OPERATING INSTRUCTIONS FOR

Model 6750

Total Organic Carbon Analyzer

P/N M

ECO:

	DANGER	
Toxic gases and or flammable liquids may be present in this monitoring system. Personal protective equipment may be required when servicing this instrument. Hazardous voltages exist on certain components internally which may persist for a time even after the power is turned off and disconnected. Only authorized personnel should conduct maintenance and/or servicing. Before conducting any maintenance or servicing, consult with authorized supervisor/manager.		

Warranty

This equipment is sold subject to the mutual agreement that it is warranted by us free from defects of material and of construction, and that our liability shall be limited to replacing or repairing at our factory (without charge, except for transportation), or at customer plant at our option, any material or construction in which defects become apparent within one year from the date of shipment, except in cases where quotations or acknowledgements provide for a shorter period. Components manufactured by others bear the warranty of their manufacturer. This warranty does not cover defects caused by wear, accident, misuse, neglect or repairs other than those performed by TI/AI or an authorized service center. We assume no liability for direct or indirect damages of any kind and the purchaser by the acceptance of the equipment will assume all liability for any damage which may result from its use or misuse.

We reserve the right to employ any suitable material in the manufacture of our apparatus, and to make any alterations in the dimensions, shape or weight of any parts, in so far as such alterations do not adversely affect our warranty.

Important Notice

This instrument provides measurement readings to its user, and serves as a tool by which valuable data can be gathered. The information provided by the instrument may assist the user in eliminating potential hazards caused by his process; however, it is essential that all personnel involved in the use of the instrument or its interface, with the process being measured, be properly trained in the process itself, as well as all instrumentation related to it.

The safety of personnel is ultimately the responsibility of those who control process conditions. While this instrument may be able to provide early warning of imminent danger, it has no control over process conditions, and it can be misused. In particular, any alarm or control systems installed must be tested and understood, both as to how they operate and as to how they can be defeated. Any safeguards required such as locks, labels, or redundancy, must be provided by the user or specifically requested of TI/AI at the time the order is placed.

Therefore, the purchaser must be aware of the hazardous process conditions. The purchaser is responsible for the training of personnel, for providing hazard warning methods and instrumentation per the appropriate standards, and for ensuring that hazard warning devices and instrumentation are maintained and operated properly.

Teledyne Instruments/ Analytical Instruments, the manufacturer of this instrument, cannot accept responsibility for conditions beyond its knowledge and control. No statement expressed or implied by this document or any information disseminated by the manufacturer or its agents, is to be construed as a warranty of adequate safety control under the user's process conditions.

Specific Model Information

Instrument Serial Number: _____

Instrument Range: _____

Calibrated for: _____

Background Gas: _____

Zero Gas: _____

Span Gas: _____

Safety Messages

Your safety and the safety of others is very important. We have provided many important safety messages in this manual. Please read these messages carefully.

A safety message alerts you to potential hazards that could hurt you or others. Each safety message is associated with a safety alert symbol. These symbols are found in the manual and inside the instrument. The definition of these symbols is described below:

GENERAL WARNING/CAUTION: Refer to the instructions for details on the specific danger. These cautions warn of specific procedures which if not followed could cause bodily Injury and/or damage the instrument.

CAUTION: HOT SURFACE WARNING: This warning is specific to heated components within the instrument. Failure to heed the warning could result in serious burns to skin and underlying tissue.

WARNING: ELECTRICAL SHOCK HAZARD: Dangerous voltages appear within this instrument. This warning is specific to an electrical hazard existing at or nearby the component or procedure under discussion. Failure to heed this warning could result in injury and/or death from electrocution.

Technician Symbol: All operations marked with this symbol are to be performed by qualified maintenance personnel only.

No Symbol

NOTE: Additional information and comments regarding a specific component or procedure are highlighted in the form of a note.

CAUTION: THE ANALYZER SHOULD ONLY BE USED FOR THE PURPOSE AND IN THE MANNER DESCRIBED IN THIS MANUAL.

IF YOU USE THE ANALYZER IN A MANNER OTHER THAN THAT FOR WHICH IT WAS INTENDED, UNPREDICTABLE BEHAVIOR COULD RESULT POSSIBLY ACCOMPANIED WITH HAZARDOUS CONSEQUENCES.

This manual provides information designed to guide you through the installation, calibration operation and maintenance of your new analyzer. Please read this manual and keep it available.

Occasionally, some instruments are customized for a particular application or features and/or options added per customer requests. Please check the front of this manual for any additional information in the form of an Addendum which discusses specific information, procedures, cautions and warnings that may be peculiar to your instrument.

Manuals do get lost. Additional manuals can be obtained from TI/AI at the address given in the Appendix. Some of our manuals are available in electronic form via the internet. Please visit our website at: www.teledyne-ai.com.

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DANGER
COMBUSTIBLE GAS USAGE WARNING

This is a general purpose instrument designed for use in a non-hazardous area. It is the customer's responsibility to ensure safety especially when combustible gases are being analyzed since the potential of gas leaks always exist.

The customer should ensure that the principles of operating this equipment are well understood by the user. Misuse of this product in any manner, tampering with its components, or unauthorized substitution of any component may adversely affect the safety of this instrument.

Since the use of this instrument is beyond the control of Teledyne Instruments/ Analytical Instruments, referred as TI/AI, no responsibility by TI/AI, its affiliates, and agents for damage or injury from misuse or neglect of this equipment is implied or assumed.

Introduction

Teledyne Model 6750 Total Organic Carbon Analyzer provides accurate and reliable on-line TOC analysis with Windows™ CE Operation, using the UV/Heated Persulfate Oxidation Method.

This manual includes all necessary information to help you install, operate and service your Analyzer.

The Model 6750 TOC Analyzers have been designed for easy operation and maintenance. Particular attention has been devoted to the design, whereby any module can be replaced by the operator within 15 minutes. Components such as the NDIR unit have been specifically designed with no moving parts and use a corrosion resistant design to further reduce maintenance tasks.

Operating the analyzer is easy. It uses a standard, industrial Windows CE computer programmed for complete automatic control (there are no operator manual adjustments). Operators are advised to study pertinent chapters in this manual to fully utilize the capabilities of the analyzer and avoid problems that could be associated with any instrument. The Model 6750 TOC is shown in Figure 1-1.

1.1 Main Features of the Analyzer

The Model 6750 TOC Analyzer is sophisticated, yet simple to use. The main features of the analyzer include:

- TC (Total Carbon) analysis
- NPOC (Non-purgeable organic carbon) analysis
- TOC-True Analysis (including volatile organics)
- Microsoft Windows Touch Screen Computer with Paperless Chart Recorder
- Two alarm levels
- One Master Fault Alarm
- 3 analog 4-20 mA outputs

- RS-232C and RS-485 outputs
- Separate electronics and liquid compartments

1.2 Options

The following options are available for the Model 6750 TOC Analyzer and are described in Appendix A.3:

- Correlated BOD/COD
- Dual NDIR Analyzers
- Benchmark/Auto Validation
- Auto-Cal/Auto-Clean
- Automatic Multi-Range
- Multi-Stream Analysis
- DBPR Drinking Water

1.3 Typical Applications

With excellent TOC accuracy from low parts-per-million to high concentration levels of salt-free samples, the Model 6750 is used in a variety of applications including:

	Boiler Feedwater
Standard Method 5310 C/D	Cooling Water
EPA 415.1	Drinking Water
EPA 9060	Wastewater (limited)
ASTM D 4839-88	River Water
ASTM D 4779-88	Oil in Water

1.4 Intended Use of the Analyzer

The Analyzer is exclusively designed for monitoring of Total Organic Carbon (TOC) in water. This intended use involves carefully following the instructions provided in this manual and observing all indicated warnings, hints and instructions.

All other types of usage beyond the intended use stated above, are considered as misuse of the analyzer. The supplier assumes no responsibility for damage incurred as the result of misuse of the product.

1.5 Operator Interface

The Model 6750 Analyzer is housed in a rugged metal case and may be wall or rack mounted for operator convenience.

The enclosure is equipped with a viewing window on the front panel and all operator serviceable components may be viewed through the cabinet window, including the display.

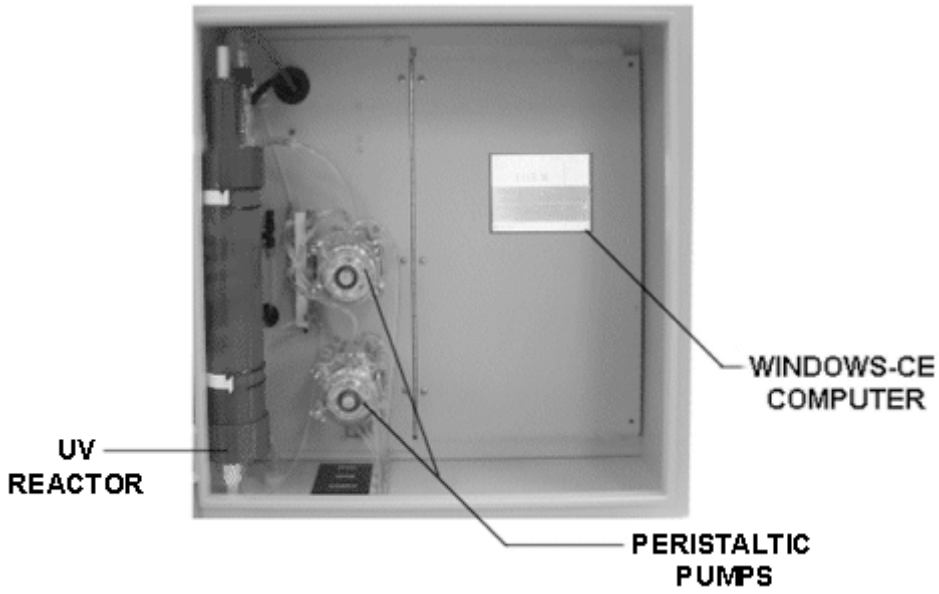


Figure 1-1: The Model 6750 TOC Analyzer (Front door removed)

All operations are automatic and are performed using the Windows Touch Screen Computer.

Theory of Operation

2.1 Overview

The Model 6750 Analyzer uses the UV/Heated Persulfate method of analysis and is well-suited for many applications involving accurate TOC analysis. The basic analyzer is configured for maximum utility using an advanced Microsoft™ Windows-based CE computer with touch screen. The analyzer is suitable for both general purpose and/or hazardous area classifications**,** if properly configured with required safety equipment.

2.2 Background

TOC analysis is the primary screening tool and control parameter for all water based applications but there are some discrepancies or misunderstanding in just what TOC is comprised of.

Many manufacturers claim TOC analysis capability without disclosing the limitations of their methods. Some treat all "TOC analyzers" as a commodity, with no distinguishing characteristics among them. Analytical results reported by the user can therefore be questionable, unless the TOC method is matched to the analytical requirement.

The following discussion is intended to provide the user adequate information in order to allow intelligent cost/performance trade-offs and select the appropriate TOC method for each application. The Model 6750 TOC Analyzer performs the following analyses on the SAME sample:

- TC: Total Carbon
- NPOC: Non-Purgeable Organic Carbon
- TIC: Total Inorganic Carbon
- POC (VOC): Purgeable Organic Carbon or Volatile Organic Carbon
- TOC-True : Total Organic Carbon

To perform correct TOC analysis, the analysis system must be capable of measuring all constituents of organic carbon present in the sample: Non-Purgeable Organic Carbon (NPOC) and Purgeable Organic Carbon (POC). Correct TOC analysis must also exclude the Total Inorganic Carbon (TIC) interference.

Figure 2-1 is a basic, commonly used technique to measure the NPOC, sometimes referred to as "TOC-Direct".

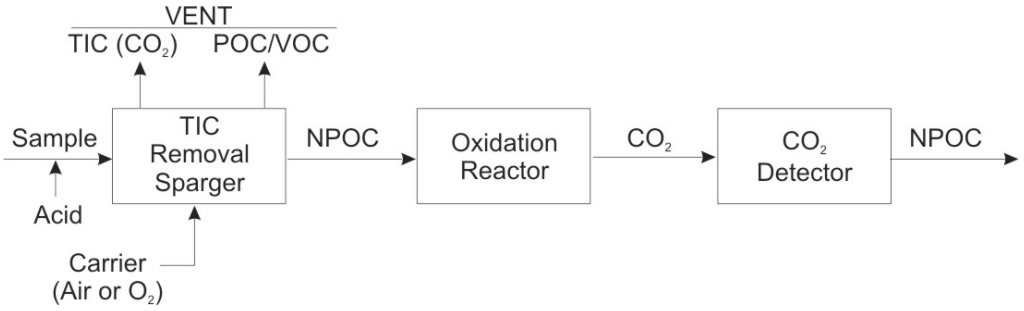


Figure 2-1: NPOC or TOC – Direct Method

In this method, acid is added to the sample, lowering its pH to approximately 2.0, at which point the carbonates present in the sample are converted to dissolved CO_2. In the sparger, the carrier gas strips (sparges) the CO_2 converted from the TIC and vents it, along with any purgeable (volatile) organics, leaving only NPOC in the sample. The resultant NPOC is then oxidized to CO_2 in the reactor and measured by the CO_2 detector as NPOC in the sample, often referred to and reported erroneously as "TOC".

In Figure 2-2 a preferred method of performing a "TOC- True" analysis is shown.

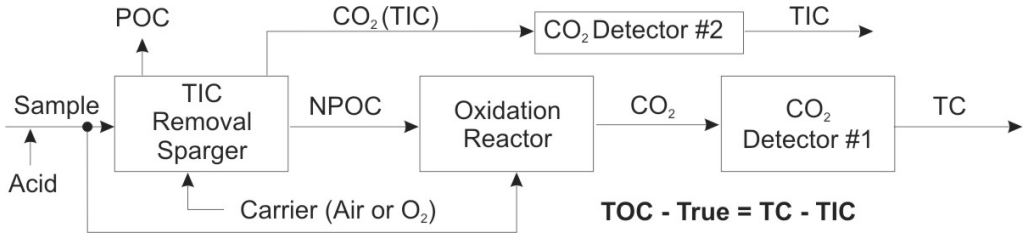


Figure 2-2: TOC – True Method

In this case, acid is added to the sample, lowering its pH to approximately 2.0, at which point the carbonates present in the sample are converted to dissolved CO_2. In the sparger, the carrier gas strips

(sparges) the CO_2 converted from the TIC and it is measured by an independent CO_2 detector as "TIC". POC is also stripped from the sample in the sparger as HC, but the HC is undetected by the CO_2 detector and does not interfere with the TIC measurement.

A portion of the same sample is also directed to the oxidation reactor, where inorganic and all organic carbon is converted to CO_2 and detected by a second CO_2 detector as "Total Carbon".

A mathematical subtraction of the TIC from the TC measurement yields a complete, Total Organic Carbon analysis performed as a "TOC-True" method.

$$TOC - True = TC - TIC$$

The difference between the Model 6750's TOC-True Method and other simple (TC-TIC) subtraction methods is that most other simple TC-TIC subtraction methods only deal with a TC measurement, then a *separate* TIC measurement and a simple mathematical difference to derive a "TOC" analysis.

In the TOC-True method used by the Model 6750, the analyzer actually performs both TC and TIC measurements simultaneously and continuously on the same sample. The TOC Measurement Basics and Methods are illustrated in Figures 2-3 and 2-4.

In conclusion:

1. NPOC is the preferred method if no POC/VOC is present in the sample.
2. TOC-True is the preferred method if POC/VOC exists in the sample and a TOC analysis is desired which includes all organic carbon species, for a TOTAL Organic Carbon measurement.

