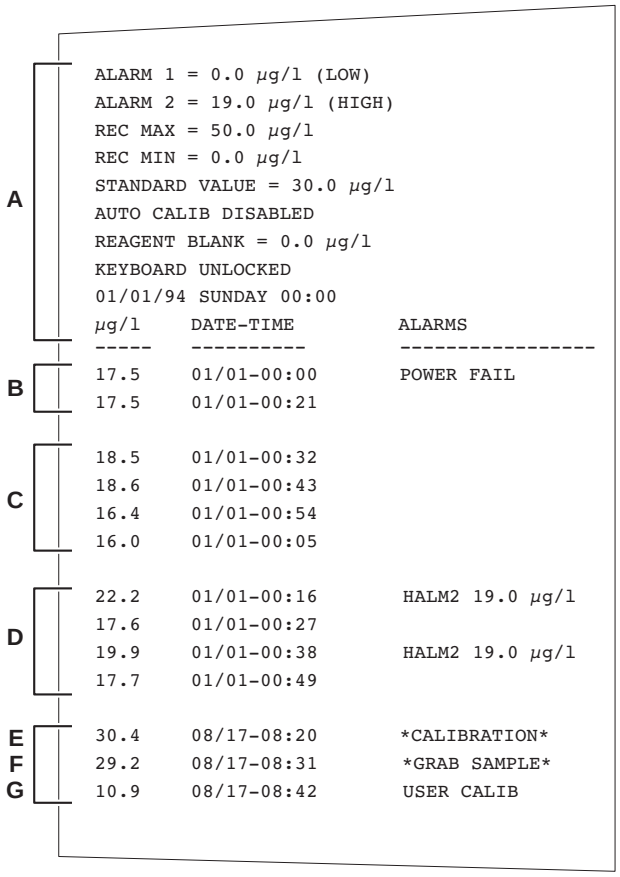
PRINTING SETUP NEXT OR CLEAR

4. When the setup values have been sent to the printer, the analyzer returns to normal silica measurement.

Figure 7 also shows:

- a system warning (B)
- normal sample measurement (C)
- when a sample concentration alarm has been activated (D)
- when a calibration has been run (E)
- when a grab sample is measured (F)
- when a user calibration is made (G)

Figure 7 Analyzer Printout



2.6.6 Remote Input Commands

Commands sent to the analyzer from a computer must be formatted as an ASCII character string in upper case letters with no spaces. Most commands are sent with a three-character code string. Refer to Table 4 for a complete command list. Some commands also permit analyzer programming data entry. These commands are sent with a three-letter prefix, an equal sign = and the data entry. No spaces are allowed within the string.

Most commands will generate a response message indicating acceptance or rejection of the command from the analyzer. If the command is rejected, the response will be [?. Commands not generating a specific response message can be checked with a recall command.

Response messages from the instrument are preceded by a steering character which the computer program can test to determine the display address. The steering character is an ASCII left bracket [(5B Hex).

Programs (Basic, C, etc.) must be written for the computer to transmit the proper command strings to the analyzer via the interface.

Table 4 Remote Command Codes

SET-UP RECORDER		
Code	**Function**	**Response**
RMX	Recall or set recorder maximum VALUE (0 to 5000). To set, enter RMX=VALUE	VALUE (on recall); OK (on set)
RMN	Recall or set recorder minimum VALUE (0 To 5000). To set, enter RMN=VALUE	VALUE (On recall);OK (on set)
OZR	Output recorder minimum VALUE. Drives recorder to minimum reading	OK
OHF	Output recorder mid-scale VALUE. Drives recorder to mid-scale reading	OK
OFS	Output recorder maximum VALUE. Drives recorder to maximum reading	OK
IMX	Increment recorder max by 1 count. To set, enter IMX=0 to 1023	OK
DMX	Decrement recorder max by 1 count. To set, enter DMX=0 to 1023	OK
IMN	Increment recorder min by 1 count. To set, enter IMN=0 to 1023	OK
DMN	Decrement recorder min by 1 count. To set, enter DMN=0 to 1023	OK
AVC	Auto setup of voltage recorder output	OK (takes approx. 2 min. to complete)
AIC	Auto setup of current recorder output	OK (takes approx. 2 min. to complete)
RSA	Recall or set recorder system alarm mode. To set, enter RSA=HOLD, MAX or MIN	HOLD, GO MAX or GO MIN

Table 4 Remote Command Codes (Continued)

SETUP-ALARM		
Code	**Function**	**Response**
ALR	Alarm reset	OK
ALE	Alarm enable	OK
ALD	Alarm disable	OK
AL1	Recall or set alarm 1 VALUE (0 to 5000):	
	To recall setting, enter AL1	R,L,H (VALUE)
	To set rate alarm, enter AL1=R (VALUE)	OK
	To set low alarm, enter AL1=L (VALUE)	OK
	To set high alarm, enter AL1=H (VALUE)	OK
AL2	Recall or set alarm 2 VALUE (0 to 5000):	
	To recall setting, enter AL2	R. H. L (VALUE)
	To set rate alarm, enter AL2=R (VALUE)	OK
	To set low alarm, enter AL2=L (VALUE)	OK
	To set high alarm, enter AL2=H (VALUE)	OK
SETUP-TIME		
Code	**Function**	**Response**
TIM	Recall or set time (set by TIM=HHMM)	HH:MM (on recall); OK (on set)
DAY	Recall or set day of the week: To set, enter DAY=DAY Example: SUN, MON, TUE, WED, THU, FRI, SAT	DAY (on recall); OK (on set)
DAT	Recall or set date: To set, enter DAT=MMDDYY	MM/DD/YY (on recall); OK (on set)
SETUP-REAGENTS		
Code	**Function**	**Response**
SDT	Recall Or Set Standard Level VALUE: To set, enter SDT=0 to 100% of full in increments of 10	VALUE (on recall); OK (on set)
RGT	Recall or set reagent level VALUE To set, enter RGT=0 to 100% of full	VALUE (on recall); OK (on set)
RGB	Recall or set reagent blank VALUE (0 to 5000): To set, enter RGB=VALUE	VALUE (on recall); OK (on set)
SETUP-INITIAL		
Code	**Function**	**Response**
CYC	Recall or set cycle time (L-long cycle, S-short cycle. To set, enter CYC=L or S)	L or S (on recall); OK (on set)

Table 4 Remote Command Codes (Continued)

CALIBRATION		
Code	**Function**	**Response**
UCV	Set user calibration conc VALUE: To set, enter UCV=VALUE (0 to 5000)	OK
SVL	Recall or set standard VALUE To set, enter SVL=VALUE (0 to 5000)	VALUE (on recall); OK (on set)
DOC	Do a calibration. Initiates auto calib cycle.	OK
DFL	Default calibration. Restore default calib	OK
CLT	Recall or set calibration time. To set, enter CLT=HHMM)	HHMM (on recall); OK (on set)
CLD	Recall or set day of the week for calibration: To set, enter CLD=DAY Example: CLD=DIS, SUN, MON, TUE, WED, THU, FRI, SAT	DAY or DIS (on recall) OK (on set)
ACV	Recall last auto-calibration value	VALUE
OPERATING COMMANDS		
Code	**Function**	**Response**
VAL	Recalls last concentration VALUE	VALUE
LST	Initiates printout of setup	Setup & data header
LCK	Initiates total keyboard lockout	OK
PLK	Initiates partial keyboard lockout	OK
ULK	Unlocks keyboard	OK
SRT	System reset (clears system alarms and restarts analyzer)	Setup & data header
CST	Initiates cold start. (Returns programmed settings to default values.)	Setup & data header
GSV	Recall last grab sample value	VALUE
DIAGNOSTIC COMMANDS		
Code	**Function**	**Response**
TRT	Recall reagent temperature	VALUE in degrees C
TSP	Recall sample pressure	VALUE in psig
TRP	Recalls reagent pressure	VALUE in psig
TSW	Test: turns on system warning relay	OK
TSA	Test: turns on system alarm relay	OK
TA2	Test: turns on alarm 2 relay	OK
TA1	Test: turns on alarm 1 relay	OK
HLT	Initiates halt mode. (Instrument idle for 30 min.)	OK
TDA	Test D/A bit weight	512 64 32 16 8 4 2 1
TVL	Recall instrument voltages, Vdc	Returns value for: V ref, DGND, +Vu, +VD, -Va, +Va, V lamp, AGNG

2.6.7 Print Setup

When Print Setup is selected, it prints out all of the current operational program settings for reference and review.

Note: *Serial interface communication protocols must be entered first.*

To print the programmed setup, press the **SETUP** to call up the Setup Menu. Then press the **NEXT** key to advance to:

PRINT SETUP **NEXT OR ENTER**

Press the **ENTER** key to print out the programmed setup:

PRINT SETUP **NEXT OR CLEAR**

Press the **CLEAR** key to exit the Setup Menu. Or, press the **NEXT** key to advance to:

2.6.8 Initial Setup

INITIAL SETUP is used to program several more or less permanent settings. Typically, once these are set, they will not need to be changed unless an analyzer cold start is executed.

To program INITIAL SETUP, press the **SETUP** key to call up the Setup Menu. Then press the **NEXT** key to advance to:

INITIAL SETUP **NEXT OR ENTER**

Press the **ENTER** key to use the Initial Setup Menu:

2.6.8.1 Time

HR:MIN = XX:YY **NEXT OR #KEYS**

The analyzer maintains a running 24-hour clock. Set the clock after start-up or after an analyzer COLD START is executed. Use the numeric keys to enter the correct time in a 24-hour format.

Two digits must be used for both hour and minutes. For example, to set the clock to 9:32 a.m., press **0 9 3 2**. Or, to set the clock to 2:18 p.m., press **1 4 1 8**. When the correct time is shown in the display, press the **ENTER** key:

HR:MIN = 14:18 **NEXT OR CLEAR**

Press the **NEXT** key to advance to:

2.6.8.2 Date

The analyzer also maintains a running calendar in a month (MM) / date (DD) / year (YY) format.

M/D/Y = MM/DD/YY
NEXT OR #KEYS

Use the numeric keys to enter the correct date; two digits must be keyed in for each. For example, July 4, 1994 is entered as **0 7 0 4 9 4**. When the correct date is displayed, press the **ENTER** key to accept:

M/D/Y = 08/04/94
NEXT OR #KEYS

Press the **NEXT** key to advance to:

2.6.8.3 Day

DAY = SUNDAY (to) SATURDAY
NEXT OR ENTER

To enter the correct day of the week, press the **ENTER** key:

DAY = SUNDAY (to) SATURDAY
SELECT WITH NEXT

Press the **NEXT** key until the correct day is displayed, then press the **ENTER** key to accept:

DAY = SUNDAY (to) SATURDAY
NEXT OR CLEAR

Press the **NEXT** key to advance to:

2.6.8.4 Cycle Time

SHORT CYCLE TIME
NEXT OR ENTER

or

LONG CYCLE TIME
NEXT OR ENTER

The Series 5000 Silica Analyzer operates on an 8.8 (short) or a 15 minute (long) cycle time depending on sample temperature. When the sample temperature is 30–50 °C (86–122 °F), select the short cycle time. When the sample temperature is 5–40 °C (41–104 °F), select the long cycle time. Either cycle time may be selected when the sample temperature is in the range of 30–40 °C (86–104 °F).

Note: *Selecting an inappropriate cycle time based on sample temperature range may result in inaccurate analyses.*

If the display shows **SHORT CYCLE**, the short (8.8 minute) cycle time is selected. If the display shows **LONG CYCLE**, the long (15 minute) cycle time is selected.

To change the selected setting, press the **ENTER** key:

SHORT CYCLE TIME **NEXT OR ENTER**

or

LONG CYCLE TIME **SELECT OR ENTER**

Press the **NEXT** key to change the displayed setting:

LONG CYCLE TIME **NEXT OR ENTER**

or

SHORT CYCLE TIME **NEXT OR ENTER**

Press the **ENTER** key to accept the displayed setting:

LONG CYCLE (or) SHORT CYCLE **NEXT OR CLEAR**

Press the **NEXT** key to advance to:

2.6.8.5 Cold Start

COLD START **NEXT OR ENTER**

Cold Start replaces all user programmed settings with factory-installed program settings. This option may be used when instrument operation

appears faulty (Table 1 on page 19 for a complete list of factory-installed program settings. To execute **Cold Start**, press the **ENTER** key:

ARE YOU SURE? ENTER OR CLEAR

Press the **ENTER** key again to initiate cold start. Or, press the **CLEAR** key to cancel and exit Setup Menu.

Press the **NEXT** key to advance to:

2.6.8.6 Serial Interface Settings

Serial interface settings establish the operating conditions for the serial interface card. These options appear in the menu. Refer to Section 3.3.4 on page 80 for instructions on setting communication protocols.

2.6.8.7 Display Contrast

The display contrast is adjustable for best visibility with on-site lighting conditions. To vary the contrast between the displayed characters and background, press the **SETUP** key to call up the Setup Menu. Press the **SETUP** key to advance to Initial Setup, press the **ENTER** key to select the Initial Setup Menu, press the **NEXT** key to advance to:

ADJUST CONTRAST NEXT OR ENTER

Press the **ENTER** key to select option:

CONTRAST = 0 (to) 7 SELECT WITH NEXT

Press next until the preferred contrast is selected for the display. Press the **ENTER** key when you are satisfied with the contrast setting:

CONTRAST = 0 (to) 7 NEXT OR CLEAR

Press the **CLEAR** key to exit the Setup Menu.

2.6.9 Keyboard Lockout

To prevent unauthorized or accidental programming changes, a keyboard lockout or secure mode using a password is provided. In the secure (locked) mode, all program menus may be viewed, but no changes to settings or operations are allowed.

The factory installed password is 1 2 3 4. The password may be changed to any value.

A partial keyboard lockout option is provided to lockout (secure) all of the program menus except those needed to perform routine or monthly

maintenance. These program menus are: System Reset, the Reagent Setup Menu, the Auto Calibration function and the Grab Sample function.

2.6.9.1 To Lock Keyboard

1. Press the **SETUP** key and use the **NEXT** key to advance to:

KYBD UNLOCKED NEXT OR ENTER

2. Press the **ENTER** key:

KB TOTAL LOCK NEXT OR ENTER

3. Press the **NEXT** key:

KB PARTIAL LOCK NEXT OR ENTER

4. Press the **ENTER** key:

PASSWORD = 0000 (to) 9999 NEXT OR #KEYS

5. Enter 1 2 3 4 and press the **ENTER** key:

KYBD LOCKED NEXT OR CLEAR

If an incorrect password is used, the display shows:

INVALID #VALUE

2.6.9.2 To Unlock Keyboard

1. Press the **SETUP** key and use the **NEXT** key to advance to:

KYBD LOCKED NEXT OR ENTER

2. Press the **ENTER** key:

PASSWORD = 0000 (to) 9999 NEXT OR #KEYS

3. Key in the correct password. Press the **ENTER** key:

KYBD UNLOCKED NEXT OR CLEAR

2.6.9.3 To Change Password

To change the password or to obtain a new one if the password is forgotten:

1. Press microswitch no. 3 of the DIP switch (SW1) on the microprocessor board to the ON position (see Figure 8; microswitch no. 3 is shown switched to the ON position).

2. Press the **SETUP** key and use the **NEXT** key to advance:

CHANGE PASSWORD NEXT OR ENTER

3. Press the **ENTER** key:

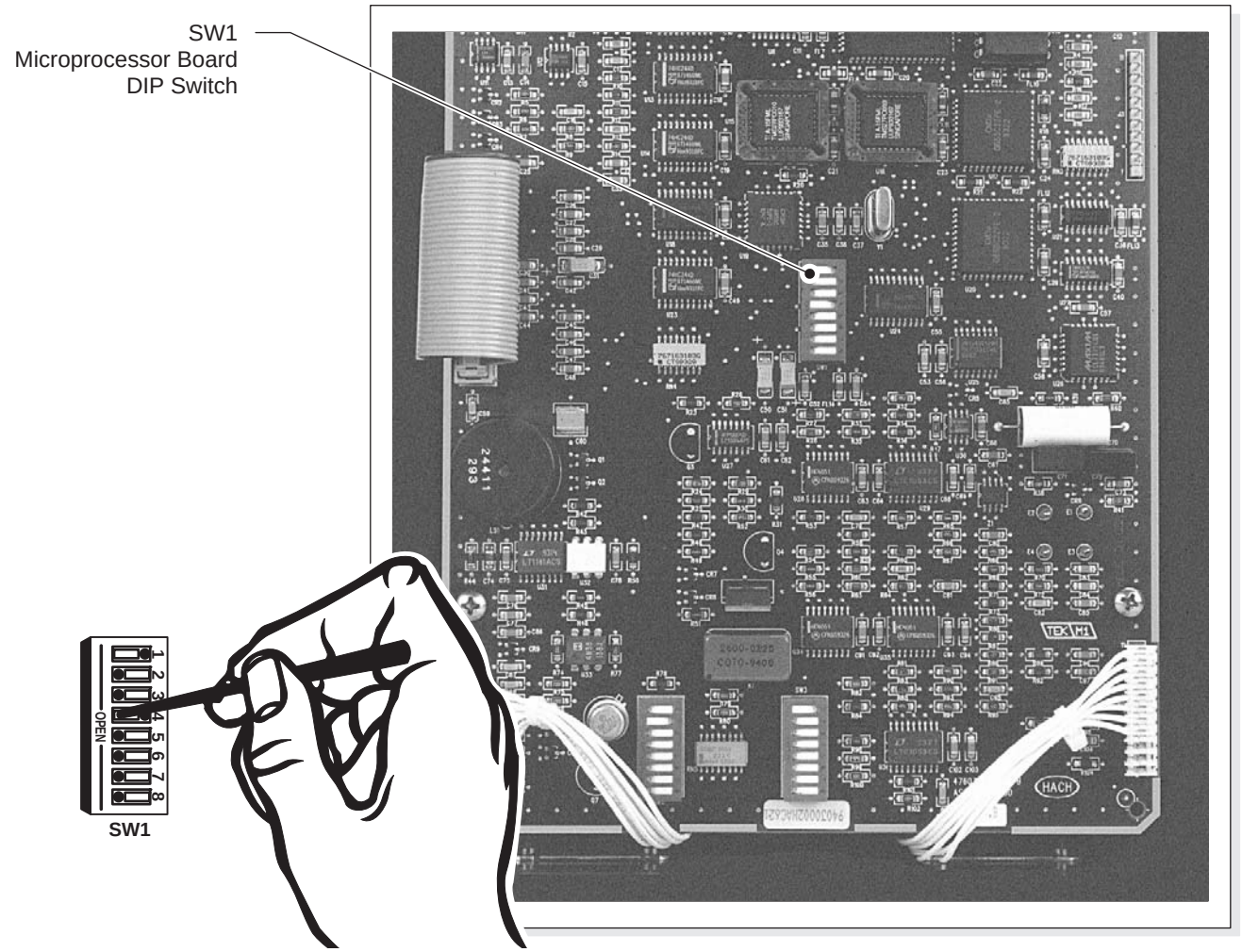
PASSWORD = 0000 (to) 9999 NEXT OR #KEYS

4. Enter any four-digit number and press the **ENTER** key.

PASSWORD SAVED NEXT OR CLEAR

5. Press microswitch no. 3 of the DIP switch on the microprocessor board to the OPEN position.

Figure 8 Microprocessor Board DIP Switch



2.7 Calibration

Series 5000 Silica Analyzers are equipped with a fully automatic self-calibration system. A silica standard of known concentration is installed in the reagent compartment. During calibration, this standard is supplied to the sample measurement cell in place of normal sample.

The standard is analyzed and compared to the entered standard concentration value. A new slope factor for the calibration curve is calculated in order to correct the analysis measurement to the entered standard value. This corrected slope factor (gain) is used in all subsequent analyses.

Standards of any known concentration between 100 and 4,000 µg/L can be used. Hach supplies a prepared standard of 500 µg/L ready to use in a 3-liter reagent bottle. Or, prepare standards manually and use a clean 3-liter reagent bottle for installation in the analyzer.

2.7.1 Default Calibration

A factory default calibration curve is stored permanently in the analyzer memory and loaded automatically. It is based on extensive factory testing of multiple analyzers. In most cases, the default calibration results in conformance to accuracy specifications.

Default calibration can be restored at any time through the Calibration Menu. To load and use the default calibration, press the **CALIB** key to call up the Calibration Menu. Then press the **NEXT** key to advance to:

DEFAULT CALIB NEXT OR ENTER

Press the **ENTER** key to select the default calibration:

ARE YOU SURE? ENTER OR CLEAR

Press the **ENTER** key again to load the default calibration. Or, press **CLEAR** to cancel and exit the Calibration Menu.

2.7.2 Auto-Calibration

Automatic calibration, using the installed known standard, can be initiated on-demand by the operator, or automatically on a programmed weekly interval. There is enough standard in a 3-liter bottle for 10 calibrations. The analyzer monitors the consumption of the standard and activates a System Warning alarm, Replace Cal Std, when there is insufficient standard to complete a requested calibration.

If the results of the calibration analysis causes a change in the slope factor of more than 10% from the default value, an error is assumed and the calibration attempt is rejected. A difference of this magnitude typically indicates an analyzer problem or an incorrect entry of the standard value. A System Warning alarm, **Unable To Calib**, is displayed.

2.7.2.1 On-Demand Calibration

Before doing a calibration, verify entry of the correct standard value. Press the **CALIB** key to call up the Calibration Menu. Then, press the **NEXT** key to advance to:

STANDARD VALUE NEXT OR ENTER

Press the **ENTER** key to check the entered standard value:

STD = 500.0 µg/l NEXT OR #KEYS

The default standard value is 500 µg/L.

Check the value of the standard installed in the reagent compartment against the entered value. If different, use the numeric keys to enter the correct

standard value. When the correct value is shown in the display, press the **ENTER** key to accept:

STD = 500.0 µg/l **NEXT OR CLEAR**

Press the **ENTER** key to exit the Calibration Menu.

To initiate an on-demand calibration, press the **CALIB** key to call up the Calibration Menu:

AUTO-CALIBRATION **NEXT OR ENTER**

Press the **ENTER** key to select auto-calibration:

START CALIB? **ENTER OR CLEAR**

Press the **ENTER** key to start calibration:

CALIB STARTED **NEXT OR CLEAR**

Press the **CLEAR** key to exit the Calibration Menu. Display indicates **(CALIBRATING)**. When calibration is complete, the value of the measured standard is displayed. The gain (slope) is corrected to give the expected result.

2.7.2.2 Weekly Programmed Calibration

Auto-calibration can be performed automatically at a programmed weekly interval.

To use this option, press the **CALIB** key to call up the Calibration Menu. Then press the **NEXT** key to advance to:

AUTO-CALIB TIME **NEXT OR ENTER**

Press the **ENTER** key to select:

HR:MIN = 08:30 **NEXT OR #KEYS**

Using the numeric keys enter the time of day desired for automatic calibration based on a 24-hour day. For example, 5:30 p.m. is entered as **1 7 3 0**. When the desired time is shown in the display, press the **ENTER** key:

HR:MIN = 17:30
NEXT OR CLEAR

Press the **NEXT** key to advance to:

CAL DISABLED
NEXT OR ENTER

When **Cal Disabled** is selected, no automatic weekly calibration is performed. This is the factory default setting. To select a day of the week for automatic calibration, press the **ENTER** key:

CAL DISABLED
SELECT WITH NEXT

Press the **NEXT** key to scroll through the days of the week until the desired day is shown in the display. Press the **ENTER** key to accept:

CAL ON SUNDAY (to) SATURDAY
NEXT OR CLEAR

Press the **CLEAR** key to exit the Calibration Menu.

