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INTERNATIONAL TECHNOLOGY CORPORATION

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Quality Assurance Manual
Laboratory - Specific Attachment

IT ANALYTICAL SERVICES - KNOXVILLE
(MIDDLEBROOK PIKE)

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ABBREVIATIONS

ITASK - IT Analytical Services, Knoxville (Middlebrook Pike)

CLP - USEPA's Contract Laboratory Program

SOP - Standard Operating Procedure

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TABLE K1-1

Contents of Laboratory-Specific Attachment
Knoxville Laboratory Operations

Sections of ITAS Quality Assurance Manual	Content	Attachment Sections
1.0	Introduction	K1.0
2.0	Laboratory Organization	K2.0
3.0	Standard Laboratory Practice	K3.0
4.0	Material Procurement and Control	K4.0
5.0	Sample Receipt and Initiation of Testing Program	K5.0
6.0	Calibration Practices	K6.0
7.0	Preventive Maintenance	K7.0
8.0	Analysis of Quality Control Samples	K8.0
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10.0	Data Verification	K10.0
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12.0	Records Management	K12.0
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15.0	Quality Reports to Management	K15.0
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K1.0 INTRODUCTION

Criteria for Quality Assurance practices within International Technology Analytical Services laboratories are documented in the IT Analytical Services Quality Assurance Manual. The ITAS Manual was written to encompass all analytical laboratories within IT Corporation. The purpose of the ITAS Manual is to assure uniform Quality Assurance practices among all (IT) laboratories; however, individual laboratory practices will vary from laboratory to laboratory.

The ITAS Knoxville, Tennessee (Middlebrook Pike) laboratory has written a "laboratory-specific" manual. This manual is an attachment to the ITAS Manual. As required by the ITAS Quality Assurance Program, this attachment is a supplement to and is incorporated with the ITAS Quality Assurance Manual to provide the Quality Assurance Program for the Knoxville laboratory operations (ITASK). Refer to the ITAS Quality Assurance Manual for specifics on issues not addressed in this attachment.

For the Knoxville laboratory operations, the ITAS Quality Assurance Manual and this attachment have been prepared to fulfill the policies of IT Corporation, the requirements of the US EPA and the State of Tennessee.

K1.1 Format of the Attachment

The laboratory-specific attachment is formatted in the same manner as the ITAS Quality Assurance Manual so that personnel in Knoxville laboratory operations can readily merge the requirements of the ITAS Manual and this document. Section headings for both documents are the same with the exception that this attachment uses the section prefix K so that attachment sections are clearly identified.

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This attachment is not meant to be a self-standing document, the ITAS Manual must be included with the attachment to fully describe the laboratory-specific Quality Assurance Program. The ITASK attachment includes only those sections of the ITAS Quality Assurance Manual which must be supplemented for full documentation of a specific activity, or which provide for the parallel implementation of Quality Assurance practices. In the event that the attachment describes an alternative means for implementation, when compared with the manner prescribed in the ITAS Quality Assurance Manual, the implementation described in this attachment shall take precedence for Knoxville laboratory operations. Contractual obligations will, of course, supersede both the ITAS QA Manual and this supplement. Review and approval of the attachment, as prescribed in this Manual is in accordance with the requirements of the ITAS Quality Assurance Program.

Table K1-1 lists the sections of the ITAS Quality Assurance Manual. The sections contained in this attachment are also identified. If a section is not contained in the attachment, the corresponding section in the ITAS Manual is adopted without supplement or change. Subsections are not listed in Table K1-1, but are fully identified in the Table of Contents.

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7.0	Preventive Maintenance	K7.0
8.0	Analysis of Quality Control Samples	K8.0
9.0	Analytical Procedures	K9.0
10.0	Data Verification	K10.0
11.0	Data Reports	K11.0
12.0	Records Management	K12.0
13.0	Nonconformances and Corrective Action	K13.0
14.0	Quality Assurance/Quality Control Audits	K14.0
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16.0	Training	K16.0

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K2.0 ORGANIZATION

K2.1.1 Quality-Related Responsibilities

The Middlebrook Pike laboratory is part of the ITAS Analytical Services group in the Knoxville area. The organization of the Middlebrook laboratory is shown in Figure K2-1. The Quality Assurance responsibilities of the positions sited are as described in Section 2.1 of the ITAS Quality Assurance Manual.

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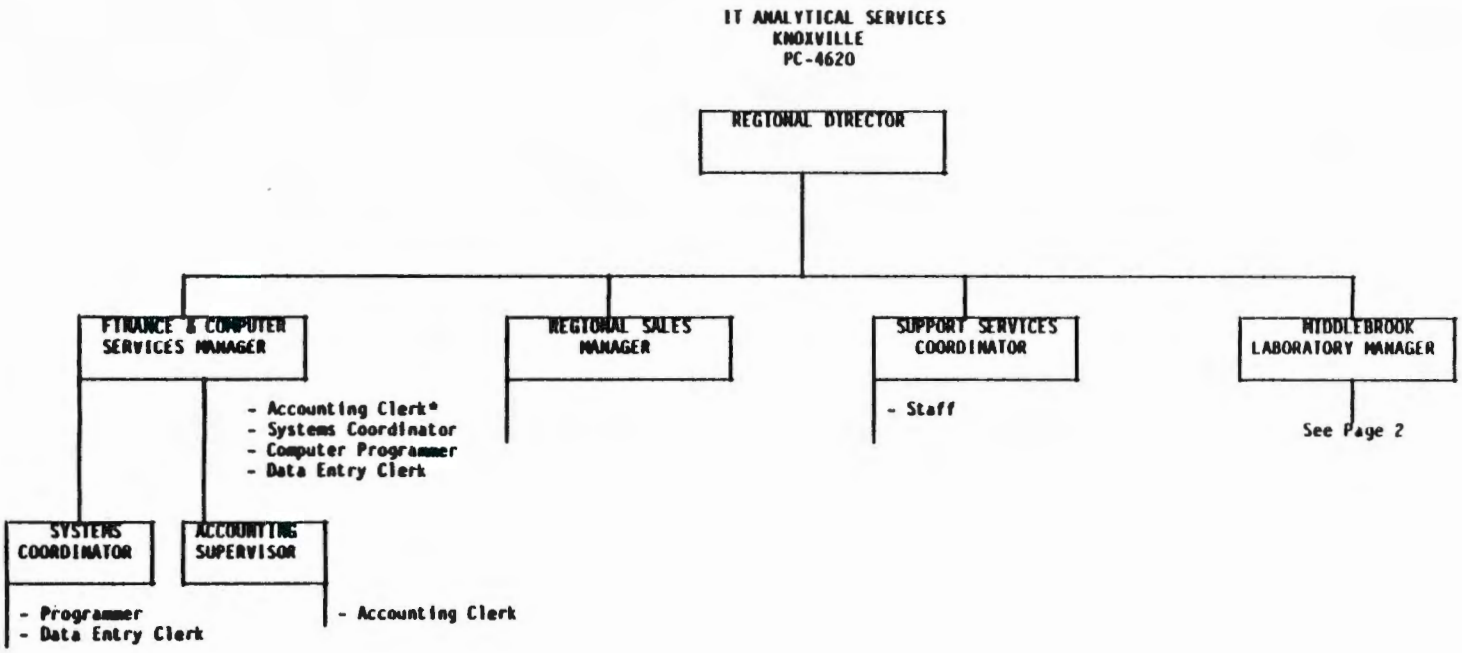
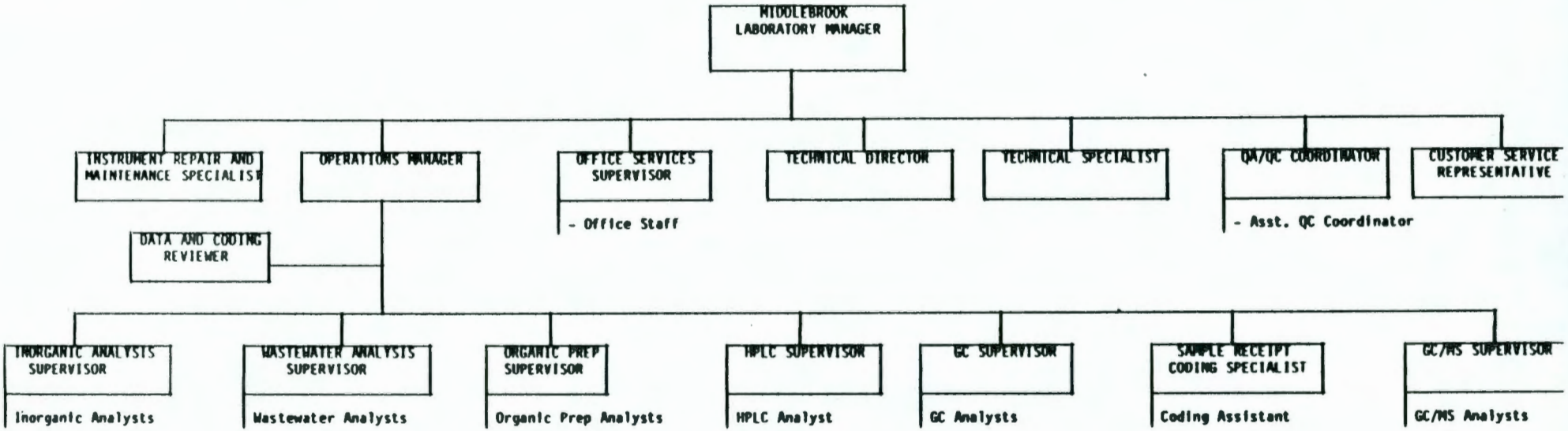

IT ANALYTICAL SERVICES
KNOXVILLE
PC-4620
REGIONAL DIRECTOR
FINANCE & COMPUTER SERVICES MANAGER
- Accounting Clerk*
- Systems Coordinator
- Computer Programmer
- Data Entry Clerk
SYSTEMS COORDINATOR
- Programmer
- Data Entry Clerk
ACCOUNTING SUPERVISOR
- Accounting Clerk
REGIONAL SALES MANAGER
SUPPORT SERVICES COORDINATOR
- Staff
MIDDLEBROOK LABORATORY MANAGER
See Page 2

IT ANALYTICAL SERVICES
KNOXVILLE
PC-4620



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K3.0 LABORATORY PRACTICE

Knoxville laboratory practices and operating procedures are described throughout the Knoxville specific QA Manual. Table K3-1 briefly describes the laboratory functions relating to the flow of samples through the laboratory. The table also indicates the party responsible for sample movement within the laboratory system. Figure K3-1 presents a flow chart of functions for laboratory analysis.

The following manual sections address specific laboratory procedures and practices.

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TABLE K3-1

ANALYSIS FLOW CHART
KNOXVILLE LABORATORY OPERATION

STEP #	DESCRIPTION	PERFORMED BY	DOCUMENTS USED
1	Samples sent to laboratory.	Client	Sample Chain-of-Custody, Request for Analysis
2	Sample is unpacked and inspected and paperwork verifying completeness.	Sample handlers and sample receptionist	Above plus any correspondence, quotations, etc.
3	A project record file is prepared, job assigned, all sample identification placed with sample in temporary storage.	Sample Custodian	Project file, samples labels
4	Project information is recorded into manual log and billing information is recorded.	Customer Service Representative	Billing information
5	Sample is placed in proper storage area with proper labels, and computer is updated with project information.	Sample Custodian	Computer data system records project file
6	Copies of job information are distributed to analytical group leaders for and test assignment processing.	Sample Custodian	Project file, Request for Analysis
7	Chemists collect samples from storage area and perform test.	Group Leaders/Analysts control removal and return	Analysis log, instrument maintenance log, data sheets

TABLE K3-1 (continued)

STEP #	DESCRIPTION	PERFORMED BY	DOCUMENTS USED
8	Analytical data is reviewed and transcribed onto data reporting sheets for typing.	Analysts or Group Leaders	Instrument calibration log, Q.C. log, data sheets
9	Analytical results to Group Leader on completion of testing protocol.	Analysts	Copies of data reporting sheet, analytical data, QA/QC results
10	Data is reviewed and approved and paperwork is placed in project file.	Group Leaders	Copies of data reporting sheet, analytical data, QA/QC results, project file
11	QC data is copied for QC Coordinator for entry into control charts.	Group Leader QC Coordinator	QA/QC results
12	Analytical data for the report is compiled and reviewed and contents of project file reviewed and approved.	Operation Manager or Project Manager	Project file
13	Analytical report is prepared.	Word processing or EDT	Final report
14	Final report is reviewed and signed by Lab Manager or Operations Manager.	Management	Signed report
15	All records and documents are maintained.	Management	All documents
16	Sample is retained for 2 weeks after report issued and then properly disposed.	Sample Custodian	Request for hazardous chemical lab disposal

