United States Air Force
611th Air Support Group
611th Civil Engineer Squadron

Elmendorf AFB, Alaska

FINAL

Granite Mountain RRS, Alaska

PRELIMINARY ASSESSMENT/
SITE INSPECTION
WORK PLAN
AND
SAMPLING & ANALYSIS PLAN

SEPTEMBER 1994

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SEPTEMBER 1994

By:

JACOBS ENGINEERING GROUP INC.
600 17th Street, Suite 1100N
Denver, CO 80202

PREFACE

This Preliminary Assessment/Site Inspection Work Plan describes the requirements for the expected tasks and activities needed to complete the investigation activities at Granite Mountain Radio Relay Station according to the requirements of Contract No. F41624-94-D-8046, Delivery Order 8, between the U.S. Air Force and Jacobs Engineering Group Inc. It was developed to make certain that all environmental data generated for the project are scientifically valid, comparable, and of known and acceptable precision and accuracy. The Work Plan has been prepared in accordance with format and content requirements, as applicable, of the *Handbook to Support the Installation Restoration Program Statements of Work* prepared by the Air Force Center for Environmental Excellence (AFCEE), Brooks AFB, dated September 1993.

The Jacobs Engineering Group Inc. Project Manager for this contract is Ms. Joyce Miyagishima. The Contracting Officer Representative for the AFCEE is Mr. Samer Karmi.

Approved:

Warner Reeser
Program Manager

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The preliminary assessment/site inspection (PA/SI) will investigate potential sources at both the Upper Camp and Lower Camp, as well as assess the presence or absence of contaminants from the sources. Media to be sampled include surface water, surface soil, shallow subsurface soil, and sediment. Field screening techniques will be used, as well as the services of offsite laboratory. Following completion of the SI, data will be evaluated, and a PA/SI report will be prepared.

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NOTICE

This report has been prepared for the U.S. Air Force by Jacobs Engineering Group Inc. for the purpose of aiding in the implementation of a final remedial action plan under the Air Force Installation Restoration Program (IRP). Because the report relates to actual or possible releases of potentially hazardous substances, its release before an Air Force final decision on remedial action may be in the public's interest. The limited objectives of this report and the ongoing nature of the IRP, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report, since subsequent facts may become known that may make this report premature or inaccurate. Acceptance of this report in performance of the contract under which it is prepared does not mean that the Air Force adopts the conclusions, recommendations, or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the U.S. Air Force.

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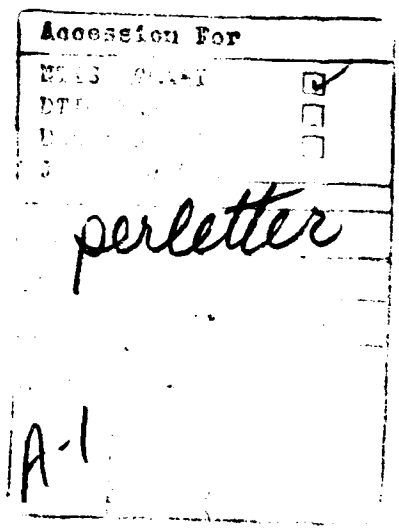

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LIST OF ACRONYMS

AA	Atomic Absorption
As	Arsenic
AST	Aboveground Storage Tank
cfs	Cubic Feet per Second
FSP	Field Sampling Plan
GFAA	Graphite Furnace Atomic Absorption
GRO	Gasoline-range Organics
Hg	Mercury
HMTC	Hazardous Materials Technical Center
HSP	Health and Safety Plan
ICP	Inductively Coupled Plasma
IRP	Installation Restoration Program
IRPIMS	Installation Restoration Program Information Management System
Jacobs	Jacobs Engineering Group Inc.
mg	Milligram
NCP	National Oil and Hazardous Substances Contingency Plan
NTIS	National Technical Information Service
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
POL	Petroleum, Oil, and Lubricants
ppm	Parts per Million
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RRS	Radio Relay Station
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act (1986)
SFO	Single Frequency Outlet
SI	Site Inspection
SVOC	Semivolatile Organic Compounds
TPH	Total Petroleum Hydrocarbons

LIST OF ACRONYMS

USGS	U.S. Geological Survey
VOC	Volatile Organic Compounds
WACS	White Alice Communications System
° F	Degrees Fahrenheit
µg/kg	Micrograms per Kilogram

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

TABLE OF CONTENTS

List of Figures

List of Tables

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1.0 INTRODUCTION

This Preliminary Assessment/Site Inspection (PA/SI) Work Plan, prepared by Jacobs Engineering Group Inc. (Jacobs), provides information on proposed activities associated with a PA/SI at the Granite Mountain Radio Relay Station (RRS) in Alaska (Figure 1-1). The Work Plan provides the rationale for the proposed environmental sampling program, the data needs and uses, and the overall objectives for the project. The plan is based on the identification of potentially contaminated areas through previous studies, as well as a site visit conducted by U.S. Air Force (Air Force) personnel in June 1994. The plan was prepared based on guidance found in the *Handbook for the Installation Restoration Program Remedial Investigations and Feasibility Studies* (Air Force 1993) and the *Guidance for Performing Preliminary Assessments Under CERCLA* (U.S. Environmental Protection Agency [EPA] 1991).

This investigation is part of a larger program known as the Installation Restoration Program (IRP), which was designed to evaluate potential hazardous waste contamination at Air Force facilities. Because of its primary mission in national defense, the Air Force has long been engaged in a wide variety of operations that involve the use, storage, and disposal of hazardous materials. In 1980, the U.S. Department of Defense (DOD) developed the IRP to investigate hazardous material disposal sites on DOD facilities, as discussed in Section 1.1.

The Work Plan has six sections. Section 1.0 provides background information on the Air Force IRP and its objectives, previous IRP work performed at Granite Mountain RRS, and the objectives of the current investigation. Section 2.0 provides a summary of the environmental setting at Granite Mountain RRS. Section 3.0 describes each IRP site or area of concern (AOC) and the rationale for the field investigation approach. Section 4.0 presents the proposed contents of the PA/SI report. Section 5.0 is the anticipated schedule for the investigation. Section 6.0 presents the references used to prepare the Work Plan.

1.1 THE AIR FORCE INSTALLATION RESTORATION PROGRAM

The objectives of the Air Force IRP are to assess past hazardous waste disposal and spill sites at Air Force installations and develop remedial actions consistent with the National Oil and Hazardous Substances Contingency Plan (NCP) for those sites that pose a threat to human health and welfare or the environment. The following sections present information on the program origins, objectives, and organization.

1.1.1 Program Origins

The Resource Conservation and Recovery Act (RCRA) of 1976, as amended, is one of the primary federal laws governing the disposal of hazardous wastes. Sections 6001 and 6003 of RCRA require that federal agencies comply with local and state environmental regulations and provide information to EPA concerning past disposal practices at federal sites. Section 3012 of RCRA requires state agencies to inventory past hazardous waste disposal sites and provide information to EPA concerning those sites.