2.7.3 User Calibration

A user calibration option is provided to enable the user to force the analyzer calibration to agree with an independently established measurement. If, for example, there was a discrepancy between the analyzer reading and a laboratory analysis for the same sample, this option can be used to set the analyzer to agree.

Note: *Analyzer accuracy with a user calibration is dependent totally on the accuracy of the user's method. For this reason Hach Company cannot guarantee the performance of the analyzer when a user calibration is used, and Hach does not recommend user calibration.*

Do this only when sample concentration is greater than 100 µg/L. At lower concentrations, typical variation in laboratory analyses easily can result in discrepancies small in absolute value, but very large in percentage error. Error correction is accomplished through a multiplier factor. Therefore, a percentage correction is applied across the entire range. Corrections made at low values may appear to achieve better analyzer/lab method correlation at the specific point set, but larger discrepancies may manifest at significantly higher or lower concentrations.

To enter user calibration, press the **CALIB** key to call up the Calibration Menu. Then, press the **NEXT** key to advance to:

USER CALIBRATION
NEXT OR ENTER

Press the **ENTER** key to select:

CONC = XXX µg/l NEXT OR #KEYS

Use the numeric keys to enter the independently established concentration value. When the independent value is shown in the display, press the **ENTER** key to accept:

CONC = (entered value) NEXT OR CLEAR

Press the **CLEAR** key to exit the Calibration Menu. The entered value shows in the display and **(USER CALIBRATION)** is displayed on the second line.

2.7.4 Recall Calibration Value

This option recalls the last calibration value.

2.8 Test Menu

The Test Menu is designed to run several analyzer system tests as an aid in troubleshooting problems. Some of these tests interrupt normal operation. When this is the case, an **ARE YOU SURE?** message is displayed.

2.8.1 Alarm Test

To test the function of the alarm relays, press the **TEST** key to call up the Test Menu:

RELAY TEST NEXT OR ENTER

Press the **ENTER** key. The alarm relays activate sequentially. When normal operation resumes, the alarms return to their previous state. If no key is pressed within 60 seconds, the analyzer returns to normal sample measurement.

2.8.2 Recorder Test

Recorder test allows you to drive the recorder output to full scale, zero and 50% of full scale. This checks the matching of the output span calibration to the recorder input settings.

To initiate recorder test, press the **TEST** key to call up the Test Menu. Then, press the **NEXT** key to advance to:

RECORDER TEST NEXT OR ENTER

Press the **ENTER** key to select:

OUTPUT REC FS NEXT OR ENTER

Press the **ENTER** key to drive the recorder output to full scale. Press the **NEXT** key to advance to:

OUTPUT REC ZERO NEXT OR ENTER

Press the **ENTER** key to drive the recorder output to zero. Press the **NEXT** key to advance to:

OUTPUT REC 1/2FS NEXT OR ENTER

Press the **ENTER** key to drive recorder output to mid-scale. Press the **CLEAR** key to exit the Test Menu. If no key is pressed within 60 seconds, the analyzer returns to normal sample measurement.

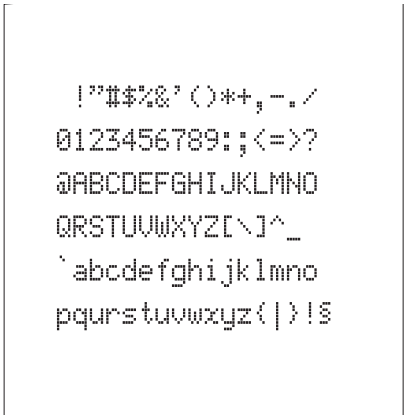
2.8.3 Printer Test

Printer Test outputs a series of character strings as a test of the Serial I/O interface and printer. The ASCII character set equivalent to 20 hex to 7F hex is printed. An enlarged example of the printer test using a Citizen printer, model iDP-562-RS, is shown in. Other printers may give a slightly different printout. To run Printer Test, press the **TEST** key to call up the Test Menu. Press the **NEXT** key to advance to:

PRINTER TEST NEXT OR ENTER

Press the **ENTER** key within 60 seconds to execute Printer Test. Press the **CLEAR** key to exit the Test Menu. If no key is pressed within 60 seconds, the analyzer returns to normal sample measurement.

Figure 9 Printer Test



2.8.4 Grab Sample Analysis

Series 5000 Silica Analyzers can be used to analyze grab samples taken from other points in the users system. This capability also can be used to introduce a series of standards to verify calibration accuracy.

To perform a grab-sample analysis, press the **TEST** key to call up the Test Menu. Press the **NEXT** key to advance to:

GRAB SAMPLE TEST NEXT OR ENTER

Press the **ENTER** key to select. Two temperature range options given in degrees Celsius are provided. Select the most appropriate one. The cycle time is automatically adjusted accordingly.

G SMP 5-40 DEG NEXT OR ENTER

Press the **NEXT** key to advance to:

G SMP 30-50 DEG NEXT OR ENTER

Press the **ENTER** key to select:

POUR IN SAMPLE THEN PRESS ENTER

Remove the funnel cover and slowly pour at least 250 mL of sample into the cell to ensure adequate flushing through the grab sample funnel Figure 10. Fill the funnel about four times.

Press the **ENTER** key to begin the test. The display shows the message **(MEAS GRAB SMP)** until the test is complete. When the analysis is complete, the analyzer displays:

G SMP (measurement) µg/l

The analyzer automatically returns to normal sample measurement. Double check grab-sample measurements to assure operator technique was correct.

2.8.4.1 Recall Grab Sample Value

To review the result of the previous grab sample analysis, press the **TEST** key to call up the Test Menu. Press the **NEXT** key to advance to:

RECALL G SMP VAL NEXT OR ENTER

Press the **ENTER** key to select:

G SMP (measurement) µg/l NEXT OR CLEAR

Press the **CLEAR** key to exit the Test Menu.

2.8.5 Time Remaining

The display shows the time remaining until the next measurement cycle in minutes and seconds. The present measurement value is displayed before the next measurement cycle begins.

To use this option, press the **TEST** key to call up the Test Menu. Press the **NEXT** key to advance to:

TIME REMAINING NEXT OR ENTER

Press the **ENTER** key:

XX MIN XX SEC CLEAR TO CANCEL

Press the **CLEAR** key:

XX MIN XX SEC NEXT OR CLEAR

To return the analyzer display to normal sample measurement, press the **CLEAR** key twice. If the **CLEAR** key is not pressed, the analyzer continues to display the count down until the sample measurement is complete. The new value is displayed at this point.

2.8.6 Display Test

The Display Test allows determination of whether or not any LCD segments are inoperative. To run the Display Test, press the **TEST** key to call up the Test Menu. Press the **NEXT** key to advance to:

DISPLAY TEST NEXT OR ENTER

Press the **ENTER** key to select and observe the display to see if any segments fail to activate. The display is an alternating checkerboard. Press the **CLEAR** key to exit the Test Menu. If no key is pressed within 60 seconds, the analyzer returns to normal sample measurement.

2.8.7 Reagent Pressure

Note: *At 25 psig (172 kPa) the pressure relief valve activates and vents to the atmosphere. Permanent damage to the pressure sensor may result at pressures greater than 30 psig (207 kPa).*

REAGENT PRESSURE displays the actual reagent delivery system pressure as measured by the pressure sensor. Pressure must be in the range of 8–18 psig (55.2–124.1 kPa) for proper operation. Pressure measurement is a running measurement and can serve as a pressure gauge for reagent pressure regulator adjustment.

To measure the reagent pressure, press the **TEST** key to call up the Test Menu. Press the **NEXT** key to advance to:

REAGENT PRESSURE NEXT OR ENTER

Press the **ENTER** key to select:

REAG P = 8.00 (to) 18.00 psi CLEAR TO CANCEL

The **CLEAR** key cancels the running reagent pressure measurement and displays:

REAG P = 8.00 (to) 18.00 psi NEXT OR CLEAR

Press the **CLEAR** key to exit the Test Menu. If no key is pressed within 60 seconds, the analyzer returns to normal sample measurement.

2.8.8 Sample Pressure

SAMPLE PRESSURE displays the actual sample inlet pressure as measured by the pressure sensor. Pressure must be in the range of 2–8 psig (14-55 kPa) for proper operation. Pressure measurement is a running measurement and can serve as a pressure gauge for inlet pressure adjustment.

Note: *Pressures greater than 30 psig (207 kPa) will damage the pressure sensor permanently.*

When selected, the current measurement cycle is cancelled. The analyzer begins flushing the sample cell until the **CLEAR** key is pressed. At that time the measurement cycle automatically begins.

To test sample pressure, press the **TEST** key to call up the Test Menu. Press the **NEXT** key to advance to:

SAMPLE PRESSURE **NEXT OR ENTER**

Press the **ENTER** key to select:

SMP P = 2.00 (to) 8.00 psi **CLEAR TO CANCEL**

The **CLEAR** key cancels the running pressure measurement and displays:

SMP P = 2.00 (to) 8.00 psi **NEXT OR CLEAR**

Press the **CLEAR** key to exit the Test menu. If no key is pressed within 60 seconds, the analyzer returns to normal sample measurement.

2.9 Alarm System Operation

When a condition occurs that interferes or may interfere with normal operation of the analyzer, a message is displayed. The three types of diagnostic messages are: *Sample Alarm Messages*, *System Alarm Messages* and *System Warning Messages*. A sample alarm message occurs when the sample concentration measurement activates one of the concentration alarms. A system alarm is activated when a malfunction makes it impossible to continue analysis. A system warning message indicates the potential for the system to no longer work as specified. If there are multiple messages, each flashes in sequence.

2.9.1 Sample Concentration Alarms

(For illustrative purposes, the concentration values shown in the following displays were chosen arbitrarily. In field use, these values may be in the range of 0.00 to 5000 µg/L.)

When **HALM1** or **HALM2** messages are displayed, the sample concentration is greater than or equal to the level specified for the appropriate alarm.

SILICA 30.05 µg/l (20.01 to 5000)
HALM1 20.00 µg/l (flashing)

SILICA 30.05 µg/l (20.01 to 5000)
HALM2 20.00 µg/l (flashing)

When **LALM1** or **LALM2** messages are displayed, the sample concentration is less than or equal to the level specified for the appropriate alarm.

SILICA 15.07 µg/l (X = 0.00 to 19.99)
LALM1 20.00 µg/l (flashing)

SILICA 15.07 µg/l (X = 0.00 to 19.99)
LALM2 20.00 µg/l (flashing)

When **RALM1** or **RALM2** messages are displayed, the sample concentration has changed at a rate of ___ µg/L/hour greater than or equal to the ___ µg/L/hour specified for the appropriate alarm. The analyzer display shows µg/L even though the precise label should be µg/L/hour.

SILICA 00.00 (to) 5000 µg/l
RALM1 20.00 µg/l (flashing)

SILICA 00.00 (to) 5000 µg/l
RALM2 20.00 µg/l (flashing)

2.9.1.1 Turning Off a Sample Alarm

A sample alarm may be turned off by pressing the **ENTER** key at RESET ALARMS in the Setup Menu. If the alarms are disabled, no new alarms occur. When a new measurement is made, the measured value is compared to the alarm limits. If the limits are exceeded, a new alarm activates. Change alarm settings through the Setup Menu (see Section 2.6.1 on page 30).

2.9.2 Analyzer System Alarms

A system alarm activates when a malfunction makes it impossible to continue analysis. Both lines of the display flash. The messages are:

****SYSTEM ALARM****
NO SAMPLE

This occurs when the sample pressure is less than 1 psig.

****SYSTEM ALARM****
REPLACE LAMP

This occurs when the lamp in the colorimeter burns out or the sample cell is dirty. First, clean the sample cell (see Section 4.2 on page 87). Replace the lamp following the steps given in Section 4.4.1 on page 89.

****SYSTEM ALARM****
REPLACE REAGS

This occurs when there may not be sufficient reagent available for sample analysis (less than 10% left in the reagent bottle). Replace the reagents following the steps given in Section 2.6.2 on page 33.

****SYSTEM ALARM****
NO REAG PRESSURE

This occurs when the reagent pressure drops below 5 psig. Check the reagent pressure source.

2.9.3 System Warnings

A system warning occurs when potential for improper analysis exists. The warning flashes on the second line of the display. When there are multiple messages, they flash in sequence.

ALARMS DISABLED

This occurs when the alarms are disabled. Enable the alarms by following the steps in Section 2.6.1.2 on page 31.

CLEAN SMP CELL

Every effort has been made to minimize discoloration of the sample cell; however, in colorimetric analysis some discoloration is normal. When the sample-cell discoloration impairs analysis, this message is displayed (see Section 4.2 on page 87).

COLD START

This message occurs when a Cold Start is made (see Section 2.6.8.5 on page 47).

INSTRUMENT ERROR

Instrument error suggests an electronics problem (refer to Repair Service on page 128).

MARGINAL OFFSETS

Marginal offsets occur when a high offset measurement is made. The primary cause is a light leak.

POWER FAIL

The power is turned off or disconnected.

REAG PRESS<8

or

REAG PRESS>18

The reagent pressure is less than 8 psig or greater than 18 psig. The propellant regulator maintains the reagent pressure at 12 psig.

REAGENTS LOW

Enough reagent is provided to ensure that the analyzer does not run out. Dispose of unused reagent and replaced with full reagent bottles. When the short cycle time is being used, there is enough reagent for at least four days. After four days a system alarm stops analysis. When the long cycle time is being used, normally there is enough reagent for at least five days. After five days a system alarm stops analysis.

REPLACE CAL STD

Enough standard solution is provided for 10 calibrations. There may not be enough standard solution left to run another calibration. Each calibration requires 260 mL. Changing standard solution is recommended.

SAMPLE PRESS>8

or

SAMPLE PRESS <2

The sample pressure is out of the specified range for accurate flow control and analysis.

SOFTWARE RESTART

The analyzer has detected an illegal condition and generated a software restart. The accuracy of the results should be unaffected unless frequent software restarts occur.

TEMPERATURE>50

or

TEMPERATURE<5

These messages indicate the environmental temperature of the analyzer is out of the specified range. Temperature is given in degrees Celsius.

UNABLE TO CALIB

The calibration slope is outside of expected limits. Check standards and reagents for proper flow.

V OUT OF LIMITS

Voltage Out Of Limits suggests a power supply problem (refer to Repair Service on page 128).

WARNING
This instrument should be installed by qualified technical personnel to ensure adherence to all applicable electrical and plumbing codes.

ATTENTION
Cet appareil doit être installé par du personnel technique qualifié, afin d'assurer le respect de toutes les normes applicables d'électricité et de plomberie.

ADVERTENCIA
Este instrumento debe ser instalado por personal técnico capacitado para asegurar el cumplimiento con todos los códigos eléctricos y de plomería aplicables.

WARNHINWEIS
Um zu gewährleisten, daß alle elektrischen und sanitärinstallationstechnischen VDE-Vorschriften und gegebenefalls die Zusatzvorschriften der zuständigen Elektrizitäts- und Wasserwerke erfüllt werden, darf dieses Gerät nur von geschultem Fachpersonal installiert werden.

AVISO
Este instrumento deve ser instalado por pessoal técnico qualificado para asegurar o cumprimento de todas as normas elétricas e de canalização aplicáveis.

3.1 Location of the Analyzer

3.1.1 Environmental Requirements

Series 5000 Silica Analyzers are designed for installation only in general-purpose indoor environments. *Do not* mount the analyzer in direct sunlight. Install analyzers where the ambient temperature is maintained between 10 and 45 °C (50 to 113 °F) and not subject to large, sudden changes in temperature.

3.1.2 Selecting a Sample Point

Analyzers should always be located as close to the point where the sample is taken as practical. The shorter the distance the sample must travel to the analyzer, the faster the analyzer can respond to changes in the process line.

Long sample lines also are more vulnerable to sediment accumulation. Sediment will adsorb silica during occurrences of high concentration. Later, silica will dissolve into the sample and cause high readings or cause longer response times to sample concentration changes.

To minimize the chances of ingesting sediment from the pipe bottom or air bubbles from the top, install a sample tap into a larger process pipe as shown in Figure 11.

3.1.3 Mounting the Analyzer

Series 5000 Silica Analyzers are designed for either bench-top or panel mounting. External dimensions of analyzer and locations of all connections and fittings are shown on Figure 10. Two molded plastic feet are installed on the bottom of the analyzer for bench-top installation.

To flush mount the analyzer in a panel, use the panel cutout dimensions shown in Figure 10. Drill holes of appropriate size in the countersunk locations. Recommended hardware is six ¼-inch screws of appropriate length with flat washers under the screw heads and nuts installed behind the panel.

Figure 10 Installation Drawings

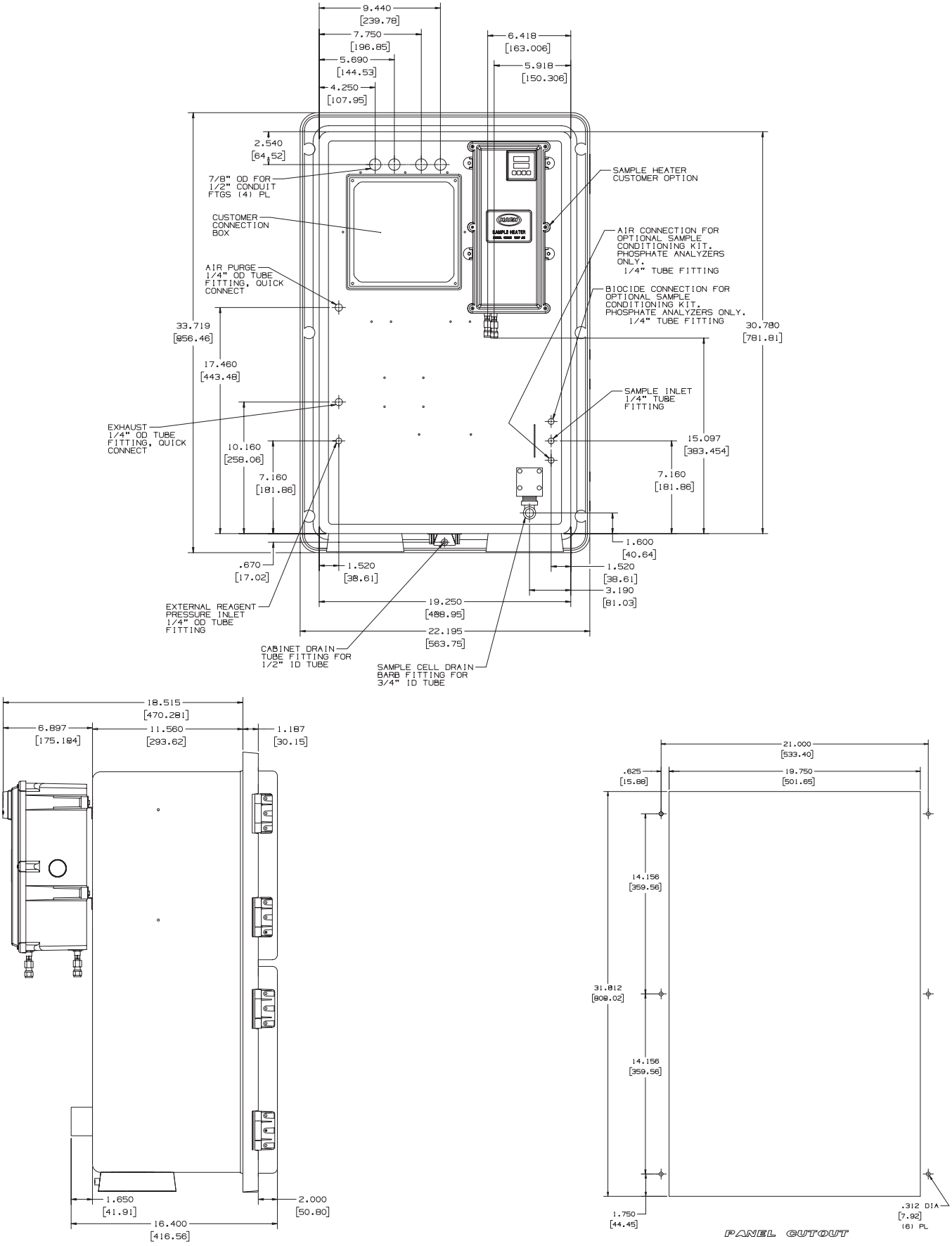
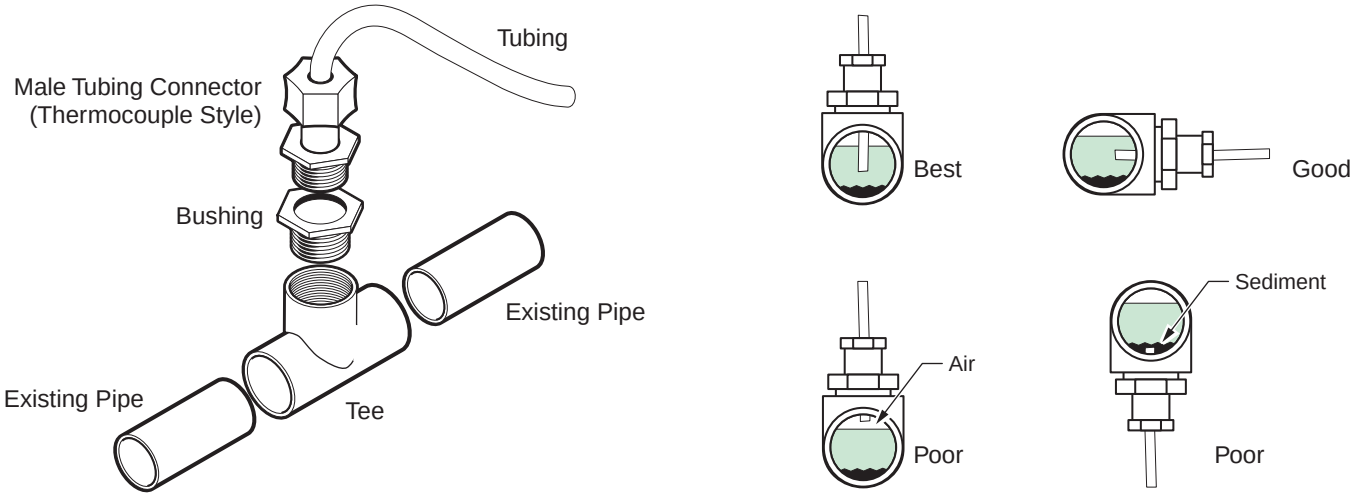


Figure 11 Sampling Techniques



3.2 Plumbing/Hydraulic Connections

3.2.1 Sample Conditioning Requirements

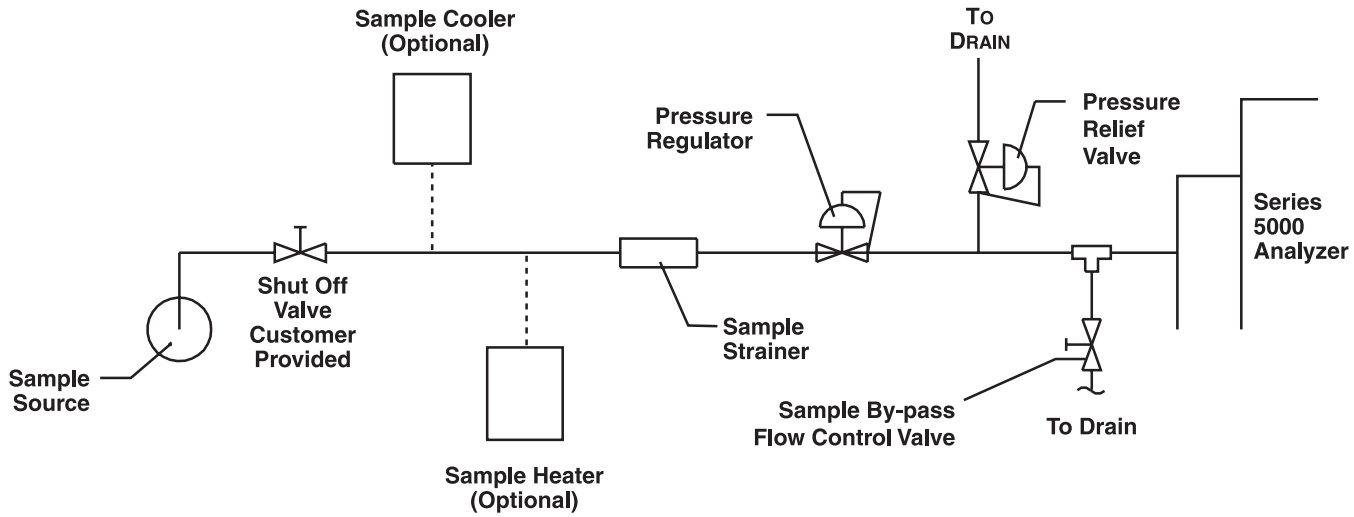
Sample must be supplied to the analyzer within the following specifications:

- Sample temperature between 5 and 50 °C (41 to 122 °F)
- Sample pressure between 2 and 8 psig
- Filtration is recommended to protect analyzer.

