EPS SAP

SAMPLING AND ANALYSIS PLAN

NYSDEC – FRANKLIN CLEANERS SITE
Hempstead, New York

SITE NO: 1-30-050
NYSDEC Contract #D004184

Prepared for:

New York State Department of Environmental Conservation
Division of Environmental Remediation

Prepared by:

Environmental Products and Services, Inc.
Westchester, NY

January 2001

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NYSDEC - FRANKLIN CLEANERS SITE
Hempstead, New York
Site No: 1-30-050

1.0 PLAN IDENTIFICATION AND APPROVALS

Project Title:	Site Remediation
Project Location:	Franklin Cleaners (former) 206-208B South Franklin Street Hempstead, NY
DEC Site No:	1-30-050
EP&S Project No:	Wxxxx
Prepared By:	Corporate Geoscience
Date Prepared:	January 19, 2001
Revision No.:	0

APPROVALS:

Project Engineer — Date

1-19-01

David Scott, Project Manager — Date

Timothy P. McArdell 1/19/01

Timothy P. McArdell, Quality Assurance Officer — Date

2.0 INTRODUCTION

Environmental Products and Services, Inc. (EPS) has prepared this Sampling and Analysis Plan (SAP) for the site remediation activities at the Franklin Cleaners Site. This SAP was developed under the New York State Department of Environmental Conservation (NYSDEC) Franklin Cleaners Site Contract (Number D004184; NYS Site No: 1-30-050). This SAP, with accompanying Work Plan and Site Specific Health and Safety Plan (SSHASP), has been developed based on the NYSDEC Contract Documents dated June 26, 2000.

In general, this SAP is intended to provide a comprehensive description of the procedures to be used for collection and analysis of vapor phase samples, soil samples, groundwater samples, air samples and all waste generated and requiring characterization during the Work. The Sampling and Analysis Plan will include, but not necessarily be limited to, procedures for sample collection, labeling, preservation, storage, custody requirements and shipping; sample analysis including analytical methods and quality assurance/quality control procedures; and data reduction, validation and reporting.

Project organization is outlined on the Organizational Chart presented as Figure 1. The EPS project Quality Assurance (QA) Officer for this project is Mr. Timothy McArdell. Mr. McArdell has a bachelors degree in environmental chemistry and a masters degree in environmental resource engineering. Mr. McArdell is 40-hour OSHA safety trained. A copy of Mr. McArdell's resume is included as Appendix A.

As required by the Contract Documents, prior to any deviations from the approved Sampling and Analysis Plan, the Engineer shall be notified and the deviation accepted by the Engineer.

3.0 SAMPLE COLLECTION AND ANALYSIS

All laboratory analysis, and in particular, all references to NYSDEC Superfund analytical chemistry, will be in accordance with the 1995 or most current edition of the NYSDEC Analytical Services Protocol (ASP). EPS has obtained the services of Severn Trent Laboratories located in Newburgh, NY (STLN), Severn Trent Laboratories located in Burlington, VT (STLV) and Long Island Analytical Laboratories, Inc. (LIL) located in Holbrook, New York. EPS certifies that these laboratories are familiar with this SAP document, and all procedures and deliverables pertaining to New York State Superfund work. All analysis must be performed by a laboratory currently certified by the New York State Department of Health Environmental Laboratory Approval Program (ELAP), and Contract Laboratory program (CLP) in all categories. The Plan will include a certification from EPS that the laboratory(s) will review the requirements of the Specifications concerning chemical analyses.

The name, qualifications and certifications of Severn Trent Laboratories located in Newburgh, NY, Severn Trent Laboratories located in Burlington, VT and Long Island Analytical Laboratories, Inc. located in Holbrook, New York are provided in Appendix B of this Plan.

3.1 SVE System and Vapor Monitoring Probe Vapor Phase Samples

Vapor phase samples will be collected for volatile organic compound analysis from the SVE system, vapor extraction wells and vapor monitoring probes via sorbent tubes attached to a universal sampling pump.

Sampling will be conducted in the following manner.

- Uncap both ends of sorbent tube;
- Attach effluent end of sorbent tube to sampling pump;
- Attach influent end of sorbent tube to sampling port on well/probe etc.;
- Open sampling port;
- Turn sampling pump on at flow rate of 0.05 L/min.;
- Pump will turn itself off when one L of air has passed through sorbent tube;
- Close sampling port;
- Remove sorbent tube from pump and sampling port and cap both ends; and,
- Deliver labeled sample tube to Long Island Analytical Laboratories, Inc. for analysis of tetrachloroethene, trichloroethene, 1,2-dichloroethene (total), 1,1-dichloroethene, and vinyl chloride by NIOSH Method 2549 using a gas chromatograph equipped with a mass spectrometer (GC/MS) with a 24-hour turn around time.

NIOSH Method 2549 is provided as Appendix C.

The number of vapor phase samples that will be collected and analyzed (including QA) during the performance test, initial operating period, and routine operating period are as follows:

Period Name	Number of Progress Monitoring Events	Number of Samples Analyzed per Event	Total Number of Samples Analyzed at LIL	Total Number of QA Samples Analyzed at STLV Lab
SVE Performance Test	28	9	252	32
Initial SVE Operating Period	6	9	54	7
Routine SVE Operating Period	68	9	612	61

Vapor samples will be collected during each progress monitoring event from the following locations; soil vapor extraction well 1 (SVE-1), soil vapor extraction well 2 (SVE-2), vapor monitoring well 1 (VM-1), vapor monitoring well 2 (VM-2), vapor monitoring well 3 (VM-3), vapor monitoring well 4 (VM-4), carbon vessel 1 inlet, carbon vessel 1 outlet, and carbon vessel 2 outlet. Results of the sampling will be reported to the Engineer within 48-hours of sample collection.

Twenty (20) of the SVE System vapor phase samples collected during the SVE Performance Test and four (4) of the SVE System vapor phase samples collected during the SVE Initial Operation Period will be split. Twelve (12) of the vapor monitoring probe samples collected during the SVE Performance Test and three (3) of the vapor monitoring probe samples collected during the Initial SVE Operating Period shall be split. Ten percent of the SVE System Vapor Phase samples collected during the Routine SVE Operating Period (61 samples estimated) will be split.

Split sample collection will differ from standard sample collection in that a y-connector will be attached to the sampling port on the well/probe so that a vapor sample and a split vapor sample may be collected, with the use of a second sampling pump, concurrently.

The split samples will be submitted to STLV for confirmatory analysis of vinyl chloride, 1,2-dichloroethene (total), 1,1-dichloroethene, trichloroethene and tetrachloroethene by NOISH Method 2549. Results will be reported in the appropriate progress monitoring report.

3.2 Groundwater Samples

Groundwater samples will be collected from the groundwater monitoring wells ASM-1, ASM-2, FC-1 and FC-2 as specified in the Contract Documents. Samples will be collected using a disposable polyethylene bailer, submitted to Severn Trent Laboratories located in Newburgh, NY and analyzed for volatile organic compounds in accordance with NYSDEC ASP Method 95-1. Samples will also be submitted to Severn Trent Laboratories located in Newburgh, NY and analyzed for dissolved iron and manganese in accordance with Superfund CLP Inorganics Methods 236.1 and 243.2, respectively. The method detection limits and the reporting limits for each analyte to be analyzed are presented in Severn Trent Laboratories' QAPP, included in Appendix B. Superfund CLP reporting and deliverables will be completed for groundwater analyses. The number of groundwater samples that will be collected and analyzed during the performance test, initial operating period, and routine operating period are as follows:

Period Name	Frequency of Groundwater Sampling Events	Number of Groundwater Samples Collected per Event	Total Number of Groundwater Samples Collected per Period
Air Sparge Performance Test	Once prior to start-up of the Air Sparging System	4	4
Initial Air Sparge Operating Period	3 (once every 2 weeks)	2	6
Routine Air Sparge Operating Period	34 (one time per month)	2 (33 events) 4 (1 event)	70

Appropriate site-specific and laboratory QA/QC sampling, including, matrix spike, matrix spike duplicates and trip blanks, in accordance with NYSDEC ASP requirements, will be included as part of the groundwater sampling conducted prior to system start-up, and as part of the final round of groundwater sampling conducted during the Routine Air Sparging Operating Period (these two rounds of sampling will include wells ASM-1, ASM-2, FC-1 and FC-2).

Specification for equipment utilized for groundwater sampling, including, but not limited to, pH, conductivity, temperature, turbidity and dissolved oxygen meters, water level indicators and pumps are included in Section 6.0 of this Plan.

Groundwater samples will be collected as follows:

1. The depth to the water level will be measured and recorded in order to calculate the liquid bore volume necessary for purging. Water level measurement will be obtained using a decontaminated electronic water level indicator in accordance with EPS standard operating procedure 1.1.1.2 "Well Gauging With the Water Level Indicator Probe" included in Appendix D.

2. The wells will be purged until a minimum of three bore volumes have been removed.

3. A sample will be collected with a dedicated disposable polyethylene bailer with dedicated disposable rope at the completion of purging. Clean, new, latex, sampling gloves will be donned for each sample that is collected to protect the sampler from potential constituents in the waste and to prevent potential contamination of the sample by the sampler's dirty hands. Sampling will be conducted in accordance with EPS Standard Operating Procedure 1.1.2.2 "Groundwater Sampling Collection for Volatile Organic Compounds with an Open Bailer" included in Appendix D. Field parameters including pH, temperature, conductivity, dissolved oxygen and turbidity will be measured using a multi meter and recorded.

4. After three well volumes have been removed, pH, temperature and conductivity values will be evaluated. Purging will continue for more than three well volumes until the pH, temperature and conductivity have stabilized to within 10 percent.

5. If purging does not result in a turbidity level of 50 NTUs or less, samples for iron and manganese analysis will be filtered in the field using a 0.45 micron filter and analyzed for dissolved iron and manganese.

6. Disposable polyethylene bailers with disposable nylon or polypropylene rope will be used for purging and sampling of the wells. If desired, EPS may utilize a decontaminated submersible pump and dedicated tubing for purging only.

Disposable sampling equipment will be used whenever possible to reduce the need for decontamination. When the use of reusable sampling equipment is necessary, decontamination of sampling equipment shall be as follows:

- Wash equipment in bath of phosphate-free detergent and potable water using brushes and scrubbing pads as necessary;
- Rinse equipment in potable water;
- Triple rinse with distilled water;
- Air dry; and,
- Wrap in aluminum foil when not in use.

The results of the groundwater sampling will be reported in the applicable Progress Monitoring Report.

3.3 Confirmatory Soil Samples

Confirmatory soil samples will be collected as specified in Section 00007 of the *Contract Documents*. Confirmatory soil samples will be collected in order to demonstrate the effectiveness of the SVE System. Clean, new, latex, sampling gloves will be donned for each sample that is collected to protect the sampler from potential constituents in the soil and to prevent potential contamination of the sample by the sampler's dirty hands. All samples will be screened in the field using a photoionization detector (PID). Standard Operating Procedures for analysis of the samples utilizing a PID are included in Section 7.0 of this Plan. A portion of each sample will be placed in a pre-cleaned certified sample container supplied by the laboratory for possible off-site analysis. Once the results of the on-site screening is reviewed by the Engineer, a decision will be made for shipment of samples to Severn Trent Laboratories located in Newburgh, NY for analysis.

Disposable sampling equipment will be used whenever possible to reduce the need for decontamination. When the use of reusable sampling equipment is necessary, decontamination of sampling equipment shall be as follows:

- Wash equipment in bath of phosphate-free detergent and potable water using brushes and scrubbing pads as necessary;
- Rinse equipment in potable water;
- Tripple rinse with distilled water;
- Air dry; and,
- Wrap in aluminum foil when not in use.

A minimum of three (3) discrete samples from each boring, as directed by the Engineer, will be sent to Severn Trent Laboratories located in Newburgh, NY for analysis for volatile organic compounds using NYSDEC ASP Method 95.1 with Superfund CLP deliverables. The method detection limits and the reporting limits for each analyte to be analyzed are presented in Severn

Trent Laboratories' QAPP, included in Appendix C. Appropriate site-specific and laboratory QA/QC sampling will be in accordance with current NYSDEC ASP requirements.

Results of the Confirmatory Soil Samples will be reported to the Engineer within 72-hrs of sample receipt by the laboratory.

3.4 Waste Samples

Representative samples of waste generated during the investigation will be collected in accordance with the matrix of the material being sampled. Liquid samples (i.e., decontamination water, development water, purge water, etc.) will be collected from the 55-gallon drums containing this waste water using a clean, disposable, polyethylene bailer. Waste soil samples will be collected from the waste containers with plastic sampling scoops. Clean, new, latex, sampling gloves will be donned for each sample that is collected to protect the sampler from potential constituents in the waste and to prevent potential contamination of the sample by the sampler's dirty hands.

Samples will be collected into clean, laboratory-supplied sample jars and/or bottles containing the preservatives appropriate to the analyses requested. Samples will be analyzed for the parameters/analytes required by the waste disposal facility for waste profiling. At a minimum these parameters will include target compound list (TCL) + 30, target analyte list (TAL) metals and cyanide.

Disposable sampling equipment will be used whenever possible to reduce the need for decontamination. When the use of reusable sampling equipment is necessary, decontamination of sampling equipment shall be as follows:

- Wash equipment in bath of phosphate-free detergent and potable water using brushes and scrubbing pads as necessary;
- Rinse equipment in potable water;
- Triple rinse with distilled water;
- Air dry; and,
- Wrap in aluminum foil when not in use.

Results for waste samples will be presented to the Engineer within two (2) weeks of sample receipt by the Laboratory.

4.0 SAMPLE DESIGNATION

Sample bottles (preserved, if necessary), labels, shipping containers, trip blanks and field blank water will be provided by the laboratory responsible for the specific analysis as described above. During collection and containment of soil samples, the sample container will be labeled with the following information:

1. EPS internal Job Number (ie. Wxxxx);
2. EPS internal Lab Log Number (ie. Wxxxx);
3. Sample (media) type identification code;
4. Sample location and/or field quality control (QC) identification code (if applicable);
5. Sample depth interval
6. Analysis to be performed;and
7. Date and time of collection

Liquid/Water and Vapor/Air sample containers will be labeled with the following information:

1. EPS internal Job Number (ie. Wxxxx);
2. EPS internal Lab Log Number (ie. Wxxxx);
3. Sample type (media) identification code;
4. Sample location and/or field quality control (QC) identification code (if applicable);
5. Type of preservative added (if applicable); and
6. Date and time of collection.

The sample identification codes provided on each sample label will follow the coding system as described below:

1. Sample type (media) abbreviations will be as presented below:
   a) Water or liquid = W
   b) Soil or solid = S
   c) Vapor or air = V
2. QC identifiers will be as follows:
   a) Field replicate = FR
   b) Field Blank = FB
   c) Matrix Spike and Matrix Spike Duplicate = MS/MSD
   d) Matrix Spike Blank = MB
   e) Trip Blank = TB

A record of sequentially numbered samples for each media with corresponding sample designations shall be kept in a log book, which will be provided to the Engineer upon request.

5.0 SAMPLE HANDLING, PACKAGING AND SHIPMENT

All samples will be collected and handled according to the appropriate analytical protocols for each matrix. The types of containers, volumes needed, holding times and preservation techniques for the proposed testing parameters are as follows:

Matrix	Analytical Method	Container Type	Container Volume	Containers per Sample	Holding Time	Preservative
Liquid/Water	NYSDEC ASP Method 95-1	Glass/Zero Headspace	40 ml.	3	14 days	HCL
	EPA CLP Method 236.1	Plastic	500 ml.	2	6 months	HNO_3
	EPA CLP Method 243.2	Plastic	500 ml.	2	6 months	HNO_3
Vapor/Air	NIOSH Method 2549 (Mod)	Sorbent Tube	1 Liter	1	3-7 days	None
	EPA Method T01/T02	Tedlar Bag	1 Liter	1	3-7 days	None
Soil	NYSDEC ASP Method 95-1	Glass	8 oz.	1	14 days	None

All samples will be delivered to the approved laboratory(s) within 24 hours of collection and will be preserved appropriately at the time of sample collection. The following sample packing and shipping procedures will be followed for samples requiring chemical analysis.

1. Prepare cooler(s) for shipment.
   a) Tape drain(s) of cooler shut;
   b) Affix "This Side Up" arrow labels and "Fragile" labels on each cooler; and,
   c) Place mailing label with laboratory address on top of cooler(s).
2. Arrange sample containers in groups by sample number.
3. Verify that all bottle labels are completed correctly. Place clear tape over bottle labels to prevent moisture accumulation from causing the label to peel off.
4. Arrange containers in front of assigned coolers.
5. Seal sample containers within plastic zip-lock bags to prevent leakage.
6. Place approximately two (2) inches of vermiculite or other packaging material at the bottom, sides and top of the cooler to act as a cushion for the sample containers.
7. Arrange containers in the cooler so that they are not in contact with the cooler or other samples.
8. Fill remaining spaces with vermiculite or other packaging material.
9. Ensure all containers are firmly packed in vermiculite or other packaging material.
10. If ice is required to preserve the samples, ice cubes should be packaged in double zip-lock bags and placed on top of the vermiculite or other packaging material.
11. Sign chain of custody form (or obtain signature) and indicate the time and date it was relinquished to carrier, as appropriate.
12. Separate copies of chain of custody forms. Seal proper copies within a large zip-log bag and tape to inside of cooler lid. Retain copies of all forms.
13. Close lid and latch.

14. Secure each cooler using custody seals.
15. Tape cooler shut on both ends.
16. Relinquish to courier service as appropriate. Retain airbill receipt for project records. All samples will be shipped for "NEXT DAY" delivery.
17. Telephone laboratory contact and provide the laboratory with the following shipment information:
    a) Sampler's name;
    b) Project name;
    c) Number of samples sent according to matrix and concentration; and
    d) Airbill number.

60 FIELD INSTRUMENTATION

The manufacturers' supplied owners manual for all instrumentation to be furnished by EPS are included in Appendix E of this Sampling and Analysis Plan. Unless otherwise specified below, EPS will follow the manufacturers recommended calibration and maintenance procedures for all instrumentation, as outlined in each instruments owners manual.

6.1 Photoionization Detector

Confirmatory soil samples will be field screened with a PE Photovac Photoionization Air Monitor/photoionization detector (PID). The user's manual for the PID is included in Appendix E and includes the meter's calibration, operation and maintenance information. The PID is equipped with a 10.6 eV bulb and has a detection limit of 0.1 parts per million (ppm) by volume referenced to an isobutylene-in-air standard. A representative portion of each soil sample, corresponding to a second portion that has been prepared for potential laboratory analyses, will be placed into an 8 ounce sample container so that the sample container is approximately ½ full. The opening of the jar will be covered with aluminium foil and the screw top lid will be screwed on. The screening samples will be allowed to equilibrate to ambient temperature. Immediately prior to screening, the jar sample will be shaken vigorously for approximately 30 seconds. A measurement of the total VOCs within the headspace of the jar sample will be obtained by removing the screw-top lid, inserting the PID probe tip through the aluminum foil into the headspace of the jar. The maximum PID reading will be recorded in the field notes and the cap placed back on the jar for disposal.

6.2 Dissolved Oxygen Meter

EPS will utilize a Hanna Instruments HI 9142 Portable Waterproof Dissolved Oxygen Meter for the determination of dissolved oxygen (D.O.) in the field during groundwater sampling activities. The Instruction Manual for the D.O. meter is presented in Appendix E and includes the meter's calibration, operation and maintenance information.

6.3 pH/Temperature Meter

An Orion Model 250 A will be used in the field for the determination of groundwater pH and temperature. The Instruction Manual for pH meter, including calibration, operation and maintenance information, is presented in Appendix E.

7.4 Turbidity Meter

A LaMotte 2020 Turbidmeter will be used for the evaluation of groundwater turbidity during purging and sampling activities. The LaMotte 2020 Instruction Manual is included in Appendix E and includes information regarding calibration, operation and meter maintenance.

6.5 Conductivity Meter

A Corning Model 311 Portable Conductivity Meter will be used in the field for the determination of groundwater conductance. The Instruction Manual for the conductivity meter, including calibration, operation and maintenance information, is presented in Appendix E.

6.6 Water Level Indicator

Groundwater Levels will be measured with a Heron H.20L – type Water Level Meter or Solinst Model 101Water Level Meter. The Operating/Maintenance Instructions are provided in Appendix E.

7.0 DATA EVALUATION REQUIREMENTS

All data generated as part of this Project will be evaluated by the QA/QC Officer. The QA/QC Officer will identify to the Engineer in writing any and all problems or potential problems with regard to the validity of the data generated. The QA/QC Officer will provide each required submittal to the Engineer a statement which evaluates the quality, validity and usability of the data provided with respect to the intended use.

Typical data evaluation activities to be performed include the following:

a. Review of chain-of-custody documents to verify sample identifies.

b. Review of sample log-in documents to verify any potential problems with custody seals, container integrity, sample preservation, labeling, etc.

c. Review of field blank data to ascertain any potential problems with container contamination, preservative contamination, sampling equipment contamination, or cross contamination between samples during transport.

d. Review of trip blank data to identify any potential problems with sample container contamination, preservative contamination, laboratory reagent water contamination, or cross contamination between samples during transport.

e. Review of method blank data to determine the presence of any sources of contamination in the analytical process.

f. Review the matrix spike (MS) data to evaluate the potential for matrix effects and as a measure of analytical accuracy. MS recoveries will be compared against laboratory acceptance criteria to determine if they are within or outside warning and control limits for percent recoveries.

g. Review of matrix spike/matrix spike duplicate (MS/MSD) data to evaluate sample homogeneity and as a measure of analytical precision. MS/MSD data will be compared to laboratory acceptance criteria for the maximum relative percent deviation (RPD)

h. Review of any blank spike BS data (if available) as a measure of analytical accuracy. BS recoveries will be compared against laboratory acceptance criteria to determine if they are within or outside of warning and control limits for percent recoveries.

i. Review of blank spike and blank spike duplicate (BS/BSD) data (if available) as a measure of analytical precision. BS/BSD data will be compared to laboratory acceptance criteria for the maximum RPD.

k. Review of sample and sample duplicate data (if available) as a measure of sample homogeneity and as a measure of analytical precision. Sample and sample duplicate data will be compared against the laboratory acceptance criteria for the maximum RPD.

l. Review of surrogate recovery data to assess extraction's efficiency, effectiveness of sample introduction and possible loss during cleanup activities. Surrogate recoveries will be compared to laboratory acceptance criteria to determine if they are within or outside of acceptable limits.

m. Review of sample dates, extraction/digestion dates, and analysis dates to determine if maximum holding times were met or exceeded.

The following items would typically <u>not</u> be reviewed under this data evaluation effort: instruments tunes, standard curves; internal standard recoveries; system performance check compound results; continuing calibration results; inter-element correction check results or laboratory notebook pages.

8.0 DELIVERABLES

A. The results of all analyses will be submitted to the Engineer in the form of typed summary tables. The summary tables will provide the sample identification number, the date and time each sample was collected and the result of the analysis for each parameter.

B. Final laboratory analytical reports will be Superfund CLP deliverables or equivalent and will be provided to the Engineer within 14 days from receipt of the sample by the laboratory, unless specified or directed otherwise by the Engineer.

C. The results of on-site analyses of vapor phase samples from the SVE System and Vapor Monitoring Probes will be provided to the Engineer within 48 hours of sample collection. Final data and, if applicable, confirmatory sample analysis, will be provided with the applicable Progress Monitoring Report.

D. The results of on-site screening of the confirmatory soil samples will be provided to the Engineer within two (2) hours of sample collection. The results of the analyses of the Confirmatory Soil Sampling will be transmitted via facsimile from the laboratory directly to the Engineer within 48 hours of sample receipt by the laboratory. Final data packages will be provided to the Engineer within two weeks of sample collection.

E. Results for groundwater sampling will be provided to the Engineer with the applicable Progress Monitoring Report.

F. Results for the waste sampling will be provided to the Engineer within two (2) weeks of sample receipt by the laboratory.

G. Results for the air monitoring sampling will be provided to the Engineer within 24 hours of sample receipt by the laboratory.

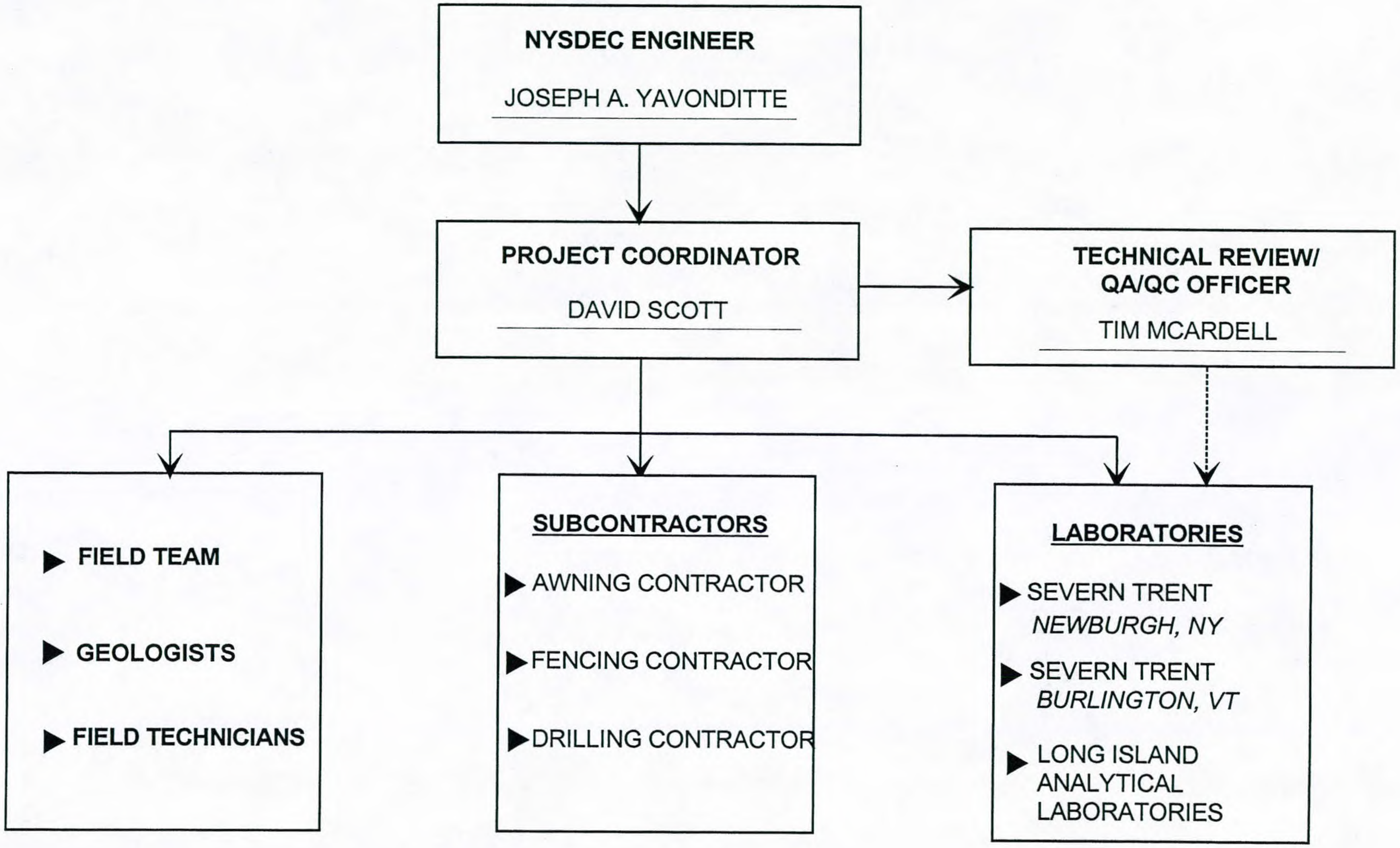
H. Calibration records for equipment utilized during the SVE System monitoring and sampling and Vapor Monitoring probe sampling will be provided with the SVE Progress Monitoring Reports.

I. Calibration records for equipment utilized during Air Sparging System monitoring and groundwater sampling will be provided with the Air Sparging Progress Monitoring Reports.

FIGURE 1

Project Organizational Chart

Proje[illegible] Organizational Chart



Environmental Products & Services, Inc.

Project Orginzational Chart
Franklin Cleaners Site
206-208B South Franklin Street
Hempstead, NY

DATE:	JANUARY 2001	PROJECT NO.:	W0000
SCALE:	NOT TO SCALE	FIGURE NO.:	1
DRAWN BY:	GEOSCIENCE	LOCATION:	HEMPSTEAD, NY

APPENDIX A

QA Officer Resume

Timothy McArdell **Corporate Geoscience Services Manager**

Professional Qualifications

Timothy McArdell is an Environmental Engineer and serves as a Geoscience Services Manager for the Corporate Geoscience Services Division of Environmental Products & Services, Inc. His responsibilities include providing technical support and oversight to Geoscience personnel in the performance of site monitoring, site assessments, subsurface investigations, and site remediation. Other responsibilities include project management and supervision, proposal preparation and review, report writing, remedial system design, construction and installation, technical QA/QC, Geoscience Services marketing, and customer service.

Education

M.S., Environmental and Resource Engineering, State University of New York College of Environmental Science and Forestry
B.S., Environmental Chemistry, State University of New York College of Environmental Science and Forestry

Registration/Certification/Training

- ASTM Risk Base Corrective Action (RBCA) Training
- 40-Hour Hazardous Waste Operations and Emergency Response
- Confined Space Entry
- Confined Space Rescue
- Hazardous Materials Transportation (HM-181)

Experience and Background

***Environmental Products & Services, Inc.**, Syracuse, NY* *1994 - present*
Corporate Geoscience Services Manager

Responsible for technical support and oversight to Geoscience personnel in the performance of site monitoring, site assessments, subsurface investigations, remedial system design, construction and installation, and site remediation.

Experience includes:

- As the Corporate Geoscience Services Manager, Mr. McArdell works with project managers company wide on all aspects of site investigation and remediation to ensure technical quality and timely project completion. Mr. McArdell's experience, training and education encompasses a wide range of environmental site assessment, investigation and remediation activities, including direct-push subsurface investigations, monitoring, and recovery well installation, laboratory analytical data analysis and interpretation, remedial system pilot testing, remedial system design and installation, and set-up of operations and maintenance schedules and site monitoring programs.

(continued)

- Mr. McArdell has also managed the construction of several mobile remediation systems for both public and private clients. These remedial systems are housed in trailers and are designed to be utilized at sites with varying degrees of soil and groundwater contamination.

- Mr. McArdell has completed a comprehensive site investigation in the Village of Warsaw in southwest New York State to delineate the nature and extent of a petroleum contaminant plume covering an area of approximately 40 acres. Upon completion of the initial subsurface investigation (advancement of more than 60 soil borings and the installation of 14 monitoring wells) and subsurface remedial pilot testing, a total of 20 recovery wells were installed across the site and a remedial strategy was formulated and implemented.

- Prior to serving as Corporate Geoscience Services Manager at Environmental Products & Services, Inc., Mr. McArdell was a project manager for the Syracuse Branch. In this capacity, he was responsible for managing site assessment and site remedial activities at several sites for both public and private clients. Additional responsibilities included field monitoring, report writing, UST assessments and closure, performance of Phase I and Phase II Environmental Site Assessments, and residential spill remediation and site closures.

- In a previous position with Environmental Laboratory Services (ELS), Mr. McArdell utilized and refined his strong analytical background. His responsibilities included analysis of volatile and semi-volatile organics using GC/MS, interpretation and reporting of results with appropriate QC data, and set up of data acquisition and reduction routines. Additional analytical experience encompassed the use of GC, GC/MS, HPLC, and IR Spectrometry instrumentation.

APPENDIX B

Laboratory QAPPs

LONG ISLAND ANALYTICAL LABORATORIES INC.

"TOMORROWS ANALYTICAL SOLUTIONS TODAY"

NYSDOH ELAP# 11693
USEPA# NY01273

January 11, 2001

Mr. Tim McArdell
7635 Edgecomb Drive
Liverpool, NY 13088

Dear Mr. McArdell:

Enclosed please find Long Island Analytical Laboratories' Quality Control, Quality Assurance Management Plan Brochure.

If you have any questions or need further information please do not hesitate to call me

Best regards,

Michael Veraldi

Michael Veraldi, President
Long Island Analytical Laboratories, Inc.

101-4 Colin Drive • Holbrook, New York 11741
Phone (631) 472-3400 • Fax (631) 472-8505 • Email: LIAL@lialinc.com

LONG ISLAND ANALYTICAL LABORATORIES INC.

"TOMORROWS ANALYTICAL SOLUTIONS TODAY"

NYSDOH ELAP# 11693
USEPA# NY01273

Quality Control, Quality Assurance Management Plan Long Island Analytical Laboratories 2000

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Rev #6-2000

LONG ISLAND ANALYTICAL LABORATORIES INC.

"TOMORROWS ANALYTICAL SOLUTIONS TODAY"

NYSDOH ELAP# 11693
USEPA# NY01273

Quality Control Management Plan

Long Island Analytical Laboratories, Inc
101-4 Colin Drive
Holbrook, New York 11741

Laboratory Director : Michael Veraldi
Michael Veraldi

Table of Contents

1.0 INTRODUCTION

1.1 Purpose

Long Island Analytical Laboratories, Inc. is a full service analytical testing laboratory that provides to its clients comprehensive solutions to their analytical needs. These services include a wide range of analytical testing in the four major categories; Potable Water, Non Potable Water, Air/Emissions and Solid Waste, along with Technical Support, Regulatory Compliance & Site Assessment and Emergency Response Services.

In the pursuit of accomplishing its corporate objectives, Long Island Analytical Laboratories, Inc. recognized that Quality Assurance is absolutely necessary in order to ensure that the samples it handles, for its clients, are analyzed within the guidelines set forth by NYSDOH, EPA SW-846, NIOSH, and NVLAP.

Accordingly, Long Island Analytical Laboratories, Inc. has established a Quality Assurance Management Plan. The Management Plan objectives are:

- To ensure the performance reliability of Long Island Analytical Laboratories.
- To provide the highest quality analytical service possible.
- To ensure that all turn around times are met.
- To ensure compliance with all applicable local, state and federal regulations.

1.2 Quality Assurance Policy Statement

Quality Assurance at Long Island Analytical Laboratories, Inc. is:

The total activities performed by all its employees in accordance and in compliance with the system requirements as set forth in its Quality Assurance Management Plan, which ensures all necessary precautions are taken, in order that the highest quality data can be generated.

Long Island Analytical Laboratories, Inc. is committed to continuously strive for improvements in quality and service and, as such, insists that all personnel and staff be aware of and practice good laboratory procedures that will assure the successful implementation of the quality polices on an ongoing basis.

1.3 Corporate Responsibility

The officers of Long Island Analytical Laboratories, Inc. have committed the company to provide and maintain high levels of quality in all aspects of its analytical concern and management of all samples. Accordingly, the president directs Long Island Analytical Laboratories' corporate officers and their respective staffs to take a leadership position in all matters dealing with the Quality Assurance of the company's operation. It is the responsibility of corporate management working directly with it's operational managers to:

- Establish policy and procedures relative to the successful achievement of the equality levels established for its site operations.

- Establish the proper mechanisms and systems that will ensure the translation of these policies to its departments in such a manner that they are integrated into the day-to-day operation.

- Provide consistent guidance and resources to all departments to ensure compliance with all applicable regulatory requirements.

- Ensure that all procedures are properly documented, updated, revised, and distributed to all appropriate personnel.

- Have final oversight responsibility for the quality assurance program of the corporation, The oversight responsibilities can include periodic audits, general quality meetings, and informational seminars.

1.4 Facility Management Responsibility

It is the responsibility of Long Island Analytical Laboratories' facility management to carry out the established corporate policies documented in the Quality Assurance Management Plan. These responsibilities can include the appointment of specific site quality teams, local audit activities, dissemination of and instruction in all quality related procedures and documents, and the appointment, where appropriate, of a separate quality officer for each department. Accordingly, it is the responsibility of each department supervisor, either directly or through proper delegation, to:

- Plan all data collection activities

- Implement all sampling, analysis and Quality Control (QC) protocols

- Document and approve all sampling, analysis, and QC protocols

- Asses the effectiveness of the QA/QC activities and to implement appropriate corrective action responses

- Review Data and determine the limits on use

1.5 Data Quality Objectives

Data Quality Objectives (DQO) are:

Statements of the level of uncertainty that a decision-maker is willing to accept in results derived from environmental data, when the results are going to be used in a regulatory compliance setting.

Customarily, DQO's are accompanied by statements of:

- The decision to be made
- Why environmental data is needed and how they will be used
- Descriptions of the environmental data to be collected
- Specifications with regard to the domain of the decisions
- Calculations, statistical or otherwise, that will be performed on the data

1.5.1 Minimization of Risk

The objective of DQO's is to minimize risk in an environmental decision. Generally, but not always, these decisions are based on data that is provided by the technical staff, sales staff or materials and methods used for the laboratory analysis. The data provided by a laboratory is customarily a statement of a certain constituent concentration level on a material sample that is understood to represent some microcosm of concern.

It is incumbent upon all individuals responsible for the collection of the material to ensure that proper procedures have been followed in order to avoid false negatives (a material is non-hazardous when, in reality, it is) or false positives (a material is judged hazardous when, in reality, it is not).

It is incumbent on the laboratory to perform the required analysis utilizing all proper and prescribed procedures that will ensure that the data provided on the material is accurate and precise within the established uncertainty acceptable, for the analytical results. Analyzing defined control samples in accordance with established laboratory QC protocols monitors the performance of an analytical laboratory.

The laboratory attests to the integrity of the number provided to the decision-maker on the specific sample analyzed. The quality officer, facility manager or the appropriately designated staff member will attest to the integrity of the entire process that went into obtaining the analytical result of the materials. The maintenance of all of the quality assurance characteristics of the process constitutes compliance with the DQO's and ensures that the risk in an environmental decision is minimized.

1.6 Quality Assurance Management Plan

A **Quality Assurance Management** Plan is:

A documented compendium of guidance, instructions and protocols that must be followed to ensure that the expected quality levels of environmental decisions can be achieved with predictability and regularity.

Long Island Analytical Laboratories has modeled it's plan along EPA guidelines as presented in Guidelines and Specifications for Preparing Quality Assurance Program Plans, QAMS-004/80, EPA-600/8-83-024, June 1983, and Interim Guidelines and

Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80, EPA-600/4-83-004, February, 1983. These documents have been published by EPA's Office of

Monitoring Systems and Quality Assurance, and the Office of Research and Development. Additional quality control (QC) elements from Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition has also been incorporated into the plan.

Long Island Analytical Laboratories Quality Assurance Management Plan contains guidance, instructions and protocols for the following areas:

- Organizational Structure and Personnel Responsibilities
- Scope and Domain of the Plan
- Sample Custody and Documentation Procedures
- Calibration Procedures and Frequency
- Analytical Procedures
- Data Reduction, Validation and Reporting
- Internal Quality Control Procedures
- Performance and System Audits
- Preventive Maintenance
- Corrective Action Procedures
- Quality Assurance Reports to Management

2.0 Organizational Structure and Personnel Responsibilities

The purpose of this section is to clearly define the functions and responsibilities each person is expected to carry out under the QAMP. In addition, this section delineates the specific lines of authority and communication, which are essential to ensuring that the goals and objectives of the QAMP are achieved.

The organizational structure for Long Island Analytical Laboratories, Inc., as it relates to the QAMP, is clear and decisive. Each individual will be held accountable for properly executing his or her assigned tasks in accordance with the QAMP. Further, Long Island Analytical Laboratories is committed to taking a strong corporate role to provide proper oversight, support, (financial and otherwise), and policy direction to ensure its analytical operations are conducted in accordance with the QAMP.

2.1 General Responsibilities For Each Job Function

Provided below is a list of the functions and responsibilities that are assigned to individuals by job position. In addition, individual company SOP's may assign specific duties and responsibilities other than those provided here. Generally, company managers and supervisors are required to ensure that each individual has the knowledge, capability, and qualifications to perform their assigned tasks. This includes assuring that assigned personnel have completed the training requirements specified in Section 2.3 of this program.

2.1.1 Vice-President and/or General Operations Manager (GOM)

The facility's GOM has the primary responsibility to ensure that the objectives of the QAMP are carried out at every level of the operation. The specific duties of GOM are as follows:

- Overall functional responsibility for program implementation
- Direct the activities of responsible personnel
- Allocate necessary resources to carry out the goals of the QAMP

2.1.2 Sales Manager

The Sales Department is often the primary source of information regarding the customer's samples. Specifically, the Sales Representatives may be involved in the acquisition of the sample; the custody of the sample, and the communication link between Long Island Analytical Laboratories and the customer for obtaining information about the sampling event. In this capacity, the Sales Department plays a vital role in ensuring that the quality of our analytical data meets the standards specified in the QAMP.

Accordingly, the Sales manager must:

- Ensure that the sales staff carries out their responsibilities under the QAMP.
- Ensure that sales personnel are properly trained in Long Island Analytical Laboratories sampling procedures, data collection methods, holding times, preservatives, and types of containers.

2.1.3 Laboratory Manager

The Laboratory Manager must ensure that responsibilities listed below are carried out in accordance with the QAMP. The Laboratory Manager may choose to assign certain functions to other laboratory personnel as appropriate. These responsibilities include:

- Developing, documenting, and implementing standard analytical and sampling procedures

- Ensuring that day to day support of operations is properly carried out in a timely manner
- Ensuring that all laboratory Quality Control procedures are properly performed
- Providing the necessary training and resources for laboratory analysts
- Performing Data Validation (as appropriate)
- Ensuring that Quality Assurance reports are provided to Management in accordance with Section 12.0 of the QAMP

2.1.4 Quality Assurance Manager (If applicable)

The QA manager is primarily responsible for ensuring that the laboratory personnel are conducting their daily operations in accordance with the QAMP and laboratory specific SOP's. If the laboratory does not have a QA Manager, or in the absence of the QA Manager, the Laboratory Manager shall be responsible for ensuring that appropriate personnel are assigned to fulfill the duties and responsibilities outlined below:

- Review laboratory data (i.e., bench sheets, lab notebooks, instrument logs, etc.)
- Monitor QC activities
- Implement and monitor Long Island Analytical laboratories performance evaluation program
- Maintain Quality assurance training records
- Perform the functions of the QA Auditor (as assigned)
- Provide Quality Assurance reports to Management (as assigned)

2.1.5 Laboratory Analysts

Laboratory analysts are responsible for the items listed below.

- Performing laboratory analysis based on documented procedures.
- Performing appropriate QC in accordance with the QAMP or documented laboratory SOP's.
- Identifying when corrective actions are necessary under the supervision of management.
- Performing data reduction calculations as required.

2.1.6 Quality Assurance Auditor

The QA Auditor will be assigned by the Laboratory manager and is responsible for maintaining the System and Performance Audits programs described in Section 9.0. In addition, the QA Auditor will provide the Quality Assurance reports to Management in accordance with Section 12.0 of the QAMP, unless otherwise specified by the Laboratory Manager. The QA Auditor may be retained by an outside firm to insure impartiality.

3.0 Personnel Qualifications and Training

All laboratory personnel, at Long Island Analytical Laboratories, must posses a Bachelors degree in Science and a minimum of two (2) years of experience in a New York State Department of Health Accredited laboratory, or equivalent. In addition, all laboratory personnel must complete all in-house quality and methods training as outlined below:

3.1 Initial Quality Control Training

The QC Manager, or designee, is responsible to provide all laboratory personnel with the appropriate training necessary to ensure that all laboratory quality control requirements are met. The training may include, but not be limited to, reviewing the Management Plan and all other in-house quality related SOP's. A record of the training will be kept in the appropriate training file.

3.2 In-House Training

All personnel will be given sufficient hands on training for any and all analytical methods for which they will be responsible. The length of time for the training will be left up to the trainer and the individual and will be dependent on the trainees previous experience. The training will include, at a minimum:

- Reading and understanding the appropriate method and all QC requirements
- Reading all applicable SOP's
- Demonstrating hands on ability to perform the analysis in question

3.3 Outside Training

Additional training outside of the laboratory will be provided on an as needed basis. Vendor training for specific instrumentation and attendance at technical seminars will be provided, when available.

3.3 Safety Training

All Long Island Analytical Personnel receive safety training relevant to the jobs they perform. In addition in-house safety meetings are conducted quarterly or as needed. All safety training is documented and placed in the appropriate training files.

4.0 Sample Custody & Documentation Procedures

The validity of analytical data is dependent upon the integrity of the samples analyzed. Once samples are received at Long Island Analytical Laboratories, they are physically inspected, checked against the accompanying paperwork and assigned a unique laboratory number.

4.1 Chain of Custody Documentation

The client is generally responsible for providing a completed chain of custody (COC) with all sample submitted. Long Island Analytical Laboratories maintains copies of COC's at its facility and will supply them to clients as needed.

When samples are received, the COC is checked for completeness and accuracy. All discrepancies are noted on the COC and corrected whenever possible. The COC is then signed and dated by both the submitter and the receiver at the time the samples arrive.

4.2 Sample Inspection

Upon arrival at the laboratory, all sample containers are inspected for damage. Any damage to a container, that may adversely effect the laboratory results, is noted on the (COC) and the client is notified.

All containers are checked to ensure that they are properly labeled and that they match the corresponding information on the COC. In situations where the sample labels do not match the information on the COC, the client must be notified for clarification prior to the samples being submitted to the laboratory for analysis.

4.3 Sample Log-In

Once the samples have been accepted for analysis, they are logged into the log book and assigned a unique lab number. The lab number is placed clearly on all corresponding sample containers as well as on the COC.

The following information is logged into the log book:

- Date Received
- Client Information
- Lab ID's assigned
- Sample collection Date and Time
- Analysis Requested
- pH for liquid samples
- Number and Type of containers

- Matrix
- Initials of the person logging in the samples

4.4 Submission to the Laboratory

Once the samples are accepted and logged in, they are submitted to the laboratory for analysis. All soil samples are placed directly into the designated refrigerator pending analysis. All liquid samples are first checked to ensure that they are properly preserved. Samples that are not preserved will have the appropriate preservative added and then placed into the refrigerator pending analysis. A copy of the COC is placed into the laboratory COC binder.

4.5 Sample Security and Storage

Access to the laboratory storage refrigerators is restricted to laboratory personnel only. Samples are removed by laboratory personnel only, prepared for analysis, and immediately returned to the refrigerator.

Samples remain in the pending analysis refrigerators until all analyses are completed and the results are submitted. Once the analysis is completed the samples are relocated to the 30 day hold area, where they are kept for a minimum of 30 days after the report is submitted to the client. At the end of the 30 days, all samples are properly disposed of in accordance with all applicable Federal, State and local regulations.

5.0 Laboratory Calibration Procedures and Frequency

Long Island Analytical Laboratories, Inc. shall create and maintain the applicable methods of calibration for each analytical method and/or procedure used in its analytical laboratories. The following sections describe the general calibration procedures used in the laboratory; where specific instrument and method calibration procedures are provided in the manufacturer literature or individual laboratory SOP's respectively. These procedures and any subsequent revisions are hereby incorporated into this document by reference.

5.1 Calibration Documentation Logbook

A record of method or instrument calibration must be maintained. At a minimum, the following information shall be recorded in a bound notebook (in chronological sequence):

- Date of calibration
- Method description
- Calibrants
- Standard value (e.g., standard concentration, pH units, standard weighs, etc.)
- Technician signature
- Comments (as appropriate)

In addition, depending upon the specific procedure being employed, other information may be included where appropriate (e.g., temperature, titrant, etc.)

5.2 Standard Preparation Logbook

A record of any calibration standards must be maintained in accordance with this QAMP. At a minimum, the following information shall be recorded in a bound notebook:

- Date the standard was prepared
- Title of the solution
- Concentration of the standard
- Manufacturer and lot number of reagent grade chemical(s) used
- Quantity prepared
- Expiration date
- Preparer's signature

5.2.1 Labeling of Standards

A label must be placed on the calibration standard container that records

- Concentration
- Title of the solution
- Dates of preparation and expiration
- Required safety or hazard information (reference the laboratory's Chemical Hygiene Plan)
- Preparer's initials

5.3 Standard Calibration Curves

5.3.1 Calibration Standards

Refer to the method SOP for any specific calibration instructions. Unless stated otherwise, the calibration standards will include the Method Detection Limit (MDL). The calibration instrument response must be linear over the entire range of the calibration concentrations used to generate the curve.

5.3.2 Frequency of Re-Calibration

The frequency of re-calibration will depend on a number of factors. If it is found that the response of the calibration verification sample exceeds the acceptance limits established for the analysis, then the instrument must be re-calibrated. An instrument must be re-calibration after it has undergone any special or repair. In addition, an examination of the Control Charts for the analyses may indicate an "out of control" situation which could be traceable to a calibration problem. As a general rule the frequency of Re-Calibration is dictated by the approved method which will be followed.

5.3.3 Generation of Standards Curves

5.3.3.1 Computer Generated

In many instances, the computer software of a specific instrument will generate the appropriate calibration curves. Refer to the individual instrument instruction manual for the proper guidance and appropriate computer settings for calibration. A hard copy of the calibration curve and response factors should be generated and kept in a separate notebook for reference.

5.3.3.2 Manually Generated

In many methods, particularly the colorimetric methods, a manual calibration curve needs to be prepared that will be used to determine the parameters concentration. Refer to the SOP for specific instructions.

All standard curves should be dated and labeled with the method, analyte, standard concentrations, and instrument responses. Using the appropriate response units (e.g. – absorbency) and the corresponding concentrations, calculate the least squares equation for the line and the correlation coefficient. An acceptable correlation coefficient is 0.997 or greater. The concentration of an unknown sample can be read directly off the calibration curve. The working range of the curve is considered to be within the range of the standards used

5.4 Calibration of Miscellaneous Equipment

The calibration procedures for the miscellaneous equipment that is generally available in all of the facility laboratories are provided below. Again, specific calibration requirements for the other analytical instrumentation found in the lab (i.e., AA, GAF, ICP, GC, GC/MS, etc.) are provided in the manufacturer's literature or individual laboratory SOP's.

5.4.2 Analytical Balance

All analytical balances are serviced by a qualified organization annually.
A sticker with the name of the service organization and date of service is placed onto each balance.

All analytical balances are be checked in two ranges weekly with Class "S" weights. The ranges selected should reflect the routine use of the balance and the actual Class "S" weights used should test the optical scale mid-point.

The calibration data is recorded in a bound book and includes the date, target and actual readings and the analyst's Initials.

5.4.3 Top-Load or Pan Balances

All Top-loading balances are services annually by a qualified service organization. A sticker with the name of the service organization and date of service is placed onto each balance.

Top-loading or pan balances are calibrated monthly using Class "S" or S-1 Reference weights in at least three weight ranges representative of routine use.

The calibration data is recorded in a bound book and includes the date, target and actual readings and the analyst's Initials.

5.4.4 pH Meter

All pH Meters are calibrated using standard buffers daily or with each day of use whichever is less frequent.

Two Point Calibration. For pH Meters with a slope adjustment, the slope is created using standard pH Buffers at the extremes of the working range (e.g. pH 4.0 and pH 10.0). The slope is then checked using a standard buffer at the middle of the working range (e.g. pH 7.0). An acceptable actual reading is target value +/-0.05 pH Units.

All calibration data is recorded in a bound book and include, the date, pH buffer target value, set points, actual readings and analysts initials.

5.4.5 Thermometers

Long Island Analytical Laboratory possesses an NBS traceable, factory certified thermometer. After the first year of service and annually thereafter, the certified thermometer is checked at the ice-point and the correction factors adjusted accordingly.

All working thermometer, in the laboratory are uniquely identified and calibrated at the temperature(s) of interest prior to being placed into service and annually thereafter. Mercury in glass thermometers that have separated columns are removed from service.

All calibration data for all thermometers are maintained in a bound note book and include the date, thermometer identification, thermometer use, calibration temperatures and correction factors.

5.4.6 Refrigerators

Laboratory refrigerators are maintained at a temperature of between 1 and 5 degrees centigrade. Refrigerator temperatures are checked twice during each workday. Readings are taken in the morning and again in the late afternoon. Temperature readings are taken using a dedicated and calibrated thermometer, having its bulb immersed in a liquid and kept in the refrigerator.

All Refrigerator temperatures are recorded in a bound notebook and include the date, refrigerator designation, temperature and analysts initials.

5.4.7 Ovens

Ovens used for drying and/or sterilization should be maintained at the target temperature of interest during use. Oven temperatures should be checked at the beginning and at the end of each cycle. Temperatures should be measured using a calibrated dedicated thermometer. The thermometer should have graduations no greater than 1 degree

centigrade. If the oven door must be opened to read the thermometer, the thermometer's bulb should be immersed in a sand bath.

The oven temperatures are recorded in a bound book and include the date, target temperature and actual temperature at the beginning and end of the cycle and the analysts initials.

5.4.8 Barometer

Long Island maintains an aneroid barometers in the laboratory. It's readings are checked weekly against the National Weather Service readings taken at the local airport. The readings are recorded in a bound notebook and include the date, National Weather Service reading, laboratory barometer reading and analysts initials.

6.0 Analytical Methodologies

All analytical methodology chosen by Long Island Analytical Laboratories must meet realistic expectations regarding sensitivity, accuracy, reliability, precision and interference's. Matrix effects, limitations, cost, and the time required, for the analysis, are also taken into consideration.

Long Island Analytical Laboratories maintains copies of all appropriate methods and incorporates and variations used in its methods manual and corresponding SOP's. Copies of all methods and SOP's are readily available for all laboratory personnel.

7.0 Data Reduction, Validation, & Reporting

All Long Island Analytical Laboratory employees are responsible for data reduction, validation, & reporting and shall utilize the following procedures.

7.1 Calculations

All calculations being performed should be recorded using the International System of Units (IS). All results should be expressed in units applicable to the sample matrix and methodology (i.e. ug/L, mg/L, ug/kg, mg/kg).

All analytical results will be reported with regard to the proper significant figures. Generally a minimum of two significant figures is required. All digits of a reported result are expected to be known definitely, with the exception of the last digit, for which there may be a degree of uncertainty. The number of digits which are justified by the accuracy (i.e. detection limits) of the test and instrument being utilized are reported

7.2 Data Reduction

Data reduction is the process of converting raw data to a usable format beginning with data processing and continuing through data review and reporting of results. Data reduction can be performed by the analyst who obtained the data or by another designated analyst. Data review begins with the laboratory manager or QA/QC officer

who verified that data reduction has been properly performed and that all forms and log books have been completely and accurately complied. Data shall generally be reduced in one of the following ways:

- Manual calculation of results directly onto data sheet or attached calculation sheets
- Input of raw data for computer processing
- Direct acquisition and processing of raw data by computer gathering system

7.2.1 Final Data Package Procedures

Raw instrument data from all sources shall be reduced to a final data package or report for a given sample by the following steps:

- Generate data for a sample using a specific analytical instrument or method. Perform data reduction for each individual analyte tested to produce the final result.
- For a particular group of analytes (ex. Metals) gather all results for raw data for a sample that was generated from various instruments and procedures.
- Gather results for all area (organics, inorganics, wet chemistry) and compile into generalized report form.

7.2.2 Computer Guidelines

Computers are replacing many manual operations in the laboratory. Computers are used to interface with instruments, perform calculations, generate technical reports, and to store and retrieve analytical databases. In concurrence with EPA draft "Good Automated Laboratory Practices" of September 20, 1990, the Long Island Analytical Laboratories computer system has been evaluated in the following manner:

- All computer generated data is randomly checked for accuracy. Any errors are reported to the Laboratory Manager and corrections to the computer programs are made if necessary.
- All laboratory computers are connected to the LIAL network. In the event of a power failure, the network computer is connected to a battery back-up. The data on the network computer is backed-up to a tape drive Monday thru Friday and the back-up tapes are stored in a fireproof safe. Access to the safe is restricted to Laboratory Management.
- Access to all data on the network is restricted to Laboratory Management by use of the Windows NT Password Protection System.

7.3 Data Validation

Data validation involves the ability of the laboratory procedures and methods to withstand external scrutiny. Data must be defensible in regard to precision and accuracy. Documentation must be maintained verifying the accuracy of testing procedures,

instrument calibrations, and sample preparation, through appropriate use of QC samples (see Section 8.0), etc. In order to validate individual samples they must be tracked from sampling through laboratory receipt, through analytical testing, to the final disposition of the sample and analytical results. This information will be maintained through sample logs, chain of custody forms, daily logs, and laboratory notebooks.

7.3.1 Data Validation Criteria

A checklist for validating chemical analyses includes, but is not limited to, the following items.

- Holding times
- Sample representatives
- Instrument tuning/maintenance
- Calibration
- Method blanks/reagent blanks
- Precision/accuracy
- Percent surrogate recovery
- Matrix spike/matrix spike duplicates
- Internal standards
- Dilution analysis
- Hard copy graphs and chromatograms

It is the responsibility of the laboratory manager to assure the validity of all laboratory procedures and to ensure the accuracy of all results reported from their facility laboratory.

7.4 Data Reporting Format

All reports submitted to the client include the following information. Additional information, as specified by the client, may also be added:

- Unique sample number
- Analysis required
- Sampling location
- Sample description
- Date/time of sample collection
- Name of sample collector
- Date/time received by laboratory
- Method of analysis
- Date of analysis
- Raw analytical data
- Results

All analytical reports leaving the laboratory are reviewed and signed off by the laboratory manager.

8.0 Internal Quality Control and Quality Assurance Goals

8.1 QC Requirements

An internal quality control (QC) system is a set of routine internal procedures for assuring that the data generated by a measurement system meets prescribed acceptance criteria. These acceptance limits are usually related to data precision, accuracy and completeness. Inherent and implied in this control function is a parallel objective of measuring and defining the quality of the data generated. The procedures associated with this objective are designed to provide a quantitative assessment of data quality again in terms of precision, accuracy and completeness. An additional objective of an internal QC system is to assess the impact of the sample matrix on the data being generated.

The control function is accomplished through laboratory performance QC. The daily laboratory performance QC is comprised of:

- Method and Reagent Blanks
- Calibration Verification Sample
- Instrument Control (IC) Check Samples
- GC/MS tuning criteria (where applicable)

The information obtained from these activities is used to assess daily laboratory performance. Each department will empirically establish their own laboratory's performance.

The effect of sample matrix on data quality is addressed through matrix-specific QC. Matrix-specific QC is based on the use of an actual environmental sample for precision and accuracy determinations and commonly relies on the analysis of matrix spikes. In addition, surrogate recoveries are used to monitor the effect of sample matrix on analytical data for organic compounds.

8.1.1 Frequency of Running QC Samples

Laboratory QC samples, Matrix Spike and Matrix Spike Duplicate samples and surrogate samples will be rum with every analytical batch. A batch is considered to be a group of twenty samples or less which behave similarly with respect to the method. An analytical procedure may specify an analytical batch (20 samples).

8.2 Laboratory Quality Control Samples

8.2.1.1 Blanks

Method Blanks Method blanks are-analyzed to assess the level of background contamination which may exist in the analytical system and which might lead to the reporting of elevated concentrations or false positive data. A method blank consisting of reagents specific to the methods which are processed through all aspects of the procedure including preparation, sample clean up and analysis are evaluated, in conjunction with other QC information to determine the acceptability of the dada generated for that batch of samples.

Ideally, the concentration of target analytes in the blank should be well below the reporting limit for that analyte. In practice, however, some common laboratory solvents and metals are difficult to eliminate to the parts-per-billion levels commonly reported environmental analyses. As a result, criteria for determining blank acceptability must be base on consideration of the analytical methods used, analytes reported, reporting limits and regulatory limits. Long Island Analytical Laboratories has adopted the EPA recommended criteria for determining blank concentration levels (SW-846, Chapter 1, November, 1990).

Metals Analysis Method Blanks: For metal analyses, the concentration of target analytes in the blank must be no greater than the Method Detection Limit or 5% of the regulatory limit, whichever is the greatest.

Organic Analysis Method Blanks: For organic analyses, the concentration of target analytes in the blank must be no greater than the Method Detection Limit or 5%of the regulatory limit, whichever is the greatest.

Reagent Blanks: A reagent blank is analyzed with all samples for metals analysis. It consists of laboratory water and all applicable reagents used in the digestion and analysis of the samples. The concentration of the target analytes in the reagent blanks must be no greater than the method detection limit.

If the blank does not meet acceptance criteria, an evaluation of the data to determine the extent and effect of the contamination on the sample results must be made. An attempt to identify the source of contamination must be made and appropriate corrective action must be implemented and documented. Corrective actions may include re-analysis of the blank and/or re-preparation and re-analysis of the blank and all associated samples.

8.2.1.2 Calibration Verification Criteria

Organic Analysis: For organic analyses, the response for any analyte in the initial Calibration Verification Standard must agree within +/- 20% for GC and +/- 30% for GC/MS of the predicted response for that analyte calculated from the calibration curve. If this criterion is not yet met, a new calibration curve must be prepared for that analyte before sample analysis can begin. In addition, the response for the continuing Calibration Verification Standards for GC and GC/MS must agree within +/- 15% and +/- 30% respectively of the response for the analyze in the initial calibration curve. If this criterion is not met, the system is judged to be out of control. The problem must be identified and corrected and all samples analyzed since the last in-control standard must be re-analyzed.

Metals Analysis: For metals analyses, the verification standard must produce a response that agrees within +/- 20% of the predicted response for that analyte. The verification standards must be at or just below the regulatory limit. If this criterion is not met, the instrument must be re-calibrated and the Calibration Verification Standards must be re-analyzed before sample analysis can begin. The response obtained from continuing calibration verification standards must agree within +/- 20% of the response from the original calibration curve. If this criterion is not met, the instrument must be re-calibrated and the verification standards must be re-analyzed. In addition, all samples analyzed since the last in-control standard must be re-analyzed.

8.2.2 Matrix Spikes and Matrix Spike Duplicates

The Matrix Spike (MS) and Matrix Spike Duplicate (MDS) are two aliquots of the same environmental sample to which known amounts of analytes have been added and are subjected to the entire analytical procedure.

The results of the MS/MDS analysis are used to evaluate the effect of the sample matrix and the method on the accuracy and precision (reproducibility) of the analysis

8.2.3 Organic Surrogate Recoveries

Surrogates are organic compounds which are similar to the analytes of interest in chemical behavior but which are not normally found in environmental samples. Surrogates are added to samples to monitor the effect of the matrix on the accuracy of the organic analysis. Results are reported in terms of percent recovery. If surrogate recoveries fall outside the limits prescribed in the analytical methodologies, the sample must be re-prepared and re-analyzed. If the second analysis yields results similar to the original analysis, a matrix effect may be indicated. If the second analysis yields results with all surrogates within limits, the data from the rerun is reported.

8.2.4 Instrument Controls (IC) Samples

An IC Check sample is a laboratory control sample whose concentration level is near or equivalent to the calibration verification Standard but prepared from stock solutions obtained from a different source. Either NIST or EPA standards, an approved secondary source, e.g., SUPELCO, can be used.

IC Check standards are not processed through all steps of the analytical method. The IC Check sample serves as an independent check of the instrument measurement process.

8.2.4.1 Corrective Actions

If the IC Check Sample results fall outside of the upper and lower control limits, then the out-of-control situation must be investigated. Corrective action could include re-running all of the samples analyzed prior to the recognition of the out-of-control situation.

8.3 Method Detection Limit Determination

Generally, a measured value becomes acceptable when it is larger than the uncertainty associated with the measurement. The reporting of a result will be influenced by many factors and must be corrected for when determining the detection limits. These factors include:

- Instrument Detection Limits – This is the smallest signal above background noise that an instrument can detect reliably. These detection limits are analyst and instruments specific and only make up a fraction of the total analysis.
- Sample Matrix – The effect of sample matrix will be reflected in the method detection limit for that matrix.
- Sample Dilution – The effect of sample dilution determines the limit of detection in a complex matrix where it is impossible due to interference to analyze the sample to given protocols.
- Sample Interference – Correction must be made for any spectral interference.
- Data Objectives – The use of the data which has to be reported influences the limit of detection reported.

All of these factors must be accounted for when MDL's are generated. Thus MDL's will be generated for specific instruments, analysts matrices, and data objectives. At a minimum MDL's will be generated and documented upon adoption of a method, or at least once a year for all matrices, instruments and methods.

9.0 Performance and System Audits

This section provides a description of the activities associated with the conduct of in-house Systems and Performance Audits.

A Systems Audit is a review of laboratory operations conducted to verify that the laboratory has the necessary facilities, equipment, staff and procedures in place to generate acceptable data.

A Performance Capability Audit verifies the ability of the laboratory to correctly identify and quantify analytes in Performance Evaluation Samples.

9.1 System Audits

A Systems Audit is an on-site qualitative review of the laboratory procedures. It represents a subjective evaluation of a set of interactive systems with respect to strengths, weaknesses and potential problem areas. The audit provides an evaluation of the adequacy of the overall measurement system to provide data of known quality which are sufficient to meet the objectives of the QA program.

The System Audit consists of observations and documentation of all aspects of the data generation and reporting process. In addition to evaluating analytical procedures and techniques, the Systems Audit will emphasize review of all record keeping and data handling systems. The record keeping will include, but not necessarily be restricted to, to following:

- Calibration documentation for both instruments and apparatus
- Completeness of data forms
- Data review and validation procedures
- Data archival procedures
- Sample logging procedures
- Quality control documentation
- Preventative maintenance documentation and
- Corrective action reports

A system Audit is performed monthly by the QA Auditor according to the System Audit SOP and a report is submitted to the Laboratory Manager.

9.1.1 Systems Audit Guidance

The following guidance describes some of the characteristics that will be looked for when the QA Auditors perform the Systems Audit to ensure that all laboratory activities are being performed in accordance with the QAMP and the SOP's. Any discovery found

during the course of a Systems Audit (unless otherwise noted) will be brought to the attention of the facilities Operations Manager to discuss appropriate correction action.

Review of Log Books: Each logbook found will be examined for legibility, completeness and to determine if any deviation from standard practices have been noted in the comment column, where appropriate. Deviations from acceptance limits, where applicable, will be noted by the QA Auditors.

Expiration Dates of Standards: The expiration date on all bottles (vitals, etc.) containing primary, secondary, stock and working standards will be examined by the QA Auditors. Labels on the standard are expected to be legible and complete. Any standard found expired will be noted and brought to the immediate attention of the Operators Manager and Laboratory manager.

Sample Containers: The jars containing the samples will be examined to determine that the samples for VOAs have no air spaces in the jar, the jars are clean and free from debris, and the label is properly filled out. Any deviations will be noted.

Refrigerators: All refrigerators used to store analytical samples will be examined for cleanliness. All refrigerators are expected to be clean, free from debris, and at the appropriate storage temperature. Any refrigerator and samples contained, therein, found dirty will be noted by the QA Auditors.

TCLP Extractor: The TCLP extractor will be examined for cleanliness and that the rotation rate has been checked. Any deviations will be noted by the QA Auditors.

TCLP Bottles: The TCLP bottles will be examined for cleanliness. Any bottles found dirty will be noted by the QA Auditors.

Lab Hygiene and Safety: All laboratories will be examined for general hygiene and safety. All analysts and people in the laboratory are expected to be wearing safety glasses. The laboratories should expected to be found clean and devoid of "dirty glassware" buildup. Samples should be stored in their proper place. The QA Auditors will note any situations of uncleanliness. Any situations of uncleaniness will be noted by the QA Auditors and brought to the immediate attention of the Operations Manager and Laboratory Manager.

Sampling Jar Storage: The sample containers (jars) and caps and their respective storage unit will be examined for cleanliness. The caps and jars should be clean, free from debris, and dry. The storage unit should be clean and free from debris. Jars, caps and storage unit found dirty will be noted by the QA Auditors.

Chemical Storage: All chemical and reagent storage space will be examined to ensure that the solvents, solutions, and reagents are being stored in their proper container, are in storage cabinets approved for the storage of materials, and any secondary containment is in the place, Any deviations will be noted by the QA Auditors.

Glassware Cleaniness: The glassware (volumetric flasks, beakers, pipettes, etc.) will be spot checked for cleaniness. The cleaning procedures described in the SOP's are expected to be followed. All glassware is expected to be clean, free from debris, and dry. Glassware found otherwise will be noted by the QA Auditors.

Training Records: The training records of laboratory staff will be examined to ensure that all the records are completed and consistent with the assigned responsibilities of the given analyst. Technicians performing certain analysis are excepted to have evidence in their training files that they have been trained in the techniques. Any deficiencies in the file will be noted by the QA Auditors.

9.2 Performance Capability Audits

The performance audit represents a quantitative assessment of the measurement data quality. It provides a direct, point-in-time evaluation of the accuracy of the various measurement systems and procedures. This will be accomplished by challenging each system with an accepted reference standards for the analyte(s) of interest.

Performance evaluation (PE) samples are submitted to each operational area of the laboratory on a quarterly basis by the facility's QA Officer Performance Evaluation samples are expected to be obtained from a third party vendor of certified samples.

The results of the analysis of the PE sample(s) are submitted to the QA Officer who will enter it into the PE data base and generate the PE performance report.

The precision and accuracy of the data generated are evaluated against the certified concentration values of the analytes and the prescribed QC performance limits. An evaluation report is issued to the Laboratory Manager and Operations Manager.

9.3 Audit Reporting, Review and Remediation

Immediately subsequent to a System Audit and/or Performance Audit, but prior to the issuing of the formal written report, the QA Auditor will discuss any discoveries with the appropriate Laboratory or Operations Manager to ensure implementation of the corrective action steps (Section 11) and to establish a corresponding timetable.

A formal Monthly Audit Report will be submitted by the QA Auditor to the facility Laboratory and Operations Manager and to the Corporate QA Office. The report details the findings of the System and Performance audits.

10.0 Preventive Maintenance

A Preventive Maintenance Schedule must be constructed and kept current with respect to the type of instrumentation in the laboratory. This book should be present in the laboratory at all times, and where necessary separate maintenance books should be kept for the more complex instruments (e.i. GC/MS, ICP).

10.1 Items To Be Checked

Each instrument should be checked for general wear and tear, with special attention given to consumable parts such as tubing, lamps, filaments, etc. The manufactures literature Will also recommend certain routine maintenance steps to be taken. These should be incorporated into the maintenance schedule.

10.2 Frequency and Schedule

The frequency in which the routine maintenance procedures should be conducted will depend on several parameters such as:

- Instrument Type
- Amount of Use
- Type/Quality of Samples
- Manufacturer's Recommendations

The frequency should be determined after evaluating the performance of the given instrument of a period of time. For example, if the performance criteria, a routine source cleaning may be required.

10.3 Responsibility

The responsibility of maintaining laboratory instruments starts with the individual operating the instrument at any given time. Before an individual starts working, the instrument should be put through a general performance check to determine the working status of the instrument. As problems are detected, they should be addressed immediately and all repairs and alterations to the instrument – regardless of how minor – should be documented in the ***Maintenance Log Book***. The information recorded should contain the following information:

- Nature of problem
- Date of problem
- Source of problem
- Date of correction
- Brief description of repair
- Initials of Analysts
- Copies of Service Report if available

10.4 Documentation and Review

All maintenance Logs should be reviewed by the Laboratory Director on a routine basis to ensure that the instruments are always in a state of readiness. All repairs and adjustments should be reviewed in depth to ensure that the repair has not altered the instrument enough to jeopardize the integrity of the analysis. All major repairs by service technicians which supply service reports should be kept on file and readily available.

10.5 Contingency Plans For Down Time Minimization

All laboratories must be prepared for instrument down time and alternate analytical options must be available. The foundation to any good contingency plan is to avoid substantial downtime in the event that a mechanical failure occurs contingency plans must be implemented as not to interrupt customer service.

10.5.1 Alternative Laboratories

All laboratories should make arrangements with other laboratories to run samples in the event of instrument down time. Several NYSDOH certified laboratories have made arrangement with Long Island Analytical Laboratories to handle any such over flow that might occur. However, if holding times or other circumstances do not permit this externally, laboratories should be available to provide the required analytical.

10.5.2 Alternative Methods

All Laboratories should as part of the "SOP's" have listed alternative methods available. Should the method of choice not be available, it becomes the Laboratory Directors decision to determine if the alternative method should be used or if the sample should be sent to another laboratory.

11.0 Corrective Actions

When errors, deficiencies, or out-of-control situations exist, the QA program provides systematic procedures, called "corrective actions", to resolve problems and restore proper function to the analytical system.

Personnel involved in the analytical process are alerted that corrective actions may be necessary if situations such as the following exist:

- QC data (i.e., blanks, spikes, QC check sample) are outside the acceptable limits for precision and accuracy
- Deficiencies are detected by the QA Officer during internal System Audits or Performance Evaluation Audits
- Deficiencies are discovered by external auditors
- Inquires concerning data quality are received from regulatory agencies
- Laboratory hygiene conditions are not satisfactory

11.1 Corrective Action Process

The steps in Long Island Analytical Laboratories corrective action systems are as follows:

- Definition of the problem
- Assignment of responsibility for investigating the problem
- Investigation and determination of the cause of the problem
- Determination of the appropriate corrective action
- Assignment and acceptance of responsibility for implementing the corrective action
- Implementation of the correction
- Verification that the corrective action has eliminated the problem
- Documentation of the corrective action episode

11.3 Types of Corrective Actions

Corrective Actions are categorized into five types:

11.3.1 Corrective Actions Resulting From Analyst/Bench Level

Corrective action procedures are often handled at the bench level by the analyst who reviews the preparation of extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, etc. If the problem persists or cannot be identified, the matter is referred to the Laboratory Manager, Operations Manager or QA Officer for further investigation using the protocol described above.

11.3.2 Corrective Actions Resulting from the Evaluation of Quality Control Data

Corrective actions can be generated from an evaluation of the various Quality Control Data used to monitor a method. These types of evaluations many times result in the recognition of the beginning of an unfavorable trend or shift in the performance of the analytical method over time. Normally, either the Analyst or Laboratory Manager initiates these types of corrective actions.

11.3.3 Corrective Actions Resulting from a System Audit

A System Audit is performed by the QAA Officer on a monthly basis (see Section 9). Many times a System Audit will identify a practice or condition that is not being followed according to the QAMP or Method SOP's. In addition, lack of Good Laboratory practices and Safety concerns could be identified in the System Audit. Management will be verbally notified by the QA Officer and a Corrective Action Summary Report will be immediately issued.

11.3.4 Corrective Actions Resulting from Performance Capability Audits

Each Long Island Analytical Laboratory analyzes Performance Evaluation Samples to evaluate their ability to accurately analyze the appropriate constituents. As a result of these activities biases con be identified. When a bias is identified, the laboratory is notified by their respective QA Officer. The laboratory is asked to investigate the bias, and take appropriate corrective action to remediate the problem. A Corrective Action Incident Summary Report is to be issued and completed.

11.3.5 Corrective Actions Resulting Form Ad Hoc Evaluations

The Analyst/Bench Level, Systems Audits, Performance Capabilities Audits and Control Chart evaluations are designed in a very specific way to provide oversight in those areas.

Corrective action may be necessary on any of the items in those areas when they are discovered at any point in time. The Ad Hoc Corrective Action addresses these types of discoveries. Ad Hoc corrective actions are customarily issued by either the Laboratory Manager, QA Officer, or Operations Manager, either by themselves, or through discovery by any individual involved in the analytical process.

11.4 Documentation of Corrective Actions

Unacceptable conditions that are identified as the result of an Ad Hoc, Systems, or Performance Capability audits require that the Corrective Action Process be initiated and documented using the Corrective Action Summary (CAS) Report form.

A CAS report is normally initiated by the Operations Management, Laboratory Manager, or the QA Officer along with an estimated completion date of the corrective action process. Generally this time period is one month or less. If this completion time is not possible then a reasonable completion time must be agreed upon. A copy of all initiated and completed CAS reports are to be sent to the Operations Manager, Laboratory Manager and QA Officer of the facility.

When the situation is remedied, the final completed report is submitted to the QA Officer for review and signature and copies sent to all parties concerned.

12.0 Quality Assurance Reports to Management

On a monthly basis, the QA Auditor will file a written report documenting the QA process and deficiencies. Such deficiencies will have corrective action measures suggested and management will act upon corrections where necessary. These reports will be distributed to:

- The Laboratory Manager
- The General Manager
- The Corporate QA Program Manager

The proposed format of the reports shall consist of the following sections:

I. Results of Systems Audits

Comments on the discoveries made during the reporting period and corrective actions generated.

II. Results on Performance Audits

Comments on performance by the laboratory during period and corrective actions generated.

III. Corrective Action Status

Comments on the progress of corrective action remediation accomplished and any other corrective actions still pending.

IV. Continuous Quality Improvement Activities

Comments on any activities that resulted in quality improvement or that maintained quality with cost reductions. This will include a review of any improvements demonstrated by continuing results of System and Performance Audits.

13.0 Customer Complaints

All technical complaints and negative comments received at Long Island Analytical Laboratories are reviewed and handled by the Laboratory Manager. In each case he will advise all concerned analysts as to the nature of the complaint. If necessary he will initiate corrective action measures as outlined in section 11.0. Upon resolution of the complaint or negative comment, a Customer Inquiry Report will be completed and filed.

SEVERN
TRENT
SERVICES

Severn Trent Laboratories, Inc.

D004184, Franklin Cleaner Site, Hempstead, NY

Prepared For:
STL On-Site Technologies
604 Copper Ridge Drive
Cantonment, FL 32533

Appendix A

For

STL On-Site Technologies
In support of NYSDEC Contract No. D004184, Franklin Cleaner Site, Hempstead, NY

Prepared For:
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Cantonment, FL 32533

Prepared By:
STL Newburgh
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Approved: ______________________ Date: Jan 16, 2001
STL Newburgh Project Manager
Douglas O. Tawse

Approved: Patricia Chany Date: Jan 15, 2001
STL Newburgh QA Manager
Patricia Chany

Approved: Meade Date: Jan 16, 2001
STL On-Site Technologies
John D. Meade

2.0 Table of Contents

3. DESCRIPTION

3.1 Introduction

This Quality Assurance Project Plan (QAPP) submitted by STL Newurgh describes the Quality Assurance and Quality Control (QA/QC) procedures employed to ensure he integrity, validity and usability of analytical results to be given in support of the NYSDEC Contract No. D004184, Franklin Cleaner Site project. These services will include sample analysis by EPA and NYSDEC approved methodologies. A project analyte list for this project is given in Table 1. Analytical methods are outlined in Table 9.

This QAPP presents, in specific terms, the policies, organization, objectives, functional quidelines and specific Quality Assurance and Quality Control activities designed to achieve the data quality requirements.

Table 1.0 Project Analyte List

Parameter	Cas #	"J" Value(1)	**Reporting Limit Water (ug/l)**	**Reporting Limit Soil (mg/kg)***
Volatile Organics				
Tetrachloroethene	127184	≥ 0.5	1	1
Trichloroethene	79016	≥ 0.5	1	1
1,2-Dichloroethene, total	540590	≥ 0.5	1	1
1,1-Dichloroethene	75354	≥ 0.5	1	1
Vinyl Chloride	75014	≥ 0.5	1	1
Metals				
Iron	7439896	2.8	2.8	0.56
Manganese	7439965	0.7	0.7	0.14

(1) * Limit will be adjusted for %moisture.

(2) "J" values for volatile organics are determined from the concentration used when IDL/MDL's are determined. The "J" value for inorganics is the actual instrument detection limit.

4.0 Organization and Personnel

4.1 QA Policy and Objectives

It is STL's policy to:

- provide high quality, consistent, and objective environmental testing services that meet all federal, state, and municipal regulatory requirements.
- generate data that are scientifically sound, legally defensible, meet project objectives, and are appropriate for their intended use.
- provide STL clients with the highest level of professionalism and the best service practices in the industry.
- build continuous improvement mechanisms into all laboratory, administrative, and managerial activities.
- maintain a working environment that fosters open communication with both clients and staff.

Management Commitment to Quality Assurance

STL management is committed to providing the highest quality data and the best overall service in the environmental testing industry. To ensure that the data produced and reported by STL meet the requirements of its clients and comply with the letter and spirit of municipal, state and federal regulations, STL maintains a Quality System that is clear, effective, well communicated, and supported at all levels in the company.

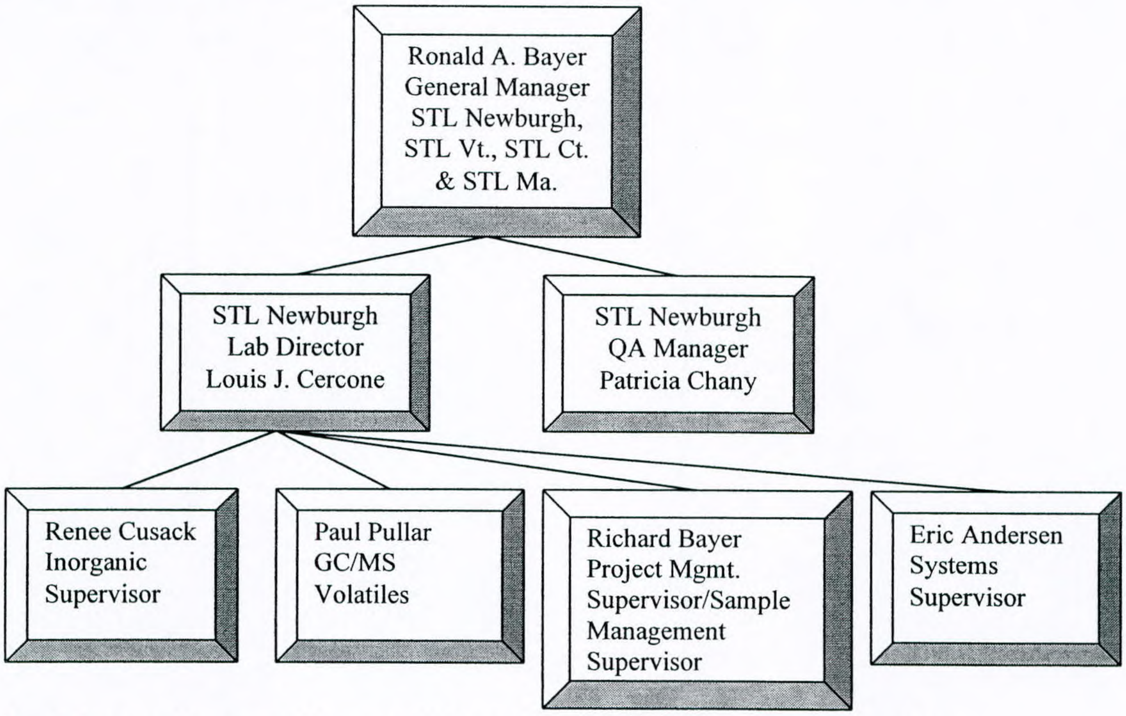
STL Mission Statement

We enable our customers to create safe and environmentally favorable policies and practices, by leading the market in scientific and consultancy services. We provide this support within a customer service framework that sets the standard to which others aspire. This is achieved by people whose professionalism and development is valued as the key to success and through continued investments in science and technology.

4.2 QA Management

4.2.1 Organization and Responsibilities

A functional organizational chart of the individuals associated with Quality Assurance Management follows. The responsibilities of the individuals associated with Quality Assurance Management are described below. A list of STL Newburgh personnel including education and experience is found in Table 7.



The Project Manager has overall responsibility for management of the analytical requirements for sample analysis. The duties and responsibilities of the Project Manager are to:

- Administer and supervise all requirements of the analytical tasks to ensure meeting the client objectives on schedule.
- Act as liaison between the laboratory and the client to discuss and resolve any problems that may occur.

- Work with laboratory supervisors in planning and conducting progress meetings.
- Take part in corrective actions.

The Sample Management Supervisor acts as sample custodian for the laboratory. The duties and responsibilities of the Sample Management Supervisor are to:

- Sign for the incoming field samples and verify the data entered on the chain-of-custody forms.
- Advise the Project Manager of discrepancies, omissions or inappropriate samples.
- Prepare laboratory site sheet and internal chain-of-custody documents.
- Oversee sample information entry into the laboratory sample data base.
- Generate computerized sample tracking data entry forms.
- Transfer sample and laboratory internal chain-of-custody documents to Laboratory Supervisors.

The System Manager is responsible for:

- The management and quality control of all computing systems.
- The installation, operation and maintenance of software and programs

The QA Manager is responsible for reviewing and advising on programs all aspects of QA/QC. The duties and responsibilities of the QA Manager are to:

- Assist the Project Manager in specifying QA/QC procedures to be used during sample analysis.
- Implement quality control procedures and techniques to assure that the laboratory achieves established standards of quality.
- Evaluate data quality and maintain records on related QC charts and other pertinent information.
- Monitor laboratory activities to determine conformance with the authorized quality assurance policy, and to implement appropriate steps to ensure adherence to quality assurance programs.
- Coordinate internal audits with the Project Manager.
- Review performance evaluation results.
- Administer intralaboratory and interlaboratory QA efforts.
- Prepare quality assurance report to management

The Laboratory Supervisors are responsible for meeting all the technical and analytical terms and conditions for sample analysis. Their areas of responsibilities are to:

- Organize the personnel, equipment and materials in a manner required to fulfill the analytical requirements of sample analysis.

- Oversee all aspects of laboratory analyses and provide technical support when necessary.
- Review analytical data for validity and clarity.
- Maintain contract with the Project Manager in areas of technical concern, and advise the Project Manager of analytical progress, needs of potential problems that occur.

The Sample Analysts are responsible for the analysis of samples. The analysts will:

- Schedule, prepare and analyze samples according to the method specific requirements indicated by the chain-of custody or CPO.
- Advise the laboratory supervisor of progress, needs and potential problems that occur.
- Verify that the laboratory QC and analytical procedures are being followed as specified.
- Review sample QC data, at least daily, including inspection of raw chromatograms and calibration curves.
- Inform laboratory supervisors if the daily review indicates a decline in data quality and implement actions.