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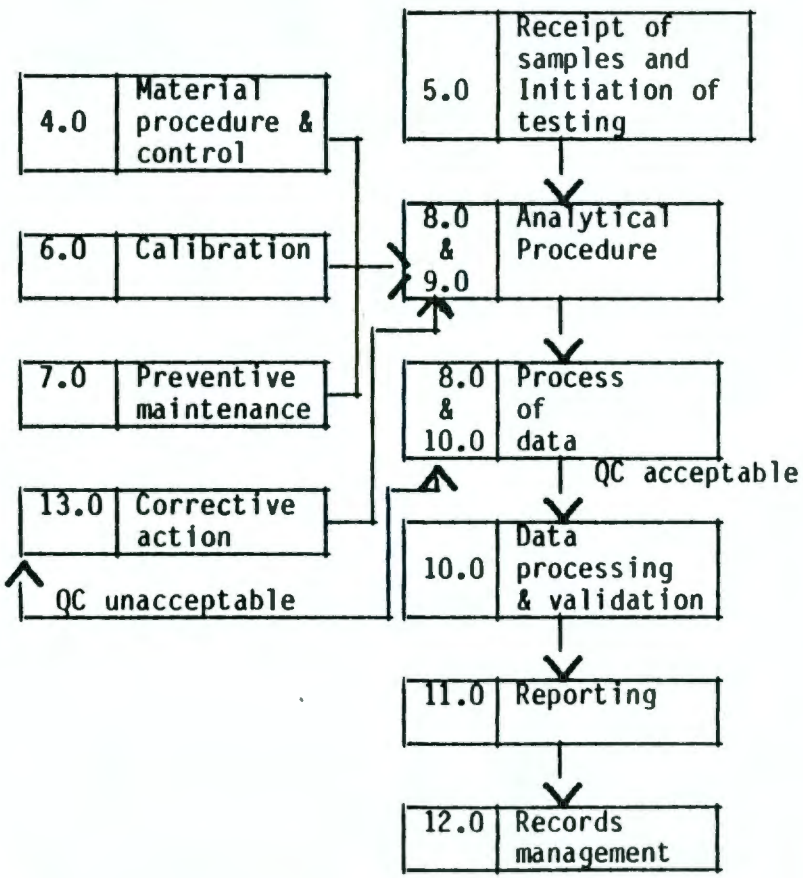
FIGURE K3-1

LABORATORY ANALYSIS FLOW CHART
KNOXVILLE LABORATORY OPERATIONS



Activities	Applicable Steps For Analytical Samples
° Complete Chain-of-Custody	
° Sample log in	1,2,3,4
° Define tests to be performed on specific samples	5,6
° Define QC sample requirements	5,6
° Analysis of samples	7
° Analysis of QC samples	7
° Summarize QC data	11
° Update control charts	11
° Statistical treatment of data	10
° Calculate analysis results	7,8
° Independent data review	9,10,12
° Summarize data	10,12
° Issue within IT or to client	13,14
° Prepare project file	10,12,15
° Maintain records	15

NOTE: 1. See TABLE K3-1

K4.0 MATERIAL PROCUREMENT AND CONTROL

This section is to provide additional detail to the ITAS Manual Section 4.0.

The duties specified in the ITAS QA Manual concerning purchasing materials and controlling them in the laboratory are assigned to the Group Leaders. Each Group Leader is responsible for materials used in his/her area.

Routinely purchased materials are tracked by a computer inventory program. This program includes a list of materials, reorder points and order sizes. A vendor catalog number for each item is also included. The catalog number defines the grade or other specifications that must be met. Purchases are made by the purchasing department and tracked using this system.

Purchase requisitions are filled out for materials not in the inventory system. Material specifications, with Group Leader approval, are stated on the requisition. The material specifications may consist of a vendor catalog number. The requisition is approved by the appropriate Group Leader and then goes to the purchasing department. Orders are placed by the purchasing department.

When materials are received, they are checked by the appropriate Group Leader or designee. The person receiving the shipment signs and dates the packing slip indicating approval of the material. The packing slip is filed with the purchasing records.

K4.1.3 Organic Chemical Analysis

Pesticide-quality solvents, methylene chloride, hexane, acetone, methanol and ether are analyzed to determine the extent of impurities present in each. Any lot of

solvent showing significant interferent peaks is eliminated from consideration for use by this laboratory. Acetone is the only exception since there are always at least three peaks present due to self-condensation products of acetone.

The purity grade of GC and GC/MS carrier and detector gases must be sufficient to meet detector and method requirements. Instrument manufacturer literature is used as a guideline for determining the purity grade to use.

K4.1.4.1 Water

Water used for the analysis of trace metals should be purified by reverse osmosis/deionization to not less than 10 MΩ cm. Water for organic determinations should be deionized and then further purified with activated carbon. Water for organic analysis should be checked for methylene chloride throughout the day whenever purge and trap methods are used.

K4.3 Storing and Maintaining Reagents and Solvents

As an exception to the ITAS QA Manual, the organic reagent TBA solution is stored at room temperature as allowed by CLP protocol.

K4.4 Glassware Cleaning Requirements

Containers provided for laboratory samples as well as closure and sealing procedures are EPA approved. When vigorously cleaned sample containers are required, commercially available, precleaned, quality controlled containers (e.g., from I-Chem) may be used. Quality control certificates shall be maintained on file by the QC Coordinator.

Chromic acid washing of glassware is used only when it is found to be necessary; for example, when routine cleaning procedures have not been sufficient to eliminate interfering residue. Cleaned glassware is stored uncovered in closed cabinets or drawers. Glassware is solvent rinsed, with the extracting solvent, prior to use.

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K5.0 SAMPLE RECEIPT AND INITIATION OF TESTING PROGRAM

K5.1 Field Sample; Receipt, Archiving, Collection and Shipment

Any samples that are damaged due to leaky containers, broken glass, or unusual odors that may be present are reported to Laboratory Management immediately.

At any time a sample is to be shipped by common carrier or sent through the United States mail, it must comply with the Department of Transportation (DOT) Hazardous Material Regulations (49 CFR "TRANSPORTATION").

Prior to collection, the collection team must consider the analyses to be performed so that the sample containers and shipping containers can be assembled and the proper preservatives added. See Table 5-1 in the ITAS QA manual. Preservatives are not added by the laboratory after receipt of samples.

K5.2 Chain-of-Custody (Form)

As stated in the ITAS QA Manual, ITASK shall not accept samples collected by IT personnel for analysis without correctly prepared Chain-of-Custody and Request for Analysis forms. Figure K5-1 is an internal Chain-of-Custody form, which is used as necessary, e.g., for analyses per CLP protocol.

K5.3 Laboratory Receipt and Entry of Sample

The sample is removed from the shipping container and the sample identification information contained on the sample bottles compared to that on sample packing lists, or included Chain-of-Custody documents. If discrepancies exist, appropriate notes (signed and dated) are made on the Chain-of-Custody document and the shipping and receiving supervisor is notified.

The following items are checked and noted on the Sample Receipt Log (Figure K5-2) upon receipt of samples.

A) The seals and tapes on the cooler are unbroken and uncut.

B) The sample containers in the cooler are intact.

C) The cooler contains ice. If not, measure the temperature of the water in the cooler.

D) The identification on the sample bottles correspond to the entries on accompanying forms.

E) The samples are of sufficient quantity to perform the requested analyses.

F) The number of sample containers received (i.e., bottles) is equal to the number of samples listed on the Chain-of-Custody or accompanying forms.

G) Projects are identified by giving each a unique, client-specific three or four character code (e.g., "EPAL" for USEPA, Las Vegas), followed by a five digit number, sequentially assigned. The label in Figure 5-6 is not used. Instead, individual samples are assigned sequential four digit numbers, preceded by one or two character prefixes. Triplicate labels, using prenumbered tape, are affixed to each sample, two of which may be transferred to subsequent aliquots for use in the laboratory.

H) Any nonconformances are noted on a nonconformance form (Figure K5-2).

Sample preservation is not checked at this time. The pH of samples for metals, wastewater, and TOC analyses is checked by the analyst just prior to analysis. If the samples are not at the proper pH, a nonconformance memo is filled out. The sample pH is adjusted by the analyst when required by the analytical method. If the pH measured does not correspond to the information on the Request for Analysis form, the client is notified in the analysis report.

K5.4 Laboratory Storage of Samples

This facility stores: Samples, and past samples, which may or may not be classified as "Hazardous". The duration of sample storage is now for 2 weeks after the report has been issued, unless otherwise obligated by contract or agreement.

K5.4.1 Pre-Analysis Storage

The samples are placed into appropriate storage by the sample custodian (or staff).

Samples are stored as prescribed in Section K5.4 of the ITASK Laboratory-Specific Q.A. Manual. The requirements for storage temperatures and holding times specified in the analytical methods are used (EPA and SW 846 methods). Note that the requirements in Table 5-1 of the ITAS QA Manual refer to water samples. The holding times may be different for other matrices.

K5.4.2 Post-Analysis Storage

Anticipation of reanalysis prescribes proper environmental control. If reanalysis is not anticipated, environmental conditions will not be observed, the samples are stored at room temperature.

K5.5 Initiation of Testing Program

After the analytical program has been entered into the laboratory computerized information management system, a coding package is produced.

The coding package contains a copy of the Chain-of-Custody and Request for Analysis forms as well as the analytical program and the computer generated test assignments.

This coding package then goes to the Group Leaders. The Group Leaders update the computer information by verifying test assignment and assigning any additional tests that are needed.

K5.6 Predisposal

K5.6.1 Sample Storage

The sample custodian will transfer samples from temporary storage to the archive storage area as analyses are completed. Storage time is two weeks after the report is issued unless:

1) Specified otherwise by the customer
2) Sample is known to be involved in litigation, in which case it is stored until the lab is notified by the client

The samples are categorized in storage according to their sample number, which in turn has traceability and directly corresponds to sequential dating.

K5.6.2 Disposa. of Lab-Generated Waste

Disposal of laboratory generated waste is addressed in ITASK SOP No. MA850107.

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Figure K5-1

ITAS-K-QA003R2

Project Code _____
EPA Case # _____
Sample No. Range _____

INTERNAL CHAIN-OF-CUSTODY FORM - ORGANICS
IT Analytical Services-Knoxville

Sample No.	Date	Extract* Type or Original Sample?	Moved From	Moved To	Reason	Signature

* O - Original Sample
A - Acid Extract
P - Pesticide/PCB Extract
E - BN/AE Extract
B - Base Neutral Extract
V - VOA Sample

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Figure K5-2

SAMPLE RECEIPT LOG ITAS-K-CD010R2

Project Code _____ Number/Type of Samples _____

Date Project Coded _____ _____

Date/Time Received _____ _____

********** For EPA-CLP Use **********

	Forms	Received	
Case # _____	Federal Express Airbill	Yes	No
SDG # _____	Traffic Report	Yes	No
Contract # _____	Sample Tags	Yes	No

Custody Seals - present, intact, & properly placed? Yes ___ No ___ Comments _____
Sample Condition - intact & properly packed? Yes ___ No ___ Comments _____
Chain-of-Custody - present & correctly filled out ? Yes ___ No ___ Comments _____
Request/Analysis - present & correctly filled out ? Yes ___ No ___ Comments _____
Blue/Wet Ice - present Yes ___ No ___ Blue Ice Frozen Yes ___ No ___
Temperature of Wet Ice _____

Turnaround Time - ___Routine (10-15 working days) ___Other (specify) _____
Rush Turnaround - ___<48 hr ___ 48-96 hr ___5-10 days ___ Other _____
QC Level - ___I ___II ___III ___IV ___Other (specify)_____

Special Instructions: _____

Lab No.	Client Identification	Analysis	Container/Location

Page ___ of ___

FIGURE K5-3

ITAS KNOXVILLE LABORATORY

NONCONFORMANCE MEMO

PROJECT CODE: _____ FILED BY: _____ DATE: _____

SAMPLE'S AFFECTED: _____

AREA: CODING ____ GC ____ GC/MS ____ HPLC ____ PREP ____ METALS ____ GEN CHEM ____ OTHER ____

NONCONFORMANCE (Check appropriate item(s)):

____ Not enough sample received for proper analysis.

____ Sample received ☐broken ☐without proper preservative _____ ☐without proper refrigeration _____ ☐in improper container _____ ☐with custody seal missing or broken ☐ with illegible sample numbers or labels missing.

____ Sample received with incomplete paperwork: ☐Request for Analysis form missing ☐Chain-of-Custody form missing/unrelinquished ☐billing instructions incomplete ☐no due date or TAT specified ☐method for sample disposition not specified ☐numbers on paperwork different than numbers on bottles _____ ☐other _____.

____ Holding time exceeded ☐at receipt ☐in the lab by ___ days. Reason. _____.

____ Sample lost during extraction/analysis; no re-prep or re-analysis possible. Reason: _____.

____ QC sample data reported to client outside of ☐method ☐internal ☐QAPP ☐contract ☐regulatory limits. Reason: _____.

____ Incorrect preparation/analysis procedure(s) used; no re-prep or re-analysis possible. Reason: _____.

____ Samples analyzed and reported under an invalid calibration curve.

____ Incorrect/incomplete data reported to client. Specify: _____.

____ Blank contamination; no re-prep of associated samples done or possible. Reason: _____.

____ Reported detection limits higher than specified in ☐method ☐contract ☐QAPP, due to ☐matrix ☐insufficient sample ☐instrumentation ☐other _____.

____ Other (specify) _____.

CORRECTIVE ACTION:

____ Client (Name: _____) informed verbally on _____ by _____.
____ Client informed in writing on _____ by _____.
____ Sample(s) processed "as is".
____ Sample(s) preserved in laboratory (specify): _____.
____ Sample(s) on hold until _____.
____ Other _____.