The IRP was implemented to identify potentially contaminated sites, investigate those sites, and evaluate and select remedial actions for potentially contaminated facilities. DOD issued the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6 regarding the IRP in June 1980.

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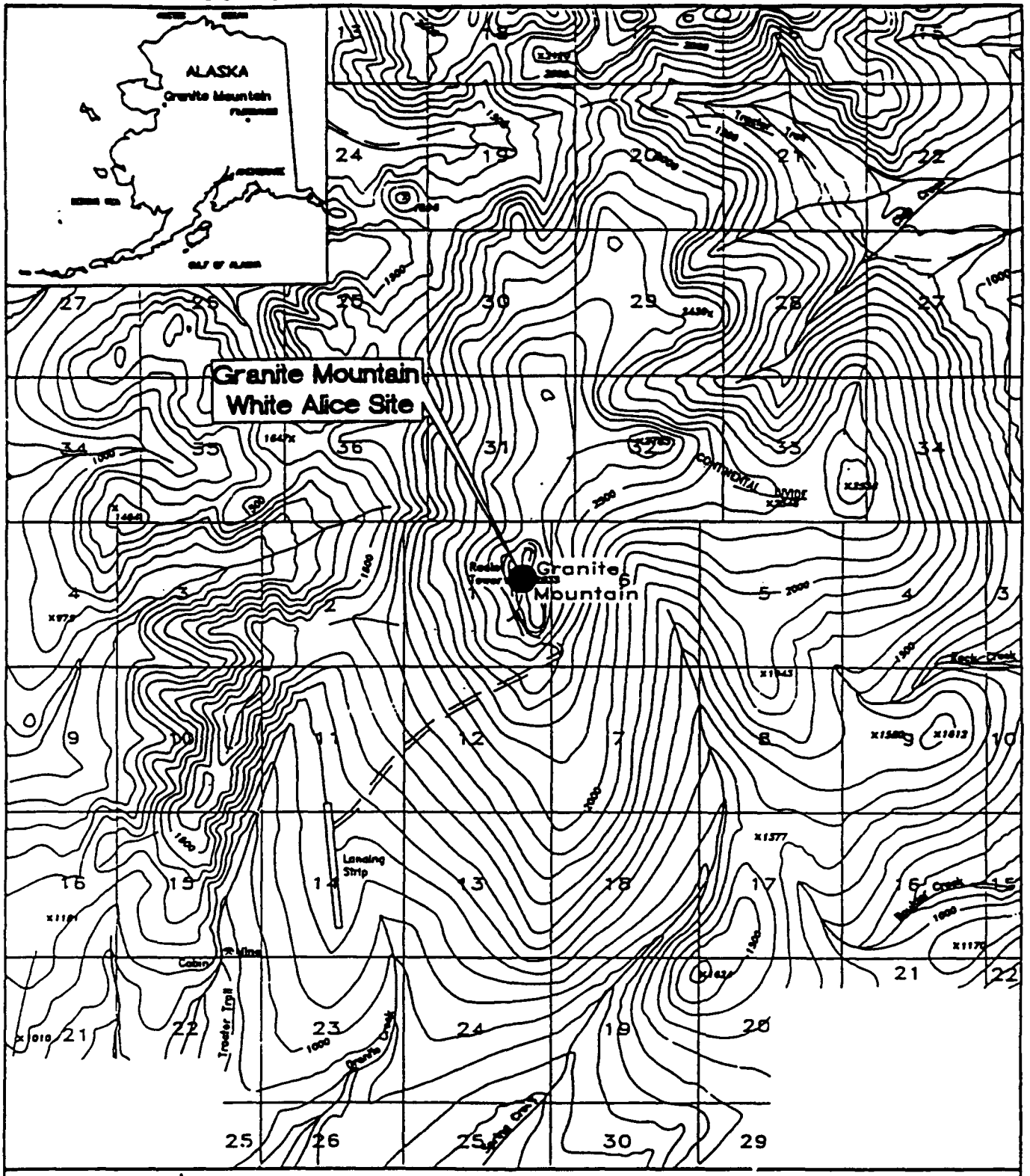

SOURCE: USGS TOPOGRAPHIC QU..D SHEET CANDLE (B-5)

FIGURE 1-1
GRANITE MOUNTAIN
LOCATION MAP
GRANITE MOUNTAIN, ALASKA

The NCP was issued in 1980 to provide guidance on a process by which contaminant releases could be identified and quantified and remedial actions selected. The NCP describes the responsibilities of federal and state governments and the parties responsible for contaminant releases.

In 1980, Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA, also known as Superfund, outlines the responsibility for identifying and remediating contaminated sites in the United States and its possessions. CERCLA legislation identifies EPA as the primary policy and enforcement agency regarding contaminated sites.

Executive Order 12580, which was adopted in 1987, gave various federal agencies, including DOD, the responsibility to act as lead agencies to conduct investigations and implement remediation efforts when they are the sole contributor to contamination on or off their properties.

The Superfund Amendments and Reauthorization Act (SARA), enacted in [illegible] extends the requirements of CERCLA and modifies CERCLA with respect to [illegible] for remediation and the process leading to the selection of a remedial action. Under SARA, technologies that provide permanent removal or destruction of a contaminant are preferable to action that only contains or isolates the contaminant. SARA also provides for greater interaction with public and state agencies and extends EPA's role in evaluating health risks associated with contamination. Under SARA, early determination of Applicable or Relevant and Appropriate Requirements (ARARs) is required, and consideration of potential remediation alternatives is recommended at the initiation of an investigation. SARA is the primary legislation governing remedial action at past hazardous waste disposal sites.

1.1.2 Program Objectives

The objectives of the IRP include the following:

- Identify and evaluate sites where contamination may be present on DOD property because of past hazardous waste disposal practices, spills, leaks, or other activities.
- Control the migration of hazardous contaminants.
- Control health hazards or hazards to the environment that may result from past DOD disposal operations.

The IRP was developed so that these objectives could be met in accordance with the NCP, CERCLA, and SARA. To meet these objectives, the following project tasks will be completed:

- Perform literature search, field investigation, laboratory analysis, and data evaluation activities consistent with PA/SI requirements.
- Develop and implement a quality assurance (QA)/quality control (QC) program to ensure data quality as specified in the Sampling and Analysis Plan (SAP) for this project.

- Develop and follow site and laboratory safety plans to protect the health and safety of personnel and to prevent the release of contaminants.

- Recommend sites or AOCs for no further action, where possible.

- Identify data gaps and recommend appropriate additional or supplemental studies for IRP sites and AOCs, as appropriate.

- Determine if an AOC should become an IRP site.

- Conduct the PA/SI in compliance with applicable federal, state, and local regulations and guidances.