Note: *Pressures greater than 30 psig will damage pressure sensors.*

When using the 8.8 minutes/cycle time (short cycle), maintain the sample temperature at 30 to 50 °C. A sample heater is recommended to elevate sample temperature or maintain a consistent sample temperature. If the sample temperature is maintained at 5 to 40 °C, the 15 minutes/cycle time (long cycle) must be used to ensure a complete chemical reaction. The configuration of a recommended sample conditioning system is shown in Figure 12.

Figure 12 Recommended Sample Conditioning System



3.2.2 Sample Pressure Conditioning Kit

Depending on the application, the user may want to install the sample pressure conditioning kit included with each Series 5000 Analyzer. Instructions for assembly are included in the kit. The kit contains:

- Pressure regulator and gauge
- Pressure relief valve
- Sample strainer
- Needle valve
- Mounting bracket, with nut
- Tubing and fittings

An installed kit is shown in Figure 13. Refer to the instruction sheet for a detailed parts list.

An optional 316 Stainless Steel Sample Conditioning Kit also is available for purchase (Cat. No. 45983-00). If the sample conditioning kit provided is not suitable for your process (Figure 14).

Table 5 PSI Rating vs. Temperature for Plastic Sample Conditioning Kit

Sample Temperature	PSI Rating
25 °C (77 °F)	150
40 °C (104 °F)	85
60 °C (140 °F)	15

Figure 13 Sample Pressure Conditioning Kit

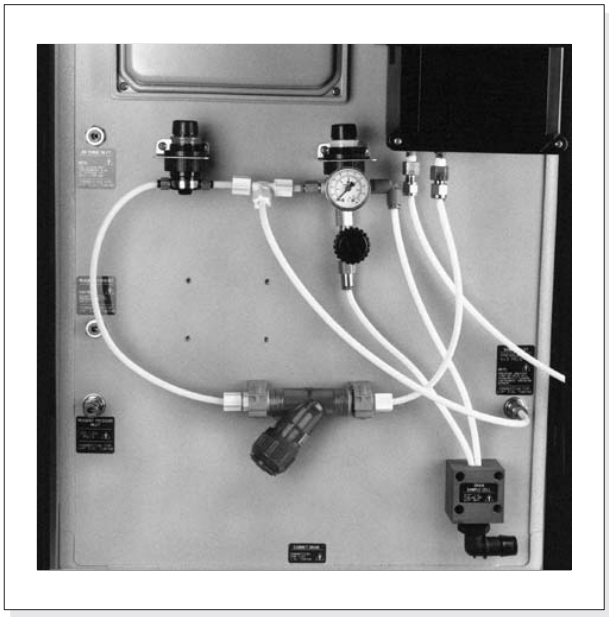
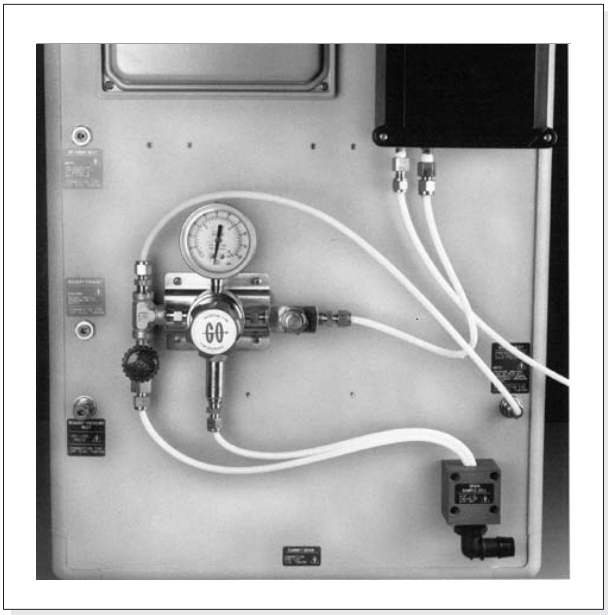


Figure 14 SS Sample Pressure Conditioning Kit



3.2.3 Sample Line Connection

WARNING
The Series 500 Analyzer is not designed for use with samples that are flammable or explosive in nature. If any sample solution other than water is used in this product, test the sample/product compatibility to assure user safety and proper product performance.

ATTENTION
L'analyseur Série 5000 n'est pas prévu pour utilisation avec des échantillons de nature inflammable ou explosive. Pour toute solution d'échantillon autre que de l'eau utilisée avec cet appareil, tester la compatibilité échantillon/appareil pour assurer la sécurité de l'utilisateur et le fonctionnement correct de l'appareil.

ADVERTENCIA
El Analizador Serie 5000 no está diseñado para usarse con muestras de naturaleza inflamable o explosiva. Si se empleara en este producto alguna solución de muestra que no fuera a base de agua, ponga a prueba la compatibilidad de la muestra/producto, para cerciorarse de la seguridad y del correcto funcionamiento del producto.

WARNHINWEIS
Der Analysator der Serie 5000 darf nicht in Verbindung mit Proben benutzt werden, die entflammbar oder explosiv sind. Wenn irgendeine andere Lösung als Wasser in diesem Gerät analysiert werden soll, muß die Proben/Gerät-Kompabilität getestet werden, um die Sicherheit des Benutzers und korrektes Arbeiten des Gerätes zu gewährleisten.

ADVERTÊNCIA
O Analizador Série 5000 não é concebido para uso com amostras que sejam inflamáveis ou explosivas. Se qualquer solução que não seja de água se usar neste produto, dever-se-á ensaiar a compatibilidade da amostra/produto para garantir segurança ao usuário e desempenho correto do produto.

Note: *Pressures greater than 30 psig (207 kPa) will damage the pressure sensor permanently.*

Use ¼-inch OD rigid or semirigid tubing (such as stainless steel, Teflon or polyethylene) for the sample line. A stainless steel compression tubing fitting sized for ¼-inch OD tubing is provided for the sample line connection (Figure 15). Route tubing as directly as possible from the sample point to the analyzer to minimize line length. Longer sample lines result in significant lag time between actual process line conditions and what the analyzer measures. Provide adequate space to access the electrical connections panel for hookup and servicing from the back of the instrument.

3.2.4 Sample Line and Valve Cleanup

New tubing, valves and other sample conditioning equipment may be contaminated with silicate-based substances (oils, dust). These may contribute to slightly high readings on initial start-up until they are cleaned. It is recommended the sample line be flushed with sample for one to two hours before calibration. For an expedient procedure, a dilute caustic solution such as 1N (5%) sodium hydroxide solution can be injected into the sample line and forced through to clean sample system components. Injecting one to four liters of caustic solution into the front end of the sample line and waiting for the solution to flow through the system and into the analyzer is usually sufficient.

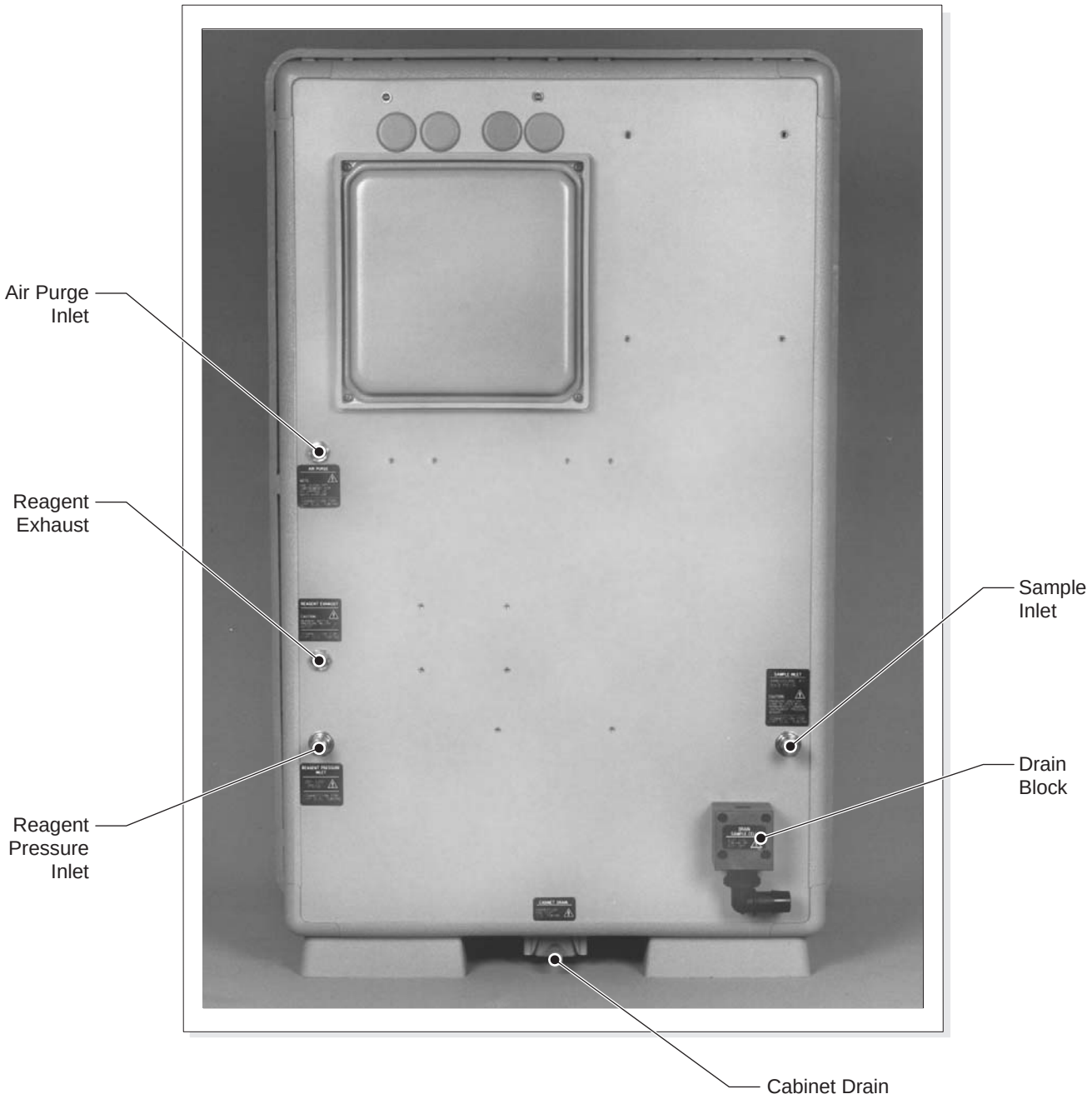
3.2.5 Sample Drain Line Connection

The analyzer is connected to a drain system through a ¾-inch elbow hose barb fitting on a drain block on the back of the analyzer case. A 1.8-meter (6-foot) length of ¾-inch ID hose is supplied for a drain connection. Be careful not to kink the hose. The sample must flow freely to drain with no back pressure to the analyzer for proper operation.

To permanently plumb the analyzer in place, remove the drain block and plumb directly to the ¾-inch NPT female fitting. Use plastic pipe and fittings to avoid corrosion.

The discharge from the analyzer is mildly acidic. Although the chemical reagents are diluted significantly, be certain the external drain system is appropriate for corrosive wastes.

Figure 15 Inlet and Drain Connections



3.2.6 Cabinet Drain/Vent Line Connection

The cabinet is connected to a drain system through a ½-inch hose fitting on a drain block at the bottom of the analyzer. A 1.8 meter (6-foot) length of ½-inch ID hose is supplied for the cabinet drain. This drain is provided as an outlet for reagent and sample spills and possible plumbing leaks that may occur; be certain the external drain system is appropriate for corrosive wastes. It is also the vent for the air purge option. Be careful not to kink this hose or otherwise block this drain.

3.2.7 Reagent Pressure System

CAUTION
Wear eye protection whenever the reagent compartment door is open, even though the system is not pressurized.

PRUDENCE
Porter des lunettes de protection lorsque la porte du compartiment des réactifs est ouverte, même si le système n'est pas pressurisé.

PRECAUCION
Use protección para los ojos siempre que el compartimiento para reactivos esté abierto, aunque el sistema no esté a presión.

VORSICHT
Wenn die Tür des Reagenzienfachs offen ist, muß immer ein Augenschutz getragon warden, auch wenn das System nicht unter Druck steht.

PRECAUÇÃO
Use proteção aos olhos sempre que a porta do compartimento dos reagentes estiver aberta, ainda que o sistema de pressurização esteja desligado.

Note: *Changing the factory set regulator adjustment may affect analyzer accuracy.*

Pressure for the reagent supply system must be obtained from an external source of pressurized inert gas.

The Series 5000 is equipped with a regulator and an integral coalescing filter for the reagent propellant to remove contaminants such as water, oil or solids. High quality propellant is provided by the coalescing filter, which removes particles down to 0.01 micron. The maximum remaining oil content of the propellant leaving the filter is 0.01 ppm at 20 °C (68 °F).

Note: *The twisted wires on the preset pressure regulator holds the red locking mechanism in place. Removal could result in damage to the pressure sensor.*

Compressed nitrogen, instrument quality air or compressed air is recommended as external pressure sources. A bulkhead fitting for ¼-inch O.D. tubing has been provided on the back of the analyzer for connection to an external pressure source. For proper operation, the external pressure source to the filter must be in the range of 20 to 60 psig (137.9 to 413.7 kPa).

3.2.7.1 Hookup

Connect the external pressure source as follows:

1. Open the reagent compartment door. The reagent pressure will be released.

2. Connect the external pressure source, regulated to 20–60 psig, to the outside of the bulkhead ¼ inch OD tubing fitting.

Note: *Reagent quality cannot be maintained without proper filtration of external pressure source.*

3. Turn on the external pressure source. The reagent compartment door should remain unlatched until ready to start the analyzer.

3.2.8 Optional Sample Heater Installation

Note: *Do not connect power to the heater until sample flow through the heater is set for the proper flow rate and plumbing connections are checked for leakage.*

The Model 48500-00 Sample Heater is configured for 115 VAC, 50/60 Hz line power and approved for use in the United States and Canada. The Model 48500-02 Sample Heater is configured for 230 VAC, 50/60 Hz line power for use in the U.S., Canada and the European Community.

Note: *Use proper NEMA or sealing hardware to seal the conduit opening to the conduit or cord strain relief in order to maintain the enclosure's environmental ratings.*

Mount the Model 48500 Sample Heater (Figure 16) to the back of the Series 5000 Silica Analyzer cabinet (see Figure 10 on page 68) using heater brackets (Cat. No. 47278-00). Using the four 8-32 x 6 mm ($^5/_8$ inch) screws supplied, mount the heater upright with the inlet and outlet ports at the bottom. Follow the instructions packaged with the heater to connect the outlet of the heater to the analyzer inlet. Adjust the Temp Set heater control to provide a sample temperature in the range of 30 to 50 °C. Select the short cycle time during start-up at this temperature (see Section 2.6.8.4 on page 46).

Note: *The Sample Heater must have a continuous sample flow at all times.*

The recommended location of the sample heater is before the Sample Conditioning Kit (refer to Figure 13 and Figure 14 on page 70). This provides the shortest distance the heated sample must travel to the sample cell. Refer to the Sample Heater manual (Cat. No. 48565-88) for electrical and sample connections.

Figure 16 Water Sample Heater



3.2.8.1 Sample Heater Temperature Set Point

1. Press the **TEST** key and select **SAMPLE PRESSURE MEASUREMENT** for 30 minutes of continuous sample flow to the sample cell for easy temperature measurements.

2. Make sure that the sample conditioning is operating as desired for bypass flow.

3. Turn on the Sample Heater and set it for 50 °C with no offset. The Sample Heater may be auto-tuned at this point if it was not done previously.

4. Remove the light shield and the sample cell cover clamp.

5. Lift the sample cell cover enough to insert the thermometer while making sure the sample delivery tube is still flowing sample to the sample cell.

6. Flow sample into the sample cell for 10 minutes before noting the temperature.

7. Read the temperature from the thermometer after 10 minutes.

8. If the temperature is less than the sample heater setting, enter that difference as a negative number as the CAL value for the Sample Heater.

   Example: The Sample Heater set point is 50 °C. The sample cell temperature is 48.2 °C. Therefore, 48.2 °C – 50 °C = -1.8 °C. Enter -2 as the Sample Heater CAL value.

9. Press the **CLEAR** key two times to return the instrument to normal operation. Place the sample cell cover, light shield and sample cell cover clamp back into position.

3.2.9 Air Purge Connections

To minimize dust accumulation and corrosive environmental conditions, an air-purge option is provided. Supply clean, dry instrument air to the analyzer fitting (Figure 15 on page 72) at approximately 15 scf/h (standard cubic feet per hour) airflow. The air purge fitting is sized for ¼-inch OD polyethylene or nylon tubing.

3.2.10 Reagent Exhaust Connection

CAUTION
Fumes generated from chemical reagents may be hazardous and must be ventilated properly.

PRUDENCE
Certaines vapeurs dégagées par les réactifs chimiques peuvent être dangereuses et doivent être correctement ventilées.

PRECAUCIO
Los vapores de algunos reactivos químicos pueden ser dañinos y por eso se deben ventilar adecuadamente.

VORSICHT
Dämpfe, die durch einige verwendeten Reagenzien entstehen können, sind gefährlich und müssen gut abgesaugt werden (ausreichende Belüftung, Abzug).

PRECAUÇÃO
Vapores de alguns reagents químicos podem ser danosos e por isso deve se ter ventilação adequada.

3.3 Electrical Connections

Access holes sized for ½-inch electrical conduit fittings are provided above the connection box (Figure 18). The cover seals are removed by loosening the wing nuts from inside the connection box. Sealing type conduit fittings (not supplied) are required to maintain the NEMA 4X and IP65 ratings of the enclosure.

3.3.1 Power Connections

The analyzer is factory set and properly fused for 115 Vac line requirements. To convert the instrument for 230 Vac line requirements, proceed with the following steps:

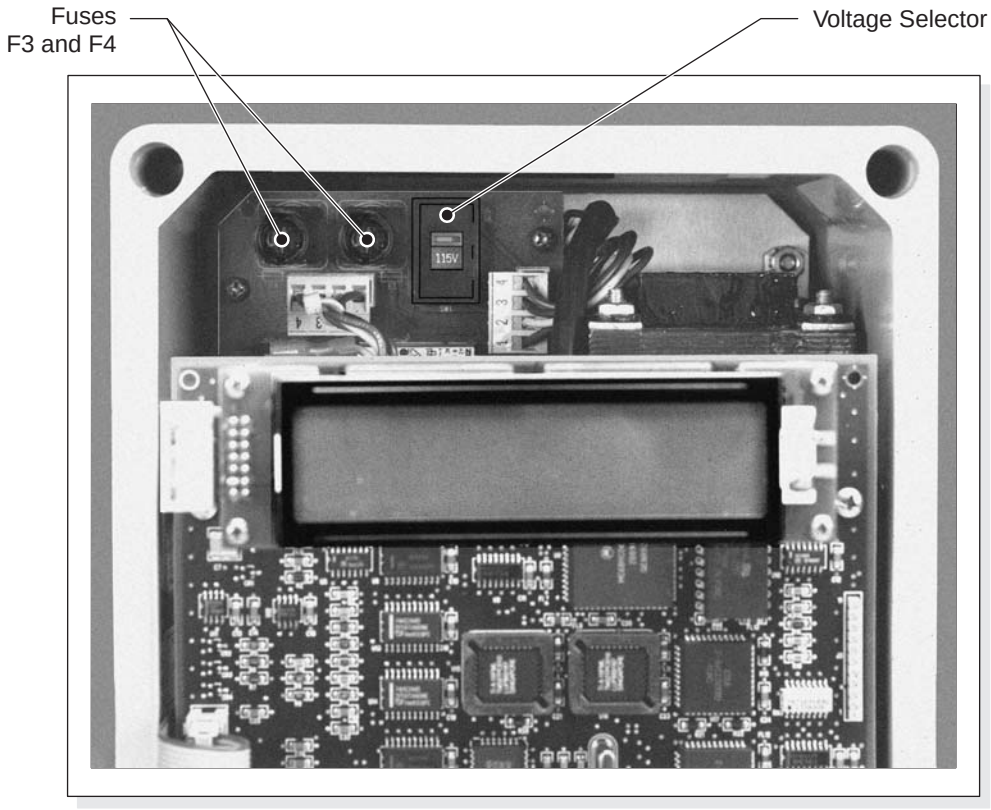
Note: *Misapplication of AC line power to this instrument can cause damage to the instrument. Prior to connection, verify that the Volt Select Switch is set for the proper AC line requirement.*

1. Remove the front panel of the control box by removing the four corner screws. Disconnect the keyboard connector from the circuit board (Figure 17).
2. Slide the voltage selector switch to the 230 Vac position.
3. Remove the two 1 ampere line fuses (F3 & F4) and replace with two ½-ampere fuses.
4. Replace the control box cover.

A power lead supply of 18 AWG is recommended, but it can be in the range of 12 AWG to 18 AWG. The Series 5000 Analyzer is designed for hard-wire connection to ensure conformation to local electrical codes. The power leads are routed through one of the two access holes on the left side of the connection box. Line voltage phases 1 and 2 are wired directly to the terminal strip TB1 (Figure 18). The ground connection is made to the adjacent ground stud using an appropriate closed loop connector (see the power cord color code below).

	North American	**IEC**
Line Conductor	black	brown
Neutral Conductor	white	blue
Ground Conductor	green	green with yellow stripe

Figure 17 Voltage Selection/Fuse Location



3.3.2 Alarm Relay Connections

3.3.2.1 High Voltage Relays (Relay 1 and 2)

WARNING
These relays are not designed for use with low voltage systems. DO NOT CONNECT VOLTAGES LESS THAN 30 V-RMS, 42 VDC TO THESE RELAYS.

ATTENTION
Ces relais ne sont pas prévus pour utilisation dans des systèmes basse tension. NE PAS RACCORDER A CES RELAIS DE TENSIONS INFERIEURES A 30 V EN COURANT ALTERNATIF, 42 V EN COURANT CONTINU.

ADVERTENCIA
Estos relés no han sido diseñados para operar con sistemas de bajo voltaje. NO CONECTE ESTOS RELES A VOLTAJES MENORES DE 30 V-RMS, 42 V-CD.

WARNHINWEIS
Diese Relais sind nicht für den Diederspannungsbereich konzipiert worden. LEGEN SIE KEINEN SPANNUNGEN UNTER 30 V RMS, 42 VDC AN DIESE RELAIS.

ADVERTÊNCIA
Estes relés não se destinam para uso com sistemas de baixa voltagem. NÃO CONECTAR VOLTAGENS INFERIORES A 30 V-RMS, 42 VDC A ESTES RELÉS.