4.3 Project Document Control Procedures

The goal of the document control program is to assure that all documents for a group of samples will be accounted for. Before releasing analytical result, the laboratory assembles and cross checks the information of custody records, lab bench sheets, analyst and instrument logs and other relevant data to ensure that data pertaining to each particular sample is consistent throughout the record.

4.3.1 Sample File Organization, Preparation and Review Procedures

Project file folders will be created, when required, following completion of the project. One file folder will be assigned for each separate project. All documents, sample tags (if applicable), custody forms, and all other laboratory data pertaining to a particular case will be placed in the folder. Project file folders will be filed in numerical order and stored in a secure area with access limited to authorized personnel. Authorized personnel are limited to Supervisors, Lab Director, QC Officer, Sample Custodian or designee.

4.4 Request, Tender, and Contract Review

4.4.1 Contract Review

For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is STL's intent to provide both standard and customized environmental laboratory services to our clients. To ensure project success, technical staff perform a thorough review of technical and QC requirements contained in contracts. Contracts are reviewed for adequately defined requirements and STL's capability to meet those requirements.

All contracts entered into by STL are reviewed and approved by the appropriate personnel at the facility or facilities performing the work. Any contract requirement or amendment to a contract communicated to STL verbally is documented and confirmed with the client in writing. Any discrepancy between the client's requirements and STL's capability to meet those requirements is resolved in writing before acceptance of the contract. Contract amendments, initiated by the client and/or STL, are documented in writing for the benefit of both the client and STL.

All contracts, Quality Assurance Project Plans (QAPPs), Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the permanent project record.

4.4.2 Project Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, STL assigns a Project Manager (PM) to each client. The PM is the first point of contact for the client. It is the PM's responsibility to ensure that project specific technical and QC requirements are effectively communicated to the laboratory personnel before and during the project. The Project Manager for the NYSDEC Contract No. D004184, Franklin Cleaner Site Project is Douglas Tawse.

Each STL facility has established procedures in order to ensure that communication is inclusive and effective. These include project memos, designation and meetings of project teams, and meetings between the laboratory staff and the client. STL has found it very effective to invite the client into this process. STL strongly encourages our clients to visit the laboratories and hold formal or informal sessions with employees in order to effectively communicate client needs on an ongoing basis, as well as project specific details for customized testing programs.

4.4.3 Subcontracting

Subcontracting is arranged with the documented consent of the client, in a timely response that shall not be unreasonably refused. All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Proof of required certifications from the subcontract facility are maintained in STL project records. Where applicable, specific QC guidelines, QAPPs, and/or SAPs are transmitted to the subcontract laboratory. Samples are subcontracted under formal Chain of Custody (COC). A separate QAPP for the subcontract work will be prepared by the subcontract laboratory and submitted under separate cover.

Subcontract laboratories may receive an on-site audit by a representative of STL's QA staff if it is deemed appropriate by the QA Manager. The audit involves a measure of compliance with the required test method, QC requirements, as well as any special client requirements.

Project reports from external subcontract laboratories are not altered and are included in original form in the final project report provided by STL.

Subcontracting may also occur between STL facilities. Subcontracting within STL is subject to the same requirements as detailed above.

4.4.4 Purchasing Services and Supplies

Evaluation and selection of suppliers and vendors is done, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, all purchases from specific vendors are approved by a member of the supervisory or management staff.

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Purchasing guidelines for equipment and reagents meet with the requirements of the specific method and testing procedures for which they are being purchased.

4.4.5 Instrument Maintenance Activities and Schedules

A complete listing of instrumentation may be found in Table 9. Instrument preventative maintenance and careful calibration help to assure accurate measurements from laboratory instruments. All laboratory instrumentation is on a service contract with the applicable instrument manufacturer or licensed service organization. The service contracts include regular preventative maintenance service calls on a scheduled basis.

Preventative maintenance procedures such as lubrication, source cleaning, detector cleaning and the frequency of such maintenance are performed according to the procedures delineated in the manufacturer's instrument manual or when deemed necessary by the analyst.

Instrument logbooks are in the laboratory at all times. They contain records of usage, calibration, maintenance and repairs. Adequate supplies of spare parts such as GC columns, syringes, septa, injection port liners, and electronic parts are maintained in the laboratory so that they are available when needed.

4.5 QA Document Control Procedure

4.5.1 Document Type

The following documents, at a minimum, are controlled at each STL Facility:

- Laboratory Quality Manual
- Standard Operating Procedures (SOP)
- Quality Management Plan

4.5.2 Document Control Procedure

Security and control of documents is necessary to ensure that confidential information is not distributed and that all current copies of a given document are from the latest applicable revision. Unambiguous identification of a controlled document is maintained by identification of the following items in the document header: Document Name, Document Number, Revision Number, Effective Date, Number of Pages. Controlled documents are authorized by Management and/or the QA Department. Controlled documents are marked as such and records of their distribution are kept by the QA Department.

Controlled documents are available at all locations where the operational activity described in the document is performed.

4.5.3 Document Revision

Changes to documents occur when a procedural change warrants a revision of the document. When an approved revision of a controlled document is ready for distribution, obsolete copies of the document are replaced with the current version of the document. The previous revision of the controlled document is archived by the QA Department.

4.6 Records

4.6.1 Record Types

Record types are described in Table 2.

Table 2 STL Record Types

Raw Data	Controlled Documents	QC Records	Project Records	Administrative Records
Calibration	LQM	Audits/ Responses	COC Documentation	Accounting
Computer Tapes/Disks	QMP	Certifications	Contracts and Amendments	EH&S, Manual, Permits, Disposal Records
QC Samples	SOPs	Corrective Action	Correspondence	Employee Handbook
Sample data		Logbooks*	QAPP	OSHA 29 CFR Part 1910
Software (Version control)		Method & Software Validation, Verification	SAP	Personnel files, Employee Signature & Initials, Training Records
		Standards Certificates	Telephone Logbooks	Technical and Administrative Policies

*Logbooks: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature,

4.6.2 Record Retention

Table 3 outlines STL's standard record retention time. For raw data and project records, record retention is calculated from the date the project report is issued. For other records, such as Controlled Documents, QC, or Administrative Records, the retention time is calculated from the date the document is formally retired. Records related to the programs listed in Table 4 have lengthier retention requirements and are not subject to STL's standard record retention time.

Table 3 STL Record Retention

Record Type		Archival Requirement
Raw Data	All*	5 Years from project completion
Controlled Documents	All*	5 Years from document retirement date
QC	All*	5 Years from archival
Project	All*	5 Years from project completion
Administrative	Personnel/Training	7 years
	Accounting	See Accounting and Control Procedures Manual

* Exceptions listed in Table 5.

4.6.3 Programs with Longer Retention Requirements

Specific client projects and regulatory programs have longer record retention requirements than the STL standard record retention length. In these cases, the longer retention requirement is noted in the archive. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Programs with record retention requirements greater than five years are detailed in Table 4.

Table 4 Special Record Retention Requirements

Program	Retention Requirement
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
NY Potable Water NYCRR Part 55-2	10 years
OSHA - 40 CFR Part 1910	30 years
Pennsylvania – Drinking Water	10 years
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement

4.6.4 Archives and Record Transfer

Archives are indexed such that records are accessible on either a project or temporal basis. Archives are protected against fire, theft, loss, deterioration, and vermin. Electronic records are protected from deterioration caused by magnetic fields and/or electronic deterioration. Access to archives is controlled and documented.

STL ensures that all records are maintained as required by the regulatory guidelines and per the QMP upon facility location change or ownership transfer.

All observations and results recorded by STL Newburgh are entered into the laboratory data entry system or into permanent laboratory logbooks. Data recorded are referenced with the sample laboratory number, date and analyst's signature at the top of the page.

All logbooks and other document entries are made in ink. Any corrections made in a logbook will be made by crossing a line through the error and entering the correct information. The person will subsequently date and initial the correction.

Corrections made to other data records are made by crossing a single line through the error, entering the correct information and initialing and dating the correction.

All chemicals and reagents received by STL Newburgh must be dated upon receipt, and again dated and initialed upon opening.

The preparation of all standards and reagents must be in accordance with the written SOP. Preparation must be documented in a bound preparation log. Documentation must include the date, analyst initials, identification of stock source and the final concentration of the solution.

Once in the possession of the Analyst, all logbooks are their responsibility to maintain. No logbooks are permitted outside the laboratory. Analysts are responsible for proper documentation in the logbooks. Once a Logbook has been completed it is returned to QA Manager for proper archiving.

4.7 Service to the Client

4.7.1 Sample Acceptance Policy

Samples are considered "compromised" if the following conditions are observed upon sample receipt:

- Cooler and/or samples are received outside of temperature specification.
- Samples are received broken or leaking.
- Samples are received beyond holding time.
- Samples are received without appropriate preservative.
- Samples are received in inappropriate containers.
- COC does not match samples received.
- COC is not properly completed or not received.
- Breakage of any Custody Seal.
- Apparent tampering with cooler and/or samples.
- Headspace in volatiles samples.
- Seepage of extraneous water or materials into samples.
- Inadequate sample volume.
- Illegible, impermanent, or non-unique sample labeling.

When "compromised" samples are received, it is documented in the project records and the client is contacted for instructions. If the client decides to proceed with analysis, the project report will clearly indicate any of the above conditions and the resolution.

4.7.2 Client Confidentiality and Proprietary Rights

Data and sample materials provided by the client or at the client's request, and the results obtained by STL, shall be held in confidence (unless such information is generally available to the public or is in the public domain or client has failed to pay STL for all services rendered or is otherwise in breach of the terms and conditions set forth in the STL and client contract) subject to any disclosure required by law or legal process. STL's reports, and the data and information provided therein, are for the exclusive use and benefit of client, and are not released to a third party without written consent from the client.

4.7.3 Samples Tracking/Custody Procedures

- Sample are received at the laboratory by the sample custodian or designee who removes the samples from the shipping containers together with all accompanying documentation such as chain-of-custody forms, analysis request forms, etc. An example chain-of custody form may be found on page 57.
- The condition of the custody seal is examined and recorded in a bound notebook.
- The temperature of the shipping container upon receipt will be recorded on the chain of custody.
- The pH of the sample (when required) will be taken upon receipt. Any inappropriate pH reading will be recorded on the chain of custody. Necessary pH adjustments will be made as required and documented.
- The samples are inspected for general condition and the letter of chain of custody received with any samples is examined for discrepancies between package contents and the enclosed documents.
- Discrepancies, omissions, or inappropriate samples discovered will be noted and discussed with the Project Manager who will contact the client to resolve the problem.
- If the client cannot be reached, the samples will be assigned to cold storage (4 degrees +- 2 degrees C) until the problem is resolved.
- Samples delivered directly by the sample collector are received and inspected by the Sample Custodian or designee in the presence of the sample collector. Discrepancies, omissions, or inappropriate samples should be noted and discussed with the sample collector to resolve the problem.
- Samples receipted through chain of custody by the Sample Custodian of designee will be assigned an STL Newburgh laboratory number.
- The Sample Custodian or designee will complete the STL Sample Log with the STL Newburgh laboratory number and corresponding client number. The STL Newburgh laboratory number will be written on the client sample bottle or adhered via printed label to the client sample bottle.

- All documents will be reviewed a second time to ensure that there are no transposition errors. The project manager or designee will validate the accuracy of the sample log-in procedure by initialing the appropriate space on the COC.
- The samples will be entered by sample entry into the laboratory sample data-base upon successful completion of the sample log-in procedure. Sample entry will prepare a laboratory chronicle for all projects that will be used for regulatory purposes. All documents, sample tags, shipping labels, etc. will be stapled to the original COC.
- Once in the possession of the Laboratory, all samples and extracts are stored and refrigerated in areas that are accessible only to Laboratory personnel. All refrigerators are locked during non-routine working hours.
- Access to the Laboratory facilities is limited to Laboratory personnel, with certain areas accessible only to Laboratory Management.
- All Samples are stored at the Laboratory for a minimum of 30 days after receipt and are not disposed of until at least one week after the final report has been issued. The samples received for this QAPP will be retained by the laboratory for 6months from the verified time of sample receipt.
- Samples are preserved per requirements or specific regulatory programs.
-

4.8 Complaints

Client complaints are documented, communicated to management, and addressed promptly and thoroughly. Client complaints are documented by the employee receiving the complaint. The documentation can take the form of a corrective action report (as described in Section 4.10) or in a format specifically designed for that purpose. The Laboratory Director, Project Manager, and QA Manager are informed of all client complaints, and assist in resolving the complaint.

The nature of the complaint is identified, documented, and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA department is required to conduct a special audit to assist in resolving the issue. A written confirmation, or letter to the client, outlining the issue and response taken is usually part of the overall action taken.

The number and nature of client complaints is reported to the Corporate QA Manager in the QA Monthly report submitted by each facility. The overall number of complaints received per facility is tracked and the appropriateness of the response to client complaints is assessed. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Management Systems Review.

4.9 Control of Non-conformances

Non-conformances include any out of control occurrence. Non-conformances may relate to client specific requirements, procedural requirements, or equipment issues. All non-conformances in the laboratory are documented at the time of their occurrence.

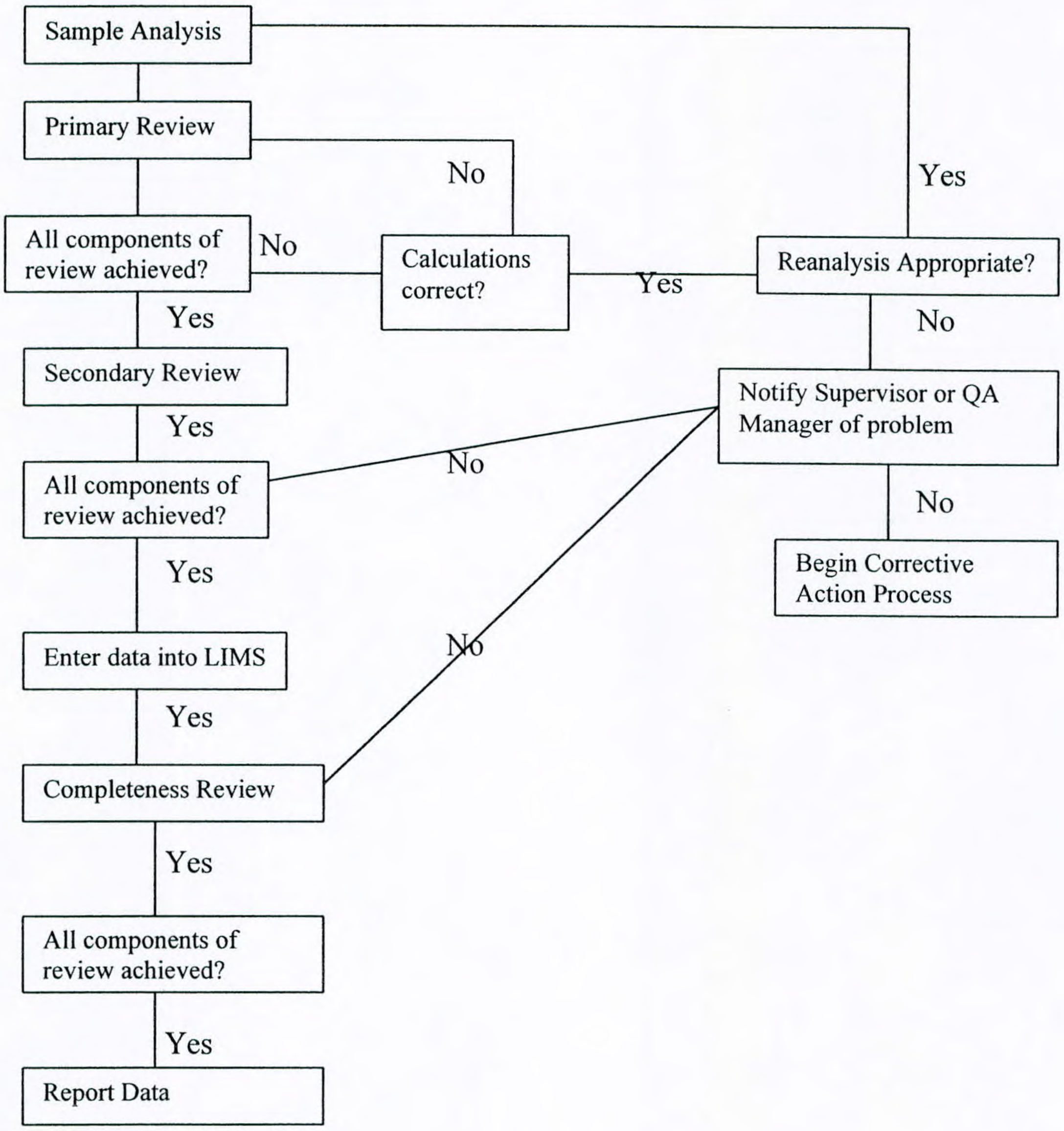
All non-conformances that affect a sample and/or sample data become part of the affected project's permanent record. When appropriate, reanalysis is performed where QC data falls outside of specifications, or where data appears anomalous. If the reanalysis comes back within established tolerances, the results are approved. If the reanalysis is still outside tolerances, further reanalysis or consultation with the Supervisor, Manager, Project Manager, Laboratory Director, or QA Manager for direction may be required. All records of reanalysis are kept with the project files.

Where non-conformances specifically affect a client's sample and/or data, the client is informed and action must be taken. Action can take the form of reporting and flagging the data, and including the non-conformance in the project narrative or cover letter.

4.10 Corrective Action

An important part of any quality assurance program is a well-defined, effective policy for correcting quality problems. This is depicted in the figure 1. STL Newburgh maintains a closed-loop corrective action system, which operates under the directions of the QA Manager. While the entire quality assurance program is designed to avoid problems, it also serves to identify and correct those that may exist. Usually these quality problems fall into two categories, immediate corrective action or long- term corrective action.

Figure 1: STL Newburgh Decision Processes, Procedures and Responsibility for Initiation of Corrective Action



Specific quality control procedures are designed to help analysts detect the need for corrective action. Often an analyst's experience will be most valuable in identifying suspicious data or malfunctioning equipment; and an immediate corrective action may then be taken. The actions should be noted in laboratory notebooks but no other formal documentation is required unless further corrective action is necessary.

The need for long-term action may be identified by standard QC procedures, control charts, performance or system audits. Any quality problem which can not be solved by immediate corrective action falls into this long-term category. STL Newburgh uses a system to insure that the condition is reported to a person who is part of the closed-loop action and follow up plan (figure 1)

The essential steps in the closed –loop corrective action system are:

- the problem will be identified
- responsibility for investigating the problem will be assigned.
- The cause of the problem will be investigated and determined.
- A corrective action to eliminate the problem will be determined
- Responsibility for implementing the corrective action will be assigned and accepted.
- The effectiveness of the corrective action will be established and corrective action implemented
- The fact that the corrective action has eliminated the problem will be verified
- The complete process of establishing and implementing corrective action will be documented.

This process of corrective action will be used to make all corrections deemed necessary by the STL Newburgh Project Manager or QA/QC Department.

4.11 Preventative Action

Preventative action is defined as noting and correcting a problem before it happens, because of a weakness in a system, method, or procedure. Preventative action includes analysis of the Quality System to detect, analyze, and eliminate potential causes of non-conformances. When potential problems are identified, preventative action is initiated to effectively address the problem to eliminate or reduce the risk identified. The preventative action process takes the same format as the corrective action process

5.0 Data Generation and Validation

5.1 Data Reduction

Analysis results will be reduced to the concentrations units specified in the analytical procedures using the equations provided in the analytical references listed in section 9. All calculations will be independently checked by senior laboratory staff.

5.2 Data Validation

Data validation is the process by which analytical data are evaluated and accepted or rejected based on a set of criteria. STL Newburgh personnel use the following criteria in the validation of laboratory data:

- use of published or approved analytical procedures
- use of properly operating and calibrated instrumentation
- precision and accuracy achieved comparable to that achieved in similar analytical programs
- precision, accuracy and blank contamination meeting the analysis specified criteria as and/or the criteria found in the applicable method.
- completeness of data set.

All data will be validated by laboratory supervisors and QA/QC Director prior to being released for reporting purposes to the STL Newburgh Project Manager. The persons validating the data will have sufficient knowledge of the technical work to identify questionable values. All analyses requiring STL Newburgh protocols will be validated in accordance with the requirements of those protocols.

5.3 Data Reporting and Authorization Procedures

Key personnel who will handle data gathering and evaluation are shown in the STL Newburgh Organizational Chart. STL Newburgh uses a computerized sample tracking for routine tracking and reporting of analysis data.

5.4 Data Review

5.4.1Primary Review

The primary review is often referred to as a "bench-level" review. In most cases, the analyst who generates the data (i.e. logs in, prepares and/or runs the samples) is the primary reviewer. In some cases, an analyst may be reducing data for samples run by an auto-sampler set up by a different analyst. In this case, the identity of both the analyst and the primary reviewer is identified in the raw data.

One of the most important aspects of primary review is to make sure that the test instructions are clear, and that all project specific requirements have been understood and followed. If directions to the analyst are not clear, the analyst must go to the Supervisor, QA Manager, or Project Manager, who must clarify the instructions.

Once an analysis is complete, the primary reviewer ensures that:

- Sample preparation information is complete, accurate, and documented.
- Calculations have been performed correctly.
- Quantitation has been performed accurately.
- Qualitative identifications are accurate.
- Client specific requirements have been followed.
- Method and process SOPs have been followed.
- Method QC criteria have been met.
- QC samples are within established limits.
- Dilution factors are correctly recorded and applied.
- Non-conformances and/or anomalous data have been properly documented and appropriately communicated.
- COC procedures have been followed.

Any anomalous results and/or non-conformances noted during the Primary Review are communicated to the Supervisor and the Project Manager for resolution. Resolution can require sample reanalysis, or it may require that data be reported with a qualification.

5.4.2 Secondary Review

The secondary review is a complete technical review of a data set and is completed by the section supervisor. The secondary review is documented and the secondary reviewer is identified. The following items are reviewed:

- Qualitative Identification
- Quantitative Accuracy
- Calibration
- QC Samples
- Method QC Criteria
- Adherence to method and process SOPs

If problems are found during the secondary review, the reviewer must work with the appropriate personnel to resolve them.

5.4.3 Completeness Review

The completeness review includes the generation of a project narrative and/or cover letter which outlines anomalous data and non-compliances using project narrative notes. The completeness review addresses the following items:

- Accuracy of Final Client Reporting Forms
- Manual Integrations – 100% as verified by signature of secondary data reviewer

- Completeness
- Special Requirements/Instructions
- Is the project report complete?
- Correct assembly of the final report.
- Does the data meet with the client's expectations?
- Were the data quality objectives of the project met?
- Have QC outages and/or non-conformances been approved and appropriately explained in the narrative notes?

If problems are found during the secondary review, the reviewer must work with the appropriate personnel to resolve them. If changes are made to the data, such as alternate qualitative identifications, identifications of additional target analytes, re-quantitation, or re-integration, the secondary reviewer must contact the laboratory analyst and/or primary reviewer of the data so that the primary analyst and/or reviewer is aware of the appropriate reporting procedures.

6.0 QA Program

6.1 Levels of QC Efforts

Every attempt will be made to have all data generated be valid data. The precision of laboratory analysis will be evaluated using sample duplicates and matrix spike duplicates. Analytical accuracy will be monitoring using recovery of analytes from system monitoring compounds, matrix spikes, blank spikes, EPA reference check standards and Performance Evaluation (PE) samples. These quality control measures and frequencies are summarized in Section 8.1. These QA efforts will assist in determining the reliability of the analytical data.

6.2 Accuracy and Precision

Accuracy is a measure of the degree of agreement between the analyzed value and the true or accepted reference value where it is known. Accuracy is usually expressed as a percent recovery. Precision is a measure of the mutual agreement among individual measurements of the sample parameter under similar conditions, usually expressed as a relative percent difference or as standard deviation. Accuracy and precision in the laboratory are assessed by the regular analysis of known standards and duplicate samples.

6.3 Completeness

Completeness is a measure of the amount of valid data obtained from the analytical measurement system, expressed as a percentage of the number of valid measurements that should have been or were planned to be collected. STL Newburgh will make every attempt to generate valid data from all samples received. However, realistically, some samples may be lost in laboratory accidents or some results may be deemed questionable based on internal QC procedures. Due to the variable nature of the completeness value, the objective will be to have data completeness for all samples received for analysis as high as possible to meet completeness objectives as described by the client.

6.4 Representativeness

Representativeness is a measure of how closely the measured results reflect the actual concentration of distribution of the chemical compounds in the sample. Sampling will be performed by the client. Sample handling protocols (e.g., storage, preservation and transportation) have been developed to preserve the representativeness of the collected samples. Proper documentation will establish that protocols have been followed and that sample identification and integrity have been assured.

6.5 Comparability

Comparability is a QA objective wherein all sample data is comparable with other representative measurements made by STL Newburgh or another organization. STL Newburgh will achieve comparability by operating within the instrument linear range and by strict adherence to analytical protocols. The use of published analytical methods, standards reporting units and thorough documentation will ensure meeting this objective.

7.0 Quality Control

7.1 Internal Quality Control

Quality control is the routine application of procedures for obtaining prescribed standards of performance in the monitoring and measurement process. Quality Control checks are the application of STL Newburgh Quality Control program for laboratory analysis in order to ensure the generation of valid analytical results on project samples. These checks are performed by project participants throughout the program, under the guidance of the Quality Assurance Manager.

7.2 Quality Control Samples

STL Newburgh makes use of a number of different types of QC samples to document the validity of the generated data. These are summarized in Table 6. The following types of QC samples are used routinely:

A. Blank Samples - Blanks are used to assess contamination introduced in transit, storage or in the laboratory.

  - Preparation Blanks – For inorganic analyses, these deionized water blanks are prepared using the same reagents and analytical procedures as the samples, in order to assess possible laboratory contamination.

- Laboratory Method Blanks – For organic analyses, theses blanks are "clean" samples, prepared in the laboratory to include surrogates, and analyzed according to a prescribed method in order to assess possible laboratory contamination.
- Laboratory Holding Blank – For organic analyses, these blanks are placed in cold storage with the volatile organic samples during the holding time to assess contamination which may be introduced in storage.
- Storage Blank – For organic analyses, these blanks are placed in the sample container storage area to assess contamination that may be introduced in storage.
- Calibration Blanks – For all analyses, these blanks are used in instrument calibration and contain all the reagents used in preparing instrument calibration standards except the parameters of interest.

B. Initial and Continuing Calibration Verification - Verification samples are analyzed during each analysis run to assure calibration accuracy for each analyte. For inorganic analysis, theses are prepared from a source other than that used for calibration.

C. System Monitoring compound – For organic analyses, all samples are spiked with surrogate compounds prior to sample preparation in order to assess the behavior of actual components in individual samples during the entire preparative and analysis scheme. Surrogate standard compounds are chemically similar to compounds of interest (target compounds).

D. Matrix Spikes/Analytical Spikes – For all analyses at frequencies particular to each method, spiking solutions are added to samples in order to evaluate any matrix effects of the sample on the analytical method. Matrix spikes and analytical spikes are performed using actual elements of interest or target compounds.

E. Duplicate Samples – For all analyses, a second aliquot of a sample carried through all sample preparation procedures to verify the precision of the analytical method. At least one sample in each analysis batch of 20 or fewer samples is analyzed in duplicate.

F. Laboratory Control Samples – For inorganic analyses, at least one sample in each preparation batch of 20 or fewer samples is prepared and analyzed for each analyte of interest, in order to verify the preparation and analytical methods.

G. Blank Spikes - For organic analyses, reagent water is spiked with all the target analytes.

Reagents used in the laboratory are normally of analytical reagent grade or higher purity. Each lot of acid or solvent received is checked for acceptability prior to lab use. All reagents are labeled with the date received and date opened. The quality of the laboratory deionized water is continuously monitored through the use of an in-line conductivity meter. The deionized water used at STL Newburgh is run through activated carbon, a cation resin, an anion resin, a mixed bed resin followed by a final mixed bed resin and is used only for inorganic analyses. The organic free water is carbon filtered and is used only for organic analyses. The deionized water and organic free water is verified daily by the analysis of the prep blank water for inorganics and by the analysis of the method blank for volatile organics. At the time of field blank preparation., a sample is taken of the deionized water and organic free water and is either analyzed immediately or held by the laboratory to be analyzed if contamination of the field blank is determined.

7.3 Internal Quality Assurance

To monitor quality, STL Newburgh QA/QC Department conducts internal quality assurance audits including:

A. QC Blind Samples- STL Newburgh routinely participates in the Analytical Standards Incorporated (ASI) Performance Evaluation Program. This program allows STL Newburgh to monitor overall performance using a comprehensive set of double-blind check samples that are received as real-time samples. STE Newburgh participates in this program on a quarterly basis. The program evalutes services as well as analytical accuracy. Participation laboratories receive detailed reports indicating an overall laboratory quality performance grade.

B. Internal Data Audit - Once per month a representative set of data is chosen randomly from work completed the previous month for one or more of STL Newburgh Commercial clients. This data review includes each laboratory section.

C. Internal Laboratory Audits - The QA/QC Directory will perform laboratory audits quarterly or as needed. This involves evaluation of:

- sample storage
- chain of custody
- instrument maintenance
- documentation
- precision
- accuracy

D. Sample Bottle Verification – A representative bottle is chosen randomly from each new batch and container type. The container is analyzed for all analytes collected in that specific container. All results must be approved by the QA/QC manager before bottles from lot are released.

In addition the QA/QC manager will meet frequently with the project manager and laboratory supervisor to review QA/QC data summaries and other pertinent information.

7.4 System and Performance Audits

7.4.1 System Audits

A system audit is an evaluation of the various components of a laboratory's measurements system to assess proper selection and use. This audit will consist of an on-site review of a laboratory's quality assurance system and physical facilities for sampling, calibration and measurements. System audits are performed on a regular basis by the various regulatory agencies. The audit may included several or all of the components listed below:

- Personnel, facilities and equipment
- Chain - of - custody procedures
- Instrument calibration and maintenance
- Standards preparation and verification
- Analytical procedures
- Quality control procedures
- Data handling procedures
- Documentation control procedures

7.4.2 Performance Audits

Performance audits provide a systematic check of laboratory operations and measurement systems by comparing independently obtained data with routinely obtained data. To fulfill the PT requirements for NELAC accreditation, STL Newburgh routinely participates in laboratory performance evaluations received from the NYSDOH ELAP as part of the Potable and Non-Potable Water/Solid & Hazardous Waste/Air & Emissions Chemistry Proficiency Programs. STL Newburgh also analyzes proficiency samples to maintain participation in the NYSDEC CLP program. A schedule for STL Newburgh participation in these performance evaluations is detailed in Table 5.

Table 5 Laboratory Performance Evaluation Schedule (1 year)

Source	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
NYSDOH Potable		X		X
NYSDOH				

Non-Potable Solid & Hazardous Waste Chemistry	X		X	
NYSDOH CLP	X		X	

7.5 Detection Limits

7.5.1 Instrument Detection Limit

The Instrument Detection Limit (IDL) is the level at which the instrument can reliably detect an analyte response. Method-specific Sample preparation steps are not considered in the IDL calculation. IDL's will be determined on a quarterly basis according to the following schedule:

- The first week of January
- The first week of April
- The first week of July
- The first week of October

Inorganic IDL Determination

Inorganic IDL's are determined by multiplying by the t-Test the standard deviation obtained for the analysis of a standard solution (each analyte in reagent water) at a concentration of 3x-5x estimated IDL on three non-consecutive days with seven consecutive measurements per day.

Organic IDL Determination

Organic IDL's are determined by multiplying by the t-Test the standard deviation obtained for three to seven replicate analyses of a standard solution (each analyte in reagent water).

The IDL is calculated by multiplying the standard deviation by the students t-Test (tn-1) value.

No. of Samples	t-statistic
3	6.96
4	4.54
5	3.75
6	3.36
7	3.14

7.5.2 Method Detection Limit

The Method Detection Limit (MDL) is the minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. A MDL utilizes all preparatory steps in the final detection.

To obtain an MDL:

1. Seven method blank samples are spiked at a concentration that is two to five times the IDL, or estimated MDL
2. The MDL is calculated by multiplying the t-Test value by the standard deviation obtained for three replicate analyses of a standard solution (each analyte in reagent water).

When a method requires that a method blank value is subtracted from the analyte response, the MDL calculations are made by subtraction the average of the individual method blank from each analyte response.

MDL's are determined annually, and when a new or changed instrument is utilized or when an analyst assumes a new method. The QA/QC Department maintains copies of MDL Forms for all tests performed at STL Newburgh.

7.6 Initial Demonstration of Capability

Prior to an analyst assuming responsibility for an analysis, an Initial Demonstration of Capability (IDC) must be performed and approved by the QA Supervisor.

- Unless specified otherwise in the method, the IDC shall consist of analyzing a standard solution at a concentration of between 2-5x's the MDL and having a percent recovery of ± 10% of the true value.
- For drinking water analysis the concentration of the standard solution shall be no more than 2-5x's the Maximum Contaminated Level (MCL).
- The QA/QC Department will maintain a file of all IDC's.
- In addition to the IDC, the analyst is also expected to be familiar with the analytical method and Laboratory SOP.
- The Section Supervisor is responsible for the proper training of all analysts and technicians.

8.0 Analytical Methodology

Calibration Procedures and Frequency

Instrument or method calibration is performed in accordance with the specific analytical methods and as outlined below. Quality control measures and frequency are summarized in Section 8.1

8.1 Volatile Organics - GC/MS

A. GC/MS instruments are tuned to meet required mass spectral abundance criteria prior to both initial and continuing calibrations. This is accomplished via the analysis of p-bromofluorobenzene (BFB).

B. Initial calibration of GC/MS volatiles consists of a 5 calibration standards containing each target analyte plus surrogate and internal standard compounds. The validity of the initial calibration is verified by:

- % relative standard deviation (RSD) of the relative response factor (RRF) for target compound.
- Minimum RRFs for each compound.
- Assessment of the relative retention time (RRT) shift for each compound between each standard run.

C. Continuing calibration is performed by analysis of a standard at a frequency of once every 12 hours. The continuing calibration standard must be preceded by a successful instrument tune. The validity of the continuing calibration is verified by:

- Assessment of % difference (%D) of the RRFs versus the initial calibration average RRF for each compound.
- Minimum RRFs for each compound.
- RRT shift for each compound between successive calibration runs.

D. Standards Preparation Procedures

Calibration Standards

- Purchase commercially available certified stock solutions.
- Prepare working standards by dilution of the stock standards.
- Verify the working standards by analysis of a calibration check standard prepared independently from standards.

8.2 Metals - ICP

A. Initial calibration for ICP metals consists of a method blank and 3 calibration standards.

B. The validity of the initial calibration is verified by the analysis of an independently prepared standard immediately after calibration.

C. Results must be within 90% to 110% of true value for each metal analyzed for analysis to begin.

D. Continuing calibration is performed by analysis of the Calibration Check Verification (CCV) standard at a frequency of 10% of sample volume, or every 2 hours, whichever is more frequent. The concentration of the CCV is at or near the mid-range of the calibration curve for each metal. The CCV is also analyzed after the last analytical sample. The validity of the calibration and analysis of preceding samples is verified by CCV results between 90% of 110% of true value.

E. Standards Preparation Procedures

Calibration Standards

- Prepare calibration standards by dilution of the stock standard.
- The calibration standards are prepared in reagent grade water, with the same acid concentrations as the digested sample.

9.0 Analytical Procedures

The analytical procedures to be used in the analysis of samples may utilize one of the following references:

References

1. Methods for Chemical Analysis of Water and Wastewater", EPA-600/4-79-020, March 1983.
2. "Test Methods for Evaluating Soil Waste", USEPA-SW846, 3RD Edition, September 1986 with all current revisions.
3. Atomic Absorption – Direct Aspiration
4. Atomic Absorption – Furnace Technique
5. Federal Register, V. 50, No.3, January 4, 1985.
6. Federal Register, V. 49, No.209, October 26, 1984.
7. "Standard Methods for the Examination of Water and Wastewater", 16th Edition, 1986.
8. "Methods for the Determination of Organic Compounds in Drinking Water EPS-600/4-88-039, December 1988.
9. The Analysis of Trihalomethanes in Finished Water by the Purge and Trap Method, EMSL, Cincinnati, Ohio 45268, November 6, 1979.
10. Volatile Aromatic and Unsaturated Organic Compounds in Water by Purge and Trap Gas Chromatography, EMSL, Cincinnati, Ohio 45268, Revision 2.0, (1989).
11. Volatile Organic Compounds in Water by Purge and Trap Capillary Column Gas Chromatography with Photoionization and Electrolytic Conductivity Detectors in Seriers, EMSL, Cincinnati, Ohio 45268, revision 2.0 (1989).
12. Determination of Chlorinated Acids in Water by Gas Chromatography with an Electron Capture Detector, EMSL, Cincinnati, Ohio 45268, Revision 4.0 (1989).
13. "New York State Department of Environmental Conservation Analytical Services Protocol, Vol. 2, October 1995.

14. "Standard Methods for the Examination of Water and Wastewater", 17th Edition, 1989.
15. "ASTM, Petroleum Products, Lubricants, and Fossil Fuel, Vol. 5.01 D56-D1947, 1990.
16. "Analytical Handbook for the Laboratory of Organic Analytical Chemistry", Wadsworth Center for Laboratories and Research, New York State Department of Health, August 1991.
17. "Standard Methods for the Examination of Water and Wastewater", 18th Edition, 1992.

Table 6 Quality Control Limits

Volatile Organics- 95-1

Sample Type	Parameter	Control Limit	Corrective Action
Holding Blank (b)	Any project analyte	≤ 3 x Reporting Limit	If parameters greater than the Reporting Limit in blank, re-analyze all samples that have positive identifications.
Method Blank	Methylene Chloride any other project analyte	≤ 3 x Reporting Limit ≤ Reporting Limit	If parameters greater than 3x the Reporting Limit in blank, re-analyze all samples that have positive identifications. Method parameters with "J" values in the blank will be flagged with a "B" in the samples.
Initial Calibration	All compounds except 1,2-dichlorothene, total	Max % RSD ≤20.5 ≤100	If %RSD > limit reanalyze curve and adjust instrument if necessary.
Continuing Calibration	All compounds except 1,2-dichloroethene, total	Max % Difference ≤ 25.0 ≤ 100	Recalibrate

une Requirements (BFB)	m/e	Ion Abundance Criteria		If criteria fail, halt analysis and adjust instrument. Re-tune. Do not submit any data without meeting tune criteria..
	50	15-40 percent of mass 95		
	75	30-60 percent of mass 95		
	95	Base-peak, 100% relative abundance		
	96	5-9% of mass 95		
	173	Less than 2.0% of mass 174		
	174	>50% of the base peak		
	175	5-9% of mass 174		
	176	> 95% but <101.0% of mass 174		
	177	5-9% of mass 176		
System Monitoring Compounds		Aqueous	Soils	Reanalyze sample once. If still fails, submit both analyses with an "RE" suffix on the re-run.
	Bromofluorobenzene	86-115	59-113	
	Dichloroethane-d4	76-114	70-121	
	Toluene-d8	88-110	84-138	
Matrix Spike/Matrix Spike Duplicate % Recovery		Aqueous %	Soils %	If the blank spike is in control, and the MS/MSD is out of control, a matrix interference is suspected.
	1,1-Dichloroethene	61-145	59-172	
	Trichloroethene	71-121	62-137	
	Benzene	76-127	66-142	
	Toluene	76-125	59-139	
	Chlorobenzene	75-130	60-133	
Matrix Spike/Matrix Spike Duplicate %D		Aqueous	Soils	If the %D is out of control, a matrix interference is suspected.
	1,1-Dichloroethene	≤ 14 RPD	≤ 22 RPD	
	Trichloroethene	≤ 14 RPD	≤ 24 RPD	
	Benzene	≤ 11 RPD	≤ 21 RPD	
	Toluene	≤ 13 RPD	≤ 21 RPD	
	Chlorobenzene	≤13 RPD	≤ 21 RPD	
Blank Spike		Aqueous/Soil%		Source of problem must be identified and corrected before proceeding. All associated samples must be re-analzyed.
	1,1-Dichloroethene	61-145		
	Trichloroethene	71-120		
	Benzene	76-127		
	Toluene	76-125		
	Chlorobenzene	75-130		

Internal Standards	1,4-Difluorobenzene Chlorobenzene-d5 Bromochloromethane	Upper Limit = +100% of internal standard area Lower Limit = +50% of internal standard area RT Upper limit = +0.05 minutes of internal standard RT Lower Limit = -0.05 minutes of internal standard.	Re-analyze sample once, if still fails submit both runs with "RE" suffix on re-analysis.

(b) unless otherwise requested, the holding blank is an aqueous sample prepared by STL Newburgh which is submitted for analysis by the laboratory, if needed.

Metals

Preparation Blank	All	≤RL		If any element above the RL, re-digest entire batch.
Initial and Continuing Calibration	ICP/GFAA Metals	90-110%		Recalibrate and re-run associated samples.
LCSW	All except silver and antimony which have no control limits for aqueous samples.	80-120%		Re-digest/distill entire batch.
LCSS	All	As determined by the manufacturers limits.		Re-digest/redistill entire batch.
Duplicate Sample	ICP/GFAA Metals	Original and duplicate samples ≥5x RL	20% RPD	If out of control limit, flag all associated data with a "*".
		Original and duplicate samples ≤5x RL	(+-)RL	
		One result >5x RL and other 5x RL	(+-)RL	
Serial Dilution	ICP Metals	Analyte concentration >50x IDL.	<10% D	If out of control limit, flag all associated data with an "E".

IDL= Instrument Detection Limit
RL- Reporting Limit

Table 7 Education and Experience

Ronald A. Bayer – M.S., Environmental Science, Syracuse University, Syracuse, New York.
General Manager
Experience: 27 years

Douglas O. Tawse – MBA, University of NH, Duham, New Hampshire.
Responsibilities: Vice President, Marketing Director
Experience: 5 years Xerox; 5 years Environmental Industry:
13 years Severn Trent Laboratories

Louis J. Cercone III – B.S., Chemistry, Mount Saint Mary College, Newburgh, New York.
Responsibilities: Laboratory Director
Experience: 22 years

Renee M. Cusack – B.S., Biology, Mount Saint Mary College, Newburgh, New York.
Responsibilities: Manager Metals, Wet Chemistry and Microbiology.
Experience: 22 years

Richard E. Bayer – Certified Wastewater Treatment Plant Operator.
Responsibilities: Manager Sample Management and Field Services.
Experience: 21 years

Patricia V. Chany – B.S., Environmental Chemistry, Empire State College
Responsibilities: Quality Assurance/Quality Control Director
Experience: Environmental Industry: 3 years Organic Supervisor; 2 years QA/QC Manager, 5 years GC/MS Analyst; 10 years Severn Trent Laboratories.

Eric Anderson – M.S., Chemistry, State University of New York, New Paltz, New York.
Responsibilities: System Manager
Experience: 16 years

Debra R. Rohl – A.A.S., State University of New York, Delhi, New York.
Responsibility: Supervisor Report Production
Experience: 12 years

Carol A. Werner – B.A. Chemistry, State University of New York, New Paltz, New York.

Responsibilities: GC/MS Semi-Volatile Organics
Experience: 16 years

Lori S. Hass – A.A.S. Environmental Control/Water Quality Monitoring, Ulster County Community College, Stone Ridge, New York.
Responsibilities: GC Volatiles
Experience: 13 years

Joyce M. Ofeldt – Sample Management
Responsibilities: Sample Management, Wet Chemistry
Experience: 12 years

Lynn M. LoTurco – B.S. Biology, State University of New York, Albany, New York
Responsibilities: Assistant QA/QC Director
Experience: 11 years

Caroline Moore – B.A., Biology, Mount Saint Mary College, Newburgh, New York.
Responsibilities: Data Validation/Report Production
Experience: 2 years

Margaret M. Bayer – B.A. Biology, Mount Saint Mary College, Newburgh, New York.
Responsibilities: Semi-volatile Data Manager
Experience: 11 years

James P. Murphy – A.A.S., Colorado Mountain College, Leadville, Colorado.
Responsibilities: Supervisor Field Services and Sample Management
Experience: 11 years

Milagros M. Creegan – Attended OCCC, Middletown, New York.
Responsibilities: Administration, Report Production, Data Entry
Experience: 11 years

Mei Hsu – M.S., Environmental Engineering, University of Delaware,
B.S. Environmental Science, Tunghai University, Taiwan,
Responsibilities: Furnace Metals
Experience: 1 years

Paul C. Pullar – B.A., Franklin Pierce College, Rindge, New Hampshire
Responsibilities: GC/MS Volatile Organics
Experience: 9 years

Janine Radar – Responsibilities: Data Entry, Specialist

Experience: 4 years

Cynthia Richichi – B.A., Business Administration and Accounting, Pace University, Pleasantville, New York.
Responsibilities: Accounting Clerk
Experience: 5 years

Jaime Salazar – Newburgh Free Academy
Responsibilities: Field Services and Sample Management
Experience: 2 years

Robin Diller – B.S.Biology, Mount Saint Mary College, Newburgh, New York
Responsibilities: Organic Preparation
Experience: 3 years

Kevin R. Jowell – A.A.S. Science/Math, Orange County Community College, Middletown, New York.
Responsibilities: Supervisor, Wet Chemistry
Experience: 4 years

Janette Burgess – Responsibilities: Accounting, Finance
Experience: 2 ½ years

Dave Ferris – Responsibilities: Field Services and Sample Management
Experience: 3 years

Peter O'Malley – B.S., Biology, Sienna College, Albany, New York.
Responsibilities: Wet Chemistry
Experience: 4 years

Christine Shrader – Attended OCCC, Middletown, New York.
Responsibilities: Administrative Assistant/Receptionist
Experience: 2 years

Laura Antash –Attending Dutchess Comm. College, Liberal Arts & Science, 40 credits.
Responsibilities: Metals Prep.
Experience: 6 months

Siobhan O'Hanlon – Attended Dutchess County Community College, Poughkeepsie, New York.
Responsibilities: GC Organics
Experience: 11 years, 1 year Severn Trent Laboratories

Heather Coughlin – A.A.S. in Science, UCCC, Stone Ridge, New York.

Responsibilities: Wet Chemistry
Experience: 6 months

Maria Drozenski – B.S. Biology/Chemistry, Marist College, Poughkeepsie, New York.
Responsibilities: ICP Metals
Experience: 16 years, 2 years Severn Trent Laboratories

Holly Gillette – B.S. Biology, SUNY New Paltz, New Paltz, New York
Responsibilities: Organic Extractions
Experience: 1 year

Lisa Lane – A.A.S. Environmental Control/ Hazardous Waste, Ulster County Community College.
Responsibilities: Metals Preparation, Mercury
Experience: 2 years metals preparation, 1 year Severn Trent Laboratories

Table 8 Facilities and Equipment

5.1 Instrumentation

Instrument	Number	Manufacturer	Model
Organics			
GC/MSD	2	Hewlett-Packard	5890-5970B
	1	Hewlett-Packard	6890-5972
GC/MSD w/7673 Autosampler	2	Hewlett-Packard	5972
GC/MSD w/autosampler	1	Hewlett-Packard	5970
Purge & Trap Equipment	1	Tekmar	LSC-3000
	1	Tekmar	ALS-2016
	4	O.I.	4560
	4	O.I.	DPM-16
	4	O.I.	MHC-16
	1	O.I.	4460A
	1	O.I.	MPM16

HP 1000 Series A Computer	1	Hewlett-Packard	A400
Gas Chromatographs	1	Varian	3600/w 8200
	2	Varian	3700
	1	Varian	3400/w 8200
	1	Varian	3400
	4	Hewlett-Packard	5890
	1	Hewlett-Packard	6890
Detectors			
Electron Capture (ECD)	4	Varian	
Electron Capture (ECD)	2	Hewlett-Packard	
Flame Ionization (FID)	2	Varian	
Hall	2	Tracor	700A
Hall	2	O.I.	
Nitrogen Phosphorous	1	Varian	
Photoionization (PID)	2	Tracor	
Photoionization (PID)	2	O.I.	
Gel Permeation Chromatography (GPC)	2	Zymark	Bench Mate
Inorganic			
Inductively Coupled Plasma	1	Applied Research	3560B
Inductively Coupled Plasma with Auto Sampler	1	Perkin Elmer	3000 Optima
Graphite Furnace	1	Varian	400Z
AA/GFAA/VGA	1	Varian	20
Ion Chromatograph	1	Dionex	4000I
Microwave Digester	1	CEM	MDS-81D
Infrared Spectrometer	1	Perkin Elmer	1310
Cold Vapor Mercury Analyzer	1	Leeman	PS-200
TCLP/ZHE (4 Station)	2	Associated Design	
Closed Cup Flash Point	2	Pensky Marten	

Bomb Calorimeter	1	Parr	
Laboratory Information Management System			
Lab Management System Multi User (Seedpak I)	1	Automated Compliance Systems	
Lab Management System Multi User (Seedpak II)	2	Automated Compliance Systems	
Personal Computers	22	IBM	
Laser Printer	6	Hewlett Packard	Series 2
Terminals	8	Wyse 60	
Novell Network	1	Netware 386	

Table 9 Summary of Project Methodology

Analysis	**Aqueous**	**Ground Water Liquid/Solid Matrices**
GC/MS Volatiles	95.1(3)	95.1(3)
Iron/Manganese	EPA 200.7(1)	SW846-6010B(2)
% Solid		EPA 160.3(1)

References
1. “Methods for Chemical Analysis of Water and Wastewater”, EPA-600/4-79-020, March 1983.
2. “Test Methods for Evaluating Solid Waste”,USEPA-SW846, Third Edition, September 1986 with all current revisions.
3. New York State Department of Environmental Conservation Analytical Services Protocol, June 2000.

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January 15, 2001

Timothy P. McArdell
Environmental Products and Services
7635 Edgecomb Drive
Liverpool, NY 13088

RE: RFQ for Field and Analytical Services
NYSDEC Contract No. D004184
Franklin Cleaner Site, Hempstead, NY

Dear Mr. McArdell:

John Meade of the STL On-Site Technologies division asked that I forward the attached Laboratory Quality Manual (LQM) for STL Burlington to you, along with our Standard Operating Procedure (SOP) for method TO14. These documents outline the quality procedures we would follow in support of the above referenced project, for the TO14 Fixed Laboratory analyses. Please contact me with any concerns regarding these documents.

Sincerely,

Jim Madison
Project Manager

attachment

MODIFIED: TO-14A
STANDARD OPERATING PROCEDURES FOR THE DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN AMBIENT AIR BY GAS CHROMATOGRAPHY/MASS SPECTROSCOPY

Applicable Matrix or Matrices: Ambient Air
Standard Compound List and Reporting Limits: see Table 1

Approvals and Signatures

UNCONTROLLED COPY

Laboratory Director: ______________________ Date: __________
Christopher A. Ouellette

QA Manager: ______________________ Date: __________
Kim B. Watson

Organics Technical Director: ______________________ Date: __________
Bryce E. Stearns

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1.0 SCOPE AND APPLICATION

1.1 This document describes a procedure for analysis of 39 volatile organic compounds (VOCs) in ambient air. The method was originally based on collection of whole air samples in SUMMA® passivated stainless steel canisters, but has now been generalized to other specially prepared canisters and Tedlar bags. The VOCs are separated by gas chromatography and measured by a mass spectrometer. This method presents procedures for sampling into canisters to final pressures both above and below atmospheric pressure (respectively referred to as pressurized and subatmospheric pressure sampling).

1.2 This method is applicable to specific VOCs that have been tested and determined to be stable when stored in pressurized and sub-atmospheric pressure canisters. Numerous compounds, many of which are chlorinated VOCs, have been successfully tested for storage stability in pressurized canisters. However, minimal documentation is currently available demonstrating stability of VOCs in subatmospheric pressure canisters.

1.3 The target list is shown in Table 1. These compounds can be recovered from canisters near their original concentrations after storage times of up to thirty days (19.3).

2.0 SUMMARY OF METHOD

2.1 Both subatmospheric pressure and pressurized sampling modes typically use an initially evacuated canister and pump-ventilated sample line during sample collection. Pressurized sampling requires an additional pump to provide positive pressure to the sample canister. A sample of ambient air is drawn through a sampling train comprised of components that regulate the rate and duration of sampling into a pre-evacuated specially prepared passivated canister.

2.2 After the air sample is collected, the canister valve is closed, an identification tag annotated and attached to the canister, a chain-of-custody (COC) form completed, and the canister is transported to the laboratory for analysis.

2.3 Upon receipt at the laboratory, the canister pressure and tag data is recorded in the Run Log Book, the COC completed, and the canister is attached to the analytical system. During analysis, water vapor is reduced in the gas stream by a Nafion® dryer (if applicable), and the VOCs are then concentrated by collection in a cryogenically-cooled trap. The cryogen is then removed and the temperature of the trap is raised. The VOCs originally collected in the trap are revolatilized, separated on a GC column, then detected by one or more detectors for identification and quantitation.

2.4 General Method - The mass spectrometer is calibrated to recognize m/z values in the range of 35-260 amu. Reference spectra and retention times for analytes are obtained by the measurement of calibration standards under the same conditions used for samples. The performance of the mass spectrometer is verified by the injection of 4-Bromofluorobenzene (BFB). Next, the instrument must demonstrate acceptable chemical calibration and linearity by the analysis of five concentrations of a standard mix containing the analytes of interest, as well as the internal standards. Before any samples are analyzed, a method blank must be analyzed to demonstrate that the instrument is free from contamination. All analyses must occur within 24 hours of the injection of the passing BFB. Another analytical sequence may be started by the analysis of a passing BFB MS tune followed by a continuing calibration standard, a laboratory control sample, and a method blank.

3.0 DEFINITIONS

Absolute Canister Pressure (Pg+Pa)-gauge pressure in the canister (kPa, psi) and Pa = barometric pressure

Absolute Pressure-pressure measured with reference to absolute zero pressure (as opposed to atmospheric pressure), usually expressed as kPa, mm Hg, or psia.

Cryogen-a refrigerant used to obtain very low temperatures in the cryogenic trap of the analytical system. A typical cryogen is liquid nitrogen (bp –194.8°C) or liquid argon (bp –184.7°C).

Dynamic Calibration-calibration of an analytical system using calibration gas standard concentrations in a form identical or very similar to the samples to be analyzed and by introducing such standards into the inlet of the sampling or analytical system in a manner very similar to the normal sampling or analytical process.

Gauge Pressure-pressure measured above ambient atmospheric pressure (as opposed to absolute pressure). Zero gauge pressure is equal to ambient atmospheric (barometric) pressure.

MS/SCAN-the GC is coupled to a MS programmed in the SCAN mode to scan all ions repeatedly during the GC run.

MS/SIM-the GC is coupled to a MS programmed to acquire data for only specified ions and to disregard all others. This is performed using SIM coupled to retention time discriminators. The GC/SIM analysis provides quantitative results for selected constituents of the sample gas as programmed by the user.

Pressurized Sampling-collection of an air sample in a canister with a (final) canister pressure above atmospheric pressure, using a sample pump.

Qualitative Accuracy-the ability of an analytical system to correctly identify compounds.

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Quantitative Accuracy-the ability of an analytical system to correctly measure the concentration of an identified compound.

Static Calibration-calibration of an analytical system using standards in a form different from the samples to be analyzed. An example of a static calibration would be injecting a small volume of a high concentration standard directly onto a GC column, bypassing the sample extraction and preconcentration portion of the analytical system.

Sub-atmospheric Sampling-collection of an air sample in an evacuated canister at a (final) canister pressure below atmospheric pressure, without the assistance of a sampling pump. The canister is filled as the internal canister pressure increases to ambient or near ambient pressure. An auxiliary vacuum pump may be used as part of the sampling system to flush the inlet tubing prior to or during sample collection context, this procedure serves as a qualitative identification and characterization of the sample.

Internal Standards (IS)-Non-target analyte compounds that are similar to the target analytes but are not expected to be found in environmental media (generally, isotopically labeled target analytes are used for this purpose) and are added to every standard, quality control sample, and field sample at a known concentration prior to analysis. IS responses are used as the basis for quantitation of target analytes.

Stock solutions-A concentrated solution containing one or more method analytes prepared in the laboratory using assayed reference materials or purchased from a reputable commercial source.

Primary Dilution Standard Solution-A solution of several analytes prepared in the laboratory from stock standard solutions and diluted as needed to prepare calibration solutions and other needed analyte solutions.

Calibration Standard (CAL)-A solution prepared from the primary dilution standard solution or stock standard solutions and the internal standards and surrogate analytes. The CAL solutions are used to calibrate the instrument response with respect to analyte concentration.

Continuing Calibration Verification (CCV)-An analytical standard solution containing all target analytes and internal standard compounds that is used to evaluate the performance of the instrument system with respect to a defined set of method criteria.

Method Blank (VBLK, similarly known as the LABORATORY REAGENT BLANK)-A canister of ambient air or other blank matrix that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and internal standards that are

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used with other samples. The VBLK is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus.

Trip Blank-A canister of ambient air or other blank matrix that is placed in a sample container in the laboratory and treated as a sample in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, preservation, and all analytical procedures. The purpose of the trip blank is to determine if method analytes or other interferences are present in the field environment (originating from the proximity of sample containers to one another during shipment and storage).

Laboratory Control Sample (LCS)-The LCS consists of an aliquot of a clean (control) matrix similar to the sample matrix and of the same weight or volume. Its purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate and precise measurements. When the results of the matrix spike analysis indicates a potential problem due to the sample matrix itself, the LCS results are used to verify that the laboratory can perform the analysis in a clean matrix.

Initial Calibration Verification (ICV)-An analytical standard solution containing all target analytes and internal standard compounds that are prepared from a source external to the laboratory and independent from the source of the initial calibration standards. The purpose of the ICV is to verify that the initial calibration is in control.

4.0 Interferences

4.1 Interferences can occur in sample analysis if moisture accumulates in the dryer. An automated cleanup procedure that periodically heats the dryer to about 125°C while purging with zero air eliminates any moisture buildup. This procedure does not degrade sample integrity for Compendium Method TO-14A target compound list (TCL) but can affect some organic compounds.

4.2 Contamination may occur in the sampling system if canisters are not properly cleaned before use. Additionally, all other sampling equipment (e.g., pump and flow controllers) should be thoroughly cleaned to ensure that the filling apparatus will not contaminate samples.

4.3 The Compendium Method TO-14A analytical system employs a Nafion® permeable membrane dryer to remove water vapor from the sample stream. Polar organic compounds permeate this membrane in a manner similar to water vapor and rearrangements can occur in some hydrocarbons due to the acid nature of the dryer. Compendium Method TO-15 provides guidance associated with alternative

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water management systems applicable to the analysis of a large group of VOCs in specially-treated canisters.

5.0 SAFETY

5.1 The toxicity or carcinogenicity of each reagent used in this method has not been fully established. Each chemical should be regarded as a potential health hazard and exposure should be as low as reasonably achievable. Cautions are included for known extremely hazardous materials or procedures.

5.2 STL-Burlington maintains a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. Material Safety Data Sheets (MSDS) are made available to all personnel involved in the chemical analysis. STL-Burlington also has a written environmental health and safety plan.

5.3 Please note chemicals that have the potential to be highly toxic or hazardous, the appropriate MSDS must be reviewed by the employee before handling the chemical.

5.3 The following method analytes have been tentatively classified as known or suspected human or mammalian carcinogens: benzene, carbon tetrachloride, 1,4-dichlorobenzene, 1,2-dichlorethane, hexachlorobutadiene, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, chloroform, 1,2-dibromoethane, tetrachloroethene, trichloroethene, and vinyl chloride. Pure standard materials and stock standard solutions of these compounds should be handled in a hood.

6.0 EQUIPMENT AND SUPPLIES

6.1 Sample Containers

- ➢ SUMMA® passivated stainless steel canisters are available from a number of commercial suppliers. STL's major suppliers are Restek and Scientific Instrumentation Specialists.
- ➢ Tedlar bags

6.2 Instrumentation:

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- VOC Autosampler: Nutech model 3600 automated sytem. This system is capable of introducing samples from up to sixteen canisters in an automated sequence.
- Cryogenic Concentrator: Nutech model 3550A cryogenic concentrator. The concentrator incorporatesTO-14 cryotrapping techniques and employs a Nafion permeable membrane dryer to remove water vapor from the sample stream.
- Electronic Mass Flow Controllers: The Nutech cryogenic concentrator is equipped with an electronic mass flow controller to maintain a constant flow for carrier gas and sample over a range of 0-200 cc/min.
- Cryofocussing Accessory: The Nutech 354A Cryofocussing accessory cryogenically refocuses the sample onto the column head.
- Gas Chromatograph: Hewlett-Packard 5890 Series II
- Mass Spectrometer: Hewlett-Packard 5971 MSD
- Primary Column: Fused silica capillary column, J&W DB-1 60m x 0.35 mm x 1.0 µm or equivalent
- Vacuum Pumps: General purpose vacuum pumps of the type specified in EPA Method TO-14A.

6.3 Syringes-1.0mL - 1.0-L gas tight syringes with Luer-Lok tip

6.4 Data System: DOS based PC software for Nutech instrumentation. Hewlett-Packard ChemServer, Target 3.5 software is used for data processing and HP Chemstation software used for instrument control and data acquisition.

6.5 Canister Cleaning System: Entech auto-canister cleaning system (Model 3000)

- Vacuum Pump: Capable of evacuating sample canisters to an absolute pressure of 29.5" Hg.
- Manifold: Equipped with stainless steel and Teflon transfer lines and connections for cleaning up to eight canisters simultaneously.

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- Vacuum Gauge: Capable of measuring vacuum in the manifold to an absolute pressure of 0.05-mm Hg or less.

- Heating Manifolds: Individually thermal-stated heating manifolds used to heat canisters during the cleaning cycle.

7.0 Reagents and Standards

7.1 Gas cylinders of ultrahigh purity helium and zero air.

7.2 Low pressure liquid nitrogen for the cryogenic concentrator and cryofocuser.

7.3 4-Bromofluorobenzene (BFB) for monitoring mass spectral tuning.

7.4 Calibration Standards: The primary standard is purchased through Restek. The 1 ppmv standard has 39 TO-14A target compounds and is traceable to a NIST standard. The calibration standards are prepared by adding a known amount of the primary standard into a humidified SUMMA canister and pressurizing with zero air to achieve the concentration wanted. The calibration levels (0.5, 5, 10, 20, 40 ppbv) are then achieved by injecting different volumes or further diluting.

7.5 Internal standards (Bromochloromethane, 1,4-Difluorobenzene, and Chlorobenzene-d5) are purchased through Spectra Gases at the 1 ppmv level. They are introduced automatically through the concentrator to achieve a final concentration of 10 ppbv.

7.6 Laboratory Control Samples: The 39 component standard is purchased through Spectra Gases at the 1 ppmv level. The concentration of the LCS is achieved by adding a known amount of the 1 ppmv standard to a humidified canister and then pressurized to achieve the target concentration, which is the midpoint of the calibration curve.

8.0 SAMPLE COLLECTION AND STORAGE

8.1 All canisters must be clean and free of any contaminants before sample collection.

8.2 All canisters are leak tested by pressurizing them to approximately 10 psig with zero air. The initial pressure is measured, the canister valve is closed, and the final

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pressure is checked after at least 1 hour. If acceptable, the pressure should not vary more than 13.8 kPa (2 psig) over the time period.

8.3 The canister(s) are connected to the manifold. The vent shut-off valve and the canister valve(s) are opened to release any remaining pressure in the canister(s). The heating band(s) are then attached to the canister(s) and turned on allowing them to heat to 100°C. The number of cycles (≥3) are chosen on the Entech 3000 cleaning system and the "Auto" button is depressed. The canister(s) are first evacuated for 5 minutes by an oiless pump and then they are pressurized with humid zero air to ~10 psig.

8.4 At the end of the evacuation/pressurization cycles, the canister is pressurized to 10 psig with humid zero air. The canister is then analyzed by a GC/MS analytical system. Any canister that has not tested clean (compared to direct analysis of humidified zero air of less than 0.2 ppbv of targeted VOCs) should not be used. 100% of the canisters will be analyzed by GC/MS until they are proven to be clean. From this point on, the canister with the highest TIC in the batch of 8 canisters being cleaned at one time will be analyzed. If this canister is proven to be clean, then the rest of the batch will be certified clean as well.

8.5 The canister is reattached to the cleaning manifold and is then reevacuated to <0.05 mm Hg. The canister valve is closed. The canister is removed from the cleaning system and the canister connection is capped with a stainless steel fitting. The canister is now ready for collection of an air sample. An identification tag is initialed, dated, and attached to the inlet of each canister for field notes and chain-of-custody purposes. An alternative to evacuating the canister at this point is to store the canisters and reevacuate them just prior to the next use.

8.6 The analytical system is comprised of a GC equipped with a mass-selective detector set in the SCAN mode. All ions are scanned by the MS repeatedly during the GC run. The system includes a computer and appropriate software for data acquisition, data reduction, and data reporting. A 200-mL air sample is collected from the canister into the analytical system. The sample air is first passed through a Nafion® dryer, through the 6-port chromatographic valve, then routed into a cryogenic trap.

[Note: While the GC-multidetector analytical system does not employ a Nafion® dryer for drying the sample gas stream, it is used here because the GC/MS system utilizes a larger sample volume and is far more sensitive to excessive moisture than the GC-multidetector analytical system. Moisture can adversely affect

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detector precision. The Nafion® dryer also prevents freezing of moisture on the 0.32-mm I.D. column, which may cause column blockage and possible breakage.]

8.6.1 The trap is heated (–160°C to 125°C in 60 sec) and the analyte is injected onto the DB-1 capillary column (0.32-mm x 60-m). *Note: Rapid heating of the trap provides efficient transfer of the sample components onto the gas chromatographic column.]*

8.6.2 Upon sample injection unto the column, the MS computer is signaled by the GC computer to begin detection of compounds, which elute from the column. The gas stream from the GC is scanned within a preselected range of atomic mass units (amu). For detection of compounds in Table 1, the range should be 35 to 265 amu.

8.6.3 A Nafion® permeable membrane dryer is used to remove water vapor selectively from the sample stream. The permeable membrane consists of Nafion® tubing (a copolymer of tetrafluoroethylene and fluorosulfonyl monomer) that is coaxially mounted within larger tubing. The sample stream is passed through the interior of the Nafion® tubing, allowing water (and other light, polar compounds) to permeate through the walls into the dry purge stream flowing through the annular space between the Nafion® and outer tubing.

8.7 Sample collection is described in method TO-14A.

8.8 Samples collected in SUMMA® canisters are analyzed within twenty days of collection. Other holding times may be selected by the client to conform with local regulatory requirements. Samples collected in Tedlar bags are analyzed within three days of collection.

8.9 The overall condition of each sample container is observed upon receipt and any signs of damage is reported immediately to the client. The pressure of each sample canister is checked by attaching a pressure gauge to the canister inlet and briefly opening the canister valve to obtain the pressure reading. The measurement is recorded in the laboratory Run LogBook. Samples received at a pressure that is less than -4.0" Hg must be pressurized to ensure that there is enough sample for analysis. The canisters are pressurized with zero grade air and the dilution factor is calculated and applied to the final results of analysis.

8.10 Samples received in Tedlar bags are inspected for condensation. If it is present, the bag is gently warmed by holding it between your hands in hope that the sample

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will return to its gaseous state. However, resampling may be necessary if this procedure does not work.

9.0 QUALITY CONTROL

9.1 4-Bromofluorbenzene - Prior to the acquisition of a calibration curve or the analysis of samples, an aliquot of BFB (1 ppmv) is automatically introduced into the GC by way of the Nutech automated sytem. If the spectrum does not meet all criteria in Table 2, another BFB tune is injected into the instrument. If the second BFB tune fails the criteria in Table 2, the MS should be retuned and adjusted to meet all criteria before proceeding with the calibration or the analysis.

9.2 Method Detection Limits - Method detection limits (MDLs) are determined annually in accordance with the method described in 40 CFR, Part 136, Appendix B. The QA Manager keeps the results of these studies on file.

9.3 Initial Calibration Verification - An ICV must be run following the acquisition of the five-point initial calibration. The ICV is prepared from a source external to the laboratory and independent from the source of the initial calibration standards. The compounds should be at a concentration of 10 ppbv. The ICV recovery limits are shown in Table 3.

9.4 Internal Standards - The internal response shall be +/- 40% of the mean internal standard response recorded during the analysis of the continuing calibration standard. The retention time shift should not be more than +/-. 33 minutes from the latest daily calibration check.

9.5 Laboratory Control Sample - A laboratory control sample should be included with each analytical batch. The compounds should be at a concentration of 10 ppbv. The LCS recovery limits are shown in Table 3.

9.6 Method Blank - One blank must be run with every batch of samples after the calibration standard. A 200-mL sample of laboratory zero air must be analyzed prior to any samples. An acceptable blank must not contain any volatile target analytes at concentrations greater than their reporting limits with the exception of methylene chloride which must be less than or equal to five times (5X) its reporting limit. If the method blank exceeds these criteria, the analytical system may be out of control. The source of the contamination must be investigated and appropriate corrective measures must be taken and documented before further sample analysis proceeds.

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10.0 CALIBRATION AND STANDARDIZATION

10.1 BFB - The ion abundances shown in Table 2 must be met before analysis of calibration standards may proceed.

10.2 Initial Calibration (IC) - The five concentrations for the initial calibration are 0.5, 5, 10, 20, and 40 ppbv. A response factor (RF) is calculated for each analyte and/or isomer pair for each calibration solution using the appropriate internal standard. The calculation is performed as follows:

$$RF = \frac{(A_x)(Q_{is})}{(A_{is})(Q_x)}$$

where:

A_x = area of the quantitation ion of the analyte
A_{is} = area of the quantitation ion of the internal standard
Q_x = quantity of analyte purged in nanograms or concentration units
Q_{is} = quantity of internal standard purged in ng or concentration units

10.2.1 For each analyte calculate the mean response factor from analyses of the calibration solutions. Calculate the standard deviation (SD) and relative standard deviation (RSD) from each mean (M).

$$RSD = 100\frac{SD}{M}$$

10.2.2 The %RSD average of all analytes must be $\leq$ 30% (2 compounds are allowed to be $\leq$40%). The RRT for each target compound at each calibration level must be within 0.06 RRT units of the mean RRT for the compound. The retention time shift for each of the internal standards at each calibration level must be within 20 s of the mean retention time over the initial calibration range for each internal standard.

10.3 Continuing Calibration Verification (CCV) - Verify the BFB MS tune and perform a continuing calibration verification at the beginning of each 24-hr work shift. The concentration of the CCV is 10 ppbv. The RF is calculated for each analyte compound from the data measured in the continuing calibration check. The percent difference is calculated using the following equation:

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$$\%Difference = \frac{RF - RF_v}{RF}(100)$$

where:
RF = mean Response Factor from the initial calibration
RF_v = Response Factor from the analyses of the verification standard

The percent difference for each CCV should be ≤ 30% for 90% of the compounds. In addition, the internal standard retention time should not change by more than .33 minutes from that in the most recent calibration. The integrated areas of the internal standards in the calibration verification standard should not change by more than +/-40% from that in the most recent calibration. If the above criteria are not met maintenance is performed on the instrument and/or a new calibration curve is acquired. Alternatively, in keeping with the approach described for the IC, if the average of the responses for all analytes is within 30% for 90% of the compounds, then the calibration has been verified. If the calibration still does not meet the 30% for 90% of the compounds limit, check the instrument operating conditions, and if necessary inject another aliquot of the calibration verification standard. If the response for the analyte is still not within +/-30% for 90% of the compounds, then a new IC must be prepared.

10.4 Laboratory Control Sample (LCS) - One LCS must be run in each 24 hour window following the CCV. The LCS is purchased from an independent source and is run at the concentration of 10 ppbv. The % recovery of each analyte is determined by the following equation:

$$\%\mathrm{Recovery} = \frac{C_s}{C_n} X100$$

where:
C_s = Measured concentration of the spiked sample aliquot
C_n = Nominal (theoretical) concentration increase that results from spiking the sample, or the nominal concentration of the spike aliquot (for LCS and ICV)

The percent difference for each compound should be ≤ 30% for 90% of the compounds. In addition, the internal standard retention time should not change by more than 20 s. from the mid-point standard level of the most recent calibration. The integrated areas of the internal standards in the calibration verification standard should not change by more +/-40% from that in the most recent calibration.

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10.5 Method Blank - A method blank is run following the passing of the BFB tune, CCV, and LCS. A 200 mL aliquot of zero grade air is run to verify that the analytical system is clean. An acceptable method blank verifies that there are no volatile organic compounds present above their reporting limits. In addition, the internal standard retention time should not change by more than 20 s. from the most recent calibration. The integrated areas of the internal standards in the method blank should not change by more +/-40% from that of the most recent calibration.

11.0 PROCEDURE

11.1 The analytical system is comprised of a GC equipped with a mass-selective detector set in the SCAN mode. All ions are scanned by the MS repeatedly during the GC run. The system includes a computer and appropriate software for data acquisition, data reduction, and data reporting. A 200-mL air sample is collected from the canister or Tedlar bag into the analytical system. The sample air is first passed through a Nafion® dryer, through the 6-port chromatographic valve, then routed into a cryogenic trap. The trap is heated (–160°C to 125°C in 60 sec) and the analyte is injected onto the DB-1 capillary column (0.32-mm x 60-m).

[Note: Rapid heating of the trap provides efficient transfer of the sample components onto the gas chromatographic column.]

Upon sample injection unto the column, the MS computer is signaled by the GC computer to begin detection of compounds, which elute from the column. The gas stream from the GC is scanned within a preselected range of atomic mass units (amu). Data is acquired and stored over the nominal mass range 35-260 with a total cycle time (including scan overhead time) of two seconds or less. The cycle time is adjusted to measure five or more spectra during the elution of each GC peak. A multi-stage temperature ramp is used to separate the components of interest for this analysis. A typical GC temperature program is described below.

- Initial temperature: 30° C, initial time 4 min.
- Ramp1: 20° C/min. to 220° C, hold for 1.5 min.
- Ramp2: 40° C/min. to 260° C, hold for 2 min.

11.2 Identification of Analytes - A sample is identified by comparison of its mass spectrum (after background subtraction) to a reference spectrum in the user-created data base. The GC retention time for each analyte should be within +/- 0.5 minutes of the midpoint standard's retention time in the initial calibration curve.

11.2.1 In general, all ions that are present above 10% relative abundance in the mass spectrum of the standard should be present in the mass spectrum of the sample component and should agree within absolute 20%. For example, if an ion has a relative abundance of 30% in the standard spectrum, its abundance in the sample spectrum should be in the range of 10-50%. Some ions, particularly the molecular ion, are of special importance, and should be evaluated even if they are below 10% relative abundance.

11.2.2 Identification requires expert judgment when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When GC peaks obviously represent more than one sample component (i.e., broadened peak with shoulder(s) or valley between two or more maxima), appropriate analyte spectra and background spectra can be selected by examining plots of characteristic ions for tentatively identified components. When analytes coelute (i.e., only one GC peak is apparent), the identification criteria can be met but each analyte spectrum will contain extraneous ions contributed by the coeluting compound.

11.2.3 Structural isomers that produce very similar mass spectra can be explicitly identified only if they have sufficiently different GC retention times. Acceptable resolution is achieved if the height of the valley between two peaks is less than 25% of the average height of the two peaks. Otherwise, structural isomers are identified as isomeric pairs. Two of the three isomeric xylenes are examples of structural isomers that are not resolved on the capillary column. These groups of isomers will be reported as isomeric pairs.

12.0 CALCULATIONS

12.1 Dilution factor:

$$DF = \frac{p_1}{P_2}$$

where:

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P_1 = Canister pressure before dilution (psig)
P_2 = Canister pressure after dilution (psig)

12.2 Concentrations of Calibrated Compounds:

$$C_x = \frac{(A_x)(C_{IS})}{(A_{IS})(\overline{RRF})}(DF)$$

where:

$\overline{RRF}$ = Average Relative Response Factor from five-point initial calibration.
C_x = Concentration of compound (ppbv)
C_{IS} = Concentration of associated internal standard (ppbv).
DF = Dilution Factor.
A_{IS} = Area of quantitation ion for associated internal standard.
A_x = Area of quantitation ion for compound.

12.3 Calculation of Recovery - Calculate the recovery of each spiked analyte in the LCS and ICV by the following equation:

$$\text{Re cov}\,ery = \%R = \frac{C_s - C_u}{C_n}(100)$$

where:
C_s = Measured concentration of the spiked sample aliquot
C_u = Measured concentration of the unspiked sample aliquot (use 0 for LCS and ICV)
C_n = Nominal (theoretical) concentration increase that results from spiking the sample, or the nominal concentration of the spike aliquot (for LCS and ICV)

12.4 Calculation of Precision - Precision is estimated from the relative percent difference (RPD) of the concentrations (not the recoveries) measured for matrix spike/ matrix spike duplicate pairs, or for duplicate analyses of unspiked samples. The RPD is calculated according to the following equation below.

$$RPD = \frac{(C_1 - C_2)}{\left(\frac{C_1 + C_2}{2}\right)}(100)$$

where:

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C_1 = Measured concentration of the first sample aliquot
C_2 = Measured concentration of the second sample aliquot

12.5 Data Reporting - Based on the mass spectra, it is appropriate to report values between the MDL and the RL. In this region, an analyte can be qualitatively detected, but not accurately quantified. Any data point reported in this region is flagged with a "J". STL reports sample specific RLs. Sample specific RLs are derived by taking into account various sample specific data, which can include the amount of the sample subject to testing, % moisture, dilution factor, interferences and the base RL for the analysis.

12.5.1 Reporting Qualifiers

B = Analyte is found in the associated method blank as well as the sample
D = Compound is identified in an analysis at a secondary dilution factor
E = Compound quantitation is above the instrument's calibration range for this analysis
J = Indicates an estimated quantitation value
U = Compound was analyzed for but not detected
X = The reported compound is a suspected laboratory contaminant
Y = An additional qualifier which will be defined at the time of use by the data reviewer
Z = The reported result is based on the combined responses from coeluting compounds

12.5.2 Data Package Definitions - Three levels of reporting are available. The difference between these levels has nothing to do with the quality of the work being performed, only how it is presented.

Level 2: A level 2 data package consists of sample results only, and may be available as either an Analytical Report or in a format similar to the OLM Form 1A's.
Level 3: A level 3 data package consists of sample, CLP-like forms with Quality Control results.
Level 4: A level 4 data package consists of a full set of RAS forms, and all supporting documentation.

Electronic-Diskettes are available upon request.

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13.0 METHOD PERFORMANCE

Method detection limits are calculated using the formula:

$$MDL = S\ t_{(n-1,\ 1\text{-alpha} = 0.99)}$$

Where:

$t_{(n-1,\ 1\text{-alpha} = 0.99)}$ = Student's t value for the 99% confidence level with n-1 degrees of freedom
n = number of replicates
S = the standard deviation of the replicate analyses

14.0 POLLUTION PREVENTION

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The USEPA has established a prevention hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the agency recommends recycling as the next best option.

14.2 The quantity of chemical purchased should be based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

14.3 For information about pollution prevention that may be applicable to laboratories and research institutions, consult “Less is Better: Laboratory Chemical Management for Waste Reduction”, available from the American Chemical Society’s Department of Government Regulations and Science Policy, 1155 16th Street N.W. Washington D.C. 20036, (202) 872-4477.

15.0 DATA ASSESSMENT AND ACCEPTANCE CRITERIA AND CORRECTIVE ACTIONS FOR OUT-OF-CONTROL DATA

15.1 Data assessment, acceptance criteria and corrective action for out of control data is summarized in Table 3.

15.2 Corrective actions for out of control data is summarized in Table 3.

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16.0 CONTINGENCIES FOR HANDELING OUT OF CONTROL OR UNACCEPTABLE DATA

Summarized in Table 3.

17.0 WASTE MANAGEMENT

17.1 The samples that are not utilized in the analysis are vented in the Volatiles Prep Lab hood and further disposed of during the canister cleaning process. The USEPA requires that laboratory waste management practices conducted be consistent with all applicable rules and regulations. Excess reagents, samples, and method process wastes should be characterized and disposed of in an acceptable manner. The Agency urges laboratories to protect the air, water and land by minimizing and controlling all releases from hoods, and bench operations, complying with the letter and spirit of any waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For further information on waste management consult the “Waste Management Manual for Laboratory Personnel”, available from the American Chemical Society at the address listed in Section 14.3.

18.0 REFERENCES

18.1 Compendium Method TO-14A, "Determination of Volatile Organic Compounds in Ambient Air using Specially Prepared Canisters and Analyzed by Gas Chromatography", USEPA, January 1996.

18.2 Compendium Method TO-15, "Determination of Volatile Organic Compounds in Ambient Air using Specially Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry", USEPA, January 1996.

18.3 Kelly T. J. and Holdren, M.W., "Applicability of Canisters for Sample Storage in the Determination of Hazardous Air Pollutants," *Atmos. Environ.*, Vol. 29, 2595-2608, May 1994.

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19.0 TABLES, DIAGRAMS, FLOWCHARTS, AND VALIDATION DATA

Table 1 - Analytes, Chemical Abstract Services Numbers and Reporting Limits (RL)

Analyte	CAS No.	RL (ppbv)
Dichlorodifluoromethane	75-71-8	0.5
Chloromethane	74-87-3	0.5
Dichlorotetrafluoroethane	76-14-2	0.5
Vinyl Chloride	75-01-4	0.5
Bromomethane	74-83-9	0.5
Chloroethane	75-00-3	0.5
Trichlorofluoromethane	75-69-4	0.5
1,1-Dichloroethene	75-35-4	0.5
Methylene Chloride	75-09-2	0.5
Trichlorotrifluoroethane	76-13-1	0.5
1,1-Dichloroethane	74-34-3	0.5
cis-1,2-Dichloroethene	156-59-2	0.5
Chloroform	67-66-3	0.5
1,2-Dichloroethane	107-06-2	0.5
1,1,1-Trichloroethane	71-55-6	0.5
Benzene	71-43-2	0.5
Carbon Tetrachloride	56-23-5	0.5
1,2-Dichloropropane	78-87-5	0.5
Trichloroethene	79-01-6	0.5
cis-1,3-Dichloropropene	10061-02-5	0.5
trans-1,3-Dichloropropene	10061-02-6	0.5
1,1,2-Trichloroethane	79-00-5	0.5

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Analyte	CAS No.	RL (ppbv)
Toluene	108-88-3	0.5
1,2-Dibromoethane	106-93-4	0.5
Tetrachloroethene	127-18-4	0.5
Chlorobenzene	108-90-7	0.5
Ethylbenzene	100-41-4	0.5
Styrene	100-42-5	0.5
1,1,2,2-Tetrachloroethane	79-34-5	0.5
m,p-Xylene	108-38-3	0.5
o-Xylene	95-47-6	0.5
1,3,5-Trimethylbenzene	108-67-8	0.5
1,2,4-Trimethylbenzene	95-63-6	0.5
1,3-Dichlorobenzene	541-73-1	0.5
1,4-Dichlorobenzene	106-46-7	0.5
1,2-Dichlorobenzene	95-50-1	0.5
1,2,4-Trichlorobenzene	120-82-1	0.5
Hexachlorobutadiene	87-68-3	0.5

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TABLE 2 - BFB CRITERIA

BFB Key Ions and Ion Abundance Criteria	
Mass	Ion Abundance Criteria
50	8.0-40.0 percent of mass 95
75	30.0-66.0 percent of mass 95
95	base peak, 100 percent relative abundance
96	5.0-9.0 percent of mass 95
173	less than 2.0 percent of mass 174
174	50.0-120.0 percent of mass 95
176	93.0-101.0 percent of mass 174
177	5.0-9.0 percent of mass 176

NOTE: BFB criteria limits are from the updated TO-15 method.

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TABLE 3 - TO-14A QUALITY CONTROL CRITERIA

Quality Control Criteria	Frequency	Acceptance	Corrective Action
BFB	24 hours	Per Method	Reshoot, Retune
ICAL: 0.5, 5, 10, 20, 40 ppbv	As Required	Average %RSD must be ≤ 30% (2 compounds allowed to ≤40%)	System check, Mix new standards, Recalibrate, Reanalyze
ICV (10 ppbv)	Following Initial Calibration Curve	Average %RSD must be ≤ 30% (2 compounds allowed to ≤40%)	System check, Mix new standards, Recalibrate, Reanalyze
CCV (10 ppbv)	Beginning of each 24 hour window	%Difference each CCC ≤30% for 90% of the compounds	System Check, Recalibrate
LCS (10 ppbv)	Following the CCV	%Difference each CCC ≤30% for 90% of the compounds	System Check, Recalibrate
Method Blank	Following each LCS	Targets < Reporting Limits (Methylene Chloride 5xs RL)	Check for contamination, Reanalyze, correct as required
Internal Standards	In every sample, blank, and QC samples	+/-40%RF from last acceptable calibration; +/-.33 min	System Check, Recalibrate
Samples	Per Request	ISTD must meet their crieteria and the concentration must fall within the calibrated range	A dilution is applied to the sample when needed; the target concentration will be the midpoint of the calibration curve. If the ISTD criteria is failing, the sample is ran again. If the ISTD fail again the sample is reported out as is.

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LABORATORY QUALITY MANUAL

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REVISION 20

LABORATORY QUALITY MANUAL

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Approved Signatures:

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1. Introduction, Purpose, and Scope

1.1. STL-Burlington, VT Overview

Severn Trent Laboratories (STL) in Burlington, Vermont was established in 1970 in response to a need for hydrographic studies in support of the nuclear power industry and water quality testing.

STL Burlington is part of the Severn Trent Laboratories, Inc., a national group of 23 laboratories. STL's group of laboratories offers a broad range of environmental testing services provided by over one thousand professionals. STL's testing capabilities include chemical, physical, and biological analyses of a variety of matrices, including aqueous, solid, drinking water, waste, tissue, air and saline/estuarine samples. Specialty capabilities throughout include air toxics, radiological testing, geotechnical testing, tissue preparation and analysis, aquatic toxicology, asbestos, miscroscopy services, and on-site technologies including mobile laboratories. STL facility locations and contact information are outlined in Table 1.