1.2 HISTORY OF INSTALLATION RESTORATION PROGRAM WORK AT GRANITE MOUNTAIN RADIO RELAY STATION

Previous IRP activities at Granite Mountain RRS were presented in the following reports:

- *Installation Restoration Program, Preliminary Assessment, Granite Mountain Radio Relay Station, Alaska* (Hazardous Materials Technical Center [HMTC] 1989); and

- *Preliminary Assessment, Granite Mountain* (CH2M Hill 1994)

Most of the information used to compile this Work Plan has been taken from these two reports. Jacobs has also conducted a literature review, consisting of a review of the Granite Mountain RRS file in the offices of the 611 Civil Engineer Squadron (CES), a review of topographic quadrangles and aerial photographs from the U.S. Geological Survey (USGS), and soil sample results from verification samples collected after retrograde activities were completed at the site in the 1980s. In addition, Jacobs has relied on information gathered during the June 1994 presurvey by Air Force personnel.

1.2.1 Installation Description and History

Granite Mountain RRS is located on the isthmus of the Seward Peninsula north of Norton Bay, approximately 130 miles east of Nome and 12 miles north of Dime Landing, within the Second Judicial District, Alaska. The RRS is located in Sections 1, 11, 12, and 14, Township 1 South, Range 13 West, Kateel River Meridian. The 257.8 acre installation is composed of an Upper Camp, a Lower Camp, a 4,000-foot long gravel runway; a well site; and an access road approximately 3.2 miles long with a water line right-of-way (Figures 1.2-1 and 1.2-2) (HMTC 1989). The 16-acre main site area of the RRS, which includes several former disposal areas, is referred to as the Upper Camp. The Lower Camp, situated at an elevation approximately 1,600 feet below the Upper Camp, consists of the runway and various support structures.

The Upper Camp is located at an elevation of approximately 2,835 feet and consists of the main radio relay antenna array and a Dormitory and Equipment Building.