Carbon Definitions:

Total carbon (TC) = Total Inorganic Carbon (TIC) + Total Organic Carbon (TOC)
Total Inorganic Carbon (TIC) = (CO2) + (H2CO3) + (HCO3-) + (CO3-2)
Total Organic Carbon (TOC) = thousands of simple and complex biological and man made compounds

Basic TOC measurement methods:

DIFFERENCE METHOD: Measure TIC → oxidize → measure TC → CALCULATE TOC as:

TOC = TC - TIC

Method prone to large errors, due to the small differences in large numbers problem (particularly for high TIC)

DIRECT METHOD NPOC: Remove TIC → oxidize → MEASURE TOC DIRECTLY

Example:

Assumed instrument error: 3%

Difference Method: TOC = 2,000 ±60 ppb - 1,500 ±45 ppb = 500 ±105 ppb

Direct Method NPOC: TOC = 500 ±15 ppb

Figure: 2-3: TOC Measurement Basics

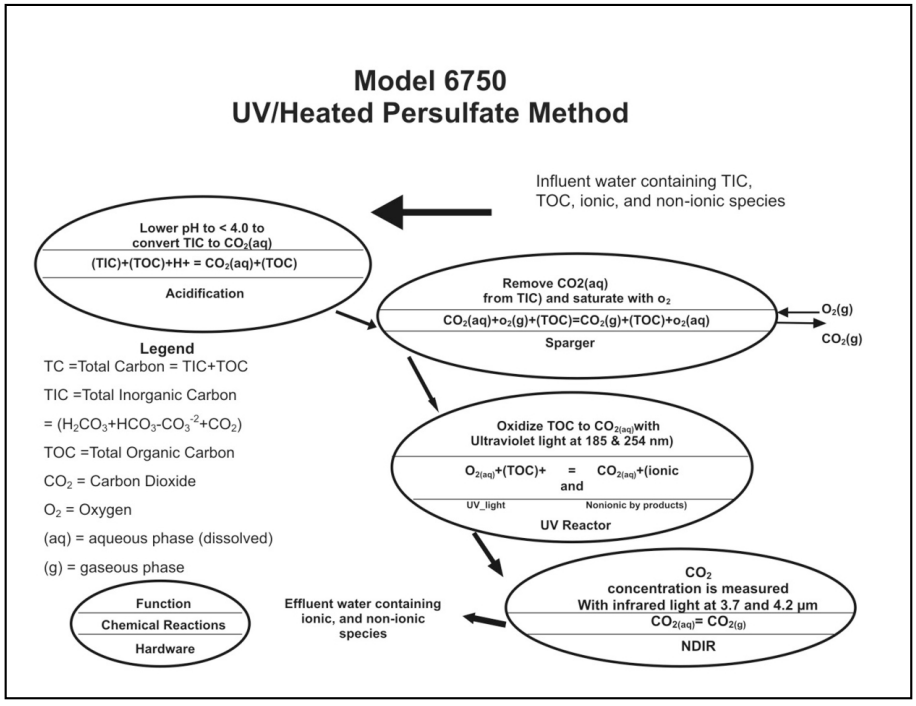


Figure 2-4: UV/Persulfate Method

2.3 The UV/Heated Persulfate Method of Analysis

In the UV/Heated Persulfate Method as used by the Model 6750, the sample is initially mixed with acid and directed to the sparger. For TOC-Direct (NPOC) analysis, the CO_2 converted from the inorganic carbon is sparged out of solution by the carrier gas and vented to atmosphere. Any volatile organic loss would occur at this point, exiting the sparger as HC gas. For TOC-True, the TIC-related CO_2 is measured by the NDIR CO_2 detector, which is blind to the HC. For NPOC analysis, the liquid, carbonate-free sample is then directed to the UV reactor, where the remaining organic carbon is oxidized to CO_2 and measured by the NDIR as a "TOC-Direct" (or NPOC) analysis.

NDIR analysis of CO_2 is specific and interference-free and is used in all critical and regulatory applications. The TOC-Direct method is the most accurate TOC analytical method, as determined by the EPA and other governmental agencies. Teledyne also offers conductivity detection but it is of limited use in these applications and is not proposed as a primary detection method for TOC analysis, especially in critical industrial applications where multiple or unknown analytes are present. Figure 2-5 compares both CO_2 detection methods.

For the TC analysis, the combined liquid/gas sample is sent directly to the reactor, where all carbon (including the volatile HC) is converted to CO_2. The NDIR thus measures the TOTAL_CO_2 (including that generated from the TIC, volatile HC and NPOC) and reports it as "TC."

The important thing is that all measurements are made on the **same sample**, eliminating potential sample introduction errors and multiple sampling inaccuracies.

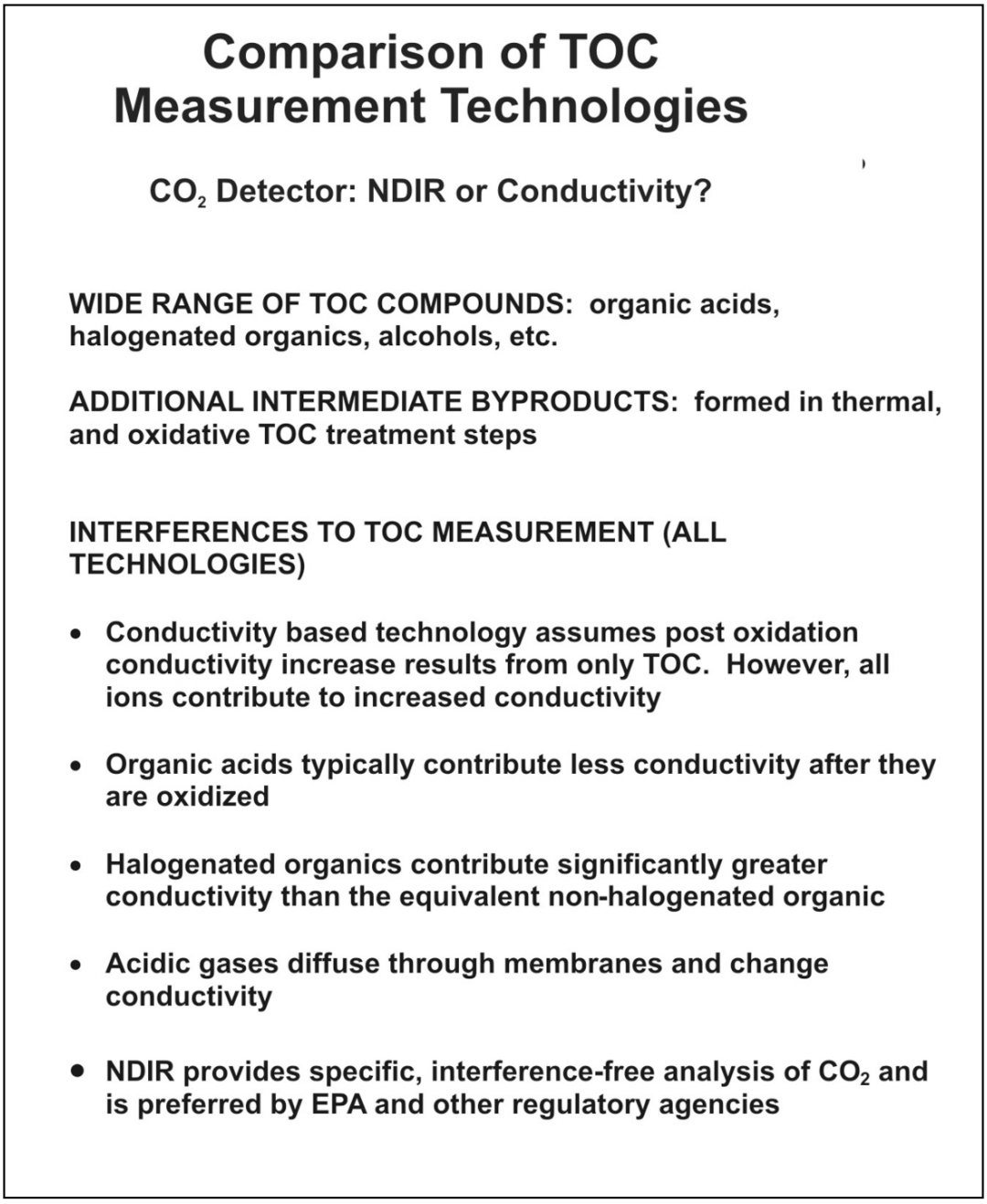


Figure 2-5: Comparison of TOC Measurement Technologies

2.4 Subsystems Principles of Operation

The Model 6750 TOC Analyzer is comprised of five subsystems:

1. Sample Handling
2. Inorganic Carbon Removal
   – OR –
   Inorganic Carbon Analysis/TOC-True Method
3. Oxidation
4. NDIR CO_2 Gas Detection
5. Electronic Signal Processing, Display and Control

The sample system is designed to accept the liquid sample and any required reagents, transporting them through the analyzer to the appropriate components. For TOC (actually, NPOC) analysis, the sample is pumped initially to the sparger, where it is mixed with acid to lower the pH between 2.0 and 3.0. At that pH, all inorganic carbon/carbonates are converted to dissolved CO_2 gas, which is sparged out of the liquid solution by the air/O_2 carrier gas. At this point, any volatile organic carbon is also sparged out and lost for inclusion in the "TOC" analysis, unless a TOC-True analysis is performed, as described below.

2.4.1 Sample Handling

The sample is processed through the analyzer in two phases: liquid and gaseous

2.4.1.1 LIQUID PHASE SAMPLE HANDLING

Referencing Figures 2-6 and 2-7, the sample is introduced to the analyzer with a self-priming peristaltic pump (P-4). It is then initially directed to the Inorganic Carbon (IC) Sparger, where it is mixed with acid delivered by pump (P-2). The pH of the solution is lowered to approximately 2, converting the inorganic carbon to CO_2, which is sparged out by the carrier gas and measured as Total Inorganic Carbon (TIC) by an infrared analyzer (NDIR-2) in the "TOC-True" mode.

The "TOC-True" mode is the preferred method of use if volatile hydrocarbons are present, which would otherwise be lost in the sparging process. Thus, through subsequent analysis of Total Carbon (TC) and

actual measurement of the TIC, a more accurate TOC is achieved since (TOC = TC - TIC).

"TOC-Direct" mode is preferred for accuracy when no or little volatiles are present. In this mode, the carbonate-free sample is extracted from the organic carbon reactor and measured directly as TOC. Pump (P –1) continuously introduces the carbonate-free sample to the reactor. No valves or complicated injection mechanisms are required. The remaining organic carbon is oxidized to CO_2 in the reactor. The resultant gaseous stream is directed to a gas/liquid separator and then to the NDIR. The CO_2 gas is analyzed by the infrared analyzer (NDIR) as a direct correlation of Total Organic Carbon (TOC).

A computer controls all functions and outputs. A "Touch Screen" provides operator interface and a paperless chart recorder utility.

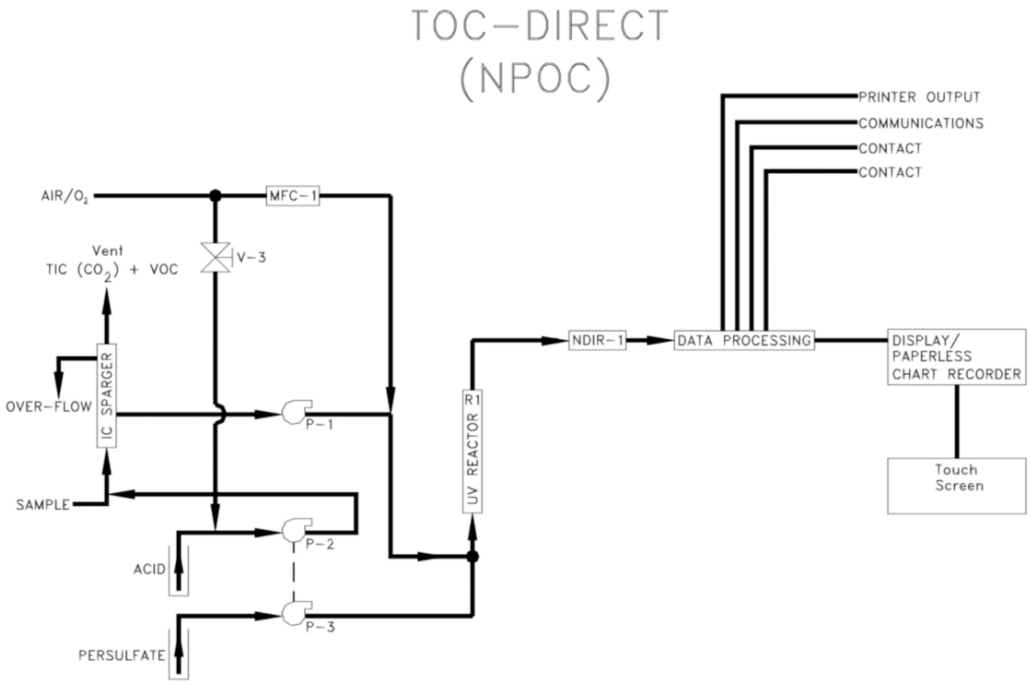


Figure 2-6: Sample Handling for TOC -Direct

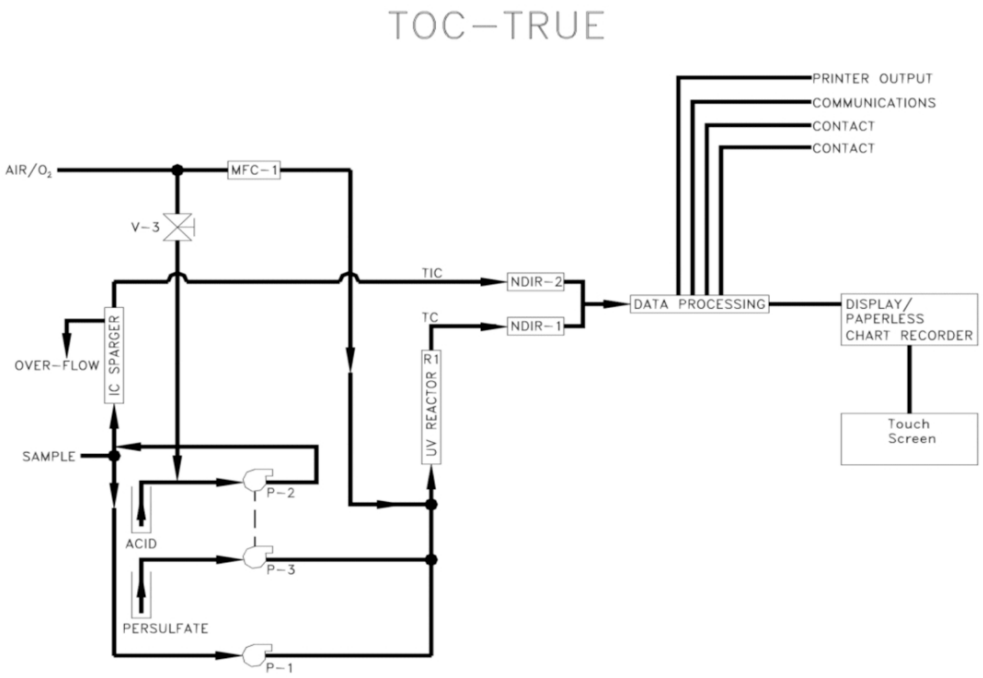


Figure 2-7: Sample Handling TOC-True

2.4.2.2 GAS PHASE SAMPLE HANDLING

Referencing Figure 3-5 and "As Built" drawings in the Appendix, a carrier gas of (99.8%) pure oxygen or CO_2 and hydrocarbon-free air is required. Erroneous TOC analysis will occur if the carrier gas has these impurities, since both CO_2 and Hydrocarbon gases will contribute a higher TOC value to the analysis than is actually present in the sample.

An Oxygen Generator (P/N ST200025) is available from Teledyne that separates oxygen from the ambient air. It is a pressure swing absorption PSA device requiring only electricity only to operate. Also available from Teledyne is an Instrument Air Purifier (P/N ST200019). This device can supply the oxygen demands of the instrument using facility instrument air.

Facility carrier gas is introduced to the analyzer, regulated at 15± 2 psi, and then controlled by an internal mass flow controller (MFC-1) to precisely control the flow rate of the carrier.

Note: Precise carrier gas flow control is mandatory for accurate

TOC analysis in a continuous, on-line TOC analyzer.

The CO_2 generated by the oxidation of carbon in the reactor is read by the NDIR as a percentage concentration of the CO_2 in the carrier gas.

$$\frac{CO_2 \text{ (TOC)}}{CO_2 \text{ (TOC)} + \text{Carrier}}$$

Any increase or decrease of the carrier flow rate will have a corresponding inverse effect on TOC reported value, (eg. double the carrier flow rate, reported TOC will approximate ½ of actual sample TOC concentration).

The Model 6750 uses a computer-controlled mass flow controller rather than a less accurate system consisting of pressure regulation with a flow meter in a capillary system.