WARNING
If high-voltage power is applied to the alarm relays, provisions must be made for disconnecting external power to the analyzer during servicing.

ATTENTION
Si du courant à haute tension doit être appliqué aux relais d'alarmes, il est nécessaire de prévoir un moyen de débrancher l'alimentation électrique externe des relais de l'analyseur au cours de la maintenance.

ADVERTENCIA
En caso de aplicarse una alimentación de alta tensión a los relés de la alarma, deben tomarse las precauciones necesarias para desconectar la potencia

externa a los relés del analizador al realizar el servicio.

WARNHINWEIS
Soll den Warnrelais Hochspannungsstrom zugeführt werden, ist dafür zu sorgen, daß während der Wartung die externe Stromversorgung zu den Analysator-Relais unterbrochen ist.

ADVERTÊNCIA
Caso os relés do alarme forem conectodos à energia de alta voltagem, deverá ser tomada a precaução de desligar a energia externa dos relés do analisador durante os consertos.

Alarm relays also are wired in the customer connection box on TB1. SPDT relay contacts are unpowered and rated to carry up to 5 amperes at 240 Vac with a resistive load. If high-current or inductive-load devices are to be controlled by analyzer alarms, use a heavy-duty slave relay actuated by the alarm relay. Both normally open and normally closed contacts are available (Figure 19). Size the wires according to the load used.

Figure 18 Customer Connection

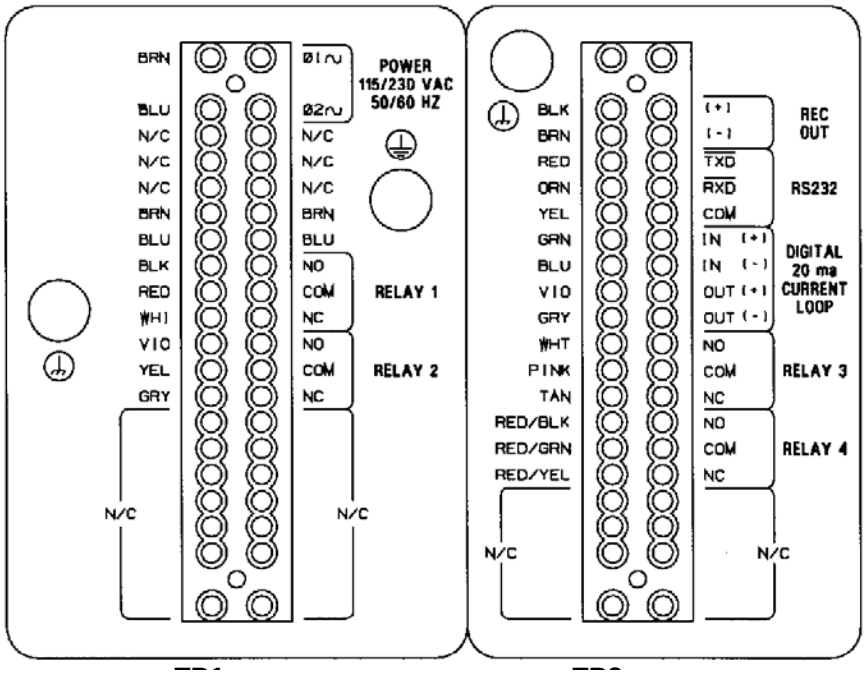
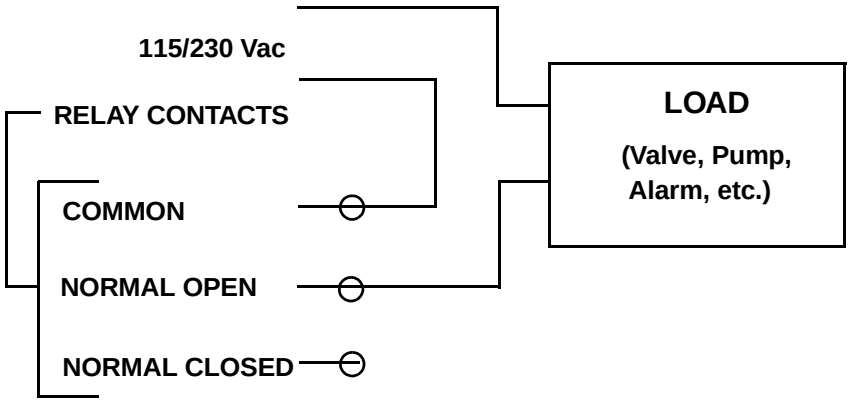


Figure 19 Typical Alarm Wiring Configuration



3.3.2.2 Low Voltage Relays (Relay 3 and 4)

WARNING
These relays are not designed for use with high voltage systems. DO NOT CONNECT VOLTAGES GREATER THAN 30V-RMS, 42V-DC TO THESE RELAYS.

ATTENTION
Ces relais ne sont pas prévus pour utilisation dans des systèmes haute tension. NE PAS RACCORDER A CES RELAIS DE TENSIONS HOCH A 30V EN COURANT ALTERNATIF, 42V EN COURANT CONTINU.

ADVERTENCIA
Estos relés no han sido diseñados para operar con sistemas de alto voltaje. NO CONECTE ESTOS RELES A VOLTAJES MAYORES DE 30V-RMS, 42V-CD.

WARNHINWEIS
Diese Relais sind nicht für den Superieuresspannungsbereich konzipiert worden. LEGEN SIE KEINEN SPANNUNGEN ÜßER 30 V RMS, 42 VDC AN DIESE RELAIS.

ADVERTÊNCIA
Estes relés não se destinam para uso com sistemas de alta voltagem. NÃO CONECTAR VOLTAGENS MAIORES A 30V-RMS, 42V-DC A ESTES RELÉS.

The alarm relay wires are routed through one of the two access holes on the right side of the connection box and connected to the terminal strip TB2 (Figure 18 on page 78). The SPDT relay contacts are unpowered and rated to carry up to 1 amperes at 30 Vac or 1 amperes at 42 VDC with a resistive load. If high-current or inductive load devices are to be controlled by analyzer alarms, use a heavy-duty alarm relay actuated by the alarm relay. Both normally open and normally closed contacts are available (Figure 19). Size the wires according to the load used.

3.3.3 Recorder Output Connections

The recorder wires are routed through one of the two access holes on the right side of the connection box and connected to the terminal strip TB2 (Figure 18 on page 78). Use shielded, twisted-pair cable to connect the analyzer with the recorder. Tie the shield to earth ground only at one end. Grounding the shield at the analyzer end and not the recorder end avoids ground loops.

A choice of outputs, 0-10 mV, 0-100 mV, 0-1 V or 4-20 mA, can be selected by a DIP switch on the microprocessor board in the Control Unit. The microprocessor board is accessible with the plastic power cover removed (Figure 20). Set the individual microswitch for the selected output to the ON (closed) position and the remaining switches to the OPEN (off) position.

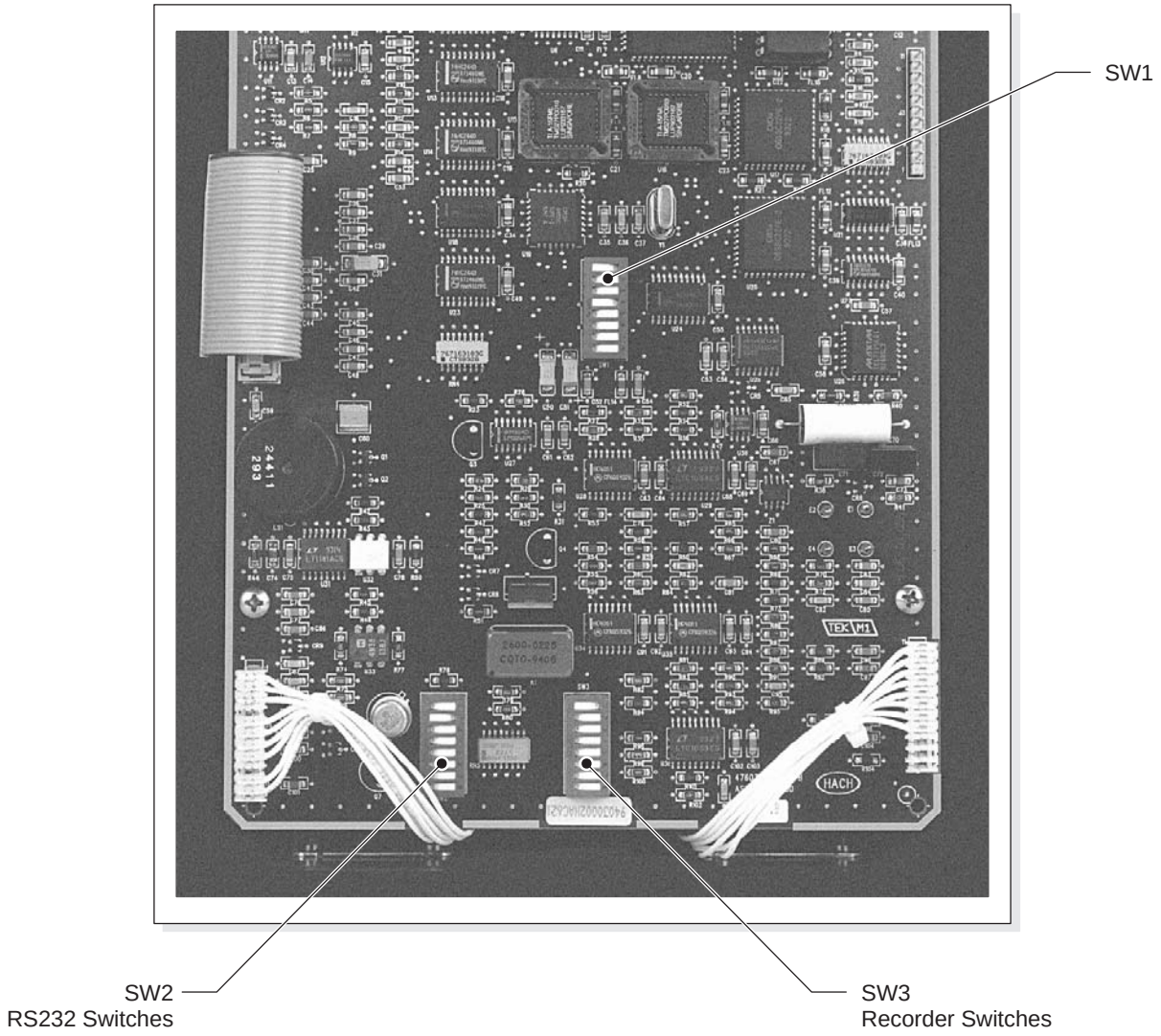
Output impedance limits are listed in Table 6.

Table 6 Recorder DIP Switch Settings (SW3)

Output	Switch in On Position*	Recommended Load Impedance
4-20 mA	1	500 ohms maximum
0-1 V	2	50,000 ohms or greater
0-100 mV	3	50,000 ohms or greater
0-10 mV	4	50,000 ohms or greater

* All other switches are open.

Figure 20 Recorder/RS232 Configuration



3.3.4 Serial Interface

3.3.4.1 RS232 Interface Configuration

The RS232 interface configuration is suitable in cases where the distance between the analyzer and an external device is relatively short (50 feet or less). Longer distances make the interface connection vulnerable to electrical interference and data transmission errors. For distances longer than 50 feet use the current loop configuration. To select the RS232 format, microswitch No. 2 of the DIP switch must be set to the closed position and microswitch No. 1 must be open. See Figure 20 and Table 7.

Table 7 DIP Switch Settings for RS232 (SW2)

Switch Number	1	2	3	4	5	6
Position	open	closed	open	open	open	open

Connections are made at TB2 of the customer connection box located on the back of the instrument (see Figure 18 on page 78 and Figure 21).

Figure 21 shows the two most common cable configurations for typical RS232 connections from the instrument to an IBM compatible personal computer.

If some other system is used to communicate with the instrument, refer to Table 8 and Table 9 for generic cable configuration and definition of terms. Because there is no handshaking with the series 5000, the RTS and CTS lines must be jumpered, and the DSR and DTR lines must be jumpered at the host computer.

If these lines can be disabled through hardware or software at the host computer, these jumpers are not needed.

Table 8 RS232 Cable Configuration

Series 5000 TB2 Connection	Host Computer/Printer Connection
(SHLD)	(SHLD)*
TB2 (TXD)	(RXD)
TB2 (RXD)	(TXD)
TB2 (COM)	(COM) (RTS) to (CTS) (DSR) to (DTR)

* Shield ground is normally tied at one end of cable only (this prevents ground looping).
If these lines can be disabled through hardware or software, then this jumper is not needed.

Table 9 RS232 Line Signal Definitions

Signal Name	Description
TXD	Transmitted Serial Data (Output)
RXD	Received Serial Data (Input)
RTS	Request To Send (Output). This signal requests permission to transmit data. Hardware handshaking uses this signal.
CTS	Clear To Send (Input). This signal indicates the equipment is ready to receive data. Hardware handshaking uses this signal
DSR	Data Set Ready (Input). This signal indicates that the remote equipment has a data block ready to transmit. Hardware handshaking uses this signal
DTR	Data Terminal Ready (Output). This signal indicates that the equipment has a data block ready to transmit. Hardware handshaking uses this signal
COM	Signal Ground (Common Return)
SHLD	Protective Ground used for shielding

3.3.4.2 Current Loop Configuration

A current loop interface configuration is used to transmit data over longer distances via a twisted-pair cable with each pair individually shielded. The current loop interface mode is selected by placing microswitch No. 1 of the DIP switch in the closed position and microswitch No. 2 in the open position (see Figure 20 on page 80 and Table 10).

Table 10 DIP Switch Settings for Current Loop

Switch Number	1	2	3	4	5	6
Position	closed	open	X*	X*	X*	X*

* Xs are based on current loop sourcing (see Table 12).

Connection in the current loop configuration is made using posts in the current loop grouping of TB2 in the customer connection box (see Figure 18 on page 78, Table 11, and Figure 22). There is no standard format for connector pin use in a current loop configuration; the user must wire connectors and cables as required for the individual installation.

Table 11 Current Loop Customer Connection Box

Post Number	Description	Function
8	Current loop in (+)	Data input loop, positive
9	Current loop in (-)	Data input loop, negative
10	Current loop out (+)	Data output loop, positive
11	Current loop out (-)	Data output loop, negative

In the recommended connection configuration shown in Figure 22, the current source for both the input and output loops is provided by the external computer or printer interface. This configuration provides an optical isolation between the analyzer and the current loop. In the second connection configuration (also shown in Figure 22), the analyzer is set up to provide both of the current sources. This configuration does not provide the isolation that may be required at the computer or printer interface. Table 12 explains the function of each of the individual microswitch closures of the DIP switch.

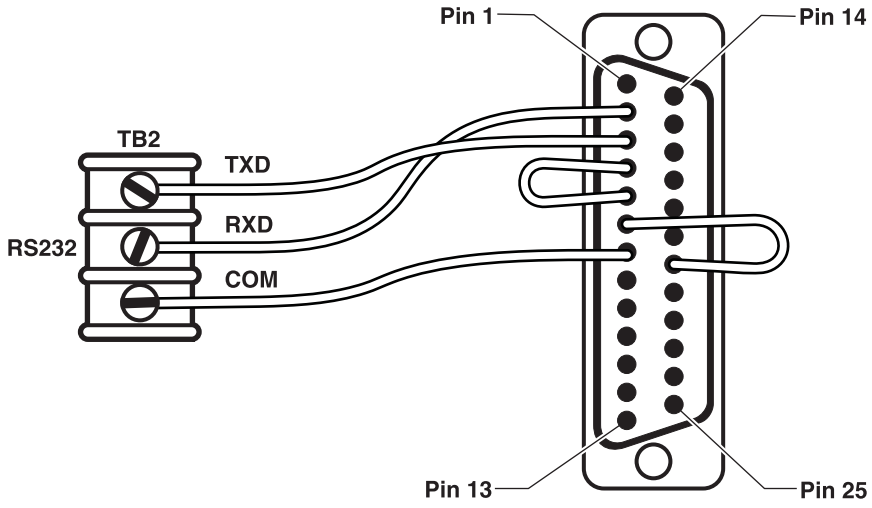
Table 12 DIP Switch Descriptions (SW2)

Micro-Switch	Function
1	Selects current loop interface
2	Selects RS232 interface
3	Selects analyzer as the output current source in current loop mode
4	Increase output current source for high impedance loads
5	Selects analyzer as the input current source in current loop mode
6	Increases input current source for high impedance loads

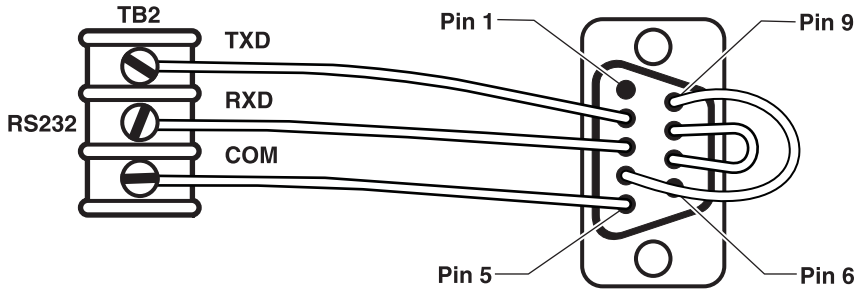
Figure 21 Typical RS232 Connections

Host Computer 25-Circuit D-Subminiature Female	Connection
PIN 1 (SHLD) *	—
PIN 2 (TXD)	TB2 (RXD)
PIN 3 (RXD)	TB2 (TXD)
PIN 4 (RTS) to PIN 5 (CTS)	—
PIN 6 (DSR) to PIN 20 (DTR)	—
PIN 7 (COM)	TB2 (COM)
PIN 8-19, 21-25 NOT USED	—

* Shield ground is normally tied at one end of cable only to prevent ground looping.



Host Computer 9-Circuit D-Subminiature Female	Connection
PIN 1, 9 (NOT USED)	—
PIN 2 (RXD)	TB2 (TXD)
PIN 3 (TXD)	TB2 (RXD)
PIN 4 (DTR) to PIN 6 (DSR)	—
PIN 5 (COM)	TB2 (COM)
PIN 7 (RTS) to PIN 8 (CTS)	—



Host Computer 25-Circuit D-Subminiature Male	Connection
PIN 3 (RXD) Black Wire	TB2 (TXD)
PIN 7 (COM) Red Wire	TB2 (COM)

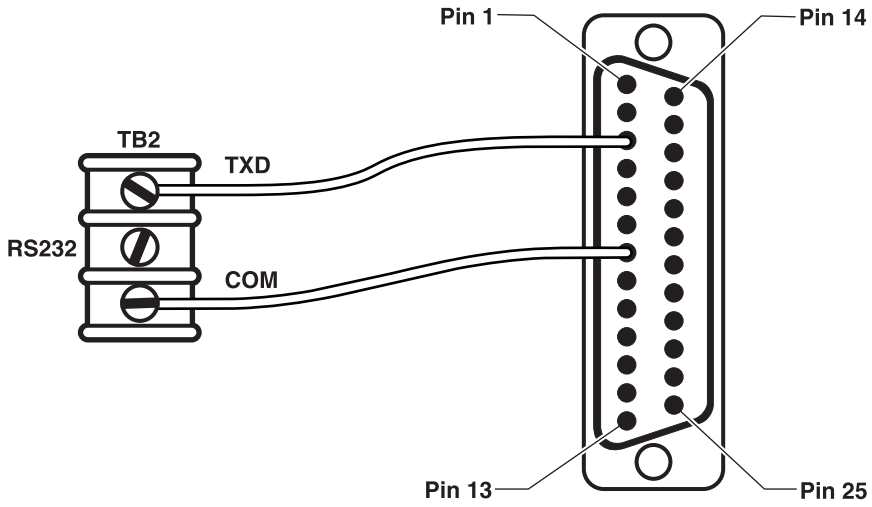
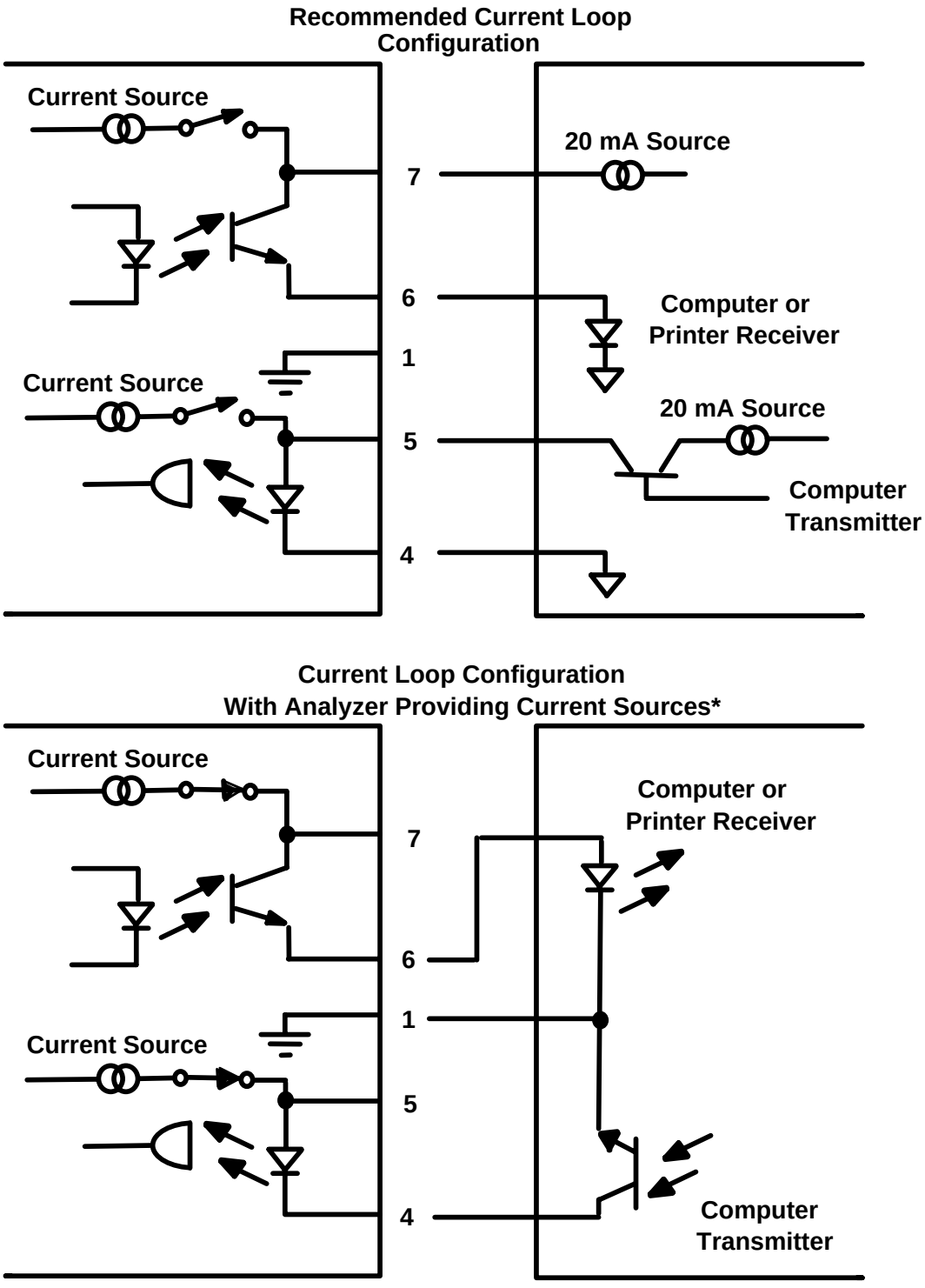


Figure 22 Recommended Current Loop Hookup



*Note: The analyzer is not isolated from the current loop in this configuration.