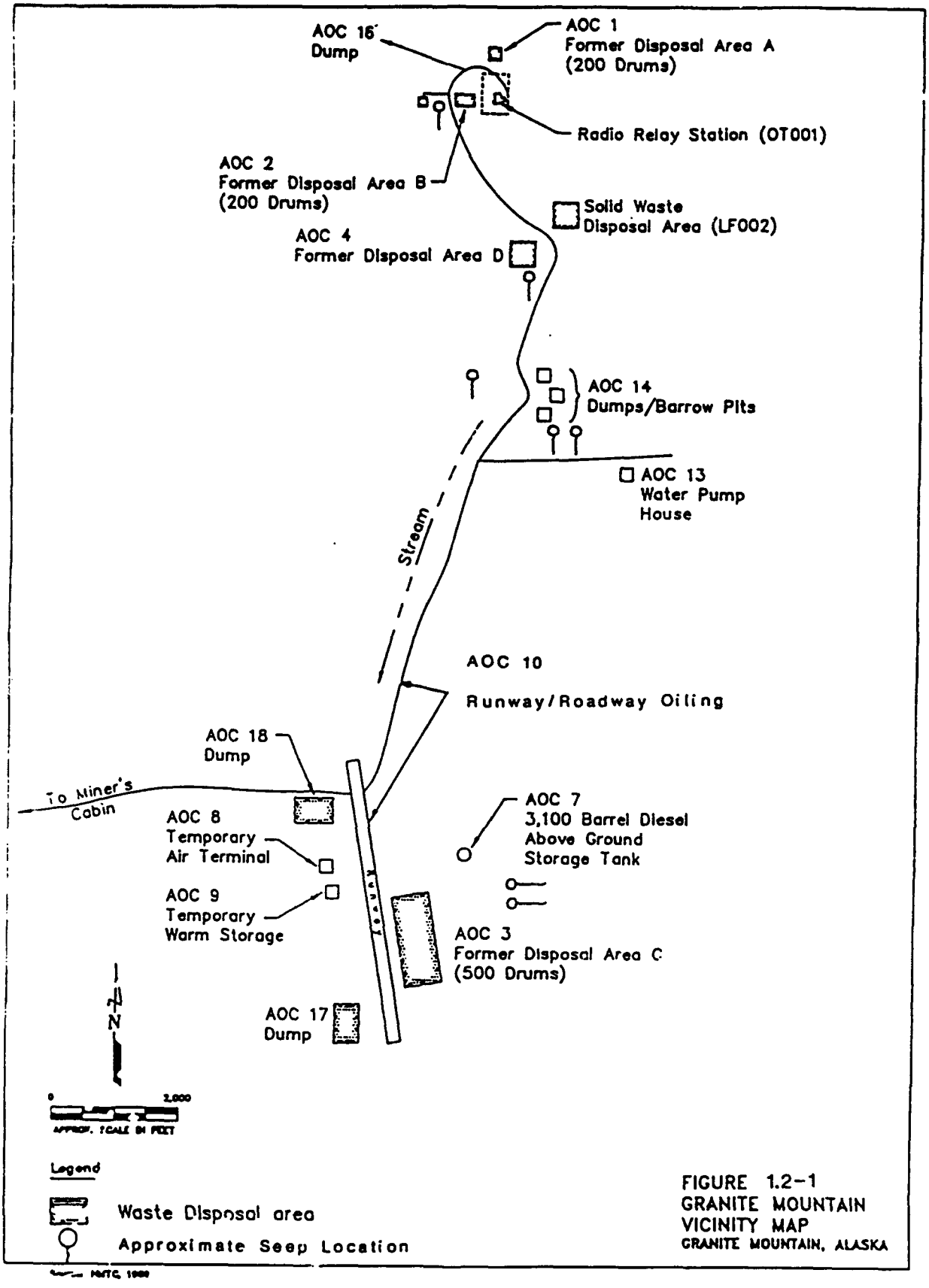

FIGURE 1.2-1
GRANITE MOUNTAIN
VICINITY MAP
GRANITE MOUNTAIN, ALASKA

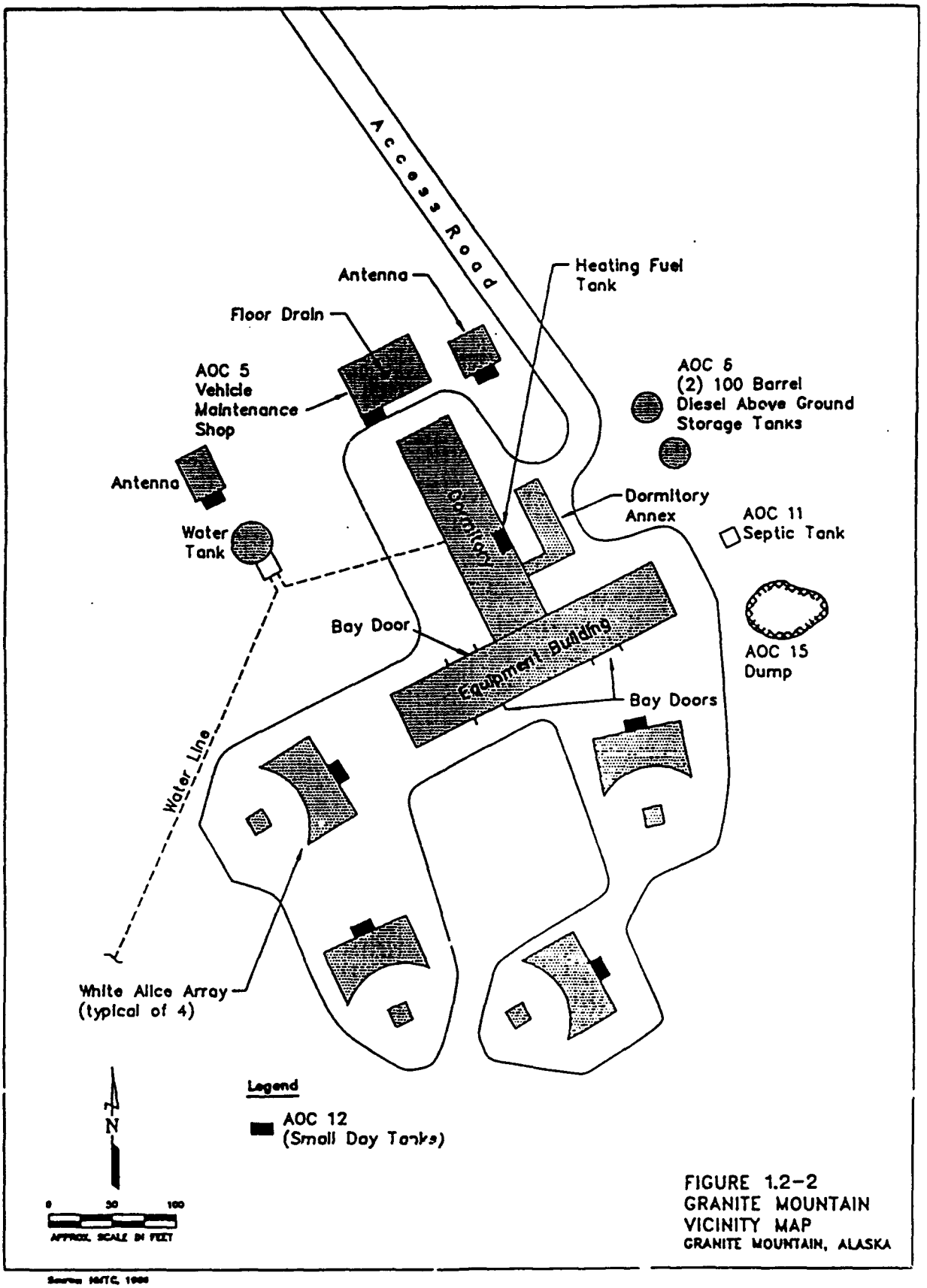

FIGURE 1.2-2
GRANITE MOUNTAIN
VICINITY MAP
GRANITE MOUNTAIN, ALASKA

Source: MMTC, 1994

The main site is composed of seven industrial buildings and 14 miscellaneous facilities including the following (HMTC 1989):

- 13,611 square foot composite building;
- 2,050 square foot vehicle maintenance shop;
- 1,408 square foot vehicle heated parking facility;
- 2,004 square foot dorm annex;
- small fire station;
- water supply building;
- two 30-foot high disk antennas;
- four 60-foot high tropospheric antennas;
- two fuel oil storage tanks; and
- one water storage tank.

To date, a total of two IRP sites and 18 AOCs have been identified at Granite Mountain RRS. These sites and AOCs have been subdivided into two categories: landfills and POL spill areas. A description, summary of background information, and description of the technical approach for each IRP site or AOC for the site inspection is included in Section 3.2.

Granite Mountain RRS was under construction from 1956 to 1957 and was activated on 25 May 1957. This RRS was a combined tropospheric scatter/TD-2 microwave station. It provided links to North River RRS, 108 miles away, with two 60-foot antennas; Anvil Mountain RRS, 130 miles away, with two 60-foot antennas; and Kotzebue RRS, 105 miles away, with a pair of 30-foot dish antennas (HMTC 1989).

Granite Mountain RRS was one of 31 White Alice Communication System (WACS) sites constructed in the 1950s. These sites enabled the Aircraft Control and Warning (AC&W) system sites to link with the Distant Early Warning (DEW-line) system and form a cohesive network relaying information back to Elmendorf Air Force Base (AFB) and Eielson AFB (HMTC 1989).

The 31 stations, including Granite Mountain RRS, became obsolete during the late 1960s with the development and implementation of satellite communication systems. Granite Mountain RRS was leased to Alascom in 1976. On 3 June 1981, a notice of intention to relinquish Granite Mountain RRS was forwarded to the Bureau of Land Management (BLM) (HMTC 1989).

According to previous reports, the BLM currently uses various facilities at the site during the summer months as a headquarters site for firefighting operations conducted in the interior of Alaska. Also, the Federal Aviation Administration (FAA) operates a Single Frequency Outlet (SFO) at the communications facility (HMTC 1989; CH2M Hill 1994). The current use of Granite Mountain RRS by BLM and the FAA will be verified during the site inspection scheduled for August 1994.

1.2.2 Previous Investigative Activities and Documentation

The 5099th Civil Engineering Operations Squadron (CEOS), now known as the 611th CES, has performed various cleanup operations at Granite Mountain RRS in 1980, 1983, and 1985. The RRS was cleaned of polychlorinated biphenyl (PCB) liquids and transformers in 1980 and again in 1983 to remove additional PCB liquids and hazardous wastes (HMTC 1989).

Between 1984 and 1986, the Air Force removed various types of debris from the Granite Mountain RRS (CH2M Hill 1994). Materials removed included large and small capacitors, drums and cans of oil and waste oil, paint and paint thinner, solvents, wastewater, creosote, cement, concrete sealer, tar, septic tank cleaners, wood preservatives, fire extinguishers, herbicides and pesticides, and various other miscellaneous compounds (CH2M Hill 1994).

Additional cleanup operations were conducted by the 5099th CEOS during the period of July through September 1985. Hazardous materials/hazardous waste were removed from two disposal areas near the communications facility (AOC 1 and AOC 2) and one disposal area east of the runway (AOC 3) (HMTC 1989).

Approximately 500 55-gallon drums containing various volumes of liquids were discovered and removed from AOC 3, east of the runway. Approximately 200 55-gallon drums were discovered and removed from AOC 2, located 500 to 1,000 yards southwest of the communications facility. Approximately 1,100 55-gallon drums were discovered in AOC 1, located 500 to 1,000 yards north of the communications facility. The contents of these drums were sampled and analyzed onsite for PCB contamination and removed to Elmendorf AFB (HMTC 1989).

Other materials identified at AOCs 1 and 2 were excavated and placed in a new landfill (AOC 4), located on the west side of the access road adjacent to the preexisting solid waste landfill. These other materials included furniture, old tires, miscellaneous equipment and equipment parts, auto parts, scrap iron, galvanized pipe, electrical conduit and cable, aluminum siding, scrap wood, water storage tank insulation, and 25 tons of unidentified trash (HMTC 1989).

These 1985 cleanup operations at Granite Mountain RRS were documented in a "Finding of No Significant Contamination" and a "PCB Clearance Certification" (HMTC 1989). Copies of these documents are included in Appendix A.