Corrective action initiated/performed by _____ Date _____

Operations Concurrence: _____ Date _____

QC Concurrence: _____ Date _____

CORRECTIVE ACTION VERIFICATION

____ Verified

____ Cannot verify. Reason _____.

QC Coordinator: _____ Date _____

THIS DOCUMENT MUST BE RETAINED IN THE PROJECT FILE

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K6.0 CALIBRATION PRACTICES

This section of the ITAS-K attachment to the QA manual prescribes the specific calibration practices used by the Knoxville laboratory. Only those procedures that vary from, or are in addition to, those described in Section 6.0 of the ITAS QA Manual are described.

K6.1.6 Calibration Records

The records prepared and the record maintenance procedures are described separately for each instrument type in Section 6.2 - 6.3.

K6.2 Operational Calibration

K6.2.1 GC/MS Calibration

K6.2.1.1 Tuning and GC/MS Mass Calibration

Each GC/MS system used for HSL compound semivolatile/pesticide analysis is tuned using DFTPP. Each GC/MS system used for HSL volatile analysis is tuned using BFB. The ion abundance criteria for both volatile and semivolatile/pesticide analyses must be demonstrated every twelve (12) hours during sample analysis. Specific ion abundance criteria are listed in the appropriate SOP and in Figures K6-1 and K6-2.

K6.2.1.2 Initial Calibration of the GC/MS System

GC/MS uses an internal standard calibration procedure. Specific methods may require modified procedures.

Each GC/MS system used for HSL compound analysis is initially calibrated using a minimum of 5 concentrations. Because of lower response, a four point calibration is

used for 9 of the semivolatile compounds and a three-point calibration is used for benzidine. Surrogates and internal standards are included in each standard. The average relative response factor (RRF) and % RSD (percent relative standard deviation) of each HSL compound is calculated and tabulated. The % RSD of the calibration check compounds (CCC) must be <30% and the average RRF of each performance check compound (SPCC) must be $\geq$ 0.300 (0.250 for Bromoform) for volatiles and $\geq$ 0.05 for semivolatiles/pesticides. See Figures K6-3 through K6-8 for CCC and SPCC details.

K6.2.1.3 Continuing Calibration

A daily standard containing 50 ng of all volatile or semivolatile HSL compounds and the required surrogates is analyzed every 12 hours during sample analysis.

The daily RRF values for each CCC are compared to the average RRF values from the initial calibration by calculating a percent difference (% D) using the following equation:

$$\% D = \frac{\text{daily RRF} - \text{avg RRF}}{\text{avg RRF}} \times 100$$

The % D of each CCC must be less than 25 percent for the daily standard to be accepted prior to sample analysis. A system performance check is also performed as described above, using the daily standard data. If the CCC and SPCC criteria are met, then RRF's and % Ds are calculated and reported for all compounds in the daily standard. If any of the CCC or SPCC criteria are not met, the system is evaluated and corrective action is taken; corrective action may involve running a new initial calibration.

The daily calibration standard may be combined with the mass calibration standard (BFB or DFTPP) and the two calibrations performed simultaneously.

6.2.1.4 GC/MS Calibration Records

Data from each tuning and mass calibration, initial calibration, and continuing calibration are recorded on calibration summary forms (Figures K6-1 through K6-8) and filed with the raw calibration data by instrument, analysis, and date in the calibration section of the laboratory operations files. These files are near the associated instrument. Copies of calibration data and summary forms are filed with the new data and data package for each associated project in the project files as described in Section K12.0.

K6.2.2 Calibration of the Gas/Liquid Chromatograph

The gas chromatography laboratory performs instrument calibration by two basic procedures depending on the nature of the project: project specific procedures and routine calibration procedures. The calibration procedures for a specific project's analyses may deviate from the described procedures if the contract specifies special requirements or if the analytical method specifies a different calibration procedure.

K6.2.2.1 Project Specific Procedures (EPA-CLP Procedures)

K6.2.2.1.1 Initial Linearity

Each time a new column is installed into a specific gas chromatograph, or the chromatographic conditions are changed, i.e., change of flow rates, detectors, electronics, etc., response linearity is established for each GC analyte at these conditions. Three different concentrations of each parameter in a set of noninterfering mixed standard solutions are analyzed. Calibration factors are then calculated for each pesticide and PCB. The linearity for the calibration factors is determined and recorded.

K6.2.2.1.2 Retention Time Windows

Retention time windows are used to tentatively identify pesticides/PCBs during sample analysis. Retention time windows are established by making three (3) injections of all pesticide/PCB standard solutions over a 72 hour period (each compound should be injected near the beginning, near the middle, and near the end of the 72 hour period). The retention time shift of the surrogate dibutyl chlorendate must be <2.0% difference for packed columns (<1.5% for mega bore column). If the dibutyl chlorendate retention time shift is acceptable, the retention time windows for the standards are calculated. The retention time window for each component is ± 3 times the standard deviation of the three absolute retention times for that component. If the calculated retention time window is less than 0.01 minutes, then the retention time window is calculated as ± 1% of the initial retention time of the component in the 72 hour sequence (± 0.75% for mega bore columns).

K6.2.2.1.3 Standard and QC Solutions

Component breakdown is monitored by injecting a standard containing DDT and endrin and looking for its breakdown products: DDD, DDE for the former, and endrin aldehyde and endrin ketone for the latter. The combined breakdown must be ≤ 20%. The breakdown check standard is injected at the beginning of a 72 hour (the second standard) run and after every tenth sample.

To ensure continued linearity, a set of low, medium, and high concentration daily evaluation standards of a representative group of pesticides or PCBs are injected before any samples are injected. Calibration factors are calculated for each parameter; the % RSD must be ≤ 10% for the run to continue. After a specified number of samples, the mid-range evaluation mix and a specified standard mix are injected to

check daily retention times, component breakdown, and calibration factor % differences. Calibration factor % differences must be ≤ 15% for quantification and ≤ 20% for confirmation.

K6.2.2.2 Routine Calibration Procedures

K6.2.2.2.1 Initial Linearity

Standards are run at a minimum of 3 to 5 different concentrations. The resulting chromatograms should elicit all respective peaks on scale to allow for quantitation using either peak height or area. PCB standards may contain more than one Aroclor only if there are no interfering peaks between them.

The results may be used to prepare a calibration curve for each analyte. Alternatively, the percent relative standard deviation (%RSD) of the RFs for each compound is determined. If the %RSD is < 20% over the working range, linearity through the origin can be assumed and the average response factor used in place of a calibration curve.

If standards are not within acceptable limits, the instrument should be checked, the source of the problem identified, and corrections made. Standards (for those out of acceptable limits) will then be rerun.

K6.2.2.2.2 Retention Time Windows

If SW-846 3rd edition methods are used, retention time windows will be established. The procedure is described in Section K6.2.2.1.2.

K6.2.2.2.3 Daily Standards

The working calibration curve or response factor must be verified on each working day by injecting a daily quantitation standard for each analyte. (More than one solution may be required to cover all the compound.) If the response for any analyte varies from the predicted response by more than ± 15%, a new calibration curve must be prepared. When comparison of the daily standard is made to the initial average response factor, the daily response factor is used for quantification. However, if comparison of the daily standard to the calibration curve is required, then the initial calibration curve is used for quantification.

If the daily quantitation standard does not meet the ± 15% difference limits, the instrument should be checked, the source of the gross deviation identified and corrections made. A new standard curve may be required depending on the action taken to correct the deviation. If changes were minor, another daily standard can be run. If the standard meets the acceptable limits, a new calibration curve will not be necessary.

An additional standard check will be run every ten samples to assure GC conditions have not changed from the initial daily standard check. This standard will be compared to the respective daily quantitation standard for retention time, response factors, and any visible chromatographic abnormalities. If retention times are outside the retention time windows or the response factor % difference is > 15% (>20% for confirmation), then all samples analyzed after the standard failing criteria and before the next good standard check will be reanalyzed.

K6.2.2.3 Calibration Records

The project specific linearity and retention time window data are reported on GC standard summary sheets and are stored along with the chromatograms in the calibration section of the laboratory operations file by instrument and date in the GC lab.

All nonproject specific initial calibration curves or data are filed in the GC lab in the calibration section of the laboratory operations file by instrument and then date, but distinguished from the project specific calibration data. When an initial calibration is replaced by a new initial calibration, it will be marked as deleted, initialed, and dated in the top right side and remain in the filing system.

The daily standards will be filed with respective projects and cross-referenced with the applicable initial calibration data.

K6.2.3 Atomic Absorption Spectrophotometer (AA)

K6.2.3.1 Calibration

Light source and optical system: The AA signal is the ratio between the initial source intensity and the intensity after the absorption process. The optimum initial source intensity for each element is provided as recommended lamp currents by instrument manufacturers.

Chemical and flame factors: Unless the fraction of atoms in both standard and samples that get aspirated into the flame are the same, inaccurate data will result. Matrix effects in samples are the primary cause of this difference. Matrix effects can be minimized by closely matching the solvent, acid concentration and the concentration of other major anions and cations in the standards with the samples.

Errors due to different matrices also can be minimized by using the standard addition method of calibration.

Because atoms absorb monochromatic light at the primary wavelength, any ionization during sample atomization will decrease sensitivity. This ionization effect, which is most pronounced for the alkali and alkaline earth elements, is minimized by adding an ionization buffer to all sample and standards.

The formation of refractory compounds in the flame also causes a loss of sensitivity. This problem can be minimized by the use of nitrous oxide-acetylene flame or using releasing agents. Method handbooks and instrument manufacturer instruction manuals provide guidance regarding the correct choice of fuel, oxidant, type of flame (rich or lean) and ionization buffers or releasing agents.

The initial determination and continued verification of the baseline noise, sensitivity and linear working range of each element are the important instrument calibration and operation considerations. In operating an atomic absorption system, a number of variables must be held constant before the system is in statistical control. These variables include instrument warm-up, burner alignment, flame type, fuel, oxidant, lamp intensity, slit width, wavelength, matrix effects, aspiration time and aspiration rate. The following applies (with further detail to be found in the manufacturer's literature):

- Install the correct lamp, set the recommended current, wavelength and spectral bandpass.
- Light the burner, allow it to stabilize and adjust its position for maximum absorbance using a midscale standard.
- Prepare standards in the recommended concentration range (see Table K6-1).

- The sensitivity is the concentration of an element that will produce an absorbance of 0.0044.

  Example: Absorbance if 1 µg/ml = 0.060 $\frac{0.0044}{0.060} = 0.073$

- The AA system shall be warmed-up until the output is stable (usually about 30 minutes. The hollow cathode lamp will be aligned to produce the maximum emitted light to the detector. In flameless AA, the inert gas flow inside the furnace must be optimized to provide maximum sensitivity.

- Aspirate the most concentrated calibration standard to be used and adjust the scale expansion to obtain full-scale output. Successively, aspirate the remaining standards (for a total of at least three) and the standard blank. Construct a calibration curve, from which the concentration of the samples is determined. A single standard addition is used on all samples, unless it has been determined to be unnecessary for a given sample matrix.

- The readout values obtained for the standard curve of each element should fall within a specified range. If readings are excessively low, the operator should check gas flow, burner or cell alignment, wavelength, slit width, photomultiplier voltage, and lamp intensity prior to analysis.

- Output from the instrument is to a suitable strip chart recorder or printer, which allows continuous monitoring of baseline noise, lamp stability, etc., and provides hard copy of all raw data.

- Any deviation from historical values indicates that some aspect of the instrument is malfunctioning or deteriorating (such as a lamp). Before proceeding, correction shall be made.

- If large amounts of dissolved salts are present in the solution to be analyzed, the nebulizer will not handle the solution in the same manner as it will a solution with a small quantity of dissolved salts. Such an interference should be accounted for by adding a salt to the standards or by matching the density of the samples and standards or by use of the method of standard additions.

K6.2.3.2 Record Storage

The charts for each instrument and each day contain calibration and sample raw data and associated calculations. Each chart is given a number. The charts are numbered sequentially and filed in the AA storage area. The charts are cross-referenced in the laboratory project files.

K6.2.4 Inductively Coupled Argon Plasma Spectrometer (ICAP)

K6.2.4.1 Initial Calibration

- A high level calibration standard of all elements is analyzed. (More than one solution may be required to cover all of the elements.)
- A calibration blank prepared at the same acid concentration as the calibration standards is analyzed.
- The ICAP computer does a linear regression using the standard and the blank and constructs the calibration curve for each element.

K6.2.4.2 Daily Calibration

An instrument check standard containing elements at a concentration equivalent to the midpoint of their respective calibration curves is analyzed. The standard(s) is prepared using standards from a different source than the calibration standards. The recovery of the daily standard must be within 90-110%.

K6.2.4.3 Record Storage

Each day's data consisting of calibration data and sample data is numbered. The charts are numbered sequentially and stored in ICAP storage areas. The charts are cross-referenced in the laboratory project files.

K6.2.5 TOC

This procedure is specific to the O.I. instrument used by ITASK.

- Set I.R. at zero so millivolt output is between 1-10 mv and fasten pump head.
- Analyze reagent blanks until the values for each type of analysis are consistent (± 0.5 mv) for four consecutive runs, average each value and enter average value in "calibration constants" display mode.
- Calculate the standard mass in µg of the calibrating, working standard of interest and enter the value in "calibration constants".
- Analyze the calibration standard at least four times. The standard deviation for three consecutive runs must be less than 5%; enter the average millivolt value in the"calibration constant" display mode.

- Analyze a water blank until all appropriate analyses are less than 1.0 ppm.
- Analyze standards of the other types of carbon analyses which are required for a project that are different than the calibration standard. If the average standard value for three consecutive runs of these standards falls within ± 10% of the true value, proceed with sample analysis.