The inorganic carbon removal system (sparger) flow rate is controlled by needle valves (V1 & V2) set at the factory. The operator will note bubbles through the liquids in the sparger, which is stripping the CO_2 converted from the carbonates to eliminate the potential interference from inorganic carbon in TOC analysis.

The carrier gas directs the CO_2 and other products of oxidation from the reactor to the Gas/Liquid Separator (GLS), where liquid waste is directed to drain and gases containing CO_2 and other gaseous products of oxidation are directed to the CO_2 specific NDIR. The CO_2 concentration is directly related to sample TOC concentration and is reported accordingly.

2.4.2 Inorganic Carbon Removal/Analysis

The choice of either TOC –Direct (NPOC) or TOC-True analysis involves a method of either measuring the TIC (for a TOC-True analysis) or not (for a Non-Purgeable TOC analysis only). The Model 6750 Analyzer can perform either method. The TOC-True method measures the inorganic carbon and is able to detect volatile organic loss in the sparger. The NPOC analysis ignores the volatile organics for a less precise NPOC analysis if organic volatiles are present.

The sparger used in the Model 6750 is a gas/liquid counter-flow stripper. Actual acid addition depends on the amount of sample buffering and pH. Factory set-up is for a nominal sample pH of 7.0, to

be reduced to approximately 2.0 to 3.0. If the sample pH is not properly reduced as described in Figure 2-8, increase the normalcy of the acid reagent until the water exiting the sparger drain is between 2.0 and 3.0.

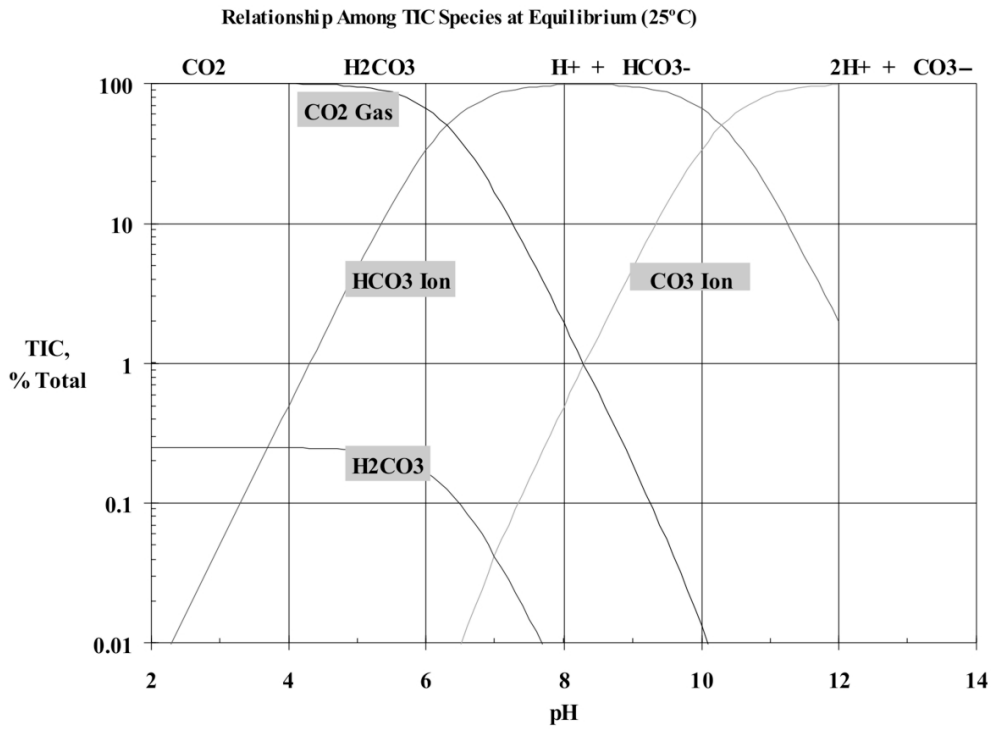


Figure 2-8: Relationship Between TIC and pH

2.4.3 Oxidation

The UV reactor and persulfate reagent provide oxidation of the carbon to CO_2. The UV reactor consists of the following:

- Mounting enclosure with viewing window
- Borosilicate reactor body
- Heater/Temperature sensor
- UV Lamp
- Miscellaneous fittings and clamps

The construction of the patented UV reactor in the Model 6750 affords superior oxidation by precisely controlling the sample temperature, adding a precise amount of ultra-pure persulfate reagent (P/N ST40000) and precisely controlling the carrier gas flow rate.

Pump (P-1) continuously meters a precise amount of carbonate-free sample from the sparger to the UV reactor. Pump (P-3) continuously meters a precise amount of persulfate reagent to the reactor. Mass Flow Controller (MFC-1) precisely controls the carrier flow rate. Refer to Figures 2-6 and 2-7.

Figure 5-10 shows UV oxidation methodology.

UV Oxidation

Generation of oxidant by UV energy:

$$2H_2O + O_2 \xrightarrow{185\ nm} H_2O + O_3 + 2H^+ \leftrightarrow 4[OH^*]$$

Hydrocarbon oxidation:

$$C_xH_y + (4x + y)[OH^*] \longrightarrow xCO_2 + (2x + y)H_2O$$

Excess O_3 is decomposed by absorption of 254 nm UV energy:

$$H_2O + O_3 + 2H^+ \xrightarrow{254\ nm} H_2O_2 + O_2 + 2H^+ \leftrightarrow 4[OH^*]$$

The overall reaction:

$$C_xH_y + ((4x + y)/4)O_2 \longrightarrow xCO_2 + (y/2)H_2O$$

Oxidant is produced as:

$$2H_2O + O_2 \xrightarrow{185\ nm} 4[OH^*] \xrightarrow{254\ nm} H_2O + O_3 + 2H^+$$

Figure 2-9: Oxidation Reactions

2.4.4 NDIR CO_2 Gas Detection

The key component for reliable TOC analysis is the precise and interference-free detection of CO_2. The Model 6750 NDIR unit requires very little maintenance because of its ability to handle the corrosive gases generated in TOC analysis. This is due in part to its non-reflective borosilicate sample cell. It has no moving parts which further reduces the maintenance load and it uses an internal self-calibrating technique.

The NDIR unit is shown in Figure 2-10. Some of the features of the NDIR unit are as follows:

- Specific, interference-free CO_2 detection
- Dual-wavelength rationing compensates for drift
- Computer-controlled for accuracy
- Sapphire protected optics
- Non-corrosive, non-reflective sample cell (borosilicate)
- No moving parts or tools required for easy maintenance and service
- No critical realignment required

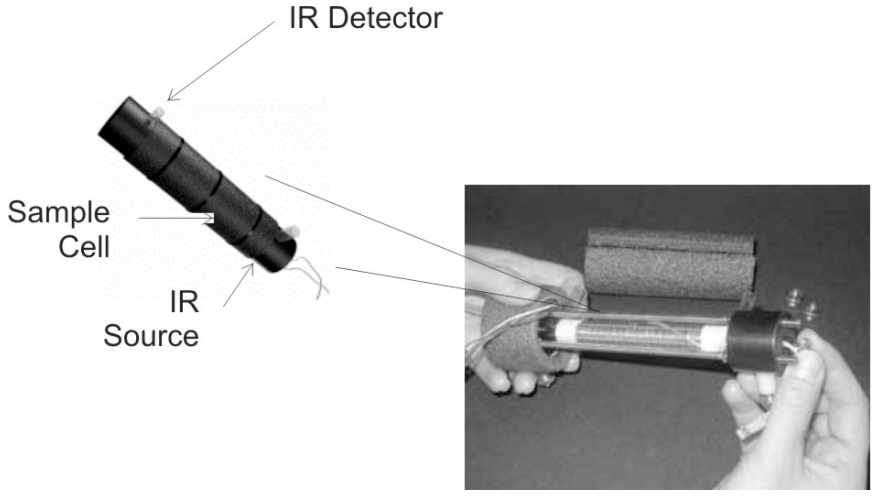


Figure 2-10: Model 6750 NDIR Unit

The NDIR CO_2 detector uses a completely solid state, dual wavelength ratioing technique with a single borosilicate sample cell that

requires no wall reflectivity and is completely resistant to corrosive gases. The NDIR unit requires no optical chopper motor or mechanical devices but utilizes a single flashing infrared source to optically "chop" the infrared (IR) beam, which equally irradiates CO_2/reference detectors. Using a reference eliminates water vapor interference. The non-reflective, corrosive resistant sample cell removes the requirement for chemically removing acid gases prior to detection.

Automatic gain control (AGC) is employed during the reference/sample cycle to compensate for such factors as IR source deterioration, dirty optical windows, etc. When the AGC level reaches a predetermined threshold, an optics alarm is activated. Malfunctions of major NDIR components are detected and indicated as an alarm, providing "fail-safe" operation. Signal detection is completely synchronous and because of the differential ratioing technique, drift is virtually eliminated.

All critical optics are protected by sapphire windows. The NDIR optical bench can be easily disassembled and windows cleaned (rarely ever required) and reassembled within fifteen (15) minutes, without realignment or the use of any tools.

The benefit of this absolute measuring, dual line spectral differential analytical technique, is that it provides simple, direct measurement of all CO_2 contributing factors (including background) for a true and accurate calibration, and precisely offsets these effects for very accurate TOC determinations.

2.4.5 Electronic Signal Processing, Display and Control

A true, industrialized Microsoft Windows™-CE Computer offers complete automatic control of the analyzer, including the following:

- Benchmark/Auto-Validation
- Auto-Calibration
- Auto-Cleaning
- On-Board Historical Data for up to one (1) year
- Paperless Chart Recorder
- Diagnostics
- Networking (RS-232C/485)

2.4.5.1 BENCHMARK/AUTO-VALIDATION

Benchmark is the European NAMUR* specified validation technique, whereby on command a chemical calibration standard is automatically introduced to the analyzer and the response is compared to the previous analyzer calibration. If the response falls within a certain specified limit, the computer/output indicates "Benchmark Passed". If the response falls outside specified performance limits, either a "Maintenance Request" or a "Fault" alarm is activated, depending on preset tolerances.

Thus, in cases of process spills, when the analyzer performance is questioned, Benchmark can rapidly and automatically validate analyzer performance. It eliminates time consuming and unnecessary recalibration cycles, which take the analyzer out of service just when it is most critically needed. Benchmark may be on-demand, or operator programmed for designated day and time activation on a repetitive basis.

On command (manual or automatic by selection of day/time), the combination of valves V3 and V4 divert the sample and introduce a liquid calibration solution to the analyzer. This is the same calibration solution used to previously calibrate the analyzer, "end-to-end". If the TOC value from the calibration solution falls within a limit (generally set at 5% of the previous calibration), then "Benchmark Passed" will be displayed and remotely reported. If the TOC "Benchmark" solution falls outside the set tolerance, then a "Benchmark Failed" message and a "Maintenance Request" are reported.

2.4.5.2 AUTO-CALIBRATION

On command (manual or automatic by selection of day/time), the combination of valves V3 and V4 alternately introduce D. I. water for a "Zero" calibration and the "Span" solution. The computer then resets the analyzer to the new calibration values.

2.4.5.3 AUTO-CLEANING

On command (manual or automatic by selection of day/time), the combination of valves V3 and V4 operate to introduce a "cleaning" solution, depending on the chemical constituents of the sample. Acid or persulfate is generally used.

Installation

This manual contains "AS BUILT" drawings and a parts list to aid in the installation and operation of the analyzer. These drawings should be referred to when ordering spare parts, operating or servicing the equipment. See the Appendix for the AS BUILT drawing package.

Installation of the Model 6750 On-line UV/Heated Persulfate TOC Analyzer includes:

1. Unpacking
2. Mounting
3. Electrical Connections
4. Gas Connections
5. Testing the System

3.1 Unpacking the Analyzer

The analyzer is shipped with all the materials you need to install and prepare the system for operation. Carefully unpack the analyzer and inspect it for damage. Immediately report any damage to the shipping agent.

3.2 Mounting the Analyzer

The analyzer is for indoor use in a general purpose area. The Hazardous Area Option should be used for applications involving hazardous areas.

The standard model is designed for wall or rack mounting. Figure 3-1 is an illustration of the mounting and Figure 3-2 shows the required front door clearance. There are four mounting holes – one in each corner of the enclosure. Refer to "As Built" drawings in the Appendix.

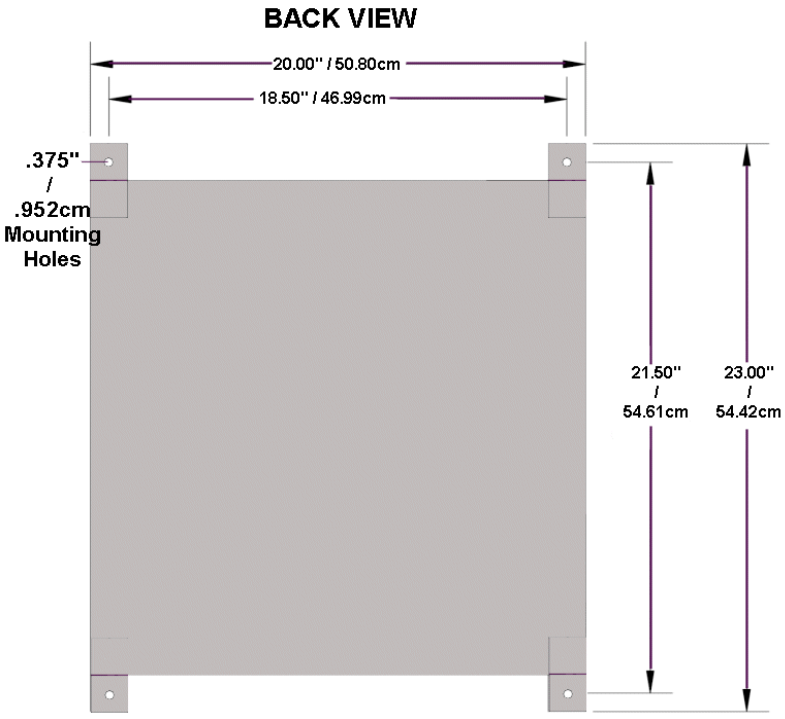


Figure 3-1: Analyzer Dimensions

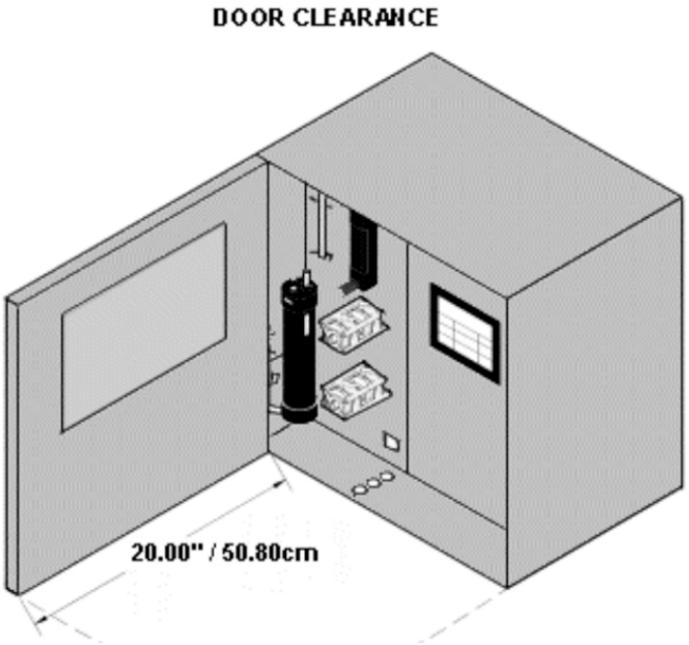


Figure 3-2: Required Door Clearance

All operator controls and serviceable components are mounted on the control panel, which is hinged and doubles as the door that provides access to those components not normally requiring maintenance.

Internal components of the Model 6750 TOC Analyzer are shown in Figure 3-3.