During the 5099th CEOS's cleanup activities, batteries were observed dumped throughout the inside of the antenna. Some batteries were leaking in boxes. Reportedly, these batteries have since been removed; however, the date and details of the removal are unspecified (HMTC 1989).

In 1988, the HMTC was retained to conduct the IRP PA of Granite Mountain RRS, Alaska. At the time of the site visit, the following observations were made (HMTC 1989):

- More than 35 55-gallon drums were observed at various areas around the RRS (more than 26 in or near the Temporary Auto Storage Building; 11 east of the runway). No leaks or spills were observed.

- What appeared to be asbestos was observed at the base of a vertical pipe in the Dormitory and Equipment Building.

- Several small (less than 4 square feet) and slightly discolored areas were observed throughout the site. Several stained areas were also observed at the solid waste landfill.

- An abandoned bulldozer was observed southeast of the Temporary Auto Storage Building and miscellaneous scrap material was observed at the solid waste landfill.

It was concluded that "at the time of the site visit, there was no visible evidence of contamination significant to threaten human health or the environment" (HMTC 1989). It was also observed that the solid waste landfill that was used while the RRS was operational may contain hazardous materials/hazardous waste, and that some asbestos may remain within buildings located on the site (HMTC 1989).

Recommendations from the 1988 PA included the following (HMTC 1989):

- Further investigation should be performed at the solid waste landfill to determine if its contents are hazardous.
- All 55-gallon drums remaining around the runway facilities should be removed and temporary fuel storage equipment and fueling operations should be managed to ensure that no fuel spills occur.
- Any asbestos remaining within the buildings should be abated.

In 1991, the ADEC requested in a letter to the Air Force that the solid waste landfill at Granite Mountain RRS be properly located on the map for permit purposes (CH2M Hill 1994).

In 1993, the U.S. Army Corps of Engineers (COE) contracted with CH2M Hill to conduct a PA of the Granite Mountain RRS, research and review available information on the site, and synthesize the data collected into an EPA-approved format for presentation and further analysis (CH2M Hill 1994).

CH2M Hill concluded that "Because leaching contamination or stressed vegetation was not observed during follow-up site visits in 1991, any remaining contamination is assumed to be minimal or sufficiently buried. Because of the persistence and bioaccumulation potential of typical contaminants such as PCB, DDT, and 2,4,5-T, and the lack of verification sampling, however, this facility is considered to be of moderate priority for a final site inspection" (CH2M Hill 1994).

In the summer of 1994, the U.S. Air Force Center for Environmental Excellence (AFCEE) contracted with Jacobs to perform the PA/SI for Granite Mountain RRS. Before the award of the contract, Air Force personnel conducted a presurvey of Granite Mountain RRS in late June 1994. During the presurvey, two IRP sites and 18 AOCs were identified for further investigation during the PA/SI.

Also during the presurvey, the IRP sites and AOCs were visually inspected and preliminary sampling locations, types of samples, and sample media were identified. In addition, a reconnaissance was conducted of the area to identify the number and type of personnel required for the SI field effort, sampling equipment, lodging and shelter for the field team, communications, vehicle needs, staging of equipment and supplies, and logistics of conducting the field effort in this remote location. Information on the presurvey was provided to Jacobs by the Air Force and have been incorporated into this planning document for the implementation of the SI to be initiated on 22 August 1994.

1.3 DESCRIPTION OF CURRENT STUDY

The following sections describe the current technical effort, including the objectives of the 1994 field effort, data needs and uses, conceptual site models, preparation of planning documents, and selection of subcontractors.

1.3.1 Project Objectives

The activities described in this plan will be performed to fulfill the PA/SI requirements set forth by EPA guidance (EPA 1991) and the Granite Mountain RRS Statement of Work. The PA/SI will assess environmental conditions and evaluate existing sites and AOCs through the collection of field data, including the collection of soil and water samples. After laboratory analysis of these samples for potential contaminants, the analytical results and field measurements will be evaluated.

The purpose of the above activities is to determine whether installation-related contaminants have entered the environment. Based on the results of the PA/SI, a recommendation will be made in the PA/SI report for each site or AOC. The recommendation will be one of the following:

- The site is recommended for no further action. (No evidence of contamination is found and a recommendation is made for no further action.)
- The site is recommended for additional investigation to determine the nature and extent of contamination. (The investigation is continued in a remedial investigation/feasiblity study and AOCs may become elevated to IRP sites.)
- The site is recommended for an expedited remedial action. (Evidence of contamination is found in sufficient quantity or quality to require an expedited remedial action to protect public health or the environment.)

The PA/SI shall comply with the specifications, procedures, and methodologies presented in the SAP for Granite Mountain RRS.

1.3.2 Data Needs and Uses

The data needs to be satisfied by the Granite Mountain RRS field investigation are determined by the overall and specific objectives and purposes of the Granite Mountain RRS PA/SI. The general purpose is to provide data to allow a recommendation of further actions for each site or AOC as described above. The broad objectives of the IRP include the following:

- Identify and evaluate sources where contamination may be present on DOD property because of past hazardous waste disposal practices, spills, leaks, or other occurrence.
- Control the migration of hazardous contaminants.
- Control the human health hazards or hazards to the environment that may result from past DOD disposal operations.

Specific objectives of the Granite Mountain RRS investigation have been developed through discussions between the Air Force and Jacobs. These objectives have been refined during the planning process leading to this Work Plan and the

companion SAP. The objectives of the Granite Mountain RRS PA/SI include the following:

- Conduct preliminary site reconnaissance to locate or verify the boundaries of known IRP sites and AOCs, verify field maps, and refine sampling locations.
- Conduct metal detection surveys to verify landfill, dump, and drum burial boundaries, and to locate buried metallic objects.
- Collect data on background concentrations of potential contaminants in soil and surface water.
- Determine the presence and concentration of soil and sediment contamination, if any. Determine whether contamination exceeds background values.
- Determine whether contamination of surface water or seeps has occurred, and if so, whether contaminated surface waters exceed background values.
- Determine if contamination is present in the abandoned cistern.

1.3.2.1 Data Applications

The data collected during the field effort will be applied to the following uses:

- Determine the presence or absence of contamination from potential releases from the site to soil or surface water.
- Determine concentrations of contaminants, if potential releases are identified.
- Identify potential pathways and targets of concern for releases.
- Recommend one of the following for each site or AOC: (1) no further action; (2) additional investigation; (3) expedited remedial action; or (4) determine if an AOC should become an IRP site.

1.3.2.2 Data Types

Data will be collected for the uses listed above. The data that will be collected include analysis of chemical constituents in soil, water, and sediment samples, as well as spatial measurements of sampling locations. These data include those needed to support a no further action decision or a recommendation for either further study or an expedited response action.

Chemical constituents that will be determined vary depending on the medium being sampled. Screening-level analyses of solid media samples will be conducted onsite using immunoassay-based test kits. Field screening of total petroleum hydrocarbons (TPH) and PCBs in soils will be conducted at selected sites. The results of screening-level analyses are intended to provide real-time data that can be used to guide field activities and sampling efforts. The screening-level sample analyses will also be used, in part, as criteria for selecting samples for analyses to be submitted to the fixed laboratory.