1.2. Quality Assurance Policy

It is STL's policy to:

- Provide high quality, consistent, and objective environmental testing services that meet all federal, state, and municipal regulatory requirements.
- Generate data that are scientifically sound, legally defensible, meet project objectives, and are appropriate for their intended use.
- Provide STL clients with the highest level of professionalism and the best service practices in the industry.
- Build continuous improvement mechanisms into all laboratory, administrative, and managerial activities.
- Maintain a working environment that fosters open communication with both clients and staff.

1.3. Management Commitment to Quality Assurance

STL management is committed to providing the highest quality data and the best service in the environmental testing industry. To ensure that the data produced and reported by STL meet the requirements of its clients and comply with the letter and spirit of municipal, state and federal regulations, STL maintains a Quality System that is clear, effective, well communicated, and supported at all levels in the company.

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Table 1 STL Facility Locations

Facility	Address	Telephone	Facsimile
STL Anaheim	1250 E. Gene Autry Way Anaheim, CA 92805	(714) 937 1094 (800) 404-2673	(714) 937-1170
STL Aurora	10703 East Bethany Drive Aurora, CO 80014	(303) 751-1780 (800) 972-2673	(303)751-1784
STL Austin	14046 Summit Park, Building B Austin, TX 78728	(512) 244-0855	(512) 244-0160
STL Baltimore	19 Loveton Circle Sparks, MD 21552	(410) 771-4920	(410) 771-4407
STL Billerica	149 Rangeway Road N. Billerica, MA 01862	(978) 667-1400	(978) 667-7871
STL Buffalo	10 Hazelwood Drive Amherst, New York 14228	(716) 691-2600	(716) 691-7991
STL Burlington	**55 South Park Drive** **Colchester, VT 05446**	**(802) 655-1203**	**(802) 655-1248**
STL Chicago	2417 Bond Street University Park, IL 60466-3182	(708) 534-5200	(708) 534-5211
STL Corpus Christi	1733 North Padre Island Drive, Corpus Christy, TX 78408	(361) 289-2673 (800) 548-8228	(361) 289-2471
STL Envirotech Edison	777 New Durham Road Edison, NJ 08817	(732) 549-3900	(732) 549-3679
STL Houston	16203 Park Row, Suite 110 Houston, TX 77084	(281) 578-5688	(281) 578-5686
STL Houston	6310 Rothway Houston, TX 77040	(713) 690-4444 (800) 946-4727	(713) 690-5646
STL Monroe	200 Monroe Turnpike Monroe, CT 06468	(203) 261-4458	(203) 268-5346
STL Newburgh	315 Fullerton Avenue Newburgh, NY 12550	(914) 562-0890	(914) 562-0841
STL Pensacola	11 East Olive Road Pensacola, FL 32514	(850) 474-1001	(850) 478-2671
STL Precision	10200 USA Today Way Miramar, FL 33025	(954) 431-4550	(954) 431-1959
STL Savannah Laboratories, Mobile	900 Lakeside Drive Mobile, AL 36693	(334) 666-6633	(334) 666-6696
STL Savannah Laboratories, Savannah	5102 LaRoche Avenue Savannah, GA 31404-6091	(912) 354-7858	(912) 351-3673
STL Savannah Laboratories, Tallahassee	2846 Industrial Plaza Drive Tallahassee, FL 32301	(850) 878-3994	(850) 878-9504
STL Savannah Laboratories, Tampa	6712 Benjamin Road, Suite 100 Tampa, FL 33634	(813) 885-7427	(813) 885-7049
STL Valparaiso	2400 Cumberland Drive Valparaiso, IN 46383	(219) 464-2389 (800) 688-6522	(219) 462-2953
STL Westfield	Westfield Executive Park 53 Southampton Road Westfield, MA 01085	(413) 572-4000	(413) 572-3707
STL Whippany	628 Route 10 Whippany, NJ 07981	(973) 428-8181	(973) 428-5222

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STL Mission Statement

We enable our customers to create safe and environmentally favorable policies and practices, by leading the market in scientific and consultancy services. We provide this support within a customer service framework that sets the standard to which others aspire. This is achieved by people whose professionalism and development is valued as the key to success and through continued investments in science and technology.

1.4. Purpose

The purpose of the Laboratory Quality Manual (LQM) is to describe the STL Quality System and to outline how that system enables all employees of STL to meet the Quality Assurance (QA) policy. The LQM also describes specific QA activities and requirements and prescribes their frequencies. This LQM formally known as the Quality Assurance Program Plan (QAPP) formalizes the quality system that has been established and is in operation for all sample related activities including sample handling, receipt, preparation, analysis and documentation. Roles and responsibilities of management and laboratory staff in support of the Quality System are also defined in the LQM.

1.5. Scope

This LQM applies to all associates of the laboratory. There is a firm commitment from all members of the laboratory to follow a comprehensive LQM. This commitment and dedication to quality is fully supported from the technician chemist to upper management in order to meet the objectives of our analytical laboratory and best serve our clients.

This LQM undergoes an annual review by the QA Manager, the General Manager, the Laboratory Director and the Technical Directors. Revisions to the LQM are distributed throughout the laboratory to replace the out dated copies so that only the most current revision is in use. It is the joint responsibility of the QA manager, the Laboratory Director, the Technical Directors and Laboratory Section Managers to ensure that all associates familiarize themselves with, and comply with, the procedures laid out in this manual and associated documentation.

The policies and practices of quality assurance/quality control presented in this manual and the Corporate Quality Management Plan (QMP) for all STL facilities are set forth as minimums.

STL operates under the regulations and guidelines of the following federal programs:

Air Force Center for Environmental Excellence (AFCEE)
US Army Corp of Engineers, Hazardous, Toxic and Radioactive Waste (USACE HTRW)
Clean Air Act (CAA)
Clean Water Act (CWA)
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
Marine Protection, Research, and Sanctuaries Act (MPRSA)

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Navy Facilities Engineering Service Center (NFESC)
National Pollution, Discharge, and Elimination System (NPDES)
Resource Conservation and Recovery Act (RCRA)
Safe Drinking Water Act (SDWA)

STL also provides services under various state and local municipal guidelines. A current list of analytical methodologies is provided in Appendix A and laboratory Certifications and Accredidations can be found in Appendix B.

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2. References

The following references were used in preparation of this document and as the basis of the STL Quality System:

EPA Requirements For Quality Management Plans, EPA QA/R-2, United States Environmental Protection Agency Management Staff, Washington, DC, Draft Interim Final, August 1994.

EPA Quality Manual for Environmental Programs, 5360, USEPA Office of Research and Development, National Center for Environmental Research and Quality Assurance, Quality Assurance Division, July 1998.

General Requirements for the Competence of Calibration and Testing Laboratories, ISO/IEC Guide 25: 1990.

General Requirements for the Competence of Testing and Calibration Laboratories, ISO/DIS 17025.

Good Automated Laboratory Practices, EPA 2185, 1995.

Quality Assurance Project Plan, HQ Air Force Center for Environmental Excellence, Version 3.0, March 1998.

National Environmental Laboratory Accreditation Conference, Constitution, Bylaws, and Standards, EPA600/R-98/151, USEPA Office of Research and Development, July 1999.

Navy Installation Restoration Laboratory Quality Assurance Guide, Interim Guidance Document, Naval Facilities Engineering Service Center, February 1996.

Shell for Analytical Chemistry Requirements, US Army Corps of Engineers, December 1998.

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3. Terms and Definitions

Accuracy: the degree of agreement between an observed value and an accepted reference value.

Audit: a systematic evaluation to determine the conformance to specifications of an operational function or activity.

Batch: environmental samples, which are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria. An analytical batch is composed of prepared environmental samples, extracts, digestates or concentrates that are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

Chain of Custody (COC): an unbroken trail of accountability that ensures the physical security of samples, data and records.

Clean Air Act: legislation in 42 U.S.C. 7401 et seq., Public Law 91-604, 84 Stat. 1676 Pub. L. 95-95, 91 Stat., 685 and Pub. L. 95-190, 91 Stat., 1399, as amended.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/Superfund): legislation (42 U.S.C. 9601-9675 et seq., as amended by the Superfund Amendments and reauthorization Act of 1986 (SARA), 42 U.S.C. 9601et seq.

Compromised Sample: a sample received in a condition that jeopardizes the integrity of the results. See Section 4.7.1 for a description of these conditions.

Confidential Business Information (CBI): information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products.

Confirmation: verification of the presence of a component using an additional analytical technique. These may include second column confirmation, alternate wavelength, derivatization, mass spectral interpretation, alternative detectors, or additional cleanup procedures.

Corrective Action: action taken to eliminate the causes of an existing non-conformance, defect or other undesirable situation in order to prevent recurrence.

Data Audit: a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

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Equipment Blank: a portion of the final rinse water used after decontamination of field equipment; also referred to as Rinsate Blank and Equipment Rinsate.

Document Control: the act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA): legislation under 7 U.S.C. 135 et seq., as amended.

Federal Water Pollution Control Act (Clean Water Act, CWA): legislation under 33 U.S.C. 1251 et seq., Public Law 92-50086 Stat. 816.

Field Blank: a blank matrix brought to the field and exposed to field environmental conditions.

Good Laboratory Practices (GLP): formal regulations for performing basic laboratory operations outlined in 40 CFR Part 160 and 40 CFR Part 729 and required for activities performed under FIFRA and TSCA.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis and still be considered valid as promulgated in the method.

Instrument Blank: a blank matrix that is the same as the processed sample matrix (i.e. extract, digestate, condensate) and introduced onto the instrument for analysis.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s), processed simultaneously with, and under the same conditions as, samples through all steps of the analytical procedure.

Laboratory Quality Manual (LQM): a document stating the quality policy, quality system and quality practices of the laboratory. The LQM may include by reference other documentation relating to the laboratory's quality system.

Matrix: The substrate of a test sample. For purposes of batch and QC requirements determination, the matrix descriptions in Table 2 are used.

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Table 2 Matrix Descriptions

Matrix	Description
Air	Air samples as analyzed directly or as adsorbed into a solution or absorption matrix and desorbed.
Aqueous	Aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine source. Includes surface water, groundwater and effluents.
Drinking Water	Aqueous sample that has been designated a potable water source.
Saline	Aqueous sample from an ocean or estuary, or other salt-water source such as the Great Salt Lake.
Liquid	Liquid with <15% settleable solids.
Solid	Soil, sediment, sludge or other matrices with $\geq$15% settleable solids.
Waste	A product or by-product of an industrial process that results in a matrix not previously defined.
Tissue	Sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Matrix Duplicate (MD): duplicate aliquot of a sample processed and analyzed independently; under the same laboratory conditions; also referred to as Sample Duplicate.

Matrix Spike (MS): field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a replicate matrix spike.

Method Blank: a blank matrix processed simultaneously with, and under the same conditions as, samples through all steps of the analytical procedure.

Method Detection Limit (MDL): the minimum concentration of a substance (an analyte) that can be measured with 99% confidence that the analyte concentration is greater than zero and determined from analysis of sample in a given matrix containing the analyte. (40 CFR Part 136 Appendix B).

Non-conformance: an indication, judgement, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Precision: the degree to which a set of observations or measurements of the same property, usually obtained under similar conditions, conform to themselves; a data quality indicator.

Preservation: refrigeration and or reagents added at the time of sample collection to maintain the chemical and or biological integrity of the sample.

Proficiency Testing: determination of the laboratory calibration or testing performance by means of inter-laboratory comparisons.

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Proficiency Test (PT) Sample: a sample, the composition of which is unknown to the analyst, that is provided to test whether the analyst/laboratory can produce analytical results within specified performance limits.

Proprietary: belonging to a private person or company.

Storage Blank: a blank matrix stored with field samples of a similar matrix.

Trip Blank: a blank matrix placed in a sealed container at the laboratory that is shipped and held unopened in the field and returned to the laboratory in the shipping container with the field samples.

Quality Assurance (QA): an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.

Quality Assurance (Project) Plan (QAPP): a formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.

Quality Control (QC): the overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users.

Quality Control Sample: an uncontaminated sample matrix spiked with a known amount(s) of an analyte(s) from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

Quality Management Plan (QMP): a formal document describing the management policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an agency, organization or laboratory to ensure the quality of its product and the utility of the product to its users.

Quality System: a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA/QC.

Raw Data: any original information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof and that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments.

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Record Retention: the systematic collection, indexing and storing of documented information under secure conditions.

Reference Standard: a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived.

Resource Conservation and Recovery Act (RCRA): legislation under 42 USC 321 et seq. (1976).

Safe Drinking Water Act (SDWA): legislation under 42 USC 300f et seq. (1974), (Public Law 93-523).

Selectivity: The capability of a method or instrument to respond to a target substance or constituent in the presence of non-target substances.

Sensitivity: the capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.

Spike: a known amount of an analyte added to a blank, sample or sub-sample.

Standard Operating Procedure (SOP): a written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks.

Systems Audit: a thorough, systematic, on-site, qualitative review of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system.

Test Method: defined technical procedure for performing a test.

Toxic Substances Control Act (TSCA): legislation under 15 USC 2601 et seq., (1976).

Traceability: the property of a result of a measurement that can be related to appropriate international or national standards through an unbroken chain of comparisons.

Verification: confirmation by examination and provision of evidence that specified requirements have been met.

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4. Management Requirements

4.1. Organization and Management

4.1.1. Organization

STL Burlington's organizational structure is presented in Figure 1. Corporate employees are located at various STL facilities as outlined in the organizational structure. A QA Manager is designated at each STL facility. The facility QA Manager has an indirect reporting relationship to the Corporate QA Manager. Each facility is under the supervision of a General Manager who reports to the Environmental Chief Operational Officer (COO).

It is the policy of the laboratory that at each management and operational level a designated deputy or deputies are assigned. These deputies maintain continuity of service and other functions in the event of the absence of key staff. The Laboratory Director ensures that all staff are made aware of their respective designated deputies and that they are fully aware of extent and limitations of their responsibility.

The Quality Managers Program within the laboratory is operated independently of the laboratory sections generating data. In this way, objectivity in the evaluation of laboratory operations is obtained. The laboratory structure provides a means for communication from the technician chemist up to the General Manager. This organizational structure facilitate the generation of data, several levels of data review, and the monitoring of the overall quality of the data produced in the laboratory before it is reported to the client. Resumes of key staff, experience and educational profiles for these staff members are available upon request.

4.1.2. Roles and Responsibilities

Each section within the laboratory has specific roles and responsibilities in terms of producing a product of known quality. All laboratory personnel are expected to have a working knowledge of the LQM. A copy of the most recent LQM is available to each laboratory section and quality management training is periodically performed for new laboratory associates. It is expected that associates at every level ensure that data is generated in compliance with this LQM. The responsibilities of certain essential positions are detailed below.

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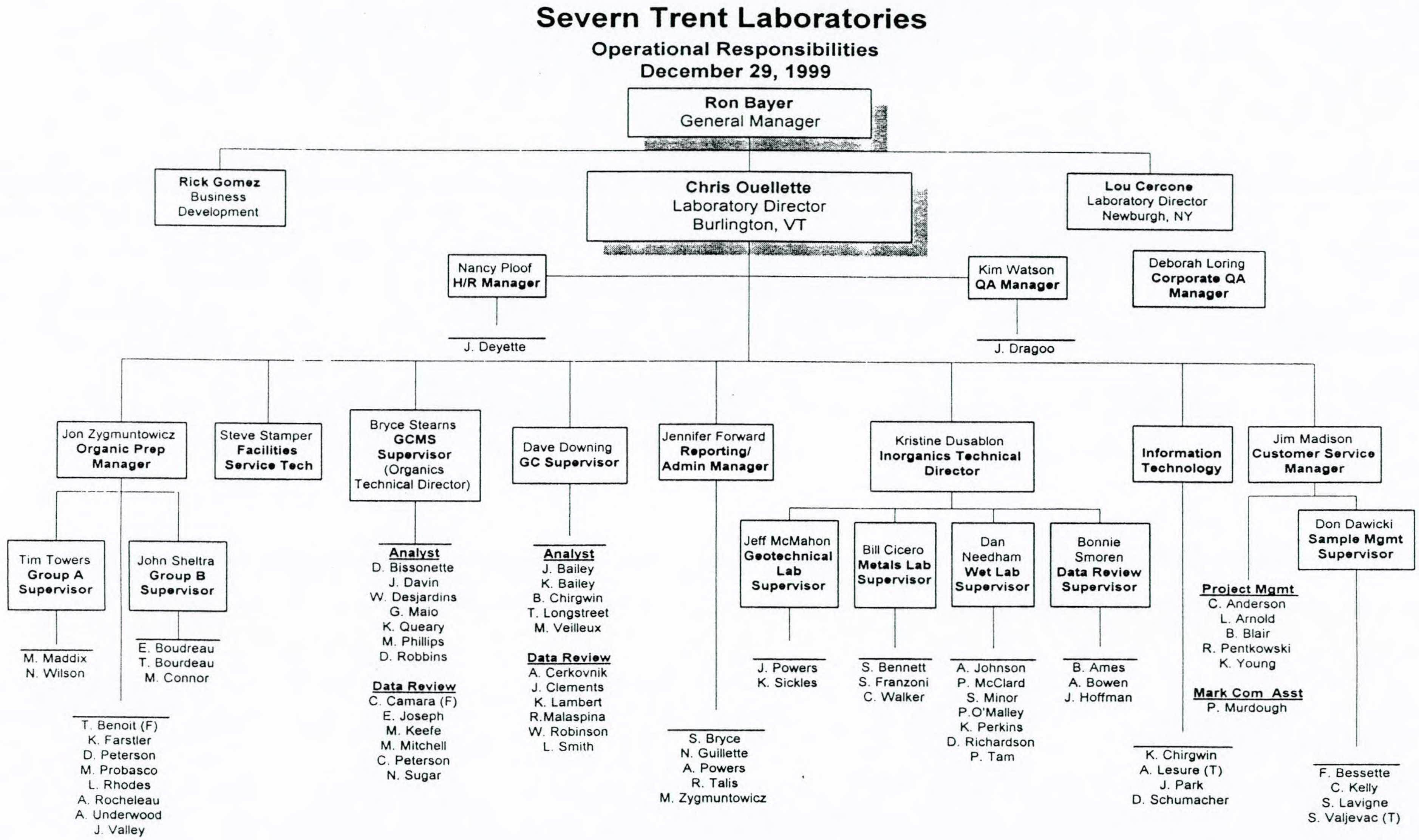
Figure 1 STL – Burlington, VT Organizational Chart



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The ***General Manager*** is directly and ultimately responsible for ensuring data quality and providing operational direction at STL. Responsibilities include:

- Development of policies and general quality assurance strategies in collaboration with the Laboratory Directory and laboratory Section Managers.
- Allocate personnel and resources throughout the laboratory section.
- Long term planning, setting goals, and achieving the financial business, and quality objectives of STL.
- Oversee the efforts of laboratory marketing and sales.
- Review monthly management reports and quality assurance reports.

The ***Laboratory Director*** reports to the General Manager and is responsible for all aspects of laboratory operations to ensure timely completion of all contractual obligations. In conjunction with the Technical Directors, responsibilities include:

- Monitor the progress of sample preparation and analysis.
- Supervision of staff, setting goals and objectives for both the business and the employees, and achieving the financial, business, and quality objectives of the facility.
- Establish the priority of sample analysis in order to meet QA and client deadlines.
- Maintain well-versed technical understanding of analytical methodology for the evaluation of laboratory operations, development of procedural improvements, investigation of non-compliant results and implementation of corrective action.
- Review Standard Operations Procedures and ensure conformance to those procedures.
- Communicate resource needs to management.
- Laboratory results signatory.

The ***QA Manager*** reports directly to the Laboratory Director and indirectly to the General Manager and Corporate QA Manager and is responsible for the preparation, maintenance and implementation of the LQM. Responsibilities include:

- Authority for stopping, accepting or rejecting analytical data, method modifications, QA programs and QC criteria.
- Conduct internal system and data audits to monitor laboratory compliance with the LQM and SOPs.
- Provide assistance in the development of laboratory management documents including SOPs as well as control, revision and distribution thereof.
- Identify areas where corrective action is required and then ensure implementation and completion of the resulting action.
- Oversee laboratory participation in performance evaluation programs and regulatory certification and accreditation programs.
- Act as point of contact regarding QA matters for the laboratory.

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- Laboratory results signatory.

The ***Technical Directors and Deputy Technical Directors*** (in some cases) report directly to the Laboratory Director. They are responsible for the maintenance of accurate SOPs and the enforcement of the LQM. Responsibilities include:

- Execute and supervise analytical procedures according to approved methodology.
- Manage laboratory operations including; work scheduling, sample tracking, prompt reporting of results.
- Perform period secondary review of raw data for accuracy and completeness, check calibrations and calculations and reconcile any non-compliant data.
- Supervision and training of staff, setting goals and objectives for the employees, and achieving the quality objectives of the facility.
- Monitoring the validity of the analyses performed and data generated in the laboratory to assure reliable data.
- Laboratory results signatory.

Project Managers are instrumental in assisting both the laboratory and the client during the course of a project. Responsibilities include:

- Coordination of laboratory services directly with clients.
- Understanding contractual requirements and effectively communicating client needs to laboratory personnel.
- Notification of clients regarding specific non-conformance, changes or difficulties encountered within the laboratory.
- Investigation of problems with samples and shipping containers received from the field.
- Monitoring of analytical work progress.
- Completeness (tertiary) review all reports generated for the project.
- Alternate case narrative signatory.

The ***Laboratory Section Supervisors and/or Group Leaders*** report directly to the Laboratory Section Managers and/or Technical Directors. They are responsible for the daily activities of analyses and maintenance of SOPs within the group. Responsibilities include:

- Supervises the daily activities of analyses, bench level chemists or data review within the group.
- Manage the groups laboratory operations including; work scheduling, sample tracking and prompt reporting of results.
- Perform secondary review of raw data for accuracy and completeness, check calibrations and calculations and reconcile any non-compliant data.
- Accept or reject data based on compliance with established quality control criteria.
- Ensure that all instrumentation and equipment meet performance criteria and

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calibration requirements. Schedules instrument repairs.

- Supervision and training of staff, setting goals and objectives for the employees, and achieving the quality objectives of their section.

At the ***Technician Chemist*** level, laboratory analysts are responsible for the generation of data by analyzing samples according to written SOPs and state regulations. Responsibilities include:

- Maintain a thorough understanding of the LQM and the SOPs associated with their specific function.
- Ensure that all steps related to sample analysis are documented with integrity, completely and accurately.
- Perform initial review of sample preparation information, calculations, qualitative identifications and raw data with the authority to stop, accept or reject data based on compliance with well-defined QC criteria.
- Provide prompt notification to the Section Manager and/or Technical Directors of problems or anomalies detected.
- Monitor and maintain standard laboratory equipment such as refrigerators, ovens, water systems as necessary.

The ***Sample Custodian*** is responsible for the receipt and handling of samples within the laboratory. Responsibilities include:

- Implementation of proper sample acceptance policies, sample receipt procedures and sample preservation.
- Implements, completes and/or reviews external and internal chain-of-custody, as appropriate.
- Communicates and records anomalies associated with condition upon receipt of samples to the Project Manager.
- Assigns a laboratory identification number to a sample and logs the sample into the Laboratory Information Management System (LIMS).
- Secures sample storage and preservation.
- Assists the Hazardous Waste Coordinator with sample disposal.
- Reviews storage monitoring records.

Reporting and Document Control Staff is responsible for compiling and achieving data results and analytical reports. Responsibilities include:

- Compiles analytical reports and provides data package and electronic data deliverables (EDD) according to the client request.
- Ensures that all aspects of data deliverable production, organization, contract compliance screening, archival storage, packaging and data delivery operations are performed according to the client requirements.

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The ***Information Technology Department*** is responsible for the design and maintenance of the laboratory's computer hardware and software. Responsibilities include:

- Responsible for preparation, maintenance and implementation of the Information Systems Quality Manual.
- Implementation and validation of new data systems.
- Network Administration.
- Hardware and software maintenance.
- E-mail Administration.
- Provide support and training to all computer users
- Review and implementation of all Client specific EDDs.

4.2. Quality System

4.2.1. Objectives of STL Quality System

The goal of the STL Quality System is to ensure that business operations are conducted with the highest standards of professionalism in the industry.

To achieve this goal, it is necessary to provide STL clients with not only scientifically sound, well documented, and regulatory compliant data, but also to ensure that STL provides the highest quality service available in the industry. A well-structured and well-communicated Quality System is essential in meeting this goal. STL's Quality System is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

The Corporate Quality Management Plan (QMP) is the basis and outline for STL's Corporate Quality System and contains general guidelines under which all STL facilities conduct their operations.

4.2.2. Laboratory Quality Manual (LQM)

The LQM further describes the specific QA program at the laboratory.

The following elements are addressed in STL Burlington facility's LQM:

1. Table of Contents, lists of tables, figures and appendices.
2. Quality policy statement, including objectives and commitments, by facility management.
3. Organization and management structure of the laboratory, its place in the STL organization and relevant organizational charts.
4. Relationship between management, technical operations, support services and the quality system.
5. Record retention procedure.

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6. Document control procedure.
7. Job descriptions of essential staff and reference to job descriptions of other staff.
8. Identification of the laboratory's approved signatories.
9. Procedure for achieving traceability of measurements.
10. List of test methods under which the laboratory performs its testing.
11. Procedure for reviewing new work.
12. Reference to the calibration and/or verification test procedures used.
13. Sample handling procedure.
14. Reference to the major equipment, reference standards, facilities and services used by the laboratory in conducting tests.
15. Reference to procedures for calibration, verification and maintenance of equipment.
16. Reference to verification practices including inter-laboratory comparisons, proficiency testing programs, use of reference materials and internal QC practices.
17. Procedures for feedback and corrective action when testing discrepancies are detected, or departures from policies and procedures occur.
18. Procedure for exceptionally permitting departures from documented policies and procedures or from standard specifications.
19. Procedure for dealing with client complaints.
20. Procedure for protecting client confidentiality and proprietary rights.
21. Procedure for audits and data review.
22. Procedure for establishing that personnel are adequately experienced and trained.
23. Reference to procedures for reporting analytical results.

4.3. Document Control

4.3.1. Document Type

The following documents, at a minimum, are controlled at STL:

- Laboratory Quality Manual
- Standard Operating Procedures (SOP)
- Quality Management Plan
- Safety and Health Management Program

4.3.2. Document Control Procedure

Security and control of documents are necessary to ensure that confidential information is not distributed and that all current copies of a given document are from the latest applicable revision. Unambiguous identification of a controlled document is maintained by identification of the following items in the document header: Document Name, Document Number (if applicable), Revision Number, Effective Date, Number of Pages. Controlled documents are authorized by Management and/or the QA Department. Controlled documents are marked as such and records of their distribution are kept by the QA Department.

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Controlled documents are controlled by the QA Department. A controlled copy number and the following red colored marking identify controlled copies of documents.

CONTROLLED DOCUMENT
Copy No.________________
DO NOT DUPLICATE
If this stamp is not colored red.
This is not a controlled copy.

As approved revisions to controlled documents are prepared and distributed, outdated versions are removed from the laboratory and destroyed. The original copy of each revision is archived by the QA Department for reference purposes. All documents distributed internally are controlled in this manner. Documents distributed externally (to clients, etc.) are controlled on a case by case basis. The laboratory SOP titled *Document Control* provides detailed procedures to laboratory associates on the essential elements of document control.

4.3.3. Document Revision

Changes to documents occur when a procedural change warrants a revision of the document. When an approved revision of a controlled document is ready for distribution, obsolete copies of the document are replaced with the current version of the document. The previous revision of the controlled document is archived by the QA Department.

4.4. Request, Tender, and Contract Review

4.4.1. Contract Review

For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is STL's intent to provide both standard and customized environ-mental laboratory services to our clients. To ensure project success, technical staff performs a thorough review of technical and QC requirements contained in contracts. Contracts are reviewed for adequately defined requirements and STL's capability to meet those requirements.

All contracts entered into by STL are reviewed and approved by the appropriate personnel at the facility or facilities performing the work. Any contract requirement or amendment to a contract communicated to STL verbally is documented and confirmed with the client in writing. Any discrepancy between the client's requirements and STL's capability to meet those requirements is resolved in writing before acceptance of the contract. Contract amendments, initiated by the client and/or STL, are documented in writing for the benefit of both the client and STL.

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All contracts, Quality Assurance Project Plans (QAPPs), Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the permanent project record as defined in Section 4.12.1.

A thorough review of the scope of services is conducted before the laboratory performs additional work within its scope or to expand its scope of testing. The General Manager or his designee, with input from the Laboratory Director and the Laboratory Section Managers, considers available resources and both current and pending workload prior to accepting new work.

For the laboratory to expand its scope of testing the same considerations must be given, as well as evaluation of the feasibility of and time frame for method development and proficiency demonstration. The availability of and requirements for certification are considered. Laboratory management including the General Manager, Laboratory Director, QA Department, Project Managers and Section Managers will consider all above factors with the ultimate decision being that of the General Manager and the Laboratory Director. If the laboratory determines it has the ability and desire to perform the work, a plan for implementation is prepared. This would include but not be limited to: acquiring necessary equipment, reagents and/or standards, training analyst, writing appropriate SOPs and performing method detection limit studies (MDL).

4.4.2. Project Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, STL assigns a Project Manager (PM) to each client. The PM is the first point of contact for the client. It is the PM's responsibility to ensure that project specific technical and QC requirements are effectively communicated to the laboratory personnel before and during the project.

STL has established procedures in order to ensure that communication is inclusive and effective. These include project memos, designation and meetings of project teams, and start-up meetings between the laboratory staff and the client. STL has found it very effective to invite the client into this process. STL strongly encourages our clients to visit the laboratories and hold formal or informal sessions with employees in order to effectively communicate client needs on an ongoing basis, as well as project specific details for customized testing programs.

Data Quality Objectives

The data quality objectives discussed below ensure that data is gathered and presented in accordance with procedures appropriate for its intended use and that the data is of known and documented quality able to withstand scientific and legal scrutiny. The quality of the

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measurement data is defined in terms of precision, accuracy, representativeness, completeness, comparability, and traceability.

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of same process under similar conditions. Total precision is the measurement of the variability associated with the entire sampling analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Duplicate samples and matrix duplicate spiked samples are analyzed to assess field and analytical precision, and the precision measurement is determined using the relative percent difference (RPD) between the duplicate sample results.

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into a LCS to a control limit. For volatile and semivolatile organic compounds, surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed.

Representativeness is defined as the degree to which a single measurement is indicative of characteristics of a larger sample or area. More specifically, it is the degree to which the data gathered by the project accurately and precisely represents the actual field conditions. The laboratory makes every effort to ensure a representative aliquot is removed from the sample container. Homogenization of the sample is carried out when appropriate.

Completeness is defined as the percentage of measurements that are judged to be valid measurements. Factors negatively affecting completeness include the following: sample leakage or breakage in transit or during handling, missing specified holding times, losing sample during laboratory analysis through accident or improper handling, improper documentation such that traceability is compromised, or rejection of sample result due to failure to conform to QC criteria specifications. A completeness objective of a least 90% of the data specified by the statement of work is the goal established for most projects.

Comparability of results between current and past sampling events, and between analytical sequences of a method is achieved through Quality Assurance Project Plans (QAPP), controlled SOPs and experienced, well trained analysts.

Traceability is the extent to which reported analytical results can be substantiated by supporting documentation. Traceability documentation exists in two essential forms: those, which link the quantitation process to authoritative standards, and those, which

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explicitly describe the history of each sample from collection to analysis and disposal. The traceability goal for the laboratory is one hundred percent (100%).

4.5. Subcontracting

STL Burlington does not routinely subcontract analytical services with the exception of dioxin, asbestos, biological analyses, mammalian tissue sample preparation and radiological analyses. Subcontracting is arranged with the documented consent of the client, in a timely response, which shall not be unreasonably refused. All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. The laboratory SOP titled *Subcontracting Analyses* provides approved detailed procedures to laboratory associates. Proof of required certifications from the subcontract facility are maintained in STL project records. Where applicable, specific QC guidelines, QAPPs, and/or SAPs are transmitted to the subcontract laboratory. Samples are subcontracted under formal Chain of Custody (COC).

Subcontract laboratories may receive an on-site audit by a representative of STL's QA staff if it is deemed appropriate by the QA Manager. The audit involves a measure of compliance with the required test method, QC requirements, as well as any special client requirements.

Project reports from external subcontract laboratories are not altered and are included in original form in the final project report provided by STL.

Subcontracting may also occur between STL facilities. Subcontracting within STL is subject to the same requirements as detailed above.

4.6. Purchasing Services and Supplies

Evaluation and selection of suppliers and vendors is done, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, all purchases from specific vendors are approved by a member of the supervisory or management staff.

Chemical reagents, solvents, gases, glassware and general supplies are ordered as needed to maintain sufficient quantities on hand. Purchasing guidelines for all equipment and reagents effecting data quality are well defined and documented. Similarly, performance specifications are documented for all items of equipment having an effect on data quality. Any item critical to the analysis, such as an instrument or reagent, received and accepted by the organization is documented. This includes type, age, and acceptance status of the item. Reagents are dated upon receipt and upon opening to establish their order of use and to minimize the possibility of

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exceeding their shelf life. The SOP for *Bulk Chemical and Standard Receipt, Tracking and Labeling* describes the laboratory's procedures and policies for receipt, tracking, and labeling of all bulk chemicals and standards at the laboratory.

Requests for equipment affecting the quality of analytical data are submitted in writing to the Section Managers or Laboratory Director for technical approval. After approval, the requisition is submitted to the Administrative Section Manager for purchase approval.

4.7. Service to the Client

Sample representativeness and integrity are the foundations upon which meaningful analytical results rely. A documented and approved sampling plan reflecting data quality objectives should be in place at the sampling site. The integrity of the sample should be maintained through the use of preservation techniques specified in the relevant protocols. Samples should be submitted to the laboratory under standard COC procedures.

4.7.1. Sample Acceptance Policy

Samples are considered "compromised" if the following conditions are observed upon sample receipt:

- Cooler and/or samples are received outside of temperature specification.
- Samples are received broken or leaking.
- Samples are received beyond holding time.
- Samples are received without appropriate preservative.
- Samples are received in inappropriate containers.
- COC does not match samples received.
- COC is not properly completed or not received.
- Breakage of any Custody Seal.
- Apparent tampering with cooler and/or samples.
- Headspace in volatiles samples.
- Seepage of extraneous water or materials into samples.
- Inadequate sample volume.
- Illegible, impermanent, or non-unique sample labeling.

When "compromised" samples are received, it is documented in the project records and the client is contacted for instructions. If the client decides to proceed with analysis, the project report will clearly indicate any of the above conditions and the resolution.

4.7.2. Client Confidentiality and Proprietary Rights

Data and sample materials provided by the client or at the client's request, and the results obtained by STL, shall be held in confidence (unless such information is generally available to the public or is in the public domain or client has failed to pay STL for all services rendered or is otherwise in breach of the terms and conditions set forth in the STL and client contract) subject to any disclosure required by law or legal process. STL's reports, and the data and information provided therein, are for the exclusive use and benefit of client, and are not released to a third party without written consent from the client.

4.8. Complaints

Client complaints are documented, communicated to management, and addressed promptly and thoroughly. Client complaints are documented by the employee receiving the complaint. The documentation can take the form of a corrective action report (as described in Section 4.10) or in a format specifically designed for that purpose. The laboratory SOP titled *Handling Complaints* provides approved detailed procedures to laboratory associates. The Laboratory Director, PM, Customer Service Manager, and QA Manager are informed of all client complaints, and assist in resolving the complaint.

The nature of the complaint is identified, documented, and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA department is required to conduct a special audit to assist in resolving the issue. A written confirmation, or letter to the client, outlining the issue and response taken is strongly recommended as part of the overall action taken.

The number and nature of client complaints is reported to the Corporate QA Manager in the QA Monthly report submitted by each facility. The overall number of complaints received per facility is tracked and the appropriateness of the response to client complaints is assessed. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Management Systems Review.

4.9. Control of Non-conformances

Non-conformances include any out of control occurrence. Non-conformances may relate to client specific requirements, procedural requirements, or equipment issues. All non-conformances in the laboratory are documented at the time of their occurrence.

All non-conformances that affect a sample and/or sample data become part of the affected project's permanent record. When appropriate, reanalysis is performed where QC data falls outside of specifications, or where data appears anomalous. If the reanalysis comes back within established tolerances, the results are approved. If the reanalysis is still outside tolerances, further reanalysis or consultation with the Client, Supervisor, Manager, PM, Laboratory Director, or QA Manager for direction may be required. All records of reanalysis are kept with the project files.

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Where non-conformances specifically affect a client's sample and/or data, the client is informed and action must be taken. Action can take the form of reporting and flagging the data, and including the non-conformance in the project narrative or cover letter.

4.10. Corrective Action

4.10.1. General

A nonconformance is typically defined as an unplanned deviation from an established protocol. An occurrence of a nonconformance may be the result of STL's actions, which would be rendered as a deficiency, or the result of events beyond STL's control, which would be termed an anomaly. All nonconformances are documented.

Deviations from the LQM or SOPs , deficiencies, errors, or out-of-control situations require corrective action. Documentation of the problem, identification of the cause and follow-up action to prevent recurrence is accomplished using a Corrective Action/Exception Report form. A copy of this form is presented in Figure 2.

4.10.2. Initiation

Any employee who detects the need for corrective action is responsible for and is authorized to initiate a corrective action. The initial source of corrective action can also be external to STL (i.e. corrective action because of client complaint, regulatory audit, or proficiency test). When a problem that requires corrective action is identified, the following items are identified by the initiator on the corrective action report: the nature of the problem, the name of the initiator, and the date. If the problem affects a specific client project, the name of the client and laboratory project number is recorded, and the PM is informed immediately.

4.10.3. Cause analysis

The corrective action process must be embarked upon as a joint, problem solving, constructive effort. Identification of systematic errors, or errors that are likely to occur repetitively due to a defect or weakness in a system, is particularly valuable in maintaining an environment of continuous improvement in laboratory operations.

When a corrective action report is initiated, the initiator works with the affected employee(s) and/or department(s) to identify the root cause of the problem. An essential part of the corrective action process is to identify whether the problem occurred due to a systematic or isolated error.

If the initiator of the corrective action report is uncertain as to what would constitute appropriate corrective action or is unable to resolve the situation, the problem is

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identified to the Supervisor, Manager, Laboratory Director or the QA Manager who provides assistance in the corrective action process.

The root cause of the problem and associated cause analysis is documented on the corrective action form.

4.10.4. Corrective Action

Once the root cause of a problem is identified, the initiator and affected employee(s) and/or department(s) examine potential actions that will rectify the present problem to the extent possible, and prevent recurrence of future, similar occurrences. An appropriate corrective action is then recommended. The corrective action must be appropriate for the size, and nature of the issue.

If the corrective action concerns a specific project related issue, the PM or Customer Service Manager approves the corrective action before its implementation.

Implementation of the corrective action and the date of implementation are documented on the corrective action report.

Copies of the corrective action form are given to the appropriate department(s) and, if related to a specific project report, included in the project file. An essential part of the corrective action process is communication and awareness of the problem, the cause, and the action taken to prevent future occurrences and/or rectify the immediate problem.

4.10.5. Monitoring Corrective Action

All corrective action reports are forwarded to the QA Department. The QA department reviews and electronically tracks all corrective actions. A corrective action report summarizing all corrective action by departments are routinely provided to the department heads. The QA department selects one or more of the more significant corrective actions for inclusion in the annual systems audit. The QA Department also may implement a special audit. The purpose of inclusion of the corrective action process in both routine and special audits is to monitor the implementation of the corrective action and to determine whether the action taken has been effective in overcoming the issue identified.

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Figure 2 Corrective Action/Exception Report

Severn Trent Laboratories – VT
Corrective Action/Exception Report

Fraction:__________________ **Client:**_______________________
Date:______________________ **SDG:**_______________________
Initiated By:_______________ **ETR:**_______________________
Project Manager:________________________ (signature required)
Org./Inorg. Laboratory Manager:__________ (signature required for holding time violations)

☐ RE-PREP ☐ HT VIOLATION ☐ CLIENT CONCERN
☐ GEN CORRECTIVE ACTION ☐ DATA QC ISSUE

SUMMARY OF PROBLEM:

RESOLUTION, RECOMMENDED ACTION OR EXPLANATION:

SUMMARY OF INVESTIGATION AND FINDINGS:
(Include a summary of conclusions based upon results)

CORRECTIVE ACTION REQUIRED? ☐ YES ☐ NO
Description of Corrective Action:

Date implemented:______________________________ Initials:____________

QA USE ONLY	FOLLOW-UP

Date:___________________________ Follow-up by:________________________________

Original (Pink): QA Copies: Data Package Prep (if Re-prep only)

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4.11. Preventative Action

Preventative action is defined as noting and correcting a problem before it happens, because of a weakness in a system, method, or procedure. Preventative action includes analysis of the Quality System to detect, analyze, and eliminate potential causes of non-conformances. When potential problems are identified, preventative action is initiated to effectively address the problem to eliminate or reduce the risk identified. The preventative action process takes the same format as the corrective action process

In order to prevent system down time, minimize corrective maintenance costs and ensure data validity, the laboratory employs a system of preventive maintenance. General preventive maintenance procedures, many of which are unique to particular instruments are outlined in each instruments' operation manual. All routine maintenance is performed as recommended by the manufacturer. The manuals also assist in the identification of commonly needed replacement parts, so that an inventory of these parts can be maintained at the laboratory. It is the Section Manager's responsibility to make sure that the most current version of the operator manual is available in the laboratory. Routine maintenance is performed by the analyst while an external technician may be called in for major repairs. In addition, an in-house instrument specialist who has received training for repair of all major pieces of laboratory equipment is available.

A bound maintenance and repair log notebook is kept with each instrument to record all routine and non-routine maintenance. Notation of the data and maintenance activity is recorded every time service procedures are performed. This includes routine service checks by laboratory personnel as well as factory service calls. The return to analytical control following instrument repair is also noted in laboratory maintenance logbooks.

4.12. Records

4.12.1. Record Types

Record types described in Table 3.

Table 3 STL Record Types

Raw Data	Controlled Documents	QC Records	Project Records	Administrative Records
Calibration	LQM	Audits/ Responses	COC Documentation	Accounting
Computer Tapes/Disks	QMP	Certifications	Contracts and Amendments	EH&S Manual, Permits, Disposal Records
QC Samples	SOPs	Corrective Action	Correspondence	Employee Handbook
Sample data		Logbooks*	QAPP	OSHA 29 CFR Part 1910

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Raw Data	Controlled Documents	QC Records	Project Records	Administrative Records
Software (Version control)		Method & Software Validation, Verification	SAP	Personnel files, Employee Signature & Initials, Training Records
		Standards Certificates	Telephone Logbooks	Technical and Administrative Policies

*Logbooks: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature,

4.12.2. Record Retention

Table 4 outlines STL's standard record retention time. For raw data and project records, record retention is calculated from the date the project report is issued. For other records, such as Controlled Documents, QC, or Administrative Records, the retention time is calculated from the date the document is formally retired. Records related to the programs listed in Table 5 have lengthier retention requirements and are not subject to STL's standard record retention time.

Table 4 STL Record Retention

Record Type		Archival Requirement
Raw Data	All*	5 Years from project completion
Controlled Documents	All*	5 Years from document retirement date
QC	All*	5 Years from archival
Project	All*	5 Years from project completion
Administrative	Personnel/Training	7 years
Accounting	All*	See Accounting and Control Procedures Manual

* Exceptions listed in Table 5.

4.12.3. Programs with Longer Retention Requirements

Specific client projects and regulatory programs have longer record retention requirements than the STL standard record retention time. In these cases, the longer retention requirement is noted in the archive. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Programs with record retention requirements greater than five years are detailed in Table 5.

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Table 5 Special Record Retention Requirements

Program	Retention Requirement
Colorado – Drinking Water	10 years
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Minnesota – Drinking Water	10 years
Navy Facilities Engineering Service Center (NFESC)	10 years
NY Potable Water NYCRR Part 55-2	10 years
OSHA - 40 CFR Part 1910	30 years
Pennsylvania – Drinking Water	10 years
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement

4.12.4. Archives and Record Transfer

Archives are indexed such that records are accessible on either a project or temporal basis. Archives are protected against fire, theft, loss, deterioration, and vermin. Electronic records are protected from deterioration caused by magnetic fields and/or electronic deterioration. Access to archives is controlled and documented.

STL ensures that all records are maintained as required by the regulatory guidelines and per the QMP upon facility location change or ownership transfer. Upon STL facility location change, all archives are retained by STL in accordance with the QMP. Upon ownership transfer, record retention requirements are addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established.

4.13. Internal Audits

4.13.1. Audit Types and Frequency

There are several different types of audits performed at STL. Audit type and frequency are categorized in Table 6.

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Table 6 Audit Types and Frequency

Audit Type	Performed by	Frequency
Systems	QA Department	Annual
Data	QA Department	5% of all projects
Special	QA Department or Designee	As Needed

4.13.2. Systems Audits

Facility systems audits are technical in nature and are conducted on an ongoing basis by the QA Manager or his/her designee. Systems audits cover all departments of the laboratory, both operational and support.

The audit report is issued by the QA Manager of the facility within 21 calendar days of the audit. The audit report includes the following elements: Introduction, Scope of Audit, Type of Audit, Improvements and Innovations, Deficiencies, and a timeframe within which the audit must be addressed. The audit report is addressed to the Department Supervisor and/or Manager, and copied to the General Manager and Laboratory Director.

Written audit responses are required within 21 calendar days of audit report issue. The audit response follows the format of the audit report, and corrective actions and time frames for their implementation are included for each deficiency. The audit response is directed to all individuals copied on the audit report. Where a corrective action requires longer than 21 days to complete, the target date for the corrective action implementation is stated and evidence of the corrective action is submitted to the QA Department in the agreed upon time frame.

4.13.3. Data Audits

Data audits are focussed to assess the level of method compliance, regulatory compliance, accuracy and completeness of test results and reports, documentation, and adherence to established QC criteria, laboratory SOPs, technical policy, and project specific QC criteria.

A data auditing frequency target of 5% has been established. The QA Department provides feedback and/or corrections and revisions to project reports where necessary. Data audits include spot-checking of manual integrations by QA personnel in order to determine that the manual integration is appropriate and documented according to Section 5.3.6.

Records of the data audits are kept, and the frequency of data audits is included in the monthly QA report. In performing data audits, it is essential that data be assessed in terms of differentiating between systematic and isolated errors. Upon noting anomalous data or occurrences in the data audits, the QA Department is responsible for seeking

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clarification from the appropriate personnel, ascertaining whether the error is systematic or an isolated error, and overseeing correction and/or revision of the project report if necessary. Errors found in client project reports are revised and the revision sent to the client. The QA Department is also responsible for assisting in the corrective action process where a data audit leads to identification of the need for permanent corrective action.

Where specific clients and regulatory programs require more frequent data auditing, the individual facility meets the data auditing frequency for that program.

4.13.4. Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, proficiency testing results, data audits, systems audits, validation comments, or regulatory audits. Special audits are focussed on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

4.13.5. External Audits

STL facilities are routinely audited by clients and external regulatory authorities. STL is available for these audits and makes every effort to provide the auditors with the personnel, documentation, and assistance required by the auditors. STL recommends that the audits be scheduled with the QA Department so that all necessary personnel are available on the day of the audit.

4.14. Management Reviews

4.14.1. QA Reports to Management

A monthly QA report is prepared by the QA Manager and forwarded to the Laboratory Director, the GM, and the Corporate QA Manager. The reports include statistical results that are used to assess the effectiveness of the Quality System. The format of the monthly report is shown in Figure 3.

A Corporate QA Monthly Report containing a compilation of the Facility QA reports statistics, information on progress of the Corporate QA program, and a narrative outlining significant occurrences and/or concerns is prepared by the Corporate QA Manager and forwarded to the COO.

4.14.2. Management Systems Review

A management systems review of each facility is performed at least annually by the QA Manager or his/her designee. The management systems review ensures that the

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laboratory's quality system is adequate to satisfy the laboratory's policies and practices, government requirements, certification, accreditation, approval requirements, and client expectations. Management systems reviews are accomplished through monthly quality assurance reporting, goal setting and an annual LQM review and revision.

Figure 3 Monthly QA Report Format

1. **Audits**
   Internal systems audits performed.
   External systems audits performed.
   Data audits performed (in percent).

2. **Revised Reports/Client Complaints**
   Revised reports in percent.
   Total number of client complaints, reason, and resolution.

3. **Certifications/Parameters Changes**

4. **Proficiency Testing**
   Score for each PT as a percent.
   Note repeat failures and/or significant problems.

5. **Miscellaneous QA and Operational Issues**
   Narrative outlining improvements, regulatory compliance issues, general concerns, and assistance required from Corporate QA. Include corrective actions and/or audit follow through that are beyond completion date.

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5. Technical Requirements

5.1. Personnel

5.1.1. General

- STL management believes that its highly qualified and professional staff is the single most important aspect in assuring the highest level of data quality service in the industry.

STL staff consists of over sixty professionals and support personnel that include the following positions:

- General Manager
- Customer Service Manager
- Quality Assurance Manager
- Laboratory Director
- Technical Directors
- Department Supervisor
- Information Technology Manager
- Human Resources Manager
- Project Manager
- Department Manager
- Analyst
- Sample Custodian
- Technician Chemist
- Facilities Technician
- Quality Assurance Specialist
- Data Review Specialist
- Information Technology Specialist

In order to ensure that employees have sufficient education and experience to perform a particular task, job descriptions are developed for all personnel.

5.1.2. Training

STL is committed to furthering the professional and technical development of employees at all levels. Personnel training procedures begin with an established orientation program designed to familiarize the new associate with safety and chemical hygiene issues, the importance of quality assurance/quality control in the analytical laboratory, and company

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policies and benefits. The basic elements of the orientation and training program are outlined in *the Employee Orientation and Training at the STL VT* SOP.

The level of training necessary to perform analytical tasks is determined from employees academic background and past experience, technical courses, and on the job training with specific methods or instrumentation. The responsibility for formal academic lies foremost with the individual. The responsibility for the additional specialized skills obtained through in-house training or external workshops is a shared obligation of the individual, their supervisor, and the laboratory. An individual's academic and profession experience is kept on file including an initial statement of qualifications or resume and any additional documentation concerning subsequent training. Copies of certificates of completion, transcripts, diplomas, or other documentation are included in the training files as appropriate.

New associates for all departments undergo the same orientation procedure. In addition, personnel are required to watch a series of lecture tapes covering basic laboratory functions. New associates complete the viewing of these tapes within their first 30 days of employment. The basic training functions covered by the fourteen lecture tapes include:

* Weighing
* Pipetting
* Safety Practices
* pH Measurement
** Hazard Communication-Employee Right to know
* Titration
* Understanding Data
* Filtration
* How to read MSDS
* Use of Syringes
* Glassware Use/Practices
* Math and the Metric System
* Use of General Lab Equip.
* Mixing & Sampling

In order to ensure that the policies and objectives of this LQM are communicated to all new personnel, all associates are required to read this LQM during the training process. This training is documented on the Record of Individual Training form and included in the training files of each associate.. A copy of this form is presented in figure 4. Training records are available for inspection from the QA department.

Trainees are under the supervision of experienced analysts who are responsible for showing them the analytical procedures including applicable QA/QC measures. A new analyst is not permitted to perform an analysis until their supervisor is confident that the analytical and QA/QC procedures can be carried out correctly and method proficiency is documented.

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Figure 4 Record of Individual Training

STL RECORD OF INDIVIDUAL TRAINING

Week Ending:

Individual employees are to submit this form with their weekly time cards to substantiate all hours charged to project 9X903 (Training and Education) or 9X920-1 (Safety Training). Copies of all certificates, diplomas, transcripts, or other documentation should be attached.

Employee Name (Print)

Project #

**THE ABOVE NAME PERFORMED
TRAINING OR INSTRUCTION ON THE DATES AND FOR THE HOURS INDICATED**

Date	Hours	NATURE OF TRAINING OR INSTRUCTION	Code

I hereby certify that I have completed and understand the training listed above.

Employee Signature – Date

Trainer or Supervisor Signature – Date

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STL has a fundamental responsibility to provide facilities, equipment, maintenance, and an organized program to make necessary improvements to ensure a safe working environment. Unless associates fulfill their responsibilities for laboratory safety, the safety-related features of the facility and established safety programs will be ineffective. The laboratory Safety and Health Management Program provides a complete discussion of the safety policies enforced by the laboratory. A copy of the manual is distributed to each associate during his or her orientation training session. Updates are distributed by the Safety Committee to each associate as they occur.

Minimum training requirements for STL employees are outlined in Table 7.

Table 7 STL Employee Minimum Training Requirements

Required Training	Time Frame*	Employee Type
Environmental Health & Safety	Month 1	All
Basic Analytical Skills	Month 1	Technical
Quality Assurance	Quarter 1	All
Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

*From date of initial employment unless otherwise indicated.

Technical training is accomplished within each laboratory by management to ensure method comprehension. All new personnel are required to demonstrate competency in performing a particular method by successfully completing an Demonstration of Capability (DOC) before conducting analysis independently on client samples.

DOCs are performed by analysis of four replicate QC check samples. Results of successive LCS analyses can be used to fulfill the DOC requirement. The accuracy and precision, measured as average recovery and standard deviation (using n-1 as the population), of the 4 replicate results are calculated and compared to those in the test method (where available). If the test method does not include accuracy and precision requirements, the results are compared to target criteria set by the laboratory. The laboratory sets the target criteria such that they reflect the data quality objectives of the specific test method or project data quality objectives. A DOC Certification Statement is recorded and maintained in the employee's training file. Figure 5 shows an example of a DOC Certification Statement.

On-Going Training

STL has a firm commitment to make sure that all analyst remain proficient in the tests that they perform. . Documentation of continued proficiency is recorded in each analyst's training file for each method they perform. Continued performance is documented annually by one of the following:

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- The acceptable performance of a double blind sample;
- Successful analysis of a blind performance sample on a similar test method using the same technology requiring documentation for only one of the test methods;
- at least four consecutive LCSs with acceptable levels of precision and accuracy;
- Analysis of an authentic samples that have been analyzed by another trained analyst with statistically distinguishable results.

Additionally, SOPs are reviewed annually and analysts are required to read the latest version of the SOP. Performance evaluations (both single and double blind are routinely analyzed by the laboratory and performance on these proficiency tests is tracked and recorded analyst's training files.

Figure 5 Demonstration of Capability Certification Statement

Demonstration of Capability
Certification Statement

Date:
Laboratory Name:
Laboratory Address:
Analyst Name:

Matrix:
Method:

We the undersigned certify that:

1. The analyst identified above, using the cited test method, which is in use at this facility for the analysis of samples under the National Environmental Laboratory Accreditation Program, has met the Demonstration of Capability.
2. The test method was performed by the analyst identified on this certification.
3. Copies of the test method and SOP are available for all personnel on site.
4. The data associated with the DOC are true, complete and representative.
5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is available for review by authorized inspectors.

Laboratory Manager/Supervisor — Signature — Date

5.1.3. Ethics Policy

Establishing and maintaining a high ethical standard is an important element of a Quality System. In order to ensure that all personnel understand the importance the company places on maintaining high ethical standards at all times; STL has established an Ethics Agreement (Figure 6). Each employee signs the Ethics Agreement, signifying agreed compliance with its stated purpose.

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Ethics is also a major component of the STL QA training program. Each employee is trained in ethics within three months of hire in a standardized QA training program that includes review of the ethics statement, and group discussions about data integrity and data misrepresentation. Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. A data integrity hotline is maintained by STL and administered by the Corporate QA Manager.

Figure 6 STL Ethics Agreement

It is the policy of STL to incorporate the highest standard of quality with all analytical programs by adhering to the following practices:

STL will only offer environmental analyses for which it can consistently demonstrate compliance with high quality, traceable and legally defensible performance standards.
All STL staff is committed to the practice of complete honesty in the production and reporting of data.
Staff who are aware of misrepresentation of facts or data manipulation to bypass established QA/QC requirements, are required to immediately inform their supervisor or any member of the upper management.

All employees are asked to sign a copy of the statement below upon their first day of employment.

I, _____________________(print name) understand that high standards of integrity are required of me with regard to the duties I perform and the data I report in connection with my employment at the Company. I agree that in the performance of my duties at the Company:
I will not intentionally report data values that are not the actual values obtained;
I will not intentionally report the dates, times, sample or QC identifications, or method citations of data analyses that are not the actual dates, times, sample or QC identifications, or method citations;
I will not intentionally misrepresent another individual's work; and
If a supervisor or a member of STL management requests me to engage in or perform an activity that I feel is compromising data validity or quality, I will not comply with the request and report this action immediately to a member of the upper management, up to and including the president of Severn Trent Laboratories Inc.
I will not intentionally report data values that do not meet established quality control criteria as set forth in the Method and/or Standard Operation Procedures, or as defined by Company Policy.

I agree to inform my Supervisor of any accidental reporting of non-authentic data by me in a timely manner. I agree to inform my Supervisor of any accidental or intentional reporting of non-authentic data by other employees. I have read this Ethics Agreement and understand that failure to comply with the conditions stated above will result in disciplinary action, up to and including termination from the Company.

Compliance with this policy of business ethics and conduct is the responsibility of every STL employee. Disregard or failing to comply with this standard of business ethics and conduct could lead to disciplinary action, up to and including possible termination of employment.

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5.2. Facilities

Approximately 36,000 square feet of floor space are utilized for analytical work and support staff. The laboratory is compliant with current Vermont Occupational Safety and Health Administration regulations and are equipped with unique environmental controls including air flow monitoring, solvent recovery, waste heat utilization, and building security systems. In addition, the laboratory is outfitted with instrumentation exhibiting advanced technology and automation. A list of instrumentation and supporting equipment can be found in Table 8.

The laboratory facility has a reverse osmosis systems, centralized high purity water system and a computer networking and centralized gas distribution to support it's analytical services.

Because of the nature of STL's work, adequate security of the facilities, equipment, and project files is necessary. Access to the facility is controlled through a system of electronic access cards. All visitors sign in, and are escorted by STL personnel while at an STL facility. Laboratory Section Managers ensure that their personnel are familiar with STL's security policies.

STL Burlington facility is designed for efficient, automated high-quality operations. STL's laboratory is equipped with Heating, Ventilation, and Air Conditioning (HVAC) systems appropriate to the needs of environmental testing laboratories and to meet the needs of the Methylene Chloride Emissions Standard. Environmental conditions in the facilities, such as hood flow, are routinely monitored and documented.

5.3. Test Methods

5.3.1. Method Selection

Most of the test methods performed at STL originate from test methods published by a regulatory agency such as the USEPA and other state and federal regulatory agencies. These include, but are not limited to, the following published compendiums of test methods:

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, USEPA, January, 1996.

Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water.

Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.

Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.

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Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991.

Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992.

NIOSH Manual of Analytical Methods, 4th ed., August, 1994.

Statement of Work for Inorganics Analysis, ILM04.0, USEPA Contract Laboratory Program Multi-media, Multi-concentration.

Statement of Work for Organics Analysis, OLM03.2, USEPA Contract Laboratory Program, Multi-media, Multi-concentration.

Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration, OLMO4.1, USEPA Contract Laboratory Program, September 1998.

Standard Methods for the Examination of Water and Wastewater, 18th/19th edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.

Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996.

Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.

National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.

5.3.2. SOPs

STL maintains an SOP Index for all standard, and laboratory developed methods. SOPs are maintained for describing processes that are not related to a specific method. Method SOPs are maintained to describe a specific test method. Procedural SOPs are maintained to describe function and procedures not related to a specific test method.

Method SOPs contain the following information:

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Title Page with Document Name, Document Number, Revision Number, Effective Date, Page Numbers and Total # of Pages, Authorized Signatures, Dates and Proprietary Information Statement (Figure 7).

1. Identification of Test Method
2. Applicable Matrix
3. Method Detection Limit
4. Scope and Application, including test analytes
5. Summary of the Test Method
6. Definitions
7. Interferences
8. Safety
9. Equipment and Supplies
10. Reagents and Standards
11. Sample Collection, Preservation, Shipment and Storage
12. Quality Control
13. Calibration and Standardization
14. Procedure
15. Calculations
16. Method Performance
17. Pollution Prevention
18. Data Assessment and Acceptance Criteria for Quality Control Measures
19. Corrective Actions for Out-of-Control Data
20. Contingencies for Handling Out-of-Control or Unacceptable Data
21. Waste Management
22. References
23. Tables, Diagrams, Flowcharts and Validation Data

Procedural SOPs contain the following information:

Title Page with Document Name, Document Number, Revision Number, Effective Date, Page Numbers and Total # of Pages, Authorized Signatures, Dates and Proprietary Information Statement (Figure 7).

1. Scope
2. Summary
3. Definitions
4. Responsibilities
5. Safety
6. Procedure
7. References
8. Tables, Diagrams, and Flowcharts

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The QA Department is responsible for maintenance of SOPs, archival of SOP historical revisions, and maintenance of an SOP index. SOPs, at a minimum, undergo annual review. Where an SOP is based on a published method, the laboratory maintains a copy of the reference method.

Figure 7 Proprietary Information Statement

This documentation has been prepared by Severn Trent Laboratories (STL) solely for STL's own use and the use of STL's customers in evaluating its qualifications and capabilities in connection with a particular project. The user of this document agrees by its acceptance to return it to STL upon request and not to reproduce, copy, lend, or otherwise disclose its contents, directly or indirectly, and not to use if for any other purpose other than that for which it was specifically provided. The user also agrees that where consultants or other outside parties are involved in the evaluation process, access to these documents shall not be given to said parties unless those parties also specifically agree to these conditions.

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SOP Appendix

In some cases, a standard laboratory procedure is modified slightly for a specific client or project at the client or regulatory agency's request. In these cases, an Appendix to the SOP may be attached that indicates the modifications to the SOP which are specific to that project.

SOPs are written procedures for standardized methods (i.e. SW-846, EPA-600 methods) and are supplied primarily to document specific laboratory procedures used to satisfy the general requirements specified in the individual methods and to explain any differences between the application of the established method and the published procedure. If any difference exists between STL's SOP and a standard method's specific procedures, method validation studies are performed to document the fact that the change does not adversely affect the applicability of the method. In general, every effort is made to adhere to the protocols of the standard method.

5.3.3. Method Validation

Laboratory developed methods are validated and documented according to the procedure described in Section 5.3.5.

5.3.4. Method Verification

Method verification is required when a validated standard test method or a method modification is implemented. The level of activity required for method verification is dependent on the type of method being implemented, or on the level of method modification and its affect on a method's robustness. Method modification often takes advantage of a method's robustness, or the ability to make minor changes in a method without affecting the method's outcome. Method verification commonly will minimally require Determination of Method Sensitivity and Determination of Accuracy and Precision as described in Section 5.3.5. When implementing new, but previously validated methodologies, method verification may require additional activities such as Determination of Range.

5.3.5. Method Validation and Verification Activities

Before analyzing samples by a particular method, method validation and/or method verification must occur. A complete validation of the method is required for laboratory developed methods. While method validation can take various courses, the following activities are generally required as part of method validation. Method validation records are designated QC records and are archived accordingly.

Determination of Method Selectivity
Method selectivity is demonstrated for the analyte(s) in the specific matrix or matrices. In some cases, to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

Determination of Method Sensitivity
Method sensitivity is determined using detection limit studies. Method detection limit studies are performed using the criteria in 40 CFR Part 136 Appendix B. Instrument detection limits are performed where required by specific data quality objectives or regulation.

Determination of Interferences
A determination that the method is free from interferences in a blank matrix is performed.

Determination of Range
Where appropriate, a determination of the applicable range of the method is performed. In most cases, range is determined and demonstrated by comparison of the response of an analyte in a curve to established or targeted criteria. The curve is used to establish the range of quantitation and the lower and upper values of the curve represent upper and lower quantitation limits. Curves are not limited to linear relationships.

Demonstration of Capability
DOCs are performed prior to method performance.

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Determination of Accuracy and Precision

Accuracy and precision studies may be required as a separate determination from the DOC. Accuracy and precision studies are generally performed using four replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Appendix describing the specific differences in the new method is acceptable in place of a separate SOP.

Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as Laboratory Control Samples and Method Blanks.

Determination of Reporting Limit

The MDL is the approximate limit at which an analyte can be qualitatively detected using a specific method at a 99% confidence interval. The MDL is a statistically calculated value and measures the sensitivity of an entire method and is independent of device. The Reporting Limit (RL) or Limit of Quantitation is the limit at which a compound can be qualitatively detected and quantified at a 99% confidence interval. The RLs are also set based on specific knowledge about the analyte, project specific requirements and/or regulatory requirements. The RL is always greater than the MDL is typically set based on 3-5 times the MDL.

STL-VT reports results to the sample specific RLs. For most methods the low calibration standard is set at the laboratory RL to monitor method sensitivity per instrument per calibration. Sample specific RLs are derived by taking into account various sample specific data, which can include the amount of the sample subject to testing, percent moisture, dilution factors, interferences and the base RLs for the analysis.

In some cases, it is appropriate to report values between the MDL and the RL. In this region, an analyte can be qualitatively detected, but not accurately quantified. Any data point reported in this region is flagged with “J” for organics and a “B” for inorganics to indicate that it is an estimated value.

5.3.6. Data review

All data, regardless of regulatory program or level of reporting, are subject to a thorough review process. All levels of the review are documented.

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Primary Review

The primary review is often referred to as a "bench-level" review. In most cases, the analyst who generates the data (i.e. logs in, prepares and/or runs the samples) is the primary reviewer. In some cases, an analyst may be reducing data for samples run by an auto-sampler set up by a different analyst. In this case, the identity of both the analyst and the primary reviewer is identified in the raw data.

One of the most important aspects of primary review is to make sure that the test instructions are clear, and that all project specific requirements have been understood and followed. If directions to the analyst are not clear, the analyst must go to the Supervisor, Manager, or PM, who must clarify the instructions.

Once an analysis is complete, the primary reviewer ensures that:

- Sample preparation information is complete, accurate, and documented.
- Calculations have been performed correctly.
- Quantitation has been performed accurately.
- Qualitative identifications are accurate.
- Manual integrations are appropriate.
- Data flags to indicate manual integrations are recorded.
- Manual integrations are authorized by a date and signature or initials of primary analyst.
- Client specific requirements have been followed.
- Method and process SOPs have been followed.
- Method QC criteria have been met.
- QC samples are within established limits.
- Dilution factors are correctly recorded and applied.
- Non-conformances and/or anomalous data have been properly documented and appropriately communicated.
- COC procedures have been followed.
- Primary review is documented by date and initials/signature of primary analyst.

Any anomalous results and/or non-conformances noted during the Primary Review are communicated to the Supervisor and the PM for resolution. Resolution can require sample reanalysis, or it may require that data be reported with a qualification. Non-conformances are documented per Section 4.9. Revisions are never erased, deleted or written over. They are corrected by drawing a single line through the error and entering the correction alongside. The correction is then initialed and dated by the person who edited the data.

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Secondary Review

The secondary review is a complete technical review of a data set. The secondary review is documented and the secondary reviewer is identified. The following items are reviewed:

- Qualitative Identification
- Quantitative Accuracy
- Calibration
- QC Samples
- Method QC Criteria
- Adherence to method and process SOPs
- Accuracy of Final Client Reporting Forms
- Manual Integrations – Minimal requirement is to spot-check raw data files for manual integration, as verified by date and initials or signature of secondary data reviewer. Some regulatory programs require 100% secondary review of manual integrations.
- Completeness
- Special Requirements/Instructions

If problems are found during the secondary review, the reviewer must work with the appropriate personnel to resolve them. If changes are made to the data, such as alternate qualitative identifications, identifications of additional target analytes, re-quantitation, or re-integration, the secondary reviewer must contact the laboratory analyst and/or primary reviewer of the data so that the primary analyst and/or reviewer is aware of the appropriate reporting procedures.

Completeness Review

The completeness review includes the generation of a project narrative and/or cover letter which outlines anomalous data and non-compliances using project narrative notes and non-compliance reports generated during the primary and secondary review. The completeness review addresses the following items:

- Is the project report complete?
- Does the data meet with the client's expectations?
- Were the data quality objectives of the project met?
- Are QC outages and/or non-conformances approved and appropriately explained in the narrative notes?

5.3.7. Data Integrity and Security

This section details those procedures that are relevant to computer systems that collect, analyze, and process raw instrumental data, and those that manage and report data.

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Security and Traceability

Access to computer systems that collect, analyze, and process raw instrumental data, and those that manage and report data is both controlled and recorded. There are various systems at STL to which this applies, which include the Laboratory Information Management System (LIMS), as well as specific systems such as a chromatography data system.

Control of the system is accomplished through limitation of access to the system by users with the education, training and experience to perform the task knowledgeably and accurately. System users are granted privileges that are commensurate with their experience and responsibilities.

Computer access is tracked by using unique login names and passwords for all employees that have access to the computer system. "General" or "multi-user" account access to computer systems that collect, analyze and process raw instrumental data, and those that manage and report data is not allowed. Entries and changes are documented with the identity of the individual making the entry, and the time and date. Where a computer system is processing raw instrumental data, the instrument identification number as described in Section 5.4.1 is recorded. Many of these systems, such as the Target Data System, have the capability of maintaining audit trails to track entries and changes to the data. This function is activated on any computer system that has that capability.

Verification

All commercially obtained software is verified prior to use and after version upgrade. Verification involves assessing whether the computer system accurately performs its intended function. Verification generally is accomplished by comparing the output of the program with the output of the raw data manually processed, or processed by the software being replaced. The records of the verification are required to contain the following information: software vendor, name of product, version, comparison of program output and manual output, raw data used to verify the program, date, and name of the individual performing the verification. Records of verification are retained as QC records.

Validation

Software validation involves documentation of specifications and coding as well as verification of results. Software validation is performed on all in house programs. Records of verification include original specifications, identity of code, printout of code, software name, software version, name of individual writing the code, comparison of program output with specifications, and verification records as specified above. Records of validation are retained as QC records.

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Auditing

The QA Department systems audit includes review of the control, security, and tracking of Information Technology (IT) systems and software.

Version Control

The laboratory maintains copies of outdated versions of software and associated manuals for all software in use at the laboratory for a period of five years from its retirement date.

5.4. Equipment

5.4.1. Equipment Operation

STL is committed to routinely updating and automating instrumentation. STL facilities maintain state of the art instrumentation to perform the analyses within the QC specifications of the test methods. Each STL facility maintains an equipment list that includes the following information:

- Identity
- Date Installed
- Manufacturer's Name, Model Number, Serial Number
- Current Location
- Preventative Maintenance Schedule

All equipment is subject to rigorous checks upon its receipt, upgrade, or modification to establish that the equipment meets with the selectivity, accuracy, and precision required by the test method for which it is to be used. All manufacturer's operations and maintenance manuals are kept up to date and accessible for the use of the equipment operator. Documentation of equipment usage is maintained using analytical run and maintenance logbooks. A comprehensive list of major instrumentation available, along with supporting miscellaneous equipment can be found in Table 8.

Table 8 Instrumentation and Supporting Equipment

Gas Chromatography/Mass Spectrometry			
Make and Model	Description	Quantity	Date Acquired
Hewlett Packard HP5971A MSD HP5972	GC/MS Systems with HP5890II GC's. Each system has a Tekmar LSC-2000 purge and trap and Tekmar ALS 2050, Aquatek 50, ARCHON or ALS 2016 autosampler. HP Apollo Series 400 Data System	4 1	3/92 3/96
Hewlett Packard HP5971A MSD HP5972	GC/MS systems with HP5890II GC's. Each system has Lauber injection ports and CTC A200S autosamplers. HP400-A1630 Data system	3 1	3/92 3/96
Perkin-Elmer 1330	Infrared spectrometer with data station	1	8/81

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Gas Chromatography			
Make and Model	Description	Quantity	Date Acquired
Hewlett Packard HP5890II HP5890	Gas Chromatographs equipped with dual electron capture (ECD) detectors and CTC A200 autosamplers. Data is collected on Fisons Multichrom data stations.	5 2	4/91, 4/91, 3/92, 3/92, 4/97
Hewlett Packard 5890 and 5890II	Gas Chromatographs equipped with a photoionization detector (PID) and an electroconductivity detector (HALL). For sample introduction, a Tekmar LSC2000 purge and trap and Tekmar LSC2050 or Dynatech PTA30 autosampler. Data is collected using a Fisons Multichrom Data station	2	1/96
Fisons Carlo Erba 8000	Gas Chromatographs equipped with dual electron capture (ECD) detectors and CTC A200 autosampler. Data is collected on a Fisons Multichrom data station.	2	3/92, 4/93
Hewlett Packard 5890 and 5890II	Gas Chromatographs equipped with HP 7673 and/or CTC A200 autosamplers, sub-ambient temperature controllers and HP3392 integrators. Detectors include Dual FPD, Dual NPD, single ECD, Dual FID, single FID, PID/FID, FID/ECD and Dual TCD. An EnviroChem 850 thermal desorber and Tekmar LSC-2 provide specialized sample introduction. Data is handled by Fisons Multichrom or Waters Maxima 820 computer data stations.	10	5/84, 5/84, 3/85, 3/85, 4/85, 6/87, 7/88, 7/88, 12/96
Waters 600 & 616 multi-solvent delivery system	HPLC-Lambda-Max LC UV-VIS spectrometer and Kratos 980 programmable fluorescence detection system. 742 WISP autosampler. Data collected on Fisons Multichrom data stations with networked VAX 3100 file serving.	2	1/88, 4/91 5/97
Waters	Post Column reaction System for HPLC including Waters Post Column Reagent Delivery System. Waters temperature control module and heater, and Waters two stage post column reactor consisting of reaction core, heater, and mixing tees.	1	5/92
Waters 616/996/717/2010	HPLC with UV detector, Millennium software and autosampler.	1	12/95
Finnigan STL-40	Ion Trap detectors equipped with Varian 3400 GC's.	2	5/92

Air Toxics			
Make and Model	Description	Quantity	Date Acquired
Hewlett Packard 5890II and 5971 MSD	GC/MS systems with HP5890II GC's with HP 5971 MSD. Data is collected using ChemStation software.	1	9/98
Nutech 3600 Autosampler	Sixteen station autosampler for Summa® canisters with an attachment for analyzing Tedlar air bags.	1	9/98
Nutech 3550A	Cryogenic concentrator, this contains a Nafion® dryer which reduces water vapor in the gas stream.	1	9/98
Nutech 354A	Cryofocus accessory focuses the volatiles in a cryogenically-cooled trap. The cryogen is then removed and the temperature of the trap is raised. The VOCs originally collected in the trap are revolatilized, separated on a GC column, then detected by one or more detectors for identification and quantitation.	1	9/98

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Air Toxics			
Tekmar 7050	Headspace autosampler	1	12/98
Varian 3600	Gas Chromatographs equipped with a flame ionization detector (FID) and a thermal conductivity detector (TCD). Data is collected using ChromPerfect software.	1	12/98
Entech 3000	Eight station canister cleaning system, utilizes heat, vacuum and zero air to clean canisters.	1	11/98

Organic Sample Preparation			
Make and Model	*Description*	Quantity	Date Acquired
Analytical bio-chemistry (ABC) 1000	Gel Permeation Chromatographs (GPC) each with UV detector and 3392 integrator	2	3/92, 3/92, 5/94
Analytical bio-chemistry (ABC) 1002B	Gel Permeation Chromatographs (GPC) each with UV detector and 3392 integrator	2	8/90, 5/93
Tekmar 600	Dual horn sonicators	2	11/91, 3/94
Tekmar 500	Sonicator	1	5/87
Organomation	Soxhlet extraction vessels	40	Various
Conventional	Soxhlet extraction vessels	45	Various
Millipore	Zero Headspace Extractors (ZHE) for TCLP VOA Extraction	10	6- (2/88), 4- (8/90)
Corning	One step continuous liquid-liquid extractors.	35	1/92
Lab-line/Labconco	Wrist shakers	2	Various
Glas-Col	Floor Shaker	2	Various
Inter.Equip/Becton	Centrifuge	2	Various
Dionex	Accelerated Solvent extractor	1	4/98
Mielabor/Multitronic	Dishwasher	2	1/95, 3/96
Various	Miscellaneous equipment: Hot Plates-PC-400, pH meter, Digital Scale and Delta Range Scales, Constant Temperature Circulators, Recovery Control System, Homogenizers (3), Furnaces 30400,		various

Atomic Spectroscopy/Metals Analysis			
Make and Model	Description	Quantity	Date Acquired
Thermo Jarrell-Ash – ICAP 61E	Trace, Simultaneous Inductively Coupled Plasma (ICP) emission spectrometer. System includes 150 position autosampler and computer control	3	3/94; 1/96, 12/97
Perkin-Elmer Z5100	Graphite Furnace atomic absorption spectrometer. System includes an AS60 autosampler and personal computer	1	9/91
Perkin-Elmer ZL5100	Graphite Furnace atomic absorption spectrometer. System includes an AS60 autosampler and personal computer	1	2/92

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Atomic Spectroscopy/Metals Analysis

Leeman Labs PS200	Mercury auto-analyzer. System includes an autosampler and a personal computer	1	10/91
Leeman Labs PS200II	Mercury auto-analyzer. System includes an autosampler and a personal computer	1	3/96
Various	Metals prep: Hot plates, 2 Mercury hot water baths, block digester, calibrated balances		Various

Wet Chemistry/ Inorganics Analysis

Make and Model	Description	Quantity	Date Acquired
Alpkem RFA 300	Auto-analyzer system for chloride, nitrate/nitrite and sulfate	1	4/92
Leeman Labs PS1214	Automated cyanide analyzer. System includes an autosampler and a personal computer	1	3/93
Dionex 2000i/SP	Ion Chromatograph	1	10/85
Dionex DX-500	Ion Chromatograph	1	4/95
Bausch and Lomb 2000	Scanning UV-visible spectrometer used for colorimetric analysis	1	4/81
Carlo Erba EA-1108	CHNS-O Elemental Analyzer with data station	1	3/91
Buck Scientific, Model HC404	Total Hydrocarbon Analyzer	1	12/93
Beckman 45	pH Meter	1	11/91
Fisher Accumet	pH Meter model 620 for fluoride analysis	1	12/93
LECO AC-300	Automatic calorimeter	1	6/84
Tecator	Soxtec System 1043 Extraction Unit	1	2/92
Oceanography International Model 700	Total Organic Carbon (TOC) analyzer	1	12/78
Dohrman	Total Organic Halogen (TOX) analyzers	1	2/91
Labconco Rapid Still II	Distillation units	2	11/92, 4/93
Tecator	Digestion system 20; 1015 digestor	1	9/91
YSI Model 58	Dissolved Oxygen Meters with 5905 BOD Probes	2	3/95
Shimadzu	TOC-5000A analyzer	1	12/97
Hach	2100A Turbidimeter	1	97
VWR	NST Digital Conductivity Meter	1	05/97
Baxter/precision	Ovens Tempcon, Model 17	2	Various
Precision	low temp incubator	1	-
Mettler	Analytical Balances-PM4800, AE200	5	Various
Viking/Beverage Air	Wet Lab Refrigerator/Freezer	2	Various

Sample Management

Make and Model	Description	Quantity	Date Acquired
Hobart	Three door refrigerator units with temperature probe connected to VAX System for automatic temperature measurement. Max/Min Thermometer back-up	14	Various
Hobart	Two door refrigerator unit with temperature probe connected to VAX System for automatic temperature measurement. Max/Min Thermometer back-up	4	Various

Sample Management			
Hobart	One door refrigerator units with temperature probe connected to VAX System for automatic temperature measurement. Max/Min Thermometer back-up	2	Various
Hobart	One door freezer units with temperature probe connected to VAX System for automatic temperature measurement. Max/Min Thermometer back-up	3	Various
Hobart	Two door freezer units with temperature probe connected to VAX System for automatic temperature measurement. Max/Min Thermometer back-up	4	Various
Hobart	Three door freezer units with temperature probe connected to VAX System for automatic temperature measurement. Max/Min Thermometer back-up	1	Various
Omega 0552 & OS90	IR Temperature Gun	2	1994

Information Systems

- All terminals, PCs and printers are connected on an integrated Local Area Network (LAN) via network switches, routers and wide area links. Nine HP GC/MS's with HP computers and 4 X-terminals; and HP-UX computers for GC Envisions with 8 X-terminals.

- Extensive variety of software to aid in data analysis and presentation: System 1032 Database, Lotus 1-2-3, Visual FoxPro, AutoCAD, Microsoft Office Products (Excel, Word, etc), WordPerfect, in addition to Visual Basic, C, Visual C++, and Visual Java ++programming environments.

- The GC division utilizes Maxima and Multichrom systems. Inorganic CLP or CLP-like data for the Metals division is generated using the Ward software package. The Envision System is used by the GC/MS Hewlett Packard lab and GC Lab. All our other systems have been custom designed by our Information Systems Department. For example, our metals laboratory utilizes software created to interface with VAX based management systems. The data is autoloaded to a central VAX where it undergoes a rigorous QC review. Additional equipment follows:

- Management personnel have access to the World Wide Web for additional resources.

- Additional equipment follows:

Information Services	
Description	Quantity
Vax 4505	1
Vax 3100	2
VT Terminals	25
Printers	34

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Information Services	
Personal computers	90
HP GC/MS's with HP chemstations	12
HP-UX chemserver computer for GC/MS Envisions (800)	1
HP-UX chemserver computer for GC/MS Envisions (735)	1
X-Terminals in support of Reporting	14
DMS Bitlab Laboratory Management System (LMS)	1
V. G. Laboratories	8
Chromservers (4 channels/server)	8
In-House Developed EDD Generator	1
NT-Server	3
In-House Wet Chemistry Data QC Summary Software	1
In-House Forecasting Module linked to BitLab	1
In-House Quote Module linked to BitLab	1
MSMail Server - Corporate and INTERNET	1
INTERNET(WWW) access	5
In-House Inorganics Processing Software Linked to BitLab	1
Ward Scientific Metals Reporting Software	1

5.4.2. Equipment Maintenance

STL employs a system of preventative maintenance in order to ensure system up time, minimize corrective maintenance costs and ensure data validity. All routine maintenance is performed as recommended by the manufacturer and may be performed by an analyst, instrument specialist or outside technician. Maintenance logbooks are kept on all major pieces of equipment in which both routine and non-routine maintenance is recorded. Notation of the date and maintenance activity is recorded each time service procedures are performed. The return to analytical control following instrument repair is documented in the maintenance logbook. Maintenance logbooks are retained as QC records.

Maintenance contracts are held on specific pieces of equipment where outside service is efficient, cost-effective, and necessary for effective operation of the laboratory.

5.4.3. Equipment Verification and Calibration

All equipment is tested upon receipt to establish its ability to meet the QC guidelines contained in the test method for which the instrumentation is to be used. This testing is

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documented in instrument run and maintenance logbooks. Once an instrument is placed in routine service, ongoing instrument calibration is demonstrated at the appropriate frequency as defined in the test method. Any instrument that is deemed to be malfunctioning is clearly marked and taken out of service. When the instrument is brought back into control, this is documented in the instrument maintenance log.

5.5. Measurement Traceability

5.5.1. General

Traceability of measurements is assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard is subject to ongoing certifications of accuracy.

At a minimum, these include procedures for checking specifications for balances, thermometers, temperature, de-ionized (DI) and reverse osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards.

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balances are calibrated on each day of use. All mercury thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use.

Laboratory DI and RO water systems have documented preventative maintenance schedules and the conductivity of the water is recorded on each day of use.

Laboratory SOPs specify the required level of accuracy in volumetric glassware. In all cases, volumetric glassware meets the requirements specified in the published test method.

5.5.2. Reference Standards

The receipt of all reference standards is documented. References standards are labeled with a unique Standard Identification Number, date received, and the expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All standards should be purchased with an accompanying Certificate of Analysis that documents the standard purity. If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis.

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The documentation of standard purity is archived, and references the Standard Identification Number.

All efforts are made to purchase standards that are ≥ 97.0% purity. If this is not possible, the weight of the standard is corrected for the purity when performing calculations.

The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a different lot is acceptable for use as a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or Laboratory Control Sample (LCS) is used as the second source confirmation.

5.5.3. Reagents

Reagents are, in general, required to be analytical reagent grade unless otherwise specific in method SOPs. Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the date the reagent was opened are documented.

5.6. Sampling

Sample representativeness and integrity are the foundations upon which meaningful analytical results rely. Where documented and approved SAPs and/or QAPPs are in place, they must be made available to the laboratory before sample receipt, and approved by laboratory management before sample receipt.

5.7. Sample Handling, Transport, and Storage

5.7.1. General

Chain of Custody (COC) can be established either when bottles are sent to the field, or at the time of sampling. STL can provide all of the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory.

Samples are received at the laboratory by a designated sample custodian and a unique Laboratory Project Identification Number is assigned. The following information is recorded for each sample shipment: Client/Project Name, Date and Time of Laboratory Receipt, Laboratory Project Number, and Signature or initials of the personnel receiving the cooler and making the entries.

Upon inspection of the cooler and custody seals, the sample custodian opens and inspects the contents of the cooler, and records the cooler temperature. All documents are

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immediately inspected to assure agreement between the test samples received and the COC.

Any non-conformance, irregularity, or compromised sample receipt as described in Section 4.7.1 is documented and brought to the immediate attention of the PM for resolution with the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the permanent project record.

Samples that are being tested at another STL facility or by an external subcontractor are repackaged, iced, and sent out under COC.

Following sample labeling as described in Section 5.7.2, the sample is placed in storage. Sample storage is required to be access controlled. All samples are stored according to the requirements outlined in the test method, and in a manner such that they are not subject to cross contamination or contamination from their environment. Unless specified by method or state regulation, a tolerance range of 4 ± 2^{o}C is used. Sample storage temperatures are monitored daily.