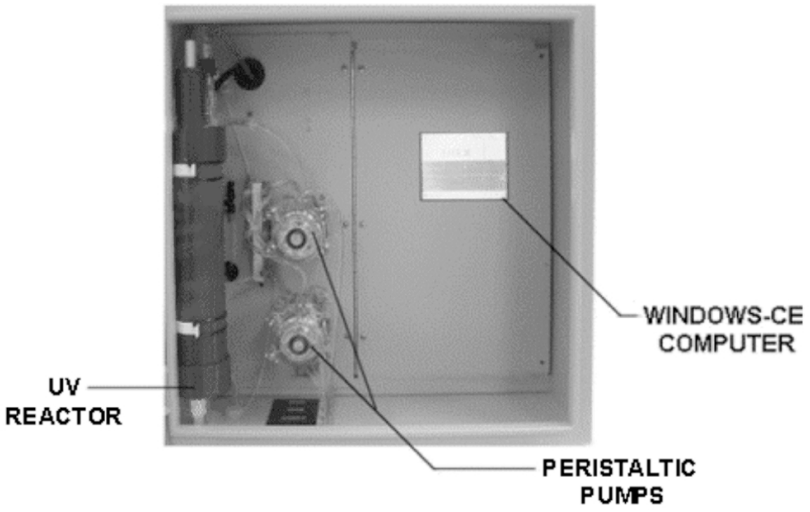


Figure 3-3: Internal Components of the Model 6750 Analyzer

3.3 Electrical Connections

Figure 3-4 shows the analyzer electrical/electronics connections for power, communication, and both digital and analog concentration outputs. See also the AS-BUILT drawing package included in the Appendix.

3.3.1 Power Connection

The universal power supply requires an 85-250 VAC, 47-63 Hz power source.

For safe connections, ensure that no uninsulated wire extends outside the connectors they are attached to. Stripped wire ends must insert completely into terminal blocks. No uninsulated wiring should be able to come in contact with fingers, tools or clothing during normal operation. Electrical/Electronics hookups include the following:

- Power ConnectionUniversal AC Power Source
- Primary Input Power

CAUTION: **POWER IS APPLIED TO THE INSTRUMENT'S CIRCUITRY AS LONG AS THE INSTRUMENT IS CONNECTED TO THE FACILITY POWER SOURCE. THE FACILITY MUST HAVE AN EXTERNAL POWER SWITCH TO REMOVE PRIMARY POWER FROM THE ANALYZER.**

- Analog Output Connections
- Alarm Connections

Figure 3-4 shows where the electrical connections are made to the instrument.

3.3.2 Analog Outputs

There are two analog output signal connections. There are two wires per output with the polarity noted. See "As Built Drawings" in the Appendix. The outputs are non isolated 4-20 mA.

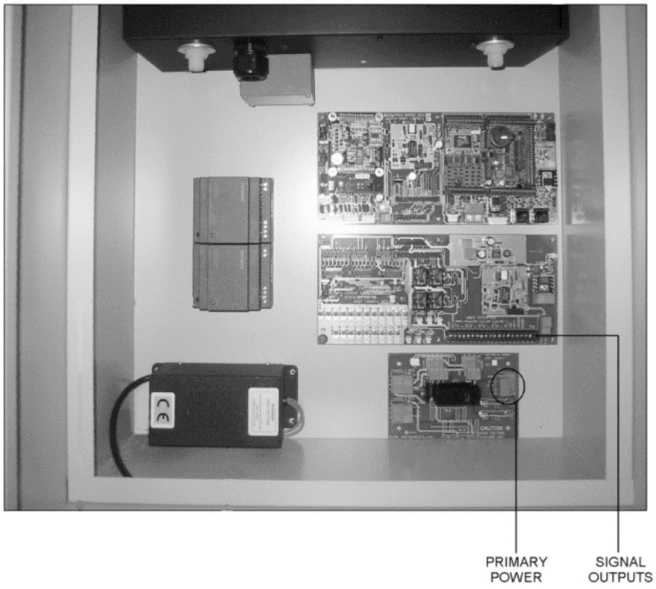


Figure 3-4: Electrical Connections to the Model 6750

3.3.3 Alarm Connections

The Model 6750 is equipped with two concentration alarms and one analyzer malfunction alarm. The three alarm-circuit connectors use spring terminals for making connections to internal alarm relay connects. Each alarm provides a set of Form C contact with both normally open and normally closed contact connections. The contact connections are indicated by diagrams on the rear panel. They are capable of switching up to 3 amperes at 250 VAC into a resistive load. See "As Built Drawings" in the Appendix. The connections are:

- Threshold Alarms:
  - Can be configured as high (actuates when concentration is above setpoint), or low (actuates when concentration is below threshold).
  - Can be configured as failsafe or non-failsafe.
  - Can be configured as latching or non-latching
- Malfunction Alarm

3.3.4 RS-232 Serial Connection

An RS-232 port is provided for serial communication (MODBUS). Connect a standard RS-232 cable from the computer to the RS-232 port on the main board.

3.4 Gas/liquid Connections

Refer to the "As Built Drawings" in the Appendix for details and Figure 3-5.

The Model 6750 Analyzer provides easy access for liquid, gas, vent and drain connections.

3.4.1 Liquid Connections

Liquid phase sample connections include the following: (See Figure 3-5):

- Sample (On-Line)
- D. I./Dilution Water
- Calibration Standard

- Reagents
- Drain (s)

Connect these lines as per Figure 3-4 and the AS-BUILT drawings in the Appendix. Make sure there are no restrictions or kinks in the sample lines.

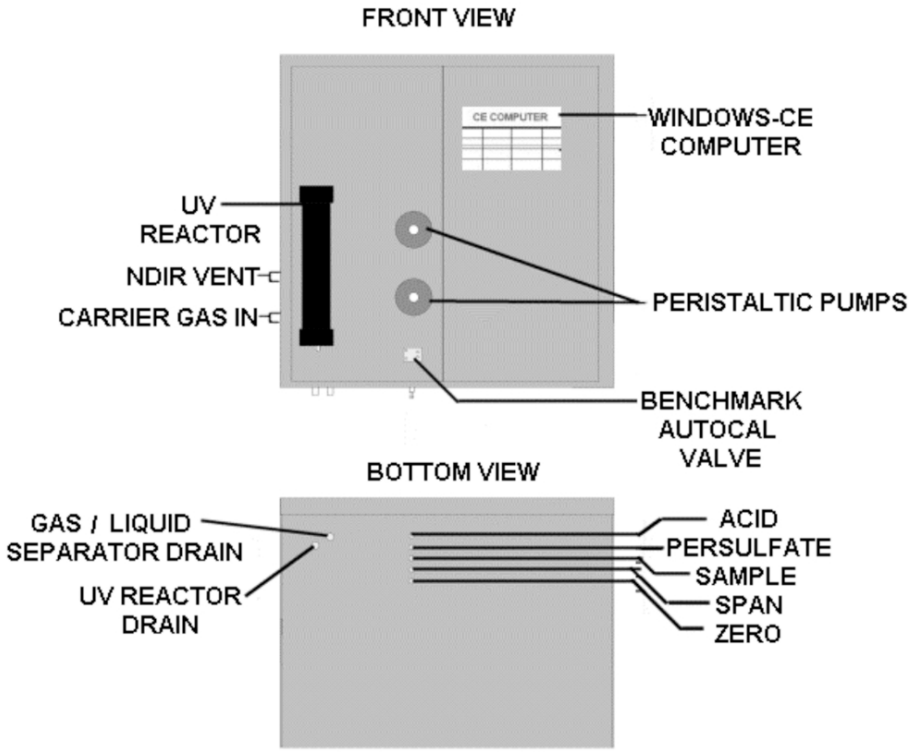


Figure 3-5: Gas and Liquid Connections to the Analyzer

3.4.2 Gas Connections

The gas connections include:

- Sample Gas
- Carrier Gas
- Vent
- Calibration Gases (zero and span)

With the exception of the vent and carrier gas inlet, all other gas connections are made on the same bottom panel as the liquid connections and are shown in Figure 3-5. The NDIR vent and carrier gas connections are made on the left side of the unit.

Gas Carrier Connections:

The facility carrier gas must be free of CO_2 and hydrocarbons and be regulated to 15±2 psi and connected as shown in "As Built" Drawings in the Appendix).

NDIR Vent (gas exhaust):

Exhaust connections must be consistent with the hazard level of the constituent gases. Check Local, State, and Federal laws, and ensure that the exhaust stream vents to an appropriately controlled area if required.

CAUTION: OPERATING THE UNIT WITHOUT CARRIER GAS CAN DAMAGE THE ANALYZER.

3.5 Checking the System

Before applying power to the instrument, check:

- All gas and liquid lines as well as vent and drains are properly connected and there are no leaks in the lines or at fittings.
- Power and signal wiring are correct and that there are no frayed or loose wires that could cause a short.

Prior to powering up the system and using the instrument for analysis, the system must be configured for your application and calibrated. This is described in Section 4.

Setup and Operation

Once the analyzer has been installed, it can be configured to your application. To do this you will:

- Set system parameters
- Calibrate the instrument
- Define the analysis range. Then choose auto-ranging or select a fixed range of analysis, as required.
- Set alarm setpoints, and modes of alarm operation (latching, failsafe, etc.)

4.1 Analyzer Startup

Referring to the Installation section and "AS-BUILT" Drawings in the Appendix, check the following:

1. Air/oxygen supply – This must provide a constant pressure of 15 +/- 2.0 psi, ultra-pure oxygen or CO_2–free air at a flow rate up to 500 cc/minute. (Pre-purified air may be used with optional Air Purifier P/N ST910003).
2. Drain Line – Check to see if the drain line is free of kinks and loops and allows normal vented gravity flow to an open receptacle (jar, pipe, etc.). AN AIR GAP AS DEFINED IS MANDATORY.

CAUTION: FAILURE TO OBSERVE THIS WILL RESULT IN IMPROPER OPERATION.

3. ELECTRICAL – Assure proper electrical installation. Refer to facility requirements.
4. SAFETY – All customer and Teledyne specified safety measures are followed.

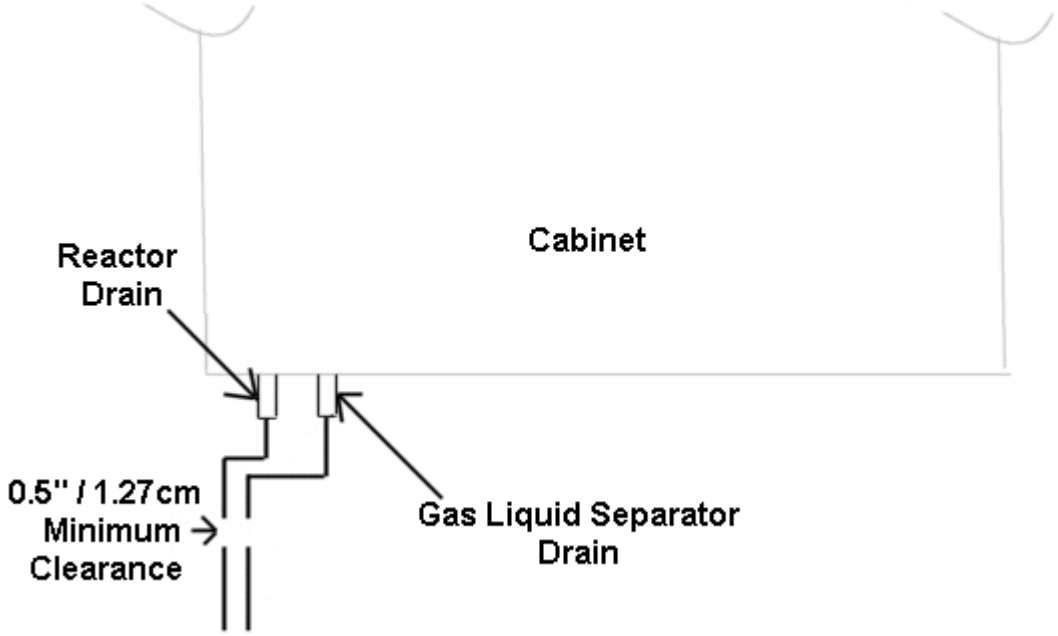


Figure4-1: Drain Connections

5. On initial start–up or after UV Reactor or Glass Liquid Separator (GLS) servicing, fill the U-Tube with D. I. water as indicated in Figure 4-2.
6. After all of the above checks, turn analyzer ON by activating the facility power switch. The system starts up in Run Mode.
7. Immerse line from "sample" port of the analyzer into D. I. water container.
8. Immerse persulfate line from the "persulfate" port of the analyzer into persulfate container.
9. Immerse acid line from the "ACID IN" port of the analyzer into ACID container.

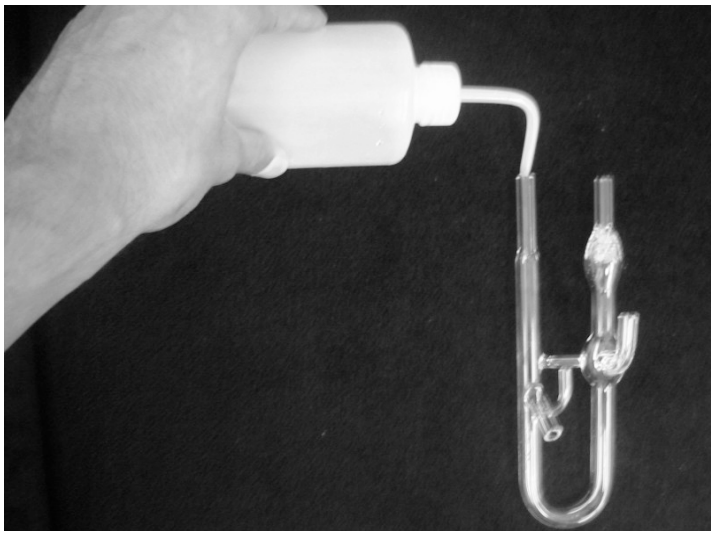


Figure 4-2: Gas Liquid Separator D. I. Filling

After reagents and DI have filled all tubing lines, it is recommended to proceed with IR Calibration followed by cal (liquid calibration) of the system. Then the analyzer may be placed in service.

4.2 Menus

The advanced design of the Model 6750 TOC Analyzer eliminates complicated, routine, and sometimes confusing menus. The operator/software interface is simple and easy to use. Menus prompt the user for required actions or input.

The analyzer has no manual adjustments. All calibrations and operations are computer controlled by the operator following menu prompting and selection of the operation of choice.

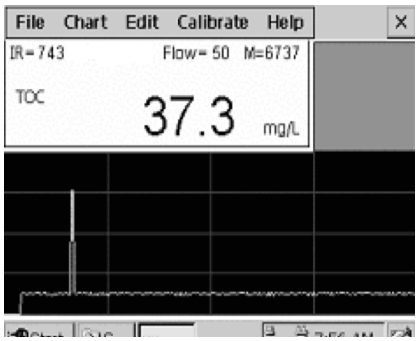
The following menu and operation descriptions are intended to guide the operator through all the functions of the analyzer.

After primary power (110/220VAC) has been applied to the analyzer and self-diagnostic procedure has been completed, the system automatically boots up to the following RUN Screen. If not, turn main power OFF, then ON to reboot.

4.2.1 Run Mode

RUN – This is the normal analysis mode. In this mode, the display indicates:

- The current TOC value,
- [IR] IR response
- [Flow] Carrier Gas Flow rate
- [m] Available Memory (kb).

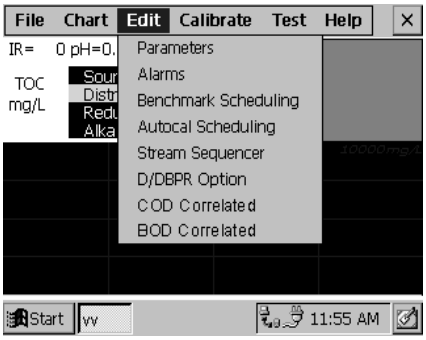


4.2.2 Parameter Menu

Although your analyzer has been optimally configured for your application, on initial startup the setup parameters should be verified Consult Factory Settings for Your Application – "As Built Drawings" in the Appendix.

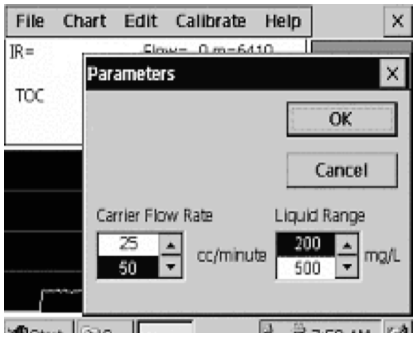
To get to the Parameters menu:

1. From the Run Screen, select [EDIT]. The following menu will appear.



Note: Options not included in your analyzer will have no response, if selected.