The samples collected for analyses will be transported to an offsite, fixed laboratory for analyses of a broad spectrum of compounds, including volatile organic

compounds (VOCs) and semivolatile organic compounds (SVOC), gasoline-range organics (GROs), diesel-range organics (DROs), residual range organics (RRO), pesticides and PCBs, and metals including mercury. Specific compounds and analytical methods are discussed in the Quality Assurance Project Plan (QAPP) (Section 1.0 of the SAP). The laboratory analyses will be the principal source of information regarding the presence or absence of contamination at IRP sites or AOCs.

Additional data that will be collected include the locations of the sampling points. The geographic position of sampling points will be recorded in the field. The data collection point will be located using a Brunton compass and a fiberglass tape measure to tie the point into a nearby structure or monument and a map of each IRP site or AOC will be generated.

1.3.3 Scoping Documents

In addition to this Work Plan, a SAP and a Health and Safety Plan (HSP) have been prepared for Granite Mountain RRS.

The SAP includes two main sections: a QAPP and a Field Sampling Plan (FSP). The QAPP, Section 1.0 of the SAP, outlines the following quality requirements for the project:

- data quality objectives (DQOs) for data collection;
- analytical procedures;
- sample handling and custody procedures;
- calibration procedures;
- data reduction and reporting procedures;
- internal QC checks for field and laboratory operations;
- performance and system audits;
- procedures to assess data precision, accuracy, and completeness;
- corrective actions; and
- QA reports.

The FSP details all sample collection procedures, including sampling for surface water and groundwater, surface and shallow subsurface soil, and sediment. Also described are procedures for site reconnaissance, site mapping, field screening methods, and waste handling. The FSP includes a discussion of the field QA/QC program, record keeping procedures for field activities, and remote site logistical information management. The FSP is Section 2.0 of the SAP.

The HSP includes all procedures to be followed in the field to ensure the health and safety of all field personnel and to prevent the inadvertent release of contaminants into the environment. A description of possible contaminants of concern along with their respective health risks is included. Accident reporting procedures and medical evacuation procedures are components of the HSP.

1.3.4 Conceptual Site Model

Conceptual site models (CSMs) generally identify contaminants present, contaminant sources, release mechanisms, contaminant transport media, exposure routes, and receptors. In general, CSMs are developed from initial data and the model evolves as more information on the site, based on field investigations and

sample analyses, becomes known. The CSM is a living/breathing model that changes as new data on contaminants and the site become known.

Data from this SI may be used toward developing a CSM for Granite Mountain RRS.

1.3.5 Subcontractors and Laboratories

The Granite Mountain RRS will require the use of a laboratory subcontractor as described in the following text.

Jacobs will subcontract Commercial Testing & Engineering Co., located in Anchorage, Alaska, to provide analytical services. Because of the remote location of the site, the use of a laboratory within the Anchorage area was considered imperative.

The process used by Jacobs to select this laboratory included review of the laboratory QAPP, Statement of Qualifications, most recent AFCEE audit report, most recent EPA Performance Evaluation sample results (water pollution and water supply), and any associated corrective actions.

Laboratory capacity and capabilities have been reviewed by Jacobs personnel. The project QA Coordinator and Project Chemist will ensure that all analytical work performed by Commercial Testing & Engineering Co. complies with the project-specific requirements and the Air Force *IRP Handbook* (Air Force 1993). Appendix A of the SAP lists the deliverables that will be provided by the laboratory to comply with the required analytical quality level. The chemical analyses to be performed by Commercial Testing & Engineering Co. will include the following:

Parameter	Method	Medium
VOCs	SW8240 SW8260	Soil Water
SVOCs	SW3540/SW8270 SW3510/SW8270	Soil Water
Chlorinated Pesticides/ PCBs	SW3540/SW8080	Soil
GRO	SW5030/AK101 (Modified)	Soil, Water
DRO	SW3540/AK102 (Modified) SW3510/AK102 (Mod)	Soil Water
RRO	SW3540/AK103	Soil
Inductively Coupled Plasma (ICP) Metals	SW3050/SW6010 SW3005/SW6010	Soil Water
Mercury	SW7471 SW7470	Soil Water

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2.0 GRANITE MOUNTAIN RADIO RELAY STATION ENVIRONMENTAL SETTING

This section provides a description of the environmental setting at Granite Mountain RRS. The information contained in this section has been derived from the PA reports prepared by the HMTC (1989) and by CH2M Hill (1994). These documents are referenced at the beginning of each subsection.

2.1 DEMOGRAPHY

The following information has been taken from the 1989 PA report (HMTC 1989).

Granite Mountain RRS is located in a remote, mountainous area. There are three additional cabins located approximately 20,000 feet (3.8 miles) southwest of the RRS. Since 1973, two more cabins have been built just north of the first one. Residential population is calculated using the USGS Candle (B-5) Quadrangle 7.5 minute topographic map and assuming each dwelling unit has 3.8 residents (47 Federal Register [FR] 31233). Therefore, the total population in the vicinity of Granite Mountain RRS is estimated to be 11.

2.2 GEOLOGY

Granite Mountain RRS is located within the Seward Peninsula Physiographic Province. This region is characterized by highlands with rolling topography and gentle slopes (HMTC 1989). The following sections provide information about the regional geology and the geology of Granite Mountain RRS.

2.2.1 Regional Geology

The information in this subsection is taken from the 1989 PA report (HMTC 1989).