Section 4 Maintenance Requirements

Maintenance of the Series 5000 Silica Analyzer primarily includes the Analysis Module components shown in Figure 3 on page 14. These components may require periodic and/or unscheduled maintenance depending on your process application. Scheduled periodic maintenance requirements of the Series 5000 Silica Analyzer are minimal-reagent replacement is required monthly, sample cell cleaning is required quarterly, and the colorimeter lamp should be replaced annually.

4.1 Monthly Replenishing of Reagents

WARNING
To familiarize yourself with handling precautions, dangers and emergency procedures, always review the Material Safety Data Sheets prior to handling containers, reservoirs, and delivery systems that contain chemical reagents and standards. Protective eye wear always is recommended when contact with chemicals is possible.

ATTENTION
Pour se familiariser avec les précautions à prendre lors de la manipulation, les dangers et les procédures d'urgence, toujours lire les Fiches de Données de Sécurite avant de manipuler les récipients, les réservoirs et les systèmes de distribution contenant les réactifs chimiques et les solutions éta-lons.Il est toujours recommandé de porter des lunettes de protection lorsqu'un contact avec les produits chimiques est possible.

ADVERTENCIA
Para familiarizarse con las precauciones de manipulación, los peligros y los procedimientos de emergencia, siempre estudie las Hojas de Datos de Seguridad de los Materiales antes de manipular recipientes, depósitos y sistemas de entrega que contengan reactivos y patrones químicos.Siempre se recomienda el uso de protectores oculares cuando sea posible el contacto con productos químicos.

WARNHINWEIS
Es wird dringend empfohlen, die Sicherheitsdatenblätter vor der Handhabung von Behältern, Tanks und Zufuhrsystemen, die chemische Reagenzien und Standardsubstanzen enthalten, aufmerksam durchzulesen, damit Sie sich mit den beim Umgang mit diesen Chemikalien notwendigen Vorsichtsmaßnahmen, Risiken und Notfallschutzmaß-nahmen vertraut machen.Es wird empfohlen, in allen Situationen, in denen mit einem Kontakt von Chemikalien zu rechnen ist, eine Schutzbrille zu tragen.

AVISO
Para familiarizar-se com as precauções de manipulação, riscos e procedimentos de emergência, examine sempre o Folheto de Dados de Segurança antes de manipular os recipientes, tanques e sistemas de distribuição que contenham reagentes químicos e outros elementos padronizados.Se recomenda sempre o uso de protetores para olhos, quando possa acontecer contato com os produtos químicos.

The reagents will last for four weeks or seven weeks depending on measurement cycle time. It is best to replace all reagents and standard, if used as a unit.

Note: *Do not mix new and old reagents. Dispose of any unused reagents with an excess of water in an approved chemical drain.*

Note: *When replacing the reagents, the reagent caps may be difficult to remove after the pressure is released. Use a strap wrench or similar device to loosen caps; pliers may crack the caps.*

The following items must be on hand to complete these procedures:

Amino Acid F Reagent Package	23531-03
Citric Acid/Surfactant Reagent, 2.9 L	23470-03
Molybdate 3 Reagent, 2.9 L	1995-03
Silica Standard Solution, 2.9 L	21008-03

Prepare and install the new reagent bottles reusing the analyzer bottle caps.

4.1.1 Amino Acid F Preparation

Add the Amino Acid F powder to the solution bottle before use; the prepared reagent has a limited shelf life when it is in solution (see Section 2.2.2.1 on page 21).

4.1.2 Reagent Blank

The Molybdate 3 reagent blank must be entered whenever the reagents are changed (see Section 2.2.4 on page 22).

4.1.3 Entering New Reagent level

If there is a “Cold Start,” or there is significant volume of reagents remaining in the bottles, set a new reagent level. If so, enter the reagent level to the nearest one per cent by bringing up the **Reag Level = __%** option under **Reagents** in the Setup Menu. Press the **ENTER** key and the appropriate number keys.

4.1.4 Priming Reagents

Whenever reagents are changed, prime the reagent tubing with new reagent before beginning analysis. This minimizes variation in results and removes any air in the lines.

To prime the reagent tubing after new reagent bottles are installed, bring up the **Prime Reagents** option under **Reagents** in the Setup Menu. Press the **ENTER** key to prime reagents.

4.1.5 Changing Standard Level

If the standard level must be changed, enter the correct volume remaining to the nearest ten per cent. Key in this level into the analyzer by bringing up the **Std Level = __%** option under **Reagents** in the Setup Menu. Press the **ENTER** key and the appropriate number keys.

4.1.6 Checking/Replacing Pressure Source

When reagents are replaced, check the reagent pressure. Follow the steps in Section 2.8.7 on page 59 to verify it is within the range of 8 to 18 psi.

4.1.7 Inspecting Sample Conditioning System

Inspect the sample conditioning system whenever the reagents are replaced. Check the sample temperature, sample strainer and the sample pressure as described in the following sections.

4.1.7.1 Check Sample Temperature

Take the sample temperature by lifting the sample cell cover part way out of the sample cell and inserting a thermometer into the sample cell. Place the sample cell cover back down on the cell (refer to Section 3.2.8.1 on page 75 for complete instructions).

4.1.7.2 Inspect/Clean Sample Strainer

If the sample strainer becomes clogged, the analyzer sample pressure may become too low for accurate analysis.

4.1.7.3 Check Sample Pressure

Verify the sample pressure is in the range of 2 to 8 psig (see Section 2.8.8 on page 60).

4.2 Quarterly Colorimeter Cell Cleaning

CAUTION
The reagents present in the sample cell, although greatly diluted, have chemical hazards associated with them. Please read Material Safety Data sheets carefully and provide adequate means of protection.

PRUDENCE
Les réactifs présents dans la cuvette du colorimètre, même s'ils sont fortement dilués, représentent un risque chimique.Veuillez lire les fiches de données de sécurité attentivement et utiliser les moyens de protection appropriés.

PRECAUCION
Los reactivos presentes en la célula para muestra, aunque están muy diluidos, siempre constituyen riesgos químicos. Por favor, lea detenidamente las Hojas de Datos de Seguridad del Material, y tome todas las precauciones indicadas.

VORSICHT
Die Reagenzien, die in der Messküvette vorliegen, können, obwohl stark verdünnt, immer noch gefährliche Eingenschaften bezitzen.Lesen Sie daher gründlich das Sicherheitsdatenblatt und verwenden Sie ausreichende Schutzkleidung und eine Schutzbrille.

PRECAUÇÃO
Embora os reagentes presentes na célula de amostra estejam bastante diluídos, há riscos químicos associados a eles.Leia cuidadosamente as Folhas de Dados sobre Segurança do Material, e forneça os meios adequados de proteção.

The following item must be on hand to complete this procedure:

Ammonium Hydroxide, 10%	14736-37

Clean the colorimeter cell window at 90-day intervals. Cleaning frequency depends on the nature and concentration of dissolved and suspended solids in the sample. The message **Clean Smp Cell** flashes when cleaning is needed.

Remove any growth, film or buildup on the colorimeter cell window. Use a 10% ammonium hydroxide solution on a damp, soft cloth to remove sediment and dirt.

4.3 Leaking Fittings

Leaks *must* be prevented in the Series 5000 Silica Analyzer because it operates as a pressurized system; aggressive attention is required. Follow these suggestions for leak-proof fittings on the most common analyzer components.

4.3.1 Finding Sample Leaks

Locate sample leaks visually. Trace the incoming sample line checking all connections from the sample pressure conditioning kit regulator (if used) through the sample inlet bulkhead fitting on the back of the analyzer. From there, trace to the sample pressure sensor and to the sample cell cover assembly while looking for visual evidence of sample leaks.

4.3.2 Finding Reagent Leaks

Also locate reagent leaks visually. Trace each reagent supply line from the reagent bottle cap through the reagent tubing module to the bottom fitting on the reagent valve. From the top fitting on the reagent valve, trace the tubing to the sample cell cover assembly while looking for visual evidence of reagent leaks.

4.3.3 Finding Reagent Pressure Leaks

Apply a soapy water solution to connections while checking for bubbles to locate reagent pressure leaks. Starting with the reagent pressure inlet bulkhead fitting on the back of the analyzer, trace the line through the pressure regulator, door pressure release valve, manifold, pressure sensor and manifold to the reagent bottles. Apply the soapy water solution to each fitting and tube connection along the way.

Leaks found at the various fitting and tube connections can be stopped by the following techniques:

4.3.3.1 Compression Fittings

If a leak is located at a compression fitting (plastic or stainless steel), carefully tighten the compression nut until the leak stops. Over-tightening eventually splits the compression nut requiring replacement of the fitting. Use two wrenches to tighten or loosen compression nuts on fittings — one on the compression nut and the other on the fitting to prevent turning.

4.3.3.2 Barb Fittings With Male Pipe Threads

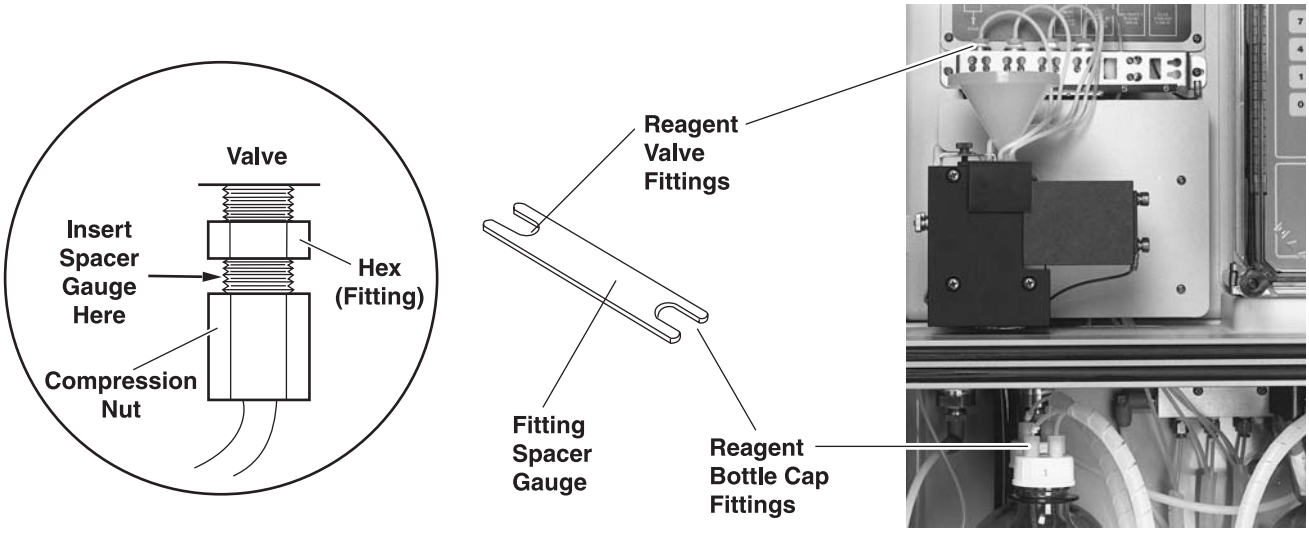
If a leak is found where the tubing connects to the barb fitting, remove the tubing. Cut off approximately ½ inch of the tubing end, and replace the tubing on the barb fitting. If a leak is found at the male pipe thread of the fitting, remove the fitting and clean. Apply fresh Teflon thread tape (*Cat. No. 70608-24* provided in the maintenance kit) to male pipe threads; do not use RTV. Keep constant tension on the tape when applying the tape to the pipe threads. The tape *must* overlap itself and be imbedded into the threads, but do *not* wrap the first two (starting) threads. When tightening the male pipe thread connection on the reagent valve or reagent bottle cap, use the spacer gauge provided (see Figure 23*).* On other fittings tighten until snug, and recheck for leaks.

4.3.3.3 Quick Connect Fittings With Male Pipe Threads

Quick connect fittings have an internal seal for the outside diameter of the tubing and a locking ring that locks the tubing into the fitting. If a leak is found where the tubing enters the fitting, push the tubing into the fitting to make sure it has engaged with the seal. If it still leaks, disconnect the tubing from the fitting by pressing in on the collet while pulling out on the tubing. Cut off approximately ¾ inch of the tubing and reinstall by pushing the tubing in until you feel the tubing pass through the locking mechanism and bottom against the fitting.

If a leak is found at the male pipe thread of the fitting, remove the fitting and clean the threads. Apply fresh Teflon thread tape (*Cat. No. 70608-24*, provided in the maintenance kit) to male pipe threads; do not use RTV. Keep constant tension on the tape when applying the tape to the pipe threads. The tape *must* overlap itself and be imbedded into the threads, but do *not* wrap the first two (starting) threads. When tightening the male pipe threads, tighten until snug and recheck for leaks.

Figure 23 Fitting Spacer Gauge



4.4 Annual Preventive Maintenance

4.4.1 Colorimeter Lamp Replacement

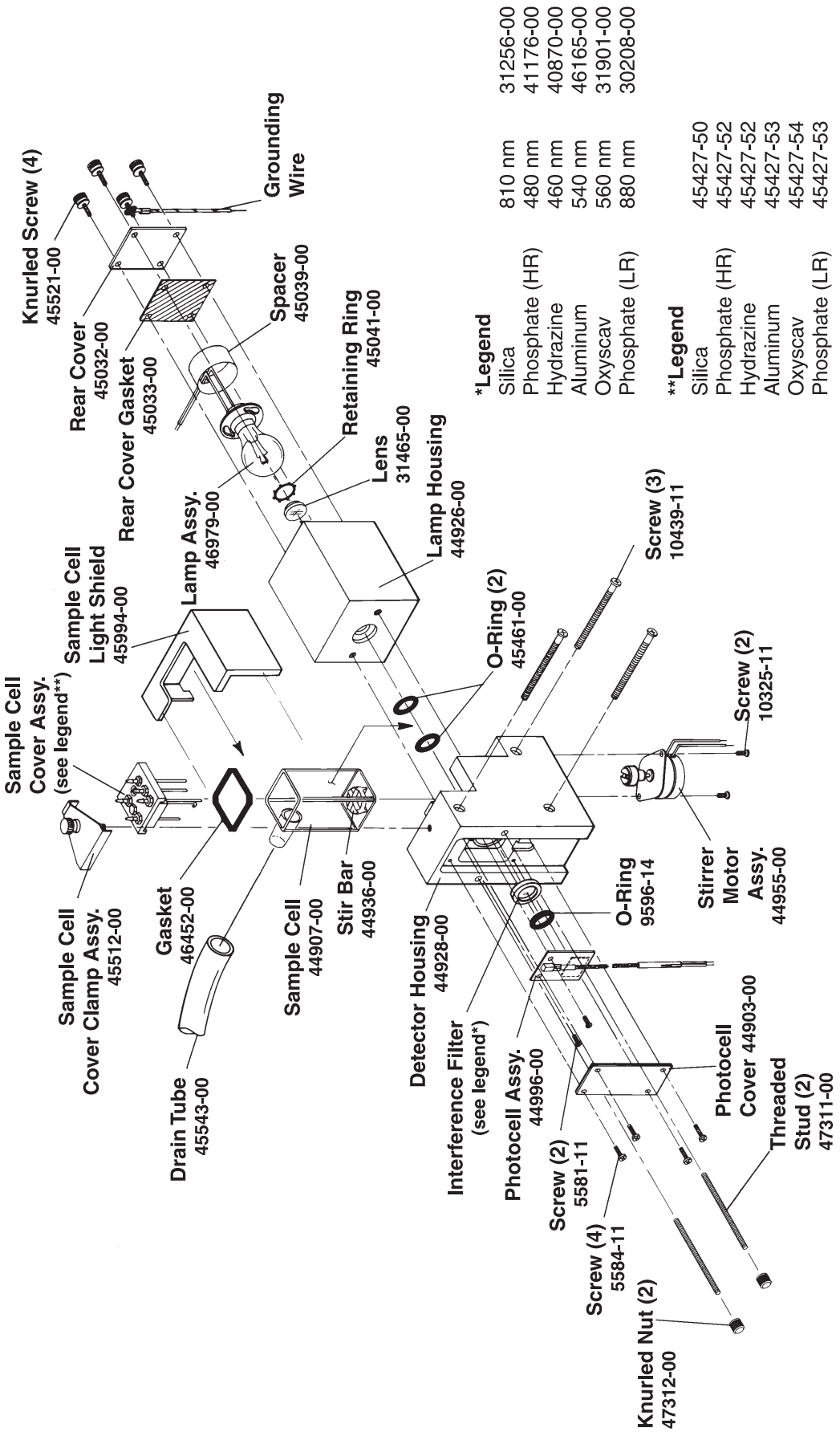
The replacement lamp assembly is listed in the replacement parts list and supplied in the maintenance kit.

The following item must be on hand to complete this procedure:

Lamp assembly	46979-00

Replace the unit as follows (see Figure 24).

Figure 24 Colorimeter Exploded View



1. Turn off power to the analyzer. Release the reagent pressure by turning the top reagent compartment knob counterclockwise.

2. Remove the four screws holding the J1 and J4 terminal block cover (see Figure 3 on page 14). Disconnect the two lamp leads from terminals 18 and 19 on the J1 and J4 terminal block (see Figure 25).

3. Remove the four knurled screws holding the lamp cover plate of the colorimeter. Disconnect the green grounding wire.

4. Remove the lamp cover plate and seal.

5. Remove the spacer and lamp assembly from the lamp housing; it should slide out.

6. Separate the lamp assembly from the spacer. Run the lamp leads for the new lamp through the wire opening in the spacer for installation.

7. Wipe finger prints off the new lamp bulb and insert the lamp and spacer into the lamp housing.

8. Install the lamp spacer ring again. Make sure the wire opening on the side of the spacer is positioned to the right, inside, to match the wire groove on the right end face of the lamp housing.

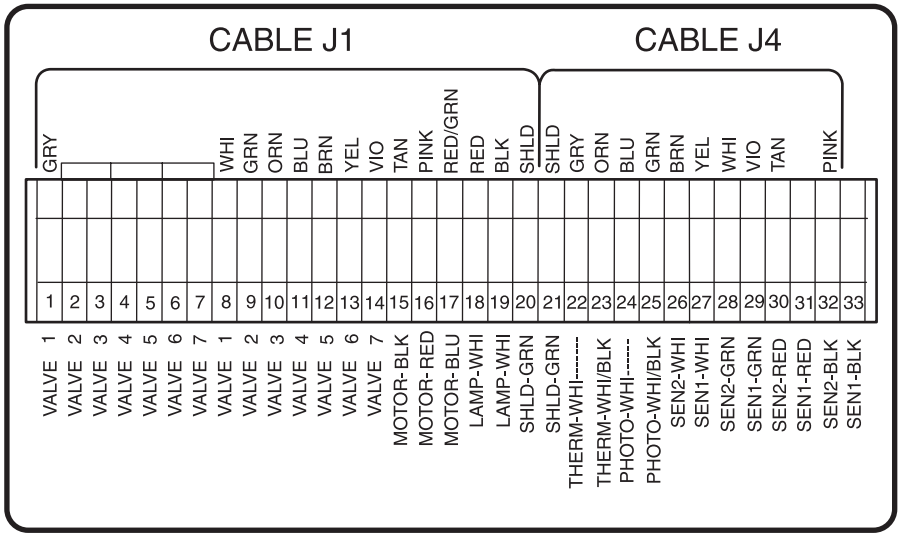
9. Reinstall the lamp block cover. Make sure wires are positioned in the lamp block groove and the ground wire is reattached at lower inside screw.

10. Reconnect the lamp leads to terminals 18 and 19. Lamp leads can be run behind the terminal block compartment by reaching up from the lower reagent compartment.

11. Replace the terminal block compartment cover.

12. Pressurize the system by latching the reagent compartment top knob. Turn on power to the analyzer.

Figure 25 J1 and J4 Connections



4.4.2 Unscheduled Maintenance Procedures

4.4.2.1 Reagent Tubing Module Replacement

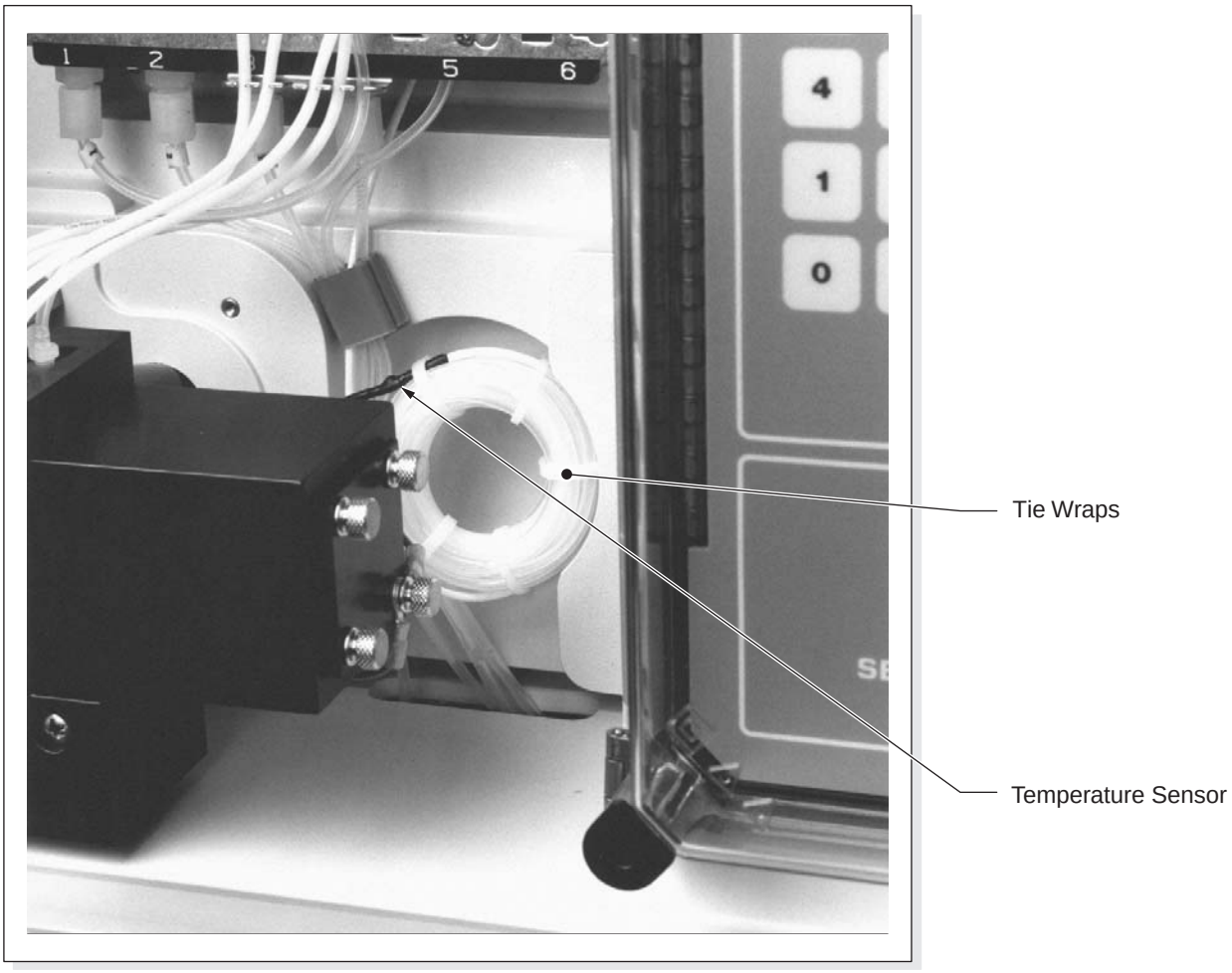
The following items must be on hand to complete these procedures:

Reagent Tubing Module	44957-30
Compression nuts, $^{1}/_{8}$-inch (4) (used with reagent bottle caps)	45428-00

1. Turn off power to the analyzer.
2. Release reagent pressure by opening the reagent compartment door.
3. Remove the three screws holding the reagent tubing module cover and reagent tubing module in place. Remove the tubing module from its compartment (see Figure 26).
4. Remove the temperature sensor from the tubing module. If necessary, cut the tubing ties to avoid damaging the sensor. It is used later with the new tubing module.
5. Cut the bottom end of tubes 1, 2 and 3 above the barb fittings near the reagent bottle caps. Remove and discard the tubes remaining on the barbs.
6. Pull the old reagent tubing module from the reagent tubing wrap.
7. Remove the compression nuts from reagent valves 1, 2 and 3. Discard the reagent tubing module, including the nuts.