5.7.2. Sample Identification and Traceability

Each sample container is assigned a unique Sample Identification Number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a sample identification label. Access to samples is controlled and documented, identifying the identity of the sample handler, and date and time of sample access.

The laboratory utilizes a custom designed Laboratory Information Management System (LIMS) to uniquely identify and track samples and analytical data throughout the facility. The laboratory additionally maintains a hand written master log as a parallel paper system backup, which is described in the *Sample Handling* SOP. Detailed instructions on the log-in and receipt procedures can be found in the *Sample Receipt and Sample Handling SOPs*. The following information is entered into the LIMS:

- Quote number (unique to the job or set of samples)
- Sample number (a sequential 6 digit number)
- Date received
- Date analytical results due
- Sample description
- Client's name and address
- Client's job number (if available)
- Billing information – purchase order numbers
- Analyses requested
- Notation of special handling instructions

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- Project specific comments

This information then becomes an Environmental Test Request (ETR). Once the ETR has been generated, method specific analytical worksheets are generated for distribution to the appropriate analysts. A secondary review of the ETR is carried out by the PM to ensure compliance with project requirements.

All unused portions of samples, including empty sample containers, are returned to the secure sample control area.

5.7.3. Sample Preparation

Holding times for every analysis are established in the method SOPs or on a project specific basis. Holding times are normally tracked throughout the facility using the LIMS. Work is scheduled by the Laboratory Director and Section Managers to avoid expiration of any sample prior to analysis. If any holding times are not met the laboratory informs the Project Manager as soon as possible and the project manager notifies the client.

Samples are prepared according to standardized methods. Batches are generated in the prep lab according to preparation method, analytical method, and matrix. In general, batches do not exceed 20 field samples of the same matrix and are defined as samples prepared at the same time.

Inorganics (Metals and Wet Chemistry) - Samples for analyses are prepared in batches containing a maximum of 20 samples of the same or similar matrix. A laboratory blank and laboratory control sample are digested with each batch. A matrix spike and replicate analyses are performed for every 20 samples of the same matrix.

Organics - Samples for organics analyses are prepared in batches containing a maximum of twenty samples of the same or similar matrix. The organic extraction labs are equipped for handling many matrices and various clean-up requirements including Florisil, GPC, silica gel, acid-base, copper and sulfur. A method blank is performed with each batch. Lab control samples are extracted with each batch for applicable methods. Matrix spike and matrix spike duplicate analyses are performed for every 20 samples of the same matrix.

Re-preparation - Re-preparation or re-analysis of a sample may be required in cases of contamination, missed dilution, low surrogate recovery, etc. If the need for reanalysis/re-preparation has been determined, the request is forwarded to the appropriate department. Additionally a Corrective Action Report is filed with the QA Department when the laboratory has initiated a re-preparation request.

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Screening - Samples for organics analyses are screened prior to analysis and/or extraction. Screening helps to prevent unnecessary re-runs and lower instrument re-calibration, re-tune and analyst labor time. All GC and GC/MS volatiles are screened prior to analysis by headspace GC ECD and FID detectors. If necessary, soil semi-volatiles are pre-screened prior to extraction to determine if they require low or medium level extraction procedures. If necessary, all semi-volatile extracts are screened prior to analysis using GC with FID detectors. Similarly, all pesticide extracts are screened prior to analysis using GC with ECD detectors.

5.7.4. Sample Disposal

Samples are retained in STL storage facilities for 30 days after the project report is sent unless prior written arrangements have been made with the client. Samples may be held longer or returned to the client per written request. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work. All radioactive or dioxin containing samples will be returned to the client.

Samples are disposed of in accordance with federal, state and local regulations. STL Burlington has an SOP detailing the disposal of samples, digestates, and extracts. Sample and extract disposal is carried out following applicable state and federal guidelines. A discussion of the storage and disposal procedures for laboratory waste generated at the laboratory is found in the *Hazardous Waste Disposal* SOP.

5.8. Assuring the Quality of Test Results

5.8.1. Proficiency Testing

STL analyzes Proficiency Test (PT) samples as required for certification and as outlined in the National Environmental Laboratory Accreditation Conference (NELAC). STL Burlington participates in the PT program semi-annually for each area of testing and matrix (e.g. organics, inorganics; aqueous and drinking water) for which the laboratory is accredited. In addition to the PT program required for NELAC accreditation, STL participates in a number of additional PT programs, such as the EPA Contract Laboratory Protocol (CLP) Performance Evaluation program and the Navy and Army Corps of Engineers Laboratory Assessment program.

PT samples are handled and tested in the same manner (procedural, equipment, staff) as environmental samples. PT test sample data is archived using the requirements for project and raw data record retention.

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STL Burlington also participates in a double blind performance. An external vendor is contracted to submit double blind samples to the laboratory. Both the level of customer service and the accuracy of the test results are assessed objectively by the external contractor, who provides a detailed report to the Corporate QA Manager and to each of the STL facilities. This is administered as a double blind program in order to assess all facets of STL operations.

5.8.2. Control Samples

Control samples are analyzed with each batch of samples to monitor laboratory performance in terms of accuracy, precision, sensitivity, selectivity, and interferences. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch. There are also a number of QC sample types that monitor field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Control Sample types and typical frequency of their application are outlined in Table 9. Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. The quality control program implemented in the laboratory includes the analysis of method blanks, check standards, laboratory control samples, analytical spikes, and surrogate spikes. Depending on the analysis, every analytical series includes one or more of these controls. Table 10 provides a brief summary of the frequency and control limits for the fundamental quality control measures performed for analyses by the laboratory. Additional types of quality control are performed as necessary.

5.8.3. Calibration

Calibration of instrumentation is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument is calibrated with standard solutions appropriate to the type of instrument and the linear range established for the analytical method.

Method specific SOP's discuss in detail how each instrument is calibrated, including frequency for calibration and re-calibration, and the source or grade of the calibration materials. The range of analyses performed and instrumentation utilized is extensive and the calibration procedures are instrument specific, varying from analysis to analysis. The calibration procedures for organics usually include an initial system performance check and some type of initial calibration (with a minimum of five calibration standards for most methods) with each analytical series. On-going and closing calibration checks are also included in most analytical series. For each type of calibration standard or performance check there are specific criteria to meet before sample analyses begin. These criteria are established in the methodologies as they are written in the referenced texts or by contract specifications.

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Gas Chromatography/Mass Spectrometry (GC/MS)- Prior to analysis of samples, the instrument is tuned with bromofluorobenzene (BFB) for volatile compounds and decafluorotriphenyl-phosphine (DFTPP) for semivolatile compounds or other tune criteria as specified by the method used. No samples are analyzed until the instrument has met the tuning criteria of the method.

In general, the instrument is then calibrated for all target compounds. An initial calibration curve is produced to define the working range to establish criteria for identification. This initial calibration is evaluated on a daily basis to ensure that the system is within calibration. If the daily standard does not meet the established criteria, the system is recalibrated.

Gas Chromatography- Each chromatographic system is calibrated prior to performance of analyses. Initial calibration consists of determining the working range, establishing limits of detection, and establishing retention time windows. The calibration is checked as required to ensure that the system remains within specifications. In addition, continuing calibrations are performed at frequencies required by the method used. If the calibration checks do not meet established criteria, corrective action which may include recalibration and reanalysis of samples is taken.

*Metals- A*nalysis for metals generally involves two types of analytical instrumentation: inductively coupled argon plasma emission spectroscopy (ICP), and atomic absorption spectroscopy (AA).

Each ICP is calibrated prior to use by analyzing a multi-element calibration standard. The calibration is then verified using standards from an independent source. A linear range verification check standard is analyzed and reported quarterly for each element analyzed by ICP. This concentration is the upper limit of the ICP linear range and any result found above this limit must be diluted and reanalyzed. The calibration is monitored throughout the day by analyzing a Continuing Calibration Blank (CCB) and a Continuing Calibration Verification Standard (CCV). If the verification standard does not meet established criteria, corrective action is performed.

Each AA unit is calibrated prior to any analyses being conducted. A calibration curve is prepared with a minimum of a calibration blank and three standards and then verified with a standard that has been prepared from an independent source at a concentration near the middle of the calibration range (CCV). The calibration is then verified on an ongoing basis with a calibration blank and a CCV. If the ongoing calibration standard does not meet established acceptance criteria, corrective action is performed.

All samples for furnace analyses are single spiked. The method of standard additions or sample dilution is used when the single spike analysis indicates matrix interferences are present.

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Wet Chemistry- The field of classical (wet) chemistry involves a variety of instrumental and wet chemical techniques. Calibration and standardization procedures vary depending on the system and analytical methodology required for a specific analysis. The calibration is checked on an ongoing basis to ensure that the system remains within specifications. If the ongoing calibration check does not meet established criteria, analysis is halted and corrective action is taken. The procedures include examination of instrument performance and recalibration and reanalysis of samples back to the previous acceptable calibration check.

5.8.4. Procedure for Permitting Departures from Documented Procedure

Where a departure from a documented SOP, test method, or policy is determined to be or perceived to be necessary, or is unavoidable, the departure is documented on a non-conformance summary or in a format specifically designed for that purpose. The departure from procedure must be authorized by the QA Manager, the Laboratory Director or the department Manager. Where a departure affects a specific client project, the PM must be informed of the deviation. In some instances, it is appropriate to inform the client before permitting a departure. Any such occurrence is documented in the cover letter and/or project narrative.

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Table 9 Control Samples

Laboratory QC Sample Type	**Use**	**Typical Frequency**
Laboratory Control Sample (Laboratory Fortified Blank)	Measures accuracy of method in blank matrix	1 per batch of 20 or less samples per matrix type per sample extraction or preparation method
Method Blank	Measures method contribution to any source of contamination	1 per batch of 20 or less samples per matrix type per sample extraction or preparation method
Instrument Blank	Measures instrumental contribution to any source of contamination	As specified in test method
Cleanup Blank	Measures clean up step contribution to any source of contamination	As specified in test method
Storage Blank	Measures storage contribution to any source of contamination (Volatiles only)	As specified in test method or SOP
Control, Brine Control, or Dilution Water	Measures effect of blank water on test organisms (Aquatic toxicology)	As specified in test method and permit
Reference Toxicant	Measure sensitivity of test organisms (Aquatic toxicology)	Annually
Field QC Sample Type	**Use**	**Typical Frequency**
Matrix Duplicate	Measures effect of site matrix on precision of method	Per SAP/QAPP
Matrix Spike	Measures effect of site matrix on accuracy of method	Per SAP/QAPP
Matrix Spike Duplicate	Measures effect of site matrix on precision of method	Per SAP/QAPP
Equipment Blank (Equipment Rinsate)	Measures field equipment contribution to any source of contamination	Per SAP/QAPP
Trip Blank	Measures shipping contribution to any source of contamination (Volatiles)	Per Cooler
Field Blank	Measures field environment contribution to any source of contamination	Per SAP/QAPP
Field Duplicate	Measures representativeness of sampling and effect of site matrix on precision	Per SAP/QAPP

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Table 10. Frequency and Control limits for QC Measures

Parameter	QC type	Frequency	Control Limits	Corrective Action
Volatile Organics	method blank	1 per batch	target analytes below RL, 10x exception for lab solvents	system check, reanalysis of associated samples
	surrogate spike	each sample, standard, blank	limits listed in method	review, reanlyze based on technical judgment
	MS/MSD	set per 20 samples per matrix	limits listed in method	report results
	LCS	1 per batch	limits listed in method	review, reanalyze LCS and associated samples, if appropriate
Semi-volatile Organics	method blank	1 per 20 samples or each batch	target analytes below RL, 5X exception for common lab contaminates.	reanalysis, if still out, reextract w/ samples
	surrogate spike	each sample, standard, blank	limits listed in method	review, re-extract based on technical judgment
	MS/MSD	set per 20 samples per matrix	limits listed in method	report results
	LCS	1 per 20 samples or each batch	limits listed in method	review, reextract w/samples, if appropriate
Extractable Organics	method blank	1 per 20 samples or each batch	all compounds below RL	reanalysis, if still out, reextract w/samples
	surrogate spike	each sample, standard, blank	limits listed in method	review, re-extract based on technical judgment
	MS/MSD	set per 20 samples per matrix	limits listed in method	report results
	LCS	1 per 20 samples or each batch	limits listed in method	review, reanalysis or reextract w/samples, if appropriate

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Parameter	QC type	Frequency	Control Limits	Corrective Action
Metals	lab reagent/ prep bank	1 per 20 samples or batch	analyte below RL	redigest batch
	LCS	1 per batch	Soils- Limits provided by vendor Waters - ± 20%	redigest batch
	replicates	1 per 20 samples per matrix	± 20%	flag results
	matrix spikes	1 per 20 samples per matrix	75-125%	flag results
Wet Chemistry	lab reagent/ prep blank	1 per 20 samples or batch	analyte RL	system check, reanalysis of batch
	LCS	1 per batch	80-120% recovery	system check, reanalysis of batch
	replicates	1 per 20 samples per matrix	± 20%	flag results
	matrix spike	1 per 20 samples per matrix	75-125%	flag results

RL = Reporting Limit

5.9. Project Reports

5.9.1. General

The criteria described in Section 5.9.2 apply to all Project Reports that are generated under NELAC requirements. The criteria described in Section 5.9.3 and 5.9.4 apply to all Project Reports.

5.9.2. Project Report Content

- Title
- Laboratory name, address, telephone number, contact person
- Unique Laboratory Project Number
- Total Number of Pages (report must be paginated)
- Name and address of Client
- Client Project Name (if applicable)
- Laboratory Sample Identification

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- Client Sample Identification
- Matrix and/or Description of Sample
- Dates: Sample Receipt, Collection, Preparation and/or Analysis Date
- Definition of Data Qualifiers
- Reporting Units
- Test Method

The following are required where applicable to the specific test method or matrix:

- Solid Samples: Indicate Dry or Wet Weight
- Whole Effluent Toxicity: Statistical package used
- If holding time ≤ 48 hours, Sample Collection, Preparation and/or Analysis Time
- Indication by flagging where results are reported below the quantitation limit.

5.9.3. Project Narrative

A Project Narrative and/or Cover Letter is included with each project report and at a minimum includes an explanation of any and all of the following occurrences:

- Non-conformances
- "Compromised" sample receipt (see Section 4.7.1)
- Method Deviations
- QC criteria failures

Project Release

The Laboratory Director or his/her designee authorizes the release of the project report with a signature.

Where amendments to project reports are required after issue, these shall be in the form of a separate document and/or electronic data deliverable. The revised report is clearly identified as revised with the date of revision and the initials of the person making the revision. Specific pages of a project report may be revised using the above procedure with an accompanying cover letter indicating the page numbers of the project revised. The original version of the project report must be kept intact and the revisions and cover letter included in the project files.

5.9.4. Subcontractor Test Results

Subcontracted data is clearly identified as such, and the name, address, and telephone number for the laboratory performing the test is included in the project report. Subcontracted results from laboratories external to STL are not reported on STL report

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forms or STL letterhead. Test results from more than one STL facility are clearly identified with the name of the STL facility that performed the testing, address, and telephone number for that facility.

5.9.5. Electronic Data Deliverables

Electronic Data Deliverables (EDD) are routinely offered as part of STL's services. STL offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), New Agency Standard (NAS), Format A, Excel, Dbase, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process in Section 4.4.1. Once the facility has committed to providing diskettes in a specific format, the coding of the format is performed. This coding is documented and validated. The validation of the code is retained as a QC record. EDDs are subject to a secondary review to ensure their accuracy and completeness.

5.9.6. Project Report Format

STL offers a wide range of project reporting formats, including EDDs, short report formats, and complete data deliverable packages modeled on the Contract Laboratory Protocol (CLP) guidelines. More information on the range of project reports available can be obtained by contacting any STL facility. Regardless of the level of reporting, all projects undergo the same levels of review as described in Section 5.3.6.

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Appendix A Analytical Methodologies

Reference	Method	Description
40CFR136	601/602	Aromatic and Chlorinated Volatile Organics
40CFR136	608	Organochlorine Pesticide & PCBs
40CFR136	610	HPLC PAHs
40CFR136	615	Chlorinated Herbicides
40CFR136	619	Triazine Pesticides
40CFR136	632	HPLC Carbamate and Urea Pesticides
40CFR136	624	GC/MS Volatile Organics
40CFR136	625	GC/MS Semivolatile Organics
40CFR136	1624	GC/MS Volatile Organics, Isotope Dilution
40CFR136	1624	1624 Vacuum Distillation
40CFR136	1625	GC/MS Semivolatile Organics, Isotope Dilution
40CFR141	502.2	GC Volatile Organics, Drinking Water
40CFR141	504	EDB and DBCP
40CFR141	524.2	GC/MS Volatile Organics, Drinking Water
ASTM	D4318-93	Liquid Limit, Plastic Limit, Plasticity
ASTM	D854	Specific Gravity
ASTM	D2216	Water (Moisture) Content of Soil and Rock
ASTM	D2217	Wet Prep for Particle Size
ASTM	D421	Dry Prep for Particle Size
ASTM	D422	Particle Size Analysis
ASTM	D1946-90	Fixed Gases in Air
CAA	TO14A (MOD)	Volatile Organic Compounds in Ambient Air by GCMS
CAA	TO15 (MOD)	Volatile Organic Compounds in Ambient Air by GCMS
CAA	375.4 (MOD)	Sulfate on Filters
CAA	353.2 (MOD)	Nitrate/Nitrite-N on Filters
EPA CLP	ILM04.0	Cyanide, Total
EPA CLP	ILM04.0	ICP Metals Analysis
EPA CLP	ILM04.0	Mercury by Cold Vapor
EPA CLP	OLC02.1	GC/MS Volatile Organics, Low Concentration
EPA CLP	OLC02.1	GC/MS Semivolatile Organics, Low Concentration
EPA CLP	OLC02.1	Organochlorine Pesticide & PCBs, Low Concentration
EPA CLP	OLM03.2	GC/MS Volatile Organics
EPA CLP	OLM03.2	GC/MS Semivolatile Organics
EPA CLP	OLM03.2	Organochlorine Pesticide & PCBs
EPA CLP	OLM04.1	GC/MS Volatile Organics
EPA CLP	OLM04.1	GC/MS Semivolatile Organics
EPA CLP	OLM04.1	Organochlorine Pesticide & PCBs
EPA SW-846	1010	Ignitability (F)
EPA SW-846	1311	Toxicity Characteristic Leaching Procedure
EPA SW-846	1312	Synthetic Precipitation Leaching Procedure
EPA SW-846	1320	Multiple Extraction Procedure
EPA SW-846	6010B	ICP Metals
EPA SW-846	6010B	Sulfur by ICP (Waters)
EPA SW-846	6010B_TCLP	ICP Metals, TCLP Leachate

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Reference	Method	Description
EPA SW-846	7196A	Hexavalent Chromium
EPA SW-846	7470A	Mercury by Cold Vapor
EPA SW-846	7471A	Mercury by Cold Vapor
EPA SW-846	7841	Thallium by Furnace AA
EPA SW-846	8010B/8020A	Aromatic and Chlorinated Volatile Organics
EPA SW-846	8015	GC Nonhalogenated Volatile Organics
EPA SW-846	8015_GAS	TPH- Gasoline
EPA SW-846	8021	GC Aromatic and Halogenated Volatile Organics
EPA SW-846	8081A	Organochlorine Pesticide & PCBs
EPA SW-846	8081A_TCLP	TCLP Organochlorine Pesticides
EPA SW-846	8082	GC PCB
EPA SW-846	8082	GC PCB Congeners
EPA SW-846	8141A	Organophosphorus Pesticides
EPA SW-846	8151A	Herbicides
EPA SW-846	8151A_TCLP	TCLP Herbicides
EPA SW-846	8260B	GC/MS Volatile Organics
EPA SW-846	8260B	GC/MS Low Level Volatile Organics
EPA SW-846	8270C	GC/MS Semivolatile Organics
EPA SW-846	8310	HPLC PAH's
EPA SW-846	8315A_OGD	HPLC Aldehyde
EPA SW-846	8330	HPLC Explosives
EPA SW-846	9020B	Total Organic Halides
EPA SW-846	9038	Total Sulfate
EPA SW-846	9056	Inorganic Anions by Ion Chromatography
EPA SW-846	9060	Total Organic Carbon
EPA SW-846	9065	Total Phenols
EPA SW-846	9081	Cation-Exchange Capacity
EPA SW-846	9012A	Total Cyanide
EPA SW-846	9030B/9034	Sulfide
EPA SW-846	9040B	pH (std. units)
EPA SW-846	9045C	Soil pH (std. Units)
EPA SW-846	9250	Chloride, Total
EPA SW-846	9095A	Paint Filter Liquids Test
EPA SW-846	Sec. 7.3.3.	Reactive Cyanide
EPA SW-846	Sec. 7.3.4.	Reactive Sulfide
In house	IN623	Percent Solids
In house	In house	Explosive Aqueous Sample Screen
In house	In house	Explosive Soil Screen: TNT and RDX
In house	OLM_SAT	Low Level Organochlorine Pesticide & PCBs
In house	OR215	TPH Extractables (California LUFT)
In house	OR560	Alkyl Tin Analysis
In house	NOAA	GC/MS SIM PAHs
In-house	RSK-175	Dissolved Gases in Groundwater
Lloyd Khan	Lloyd Khan	Total Organic Carbon in Soil
MCAWW	110.1	Color
MCAWW	120.1	Conductivity/Salinity
MCAWW	130.2	Total Hardness as CaCO3

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Reference	Method	Description
MCAWW	150.1	pH (std units)
MCAWW	160.1	Total Dissolved Solids
MCAWW	160.2	Total Suspended Solids
MCAWW	160.3	Total Solids
MCAWW	160.4	Volatile Total Solids
MCAWW	160.5	Settleable Solids (ml/l)
MCAWW	180.1	Turbidity (NTU)
MCAWW	200.7	Metals
MCAWW	300.0	Inorganic Anions by Ion Chromatography
MCAWW	310.1	Alkalinity (as CaCO3)
MCAWW	325.2	Chloride
MCAWW	340.2	Fluoride
MCAWW	350.2	Ammonia Nitrogen
MCAWW	351.3	Total Kjeldahl Nitrogen
MCAWW	353.2	Nitrate/Nitrite Nitrogen
MCAWW	354.1	Nitrite Nitrogen
MCAWW	360.2	Dissolved Oxygen
MCAWW	365.2:ORTH	Orthophosphate as P
MCAWW	365.2:TOTL	Total Phosphate as P
MCAWW	375.4	Sulfate
MCAWW	376.2	Sulfide
MCAWW	377.1	Sulfite
MCAWW	405.1	BOD5
MCAWW	410.1	COD
MCAWW	413.1	Oil and Grease
MCAWW	413.2	Oil and Grease
MCAWW	415.1	Total Organic Carbon
MCAWW	418.1	Petroleum Hydrocarbons
MCAWW	420.1	Total Phenols
MCAWW	425.1	MBAS (mg LAS/L)
MCAWW	245.1	Mercury by Cold Vapor
MCAWW/SW-846	335.1, 335.2	Cyanide, Total and Amenable
MCAWW/SW-846	450.1	Total Organic Halides
Standard Methods	4500G	Dissolved Sulfide in Soil
Standard Methods	3500FE	Ferrous Iron (Phenanthroline Method)
Standard Methods	4500FC	Fluoride by Ion Selective Electrode
Standard Methods	4500PE	Ortho Phosphate as P
Standard Methods	4500CNG/CNE	Cyanide, Total and Amenable
Standard Methods	4500NO2B	Nitrite Nitrogen
Standard Methods	2540C	Total Dissolved Solids
Standard Methods	2510B	Conductivity
Standard Methods	2320B	Alkalinity (as CaCO3)
Standard Methods	5210 (MOD)	Carbonaceous BOD
State of MA	EPH	EPH for MA
State of MA	VPH	VPH for MA
Status and Trends	SATPPCB	Status and Trends Pest/Congener

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Appendix B List of Certifications

Certifications

(as of January 2000)

The following list is a summary of the professional certifications held by our laboratory. Actual certificates are available upon request.

California Department of Health Services
Certified for Inorganic and Organic for
Drinking Water, Wastewater, and Hazardous Waste
Contact Person: Dr. George Kulasingam
Certification ID Number 2363
Phone Number: 510-540-2800

State of Connecticut Department of Health Services
Approved Public Health Laboratory
Certified for Inorganic and Organic in Potable Water and Wastewater
Contact Person: Mr. Nicholas Macelletti
Certificate Number PH-0751
Phone Number: 203-566-4045

Florida Department of Health and Rehabilitative Services,
Certified for Inorganic and Organic Parameters in Wastewater
and Hazardous Waste
Contact Person: Mr. Carl C. Kircher
Certificate No's E87467 and 87751
Phone Number: 904-359-6456

State of Maine Department of Human Services
Certified for Inorganic, and Organic in Drinking Water
Contact Person: Mr. Michael Sodano
Certificate ID: VT008
Phone Number: 207-287-1929

The Commonwealth of Massachusetts
Department of Environmental Protection
Certified for Inorganic and Organic Parameters in Drinking Water
and Wastewater
Contact Person: Ms. Anne Marie Allen
Laboratory ID Number M-VT008
Phone Number: 508-688-0352

New Jersey Department of Environmental Protection and Energy
Certified for Inorganics and Organics in Water and Wastewater
Contact Person: Mr. Michael Miller
Laboratory ID Number 85972
Phone Number: 609-633-2804

State of New Hampshire Department of Environmental Services
Certified for Inorganics and Organics in Water and Wastewater
Contact Person: Mr. Charles Dyer
Certificate No.'s 200699-A and 200699-B

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Phone Number: 603-271-3503

New York State Department of Health
Certified for Inorganics and Organics in Water and Wastewater
Certified for Inorganics and Organics in Air and Emissions, Solid and
Hazardous Waste and CLP
Contact Person: Mr. Matthew Caruso
Lab ID number 10391
Phone Number: 518-485-5570

State of Pennsylvania Department of Environmental Resources
Certified for Inorganics and Organics in Drinking Water
Contact Person: Mr. Edward Maser
ID # 68-489
Phone Number: 717-783-7150

State of Rhode Island and Providence Plantations Department of Health
Certified for Inorganics and Organics in Potable, Non-Potable, and Wastewater
Contact Person: Ms. Deborah Dehmel
License #81
Phone Number: 401-277-2566

Vermont Department of Health Laboratory
Certified for Inorganic and Organic in Drinking Water
Contact Person: Mr. George Mills
Certification ID: VT-4000
Phone Number: 802-863-7335

The Naval Facilities Engineering Service Center (NFESC)
Recommended for approval for organic and inorganic analyses
Contact Person: Pati Moreno
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United States Army Corps of Engineers
Certified for inorganic and organic determinations
Contact Person: Ms. Elena Webster
Phone Number: 402-697-2574

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APPENDIX C

NIOSH Method 2549

VOLATILE ORGANIC COMPOUNDS (SCREENING) 2549

FORMULA see Table 1 MW: see Table 1 CAS: see Table 1 RTECS: see Table 1

METHOD: 2549, Issue 1 **EVALUATION: PARTIAL** **Issue 1: 15 May 1996**

OSHA :
NIOSH: varies with compound
ACGIH:

PROPERTIES: See Table 1

SYNONYMS: VOCs; See individual compounds in Table 1

SAMPLING

SAMPLER:	THERMAL DESORPTION TUBE (multi-bed sorbent tubes containing graphitized carbons and carbon molecular sieve sorbents [See Appendix])
FLOW RATE:	0.01 to 0.05 L/min
VOL-MIN:	1 L
-MAX:	6 L
SHIPMENT:	Ambient in storage containers
SAMPLE STABILITY:	Compound dependent (store @ -10 °C)
BLANKS:	1 to 3 per set

ACCURACY

RANGE STUDIED:	not applicable
BIAS:	not applicable
OVERALL PRECISION ($\hat{S}_{rT}$):	not applicable
ACCURACY:	not applicable

MEASUREMENT

TECHNIQUE:	THERMAL DESORPTION, GAS CHROMATOGRAPHY, MASS SPECTROMETRY
ANALYTE:	See Table 1
DESORPTION:	Thermal desorption
INJECTION VOLUME:	Defined by desorption split flows (See Appendix)
TEMPERATURE-DESORPTION:	300 °C for 10 min.
-DETECTOR (MS):	280 °C
-COLUMN:	35 °C for 4 min; 8 °C/min to 150 °C, 15 °C/min to 300 °C
CARRIER GAS:	Helium
COLUMN:	30 meter DB-1, 0.25-mm ID, 1.0-µm film, or equivalent
CALIBRATION:	Identification based on mass spectra interpretation and computerized library searches.
RANGE:	not applicable
ESTIMATED LOD:	100 ng per tube or less
PRECISION ($\hat{S}_r$):	not applicable

APPLICABILITY: This method has been used for the characterization of environments containing mixtures of volatile organic compounds (See Table 1). The sampling has been conducted using multi-bed thermal desorption tubes. The analysis procedure has been able to identify a wide range of organic compounds, based on operator expertise and library searching.

INTERFERENCES: Compounds which coelute on the chromatographic column may present an interference in the identification of each compound. By appropriate use of background subtraction, the mass spectrometrist may be able to obtain more representative spectra of each compound and provide a tentative identity (See Table 1).

OTHER METHODS: Other methods have been published for the determination of specific compounds in air by thermal desorption/gas chromatography [1-3]. One of the primary differences in these methods is the sorbents used in the thermal desorption tubes.

REAGENTS:

1. Air, dry
2. Helium, high purity
3. Organic compounds of interest for mass spectra verification (See Table 1).*
4. Solvents for preparing spiking solutions: carbon disulfide (low benzene chromatographic grade), methanol, etc.(99+% purity)

* See SPECIAL PRECAUTIONS

EQUIPMENT:

1. Sampler: Thermal sampling tube, ¼" s.s. tube, multi-bed sorbents capable of trapping organic compounds in the C_3-C_{16} range. Exact sampler configuration depends on thermal desorber system used. See Figure 1 for example.
2. Personal sampling pump, 0.01 to 0.05 L/min, with flexible tubing.
3. Shipping containers for thermal desorber sampling tubes.
4. Instrumentation: thermal desorption system, focusing capability, desorption temperature appropriate to sorbents in tube (~300 °C), and interfaced directly to a GC-MS system.
5. Gas chromatograph with injector fitted with 1/4" column adapter, 1/4" Swagelok nuts and Teflon ferrules (or equivalent).
6. Syringes: 1-µL, 10-µL (liquid); 100-µL, 500-µL (gas tight)
7. Volumetric Flasks, 10-mL.
8. Gas bulb, 2 L

SPECIAL PRECAUTIONS: Some solvents are flammable and should be handled with caution in a fume hood. Precautions should be taken to avoid inhalation of the vapors from solvents as well. Skin contact should be avoided.

SAMPLING:

NOTE: Prior to field use, clean all thermal desorption tubes thoroughly by heating at or above the intended tube desorption temperature for 1-2 hours with carrier gas flowing at a rate of at least 50 mL/min. Always store tubes with long-term storage caps attached, or in containers that prevent contamination. Identify each tube uniquely with a permanent number on either the tube or tube container. Under no circumstances should tape or labels be applied directly to the thermal desorption tubes.

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Remove the caps of the sampler immediately before sampling. Attach sampler to personal sampling pump with flexible tubing.
   NOTE: With a multi-bed sorbent tube, it is extremely important to sample in the correct direction, from least to maximum strength sorbent.
3. For general screening, sample at 0.01 to 0.05 L/min for a maximum sample volume of 6 L. Replace caps immediately after sampling. Keep field blanks capped at all times. Tubes can act as diffusive samplers if left uncapped in a contaminated environment.
4. Collect a "humidity test" sample to determine if the thermal adsorption tubes have a high water background.
   NOTE: At higher sample volumes, additional analyte and water (from humidity) may be collected on the sampling tube. At sufficiently high levels of analyte or water in the sample, the mass spectrometer may malfunction during analysis resulting in loss of data for a given sample.
5. Collect a "control" sample. For indoor air samples this could be either an outside sample at the same location or an indoor sample taken in a non-complaint area.
6. Ship in sample storage containers at ambient temperature. Store at -10 °C.

SAMPLE PREPARATION:

7. Allow samples to equilibrate to room temperature prior to analysis. Remove each sampler from its storage container.

8. Analyze "humidity test" sampler first to determine if humidity was high during sampling (step 10).
9. If high humidity, dry purge the tubes with purified helium at 50 to 100 mL/min for a maximum of 3 L at ambient temperature prior to analysis. .
10. Place the sampler into the thermal desorber. Desorb in reverse direction to sampling flow.

CALIBRATION AND QUALITY CONTROL:

11. Tune the mass spectrometer according to manufacturer's directions to calibrate.
12. Make at least one blank run prior to analyzing any field samples to ensure that the TD-GC-MS system produces a clean chromatographic background. Also make a blank run after analysis of heavily concentrated samples to prevent any carryover in the system. If carryover is observed, make additional blank runs until the contamination is flushed from the thermal desorber system.
13. Maintain a log of thermal desorber tube use to record the number of times used and compounds found. If unexpected analytes are found in samples, the log can be checked to verify if the tube may have been exposed to these analytes during a previous sampling use.
14. Run spiked samples along with the screening samples to confirm the compounds of interest. To prepare spiked samples, use the procedure outlined in the Appendix .

MEASUREMENT:

15. See Appendix for conditions. MS scan range should cover the ions of interest, typically from 20 to 300 atomic mass units (amu). Mass spectra can either be identified by library searching or by manual interpretation (see Table 1). In all cases, library matches should also be checked for accurate identification and verified with standard spikes if necessary.

EVALUATION OF METHOD:

The method has been used for a number of field screening evaluations to detect volatile organic compounds. Estimate of the limit of detection for the method is based on the analysis of spiked samples for a number of different types of organic compounds. For the compounds studied, reliable mass spectra were collected at a level of 100 ng per compound or less. In situations where high levels of humidity may be present on the sample, some of the polar volatile compounds may not be efficiently collected on the internal trap of the thermal desorber. In these situations, purging of the samples with 3 L of helium at 100 mL/min removed the excess water and did not appreciably affect the recovery of the analytes on the sample.

REFERENCES:

[1] Health and Safety Executive [1992]. MDHS 72 - Volatile organic compounds in air. Methods for the determination of hazardous substances. HMSO: London: ISBN 0-11-885692-8.

[2] McCaffrey CA, MacLachlan J, Brookes BI [1994]. Adsorbent tube evaluation for the preconcentration of volatile organic compounds in air for analysis by gas chromatography-mass spectrometry. Analyst 119:897-902.

[3] Bianchi AP, Varney MS [1992]. Sampling and analysis of volatile organic compounds in estuarine air by gas chromatography and mass spectrometry. J. Chromatogr. 643:11-23.

[4] EPA [1984]. Environmental Protection Agency Air Toxics Method T01. Rev. 1.0 (April, 1984): Method for the determination of volatile organic compounds in ambient air using Tenax(R) adsorption and gas chromatography/mass spectrometry (GC/MS), Section 13.

METHOD WRITTEN BY:

Ardith A. Grote and Eugene R. Kennedy, Ph.D., NIOSH, DPSE

TABLE 1. COMMON VOLATILE ORGANIC COMPOUNDS WITH MASS SPECTRAL DATA

Compound /Synonyms	CAS# RTECS	Empirical Formula	MW[a]	BP[b] (°C)	VP[c] @ 25 °C mm Hg	kPa	Characteristic Ions, m/z
Aromatic Hydrocarbons							
Benzene /benzol	71-43-2 CY1400000	C_6H_6	78.11	80.1	95.2	12.7	78*
Xylene /dimethyl benzene	1330-20-7 ZE2100000	C_8H_{10}	106.7				91, 106*, 105
o-xylene				144.4	6.7	0.9	
m-xylene				139.1	8.4	1.1	
p-xylene				138.4	8.8	1.2	
Toluene /toluol	108-88-3 XS5250000	C_7H_8	92.14	110.6	28.4	3.8	91, 92*
Aliphatic Hydrocarbons							
n-Pentane	109-66-0 RZ9450000	C_5H_{12}	72.15	36.1	512.5	68.3	43, 72*, 57
n-Hexane /hexyl-hydride	110-54-3 MN9275000	C_6H_{14}	86.18	68.7	151.3	20.2	57, 43, 86*, 41
n-Heptane	142-82-5 MI7700000	C_7H_{16}	100.21	98.4	45.8	6.1	43, 71, 57, 100*,41
n-Octane	111-65-9 RG8400000	C_8H_{18}	114.23	125.7	14.0	1.9	43, 85, 114*, 57
n-Decane /decyl hydride	124-18-5 HD6500000	$C_{10}H_{22}$	142.29	174	1.4	0.2	43, 57, 71, 41, 142*
Ketones							
Acetone /2-propanone	67-64-1 AL3150000	C_3H_6O	58.08	56	266	35.5	43, 58*
2-Butanone /methyl ethyl ketone	78-93-3 EL6475000	C_4H_8O	72.11	79.6	100	13	43, 72*
Methyl isobutyl ketone /MIBK, hexone	108-10-1 SA9275000	$C_6H_{12}O$	100.16	117	15	2	43, 100*, 58
Cyclohexanone /cyclohexyl ketone	108-94-1 GW1050000	$C_6H_{10}O$	98.15	155	2	0.3	55, 42, 98*, 69
Alcohols							
Methanol /methyl alcohol	67-56-1 PC1400000	CH_3OH	32.04	64.5	115	15.3	31, 29, 32*
Ethanol /ethyl alcohol	64-17-5 KQ6300000	C_2H_5OH	46.07	78.5	42	5.6	31, 45, 46*
Isopropanol /1-methyl ethanol	67-63-0 NT8050000	C_3H_7OH	60.09	82.5	33	4.4	45, 59, 43
Butanol /butyl alcohol	71-36-3 EO1400000	C_4H_9OH	74.12	117	4.2	0.56	56, 31, 41, 43

Compound /Synonyms	CAS# RTECS	Empirical Formula	MW[a]	BP[b] (°C)	VP[c] @ 25 °C		Characteristic Ions, m/z
					mm Hg	kPa	
Glycol Ethers							
Butyl cellosolve /2-butoxyethanol	111-76-2 KJ8575000	$C_6H_{14}O_2$	118.17	171	0.8	0.11	57, 41, 45, 75, 87
Diethylene glycol ethyl ether /Carbitol	111-90-0 KK8750000	$C_6H_{14}O_3$	134.17	202	0.08	0.01	45, 59, 72, 73, 75, 104
Phenolics							
Phenol /hydroxybenzene	108-95-2 SJ3325000	C_6H_5OH	94.11	182	47	0.35	94*, 65, 66, 39
Cresol	1319-77-3 GO5950000	C_7H_7OH	108.14				108*, 107, 77, 79
2-methylphenol	95-48-7			190.9	1.9	0.25	
3-methylphenol	108-39-4			202.2	1.0	0.15	
4-methylphenol	106-44-5			201.9	0.8	0.11	
Chlorinated Hydrocarbons							
Methylene chloride /dichloromethane	75-09-2 PA8050000	CH_2Cl_2	84.94	40	349	47	86*, 84, 49, 51
1,1,1-Trichloroethane /methyl chloroform	71-55-6 KJ2975000	CCl_3CH_3	133.42	75	100	13.5	97, 99, 117, 119
Perchloroethylene /hexachloroethane	127-18-4 KX3850000	CCl_3CCl_3	236.74	187 (subl)	0.2	<0.1	164*, 166, 168, 129, 131, 133, 94, 96
o-,p-Dichlorobenzenes		$C_6H_4Cl_2$	147.0				146*, 148, 111, 113, 75
/1,2-dichlorobenzene	95-50-1 CZ4500000			172-9	1.2	0.2	
/1,4-dichlorobenzene	106-46-7 CZ4550000			173.7	1.7	0.2	
1,1,2-Trichloro-1,2,2-trifluoroethane /Freon 113	76-13-1 KJ4000000	CCl_2FCClF_2	187.38	47.6	384	38	101, 103, 151, 153, 85, 87
Terpenes							
d-Limonene	5989-27-5 OS8100000	$C_{10}H_{16}$	136.23	176	1.2		68, 67, 93, 121, 136*
Turpentine (Pinenes)	8006-64-2	$C_{10}H_{16}$	136.23	156 to 170	4 @ 20°		93, 121, 136*, 91
α-pinene	80-56-8			156			
β-pinene	127-91-3			165			
Aldehydes							
Hexanal /caproaldehyde	66-25-1 MN7175000	$C_6H_{12}O$	100.16	131	10	1.3	44, 56, 72, 82, 41

Compound /Synonyms	CAS# RTECS	Empirical Formula	MW[a]	BP[b] (°C)	VP[c] @ 25 °C mm Hg	kPa	Characteristic Ions, m/z
Benzaldehyde /benzoic aldehyde	100-52-7 CU4375000	$C_7H_{12}O$	106.12	179	1.0	0.1	77, 105, 106*, 51
Nonanal /pelargonic aldehyde	124-19-6 RA5700000	$C_9H_{18}O$	142.24	93	23	3	43, 44, 57, 98, 114
Acetates							
Ethyl acetate /acetic ether	141-78-6 AH5425000	$C_4H_8O_2$	88.1	77	73	9.7	43, 88*, 61, 70, 73, 45
Butyl acetate /acetic acid butyl ester	123-86-4 AF7350000	$C_6H_{12}O_2$	116.16	126	10	1.3	43, 56, 73, 61
Amyl acetate /banana oil	628-63-7 AJ1925000	$C_7H_{14}O_2$	130.18	149	4	0.5	43, 70, 55, 61
Other							
Octamethylcyclotetrasiloxane	556-67-2 GZ4397000	$C_8H_{24}O_4Si_4$	296.62	175			281, 282, 283

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[a] Molecular Weight
[b] Boiling Point
[c] Vapor Pressure
* Indicates molecular ion

APPENDIX

Multi-bed sorbent tubes: Other sorbent combinations and instrumentation/conditions shown to be equivalent may be substituted for those listed below. In particular, if the compounds of interest are known, specific sorbents and conditions can be chosen that work best for that particular compound(s). The tubes that have been used in NIOSH studies with the Perkin Elmer ATD system are ¼" stainless steel tubes, and are shown in the diagram below:

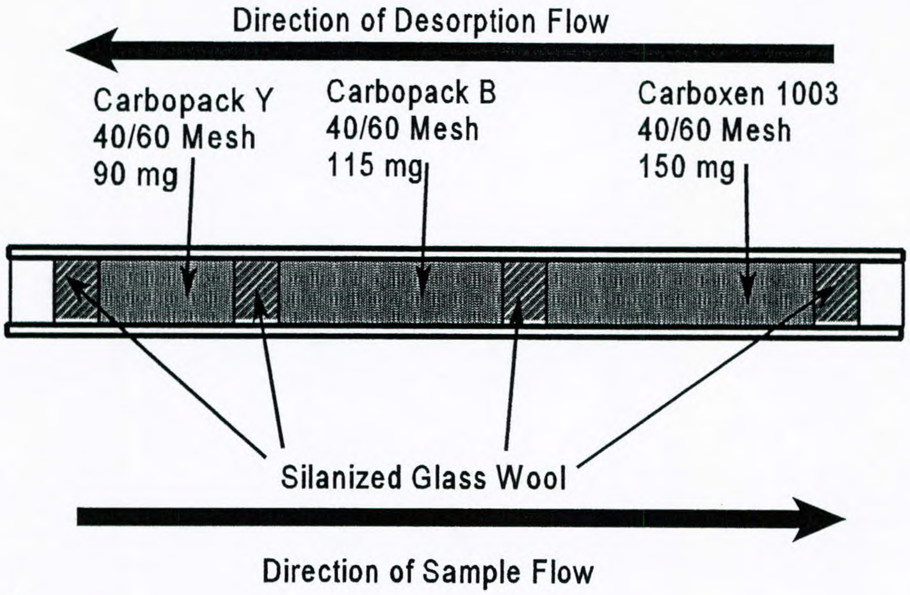


Figure 1

Carbopack™ and Carboxen™ adsorbents are available from Supelco, Inc.

Preparation of spiked samples Spiked tubes can be prepared from either liquid or gas bulb standards.

Liquid standards: Prepare stock solutions by adding known amounts of analytes to 10-mL volumetric flasks containing high purity solvent (carbon disulfide, methanol, toluene). Solvents are chosen based on solubility for the analytes of interest and ability to be separated from the analytes when chromatographed. Highly volatile compounds should be dissolved in a less volatile solvent. For most compounds, carbon disulfide is a good general purpose solvent, although this will interfere with early eluting compounds.

Gas bulb standards: Inject known amounts of organic analytes of interest into a gas bulb of known volume filled with clean air [4]. Prior to closing the bulb, place a magnetic stirrer and several glass beads are placed in the bulb to assist in agitation after introduction of the analytes. After injection of all of the analytes of interest into the bulb, warm the bulb to 50 °C and place it on a magnetic stirring plate and stir for several minutes to ensure complete vaporization of the analytes. After the bulb has been stirred and cooled to room temperature, remove aliquots from the bulb with a gas syringe and inject into a sample tube as described below.

Tube spiking Fit a GC injector with a ¼" column adapter. Maintain the injector at 120 °C to assist in vaporization of the injected sample. Attach cleaned thermal desorption tubes to injector with ¼" Swagelok nuts and Teflon ferrules, and adjust helium flow though the injector to 50 mL/min. Attach the sampling tube so that flow direction is the same as for sampling. Take an aliquot of standard solution (gas standards 100 to 500 µL; liquid standards, 0.1 to 2 µL) and inject into the GC injector. Allow to equilibrate for 10 minutes. Remove tube and analyze by thermal desorption using the same conditions as for field samples.

Instrumentation: Actual media, instrumentation, and conditions used for general screening of unknown environments are as follows: Perkin-Elmer ATD 400 (automated thermal desorption system) interfaced directly to a Hewlett-Packard 5980 gas chromatograph/HP5970 mass selective detector and data system.

ATD conditions:

Tube desorption temperature: 300°C
Tube desorption time: 10 min.
Valve/transfer line temperatures: 150°C
Focusing trap: Carbopack B/Carboxen 1000, 60/80 mesh, held at 27°C during tube desorption
Focusing trap desorption temperature: 300°C
Desorption flow: 50-60 mL/min.
Inlet split: off
Outlet split: 20 mL/min.
Helium: 10 PSI

GC conditions:

DB-1 fused silica capillary column, 30 meter, 1-µm film thickness, 0.25-mm I.D.
Temperature program: Initial 35°C for 4 minutes, ramp to 100°C at 8°/min., then ramp to 300°C at 15°/min, hold 1-5 minutes.
Run time: 27 min.

MSD conditions:

Transfer line: 280°C
Scan 20-300 amus, EI mode
EMV: set at tuning value
Solvent delay: 0 min. for field samples; if a solvent-spiked tube is analyzed, a solvent delay may be necessary to prevent MS shutdown caused by excessive pressure.

APPENDIX D

Monitoring Well Gauging and Sampling Protocols

Geoscience Services Division
Standard Operating Procedure

1.1.1.2

TITLE: Well Gauging With the Water Level Indicator Probe

DATE: August 18, 1994

Purpose

Groundwater elevations are one of the primary sources of hydrogeologic data and vital during subsurface investigations and remediation. Accurate well gauging data provide a permanent record of seasonal groundwater fluctuations (hydrograph). Inaccurate well gauging data can cause a complete misinterpretation of subsurface conditions and groundwater flow direction.

Equipment

- Water Level Indicator Probe (WLI)
- Monitoring Form
- Field notebook
- Roadbox key or ratchet wrench
- Keys, Extra locks (keyed alike), Extra well caps
- Bolt cutters
- Tank Stick and Water Paste
- Means of removing water from road box (hand pump or cup)
- Clear bailer with rope
- Sorbent pads to wipe the probe
- Alconox or Liquinox solution
- Distilled water
- Gloves
- Indelible marker
- Paper Towels, Wipes, Rags
- Site plan
- Previous well gauging data

Procedure

1. Check the WLI to see that it is clean and functioning properly before leaving the shop; familiarize yourself with the WLI: A steady tone indicates water.

2. Approach the monitoring well with caution in traffic areas (use cones and vests; flagman - do not gauge wells in any roadway alone); avoid hazardous vapors; remove the roadbox lid and the well cap.

3. Remove accumulated water in roadbox to below top of casing; note if accumulated water has leaked into the well, if a sheen is present, or if the water level is at the top of the casing.

4. Decontaminate the probe prior to first measurement.

5. Locate the survey point near the top of the well casing; it should be marked with paint, a notch, or indelible pen; if no survey point is present use the highest point of the well casing and mark that point for future reference; it will also be helpful to touch up faded marks; if you do not know where the survey point is, call the Project Manager.

6. Lower the WLI tip into the well until the tone is heard; measure depth to water from the survey point using graduated marks on the WLI tape; record depth to water (DTW); make sure to record the depth using proper units; WLI tapes are typically graduated in 1/100's of feet or 1/16's of inches (see attachment).

7. Remove the WLI from the well, check for a petroleum sheen, wipe and lightly clean the probe with a sorbent pad, and repeat the process -- it is important to double check all measurements.

8. Clean the probe and tape thoroughly before winding it back onto the spool; use sorbent pads, liquinox, and distilled water.

9. If a petroleum (or other) sheen was detected from the probe, check for petroleum sheen or thickness visually, using a clear bailer and record its appearance.

10. Record any well repair or replacement parts needed (caps, bolts, etc.);

11. Cap the well and lock it if appropriate; wipe top of casing and cap, clean the roadbox cover gasket, if present; close and bolt (or lock) the protective casing; replace the lock and/or cap, if missing.

12. Record all measurements and observations on a Site Visit Report form (see attachment); be sure to fill in the form completely including date, time, project number, and your name; use the abbreviation "NA" for areas where no data is available.

Guidelines

- Never use a water level indicator in a well which may contain, or has historically contained, liquid-phase petroleum

- If the water level indicator is inadvertently immersed in liquid-phase petroleum, **do not wind the probe and tape up onto the spool**. Instead, retract the probe and tape, wipe with sorbent pads, and thoroughly decontaminate the probe and tape using appropriate decontamination procedures; inform the branch geoscience manager if a WLI has been exposed to liquid-phase petroleum

- Always gauge wells in order from least to most contaminated based on previous data; it may help to dedicate the ORS Interface Probe (SOP 1.1.1.1) for wells with liquid-phase petroleum

- Be consistent and establish a routine

- Prior to gauging wells, inform appropriate parties (e.g. the station manager) of your arrival at the site and the purpose of your visit

- For field usage; if a probe is missing any segment of the tape, make a notation on the gauging form (e.g. "subtract 1.23-feet from all readings"); read the measurement directly from the tape, the data will be corrected when it is entered into the computer; for this reason, always use the same instrument at a given site; make a note of the replacement part needed and get the unit repaired

- Compare current measurements to previous measurements; as a rule-of-thumb, current groundwater elevations should be somewhat similar to previous elevations (within one-foot to two-feet, maximum); if a drastic difference is noted, double check the measurement and call the Project Manager;

- Note any unusual occurrences at the site such as bacterial buildup on equipment; at sites where remedial systems are operating, check to see that the equipment is running normally

- It is important to keep probes clean and free of dirt; always clean probe tape **before** reeling it onto the spool; use a sorbent pad, liquinox, and distilled water

- When petroleum is detected in a well, confirm the reading with a clear bailer; note the color and clarity of the petroleum on the gauging form; bail the petroleum from the well and store it in a product storage tank or drum at the site

- If petroleum is detected in a well where it has not been detected before, or has not been detected in several previous gauging events, verify the reading with a clear bailer; communicate this to the Project Manager when you call the office

- If a petroleum storage tank is in use at the site, gauge the DTW and DTP in the tank using a tank stick and water paste; record the measurements on the monitoring form; notify the Project Manager if the tank is almost full

- **WRITE DOWN EVERYTHING YOU SEE OR DO** in a field notebook; no matter how hard you try, you cannot remember everything you did when back at the office

- Complete all paperwork (monitoring form) while at the site; note the weather, temperature, status of equipment, model-number of probe used, whether water samples were collected, etc.; if questioned by the client or regulatory representatives, note the name and affiliation of the person(s), questions asked, and answers given

- Call the Project Manager prior to leaving the site; do not leave the site without contacting the Geoscience Services Division if you encounter any problems

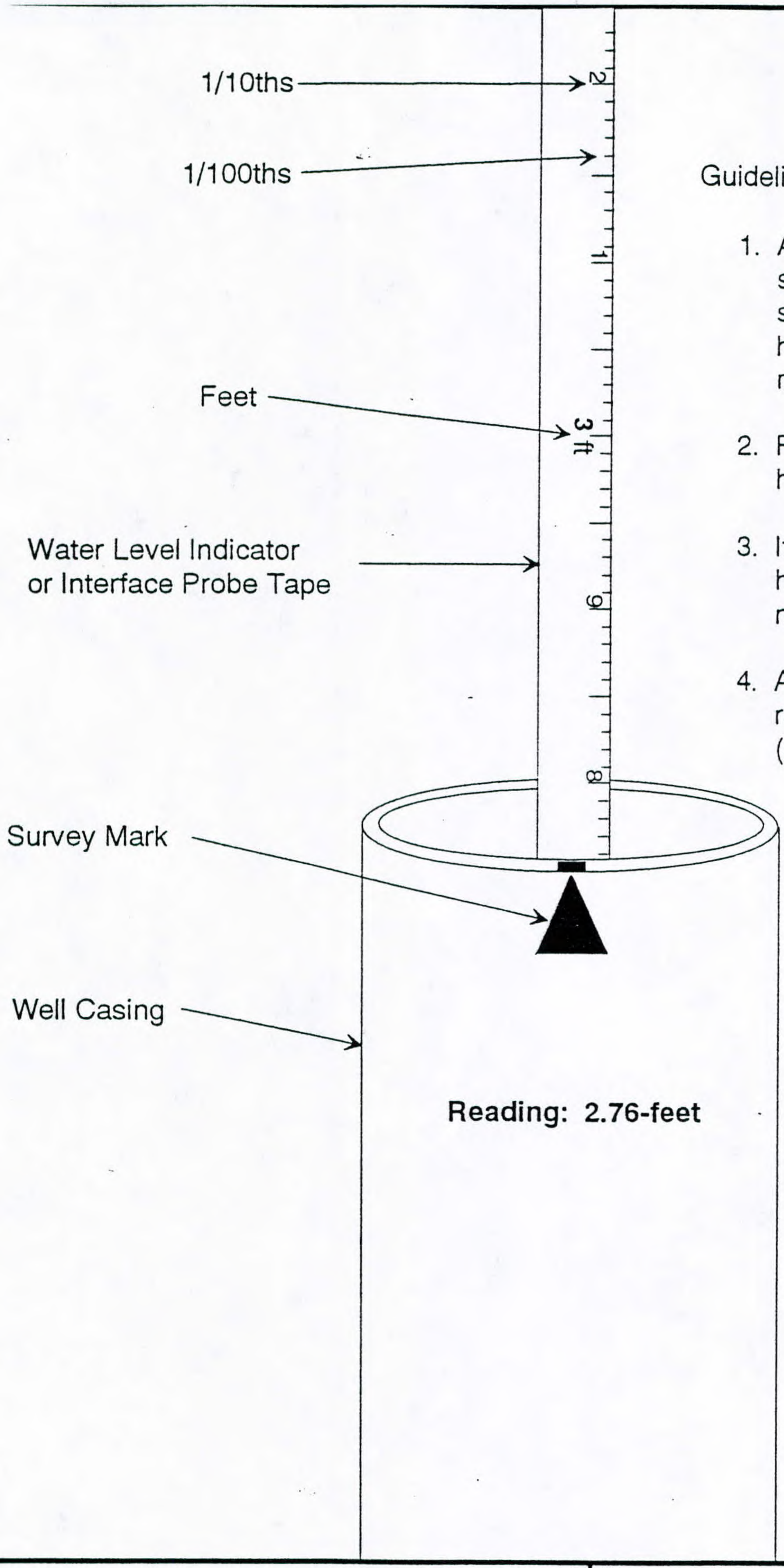
- When you return to the office, submit all paperwork to the Project Manager

- Always store the WLI in its protective box or case; do not let it get bumped, banged, dropped, or knocked around in any way

- Do not hesitate to call the Project Manager with any questions while on site; it is better to call and ask than to guess and be wrong

- If the well contains a dedicated bailer, leave the bailer in the well when taking groundwater measurements; if a bailer blocks the well and a reading is unobtainable, remove the bailer slowly and let the well recover for ten-minutes before gauging; note this process.

Author: Dave Lipson
Rev.: 9/16/94



Guidelines:

1. Always read the tape at the well survey mark. If there is no survey mark, read the tape at the highest point on the casing and make a new mark there.
2. Read feet first, then tenths, then hundredths.
3. If the reading is between hundredths, round up to the nearest hundredth.
4. Always record hundredths of feet, regardless of the number (e.g. 4.10-feet ; 5.00-feet).

Environmental Products & Services, Inc.	Date: September, 1994	Project No.: SOP
Measuring Water Levels With the Interface Probe or Water Level Indicator	Scale: Not to Scale	Figure No.:
	Drawn By: DSL	Location:

SITE VISIT REPORT

Groundwater Sampling/Groundwater Remediation System

Date: 6/30/94

Job #: X0002

PC: 065

Site Name: Service Station

Time on Site:

From: 10:00 am/

To: 11:30 am/

FLOW METER DATA

Unit	GPM	Totalizer (gal)
WTDP No. 1	5.5	123,723.49
WTDP No. 2	4.7	579,630.2
WTDP No. 3	—	—
Stripper Outlet	—	—
Other	—	—

RECOVERY TANK DATA

	Stick To: (Total Depth)	Inches Water:	Inches Product:
Tank No. 1	NA		
Tank No. 2			

WELL STATUS/PRODUCT THICKNESS/SAMPLING DATA (2" => 0.16. 4" => 0.65)

Well I.D.	Depth to Product (ft.)	Depth to Water (ft.)	Product Thickness (ft.)	Depth to Bottom (ft.)	Well Volume (gal.)	No. Vol's Removed (gal.)	Color		Appearance		Odor		Sheen	
							Start	Sample	Start	Sample	Start	Sample	Start	Sample
RW1														
RW2	NA													
RW3														
MW1		12.27												
MW2		13.02												
MW3		12.53												
MW4		12.79												
MW5														
MW6														
MW7														
MW8														
MW9														
MW10														
MW11														
MW12														

Weather:

Samples collected for analysis: ☐ Yes ☐ No

If yes, provide Chain of Custody Number(s):

COMMENTS (Status of panel lights; system operational?; maintenance/repairs performed or needed, etc.)

- Sheen observed at MW-1; decontaminated probe w/ Hexane, Liquinox, and distilled water
- Fixed gasket at MW-2
- Water in roadbox at MW-3

Field Technician Name: David Lipson **Field Technician Signature:** David S. Lipson

Environmental Products & Services, Inc.

2033.08B.200.9205

White - CORPORATE GEOTECH DEPARTMENT **Canary - GEOLOGIST/PROJECT COORDINATOR** **Pink - FIELD TECHNICIAN**

Geoscience Services Division Standard Operating Procedure

1.1.2.2

TITLE: Groundwater Sampling Collection for Volatile Organic Compounds with an Open Bailer

DATE: September 16, 1994

Purpose:

Groundwater sample collection and analysis remains one of the Hydrogeologist's most important tools for delineating the type and extent of groundwater contamination. This Standard Operating Procedure (SOP) reviews the procedure to follow to assure quality assurance and quality control for the collection of groundwater samples to be analyzed for Volatile Organic Compounds (e.g. EPA Methods 503.1, 602, 8020, 8021, and others). This SOP assumes that groundwater gauging and well purging will be been done in accordance with other SOPs.

Equipment:

- Field Book
- Indelible Marker
- Disposable or Stainless Steel Bailers
- Sampling Rope
- Alconox and Liquinox solutions
- Deionized Water
- Spray Bottles (spritzers)
- Disposable Sampling Gloves
- 40 ml VOA vials
- Sample Preservative (lab specific)
- Sterile Syringe or Medicine Dropper
- Cooler (large enough to store all samples)
- Ice (enough to lower temperature of cooler to 4°C)

Paperwork (in order of completion):

- Laboratory Log Number Analysis Index
- Purchase Order
- Alternative Laboratory Record
- Sample Submittal Form for NYS DEC Projects
- Sample Labels
- Chain of Custody Record form
- Site Visit Report form
- Daily Job Report Form

Procedure:

Prior to sampling

1. Call the laboratory that will be performing the analyses and request the appropriate glassware, preservatives, and other relevant materials and/or documentation.

2. If the laboratory is not preserving the glassware, then, in a sterile atmosphere, prepare the sample vials with the sample preservative as directed by the lab. Be certain to wear sampling gloves at all times and use an equal amount of preservative in each vial.

3. Check to see that all necessary equipment (sample vials, cooler, bailer, etc.) are within reach of the sample area.

4. Wear sampling gloves at all times and replace them if you suspect the gloves have been contaminated.

5. Open sample vials, and open the caps loosely, leaving the caps on the vial. Place vials on a fresh section of aluminum foil beside the well to be sampled with the caps loosely in place. Do not place caps open end down on the ground or on anything else.

6. Calculate the well volumes and purge the wells in accordance with SOP 1.1.2.1.

7. Obtain of copy of past analytical results for samples previously collected from the site.

Paperwork

1. Obtain a sample number by completing a new entry in the Laboratory Log Book on the "Laboratory Log Number Analysis Index" form (see attached for example).

2. If the samples will be submitted to a laboratory other than Environmental Laboratory Services, Inc., obtain a Purchase Order (PO) number from the branch administrative assistant and complete a "PO" form (see attached for example). Also, complete an "Alternative Laboratory Record" from (see example).

3. If the samples collection and analysis are to be billed to the NYS DEC, complete a "Sample Submittal Form for NYS DEC Projects" form (see attached).

4. Complete one (1) "Sample Label" for every sample collected, including duplicates, field blanks, and trip blanks (see attached).

5. Complete a "Chain of Custody Record" form while on site.

6. Complete a "Site Visit Report" form while on site.

7. Complete a "Daily Job Report" form.

Sampling

1. If the well has been purged by a means other than a stainless steel bailer or a disposable bailer, prepare a properly decontaminated stainless steel or disposable bailer with a rope.

2. Lower the bailer into well slowly until you have reached the water table, and fill the bailer with groundwater from the top column of water.

3. Bring the bailer to the surface, and hold in air with one arm, do not allow the bailer or the rope to come in contact with anything.

4. With free hand, remove cap from sample vial.

5. Keep in mind when filling the sample vials that after the cap is replaced, there can be no air pockets with in the vial. In addition, the bailer and the rope must remain in your hands and away from contact with anything until all samples from that well have been taken. Both samples should be taken from the same grab, if possible.

6. Collect a sample by one of the following two methods;

    - Collect sample from open top of bailer (this is the preferred method of sampling). Hold bailer below the midway point with one hand. In other hand hold the sample vial with all fingers wrapped around it and extend thumb upwards in a "hitch-hiker like" position. Utilizing your thumb to balance and control the bailer, tilt the bailer over the vial and gently fill. Tap out any air bubbles as you fill the vial. Gently fill the vial so that you create a mound of groundwater above the top of the vial (do not overfill the sample vial as you may lose your preservative). When the vial is nearly full, you may find it helpful to fill the cap with groundwater, and empty the cap into the vial in order to create the mound (do not let the septum fall out). Cap the vial and invert, tap the vial against your hand and check for air pockets. If you do have an air pocket, you must uncap the vial, chase the air-pocket to the top (by tapping), create a new mound, recap, and check for air pockets (bubbles). Repeat these final steps until the sample is complete.

- Collect a sample from the bottom of the bailer. Use this method only if it is impossible to collect a sample from the top of the bailer. The chances of cross-contamination are greatly increased when sampling from the bottom of bailers.

  Hold bailer below the midway point with one hand. In other hand hold the sample vial with fingers wrapped around it and extend thumb upwards in a "hitch-hiker like" position or extend your fore finger and reposition the vial. Utilize your thumb or fore finger to elevate the ball (check valve) within the bailer to allow groundwater to exit through the bottom. Use this flow to fill the sample vial. The disposable bailers should come with an attachment that can be inserted into the bailer from the bottom that will not only depress the check valve, but provide a channel through which the fluid can pass. Tap out any air bubbles as you fill the vial. Gently fill the vial so that you create a mound of groundwater above the top of the vial (do not overfill the sample vial as you may lose your preservative). When the vial is nearly full, you may find it helpful to fill the cap with groundwater, and empty the cap into the vial in order to create the mound (do not let the septum fall out). Cap the vial and invert, tap the vial against your hand and check for air pockets. If you notice an air pocket, you must uncap the vial, chase the air-pocket to the top (by tapping), create a new mound, recap, and check for air pockets (bubbles). Repeat these final steps until the sample is complete.

Post Sampling

1. Decontaminate the stainless steel bailers (if applicable) for reuse later and dispose of the other materials (sample gloves, aluminum foil, etc.).

2. Label the sample vials appropriately (see example attached).

3. Without exception, all groundwater sampling activities should be documented in a field book. A sample field book entry is attached.

   - Name of sample collector
   - Names of other relevant people on site
   - Weather
   - Method of well purging
   - Collection method

- Types of sample containers used and identification numbers
- Preservatives used
- Analysis parameters
- Identification of the well
- Well depth
- Static water level depth
- Visual/ Odor presence of petroleum
- Well volume and volume purged
- Date and time of sample collection
- Field observations (groundwater color, recharge rates, etc.)

4. Place the labeled sample vials into the cooler.

5. Complete any additional paperwork required by the client.

Guidelines

1. Always complete a chain-of-custody form while on site using the information from the field note book (see attached example). The chain-of custody form must accompany the samples at all times and must be signed by sample collectors, relinquishers, and recipients. Incomplete chain-of-custody forms immediately invalidate a sampling effort and result in resampling at the company's expense.

2. Do not sample wells that contain liquid-phase petroleum or a petroleum sheen after purging. Mention the presence of petroleum sheens or odors in the field note book and on the chain-of-custody form.

3. Do not sample wells with bailers that have come into contact with liquid-phase petroleum.

4. Always sample the wells in order from least contaminated to most contaminated based on past analytical results. If no past analytical results exist, the sampling order should be from wells furthest from a contaminant source to wells closest to a contaminant source. If you are unsure about sampling order, call the project or branch geoscience manager and ask.

5. Complete as many forms as possible while on site (e.g. Sample Labels, Chain of Custody, Site Visit Report, and Daily Job Report).

6. If a well is found to contain liquid-phase petroleum that was previously unaffected, call and inform the project or branch Geoscience Manager.

7. If you have any questions in the field, or are unsure about any of these procedures or protocols, call and ask.

Author: Christopher Staiti
Rev.: 10/27/94

LABORATORY LOG NUMBER ANALYSIS INDEX

Lab Log No.	Generator Name	Job No.	Laboratory	Date Sample Taken	Initials of Sampler
X-2047A-6	NYSDEC, Region 14, Typical Petroleum, Inc.	X9999	Typical Laboratory, Inc.	9/19/94	JS.

Environmental
PRODUCTS & SERVICES, INC.

P.O. Box 369
Liverpool, NY 13088
(315) 451-6666
FAX (315) 457-6652

PURCHASE ORDER

Show this Purchase Order Number on all correspondence, invoices, shipping papers and packages. №

DATE 9/19/94	REQUISITION NO. 1-111
SHIP TO NYS DEC, Region 14 Arthur Dodsberry Spill # 94-0001 PIN # SP-9999	

TO Typical Laboratories, Inc.
666 Devil's Advocate Drive
Syracuse, NY, 88888

QUOTED BY Tony

REQUISITIONED BY	WHEN SHIP	SHIP VIA	F.O.B. POINT	TERMS
JS				

QTY. ORDERED	QTY. RECEIVED	STOCK NO./DESCRIPTION	UNIT PRICE		TOTAL	
7		EPA Method 8020	$50.	00	$350.	00

White - CORPORATE BILLING
Canary - BRANCH BILLING
Pink - CORPORATE ACCOUNTING
Goldenrod - VENDOR COPY

AUTHORIZED BY B. Manager

2027.014.9206

Instructions: Complete this form for any analytical work sent to a laboratory other than Environmental Laboratory Services. Please print all information as indicated. Send completed forms to the Corporate Environmental Department.

Date: 9/19/94 Job No.: X9999 Branch: Corporate

Customer Name: NYS DEC, Region 14, Arthur Dodsberry, Spill # 94-0001 PIN# SP-9999

Project Manager: John Smith

Laboratory Used: Typical Laboraties, Inc.

Sample Log Number(s):

X-2047A-G

Reason for selecting an alternative laboratory:

☐ Job was direct referral from outside laboratory

☐ Sample requiring state certification was collected from a state other than CT, DE, MA, NH, NY, PA, or VT. (Please identify state: ________)

☐ Urgent turnaround demands required immediate sample submission to a local laboratory:

Analyte(s) ________ Turnaround Time ________

☐ Estimated sample shipment cost exceeds 15% of analytical work

☒ Other: NYS DEC Requirement

Approvals:

Environmental Coordinator:*

E. Coordinator	EC	9/19/94
name	signature/initial	date

Environmental Department Review:

E. Manager	E.M.	9/19/94
name	signature/initial	date

**Branch Manager may endorse in Environmental Coordinator's absence.*

SAMPLE SUBMITTAL FORM FOR NYS DEC PROJECTS

Instructions: Fill out this form completely when submitting samples to be billed to the New York State Department of Environmental Conservation.

[illegible]pany Submitting Sample Environmental Products & Services, Inc. Date 9/19/94

Contract Area: (Please check one) ☒ Spill ☐ Hazardous Materials

Spill No. 94-0001

PIN SP-9999

Lab Log No. X2047-A-G

Job No. (Optional) X9999

Spill Site NYS DEC, Region 14, Typical Petroleum, Inc. Rt 66

NYS DEC Region: (Please check one)

Regional Contact Arthur Dodsberry

REGION 1

☐ Region 1
SUNY Campus, Bldg. 40
Stony Brook, NY 11794

REGION 2

☐ Region 2
Hunters Point Plaza
47-80 21st St.
Long Island City, NY 11101

[illegible]ION 3

☐ [illegible]egion 3
[illegible]1 South Putt Corners Rd.
New Paltz, NY 12561

☐ Region 3 SUB-OFFICE
202 Mamaroneck Ave.
White Plains, NY 10601

☐ Region 3 SUB-OFFICE
Stoney Kill
Route 9D
Wappinger Falls, NY 12590

REGION 4

☐ Region 4
2176 Guilderland Ave.
Schenectady, NY 12306

☐ Region 4 SUB-OFFICE
Route 10, Jefferson Rd.
Stamford, NY 12167

☐ Region 4 SUB-OFFICE
P.O. Box 430
Catskill, NY 12414

REGION 5

Region 5
[illegible]oute 86
[illegible]ay Brook, NY 12977

☐ Region 5 SUB-OFFICE
Box 220
Hudson St. Extension
Warrensburg, NY 12885

☐ Region 5 SUB-OFFICE
Main St. Extension
Northville, NY 12134

REGION 6

☐ Region 6
State Office Building
317 Washington St.
Watertown, NY 13601

☐ Region 6 SUB-OFFICE
30 Court St.
Canton, NY 13617

☐ Region 6 SUB-OFFICE
State Office Building
207 Genesee St.
Utica, NY 13501

☐ Region 6 SUB-OFFICE
RD 3, Box 22A, Route 812
Lowville, NY 13367

☐ Region 6 SUB-OFFICE
225 N. Main St.
Herkimer, NY 13350

REGION 7

☐ Region 7
615 Erie Blvd. W.
Syracuse, NY 13204

☐ Region 7 SUB-OFFICE
PO Box 1169, Fisher Ave.
Cortland, NY 13045

☐ Region 7 SUB-OFFICE
Route 11
Kirkwood, NY 13795

☐ Region 7 SUB-OFFICE
Route 80
Sherburne, NY 13480

REGION 8

☐ Region 8
6274 E. Avon-Lima Rd.
Avon, NY 14414

☐ Region 8 SUB-OFFICE
7291 Coon Rd.
Bath, NY 14810

☐ Region 8 SUB-OFFICE
180 Clemans Ctr. Parkway
Elmira, NY 14901

REGION 9

☐ Region 9
600 Delaware Ave.
Buffalo, NY 14202

☐ Region 9 SUB-OFFICE
215 South Work St.
Falconer, NY 14733

☐ Region 9 SUB-OFFICE
128 South St.
Olean, NY 14760

☐ Region 9 SUB-OFFICE
RD1, Angelica Rd.
Belmont, NY 14813

☒ OTHER:
Region 14

Example of
Sample Label

Environmental Products & Services, Inc.

Job No.: X-9999 EPS Lab Log No.: X-2047A

Date: 9/19/94 Time: 1:30 PM

Sample ID/Desc.: MW-1

Collected by: J.S. Preservative: HCl

Test for: EPA 8020

Environmental
PRODUCTS & SERVICES, INC.

(315) 471-050 (800) 843-8265

CHAIN OF CUSTODY RECORD

EPS LAB LOG NO. X 047A-G

JOB NUMBER: X-9999 PIN NUMBER: SP-9999
P.O. NUMBER: 1-111 SPILL NUMBER: 94-0001

EPS CONTACT: John Smith

REPORTING REQUIREMENTS (other than mail):
☐ PHONE NO.:
☒ FAX NO.:

TURN AROUND TIME
24-HOUR ☐
48-HOUR ☐
NORMAL ☒
OTHER ☐

SPECIAL DETECTION LIMITS
Yes ☒ No ☐
(Specify) 1.0 ug/L

SPECIAL QA/QC LEVEL
Yes ☐ No ☒
(Specify)
WASTE SAMPLE
Yes ☐ No ☒

CONTAINER TYPE:
V - VOA VIALS
G - GLASS
P - PLASTIC
O - OTHER

SAMPLE TYPE:
G - GRAB
C - COMPOSITE
W - WIPE
SS - SURFACE SCRAPE
O - OTHER (SPECIFY)

ANALYSIS REQUESTED

For Lab Use Only	SAMPLE I.D./ DESCRIPTION	DATE	TIME	CONTAINER Number	CONTAINER Size	CONTAINER Type (Enter Code)	MATRIX Groundwater	MATRIX Soil	MATRIX Sludge	MATRIX Other	TYPE (ENTER CODE)	PRESERVATIVE HCl	PRESERVATIVE HNO_3	PRESERVATIVE H_2SO_4	PRESERVATIVE Ice (4°C)	PRESERVATIVE Teflon Liner	PRESERVATIVE Filtered	PRESERVATIVE Other	CORROS ☐ FLASH ☐ REACT ☐ pH ☐	TCLP: METALS ☐ VOA ☐ SEMI-VOA ☐	TCLP: PEST ☐ HERB ☐	TOTAL METALS ☐ LIST:	OIL AND GREASE: EPA 413.1 ☐ EPA 413.2 ☐	TPH: EPA 418.1(IR) ☐ NYS DOH 310-13(GC) ☐	EPA 503.1 ☐ EPA 524 ☐ WITH MTBE ☐	EPA 601 ☐ EPA 8010 ☐	BTEX: EPA 602 ☒ EPA 8020 ☐ WITH MTBE ☒	EPA 608 ☐ EPA 8080 ☐ PCB ONLY ☐	EPA 624 ☐ EPA 8240 ☐ (+15) ☐ EPA 8260 ☐	EPA 625 ☐ EPA 8270 ☐ (+25) ☐ EPA 8250 ☐			SPECIAL INSTRUCTIONS / COMMENTS
	X2047A (MW-1)	9/19/94	1:30P	2	40ml	V	X				G	X															X						
	X2047B -MW2	9/19/94	1:45P	2	40ml	V	X				G	X															X						
	X2047C -MW3	9/19/94	2:00P	2	40ml	V	X				G	X															X						
	X2047D -MW4	9/19/94	2:15P	2	40ml	V	X				G	X															X						
	X2047E -MW5	9/19/94	2:30P	2	40ml	V	X				G	X															X						Mild Odor
	X2047F -MW6	9/19/94	2:45P	2	40ml	V	X				G	X															X						Moderate Odor
	X2047G -MW7	9/19/94	3:00P	2	40ml	V	X				G	X															X						Strong Odor

CUSTODY TRANSFERS

		DATE	TIME		DATE	TIME
SAMPLED BY:	John Smith					
RELINQUISHED BY:	John Smith	9/19/94	4:00P	RECEIVED BY:		
RELINQUISHED BY:				RECEIVED AT LAB BY: Joe Technician	9/19/94	4:00P

LABORATORY: Typical Laboratories, Inc.
ADDRESS: 666 Devil's Advocate Road.

White - LABORATORY Canary - CORPORATE ENVIRONMENTAL Pink - PROJECT COORDINATOR Goldenrod - BRANCH FILE

2202.ENV.202.9307

SITE VISIT REPORT

Groundwater Sampling/Groundwater Remediation System

Date: 9/19/94
Job #: X9999
PC: J Smith
Site Name: Typical Petroleum Inc.

Time on Site:
From: 10:00 am/~~pm~~
To: 3:30 ~~am~~/pm

FLOW METER DATA

Unit	GPM	Totalizer
WTDP No. 1	N/A	
WTDP No. 2		
WTDP No. 3		
Stripper Outlet		
Other ______		

RECOVERY TANK DATA

	Stick To: (Total Depth)	Inches Water:	Inches Product:
Tank No. 1	N/A		
Tank No. 2			

WELL STATUS/PRODUCT THICKNESS/SAMPLING DATA (2" => 0.16, 4" => 0.65)

Well I.D.	Depth to Product (ft.)	Depth to Water (ft.)	Product Thickness (ft.)	Depth to Bottom (ft.)	Well Volume (gal.)	No. Vol's Removed (gal.)	Color		Appearance		Odor		Sheen	
							Start	Sample	Start	Sample	Start	Sample	Start	Sample
RW1	N/A													
RW2														
RW3														
MW1	None	6.42	0	18.70	7.98	24	clear	clear	clear	clear	None		None	
MW2	None	7.49	0	17.60	6.60	19.7	tan	tan	turbid	turbid	None		None	
MW3	None	8.79	0	22.00	8.60	25.8	clear	clear	clear	clear	None		None	
MW4	None	8.97	0	26.00	11.10	33.2	tan	tan	turbid	turbid	None		None	
W5	None	5.21	0	15.10	6.40	19.3	tan	tan	turbid	turbid	Mild		None	
MW6	None	4.99	0	16.20	7.30	21.9	clear	clear	clear	clear	Moderate		None	
MW7	None	6.43	0	21.30	9.70	29.0	clear	clear	clear	clear	Strong		None	
MW8														
MW9														
MW10														
MW11														
MW12														

Weather: 70°, Sunny, No Wind

Samples collected for analysis: ☒ Yes ☐ No
If yes, provide Chain of Custody Number(s): Lab Log # X2047A-G

COMMENTS (Status of panel lights; system operational?; maintenance/repairs performed or needed, etc.)

- Gauged all wells w/ ORS interface probe
- Used disposable Bailers
- Used Typical Laboratories, Inc.

Field Technician Name: John Smith **Field Technician Signature:** John Smith

Environmental Products & Services, Inc.

2033.08B.200.9205

White - CORPORATE GEOTECH DEPARTMENT **Canary - GEOLOGIST/PROJECT COORDINATOR** **Pink - FIELD TECHNICIAN**

APPENDIX E

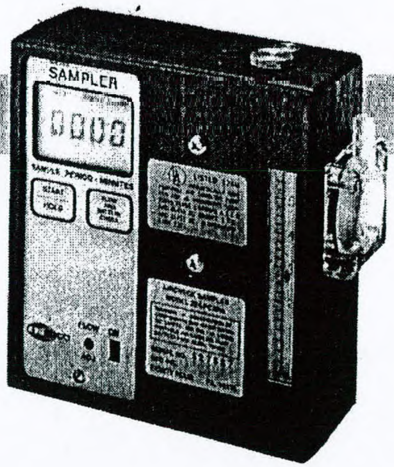
Equipment Instruction/Owner's Manuals

SKC®

Universal Sample Pump

Operating Instructions

Catalog No. 224-PCXR4



SKC®

Operating Instructions

Universal Sample Pump

Catalog No. 224-PCXR4

SKC Inc.
863 Valley View Road
Eighty Four, PA 15330 USA

Form #37712 Rev 9904

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Inhaltsverzeichnis

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Description

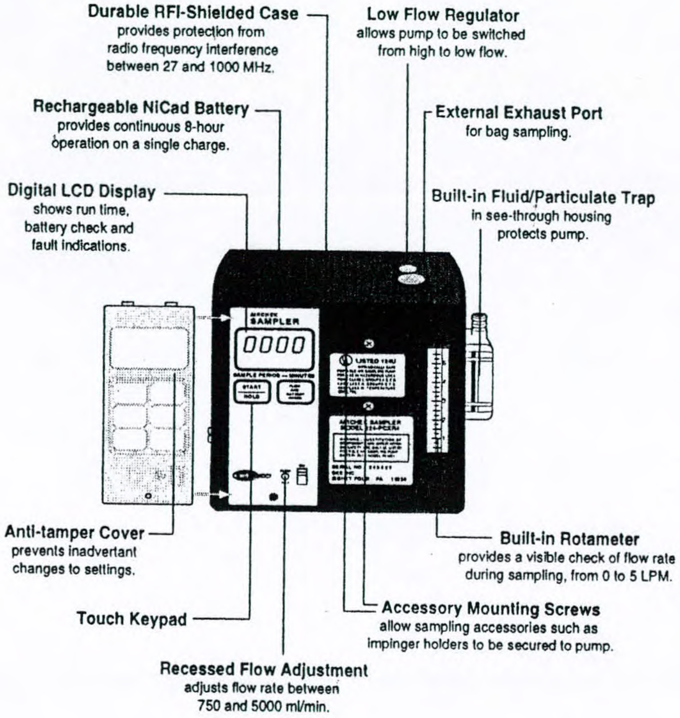
The result of extensive research and development, the PCXR4 is a constant flow air sampler suited for a broad range of applications. It is ideal for industrial hygiene studies as well as environmental testing.

Specifically designed for "on worker" and "fenceline" applications, the PCXR4 is typically used with collecting devices such as filters, impingers, sorbent sample tubes and sample bags.

Descripción

El resultado de un proceso exhaustivo de investigación y desarrollo, el PCXR4 es un dispositivo de muestreo de aire de flujo constante apropiado para una amplia gama de aplicaciones. Es ideal para estudios de higiene industrial al igual que las pruebas ambientales.

Diseñado específicamente para las aplicaciones "sobre el trabajador" y de "monitoreo perimetral", el PCXR4 es utilizado típicamente con dispositivos de colección, tales como filtros, golpeadores, tubos de muestras de sorbentes y bolsas de muestras.



Beschreibung

Das Ergebnis intensiver Forschung die PCXR4 ist eine Konstantfluß-Probenahmepumpe für einen breiten Anwendungsbereich. Sie ist ideal für Luftprobenahme und Umweltschutz geeignet.

Speziell für personenbezogenen und stationären Einsatz konzipiert wird die PCXR4 mit Sammeleinrichtungen wie Filter, Impinger, Adsorptionsröhrchen und Gasbeuteln eingesetzt.

Description

Fruit d'une recherche et d'un développement intensifs, le modèle PCXR4 est un appareil d'échantillonnage d'air à débit constant, approprié pour une vaste gamme d'applications. Il est idéal aussi bien pour les études d'hygiène industrielle que pour les contrôles de l'environnement.

Spécialement conçu pour les applications "sur employé" et "en bordure de site", le PCXR4 est habituellement utilisé avec des dispositifs de prélèvement tels que filtres, barboteurs, tubes de sorbant et sacs d'échantillonnage.

Specifications

Operating Range:	5-5000 ml/min (5-500 ml/min requires adjustable low flow holder)
Weight:	34 oz (964 gm)
Dimensions:	1.9 x 4.7 x 5.1 inches; 46.5 cubic inches (4.9 x 11.9 x 13 cm, 758 cubic cm)
Compensation Range:	750 to 2500 ml/min—to 40 inches water back pressure 2500 to 4000 ml/min—to 20 in water back pressure
Flow Control:	±5% set point constant flow
Run Time:	8 hrs min at 4000 ml/min & 20 in water back pressure
Flow Indicator:	Built-in flow indicator with 250 ml division; scale marked at 1, 2, 3, 4, & 5 LPM
Battery Assembly:	Plug in battery pack, rechargeable NiCad 2.0 Ah, 6.0 V UL Listed.
Intrinsically Safe:	UL Listed for: Class I, Groups A, B, C, D; Class II, Groups E, F, G; and Class III. Temp Code T3C.
Operating Temp:	-20 C to +45 C (-4 F to +113 F)
Storage Temp:	-40 C to +45 C (-40 F to +113 F)
Charging Temp:	+5 C to +45 C (+41 F to +113 F)
Operating Humidity:	0 to 95% Relative
Multiple Sampling:	Built-in constant pressure regulator allows user to take up to four simultaneous samples at different flow rates up to 500 ml/min (maximum total combined flow 1350 ml/min) using optional low flow control.
RFI-Shielding Performance:	Complies with requirements of EN 55022, FCC Part 15 Class B, EN 50082-1, Frequency range of the radiated susceptibility test was 27 MHz to 1000 MHz. CE approved.