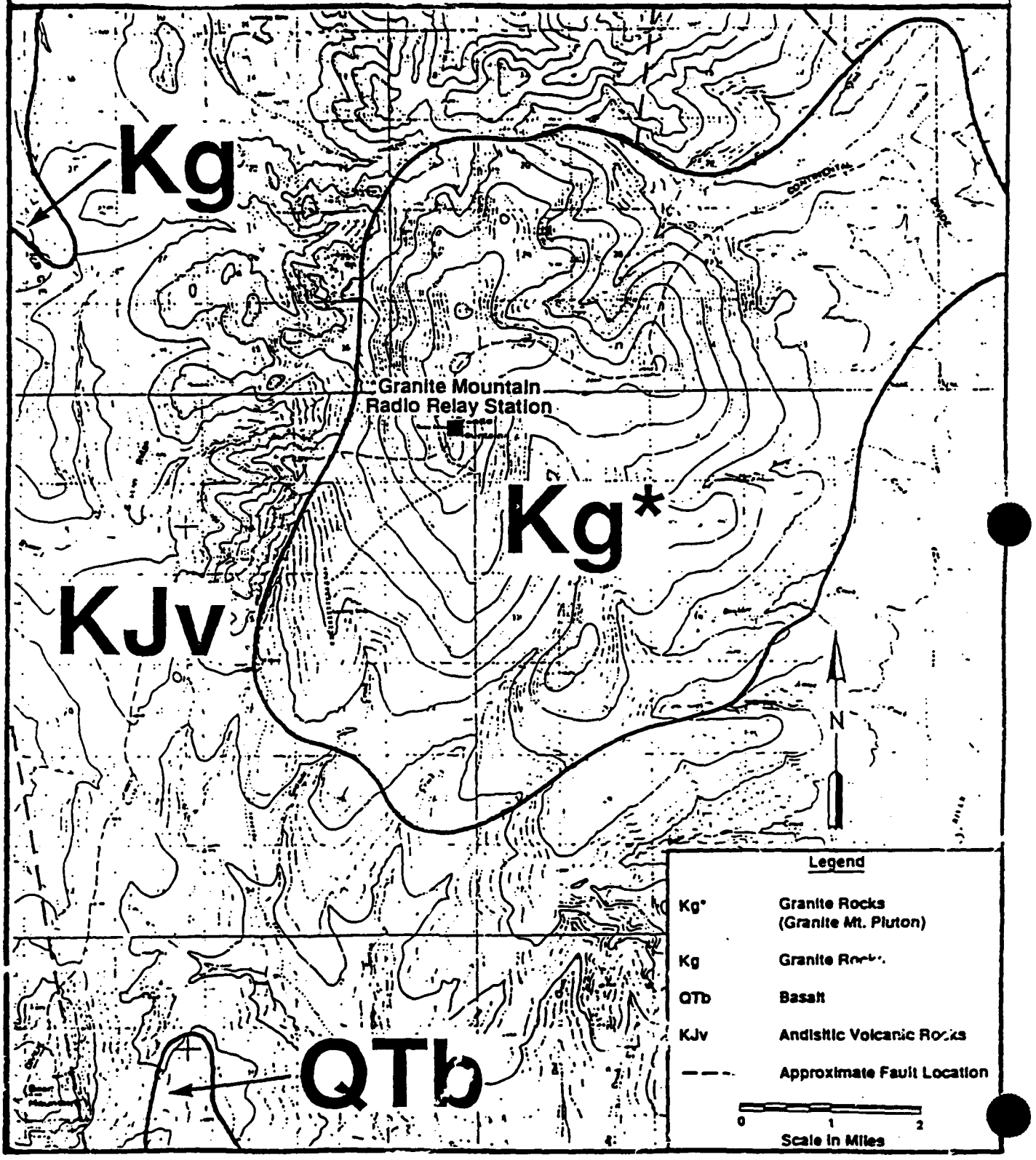
Granite Mountain RRS is situated on the Granite Mountain Pluton. The pluton is composed of biotite quartz monzonite rock of mid-Cretaceous age (Figure 2.2-1). Outcrops of this unit are a predominant surface feature around the peak of Granite Mountain. This pluton is surrounded by an andesitic volcanic unit of early Cretaceous age. This unit is predominantly composed of andesitic trachyandesitic crystal and lithic tuffs, tuffaceous volcanic graywacke, massive andesitic breccia, agglomerate, conglomerate, and intercalated flows of porphyritic pyroxene andesite and basalt. A similar unit is located approximately 4 miles northwest of the mountain. Within the vicinity of Granite Mountain Pluton, these rocks are characteristically hornfelsic and propylitically altered to a hard, pale green aggregate of chlorite, epidote, calcite, and sodic plagioclase. Many small unmapped intrusive bodies of hybrid diorite, syenite, and monzonite occur within this unit in the vicinity of granitic plutons, such as Granite Mountain. Some minor faulting has occurred in this unit approximately 6 miles southwest and 4 miles northeast of Granite Mountain. Approximately 7 miles southwest of the mountain is an early to middle Cretaceous unit of gray to dark red vesicular olivine basalt flows.

According to the U.S. Soil Conservation Service, Granite Mountain RRS lies within the Pergelic Cryaquepts-Pergelic Cryorthents, very gravelly, hilly to steep soil association. This soil association is found on the Seward Peninsula near sea level to about 2,800 feet. The area consists of high ridges separated by narrow valleys and includes numerous mountain peaks. The soils were formed in colluvial material derived from local rock or at lower elevations, glacial till.

HMTC

Source: U.S.G.S. Misc.
Field Investigation
Map I-492.

FIGURE 2.2-1
Geology of Granite Mountain Radio Relay Station, Alaska and Vicinity.



This association consists of poorly drained to well drained soils with permafrost. Poorly drained soils are found on long uniform slopes, foot slopes, valley bottoms and steep north-facing slopes. The well drained soils occur on high ridges and steep south-facing slopes. Common frost features are solifluction lobes, frost boils, and stone stripes. Soils of this association are usually too wet or steep for most construction, forestry, and farming purposes.

This association consists of six principal components (95 percent) and four other components (5 percent). The following are principal components.

Pergelic Cryaquepts, very gravelly, hilly to steep (35 percent), are poorly drained soils on broad sloping ridges and long steep mountainsides and hillsides. They were mainly formed in gravelly and stony colluvial material but at some lower elevations in very gravelly glacial deposits. The soils consist of a few inches of organic matter and a thin layer of dark gray silt loam over mottled dark gray very gravelly silt loam. Permafrost is usually encountered at a depth of 16 inches. Bedrock is usually deep but has been encountered at depths shallower than 40 inches. Solifluction lobes and frost scars are common.

Pergelic Cryaquepts, very gravelly, hilly to steep (20 percent) are well drained soils on steep slopes or ridges, hills, and mountains. They were formed in very gravelly colluvium under a cover that includes low shrubs, grass, dryas, and lichens. Typically, under a very thin mat of coarse organic material there is a thick dark brown gravelly silt loam layer over dark yellowish brown and olive brown very gravelly silt loam. It is underlain by shattered bedrock at a depth of about 14 inches.

Histic Pergelic Cryaquepts, very gravelly, hilly to steep (15 percent) are well drained soils on ridges, hills, and mountains under vegetation dominated by low shrubs. In many places they are in close association with Pergelic Cryorthents and differ from those soils only in that they have fairly thick dark brown upper horizons.

Histic Pergelic Cryaquepts, very gravelly, hilly to steep (15 percent) are poorly drained soils on north-facing hillsides and mountainsides, on foot slopes, and in drainageways. Most of these soils were formed in very gravelly colluvium, but in some valleys they consist of glacial till with a silty mantle. The vegetation includes low shrubs, sedges, mosses, and lichens. Usually, the soils have a thin layer of black mucky silt loam over mottled gray very gravelly silt loam located under a thick mat of organic material. Permafrost is about 10 inches below the mineral surface. A few soils with gentle or moderate slopes are included.

Pergelic Ruptic-Histic Cryaquepts, very gravelly, hilly to steep (5 percent) are poorly drained soils on rounded ridges and long side slopes. They were formed in very gravelly and stony residual and colluvial material. Polygons, solifluction lobes, and other patterned surface features are common. In troughs between polygons and in other low positions in the microrelief, there lies a thick mat of organic matter over mottled gravelly silt loam. In centers of polygons and other high points, the organic mat is thin or absent. Permafrost is shallow under the thick mat and is moderately deep under the frost scars. The soil material is frost-churned and contains streaks and patches of organic matter and mineral material of varying texture.