2. From this menu, select:[Parameters]
   The following screen appears:



This is the Parameters menu from which the analyzer may be configured to suit the requirements of the operator

Verify the following settings are correct or select the desired settings: (Consult "As Built Drawings' in the Appendix and Factory Settings Chart – Page V")

- Carrier Flow Rate
- Liquid Range

Note: The "Liquid Range" setting is that value to which the full-scale output range is to be set (not the value of the Liquid Span).

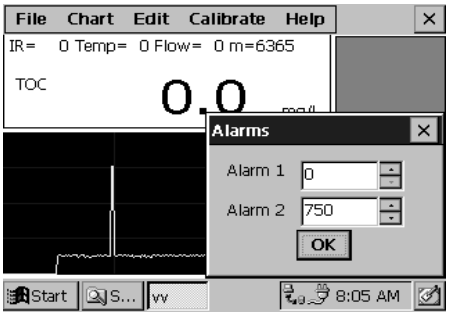
4.2.3 Alarm Settings

The next settings to verify or set are the Alarm Settings.

To adjust the alarm settings:

From the [Edit] Menu, select [Alarms].

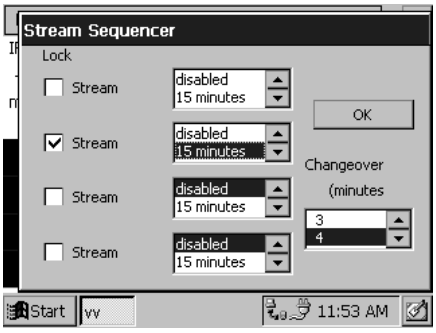
The following Menu appears:



From this menu verify or change the concentration alarm setpoints using the onscreen scroll arrows.

4.2.4 Stream Sequencer

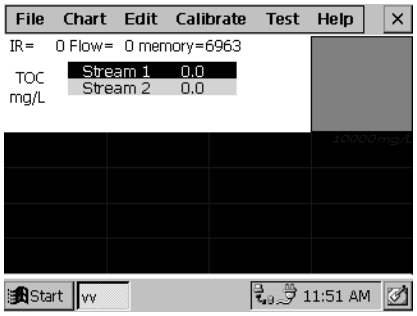
If your analyzer has been configured for a multi-stream sequencer (P/N ST200009), from the [Edit] Menu, select [Sequencer]. The following menu appears:



From this menu, you can:

- Configure the duration of analysis for each stream (how long it will analyze that stream before selecting the next stream)
- Configure the changeover time (to allow the prior stream to pass through sampling systems and clear the analyzer before analysis of the next steam begins),
- Enable and disable each stream analysis (for example, to concentrate on only one stream).

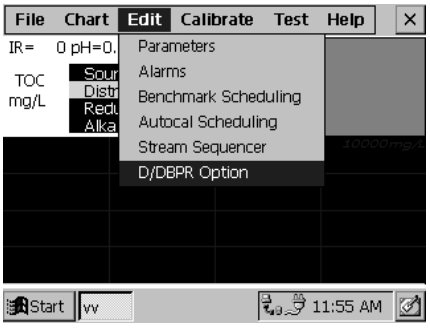
The following window is illustrative of a dual stream [Run] screen.



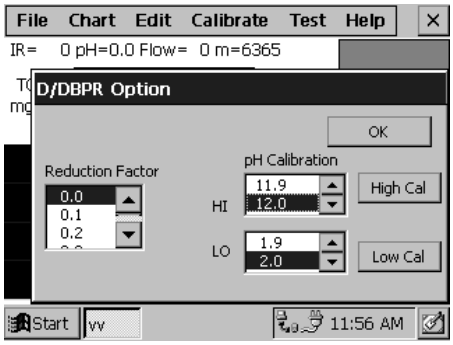
4.2.5 D/DBPR

This optional utility allows convenient external pH calibration and input of alkalinity data consistent with the D/DBPR requirements

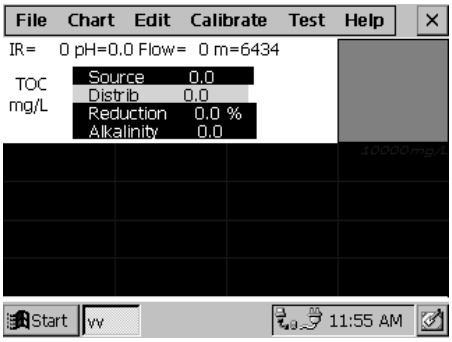
If your analyzer has been configured for the D/DBPR option, from the following [Edit] Menu, select [D/DBPR].



The following screen appears:



The following window is illustrative of the D/DBPR [Run] screen.



4.3 Detailed Calibration Procedures

1. Although the instrument has been calibrated to your specifications at the factory, it should be rechecked after satisfactory installation and periodically calibrated as suggested for your application.
2. Instrument calibration is performed by an “end-to-end” method, whereby a known organic carbon chemical standard solution is introduced to the analyzer and the analyzer is “spanned” to that value.
3. Organic and Inorganic Carbon Standards:
   a. (Potassium Hydrogen Phthalate) is recommended for the organic carbon standard solution.
   b. Sodium Carbonate is recommended for the inorganic carbon standard.
   c. Table 4-1 provides the concentration to be used for two ranges of different chemical compounds (organic & inorganic carbon).
   d. Ratioing of these concentrations will provide other ranges for the span solution.

Table 4-1: Preparation of Standards (TOC/TIC)

ORGANIC COMPOUNDS	100 mg/Liter TOC (AS CARBON)	1000 mg/Liter TOC (AS CARBON)
Ethylene Glycol	.233 ml/L H_20	2.33 ml/L H_20
Methanol	.337 ml/L H_20	3.37 ml/L H_20
Ethanol	.242 ml/L H_20	2.42 ml/L H_20
Acetone	.204 ml/L H_20	2.04 ml/L H_20
Carbon Tetrachloride	.807 ml/L H_20	8.07 ml/L H_20
Sucrose	.238 gm/L H_20	2.38 gm/L H_20
Urea	.500 gm/L H_20	5.00 gm/L H_20
Acetic Acid	.250 gm/L H_20	2.50 gm/L H_20
KHP (Potassium acid phthalate)	.212 gm/L H_20	2.12 gm/L H_20
Glycine	.313 gm/L H_20	3.13 gm/L H_20
Sodium Stearate	.141 gm/L H_20	1.41 gm/L H_20
Succinic Acid	.246 gm/L H_20	2.46 gm/L H_20
Sodium Oxalate	.555 gm/L H_20	5.55 gm/L H_20

INORGANIC COMPOUNDS	50 mg/Liter TIC (AS CARBON)
Sodium Carbonate	.442 gm/L H_20
Potassium Carbonate	.575 gm/L H_20
Ammonium Carbonate	.475 gm/L H_20

Add amounts shown (in milliliters or grams) to clean dry, one liter volumetric flask and dilute to one (1) liter with distilled, deionized water.

4. Reagent Preparation:

PREPARATION OF ONE MOLAR SODIUM PERSULFATE SOLUTION (OXIDIZING REAGENT)

CAUTION: **SODIUM PERSULFATE IS A STRONG OXIDIZING AGENT. TAKE ALL NECESSARY PRECAUTIONS AS WITH HANDLING ANY CORROSIVE MATERIAL.**

ALL CHEMICALS, INCLUDING WATER, SHOULD BE REAGENT GRADE OR BETTER AND FREE OF CARBON-CONTAINING COMPOUNDS.

THE CONTAINER USED SHOULD BE FLUSHED WITH DISTILLED OR DEIONIZED (DI) WATER.

a. Dissolve 238 grams of ultra-pure reagent grade sodium persulfate (P/N ST40000) into one (1) liter of distilled water.

b. Do not heat reagent to dissolve, as this is not necessary and can reduce the effectiveness of the solution. It should be noted that some reagent grade sodium persulfate is not really "pure". All persulfate supplied by Teledyne is guaranteed to have sufficient purity for proper operation.

5. Acid Preparation:
Phosphoric Acid is the acid of choice.

PREPARATION OF PHOSPHORIC ACID SOLUTION

a. The container used should be flushed with distilled or deionized (DI) water.

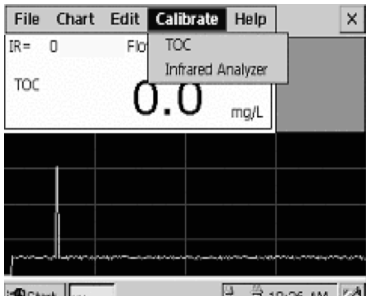
b. Add 117ml of 85% phosphoric acid to one (1) liter of DI Water.

CAUTION: **CONTACT WITH PHOSPHORIC ACID LIQUID OR VAPOR CAN DAMAGE TISSUE, CAUSE EYE DAMAGE, RESULT IN SEVERE BURNS AND CAUSE LUNG AND RESPIRATORY DAMAGE. WEAR PROPER PROTECTIVE CLOTHING AND SAFETY GLASSES WITH SPLASH SHIELDS. TREAT ALL ACIDS WITH CAUTION AND HANDLE WITH CARE. ALWAYS WORK IN AN APPROVED FUME HOOD WHEN HANDLING OPEN CONTAINERS OF ACIDS.**

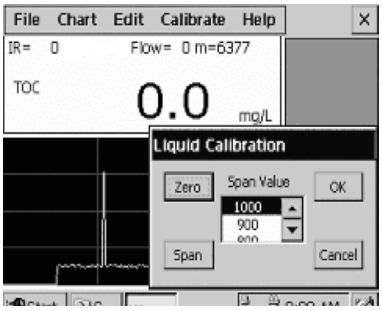
6. "End-to End" Calibration:

Note: On the initial Startup, IR gas calibration should be performed prior to liquid calibration

a. Select [CALIBRATE] from the main menu. The following screen will appear:



b. Select [TOC].
The following screen appears:



c. Flow "ZERO" (D. I. Water) and allow NDIR reading to stabilize. For maximum accuracy, especially at lower ranges, this process may take 20 minutes. When reading is stable, select [ZERO].

d. Flow Liquid Span Standard Solution. Allow NDIR reading to stabilize, (approximately 15 minutes).

e. Select [SPAN]. It is recommended that the operator continue to observe the reading and if not stabilized at the desired span setting ± 2%, repeat the span selection until stable.

f. If the calibration is acceptable, select [OK] or [CANCEL] if not acceptable.

The analyzer is now calibrated and ready for analysis.

4.4 Operation

After proper installation and calibration, the instrument is ready to be placed "ON-LINE" for continuous operation.

Note: For any non–standard or specific operational procedures, please refer to the "INSTALLATION" and "AS–BUILT" drawings in the Appendix or any Addenda that accompanies this manual. If applicable, the Appendix or Addenda will include details on your specific application, which may involve valving, stream sequencing, automatic calibration, etc.

The RUN screen will automatically appear on the screen. It will also appear whenever the computer is rebooted or the power is turned off and back on again. Figure 4-3 shows the RUN screen and identifies the data fields.

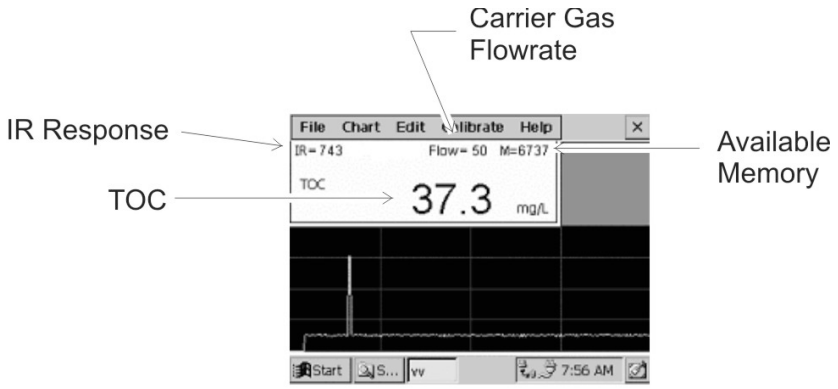


Figure 4-3: The RUN Screen

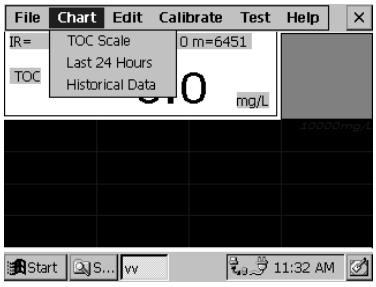
4.5 Shutdown

Prior to shutdown of the analyzer or performing service on the reactor, flush D. I. water through all sample and reagent lines for at least 30 minutes to clean all tubing.

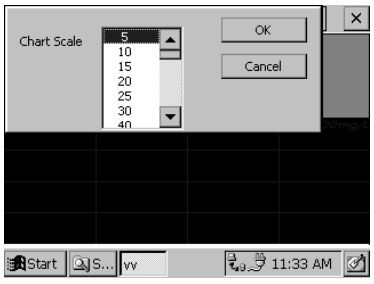
CAUTION: FAILURE TO OBSERVE ADEQUATE FLUSHING COULD RESULT IN HARMFUL ACID BURNS AND/OR A REACTOR CLOG.

4.6 Historical Data

Previous data may be obtained by selecting [CHART] from the screen. The following menu will appear.

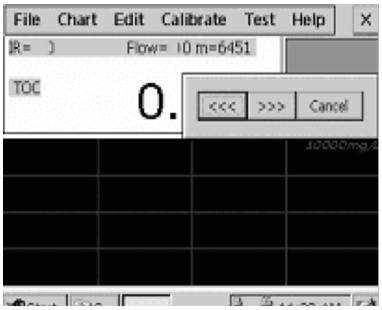


The display scale can be adjusted using the Select [TOC SCALE] item from the [CHART] menu. The following screen will appear.



Edit Scale as desired.

To view the data produced in the last 24 hours, select [LAST 24 HOURS]. The following screen will appear:



Using the Scroll Bar, select the data to be viewed.

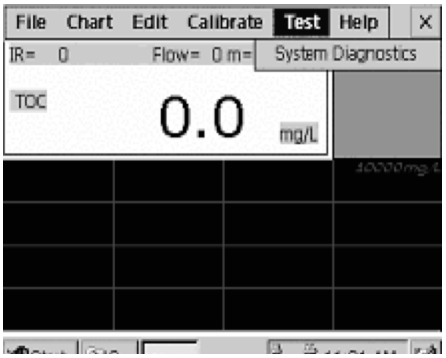
Selecting [HISTORICAL DATA] allows you to view any archived data within the memory limits of the computer. A screen appears which will allow you to select the archived time period desired. How far back you can go depends on the available memory.

Maintenance

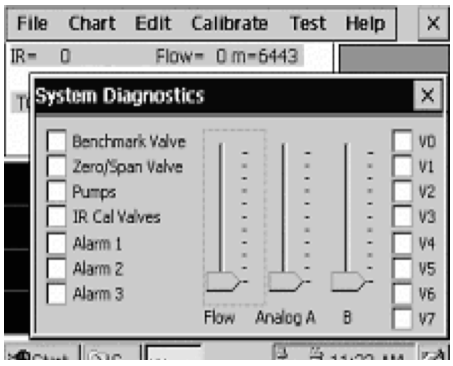
5.1 Compupter-aided Testing

Prior to performing detailed troubleshooting procedures listed below, first perform computer-aided testing of the analyzer, as follows:

1. From the screen, select [TEST]. The following menu appears:



2. Select [SYSTEM DIAGNOSTICS]. The following menu appears:



From this screen the operator may perform individual testing of components related to functionality and settings.

5.2 Troubleshooting

If you are experiencing trouble with your instrument, refer to Table 5-1: Troubleshooting.