Especificaciones

Gama de funcionamiento:	5-5000 ml/min (5-500 ml/min requiere portatubo de flujo ajustable)
Peso:	34 oz (964 gm)
Dimensiones:	1.9 x 4.7 x 5.1 pulgadas; 46.5 pulgadas cúbicas (4.9 x 11.9 x 13 cm, 758 cm cúbicos)
Alcance de Compensación:	750 a 2500 ml/min--a contrapresión de 40 pulgadas 2500 a 4000 ml/min--a contrapresión de 20 pulgadas
Control de Flujo:	±5% punto de fijación de flujo constante
Tiempo de Marcha:	8 hrs mín a 4000 ml/min y contrapresión de agua de 20 pulgadas
Indicador de Flujo:	Indicador de flujo integral con división de 250 ml; escala marcada a 1, 2, 3, 4, y 5 LPM.
Ensamblado de Batería:	Estuche de batería enchufable, NiCad recargable 2.0 Ah, 6.0 V, Listado UL.
Intrínsicamente Seguro:	Enlistado por UL para: Clase I, Grupos A, B, C, D; Clase II, Grupos E, F, G, y Clase III. Código de Temperatura T3C.
Temp. de Funcionamiento:	-20 C a +45 C (-4 F a +113 F)
Temp. de Almacenamiento:	-40 C a +45 C (-40 F a +113 F)
Temp. de Carga:	+5 C a +45 C (+41 F a +113 F)
Humedad de Funcionamiento:	Humedad Relativa de 0 a 95%
Muestreo Múltiple:	Regulador integral de presión constante permite que el usuario tome hasta cuatro muestras simultáneas a distintas tasas de flujo hasta 500 ml/min (flujo total combinado máximo de 1350 ml/min) utilizando el control opcional de flujo bajo.
Rendimiento del blindaje RFI:	Cumple con los requisitos de EN55022, FCC Parte 15, Clase B, EN50082-1. El alcance de frecuencia de la prueba de susceptibilidad radiada fue de 27 MHz a 1000MHz. Aprobado CE.

Spezifikationen

Arbeitsbereich:	5-5000 ml/min (5-500 ml/min erfordert einstellbaren Halter)
Gewicht:	964 g
Maße:	4.9 x 11.9 x 13 cm, 758 ccm
Kompensierung:	750-2500 ml/min bis 1m WS 2500-4000 ml/min 0.5 m WS
Flußkonstanz:	± 5% vom eingestellten Wert
Betriebszeit:	Mindestens 8 Std.bei 4000 ml/min und 0.5 m WS Druckabfall
Flußanzeige:	Eingebaute Anzeige mit 250 ml-Teilung und Markierungen bei 1,2,3,4,5 L/min
Batteriepack:	Eingesteckter aufladbarer NiCd-Pack 2.0 Ah, 6.0V, UL-Zugelassen
Innensicher:	UL für Klasse I, Gruppe A,B,C,D; Klasse II, Guppen E, F, G und Klasse III. Tempcode T3C.
Betriebstemperatur:	-20 °C bis + 45°C
Lagertemperatur:	-40 °C bis +45 °C
Ladetemperatur:	+5 °C bis +45 °C
Luftfeuchtigkeit:	0-95 % Relativ
Mehrfachproben:	Eingebauter Konstantdruckregler ermöglicht simultan bis zu vier Proben mit verschiedenen Flüssen bis zu 500 ml/min (Gesamtfluß max 1350 ml/min) mit zusätzlichem einstellbaren Halter.
RFI-Abschirmung:	Entspricht den Anforderungen von EN 550022, FCC Part 15 Class B, EN 50082-1, Frequenzbereich beim Test war 27 MHz bis 1000 MHz. CE-zugelassen.

Spécification

Gamme d'opération:	5-5000 ml/min (5-500 ml/min demande un support à débit réglable)
Poids:	964 g (34 onces)
Dimensions:	4,9 x 11,9 x 13 cm, 758 cm3 (1-15/16 x 4-11/16 x 5-1/8 po., 46,5 po)
Plage de compensation:	750 à 2500 ml/min -- 100 mbar (40 po. d'eau) de contre-pression 2500-4000 ml/min -- 50 mbar (20 po. d'eau) de contre-pression
Contrôle de débit:	Débit constant à ±5% de la valeur de référence
Durée de fonctionnement:	8 heures à 4000 ml/min et 50 mbar (20 po. d'eau) de contre-pression
Indicateur de débit:	Indicateur de débit incorporé gradué tous les 250 ml ; échelle marquée à 1, 2, 3, 4, et 5 l/min
Ensemble bloc d'alimentation:	Bloc d'alimentation à connecter, à piles NiCad de 2,0 Ah, 6,0 V, listé par UL.
Sécurité intrinsèque:	Listé par UL pour : Classe I, Groupes A, B, C, D; Classe II, Groupes E, F, G; et Classe III, Code de température T3C.
Temp. de fonctionnement:	-20°C à +45°C (-4°F à +113°F)
Temp. d'entreposage:	-40°C à +45°C (-40°F à +113°F)
Temp. de chargement:	+5°C à +45°C (+41°F à +113°F)
Humidité en fonctionnement:	0 à 95% humidité relative
Echantillonnage multiple:	Un régulateur incorporé de pression constante permet à l'utilisateur de prendre jusqu'à quatre échantillons simultanés à des débits différents jusqu'à 500 ml/min (maximum débit combiné total de 1350 ml/min), en utilisant le contrôleur de débit réduit en option.
Protection contre les interférences radios:	Selon les exigences de EN 55022, FCC Partie 15, Classe B, EN 50082-1, la gamme de fréquence de l'essai de susceptibilité de rayonnement a été de 27 MHz à 1000 MHz. Approuvé CE.

Specifications (cont)

Flow Fault:	Fault shutdown with LCD indicator and time display retention if flow is restricted.
Battery Test:	LCD indicator verifies battery condition prior to sampling.
Time Display:	LCD indicator displays sampler run time in minutes.
Timing Accuracy:	±0.05%
Sampling Pause:	Allows user to temporarily halt sampling without loss of timing data. Restart does not require resetting time.

Notice: This operating instruction may not address all safety concerns (if any) associated with this product and its use. The user is responsible for determining and following the appropriate safety and health practices and regulatory limitations (if any) before using the product. The information contained in this document should not be construed as legal advice, opinion, or as a final authority on legal or regulatory procedures.

Especificaciones (cont)

Falla de Flujo:	Apagado de falla con retención del indicador LCD y visualización de tiempo si el flujo está restringido.
Prueba de Batería:	El indicador LCD verifica el estado de la batería antes del muestreo.
Visualización de Tiempo:	El indicador LCD visualiza el tiempo de funcionamiento del muestreador en minutos.
Precisión de Cronometraje:	±0.05%
Pausa de Muestreo:	Permite que el usuario detenga el muestreo temporariamente sin pérdida de los datos de cronometraje. La reanudación no requiere el restablecimiento del tiempo.

Aviso: Estas instrucciónes no puedan hablar por todos los asuntos de seguridad (si alguno) con este producto y su uso. El que usa se debe determinar y seguir practicas y regulaciónes apropiadas para seguridad y salud. La información contenida en este documento no es aviso legal, opinión, or una autoridad última en procediemientos legales or reglamentarias.

Spezifikationen (Fortsetzung)

Fehlerzeichen:	Fehlerabschaltung mit Speicherung der Zeitanzeige bei Flußunterbrechung
Die Batteriestand:	LCD-Anzeige überprüft vor der Probenahme den Batterieladezustand
Die Zeitanzeige:	LCD-Anzeige der Sammelzeit in Minuten
Zeitgenauigkeit:	± 0.05%
Pause Probenahme:	Ermöglicht vorübergehend die Probenahme ohne Datenverlust zu unterbrechen. Wiederstart benötigt keine erneute Zeiteinstellung.

Spécification (cont)

Blocage du débit:	En cas de blocage, arrêt automatique signalé par l'indicateur à cristaux liquides et arrêt du compteur horaire.
Essai des piles:	L'indicateur à cristaux liquides confirme l'état des piles avant l'échantillonnage.
Affichage horaire:	Un indicateur à cristaux liquides affiche la durée d'échantillonnage en minutes.
Exactitude du compteur horaire:	± 0.05 %
Pause en cours d'échantillonnage:	Permet à l'utilisateur de suspendre temporairement le prélèvement des échantillons sans perte des données horaires. Il n'est pas nécessaire de modifier le compteur horaire lors du redémarrage.

ANMERKUNG: Diese Betriebsanleitung beschreibt nicht alle eventuell für dieses Produkt und seine Benutzung in Frage kommenden Sicherheitsaspekte. Es ist allein Sache des Anwenders vor der Benutzung dieses Produktes alle zutreffenden Sicherheits-und Schutzbestimmungen und gesetzliche Vorschriften einzuhalten. Die in dieser Betriebsanleitung enthaltenen Informationen sind keine juristischen oder gesetzlichen Vorschriften oder Anweisungen.

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Operation

High Flow Applications (750-5000 ml/min)

Setup

Fully charge the battery by connecting the charger plug to the sampler charging jack (Figure 1, #18). Use only an SKC charger designated for this model. **CAUTION: DO NOT CHARGE IN A HAZARDOUS ENVIRONMENT.** Using flexible tubing, connect the sampling media to the pump intake (Figure 1, #9). Make sure the pump is set for high flow. (See "Return to High Flow" p. 12).

Setting the Flow Rate

Test the battery pack by turning the sampler on using the ON/OFF switch (Figure 1, #4). Press the START/HOLD key then the FLOW AND BATTERY CHECK key. Adjust the flow to 2 L/min using the FLOW ADJUST SCREW (Figure 1, #7). The LCD should indicate "BATT OK" in the upper left corner, if not, recharge the battery. Press the FLOW AND BATTERY CHECK key to place the pump in "HOLD" mode.

Connect a flowmeter to the intake of the sampling media using flexible tubing. [For pressure applications, insert the exhaust port fitting into the exhaust port (Figure 1, #15) and connect the sample bag to this fitting.] Press the FLOW AND BATTERY CHECK key to start the pump and set the flow rate using the FLOW ADJUST SCREW (Figure 1, #7). When the flow rate is set, press the FLOW AND BATTERY CHECK key to place the pump in "HOLD".

Caution: When using impingers, place an in-line trap between the pump and the impinger to protect the sampler from liquid or vapors. **FAILURE TO USE THE IMPINGER TRAP VOIDS THE WARRANTY.** The impinger and trap may be mounted to the sampler using the accessory mounting screws (Figure 1, #8).

Funcionamiento

Aplicaciones de Flujo Alto (750-5000 ml/min)

Montaje

Cargue la batería plenamente al conectar el enchufe del cargador al receptáculo de carga del dispositivo de muestreo (Figura 1, 18). Solamente utilice un cargador SKC designado para este modelo. **PRECAUCION: NO CARGUE EN UN AMBIENTE PELIGROSO.** Haciendo uso de una tubería flexible, conecte el medio de muestreo a la entrada de la bomba (Figura 1,9). Asegúrese que la bomba se encuentre fijada en flujo alto. (Vea "Regreso al Flujo Alto", p.12).

Fijando la Tasa de Flujo

Pruebe el paquete de baterías al activar el muestreador mediante el uso del interruptor de ON/OFF (ENCENDIDO/APAGADO) (Figura 1,4). Oprima la tecla de START/HOLD (ARRANQUE/DETENCION) seguida por la tecla de FLOW AND BATTERY CHECK (VERIFICACION DE FLUJO Y DE BATERIA). Ajuste el flujo a 2 L/min utilizando el FLOW ADJ (TORNILLO DE AJUSTE DE FLUJO) (Figura 1,7). El LCD debe indicar "BATT OK" en la esquina superior izquierda. Si no, vuelva a cargar la batería. Oprima la tecla de FLOW AND BATTERY CHECK (VERIFICACION DE FLUJO Y DE BATERIA) para colocar la bomba en la modalidad de "HOLD" ("DETENCION").

Conecte un medidor de flujo a la entrada del medio de muestreo, haciendo uso de tubería flexible. [Para las aplicaciones de presión, inserte el accesorio del puerto de escape en el puerto de escape (Figura 1,15) y conecte la bolsa de muestreo a dicho accesorio]. Oprima la tecla de FLOW AND BATTERY CHECK (VERIFICACION DE FLUJO Y DE BATERIA) para activar la bomba y determine la tasa de flujo utilizando el FLOW ADJ (TORNILLO DE AJUSTE DE FLUJO) (Figura 1,7). Una vez establecida la tasa de flujo, oprima la tecla de FLOW AND BATTERY CHECK (VERIFICACION DE FLUJO Y DE BATERIA) para colocar la bomba en "HOLD" ("DETENCION").

¡Precaución: Al usar burbujeadores, coloque un colectador en línea entre la bomba y el burbujeadores para proteger el dispositivo de muestreo de cualquier líquido o vapores. **EL NO USAR EL COLECTADOR DEL BURBUJEADORES INVALIDA LA GARANTIA.** Los burbujeadores y colector pueden ser montados al muestreador utilizando los tornillos de montaje de accesorios (Figura 1, 8).

Betrieb

Arbeiten mit hohem Fluß (750-5000 ml/min)

Einstellung

Die Batterie voll aufladen; Ladestecker siehe Fig. 1,18. Nur von SKC für dieses Modell zugelassene Ladegeräte benutzen. **NICHT IN GEFÄHRLICHER UMGEBUNG LADEN.** Das Sammelmedium mit Schlauch an den Pumpeneinlaß anschließen.(Fig. 1,9). Überprüfen, daß die Pumpe für hohen Fluß eingestellt ist (Siehe "Wieder auf hohen Fluß einstellen" Seite 13).

Den Fluß einstellen

Durch Einschalten der Pumpe (On/Off-Schalter Fig. 1,4) den Batteriezustand prüfen.Die START/HOLD-Taste und dann die FLOW AND BATTERY CHECK-Taste drücken. Den Fluß auf 2 L/min mit der FLOW ADJUST-Schraube einstellen (Fig. 1,7). Die Anzeige muß oben links BATTERY OK anzeigen, sonst die Batterie neu laden. Die FLOW AND BATTERY CHECK-Taste drücken, um die Pumpe in den HOLD-Modus zu bringen.

Mit Schlauch einen Strömungsmesser and den Einlaß des Sammelmediums anschließen. (Für Überdruckanwendungen den Auslaßfitting in den Auslaß einschrauben (Fig. 1,15) und den Gasbeutel an diesen Fitting anschließen.Drücke die FLOW AND BATTERY CHECK-Taste, um die Pumpe zu starten und stelle mit der Flußeinstellschraube den gewünschten Fluß ein. (Fig. 1,7). Wenn der Fluß eingestellt ist, durch Drücken von FLOW AND BATTERY CHECK die Pumpe in HOLD bringen.

ACHTUNG: Bei Impingern (Waschflaschen)eine Schutzfalle zwischen Pumpe und Impinger schalten, damit keine Dämpfe/Flüssigkeit in die Pumpe gelangen. **BEI ARBEITEN OHNE IMPINGER-SCHUTZFALLE ERLISCHT DIE GARANTIE!** Impinger und Schutzfalle können mit den Befestigungsschrauben an der Pumpe befestigt werden.(Fig. 1, 8)

Fonctionnement

Applications à débit élevé (750-5000 ml/min)

Installation

Charger complètement le bloc d'alimentation en branchant la fiche du chargeur à la prise de chargement de l'appareil d'échantillonnage (Figure 1, 18). N'utiliser qu'un chargeur SKC conçu pour ce modèle. **ATTENTION: NE PAS CHARGER DANS UN ENVIRONNEMENT DANGEREUX.** Au moyen d'un tube souple, brancher le récipient de recueil de l'échantillon sur l'arrivée de la pompe (Figure 1, 9). S'assurer que la pompe est réglée sur le débit élevé. (Voir Retour au débit élevé, p. 13.)

Réglage du débit

Vérifier les piles en allumant la pompe d'échantillonnage au moyen de l'interrupteur ON/OFF (marche/arrêt) (Figure 1, 4). Appuyer sur la touche START/HOLD (départ/attente), puis sur la touche FLOW AND BATTERY CHECK (vérification des piles et du débit). Régler le débit à 2 l/min au moyen de la vis FLOW ADJUST de réglage du débit (Figure 1, 7). Le message "BATT OK" (piles en bon état) doit apparaître en haut à gauche de l'écran. Dans le cas contraire, recharger les piles. Appuyer sur la touche FLOW AND BATTERY CHECK pour mettre la pompe en attente (l'écran affiche "HOLD").

Avec un tube souple, relier un débitmètre à l'entrée du récipient d'échantillonnage. [Pour les applications sous pression, introduire le raccord de sortie dans l'orifice correspondant (Figure 1, 15)]. Appuyer sur la touche FLOW AND BATTERY CHECK (vérification des piles et du débit) pour démarrer la pompe et régler le débit au moyen de la vis FLOW ADJUST (Figure 1, 7). Une fois le débit réglé, appuyer sur la touche FLOW AND BATTERY CHECK pour mettre la pompe en attente (l'écran affiche "HOLD").

Attention: Lors de l'utilisation de barboteur, placer une trappe en ligne entre la pompe et l'appareil d'échantillonnage pour la protéger contre les liquides et les vapeurs. **LE FAIT DE NE PAS UTILISER LA TRAPPE ANNULE LA GARANTIE.** Le barboteur et la trappe peuvent être montés sur l'appareil d'échantillonnage à l'aide des vis de montage pour accessoires (Fig. 1, 8).

Sampling

For personal sampling, clip the sample collection media to the worker in the breathing zone. While the LCD shows "HOLD," start the test cycle by pressing the START/HOLD key at the beginning of the desired sampling period. "SAMPLE RUNNING" will display. Record the start time. The time display will automatically track the sampling period time elapsed.

User options during sampling:
Pause - pause (shutdown) by pressing the START/HOLD key. All timing data will freeze. To resume sampling press the START/HOLD key, timing data will resume.
Fault shutdown - during restricted flow or low battery conditions the sampler will shut down. "HOLD" will display on the LCD and timing functions will pause. "LO BATT" or "FLOW FAULT" will display on the LCD depending on the cause of the shutdown. To restart a pump in "FLOW FAULT," correct the flow blockage and press the START/HOLD key. A pump displaying "LO BATT" must be recharged before sampling.

Low Flow Applications (5-500 ml/min)

Setup

Fully charge the battery by connecting the charger plug to the sampler charging jack (Figure 1, #18). Use only an SKC charger designated for this model. **CAUTION: DO NOT CHARGE IN A HAZARDOUS ENVIRONMENT.**

Test the battery pack by turning the sampler on using the ON/OFF switch (Figure 1, #4). Press the START/HOLD key then the FLOW AND BATTERY CHECK key and adjust the flow to 1.5 L/min using the FLOW ADJUST SCREW (Figure 1, #7). If performing multiple sampling using an adjustable flow tube holder (dual, tri, or quad), the flow rate of the pump must be greater than the sum of the flow rates through the tubes; the flow rate through any one tube cannot exceed 500 ml/min. The LCD should indicate "BATT OK" in the upper left corner. If not, recharge the battery. Press the FLOW AND BATTERY CHECK key to place the pump in "HOLD".

Muestreo

Para el muestreo personal, presille el medio de colección de muestras al trabajador en la zona de respiración. Mientras que el LCD muestre HOLD (detención), inicie el ciclo de prueba oprimiendo la tecla de START/HOLD (ARRANQUE/DETENCION) al comienzo del período de muestreo deseado. Podrá visualizarse "SAMPLE RUNNING" (MARCHA DE MUESTRA). Registre el tiempo de arranque. La visualización de tiempo llevará el seguimiento automático del período de muestreo transcurrido.

Opciones del usuario durante el muestreo:
Pausa - pausa (apagado) al oprimir la tecla de START/HOLD (ARRANQUE/DETENCION). Todos los datos de tiempo quedarán congelados. Para reanudar el muestreo, oprima la tecla de ARRANQUE/DETENCION, y se reanudará el cronometraje de datos.
Apagado de Falla - el muestreador se apagará durante condiciones de flujo restringido o de potencia baja en la batería. El LCD visualizará "HOLD" ("DETENCION") y las funciones de cronometraje se detendrán. Se visualizará "LO BATT" o "FLOW FAULT" (BATERIA BAJA o FALLA DE FLUJO) en el LCD según sea la causa del apagado. Para reanudar el funcionamiento de una bomba en "FALLA DE FLUJO", corrija la obstrucción del flujo y oprima la tecla de ARRANQUE/DETENCION. Una bomba que visualice "BATERIA BAJA" debe ser cargada nuevamente antes del muestreo.

Aplicaciones de Flujo Bajo (5-500 ml/min)

Montaje

Cargue la batería plenamente al conectar el enchufe del cargador al receptáculo de carga del dispositivo de muestreo (Figura 1, #18). Solamente utilice un cargador SKC designado para este modelo. **PRECAUCION: NO CARGUE EN UN AMBIENTE PELIGROSO.**

Pruebe el paquete de baterías al activar el muestreador mediante el uso del interruptor de ON/OFF (ENCENDIDO/APAGADO) (Figura 1,4). Oprima la tecla de START/HOLD (ARRANQUE/DETENCION) seguida por la tecla de FLOW AND BATTERY CHECK (VERIFICACION DE FLUJO Y DE BATERIA). Ajuste el flujo a 1.5 L/min utilizando el FLOW ADJ (TORNILLO DE AJUSTE DE FLUJO) (Figura 1,7). Si se va a realizar el muestreo múltiple haciendo uso de un portatubo de flujo ajustable (con dos, tres ó cuatro tubos), la tasa de flujo de la bomba debe ser mayor que la suma de las tasas de flujo a lo largo de los tubos; la suma del flujo por cualquier uno de los tubos no puede sobrepasar los 500 ml/min.El LCD debe indicar "BATT OK" en la esquina superior izquierda. Si no, vuelva a cargar la batería. Oprima la tecla de VERIFICACION DE FLUJO Y DE BATERIA para colocar la bomba en la modalidad de "HOLD" ("DETENCION").

Probennahme

Zur personenbezogenen Probenahme das Sammelmedium in der Atemzone der Person anclipsen.Während die Anzeige HOLD zeigt, den Test-Zyklus durch Drücken von START/HOLD am Anfang der gewünschten Probenahmeperiode starten.Es wird "SAMPLE RUNNING" angezeigt. Die Startzeit notieren. Die Anzeige wird automatisch die abgelaufene Zeit aufzeichnen.

Mögliche Anwendereingriffe während der Probenahme:
Pause - Pause durch Drücken der START/HOLD-Taste. Alle Zeitdaten werden festgehalten. Zum Fortsetzen die START/HOLD-Taste drücken. Zeitnahme wird fortesetzt.
Fehlerabschaltung - bei Flußunterbrechung oder zu geringer Batterieladung stoppt die Pumpe. Die Anzeige zeigt "HOLD" und die Zeiten bleiben stehen. "LO BATT" oder "FLOW FAULT" wird je nach der Ursache der Störung angezeigt.Um die Pumpe bei "FLOW FAULT" wiederzustarten, die Fehlerursache beheben und START/HOLD-Taste drücken. Bei "LO BATT" muß der Akku vor der Probenahme neu aufgeladen werden.

Arbeiten mit kleinem Fluß (5-500 ml/min)

Einstellung

Die Batterie voll aufladen. Ladestecker siehe Fig. 1,18. Nur von SKC für dieses Modell zugelassene Ladegeräte benutzen.
ACHTUNG: NICHT IN GEFÄHRLICHER UMGEBUNG LADEN.

Durch Einschalten der Pumpe (On/Off-Schalter Fig. 1,4) den Batteriezustand prüfen.Die START/HOLD-Taste und dann die FLOW AND BATTERY CHECK-Taste drücken. Den Fluß auf 1,5 L/min mit der FLOW ADJUST-Schraube einstellen (Fig. 1,7). Wird mit einem Mehrfachhalter gearbeitet, muß der Pumpenfluß größer sein als die Summe aller Röhrchen.; die FluBrate darf im Röhrchen 500 ml/min nicht übersteigen. Die Anzeige muß oben links "BATT OK" anzeigen.Sonst die Batterie neu laden.Die FLOW AND BATTERY CHECK-Taste drücken, um die Pumpe in "HOLD" zu bringen.

Échantillonnage

Pour l'échantillonnage personnel, attacher le milieu de collection d'échantillon au travailleur près de la zone de respiration. Lorsque l'écran indique "HOLD" ("attente"), lancer le cycle de test en appuyant sur la touche START/HOLD (départ/attente) au début de la période d'échantillonnage désirée. Le message "SAMPLE RUNNING" ("échantillonnage en cours") apparaît. Noter l'heure du début de l'échantillonnage. Le compteur horaire enregistre la durée d'échantillonnage écoulée.

Options utilisateur pendant l'échantillonnage:
Pause - Pour interrompre (arrêter) l'échantillonnage, appuyer sur la touche START/HOLD (départ/attente). Le compteur horaire s'arrête sur la dernière donnée enregistrée. Pour reprendre l'échantillonnage, appuyer sur la touche START/HOLD. Le compteur horaire recommence à fonctionner.
Arrêt en cas de panne - Si le débit se fait mal ou si les piles sont déchargées, la pompe s'arrête. Le message "HOLD" ("attente") apparaît sur l'écran et le compteur horaire s'arrête. Les messages "LO BATT" ("batterie déchargée") ou "FLOW FAULT" ("blocage") s'affichent à l'écran selon la panne ayant provoqué l'arrêt. Pour redémarrer la pompe en cas de blocage, déboucher et appuyer sur la touche START/HOLD. Une pompe affichant le message "LO BATT" doit être rechargée avant échantillonnage.

Applications à débit réduit (5-500 ml/min)

Installation

Charger complètement le bloc d'alimentation en branchant la fiche du chargeur à la prise de chargement de l'appareil d'échantillonnage (Figure 1, #18). N'utiliser qu'un chargeur SKC conçu pour ce modèle. ATTENTION! NE PAS CHARGER DANS UN ENVIRONNEMENT DANGEREUX.

Vérifier les piles en allumant la pompe d'échantillonnage au moyen de l'interrupteur ON/OFF (marche/arrêt) (Figure 1, 4). Appuyer sur la touche START/HOLD (départ/attente), puis sur la touche FLOW AND BATTERY CHECK (vérification des piles et du débit) et régler le débit à 1,5 l/min au moyen de la vis FLOW ADJUST (Figure 1, 7). En cas d'échantillonnage multiple avec un contrôleur réglable de débit double, triple ou quadruple, et le débit d'un tube ne doit pas dépasser 500 ml/min. Le message "BATT OK" ("piles en bon état") doit apparaître en haut à gauche de l'écran. Dans le cas contraire, recharger les piles. Appuyer sur la touche FLOW AND BATTERY CHECK pour mettre la pompe en attente (l'écran affiche "HOLD").

Remove the screw cap (Figure 1, # 14) covering the regulator isolation valve. Turn the exposed screw 4-5 turns counterclockwise. Replace the screw cap. The pump is now set for low flow. Connect an adjustable low flow holder (Figure 2) to the pump intake (Figure 1, #9) using flexible tubing. Insert an opened sorbent tube into the rubber sleeve of the low flow holder so the arrow on the tube points toward the holder.

Caution! Long duration color detector tubes require a special tube cover which accommodates an in-line trap tube. The trap tube protects the pump from caustic fumes which are often released from detector tubes. **FAILURE TO USE THE TRAP TUBE VOIDS THE WARRANTY.**

Setting the Flow Rate

Connect a flowmeter to the exposed end of the sorbent tube. Loosen the screw on the low flow holder, for Tri and Quad models first rotate the anti-tamper cover (Figure 2, #1) to expose the brass screw(s) (Figure 2, #2). Activate the pump by pressing the FLOW AND BATTERY CHECK key and adjust the flow rate by turning the brass screw until the flowmeter indicates the desired flow. Do not adjust the flow on the pump. Adjust the flow only by using the brass screw (Figure 2, #2) on the low flow holder.

When the flow rate is set, place the pump in "HOLD" by pressing the FLOW AND BATTERY CHECK key and disconnect the flowmeter. Replace the sorbent tube used for setting the flow with a new sorbent tube for sample collection. Place the appropriate size tube cover (Figure 2, #5) over the tube, and screw it in place on the low flow holder.

Sampling

For personal sampling, clip the sample collection media to the worker in the breathing zone. While the LCD shows "HOLD," start the test cycle by pressing the START/HOLD key at the beginning of the desired sampling period. "SAMPLE RUNNING" will display. Record the start time. The time display will automatically track the sampling period time elapsed.

Quite la tapa enroscable (Figura 1, 14) que cubre la válvula de aislamiento del regulador. Vire el tornillo expuesto unas 4-5 vueltas contra las manecillas del reloj. Reponga la tapa enroscable. La bomba está fijada ahora para flujo bajo. Conecte un portatubo de flujo ajustable (Figura 2) a la entrada de la bomba (Figura 1, 9) haciendo uso de la tubería flexible. Inserte un tubo de sorbente abierto en la manga de caucho del detentor de flujo bajo de manera que la flecha en el tubo apunte hacia el detentor.

¡Precaución! Los tubos detectores de color de larga duración requieren una tapa de tubo especial que alberga otro tubo colectador de línea. El tubo colectador protege la bomba contra vapores cáusticos que a menudo se desprenden de los tubos detectores. **EL NO USAR EL TUBO COLECTADOR INVALIDA LA GARANTIA.**

Fijando la Tasa de Flujo

Conecte un medidor de flujo al extremo expuesto del tubo de sorbente. Afloje el tornillo en el portatubo de flujo bajo. Para los modelos Tri y Quad, debe girar primero la tapadera anti-interferencia (Figura 2, 1) para dejar expuesto el tornillo (o los tornillos) de bronce (Figura 2, 2). Active la bomba oprimiendo la tecla de FLOW AND BATTERY CHECK (VERIFICACION DE FLUJO Y DE BATERIA) y ajuste la tasa de flujo girando el tornillo de bronce hasta que el medidor de flujo indique el flujo deseado. No ajuste el flujo en la bomba. Ajuste el flujo sólo mediante el uso del tornillo de bronce (Figura 2, 2) en el portatubo de flujo ajustable.

Cuando se haya establecido la tasa de flujo, coloque la bomba en "HOLD" ("DETENCION") oprimiendo la tecla de FLOW AND BATTERY CHECK (VERIFICACION DE FLUJO Y DE BATERIA), y desconecte el medidor de flujo. Reponga el tubo de sorbente utilizado para establecer el flujo con uno nuevo para la recolección de muestras. Coloque una tapa de tubos del tamaño debido (Figura 2, 5) sobre el tubo, y atorníllelo en su lugar sobre el detentor de flujo bajo.

Muestreo

Para el muestreo personal, presille el medio de colección de muestras al trabajador en la zona de respiración. Mientras que el LCD muestre "HOLD" ("DETENCION"), inicie el ciclo de prueba oprimiendo la tecla de START/HOLD (ARRANQUE/DETENCION) al comienzo del período de muestreo deseado. Podrá visualizarse "SAMPLE RUNNING" ("MARCHA DE MUESTRA"). Registre el tiempo de arranque. La visualización de tiempo llevará el seguimiento automático del período de muestreo transcurrido.

Die Abdeckkappe (Fig. 1,14), die das Reglerventil abdeckt, abschrauben. Die darunter befindliche Schraube 4-5 Umdrehungen entgegen dem Uhrzeigersinn drehen. Die Abdeckkappe wieder aufschrauben. Einen einstellbaren Röhrchenhalter Fig. 2) mit Schlauch an den Pumpeneinlaß anschließen. (Fig. 1,9). Ein offenes Adsorptionsröhrchen mit dem Pfeil zum Halter zeigend in den Gummianschluß des Halters einstecken.

ACHTUNG: Direktanzeigende Farbröhrchen erfordern ein spezielles Schutzrohr und eine In-Line Schutzfalle, die die Pumpe vor Dämpfen schützt, die oft von diesen Röhrchen freigesetzt werden. **BEIM ARBEITEN OHNE SCHUTZFALLE ERLISCHT DIE GARANTIE.**

Den Fluß einstellen

Einen Strömungsmesser an das offene Ende des Röhrchens anschließen. Die Schraube am Einstellbaren Röhrchenhalter lösen (bei Tri-und Quad-Modellen erst den Verstellschutz zur Seite drehen).(Fig, 2, 1) um die Messingschraube(n) (Fig. 2, 2) freizulegen. Die Pumpe durch Drücken von FLOW AND BATTERY CHECK starten und mit der Messingschraube den gewünschten Fluß einstellen. Den Fluß nur mit der Messingschraube am Röhrchenhalter einstellen,(Fig. 2,2) nicht an der Pumpe.

Nach dem Einstellen des Flusses, die Pumpe durch Drücken von FLOW AND BATTERY CHECK in "HOLD" bringen und den Strömungsmesser abnehmen. Das beim Einstellen benutzte Röhrchen durch ein neues ersetzen. Das passende Schutzrohr (Fig. 2,5) über das Röhrchen schrauben.

Probenahme

Für personenbezogene Probenahme das Sammelmedium in der Atemzone der Person anclipsen. Während die Anzeige "HOLD" zeigt die Probenahme im gewünschten Moment durch Drücken von START/HOLD starten.Es wird "SAMPLE RUNNING" angezeigt. Die Startzeit notieren. Die Anzeige zeigt die seit dem Start verflossene Zeit an.

Enlever le couvercle de la vis (Figure 1, 14) qui couvre la soupape d'isolation du régulateur. Tourner la vis apparente de 4-5 tours en sens anti-horaire. Remettre le couvercle de la vis. La pompe est maintenant prête pour le débit réduit. Au moyen d'un tube souple, brancher le contrôleur réglable de débit réduit (Figure 2) sur l'arrivée de la pompe (Figure 1, 9). Insérer un tube sorbant ouvert dans le manchon en caoutchouc du contrôleur de débit réduit de sorte que la flèche du tube soit orientée vers le support.

Attention ! Les tubes couleur de détection de longue durée demandent un couvercle de tube spéciale qui loge un tube de trappe en ligne. Le tube de trappe protège la pompe contre les fumées caustiques qui sont souvent émanées par les tubes de détecteur. **LE FAIT DE NE PAS UTILISER LE TUBE DE TRAPPE ANNULE LA GARANTIE.**

Réglage du débit

Brancher un débitmètre sur l'extrémité libre du tube sorbant. Desserrer la vis du contrôleur de débit réduit. Dans le cas des modèles Tri et Quad, tourner d'abord le couvercle de protection (Figure 2, 1) pour exposer la vis en laiton (Figure 2, 2). Déclencher la pompe en appuyant sur la touche FLOW AND BATTERY CHECK (vérification des piles et du débit) et régler le débit en tournant la vis en laiton jusqu'à ce que le débitmètre indique le débit désiré. Ne pas ajuster le débit sur la pompe. Ajuster le débit seulement en utilisant la vis en laiton (Figure 2, 2) du contrôleur de débit réduit.

Une fois le débit réglé, mettre la pompe en attente (le message "HOLD" apparaît), en appuyant sur la touche FLOW AND BATTERY CHECK, et débrancher le débitmètre. Remplacer le tube sorbant utilisé pour régler le débit avec un nouveau tube pour la collection d'échantillons. Placer le couvercle de tube de dimension appropriée (Figure 2, 5) par-dessus le tube, et le visser en place sur le contrôleur de débit réduit.

Echantillonnage

Pour l'échantillonnage personnel, attacher le milieu de collection d'échantillon au travailleur près de la zone de respiration. Lorsque l'écran indique "HOLD" ("attente"), lancer le cycle de test en appuyant sur la touche START/HOLD (départ/attente) au début de la période d'échantillonnage désirée. Le message "SAMPLE RUNNING" ("échantillonnage en cours") apparaît. Noter l'heure du début de l'échantillonnage. Le compteur horaire enregistre la durée d'échantillonnage écoulée.

User options during sampling:
Pause - pause (shutdown) by pressing the START/HOLD key. All timing data will freeze. To resume sampling press the START/HOLD key, timing data will resume.
Fault shutdown - during restricted flow or low battery conditions the sampler will shut down. "HOLD" will display on the LCD and timing functions will pause. "LO BATT" or "FLOW FAULT" will display on the LCD depending on the cause of the shutdown. To restart a pump in "FLOW FAULT," correct the flow blockage and press the START/HOLD key. A pump displaying "LO BATT" must be recharged before sampling.

Return to High Flow

To return to High Flow, remove the screw cap (Figure 1, # 14) covering the regulator isolation valve. Turn the exposed screw clockwise until it stops. (Do not over-tighten.) Replace the screw cap. The pump is now set for high flow.

Bag Sampling by Positive Pressure

Using flexible tubing, connect the sampling media to the pump intake (Figure 1,#9). [For sample bags using positive pressure filling, insert the exhaust fitting into the exhaust port (Figure 1, #15). After setting the flow rate, you will connect the sample bag to this fitting instead.]

Opciones del usuario durante el muestreo:
Pausa - pausado (apagado) al oprimir la tecla de START/HOLD (ARRANQUE/DETENCION). Todos los datos de tiempo quedarán congelados. Para reanudar el muestreo, oprima la tecla de START/HOLD (ARRANQUE/DETENCION), y se reanudará el cronometraje de datos.
Apagado de Falla - el muestreador se apagará durante condiciones de flujo restringido o de potencia baja en la batería. El LCD visualizará "HOLD" (DETENCION) y las funciones de cronometraje se detendrán. Se visualizará "LO BATT" o "FLOW FAULT" ("BATERIA BAJA o FALLA DE FLUJO") en el LCD según sea la causa del apagado. Para reanudar el funcionamiento de una bomba en "FALLA DE FLUJO", corrija la obstrucción del flujo y oprima la tecla de ARRANQUE/DETENCION. Una bomba que visualice "BATERIA BAJA" debe ser cargada nuevamente antes del muestreo.

Regreso al Flujo Alto

Para regresar al Flujo Alto, quite la tapa enroscable (Figura 1, 14) que cubre la válvula de aislamiento del regulador. Vire el tornillo expuesto en sentido de las manecillas del reloj hasta que se detenga (no apriete excesivamente). Reponga la tapa enroscable. La bomba se encuentra fijada ahora para el flujo alto.

Muestreo de Bolsa por Presión Positiva

Conecte el medio de muestreo a la entrada de la bomba (Figura 1,9) mediante el uso de la tubería flexible. [Para las bolsas de muestra que utilizan un llenado de presión positiva, inserte el ajuste del escape en el puerto de escape (Figura 1, 15). Tras de fijar la tasa de flujo, usted conectará, en su lugar, la bolsa de muestreo a este ajuste.]

Mögliche Anwendereingriffe während der Probenahme:
Pause - Pause durch Drücken der START/HOLD-Taste. Alle Zeitdaten werden festgehalten. Zum Fortsetzen die START/HOLD-Taste drücken. Zeitnahme wird fortesetzt.
Fehlerabschaltung- Bei Flußunterbrechung oder zu geringer Batterieladung stoppt die Pumpe. Die Anzeige zeigt "HOLD" und die Zeiten bleiben stehen. "LO BATT" oder "FLOW FAULT" wird je nach der Ursache der Störung angezeigt. Um die Pumpe bei "FLOW FAULT wiederzustarten, die Fehlerursache beheben und **START/HOLD**-Taste drücken. Bei "LO BATT" muß der Akku vor der Probenahme neu aufgeladen werden.

Zurück zu hohem Fluß

Um zu hohem Fluß zurückzukehren die Abdeckkappe (Fig. 1,14) abschrauben und die darunterliegende Stellschraube im Uhrzeigersinn bis zum Anschlag drehen (nicht überdrehen). Die Abdeckkappe wieder aufschrauben. Die Pumpe ist jetzt im hohen Flußbereich.

Das Sammelmedium mit Schlauch an den Pumpeneinlaß anschließen (Fig, 1, 9). (Für Gasbeutel wird der Auslaßstutzen (Fig. 1,15) in den Auslaß der Pumpe geschraubt. Nach dem Einstellen der Flußrate wird der Gasbeutel an den Auslaßstutzen der Pumpe angeschlossen).

Options utilisateur pendant l'échantillonnage :
Pause - Pour interrompre (arrêter) l'échantillonnage, appuyer sur la touche START/HOLD (départ/attente). Le compteur horaire s'arrête sur la dernière donnée enregistrée. Pour reprendre l'échantillonnage, appuyer sur la touche START/HOLD. Le compteur horaire recommence à fonctionner. **Arrêt en cas de panne** - Si le débit se fait mal ou si les piles sont déchargées, la pompe s'arrête. Le message "HOLD" ("attente") apparaît sur l'écran et le compteur horaire s'arrête. Les messages "LO BATT" ("batterie déchargée") ou "FLOW FAULT" ("blocage") s'affichent à l'écran selon la panne ayant provoqué l'arrêt. Pour redémarrer la pompe en cas de blocage, déboucher et appuyer sur la touche START/HOLD. Une pompe affichant le message "LO BATT" doit être rechargée avant échantillonnage.

Retour au débit élevé

Pour retourner au débit élevé, enlever le couvercle de la vis (Figure 1, 14) qui couvre la soupape d'isolation du régulateur. Tourner la vis exposée en sens horaire jusqu'à ce qu'elle s'arrête. (Ne pas forcer.) Remettre le couvercle de la vis. La pompe est maintenant réglée pour le débit élevé.

Échantillonnage en sac par pression positive

Au moyen d'un tube souple, brancher le récipient de recueil de l'échantillon sur l'arrivée de la pompe (Figure 1, 9). [Pour les sacs d'échantillonnage utilisant un remplissage à pression positive, insérer le raccord d'évacuation à l'orifice d'évacuation (Figure 1, 15). Après avoir réglé le débit, connecter le sac d'échantillonnage à ce raccord.]

Preventive Maintenance

Battery Pack Maintenance

Removal—Remove the two screws (Figure 1, #16) which secure the battery pack (Figure 1, #17) and loosen the four case screws above and below the belt clip. Carefully slide the battery pack out from under the belt clip (Figure 1, #19) being careful to keep it straight.

Replacement—Slip the front edge of the battery pack (Figure 1, #17) under the belt clip (Figure 1, #19) and rotate the battery pack so the rails engage the slots on the case front. Push the battery pack until it is properly located. Reinstall battery screws and tighten the case screws (Figure 1, #16).

Charge Maintenance
For proper maintenance of battery packs, SKC produces an optional cycling charger (Catalog No. 223-426) which discharges and recharges the battery automatically to protect against memory effects.

Rotate the use of any spare pack to avoid idle periods in excess of one month. Fully charge packs before or after use or storage.

SKC UL listed battery packs (SKC Catalog No. P21661) contain a protective device to eliminate potential short circuiting while the pump is in use. If the indicator light on the charger will not light while charging, either the battery pack, charger, or wall outlet is inoperative. If you are unable to determine which is inoperative, please contact SKC Technical Support at 724-941-9701 or e-mail skctech@skcinc.com.

Caution: Do not charge in a hazardous environment.

Warning: Using a non-approved charger voids the SKC warranty.

Warning: Tampering with the battery pack voids the SKC warranty and the UL Intrinsic Safety listing.

Mantenimiento Preventivo

Mantenimiento del Estuche de Baterías

Desmontaje--Quite los dos tornillos (Figura 1, 16) que fijan el estuche de baterías (Figura 1, 17) y afloje los dos tornillos del estuche por encima y por debajo de la presilla del cinturón. Deslice con cuidado el estuche de baterías por debajo de la presilla del cinturón (Figure 1, 19) teniendo cuidado en mantenerlo derecho.

Reemplazo--Deslice el extremo delantero del estuche de baterías (Figura 1, 17) por debajo de la presilla del cinturón (Figura 1, 19) y gire el estuche de baterías de tal manera que los rieles se acoplen a las ranuras en el frente del estuche. Empuje el estuche de baterías hasta que se encuentre debidamente ubicado. Vuelva a instalar los tornillos de la batería y apriete los tornillos del estuche (Figura 1, 16).

Mantenimiento de Carga
Para el mantenimiento debido de los estuches de baterías, SKC produce un cargador de ciclos opcional (No. de Catálogo 223-426) que recarga y descarga la batería automáticamente para protegerla contra los efectos de memoria.

Haga rotación con el uso de cualquier estuche de repuesto para evitar períodos de desuso en exceso de un mes. Cargue los estuches plenamente antes ó después del uso o del almacenaje.

Los estuches de baterías SKC, listados por UL (No. de Catálogo SKC P21661) contienen un dispositivo protector para eliminar cortocircuitos potenciales mientras que la bomba se encuentre en uso. Si la luz indicadora en el cargador no se ilumina durante la operación de carga, esto significa que el paquete de baterías, el cargador, o el tomacorrientes se encuentra inoperante. Si no es capaz de determinar cual de ellos es inoperante, tenga la bondad de comunicarse con el Servicio de Apoyo Técnico de SKC al 724-941-9701 o por correo electrónico a skctech@skcinc.com.

¡Precaución: No utilice el cargador en un ambiente peligroso.

Cuidado: Se debe usar un cargador aprobado por SKC o la garantía no será valida.

Cuidado: Si se toca el paquete de la batería, se invalidará la garantía de SKC y el aprobación de UL.

Wartung

Wartung des Batteriepacks

Anehmen- Die beiden Halteschrauben (Fig. 1,16) abschrauben und die vier Schrauben des Gürtelclips (Fig. 1,17) lösen. Vorsichtig den Batteriepack unter dem Gürtelclip (Fig. 1,19) herausschieben.

Einbau: Die Vorderkante des Batteriepacks (Fig. 1,17) unter den Gürteclip (Fig, 1, 19) schieben und den Batteriepack so positionieren, daß er richtig in die Gehäuseschlitze einrastet. Die Halteschrauben einschrauben (Fig. 1,16).

Ladezustand
Zur optimalen Wartung der Batteriepacks liefert SKC ein zyklisch arbeitendes Ladegerät (Kat.Nr. 223-426), das automatisch die Batterien entlädt und wiederaufladet um Memoryeffekte zu vermeiden.

Benutzen Sie Ihre Ersatzbatterien, um Lagerzeiten von mehr als einem Monat zu vermeiden. Vor und nach der Benutzung Batteriepacks voll aufladen.

Der UL-zugelassene SKC-Batteriepack enthält eine Schutzschaltung um Kurzschlüsse zu vermeiden. Leuchtet die Anzeigelampe am Laadergerät beim Laden nicht, ist entweder der Batteriepack, das Ladegerät oder die Schutzschaltung defekt. Können Sie nicht feststellen wo der Fehler liegt, wenden Sie sich an Ihre SKC-Vertretung (MTC. 07631/5545).

ACHTUNG: NICHT IN GEFÄHRLICHER UMGEBUNG LADEN.

ACHTUNG: BEI BENUTZUNG VON LADEGERATEN DIE NICHT VON SKC ZUGELASSEN SIND, ERLISCHT DIE GARANTIE.

ACHTUNG: BEI EINGRIFFEN IN DEN BATTERIEPACK ERLISCHT DIE GARANTIE UND DER UL-EXSCHUTZ.

Entretien préventif

Entretien du bloc d'alimentation

Enlèvement – Enlever les deux vis (Figure 1, 16) qui maintiennent le bloc d'alimentation (Figure 1, 17) et desserrer les quatre vis du boîtier situées au-dessus et en-dessous de l'attache de ceinture (Figure 1, 19) en faisant attention de la maintenir droite.

Remplacement – Glisser le bord avant du bloc d'alimentation (Figure 1, 17) sous l'attache de ceinture (Figure 1, 19) et tourner le bloc d'alimentation de sorte que les rails s'engagent dans les fentes à l'avant du boîtier. Pousser le bloc d'alimentation jusqu'à ce qu'il soit correctement inséré. Réinstaller les vis de la batterie et serrer les vis du boîtier (Figure 1, 16).

Entretien de la charge
Pour l'entretien approprié le bloc d'alimentation, SKC produit un chargeur cyclique facultatif (N° de catalogue 223-426) qui décharge et recharge automatiquement le bloc d'alimentation pour le protéger contre les effets de mémoire.

Alterner l'utilisation du bloc d'alimentation de réserve afin d'éviter les périodes d'inactivité de plus d'un mois. Charger complètement le bloc d'alimentation avant ou après l'utilisation ou l'entreposage.

Les blocs d'alimentation SKC listées par UL (N° de catalogue SKC P21661) contiennent un dispositif de protection pour éliminer les courts-circuits potentiels lorsque la pompe est en fonctionnement. Si le bloc d'alimentation est défectueux, l'indicateur lumineux du chargeur du bloc d'alimentation ne sera pas allumé pendant le chargement. Sinon, le chargeur ou la prise au mur sont défectueux. Le défaut sera déterminé par élimination. Si vous ne pouvez pas d´terminer l'unité défectueuse, veuillez contacter le Département des Services aux Clients de SKC (724-941-9701) pour de l'aide supplémentaire, ou envoyer un courrier électronique à l'adresse suivante : skctech@skcinc.com.

Attention: Ne pas charger dans un environnement dangereux.

Avertissement: Le fait de ne pas utiliser un chargeur approuvé par SKC annule la garantie.

Avertissement: Le fait d'altérer le bloc d'alimentation annule la garantie et le listage UL de securité intrinsèque.

Pump Inlet Filter

The SKC sampler is fitted with a filter/trap inside the clear plastic intake port housing. This prevents particulates from being drawn into the pump mechanism. Occasionally, the filter should be visually checked to assure that it does not become clogged. If maintenance is necessary:

1. Clean all dust and debris from around the filter housing.
2. Remove the four screws (Figure 1, #10) and the front filter housing.
3. Remove and discard the filter membrane (Figure 1, #12) and O-ring (Figure 1, #11).
4. Clean the filter housing.
5. Insert a new filter membrane and o-ring. (Filter Replacement Kit, SKC Catalog No. P22409)
6. Reattach the front filter housing and cross-tighten the four screws.

Pump Service

Pumps under warranty should be sent to SKC Inc. for servicing (see Service p. 25). For further information on pump maintenance, testing and replacing pump components, and troubleshooting, request the Universal Pump Service Manual (SKC Publication No. 1377).

Filtro de Entrada de la Bomba

El dispositivo de muestreo SKC está provisto de un filtro/colector dentro del alojamiento hecho de plástico transparente del puerto de entrada. Esto impide la entrada de materia particulada al mecanismo de la bomba. Ocasionalmente, el filtro debe cotejarse visualmente para asegurar que esté libre de obstrucciones. De ser necesario el mantenimiento:

1. Limpie todo el polvo y escombros de los alrededores del albergue del filtro.
2. Quite los cuatro tornillos (Figura 1, 10) y el albergue del filtro delantero.
3. Quite y descarte la membrana del filtro (Figura 1, 12) y el anillo tórico. (Figura 1, 11)
4. Limpie la carcasa del filtro.
5. Inserte una nueva membrana de filtro y anillo tórico (Estuche de reemplazo de filtro, No. de catálogo SKC No. P22409).
6. Vuelva a conectar la carcasa delantera del fitro y apriete los cuatro tornillos transversalmente.

Sercicio de la Bomba

Favor de mandar las bombas con garantía a SKC Inc. para servicio (refiere a Servicio página 25). Para más información relacionada al mantenimiento de la bomba, la prueba y el reemplazo de los componentes de las bombas así como también diagnosis de los problemas, favor de pedir el Manual de Servicio de las Bombas Universales (No. de Publicación de SKC 1377).

Pumpen-Einlaßfilter

Die SKC-pumpe hat in dem durchsichtigen Filtergehäuse am Einlaß ein Filter, das verhindert, daß Partikel in die Pumpe gesaugt werden. Das Filter soll von Zeit zu Zeit überprüft werden, damit es nicht verstopft. Wenn notwendig:

1. Filtergehäuse von Staub und Partikeln säubern.
2. Die vier Schrauben (Fig 1,10) und den Gehäusedeckel abnehmen.
3. Die Filtermembran(Fig.1,12) und O-Ring (Fig. 1,11) abnehmen.
4. Filtergehäuse reinigen
5. Neue Filtermembran und O-Ring einsetzen (Ersatzteilkit Nr. P22409)
6. Filtergehäusedeckel aufsetzen und die vier Schrauben über Kreuz anziehen.

Service an Pumpen

Pumpen unter Garantie sollen zwecks Wartung an SKC bzw. die zuständige Vertretung geschickt werden (siehe S. 25). Weitere Informationen uber Wartung, Prüfung, Ersatz von Komponenten und Fehlersuche siehe Universal Pump Service Manual (SKC Publikation Nr. 1377).

Filtre d'admission de la pompe

L'appareil d'échantillonnage de SKC est équipé d'un filtre/trappe à l'intérieur du corps en plastique transparent du conduit d'admission. Ceci empêche l'aspiration des particules dans le mécanisme de la pompe. Le filtre doit être vérifié visuellement, à l'occasion, pour s'assurer qu'il n'est pas bouché. S'il faut de l'entretien :

1. Nettoyer toute les poussières et débris autour du corps du filtre.
2. Enlever les quatre vis (Figure 1, 10) et le corps du filtre avant.
3. Enlever et jeter le filtre (Figure 1, 12) et le joint torique (Figure 1, 11).
4. Nettoyer le corps du filtre.
5. Insérer un nouveau filtre et un nouveau joint torique. (Ensemble de remplacement de filtre, N° de catalogue SKC P22409)
6. Remettre en place le corps du filtre avant et serrer en croix les quatre vis.

Maintenance de la pompe

Toute pompe sous garantie doit être renvoyée au service après-vente de la société SKC Inc (voir page 25). Pour toute autre information relative à la maintenance, essai ou remplacement de pièces détachèes et anomalie de fonctionnement, demandez le manuel d'entretien de la pompe 'Universal' (SKC publication No. 1377).

Diagrams/Part Description for Figure 1

Model 224-PCXR4

No. Description

1. **LCD:** Indicators for all sampler functions.
2. **FLOW AND BATTERY CHECK Key:** Allows setting flow rate and testing battery condition.
3. **START/HOLD Key:** Used when ready to begin the sampling cycle, pause the sampling cycle and restart the cycle after pause.
4. **ON/OFF Switch:** Allows the pump to be shut down completely, clears time display.
5. **Anti-tamper Cover:** Protects controls from incidental contact or tampering.
6. **Cover Screw:** Fastens anti-tamper cover.
7. **Flow Adjustment Control:** Adjusts flow from 750-5000 ml/min.
8. **Accessory Mounting Screws (2):** Secure accessories such as impinger and trap holders.
9. **Filter Housing (intake):** Air intake port and trap.
10. **Filter Housing Screws (4):** Secure filter housing.
11. **Filter O-ring:** Leak seal for filter in housing.
12. **Filter (10 micron nylon):** Filters particulates before entering pump.
13. **Built-in Flowmeter:** Monitors flow changes.
14. **Regulator Isolation Cap:** Accesses regulator isolation valve.
15. **Exhaust Port Cap:** Accesses exhaust port.
16. **Battery Pack Screws (2):** Secures pack to pump.
17. **Battery Pack Assembly:** Provides power to pump.
18. **Charging Jack:** Connector for battery charger.
19. **Belt Clip:** Secures pump to worker.

A **Compensation Pot A:** Adjusts pump compensation which is factory set. Access screw guards against accidental contact or tampering.

B **Compensation Pot B:** Adjusts pump compensation which is factory set. Access screw guards against accidental contact or tampering.

Diagramas/Descripción de Piezas para la Figura 1

Modelo 224-PCXR4

No. Descripcíon

1. **LCD:** Indicadores para todas las funciones del muestreador.
2. **TECLA DE FLOW AND BATTERY CHECK (VERIFICACION DE FLUJO Y DE BATERIA):** Permite el establecimiento de la tasa de flujo y la prueba del estado de la batería.
3. **Tecla de START/HOLD (ARRANQUE/DETENCION):** Utilizada cuando el ciclo de muestreo está listo para comenzar, para pausar el ciclo de muestreo y para reanudar el ciclo después de una pausa.
4. **Interruptor de ON/OFF (ENCENDIDO/APAGADO):** Permita El apago completo de la bomba y aclara la visualización de tiempo
5. **Tapadera a Prueba de Alteración:** Protege contra el contacto accidental o alteraciones.
6. **Tapa de Tornillo:** Fija la tapadera a prueba de alteraciones.
7. **Control de Ajuste de Flujo:** Ajusta el flujo desde 750-5000 ml/min.
8. **Tornillos de Montaje de Accesorios (2):** Aseguran tales accesorios como el golpeador y los detentores de colectores.
9. **Alojamiento del Filtro (entrada):** Puerto y colector de la entrada de aire.
10. **Tornillos del Alojamiento del Filtro (4):** Aseguran el alojamiento del filtro.
11. **Anillo Tórico del Filtro:** Sello contra fugas del filtro en el alojamiento.
12. **Filtro (10 micrones, nylon):** Filtra materia particulada antes de entrar a la bomba.
13. **Medidor de Flujo Integral:** Monitorea los cambios en el flujo.
14. **Tapadera de Aislamiento del Regulador:** Proporciona acceso a la válvula de aislamiento del regulador.
15. **Tapadera del Puerto de Escape:** Proporciona acceso al puerto de escape.
16. **Tornillos del Estuche de Baterías (2):** Asegura el estuche a la bomba.
17. **Ensamblado del Estuche de Baterías:** Suministra potencia a la bomba.
18. **Enchufe de carga:** Conectador para el cargador de baterías.
19. **Presilla de Cinturón:** Asegura la bomba al trabajador.

A **Potenciómetro de Compensación A:** Ajusta la compensación de la bomba, que viene fijada de fábrica. Un tornillo de acceso protege contra el contacto accidental o alteraciones.

B **Potenciómetro de Compensación B:** Ajusta la compensación de la bomba, que viene fijada de fábrica. Un tornillo de acceso protege contra el contacto accidental o alteraciones.

Zeichnungen/Teileliste Fig. 1

Modell 224-PCXR4

Nr. Beschreibung

1. LCD: Anzeige für alle Funktionen der Pumpe
2. **FLOW AND BATTERY CHECK-Taste**: ermöglicht Flußeinstellung und Prüfung des LAdezustandes der Batterie.
3. **START/HOLD-Taste**: Startet die Probenahme, unter bricht die Probenahme (Pause) und setzt die Probenhame nach der Pause fort.
4. **Ein/Aus-Schalter**
5. **Schutzdeckel**: Schützt vor unbeabsichtigtem Verstellen der Einstellungen
6. **Deckelschraube**: Befestigt Schutzdeckel
7. **Flußeinstellung**: von 750 - 5000 ml/min
8. **Zusätzliche Halteschrauben(2)**: Zum Anbringen von Impingern und Haltern für Schutzfallen.
9. **Filtergehäuse**: Lufteinlaßstutzen und Filter
10. **Filter Housing Screws (4)**: Secure filter housing.
11. **Filtergehäuseschrauben(4)**: Halten Filtergehäuse
12. **Filter O-Ring**: Dichtung für Filtergehäuse
13. **Filter (10 Mikron Nylon)**: Schützt Pumpe vor Staub
14. **Reglerkappe**: Zugang zum Reglerventil
15. **Auslaßkappe**: Verschließt Pumpenauslaß.
16. **Batteriepackschrauben (2)**
17. **Batteriepack**: Liefert der Pumpe Strom
18. **Ladeanschlußstecker für Ladegerät**
19. **Gürtelclip**: Hält Pumpe an der Person

A **Kompensierungspoti A**: Einstellen der Pumpen-kompensierung (Werkseinstellung). Abdeckschraube vermeidet Verstellen

B **Kompensierungspoti B**: Einstellen der Pumpen-kompensierung (Werkseinstellung). Abdeckschraube vermeidet Verstellen.

Schémas/Description des pièces pour la Figure 1

Modèle 224-PCXR4

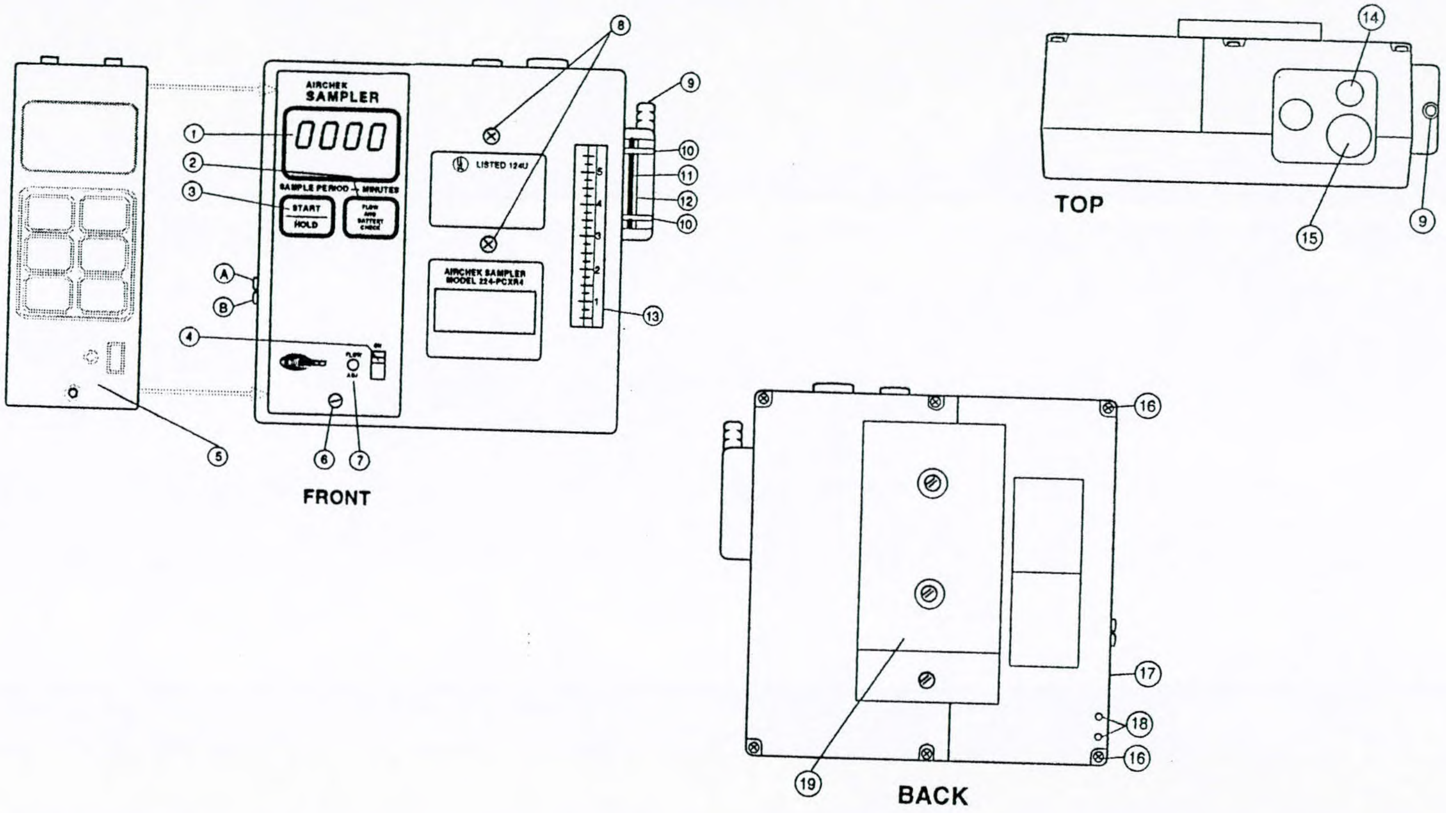
Nº Description

1. LCD: Indicateur à cristaux liquides pour toutes les fonctions de la pompe.
2. Touche FLOW AND BATTERY CHECK **(vérification des piles et du débit)**: Permet de vérifier le débit d'échantillonnage et l'état des piles.
3. Touche START/HOLD **(départ/attente)**: Utilisée pour commencer le cycle d'échantillonnage, pour interrompre momentanément ce dernier et le redémarrer après une pause.
4. **Interrupteur ON/OFF** (march/arrêt)
5. **Couvercle de protection**: Protège les commandes contre le contact accidentel et les modifications.
6. **Vis de couvercle**: Maintient le couvercle de protection.
7. **Commande d'ajustage du débit**: Règle le débit entre 750 et 5000 ml/min.
8. **Vis de montage d'accessoires (2)**: Fixent les accessoires tels que les supports de l'injecteur et de la trappe.
9. **Corps du filtre (admission)**: Conduit d'admission d'air et la trappe.
10. **Vis du corps du filtre (4)**: Fixent le corps du filtre.
11. **Joint torique du filtre**: Garniture d'étanchéité pour le filtre dans le corps.
12. **Filtre (10 microns, en nylon)**: Filtre les particules avant d'entrer dans la pompe.
13. **Débitmètre incorporé**: Surveille les changements du débit.
14. **Couvercle d'isolation du régulateur**: Accède à la soupape d'isolation du régulateur.
15. **Couvercle du conduit d'évacuation**: Accède au conduit d'évacuation.
16. **Vis du bloc d'alimentation (2)**: Fixent la batterie à la pompe.
17. **Bloc d'alimentation**: Fournit le courant à la pompe.
18. **Prise de chargement**: Connecteur pour le chargeur dbloc d'alimentation.
19. **Attache de ceinture**: Fixe la pompe au travailleur.

A **Potentiomètre de compensation A**: Ajuste la compensation de la pompe qui est réglée en usine. La vis d'accès protège contre le contact accidentel et les modifications.

B **Potentiomètre de compensation B**: Ajuste la compensation de la pompe qui est réglée en usine. La vis d'accès protège contre le contact accidentel et les modifications.

Figure 1

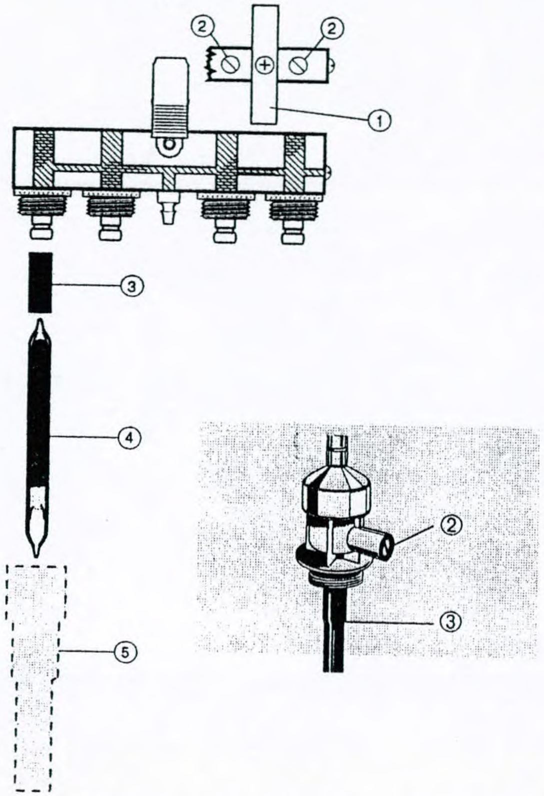


FRONT

TOP

BACK

Figure 2



Quad Adjustable Low Flow Holder

Single Adjustable Low Flow Holder

Figure 2 - Adjustable Low Flow Holder

1. Anti-tamper Cover
   (tri and quad only)
2. Manifold Flow Adjustment
3. Rubber Sleeve
4. Sorbent Sample Tube
5. Protective Cover
   (not included)

Figura 2 - Portatubo de flujo ajustable

1. Tapadera resistente a alteraciones.
   (sólo dos o tres tubos)
2. Ajuste de flujo de colector.
3. Manga de caucho.
4. Tubo de muestra de sorbente.
5. Tapadera protectora.
   (no incluido)

Fig. 2 Einstellbarer Halterfür kleinen Fluß

1. Schutzdeckel
2. Flußeinstellung
3. Gummianschluß
4. Adsorptionsröhrchen
5. Schutzkappe

Figure 2 - Contrôleur réglable de débit réduit

1. Couvercle de protection
   (pour modèles triple et quadruple)
2. Réglage du débit d'admission
3. Manchon en caoutchouc
4. Tube d'échantillonnage sorbant
5. Enveloppe de protection
   (non-inclus)

Part Description for Figure 3
Replacement Parts

P22409*	Replacement Filter Kit
P22433R	Cap Screws (set of 2)
P22417C*	Exhaust Port Fitting
P22417D	Filter Housing Assembly
P22417E	Bottom Plate Assembly
P22417F	Valve Plate Assembly
P22417G	Pump Body
P22417H	Diaphragm/Yoke Assembly
P22417J	Regulator Assembly
P22417K	Pulsation Dampener Assembly (2)
P22417M	Motor/Eccentric Assembly
P21661	Battery Pack Assembly
P21411	Case Parts (excluding Battery Case)
P22433L	Flowmeter Assembly
P22433T	Control Board
P22433RS2	Replacement Stack
P22417BC	Belt Clip with Screws
P22433N	Keyboard Assembly
P22433C*	Anti-tamper Cover
P22433ES*	External Screw Pack

Descripción de Piezas para la Figura 3
Piezas de Repuesto

P22409*	Estuche de Reemplazo de Filtro
P22433R	Tapones Roscados (juego de 2)
P22417C*	Ajuste del Puerto de Escape
P22417D	Ensamblado del Alojamiento del Filtro
P22417E	Ensamblado de la Placa Inferior
P22417F	Ensamblado de la Placa de Válvula
P22417G	Cuerpo de la Bomba
P22417H	Ensamblado de Diafragma/Abrazadera
P22417J	Ensamblado del Regulador
P22417K	Ensamblado del Amortiguador de Pulsaciones(2)
P22417M	Ensamblado Excéntrico/Motor
P21661	Ensamblado del Estuche de Baterías
P21411	Piezas del Armazón (excluyendo el Armazón de Baterías)
P22433L	Ensamblado del Medidor de Flujo
P22433T	Tablero de Controles
P22433RS2	Apilamiento de Repuesto
P22417BC	Presilla de Cinturón con Tornillos
P22433N	Ensamblado del Teclado
P22433C*	Tapadera Anti-Interferencia
P22433ES*	Conjunto de Tornillo Externo

Teilebeschreibung Fig. 3
Ersatzteile

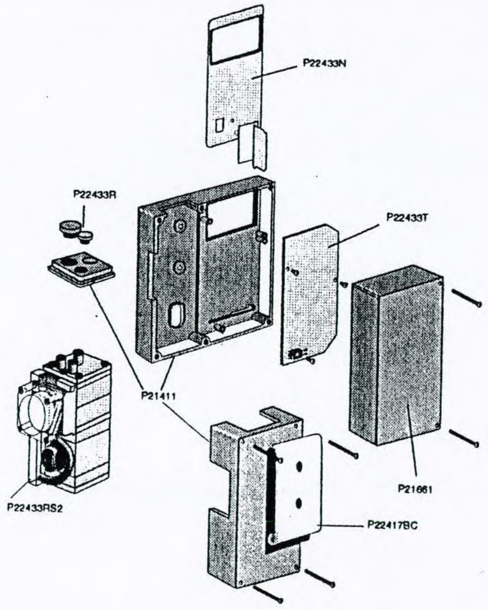
P22409*	Ersatzfilterkit
P22433R	Schraubkappen (2 Stck)
P22417C*	Auslaßstutzen
P22417D	Filtergehäuse
P22417E	Grundplatte
P22417F	Ventilplatte
P22417G	Pumpenkörper
P22417H	Membran/Kolbeneinheit
P22417J	Reglereinheit
P22417K	Pulsdämpfer(2)
P22417M	Motor/Exzenter
P221661	Batteriepack
P21411	Gehäuseteile (außer Batteriegehäuse)
P22433L	Strömungsmesser
P22433T	Steuerungsplatine
P22433RS2	Pumpantriebseinheit
P22417BC	Gürtelclip mit Schrauben
P22433N	Tastatur
P22433C*	Verstellschutz-Deckel
P22433ES*	Packung äußere Schrauben

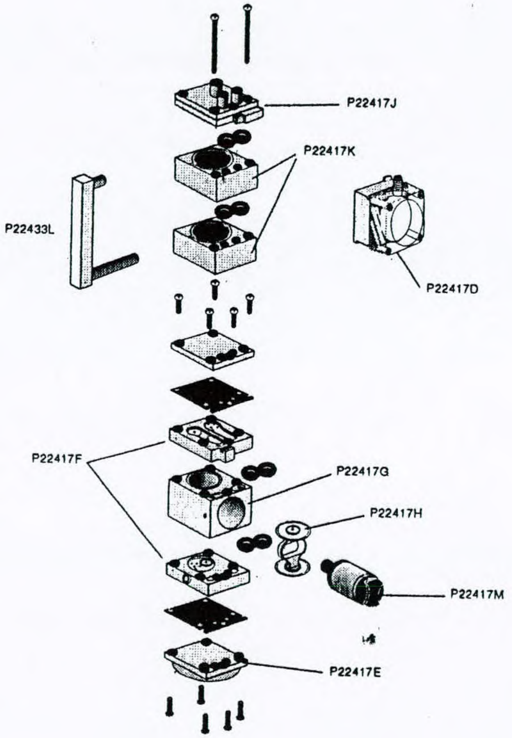
Description des pièces pour la Figure 3
Pièces de rechange

P22409*	Ensemble de filtre de remplacement
P22433R	Vis à tête (jeu de 2)
P22417C*	Raccord de conduit d'évacuation
P22417D	Corps du filtre
P22417E	Plaque inférieure
P22417F	Plaque de soupape
P22417G	Corps de pompe
P22417H	Ensemble de diaphragme/collier
P22417J	Régulateur
P22417K	Amortisseurs (2)
P22417M	Ensemble de moteur/excentrique
P21661	Bloc d'alimentation
P21411	Pièces de boîtier (sauf le boîtier du bloc d'alimentation)
P22433L	Ensemble du débitmètre
P22433T	Carte de commande
P22433RS2	Pièces de remplacement
P22417BC	Fixation de ceinture avec vis
P22433N	Ensemble clavier
P22433C*	Couvercle de sécurité
P22433ES*	Jeu de vis extérieures

* Not shown in Figure 1 or 2

Figure 3 — Replacement Parts for 224-PCXR4





For further information on testing and replacing pump components, request the Universal Pump Service Manual (SKC Publication No. 1377).

Exploded view of stack # P22433RS2

Optional Accessories

Adjustable Low Flow Holders:

224-26-01	Single Holder
224-26-02	Dual Holder
224-26-03	Tri Holder
224-26-04	Quad Holder

Protective Sample Tube Covers:

	for tubes up to:
224-29A	70 mm long
224-29B	110 mm long
224-29C	150 mm long
224-29D	220 mm long
224-29T	115 mm with tandem trap tube cover

Battery Chargers:

223-226	Single Battery Charger 115 V
223-227	Single Battery Charger 230 V
223-426	Deluxe 5 Station Battery Charger, Switchable for 115 or 230 V operation

Miscellaneous:

224-11	Sampler Tool Kit
224-95 224-95A	Protective Nylon Pouch with belt and shoulder strap, available in brown or red

Accesorios Opcionales

Portatubos de Flujo Ajustables

224-26-01	Portatubos Sencillo
224-26-02	Portatubos Doble
224-26-03	Portatubos Triple
224-26-04	Portatubos Cuádruple

Tapaderas Protectivas

224-29A	70 mm de largo
224-29B	110 mm de largo
224-29C	150 mm de largo
224-29D	220 mm de largo
224-29T	115 mm de largo con tapa de tubo colector tándem

Cargadores de Baterías

223-226	Cargador de Baterías Sencillo 115 V
223-227	Cargador de Baterías Sencillo 230 V
223-426	Cargador de Baterías Deluxe de 5 estaciones, conmutable para el funcionamiento a 115 ó 230V.

Artículos Misceláneos:

224-11	Estuche de Herramientas de Muestreo
224-95 224-95A	Funda Protectora de Nylon con cinturón y correa para cargar al hombro, parda, roja

Weiteres Zubehör

Einstellbare Halter

226-26-01	Einfachhalter
226-26-02	Zweifachhalter
226-26-03	Dreifachhalter
226-26-04	Vierfachhalter

Schutzrohre

224-29A	70 mm lang
224-19B	110 mm lang
224-29C	150 mmlang
224-29D	220 mm lang
224-29T	115 mm mit Tandemfallen-Schutzrohr

Ladegeräte

223-226	Ladegerät 115 V
223-227	Ladegerät 230 V
223-426	5-Kanal-Ladegerät 115/230 V

Verschiedenes

224-11	Pumpenwerkzeugkit
224-95 224-95A	Nylon-Schutztasche mit Gürtel und Schultergurt, braun, rot

Accessoires facultatifs

Contrôleur réglable de débit :

224-26-01	Contrôleur simple
224-26-02	Contrôleur double
224-26-03	Contrôleur triple
224-26-04	Contrôleur quadruple

Couvercle de protection :

224-29A	70 mm de long
224-29B	110 mm de long
224-29C	150 mm de long
224-29D	220 mm de long
224-29T	115 mm avec couvercle de tube de trappe en tandem

Chargeurs du bloc d'alimentation:

223-226	Chargeur simple de 115 V
223-227	Chargeur simple de 230 V
223-426	Chargeur deluxe à 5 stations, commutable pour le fonctionnement à 115 ou 230 V

Divers :

224-11	Trousse à outils de l'appareil d'échantillonnage
224-95 224-95A	Sac de protection en nylon avec ceinture et bretelle, brun, rouge

Service

Product to be serviced should be sent, freight prepaid, to:

SKC Inc.
National Service Center
863 Valley View Road
Eighty Four, PA 15330

Care should be taken in packaging to prevent damage in transit. Please include a contact name and phone number, shipping address, and a brief description of the problem. For nonwarranty repairs, a purchase order number and billing address is also required. The Service Center will contact nonwarranty customers with an estimate before proceeding with repairs.

SKC QualityCare

QualityCare is a cost-effective preventive maintenance program that assures that pumps are tested, repaired, and calibrated on an annual basis. Participants will receive certificates of compliance for each pump, each year, to demonstrate adherence to Occupational Health and Safety Management Systems or company quality programs.

For more information on QualityCare call our SKC Customer Service Team at 724 941-9701.

Note: *SKC Inc. will accept for repair any SKC product which is not contaminated with hazardous materials. Products determined to be contaminated will be returned unserviced.*

Universal Pump Service Manual

Customers who wish to self-service their out-of-warranty pumps should request the Universal Pump Service Manual (SKC Publication No. 1377).

SKC INC. LIMITED ONE YEAR WARRANTY

1. SKC warrants that its instruments provided for industrial hygiene, air pollution, gas analysis, and safety and health applications are free from defects in workmanship and materials under normal use for a period of one (1) year.

This warranty does not cover claims due to abuse, misuse, neglect, alteration, or accident, or use in application for which the instrument was either not designed or not approved by SKC Inc., or due to the buyer's failure to maintain normal maintenance, improper selection or misapplication. This warranty shall further be void if changes or adjustments to the instrument are made by other than an employee of the seller, or if the operating instructions furnished at the time of installation are not complied with.

2. **SKC Inc. hereby expressly disclaims all warranties either expressed or implied, including any implied warranties of merchantability or fitness for a particular purpose, and neither assumes nor authorizes any other person to assume for it any liability in connection with the sale of these instruments. No description of the goods being sold has been made a part of the basis of the bargain or has created or amounted to an express warranty that the goods will conform to any such description. Buyer shall not be entitled to recover from SKC Inc. any consequential damages, damages to property, damages for loss of use, loss of time, loss of profits, or income or other incidental damages. Nor shall buyer be entitled to recover from SKC Inc. any consequential damages resulting from defect of the instrument including, but not limited to, any recovery under section 402A of the Restatement, Second of Torts.**
3. This warranty extends only to the original purchaser of the warranted instrument during the term of the warranty.
4. Completion and return by the buyer of the instrument registration card is a condition precedent to warranty coverage and performance. In addition, the buyer may be required to present proof of purchase in the form of a paid receipt for the instrument.
5. This warranty covers the instrument purchased and each of its component parts.
6. In the event of a defect, malfunction, or other failure of the instrument not caused by any misuse or damage to the instrument while in possession of the buyer, SKC Inc. will remedy the failure or defect, without charge to the buyer. The remedy will consist of service or replacement of the instrument, or refund of the purchase price, at the option of SKC Inc. However, SKC Inc. will not elect refund unless it is unable to provide replacement, and repair is not commercially practicable.
7. The term of this warranty begins on the date the instrument is delivered to the buyer, and continues for a period of one (1) year,
8. (a) To obtain performance of any obligation under this warranty, the buyer shall return the instrument, freight prepaid, to SKC Inc., at the following address:
SKC Inc., National Service Center, 863 Valley View Road, Eighty Four, PA 15330 USA
(b) To obtain further information on the warranty performance you may telephone (724) 941-9701 at the address above.
9. This warranty shall be construed under the laws of the Commonwealth of Pennsylvania which shall be deemed to be the situs of the contract for purchase of SKC Inc. instruments.
10. No other warranty is given by SKC Inc. in conjunction with this sale.

Form #3755 Rev 9409

333 Pfingsten Road
Northbrook, Illinois 60062-2096
(708) 272-8800
FAX No. (708) 272-8129
MCI Mail No. 254-3343
Cable ULINC NORTHBROOK, IL
Telex No. 6502543343

Underwriters Laboratories Inc.®

CERTIFICATE No. Ex.280693-62011
28 June 1993

Issued to:
SKC Inc.
R. D. 1 No. 395 Valley View Rd.
Eighty-Four, PA 15330 U. S. A.

This is to certify that: Intrinsically safe Portable Air Sampling Pumps, Models 224-43XR, 224-44XR, 224-PCXR3, 224-PCXR4, 224-PCXR7, 224-PCXR8 for use with self-contained 6.0V battery pack, Models 224-30, or P21661 and intrinsically safe portable air sampling pumps, Models 224-PC3 and 224-PC7 for use with self-contained 4.8V battery pack, Model 224-17SD have been investigated by Underwriters Laboratories Inc. in accordance with the standard indicated in this certificate.

UL Standard for Safety:

ANSI/UL 913-1988 Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1 Hazardous Locations, Fourth Edition.

The Air Sampling Pumps comply with the requirements as defined by the standard indicated in this document for intrinsically safe apparatus for use in Class I, Division 1 and 2, Groups A, B, C and D, Class II, Division 1 and 2, Groups E, F and G and Class III hazardous locations.

To establish that a product is under the Certification program it is necessary to determine that the product has been manufactured under UL's Follow-Up Service. The Listing Mark of Underwriters Laboratories Inc. on the product is the only method provided by UL to identify a product manufactured under its Follow-Up Service. The Listing Mark includes the symbol of Underwriters Laboratories Inc. " Ⓤ " together with the word "Listed" and the control number 124U.

Code: Intrinsically safe apparatus: Class I, Division 1 and 2, Groups A, B, C, D; Class II, Division 1 and 2, Groups E, F, G; and Class III, Temperature Code T3C

Tamb= 40C

Albert A Bartkus
Albert A. Bartkus
Associate Managing Engineer
Hazardous Locations
Engineering Services

Investigation and Test
Report Reference:
E62011, 20 January 1987

A not for profit organization
dedicated to public safety and
committed to quality service

MAN9142R1
12/95

MAN9142R1

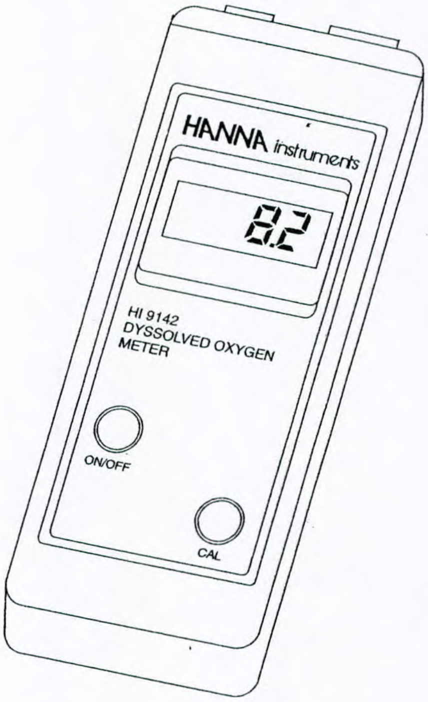
HANNA instruments

Stay in Touch with the Manufacturer!

Instruction Manual

HI 9142

Portable Waterproof
Dissolved Oxygen Meter



This Instrument is in Compliance with the CE Directives

HANNA instruments CE

Dear Customer,

Thank you for choosing a Hanna Instruments Product.

Please read this instruction manual carefully before using the instrument.

This manual will provide you with all the necessary information for the correct use of the instrument, as well as a more precise idea of its versatility in a wide range of applications.

This instrument is in compliance with the CE directives EN 50081-1 and 50082-1.

TABLE OF CONTENTS

HANNA instruments *ISO 9000 Certified Company since 1992*

PRELIMINARY EXAMINATION

Remove the instrument from the packing material and examine it to make sure that no damage has occurred during shipping. If there is any damage, notify your Dealer.

In addition to this manual you should find the following items:

- D.O. meter
- 4 x 1.5V AAA batteries
- DO Probe (HI 76407/4)
- Membrane cap (HI 76407A)
- Protective cap
- 30 mL electrolyte solution (HI 7041S)
- Rugged carrying case

Note: Save all packing material until you are sure that the instrument functions correctly. All defective items must be returned to us in the original packaging with the supplied accessories.

GENERAL DESCRIPTION

Hanna Instruments' **HI 9142** is a water-resistant, Dissolved Oxygen meter with Automatic Temperature Compensation. It has been developed for dissolved oxygen measurement in water and wastewater applications as well as other applications such as fish farming.

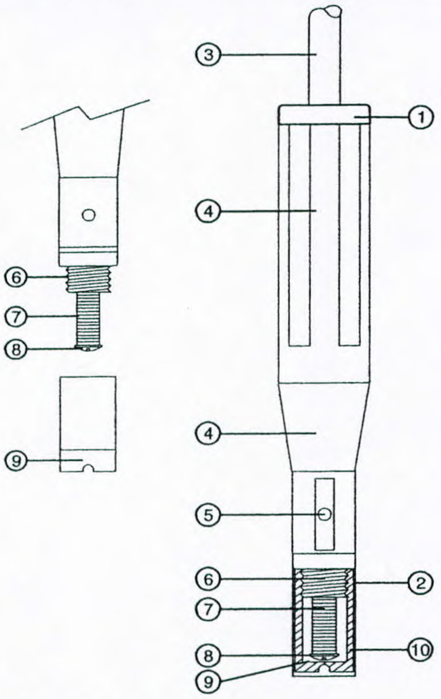
Dissolved oxygen is indicated in tenths of parts per million (ppm=mg/l).

Four 1.5V AAA batteries provide power and make the instrument completely portable.

The meter is housed in a rugged water-resistant case for maximum protection in the field as well as in the laboratory.