Calibration data and charts are filed by project in the laboratory project files.

K6.2.6 High Pressure Liquid Chromatograph (HPLC)

K6.2.6.1 Initial Calibration

A minimum of three (3) concentrations are analyzed. The results may be used to prepare a calibration curve for each analyte. Alternatively, linearity through the origin may be assumed if the present relative standard deviation (%RSD) of the response factor is ≤ 20% and an average response factor used.

K6.2.6.2 Daily Calibration

A daily standard is analyzed for each analyte. The daily response must be within ± 15% of the predicted response using the initial calibration data.

K6.2.6.3 Standard Check

A standard check is run every ten samples to assure HPLC conditions have not changed from initial daily standard check. This standard is compared to the respective daily standard for retention time, peak heights, response factor, and any visible chromatographic abnormalities. If there is significant deviation in these characteristics, all samples analyzed after the last good standard check and before the next good standard check will be reanalyzed.

K6.2.6.4 Record Storage

Three-point calibration curves are filed by date with the project they were run with. The daily standards are filed with their respective projects and cross referenced with the applicable three-point chromatograms.

K6.2.7 Ion Chromatography

A calibration curve is prepared by injecting standards, (single anion or mixture). The order of retention is always F^-, Cl^-, NO_2^-, Br^-, NO_3^-, PO_4^{3-}, SO_4^{2-}. Inject at least three concentrations for each anion plus a blank. This will produce a calibration curve with a peak height vs. concentration per anion. If linearity is established for a given detector setting, (correlation coefficient > 0.995) it is acceptable to calibrate with a single standard. The daily calibration standard must be within ± 10% of the calibration curve. Calibration data is stored at the instrument in the instrument logbook.

K6.2.8 Ultra Violet/Visible Light UV/VIS Spectrophotometry

Wavelength accuracy - can be checked using optical glass filters or chemical solutions which exhibit absorption spectra with strong, sharp peaks. Didymium glass has a strong absorption line at 585 nm. Nickel, cobalt, chromium, and holmium oxide solutions can also be used to check wavelength accuracy. Prepared solutions are also available for this purpose. Note that the absorption peaks may be shifted on instruments with wide band widths. If the wavelength accuracy checks do not meet specifications quoted for the instrument, have it serviced immediately.

Stray light - is defined as all undesired radiant energy reaching the detector. Stray light causes deviation from Beer's law. Stray light of 0.5 and 5.0 percent causes a deviation of 2 and 15 percent respectively, at an absorbance of one. To check for stray light problems: Prepare a solution of 0.16g potassium chromate per liter in 0.05N potassium hydroxide. Set the instrument wavelength to 374nm and measure the transmittance of the solution. It should be less than 0.05 percent or within instrument specification. If it is greater, check for obvious leaks or have the instrument serviced.

Length and positioning of sample cells can affect the absorbance measured. Do not assume that a group of cells have the same path length as their listing. A common mistake is to develop a standard curve with one cell and then measure samples with another. Measure the absorbance of the cobalt solution described above at 510nm using all cells. Set aside all cells with absorbances that do not agree within 1 percent. Cell windows must be clean, and the cells can be reproducibly placed in the spectrophotometer.

Photometric linearity - is measured by the additivity of absorbance values. Instrument linearity can be evaluated by measuring the absorbance of serial dilutions of chromium, cobalt and nickel solutions. Calibration records are kept in a logbook at the instrument.

K6.2.9 pH Meter

Calibration is obtained by using 2 commercial buffers at concentrations to bracket the expected sample concentration range. Calibration records are kept in a logbook at the instrument.

K6.2.10 *Conductivity Meter*

Calibration is performed using a 0.01m solution of KCL and water with a conductivity of less than 1 µmhos/cm. Equilibrate the solution at 25°C. Rinse the electrode in the above KCL solution and measure the conductivity. The conductivity should be approximately 1400 µmhos/cm. The cell is replaced or new standards are made if results are outside 1400 ± 30 µmhos/cm. Calibration records are kept in a logbook at the instrument.

K6.3 Periodic Calibration

K6.3.1 Balances

Calibration: all balances are serviced quarterly under a maintenance contract with a balance service company. Using class "S" weights, the analytical balances are checked daily. The results are recorded in a logbook. For balances which are direct reading to 0.01 gram, the acceptance criteria for the calibration check is ± 0.01g for 0 to 100g and ± 0.1 percent of the applied weight over 100g. If the daily calibration check is not acceptable, the balance will be serviced as needed. The balances are calibrated to at least 95% capacity a minimum of once every 3 months. Calibration records are kept in the balance room.

K6.3.2 Thermometers

Thermometers are all directly tracable to NBS thermometers. All working thermometers are calibrated annually using NBS traceable thermometers.

K6.4 Summary of ITASK Calibration Requirements

Requirements for ITASK instrument calibration are summarized in Tables K6-1 and K6-2. Table K6-2 shows a list of instrument logs maintained by the laboratory.

Table K6-1. Summary of Operational Calibration Requirements

Instrument	Calibration Standards Used, Initial and Daily Minimum	Acceptance Limits	Corrective Actions	Reference[1]
Atomic Absorption Spectrophotometer	Initial: 3 levels + blank Daily: 1 check standard (midrange) per 10 samples;	Linear regression correlation coefficient >0.995; Daily check std 90-110% recovery	Make new standards or establish new calibration curve	1,2
Gas Chromatograph	Initial: 3-5 levels	Std curve or calibration factor (CF) if % RSD <20;	Make new standards or establish new calibration curve	1
	Daily: 1 level of check standard	CF < ± 15% of initial calibration		
	Std check every 10 samples	CF ± 15% of daily calibration (< ± 20% for confirmation). Retention times within retention time windows. (For methods using retention time windows.)		
Inductively Coupled Plasma Emission Spectrophotometer	Initial: high standard + blank Daily: Instrument check standard and calibration blank every 10 samples	Check std 90-110%	Recalibrate. Repeat twice; if outside control limit, then: recalibrate and make new stds if necessary	3
Ion Chromatograph	Initial: 3 levels + blank Daily: 1 level of check standards every 10 samples (midrange)	Linear regression correlation coefficient >0.995 Daily: ± 10% of original curve	Make new standards, recalibrate	4

Table K6-1. Summary of Operational Calibration Requirements (cont.)

Instrument	Calibration Standards Used, Initial and Daily Minimum		Acceptance Limits	Corrective Actions	Reference[1]
pH Meter	Daily:	2 levels	±0.05 pH unit Bracket sample range	Clean or replace electrod; recalibrate	1
UV-Visible Spectrophotometer	Initial: Daily: Monthly:	3 levels + blank Check standard Wavelength accuracy and photometric linearity	Std curve + 10% of initial calibration Manufacturer specifications ± 10% previous observations	Recalibrate Service Service	5
HPLC	Initial: Daily:	3 levels + blank Check standard and check std every 10 samples	Std curve or calibration factor % RSD <20% 15% of original curve	Make new standards and/ or establish a new calibration curve.	
Total Organic Carbon	Daily:	1 level + blank	± 10% of true value	Make new standards	1
GC/MS	Tune: Initial: Daily:	BFB or DFTPP 5 levels + blank 1 level	Meets criteria %RSD <30% (CCC) ± 25% of initial curve (CCC) Retention time ± 30 sec for internal standards	Make new standard recalibrations	1
Conductivity Meter	Daily: (when used)	1 level	Direct reading approximately 1400 ± 30 µmhos/cm	Clean or replace cell	6

References:
1) EPA SW-846, "Test Methods for Evaluating Solid Waste"
2) USEPA Methods for Chemical Analysis of Water and Wastes, 1979
3) USEPA 200.7, 1982
4) USEPA 300.0, 1984
5) Directions for DIDYMIUM Calibrating Standard Coleman No. 6-400. Perkin Elmer 12/1972
6) Instrument Manual

Table K6-2. Summary of Periodic Calibration Requirements

Instrument	Calibration Frequency	Acceptance Limits	Corrective Actions	Reference
Analytical Balance	Daily: Sensitivity (with Class "S" weight)	0.001 gm Difference less than 0.1 mg	Adjust, sensitivity	QA 841214R1-3
Thermometers	Calibrate in constant temperature baths at two temperatures against precision thermometers certified by NBS annually	$\pm 0.5^{\circ}C$	Tag and remove from service, replace	QA 860626R0
Pipettors	Gravimetric check semi-annually	High volume (>100 µL): < 1.0% relative error and RSD Low volume (<100 µL): < 2.0% relative error and RSD	Service or replacement	QA 870624R0

TABLE K6-3

Table of maintained instrument log books at ITASK Laboratory (each log sheet includes: Date of Review, Initials of person entering data and/or observations).

A. Extraction Lab Logs (pipettors)

B. GC Analysis Logs

C. GC/MS Analysis Logs

D. GC Maintenance Logs

E. GC/MS Maintenance Log

F. Refrigerator Temperature Logs

G. Analytical Balance Check Logs

H. Freezer Temperature Logs

I. AA/ICAP Run Logs

J. AA/ICAP Maintenance Logs

K. Misc. Lab Logs

L. Misc. Lab Maintenance Logs

M. Conductivity Logs

9 1 1 2 7 6 4 0 3 6 6

K7.0 PREVENTIVE MAINTENANCE

The ITASK Preventive Maintenance Program was developed to meet and supplement the guidelines prescribed by the ITAS QA Manual. Routine preventive maintenance procedures are the responsibility of the individual Group Leaders. A department specializing in equipment and instrument maintenance has been created for this laboratory. The ITASK Instrument Maintenance Specialist performs in-house corrective maintenance and may perform the more difficult and intricate preventive maintenance procedures.

Table K7-1 summarizes the preventive maintenance requirements for the ITASK laboratory. The table lists the instruments and equipment included in the program, items to be checked/serviced and the frequency of the required maintenance procedure. Figures K7-1 through K7-15 are examples of the Preventive Maintenance Records maintained by the laboratory.

Preventive maintenance records are kept in each laboratory department either in a central file or in individual instrument/equipment logbooks. A copy of the preventive maintenance schedule is placed in the front of the respective instrument/equipment logbook. Documentation of the preventive maintenance procedures are recorded in the logbook as they are performed. Specifics for preventive maintenance are detailed in the respective instrument maintenance S.O.P.'s.

For reference, a central file listing the instruments and equipment covered by the Preventive Maintenance Program is kept in the Instrument Maintenance Shop. Maintenance frequency and items to be checked/serviced are listed (Table K7-1). Behind this table, filed by department, are examples of the preventive maintenance records and a listing of the spare parts routinely maintained by the laboratory.

TABLE K7-1

Preventive Maintenance Requirements
Knoxville Laboratory Operations

INSTRUMENT	ITEMS CHECKED/SERVICED	FREQUENCY
Inductively Coupled Argon Plasma (ICAP)	Replace Pump Tubing	As needed
	Inspect and Clean Sample Introduction System	As needed
	Drain Air Filters	Semi-weekly
	Check Drain Receptacle Level	Weekly
	Clean Torch	Monthly
AA 151B For Mercury Analysis (AVA)	Replace Check Valves	As needed
	Check Pump Delivery	As needed
	Check Tubing Integrity	As needed
	Clean Burner/Adsorption Cell Mount	Monthly
	Clean Adsorption Cell	Monthly
	Replace System Tubing	Semi-Annually
Atomic Absorption Spectrophotometer - Flame Units	Inspect Backflash Diaphram	As needed
	Check Drain Receptacle Level	As needed
	Replace Nebulizer Chamber O-rings	As needed
	Replace Beam Splitter	As needed
	Clean Nebulizer	Weekly
	Clean Burner Head	Weekly
	Clean Spray Chamber	Weekly
	Remove and Clean Burner Mount	Monthly

TABLE K7-1 (continued)

INSTRUMENT	ITEMS CHECKED/SERVICED	FREQUENCY
Graphite Furnace 951/655	Replace Graphite Cuvette	As needed
	Replace Dry-Rite and Glass Wool	As needed
	Check Drain Receptacle	As needed
	Replace Temperature Sensor	As needed
	Clean Electrodes	As needed
	Replace Graphite Inserts	As needed
	Replace Electrodes and Sensor Posts	As needed
	Check Graphite Insert	Weekly
	Check Recirculator Water Level	Weekly
	Replace Set Screw	Weekly
	Check Electrode Appearance	Weekly
	Clean Nebulizer and Spray Chamber	Monthly
	Clean Furnace Chamber and Windows	Monthly
	Flush Furnace Head with Acetic Acid	Semi-Annually
	Replace Recirculator Water	Semi-Annually
Graphite Furnace 12E/188	Check Drain Receptacle	As needed
	Clean Saphire Window	As needed
	Replace Graphite Cuvette	As needed
	Clean Cell Body and Windows	Weekly
	Replace Marble Chips	Weekly
	Check Recirculator Water Level	Weekly
	Clean Temperature Sensor Filter	Semi-Monthly
	Clean FASTAC Pump	Monthly
	Clean Nebulizer and Spray Chamber	Monthly
	Clean Air Filter	Monthly
	Flush Furnace Head with Acetic Acid	Semi-Annually
	Replace Recirculator Water	Semi-Annually

TABLE K7-1 (continued)