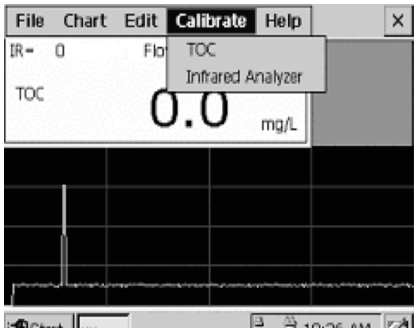
Table 5-1: Troubleshooting

PROBLEMS	SOLUTION
Analyzer will not turn on	• Check fuse & power connections. • Look for loose or damaged wiring. • Check for 12V DC from power supply. • Check power supply fuse.
Analyzer does not Calibrate, is sluggish	• Look for & correct any liquid or gas line leaks.
Analyzer is excessively noisy	• Check for leaks at tubing connections
Display not functioning	• Check cable connections • Check power supply voltage • Suspect: • Malfunctioning Computer (P/N ST13039). • Master Control Panel Assembly (P/N ST13042-1)
Pump head not rotating	• Refer to section “Pumps” 12.3.12 • Verify that carrier loss did not cause the pumps to be turned off. • Check for AC voltage at terminal strip on inside of application panel. •
Pump head rotating but not pumping fluid	• Refer to section “PUMPS” • Change tubing • Verify sample line is in liquid.

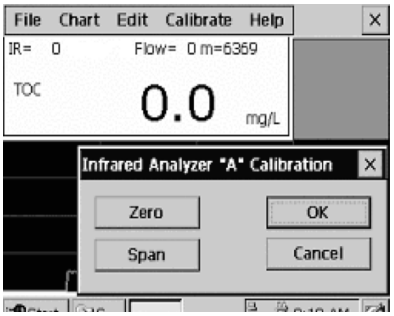
5.3 Module Service

5.3.1 NDIR (Gas Calibration)

1. From the Menu, select [CALIBRATE].
   The following screen will appear:



2. Select [INFRARED ANALYZER]. The following Screen will appear:



3. Disconnect tubing from reactor output and connect IR calibration adapter (P/N ST20026) as shown in Figures 5-1, 5-2, and 5-3.
4. Connect facility tubing to “Zero” and “Span” Gas Bottles

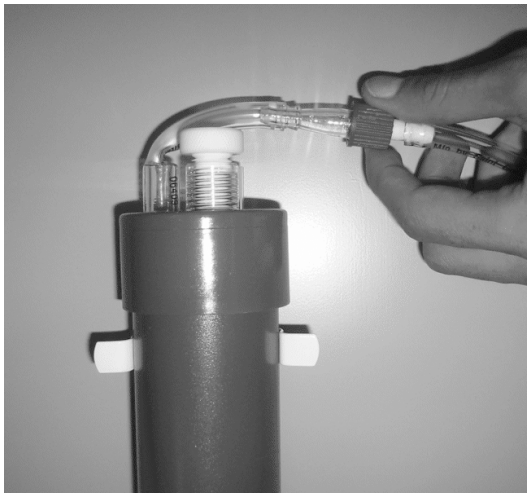


Figure 5-1: Disconnecting Tubing from Reactor

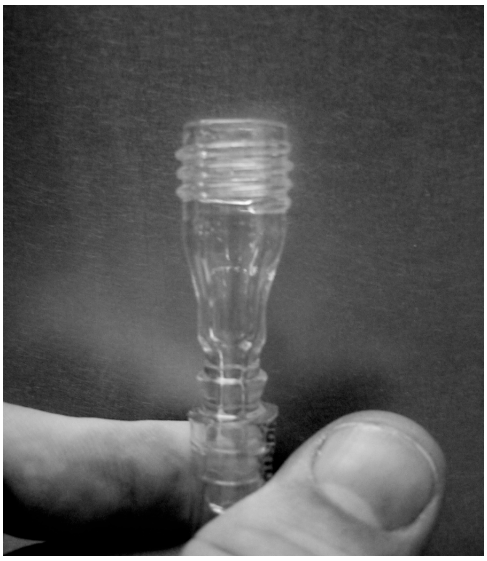


Figure 5-2: IR Calibration Adapter P/N ST20026

IR Calibration

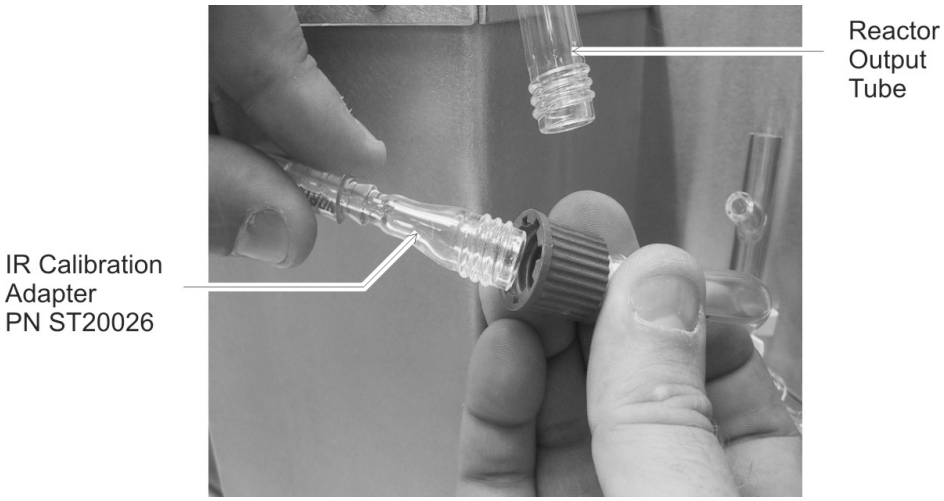


Figure 5-3: Installing Calibration Adapter

5. To set IR "Zero", flow 200cc/minute oxygen (or CO_2-free air) for 5 minutes. Allow NDIR reading to stabilize. Select [ZERO]. NDIR reading is reset to 0.
6. To set IR "Span" for the 6 inch (shorter) IR bench, use a gas calibration standard mixture of 1% CO_2 in pure nitrogen. For the longer (15 inch) bench, a gas mixture of 0.1% CO_2 in pure nitrogen is required for. Flow 200 cc/minute of this cal gas for at least three minutes. Allow NDIR reading to stabilize and then select [SPAN]. NDIR reading is set to 10,000. Select [OK] to save or [CANCEL] to reject the calibration setting.

The NDIR unit has now been properly calibrated. Reconnect the fitting to reactor output tube.

5.3.2 NDIR Service

To remove and service the NDIR, simply follow the illustrated sequence as described in this section following Figure 5-4.

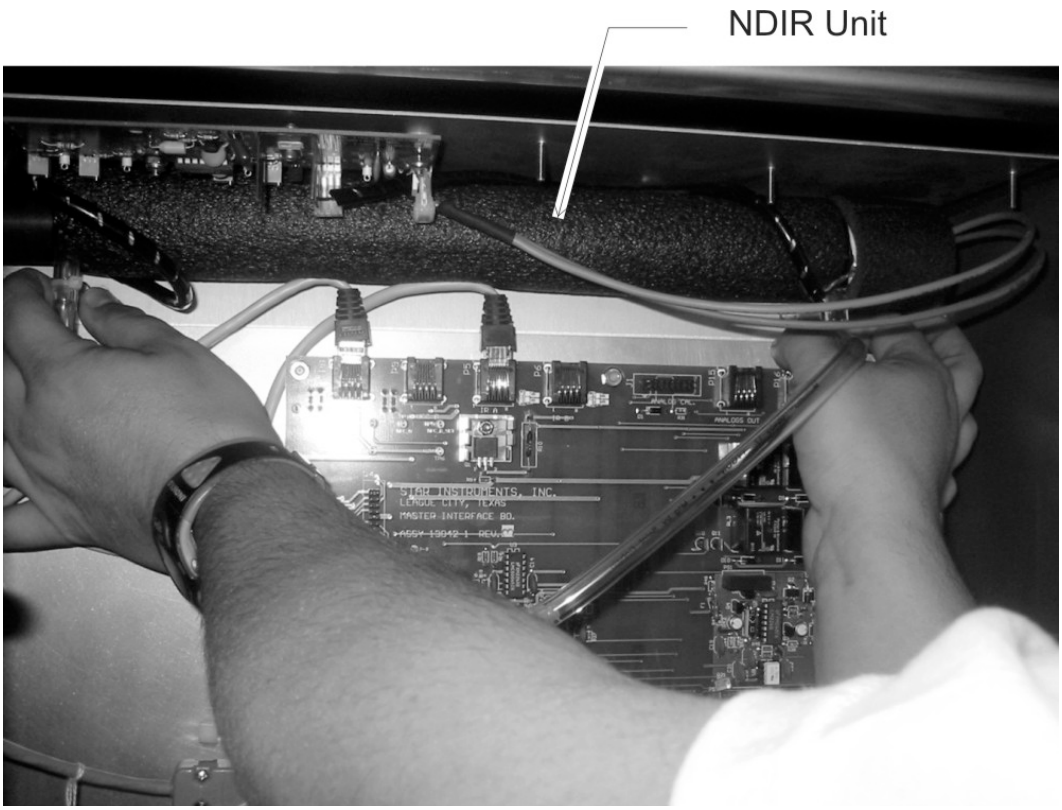
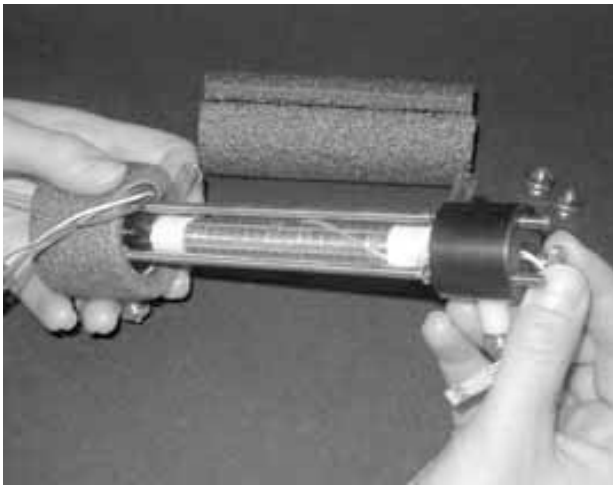


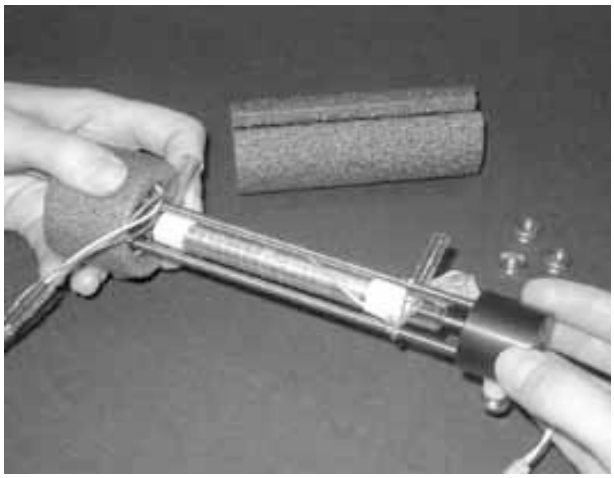
Figure 5-4: Removing the NDIR Unit P/N ST36000

To Replace the NDIR Unit:

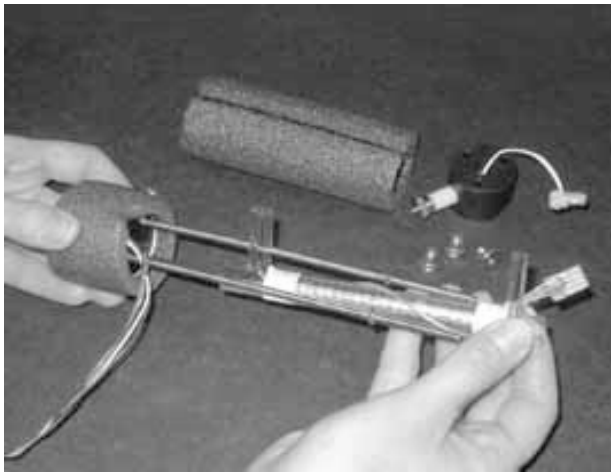
1. Turn off power.
2. Remove inlet tube from NDIR Assembly.
3. Remove vent tube from NDIR Assembly.
4. Unplug interface cable from NDIR Assembly.
5. Remove NDIR Assembly from cabinet.



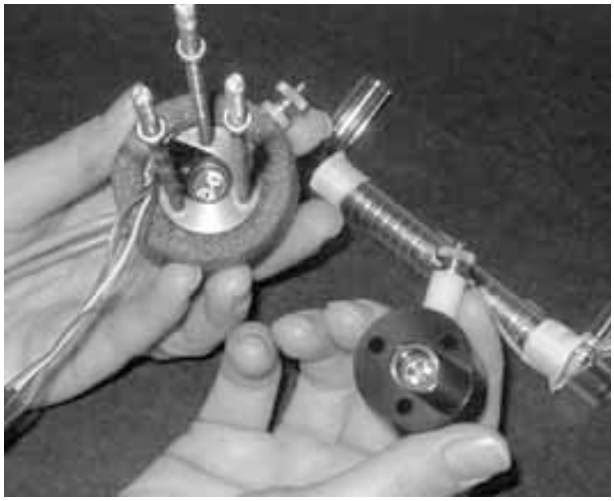
- Remove insulation from IR Cell.
- Remove lock-tight from three thumbnuts and remove.



- Slide out and remove Source Assembly.



- Remove IR Cell Assembly



Note:

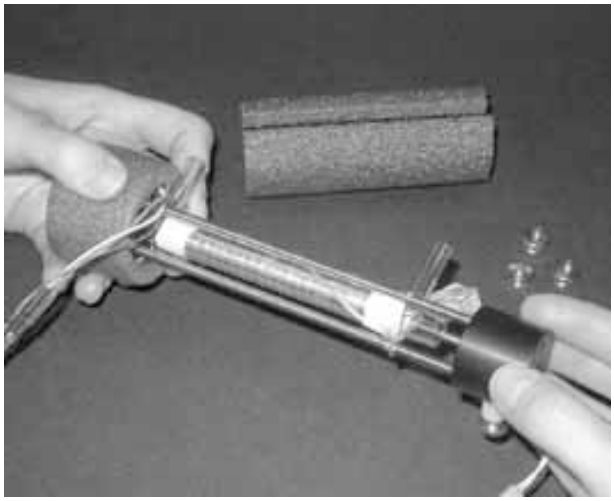
a. 'O'-Rings in each of Detector Assembly (left) and Source Assembly (right).

b. Sapphire windows located under 'O'-Rings

- *Remove 'O'-Ring and Sapphire window taking care to avoid scratching Sapphire window.

  *Recommend using toothpick.

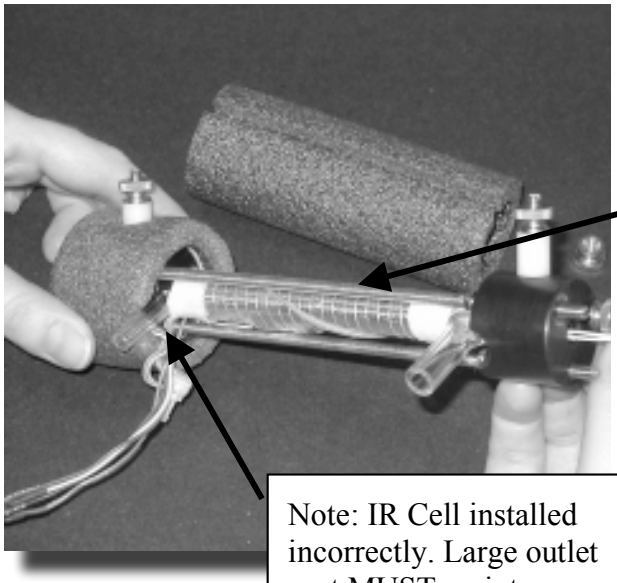
- Clean sapphire windows with a soft, lintless tissue (use DI water, if necessary).



To Reassemble

- Install IR Cell.
- Install Source Assembly end piece.

Note: Large outlet port goes into Detector Assembly (left)



- Tighten three thumbnuts until Source Assembly bottoms out on squeeze nuts.
- Recommend:

Use alternate tightening sequence

Note: IR Cell installed incorrectly. Large outlet port MUST go into Detector Assembly (left)

- Insert lock-tight on three thumbnuts to prevent backoff.
- Install insulation. Replace assembly as before.
- Recalibrate NDIR (Section 4.3).

5.3.3 Master Interface Board (P/N ST13042-1).

The Master Interface Board has no field adjustment. If malfunctioning, replace the module P/N ST13042-1 using the instructions below. See Figure 5-5.