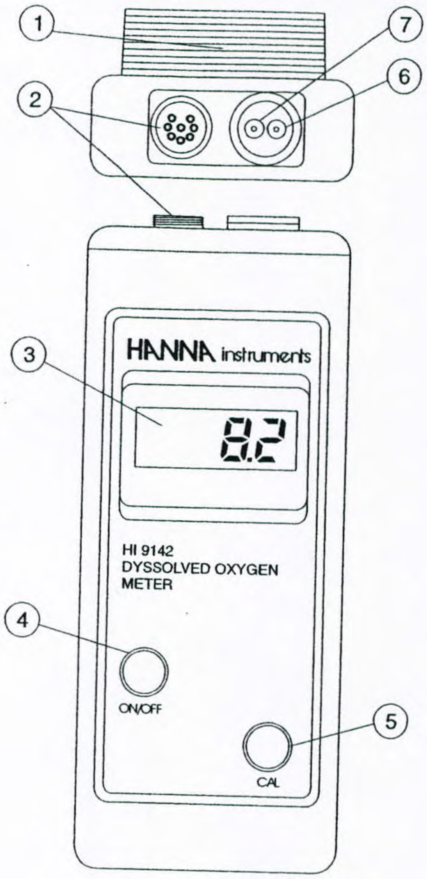
The dissolved oxygen probe has a membrane covering the polarographic sensors and a built-in thermistor for temperature measurements and compensation. The thin permeable membrane isolates the sensor elements from the testing solution, but allows oxygen to enter. When a voltage is applied across the sensor, oxygen that has passed through the membrane reacts causing the current to flow, allowing the determination of its concentration.

FUNCTIONAL DESCRIPTION PROBE



1. D.O. Probe
2. Protective Cap
3. Water-tight Shielded Cable
4. Polypropylene Probe Body
5. Temperature Sensor
6. O-Ring Seal
7. Silver Chloride Anode
8. Platinum Cathode (sensor)
9. Oxygen Permeable Teflon Membrane
10. Membrane Cap

FUNCTIONAL DESCRIPTION



1. Battery Compartment
2. Probe Connector
3. Liquid Crystal Display
4. ON/OFF Button
5. Calibration Button
6. Slope Calibration Trimmer
7. Zero D.O. Calibration Trimmer

SPECIFICATIONS

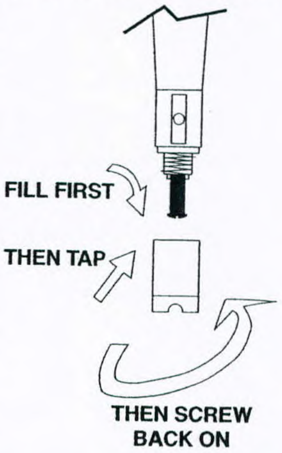
	HI 9142
Range	0.0 to 19.9 mg/l
Resolution	0.1 mg/l
Accuracy	±1.5% Full Scale
Typical EMC Deviation	±0.8 mg/l with 4 m cable probe
Calibration	Manual on 2 points (zero and slope)
Temperature Compensation	Automatic from 0 to 30°C (32 to 86°F)
Probe	HI 76407/4 polarographic with 4 m cable
Battery Type **Life**	4 x 1.5V AAA 100 hours of continuous use
Environment	0 to 50°C (32 to 122°F); 100% RH
Dimensions	196x80x60 mm (7.7x3.1x2.4")
Weight	425 g (15 oz.); kit: 1.4 kg (3.1 lbs)

INITIAL PROBE PREPARATION

Probe Preparation

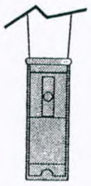
All probes shipped from Hanna Instrument are dry. To hydrate the probe and prepare it for use, connect it to the meter and proceed as follows.

1 Remove the red and black plastic cap. This cap is for shipping purposes and can be thrown away.
2 Wet the sensor by soaking the bottom 2½ cm (1") of the probe in electrolyte (**HI 7041S**) for 5 minutes.
3 Rinse the membrane (**HI 76407A** supplied in the kit with the meter) with electrolyte while shaking it gently. Refill with clean electrolyte.
4 Gently tap the sides of the membrane with your finger tip to ensure that no air bubbles remain trapped. To avoid damaging the membrane, do not tap the membrane directly on the bottom.



5 Make sure that the rubber O-ring sits properly inside the membrane cap.
6 With the sensor facing down, screw the cap clock-wise. Some electrolyte will overflow.

When not in use, place the protective cap supplied in the kit with the meter.



CALIBRATION PROCEDURE

PROBE POLARIZATION

The probe is under polarization with a fixed voltage of approximately 800 mV.

Probe polarization is essential for stable measurements with the same recurring degree of accuracy.

With the probe properly polarized, oxygen is continually "consumed" by passing through the sensitive diaphragm and dissolving in the electrolyte solution contained in the probe.

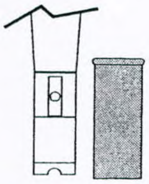
If this operation is interrupted, the electrolyte solution continues to be enriched with oxygen until it reaches an equilibrium with the surrounding solution.

Whenever measurements are taken with a non-polarized probe, the oxygen level revealed is both that of the tested solution as well as that present in the electrolyte solution. This reading is incorrect

The calibration is very simple and fast.

- Make sure the probe is ready for measurements (see initial preparation at page 5), i.e. the membrane is filled with electrolyte and the probe is connected to the meter.
- Switch the meter on by pressing the ON/OFF key

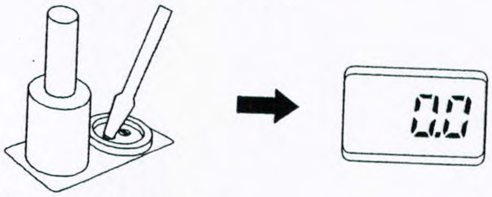
- For an accurate calibration, it is recommended that you wait at least 15 minutes to ensure precise conditioning of the probe.
- Remove the protective cap from the D.O. probe.



Zero Calibration:

- Dip the probe into **HI 7040** zero oxygen solution and stir gently for 2-3 minutes.

- Allow 2 minutes for the LCD readout to stabilize.
- Adjust the zero D.O. calibration trimmer until the display reads "0.0".

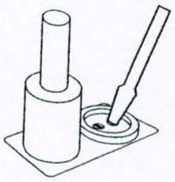


Slope Calibration:

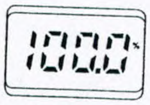
It is suggested to perform the slope calibration in satured air.

- Rinse the probe in a large amount of clean water to remove any residual zero oxygen solution.
- Dry the probe tip and allow a few minutes for the LCD readout to stabilize.
- Press and hold the CAL key.

- Adjust the slope trimmer on the top of the meter to read "100%" on the LCD (while still holding the CAL button).



- Release the CAL key and the LCD will display the value in ppm of oxygen.



The **zero calibration** of the **HI 9142** is very stable, therefore this procedure needs only to be performed **whenever the probe is replaced**.

However, because the **slope calibration** is more critical, **it is recommended to perform this procedure every week**.

TAKING MEASUREMENTS

Make sure the meter has been calibrated and the protective cap has been removed. Immerse the tip of the probe in the sample to be tested.

Make sure the temperature sensor is also immersed.

For accurate dissolved oxygen measurements a water movement of 0.3 m/sec is required at a minimum. This is to ensure that the oxygen-depleted membrane surface is constantly replenished. A moving stream will provide adequate circulation. To quickly check if the water speed is sufficient, wait for the reading is stable and then move the D.O. probe. If the reading is still stable, the measurement conditions are right, while if the reading increases the water movement is too low.

During field measurements, this condition may be met by manually agitating the probe. Accurate readings are not possible while the liquid is at rest.

During laboratory measurements, the use of a magnetic stirrer to ensure a certain velocity in the fluid is recommended. In this way, errors due to the diffusion of the oxygen present in the air in the solution are reduced to a minimum.

At all times, the time necessary for thermal equilibrium to occur between the probe and the sample must be allowed (a few minutes for temperature difference of several degrees).

ALTITUDE & SALINITY COMPENSATION

If the sample contains salts or if you are performing the measurements at a different altitude than sea level, the readout values must be corrected, taking into account the lower degree of oxygen solubility in such occasions as explained below.

ALTITUDE COMPENSATION

All the readouts are referred to the sea level, thus the displayed measurements are higher than the actual values. In fact, altitude affects D.O. concentration decreasing its value. The following table reports the oxygen solubility at various temperatures and altitudes, based on sea level barometric pressure of 760 mm Hg.

°C	Altitude, Meters above Sea Level							°F
	0 m	300 m	600 m	900 m	1200m	1500m	1800m	
0	14.6	14.1	13.6	13.2	12.7	12.3	11.8	32.0
2	13.8	13.3	12.9	12.4	12.0	11.6	11.2	35.6
4	13.1	12.7	12.2	11.9	11.4	11.0	10.6	39.2
6	12.4	12.0	11.6	11.2	10.8	10.4	10.1	42.8
8	11.8	11.4	11.0	10.6	10.3	9.9	9.6	46.4
10	11.3	10.9	10.5	10.2	9.8	9.5	9.2	50.0
12	10.8	10.4	10.1	9.7	9.4	9.1	8.8	53.6
14	10.3	9.9	9.6	9.3	9.0	8.7	8.3	57.2
16	9.9	9.7	9.2	8.9	8.6	8.3	8.0	60.8
18	9.5	9.2	8.7	8.6	8.3	8.0	7.7	64.4
20	9.1	8.8	8.5	8.2	7.9	7.7	7.4	68.0
22	8.7	8.4	8.1	7.8	7.7	7.3	7.1	71.6
24	8.4	8.1	7.8	7.5	7.3	7.1	6.8	75.2
26	8.1	7.8	7.5	7.3	7.0	6.8	6.6	78.8
28	7.8	7.5	7.3	7.0	6.8	6.6	6.3	82.4
30	7.5	7.2	7.0	6.8	6.5	6.3	6.1	86.0
32	7.3	7.1	6.8	6.6	6.4	6.1	5.9	89.6
34	7.1	6.9	6.6	6.4	6.2	6.0	5.8	93.2
36	6.8	6.6	6.3	6.1	5.9	5.7	5.5	96.8
38	6.6	6.4	6.2	5.9	5.7	5.6	5.4	100.4
40	6.4	6.2	6.0	5.8	5.6	5.4	5.2	104.4

This gives an idea of the error that can be introduced at different altitudes and allow you to calculate the quantity to be subtracted to correct your reading.

SALINITY COMPENSATION

The table below shows the influence of salt in the measurement of oxygen.

In **HI 9142** all the readouts are referred to 0 g/l of salinity value. In fact, salinity affects D.O. concentration decreasing its value.

For your reference the table below reports the oxygen solubility at various temperatures and salinity. From the table you can calculate the quantity to be subtracted to correct your reading.

℃	Salinity (g/l) at Sea Level					°F
	0 g/l	10 g/l	20 g/l	30 g/l	35 g/l	
10	11.3	10.6	9.9	9.3	9.0	50.0
12	10.8	10.1	9.5	8.9	8.6	53.6
14	10.3	9.7	9.1	8.6	8.3	57.2
16	9.9	9.3	8.7	8.2	8.0	60.8
18	9.5	8.9	8.4	7.9	7.6	64.4
20	9.1	8.5	8.0	7.6	7.4	68.0
22	8.7	8.2	7.8	7.3	7.1	71.6
24	8.4	7.9	7.5	7.1	6.9	75.2
26	8.1	7.6	7.2	6.8	6.6	78.8
28	7.8	7.4	7.0	6.6	6.4	82.4

PROBE & MEMBRANE MAINTENANCE

The oxygen probe body is made of reinforced plastic for maximum durability.
A thermistor temperature sensor provides temperature measurements of the sample tested. It is always recommended that the protective cap be kept on the probe when the probe is not in use to provide protection against damage and dirt.

To replace the membrane or refill with electrolyte, proceed as follows:

- Remove the protective cap by gently twisting and pulling it off the body of the probe (see fig. 1).
- Unscrew the membrane by turning it counter-clockwise with the other hand (see fig.2)
- Wet the sensor by soaking the bottom 2½ cm (1") of the probe in electrolyte (**HI 7041S**) for 5 minutes.
- Rinse the new membrane (**HI 76407A**) supplied with the meter with electrolyte while shaking it gently. Refill with clean electrolyte.
- Gently tap the sides of the membrane with your finger tip to ensure that no air bubbles remain trapped. Do no directly tap the bottom with your finger as this will damage the membrane.

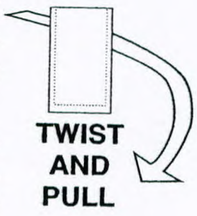


fig. 1

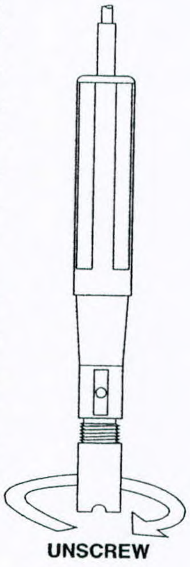


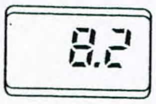
fig. 2

- Make sure that the rubber O-ring is seated properly inside the membrane cap.
- With the sensor facing down, screw the membrane cap clock-wise. Some electrolyte will overflow.

The Platinum cathode (#8 in the Functional Description at page 2) should always be bright and untarnished. If it is tarnished or stained, which could be due to contact with certain gases or extended use with a loose or damaged membrane, the cathode should be cleaned. You can use a clean lint-free cardboard or cloth. Rub the cathode very gently side to side 4-5 times. This will be enough to polish and remove any stains without damaging the platinum tip. Afterwards, rinse the probe with deionized or distilled water and install a new membrane cap using fresh electrolyte and follow the steps above. Recalibrate the instrument.

Important: in order to have accurate and stable measurements, it is important that the surface of the membrane is in perfect condition. This semi-permeable membrane isolates the sensor elements from the environment but allows oxygen to enter. If any dirt is observed on the membrane, rinse carefully with distilled or deionized water. If any imperfections still exist, or any damage is evident (such as wrinkles or tears - holes), the membrane should be replaced. Make sure that the O-Ring is properly seated in the membrane cap.

BATTERY REPLACEMENT

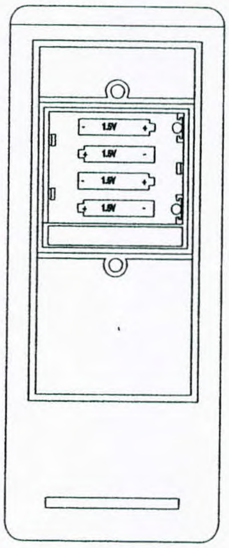


When the battery is rundown "V" is displayed on the Liquid Crystal Display to warn the user.

This is to inform the user that the display will be shut-off after about 4 hours of use to prevent erroneous measurements being taken due to low voltage.

Battery replacement must only take place in a non hazardous area using the battery types specified in this instruction manual (see page 14).

In order to replace run-down batteries, simply remove the two screws on the rear cover of the instrument and replace the four 1.5V AAA batteries with new ones, paying attention to the correct polarity (refer to #1 in the Functional Description page 3).



ACCESSORIES

BAT1.5AAA/P	1.5V AAA size battery (16 pcs)
HI 7040M	Zero Oxygen calibration solution, 230 mL
HI 7040L	Zero Oxygen calibration solution, 460 mL
HI 7041S	Refilling Electrolyte solution, 30 mL
HI 76407/10	Spare probe with 10 meters (33') cable
HI 76407/20	Spare probe with 20 meters (66') cable
HI 76407A/P	5 spare membranes
MAN9142R1	Instruction manual

WARRANTY

All Hanna Instruments **meters are warranted for two years** against defects in workmanship and materials when used for their intended purpose and maintained according to the instructions. The **probes are warranted for a period of six months**.

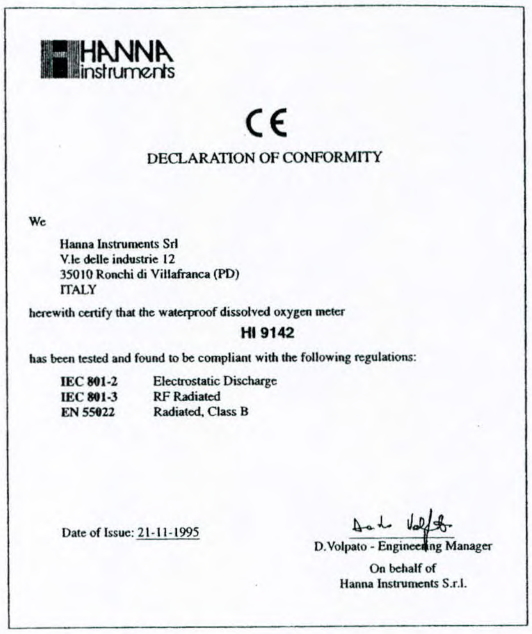
Damages due to accidents, misuse, tampering or lack of prescribed maintenance are not covered. This warranty is limited to repair or replacement free of charge.

If service is required, contact the dealer from whom you purchased the instrument. If under warranty, report the model number, date of purchase, serial number and the nature of the failure. If the repair is not covered by the warranty, you will be notified of the charge for repair or replacement. If the instrument is to be returned to Hanna Instruments, obtain a Return Goods Authorization from the Customer Service Department first and then send it with shipment cost prepaid. When shipping any instrument, make sure it is properly packaged for complete protection.

To validate your warranty, fill out and return the enclosed warranty card within 14 days from the date of purchase.

Hanna Instruments reserves the right to modify the design, construction and appearance of its products without advance notice.

CE DECLARATION OF CONFORMITY



HANNA instruments

CE

DECLARATION OF CONFORMITY

We

Hanna Instruments Srl
V.le delle industrie 12
35010 Ronchi di Villafranca (PD)
ITALY

herewith certify that the waterproof dissolved oxygen meter

HI 9142

has been tested and found to be compliant with the following regulations:

IEC 801-2	Electrostatic Discharge
IEC 801-3	RF Radiated
EN 55022	Radiated, Class B

Date of Issue: 21-11-1995

D.Volpato - Engineering Manager
On behalf of
Hanna Instruments S.r.l.

Recommendations for Users

Before using this product, make sure that it is entirely suitable for the environment in which it is used.

Operation of this instrument in residential area could cause unacceptable interferences to radio and TV equipments, requiring the operator to take all necessary steps to correct interferences.

Any variation introduced by the user to the supplied equipment may degrade the instrument's EMC performance.

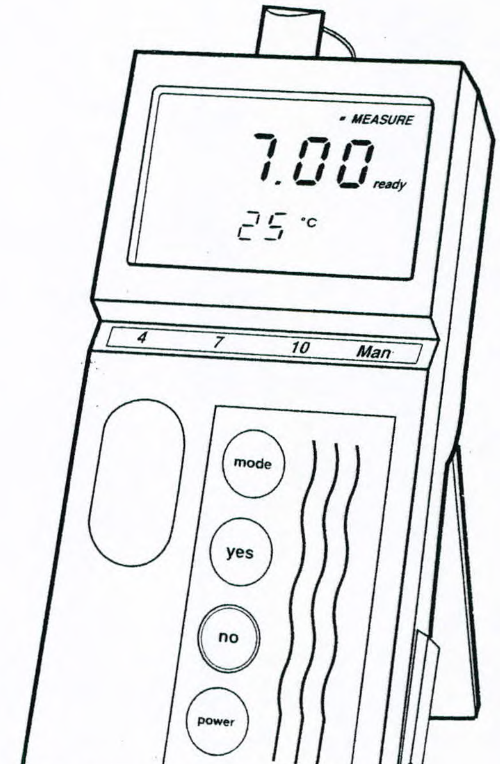
To avoid electrical shock, do not use this instrument when voltages at the measurement surface exceed 24VAC or 60 VDC.

To avoid damages or burns, do not perform any measurement in microwave ovens.

In particular cases the meter could turn off. In these cases it can be turned on by pressing the ON/OFF key.

Benchtop pH/ISE Meters
Models 210A, 230A, [✓ 250A], 290A

INSTRUCTION MANUAL



ORION

Table Of Contents

Chapter I

Introduction

Orion's Portable Meters are compact, battery operated and microprocessor controlled for all measurement needs. All meters feature a custom digital LCD display, which simultaneously displays temperature along with measurement results. Ideal for field, plant, or laboratory use, each meter is lightweight and designed to fit comfortably in the hand. A flip stand allows easy use in the lab.

The model 210A is a basic pH meter that features 2 point autocalibration.

The model 230A is a pH meter that features autocalibration and automatic temperature compensation.

The model 250A has all the features of the 230A plus a millivolt and relative millivolt mode, and RS232-C output for use with the Orion 900A printer or other serial peripherals.

The model 290A adds concentration measurements and an internal datalogging function to make a truly versatile meter for pH or ISE analysis.

This manual contains instructions for all four meters. See the calibration and measurement section for details on your particular meter. The general information section contains descriptions of hardware which pertain to all meters. The Temperature Compensation and Troubleshooting sections contain information applicable to all meters.

Chapter II

General Information

Orion's Portable Meters have a large custom LCD display and keypad with tactile and audible feedback. Designed for one-handed operation each features an electrode clip to attach electrode directly to meter and molded grip area. (Electrode clips included in Portable Meter Starter Kit, Orion Cat. No. OPBLSK)

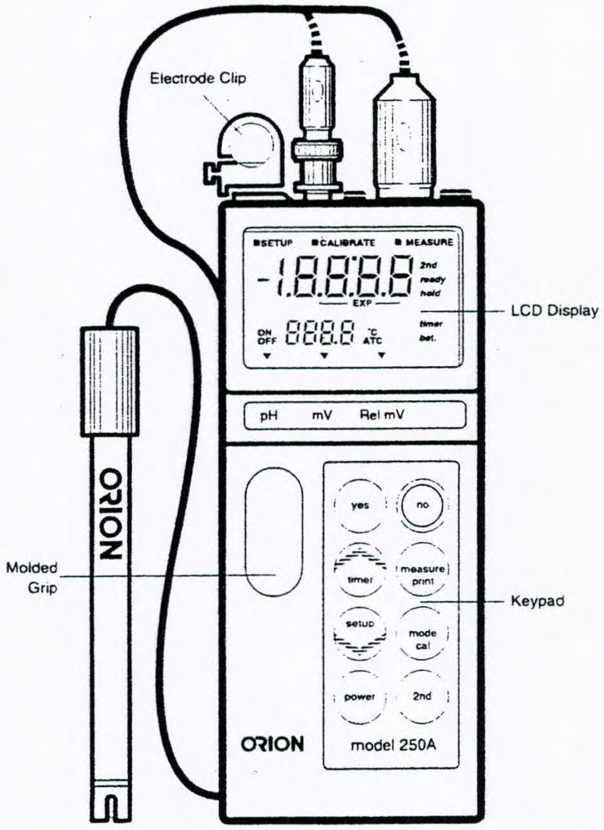


Figure 1: Front Panel Model 250A

A. Top Panel

1. Electrode Connections: Accepts BNC connector from combination or half-cell sensing electrode(s) (1A), A separate pin tip (1B) accepts a reference electrode.
2. ATC Probe Jack: Accepts thermistor type Automatic Temperature Compensation probe with DIN connector.
3. Line Converter Jack: Accepts an AC line converter for use without batteries.

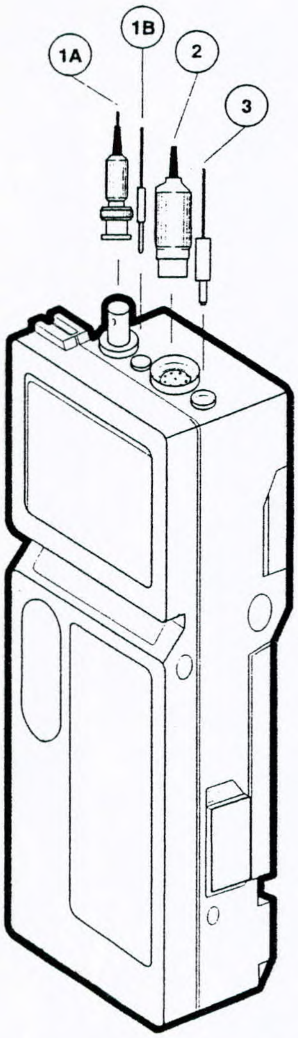


Figure 2: Top Panel Model 250A

B. Rear Panel

1. Battery Compartment: Accepts one 9 V battery, either alkaline or lithium.
2. Setup Menu Label: Identifies setup parameters and corresponding I.D. codes.
3. Electrode Clip: Attaches an electrode directly to the meter for one-handed operation.
4. Electrode Storage Compartment: Stores electrode in between measurements. Compartment can contain electrode storage solution to keep electrode moist and ready for use.
5. Cable Management: The cable(s) from the electrode(s) will slide under the left side of the storage compartment.

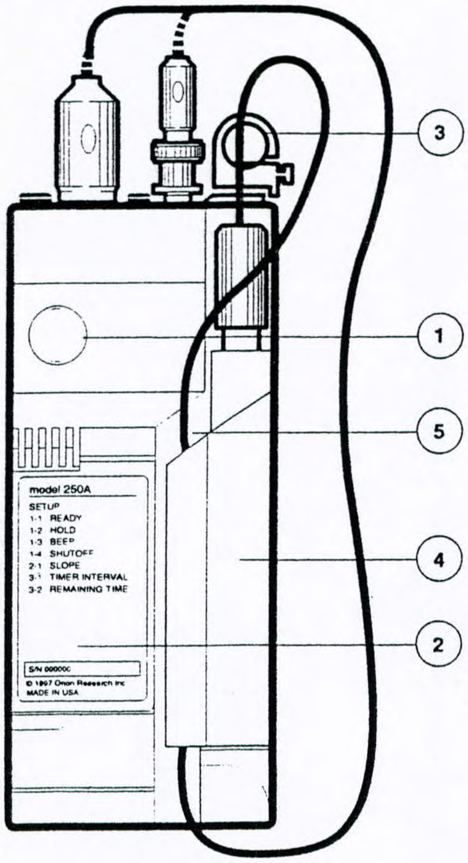


Figure 3: Rear Panel Model 250A

C. Electrode Clip

The electrode clip allows easy one-handed dip and read operation. Two or more electrodes may be joined together and then attached directly to the meter.

1. Slide electrode clip onto electrode.
2. If using two electrodes slide second electrode clip into opening on the first electrode clip (see inset).
3. Attach electrode(s) to meter by sliding clip from left to right into meter until securely seated.

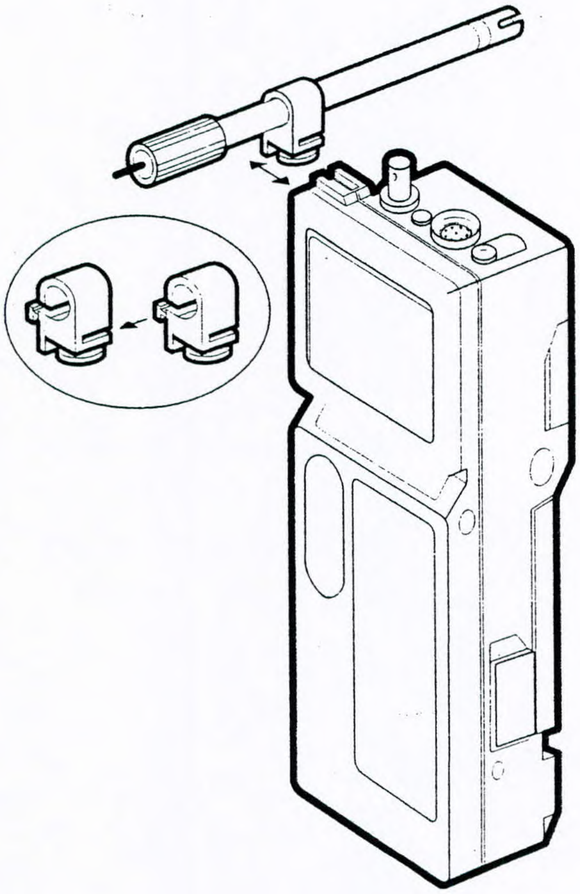


Figure 4: Electrode Clip

D. Electrode Storage Compartment

The electrode storage compartment provides a convenient place for electrode storage between measurements and in the field. Add a few drops of pH electrode storage solution Orion Cat No. 910001 to the storage compartment cap to ensure your electrode will be ready for use. The entire compartment is removable for easy cleaning.

The right-hand side of the compartment (when the meter is turned over and facing down) provides a space for the electrode cables. Slide the cable underneath the edge of the compartment.

1. With the meter facing down slide the compartment to the right to remove.
2. Rinse with distilled or deionized water.
3. Replace compartment by lining up pins on meter with slides on electrode storage compartment then slide to the left until firmly in place.

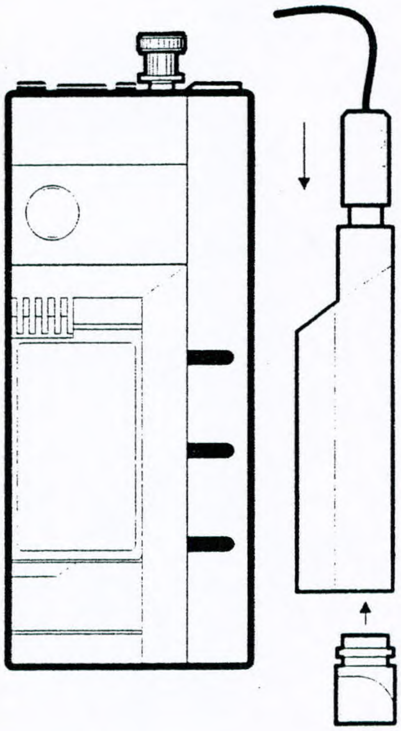


Figure 5: Electrode Storage Compartment

E. RS232-C Interface

Both the Models 250A and 290A have an RS232-C interface for use printers or serial peripherals.

The Model 250A has a one way interface for communication with the Orion 900A printer or other device. The instrument can send (but not receive) information via this port.

The Model 290A has a bi-directional interface for communication with printers or computers. The instrument can send or receive information using this port.

The Model 900A printer is battery operated and attaches directly to either meter making a compact package for field measurement and recording. See printer manual, part no. 213377-001.

Chapter III

Set Up and Self-Test Procedures

A. Power Source

The Orion Portable Meters operate on either one 9 V alkaline battery, one 9 V lithium battery, or an AC line adapter. The estimated battery life is 50 hours of continuous operation for an alkaline battery and 100 hours of continuous operation for a lithium battery. Insert battery as described below or plug in the line adapter.

B. Battery Installation

1. Open battery compartment by pushing closure up. This is most easily accomplished by using a coin (such as a dime) and inserting it into the slot on the side of the meter.
2. Insert battery pushing gently until it locks in place. Ensure polarity is correct as shown in the battery compartment.
3. Replace battery compartment cover.

   NOTE: After replacing the battery, recalibrate. Without the battery installed or meter plugged into line power, the meter loses calibration data and other information in memory. To prevent loss of data in the field, turn meter off if the low battery signal comes on. Check and replace batteries regularly prior to field use.

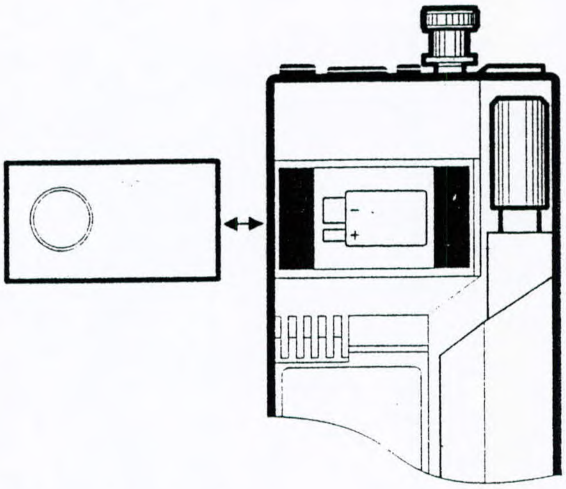


Figure 6: Battery Compartment

C. Power Up and Self-Test

NOTE: Use this procedure when the instrument is first received and whenever troubleshooting becomes necessary.

1. Attach the BNC Shorting Plug (Orion Cat. No. 090045) to BNC connector on top of meter.
2. Press the **power** key to turn meter on.
3. If battery indicator remains on, replace battery or use line adapter.
4. Press the **power** key to turn meter off.
5. Press the **power** key and quickly press the **yes** key to start the self-test. (Alternatively, press and hold the **yes** key while pressing the **power** key). The instrument automatically performs electronic and hardware diagnostic tests. For a more detailed explanation, see the self-test section of the troubleshooting guide, page 81.
6. When the code 7 appears in the lower display field, "0" will be displayed, press each key, including the **power** key, one at a time. A numeric digit will be displayed upon each key press.

   NOTE: All keys must be pressed within 10 seconds to complete test 7.

7. For Model 210A or Model 230A: After the keypad test, the meter will shut off.

   For Model 250A or Model 290A: After the keypad test, the meter will turn off then back on again. After completing the self-test, the meter will resume normal operation.

8. If any problems are found during self-test, the meter will display the operator assistance code (for details, see page 83) until acknowledged by pressing the **yes** key.

D. Electrode Connections

Orion Triode

Attach Orion TRIODE electrode by sliding the BNC connector onto the sensor input then push down and turn clockwise to lock into position. Slide the DIN connector into the ATC jack until it is firmly seated.

Other Electrodes

Attach electrodes with BNC connectors to sensor input by sliding connector onto input, pushing down and turning clockwise to lock into position. Connect reference electrodes with pin tip connectors by pushing connector straight into reference input.

> *NOTE: If using a combination electrode with a BNC connector, the reference pin-tip is not used.*

Chapter VI

Model 250A

A. Display

Operating Mode	Indicates instrument operating mode.
SETUP	*Indicates meter is in SETUP mode. Used to define operating parameters.*
CALIBRATE	*Indicates meter is in calibration mode, accessed by pressing **2nd** then **cal** keys.*
MEASURE	*Indicates the meter is in measurement mode, accessed by pressing the measure key.*
Main Field	Displays pH, millivolts, or relative millivolts depending on the meter operating mode.
ON/OFF	Indicates if a particular feature is active or not in the SETUP menu.
Lower Field	Displays temperature in degrees Celsius. The °C designation is displayed when temperature is displayed.
ATC	Displayed when a temperature probe is attached.

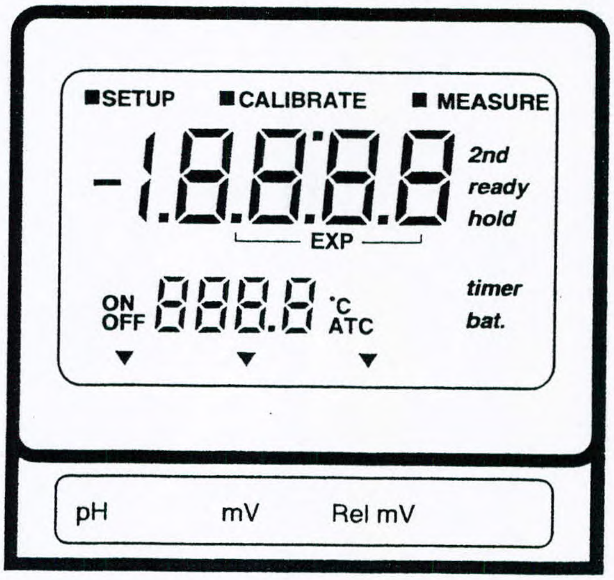


Figure 12: 250A Display

2nd	Displayed when the **2nd** key has been pressed, indicating the meter is ready to perform a secondary function.
READY	Displayed when the electrode signal is stable. The READY function may be turned on or off in the SETUP menu.
HOLD	Displayed when the pH reading is frozen after reaching stability in measure mode. The HOLD feature may be turned on or off in the SETUP menu.
TIMER	Displayed when the timer function has been activated.
BAT	Displayed when the battery is low and needs to be replaced.
Mode Indicator	Designates instrument measurement mode either pH, millivolts (mV) or Relative millivolts (Rel mV).

B. Keypad

Primary Functions

yes	Press to enter a value during calibration or setup. May also be used to scroll through the setup menu without changing any parameters.
no	Press to cancel a change to a parameter before entering.
measure	Press for sample analysis. Instrument will remain in measure mode until another key is pressed. Press to unlock HOLD.
mode	Press to change measurement modes. The options are pH, mV, or REL mV.
2nd	Press to access second functions: cal, timer, setup or print.
Λ	Press to increase value.
V	Press to decrease value.
power	Press to turn meter on or off.

Second Functions

All second functions are accessed by first pressing the **2nd** key.

cal	Press to start calibration. Meter automatically advances to MEASURE after the calibration is complete.
timer	Press to start the timer. When the preset time has elapsed, the instrument will beep for one minute (or until a key is pressed).
print	Press to print display data
setup	Press to access the setup menu. This is used for setting instrument operating parameters.

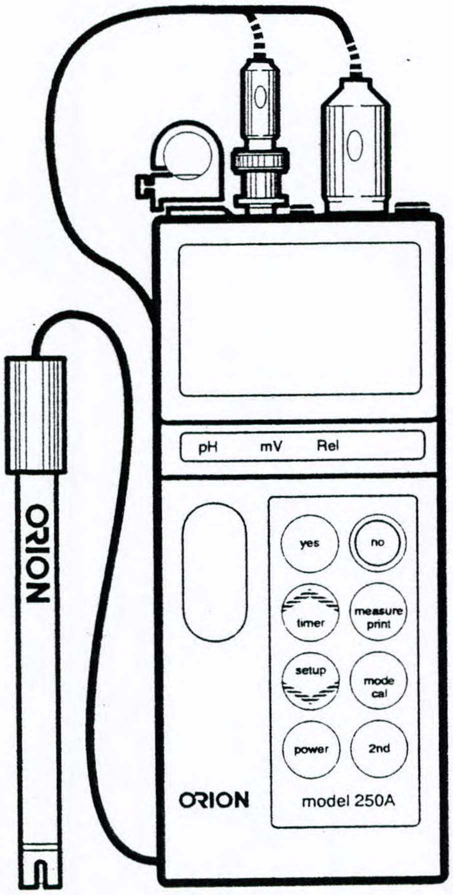


Figure 13: 250A Keypad

SET UP

1-1 READY
1-2 HOLD
1-3 BEEP
1-4 AUTO SHUTOFF
2-1 SLOPE
2-2 RESOLUTION
2-3 ISOPOINT
2-4 RESET
3-1 TIMER INTERVAL
3-2 REMAINING TIME
3-3 SET REAL TIME
3-4 SET DATE
5-1 PRINT MODE 1 = MAN
2 = READY, 3 = TIMED
5-2 PRINT INTERVAL

C. Self Test and Checkout Procedure

1. Attach the BNC Shorting Plug (Orion Cat. No. 090045) to BNC connector on top of meter.
2. Press the **power** key to turn meter on.
3. If battery indicator remains on, replace battery or use line adapter.
4. Press the **power** key to turn meter off.
5. Press the **power** key and quickly press the **yes** key to start the self-test. (Alternatively, press and hold the **yes** key while pressing the **power** key). The instrument automatically performs electronic and hardware diagnostic tests. For a more detailed explanation, see the self-test section of the troubleshooting guide, page 81.
6. When the code 7 appears in the lower display field, "0" will be displayed, press each key, including the **power** key, one at a time. A numeric digit will be displayed upon each key press.

   NOTE: All keys must be pressed within 10 seconds to complete test 7.

7. After the keypad test, the meter will turn off then back on again. After completing the self-test, the meter will resume normal operation.
8. If any problems are found during self-test, the meter will display the operator assistance code (for details, see page 83) until acknowledged by pressing the **yes** key.
9. Press the **measure** key. Main display should read a steady 7.00 ± 0.02. If not, follow steps 9a through 9b.
   a. Press the **cal** key, when the display flashes 7.00, press the **yes** key.
   b. Press the **measure** key. The main display should read 100.0, with the legend SLP, in the lower display. If so, press the **yes** key. If not, scroll until the display reads 100.0. Then press the **yes** key. The meter advances to measure and the display should now read a steady 7.00.
10. Press the **mode** key to enter millivolt mode. 0.0 ± 0.1 should be displayed. If not, reseat the shorting cap and repeat steps 4 through 10.
11. Press the **mode** key to enter REL mV mode. 0.0 ± 0.1 should be displayed. If not, press the **2nd** then the **cal** keys. Then press the **yes** key to enter the value 0.0. Display should read a steady 0.0.
12. After steps 9 through 11 have been successfully completed, the meter is ready for use with electrodes. Remove the shorting plug.

D. SETUP Menu

The SETUP menu is used to identify and change instrument operating parameters. In setup, the **yes** key is used to scroll through the menu without changing any parameters. To change a parameter, press one of the scroll keys, **Λ** or **V**, then press the **yes** key to enter the change into the meter memory. Press the **no** key to restore the parameter to its former state (if done before entering the new parameter).

To enter the SETUP menu, press the **2nd** then the **setup** keys. 1-1 and READY will be displayed. The ON or OFF indicator flashes indicating the current status. Press the **yes** key to accept and continue through the menu. Press a scroll key, **Λ** or **V**, to change. After changing a setting, press the **yes** key to enter the change into the meter memory.

To change a numeric value, press the **Λ** or **V** key, the first digit will start flashing. Scroll until the first digit is the desired value. Then press the **yes** key. The second digit will flash, scroll until the desired value is displayed. Then press the **yes** key. Continue in this manner until all digits have been changed to the desired value. Then press the **yes** key to enter the new value into the meter memory.

Scroll through the SETUP menu accepting or changing parameters as desired.

To exit the SETUP menu, press the **2nd** then the **cal** keys to begin the calibration sequence or press the **measure** key to analyze samples.

The following parameters are accessed in the setup menu.

1-1 READY	Turning READY on will cause the ready indicator to be displayed when the electrode signal is stable. The default setting is on.
1-2 HOLD	Turning HOLD on will cause the display to freeze during sample measurements when the electrode signal is stable. Press the **measure** key to unlock the hold and returns the meter to live displays during sample measurement. The default setting is off.
1-3 BEEP	Turning BEEP on will cause an audible signal to sound on ready, when a key is pressed and when an operator assistance code appears. The default setting is on.

1-4 AUTO-SHUTOFF	Turning AUTOSHUTOFF on will cause the meter to turn off if no keys have been pressed for 10 minutes. This feature will save battery life. The default setting is on.
2-1 SLOPE	Allows review of electrode slope in memory at any time. The slope value cannot be changed in the setup menu.
2-2 RESOLUTION	Allows selection of either 0.1 or 0.01 pH resolution. Press a scroll (**Λ** or **V**) key to change the resolution. Then press the **yes** key to enter and continue through the menu. The default setting is 0.01.
2-3 ISOPOTENTIAL POINT	Use to change the isopotential point for a particular pH electrode. In pH mode, the default value is 7.00.
2-4 RESET	Sets all the calibration data and setup options to factory default values. This is particularly useful during trouble shooting or starting with a fresh electrode. To RESET press the **Λ** scroll key, the ON will flash and the beeper will ring rapidly. Press the **yes** key to reset. Press the **no** key to cancel.

NOTE: *Setup functions 2-1 Slope, 2-2 Resolution, and 2-3 Isopotential Point are only accessed in pH mode.*

3-1 TIMER INTERVAL	Used to set the timer interval. The maximum interval that can be set is 23 hours, 59 minutes, and 59 seconds. The minimum interval is five (5) seconds. When the TIMER INTERVAL code, 3-1, is displayed the current interval hours setting is displayed in the main field (H 00). Press the **yes** key to accept or scroll to change, then press the **yes** key. Next, the current interval minutes:seconds will be displayed (00:00). Press the **yes** key to accept current setting or scroll to desired value then press the **yes** key to accept. The default setting is five (5) seconds.
3-2 TIME REMAINING	Allows review of the time remaining before the TIMER is set to go off.

3-3 SET REAL TIME	Used to set the actual time of day. The meter uses a 24-hour clock. When the code 3-3 is displayed in the lower field, the current time (hours: minutes) is displayed in the main field. If correct, press the **yes** key to accept. Otherwise, change as required then press the **yes** key to accept the new time.
3-4 SET DATE	Used to set the current date. When the code 3-4 is displayed in the lower field, the current date (month:day) is displayed in the main field. Press the **yes** key to accept or change the date as needed then press the **yes** key to accept. Next, the current year is displayed. Press the **yes** key to accept or change as required then press the **yes** key to accept.
5-1 PRINT MODE	When 5-1 is displayed in the lower field, the current print mode is displayed in the main field. The options are: 1-Manual Print, indicates no automatic output to the printer. The user may print on command by pressing the **2nd** then **print** keys; 2-Print on Ready, the meter will send information to the printer whenever the electrode signal reaches stability; 3-Print on a timed interval, printing occurs at a preset timed interval. Use the scroll keys to change the setting, then press the **yes** key to enter the new setting into meter memory. The default setting is 1; print on command.
5-2 SET PRINT INTERVAL	Used to set the timed print interval. The maximum print interval is 23 hours, 59 minutes and 59 seconds. The minimum print interval is 5 seconds. When the code 5-2 is displayed in the lower field, the current print interval hours will flash in the main display. Press the **yes** key to accept or change using the scroll keys. Then press the **yes** key to enter. Next, the print interval minutes:seconds will be displayed in the main field. Press the **yes** key to accept or change, then press the **yes** key to enter the new setting into the meter memory. The default setting is 1 minute.

E. Calibration and Measurement Procedures

pH Measurements

A one or two buffer calibration should be performed before pH is measured. It is recommended that a two buffer calibration, using buffers that bracket the expected sample range, be performed at the beginning of each day to determine the slope of the electrode. This serves the dual purpose of determining if the electrode is working properly and storing the slope value in the memory. Perform a one buffer calibration every two hours to compensate for electrode drift.

Prior to calibration, scroll through the SETUP menu and ensure all parameters are set properly for the analysis you want to perform. Select the desired resolution and verify that the isopotential point is set correctly for the electrode.

There are two ways of calibrating the 250A Meter: autocalibration or manual calibration. Following are descriptions and instructions for each method.

Autocalibration

Autocalibration is a feature of the Model 250A Meter that automatically recognizes the buffers 7.00, 4.01 and 10.01 with a range of ±0.5 pH units. During calibration, the user waits for a stable pH reading. Once the electrode is stable, the meter automatically recognizes and displays the temperature-corrected value for that buffer. Press the **yes** key to enter the value into the meter memory.

NOTE: Do not scroll when using autocalibration.

The 250A Meter compares actual values to theoretical values to determine if the buffer is within range. Results greater than ±0.5 pH units from the correct value will trigger an operator assistance code. For best results, it is recommended that an ATC probe be used. If an ATC probe is not used all samples and buffers should be at the same temperature or manual temperature compensation should be used.

Autocalibration with Two Buffers

1. Connect the electrode(s) to meter. Choose either 4.01 and 7.00, or 7.00 and 10.01 buffers, whichever will bracket your expected sample range.
2. Press the **mode** key until the pH mode indicator is displayed.
3. Rinse the electrode(s) and place into either the 4.01, 7.00 or 10.01 buffer.
4. Press the **2nd** then the **cal** keys. CALIBRATION is displayed above the main field and the time and date of the last calibration are displayed. After a few seconds, P1 is displayed in the lower field. P1 indicates that the meter is ready for the first buffer and a value has not yet been entered. When READY is displayed, indicating electrode stability, and the reading begins to flash, press the **yes** key. The display will remain frozen for two seconds. Then P2 will be displayed in the lower field indicating the meter is ready for the second buffer.
5. Rinse the electrode(s) and place in second buffer. When READY is displayed, indicating electrode stability, and the reading begins to flash, press the **yes** key. The display will remain frozen for two seconds.

   After the second buffer value has been entered, the electrode slope will be displayed. SLP appears in the lower field with the actual electrode slope, in percent, in the main field.

   The meter automatically advances to the measure mode. MEASURE is displayed above the main field.
6. Rinse the electrode(s) and place into sample. Record pH directly from the main meter display and temperature from the lower field.

Autocalibration with One Buffer

1. Connect the electrode(s) to meter. Select one buffer, either 4.01, 7.00 or 10.01, whichever most closely approximates the expected sample pH.
2. Press the **mode** key until the pH mode indicator is displayed.
3. Rinse the electrode(s) and place into the buffer and press the **2nd** then the **cal** keys. CALIBRATE will be displayed above the main field and the time and date of the last calibration will be displayed. After a few seconds, P1 will be displayed in the lower field.
4. When READY is displayed, indicating electrode stability, and the reading begins to flash, press the **yes** key. The display remains frozen for two seconds. Then P2 is displayed in the lower field.
5. Press the **measure** key. SLP will be displayed in the lower field and the electrode slope in memory in the main field. If necessary, enter the correct electrode slope determined by a two point calibration and press the **yes** key. If slope value is unknown, enter 100.0 or perform a two buffer calibration.
6. Rinse the electrode(s) and place into sample. Read the pH directly from the main display and temperature from the lower field.

Manual Calibration

To calibrate with buffers other than 4.01, 7.00 or 10.01, use the manual calibration technique. The calibration sequence is the same as autocalibration except buffer values are manually entered using the scroll keys.

For best results, it is recommended that an ATC probe be used. If an ATC probe is not used, all samples and standards should be at the same temperature or manual temperature compensation should be used.
See page 75.

Manual Calibration with Two Buffers

1. Connect the electrode(s) to meter. Choose two buffers that will bracket your expected sample range.
2. Press the **mode** key until the pH mode indicator is displayed.
3. Rinse the electrode(s) and place into the first buffer.
4. Press the **2nd** then the **cal** keys. CALIBRATE will be displayed above the main readout and the time of the last calibration will be displayed. After a few seconds, P1 will be displayed in the lower field.
5. When READY is displayed, indicating electrode stability, and the reading begins to flash, press the **Λ** or **V** key. The first digit will start flashing. Scroll until the correct value appears in the first digit, then press the **yes** key. The second digit will start flashing. Scroll until the correct value appears in the second digit. Press the **yes** key. Continue in this manner until all digits have been correctly entered, then press the **yes** key to enter the value into the meter memory.

   The display remains frozen for two seconds. Then P2 is displayed in the lower field indicating the meter is ready for the second buffer.
6. Rinse the electrode(s) and place into second buffer. When READY is displayed, indicating electrode stability, and the reading begins to flash, enter the correct value as described above.

   The electrode slope is then displayed in the main field with SLP in the lower field. The meter automatically advances to MEASURE mode.
7. Rinse the electrode(s) and place into sample. Record pH and temperature directly from the meter display.

F. Dissolved Oxygen Measurements

Dissolved oxygen measurements are displayed in ppm when the ORION Model 97-08 Dissolved Oxygen Electrode is used with the ORION Model 250A Meter. Follow these instructions for preparing the meter and calibrating the electrode.

1. Connect the Model 97-08 to meter and leave electrode mode switch "OFF".
2. Disconnect the ATC probe.

   NOTE: ATC probe must not be connected to the meter.
3. Press the **mode** key until the pH mode indicator is displayed.
4. Turn the hold feature (1-2) off.
5. Press the **measure** key. Using the **scroll** keys, change the temperature value to 25.0 °C.
6. Press the **2nd** then the **cal** keys. Enter the value 7.00 and press the **yes** key.
7. Press the **measure** key. The slope prompt, SLP, will be displayed in the lower field. Enter 100.0 then press the **yes** key. The meter automatically enters the measure mode.
8. Turn the mode switch on the electrode to BT CK. Good battery operation is indicated by a reading of 13.40 or greater on the meter.
9. Turn the mode switch on the electrode to ZERO. Use the zero calibration control to set the meter to read 0.00.
10. Insert the reservoir (funnel) into a BOD bottle containing enough water to just cover the bottom. Insert the electrode, making sure that the electrode tip is not immersed in the water and does not have water droplets clinging to the outside of the membrane. Let stand approximately 30 minutes to ensure water saturation of air in the BOD bottle. This bottle should be used for storage between measurements.
11. Turn the electrode mode switch to the AIR position. If measurements are being made at sea level, use the AIR calibration control on the electrode to set the pH meter reading to the prevailing barometric pressure in mm Hg (divided by 100). If the barometric pressure is unknown, if the elevation is above sea level or if the sample has a salinity greater than 2 parts per thousand, consult Table 1 found in the Model 97-08 Instruction Manual to obtain the correct AIR setting.
12. Turn the electrode mode switch to H_2O for sample analysis.

Instruction Manual

Corning Model 311 Portable Conductivity Meter

This manual contains complete instructions for setting up and using the Corning Model 311 Portable Conductivity Meter.

The information contained in this manual was correct at the time of going to print. However, we continue to improve products and reserve the right to change specifications, equipment and maintenance procedures at any time.

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Instruction Manual

Corning Model 311 Portable Conductivity Meter

Contents

1 Set Up

2 Operation

3 Support Information

Instruction Manual

Corning Model 311 Portable Conductivity Meter

1.1 Unpacking and Installation

1. Unpack the instrument and examine it carefully to make sure that no damage has occurred during shipping. If there is any noticeable damage, notify your distributor immediately.

2. In addition to this manual, you should find the following items:

Meter w/Wrist Strap	1
Conductivity Probe (476612)	1
Carry Case (470442)	1
1413 µS Cal Std Sachets (473738) or 100ml Sample Bottle	1
12.88 mS Cal Std Sachets (473737) or 100ml Sample Bottle	1
Warranty Card	1
Guide to Conductivity and Disolved Oxygen (470439)	1
Calibration Trimmer Screwdriver	1
9V Battery (471027)	1

3. Save all packing materials until you are sure that the instrument functions correctly. Any defective or damaged items must be returned in the original carton together with the supplied accessories.

4. Fill in and return the warranty card. For your own record make a note of the serial number, date of purchase and supplier on page 14 of this manual.

1.2 Product Description

The Corning Model 311 is a multi-range, water resistant, Conductivity Meter with automatic temperature compensation. The sensors in the meter's probe utilise the latest technology in conductivity measurement. The four-ring potentiometric method incorporated into the probe has been proven to provide higher accuracy than the more common amperometric method. The Model 311 has a range of 0 to199,900 µS/cm and can be used in any sample from treated water to brine. The temperature of all conductivity measurements are automatically compensated for by the meter's ATC circuitry. The probe is easily detached and can be changed without having to be returned to the factory.

The meter is constructed with a water-resistant, rugged ABS plastic housing which allows the versatility of both laboratory and field use.

Other features include a Low Battery Indicator warning which prevents erroneous readings due to low battery voltage.

Corning Model 311 Portable Conductivity Meter

1.3 Functional Description

Model 311

1 Watertight Shielded Cable

2 Air-Release Holes

3 PVC Protective Sleeve

4 Conductivity and Temperature Sensors

5 mS or μS Indicator

6 Battery Housing Cover

7 Probe Plug

8 Conductivity Calibration Trimmer

9 LCD Display

10 **on/off** Button

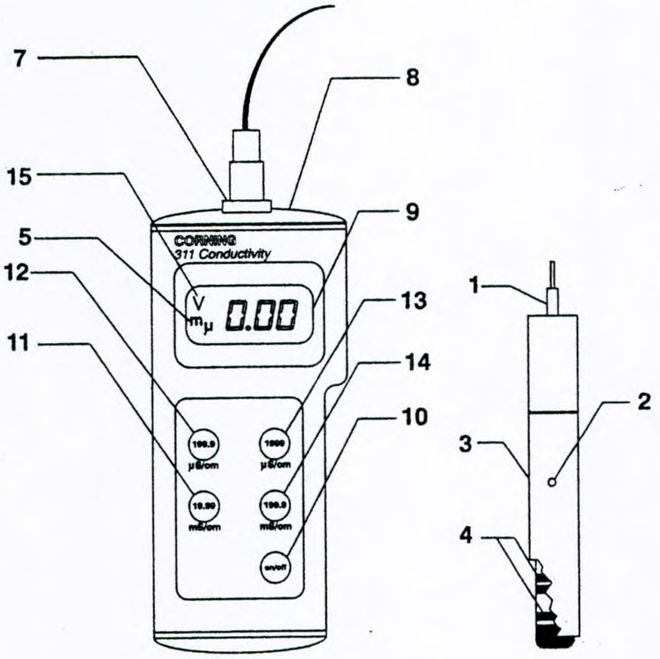
19.99 mS/cm Range Selector

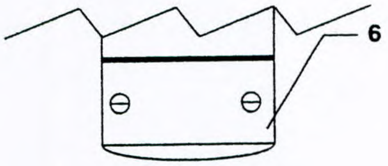
12 199.9 μS/cm Range Selector

13 1999 μS/cm Range Selector

14 199.9 mS/cm Range Selector

15 'V' Low Battery Indicator





Back View

2.1 Calibration

It is recommended that the Model 311 be calibrated frequently, especially when used often or in samples with widely differing conductivity values.

For best results choose a conductivity standard that is closest in value to the sample to be measured.

For example, if your measurements are in the 2 to 20 mS/cm range you would use the 473624 or 473737 - 12.88 mS/cm conductivity standard as in the following process.

In order to perform the calibration the following items will be required:

- Conductivity solution (473624 or 473737 for this example) (12.88 mS/cm at 25°C [77°F])
- A calibration trimmer screwdriver

Procedure:

- Ensure that the probe is connected to the meter securely by aligning the pins with the socket, pushing the plug in and tightening the threaded ring. Insert the probe into the PVC sleeve with the holes towards the top (the end nearest to the cable) of the probe.
- Pour enough 473624 into a beaker to achieve at least 80mm of depth. Or, use a convenient sachet (473737) by opening and folding the packet in half to concentrate the solution to a depth of 80mm. Immerse the probe into the beaker or sachet. The level of solution should be just below the holes on the PVC sleeve.
- Turn the instrument on and select the **19.99 mS** range.
- Tap the probe gently on the bottom of the beaker and stir it to ensure that no air bubbles are trapped inside the sleeve.
- If the temperature of the probe is close to that of the solution the display will stabilize quickly and provide you with temperature compensated conductivity measurements.
- If there is a temperature difference of 5°C (9°F) or more, allow a few minutes for the ATC circuitry to compensate completely.
- When the reading stabilizes, turn the trimmer on the top of the instrument (Number 8 in the Functional Description, page 4) until the displays reads '12.88 mS'.
- The calibration is now complete and the instrument is ready for use. All subsequent measurements will now be compensated to 25°C (77°F).

If the instrument will not calibrate, refer to the Probe Maintenance and Cleaning section (page 7).

Note: It is also possible to standardize temperature to 20°C (68°F) rather than 25°C (77°F). Simply adjust the trimmer to the calibration buffer reading at 20°C (68°F).

This value can be found on the label of the solution container.

2.2 Measurements

Note: The probe body and sleeve are made of PVC and are very susceptible to damage due to temperatures exceeding 50°C (122°F). If the probe is exposed to high temperature, the bond between the rings and the probe body may become damaged. Such damage is not covered under warranty.

- Confirm the probe is connected to the meter securely by aligning the pins with the socket, pushing the plug in and tightening the threaded ring. Insert the PVC sleeve over the probe with the holes closest to the end with the cable.
- To take a conductivity measurement simply place the probe into the solution. The level of solution should be just below the holes on the PVC sleeve. Tap and stir the probe to remove all air bubbles that may be trapped in the PVC sleeve.
- Press **on** and select one of the four conductivity ranges by pressing the appropriate button. If the LCD displays a '1' on the far left side with no other readings displayed on the right, the meter is out of range. Select a higher range.

The probe of the Model 311 has a temperature sensor built in and will automatically compensate for any temperature difference. If the temperature of the probe is close to that of the solution, the display will stabilize quickly and provide you with temperature compensated conductivity measurements. If there is a temperature difference of 5°C (9°F) or more, allow a few minutes for the ATC circuitry to compensate completely.

- Once the reading stabilizes the measurement is complete. If further measurements are desired, rinse the probe and sleeve with distilled or deionized water and test the next sample.

When all measurements are completed, the meter should be turned **off** and the probe cleaned (see the next section).

3.1 Probe Maintenance and Cleaning

After every measurement the probe should be rinsed in distilled or deionized water. If a more thorough cleaning is desired, remove the PVC sleeve and clean the sensors with a non-abrasive cloth and alcohol.

When reinstalling the PVC sleeve onto the probe, be sure that the four holes are towards the top of the probe (the end with the cable).

After cleaning the probe, recalibrate the instrument.

3.2 Low Battery Indicator

The Model 311 is supplied with a Low Battery Indicator. This detects a low power condition in the battery and displays a 'V' on the LCD. This alerts the user that the display will shut off after approximately 5 more hours of use.

This feature shuts off the display to prevent the chance of taking erroneous measurements. When the display shuts off simply replace the 9V battery housed in the back of the meter. When the meter is turned on, the new battery is detected and the 311 functions properly.

The meter must be calibrated after a battery change.

3.3 Specifications

Measurement Range	0.0 to 199.9 μS/cm 0 to 1999 μS/cm 0.00 to 19.99 mS/cm 0.0 to 199.9 mS/cm
Resolution	0.1μS/cm, 1μS/cm 0.01 mS/cm, 0.1 mS/cm
Accuracy	±1.5% full scale
Temperature Compensation	Automatic from +10 to 40°C with 2%
Probe	476612 with 4 stainless steel AISI 316 rings and incorporated temperature sensor. Probe length is 120mm, diameter is 20mm and cable length is 1 meter.
Battery	9V for 100 hours of continuous use
Operating Temperature	0 to +50°C (+32 to +122°F)
Dimensions (mm)	190L x 84W x 43D
Weight (g)	340

Instruction Manual

Corning Model 311 Portable Conductivity Meter

Consumables/Accessories

476612	Conductivity Probe w/1m Cable
470439	Guide Book to Conductivity and Dissolved Oxygen
470442	Carry Case
473732	84 µS/cm, 460ml
473623	1,413 µS/cm, 500ml
473624	12.88 mS/cm, 500ml
473733	80 mS/cm, 460ml
473740	84 µS/cm Sachets, 30 per pack
473738	1413 µS/cm Sachets, 30 per pack
473737	12.88 mS/cm Sachets, 30 per pack
473741	80 mS/cm Sachets, 30 per pack

Warranty

Corning warrants this product to be free from defects in materials and workmanship. The warranty period for the meter is one (1) year from the date of purchase and the probe is six (6) months from the date of purchase.

This instrument is in compliance with the CE directives EN 50081-1 and EN 50082-1.

For your reference, make a note of the serial number, date of purchase and supplier here.

Serial No. C00 777

Date Purchased ....

Supplier ....

....

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2020
Photoionization
Air Monitor

User's Manual

PE PHOTOVAC

Tech. Svcs:

(203) 761-5050

To Return for repairs:

(888) 732-4766

Warning: Limitation of Liability

The ultimate responsibility of the consequences of use of toxic compounds rests with the user. PE Photovac's role is as a supplier of instrumentation to assist in the early detection of hazardous conditions involving such compounds.

2020 represents a major advance in this field and, as with all complex instruments, it is vitally important to ensure that 2020 is maintained in accordance with PE Photovac's instructions and that proper calibration is regularly performed.

As with any complex device, 2020 is subject to failure and, while PE Photovac has taken, and continues to take, all possible precautions to (a) reduce the possibility of failure, and (b) warn the user in the event of failure, circumstances may occasionally occur in which there is a failure despite such precautions on PE Photovac's part. PE Photovac regrets that it cannot accept liability for damages of any kind caused as a result of either failure of the user to follow instructions or of 2020 to perform.

Addendum

Starting Oct. 20 1997, the lamp (Part No. 390011, 380029) has been replaced by lamp (Part No. 350023). Please specify Part No. 350023 when ordering replacement lamps for 2020.

PN600803

2020

Photoionization Air Monitor

User's Manual

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Part No. 350001 Rev D

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Reference No. 600762

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FCC Warning

This equipment has been tested and found to comply with the limits for a Class B Digital Device, pursuant to Subpart B, Class B of 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.

2020 I/S Notice

Listed
77463

CONFORMS TO
UL STANDARD 913

CERTIFIED TO
CSA STANDARD
CSA 22.2 No. 157

Intrinsically safe/Sécurité intrinsèque for use in Class I, Division 1, Groups A, B, C, D, Hazardous Locations, Temperature Code T4, Exia

2020 I/S IS CLASSIFIED FOR USE IN CLASS I, DIVISION 1, GROUPS A, B, C, D HAZARDOUS LOCATIONS. T4 (135°C) RATING.

It has been listed by ETL® to comply with Underwriters Laboratories® Inc. UL® 913 *Standard for Intrinsically Safe Apparatus and Associated Apparatus for use in Class I, Division 1, Groups A, B, C, D Hazardous (Classified) Locations*, Fourth Edition.

2020 I/S IS NOT INTENDED TO DETECT COMBUSTIBLE LEVELS OF GASES. 2020 I/S IS CLASSIFIED FOR USE IN ATMOSPHERES CONTAINING COMBUSTIBLE LEVELS OF GASES.

These PE Photovac accessories are for use with 2020 I/S in a hazardous location:

350006	Calibration Regulator
350007	Wrist Strap
350008	Belt-Clip Holster
350010	Carrying Case
350014	User's Reference Card
390006	Long Sample Probe
395001	Short Sample Probe

Do not use any other accessories with 2020 I/S in a hazardous location.

Substitution of components may affect safety rating.

CAUTION

To reduce the risk of fire or injury to persons, read and follow these instructions:

1. All calibration, maintenance and servicing of this device, including battery charging, must be performed in a safe area away from hazardous locations.
2. For replacement battery pack use only Part No. 350009.
3. Do not dispose of the battery pack in a fire. The cell may explode. The battery pack must be disposed of properly or returned to PE Photovac for recycling. Check with local codes for possible special disposal instructions.
4. Do not open or mutilate the battery pack.
5. Exercise care in handling battery packs in order not to short the terminals with conducting materials such as rings, bracelets and keys. The battery or conductor may overheat and cause burns.
6. Do not defeat proper polarity orientation between the battery pack and battery charger.
7. Charge the battery pack using the AC adapter provided with or identified for use with this product only in accordance with the instructions and limitations specified in this manual. For AC adapter use only Part No. 350002 (115 Volts AC), 396013 (220 Volts AC).

ATTENTION

2020 I/SC EST CLASSIFIÉ POUR USAGE DANS LES EMPLACEMENTS DANGEREUX DE CLASSE I, DIVISION 1, GROUPES A, B, C, D. ÉVALUATION T4 (135°C).

2020 I/SC est conforme à la norme des Underwriters Laboratories Inc. UL 913 *Standard for Intrinsically Safe Apparatus and Associated Apparatus for use in Class I, Division 1, Groups A, B, C, D Hazardous (Classified) Locations.* Quatrième édition.

2020 I/SC est conforme à la norme de *CSA Standard 22.2 No. 157-92 - Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations.*

2020 I/SC C'EST NE PAS INTENDER POUR DETECTER DES NIVEAUX DE COMBUSTION DES GAZ. CET APPAREIL EST CLASSIFIÉ POUR USAGE DANS DES ATMOSPHÈRES CONTENANT DES NIVEAUX DE COMBUSTION DES GAZ.

Les accessoires PE Photovac suivants peuvent également être utilisés avec l'appareil dans un emplacement dangereux:

350006	Régulateur de calibration
350007	Sangle de poignet
350008	Étui de ceinture
350010	Étui de transport
350014	Carte de référence
390006	Gamme d'échantillons
395001	Petite Gamme d'échantillons

Ne pas utiliser d'autres accessoires avec cet appareil dans un emplacement dangereux.

La substitution des composantes peut nuire à la sécurité d'emploi.

MISE EN GARDE

Afin de réduire les risques d'incendie et les blessures, lire et suivre ces instructions:

1. Tout étalonnage, entretien et réparation de cet appareil, y compris le chargement de la pile, doit être effectué dans un endroit sûr, à l'écart des zones dangereuses.

2. N'utiliser que la pièce numéro 350009 lorsqu'il faut remplacer le bloc-pile.
3. Ne pas jeter la pile dans un feu. La cellule pourrait exploser. Vérifier les codes locaux, qui peuvent comporter des instructions de mise au rebut particulières.
4. Ne pas ouvrir et ne pas abîmer le bloc-pile.
5. Manipuler le bloc-pile avec soin, afin de ne pas court-circuiter les bornes avec des matériels conducteurs tels qu'une bague, un bracelet ou des clés. La pile ou le conducteur pourraient surchauffer et causer des brûlures.
6. Ne pas modifier l'orientation de la polarité appropriée entre le bloc-pile et le chargeur.
7. Charger le bloc-pile fourni avec ou reconnu pour usage avec ce produit seulement conformément aux instructions et restrictions spécifiées dans ce manuel. Pour le chargeur, n'utiliser que la pièce numéro 350002 (115 Volts AC), 396013 (220 Volts AC).

2020 Ex Notice

CONFORMS TO
EEx ib m IIC T4.
DEMKO NO. 95D 119 472

CLASSIFIED BY DEMKO AS INSTRINSICALLY SAFE FOR USE IN ZONE 1 LOCATIONS. EEx ib m IIC T4.
DEMKO NO. 95D 119 472

2020 Ex complies with the harmonized European Standards EN50014 incl. amd. 1 - 5, EN50020 incl. amd. 1 - 5.and EN50028, First Edition (1987).

2020 EX IS NOT INTENDED TO DETECT COMBUSTIBLE LEVELS OF GASES. 2020 EX IS CLASSIFIED FOR USE IN ATMOSPHERES CONTAINING COMBUSTIBLE LEVELS OF GASES.

These optional accessories may be used with 2020 Ex in a hazardous location:

350006	Calibration Regulator
350007	Wrist Strap
350008	Belt-Clip Holster
350010	Carrying Case
350014	User's Reference Card
390006	Long Sample Probe
395001	Short Sample Probe

Do not use any other accessories with 2020 Ex in a hazardous location.

Substitution of components will invalidate certificate.

CAUTION

To reduce the risk of fire or injury to persons, read and follow these instructions:

1. All calibration, maintenance and servicing of this device, including battery charging, must be performed in a safe area away from hazardous locations.
2. For replacement battery pack use only Part No. 350009.
3. Do not dispose of the battery pack in a fire. The cell may explode. The battery pack must be disposed of properly or returned to PE Photovac for recycling. Check with local codes for possible special disposal instructions.
4. Do not open or mutilate the battery pack.
5. Exercise care in handling battery packs in order not to short the terminals with conducting materials such as rings, bracelets and keys. The battery or conductor may overheat and cause burns.
6. Do not defeat proper polarity orientation between the battery pack and battery charger.
7. Charge the battery pack using the AC adapter provided with or identified for use with this product only in accordance with the instructions and limitations specified in this manual. For AC adapter use only Part No. 350002 (115 Volts AC), 396013 (220 Volts AC).

CE Directive

CE CONFORMS TO
COUNCIL DIRECTIVE 89/336/EEC
COUNCIL DIRECTIVE 91/157/EEC

Council Directive 89/336/EEC - Electromagnetic Compatibility and the Applicable Standards. 2020 complies with EN50082-01 Generic Immunity Standard for Electromagnetic Compatibility Part 1: Light Industrial Environment. 2020 has been tested and conforms to the guidelines specified in EN50082-02 Generic Immunity Standard for Electromagnetic Compatibility Part 2: Industrial Environment

Council Directive 91/157/EEC - Recovery and Disposal of Spent Batteries

You must use the 220 V battery charger (Part No. 396013) in order to comply with the requirements of the applicable Council Directives.

1. Introduction

1.1. About this Manual

This manual provides detailed instructions for setup, operation and maintenance of the PE Photovac 2020™ Photoionization Air Monitor.

Before unpacking the instrument, please read Section 1.2 Warnings and Safety Practices. This section describes possible hazards that might injure the user, damage the instrument or compromise its operation. Some general safety information is also provided.

To help you learn to use 2020 quickly, this manual is organized by tasks beginning with a tutorial and description of operation in Chapter 2. More detailed operational instructions are provided in Chapter 3. Accessories are covered in Chapter 4. Routine maintenance is covered in Chapter 5. Troubleshooting techniques are covered in Chapter 6. Chapter 7 provides a technical description of 2020.

The 2020 manual uses a few conventions for key names on the keypad and for text that is shown on the display.

UPPERCASE	Fixed key names are denoted by uppercase text.
"Display Text"	Text that appears on the 2020 status display is in quotation marks.

	Soft key names are also shown in quotation marks.
<Angle Brackets>	Computer keyboard names are denoted by angle brackets, e.g. <Ctrl>.
C:\2020	Text that must be typed in using the computer keyboard is shown in italics.

In the text you will find various warnings and notes.

Warning: A warning indicates an operation that could cause personal injury if precautions are not followed.

Note: A note indicates an operation that could cause instrument damage if precautions are not followed. A note also indicates significant information.

1.2. Warnings and Safety Practices

Please read this section before operating 2020.

1.2.1. Approved Models of 2020

This manual provides operational information for all models of 2020. The 2020 I/S and the 2020 Ex are intrinsically safe and approved for use in hazardous locations. Refer to the manual introduction for details of each approval.

Throughout the manual, notes are provided to inform you of the limitations of usage for the 2020 I/S and 2020 Ex models.

Warning: If the 2020 you are using is not specifically identified as intrinsically safe, do not use it in a location were flammable concentrations of gases and vapors may exist.

1.2.2. Compressed Gases

Cylinders of compressed gas, such as calibration gas, must be handled with extreme care. For safety, the calibration gas cylinders must be secured before use.

Please observe the following handling procedures:

1. Mark each new regulator with its intended gas service and never use a regulator for more than one service. To ensure safety and avoid contamination, regulators should be dedicated to one service. Do not change gas service or adapt equipment without consulting your gas supplier.
2. Do not heat or expose cylinders or regulators to temperatures above 52°C (125°F). The cylinders may rupture at high temperatures.
3. Use only the specified regulator for the calibration gas. Confirm regulator type and material with your specialty gas supplier.
4. Always secure cylinders before removing the cylinder valve protection cap.
5. Do not drag or roll cylinders. Large cylinders should only be moved on carts designed for compressed gas cylinders. Do not move cylinders without the valve protection cap in place.
6. Wear safety glasses when working with compressed gases.
7. Do not store cylinders in a hazardous location. Store cylinders in an upright position away from possible sources of heat or sparks.
8. Never plug, obstruct or tamper with safety relief devices.

1.2.3. Regulators for Compressed Gases

When connecting a regulator to a large cylinder:

1. Ensure cylinder valve and regulator connection match.
2. Ensure regulator construction materials are compatible with the gas, and that the cylinder pressure gauge will withstand the cylinder pressure.
3. Never use the regulator as a shut-off valve. Close the cylinder when it is not in use.
4. Do not subject the regulator to an inlet pressure greater than recommended.
5. Do not move or detach the regulator when it is pressurized or when it is in use.
6. Before connection, ensure the gas cylinder valve and the regulator CGA connection are clean.

7. Turn the pressure control valve on the cylinder all the way out (close the cylinder). Turn the regulator outlet to off. Open the gas cylinder valve slowly and check for leaks. Adjust the delivery pressure and then open the regulator outlet valve.

1.2.4. Calibration Gas

Adequate ventilation must be provided when 2020 is being calibrated.

If compound threshold limit values (TLV™) are exceeded, you should use a gas bag for sampling and calibration.

To determine the TLV of the compounds contained in the calibration gas, refer to the Material Safety Data Sheet (MSDS) supplied with your calibration gas cylinder. See Section 3.3 for details of calibration using a gas bag.

1.2.5. Battery Pack Care

Leaving 2020 for more than 3 months, without turning it on, may result in the loss of recorded data and setup parameters. If 2020 is not used for long periods of time, turn the instrument on for a few hours every month to avoid loss of data. See Section 1.5 for instructions on charging the battery.

Please observe the following:

1. For replacement battery pack use only Part No. 350009.
2. Do not dispose of the battery pack in a fire. The cell may explode.
3. The battery pack is 24% cadmium (Cd) by weight. This battery pack must be disposed of properly. Check with local codes for special disposal instructions. Alternatively, you can return the battery pack to the nearest PE Photovac facility for recycling.
4. Do not open or mutilate the battery pack.
5. Exercise care in handling battery packs in order not to short the terminals with conducting materials such as rings, bracelets and keys. The battery or conductor may overheat and cause burns.
6. Charge the battery pack using the AC adapter provided with or identified for use with this product only in accordance with the instructions and limitations specified in this manual. For AC adapter use only Part No. 350002 (North America) or 396013 (Europe).

1.2.6. Excessive Heat and Cold

Do not expose the instrument to intense sunlight for prolonged periods.

Exposure to excessive heat or cold may result in erroneous readings.

1.3. Unpacking

The following accessories are included with your 2020:

1. Sample Probe
2. User's Manual
3. Multi-Tool
4. AC Adapter or AC Adapter with AC Line Cord
5. Wrist Strap
6. Replacement Sample Inlet Filters (10 pieces)
7. Reference Card

Ensure all of these accessories have been included with the instrument. If any items are missing or damaged, contact PE Photovac immediately.

1.4. Support Equipment and Consumables

1.4.1. Calibration

For normal operation these items are required:

1. Calibration Gas Regulator (Part No. 350006).
2. Calibration gas containing 100 ppm isobutylene. (Part No. 350012). Other concentrations of the calibration gas may be required. This will depend on your application.
3. Zero air. Occasionally, clean, ambient air is suitable for calibration.

Alternatively, you can use a gas sampling bag and a source of hydrocarbon free air. Air should not have more than 0.1 ppm total hydrocarbons (THC).

If you will be using large tanks of gas, specify a single stage, high purity regulator with a CGA 590 connection at the inlet. The regulator should also have a 1/8" parallel, compression fitting with which to connect the regulator to the gas bag adapter. The delivery pressure must be adjustable to between 5 and 20 psig (34.5 and 138 kPa). You may require a gas bag and gas bag adapter (Part No. 395072 - gas bag, 395073 - gas bag and adapter).

4. If compound threshold limit values (TLVs) are exceeded, you should use a gas bag for sampling and calibration.

   To determine the TLV of the compounds contained in the calibration gas, refer to the Material Safety Data Sheet (MSDS) supplied with your calibration gas cylinder.

   If you will be using a gas bag for calibration, you should obtain the calibration kit (Part No. 390033). The calibration kit contains a regulator, a gas sampling bag and a gas bag adapter. See Section 3.3 for details of calibration using a gas bag.

1.4.2. Field Operation

For field operation, a 2020 Field Kit (Part No. 350005) is available. The field kit includes a cable kit, a carrying case and a calibration regulator, spare battery pack and a cylinder of 100 ppm isobutylene calibration gas.

Refer to the check list in Section 3.7 to ensure you have all the necessary accessories and equipment before beginning field operation.

1.4.3. Printer

2020 may be used with a printer to generate printed reports. The printer must have a printing width of at least 65 characters and must use fixed spaced fonts. See Section 4.1 for details of connecting a printer to 2020.

If you are using a parallel printer, you will need the serial to parallel converter (Part No. 380145). See Section 4.3 for details of connecting and operating 2020 with a serial to parallel converter.

Note: 2020 is not classified for use in hazardous locations with a printer.

1.4.4. Computer

2020 may also be connected to a computer. The computer must be 100% compatible with an IBM PC. Use the cable kit (Part No. 350011) to connect 2020 to the computer.

You will also need terminal emulation software. Software packages such as Crosstalk®, and Procomm® are recommended for use with 2020. If you are using Microsoft® Windows™ you do not need to purchase any separate software. If you are already using another type of communication or terminal emulation software package, it is not necessary to purchase separate software for 2020. See Section 4.2 for details.

Note: 2020 is not classified for use in hazardous locations with a computer.

1.5. Battery Charging

Before beginning operation of 2020, the battery pack must be charged. You can also remove the battery pack and replace it with a fully charged, spare battery pack (Part No. 350009).

Note: You must use the 220 V battery charger (Part No. 396013) in order to comply with the requirements of the applicable Council Directives.

1.5.1. Removing and Replacing the Battery Pack

Note: Do not remove or recharge the battery pack in a hazardous location

1. If the instrument has been turned on, turn it off by pressing the ON/OFF key momentarily and then releasing it.

Note: If you do not turn 2020 off before removing the battery pack, you will reset the instrument and you will lose all logged data and setup parameters.

2. Locate the battery hatch on the back of the instrument. See Figure 1.
3. Loosen the two screws in the battery hatch.
4. The battery hatch can now be removed.
5. Lift the battery pack out of the case and carefully disconnect the connector from 2020.
6. Attach the connector from the charged battery pack to the 2020.

Note: The connector is polarized. It will only fit one way. Do not force the connection.

7. Place the battery pack in the 2020 case. Ensure the battery wires are not pinched or strained.
8. Ensure the wrist strap ring is in place. This ring holds the wrist strap in place.
9. Replace the battery hatch and then replace the two screws. Do not over-tighten the screws as you will damage the case.

1.5.2. Charging the Battery Pack

Note: Only use the AC adapter specified for use with 2020. Using another AC adapter will result in damage to the battery pack, 2020 or the adapter itself.

1. Plug the AC adapter into the jack located on the back of the 2020. See Figure 1.
2. Plug the AC adapter into an AC outlet. If you are using the European AC adapter, ensure the correct plug is installed on the line cord. If it is not correct for the wall outlet in your area then it must be replaced. See Appendix 8.4.
3. The LED on the 2020 indicates the charge state. Red indicates the battery is being charged. Green indicates the battery is fully charged and ready for use.

   It is normal for a fully charged battery to indicate it is charging (red light) when first plugged in. The LED will turn green as the battery charges.

4. When the battery pack is fully charged remove the AC adapter, first from the wall outlet and then from 2020.

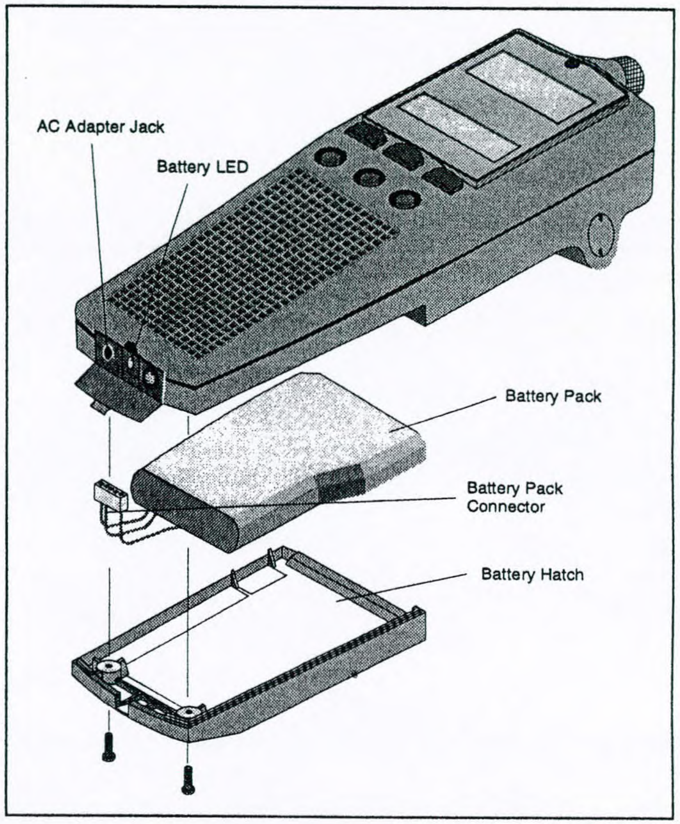


Figure 1 Battery Pack Removal and Replacement

Charging a fully discharged battery pack will take approximately 4 hours.

Optionally you can use the off line charger (Part No. 350015, 350019) to charge the battery pack independently of the instrument. See Section 4.8.

If you are charging the battery pack in the instrument you can use all the features of 2020 while the battery pack is being charged.

Leaving the AC adapter connected to 2020 will not harm the battery or the AC adapter in any way. If 2020 is to be left indefinitely, leave it connected to the AC adapter so that the battery will be fully charged and ready for operation.

On average a fully charged battery pack will provide 8 hours of continuous operation. Battery life is shorter if the instrument is turned off and then on again repeatedly or if the backlighting is turned on.

1.6. Overview

2020 measures the concentration of airborne photoionizable gases and vapors and automatically displays and records these concentrations. It does not distinguish between individual pollutants. The reading displayed represents the total concentration of all photoionizable chemicals present in the sample. 2020 is factory set to display concentration in units of ppm or mg/m^3.

2020 operates automatically. The meter display updates itself once per second. You can read concentrations directly from the meter display. If you are using the dilution probe (Part No. 350013) you must multiply the displayed reading by the dilution factor. See Section 4.5 for details.

2020 is always performing short term exposure limit (STEL), time weighted average (TWA) and PEAK calculations. You can view any of these results, but only one mode may be viewed at a time.

2020 has many datalogging options. You can select an averaging interval, or you can use manual operation. If you select an averaging interval, the minimum, maximum, and average concentrations measured in each period are automatically recorded in 2020's datalogging memory. 2020 can log up to 1000 entries

In manual operation, 2020 prompts you to locate a site and then to record a background and sample readings for the site. You can record up to 1000 manual entries. There is no averaging of data in manual operation.

Recorded data can be reviewed on the display, sent to a printer in either tabular or graphical format, or sent to a computer. Data are recorded by date and time.

2020 has 6 keys for alphanumeric entry and for accessing 2020's functions. The keys are used to set up and calibrate 2020. They allow you to manipulate the concentration data in various ways.

All information entered with the keys and stored in 2020's memory is retained when the instrument is switched off. The clock and calendar continue to operate and do not need to be set each time 2020 is turned on.

2. Tutorial Session

2.1. Displays

The 2020 has a meter display for reporting detected concentration, and a status display used to display status information and guide you through configuration options. All functions of the 2020 will be controlled or reported using one of these displays.

2.1.1. Meter Display

The meter display is a 4 digit display. It will always be used for reporting detected concentration. When the detector and pump are off, the meter display will be blank.

In order to accommodate the range of concentrations 2020 can detect, the meter reading will be reported using one of 2 resolutions. A resolution of 0.1 will be used for concentrations below 100 ppm, and a resolution of 1 will be used for concentrations above 100 ppm.

The meter display reports PEAK, MAX, STEL or TWA concentration. The update rate is dependent on the reading being reported. See Section 2.5 for a description of these measurements.