Note: *When tightening or loosening compression nuts on fittings, use two wrenches. One wrench is for the compression nut, and the other is to prevent the fitting from turning and breaking the Teflon tape seal.*

Figure 26 Reagent Tubing Module



8. Slide a new compression nut on the top end of tube 1 of the replacement reagent tubing module with the tube extending approximately 1 inch beyond the nut. Insert the end of the tube into the bottom fitting of reagent valve 1 as far as possible and then slide the nut up and thread it onto the valve fitting. Tighten the nut using two wrenches.

9. Repeat step 8 to connect the new tubes 2 and 3 to reagent valves 2 and 3, respectively.

10. Install the temperature sensor under the tube ties of the new reagent tubing module.

11. Run tubes 1, 2 and 3 through the appropriate tubing wraps for connection to reagent bottles 1, 2 and 3, respectively.

12. Select tube 1, trim off excess length and install a new $^{1}/_{16}$-inch thru-hose barb fitting for connection to the #1 reagent bottle tubing. Cut the old fitting from the top end of the bottle tubing and join the two #1 tubes.

13. Repeat the procedure described in step 12 for bottles 2 and 3.

14. Install the reagent caps on new bottles of 1, 2 and 3 reagents and place them into the reagent compartment.

15. Place the reagent tubing module in its compartment and secure it by installing the tubing module cover.

16. Pressure the system by closing and latching the reagent compartment door.

4.4.2.2 Reagent Bottle Tubing Replacement

The following items must be on hand to complete this procedure:

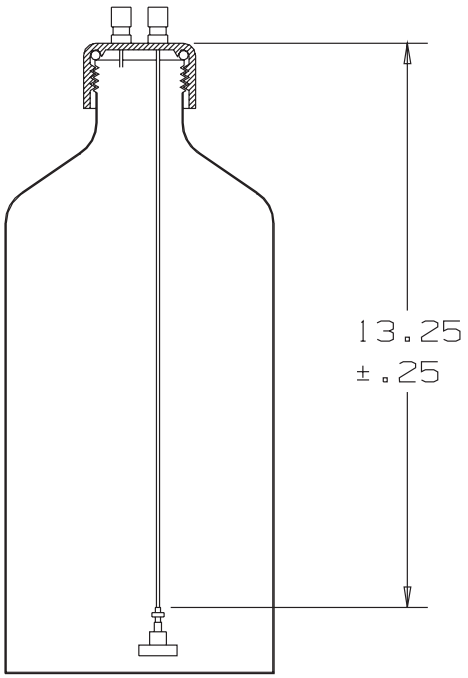
Tubing, polyethylene (62 inches)	45524-00
Filter, reagent bottle (4)	44953-00
Fitting, reagent bottle filter (4)	31002-00
O-rings, reagent bottle caps (4)	45515-00
Compression Nuts (4)	45428-00

1. Cut the reagent bottle tubing from the barb fitting above the reagent bottle cap.

2. Remove and discard the old compression nut from the reagent bottle cap. Remove the bottle cap, wipe dry with a paper towel and replace the O-ring with a new one.

3. Cut a 15.5-inch segment of tubing for the bottle tubing. Slide a new compression nut onto the tube. Run the end of the tubing down through the hole in the bottle cap threaded extrusion far enough to reach the proper depth (13.25 inches) in the bottle (see Figure 27). *Do not cut the tubing to adjust the length*.

Figure 27 Reagent Tubing Depth



4. Install a new hose barb fitting and reagent bottle filter on the end of the tube. With the proper depth dimension below the bottle cap, tighten the new compression nut using the spacer gauge.

5. Connect the top end of the bottle tubing to the fitting in the reagent tubing module tube.

6. Repeat the above procedure to replace the other reagent bottle tubes.

4.4.2.3 Sample Cell Replacement

The following item must be on hand to complete this procedure:

Sample cell	44907-00

Remove the sample cell as follows (see Figure 24 on page 90):

CAUTION
The reagents present in the sample cell, although greatly diluted, have chemical hazards associated with them. Please read Material Safety Data sheets carefully and provide adequate means of protection.

PRUDENCE
Les réactifs présents dans la cuvette du colorimètre, même s'ils sont fortement dilués, représentent un risque chimique.Veuillez lire les fiches de données de sécurité attentivement et utiliser les moyens de protection appropriés.

PRECAUCION
Los reactivos presentes en la célula para muestra, aunque están muy diluidos, siempre constituyen riesgos químicos. Por favor, lea detenidamente las Hojas de Datos de Seguridad del Material, y tome todas las precauciones indicadas.

VORSICHT
Die Reagenzien, die in der Messküvette vorliegen, können, obwohl stark verdünnt, immer noch gefährliche Eingenschaften besitzen. Lesen Sie daher gründlich das Sicherheitsdatenblatt und verwenden Sie ausreichende Schutzkleidung und eine Schutzbrille.

PRECAUÇÃO
Embora os reagentes presentes na célula de amostra estejam bastante diluídos, há riscos químicos associados a eles.Leia cuidadosamente as Folhas de Dados sobre Segurança do Material, e forneça os meios adequados de proteção.

1. Turn off power to the analyzer. Release the reagent pressure by opening the reagent compartment door.

2. Remove the funnel and sample cell light shield.

3. Loosen the sample cell cover-clamp assembly and lift out the sample cell cover. Save the gasket for use with the new sample cell.

4. Loosen the two knurled nuts on the left side of the detector housing. Lift the sample cell and drain hose free.

5. Disconnect the drain hose from the sample cell port.

6. Retrieve the stir bar.

7. Dispose of the sample cell contents down an approved chemical drain.

8. Attach the drain hose to the new sample cell. Do not place the drain hose up against the sample cell wall. It could prevent the sample cell bottom from resting flat and level on the detector housing.

9. Wipe the new sample cell outside surfaces clean of fingerprints. Slide the new sample cell in. Make sure the O-rings are in place on both sides of the cell. Add the stir bar. The sample cell must bottom against the colorimeter block.

10. Tighten the two knurled nuts on the left side of the detector housing.

11. Replace the sample cell cover and gasket.

12. Replace the sample cell light shield and sample cell cover clamp. Replace the funnel.

13. Turn on power to the analyzer. Restore reagent pressure by closing and latching the reagent compartment door.

4.4.2.4 Sample Cell Cover Assembly Replacement

The sample cell cover assembly includes the reagent straws and tubing fittings. Reagent straws and tubing fittings are not available separately.

The following items must be on hand to complete these procedures:

Cover, sample cell assembly	45427-50

To replace the sample cell cover:

1. Turn off power to the analyzer. Release reagent pressure by turning the top reagent compartment door knob counterclockwise.

2. Remove the funnel and sample cell light shield.

3. Disconnect the reagent tubing from each fitting on the present sample cell cover.

4. Remove the sample cell cover clamp and lift out the sample cell cover. Save the gasket for use with the new sample cell cover.

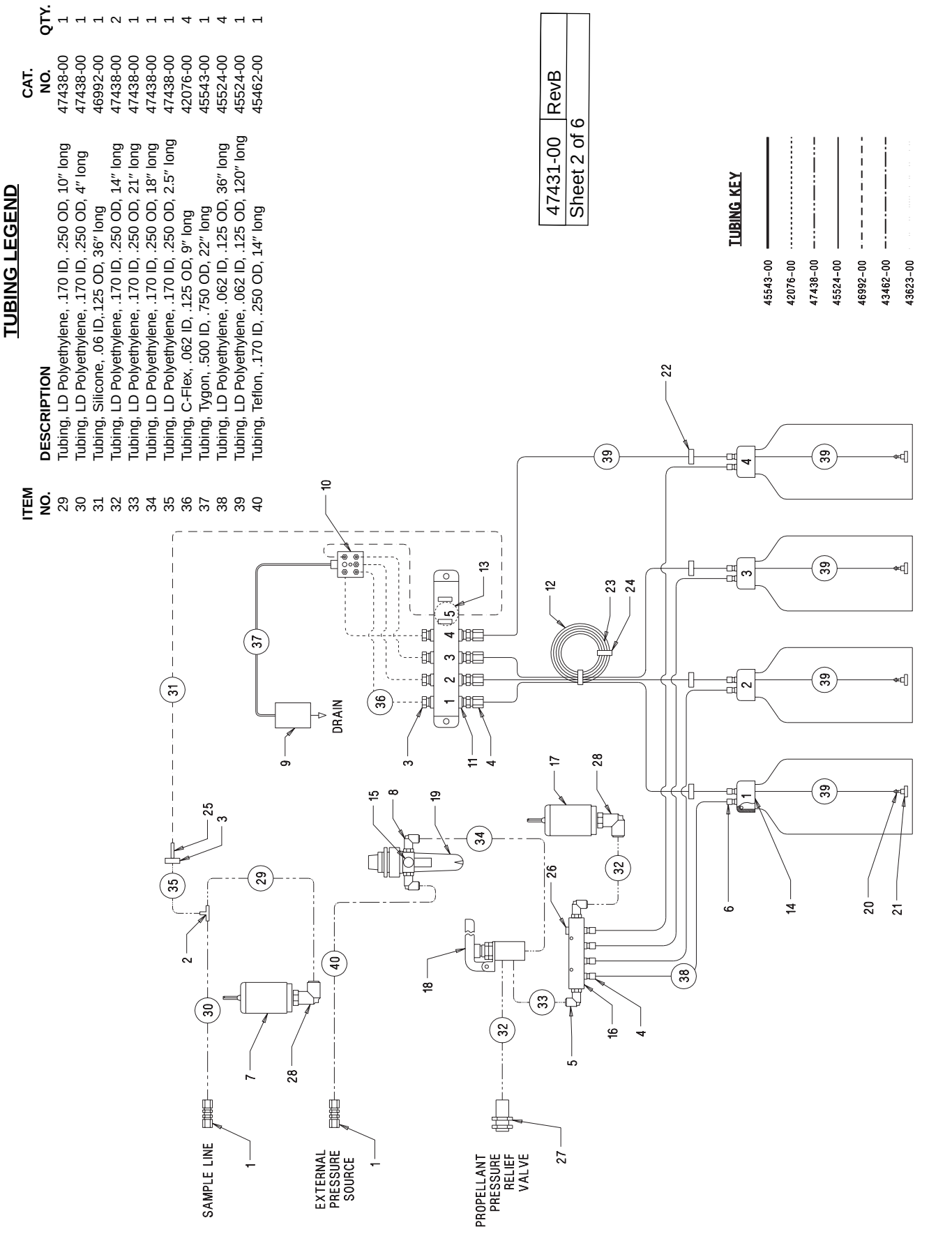
5. Replace with the new sample cell cover assembly. Be sure the gasket is positioned properly. Install the sample cell cover clamp.

6. Attach the appropriate tubing to the matching fitting (see Figure 28).

7. Replace the sample cell light shield and funnel.

8. Restore reagent pressure by closing and latching the reagent compartment door. Turn on power to the analyzer.

Figure 28 Analyzer Tubing



4.4.2.5 Reagent Valve Replacement

The following items must be on hand to complete these procedures:

Valve, reagent	44948-00
Barbed fitting for top of reagent valve (Four are included in maintenance kit.)	45486-00
Compression fitting for bottom of reagent valve (Four are included in maintenance kit.)	44945-00

Replace a reagent valve as follows:

1. Turn off power to the analyzer. Release reagent pressure by turning the top knob of the reagent compartment door counterclockwise.
2. Remove the reagent tubing cover to gain access to the valve's lower tubing fittings. Also remove the cover over the terminal block compartment.
3. Remove the tubing fittings from the appropriate valve.
4. Disconnect the reagent valve wires connected to the J1 and J4 terminal block (see Figure 25 on page 91). Remove the old reagent valve by loosening the two screws and sliding the valve up and out the back of the mounting bracket.
5. Insert new fittings (*45486-00* & *44945-00*) into the new valve. Apply Teflon thread tape to the male pipe threads.
6. Install the new valve into the bracket using the screws from the replaced valve.
7. Connect the tube from the sample cell cover (that was disconnected for valve replacement) to the hose barb fitting in the top of the new valve.
8. From the tube that was disconnected from the bottom valve fitting, cut off and discard the old fitting and compression nut. Slide a new compression nut onto the tube and make the connection to the bottom fitting in the new valve.
9. Connect the valve electrical wires to the appropriate terminals on the J1 and J4 terminal block (see Figure 25 on page 91).
10. Replace the covers over the terminal block and reagent tubing module.
11. Restore reagent pressure by closing and latching the reagent compartment door. Restore power to the analyzer.

4.4.2.6 Sample Pinch Valve Replacement

The following item must be on hand to complete this procedure:

Valve, pinch, sample	47302-00

The sample pinch valve is located in position 5 of the reagent valve bracket. Replace the sample pinch valve as follows:

1. Remove the cover from the reagent tubing module compartment.
2. Initiate a flush cycle by pressing **SYSTEM RESET**. The pinch valve opens.
3. Grasping the tube above and below the pinch valve, slide the tube to the left until free of the pinch valve.
4. Turn off power to the analyzer and release reagent pressure by opening the reagent compartment door.
5. Remove the cover from the terminal block compartment. Disconnect the two pinch valve wires from terminals 5 and 12.
6. Loosen the two screws holding the pinch valve to the bracket and remove the pinch valve.
7. Install the replacement pinch valve on the bracket. Connect the wires to terminals 5 and 12 (see Figure 25 on page 91).
8. Replace the cover over the terminal block compartment.
9. Restore power and reagent pressure.
10. While the new pinch valve is in the open position, (approximately 3 minutes after the instrument is turned on) slide the sample tube to the right into the pinch valve. When the tube is in place, it will move up and down easily.
11. Replace the cover over the reagent tubing module compartment.

4.4.2.7 Fuse Replacement

WARNING
Disconnect all power (including voltages > 30V-RMS that are connected to relays) to the instrument before removing the power supply board cover. Electrical shock can cause serious injury.

ATTENTION
Ces relais ne sont pas prévus pour utilization dans de systèmes basse tension. NE PAS RACCORDER A CES RELAIS DE TENSIONS INFERIEURES A 30V EN COURANT ALTERNATIF, 42V EN COURANT CONTINU.

ADVERTENCIA
Estos relés no han sido diseñados para operar con sistemas de bajo voltaje. NO CONECTE ESTOS RELES A VOLTAJES MENORES DE 30V-RMS, 42V-CD.

VORSICHT
Unterbrechen Sie die Stromzufuhr (einschließlich Spannungen von mehr als 30 v RMS, die an den Relais anliegen) bevor Sie die Abdeckung der Netzplatine entfemen.

ADVERTÊNCIA
Estes relés não se destinam para uso com sistemas de baixa voltagem. NÃO CONECTAR VOLTAGENS INFERIORES A 30V-RMS, 42V-DC A ESTES RELÉS.

The line fuses are located in fuse holders on the power supply board (see Figure 17 on page 77). Use the following steps to change the fuses:

1. Remove the front panel of the control box by removing the four corner screws. Disconnect the keyboard connector from the circuit board.
2. Remove the two fuses (F3 & F4) from the fuse holders.

3. Replace the two fuses with 1 ampere fuses for 115 Vac operation and ½-ampere fuses for 230 Vac operation.

4. Replace the control box cover.

4.4.3 Sample Cell Drain Tubing Replacement

The following item must be on hand to complete the following procedure.

Tubing, Tygon, 0.75 inch OD, 0.50-inch ID, 3 feet long	45543-00

Replace the sample drain tubing as follows (see Figure 24 on page 90):

1. Remove the sample cell light shield and sample cell cover clamp.

2. Loosen the two knurled nuts from the left-hand side of the detector housing.

3. Cut the drain tubing from the elbow fitting in the back of the reagent compartment.

4. Lift the sample cell from the detector housing and disconnect the drain tubing from the sample cell port. Remove the drain tubing from the analyzer.

5. Install the new tubing. Run the 3-foot tubing through the hole in the partition behind the colorimeter. Attach the drain tubing to the sample cell port. Do not push the drain hose up against the sample cell wall. It could prevent the sample cell bottom from resting flat and level on the detector housing. Connect the other end of the drain tubing to the elbow fitting at the bottom of the reagent compartment.

6. Insert the sample cell into the colorimeter. Make sure that the cell touches bottom. Secure the cell in place by tightening the knurled nuts.

4.4.3.1 Control Module Replacement

To remove the existing module:

1. Turn the power off to the instrument.

2. Remove the two screws that secure the guard covering the upper portion of the four connectors on the bottom of the control module. Let the guard drop out of the way.

3. Unscrew the rings of the four black connectors on the bottom of the module and gently unplug the connectors from the module.

4. Remove the Control Module cover.

5. Use a # 2, (5 to 6 inch) Phillips screwdriver to remove the four screws at each corner that hold the module in place. Gently remove the module.

To install the new module:

1. Place the control module on the shelf so the four screws are aligned on the back of the module. Tighten the screws in place securing the module. (Use the four screws from the old unit.)

2. Replace the Control Module cover.

3. The four black electrical connectors are labeled for their placement:

   LR-Left rear, J1

   RR-Right rear, J4

   LF-Left front, J2

   RF-Right front, J3

   A diagram on the bottom of the module also identifies where the connectors are located.

4. Gently plug the connectors in the appropriate end. The connectors are keyed and should slip easily into place.

5. Twist the outer black ring on the connector until it clicks.

Note: *No tools are necessary to connect or disconnect the plugs! If the connectors are difficult to replace, they may be misaligned and could damage the pins.*

6. Replace the guard over the four connectors. Refer to Section 2.2 on page 20.

4.4.3.2 Pressure Sensor Replacement

The following items must be on hand to complete this procedure:

Pressure sensor assembly, for sample line or Pressure sensor assembly, for reagent line	46974-30 46975-30
Teflon thread tape (from Maintenance Kit)	70608-24

Replace the appropriate pressure sensor as follows:

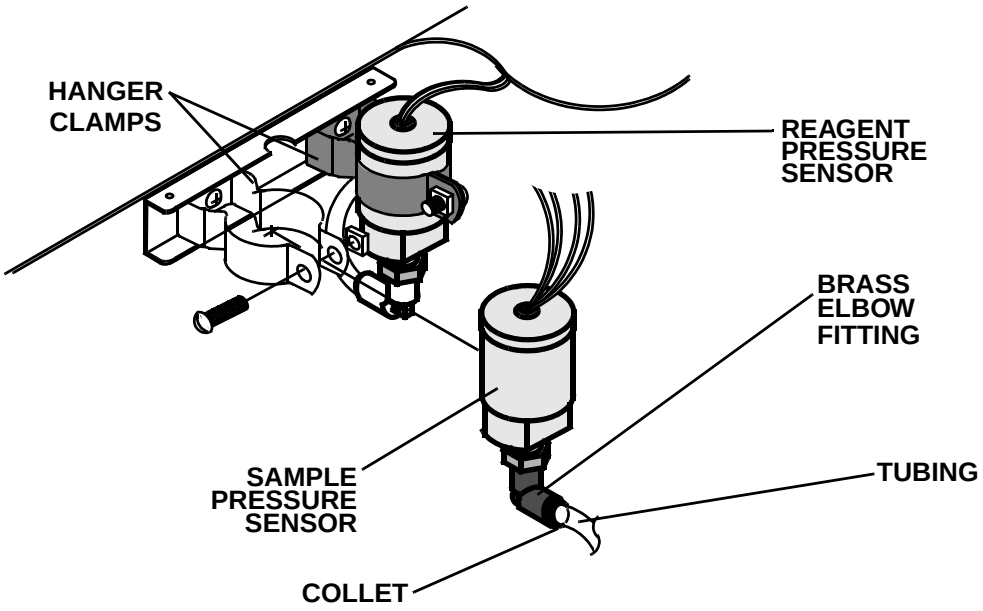
1. Turn off power to the analyzer. Release reagent pressure by turning the upper knob on the reagent compartment door counterclockwise. Stop sample flow to the analyzer.

2. Remove the cover from the terminal block compartment. Disconnect the sensor leads from their terminals (see Figure 25 on page 91).

3. Locate the appropriate pressure sensor under the shelf. The sample sensor is on the left and the reagent sensor is on the right. Remove the sensor to be replaced from its hanger clamp (see Figure 29).

4. Disconnect the tubing from the elbow fitting by pressing in on the collet while pulling out on the tubing. Remove the brass elbow fitting from the base of the sensor using $^{11}/_{16}$-inch and 1-inch open-end wrenches. Wipe the threads clean.

Figure 29 Pressure Sensor Replacement



5. Prepare the new sensor for installation by removing the protective cap.

Note: *Do not touch or poke the diaphragm in the sensor.*

6. Apply Teflon thread tape to the threads of the brass fitting removed from the old sensor. Install the brass elbow fitting in the base of the new pressure sensor.

Note: *When tightening the fitting, support the sensor only by the machined flats at the base of the sensor. Failure to do so could damage the sensor.*

7. Insert the end of the tubing removed from the old sensor into the elbow fitting, pushing until you feel the tubing pass through the locking mechanism and bottom against the fitting.

8. Install the new sensor in the hanger clamp and tighten the clamp around the sensor using the screw and nut provided.

9. Run the sensor leads up behind the tubing module and terminal block compartments and out through the right-hand slot below the J1 and J4 terminal block. Connect the leads as follows:

Sample Sensor	**Reagent Sensor**
Green to terminal 29	Green to terminal 28
White to terminal 27	White to terminal 26
Red to terminal 31	Red to terminal 30
Black to terminal 33	Black to terminal 32

10. Restore reagent pressure and sample flow. Inspect the fitting connections for leaks. If a leak is heard or otherwise suspected in the reagent line, apply soapy water at the connection to confirm the existence or absence of a leak.

Note: *Pressure greater than 30 psig (207 kPa) will damage the pressure sensor.*

11. Replace the terminal block compartment cover.

12. Restart the analyzer. Perform a pressure check of the appropriate line as described in Section 2.8.7 or in Section 2.8.8 on page 60 to verify the line with the new sensor is working properly.

4.5 Extended Shutdown

The analyzer can be shutdown at any time by turning off sample flow to the analyzer. Analysis begins automatically after sample flow is turned on.

When the analyzer is shutdown for a period greater than three days but less than three weeks, prime the reagent tubing. Select the **Prime Reagents** option in the Setup Menu two times. This step ensures fresh reagent is supplied to the sample cell.

When the analyzer is shutdown for periods greater than three weeks, remove all of the reagents from the analyzer, and flush the reagent tubing with deionized water. Also, turn off the sample flow and reagent pressure source.

Prepare for an extended shutdown as follows:

1. Depressurize the analyzer. Empty the reagent bottles in an appropriate drain.

2. Rinse the bottles with deionized water several times and fill with deionized water.

3. Repressurize the system.

4. Using the **Prime Reagents** option under the Setup Menu, flush deionized water through the reagent tubing. One priming cycle takes approximately 2.5 minutes.