INSTRUMENT	ITEMS CHECKED/SERVICED	FREQUENCY
High Performance Liquid Chromatography (HPLC)	Degas Solvents	Daily when used
	Check for Leaks	Daily when instrument used
	Flush Column	Daily when instrument used
	Check Injector for Blockage/ Pressure Drop	Daily when instrument used
	Check Column Pressure	Daily when instrument used
	Replace Lamp	As needed
	Replace Guard Column	As needed
Organic Prep: Sonicator	Inspect Probe Tips for Etching/ Pitting	Daily when used
	Replace Probe Tip	As needed
	Disassemble and Clean Sonicator Probe Tips	Semi-Annually
	Tune Sonicator	Semi-Annually
pH Meters	Gel Filled Maintenance Free Electronics Checked	As needed
UV/VIS Spectrophotometer	Replace Lamp	As needed
	Check Wavelength	Monthly
Millipore Water System	Conductivity Checked	Daily
	Pressure Check	Daily
	Change Ion Exchange Bed and Filters	As needed
Analytical Balance	Internal Weight Train, Gears Electronics	Annually by Service Contract

TABLE K7-1 (continued)

INSTRUMENT	ITEMS CHECKED/SERVICED	FREQUENCY
Ion Chromatograph	Degas Pump Head	As needed
	Rebuild Pump Head	As needed
	Clean/Replace Cell Packing	As needed
	Change Column	As needed
	Check Plumbing	Daily when in use
	Check Bed Support by Monitoring Pressure	Daily when in use
	Replace Plunger Seals	Semi-Annually
	Clean Check Valve	Semi-Annually
	Oil Pumps	Semi-Annually
Refrigerators	Temperature Checked and Logged	Daily
Walk-in Coolers	Temperature Checked and Logged	Daily
Ovens	Temperature Checked and Logged	Daily

TABLE K7-1 (continued)

INSTRUMENT	ITEMS CHECKED/SERVICED	FREQUENCY
Gas Chromatograph	Inlet, Detector and Column Temperatures	Daily when instrument in use
	Gas pressures	Daily
	Column and Detector Flow Rates	Daily when instrument in use
	Check Zero and Noise Level	Daily when instrument in use
	Check Responses, Retention Times Using a Check Standard	Daily when instrument in use
	Check Autosampler for Bubbles, Flush Volume	Daily when instrument in use
	Check Electrolyte Level and Flow Rate (HALL only)	Daily when instrument in use
	Reactor Tube Temperature (HALL only)	Daily when instrument in use
	Check Pressure in Gas Tanks, Replace in <500 PSI	Weekly
	Clean Outside Surfaces of Instruments	Weekly
	Replace Septa	As needed
	Replace Column or Part of Column Packing	As needed
	Clean/Replace Detector	As needed
	Replace Glass Wool/Glass Insert	As needed
	Clean Injection Port	As needed
	Replace Reaction Tube (HALL only)	As needed
GC Purge and Trap GC Purge and Trap Autosampler	Check Zone Temperatures	Daily when in use
	Helium Tank Pressure (>500 PSI)	Daily when in use
	Purge and Trap Regulator Pressure (20 PSI)	Daily when in use
	Bake Trap	Daily when in use
	Replace Trap	As needed
	Acid Wash Purge Vessel	As needed
	Leak Test	As needed

TABLE K7-1 (continued)

INSTRUMENT	ITEMS CHECKED/SERVICED	FREQUENCY
Total Organic Carbon Analyzer	Gas Tank Pressures	Daily when in use
	N_2 and O_2 Regulator Pressures	Daily when in use
	Zone Temperature	Daily when in use
	Purge and Detector Flow Rates	Daily when in use
	Clean Port Valves	After 72 hrs of operation
	Purge Gas and Detector Leak Test	After 72 hrs of operation
GC/MS	Diffusion Pump Oil	Bi-Weekly
	Mechanical Pump Oil	Quarterly
	Power Con. Air Filter	Bi-Weekly
	QEM Filter	Bi-Weekly
	Water Bay Filter	Bi-Weekly
	Interface Box	Bi-Weekly
	Vacuum Chaff Filter	Monthly
	Turbo Pump Oil	Quarterly
	Water Filter (if applicable)	Observe and change as needed
	Computer Air Filter	Monthly
	Card Cage Air Filter	Monthly
	Source-Clean Ceramics, Polish Lenses	As needed
	Clean Poles and Ceramics on the Poles	As needed
	Clean Contacts on the Component Boards	As needed
	Vacuum the Component Boards	As needed
	Clean All Fan Screens	Weekly
	Vacuum Outside of Instrument	Weekly
	Clean Grob and Replace Quartz Insert	As needed
	Replace Septum	Daily (each shift)
	Injection Port Liner Checked	Daily
	Column maintenance	As needed
	Disk Drive (CMD only)	Semi-Annual (Service Engineer) or as needed
	Printer	Quarterly

Figure K7-1

Example - AA Preventive Maintenance Record - Week 1

PREVENTIVE MAINTENANCE - METALS
_____ - WEEK 1

ITEM (FREQUENCY)	INITIALS/DATE
General Laboratory	
Drain Air Compressor (W)	_____
Clean Lab Area (General Housekeeping) (W)	_____
Clean Fume Hood - Prep (W)	_____
Clean Fume Hood - Mercury (M)	_____
Clean Hot Plates (M)	_____
Dispose of Sample Digestates - Organize Shelves (M)	_____
Inductively Coupled Argon Plasma (ICAP) Unit	
Clean Air Filters (BW)	_____
Clean Air Filters (BW)	_____
Check Drain Receptacle Level (W)	_____
Clean Torch (M)	_____
Mercury Analysis - 151B with Automatic Vapor Accessory (AVA)	
Clean Burner/Absorption Cell Mount (M)	_____
Clean Absorption Cell (M)	_____
Flame Atomic Absorption Spectrophotometer Unit(s)	
Clean Nebulizer (W)	_____
Clean Burner Head (W)	_____
Clean Spray Chamber (W)	_____
Remove & Clean Burner Mount (M)	_____
Graphite Furnace 951/655	
Check Graphite Insert (W)	_____
Check Recirculator Water Level (W)	_____
Replace Set Screw (W)	_____
Check Electrode Appearance (W)	_____
Clean Nebulizer & Spray Chamber (M)	_____
Clean Furnace Chamber & Windows (M)	_____
Graphite Furnace 12E/188	
Clean Cell Body & Windows (W)	_____
Replace Marble Chips (W)	_____
Check Recirculator Water Level (W)	_____
Clean FASTAC Pump (M)	_____
Clean Nebulizer & Spray Chamber (M)	_____
Clean Air Filter (M)	_____
Clean Temperature Sensor Filter (BM)	_____

9 1 1 2 7 4 0 3 7 4

Figure K7-2

Example - AA Preventive Maintenance Record - Week 2

PREVENTIVE MAINTENANCE - METALS
_____ - WEEK 2

ITEM (FREQUENCY)	INITIALS/DATE
General Laboratory	
Drain Air Compressor (W)	
Clean Lab Area (General Housekeeping) (W)	_____
Clean Fume Hood - Prep (W)	_____
	_____
Inductively Coupled Argon Plasma (ICAP) Unit	
Clean Air Filters (BW)	
Clean Air Filters (BW)	_____
Check Drain Receptacle Level (W)	_____
	_____
Mercury Analysis - 151B with Automatic Vapor Accessory (AVA)	
Flame Atomic Absorption Spectrophotometer Unit(s)	
Clean Nebulizer (W)	
Clean Burner Head (W)	_____
Clean Spray Chamber (W)	_____
	_____
Graphite Furnace 951/655	
Check Graphite Insert (W)	
Check Recirculator Water Level (W)	_____
Replace Set Screw (W)	_____
Check Electrode Appearance (W)	_____
	_____
Graphite Furnace 12E/188	
Clean Cell Body & Windows (W)	
Replace Marble Chips (W)	_____
Check Recirculator Water Level (W)	_____
	_____

Figure K7-3

Example - AA Preventive Maintenance Record - Week 3

PREVENTIVE MAINTENANCE - METALS
_____ - WEEK 3

ITEM (FREQUENCY)	INITIALS/DATE
General Laboratory	
Drain Air Compressor (W)	_____
Clean Lab Area (General Housekeeping) (W)	_____
Clean Fume Hood - Prep (W)	_____
Inductively Coupled Argon Plasma (ICAP) Unit	
Clean Air Filters (BW)	_____
Clean Air Filters (BW)	_____
Check Drain Receptacle Level (W)	_____
Mercury Analysis - 151B with Automatic Vapor Accessory (AVA)	
Flame Atomic Absorption Spectrophotometer Unit(s)	
Clean Nebulizer (W)	_____
Clean Burner Head (W)	_____
Clean Spray Chamber (W)	_____
Remove & Clean Burner Mount (M)	_____
Graphite Furnace 951/655	
Check Graphite Insert (W)	_____
Check Recirculator Water Level (W)	_____
Replace Set Screw (W)	_____
Check Electrode Appearance (W)	_____
Graphite Furnace 12E/188	
Clean Cell Body & Windows (W)	_____
Replace Marble Chips (W)	_____
Check Recirculator Water Level (W)	_____
Clean Temperature Sensor Filter (BM)	_____

9 1 1 2 3 6 4 0 3 7 6

Figure K7-4

Example - AA Preventive Maintenance Record - Week 4

PREVENTIVE MAINTENANCE - METALS
_____ - WEEK 4

ITEM (FREQUENCY)	INITIALS/DATE
General Laboratory	
Drain Air Compressor (W)	_____
Clean Lab Area (General Housekeeping) (W)	_____
Clean Fume Hood - Prep (W)	_____
Inductively Coupled Argon Plasma (ICAP) Unit	
Clean Air Filters (BW)	_____
Clean Air Filters (BW)	_____
Check Drain Receptacle Level (W)	_____
Mercury Analysis - 151B with Automatic Vapor Accessory (AVA)	
Flame Atomic Absorption Spectrophotometer Unit(s)	
Clean Nebulizer (W)	_____
Clean Burner Head (W)	_____
Clean Spray Chamber (W)	_____
Graphite Furnace 951/655	
Check Graphite Insert (W)	_____
Check Recirculator Water Level (W)	_____
Replace Set Screw (W)	_____
Check Electrode Appearance (W)	_____
Graphite Furnace 12E/188	
Clean Cell Body & Windows (W)	_____
Replace Marble Chips (W)	_____
Check Recirculator Water Level (W)	_____

Figure K7-5

Example - AA Preventive Maintenance Record - Week 5

PREVENTIVE MAINTENANCE - METALS
JANUARY - WEEK 1

ITEM (FREQUENCY)	INITIALS/DATE
General Laboratory	
Drain Air Compressor (W)	_____
Clean Lab Area (General Housekeeping) (W)	_____
Clean Fume Hood - Prep (W)	_____
Clean Fume Hood - Mercury (M)	_____
Clean Hot Plates (M)	_____
Dispose of Sample Digestates - Organize Shelves (M)	_____
Inductively Coupled Argon Plasma (ICAP) Unit	
Clean Air Filters (BW)	_____
Clean Air Filters (BW)	_____
Check Drain Receptacle Level (W)	_____
Clean Torch (M)	_____
Mercury Analysis - 151B with Automatic Vapor Accessory (AVA)	
Clean Burner/Absorption Cell Mount (M)	_____
Clean Absorption Cell (M)	_____
Replace System Tubing (BA)	_____
Flame Atomic Absorption Spectrophotometer Unit(s)	
Clean Nebulizer (W)	_____
Clean Burner Head (W)	_____
Clean Spray Chamber (W)	_____
Remove & Clean Burner Mount (M)	_____
Graphite Furnace 951/655	
Check Graphite Insert (W)	_____
Check Recirculator Water Level (W)	_____
Replace Set Screw (W)	_____
Check Electrode Appearance (W)	_____
Clean Nebulizer & Spray Chamber (M)	_____
Clean Furnace Chamber & Windows (M)	_____
Flush Furnace Head with Acetic Acid (BA)	_____
Replace Recirculator Water (BA)	_____
Graphite Furnace 12E/188	
Clean Cell Body & Windows (W)	_____
Replace Marble Chips (W)	_____
Check Recirculator Water Level (W)	_____
Clean FASTAC Pump (M)	_____
Clean Nebulizer & Spray Chamber (M)	_____
Clean Air Filter (M)	_____
Clean Temperature Sensor Filter (BM)	_____
Flush Furnace Head with Acetic Acid (BA)	_____
Replace Recirculator Water (BA)	_____

Figure K7-6

EXAMPLE - HPLC PREVENTIVE MAINTENANCE RECORD

Maintenance Performed	Date/Initials				
1) Check column pressure & injector system for pressure drop					
2) Flush column (organic flush)					
3) Leak check					
4) Degas solvents					
5) Replace or change guard column or column					
6) Replace lamp					
Other (Specify) _____ _____ _____ _____					

Maintenance Frequency: Items 1-4 are performed daily when the instrument is in use. Other items are performed on an as needed basis.