2.1.2. Status Display

The status display is a 2 line by 16 character display. The top line is used to display status information and prompts you for information. The bottom line is used for soft key names. Up to 3 names can be displayed for the three soft keys. If a name does not appear for a soft key, then the soft key has no associated function.

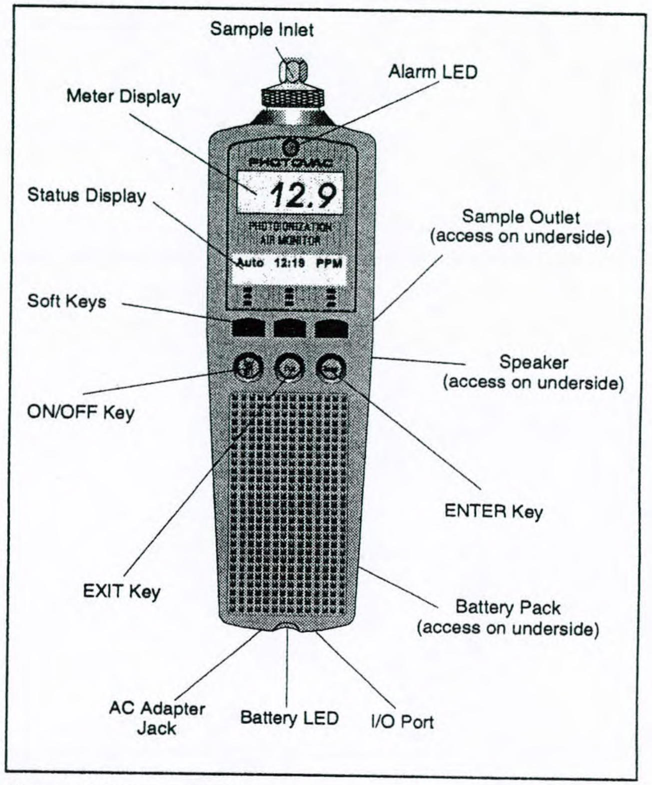


Figure 2 Layout of 2020

2.2. Keys

2.2.1. Fixed Keys

The three round keys below the soft keys each have a fixed function. The first key is the ON/OFF key, the middle key is EXIT and the last key is ENTER.

The ON/OFF key is used to both turn power on to the 2020 as well as turn the power off. To turn on 2020, press the ON/OFF key. To turn the power off, press the ON/OFF key and hold it down for 2 seconds, and then release it. This is done to prevent accidental power off.

The EXIT key provides a way of returning to the default display. In the functional map, the soft keys allow you to advance and the EXIT key provides a way to go back. See Figure 3. If you are at the root entry of the menu, EXIT will return you to the default display.

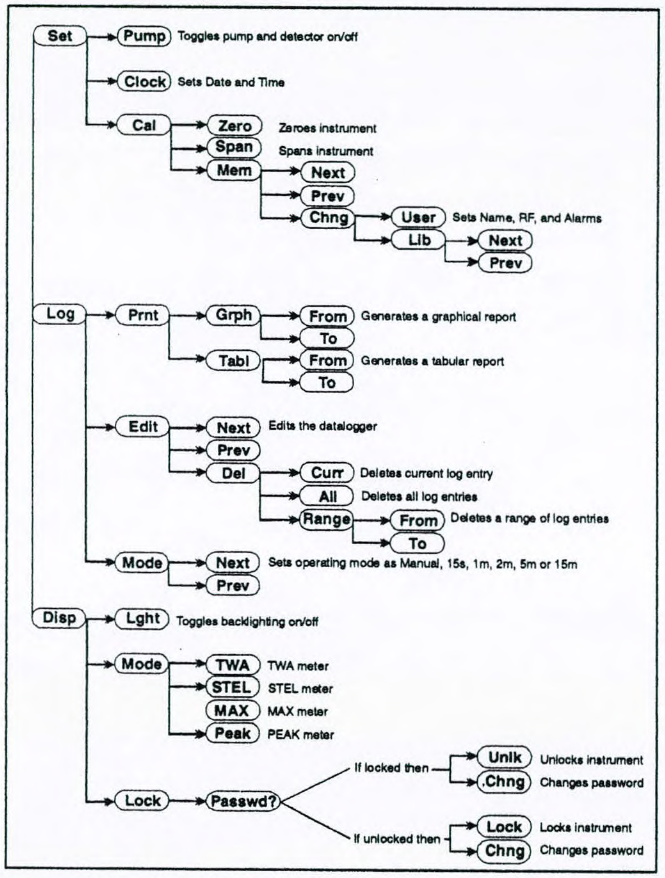


Figure 3 Function Map

The ENTER key has a context sensitive function. When you are operating or navigating through the function map, the ENTER key is used to exit the functions and return you to the default display. When entering data such as a name, number, date or time, ENTER is used to confirm the entry.

2.2.2. Soft Keys

The three soft keys on 2020 are located directly below the status display. Each key has varying functions for configuring 2020, editing the datalogger, and controlling the display. Since only three soft keys are available, each function is broken down into a path. A map, showing each path and the resulting functions, is shown in Figure 3.

2.2.3. Entering Text With the Soft Keys

For all information that you must enter, the left, center and right soft keys correspond to the up, down, and right arrow. See Figure 4.

The up and down arrows are used to change the character highlighted by the cursor. The right arrow is used to advance the cursor to the next character on the right. When the cursor is advanced past the right most character, it wraps around to the first character again. To accept the changes, press the ENTER key. To ignore the changes, press EXIT.

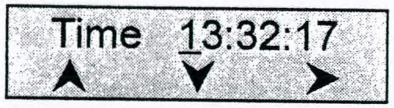


Figure 4 Soft Arrow Keys

Formatting characters, such as the colon (:) in the time, the decimal (.) in a concentration, and the slash (/) in date are skipped when advancing the cursor.

All inputs use an 8 character input, which is displayed on the right side of the top line of the status display. The prompt, describing the input, occupies the left half of the top line. The soft keys are defined on the bottom line of the status display.

2.3. Beginning Operation

2.3.1. Turning 2020 On

1. Turn 2020 on by pressing the ON/OFF key. See Figure 2 for the location of the ON/OFF key.
2. 2020 will display the software version number. Wait for the 2020 to proceed to the default display.
3. Allow 10 minutes for the instrument to warm-up and stabilize.

2.3.2. Default Display

The meter display shows the detected concentration. The resolution of the display changes with the magnitude of the reading. A reading of 0 to 99.9 will be displayed with a resolution of 0.1 ppm or mg/m³. A reading greater than 99.9 will be shown with a resolution of 1 ppm or mg/m³. The meter will display concentrations up to 2000 ppm or 2000 mg/m³.

The status display is used to display the instrument status, date, time, units and active soft keys. Figure 5 shows the status displays.

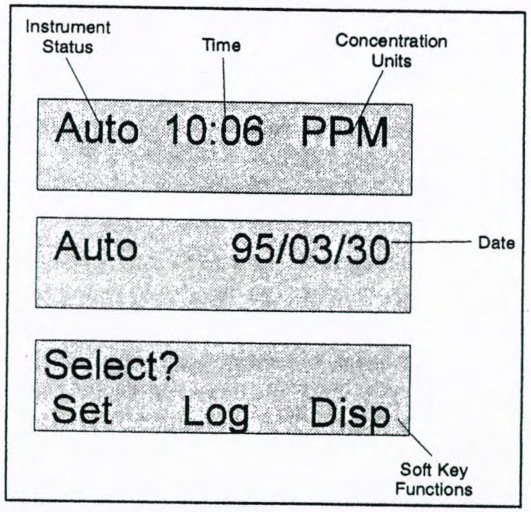


Figure 5 Status Displays

The default display provides the following information: instrument status, current detected concentration, time, date and measurement units. The status display toggles between showing time and units and then the date.

When the display mode is MAX, the date and time correspond to the date and time the MAX concentration was recorded. In TWA mode, the time represents the number of hours and minutes during which the TWA has been accumulating. For PEAK and STEL monitoring, the date and time correspond to the current date and time.

2.4. Monitoring

2.4.1. Instrument Status

The instrument status is shown on the left of the first line of the status display and on the Table and Graph outputs. Each status has a priority assigned to it. If more than one status is in effect, then the status with the highest priority is displayed until the condition is corrected or until the option is turned off. Table 1 is a list of the possible status messages.

Status	Description
Falt1	Zero fault. See Section 6.2.
Falt2	Span fault. See Section 6.2.
Falt3	Lamp fault. See Section 6.2.
Falt4	Pump fault. See Section 6.2.
Cal	Will not be observed on the display during normal operation as various calibration prompt messages are displayed during calibration. If the instrument is turned off during calibration, Cal will be displayed when 2020 is turned on again to indicate the last calibration was incomplete.
Over	Instrument over range. The detector electronics have become saturated. See Section 6.2.
ALPK	Detected concentration exceeds the PEAK alarm level.
ALST	STEL alarm level has been exceeded.
ALTW	TWA alarm level has been exceeded.
LBat	Battery pack power is low.
ELog	The datalogger is full.

Table 1 Instrument Status

Status	Description
TWA	TWA display mode.
MAX	MAX display mode.
STEL	STEL display mode.
Auto	PEAK display mode.
Loc	Locate site. Used for manual operation.
BkGd	Record background reading. Used for manual operation.
Samp	Record sample reading. Used for manual operation.
Off	Pump is off

Table 1 Instrument Status continued

2.4.2. Alarms

While operating the instrument, any one of three alarm conditions can occur. To accurately identify the source of the alarm, each type of alarm has been given a unique status. See Table 1.

In addition to the status, 2020 also has an audio alarm and an alarm LED. To conserve power the 2020 alternates between the LED and audio. Different alarms are identified by the frequency at which the 2020 alternates between the audio and LED; Peak alarm is 5 times per second, STEL alarm is 2.5 times per second, and TWA alarm is 1.25 times per second.

The left soft key is used for acknowledging alarms, and is named "Ack". If no alarm exists, then the "Ack" key is not shown. To clear the alarm, press the "Ack" key. Once acknowledged, the alarm indicators are cleared. The alarm status will remain until the alarm condition clears.

2020 updates the peak concentration once every second. Following every update, the peak concentration is compared to the peak alarm level, and if exceeded, an alarm is triggered.

If a 15 minute average exceeds the STEL, a STEL alarm is generated.

The TWA alarm is generated when the current average of concentration, since the TWA was last cleared, has exceeded the TWA exposure limit.

During calibration, all alarms are disabled. Once the calibration is complete, the alarms are re-enabled.

2.5. STEL, TWA, MAX and PEAK Operation

The 2020's meter display can be configured to show one of 4 values: STEL, TWA, PEAK and MAX.

2.5.1. Short Term Exposure Limit (STEL) Mode

The Short Term Exposure Limit (STEL) mode displays the concentration as a 15 minute moving average. 2020 maintains 15 samples, each representing a one minute averaging interval.

Once every minute, the oldest of the 15 samples is replaced with a new one minute average. This moving average provides a 15 minute average of the last 15 minutes with a one minute update rate. Since the average is calculated using 15 one minute averages, the meter display will only update once every minute.

STEL is set to zero each time the instrument is turned on. Since STEL is a 15 minute moving average, there is no need to clear or reset the STEL.

STEL calculations are always being performed by 2020. You can display the results of the calculations by selecting STEL as the Display mode. See Section 2.8.2 for details of switching between display modes.

2.5.2. Time Weighted Average (TWA) Mode

The TWA accumulator sums concentrations every second until 8 hours of data have been combined. If this value exceeds the TWA alarm setting, a TWA alarm is generated. The TWA is not calculated using a moving average. Once 8 hours of data have been summed, the accumulation stops. In order to reset the TWA accumulator, press the "Clr" key.

This sum will only be complete after 8 hours, so the meter displays the current sum divided by 8 hours. While you are in TWA mode, the time on the status display will show the number of minutes and hours of data that TWA has accumulated. When this reaches 8:00 or 8 hours, 2020 stops accumulating data and the TWA is complete.

TWA calculations are always being performed by 2020. You can display the results of the calculations by selecting TWA as the Display mode. See Section 2.8.2 for details of switching between display modes.

2.5.3. MAX Mode

The MAX mode displays the maximum signal, with the date and time that it was recorded. 2020 continues to log data according to the selected averaging interval, but only the maximum detected concentration is displayed on the meter display.

The right soft key is used to clear the meter when displaying MAX. The "Clr" key only affects the reading that the meter is displaying. For example, if you display the MAX reading, and you press "Clr", only the MAX value is cleared. The TWA is still accumulating in the background.

2.5.4. PEAK Mode

The PEAK mode displays the current detected concentration. The reading is updated once a second. In the background, the 2020 datalogger is sampling the concentration and measuring minimum, maximum, and average concentrations for the selected averaging interval. At the end of every interval, one entry is placed in the datalogger until the datalogger is full. See Section 2.8.2 for details of switching between display modes.

2.6. Set Functions

Set functions are used to setup 2020. There are 3 functions which can be set on the 2020; Calibration, Pump and Clock. Figure 6 shows a map detailing the Set functions and the key presses required for accessing them.

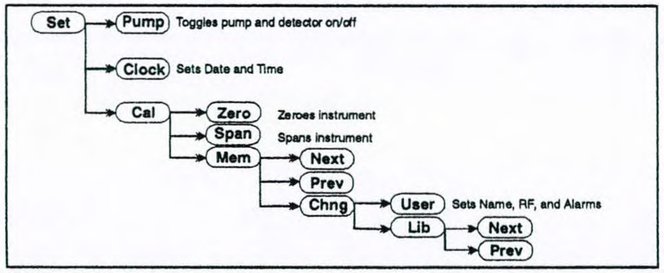


Figure 6 Set Function Map

2.6.1. Pump

The Pump function is used to control the pump. After selecting Set Pump, 2020 responds by displaying the new pump status.

The detector is also turned off when you turn the pump off. This prevents the detector from being damaged when there is no sample flowing through the detector.

When the pump and the detector are off, the meter display will be blank. Turn the pump and detector off when concentration measurements are not necessary, and 2020 will only be used for reviewing data or generating reports. By operating the instrument with the pump and detector off when you do not need them, you will conserve the battery and ultraviolet (UV) lamp.

1. Press the ENTER key. The top line of the status display changes to "Select?". The bottom line displays 3 soft key names; "Set", "Log" and "Disp".
2. Press the soft key below "Set".
3. The names of the soft keys change to reflect the Set options. The display now shows 3 devices which can be set: "Clock", "Pump", and "Cal". Press the "Pump" key.
4. The 2020 turns the pump off. If the pump was off, pressing "Pump" will turn the pump on.
5. A message will be displayed to show you the status of the pump. 2020 reverts back to the previous menu after a few seconds.
6. To return to the default display, press the ENTER key.

2.6.2. Clock

The Clock function is used to set both the current date and time.

1. Press the ENTER key.
2. Press the "Set" key.
3. When the names of the soft keys change, press the "Clock" key.

The up and down arrows are used to change the character underlined by the cursor. The right arrow is used to advance the cursor to the next character on the right. When the cursor is advanced past the right most character, it wraps around to the first character again.

Formatting characters, such as the colon (:) in the time and the slash (/) in the date are skipped when advancing the cursor.

4. Use the "arrow keys" to enter the correct time. The time is formatted as Hour:Minute:Second.
5. Press the ENTER key to confirm the time and move to the date option.
6. When setting the date, the 2020 prompts you for the current date formatted as Year/Month/Day. Use the "arrow keys" to enter the correct date.
7. Press the ENTER key to confirm the date and return to the Set options. You can wait for the display to timeout or press ENTER to return to the default display.

2.6.3. Cal

Cal allows you to setup and calibrate 2020. You have three options under the Cal function: "Zero", "Span" and "Mem".

A calibration memory consists of a name, a response factor, and PEAK, TWA and STEL alarm levels.

The "Zero" and "Span" keys will be covered in detail in Section 3.1.

To edit the calibration memory , select "Mem" and then "Chng". The 2020 prompts you with two new soft keys; "User" and "Lib".

2.6.4. Library

Library selections simplify Cal Memory programming, and provide standard response factors for approximately 70 applications. "Lib" allows you to select an entry from a pre-programmed Library. The name, response factor and three alarm levels are all set from the library. To select a library entry to program the selected Cal Memory:

1. Select "Set", "Cal", "Mem", "Chng" and "Lib".
2. Use the "Next" and "Prev" keys to scroll through the list. See Appendix 8.8 for a list of the library entries.

3. When the required entry is displayed, press the ENTER key to select it. All the Cal Memory parameters will now be copied from the selected library entry to the current calibration memory.
4. Press the "Set", "Cal", "Mem", "Chng", "User" keys to review the Cal Memory settings.

   The "User" key is used to edit the Cal Memory information manually. Press ENTER to move you through each step of the cal memory: name, response factor, PEAK, STEL and TWA alarms. "User" will be covered in more detail in Chapter 3.

   You can change any of the values entered in the Cal Memory. Changes, made to the library information that has been loaded into a Cal Memory, will have no effect on the original library entry.
5. Press the ENTER key to proceed to the next step.

2.7. Log Functions

The Log functions provide options for reporting, editing and configuring 2020's built in datalogger. Figure 7 shows a map of the Log functions.

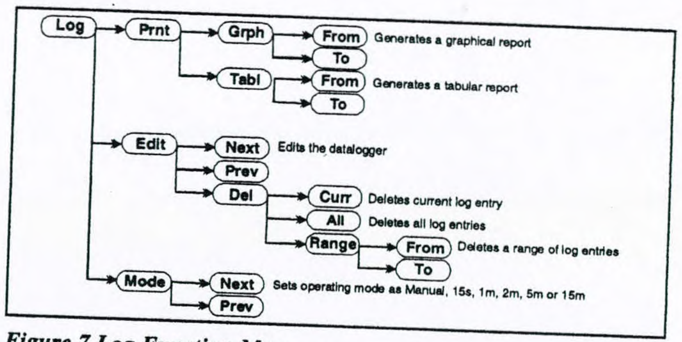


Figure 7 Log Function Map

2.7.1. Mode

2020 has two operating modes; manual and interval. When operating the 2020 in manual mode, each log entry contains a background and sample reading. In interval mode, 2020 automatically records the minimum, maximum and average readings at the preset interval. The 2020 also records date, time and status with each entry in the datalogger.

You can set an averaging interval: 15 seconds, 1 minute, 2 minutes, 5 minutes or 15 minutes. 2020's datalogger can store 1000 entries. The interval you select will determine the period of operation. At the end of the period, the datalogger will be full and you will see an "Elog" status.

Averaging Interval	Hours of Operation to Fill the Datalogger
15 s	4.1
1 m	16
2 m	33
5 m	83
15 m	250

Table 2 Averaging Intervals and Periods

To change the datalogging mode:

1. Press the ENTER key.
2. Press "Log" and select the "Mode" key.
3. Use the "Next" and "Prev" keys to scroll through the list.
4. Press the ENTER key. If you select manual operation, the datalogger will be cleared.

   Before the datalogger is cleared, 2020 will confirm your selection with the prompt "Are you sure?". Press "YES" to confirm your selection and clear the datalogger. If you do not want to lose your previously recorded data, press "NO", then print or save the data to disk before changing to manual operation. See Sections 2.7.3, and 4.2 for printing and saving logged data.

2.7.2. Edit

Edit allows you to review and delete the contents of the datalogger. To review the contents of the datalogger, use the "Next" and "Prev" keys. The average concentration and the time it was recorded are displayed. Hold down the keys to scroll through the data more quickly.

1. To delete entries from the datalogger, press "Del". You can delete the current entry, all entries or a range of entries.

> **Note:** Deleted information cannot be recovered. You should play back and print or download the contents of the datalogger before deleting any information.

2. To delete the current entry, press "Curr". You will be prompted to confirm your selection. Press "YES" to delete the last displayed entry. Press "NO" to return to the Delete options.
3. If you want to delete the entire contents of the datalogger, press "All". You will be prompted to confirm your selection. Press "YES" to delete all entries. Press "NO" to return to the Delete options.
4. If you want to delete a range of entries you must select a start and stop time. Press "Range" and use the "Next" and "Prev" keys to select the start time.
5. Press the ENTER key, and select the stop time. All entries between, and including, the start and stop entries will be deleted.

> **Note:** Deleting entries from the middle of the datalogger will not free space to store more entries. Deleting entries from the start of the datalogger, or at the end of the datalogger will free usable space.

2.7.3. Print

You can print logged data in tabular or graphical format. You must have a printer connected to 2020 in order to use the print options. See Section 4.1 for instructions on connecting and configuring a printer for use with 2020. See Section 4.3 for instructions on connecting the serial to parallel converter to 2020 and to the printer.

When you are using interval operation, the date, time and instrument status are printed along with the minimum, average and maximum concentration of each averaging interval. See Figure 8.

```
                    2020 Report

 Date      Time    Status         Min      Avg      Max
95/03/07 11:24:21 OK              3.5     15.4     62.7
95/03/07 11:24:36 OK              2.7      8.8     46.3
95/03/07 11:24:51 OK             12.2     57.9     98.2
95/03/07 11:25:06 OK              2.9     53.1     98.5
95/03/07 11:25:21 OK              3.5      232      238
95/03/07 11:25:36 OK             40.7      360      496
95/03/07 11:25:51 ALPK           60.3      606      916
95/03/07 11:26:06 ALPK            129      943     1832
95/03/07 11:26:21 ALPK            4.9      705     1702
95/03/07 11:26:36 OK              3.4      3.9      5.7
```

Figure 8 Tabular Report (Averaging Interval)

The graphical report prints a range of entries from the datalogger. 2020 stores one set of readings (Min, Avg and Max) for each averaging interval. In each averaging interval the graphed minimum is the minimum of all the stored readings in that interval. The graphed Avg is the average of all the stored readings for the interval and the Max is the maximum of all the recorded maximum readings. In manual operation, the background, sample and the difference are printed.

A minus sign is used to draw the graph from the minimum to the average. Plus signs are used to graph the area between average and maximum. See Figure 9.

```
                           2020 Report


Date      Time  Status [0                                         2000]

95/03/07 11:24:21 OK    ++
95/03/07 11:24:36 OK    +
95/03/07 11:24:51 OK    -+
95/03/07 11:25:06 OK    -+
95/03/07 11:25:21 OK    ----+
95/03/07 11:25:36 OK    -------+++
95/03/07 11:25:51 ALPK   -----------+++++++
95/03/07 11:26:06 ALPK    ---------------+++++++++++++++++++
95/03/07 11:26:21 ALPK  --------------+++++++++++++++++++++
95/03/07 11:26:36 OK    +
```

Figure 9 Graphical Report (Averaging Interval)

In manual operation the date and time are printed. A minus sign is used to draw the graph from the background to the difference. Plus signs are used to graph the area between difference and sample. Difference is calculated by subtracting the background from the sample.

1. Press the ENTER key. Select "Log", "Prnt" and then select "Grph" or "Tabl".
2. Select a start time using the "Next" and "Prev" keys. Hold down the "Next" and "Prev" to scroll through the data quickly.
3. Press the ENTER key, and select the stop time. All entries between, and including, the start and stop entries will be printed.

While printing, the 2020 displays a busy message. Do not try to perform additional functions while 2020 is printing. Pressing EXIT will abort the printout.

Although interval and manual mode generate different reports, the format of the reports is similar. For interval data, the column headings for the results are Min, Avg and Max. For manual data, the column headings are BkGd, Sample and Diff.

2.8. Display Functions

The Display function is used to control and configure 2020's display options. These options control the backlighting, select the display format, and lock the display to prevent access. Figure 10 shows a map of the Display functions.

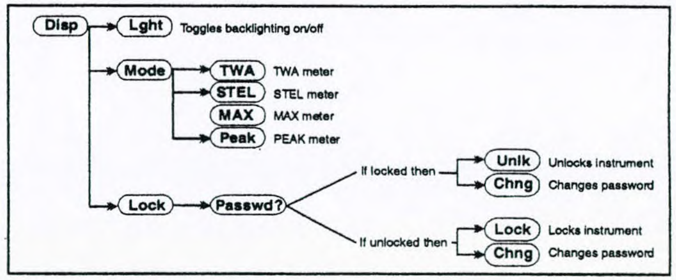


Figure 10 Display Function Map

2.8.1. Light

The Light function is used to switch the backlighting on and off.

1. Press the ENTER key.
2. Select "Disp" and then press "Lght". If the backlighting was off, it will be turned on.
3. Press EXIT to return to the function display.

To extend the operating life of the battery pack, turn the backlighting off when it is not required.

2.8.2. Mode

The Mode function is used to select the display type. You can select TWA, STEL, MAX, and PEAK.

1. Press the ENTER key.
2. Select "Disp" and then press "Mode". Select the mode you want to view. The current mode is not assigned a soft key.

   For example, if the current mode is TWA, then when you press the "Mode" key, "PEAK", "STEL" and "MAX" will be displayed.

When you have selected the new display mode, the meter display and status display will be updated to reflect the new mode. See Section 2.5. for a detailed description of each mode.

2.8.3. Lock

The "Lock" key is used to prevent access to 2020's sensitive options. Sensitive options are those which can affect 2020's readings. These include selecting a calibration memory, zeroing the instrument and spanning the instrument. If any one of these functions are selected when the instrument is locked, 2020 will prompt you to unlock the instrument before you can access the functions.

To lock 2020:

1. Press the ENTER key. Press "Disp" and then select "Lock".

2. You will be prompted for a password. If no password has been entered, then press the ENTER key. If a password has been entered, enter the correct password and then press the ENTER key.
3. If you want to enter a password, press "Chng" and enter a password. The password can be up to 4 numerical characters. Press the ENTER key to accept the password.

Note: If you change the password, make sure you record the setting. Once the instrument is locked, there is no way to unlock it without losing all your data.

4. Press "Lock" to lock 2020. The message "Lock is on" will be displayed. If "Unlk" is displayed, 2020 is already locked.

2.8.4. Unlock

If you try to calibrate 2020 while it is locked you will see the message "Error: LOCKED! See Disp". To gain access:

1. Press EXIT twice and then press "Disp".
2. Press "Lock", enter the password and press ENTER. Once the password has been entered and verified, press "Unlk" to unlock the instrument.
3. Press EXIT twice and continue with calibration.

3. Detailed Operation

3.1. General Information

2020 must be calibrated in order to display concentration in ppm or mg/m³ units equivalent to the calibration gas. First, a supply of zero air which contains no ionizable gases or vapors, is used to set 2020's zero point. Then, calibration gas, containing a known concentration of a photoionizable gas or vapor, is used to set the sensitivity.

Occasionally clean ambient air will be suitable as zero air. Due to 2020's sensitivity, outdoor air is usually unsuitable for calibration. For best results, use a commercial source of zero grade air and a second regulator. Zero air should have not more than 0.1 ppm total hydrocarbons (THC).

If compound threshold limit values (TLVs) are exceeded, you should use a gas bag for sampling and calibration.

To determine the TLV of the compounds contained in the calibration gas, refer to the Material Safety Data Sheet (MSDS) supplied with your calibration gas cylinder.

If you will be using a gas bag for calibration, you should obtain the calibration kit (Part No. 390033). The calibration kit contains a regulator, a gas sampling bag and a gas bag adapter. See 3.3 for details of calibration using a gas bag.

Note: Disconnect 2020 from the AC adapter before beginning calibration.

3.2. Calibration Using the Flow-Match Regulator

3.2.1. Connecting the Flow-Match Regulator to the Cylinder

Warning: Observe proper handling procedure for all gases! See Section 1.2.2.

1. Connect the regulator to the calibration gas cylinder.

   If you are using a portable tank of calibration gas (Part No. 350012), connect the regulator (Part No. 350006) directly to the tank.

2. When the regulator is connected properly, you can read the cylinder contents from the regulator gauge.
3. Connect the adapter tubing to the regulator.

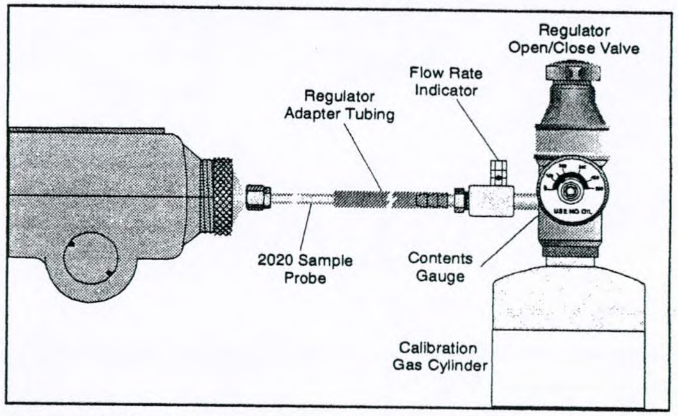


Figure 11 Flow-Match Regulator

3.2.2. Calibrating 2020 with the Flow-Match Regulator

1. Ensure the short sample probe is connected to the 2020 inlet. If you are using the long probe for sampling, then ensure the long probe is connected to 2020.

Note: Ensure the sample probe is free of any contamination as this will effect the calibration

2. Press the ENTER key.
3. Select "Set", "Cal" and then "Mem".
4. Select the desired Cal Memory. 2020 has 15 Cal Memories and can be calibrated with 15 different span gases or response factors if required. Only one Cal Memory can be used at a time. Each Cal Memory stores a different response factor, zero point, sensitivity, and alarm levels.
5. Select "Chng" and then "User". Enter a name for the calibration memory.

Press the ENTER key and enter a response factor (RF). Refer to Appendix 8.7 for a list of Response Factors. If the compound is not listed in Appendix 8.7 or you are measuring gas mixtures, then enter a value of 1.0. The concentration detected by 2020 will be multiplied by the response factor before it is displayed and logged.

6. Press the ENTER key and enter an alarm level for STEL, TWA and PEAK.
7. Press ENTER and expose 2020 to a supply of zero air.
8. Select "Set", "Cal" and "Zero". Allow 2020 to set its zero point.

100,0 ← CONC. SPAN

9. Select "Set", "Cal" and "Span". 2020 asks for the span gas concentration. Enter the known span gas concentration, without pressing the ENTER key to confirm it.
10. Insert the 2020 sample probe into the adapter tubing from the regulator. See Figure 11.
11. Ensure the calibration gas cylinder is upright and open the regulator by turning the valve counterclockwise. Open the regulator until the ball is 1/8" from its rest position.

Note: Do not set the flow rate too high.

12. Press the ENTER key. 2020 sets its sensitivity.
13. When the display reverts to the default display, 2020 is calibrated and ready for use.
14. Remove the adapter tubing from the inlet and close the regulator.

If you turn off 2020 in the middle of zeroing or spanning, the next time you turn it on it will display a Cal status. This indicates that you need to calibrate 2020.

Note: While the Cal status is active, all alarms are deactivated.

3.3. Calibration Using a Gas Bag

3.3.1. Preparing the Calibration Gas Bag and the Zero Air Bag

Use the calibration kit (Part No. 390033) as follows:

Warning: Observe proper handling techniques for all gases! See Section 1.2.2.

1. Connect the regulator to the calibration gas cylinder.

   If you are using a portable tank of calibration gas, connect the regulator (Part No. 600649) directly to the tank.

   If you are using a large cylinder of calibration gas, you must obtain a high purity regulator as specified in Section 1.4. Isobutylene in air is usually supplied with a standard CGA 590 cylinder valve outlet. Obtain a regulator with the matching fitting. Connect the regulator to the tank of calibration gas. Tighten the regulator onto the tank with a wrench. Do not over-tighten.

Note: Do not force the connection.

Do not use Teflon tape with CGA fittings. In general, these fittings are designed for metal to metal sealing.

Do not use adapters to connect one CGA fitting to another type of CGA fitting. If the regulator does not match the outlet on your calibration tank, contact your specialty gas supplier.

2. Attach the knurled nut on the gas bag adapter to the regulator. Finger-tighten the fitting.

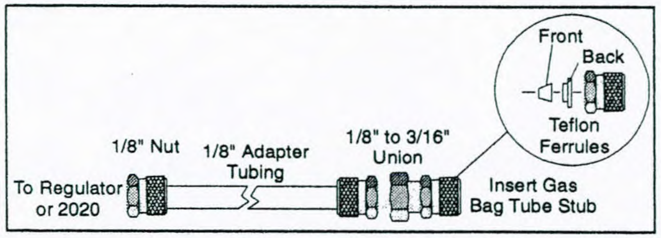


Figure 12 Gas Bag Adapter

3. Loosen the knurled nut on the reducing union of the gas bag adapter.

> **Note:** Do not remove the nut from the union as the Teflon ferrules contained inside the nut may be lost. See Figure 12.

4. Insert the tube stub from the gas bag into the knurled nut. Tighten the knurled nut and ensure the tube stub is secure. If the gas bag is not secure, ensure you have inserted the tube stub far enough into the knurled nut. Do not over-tighten the fitting.

> **Note:** Over-tightening the Teflon ferrules will result in damage to the ferrules!

5. The union should be connected to the gas bag adapter. If it is not, then tighten the nut on the adapter tube to the union.
6. Flush and fill the gas bag. See Appendix 8.6 for instructions.
7. Remove the knurled nut on the adapter tube from the regulator.
8. Repeat this procedure, if necessary, to prepare a bag of zero air.

> **Note:** Do not use the same gas bag or gas bag adapter for the bag of zero air. You will contaminate the bag of zero air.

3.3.2. Calibrating 2020 with a Gas Bag

1. Disconnect the probe from the 2020.
2. Press the ENTER key.
3. Select "Set", "Cal" and then "Mem".

4. Select the desired Cal Memory. 2020 has 15 Cal Memories and can be calibrated with 15 different span gases or response factors if required. Only one Cal Memory can be used at a time. Each Cal Memory stores a different response factor, zero point, sensitivity, and alarm levels.
5. Select "Chng" and then "User". Enter a name for the calibration memory.
6. Press the ENTER key and enter a response factor.
7. Press the ENTER key and enter an alarm level for each mode.
8. Press the ENTER key and enter a response factor. Refer to Appendix 8.7 for a list of Response Factors.

   If the compound is not listed in Appendix 8.7 or you are measuring gas mixtures, then enter a value of 1.0. The concentration detected by 2020 will be multiplied by the response factor before it is displayed and logged.
9. Connect the supply of zero air. If you are using a gas bag with zero air, open the bag and connect the gas bag adapter to the inlet.
10. Select "Set", "Cal" and "Zero". The 2020 sets its zero point.
11. Select "Set", "Cal" and "Span". The 2020 asks for the span gas concentration. Enter the known span gas concentration, without pressing the ENTER key to confirm it.
12. Open the bag and then connect the gas bag adapter to the inlet. Press ENTER. 2020 sets its response factor.

> **Note:** Readings may fluctuate slightly as the gas bag empties. Do not allow 2020 to evacuate the bag completely.

13. When the display reverts to the default display, 2020 is calibrated and ready for use. Remove the span gas bag from the inlet.

If 2020 is powered off in the middle of zeroing or spanning, it will power on displaying a Cal status. This indicates that you need to calibrate 2020. While the Cal status is active, all alarms are inactive.

3.4. Programming the Cal Memories

2020 has 15 Cal Memories and can be calibrated with 15 different span gases or response factors if desired. To program the Cal Memories:

1. If you will be calibrating directly from the portable cylinder, connect a flow-match regulator (Part No. 350006) to each tank. You must use a separate regulator for each compound to prevent cross contamination.

   If you are using gas bags, prepare the bags of calibration gas as outlined in Section 3.3. Use a different gas bag and gas bag adapter for each concentration and for each type of calibration gas. You can use the same gas bag to zero all the Cal Memories, however, you must refill the bag before zeroing each Cal Memory.
2. Select "Set", "Cal" and "Mem".
3. Select the desired Cal Memory (1 to 15) with the "Next" and "Prev" keys.
4. Press "Chng" to change the parameters of the Cal Memory. Select "User" or "Lib".
5. If you selected "User", enter the name, response factor and alarm levels.
6. If you entered "Lib", use the "Next" and "Prev" keys to select the required library. See Appendix 8.8 for a list of Library entries.

Note: It does not matter which Cal Memory is selected or which response factor is entered, 2020's response is not specific to any one compound. The reading displayed represents the total concentration of all ionizable compounds in the sample.

7. Calibrate the instrument as described in Section 3.2.2 or 3.3.2. When the calibration is completed, the calibration information is automatically stored in the selected Cal Memory.
8. Repeat this procedure for each Cal Memory you need.

Whenever the instrument is calibrated, 2020 updates the selected Cal Memory only. Each Cal Memory must be calibrated at least once a day. Frequency of calibration will depend on ambient conditions and instrument response. If ambient conditions change or the response has drifted, a calibration must be performed for each Cal Memory to ensure reliable operation.

3.5. Response Factors for Gases and Vapors

3.5.1. General Information

In situations where only a single pure compound is present in air, 2020 should be calibrated with a standard of that specific compound as span gas. 2020's 15 Cal Memories can be used to store calibration information for 15 different span gases.

The displayed reading will always be influenced by any other photoionizable compounds present in the air sample.

Note: Even if 2020 has been calibrated with a specific compound, its response is not specific and the presence of another ionizable impurity may render the numerical result invalid.

It is often impractical to carry a range of different standards into the field. Approximate results can be obtained by calibrating 2020 with the recommended span gas and entering the appropriate response factor. The response factor is based on the ratio of the response of the specific compound to the response of the span gas. The response factor multiplies 2020's reading then displays and records it.

Appendix 8.7 provides response factors from which approximations can be made for guidance purposes. Data extrapolated from the use of response factors must be regarded as interim and approximate only. Appendix 8.7 should be used only for concentrations up to 500 ppm of the specific compound, as response factors change with concentration.

3.5.2. Using Response Factors

1. Select "Set", "Cal" and "Mem".
2. Select the desired Cal Memory (1 to 15) with the "Next" and "Prev" keys.
3. Press "Set", "Cal" and "Mem" and "Chng" to change the parameters of the Cal Memory. Select "User" or "Lib".
4. If you selected "User", enter the name, response factor and alarm levels.

5. If you entered "Lib", use the "Next" and "Prev" keys to select the required library. See Appendix 8.8 for a list of Library entries.
6. Calibrate 2020 with zero air and 100 ppm isobutylene as described in Section 3.2.2 or 3.3.2.
7. Expose 2020 to the sample. The displayed reading is the approximate concentration of the specific compound.

The response factors in Appendix 8.7 serve only as a guide to concentrations measured by 2020.

Results are expected to be accurate to within +/-10 ppm or +/-25% of the displayed result, whichever is greater. Accuracy of response factors to other gases and vapors may differ from those listed in Appendix 8.7.

3.6. Manual Operation

As part of manual operation, you setup 2020 to monitor various locations. Since each location may contain different compounds and concentration ranges you can program a Cal Memory and the associated response factor and alarm level for up to 15 different applications. In this way you can sample numerous locations without having to re-calibrate 2020 at each location.

Prepare a monitoring schedule for you application. Your schedule should contain a list of sites that must be monitored and the Cal Memory that must be used when monitoring the site. Also include any reference information that will help you define the site and the monitoring application. If you create your schedule using spreadsheet software, you can later download 2020 data to a computer and then copy it into the spreadsheet for further calculations.

Once you have programmed 2020, and prepared a list of sites to be monitored, you will move around to each location and manually log data at each site.

1. You must determine the number of calibration standards that will be required to perform manual monitoring for your application. Program and calibrate all the calibration memories that you need. See Section 3.2 and 3.4.

Note: It does not matter which Cal Memory is selected or which response factor is entered, 2020's response is not specific to any one compound. The reading displayed always represents the total concentration of all ionizable compounds in the sample.

2. Ensure the 2020 is in PEAK mode. To change the mode, press ENTER and select "Disp". Press "Mode" and select PEAK.
3. Switch to manual operation. Press ENTER and then "Log". Select "Mode". Use the "Next" and "Prev" keys to scroll through the list. When Manual is displayed press ENTER. When you switch between interval and manual operation, the datalogger will be cleared. Press "YES" to confirm your selection and clear the datalogger. If you do not want to lose your previously recorded data, press "NO", then print or save the data to disk before changing to manual operation. See Sections 2.7.3 and 4.2 for printing and saving logged data.
4. The instrument status will change to "Loc".
5. Select the required Cal Memory for this location. Press ENTER and select "Set", "Cal" and then "Mem". Use the "Next" and "Prev" keys to select the desired Cal Memory.
6. Press the ENTER key and locate the first site on your schedule. The middle soft key is used to advance to the next measurement when you are operating in manual mode. Press the "Next" key. If you are not using manual operation, the "Next" key is not shown.
7. The instrument status will change to "BkGd". A background measurement must be made. When you have an accurate background, press "Next". 2020 will record the displayed concentration when you press the "Next" key.
8. The instrument status will now be "Samp". Take a sample measurement. When you have an accurate sample, press "Next". 2020 will record the displayed concentration when you press the "Next" key.
9. The instrument status will again be "Loc". Go to the next site on your schedule.

When you have completed your monitoring you can download the contents of the datalogger to a computer and add the 2020 data to your spreadsheet.

If you change from manual operation to an averaging interval, you will lose the contents of the datalogger. Print or save the data to disk before changing the interval. See Sections 2.7.3 and 4.2 for printing and saving logged data.

3.7. Preparing for Field Operation

3.7.1. Field Check List

When using 2020 for field operation, the following items should be carried into the field to reduce or eliminate down time of the instrument.

If you are going to be in the field for a single 8-10 hour day, then you should include the following accessories:

☐ Spare battery pack (Part No. 350009)
☐ Spare UV lamp (Part No. 390011)
☐ 2020 multi-tool (Part No. 396012)
☐ Sample line (Part No. 390006)
☐ Calibration kit(s) (Part No. 390033)
☐ Calibration regulator (Part No. 350006)
☐ Tank(s) of calibration gas (Part No. 350012)
☐ Spare gas bag for zero air (Part No. 396017)
☐ Gas bag adapter for zero air (Part No. 396010)
☐ Supply of commercial zero air
☐ Spare inlet filters (Part No. 396015 or 396000)
☐ Dilution probe (Part No. 350013)
☐ Spare charcoal filters for the dilution probe (Part No. 395064 or 395067)
☐ Carrying case (Part No. 350010)
☐ User's manual (Part No. 350001)
☐ DC power cord (Part No. 350004)

Table 3 Check List for Field Operation

If you will be in the field for more than one day you should include the following additional items:

☐ AC adapter (Part No. 350001 or 396013)
☐ Printer (Part No. 380120)
☐ Cable kit (Part No. 350011)
☐ Computer and associated cables
☐ Serial to parallel converter (Part No. 380145)

Table 4 Additional Field Items

3.7.2. Operational Check List

Before beginning field work, set up and calibrate 2020 for your particular application. Ensure the instrument is in working order before heading into the field:

1. Press the "Set" and "Clock" keys and ensure the correct time is entered. Press the ENTER key and ensure the correct date has been entered.
2. Ensure the battery pack is fully charged. If you are unsure about the status of the battery, replace the battery pack with one that is fully charged. See Section 1.5.
3. Program and calibrate all the Cal Memories you need. See Section 3.4. After calibration is complete, sample the calibration gas and the bag of zero air to ensure 2020 has been calibrated correctly.
4. Select the correct operating mode. See Section 2.8.2.
5. Reset the TWA accumulator, the STEL moving average and the MAX. See Section 2.5.
6. You may want to delete all entries from the datalogger to avoid confusion between different days' data and to avoid running out of space in the datalogger. See Section 2.7.2.

4. Connecting Accessories

4.1. Printer

The printer must have a printing width of at least 65 characters and must use fixed spaced fonts. The serial communication parameters on 2020 have been fixed at 9600 baud, no parity, 8 data bits and 1 stop bit. Your printer must be able to match these settings.

If you are using a parallel printer, you will need the serial to parallel converter (Part No. 380145). See Section 4.3 for details of connecting and operating 2020 with a serial to parallel converter.

Note: 2020 is not classified for use in hazardous locations with a printer.

1. Turn 2020 off.

Note: You must turn the instrument off before connecting or disconnecting the printer cable.

2. Connect the printer cable (Part No. 350011) to the I/O port on the back of the 2020 and then to the serial port on the printer.
3. Turn 2020 on.
4. The serial communication parameters on 2020 have been fixed. It communicates at 9600 baud, no parity, 8 data bits and 1 stop bit. You must set your printer accordingly.

5. Use the "Grph" and "Tabl" keys as detailed in Sections 2.7.3.

If this arrangement does not produce the desired results, see Section 6.4.

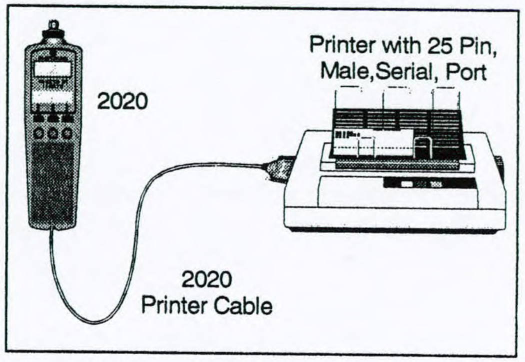


Figure 13 Connecting 2020 to a Serial Printer

4.2. Computer

2020 can send information stored in its datalogger to a computer. This option may be used if you need to prepare reports based on 2020's recorded data. This feature may also be used if you need the recorded data in a format that can be imported into a spreadsheet or database for further calculations.

Note: 2020 is not classified for use in hazardous locations with computers.

You may need to keep more data than can be logged by 2020. If this is the case you have two options: you may print the data before they are deleted from the datalogger and keep the printed reports, or you may store the data on disk for later use. You may not, however, load data that have been stored on disk back into 2020.

In order to establish communication with 2020 and receive data stored in the datalogger, the computer must be set up to emulate a terminal. In order to do this you will need a communications software package that will allow you to transfer data from 2020 to a computer. Software packages such as Crosstalk, and Procomm are recommended for use with 2020. Crosstalk XVI will be used as an example in the instructions below.

If you are using Microsoft Windows you do not need to purchase any separate software. Instructions for downloading information to Windows' Terminal program are also provided.

If you are already using another type of communication or terminal emulation software package, it is not necessary to purchase a copy of Crosstalk or Procomm. Use your communications package to set up the computer to receive data at 9600 baud, no parity, 8 data bits and 1 stop bit. Refer to the user's manual, provided with your software, for specific details.

Once data have been transferred to Crosstalk, they must be saved to a floppy or hard disk. In order to manipulate the data, you must import the data either as a text file into a spreadsheet, where the data may be parsed and converted to numeric data, or into a text editor or word processor where the data may be viewed and edited.

The instructions below will provide you with the most basic information for using 2020 with communications software. Please refer to the software user's manual for specific details of operation.

4.2.1. Using Crosstalk

The following instructions are for Crosstalk XVI Version 3.71. The commands may vary with the version of Crosstalk you are using. To initiate communications between 2020 and the computer:

1. Start Crosstalk. The Status Screen will appear.
2. At the bottom of the Status Screen there will be a highlighted bar with the word Command?. If the word Command? does not appear press the <Esc> key on the computer keyboard.
3. Type *SP* and press <Enter>. This will allow you to set the baud rate at which the computer will receive data from 2020. Type 9600 and press <Enter>.
4. On 2020 the number of data bits has been fixed at 8, stop bits has been fixed at 1. You must set up Crosstalk accordingly. Type *DA* and press <Enter>. Type in *8* and press <Enter>.
5. Type in *ST* and press <Enter>. Type in *1* and press <Enter>.
6. Type in *PA* and press <Enter>. Type in *None* and press <Enter>. This sets the parity to None

7. Turn 2020 off.

Note: You must turn the instrument off before connecting or disconnecting the printer cable.

8. 2020 must be connected to a serial port. Use the printer cable (Part No. 350011) to connect 2020 to one of the computer's serial ports. Take note of which serial port you are using. Normally you will use Com1 or Com2.
9. If the 2020 printer cable plugs directly into the port on the computer without the gender changer or the 9 to 25 pin adapter (null modem), you are most probably connected to a parallel port. You will need at least one of the adapter cables to connect 2020 to a serial port. See Section 6.6.
10. Type *PO* and press <Enter>. Type in *1* if you connected 2020 to Com1 or type in *2* if you connected 2020 to Com2 and press <Enter>. If you connected 2020 to another serial port enter the corresponding number.
11. Type *MO* and press <Enter>. Type in *A* to change the mode to answer.
12. In order to capture the data and store them on a disk you must turn the Crosstalk capture command on and specify a disk to which the data can be stored. Type *CA* and press <Enter>.
13. Now type in the disk drive and the name of the file where you want the data stored. For example if you want to store the data in a file called 2020 on a floppy disk in drive A, then type *A:\2020.dta* and press <Enter>.
14. If the word Command? does not appear at the bottom of the Crosstalk Capture Screen, press <Esc>.
15. You have now set up Crosstalk to communicate with 2020. Type *GO L* to begin the downloading session. The Status Screen will disappear and the Capture Screen will appear.
16. Press the ENTER key. Select "Log", "Prnt" and then select "Grph" or "Tabl".
17. Select a start time using the "Next" and "Prev" keys. Hold down the "Next" and "Prev" to scroll through the data quickly.

18. Press the ENTER key, and select the stop time. All entries between, and including, the start and stop entries will be sent to the computer.

19. When all the data have been sent, press <Esc>. Type *CA off* and press <Enter>. This will turn the capture option off and write the captured file to the disk drive you specified in step #13.

20. Press <Home> to return to the Status Screen.

21. Type *QU* and press <Enter>. This will end your communications session.

Convert the file to a text file or a print file using the MS-DOS® Copy Command:

22. To convert the file to a text file, at the DOS prompt type: *Copy 2020.dta 2020.txt*

23. To convert the file to a print file, at the DOS prompt type: *Copy 2020.dta 2020.prn*

Once the file has been converted to a text file you can use a text editor to view and edit the contents.

If you are not comfortable with the Crosstalk commands used above, you should familiarize yourself with these commands by reading the Crosstalk user's manual. It is important to understand each of the commands in order to ensure both Crosstalk and 2020 are set up correctly.

4.2.2. Using Microsoft Windows

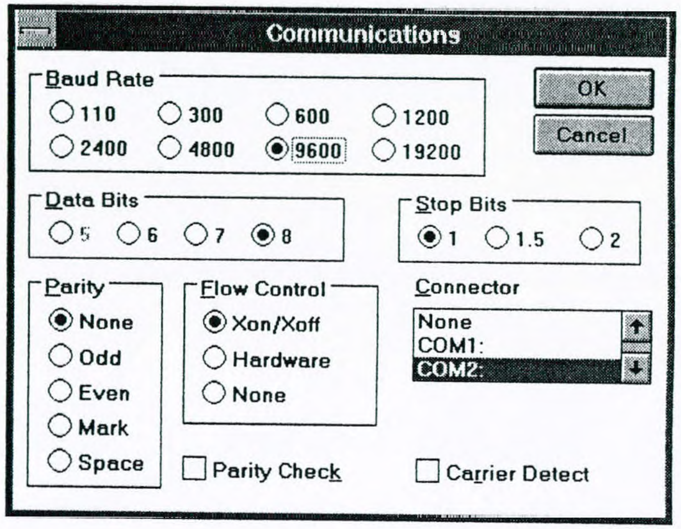
If you are using Microsoft Windows you do not need to purchase any separate software. The rules for connecting 2020 to the serial port still apply. See steps #7 to 9 in Section 4.2.1.

In order to use these instructions, you must be familiar with Microsoft Windows Version 3.1 and it must be installed and running on your computer.

To initiate communications between 2020 and Windows:

1. Start Windows and then start the Terminal Program. The Terminal Program may be in the Accessories Program Group. Its location will depend on how you have set up Windows.

2. Open the Settings Window and select Communications.



Baud Rate: ○ 110 ○ 300 ○ 600 ○ 1200 ○ 2400 ○ 4800 ● 9600 ○ 19200

Data Bits: ○ 5 ○ 6 ○ 7 ● 8

Stop Bits: ● 1 ○ 1.5 ○ 2

Parity: ● None ○ Odd ○ Even ○ Mark ○ Space

Flow Control: ● Xon/Xoff ○ Hardware ○ None

Connector: None, COM1:, COM2: (selected)

☐ Parity Check

☐ Carrier Detect

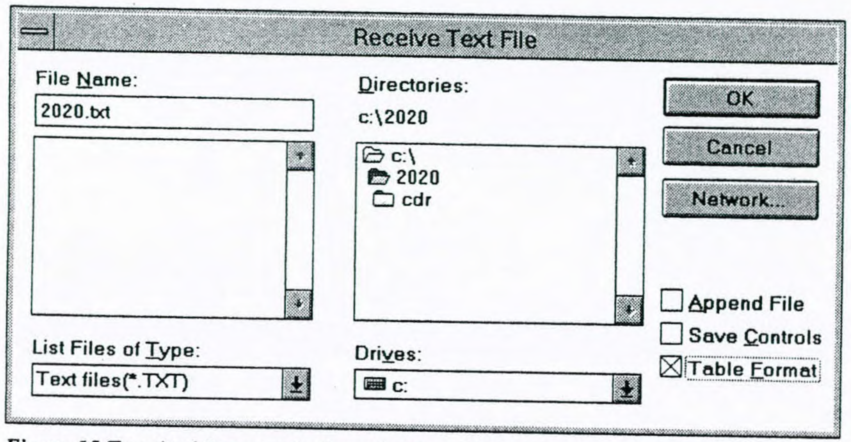
Figure 14 Terminal Program's Communication Dialog Box

3. Select the correct Baud Rate, Data Bits, Stop Bits, Parity and Connector. Select Xon/Xoff for the Flow Control option. Leave the Parity Check and Carrier Detect options off. Select OK to close the dialog box and accept the changes.

4. Open the Transfers Window and select Receive Text File. A Receive Text File dialog box will open. See Figure 15.

5. Type in the desired path and filename for the data that are to be downloaded. Ensure the path is correct.

   Ensure the filename has a .txt extension. The .txt extension will make it easier to use the downloaded data later.



File Name: 2020.txt

Directories: c:\2020

c:\
2020
cdr

☐ Append File
☐ Save Controls
☒ Table Format

List Files of Type: Text files(*.TXT)

Drives: c:

Figure 15 Terminal Program's Transfer Text File Dialog Box

6. Select the Table Format option and then select OK. At the bottom of the screen the message, "Receiving Data" is displayed.
7. Press the ENTER key. Select "Log", "Prnt" and then select "Grph" or "Tabl".
8. Select a start time using the "Next" and "Prev" keys. Hold down the "Next" and "Prev" keys to scroll through the data quickly.
9. Press the ENTER key, and select the stop time. All entries between, and including, the start and stop entries will be sent to the computer.
10. To terminate communications select Stop from the bottom of the screen.

The logged data can now be copied or cut to the Windows Clipboard and pasted into a text editor, such as Windows' Notepad, or a spreadsheet for editing.

Refer to the Microsoft Windows User's Guide for detailed instructions on installation and operation of Microsoft Windows.

4.3. Serial to Parallel Converter

This device allows 2020, which is capable of serial communication, to communicate with a parallel device. This will be most useful for printing, as most printers utilize parallel communications.

The printer must have a printing width of at least 65 characters and must use fixed spaced fonts. The serial communication parameters on 2020 have been fixed at 9600 baud, no parity, 8 data bits and 1 stop bit. Your converter must be set to match these settings.

4.3.1. DIP Switch Settings

The DIP switch settings are very important and must be set correctly in order to correctly communicate with 2020. 2020 will always be the serial device so the data flow direction will be serial to parallel.

To configure the serial port of the converter:

1. Locate the DIP switches located on the side of the converter.

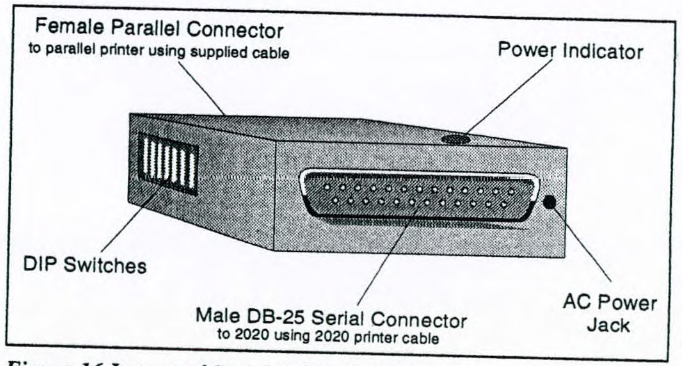


Figure 16 Layout of Serial to Parallel Converter

2. Determine the baud rate at which the converter will be receiving data from the instrument. The value you set here must match 2020.
3. Use the first three DIP switches to set the baud rate to 9600. See Table 5.

Baud Rate	SW1	SW2	SW3
9600	On	Off	On

Table 5 DIP Switch Settings for Baud Rate

4. Switch 4 sets the data bits. Off = 7 Bits. On = 8 Bits. Set the data bits to 8.
5. Use Switches 5 and 6 to set the parity to none.

Parity	SW5	SW6
None	Off	Off

Table 6 DIP Switch Settings for Parity

6. Switch 7 sets the Handshake mode. Off = Xon/Xoff. On = DTR. Set the Handshake mode to Xon/Xoff.
7. Use switch 8 to set the data flow direction to serial to parallel. Off = Serial to Parallel. On = Parallel to Serial.
8. Check your settings. It is imperative that you have the correct settings or you will be unable to establish communications. Your settings should match those in Table 7.

SW1	SW2	SW3	SW4
On	Off	On	On
SW5	**SW6**	**SW7**	**SW8**
Off	Off	Off	Off

Table 7 DIP Switch Settings

4.3.2. Using 2020 with the Serial to Parallel Converter

Note: 2020 is not classified for use in hazardous locations with printers or with the serial to parallel converter.

1. Turn 2020 off

Note: You must turn the instrument off before connecting or disconnecting the printer cable.

2. Unplug the converter from the AC outlet.
3. Use the cable kit (Part No. 350011) to connect the 2020 I/O connector to the converter.

4. Use the parallel cable, supplied with the converter, to connect the converter and the printer. If this cable is not suitable, see Section 6.5 for the cable requirements.

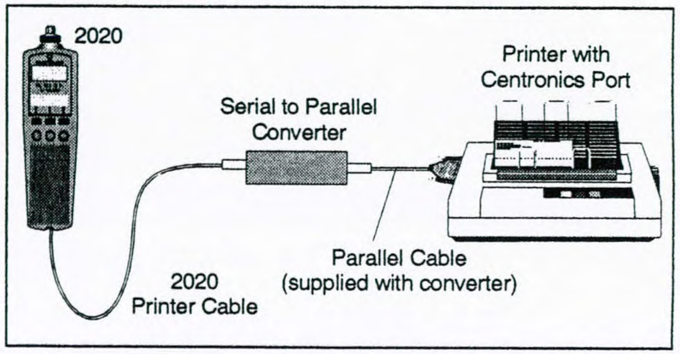


Figure 17 Connecting 2020 to the Serial to Parallel Converter

5. Plug the converter into an AC outlet.
6. Turn 2020 on.
7. Ensure the printer has been setup correctly. It must be on-line. Ensure paper is available and has been aligned properly.
8. Press the ENTER key. Select "Log", "Prnt" and then select "Grph" or "Tabl".
9. Select a start time using the "Next" and "Prev" keys. Hold down the "Next" and "Prev" keys to scroll through the data quickly.
10. Press the ENTER key, and select the stop time. All entries between, and including, the start and stop entries will be sent to the printer.

4.4. Sample Line

A 3 meter (9') sample line (Part No. 390006) may be connected to 2020 for remote sampling. Connect the sample line to the 2020 inlet using the fittings supplied with the sample line.

Note: When using the sample line, be especially careful not to aspirate liquids or solids as they will damage 2020.

4.5. Dilution Probe

4.5.1. Description

Note: 2020 is not classified for use in hazardous locations with the dilution probe.

The dilution probe (Part No. 350013) attaches to the underside of 2020 and allows 2020 to read concentrations up to 20000 ppm isobutylene equivalent units.

A metering valve controls the ratio of sample to zero air. 2020's pump draws air through both the dilution probe inlet and through the charcoal filter. You set the metering valve so that 2020 reads 10% of the actual sample concentration. Zero air is created by drawing room air through a charcoal filter.

2020 is calibrated with 100 ppm isobutylene. The dilution probe is then connected to the 2020 inlet and the dilution probe—2020 system is calibrated with 100 ppm isobutylene. For high accuracy operation, the dilution probe is calibrated with 1000 ppm isobutylene.

Note: Do not use the 11.7 eV lamp in conjunction with the dilution probe.

4.5.2. Assembling the Dilution Probe

1. Slide the charcoal filter tube into the 1/4" compression nut on the zero air inlet of the dilution probe. See Figure 18.

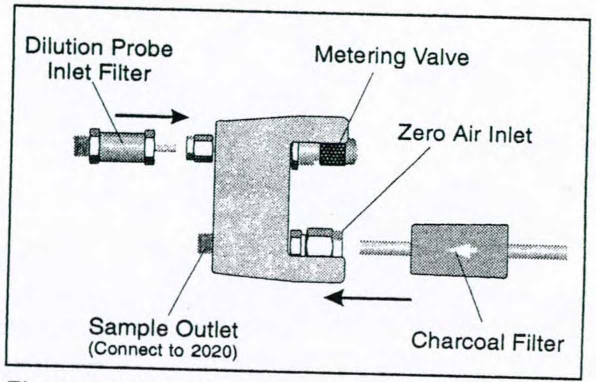


Figure 18 Dilution Probe Layout

2. Finger-tighten the nut. Then use a wrench to tighten the nut 3/4 of a turn further. This will compress the ferrules onto the tube.
3. Slide the inlet filter into the 1/8" compression nut on the sample inlet of the dilution probe. See Figure 18.
4. Finger-tighten the nut and then use a wrench to tighten the nut 3/4 of a turn further. This will compress the ferrules onto the filter tube.

4.5.3. Installing the Dilution Probe

1. Remove the two screws from the bottom of the 2020 control housing.
2. Use the long mounting screws supplied with the dilution probe to connect the mounting bracket to the 2020 bottom housing. See Figure 19.
3. Use the short mounting screws and the washers to connect the dilution probe to the mounting bracket.

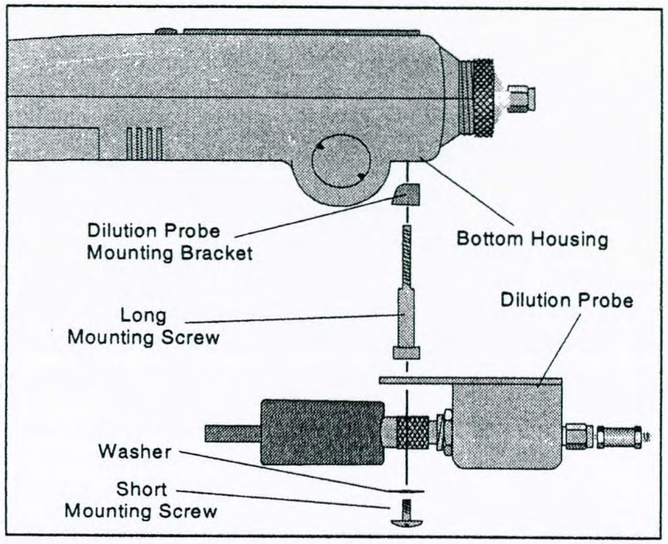


Figure 19 Installing the Dilution Probe

4.5.4. Calibration with the Dilution Probe

2020 must be calibrated in order to display concentration in units equivalent to ppm.

Occasionally clean ambient air will be suitable as zero air. If there is any doubt, use a commercial source of zero grade air and a regulator or second sampling bag. Span gas of the desired compound and concentration is also required and may be obtained from a specialty gas supplier. See Appendix 8.5.

Isobutylene at 100 ppm in air is recommended as span gas (Part No. 350012). If you are using another type of span gas, you must obtain the required gas and concentration. If compound threshold limit values (TLVs) are exceeded, you should use a gas bag for calibration.

Calibrate the instrument as follows:

1. Calibrate 2020 as outlined in Section 3.2.2 or 3.3.2.

2. Remove the 2020 sample probe. Use the tubing supplied with the dilution probe to connect the dilution probe outlet to the 2020 inlet.
3. If you are using gas bags, flush and fill the gas bags with 100 ppm isobutylene.
4. Use the hex wrench to loosen the screw in the metering valve handle. Do not remove the hex screw.
5. Insert the tube from the dilution probe inlet into the adapter tubing from the flow-match regulator. If you are using gas bags, connect the gas bag adapter to the dilution probe inlet.
6. Ensure the calibration gas cylinder is upright and open the regulator until the float is 1/8" from its rest position. Do not set the flow rate too high.
7. Adjust the metering valve until the display reads 10% of the actual span gas concentration.
8. Use the hex wrench to tighten the screw and lock the metering valve handle.
9. The dilution probe is now calibrated and ready for use. Disconnect the adapter tubing or the gas bag from the inlet.

Note: When the dilution probe is connected to 2020, the displayed readings are always 10% of the actual reading.

4.5.5. High Accuracy Operation

The 2020–dilution probe system can be calibrated for higher accuracy operation. 2020 is calibrated with 100 ppm isobutylene and the dilution probe is calibrated with 1000 ppm isobutylene.

1. Calibrate the 2020 as described in Section 3.2.2 or 3.3.2. Use 100 ppm isobutylene as the calibration gas.
2. Connect the dilution probe to the 2020 inlet.
3. If you are calibrating directly from the calibration tank, Insert the 2020 sample probe into the adapter tubing of the regulator.

   Ensure the calibration gas cylinder is upright, and open the regulator by turning the valve counterclockwise. Open the regulator until the ball is 1/8" from its rest position. Do not set the flow rate too high.

4. If you are using gas bags, flush and fill the gas bags with 1000 ppm isobutylene. It is advisable to obtain a second calibration kit (Part No. 390033) for the 1000 ppm isobutylene. See Section 3.3.1 for details of filling the gas bags.
5. Adjust the metering valve until the display reads 10% of the actual isobutylene gas concentration.

4.6. DC Power Cord

2020 can be connected to a car battery through the cigarette lighter with the DC power cord. While 2020 is connected to the car battery the 2020 battery is being charged.

Note: 2020 is not classified for use in hazardous locations with a DC power cord.

1. Turn the instrument off by pressing the ON/OFF key for 2 seconds.
2. Connect the DC power cord (Part No. 390004) to the 2020 AC adapter jack on the rear of the instrument.
3. Connect the other end of the DC power cord to the cigarette lighter in the car.
4. Turn the instrument on again by pressing the ON/OFF key.

If the car is running, ensure the car exhaust does not contaminate your samples.

4.7. Belt Clip Holster

Use the belt clip holster (Part No. 350008) to protect the instrument and to mount the instrument to a belt or personal apparatus.

1. Disconnect the top strap of the holster and insert 2020 into the holster.
2. Reconnect the strap so that 2020 is held securely.

4.8. 11.7 eV UV Lamp

4.8.1. General Information

2020 is equipped with a standard 10.6 eV UV lamp. An 11.7 eV UV lamp (Part No. 390024) available for special applications.

Install this lamp as outlined in Section 5.2.1. When you install a UV lamp other than the standard 10.6 eV lamp, all the response factors become invalid. You must set the response factor for the current cal memory to 1. Contact the Applications Department for further information.

Note: Do not use the 11.7 eV lamp in conjunction with the dilution probe.

4.8.2. Limitations of Lithium Fluoride Lamp Window

This lamp is intended for special applications only. It is not suitable for normal operation, due to limitations of the lamp window material.

The 11.7 eV lamp window material is lithium fluoride (LiF). LiF is composed of two light elements which are easily disrupted within the crystal lattice by the UV light generated by the lamp. Disruption of the lattice causes the crystal to turn a yellowish color, and again performance declines.

Unlike other lamp windows, LiF readily absorbs water from atmospheric humidity. When contaminated by moisture, the window loses its ability to transmit UV light. Clean the lamp window as outlined in Section 5.2.3.

Note: Do not touch the lamp window or handle it near liquid water.

4.8.3. Using the 11.7 eV UV Lamp

With an 11.7 eV lamp installed, your instrument functions as a leak detector responding to gases and vapors which ionize at 11.7 eV or less. The 11.7 eV lamp may be useful for detecting leaks of chemicals not ionized by the standard 10.6 eV lamp.

Due to the lamp window limitations, the lifetime of the 11.7 eV lamp is restricted and it must be used sparingly according to the following instructions.

1. Remove the 11.7 eV lamp from the supplied desiccant bottle and install the lamp according to the instructions in the instrument user's manual. Install the lamp as outlined in Section 5.2.1.

Note: Do not remove or replace any detector lamp in a hazardous location.

2. Turn the instrument on and wait for the ready status. If the lamp cannot be started, contact the PE Photovac Service Department.
3. Calibrate 2020 as outlined in Section 3.2. All response factors are invalid when an 11.7 eV lamp is installed. You must set the response factor for the current cal memory to 1.
4. Recalibrate the instrument every 15 minutes of operation.
5. Every hour of operation, switch off the instrument, remove the lamp and examine the window for yellowing. If the window is yellow, then regenerate the window according to the procedure in Section 5.2.3
6. After use, remove the lamp and store it in the supplied desiccant bottle.

Do not leave the 11.7 eV lamp in the instrument when you turn it off. Always remove the 11.7 eV lamp and store it in the supplied desiccant bottle.

4.9. Off Line Charger

4.9.1. General Information

The off line charger (Part No. 350015, 350019) allows you to charge a battery pack independently of 2020. To charge a battery pack without removing it from the 2020 see Section 1.5.

The off line charger requires one of the following 2020 accessories for operation:

1. AC Adapter (Part No. 350002 - North America)

2. AC Adapter (Part No. 396013 - Europe)
3. DC Power Cord (Part No. 350004)

Use only the AC adapter specified for use with 2020. Using another AC adapter will result in damage to the battery pack, the off line charger, or the adapter.

4.9.2. Charging from an AC Source

Note: Do not charge the battery pack in a hazardous location.

1. Remove the battery pack as outlined in Section 1.5.
2. Attach the connector from the battery pack to the socket on the off line charger.

Note: The connector is polarized. It will only fit one way. Do not force the connection.

3. Plug the AC adapter into the jack on the opposite face of the off line charger.
4. Plug the AC adapter into an AC outlet. If you are using the European AC adapter, ensure the correct plug is installed on the line cord. If it is not correct for the wall outlet in your area, then it must be replaced.
5. The LED on the upper face of the off line charger indicates the charge state of the battery pack. Red indicates the battery is being charged. Green indicates the battery is fully charged.
6. Charging a fully discharged battery pack will take approximately four hours.
7. It is normal for a fully charged battery pack to indicate it is charging (red light) when first plugged in. The LED will turn green as the battery charges.
8. When the battery pack is fully charged, remove the AC adapter, first from the wall outlet, then from the off line charger.
9. Remove the battery pack connector from the socket on the off line charger.
10. Replace the battery pack in 2020 as outlined in Section 1.5.

You can keep the battery pack fully charged indefinitely, without overcharging it, by leaving it connected to the off line charger while the charger is operating.

4.9.3. Charging from a DC Source

1. Remove the battery pack as outlined in Section 1.5.
2. Attach the connector from the battery pack to the socket on the off line charger.

Note: The connector is polarized. It will only fit one way. Do not force the connection.

3. Plug the DC power cord into the jack on the opposite face of the off line charger.
4. Plug the DC power cord into a vehicle auxiliary 12 VDC or cigarette lighter socket.
5. The LED on the upper face of the off line charger indicates the charge state of the battery pack. Red indicates the battery is being charged. Green indicates the battery is fully charged.
6. Charging a fully discharged battery pack will take approximately 4 hours.
7. It is normal for a fully charged battery pack to indicate it is charging (red light) when first plugged in. The LED will turn green as the battery charges.
8. When the battery pack is fully charged, remove the DC power cord, first from the vehicle auxiliary 12 VDC or cigarette lighter socket, then from the off line charger.
9. Remove the battery pack connector from the socket on the off line charger.
10. Replace the battery pack in 2020 as outlined in Section 1.5.

You can keep the battery pack fully charged indefinitely, without overcharging it, by leaving it connected to the off line charger while the charger is operating.

5. Routine Maintenance

5.1. Battery Charging

A fully charged battery pack powers 2020 for approximately 8 hours. If the instrument is to be used for more than 8 hours, carry a spare battery pack (Part No. 350009). When the first one has been discharged, replace it with the spare.

Note: If you do not turn 2020 off before removing the battery pack, you will reset the instrument and you will lose all logged data and setup parameters.

When the instrument status displays "LBat", the battery pack requires charging. When the "LBat" status is displayed, you have 30 minutes of operation left. 2020 will turn itself off before the battery pack becomes critically low.

Warning: Do not remove or recharge the battery pack in a hazardous location.

Upon return from field work, charge the battery packs as outlined in Section 1.5. Use only the AC adapter specified for use with 2020. Optionally you can use the off line charger to charge the battery pack independently of the instrument. See Section 4.8.

Note: You must use the 220 V battery charger (Part No. 396013) in order to comply with the requirements of the applicable Council Directives.

If you do not require portable operation, you can use 2020 while it is connected to the AC adapter

The AC adapter automatically charges at a high charge rate until the battery pack is fully charged. It then maintains the full charge with a low continuous charge rate indefinitely so there is no danger of over-charging.

When the LED, on the bottom of 2020, is red, the battery is charging. When the LED turns green, the battery is fully charged.

Note: Leaving 2020 for more than 3 months without turning it on may result in the loss of recorded data and setup parameters. If 2020 is not used for long periods, turn the instrument on for a few hours every month to avoid loss of data.

5.2. Maintenance of the UV Lamp

5.2.1. Removing and Replacing the UV Lamp

Note: Do not remove or replace the UV lamp in a hazardous location.

1. Ensure the instrument is turned off.

Warning: You must turn the instrument off before removing the lamp cover!

2. Use the 2020 multi-tool to remove the lamp housing cover.
3. Tilt 2020 slightly and remove the UV lamp.

Warning: Do not touch the wire grid inside the detector cell. Any dust or dirt in the detector cell can be blown out with a gentle jet of compressed air.

Do not insert any object, other than the UV lamp, into the lampholder.

4. Discard the o-ring and spring supplied with the replacement lamp.
5. Without touching the lamp window, place the new lamp into the 2020 lampholder, window first. See Figure 20.

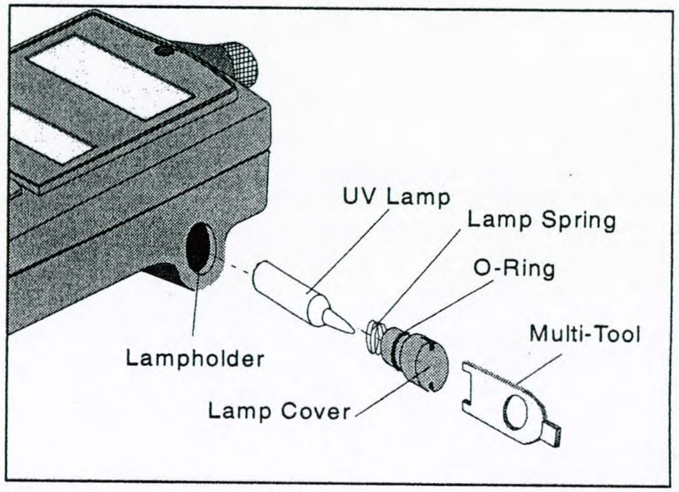


Figure 20 Removing the UV Lamp

Note: If you have a UV lamp with a white serial number label, it is possible that the UV lamp may not fit into the lampholder. Do not force the lamp into the lampholder. See Section 6.3.

6. Replace the lamp housing cover. Tighten the cover down with the multi-tool. Do not overtighten.
7. Calibrate all Cal Memories that you are using and then continue normal operation.

5.2.2. Cleaning the UV Lamp Window

During the course of normal operation, a film builds up on the window of the UV lamp. The rate at which the film develops depends on the type and concentration of the gases and vapors being sampled and results from the UV light interacting with them.

Hot gases and vapors may contribute to a decrease in sensitivity because they may condense on the lamp window. Condensation may eventually evaporate off the window, but it will usually leave a residue that must be removed by cleaning the lamp window.

Since some UV inhibiting deposits are invisible to the eye, regular cleaning of the lamp window is strongly recommended. Clean the lamp frequently to prevent a heavy build-up of deposits that may be difficult to remove. As a guide, clean the window every 24 hours of operation.

Warning: Do not remove the UV lamp in a hazardous location.

The UV lamp cleaning kit (Part No. 380336) includes aluminum oxide powder (3.0 micron powder) and cotton swabs. Additionally, you will require approximately 10 mL of methanol. When ordering methanol, specify purge and trap grade.

The instructions provided below are for 8.4 eV, 9.5 eV, 10.0 eV and 10.6 eV lamps. Refer to Section 5.2.3 for special instruction to clean the 11.7 eV lamp window.

Warning: Never touch the UV lamp window with your fingers.

1. Remove the lamp as outlined in Section 5.2.1.
2. Allow the lamp to cool to room temperature to avoid thermal shock which could crack the window.
3. Dampen a cotton swab in methanol and dab it into the cleaning compound. Allow a small amount of the cleaning compound to adhere to the cotton tip.

Warning: Do not use methanol to clean the 11.7 eV lamp window.

4. Using small circular motions, rub the cleaning compound onto the lamp window. Do not exert excessive force onto the window, since window can be permanently damaged by misuse.
5. Continue cleaning for approximately one minute.
6. Dampen a new cotton swab with methanol and remove any trace amounts of the cleaning compound from the lamp window.

7. Wipe the window and the lamp with a dry, lint free tissue to remove any trace amounts of the cleaning compound and methanol. All traces of cleaning compound must be removed.
8. If you removed an o-ring from the lamp, replace it now. Ensure your hands are clean and dry.
9. Without touching the lamp window, replace the lamp as outlined in Section 5.2.1

5.2.3. Cleaning the Lithium Fluoride Window

To clean the 11.7 eV lamp window:

1. Clean the lamp window with dry aluminum oxide powder on a dry cotton swab. Do not use methanol or water.
2. The lamp window can also be regenerated by storing the lamp in a desiccator for at least 5 days.

Note: You may not be able to fully clean the 11.7 eV lamp window.

5.3. Replacing the Sample Inlet Filter

2020 is equipped with a combined dust and water filter to reduce detector contamination. As the filter collects dust, 2020's inlet flow rate and sensitivity decrease. The filter will not allow water to pass through, but the filter will not stop all solvents.

Note: Do not aspirate liquid samples with 2020!

Replace the filter on a weekly basis, or more frequently if 2020 is used in a dusty or wet environment. You must replace the filter if 2020 has been exposed to liquid water. If you are sampling hot gases or vapors, condensation in the sample line may also affect the filter. The pump will sound labored when the filter requires replacement.

Warning: Do not replace the inlet filter in a hazardous location.

1. Turn the instrument off. Unscrew the filter housing from the detector housing. Be careful not to lose the O-ring seal.

Note: Each filter is protected by a piece of blue plastic. Remove the plastic before installing the filter in 2020.

2. Remove the Teflon/Polypropylene filter and install the new filter (Part No. 396000 or 396015). Place the filter so that the Teflon side is facing down in the filter housing and the mesh side is facing the 2020.

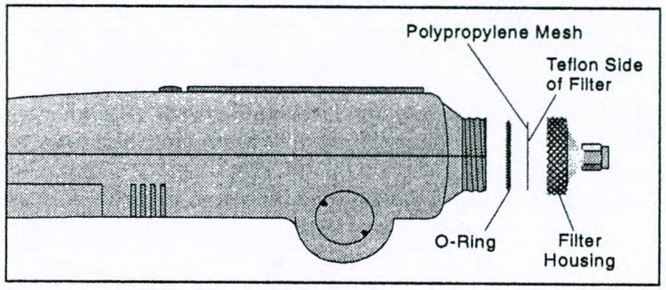


Figure 21 Replacing the Inlet Filter

Handle the filter disk only by the edges. The mesh may be damaged or contaminated by excessive handling. Use forceps if possible.

3. Replace the filter housing.
4. Calibrate all Cal Memories, that you are using, and then continue normal operation.

Warning: Do not operate 2020 without an inlet filter.

5.4. Maintenance of the Dilution Probe

5.4.1. Charcoal Filter

The charcoal filter will remove hydrocarbon contaminants for up to 4000 ppm-hours. This means that the filter will last for 1 hour removing 4000 ppm of hydrocarbon contaminants or will last for 4 hours removing 1000 ppm. The exact time will be determined by the operating environment. You will notice an increased hydrocarbon background when the filter requires replacement.

To replace the charcoal filter:

1. Loosen, but do not remove, the 1/4" compression fitting on the dilution probe zero air inlet and remove the charcoal filter from the dilution probe. See Figure 18.
2. Slide the replacement charcoal filter tube into the compression nut. (Part No. 395067).
3. Finger-tighten the nut. Then use a wrench to tighten the nut 3/4 of a turn further. This will compress the ferrules onto the tube.

When the dilution probe is not in use, place the charcoal filter in its plastic bag and store it in a clean, dry place.

5.4.2. Inlet Filter

The dilution probe is equipped with a dust filter to reduce detector contamination. As the filter collects dust, the inlet flow rate and sensitivity decrease. Replace the filter every 240 hours of operation, or more frequently if the instrument is used in a dusty environment.

Note: Do not operate 2020 or the dilution probe without an inlet filter.

1. Turn 2020 off and remove the dilution probe from the instrument.
2. Hold the filter housing near the housing with a 9/16" wrench. See Figure 22.
3. Unscrew the top of the filter housing with another 9/16" wrench. Be careful not to lose the filter spring.
4. Remove the spring and filter. Install the new filter (Part No. 395000), open end first. Press the filter into place so it will seal at the bottom of the filter housing. Replace the filter spring and the top of the filter housing.

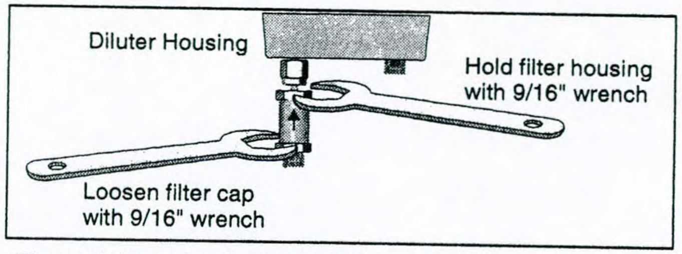


Figure 22 Removing the Dilution Probe Inlet Filter

5. Tighten the top nut while holding the bottom one stationary with the wrench.
6. Calibrate both 2020 and the dilution probe before continuing normal operation. See Section 4.5.4

6. Troubleshooting

6.1. General Information

If you have a service related question about 2020, consult this manual first. If you cannot find the answer in this documentation, contact the PE Photovac Service Department.

When you call, you should have your 2020 in front of you. You should also have this manual at hand. Lastly, please have the following information ready:

1. A description of what happened and what you were doing when the problem occurred.
2. Any corrective action that you have tried.
3. The exact wording of any messages that appeared on the display.

Warning: Do not service 2020 in a hazardous location.

6.2. Fault Messages

When the "Falt" status is displayed, 2020's operation is compromised.

Falt1: Signal from zero gas is too high.

Cause: If another fault occurred while 2020 was setting its zero point, then this fault is displayed.

Action: Ensure no faults are occurring and calibrate 2020 again.

Cause: Contamination of sample line, sample probe, inlet filter or fittings before the detector.

Action: Clean or replace the sample line, sample probe or the inlet filter. See Section 5.3.

Cause: Span gas and zero air are mixed up.

Action: Ensure clean air is used to zero 2020, If you are using gas bags, mark the calibration and zero gas bags clearly.

Cause: Ambient air is contaminated.

Action: If you are unsure about the quality of ambient air, use a supply of commercial zero grade air to zero 2020. See Section 3.1.3.

Falt2: Signal from span gas is too small.

Cause: Span gas and zero air mixed up.

Action: Ensure clean air is used to zero 2020. If you are using gas bags, mark the calibration and zero gas bags clearly.

Action: Ensure the span gas is of a reliable concentration.

Cause: UV lamp window is dirty.

Warning: Do not remove the UV lamp in a hazardous location.

Action: Clean the UV lamp window. See Section 5.2.2

Cause: UV lamp is failing.

Warning: Do not remove or replace the UV lamp in a hazardous location.

Action: Install a new UV lamp. See Section 5.2.1.

Cause: Incompatible application.

Action: The concentration and sample gas are incompatible for use with 2020.

Falt3: UV lamp fault. UV lamp has not started.

Cause: UV lamp has not started immediately.

Action: This fault may be seen momentarily when 2020 is first turned on. Allow 60 seconds for the UV lamp to start and the fault to clear.

Action: Turn 2020 off and then on again. Allow 60 seconds for the UV lamp to start and the fault to clear.

Cause: UV lamp serial number label is blocking the photocell.

Warning: Do not remove or replace the UV lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the label is blocking the photocell. Rotate the lamp approximately 90° and then try to start 2020 again. If the fault persists, replace the lamp.

Cause: UV lamp is not installed.

Warning: Do not remove or replace the UV lamp in a hazardous location.

Action: Install a UV lamp. See Section 5.2.1.

Cause: UV lamp has failed.

Warning: Do not remove or replace the UV lamp in a hazardous location.

Action: Install a new UV lamp. See Section 5.2.1.

Cause: Electronic problem.

Action: If a new UV lamp still generates this fault, then contact the PE Photovac Service Department.

Falt4: Pump current too low or too high.

Cause: If the pump sounds labored, then the pump is operating beyond normal operating parameters.

Action: Check for an obstruction in the sample line. Make sure the sample line, the sample probe and the inlet filter are not blocked.

Warning: Do not replace the inlet filter in a hazardous location.

Action: Replace the inlet filter. See Section 5.3.

Action: Ensure the sample outlet, located on the underside of 2020, is not obstructed.

Cause: UV lamp is too wide, causing flow to be restricted.

Warning: Do not remove or replace the UV lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too wide for the lampholder. Contact the PE Photovac Service Department.