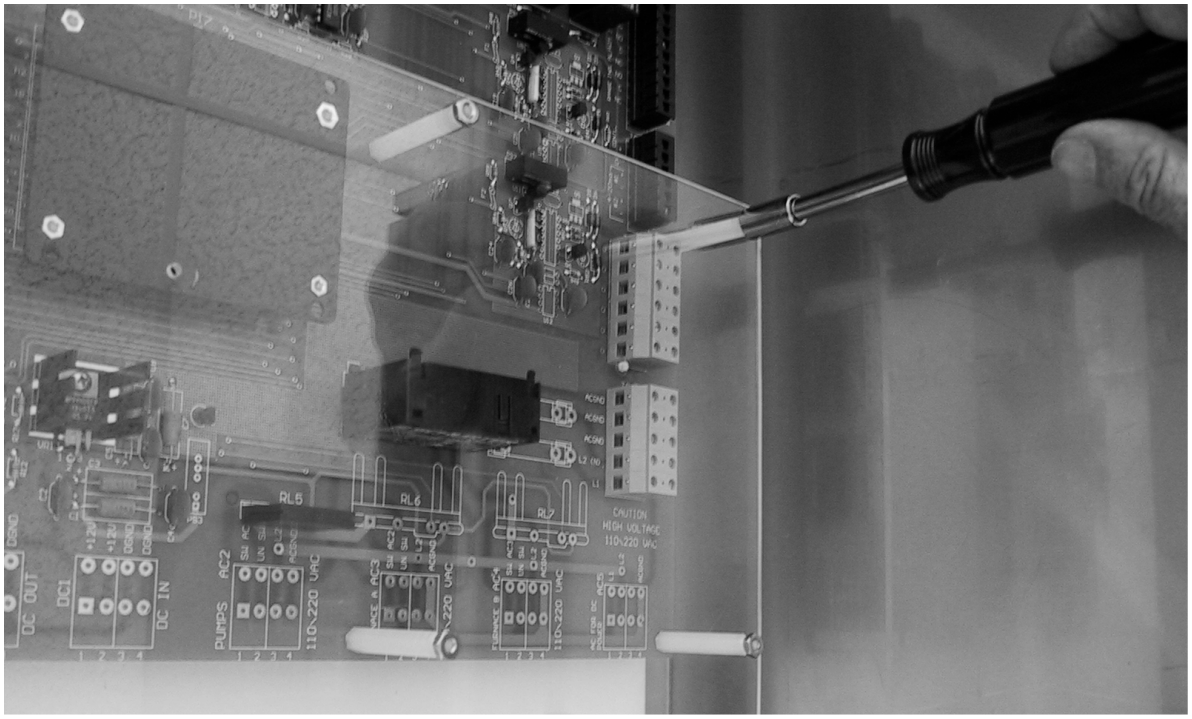


Figure 5-5: Removing the Master Interface Board

To Remove the PC Board:

1. Turn off power.
2. Remove plastic cover.
3. Disconnect connectors.
4. Remove panel.

Note: Depending on the configuration, there may be one or two master interface boards.

5.3.4 D. C. Power Supply

The power supply has no field adjustment. If malfunctioning, replace the module (P/N ST15083) using the directions below. See Figure 5-6.

Figure 5-6: DC Power Supply Module

To replace the module:

1. Turn off power.
2. Remove plastic cover.
3. Disconnect connectors.
4. Remove nuts holding Power Supply.
5. Remove Power Supply Module.
6. Replace Power Supply Module.
7. Reverse steps for installation.
8. (Refer to Installation Drawings for proper connector assembly.)
9. Recalibrate liquid and span values.

5.3.5 CE Computer (P/N 13039)

If malfunctioning, replace the Computer Module using the directions below. See Figure 5-7.

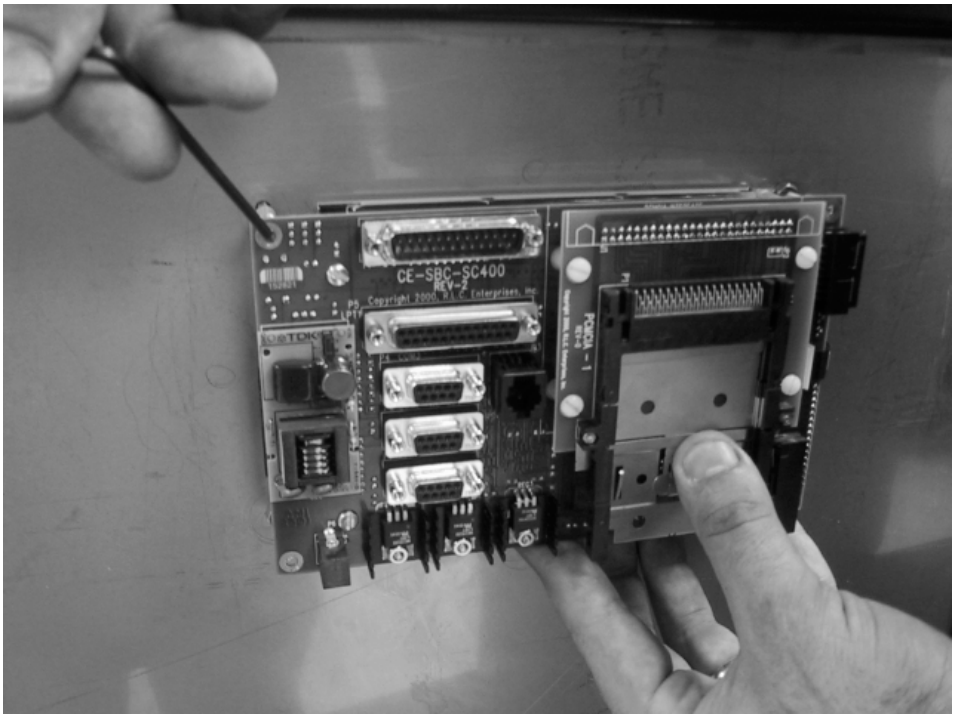


Figure 5-7: Replacing CE Computer

To Replace the CE Computer:

1. Turn off power
2. Disconnect electrical connectors.
3. Remove screws holding Module in place.
4. Remove module.
5. Install new CE Computer in reverse disassembly instruction procedure steps. (Install electrical connectors per supplied drawing).
6. Verify proper software install per directions shipped with new CE Computer.
7. Recalibrate liquid zero and span values.

5.3.6 UV Lamp (P/N ST20009)

Normal lamp replacement frequency is suggested at least every 12 months, however, if a lamp is "burned-out" (weak or no blue glow), replace with UV Lamp (P/N ST20009), per directions in Figure 8.

Figure 5-8: UV Lamp Replacement

To replace the UV lamp:

1. Turn off the UV lamp at the UV power supply. Remove persulfate and acid reagent lines from containers, as well as the sample inlet line and submerse all three (3) lines into D. I. water to completely flush system.

CAUTION: FAILURE TO DO SO MAY RESULT IN ACID BURNS, CLOGGED REACTOR. FLUSH FOR 30 MINUTES.

CAUTION: USE ONLY P/N ST20009 UV LAMP TO ASSURE PROPER 185 MM AND 254 MM POWER SPECTRAL DENSITY AND PROPER OXIDATION EFFICIENCY.

CAUTION: THE UV LIGHTED LENGTH MUST BE AT LEAST 12 ½ INCHES FOR PROPER OPERATION. DO NOT USE STANDARD 12 INCH LIGHTED LENGTH UV LAMPS.

2. Turn off power allow 10 minutes for cool down.
3. Disconnect electrical connectors.
4. Loosen fittings as illustrated.
5. Remove UV Lamp.
6. Recalibrate analyzer.

5.3.7 UV Reactor Assembly (P/N ST20003-1)

If malfunctioning, clean the assembly. If still malfunctioning, replace the assembly (P/N ST20003-1). See Figure 5-9.

Figure 5-9: Removing the UV Reactor Assembly

To Replace the UV Reactor Assembly:

1. Turn off UV Lamp at the UV Power Supply. Remove Persulfate and Acid Reagent lines from containers, as

well as the sample inlet line and submerse all three (3) lines into D. I. water to completely flush system.

CAUTION: FAILURE TO DO SO MAY RESULT IN ACID BURNS, CLOGGED REACTOR, ETC. FLUSH FOR 30 MINUTES.

2. Turn off power.
3. Disconnect electrical connectors.
4. Disconnect tubing.
5. Remove thumbnuts holding UV Reactor in—place.
6. Remove UV Lamp (See Figure 5-9).

To clean the UV Reactor Assembly:

1. Run warm water through all tubing until clean.
2. Replace assembly as before.
3. Charge reactor with D. I. water.
4. Recalibrate analyzer.

5.3.8 UV Power Supply

The UV Power Supply (P/N ST15002 for 110 VAC or P/N ST15000 for 220VAC) is normally checked with another good UV lamp. If it activates the UV lamp, the UV Power Supply is good. If the Power Supply is not good, replace the Module (P/N ST15002 for 110 VAC or P/N ST15000 for 220 VAC). See Figure 5-10.

To replace the UV Power Supply:

1. Turn power off.
2. Disconnect UV and main power connectors.
3. Remove power supply mounting screws.
4. Replace power supply.
5. Reverse steps for installation.
6. Recalibrate liquid and span value.

Figure 5-10: Removing the UV Power Supply

5.3.9 Mass Flow Controller (P/N ST18001A)

If proper flow is not detected by the computer, an alarm will be activated and displayed. The fault may be in the O_2/Air supply (check for 20 psi and flow of the supply by disconnecting the input). If supply flow exists, fault may be in the tubing. Disconnect output side of mass flow controller and check for flow. If no flow exists, exchange mass flow controller as described below. See Figure 5-11. If flow still does not exist, check rest of tubing for restrictions, leaks, etc.

To remove the mass flow controller:

1. Shut off Power to Instruments.
2. Shut off all gas to analyzer and bleed system for "O" pressure**.**
3. Disconnect fittings/tubing.
4. Loosen screws holding Module in-place.
5. Remove Module
6. Recalibrate analyzer after re-installation of exchange Module.

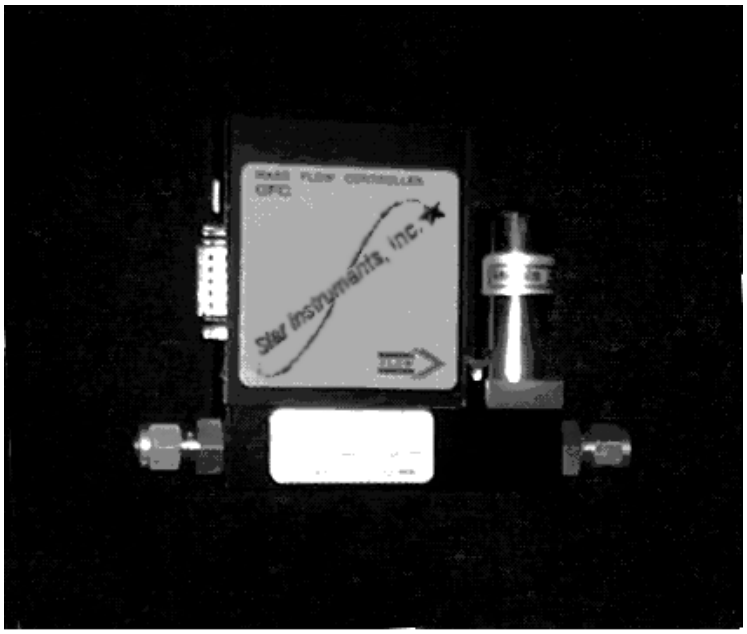


Figure 5-11: Mass Flow Controller

5.3.10 Metering Valve (P/N ST16050)

If no O_2/air flow to the sparger (P/N ST20025) is observed (no bubbles), check for tubing and fitting leaks, restrictions and adjust metering valve (be careful to return to previous indicated bubble rate). If flow cannot be restored, replace the metering valve (P/N ST16050) according to the directions below. See Figure 5-12.

To replace the metering valve:

1. Turn carrier gas (Air/O_2) OFF.
2. Turn pumps OFF.
3. Remove fittings and tubing.
4. Remove metering valve.
5. Recalibrate TIC if TIC and/or TOC–TRUE analysis is required. NPOC analysis only does not require recalibration.
6. Reinstall metering valve in reverse order.

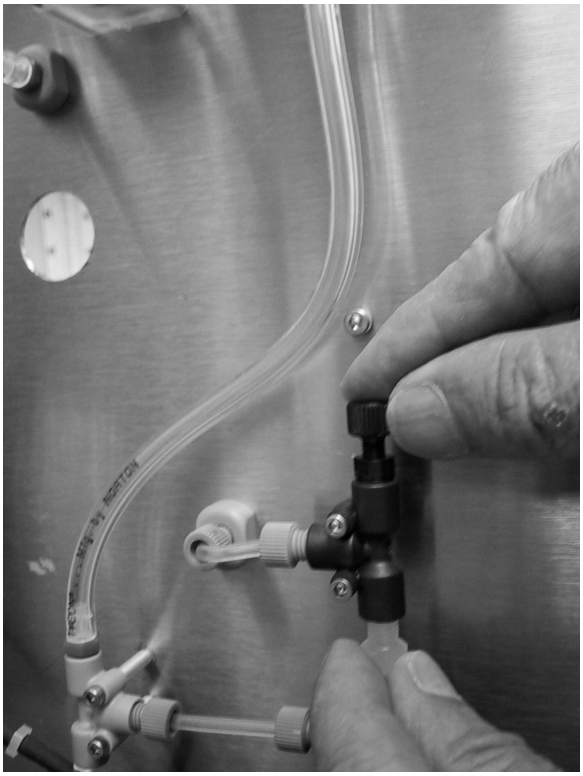


Figure 5-12: Metering Valve

5.3.11 Sparger (P/N ST20025)

The sparger may be removed for cleaning with detergent and subsequent flushing with DI water. If the sparger inner glass body is observed to be leaking (cracked glass, etc.), or is clogged beyond cleaning, replace sparger (P/N ST20025) according to the directions below. See Figure5-13.

To replace the sparger:

CAUTION: **CONTACT WITH ACID LIQUID OR VAPOR CAN DAMAGE TISSUE, CAUSE EYE DAMAGE, RESULT IN SEVERE BURNS AND CAUSE LUNG AND RESPIRATORY DAMAGE. WEAR PROPER PROTECTIVE CLOTHING AND SAFETY GLASSES WITH SPLASH SHIELDS. TREAT ALL ACIDS WITH CAUTION AND HANDLE WITH CARE. ALWAYS WORK IN AN APPROVED FUME HOOD WHEN HANDLING OPEN CONTAINERS OF ACIDS.**

1. Turn machine OFF.
2. Turn carrier gas (Air/O_2) OFF.
3. Remove and drain tubing and sparger.
4. Remove sparger from spring clips.

To clean the sparger:

1. Run warm water through tubing to flush out any solid contamination.
2. Reinstall sparger in reverse order.

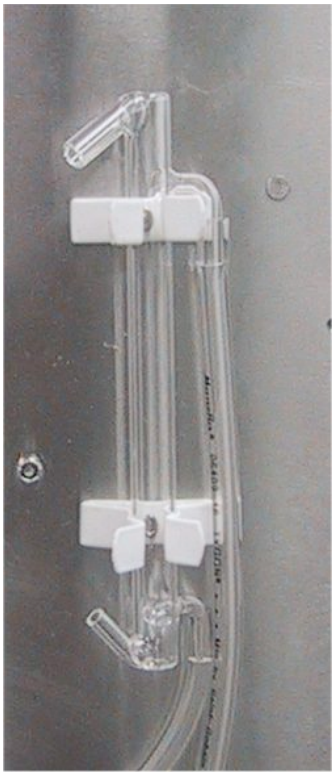


Figure 5-13: Sparger

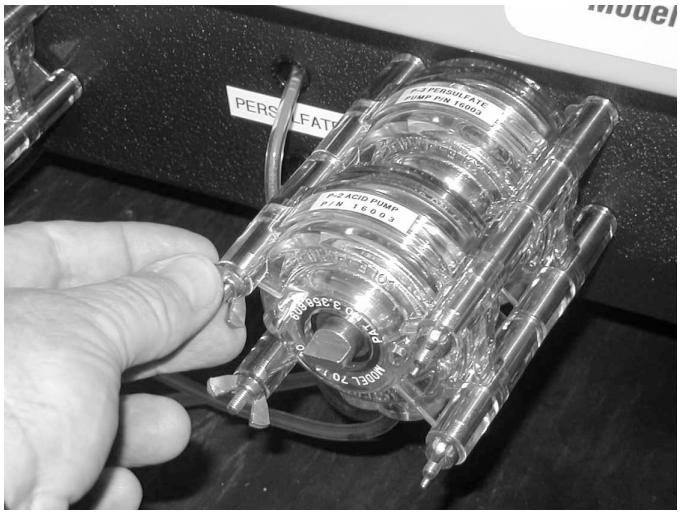
5.3.12 Pumps

If any of the pumps are not pumping (liquid flow is not observed moving up the tubing), check to see if the motor is turning the pump heads and the motor is not binding. Check for proper power and connections to the pump motor. If the motor has failed (e.g., open windings, etc.), replace motor. For 110 V 2 RPM motor , use P/N ST18002; for 220 V 2 RPM motor use P/N ST18003. For pump motor replacement, refer to Section 5.3.12.1 and Figure 5-14.