9 1 1 2 1 1 0 1 0 7 2 7 9

Figure K7-7

EXAMPLE - SONICATOR PREVENTIVE MAINTENANCE RECORD

Maintenance Performed	Date/Initials				
Inspect probe tips for etching/pitting					
Replace probe tip					
Disassemble and clean probe tip					
Tune sonicator					
Other (Specify) _____ _____ _____ _____					

Maintenance Frequency:

Inspect probe tips daily when used

Replace probe tip as needed

Disassemble and clean probe tip semi-annually

Tune Sonicator semi-annually

Figure K7-8

Example - UV/VIS Preventive Maintenance Record

06

Date	λ of min. Trans.	Adjustment Not Required	Adjustment Required	Action Taken	Initials
4/5/85	585		✓	Reading unsteady w/ empty sample well; changed lamp — no help; cleaned bottom & blew some dust out — seems OK now	GHW
7/23/85	585	✓		Same thing, but this time new lamp & cleaning did not help — call PE	GHW
3/23/87	585	✓		Normal calibration test run	DFW
~~7/10/87~~ 7/10/87	585	✓		—	DFW.
8/28/87	585	✓		—	DFW
9/87	—	—	—	No Calib. check made	DFW
10/9/87	585	✓		No problems, no maintenance needed	DFW
11/13/87	585.	✓		No vis. problem, no main. required	DFW
12/11/87	585.	✓		No maintenance required	DFW
1/26/88	585.	✓		No maintenance required	DFW
2/15/88	585.	✓		No maintenance required	DFW
3/2/88	585.	✓		No maintenance required	DFW
4/15/88	585	✓		- - -	DFW
5/23/88	585	✓		—	DFW
6/9/88	585	✓		—	DFW

Figure K7-9

Example - UV/VIS Preventive Maintenance Record

Exciter Lamp Changes: Date:	Analyst Initials:
① 2-4-81	DCH
② 5-4-81	DCH
③ 3-2-83	KLD
④ 12-29-83	DJW
⑤ 7-22-85	DJW
⑥ 8-21-85	KLD
⑦ 9-30-85	DJW
⑧ 11-11-85	KLD
⑨ 1-23-86	KLD
⑩ 3-20-86	DJW
⑪ 4-16-86	KLD
⑫ 5-15-86	LWC
⑬ 8-19-86	LWC
⑭ 11-10-86	DJW
⑮ 2-5-87	KAK
⑯ 5-11-87	DJW
⑰ 7-6-87	KAK/DFW
⑱ 12-11-87	D.J.W.
⑲ 2-8-88	KAK
⑳ 5-23-88	DJW
㉑ 7-6-88	DJW
㉒ 9-12-88	DJW

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Figure K7-10

Example - Millipore Water System Preventive Maintenance Record

71

Year: 1988

Mo.	Day	Resistivity (mega Ohms)	Time of Reading	(Pressure) PSI	Initials
July	11	-17-	08 30	10.5	DHW
"	12	-17-	09 10	10.5	DHW
July	13	No Reading Recorded This Date			
"	14	No Reading Recorded This Date			
July	15	-17-	16 00	12.5	DHW
"	18	-17- (Filter change)	14 00	20.5	DHW
July	19	-17-	10 30	19.5	DHW
"	20	-17-	08 30	16.5	DHW
July	21	-17-	10 45	15.5	DHW
"	25	-17-	14 05	15.5	DHW
July	26	No Readings Recorded This Date			
"	27	-17-	09 30	15.0	DHW
July	28	No Readings Recorded This Date			
"	29	-17-	08 45	15.0	DHW
August	1	-17-	1553	18.0	RSR
"	2	-17-	0905	15.0	RSR
August	3	-16-	0830	17.5	DHW
"	4	Changed filters -17-	10 00	15.0	DHW
August	5	-17-	1215	14.0	DHW
"	8	No Readings Recorded This Date			
"	9	-17-	1605	15.5	RSR
August	10	No Readings Recorded This Date			
"	11	-17-	08 30	14.5	DHW
August	12	-17-	09 20	14.5	DHW
August	15	-17-	0730	18.0	RSR
"	16	No Readings Recorded This Date			
"	17	No Readings Recorded This Date			
"	18	-17-	1449	15.5	RSR
Aug	19	No Readings Recorded This Date			
"	22	No Reading Recorded This Date			
Aug	23	-17-	10 15	14.0	DHW
"	24	-17-	08 05	14.0	DHW

Figure K7-11

Example - Ion Chromatograph Preventive Maintenance Record

INTERNATIONAL TECHNOLOGY CORPORATION

By _____ Date _____ Subject Ion Chromatograph Preventive Maintenance Sheet No. ____ of ____
Chkd. By ____ Date _____ INSTR. _____

1989	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
1												
2												
3												
4												
5												
6												
7												
Semiannually												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												

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Figure K7-12

Example - Daily Temperature Log

DAILY TEMPERATURE LOG

I.D. Number										
Temp Range °C			4 ± 2	-10 ± 2	4 ± 2	20 ± 1	105 ± 2	35 ± 0.5		180 ± 2
Date	Time	Initials								

Figure K7-13

Example - Gas Chromatograph Preventive Maintenance Record

INTERNATIONAL TECHNOLOGY CORPORATION

By _____ Date _____ Subject Gas Chromatograph Daily and Weekly Preventive Maintenance Sheet No. ____ of ____

Chkd. By ____ Date _____ INSTR. _____

1989		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
	1												
	2												
	3												
	4												
	5												
	6												
	7												
weekly													
	8												
	9												
	10												
	11												
	12												
	13												
	14												
weekly													
	15												
	16												
	17												
	18												
	19												
	20												
	21												
weekly													
	22												
	23												
	24												
	25												
	26												
	27												
	28												
weekly													
	29												
	30												
	31												

Figure K7-14

Example - GC/MS Preventive Maintenance Record

GC/MS DAILY PREVENTIVE MAINTENANCE

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
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21												
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24												
25												
26												
27												
28												
29												
30												
31												

Figure K7-15

Example - GC/MS Preventive Maintenance Record

GC/MS MONTHLY AND QUARTERLY PREVENTIVE MAINTENANCE

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	TOTAL

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	TOTAL

K8.0 ANALYSIS OF QUALITY CONTROL SAMPLES

This section of the ITAS QA Manual discusses samples which are routinely added to the normal laboratory sample stream to demonstrate that the laboratory is operating within prescribed requirements for accuracy and precision. The following discussion supplements the ITAS Quality Assurance Manual, only those points of the ITASK routine program that vary from the ITAS QA Manual are addressed. As stated in the ITAS QA Manual, specific analytical procedures may prescribe different QC samples.

K8.1.4 Method Blank Analyses

A method blank is included with each group of samples or one per twenty whichever is more frequent. All GC/MS method blanks are spiked with surrogate compounds.

K8.1.7 Duplicate Sample Analysis

For organic analyses the duplicate sample may be a spiked duplicate. The frequency of analysis is one MS/MSD pair per twenty (20) samples or at least one per month.

K8.1.14 Blank Spike Analyses

If the results of MS/MSD sample analyses are acceptable, a blank spike analysis is not required.

K8.2 Performance Evaluation and Certification Programs

ITASK routinely participates in several interlaboratory certification and performance evaluation programs. A discussion of laboratory performance programs follows; a current summary of ITASK laboratory certifications is maintained by the Quality Control Coordinator in the Quality/Operations files.

K8.2.1 Laboratory Performance Programs

- The EMSL-LV (Environmental Monitoring Systems Laboratory-Las Vegas) Quarterly Organic Performance Evaluation Study. The evaluation consists of aqueous materials spiked with Hazardous Substance List pollutants, at environmentally representative levels. Samples for all laboratories are from the same homogeneous batch.

- The annual WSPE (Water Supply Performance Evaluation). Samples originate from EMSL-Cincinnati (Environmental Monitoring and Support Laboratory).

- The annual WPPE (Water Pollution Performance Evaluation Study). This study is a continuing effort to provide independent evaluations of the EPA Regional laboratories, State laboratories and selected laboratories for water pollution parameters.

- The NIOSH-Proficiency Analytical Testing (P.A.T.). Participation is required for all laboratories with AIHA Certification. Laboratories participating in P.A.T. must pass to be certified. Samples are received quarterly in two categories: metals and organics.

K9.0 ANALYTICAL PROCEDURES

Details of the procedures followed by ITASK for the analysis of samples are documented in the appropriate individual SOPs (Standard Operating Procedures). The SOPs used by ITASK are collected together into a laboratory Standard Operating Procedures Manual. Activities pretaining to calibration, preventive maintenance and quality control sample analyses are addressed in the appropriate section of the ITASK QA Manual as well as in the SOP Manual.

K9.1 Analytical Methods

Tables K9-1 and K9-2 list the analytical procedures normally used by ITASK for sample analysis. Parameters, approved methods and references are presented. If the laboratory has need to analyze fór a parameter that is not listed in Table K9-1 or K9-2 but is included in the ITAS approved method list, then the ITAS approved method will be used. Any variations from approved methods, which are sometimes necessary due to limited sample quality, unusual sample matrix, etc., should be approved by the Laboratory Manager, or the Operations Manager and the Technical Director.

K9.2 Detection Limits

The ITASK method for reporting detection limits varies from the method described in the ITAS QA Manual. The quantitation limit or Contract Required Quantitation Limit (CRQL) is reported with a "U" qualifier following the value. For GC/MS and Metals CLP analyses the quantitation limit or CRQL is not the actual detection limit. The concentration of GC/MS analyte found below the quantitation limit but above the detection limit are reported with a "J" qualifier following the value. Metals data under CLP protocol uses a "B" qualifier instead of the "J" used by GC/MS. For GC data the quantitation limit or CRQL is assumed to also be the detection limit.

Usually the listed EPA method detection limits are used as the ITASK method detection limit. A higher quantitation limit may be used when the client does not need the lower EPA method detection limits. In other cases, depending upon client needs, detection limits lower than the published limits may be used. Lower detection limits are used only when it can be demonstrated that the reported limits are actually achievable.

Instrument detection limits, when required, are determined as appropriate to the specific analytical method being used.

9 1 1 2 3 6 1 0 3 9 2

TABLE K9-1

List of Approved Test Procedures
ITASK Laboratory Operations

Parameters	Approved Methods		
	SW-846	EPA 1983	Standard Method 16th Edition
1. Acidity		305.2	402
2. Alkalinity		310.1	403
3. Aluminum	7020	202.1 202.2	
4. Ammonia		350.2	
5. Antimony	7041 6010	204.1 204.2 200.7	
6. Arsenic	7060 6010	206.2 200.7	
7. Barium	7080	208.1 200.7	
8. Beryllium	7090 6010	210.1 200.7	
9. Biochemical Oxygen Demand		405.1	507
10. Boron	6010	200.7	
11. Bromide-Ion Chromatography			429
12. Cadmium	7130 7131 6010	213.1 213.2 200.7	
13. Calcium	7140 6010	215.1 200.7	

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TABLE K9-1 (continued)

Parameters	Approved Methods		
	SW-846	EPA 1983	Standard Method 16th Edition
14. Chemical Oxygen Demand (COD)		410.2 410.1	
15. Chloride		325.3	
Ion Chromatography		300.0	429
16. Chlorine-Total Residual		330.5	
17. Chromium VI Dissolved			312B
18. Chromium-Total	7190 6010	218.1 200.7	
19. Cobalt-Total	7200 6010	219.1 200.7	
20. Color		110.2	
21. Copper-Total	7210 6010	220.1 200.7	
22. Cyanide-Total	9010	335.2	
23. Cyanide Amenable to Chlorination		335.1	412F
24. Fluoride-Total		340.2	
Ion Chromatography		300.0	
25. Gold-Total		231.1	
26. Hardness-Total		215.1 + 241.1 200.7	
27. Hydrogen Ion (pH)		150.1	
28. Iron-Total	7380 6010	236.1 200.7	
29. Kjeldahl Nitrogen-Total		351.3	

TABLE K9-1 (continued)

Parameters	Approved Methods		
	SW-846	EPA 1983	Standard Method 16th Edition
30. Lead-Total	7420 7421 6010	239.1, 239.2 200.7	
31. Magnesium-Total	7450 6010	242.1 200.7	
32. Manganese-Total	7460 6010	243.1 200.7	
33. Mercury-Total	7470, 7471	245.1, 245.5	
34. Molybdenum-Total	7480 6010	246.1 200.7	
35. Nickel-Total	7520 6010	249.1 200.7	
36. Nitrate (as N) Ion Chromatography		353.3 300.0	 429
37. Nitrate-nitrite		353.3 300.0	418C 418F
38. Nitrite (as N) Ion Chromatography		 300.0	419 429
39. Oil and Grease-Total recoverable	9071	413.1	503D
40. Organic Carbon-Total (TOC)		415.1	505
41. Organic Nitrogen (as N)			420
42. Orthophosphate (as P)		365.3	
43. Osmium-Total	7550 6010	252.1 200.7	303C
44. Oxygen, dissolved		360 405.1	421B 412F

TABLE K9-1 (continued)

Parameters	Approved Methods		
	SW-846	EPA 1983	Standard Method 16th Edition
45. Palladium-Total		253.1	303A 304
46. Phenols-Total		420.1	556
47. Platinum-Total		255.1	
48. Potassium-Total	7610 6010	258.1 200.7	
49. Residue-Total		160.3	209
50. Residue-filterable (TDS)		160.1	209
51. Residue-nonfilterable (TSS)		160.2	209
52. Residue-settleable		160.5	209
53. Residue-volatile (TVS)		160.4	209
54. Selenium-Total	7740 6010	270.2 200.7	
55. Silica-dissolved		200.7	
56. Silver-Total	7760 6010	272.1, 272.2 200.7	
57. Sodium-Total	7770 6010	273.1, 200.7	
58. Specific Conductance		120.1	
59. Sulfate (as SO^2) Ion Chromatography		375.4 300.0	
60. Sulfide (as S)	9030	376.1	
61. Sulfite (as SO^3)		377.1	428A
62. Surfactants		425.1 Hach*	512A