Cause: 2020 has been exposed to a solvent that can pass through the inlet filter and liquid has been aspirated.

Action: Contact the PE Photovac Service Department.

Cause: The pump has failed.

Action: Contact PE Photovac Service Department.

6.3. Troubleshooting

Problem: Very low or no instrument response detected, yet compounds are known to be present.

Cause: 2020 has not been calibrated properly.

Action: Ensure the calibration gas is of a reliable concentration and then calibrate the instrument as outlined in Section 3.2 or 3.3.

After the instrument has been calibrated, sample the bag of calibration gas. A reading equivalent to the calibration gas should be displayed. If not, contact the PE Photovac Service Department.

Warning: Do not remove or recharge the battery pack in a hazardous location

Action: Disconnect the battery charger before calibrating 2020. Section 3.1 or 3.3 for calibration instructions.

Cause: Cal Memories have not been programmed correctly.

Action: Program all the Cal Memories you require for your application. You must use the correct calibration gas and concentration for each Cal Memory. See Section 3.4.

Cause: Response factor has been set to zero.

Action: Enter the correct response factor. Refer to Appendix 8.7 for a list of response factors. If the compound is not listed in Appendix 8.7 or you are measuring gas mixtures, then enter a value of 1.0.

Cause: You are not using the correct Cal Memory.

Action: Select the correct Cal Memory for your application. See Section 3.2.2 or 3.3.2.

Note: It does not matter which Cal Memory is selected or which response factor is entered. 2020's response is not specific to any one compound. The reading displayed represents the total concentration of all ionizable compounds in the sample.

Cause: Detector is leaking. A decrease in sensitivity may be due to a leak in the detector.

Warning: Do not remove or replace the UV lamp in a hazardous location.

Action: Ensure the UV lamp has been installed correctly. See Section 5.2.1.

Action: Ensure the lamp cover has been tightened down. Do not overtighten the cover.

Action: Ensure the o-ring seal on the lamp cover is positioned correctly. See Section 5.2.1.

Cause: UV lamp is too long, causing flow to be restricted.

Warning: Do not remove or replace the UV lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too long for the lampholder. Replace the lamp and contact the PE Photovac Service Department. See Section 5.2.1.

Cause: UV lamp is too wide, causing flow to be restricted.

Warning: Do not remove or replace the UV lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too wide for the lampholder. Contact the PE Photovac Service Department.

Cause: Sampling environment is extremely humid.

Action: Water vapor is not ionized by the PID, but it does scatter and absorb the light and results in a lower reading.

The 2020 detector has been designed to operate under high humidity conditions. Under extreme conditions you may notice decreased response due to humidity.

Cause: UV lamp is failing.

Warning: Do not remove or replace the UV lamp in a hazardous location.

Action: Install a new UV lamp. See Section 5.2.1.

Cause: High concentration of non-ionizable compounds.

Action: Chemical compounds, such as methane, with IPs greater than the 10.6 eV scatter and absorb the UV light. Sensitivity may be decreased significantly.

Application with high backgrounds of such materials, may be incompatible with 2020.

Contact the PE Photovac Applications Department for more information.

Problem: Erroneously high readings.

Cause: Sampling environment is extremely humid.

Action: Water vapor may contain mineral salts which carry a charge. The water vapor becomes an electrolytic solution which becomes ionized when it enters the detector.

Atmospheric water in areas around the sea or stagnant water may produce a response in the absence of contaminants. The same effect may be seen when conducting ground water investigations in areas where the water is hard because it contains a significant concentration of minerals.[1]

Cause: 2020 has not been calibrated properly.

Action: Ensure the calibration gas is of a reliable concentration and then calibrate the instrument as outlined in Section 3.1 or 3.3.

After the instrument has been calibrated, sample the bag of calibration gas. A reading equivalent to the calibration gas should be displayed. If not, contact the PE Photovac Service Department.

Cause: Cal Memories have not been programmed correctly.

Action: Program all the Cal Memories you require for your application. You must use the correct calibration gas and concentration for each Cal Memory. See Section 3.4.

Cause: You are not using the correct Cal Memory.

Action: Select the correct Cal Memory for your application. See Section 3.2.2 or 3.3.2.

Note: It does not matter which Cal Memory is selected or which response factor is entered. 2020's response is not specific to any one compound. The reading displayed represents the total concentration of all ionizable compounds in the sample.

Cause: Detector has been short circuited by foreign matter in the detector cell.

Warning: Do not service 2020 in a hazardous location.

Action: Do not touch the wire grid inside the detector cell. Use a gentle jet of compressed air to remove any dust or dirt in the detector cell.

Warning: Do not insert any object, other than the UV lamp, into the lampholder.

Cause: There is an undetermined problem.

Action: Contact the PE Photovac Service Department.

Problem: Date and time settings are not retained.

Cause: The battery pack has been removed before 2020 was turned off.

Warning: Do not remove or recharge the battery pack in a hazardous location

Action: Replace the battery pack and reset the time and date. Ensure 2020 has been turned off before removing the battery pack. See Section 1.5.1.

Cause: 2020 has not been used for 3 months or more and the internal battery (not the external battery pack) has discharged.

Warning: Do not remove or recharge the battery pack in a hazardous location

Action: Connect 2020 to the AC adapter and turn 2020 on. Turn the pump off. See Section 2.6.1. While 2020 is running the internal battery is charging. Leave the instrument running for approximately 24 hours.

Problem: Instrument status shows "Over".

Cause: High concentrations of gases and vapors will cause a rapid change in signal level. The detector and associated electronics may become temporarily saturated.

Action: Wait a few seconds for the status to return to normal. PIDs are designed to detect relatively low concentrations of gases and vapors. Exposure to very high concentrations may result in a very high or maximum response.

Cause: The detector has become saturated.

Action: Move 2020 to a location where it can sample clean air. Sample clean air until the reading stabilizes around 0.

Cause: Detector has been short circuited by foreign matter in the detector cell.

Warning: Do not service 2020 in a hazardous location.

Action: Do not touch the wire grid inside the detector cell. Use a gentle jet of compressed air to remove any dust or dirt in the detector cell.

Warning: Do not insert any object, other than the UV lamp, into the lampholder.

Cause: There is an undetermined problem.

Action: Contact the PE Photovac Service Department.

Problem: Display is blank.

Cause: Battery pack is critically low.

Warning: Do not remove or recharge the battery pack in a hazardous location

Action: Replace the battery pack or connect 2020 to the AC adapter.

Cause: The battery pack is not connected to the instrument correctly.

Action: Ensure the battery pack connector is securely attached to the connector on 2020. See Section 1.5.

Cause: There is an undetermined problem.

Action: Reset 2020. Turn the instrument on and disconnect the battery pack as outlined in Section 1.5.1. You must leave the instrument on while you disconnect the battery pack. This will reset the instrument. Reconnect the battery pack and close the battery hatch. Turn on 2020, set the time and date and program all the calibration memories that you are using.

Action: Contact the PE Photovac Service Department.

Problem: Sample flow rate is less than 300 ml/min.

Cause: Inlet filter is plugged.

Warning: Do not replace the inlet filter in a hazardous location.

Action: Replace inlet filter. See Section 5.3.

Cause: Inlet filter has not been installed properly.

Action: Ensure that the inlet filter has been installed correctly. See Section 5.3.

Cause: UV lamp is too long, causing flow to be restricted.

Warning: Do not remove or replace the UV lamp in a hazardous location.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too long for the lampholder. Replace the lamp and contact the PE Photovac Service Department. See Section 5.2.1.

Cause: UV lamp is too wide, causing flow to be restricted.

Action: If you have a UV lamp with a white serial number label, it is possible that the lamp is too wide for the lampholder. Contact the PE Photovac Service Department.

Cause: 2020 has been exposed to a solvent that can pass through the inlet filter and liquid has been aspirated.

Action: Contact the PE Photovac Service Department.

Cause: Sample outlet is obstructed.

Action: Ensure the sample outlet in not obstructed in any way.

Cause: Pump has been damaged.

Action: Contact the PE Photovac Service Department.

Problem: Liquid has been aspirated.

Cause: 2020 has been exposed to a solvent that can pass through the inlet filter.

Action: Contact the PE Photovac Service Department.

Problem: Corrosive gases and vapors have been sampled.

Cause: 2020 has been exposed to corrosive gases and vapors.

Action: Corrosive gases and vapors can affect the electrodes within the detector as well as the lamp window. Prolonged exposure to corrosive materials may result in permanent fogging or etching of the window. If 2020 is exposed to corrosive material, contact the PE Photovac Service Department.[1]

6.4. Printer Troubleshooting

Note: 2020 is not classified for use in hazardous locations with a printer.

Problem: Printer will not print.

Cause: Printer is not connected properly.

Action: Ensure that you have the correct cable for your instrument. The printer cable must be properly connected. If you are using the serial to parallel converter, ensure the cables are connected to the converter, to the instrument and to the printer.

Note: Turn the converter and 2020 off before connecting the cables.

Cause: Mechanical problem with the printer.

Action: Make sure that the printer is plugged in and turned on.

Action: Make sure that the printer is on-line, as shown on its control panel.

Action: Check the ribbon, the print wheel or cartridge, and the paper supply.

Cause: Printer cable is not configured correctly.

Action: In order to modify the existing printer cable, the pinout information for the printer connector is required. Refer to the printer user's manual for specific details.

The pinouts for the 2020 printer cable are shown in Figure 23. If modifying the cable is not possible, take the electrical and pinout information to a computer store where a suitable adapter may be obtained.

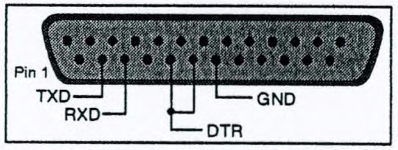


Figure 23 Printer Cable Configuration

Cause: Printer is not configured properly.

Action: Many printers have a set of configuration (DIP) switches. Generally, PE Photovac instruments expect these switches to be set in the factory default settings.

Many printers have switches for enabling automatic line feeds when receiving a carriage return. These switches should be set to carriage returns only, which is normally the factory default setting.

Some printers have switches or control panels that enable you to set the printer for different modes, such as sans serif, letter quality, or compressed text. Do not use these controls. If you do use them, you may cause your tabular or graphed output to be printed incorrectly.

Problem: Data are printed or downloaded correctly at first but become garbled.

Cause: Baud rate may be set too high.

Action: Ensure the baud rate of the printer is set to 9600.

6.5. Serial to Parallel Converter Troubleshooting

Problem: Data are printed correctly at first but become garbled.

Cause: Baud rate may be set too high.

Action: Ensure the baud rate of the printer and the serial to parallel converter are set to 9600 baud.

Cause: Baud rate is not set correctly.

Action: Ensure the baud rate of the printer and the serial to parallel converter are set to the same value.

Problem: Printer will not print.

Cause: Problem with the printer.

Action. Refer to the corrective action in Section 6.4.

Cause: Serial card is installed in the printer.

Action: If a serial card is installed in your printer, you do not need the serial to parallel converter. Disconnect the converter and connect the instrument directly to the printer.

Cause: The serial to parallel converter is not turned on.

Action: Ensure the serial to parallel converter is connected to the AC adapter and the adapter is plugged into an AC outlet. The red LED on the top of the converter will be on. See Figure 16.

Cause: Cables are not configured correctly.

Action: You must use the correct type of cable to ensure trouble free data transmission. The length of the cable at the parallel side must not exceed 15 feet. On the serial side, use only the 2020 printer cable and suitable adapter.

When you are connecting the parallel side of the converter to a Centronics 36 pin, female connector, use a straight wired cable with 36 conductors and a Centronics 36 pin, male connector at each end. This cable is supplied with the converter.

When you are connecting the parallel side of the converter to a Centronics 36 pin, male connector, use a straight wired cable with 36 conductors and a Centronics 36 pin, female connector at one end and a Centronics 36 pin, male connector at the other end.

If you are connecting the parallel side of the converter to a female DB-25 pin connector use a straight wired cable with a DB-25 pin, male connector on one end and a 36 pin, Centronics, male connector on the other end. The pin assignments for all parallel port signals are listed in Table 8.

Pin #	Name	I/O Parallel to Serial	I/O Serial to Parallel
1	/Strobe	In	Out
2-9	Data0-7	In	Out
10	/Acknlg	Out	Not Used
11	Busy	Out	—
12	PE	Pull Low	Pull High
13	Select	Pull High	Pull Low
14	/Auto FF	Not Used	Not Used
15	NC	Not Used	Not Used
16	Ground	—	—
17	NC	Not Used	Not Used
18	NC	Not Used	Not Used
19-30	Ground	—	—
31	/Init	Not Used	Out
32	/Error	Pull High	Pull High
33	Ground	—	—
34	NC	Not Used	Not Used
35	NC	Not Used	Not Used
36	/Slct In	Not Used	Not Used

Table 8 Serial to Parallel Converter Parallel Port Signal

The pin assignments for all serial port signals are listed below.

Pin #	Name	I/O Parallel to Serial	I/O Serial to Parallel
1	Frame Ground	—	—
2	TXD	Out	Out
3	RXD	In	In
6	DSR	In	—
7	GND	—	—
20	DTR	—	Out

Table 9 Serial to Parallel Converter Serial Port Signals

> **Note:** A DB-25, female connector is sometimes a parallel port. Do not connect the serial port of the converter to a parallel port.

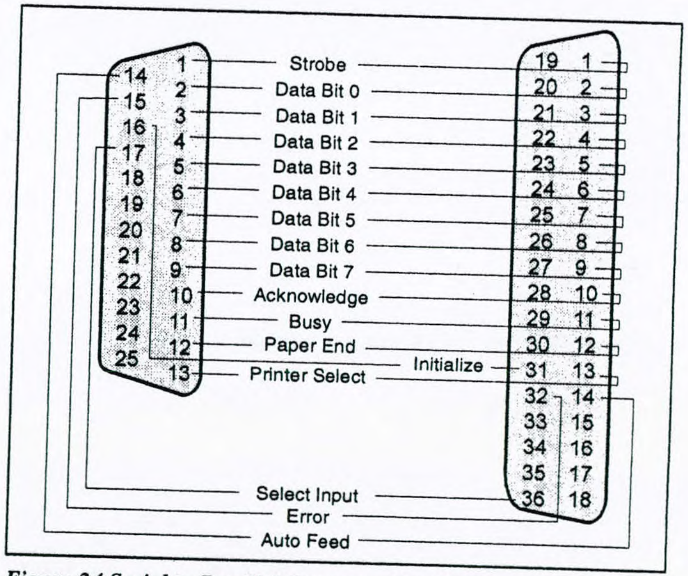


Figure 24 Serial to Parallel Converter Parallel Port Signals

6.6. Establishing Computer Communications

If, after having followed the procedure in Section 4.2, communications cannot be established with a computer, the problem may lie with the hardware connections or the printer cable configuration.

1. Ensure 2020 is connected to the serial port of the computer.

   The serial port will usually be a male connector, typically 9 pins on an IBM-AT® and compatibles and 25 pins on an IBM-XT® and compatibles. The 25 (or more) pin female connector is usually a parallel port. An exception to this rule is Tandy® Computers, which use a female 25 pin connector for the serial port. 2020 cannot be connected to a parallel port unless you are using the serial to parallel converter. (Part No. 380145)

   If you do not have a free serial port on you computer and you want to connect 2020 to the parallel port, you will need the serial to parallel converter. Connect 2020 to the serial port on the converter and then connect the computer to the parallel port. If the port on the computer is anything other than a female, 36 pin Centronics connector you will need an adapter in order to use the cable supplied with the converter. See Section 6.5 for more details.

2. Ensure the cable being used is compatible with the device.

   An IBM-AT and compatibles with a 9 pin serial connector will first require a null modem to switch pins 2 and 3. Next a gender changer that converts the male DB-25 connector on the printer cable from male 25 pins to female 9 pins is required. These two adapters have been combined into one, which is supplied in the 2020 cable kit. See Figure 25.

   An IBM-XT and compatibles should not require a null modem but will require a gender changer. A gender changer will convert the male DB-25 connector on the printer cable to a female connector. A gender changer is supplied with the 2020 printer kit. See Figure 26.

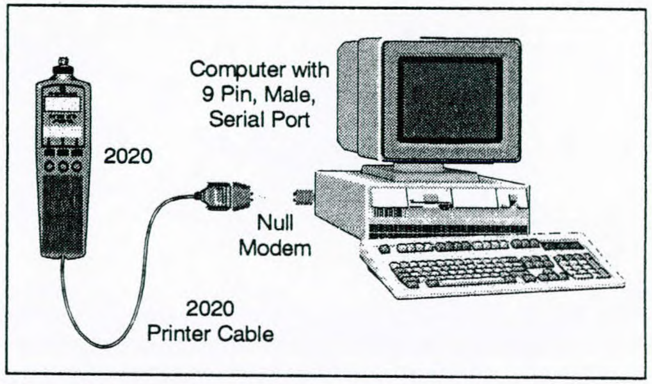


Figure 25 Connecting 2020 Using the Null Modem Cable

The pin definitions of interest are listed in Table 10. Only pins 2 and 3 are shown since these are the problem pins:

Pin #	2020	IBM-AT	IBM-XT
2	RXD	RXD	TXD
3	TXD	TXD	RXD

Table 10 Serial Port Pin Definitions

Pins 2 and 3 should be mismatched between 2020 and the computer. Ensure this is the case. It is also possible that the cable being used may switch pins 2 and 3, even if it is not necessary. The cable may be a null modem. IBM-XT cables are usually null modems, since a null modem is required for connection to a printer.

If you are using an IBM-AT and find that a null modem is not required it is possible that an IBM-XT serial port has been added to an expansion slot and thus does not require a null modem. The opposite may be the case if an IBM-AT serial port was added to an IBM-XT expansion slot, in which case the null modem is required.

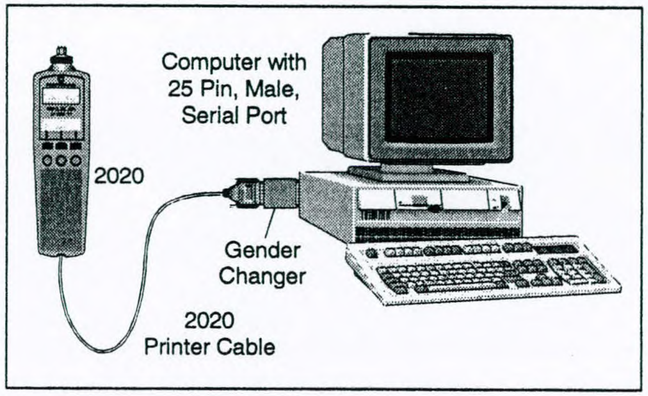


Figure 26 Connecting 2020 Using the Gender Changer

3. Ensure all hardware is working properly.

   Use a printer to test both 2020 and the computer. Connect 2020 to the printer and ensure that this arrangement produces the desired results. If the correct printout is obtained, then the 2020 and the printer cable are okay.

   Now connect the computer to the printer and ensure this works. If the desired printout is obtained this ensures the computer parts are handling data correctly.

7. Technical Description

7.1. General Operation

2020 is a microprocessor controlled air monitor for measuring the presence of photoionizable chemicals in air at parts-per-million levels. The block diagram in Figure 27 shows the main components of 2020.

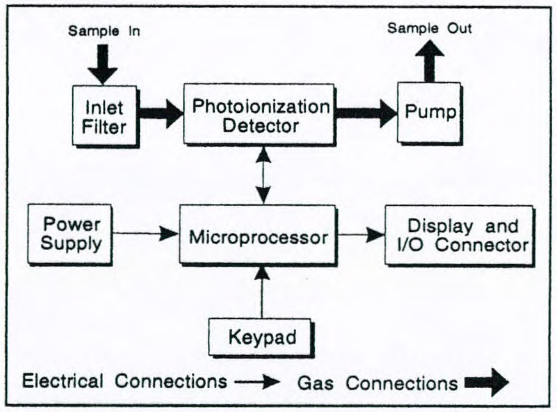


Figure 27 2020 Block Diagram

The microprocessor controls the components of the instrument and interprets and records the signal generated by the photoionization detector (PID). Recorded data and setup information entered into the microprocessor's memory are retained when 2020 is turned off.

A pump continuously pulls the air under test through 2020's PID. The PID converts the concentration of photoionizable chemicals in the sample into an electrical signal. The microprocessor subtracts any background from the signal and divides this signal by a sensitivity obtained by calibrating with a standard gas of known concentration. This concentration appears on 2020's display and, depending on the values entered through 2020's keypad, an alarm status may be displayed and an audio signal may be heard.

2020 can detect thousands of different types of airborne gases and vapors and its response depends on the type as well as the concentration. 2020 does not distinguish one type of chemical from another, but displays a number indicating the total concentration of all photoionizable compounds in the sample.

A standard of isobutylene at a known concentration may be used for setting the sensitivity. If 2020 is calibrated with isobutylene, it displays concentrations in units equivalent to ppm of isobutylene. If isobutylene were the only photoionizable chemical in the sample, then 2020 would display its concentration directly.

2020 responds more or less readily to other chemicals than it does to isobutylene. Because it has a medium sensitivity to isobutylene, this gas has been chosen as a reliable means of reporting an average concentration of total ionizables present.

For special applications, gases other than isobutylene can be used to calibrate 2020.

7.2. Photoionization Detector

2020's PID is shown in Figure 28. The PID measures the concentration of photoionizable chemicals in the gas stream from the sample inlet and produces an electrical signal for the microprocessor.

A UV lamp generates photons which ionize specific molecules in the gas stream. The permanent air gases (argon, carbon dioxide, nitrogen, oxygen, water vapor etc.) require a relatively high energy for ionization, and are not ionized by the UV photons. Many of the chemicals considered pollutants, including most hydrocarbons, are ionized.

The gas stream is directed into the PID through a small port at the center of the UV lamp window and through a series of larger ports around the perimeter of the lamp window. This arrangement permits a high sample flow rate and short response.

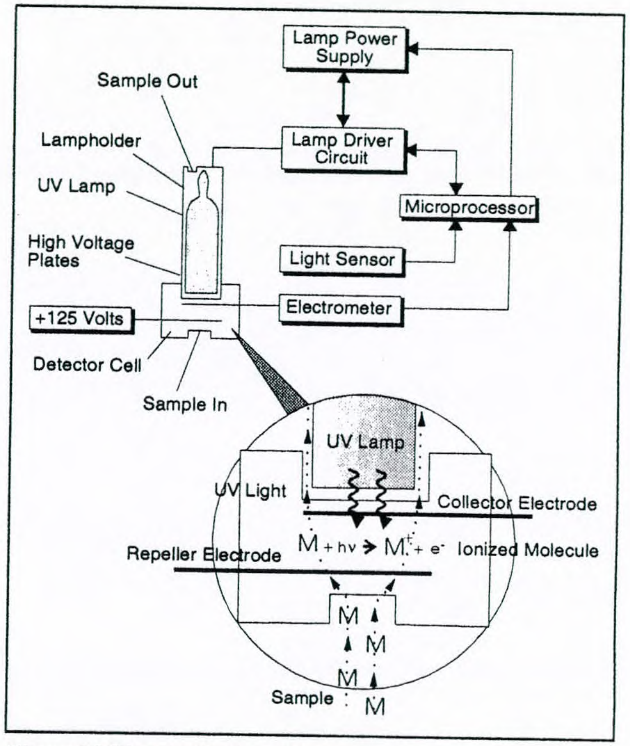


Figure 28 Photoionization Detector

The ionized molecules in the detector cell are subjected to a continuous electric field between the repeller electrode and the collector electrode. The ions move in the electric field, generating a current which is proportional to the concentration of the ionized molecules in the detector cell. An electrometer circuit converts the current to a voltage which is then fed to the microprocessor.

The UV lamp is operated by a high voltage lamp driver circuit which delivers high voltage energy to the lamp through plates in the lampholder. The lamp driver power supply is controlled by the microprocessor based on a feedback signal from a light sensor on the driver circuit board.

7.3. Calibration

Periodic calibration is required to compensate for 2020 output changes due to inlet filter restriction, ionization chamber cleanliness, pump wear and other factors.

During calibration, 2020 is first exposed to zero air. A small signal is generated. This zero signal is stored by the microprocessor.

2020 is next exposed to span gas. This span gas signal is stored by the microprocessor. The microprocessor subtracts the zero signal from the span gas signal and divides the difference by the user-entered span gas concentration. The resulting sensitivity is stored in the selected Cal Memory with the zero signal and the alarm levels. This number is then multiplied by the response factor and displayed.

2020 readings are always relative to the calibration gas. After calibration with isobutylene, 2020 will respond directly in units equivalent to isobutylene. Most volatile organic compounds will be detected by 2020. It cannot distinguish between isobutylene and other ionizable compounds. A reading of 10 ppm indicates all ionizable compounds that are present have generated an ion current proportional to 10 ppm of isobutylene. The reading is actually 10 ppm isobutylene equivalent units. 2020 readings give an indication of the total ionizables present and their concentration relative to the calibration gas.

7.4. Datalogger

7.4.1. Interval Operation

The microprocessor accumulates all readings in an averaging interval, that you select, and determines the minimum, average and maximum readings. It stores these numbers along with the highest priority instrument status and the most recent time and date. The datalogger can store 1000 of these entries.

These recorded data can now be reviewed and edited. Recorded data can also be printed as either a table or a graph. For each averaging interval, 2020 prints the minimum of all the minima, the average of all the readings for the interval and the maximum of all the maxima.

In PEAK mode, the reading is updated once a second. In the background, the 2020 datalogger is sampling the concentration and measuring min, max, and average concentrations for the selected averaging interval. At the end of every interval, one entry is placed in the datalogger until the datalogger is full.

The MAX mode displays the maximum signal, with the date and time that it was recorded. 2020 continues to log data according to the selected averaging interval, but only the maximum detected concentration is displayed on the meter display.

In STEL mode, 15 samples are combined to form a 15 minute average. Once every minute, the oldest of the 15 samples is replaced with a new one minute average. This moving average provides a 15 minute average with a one minute update rate so the meter display will only update once every minute. STEL is set to zero each time the instrument is turned on.

STEL calculations are always being performed by 2020. You can display the results of the calculations by selecting STEL as the Display mode

TWA mode sums concentrations every second until 8 hours of data have been accumulated. Once 8 hours of data have been summed, the accumulation stops.

This sum will only be complete after 8 hours, so the meter displays the current sum divided by 8 hours. While you are in TWA mode, the time on the status display will show the number of minutes and hours of data that TWA has accumulated. When this reaches 8 hours, 2020 stops accumulating data and the TWA is complete.

TWA calculations are always being performed by 2020. You can display the results of the calculations by selecting TWA as the Display mode.

7.4.2. Manual Mode

In manual operation you are prompted to locate a specific sampling site and then record both a background and a sample entry in the datalogger. 2020 stores these numbers along with the highest priority instrument status and the most recent time and date.

Recorded data can also be printed as either a table or a graph. The difference between the sample and background is calculated and shown on the printed output.

8. Appendices

8.1. Specifications

Size:	25.4 cm (10") long, 7.6 cm (3") wide, 5 cm (2") high
Weight:	0.8 kgs (1.75 lbs)
Detector:	Instant on photoionization detector with standard 10.6 eV UV lamp.
Keypad:	6 silicone keys with tactile feedback
Status Display:	2-line, 16-character dot-matrix, backlit, liquid crystal display for alphanumeric readouts and soft key display.
Meter Display:	4 digit, 7 segment display for real time concentration readout.
Datalogger memory:	16 kilobytes or 1000 entries
Serial output:	RS-232, 9600 baud, 8 data bits with no parity, for tabular and graphic printouts and connection to an IBM compatible computer
Audio output:	95 decibels @ 2048 Hz, on Alarm
Inlet connection:	1/8" compression fitting

Battery type:	Nickel cadmium rechargeable cell with intelligent charger. The battery pack is 24% cadmium (Cd) by weight.
Charge/discharge time:	4 hr/8 hr
Battery charger:	Automatically charges and maintains full charge in battery pack
Materials in sample stream:	Stainless steel, Teflon®, Viton®, polypropylene, nitrile chorobutadiene rubber, nickel
Inlet filter:	Replaceable Teflon/Polypropylene, 1 um
Inlet flow rate:	Greater than 300 mL/min.
Operating temperature range:	0 to 40°C (32 to 105°F)
Operating humidity range:	0 to 100% relative humidity (non-condensing)
Operating concentration range:	0.5 to 2000 ppm, isobutylene
Accuracy:	+/-10% or +/-2 ppm, whichever is greater
Precision:	1% of calibration (calibrated with 100 ppm isobutylene)
Response time:	Less than 3 seconds to 90%
Detection limit:	0.5 ppm isobutylene
Dilution probe:	Normal calibration: concentrations between 100 to 20000 ppm +/- 20% High accuracy calibration: concentrations between 100 to 1000 ppm +/- 15%. Concentrations between 1000 to 20000 ppm +/- 20%

Note: Specifications subject to change without notice.

8.2. Warranty

2020 is warranted for one year against defects in materials and workmanship.

PE Photovac warrants that its manufactured product will be free from defects in materials and workmanship for a period of one (1) year from the date of receipt by the Customer. This may be voided if, in the opinion of PE Photovac, the product has been abused or treated in a negligent manner so as to cause damage or failure. Negligent use includes, but is not limited to, exposure of the internal parts of the equipment to water. Damage caused thereby is expressly excluded from this Warranty.

Consumable supplies and parts routinely replaced are not warranted.

PE Photovac and its vendors disclaim any implied warranty of merchantability or fitness for a particular purpose. PE Photovac and its vendors will not be liable for any indirect, special, incidental, or consequential damages, irrespective of whether PE Photovac or the vendor has advance notice of the possibility of such damages.

PE Photovac's sole liability under this warranty is limited to the repair or replacement of the product at its Service/Repair facility and return to the Customer.

When PE Photovac is made aware of a problem that would be eligible for remedy under Warranty, it will issue a Return Authorization Number to the Customer. No return will be accepted unless such authorization has been obtained. The customer is responsible for insurance and shipping to the designated PE Photovac Service/Repair facility.

8.3. Contacting PE Photovac

To place an order, check the status of an order, obtain current pricing and availability	1-800-231-9918
Service and repair of your instrument	(203)761-5330
Applications Department	Tel.: (203)761-5330 Fax.: (203)761-2677

Table 11 PE Photovac Contact Information

Customer Service	Tel.: (905)477-8088 Fax.: (905)477-8220
In the USA	The Perkin-Elmer Corporation Photovac Monitoring Instruments 761 Main Avenue Norwalk, CT 06859-0211 Tel.: (203)761-5330 Fax.: (203)761-2677
In Canada	PE Photovac 330 Cochrane Drive Markham, Ontario, L3R 8E5 Tel.: (905)477-8088 Fax.: (905)477-8220
In Europe	Photovac Europa Sjaelsoe Allé 7 A P.O. Box 79 DK-3450 Allerod, Denmark Tel.: +45-48-100-400 Fax.: +45-48-100-401
In all other areas contact your PE Photovac representative.	

Table 11 PE Photovac Contact Information - continued

8.4. Installing Alternate AC Plug on the Battery Charger

In most cases 2020 will be shipped with an AC line cord that will fit the AC wall outlet in your area. If this cannot be done, you may need to obtain an AC line cord suitable for the AC receptacle in your area.

The AC line cord, attached plug and receptacle must be marked with your country's certification mark and the cord must have a Harmonization (HAR) mark.

The line cord must be rated for either 100 to 120 VAC at 60 Hz or 220 to 240 VAC at 50 Hz. The voltage rating will depend on the voltage in your area.

Contact your PE Photovac representative to obtain more information.

8.5. Calibration Gas Supplier

The recommended span gas is isobutylene in air. 100 ppm isobutylene in air may be obtained from PE Photovac. (Part No. 350012 for Flow Match regulator, 395066 for gas bag calibration).

The exact concentration will be determined by your application. Other concentrations and other gases may be obtained from Scott Specialty Gases Inc. When ordering, specify a Scotty® V or Mini-Mix™ Cylinder.

Scott Specialty Gases Inc.
1290 Combermere Street
Troy, Michigan 48083

Telephone (within the USA): 1-800-774-9447
Telephone (outside USA): 1-810-589-2950
Fax: 1-810-589-2134

8.6. Using the Gas Bag

1. Turn the knurled plastic knob counterclockwise to unlock it. Use the knurled collar on the valve tube to gently push the valve tube down, toward the bag.
2. Turn the knurled plastic knob clockwise to lock the valve tube in place.
3. Turn the regulator knob counterclockwise about half a turn to start the flow of gas. Fill the gas bag about half full and then close the regulator.
4. Open the syringe port and empty the bag. Flush the bag a few times with the calibration gas and then fill it.
5. To close the gas bag valve, turn the knurled plastic knob counterclockwise to unlock it. Gently pull the valve tube up to close the valve. Turn the knurled plastic knob clockwise to tighten it against the valve tube.

Once the bag has been filled, use the bag and sample as soon as possible.

Note: Do not use gas bags to sample unstable or highly reactive compounds. Do not use Tedlar® bags for storage of hazardous materials.

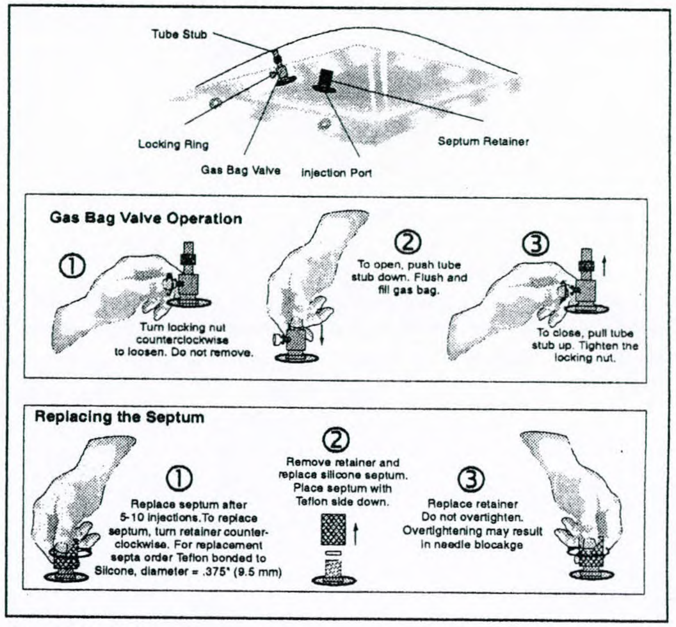


Figure 29 Using the Gas Bag

8.7. Response Factors

The response factors were determined over the range 5 - 500 ppm, based on a 100 ppm isobutylene calibration. Isobutylene RF = 1.0. The following formula was used for calculation of response factors:

$$\text{Response Factor} = \frac{\text{Actual Concentration}}{\text{2020 Response}}$$

A response factor less than 1.0 indicates a compound response better than that of isobutylene. A response factor greater than 1.0 indicates a lower response than that of isobutylene.

Note: It does not matter which Cal Memory is selected or which response factor is entered. 2020's response is not specific to any one compound. The reading displayed represents the total concentration of all ionizable compounds in the sample.

When using response factors, results are expected to be accurate to +/- 10 ppm or +/- 25%, whichever is greater.

Compound	Response Factor
Acetaldehyde	10.5
Acetone	1.2
Acrolein (2-Propenal)	4.0
Allyl Chloride (3-Chloro-1-Propene)	3.9
Benzene	0.5
Bromoform (Tribromomethane)	2.0
1,3-Butadiene	0.7
n-Butanol	3.4
n-Butyl Acetate	2.3
n-Butyl Acrylate	1.8
n-Butyl Mercaptan (Butanethiol)	0.6
Carbon Disulfide	1.3
Chlorobenzene	0.4
Crotonaldehyde (2-Butenal)	1.2
Cumene (Isopropylbenzene)	0.6
Cyclohexane	1.3
Cyclohexanone	0.9
1,2-Dichlorobenzene (ortho-)	0.5
cis-1,2-Dichloroethylene	0.8
trans-1,2-Dichloroethylene	0.4
N,N-Dimethylformamide (DMF)	0.8
1,4-Dioxane	1.3
Epichlorohydrin	6.5
Ethanol	8.8
Ethyl Acetate	3.8
Ethyl Acrylate	2.3
Ethylbenzene	0.5
Ethyl Cellosolve (2-Ethoxyethanol)	1.3
Ethyl Ether (Diethyl Ether)	1.2
Ethyl Mercaptan (Ethanethiol)	0.6
Ethylene	10.1
n-Heptane	2.4
n-Hexane	4.7
Hydrogen Sulfide	3.3
Isoamyl Acetate	1.8
Isobutyl Acetate	2.6

Table 12 Response Factors

Isobutyraldehyde	1.1
Isopentane	8.2
Isoprene (2-Methyl-1,3-Butadiene)	0.6
Isopropanol	4.4
Isopropyl Acetate	2.6
Isopropyl Ether	0.8
Methyl Bromide (Bromomethane)	1.6
Methyl Ethyl Ketone (2-Butanone)	0.8
Methyl Isobutyl Ketone	1.0
Methyl Mercaptan	0.5
Methyl Methacrylate	1.4
Methyl tert-Butyl Ether (MTBE)	0.8
Monomethylamine	1.3
n-Nonane	1.4
iso-Octane (2,2,4-Trimethylpentane)	1.2
n-Pentane	10.4
n-Propanol	5.1
Propionaldehyde (Propanal)	14.8
n-Propyl Acetate	3.1
Propylene	1.2
Propylene Oxide	5.8
Styrene	0.4
Tetrachloroethylene (Perchloroethylene)	0.5
Tetrahydrofuran	1.5
Toluene	0.5
Trichloroethylene (TCE)	0.5
Trimethylamine	0.9
Vinyl Acetate	1.2
Vinyl Bromide	0.4
Vinyl Chloride (Chloroethylene)	1.7
Vinylidene Chloride (1,1-DCE)	0.8
meta -Xylene	0.5
ortho -Xylene	0.5
para-Xylene	0.5

Table 12 Response Factors - continued

8.8. Library Entries

Library selections simplify Cal Memory programming, and provide standard response factors and alarm levels for approximately 70 applications. The name, response factor and three alarm levels are all set from the library.

You can change any of the values entered in the Cal Memory. Changes, made to the library information that has been loaded into a Cal Memory, will have no effect on the original library entry.

Note: It does not matter which library or Cal Memory is selected or which response factor is entered. 2020's response is not specific to any one compound. The displayed reading represents the total concentration of all ionizable compounds in the sample.

See Section 2.6.4 for details on using libraries to program the Cal memories.

Compound	Code	RF
Acetaldehyde	ACETAL	**10.5**
Acetone	ACETONE	**1.2**
Acrolein (2-Propenal)[3]	ACROLEIN	**4.0**
Allyl Chloride (3-Chloro-1-Propene)[3]	ALLCHLOR	**3.9**
Benzene	BENZENE	**0.5**
Bromoform (Tribromomethane)[3]	BROMFORM	**2.0**
1,3-Butadiene	13BUTADI	**0.7**
n-Butanol	nBUTANOL	**3.4**
n-Butyl Acetate	nBUTACET	**2.3**
n-Butyl Acrylate	nBUTACRY	**1.8**
n-Butyl Mercaptan (Butanethiol)[4]	nBUTMERC	**0.6**
Carbon Disulfide	CS2	**1.3**
Chlorobenzene	CHLOBENZ	**0.4**
Crotonaldehyde (2-Butenal)	CROTONAL	**1.2**
Cumene (Isopropylbenzene)	CUMENE	**0.6**
Cyclohexane	CYCHEXAN	**1.3**
Cyclohexanone	CYCHEXON	**0.9**
1,2-Dichlorobenzene (ortho-)	12DCBENZ	**0.5**
cis-1,2-Dichloroethylene	cis12DCE	**0.8**
trans-1,2-Dichloroethylene	trn12DCE	**0.4**

Table 13 Library Entries

N,N-Dimethylformamide (DMF)	N,N-DMF	**0.8**
1,4-Dioxane	DIOXANE	**1.3**
Epichlorohydrin[3]	EPICLHYD	**6.5**
Ethanol	ETHANOL	**8.8**
Ethyl Acetate	ETHYACET	**3.8**
Ethyl Acrylate	ETHYACRY	**2.3**
Ethylbenzene	ETBENZEN	**0.5**
Ethyl Cellosolve (2-Ethoxyethanol)	ETHCELLO	**1.3**
Ethyl Ether (Diethyl Ether)	ETHETHER	**1.2**
Ethyl Mercaptan (Ethanethiol)[4]	ETHMERC	**0.6**
Ethylene[5]	ETHYLENE	**10.1**
n-Heptane	nHEPTANE	**2.4**
n-Hexane	nHEXANE	**4.7**
Hydrogen Sulfide	H2S	**3.3**
Isoamyl Acetate	IAMYACET	**1.8**
Isobutyl Acetate	IBUTACET	**2.6**
Isobutyraldehyde[6]	IBUTALDE	**1.1**
Isopentane	IPENTANE	**8.2**
Isoprene (2-Methyl-1,3-Butadiene)[6]	ISOPRENE	**0.6**
Isopropanol	IPA	**4.4**
Isopropyl Acetate	IPACETAT	**2.6**
Isopropyl Ether	IPROPETH	**0.8**
Methyl Bromide (Bromomethane)	MeBROM	**1.6**
Methyl Ethyl Ketone	MEK	**0.8**
Methyl Isobutyl Ketone	MIBK	**1.0**
Methyl Mercaptan (Methanethiol)[4]	METHMERC	**0.5**
Methyl Methacrylate	MeMeACRY	**1.4**
Methyl tert-Butyl Ether (MTBE)	MTBE	**0.8**
Monomethylamine	MMeAMINE	**1.3**
n-Nonane	nNONANE	**1.4**
iso-Octane (2,2,4-Trimethylpentane)	IOCTANE	**1.2**
n-Pentane	nPENTANE	**10.4**
n-Propanol	nPA	**5.1**
Propionaldehyde (Propanal)[3]	PROPANAL	**14.8**
n-Propyl Acetate	nPROACET	**3.1**

Table 13 Library Entries - continued

Propylene [5]	PROPYLEN	**1.2**
Propylene Oxide	PROPOXID	**5.8**
Styrene	STYRENE	**0.4**
Tetrachloroethylene (PCE)	PCE	**0.5**
Tetrahydrofuran	THF	**1.5**
Toluene	TOLUENE	**0.5**
Trichloroethylene	TCE	**0.5**
Trimethylamine	TRMeAMIN	**0.9**
Vinyl Acetate	VINACET	**1.2**
Vinyl Bromide	VINBROM	**0.4**
Vinyl Chloride (Chloroethylene)	VINCHLOR	**1.7**
Vinylidene Chloride (1,1-DCE)	1,1-DCE	**0.8**
meta-Xylene	mXYLENE	**0.5**
ortho-Xylene	oXYLENE	**0.5**
para-Xylene	pXYLENE	**0.5**

Table 13 Library Entries - continued

Notes

1 Peak alarm levels have been established as the TLV-Ceiling concentration, or the TLV-STEL concentration in those cases where no TLV-Ceiling value exists.

2 In cases where no STEL exists for a compound, the STEL value has been established as equivalent to the TWA value.

3 In cases where recommended exposure limits are below the detection limit for the compound in question, the estimated lower limit of detection has been substituted for those values.

4 2020 is not suitable for monitoring these compounds at ACGIH recommended levels.

5 A 1000 ppm TWA has been established for those compounds which are "Simple Asphyxiants", and for which no exposure value exists.

6 For those compounds which lack established exposure levels, an arbitrary value of 200 ppm has been established for the TWA, STEL and PEAK alarms.

8.9. References

1. Maslansky, Carol J. and Steven P. Maslansky. *Air Monitoring Instrumentation.* New York: Van Nostrand Reinhold, 1993
2. American Conference of Governmental Industrial Hygienists. *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices (1994-1995).* Reprinted with permission

Note: The TLV/BEI™ publication is revised annually.

3. Scott Specialty Gases, Catalog, 1994
4. National Institute for Occupational Safety and Health (NIOSH). *Recommendations for Occupational Safety and Health, Compendium of Policy Documents and Statements*, January 1992.

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Heron

H.2OL and Dipper-T Water Level Meters

Operating/Maintenance Instructions
& Warranty

Response Rentals
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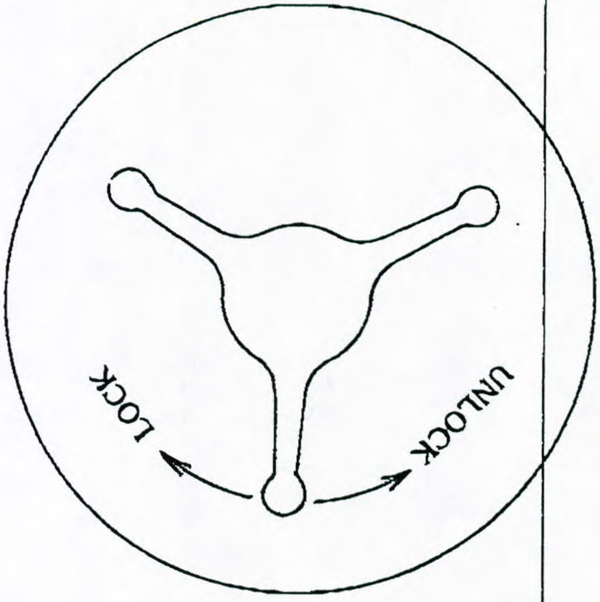
HERON
INSTRUMENTS
Groundwater Monitoring INC.

Unlock the instrument completely to release for use.



Warranty

Heron Instruments Inc warrants all parts to be free from defects in material and workmanship affecting serviceability of the product for a period of 12 months following invoice date.

Heron Instruments Inc further warrants all parts excluding labour and shipping charges for a further 108 months. (H2OL only)

Note:
Customer shall notify Heron Instruments Inc prior to returning product under above warranty.

Heron Instruments Inc shall in its sole discretion decide if parts are defective and are covered by the limited warranty herein.

Heron Instruments Inc reserves the right to substitute such parts as it considers appropriate from current models.

Heron Instruments Inc will not be responsible or liable for consequential damages caused by instrument failure for any reason whatsoever.

The warranty herein will not apply to products used as rental equipment or to products contaminated by materials which are hazardous to such products as outlined in the product information supplied.

The warranty herein will not extend to tape, bag or batteries used with the product.

The warranty will not extend to parts failure due to neglect in cleaning or servicing the product; nor will it extend to failure of parts caused by misuse or inappropriate use of the product.

General

Avoid sharp edged casing

Avoid entanglement with other equipment in boreholes and wells.

Do not use to plumb borehole depths

Do not use as guide to backfilling with sand etc. Instrument may get locked in sand.

Rewind tape onto reel after each use

Warranty is conditional upon adherence to these guide lines.

Maintenance continued inside

* IMPORTANT *
Ensure that the Panel Securing Nuts are tight before use.

Equipment Check

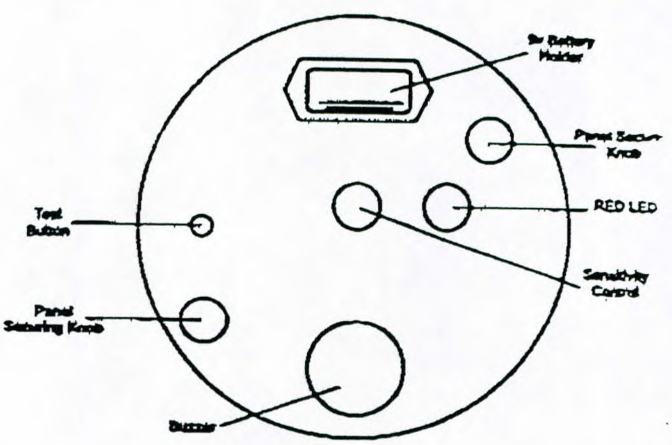
1. Test circuit and battery by pressing the test button. If the unit does not sound, adjust the sensitivity knob on the faceplate and make sure the panel securing knobs are tight (see diagram). If the unit still does not sound, replace the battery (one 9 volt) in the drawer on the faceplate and repeat the tests.
2. Test tape and probe by shorting out the centre conductor and probe body on the pin on the back axle of the unit while touching the white band on the probe with a moistened finger. The buzzer and light should activate; if not, adjust the sensitivity and repeat.
3. Test the unit in tap water before going out to the field. DO NOT use distilled or deionized water.

Use in the Field

1. Reel the tape down the well carefully, avoiding the edge of the casing. Hang the unit on the casing where possible and run the tape over the frame leg to avoid cuts and nicks.
2. When the unit sounds, carefully measure the depth to water from your reference point by slowly lowering and raising the probe to the air/water interface. Raise the probe, shake off the water and repeat the measurement. In wells with cascading water, reduce the sensitivity by turning down the sensitivity knob (anti-clockwise) to minimize false signals.
3. The probe is rated to full depth and can be used to measure depth to bottom. Reel the tape until the probe touches bottom and the tape becomes slack. DO NOT let the probe fall under gravity or it will be damaged when it hits the bottom of the well. DO NOT use the unit to measure sand backfill as the tape and probe may get "locked" in the backfill.
4. Wind the tape back onto the reel, removing any excess moisture and dirt.

Cleaning the Meters

1. Always the clean the meters after use in the field to maintain optimal performance and extend the life of the unit.
2. Unwind the tape and probe and wash with a mild detergent. Rinse well, wipe and rewind onto the reel. The tape and probe can be cleaned and degreased with the following: soap solution, naptha alcanox 10%, Joy detergent 10%, Lestoil; methyl, isopropyl and isobutyl alcohols; hexane, heptane and fully halogenated freon. Rinse thoroughly with water afterwards.



3. Wash reel if necessary. The central electronic panel can be removed and the reel washed down. Unthread the panel securing knobs and carefully pull out the central panel. Disconnect the panel from the tape. The reel may be cleaned with the following: soap solution, naptha alcanox 10%, Fantastic, Windex, Joy, Top Job, Mr. Clean, Formula 409; hexane, heptane, white kerosene, mineral spirits; methyl, isopropyl, isobutyl and 1 + 3 denatured alcohols; freons TF + TE. Rinse well with water and let dry before putting the panel back in. DO NOT use abrasives, partially halogenated hydrocarbons or ketones to clean the reel.

Trouble Shooting

No Sound when the unit is tested

1. Check battery and circuit board by pressing test button. Replace battery if low and make sure panel securing knobs are tight. If unit still does not sound, remove black central panel and check all connections.
2. Repeat step 2 of equipment check. Check probe conductor to make sure it is clean and not crusted with mineral deposits. Check tape/probe connection for any breaks.

Continuous Sound when the unit is turned on or probe removed from water.

1. Make sure probe conductor tip is clean.
2. Check for excess moisture on the back of the electronic panel and check the test button.
3. Check probe/tape connection and tape for any breaks or leaks where water might get in.

If you have any questions, contact your supplier or call Heron Instruments at 1-800-331-2032

LaMotte

LaMOTTE COMPANY

PO Box 329 • Chestertown • Maryland • 21620 • USA

800-344-3100 • 410-778-3100
fax 410-778-6394 • email http://www.lamotte.com

5.17.99 • 61799

LaMotte

RR Response Rentals
Sales • Service • Repairs
800-242-3910

2020
TURBIDIMETER

Instructio
MANUA

50$ CHARGE IF MANUAL NOT RETURNED !!

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GENERAL INFORMATION

PACKAGING & DELIVERY

Experienced packaging personnel at LaMotte Company assure adequate protection against normal hazards encountered in transportation of shipments. After the product leaves the manufacturer, all responsibility for safe delivery is assured by the transportation company. Damage claims must be filed immediately with the transportation company to receive compensation for damaged goods.

Should it be necessary to return the instrument for repair or servicing, pack the instrument carefully in a suitable container with adequate packing material. A return authorization number must be obtained from LaMotte Company by calling 1-800-344-3100 or faxing 1-410-778-6394. Attach a letter with the authorization number to the shipping carton which describes the reason for the return. This information will enable the service department to make the required repairs more efficiently.

GENERAL PRECAUTIONS

Read the instruction manual before attempting to set up or operate this instrument. Failure to do so could result in personal injury or damage to the instrument.

The 2020 Turbidimeter should not be stored or used in a wet or corrosive environment. Care should be taken to prevent water from wet turbidity tubes from entering the turbidimeter light chamber.

NEVER PUT WET TUBES IN THE TURBIDIMETER.

SAFETY PRECAUTIONS

Read the label on all reagent containers. Some labels include precautionary notices and first aid information. Certain reagents are considered hazardous substances and are designated with a * in the instruction manual. Material Safety Data Sheets (MSDS) are supplied for these reagents. Read accompanying MSDS before using these reagents. Additional emergency information for all LaMotte reagents is available 24 hours a day from the Poison Control Center listed in the front of the phone book. Be prepared to supply the name and four digit LaMotte code number found on the container label or at the top of the MSDS. LaMotte reagents are registered with POISONDEX, a computerized poison control information system available to all local poison control centers.

LIMITS OF LIABILITY

Under no circumstances shall LaMotte Company be liable for loss of life, property, profits, or other damages incurred through the use or misuse of their products.

SPECIFICATIONS

Instrument Type	Nephelometric turbidity, calibrated in NTU	
Range	0.00 - 1100 NTU	
Accuracy	0.5 or ±2% for readings below 100 NTU, whichever is greater ±3% above 100 NTU	
Resolution	*Standard Mode* 0.01 from 0.00 - 10.99 NTU 0.1 from 11.0 - 109.9 NTU 1 from 110 - 1100 NTU	
	EPA Mode	
	NTU	Reported to the nearest NTU
	0 - 1.0	0.05
	1.0 - 10	0.1
	10 - 40	1
	40 - 100	5
	100 - 400	10
	400 - 1000	50
	1000	100
Display	3½ digits	
Response Time	5 seconds	
Warm-up time	Not required	
Automatic Shut Off	2 minutes	
Lamp	Tungsten Filament bulb (approximate life 800 hours)	
Sample	15 mL in capped tube	
Sample Chamber	Accepts 25mm diameter flat-bottomed tubes (capped)	
Power source	Battery Operation: 9 Volt Alkaline Line Operation: 120V/50Hz, 220V/60Hz*, with supplied adapter	
Size (L X W X H)	8.5 x 16.2 x 6.7 cm, 3.4 X 6.4 X 2.6 inches	
Shipping Weight	Meter only: 11 oz. (312g) Kit: 3 lb. 7 oz. (1560g)	
Serial Interface	RS232, 8 pin mDIN, 9600b, 8, 1, n	

**CE Mark: The devise complies to the product specifications for the Low Voltage Directive when furnished with the 220V AC Adapter (Code 1774). The 120V AC adapter is not CE approved.*

PARTS & ACCESSORIES

Included in the Model 2020 Turbidity Meter Kit (Code 1799 OR 1799-EX2):

Code	Item
26856	2020 Turbidity Meter
1773	AC Adapter, 9V (or 1774 with 1799-EX2)
1476	AMCO™ 2020 Turbidity Standard, 1.0 NTU, 60 mL
1477	AMCO™ 2020 Turbidity Standard, 10 NTU, 60 mL
)286-4	Turbidity tubes, set of 4

)ptional Accessories:

478	AMCO™ 2020 Turbidity Standard, 100 NTU, 60 mL
479	AMCO™ 2020 Turbidity Standard, 250 NTU, 60 mL
800	High Turbidity Dilution Kit includes: Syringe, Filter Holder, Membrane Filters
)43	Syringe
598	Filter holder
103-6	Membrane Filters, 0.45 micron, pkg of 6
!15PS	Deionized Water
95-H	Formazin Turbidity Standard, 4000 NTU

PA COMPLIANCE

iis instrument meets or exceeds EPA design
ecifications for NPDWR and NPDES turbidity
onitoring programs as specified by the USEPA
thod 180.1. There is also a compliance reading
ode which rounds the reading to meet EPA
orting requirements.

EPA COMPLIANT

ARRANTY

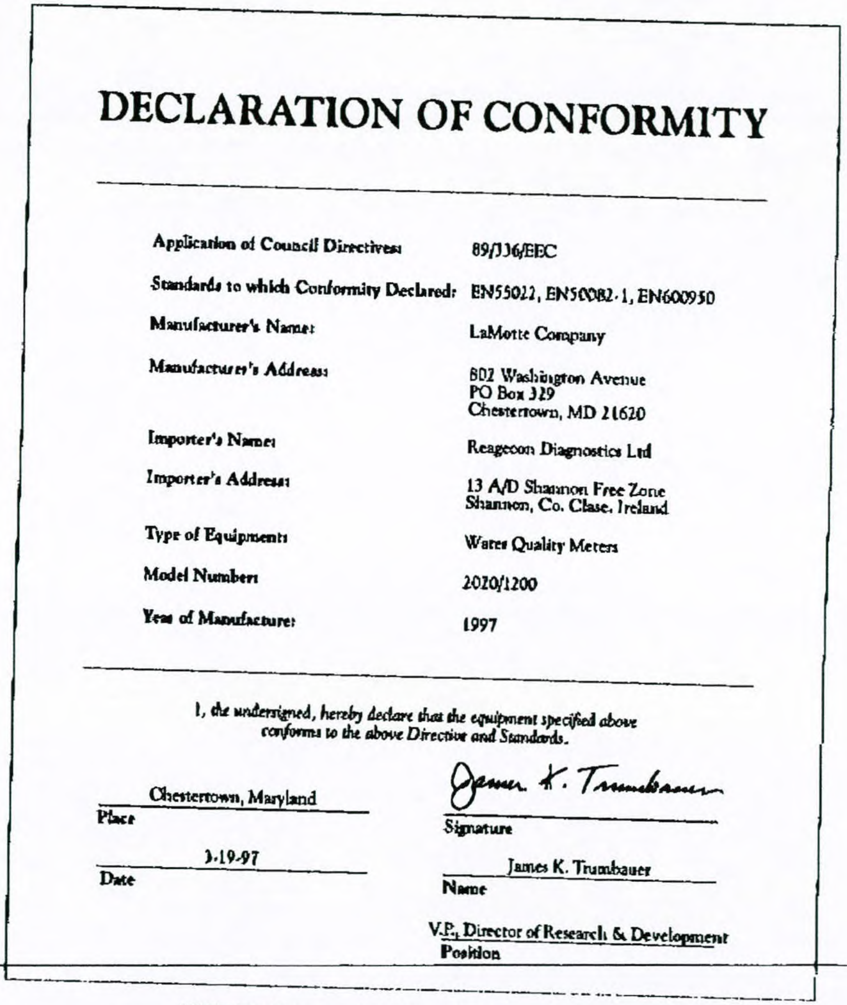
is instrument is guaranteed to be free from defects
naterial and workmanship for one year from
ginal purchase date. If within that time the
rument is found to be defective, it will be repaired
hout charge except for transportation costs. The
rantee does not cover batteries.

one YEAR WARRANTY

CE COMPLIANCE

The 2020 Turbidimeter has been independently tested and has earned the European CE Mark of compliance for electromagnetic compatibility and safety.

EUROPEAN CE MARK



DECLARATION OF CONFORMITY

Application of Council Directives: 89/336/EEC

Standards to which Conformity Declared: EN55022, EN50082-1, EN600950

Manufacturer's Name: LaMotte Company

Manufacturer's Address:
802 Washington Avenue
PO Box 329
Chestertown, MD 21620

Importer's Name: Reagecon Diagnostics Ltd

Importer's Address:
13 A/D Shannon Free Zone
Shannon, Co. Clase, Ireland

Type of Equipment: Water Quality Meters

Model Number: 2020/1200

Year of Manufacture: 1997

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive and Standards.

Place: Chestertown, Maryland

Signature: James K. Trumbauer

Date: 3-19-97

Name: James K. Trumbauer

Position: V.P., Director of Research & Development

NOTE: The devise complies to the product specifications for the Low Voltage Directive when furnished with the 220V AC Adapter (Code 1774).

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WHAT IS TURBIDITY?

Turbidity, cloudiness in water, can be interpreted as an absence of clarity or brilliance. It is caused by suspended and colloidal matter such as clay, silt, organic and inorganic matter and microscopic organisms. Turbidity should not be confused with color since a darkly colored water can still be clear and not turbid.

Turbid water is often an indicator of conditions that could cause damage to manufacturing equipment. Water clarity is especially important to the producers of consumer products such as beverage producers, food processors and water treatment plants. The particulates that cause turbidity may not always be harmful to human health, but are considered an undesirable characteristic.

Turbidity in industrial water used for boiler and cooling systems should be as low as possible. In boilers, the particles may become concentrated and settle out as a sludge that will damage equipment and cause foaming. In cooling water systems, particles can interfere with corrosion inhibitors. Water clarity is improved with fluid-particle separation processes such as sedimentation, coagulation and filtration.

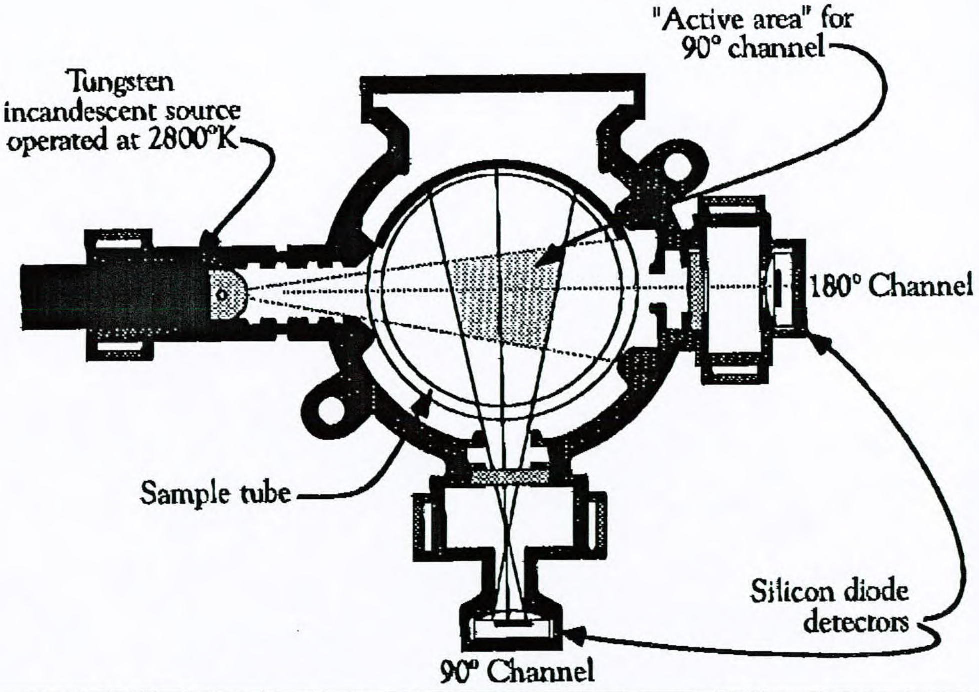
In swimming pools, cloudy water is a common problem. The usual causes for poor water clarity are corrosion, improper filtration and/or improperly balanced water. An algae condition or severe chloramine condition can also cloud pool water.

In natural waters, turbidity is an indicator of quality and productivity and can be used to monitor the health of streams and lakes. Turbid water may indicate runoff from construction, agriculture or other types of pollution. Suspended sediment can carry nutrients and pesticides throughout the water system. Suspended particles near the surface absorb additional heat from sunlight, raising the water temperature and blocking out the light needed by submerged aquatic vegetation and bottom dwelling creatures.

HOW IS TURBIDITY MEASURED?

Light passing through clear water will travel in a straight line. Particles in turbid water will cause the light to scatter giving it a "cloudy" appearance. The turbidity of a sample is determined by measuring the amount of scatter when a light is passed through a sample. The higher the turbidity, the greater the amount of scatter.

Turbidity can be measured in many ways. Visual methods include, the comparative methods, the Secchi disk method and the Jackson Candle method. Comparative methods are used in shallow water and determine turbidity by matching the turbidity of a water sample to a standard of known turbidity either with a "target" at the bottom of a tube or with a turbidity comparator. In the deeper waters of lakes, ponds, rivers and estuaries the Secchi disk is often used to measure turbidity. The Secchi disk is a disk about eight inches in diameter that is either white or is marked with black and white quadrants. The disk is lowered into the water on a calibrated line and the depth is noted where the disk just disappears from sight. The disk is then raised until it is visible. The average of these two distances is known as the "Secchi depth".



2020 Nephelometer

At waterworks and wastewater treatment plants the Jackson Candle apparatus was a standard instrument for measuring turbidities of incoming raw waters and treated wastewater effluents for many years. The equipment was modified over time but originally it consisted of a long glass tube supported over a "standard candle." Water was added to or removed from the tube until the image of the candle flame became indistinct. The depth of the water in the tube was read off a calibrated scale etched into the side of the tube, and results were reported numerically as Jackson Turbidity Units (JTU). The lowest turbidity that can be determined with this method is 25 Nephelometric Turbidity Units (NTU). Since the EPA's Surface Water Treatment requirements state that, finish water from municipal treatment plants will have a turbidity less than 1 NTU, indirect methods were developed to measure turbidity. Turbidimeters are the preferred method.

Nephelometers, such as the 2020, are turbidimeters that measure the scattered light at 90 degrees from the light source. A reference beam passes through the sample and is measured at 180 degrees. The ratio of these two readings is electronically converted to a turbidity measurement in NTU.

GENERAL OPERATING INFORMATION

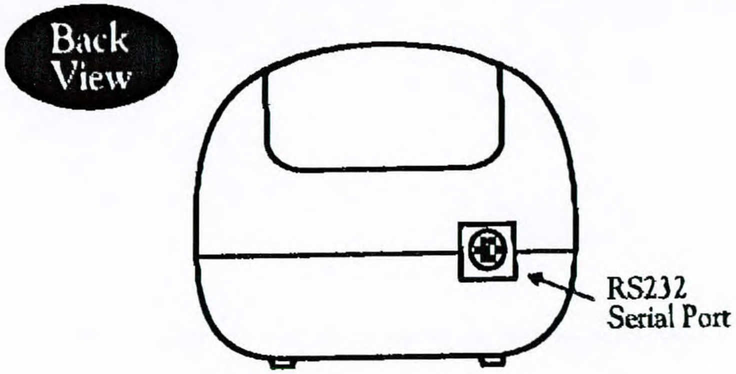
OVERVIEW

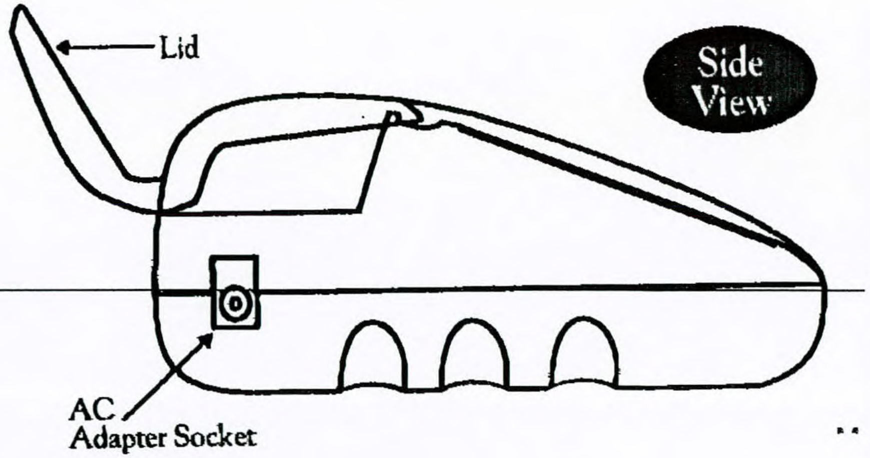
The 2020 Turbidimeter is a portable, microprocessor controlled nephelometer. A multi-detector optical configuration assures long term stability and minimizes stray light and color interferences. All readings are determined by the process of signal averaging over a 5 second period, minimizing fluctuations in readings attributed to large particles and enabling rapid, repeatable measurements. It has a sealed keypad. The microprocessor enables auto-ranging over the full range of 0 to 1100 NTU and provides direct digital readout with a resolution of 0.01 NTU for the lowest range.

The optics feature a tungsten bulb light source with a life expectancy of 800 hours. The light is detected by a silicon photo diode.

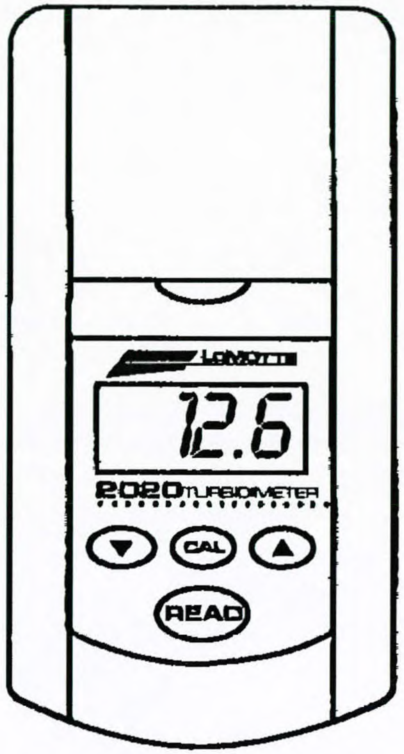
The 2020 is supplied with a 9 volt alkaline battery and an AC power adapter.

A RS-232 serial port on the back of the meter allows an interface of the turbidimeter with an IBM compatible computer for real time data acquisition an data storage using the PC. This port also allows an interface with a RS-232 serial printer.

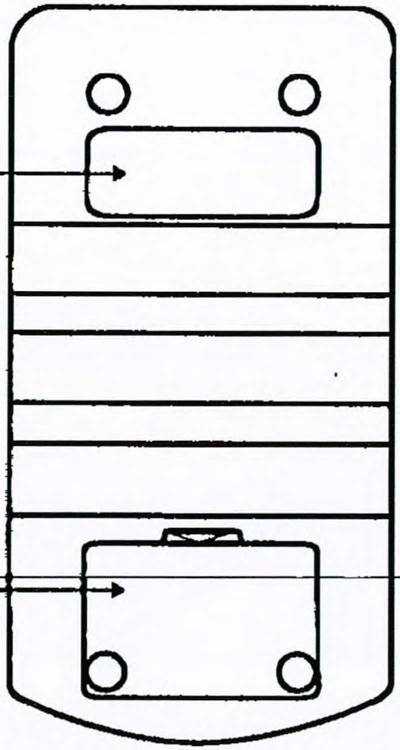




Top View



Bottom View



THE KEYPAD

The DISPLAY will display turbidity reading with the following resolution:
0.00 - 10.99 NTU; 11.0 - 109.9 NTU; 110 - 1100 NTU

- When the **READ** button is first pushed, a number will be briefly displayed that indicates the software version number.
- A walking dash "-" will be displayed when measurement is taking place.
- The display will flash after the **CAL** button has been pushed during the calibration procedure until the **CAL** button has been pushed again to enter the adjusted value.
- "*OFF*" will be displayed after the **READ** button has been held down for 1 second. The meter will turn off when the button is released.
- "*Er1*" will be displayed when the battery voltage is very low.
- "*Er2*" will be displayed when measured turbidity is over range (1100 NTU).
- "*Er3*" will be displayed when the bulb has burned out or the tube is misaligned.
- "BAT" will be displayed when the battery voltage is getting low. Readings are reliable. Replace battery as soon as possible.
- "•" will be displayed when the meter is in EPA mode.

See TROUBLE SHOOTING GUIDE page 23

The DOWN ARROW will **DECREASE** the numerical value of the display while in calibration mode.

The UP ARROW will **INCREASE** the numerical value of the display while in calibration mode.

The READ button is used to turn the meter ON and to take readings. Pressing the button for 1 second will cause the meter to display OFF. Releasing the button when OFF is displayed turns the meter OFF.

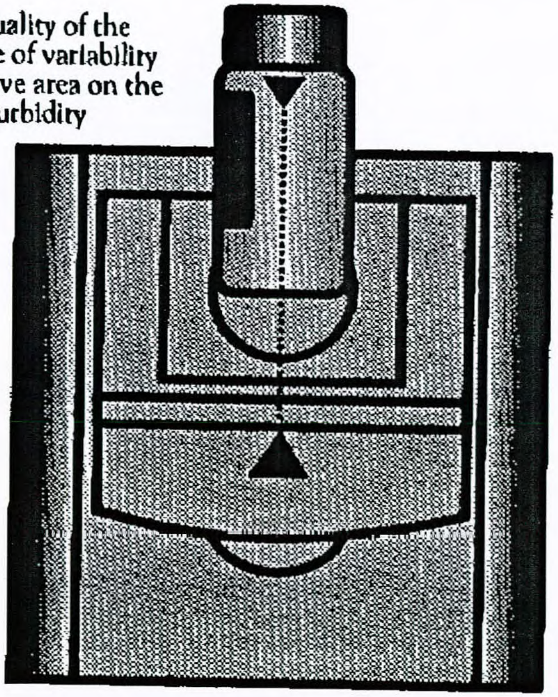
The CAL button is used for **CALIBRATION** procedures and to change between standard operating mode and EPA mode.

TURBIDITY TUBES

Turbidity tubes should always be washed prior to use. Use a mild detergent to remove any dirt or finger prints. Dry the outside of the turbidity tubes with a clean, lint-free cloth or disposable wipe. Allow the turbidity tubes to air-dry in an inverted position to prevent dust from entering the tube.

The handling of the turbidity tubes is of utmost importance. Scratches, fingerprints and water droplets on the turbidity tube or inside the light chamber can cause stray light interference leading to inaccurate results. It is imperative that the turbidity tubes and light chamber be clean and dry. Scratches and abrasions will permanently affect the accuracy of the readings. Tubes can be acid washed periodically and coated with special silicon oil to mask imperfections in the glass. After a tube has been filled and capped, it should be held by the cap and the outside surface should be wiped with a clean, lint-free absorbent cloth until it is dry and smudge-free. Handling the tube only by the cap will avoid problems from fingerprints. Always set the clean tube aside on a clean surface that will not contaminate the tube.

Variability in the geometry and quality of the glassware is the predominate cause of variability in results. The special anti-reflective area on the 2020 tubes allows more accurate turbidity readings for low NTU samples. Only 2020 tubes should be used with the 2020 turbidimeter. Orientation of the tube in the chamber will greatly affect the test results. To obtain the most accurate results, the tubes must be positioned so that the arrow-shaped index mark on the tube is aligned with the arrow-shaped index mark molded into the housing in front of the light chamber. This will ensure that the most accurate results are obtained.

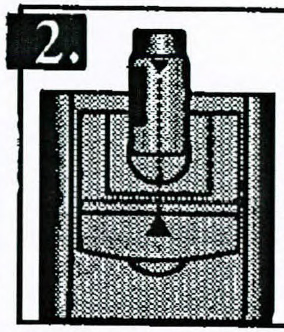


The 2020 turbidity tubes are optically selected but very small variations in the tubes may cause different readings on the same sample in low turbidity water. If greater accuracy is required, such as for Drinking Water requirements, the tubes supplied with the 2020 should be individually calibrated. This procedure is important for reading below 10 NTU but is probably not needed for samples above 10 NTU.

1.

Fill each tube (0286) with high-quality water. (Generally distilled water or drinking water is sufficient.)

2.

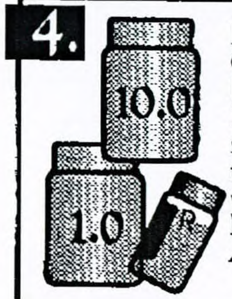


Record a turbidity reading for each tube following the instructions for turbidity measurement on page 21.

3.

Mark the tube with the lowest reading with an "R", for reference turbidity tube, near the top of the tube with a permanent marker.

4.

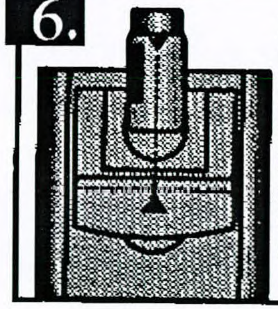


Follow the Calibration Procedure on page 16 using the reference turbidity tube, turbidity-free water, and the 1.00 NTU or 10.0 NTU AMCO™ standard.

5.

Fill the remaining turbidity tubes with the same AMCO™ turbidity standard as in the reference turbidity tube.

6.



Insert each tube into the meter with the proper orientation, Close lid and record the reading for each tube.

7.

The difference between the theoretical value (1.00 NTU or 10.0 NTU) and the actual value is the correction factor for that tube. This factor should be used when comparing results from different tubes.

STANDARD SOLUTIONS

The 2020 has been pre-calibrated in the range of 0 to 1100 NTU with AMCO™ primary standards manufactured by Advanced Polymer Systems, Inc. This allows the 2020 to be used for treated water, natural water or wastewater. Recalibration of the 2020 by the user is not required. However, a procedure to standardize the calibration should be performed to obtain the most accurate readings over a narrow range.

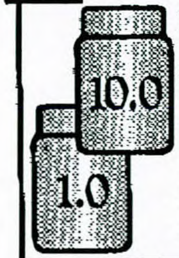
Two AMCO™ standards of 1.00 NTU and 10.0 NTU are supplied with the 2020. Standards of other values are available as accessories. The standards are a suspension of uniformly sized plastic "micro spheres" in ultra pure water, which require no preparation and are stable for long periods of time. These standards were manufactured specifically as a reference to calibrate the 2020. Only LaMotte specific AMCO™ standards should be used with the 2020. These standards are guaranteed to be accurate to within ±1%, if the following precautions are observed:

- The standards will remain stable for up to 4 years prior to opening if stored between 10 and 40°C.
- Once the seal of the bottle is broken, the stability of the standard is only guaranteed for 1 year if stored between 10 and 40°C.
- Never pour any unused or used standard back into the primary standard bottle.
- Do not open the bottle in a dusty or dirty environment. Dust and contaminants from the air can ruin the quality of the standard solutions.
- Before filling a tube with a standard, rinse the inside of the tube with a small amount of standard.
- Cap the standard bottle and the tube immediately after filling.

With proper preparation techniques, freshly prepared Formazin standards should be equivalent to the AMCO™ standards and can be used for meter calibration. A 4000 NTU Formazin Standard is available from LaMotte Company for use in preparing calibration standards. (See "Optional Accessories," pg. 6.) Correct procedures and approved methods for the use of Formazin standards can be found in the current edition of Standard Methods for Examination of Water and Wastewater.

CALIBRATION PROCEDURE

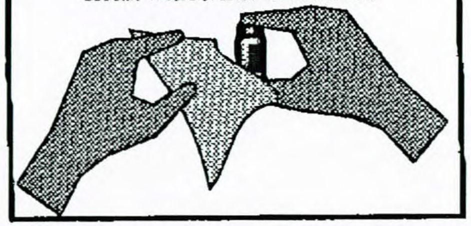
1.



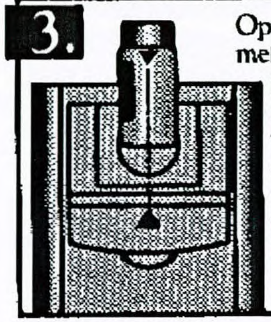
Select a LaMotte AMCO™ 2020 Standard in the range of the samples to be tested. NOTE: Only use LaMotte AMCO™ Standards specific to the 2020 Turbidimeter. Contact LaMotte for replacement standards.

2.

Fill a turbidity tube with the standard, cap, and wipe the tube clean with a lint-free cloth.



3.



Open the lid of the meter. Align the indexing arrow mark on the tube with the indexing arrow mark on the meter, and insert the tube into the chamber.

4.

Close the lid. Push the **READ** button. If the displayed value is not the same as the value of the reacted standard (within the specification limits), continue with the calibration procedure.

5.

Push the **CAL** button for 5 seconds until **CAL** is displayed. Release button. The display will flash. Adjust the display with the ▼ and ▲ buttons until the value of the standard is displayed.

6.

Push the **CAL** button again to memorize the calibration. The 2020 display will stop flashing. Calibration is complete.

7.

Turn the unit off by holding the **READ** button down for at least 1 second, or proceed to measure the test samples following the procedure on page 19.

Note

The calibration procedure should be followed once a week, or more often as required by regulations and laws for compliance monitoring. The calibration of the meter is independent of the operating mode.

SELECTING THE EPA MODE

The 2020 turbidity meter has two operating modes, the standard operating mode and the EPA mode. The meter can only be switched from one mode to the other while turning the 2020 on, from the OFF state. The 2020 will remain in which ever mode it was last used, even if the meter has been turned OFF.

To switch from one mode to the other mode:

1.

Turn OFF the 2020, if it is on.

2.

Press **CAL** button and hold it down while pressing the **READ** button to turn the meter on.

The meter will come on in the opposite mode than it was in previously. (While in EPA mode the ▲ will be visible on the display).

The standard operating mode displays the measured turbidity to the full resolution of the meter. The EPA mode displays the measured turbidity rounded to the reporting requirements of the EPA and Standard Methods compliance monitoring programs. This greatly simplifies the reporting requirements by eliminating the need for the user to manually round off the results according to EPA specifications. The EPA requires these reporting requirements because it recognizes the inherent accuracy of turbidity measurements within the specified ranges.

Note: The calibration of the meter is independent of the operating mode.

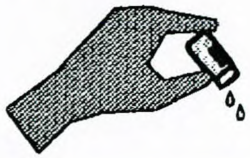
TURBIDITY MEASUREMENT

1.

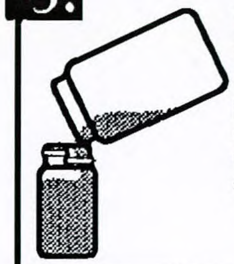
Fill a clean container with at least 50 mL of sample water and cover. Set sample aside to allow sample to equilibrate to air temperature and let gases escape. Avoid contaminants. Analyze as soon as possible.

2.

Rinse an empty turbidity tube with a portion of the sample. Shake out excess water.



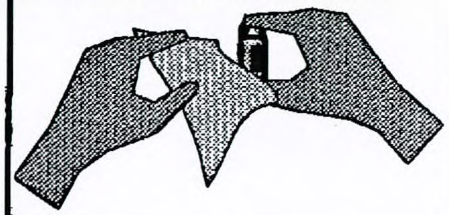
3.



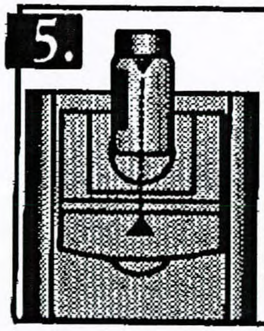
Fill the turbidity tube (0286) to the neck by carefully pouring the sample down the side of the tube to avoid creating bubbles.

4.

Cap the tube and wipe tube dry with a clean lint-free tissue.



5.



Open the 2020 lid. Align the indexing arrow on the tube with the indexing arrow on the meter. Insert the turbidity tube into chamber.

6.

Close the lid. Push the **READ** button. The turbidity in NTU units will be displayed within 5 seconds.

7.

The 2020 will turn off automatically 2 minutes after the last button push. To turn the meter OFF manually, hold the **READ** button down for at least 1 second. Release the button when OFF is displayed.

Note

If the sample is higher than 1100 NTU, it must be diluted and retested. See pages 20-22.

DILUTION PROCEDURES

If a sample is encountered that is higher than 1100 NTU, a careful dilution will bring the sample into the acceptable range. However, there is no guarantee that halving the concentration will exactly halve the NTU values. The particulates often react in an unpredictable manner when diluted.

TESTING TIPS

1. Samples should be collected in a clean glass or polyethylene container.
2. Samples should be analyzed as soon as possible after collection.
3. Discard tubes that are badly scratched.
4. Gently mix sample by inverting before taking a reading but avoid introducing air bubbles.
5. Turbidity readings will be affected by electric fields around motors.
6. Carbon in the sample will absorb light and cause low readings.
7. Observe shelf life recommendations for turbidity standards.
8. The turbidimeter should be placed on a surface free from vibration. Vibrations can cause high readings.
9. Excessive color in a sample will absorb light and cause high readings. The user should verify if a certain level of color will cause a significant error at the level of turbidity being tested.

TROUBLESHOOTING

PROBLEM	CHECK	ACTION
Meter won't turn on	Battery	Replace
	AC Adapter	Plug in
	AC Wall Outlet	Verify power source
	Contact LaMotte for Return Authorization	Return to LaMotte for repair
Suspect Calibration	Check calibration with standards	Use new standards
	Verify standards with Formazin	Run alternate test with Formazin
	Verify with another meter	Check other meter calibrations
	Check tube alignment	Re-align tube
	Check sample tubes for dirt and scratches	Check, clean and/or replace if necessary
	Check to see if internal meter components are wet	Always dry tubes before inserting. Examine chamber for visible moisture.
	Contact LaMotte for Return Authorization	Return for calibration check
Er1	Very low battery	Change battery
Er2	Over range	Dilute sample
Er3	Burnt out bulb or misaligned tube	Check tube alignment Call LaMotte
BAT	Low battery	Change battery

RS232 PORT

The 2020 Turbidimeter may be interfaced with any IBM compatible computer using an Interface cable (Code 1772). The meter may also be interfaced with an RS-232 serial printer, using an appropriate cable and setting the printer configuration to the output below.

Output: RS232 compatible, asynchronous serial, 9600 baud, no parity, 8 data bits, 1 stop bit.

Computer Connection: RS232-(1772) interface connection, 8 pin mDIN/9 pin F D-submin.

Pin out:

5	RS-232 TxD
3	RS-232 RxD
4, 6, 8	digital ground

MAINTENANCE

REPLACING THE BATTERY

The LaMotte 2020 uses a standard 9-volt alkaline battery that is available worldwide. The battery compartment is located on the bottom of the case. To replace the battery:

1. Open the battery compartment lid
2. Remove the battery and disconnect the battery from the polarized plug.
3. Carefully connect the new battery to the polarized plug and insert it into the compartment.
4. Close the battery compartment lid

REPLACING THE LAMP

The tungsten lamp included with the model 2020 has a life of approximately 800 hours. If the display becomes unstable when using LaMotte AMCO™ standards, call LaMotte Company for a return authorization number to have the lamp replaced and have the unit examined.

REPAIRS

If it is necessary to return the instrument for repair, telephone LaMotte Company at 1-800-344-3100 or fax 1-410-778-6394 for a return authorization number.