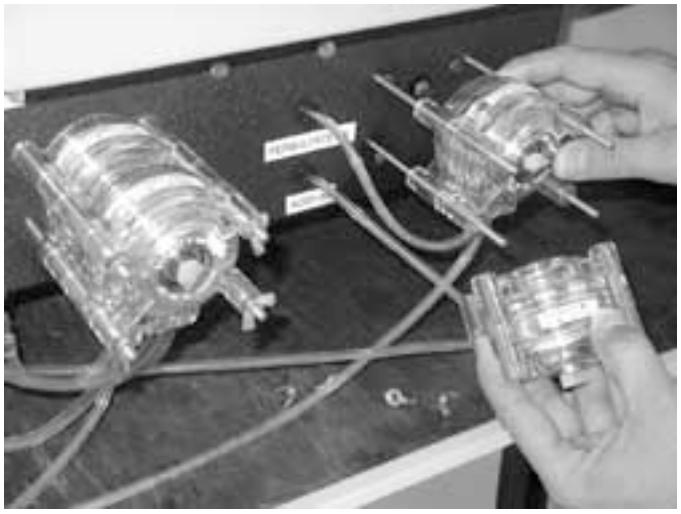
If the motor is operating properly, worn tubing is the probable cause for poor or non–existent pumping. Retube pump heads as described in Section 5.3.12.2 and Figure 5-15.

5.3.12.1 PUMP MOTOR REPLACEMENT

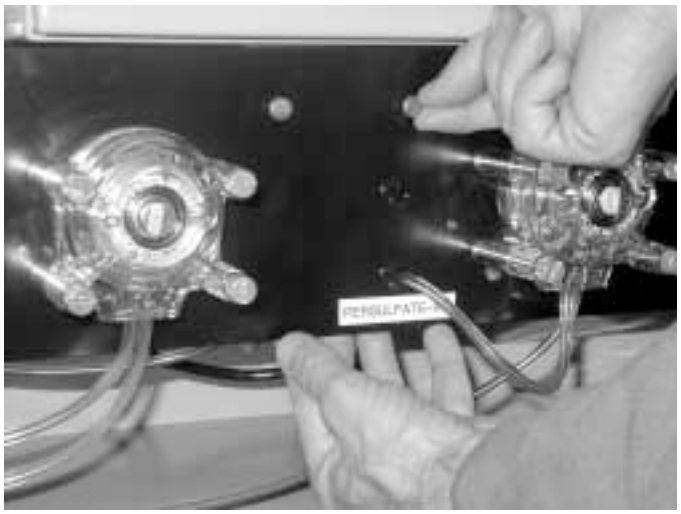
Note: Masterflex pump heads must be removed for access to Pump Motor Mounting Screws.



1. Turn main power OFF.
2. Remove 4 wing nuts from pump head mounting hardware.



3. Remove pump as illustrated to gain access to pump mounting screws.



4. Remove two thumbscrews for pump panel removal.
5. Disconnect Pump Motor Connector.

6. Remove 4 pump mounting screws for pump removal.
7. Replace motor and reassemble in reverse step sequence.

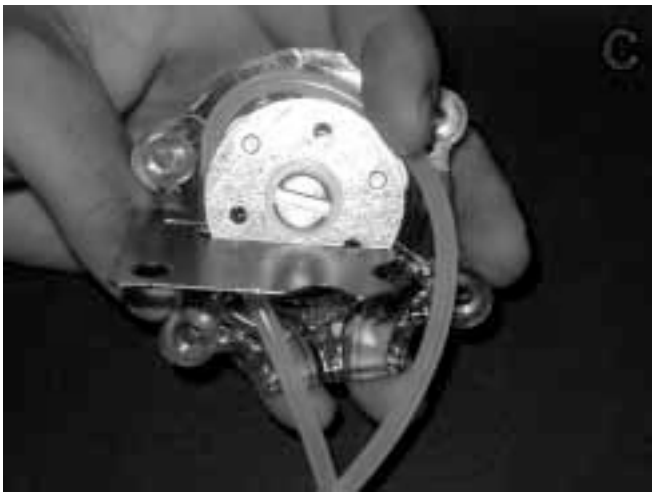
Figure 5-14: Removing the Pump

Note: Actual mounting panel may appear somewhat different but mounting hardware is the same.

5.3.12.2 PUMP HEAD TUBING REPLACEMENT

1. Separate the end bells (the pump head halves).
2. Hold the end bell containing the rotor as shown with the tubing retainer grooves pointing down.

3. Place tubing in the right groove and against the first two rollers.
4. Hold tubing with thumb.
5. Near groove, insert smaller prong of loading key between the top of the rotor and tubing.
6. Push key in as far as possible.



7. Push down and turn key counterclockwise (ccw) completely around the rotor.
8. The key will push the tubing uniformly into the end bell assembly.
9. Hold the second end of tubing.
10. Remove the key.

11. Position the other end bell on top and press the end bells together.
12. Be careful not to pinch the tubing.
13. If end bells do not snap tightly together, reload tubing.
14. If necessary, turn key in slot on rotor shaft to adjust tubing (as in next step - E).

15. With key in slot on rotor shaft, turn key to align tang on rotor shaft with slot in motor drive shaft.
16. Point tubing retainer grooves up.
17. Shift the pump head slightly until it snaps on the alignment pins (if present).
18. Secure with four provided screws.
19. Tighten with fingers only.

Figure 5-15: Pump Head Tubing Replacement

5.3.13 4-20 mA Adjustment Procedure

1. Select [TEST] from the Run Screen task bar, then, select [SYSTEM DIAGNOSTICS].
2. Locate Analog A cursor and position the cursor to MAX for a moment, then, return the cursor to MIN.

5.3.13.1 SETTING 100 MV CONTROL VOLTAGE

1. Using a DC voltmeter, connected to measure DC voltage, connect the black lead to the (-) side of capacitor C1. Located near the lower left corner of the circuit board. Connect the (+) lead to the top of resistor R19, located slightly to the left of the center of the circuit board. Note the mV reading (typically no greater than 3 mV).
2. Next, position the Analog A cursor to Max position. Note the mV reading from the top of R19. Use pot R21 located slightly to the right of the center of the circuit board to adjust the mV reading 100 mV higher than minimum reading. Reposition Analog A to Min and re-check Min and Max mV readings.

5.3.13.2 SETTING OF 4-20 MA OUTPUT

1. Using a digital voltmeter connected to read mA, connect the black lead to #1 4-20mA out (-) and the red lead to #1 4-20 mA out (+).
2. Adjust R41 for 4mA when Analog A is at minimum. Adjust R42 for 20mA when Analog A is at Maximum. Repeat Analog Min/Max until 4-20 mA is achieved.

Appendix

A.1Specifications

Measurement Methods:	TC (Total Carbon) – UV/Persulfate Oxidation
	TOC (Total Organic Carbon) acidification and sparging to eliminate inorganic carbon interference.
Temperature:	25^{o} C ± 5^{o}
Measurement Ranges:	0-10 through 0-10,000 ppm, full scale (std.)

Note: Range changes often require carrier gas adjustments. The Model 6750 uses the precision of computer controlled mass flow controllers to eliminate operator error and the use of inaccurate mechanical flow meters.

Display:	Windows with Paperless Chart Recorder 2 Line LCD
Data Handling:	RS-232C, RS-485
Analog Output:	4-20mA
Alarms:	Two concentration alarms One master fault alarm

Performance:

Response Time:	Dependant upon application
Repeatability:	±2% FS (std. Dev. 1 sigma)
Zero/span stability:	±2% FS (at 25^{o} C)
Linearity:	±2% FS

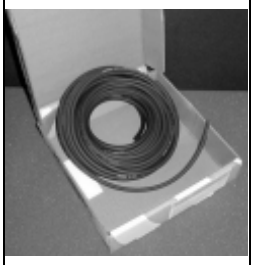
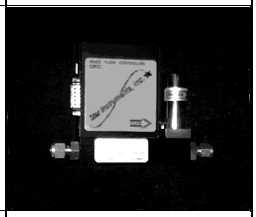
Sample requirements:

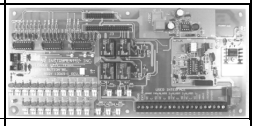
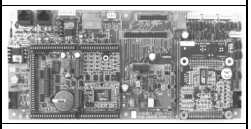
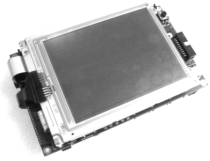
Inlet Pressure:	Atmospheric to 3 psig
Flow Rate:	20cc/min. (nom)
Drain:	Gravity drain vented to atmosphere
Suspended Solids:	1,000 microns (max.)
Reagents (TOC Mode):	Sodium Persulfate: 4.0 gal/month Phosphoric Acid, 10% v/v: 4.0 gal/month (nom.).
Calibration:	One point span, Chemical standard, computer-stored multiple calibration curves.

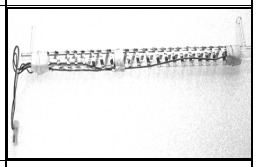
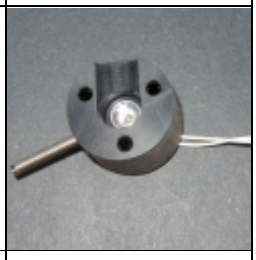
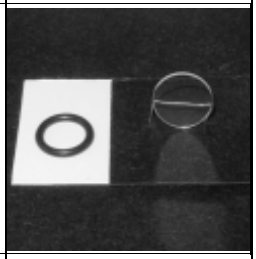
Facility requirements:

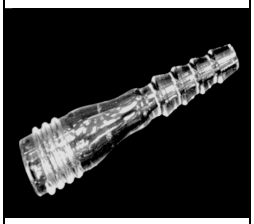
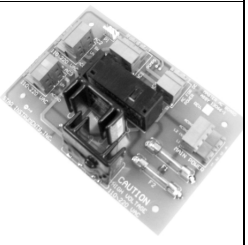
Power:	115 $\pm$ 10% VAC, 50/60 Hz 7A Service Recommended. 220 $\pm$ 10% VAC, 50/60 Hz (optional) 4 A Service Recommended
Air:	Clean, dry, oil free, CO_2 free instrument air at 15 psi +/- 2 psi, consumption < 500 cc/minute.

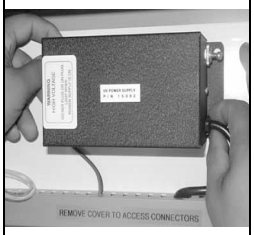
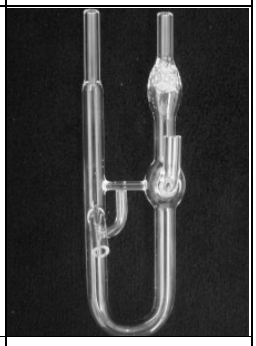
A.2 Parts Listing

Part #	Description	Image
ST16002 ST16003 ST16004 ST16004 ST16005 ST16006	#7013 Pump Head #7014 Pump Head #7015 Pump Head #7016 Pump Head #7017 Pump Head #7018 Pump Head	
ST18002-1 2 RPM 110V ST18003-1 2 RPM 220V	Pump Motor Assembly	
ST16007 ST16008 ST16009 ST16010 ST16011 ST16012	#13 Tygon Tubing #14 Tygon Tubing #15 Tygon Tubing #16 Tygon Tubing #17 Tygon Tubing #18 Tygon Tubing	
ST18001A	Mass Flow Controller	

Part #	Description	Image
ST15083	12V DC Power Supply	
ST13069-1	Distribution Board	
ST13070-1	Interface Board	
ST13039	CE Computer	
ST100001-6	6” NDIR Assembly	
ST100001-15	15” NDIR Assembly	

Part #	Description	Image
ST100006-1	NDIR Detector Assembly	
ST100009-6	6” NDIR Cell Assembly	
ST100009-15	15” NDIR Cell Assembly	
ST100008-1	NDIR Source Assembly	
ST17007 ST20001	NDIR O-Ring NDIR Sapphire Window	
ST20025	Sparger	

Part #	Description	Image
ST16050	Metering Value	
ST200026	IR Calibration Adapter	
ST20009	UV Process Lamp	
ST13066-1	AC Board Assembly	

Part #	Description	Image
ST200003-1	UV Reactor Assembly	
ST15000-110V ST15002-220V	UV Power Supply	
ST18050	Flow Switch	
ST20024T	Gas Liquid Separator	

A.3 Options

A.3.1 Option 200008

BENCHMARK (with single point autocal)

This option automatically determines analyzer performance to specified limits. It is accomplished by introducing a known chemical standard solution to the analyzer and performing a computation and analysis to verify its operation. If "Benchmark" tests fall outside specified limits, the operator may either manually perform an analyzer calibration or pre-program the analyzer to perform a single point "AUTO CAL" with appropriate outputs (relay or serial communication) to alert control rooms of analyzer status. The analyzer would then be automatically reset to fully calibrated operation. Because the analyzer is equipped with "BENCHMARK", the time for the subsequent auto cal (if required) is significantly reduced, as the "BENCHMARK" standard would become the "SPAN" solution and the computer controlled analyzer "reset" to a fully calibrated condition.

This feature may be scheduled to be performed automatically by the operator.

All valving is included.

A.3.2 Option 200009

AUTO CAL

AUTO CAL is a feature to automatically 2-point calibrate the analyzer with known chemical standards. The operator may program its schedule and during its operation, appropriate outputs (relay or serial communications) are available to alert control rooms of analyzer status. All valving is included.

A.3.3 Option 200010

AUTO CAL/AUTO CLEAN

AUTO CAL/AUTO CLEAN is a feature to automatically 2-point calibrate the analyzer with known chemical standards and/or introduce a cleaning agent (generally acid or persulfate) to clean analyzer internal fluid lines. All valving is included.

A.3.4 Option 200016

EXTERNAL RANGE CHANGE

This option provides for local or remote analyzer range change by contact closure.

A.3.5 Option 200017

TRUE DUAL RANGE OPTION (not an electronic scaling)

A.3.6 Option 200009

MULTI-STREAM SEQUENCER

This option allows time sequencing of analysis of up to Four (4) different streams.

A.3.7 Option 400008

DBPR OPTION

This option is configured to fully comply with the Disinfection Byproducts Rule as defined by the USEPA. The analyzer is configured for a two stream sequencer and displays source TOC, distribution TOC, out-of-tolerance alarms, alkalinity input and pH input.

A.3.8 Option 200026

COD/BOD CORRELATIONS

Both COD and BOD readouts are correlated to "instantaneous" TOC analyses. Thus, the operator is provided with useful, predictive, real-time analogs derived from the actual organics in the sample. While TOC provides the most specific measurement for process control for organic loading/treatment, spill detection, etc., COD and BOD continue to provide useful data, which is often required for permits. Regulatory agencies will often allow substitution of TOC analysis for COD and BOD if proper correlation is performed. The correlation requires multiple testing for COD and/or BOD on the same sample taken at the same time of TOC analysis and recording those results when available later. This may take one sample per day for 30 days. After sample characterization, COD and BOD readouts may then be used as "instantaneous" control parameters.

Since COD & BOD analysis may vary with seasonal influences or other particular conditions, correlations for those conditions would be used at those times.

After obtaining a representative amount of TOC/COD/BOD data, the operator enters those factors into the analyzer computer. Thereafter, all three parameters (TOC,COD,BOD) are continuously displayed. Updates to these correlations may be made at any time. Consult the factory for particular user applications.

A.4 AS-BUILT Drawings

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