*Hach Crystal Violet Analytical Chem 38, 791 (1966)

9 1 1 2 3 4 1 0 3 9 6

TABLE K9-1 (continued)

Parameters	Approved Methods		
	SW-846	EPA 1983	Standard Method 16th Edition
63. Temperature, °C		170.1	212
64. Thallium-Total	7841 6010	279.2 200.7	
65. Tin-Total	7870 6010	282.1 200.7	
66. Titanium		283.1 200.7	
67. Vanadium	7910 6010	286.1 200.7	
68. Zinc-Total	7950 6010	289.1 200.7	

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TABLE K9-1 (continued)

EPA Methodologies

Purgeable Halocarbons - Method 601 or 8010

Bromodichloromethane
Bromoform
Bromomethane
Carbon Tetrachloride
Chlorobenzene
Chlorethane
2-Chloroethylvinyl Ether
Chloroform
Chloromethane
Dibromochloromethane
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Dichlorodifluoromethane
1,2-Dichloroethane
1,1-Dichloroethane
trans-1,2-Dichloroethane
1,2-Dichloropropane
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
Methylene Chloride
1,1,2,2-Tetrachloroethane
Tetrachloroethene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Tetrachloroethane
Trichlorofluoromethane
Vinyl Chloride

Purgeable Aromatics - Method 602 or 8020

Benzene
Chlorobenzene
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Ethylbenzene
Toluene

Drinking Water VOC's - Method 502.2 or 524

TABLE K9-1 (continued)

Phthalate Esters - Method 606 or 8060

Bis(2-ethylhexy) phthalate
Butyl benzyl phthalate
Di-n-butyl phthalate
Diethyl phthalate
Dimethyl phthalate
Di-n-octyl phthalate

Organochlorine Pesticides and PCB's - Method 608 or 8080

Aldrin
α-BHC
β-BHC
γ-BHC
δ-BHC
Chlordane
4,4'-DDD
4,4'-DDE
4,4'-DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Endrin
Endrin Aldehyde
Heptachlor
Heptachlor Epoxide
Toxaphene
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260

PAH's (PNA's) - Method 610 or 8100

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g)perylene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,h)anthracene

9 1 1 2 1 0 1 0 3 0 6

TABLE K9-1 (continued)

Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene
Naphthalene
Phenanthrene
Pyrene

Priority Pollutants 1984 October EPA 624
Volatile Organic Compounds (Method 624 or 8240 - Purge and Trap GC/MS)

Extractable Organic Compounds (EPA Method 625 or 8270 - Extraction GC/MS)

REFERENCES

1) Standard Methods for the Examination of Water and Wastewater, 16th Edition.

2) SW-846, Test Methods for Evaluation Solid Waste, Physical, Chemical Methods, 2nd Edition, USEPA, 1982.

3) SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 3rd Edition, USEPA, 1986.

4) Annual Book of ASTM Standards 1983, 1984.

5) EPA-600/4-79-020 Methods for Chemical Analysis of Water and Wastes, Revised March 1983.

6) EPA-600/4-82-057 Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, March 1983.

K10.0 DATA VERIFICATION

The data verification steps described in Revision 1 of the ITAS QAM will be followed by the ITAS-Knoxville laboratory. The modifications used by the ITAS-Knoxville are described below:

K10.1.1. Specific Routine Procedures Used to Assess Data Revision and Accuracy

- The analysis of field, trip, bottle, and rinsate blanks as well as field spikes and duplicates, are performed upon client request.
- The frequency of analysis and criteria for acceptability of quality control samples are described in the appropriate methods or SOPs.
- Blind duplicates will be introduced by the QCC for one major analysis type (volatiles, semivolatiles, pesticides/PCBs, metals, explosives, or general chemistry) per month.

K10.2.1 Review of Data Processing

The "original check" procedure is used by the ITAS-Knoxville laboratory.

K11.0 DATA REPORTS

The format and content of a data report are dependent upon project needs, such as: whether or not explanatory text is required, client or contract requirements, and government agency reporting formats. The ITAS Quality Assurance Program does not specify a report format; however, the following are modifications to the data presentation recommendations in the QAM:

- The final data presentation shall be checked in accordance with data verification requirements of Section 10.2.2 and approved by the Laboratory Manager or Operations Manager.
- Data are generally formatted as a Certificate of Analysis as shown in Figure K11-1, or as the Certificate of Analysis shown in Figure K11-2 for intercompany projects.
- Explanatory text is issued with analytical results as appropriate, e.g., as a case narrative with CLP data packages, as required by the client, and to explain nonconformances/analytical difficulties that have an effect on data interpretation/usage.

Figure K11-1

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

5815 Middlebrook Pike • Knoxville Tennessee 37921 • 615-588-6401

CERTIFICATE OF ANALYSIS

TO

DATE REPORTED
PROJECT CODE
ORDER NUMBER
PAGE _____ OF _____

AUTHORIZED BY

TITLE

AALA Accredited by the American Association for Laboratory Accreditation in the testing field of testing as listed in the current AALA Directory of Accredited Laboratories

93 9 85

9 1 1 2 7 6 4 0 4 0 3

Figure K11-2

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

American Council of Independent Laboratories
International Association of Environmental Testing Laboratories
American Association for Laboratory Accreditation

IT Analytical Services, 5815 Middlebrook Pike, Knoxville, TN 37921

9112364040

K12.0 RECORDS MANAGEMENT

The records management system followed by ITASK complies with the criteria listed in the QAM, in that:

- o Data are secure, retrievable, and complete,
- o Laboratory records are available from time of sample receipt through sample disposal,
- o Laboratory records are stored in a manner that safeguards their integrity,
- o Reported results are available upon client request, and
- o Data are stored in a manner that allows prompt retrieval and assembly into a complete profit file, as needed.

The following SOP's provide the details for compiling project records within the individual departments:

ITASK SOP No. WW870713R0, "Records Management - WW".

ITASK SOP No. AA870713R0, "Records Management - AA/ICP".

ITASK SOP No. OP870713R0, "Records Management - Organic Prep".

ITASK SOP No. GC840523R2, "Records Management - GC".

ITASK SOP No. M_870715R0, "Records Management - GC/MS".

K12.1 Project Records

Project files are established and maintained for each laboratory project (usually one shipment of samples for one client). Each file is assigned a unique alpha-numeric project code consisting of a 3-4 letter acronym for client name/location, followed by

K12.1 Project Records (cont.)

a sequentially assigned 5 digit number (e.g., EPAL 42051). Within a project file, categories of information are filed in accordance with the project index shown in Table K12.1. SOP No. QA870521R1, "Project Records Maintenance" describes the content of each of the project index categories.

K12.2 General Laboratory Operations Records

These records are filed as described in SOP No. QA870622R0, "Quality and Operations Records Retention."

9 1 1 2 7 5 4 0 4 0 6

Table K12.1

PROJECT INDEX CHECKLIST

Project Code: _____

FILE DESIGNATION	RECORD DESCRIPTION	INCLUDED IN FILE	IF "NO" SPECIFY LOCATION OF FILE
A	Correspondence	YES___ NO___ N/A___	_____
B	Tracking Records/ Coding Information	YES___ NO___ N/A___	_____
C	Organic Analytical/ QC Information		
	- GC	YES___ NO___ N/A___	*
	- HPLC	YES___ NO___ N/A___	*
	- GC/MS	YES___ NO___ N/A___	*
	- Misc. Organics	YES___ NO___ N/A___	_____
	- Organic Prep	YES___ NO___ N/A___	_____
	- Subcontractor	YES___ NO___ N/A___	_____
D	Inorganic Analytical/ QC Information		
	- Metals	YES___ NO___ N/A___	*
	- Water/Wastewater	YES___ NO___ N/A___	_____
	- Subcontractor	YES___ NO___ N/A___	_____
E	Data Reports	YES___ NO___ N/A___	_____
F	Nonconformances	YES___ NO___ N/A___	_____
G	QAPP Summary/ Proj. Spec. Req.	YES___ NO___ N/A___	_____

*GC, HPLC, GC/MS, and metals raw data and data packages are filed in the respective labs.

Completed & Reviewed By: _____ Date: _____

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K13.0 NONCONFORMANCES AND CORRECTIVE ACTION

The procedures for handling nonconformances and corrective actions will be followed as described in Revision 1 of the ITAS QAM. However, the nonconformance memo has been standardized for use within all groups in the laboratory (see Figure K13-1). The nonconformance memo will no longer be used to document routine re-extraction, reanalysis, and rework options which are handled at the bench-level or by operations. However, these bench-level/operations decisions will be documented either in case narratives or exception reports.

Corrective actions will be verified by the QCC or Assistant QCC when possible. The log used to track nonconformances and corrective actions is attached (Figure K13-2).

K13.3 Internal Nonconformance Corrective Action Procedure

The only exception to the internal nonconformance corrective action procedure described in the QAM involves the use of nonconformance equipment tags. Equipment/hardware failure will not result in an adverse effect on data quality, as such equipment is taken out of service and repaired as soon as possible. At such time when the laboratory becomes an around the clock operations, nonconformance tags may be used for communication to the 2nd and 3rd shifts.

K13.4 External Nonconformance Corrective Action Procedure

The intent of the external nonconformance corrective action procedure described in the QAM is followed by ITAS-Knoxville. However, the method for documenting such nonconformances is different; i.e., the memorandum form is used rather than a nononformance form.

FIGURE K13-1

ITAS KNOXVILLE LABORATORY

NONCONFORMANCE MEMO

PROJECT CODE: _____ FILED BY: _____ DATE: _____

SAMPLE(S) AFFECTED: _____

AREA: CODING _____ GC _____ GC/MS _____ HPLC _____ PREP _____ METALS _____ GEN CHEM _____ OTHER _____

NONCONFORMANCE (Check appropriate item(s)):

____ Not enough sample received for proper analysis.

____ Sample received ☐broken ☐without proper preservative _____ ☐without proper refrigeration _____ ☐in improper container _____ ☐with custody seal missing or broken ☐ with illegible sample numbers or labels missing.

____ Sample received with incomplete paperwork: ☐Request for Analysis form missing ☐Chain-of-Custody form missing/unrelinquished ☐billing instructions incomplete ☐no due date or TAT specified ☐method for sample disposition not specified ☐numbers on paperwork different than numbers on bottles _____ ☐other _____.

____ Holding time exceeded ☐at receipt ☐in the lab by ____ days. Reason. _____.

____ Sample lost during extraction/analysis; no re-prep or re-analysis possible. Reason: _____.

____ QC sample data reported to client outside of ☐method ☐internal ☐QAPP ☐contract ☐regulatory limits. Reason: _____.

____ Incorrect preparation/analysis procedure(s) used; no re-prep or re-analysis possible. Reason: _____.

____ Samples analyzed and reported under an invalid calibration curve.

____ Incorrect/incomplete data reported to client. Specify: _____.

____ Blank contamination; no re-prep of associated samples done or possible. Reason: _____.

____ Reported detection limits higher than specified in ☐method ☐contract ☐QAPP, due to ☐matrix ☐insufficient sample ☐instrumentation ☐other _____.

____ Other (specify) _____.

CORRECTIVE ACTION:

____ Client (Name: _____) informed verbally on _____ by _____.
____ Client informed in writing on _____ by _____.
____ Sample(s) processed "as is".
____ Sample(s) preserved in laboratory (specify): _____.
____ Sample(s) on hold until _____.
____ Other _____.

Corrective action initiated/performed by _____ Date _____

Operations Concurrence: _____ Date _____

QC Concurrence: _____ Date _____

CORRECTIVE ACTION VERIFICATION

____ Verified

____ Cannot verify. Reason _____.

QC Coordinator: _____ Date _____

THIS DOCUMENT MUST BE RETAINED IN THE PROJECT FILE

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INTERNAL NONCONFORMANCE LOG

Page: _____

ITAS-K-QA035R0

Date of Entry	Date N/C was Initiated	Description of Problem	Responsible Group and Supervisor	Description of Corrective Action	Project(s) Affected	Sample Number(s) Affected	Close-Out Date	QCC Verification of Corrective Action

FIGURE K13-2

K14.0 QUALITY ASSURANCE/QUALITY CONTROL AUDITS

In addition to the performance audits conducted by the QC Coordinator and the systems audits conducted by the ITAS QA Manager, ITASK is frequently audited by various Federal and State agencies and other contractors. Results of such audits shall be reported to the Laboratory Director, the Laboratory Manager, the Technical Director, and the ITAS QA/C Director.

ITASK follows the ITAS QA Manual with the exception of the following changes and supplements.

The QCC monitors laboratory operations by conducting monthly surveillances and semi-annual internal audits. The QCC will observe the activity of interest or review objective evidence; checklists may be used for this review, if applicable.

9 1 1 2 7 3 6 1 0 4 1 1

K15.0 QUALITY REPORTS TO MANAGEMENT

ITASK follows the ITAS QA Manual with the exception of the following changes and supplements.

15.1 Performance Audit Reporting

The results of the monthly performance audit will be included in the QCC's monthly report to the QA/C Director. The format of the monthly performance audit report will vary depending on the activity audited. The Laboratory Manager will receive a copy of this report.

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K16.0 TRAINING

This section supplements Section 16 of the ITAS Quality Assurance Manual. The general types of qualification procedures are addressed and the records maintained to document employee qualifications and training are described.