5. Repeat step 4.

6. Depressurize the system and empty the reagent bottles.

7. Reattach the empty reagent bottles and pressurize the system.

8. Select the **Prime Reagents** option again. The inert gas from the pressure source purges the reagent tubing of deionized water.

9. Repeat step 8.

10. Turn the analyzer, sample flow and pressure source off.

11. Flush the contents of the sample cell with deionized water several times and drain.

Section 5 Troubleshooting

Troubleshooting for the Series 5000 Silica Analyzer is done with the self-diagnostic functions and programmed diagnostics built into the analyzer (refer to Table 13 and Table 14). Self-diagnostic functions are used to detect certain types of system failures, actuate a system warning or alarm and display an error message describing the nature of the failure (see Section 2.9 on page 60). Programmed diagnostics, initiated by pressing the **TEST** key, are used to verify operation of alarm circuits, recorder output, printer output, grab sample analysis, display output, and reagent and sample pressures (see Section 2.8.6 on page 59).

5.1 Problems with Consistency and Accuracy at Low Concentrations

Problems with consistent readings at lower concentration may be caused by humidity in the environment. Humidity can condense on the sample cell wall in the light path if the sample temperature is below the dew point of the air next to the sample cell in the colorimeter. Environmental humidity and temperature can change throughout the day and from day to day. Humidity in a enclosed water plant may change when the building is closed up for cold weather or opened up for warm weather. These humidity and temperature changes can affect the consistency and accuracy of the readings.

Use the following actions to reduce potential humidity and temperature problems:

1. Make sure the small red plug is in the hole in the sample cell cover and the sample cell cover is tight. Seal any fittings that might leak fluids into the instrument. Dry any fluids inside the instrument enclosure before closing the doors.

2. Purge the instrument with dry instrument air or dry nitrogen to prevent excess humidity buildup inside the instrument enclosure. Leave the instrument's bottom drain open if purging with instrument air. Adhere to purging air low ratings.

3. Purchase an optional Hach Sample Heater to raise the sample temperature above the dew point.

4. Place the instrument in an environmentally controlled (for temperature and humidity) building.

Table 13 System Warnings

SYSTEM WARNINGS	1ST ACTION	2ND ACTION	3RD ACTION
ALARMS DISABLED	Alarm relays are disabled. Enable through ALARMS option of the Setup Menu.		
CLEAN SAMPLE CELL	Clean sample cell and stir bar. Initiate SYSTEM RESET.	Replace lamp. Initiate SYSTEM RESET.	**1.** Optic path may be obscured. **2.** Check interference filter. **3.** Check photocell assy. **4.** Check cables and connections. **5.** Electronic failure. Call a Hach service center.
COLD START	Instrument has been re-initialized and programmable parameters have been reset to default values.	Reset warning through ALARMS option of the Setup Menu or initiate SYSTEM RESET.	**1.** COLD START has been performed through the INITIAL SETUP option of the Setup Menu. **2.** Check to see that all switches on DIP SW1 on the microprocessor board are in the “open” position. **3.** RAM battery failure. Call a Hach service center.
INSTRUMENT ERROR	Call a Hach service center.	Electronic failure.	
MARGINAL OFFSETS	Possible excessive stray light. Insure light shield is in place and initiate SYSTEM RESET.	Disconnect the photocell at terminal 24 & 25 on terminal block located behind reagent valves. Initiate SYSTEM RESET. Does warning return?	No - Replace photocell assy. Yes - **1.** Possible ground loop on recorder output circuit. **2.** Check cables and connections. **3.** Electronic failure. Call a Hach service center.
POWER FAIL	Indicates a loss of AC power to the analyzer since last SYSTEM RESET.	Initiate SYSTEM RESET to clear warning.	
REAGENT PRESS < 8	Check pressure source. If good, check analyzer tubing, pressure connections and bottle caps for cracks and/or leaks.	Turn off analyzer and remove from power. Locate SEN1 WHI and SEN2 WHI (26 & 27) on the terminal block behind the reagent valves. Reverse these connections. Locate SEN1 GRN and SEN2 GRN (28 & 29). Reverse these connections. Return power and restart analyzer. Initiate SYSTEM RESET. Does REAGENT PRESS < 8 return?	No - If no warning or SMP PRESS warning is observed, replace reagent pressure sensor. Replace sensor wires to proper terminals. Yes - **1.** Check reagent propellant valve. **2.** Check reagent pressure regulator. **3.** Electronic Failure. Call a Hach service center.
REAGENT PRESS > 18	While displaying Reagent Pressure through the Test Menu, open the reagent compartment door. Does pressure drop to nearly zero?	Yes - Check reagent pressure regulator. No - Swap sensor inputs as described for REAGENT PRESS < 8. Does warning change to SMP PRESS warning?	Yes - Replace reagent pressure sensor. No - Electronic failure. Call a Hach service center.
REAGENTS LOW	Replace reagents and enter level at 100% through the REAGENT option of the Setup Menu.		
REPLACE CAL STD	Replace calibration standard and enter level at 100% through the REAGENT option of the Setup Menu.		
SMP PRESS < 2	Check the pressure gauge on the sample inlet of the analyzer. Is the reading 2 psi or less?	Yes - Check external sample line, sample strainer and regulator. No - Swap sensor inputs as described for REAGENT PRESS < 8. Does warning change to REAGENT PRESS warning?	Yes - Replace sample pressure sensor. No - Electronic failure. Call a Hach service center.

Table 13 System Warnings (continued)

SYSTEM WARNINGS	1ST ACTION	2ND ACTION	3RD ACTION
SMP PRESS > 8	Check the pressure gauge on the sample inlet of the analyzer. Is the reading 8 psi or more?	Yes - Attempt to reduce pressure by adjusting the regulator. Replace regulator if necessary. No - Swap sensor inputs as described for REAGENT PRESS < 8. Does SMP PRESS > 8 return?	Yes - Electronic failure. Call a Hach service center. No - If no warning or REAGENT PRESS warning is observed, replace sample pressure sensor.
SOFTWARE RESTART	Illegal address call detected by microprocessor.	Infrequent resets are usually not a problem. For frequent reset problems, refer to FREQUENT RESETS in Table 14.	Static discharge. Possible problem with memory functions.
TEMP > 50 or TEMP < 10	Is the ambient temperature greater than 50 °C or less than 10 °C (lower temperature limit varies with analysis)?	Yes - Analyzer is operating outside of specified temperature range. No - Disconnect the thermistor at the terminal block located behind the reagent valves (22 & 23). Install a 30 kohm resistor in its place. Initiate SYSTEM RESET. Does TEMP warning return?	Yes - Electronic failure. Call a Hach service center. No - Replace Thermistor assy.
UNABLE TO CALIB	Does programmed STANDARD VALUE match the value of the solution in the Standard Bottle?	Yes - Is the Standard being delivered? No - Enter the correct value and recalibrate.	Yes - **1.** Is the stir bar in place and operating properly? **2.** Check for leaking valves by looking at straws in cell cover. **3.** Obstruction in light path. **4.** Are reagents being dispensed? **5.** Electronic failure. Call a Hach service center. No - **1.** Blocked or failed standard valve. **2.** Electronic failure. Call a Hach service center.
V OUT OF LIMITS	Initiate SYSTEM RESET. Does warning return?	Yes - Electronic failure. Call a Hach service center. No - OK if very infrequent.	
NO SAMPLE	Analyzer detects less than 1.0 psi sample pressure. Does external pressure gauge on sample conditioning read 1.0 psi or less?	Yes - Is there sample flow to the analyzer? Check external sample line, sample strainer and regulator. No - Swap sensor inputs as described for REAGENT PRESS < 8. Does warning change to a REAGENT PRESS warning?	Yes - Replace sample pressure sensor. No - Electronic failure. Call a Hach service center.
REPLACE LAMP	Initiate SYSTEM RESET. After 90 seconds look in sample cell. Is the lamp on?	Yes - Check for obstruction in light path. Check cables and connections. Replace photocell assy. Electronic failure. Call a Hach service center. No - Turn off analyzer, disconnect lamp and check for continuity. Does check indicate the lamp is “open”?	Yes - Replace lamp. No - **1.** Check cables and connections. **2.** Electronic failure. Call a Hach service center.
REPLACE REAGENTS	Replace reagents and enter level at 100% through the REAGENT option of the Setup Menu.		

Table 13 System Warnings (continued)

SYSTEM WARNINGS	1ST ACTION	2ND ACTION	3RD ACTION
No Reagent Pressure	Check pressure source. If good, check analyzer tubing, pressure connections and bottle caps for cracks and/or leaks.	Swap sensor inputs as described for REAGENT PRESS < 8. Does warning change to a SMP PRESS warning?	Yes - Replace reagent pressure sensor. No - **1.** Check reagent pressure regulator. **2.** Electronic failure. Call a Hach service center.

Table 14 Performance Problems

Fault or Symptom	1ST Action	2ND Action	3RD Action
Nothing Works	**1.** Check power to analyzer. **2.** Check power conversion switch next to power on/off switch. **3.** Check for blown fuses. **4.** Check cables and connections.	Electronic failure. Call a Hach service center.	
Frequent Resets	**1.** Power supply overloads. **2.** Brown outs. **3.** Large inductive loads on same power circuit. **4.** Static discharge. **5.** Shorting lamp filaments. **6.** Electronic failure. Call a Hach service center.		
Blown Fuse	Is fuse proper value for selected voltage?	Yes - **1.** Possible defective fuse. **2.** Electronic failure. Call a Hach service center.	No - Replace with proper fuse.
Measurements are Stable, but Low or Negative	Is stir bar operating?	Yes - Is sample valve leaking? No- **1.** Electronic failure. Call a Hach service center. **2.** Defective stir motor.	Yes - Replace sample valve. No - **1.** Sample not warm enough for short cycle? **2.** Blocked reagent valve? **3.** Blank value needs correction. See Appendix B “Low Level Silica Verification for Analyzer Users”.
Measurements are Stable, but High	Is standard valve leaking?	Yes - Replace standard valve.	No - **1.** Check interference filter. **2.** Blocked reagent valve? **3.** Blank value needs correction. See Appendix B “Low Level Silica Verification for Analyzer Users”.
Measurements are Erratic	Check all valves. Are any leaking OR blocked?	Yes - Replace valve.	No - **1.** Erratic stir bar operation. **2.** Lamp assy. **3.** Dirty, oxidized or corroded connections between lamp and control box. **4.** Electronic failure. Call a Hach service center.

Table 14 Performance Problems (continued)

Fault or Symptom	1ST Action	2ND Action	3RD Action
Grab & Process Sample Disagree	Is grab sample set up for proper temperature?	Yes - Does analyzer have a sample heater? No - Set GRAB SAMPLE TEST for proper temperature range through the Test Menu.	**5.** Yes - Bring grab sample to same temperature as sample heater. See Appendix B “Low Level Silica Verification for Analyzer Users”. **6.** No - Contamination of grab sample container or funnel.
Alarm/Relay Circuit Problems	**1.** Check for proper setup through ALARMS option of the Setup Menu. **2.** Verify power to customer circuit switched through analyzer alarm relay.	**3.** Check connection of customer circuit to analyzer alarm relay with respect to Normally Open and Normally Closed contacts. **4.** Disconnect customer circuit from analyzer and check for relay continuity at the terminal block with an Ohm meter through the RELAY TEST option of the Test Menu.	Electronic failure. Call a Hach service center.
Recorder Output Circuit Problems	**1.** Has the proper recorder output been selected at the Recorder DIP switch? (Rocker switch pushed in to the right.) **2.** Check for proper recorder setup and scale through the RECORDER option of the Setup Menu.	**3.** If recorder is programmable, has it been setup properly? **4.** Check for proper connection to analyzer. (REC OUT + & -) **5.** Disconnect recorder from analyzer and check for proper output through the RECORDER TEST option of the Test Menu with a multimeter.	**1.** Ground loop between analyzer and recorder. **2.** Electronic failure. Call a Hach service center.
Printer or Computer Interface Problems	**1.** Are all eight switches open except for switch #2 on DIP SW2 on the microprocessor board? (except in current loop mode) **2.** Check protocol settings. **3.** Check connections.	**4.** Check DIP switch settings on printer. **5.** Check baud rate setting.	**1.** Equipment not compatible. **2.** Electronic failure. Call a Hach service center.

Table 15 Series 5000 Silica Analyzer Quick Reference Guide*

Key	Options	Description
Setup		
	Alarms	
	RESET ALARMS	Reset present sample alarms and system alarms
	ALARMS ENABLED	Enables/disables sample alarms
	L ALM 1 0.00 µg/l	Sample alarm 1 (High, Low, Rate; 0.00 to 5000)
	H ALM 2 5000 µg/l	Sample alarm 2 (High, Low, Rate; 0.00 to 5000)
	ALARM CONFIG	Configuration of sample alarms: ALARM 1 = LOW (High, Low, Rate); ALARM 2 = HIGH (High, Low, Rate); POWER FAIL: OFF (Off, On)
	RELAY CONFIG	Configuration of alarm relays: Relay 1 and 2 high voltage rating; relay 3 and 4 low voltage rating

Table 15 Series 5000 Silica Analyzer Quick Reference Guide* (continued)

Key	Options		Description
Setup			
	Reagents		
		RBLANK 0.00 µg/l	Concentration of reagent blank to be automatically subtracted from results
		REAG LEVEL 100%	Present level of reagents — set to 100% when replaced
		STD LEVEL 100%	Present level of standard — set to 100% when replaced
		PRIME REAGENTS	Fills reagent tubing with reagent
	Recorder		
		RECMAX 5000 µg/l	Upper limit of recorder in terms of concentration
		RECMIN 0 µg/l	Lower limit of recorder in terms of concentration
		ON ALARM	
			HOLD — Recorder output continues holding at the output last detected before the system alarm occurred
			GO MAX — Recorder output to full scale
			GO MIN — Recorder output to zero
		AUTO-SET CURRENT	Calibrates the range of the recorder to 4-20 mA when current output is selected
		AUTO-SET VOLTAGE	Calibrates the range of the recorder when a voltage output is selected
		MANUAL SET REC	
			INCR FULL SCALE — Use with Test Menu, RECORDER TEST, OUTPUT REC FS option. Use INCR FULL SCALE to increase to desired level if recorder full scale is too small
			DECR FULL SCALE — Use with Test Menu, RECORDER TEST, OUTPUT REC FS option. Use DECR FULL SCALE to decrease to desired level if recorder full scale is too large
			INCR ZERO — Use with Test Menu, RECORDER TEST, OUTPUT REC ZERO option. Use INCR ZERO to increase to desired level if recorder zero is too small.
			DECR ZERO — Use with TEST menu, RECORDER TEST, OUTPUT REC ZERO option. Use DECR ZERO to decrease to desired level if recorder zero is too large.
	PRINT SETUP		Prints analyzer settings

Table 15 Series 5000 Silica Analyzer Quick Reference Guide* (continued)

Key	Options		Description
Setup			
	INITIAL SETUP		
		HR:MIN 00:00	Current military time of day
		M/D/Y 01/01/94	Current date
		DAY SUNDAY	Current day of week
		LONG CYCLE TIME	Determines measurement cycle time of 15 or 8.8 minutes (Long, Short)
		COLD START	Resets analyzer to default conditions
		BAUD RATE 1200	Baud rate of serial I/O (300, 600, 1200, 2400, 4800, 9600)
		STOP BITS 2	Number of stop bits of serial I/O (1, 2)
		PARITY NONE	Parity of serial I/O (Odd, Even, None)
		CHAR LENGTH 8	Character length of serial I/O (7, 8)
		ADJUST CONTRAST	Modifies display contrast (0, 1, 2, 3 , 4, 5, 6, 7)
	KYBD UNLOCKED		
			Prevents unauthorized keyboard access (KYBD UNLOCKED, KYBD LOCKED, KYBD PARTIAL LOCK)

* Press one of the following keys on power up to select an alternative menu language: 1 for English, 2 for German, 3 for French, or 4 for Spanish. Default condition at cold start.

Key	Options	Description
CALIB		
	AUTO-CALIBRATION	Initiates automatic calibration at user request
	RECALL CAL VALUE	Recalls the last calibration value
	AUTO-CALIB TIME	Initiates automatic calibration on a specified day and time of the week and may be disabled
	STANDARD VALUE	Concentration of standard used in automatic calibration
	USER CALIBRATION	Changes currently displayed concentration to agree with independently established value — (not recommended; specifications are based on automatic calibration)
	DEFAULT CALIB	Resets analyzer to default calibration

Key	Options	Description
TEST		
	RELAY TEST	Activates alarms at user request
	RECORDER TEST	Confirms recorder setup for full scale, zero and ½ scale
	PRINTER TEST	Verifies normal printer operation
	GRAB SAMPLE TEST	Allows user to measure grab sample
	RECALL G SMP VAL	Recalls the last grab sample value
	TIME REMAINING	Displays time remaining in present measurement cycle
	DISPLAY TEST	Verifies normal display operation
	REAGENT PRESSURE	Measures and displays reagent pressure
	SAMPLE PRESSURE	Measures and displays sample pressure to analyzer
SYSTEM RESET		
		Resets system alarms, warnings and sample alarms and starts new cycle
CLEAR		
		Clears data entry or returns to normal display
NEXT		
		Use to move through menus and select fixed options
ENTER		
		Use to enter sub-menus and to select values

Figure 30 on page 116 identifies the most commonly replaced plumbing. Figure 28 on page 97 identifies the tubing used in the Series 5000 Silica Analyzer.

Replacement Parts

Description	Cat. No.
Installation Kit	47653-00
Bushing, strain relief (4), for customer connection box	43794-00
Funnel, powder, polypropylene, 150 mm	22644-72
Fuse, (2) 250 V, ½-ampere, IEC (for 230 V, European applications)	44592-00
Gauge, fitting spacer	45548-00
Locknut (4), for bushing 43794-00	10596-12
Manual	60000-18
Quick Reference Card	60000-44
Sample pressure conditioning kit	46991-00
Seal, ring, for customer connection box conduit hole (4)	10338-14
Stir bar, for sample cell	44936-00
Tubing, Tygon, 6-foot, for drain	13201-00
Maintenance Kit	46981-00
Cap, molded with 0-ring, for reagent bottle (4)	44902-01
Filter, for reagent bottle (4)	44953-00
Fitting, for reagent bottle filter (4)	31002-00
Fitting, $^1/_{16}$-inch barb x $^1/_8$-inch NPT (5), for top of reagent valve	45486-00
Fitting, male $^1/_8$-inch NPT x $^1/_8$-inch OD tubing (4), for bottom of reagent valve	44945-00
Lamp assembly	46979-00
Nut, compression, ¼-inch OD tube (3)	45554-00
Nut, compression, $^1/_8$-inch OD tube (8)	45428-00
O-ring, for reagent bottle caps (4)	45515-00
O-ring, for sample cell (2)	45461-00
Plug, for sample cell cover (6)	45552-00
Stir bar, for sample cell	44936-00
Teflon thread tape	70608-24
Replacement Tubing Kit	46982-00
Tubing, polyurethane, 0.125 OD x 0.031 wall, 1.5 feet	43623-00
Tubing, polyurethane, 0.170-inch ID, 0.250 OD, 10 feet	47438-00
Tubing, Tygon, 0.750-inch OD, 0.125-inch, 3 feet	45543-00
Tubing, Teflon, 0.170-inch ID, 0.250-inch OD, 2 feet	45462-00
Tubing, C-flex, 0.062-inch ID, 0.125-inch OD, 5 feet	42076-00
Tubing, polyethylene, 0.062-inch ID, 0.125-inch OD, 20 feet	45524-00
Tubing, silicone, 0.062 ID, 0.125 OD, 3 feet	46992-00

Other Items

Description	Cat. No.
Circuit board, microprocessor	47604-10
Circuit board, power supply	47602-00
Colorimeter assembly	44954-00
Filter, color, 810 nm, 1-inch diameter	31256-00
Filter, for reagent bottle	44953-00
Filter and regulator assembly	46125-00
Filter Element Kit	46112-00
Fitting, barb, 0.062-inch ID tube, 1/8-inch NPT	45486-00
Fitting, bulkhead, ¼-inch OD tube	40658-00
Fitting, male connector, ¼-inch tube	44946-00
Fitting, male connector, 1/8-inch tube	44945-00
Fitting, tee union, ¼-inch, OD tube, polypropylene	45474-00
Fitting connector, 1/16-inch x 1/16-inch barb for reagent filter	31002-00
Fitting, quick connect elbow, ¼-inch OD tube x 1/8-inch NPT male	47306-00
Fitting, quick connect, ¼-inch OD tube x 1/8-inch NPT male	47347-00
Fitting, quick connect, elbow, ¼-inch OD tube x 3/8-inch NPT male	47304-00
Fitting, quick connect, 1/8-inch OD tube x 1/8-inch NPT male	47307-00
Fitting, quick connect, ¼-inch OD tube x 1/8-inch NPT female	47281-00
Funnel, grab sample, polypropylene	45551-00
Funnel cover, grab sample	45553-00
Fuse, 250 V, ½-ampere, IEC (for 230 V European applications)	44592-00
Fuse, 250 V, 1.0 ampere, UL/CSA (for 115 V North American applications)	44590-00
Gasket for cover assembly	46452-00
Keyboard Assembly	47659-00
Latch, door, locking, with key	47266-00
Nut, compression, 1/8-inch OD tube	45428-00
0-ring, flcar, 0.139-inch W x 0.609-inch ID, for sample cell	45461-00
0-ring, for reagent bottle	45515-00
Pressure sensor assembly, sample	46974-30
Pressure sensor assembly, reagent	46975-30
Reagent tubing module	44957-30
Reagent tubing wrap, 0.5-inch wide	44952-00
Sample cell	44907-00
Sample cell light shield	45994-00
Sample cell cover assembly	45427-50
Stir motor assembly	44955-00
Thermistor assembly	44956-00
Valve, pressure relief, for propellant	47260-00
Valve, reagent	44948-00
Valve, sample	47302-00