K16.2 Professional Staff, Training and Qualifications

Specific criteria for qualification in an area will be established by the area supervisor or Group Leader. The qualification procedures must receive approval from the Technical Director and the Laboratory Manager or Operations Manager. As criteria are established, the Group Leaders (Supervisors) will document the procedures in appropriate SOP's.

Training may include attendance of off-site and/or in-house (ITAS/ITASK) training courses appropriate to the employee's area. Observation of step performance and written tests will be included as appropriate to employee qualification.

At a minimum, initial qualification will require the acceptable performance on a Performance Evaluation sample. The Performance Evaluation (PE) sample will be an external SRM or PE sample, when available. The PE sample may be a laboratory generated sample.

Annual requalification may be demonstrated by acceptable performance on a PE sample.

Only the QC Coordinator and assistant will receive training in the performance of audits.

K16.0 TRAINING (continued)

K16.4 Qualification and Training Records

The QC Coordinator will maintain a qualification and training record for each technical employee. Each employee's file will contain:

1. Personnel resume
2. Results of qualifying sample sets (PE samples)
3. Quality Assurance examinations
4. Attendance records of training sessions
5. Internal training certificates of qualifications (Personnel Qualification Record).

The personnel resume will replace Figure 16.1.

ITASK has developed its own Personnel Qualification Record forms. Figure K16.1 - K16.14 are examples.

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FIGURE K16.1

ITAS - MIDDLEBROOK PIKE
GC LAB ANALYST TRAINING LOG

Analyst's Name _____ Technician Level _____

Date Hired _____ Chemist Level _____

This form is to certify that the above named analyst has been instructed in and has successfully completed analyses using the following test methods. The GC Group Supervisor will date and initial to indicate which analyses the analyst has sufficient knowledge of in order to successfully perform sample analyses.

Methods:	Date	Initial
(EPA) 608		
Organochlorine pesticides in water	____	____
Polychlorinated biphenyls in water	____	____
(EPA) 617		
Organochlorine pesticides in city water	____	____
(SW-846) 8080		
Organochlorine pesticides in soil	____	____
Organochlorine pesticides in waste	____	____
Organochlorine pesticides in RCRA (EP Tox)	____	____
Polychlorinated biphenyls in soil	____	____
Polychlorinated biphenyls in waste	____	____
Polychlorinated biphenyls in surface wipes	____	____

Signatures: Analyst _____ Date _____

Group Supervisor _____ Date _____

QC Coordinator _____ Date _____

FIGURE K16.2

GC LAB ANALYST TRAINING LOG
(continued)

Analyst's Name _____

Methods:	Date	Initial
(SOP) GC870731R0		
PCB's in oil	____	____
(SW-846) 5503		
PCB's in air (Florisil tubes)	____	____
(SW-846) 8150		
Chlorinated herbicides in soil	____	____
Chlorinated herbicides in waste	____	____
Chlorinated herbicides in RCRA (EP Tox)	____	____
(SOP) GC860523R0		
Chlorinated herbicides in city water	____	____
(EPA) 604		
Phenols	____	____
(SW-846) 8015/8020		
BTXE/gasoline	____	____
Gasoline/diesel fuel	____	____
High boiler hydrocarbons	____	____
(EPA) 601/602	____	____

Signatures: Analyst _____ Date _____

Group Supervisor _____ Date _____

QC Coordinator _____ Date _____

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FIGURE K16.3

GC LAB ANALYST TRAINING LOG
(continued)

Analyst's Name _____

Methods:	Date	Initial
(SOP) GC850624R0 - Pest/PCB's by CLP	____	____
P + CAM 127 Industrial Hygiene (GC 851230R0)	____	____
(SOP) FA850802R1 - Livingston	____	____
(SOP) GC850619R0 - THM's	____	____
(SW-846) 9060		
Total organic and inorganic carbon in water	____	____
Total non-purgeable organic carbon in soils	____	____
Total inorganic carbon in soils	____	____
Total purgeable organic carbon in soils	____	____
(SOP) OM861023R0		
Total organic halogen in water	____	____
(EPA) 502		
Volatile organic compounds	____	____

Signatures: Analyst _____ Date _____

Group Supervisor _____ Date _____

QC Coordinator _____ Date _____

FIGURE K16.4

ITAS-MIDDLEBROOK PIKE
WATER/WASTEWATER LABORATORY
ANALYST TRAINING LOG

Analyst's Name _____ Technician Level _____
Date Hired _____ Chemist Level _____

This form is to certify that the above named analyst has been instructed in and has successfully completed analyses using the following test methods. The Water/Wastewater Group Supervisor will date and initial to indicate which analyses the analyst has sufficient knowledge of in order to successfully perform sample analyses.

Methods:

Titrimetric		Date	Initials
Acidity	(EPA 305.2)		
Alkalinity	(EPA 310.1)		
COD	(EPA 410.1 & 410.2)		
Chloride	(EPA 352.3)		
Sulfide	(EPA 376.1)		
Sulfide	(SW-846, Meth. 9030)		
Sulfite	(EPA 377.1)		
Un-Ionized H_2S	(Std. Meth. 427E.)		
Iodide	(EPA 345.1)		
Turbidimetric			
Sulfate	(EPA 375.4)		
Turbidity	(EPA 180.1)		
Biological			
BOD	(EPA 405.1)		
Fecal Coliform	(Std. Meth. 909C)		
Total Coliform	(Std. Meth. 909A)		

Signatures: Analyst _____ Date _____

Group Supervisor _____ Date _____

QC Coordinator _____ Date _____

FIGURE K16.5

ANALYST TRAINING LOG (continued)

Analyst's Name _____

Methods:

Distillations/Digestions		Date	Initials
Ammonia	(EPA 350.2)		
COD	(EPA 410.1 & 410.2)		
Cyanide, Total	(EPA 335.2)		
CN^-, Free	(Std. Meth. 412H)		
CN^-, Amenable to Cl^-	(EPA 335.1)		
Fluoride	(EPA 340.1)		
Total Kjedahl Nitrogen	(EPA 351.3)		
Phenols, Total	(EPA 420.1)		
Phosphorus, Total	(EPA 365.3)		
Colorimetric			
Ammonia/TKN	(EPA 350.2 & 351.3)		
Bromide	(Std. Meth. 405)		
Color	(EPA 110.2)		
Cyanide	(EPA 335.1 & 335.2)		
	(Std. Meth. 412H)		
Iodine	(HACH DPD Method)		
Nitrate	(EPA 353.3 by HACH)		
Nitrite	(EPA 353.3 by HACH)		
Phosphorus, Total	(EPA 365.3)		
Ortho-Phosphate	(EPA 365.3)		
Residual (Free) Chlorine	(EPA 330.5)		
Hexavalent Chromium	(Std. Meth. 3128)		
Extractions			
Oil & Grease	(EPA 413.1)		
Oil & Grease	(Std. Meth. 5030)		
Oil & Grease	(SW-846, Meth. 9071)		
Phenols	(EPA 420.1)		
Surfactants	(EPA 425.1)		

Signatures: Analyst _____ Date _____

Group Supervisor _____ Date _____

QC Coordinator _____ Date _____

FIGURE K16.6

ANALYST TRAINING LOG (continued)

Analyst's Name _____

Methods:

Electrode		Date	Initials
Chloride	(Std. Meth. 407C)		
Fluoride	(EPA 340.2)		
pH	(EPA 150.1)		
pH	(SOP WW01-WW801119R1)		
Specific Conductance	(EPA 120.1)		
Residues			
Moisture	(*)		
Total Solids	(EPA 160.3)		
Total Dissolved Solids	(EPA 160.1)		
Total Suspended Solids	(EPA 160.2)		
Total Settleable Solids	(EPA 160.5)		
Total Volatile Solids	(EPA 160.4)		
Total Volatile Suspended Solids	(*)		
Miscellaneous			
Bicarbonates	(Std. Meth. 403/406 A or C)		
Carbonates	(Std. Meth. 403/406 A or C)		
Hydroxide	(Std. Meth. 403/046 A or C)		
Odor	(EPA 140.1)		
Ion Chromatography			
Anion Scan	(EPA 300.0)		
	(Std. Meth. 429)		
	($F^-/Cl^-/Br^-/NO_2/NO_3/PO_4/SO_4$)		
Other _____			
_____			

*SOP to be written

Signatures: Analyst _____ Date _____

Group Supervisor _____ Date _____

QC Coordinator _____ Date _____

9 1 1 2 3 6 4 0 4 2 0

FIGURE K16.7

ANALYST TRAINING LOG (continued)

Analyst's Name _____

Methods:

Other Test Methods	Date	Initials

Signatures: Analyst _____ Date _____

Group Supervisor _____ Date _____

QC Coordinator _____ Date _____

9 1 1 2 7 6 1 0 4 2 1

FIGURE K16.8

ITAS-MIDDLEBROOK PIKE
AA/ICP LABORATORY
ANALYST TRAINING LOG

Analyst's Name _____ Technician Level _____
Date Hired _____ Chemist Level _____

This form is to certify that the above named analyst has been instructed in and has successfully completed analyses using the following test methods. The AA/ICP Group Supervisor will date and initial to indicate the analyst has sufficient knowledge of each of the following test methods to successfully perform sample analyses.

9 1 1 2 3 6 4 0 4 2 2

FIGURE K16.9

Methods:

Sample Preparation	Date	Initials
Sample preservation to pH <2 with HNO_3		
Percent solids per CLP SOW		
Density ASTM D1475-60		
Dissolved Metals by Filtration 0.45 u		
EPA SW-846 Method 3005		
EPA SW-846 Method 3010		
EPA SW-846 Method 3020		
EPA SW-846 Method 3050 Flame		
EPA SW-846 Method 3050 Furnace		
EPA CLP Modified 3010		
EPA CLP Modified 3020		
EPA CLP Modified 3050 Flame		
EPA CLP Modified 3050 Furnace		
Total Metals in Air P:CAM 173		
Total Metals on Glass Fiber Fillers HNO_3 Leach		
Preparation PE/SRM Per Instructions		
EP Toxicity Extraction SW-846 1310		
pH MCAWW 150.1		

FIGURE K16.10

				Date	Initials
ICAP	Inductively Coupled Argon Plasma Spectroscopy				
	Methods for Chemical Analysis of Water: Wastes (MCAWW) 200.7				
	EPA-SW-846 Method 6010				
	EPA-CLP Modified 200.7				
GFAA	Graphite Furnace Atomic Absorption Spectroscopy				
	MCAWW	Antimony	204.2		
		Arsenic	206.2		
		Lead	239.2		
		Selenium	270.2		
		Thallium	279.2		
	SW-846	Antimony	7041		
		Arsenic	7060		
		Lead	7421		
		Selenium	7740		
		Thallium	7840		
	CLP-Mod	Antimony	204.2		
		Arsenic	206.2		
		Lead	239.2		
		Selenium	270.2		
		Thallium	279.2		

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FIGURE K16.11

				Date	Initials
CVAA	Manual Cold Vapor Atomic Absorption Spectroscopy				
	MCAWW	Mercury in Liquids 245.1			
		Mercury in Sediments 245.5			
	SW-846	Mercury in Liquid Waste 7470			
		Mercury in Solid or Semisolid Waste 7471			
	CLP-Mod	Mercury in Water 245.1			
		Mercury in Soil/Sediment 245.5			
FAA	Flame Atomic Absorption Spectroscopy				
	MCAWW	Aluminum	202.1		
		Barium	208.1		
		Beryllium	210.1		
		Cadmium	213.1		
		Calcium	215.1		
		Chromium	218.1		
		Cobalt	219.1		
		Copper	220.1		
		Gold	231.1		
		Iron	236.1		
		Lead	239.1		
		Magnesium	242.1		
		Manganese	243.1		
		Molybdenum	246.1		
		Nickel	249.1		
		Osmium	252.1		
		Platinum	255.1		
		Potassium	258.1		

FIGURE K16.12

FAA	Flame Atomic Absorption Spectroscopy (continued)		Date	Initials
MCAWW	Silver	272.1		
	Sodium	273.1		
	Tin	282.1		
	Titanium	283.1		
	Vanadium	286.1		
	Zinc	289.2		
SW-846	Aluminum	7020		
	Barium	7080		
	Beryllium	7090		
	Cadmium	7130		
	Calcium	7140		
	Chromium	7190		
	Cobalt	7200		
	Copper	7210		
	Iron	7380		
	Lead	7420		
	Magnesium	7450		
	Manganese	7460		
	Molybdenum	7480		
	Nickel	7520		
	Osmium	7550		
	Potassium	7610		
	Silver	7760		
	Sodium	7770		
	Tin	7870		
	Vanadium	7911		
	Zinc	7950		

9 1 1 2 7 5 4 0 4 2 6

FIGURE K16.13

FAA	Flame Atomic Absorption Spectroscopy (continued)		Date	Initials
	CLP-Mod Aluminum	202.1		
	Barium	208.1		
	Beryllium	210.1		
	Cadmium	213.1		
	Chromium	218.1		
	Cobalt	219.1		
	Copper	220.1		
	Iron	236.1		
	Lead	239.1		
	Manganese	243.1		
	Nickel	249.1		
	Silver	272.1		
	Vanadium	286.1		
	Zinc	289.2		

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FIGURE K16.14

Other	Date	Initials
SW-846 Chromium, Hexavalent Coprecipitation 7195		

Signatures: Analyst _____ / Date _____

Group Supervisor _____ / Date _____

QC Coordinator _____ / Date _____

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