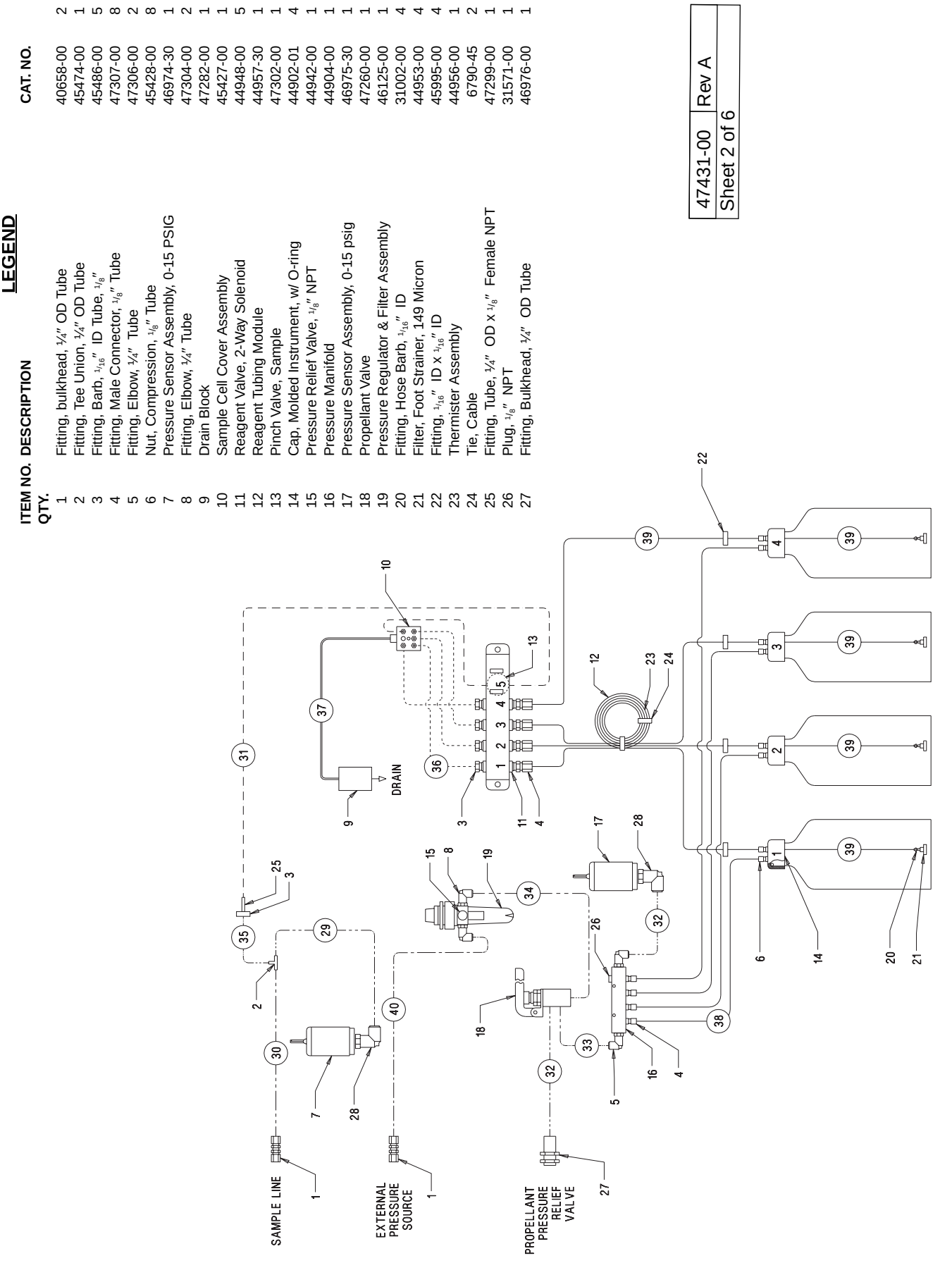
Replacement Reagents

Description	Cat. No.
Amino Acid F Reagent Package, contains 2.7 L Amino Acid F Diluent and 308 g reagent, each	23531-03
Citric Acid/Surfactant Reagent, 2.9 L	23470-03
Molybdate 3 Reagent, 2.9 L	1995-03
Silica Standard Solution, 500 µg/L ± 1%, as SiO_2, 2.9 L	21008-03

Optional Reagents and Accessories

Ammonium Hydroxide, 10%, 100 mL, MDB	14736-32
Connecting cable, printer	25941-00
Flow meter kit	46436-00
Heater, sample, 120 VAC, stainless steel	48500-00
Heater, sample, 240 VAC, stainless steel	48500-02
Paper, 12 rolls/pkg	23619-00
Power Cord, 125 V, 10 A, 1.83 meters (6 feet)	46964-00
Power Cord, 250 V, 10 A, 1.83 meters (6 feet), Continental European plug	47439-00
Printer, Citizen, Model iDP-562-RS, 40 column, 115 VAC	25933-00
Printer, Citizen, Model iDP-562-RS, 40 column, 230 VAC	25933-02
Printer ribbon, cartridge	25934-00
Sample cooler	17577-00
Sodium Hydroxide Solution, 1 N (5%), 900 mL	1045-53
Sodium Hydroxide Solution, 1 N (5%), 3.60 L	1045-17
Stainless Steel Sample Pressure Conditioning Kit, 316 SS	45983-00

Figure 30 Plumbing Replacement Parts



APPENDIX

A. Silica, Ultra Low Range Procedure

B. Low-Level Silica Verification for Analyzer Users

SILICA, Ultra Low Range

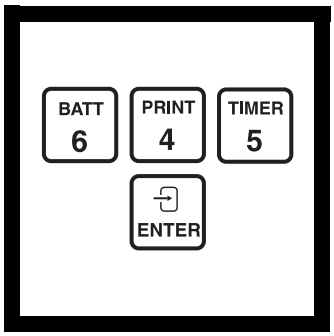
Method 8282

Heteropoly Blue Method*

Scope and Application: For ultrapure water.

(0 to 1000 µg/L)

* Adapted from S*tandard Methods for the Examination of Water and Wastewater.*



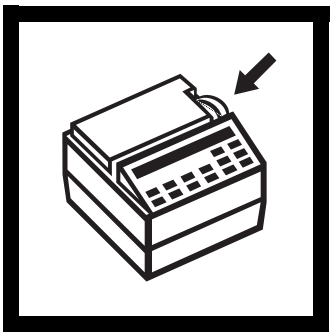
1. Enter the stored program for ultra low range silica.

Press: **6 4 5 ENTER**

The display will show:

Dial nm to 815

Note: The Pour-Thru Cell must be used.



2. Rotate the wavelength dial until the small display shows:

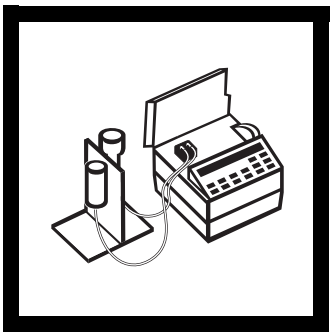
815 nm

When the correct wavelength is dialed in, the display will quickly show:

Zero Sample

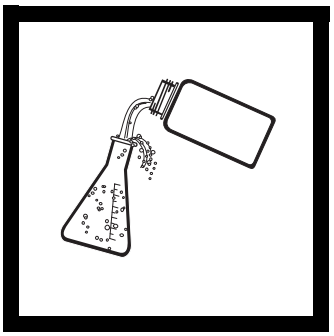
then:

µg/L SiO_2 ULR

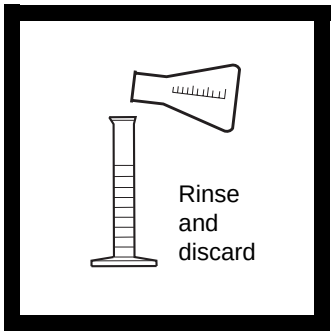


3. Install the Pour-Thru Cell and flush with 50 mL of deionized water.

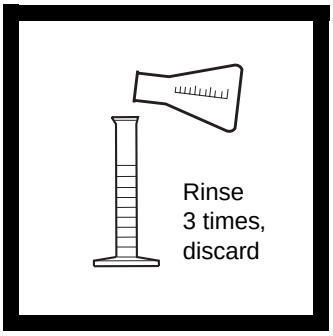
Note: See Treating Analysis Labware for information on cleaning labware.



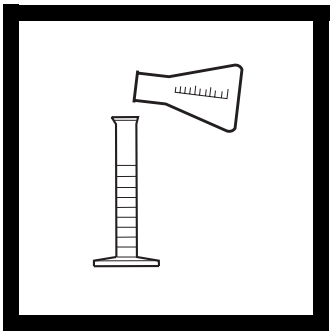
4. Fill two clean 250-mL Erlenmeyer flasks to overflowing with the sample.



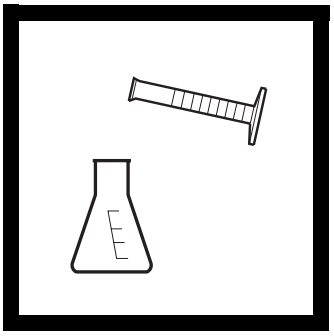
5. Fill a clean 50-mL plastic graduated cylinder with sample from one of the flasks and then discard the cylinder contents.



6. Repeat the rinsing of the cylinder three times from the same sample flask, discarding each rinse.



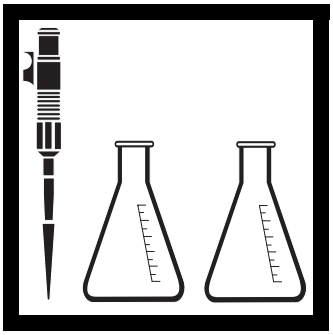
7. Fill the cylinder to the 50-mL mark with sample from the same flask, discarding any sample remaining in the flask.



8. Pour the contents of the cylinder back into the original flask.

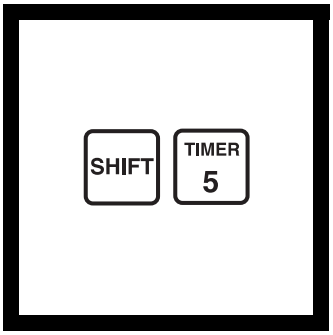


9. Repeat steps 5–8 for the second flask containing sample, then continue with step 10.



10. Using a TenSette® Pipet, add 1.0 mL of Molybdate 3 Reagent to each flask. Swirl to mix.

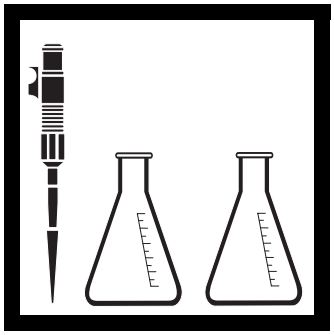
Note: An all-plastic 1.0-mL dropper is also available.



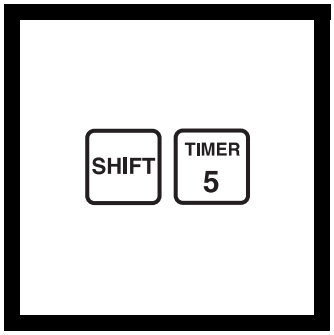
11. Press: **SHIFT TIMER**

A 4-minute reaction period will begin.

Note: The time given is for samples at 20 °C (68 °F). If the sample temperature is 10 °C (50 °F), wait 8 minutes. If the sample temperature is 30 °C (86 °F), wait 2 minutes.



12. When the timer beeps, add 1.0 mL of Citric Acid F Reagent to each flask. Swirl to mix.

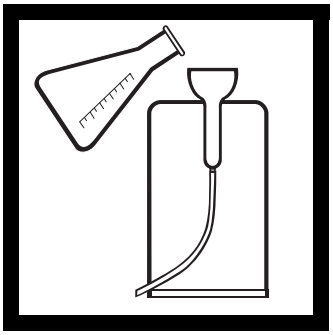


13. Press: **SHIFT TIMER**

A 1-minute reaction period will begin.

Note: The destruction of phosphate interference occurs during this period.

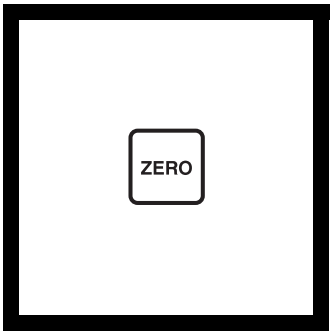
Note: The time given is for samples at 20 °C (68 °F). If the sample temperature is 10 °C (50 °F), wait 2 minutes. If the sample temperature is 30 °C (86 °F), wait 30 seconds.



14. When the timer beeps, the display will show:

µg/L SiO_2 ULR

Pour the contents of one flask through the Pour-Thru Cell.

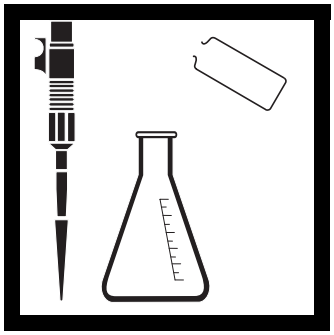


15. After the flow has stopped, press: **ZERO**

The display will show:

Zeroing. . . .

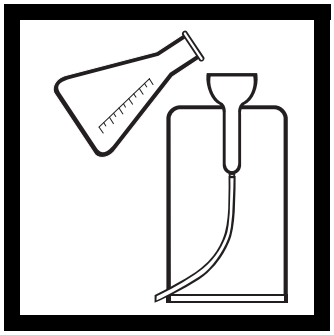
then: **0 µg/L SiO_2 ULR**



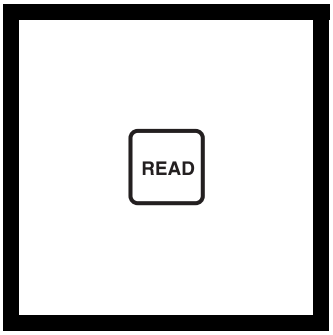
16. Add 1.0 mL of Amino Acid F Reagent Solution or pour the contents of one ampule of Amino Acid F Reagent into the second flask. Swirl to mix.

Note: For greatest accuracy use a TenSette pipet to dispense 1.0 mL from the ampule.

Note: A faint blue color will develop if silica is present.



17. Wait 15 seconds for color formation, then pour the contents of the second flask through the Pour-Thru Cell.



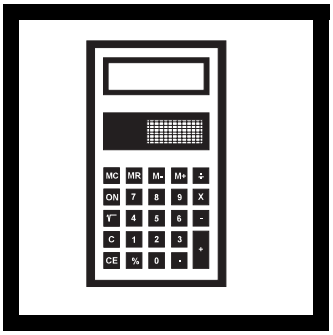
18. After the flow has stopped, press: **READ**

The display will show:

Reading. . . .

Then the result in µg/L of SiO_2 will be displayed.

Forms ▲ Si
SiO_2



19. Subtract the reagent blank value found on the Molybdate 3 reagent container from the value obtained in step 18.

Note: See Reagent Blank section if analyzer reagents are used.



20. Flush the Pour-Thru Cell with at least 50 mL of deionized water immediately after use.

Note: Protect the Pour-Thru Cell from contamination by inverting a small beaker over the top of the glass funnel.

Sampling and Storage

The sampling procedure in steps 4–8 has proven effective in harsh and dirty testing environments. In this procedure it improves accuracy.

Use only plastic containers with tight-fitting closures. Glass containers can contaminate the sample with silica. Soak sampling containers with solution of one part Molybdate 3 Reagent to 50 parts low-level silica deionized water. Fill completely and let stand for several hours. Rinse thoroughly with low-level silica water, drain and close. Repeat this cleaning periodically.

Allow the sample stream to flow for 1–2 minutes before collection. Do not adjust the flow during the sampling period this may introduce particulates. Rinse the container well with sample before collecting the portion for analysis. Analyze as soon as possible.

Reagent Preparation

Amino Acid F Reagent Solution is available in either 100-mL bottles or a package of 20-unit dose ampules. The bottled reagent has a limited shelf life after opening due to air oxidation. The ampuled reagent is sealed under argon and is more stable (greater than 1 year). Instability is evidenced by reduced sensitivity at high silica concentrations. Check the bottled reagent on a routine basis by performing the test on a 1000 µg/L silica standard. If the concentration result is less than 950 µg/L, use a fresh bottle of Amino Acid F Reagent Solution.

Alternatively, prepare larger or smaller volumes of Amino Acid F Reagent solution by dissolving Amino Acid F Reagent Powder in Amino Acid F Reagent Solvent at a ratio of 11 grams per 100 mL. These reagents are available as the Amino Acid F Reagent Package listed under Optional

Reagents. This prepared solution has limited stability; test routinely with the 1000 µg/L silica standard as above.

Users performing a large number of analyses may wish to use the Rapid Liquid Method for ULR Silica, program number 645.

Treating Analysis Labware

All containers used in this test must be cleaned thoroughly to remove any traces of silica. If possible, use plastic containers for all analysis and storage because glass can contaminate the sample with silica. Small bottles or flasks with screw-type closures work well. Clean containers by normal means (do not use phosphate detergents), then rinse with high quality deionized water with low-level silica concentration. Soak for 10 minutes with a 1:50 dilution of Molybdate 3 Reagent in low-level silica water. Rinse well with low-level silica water or the sample before use.

Keep containers for silica analysis only. Fill the Pour-Thru Cell with this same mixture of Molybdate 3 and water. Let stand for several minutes before use. Rinse with low-level silica water.

Reagent Blank

If analyzer reagents are used in the ULR Silica method, multiply the reagent blank value printed on the bottle label by the appropriate multiplier. Use this value in step 19 of the procedure.

Analyzer	Reagent Used (Cat. No.)	Multiplier
1234D	Molybdate 3 (1995-17)	1.00
Series 5000	Molybdate 3 (1995-03)	1.09

Cleaning the Pour-thru Cell

The Pour-Thru Cell may accumulate a buildup of colored products, especially if the reacted solutions are allowed to stand in the cell for long periods after measurement. Remove the color by rinsing with a 1:5 dilution of ammonium hydroxide, followed by several deionized water rinses. Cover the glass funnel when it is not in use.

Accuracy Check

a. Use a TenSette Pipet to add 0.1, 0.2 and 0.3 mL of either 1-mg/L Silica Standard Solution or 10-mg/L Silica Standard Solution to three 50-mL samples, respectively.

b. Analyze each spiked sample as described above. The silica concentration should increase 2.0 µg/L for each 0.1 mL of 1-mg/L standard. The silica concentration should increase 20.0 µg/L for each 0.1 mL of 10-mg/L standard.

Precision

In a single laboratory, using blanks and standard additions of 5 µg/L Si, a single operator obtained a standard deviation of less than ± 1 µg/L Si.

Interferences

Color and turbidity interferences are eliminated by zeroing the instrument with the original sample.

Phosphate does not interfere appreciably at levels less than 50 mg/L PO_4^{3-}. Sulfides and large amounts of iron interfere.

Summary of Method

A number of modifications are necessary to adapt the Low Range Silica method for analyzing trace levels in the Ultra Low Range Silica method. It is absolutely necessary to use the one-inch Pour-Thru Cell and liquid reagents. The Pour-Thru Cell increases the reproducibility of the optics and reduces the instability of the readings that result with moveable sample cells. Liquid reagents contribute to more reproducible readings and lower blanks by eliminating slight turbidity that may remain when using powdered reagents. In addition, the liquid reagents are used with Hach process analyzers for continuous silica measurement.

Silica and phosphate in the sample react with molybdate ion under acidic conditions to form yellow silicomolybdic acid complexes and phosphomolybdic acid complexes. Addition of citric acid destroys the phosphate complexes. An amino acid reagent is then added to reduce the yellow silicomolybdic acid to an intense blue color, which is proportional to the silica concentration.

Required Reagents

Description	Cat. No.
ULR Silica Reagent Set (using Amino Acid F *solution*; 100 tests) Includes: (2) 1995-32, (2) 22542-32, (1) 23864-42	25535-00
ULR Silica Reagent Set (using Amino Acid F *ampules*; 40 tests) Includes: (1) 1995-32, (1) 22542-32, (2) 23864-20	25814-00

Description	Quantity Required Per Test	Unit	Cat. No.
Amino Acid F Reagent Solution	1 mL	100 mL	23864-42
or			
Amino Acid F Reagent Ampules	1 each	20/pkg	23864-20
Citric Acid F Reagent	2 mL	100-mL MDB	22542-32
Molybdate 3 Reagent	2 mL	100-mL MDB	1995-32

Required Apparatus

Cylinder, graduated, 50-mL poly	1	each	1081-41
Flask, Erlenmeyer, 250-mL PMP, w/ cap	2	each	20898-46
Pipet, TenSette®, 0.1 to 1.0 mL	1	each	19700-01
Pipet Tips, for 19700-01 Pipet	3	50/pkg	21856-96
Pour-Thru Cell Assembly Kit	1	each	45215-00

Optional Reagents

Description	Unit	Cat. No.
Amino Acid F Reagent Package: Amino Acid F Reagent Powder, 308 g Amino Acid F Reagent Solvent, 2.7 L		23531-03

Ammonium Hydroxide, ACS	500 mL	106-49
Molybdate 3 Reagent	2.9 L	1995-03
Molybdate 3 Reagent	3.78 L	1995-17
Silica Standard Solution, 1 mg/L SiO_2	500 mL	1106-49
Silica Standard Solution, 10 mg/L SiO_2	500 mL	1043-49
Water, deionized	4 L	272-56

Optional Apparatus

Ampule Breaker	each	24846-00
Beaker, polypropylene, 100-mL	each	1080-42
Bottle, wash, 250-mL	each	620-31
Flask, Erlenmeyer, 250-mL, PMP w/ cap	4/pkg	20898-76
Measuring Dropper, squeezer type, 1-mL	10/pkg	21247-10
Pipet Tips, for 19700-01 TenSette® Pipet	1000/pkg	21856-28
Thermometer, -20 to 105 °C	each	1877-01

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Outside the U.S.A.—Contact the Hach office or distributor serving you.

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By Fax:
(970) 669-2932

By Mail:
Hach Company
P.O. Box 389
Loveland, Colorado 80539-0389 U.S.A

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- Your name and phone number
- Purchase order number
- Brief description or model number
- Billing address
- Shipping address
- Catalog number
- Quantity

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Catalog descriptions, pictures and specification, although accurate to the best of our knowledge, are not guarantee or warranty.

For a complete description of Hach Company's warranty policy, request a copy of our Terms and Conditions of Sale for U.S. Sales from our Customer Service Department.

Certification

Hach Company certifies this instrument was tested thoroughly, inspected and found to meet its published specifications when it was shipped from the factory.

The **Series 5000 Analyzer** has been tested and is certified as indicated to the following instrumentation standards:

Product Safety:

UL 61010A–1: Tested by ETL

CSA C22.2 No. 1010.1: ETL

Certified by Hach to **EN61010-1/IEC 1010-1 per 73/23/EEC**. Supporting test records held by Intertec Testing Services.

Immunity:
The Series 5000 Analyzer was tested for Industrial level EMC per:

EN 61326:1998 (EMC Requirements for Electrical Equipment for Measurement, Control and Laboratory Use) **per 89/336/EEC EMC**: Supporting test records by Hach Company, certified compliance by Hach Company.

Standard/s include:

IEC 1000-4-2:1995 (EN 61000-4-2:1995) Electro-Static Discharge Immunity (Criteria B)
IEC 1000-4-3:1995 (EN 61000-4-3:1996) Radiated RF Electro-Magnetic Field Immunity (Criteria A)
IEC 1000-4-4:1995 (EN 61000-4-4:1995) Electrical Fast Transients/Burst (Criteria B)
IEC 1000-4-5:1995 (EN 61000-4-5:1995) Surge (Criteria B)
IEC 1000-4-6:1996 (EN 61000-4-6:1996) Conducted Disturbances Induced by RF Fields (Criteria A)
IEC 1000-4-11:1994 (EN 61000-4-11:1994) Voltage Dip/Short Interruptions (Criteria B)

Additional Immunity Standard/s include:

ENV 50204:1996 Radiated Electro-Magnetic Field from Digital Telephones (Criteria A)

Emissions:
The Series 5000 Analyzer was tested for Radio Frequency Emissions as follows:

Per 89/336/EEC EMC: EN 61326:1998(Electrical Equipment for measurement, control and laboratory use—EMC requirements) Class “A” emission limits. Supporting test records by Amador Product Services (now TUV) NVLAP #0271, and certified compliance by Hach Company.

Standard/s include:

EN 61000-3-2 Harmonic Disturbances Caused by Electrical Equipment
EN 61000-3-3 Voltage Fluctuation (Flicker) Disturbances Caused by Electrical Equipment

Additional Standard/s include:

EN 55011 (CISPR 11), Class “A” emission limits

CANADIAN INTERFERENCE-CAUSING EQUIPMENT REGULATION, IECS-003, Class A: Supporting test records by Amador Product Services (now TUV) NVLAP #0271, and certified compliance by Hach Company.

This Class A digital apparatus meets all requirements of the Canadian Interference- Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

FCC PART 15, Class “A” Limits:
Supporting test records by Amador Product Services (now TUV) NVLAP #0271, and certified compliance by Hach Company.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense. The following techniques of reducing the interference problems are applied easily.

1. Disconnect power from the Series 5000 instrument to verify that it is the source of the interference.

2. If the Series 5000 instrument is plugged into the same outlet as the device with which it is interfering, try another outlet.

3. Move the Series 5000 instrument away from the device receiving the interference.

4. Reposition the receiving antenna for the device receiving the interference.

5. Try combinations of the above.

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