Rough mountain land (5 percent) occupies barren peaks, ridges, and talus slopes, commonly at higher elevations. It supports only scattered vegetation. This is the predominant soil type at the RRS.

The other components (5 percent) consist of (1) Pergelic Cryoborolls, very gravelly, hilly to steep; (2) Typic Cryaquepts, very gravelly, hilly to steep; (3) Lithic Ruptic-Entic Cryoborolls, very gravelly, hilly to steep; and (4) Lithic Ruptic-Entic Cryumbrepts, very gravelly, hilly to steep.

According to the U.S. Soil Conservation Service, permeability in this soil association will vary depending on the specific location until permafrost is encountered. Once permafrost is encountered, the soil is impermeable.

2.2.2 Geology of Granite Mountain Radio Relay Station

The information in this subsection is taken from the 1994 PA report (CH2M Hill 1994).

The Granite Mountain RRS site is overlain by large, blocky granite cobbles and boulders from 3 inches to 15 feet in diameter. Test pit logs from a 1963 COE geotechnical investigation for the vehicle maintenance shop are included in Appendix B. Locally present in the spaces between the boulders and cobbles at the time of investigation were 20 to 30 percent, frozen, silty sand and sandy silt. Relatively unfractured bedrock occurred at depths of from 7 to 10.5 feet below grade in three different test pits. In some of the depressed areas, a thin mantle of moss and silt is prevalent; in general, the site area is lacking mantle. The unconsolidated debris in the area is primarily caused by the mechanical phases of weathering, which produce angular talus (residual) in the area. A few lichens and mosses cover the exposed rocks, but very little vegetation of any other sort exists.

2.3 GROUNDWATER

The information in this subsection is taken from the 1994 PA report (CH2M Hill 1994).

Specific groundwater data for Granite Mountain RRS are not available; however, some general assumptions can be made on the basis of the nature of the soils and the geology of the region. Much of the rainfall at the facility infiltrates through the thin soil layer and into the joints and fractures of the underlying granitic rock. These joints and fractures influence the direction of groundwater flow. The extreme topography of the mountain also affects the direction of flow. Some groundwater discharges from the mountain at lower elevations in the form of springs, which can become headwaters to nearby creeks. One such spring occurs at about 1.5 to 2.0 miles northeast of the runway, along the north side of the access road. Shallow groundwater flow within the active layer near the runway probably mimics the surface topography and flows to the southwest and south.

The region is one of almost continuous permafrost. The frozen layer ranges in thickness from 15 to more than 260 feet. The surface layers of the soil thaw to depths of 1 to 10 feet, depending on the surface material, vegetation cover, and exposure. The permafrost serves as a relatively impermeable boundary between any water collected seasonally in the active layer and the underlying subpermafrost aquifer.

It is unknown if the groundwater is used by seasonal miners. No wells are listed within a 4-mile radius of the site, according to the USGS Groundwater Site Inventory

Database (1993). However, a cistern is located at the site that was used to collect surface water flow from natural springs for drinking water.

2.4 SURFACE WATER

The information in this subsection is taken from the 1994 PA report (CH2M Hill 1994).

The Granite Mountain RRS site is on a topographic high on the Continental Divide. The site is predominantly rocky and devoid of surface water bodies. The headwaters of many creeks, which often are springs, originate off the flanks of Granite Mountain.

Surface water flow originating from snowmelt or rain drains west or east of Granite Mountain RRS into the Kiwalik River or Peace River drainages, respectively. Surface water runoff in the vicinity of the airfield drains east and south into Granite Creek (1/2 mile away) and Spring Creek (1 to 2 miles away), which are tributaries of Sweepstakes Creek. Sweepstakes Creek then discharges into the Peace River. The average annual flow of the Peace River is estimated to be 234 cubic feet per second (cfs). Spring Creek and the Kiwalik River are the closest surface waters to Granite Mountain RRS, both a mile away. The average annual flow of the Kiwalik River is estimated at 545 cfs.

Surface water from Granite Mountain RRS may travel over a drainage area of roughly 1,800 acres to the point of probable entry into Spring Creek, and roughly 210 acres to the probable point of entry into a tributary of the Kiwalik River. The USGS gaging station on the Kiwalik River at Candle is about 25 miles downstream northwest of the site. The only discharge data available from this station were the following mean monthly flow rates for 1990: 140 cfs in July, 96.4 cfs in August, and 41.4 cfs in September.

Population served by surface water downstream of the Granite Mountain site may consist of seasonal miners living along the northern forks of Sweepstakes Creek. This water may be used as a drinking water source and in mining operations.

2.5 CLIMATOLOGY AND METEOROLOGY

The bulk of the information in this subsection is taken from the 1989 PA report (HMTC 1989). The wind speed information is taken from the 1994 PA report (CH2M Hill 1994).

Because meteorologic data for Granite Mountain RRS are unavailable, Candle, Alaska, which is located approximately 42 miles north-northwest of the RRS, is used as a reference point.

The climate at Candle, Alaska is characterized by extreme variations in temperature and by low precipitation. Temperature extremes range from 84 degrees Fahrenheit (°F) in summer to 56° F below zero in winter. Annual precipitation averages 8.61 inches with over half of the total annual rainfall occurring in June, July, August, and September. Maximum rainfall intensity at Granite Mountain, based on a 10-year, 24-hour rainfall is 2.0 inches. More than 95 percent of the annual snow fall occurs from October through April. Net precipitation is calculated by subtracting the mean annual lake evaporation from annual precipitation. Since the mean annual lake evaporation is not available for this part of Alaska, the annual potential

evapotranspiration was used. The potential evapotranspiration for Candle is 14.61 inches per year; therefore, the net precipitation is negative 6 inches per year.

Because wind speed data for Granite Mountain RRS were unavailable, information for Nome, 120 miles west, was used. According to the FAA, the average annual wind speed for Nome is 10.8 miles per hour, with the prevailing wind direction from the north.

2.6 BIOLOGICAL RESOURCES

The following information has been taken from the 1994 PA (CH2M Hill 1994).

2.6.1 Sensitive Aquatic Environments and Wetlands

Sensitive environments consist of environments that provide habitat for critical life stages, such as spawning and rearing, of various ecological species. A sensitive environment also includes habitat critical for the survival of threatened and endangered species. Because none of the drainages within the area of the Granite Mountain RRS have had critical habitats identified, the drainages cannot be classified as a sensitive aquatic environment. Potential sensitive terrestrial environments within the area of the Granite Mountain site are described in Section 2.6.2.

According to the Alaska Division of the U.S. Fish and Wildlife Service, no endangered or threatened species of flora or fauna are found within a 1-mile radius of the Granite Mountain site. Also, no federal- or state-designated critical habitats or wilderness areas lie within a 1-mile radius of Granite Mountain RRS. Although the Granite Mountain area has not been mapped by the National Wetland Inventory, the U.S. Fish and Wildlife Service believes that wetlands are present in this area. No significant fishery occurs in the streams near the Granite Mountain WACS site.

2.6.2 Sensitive Terrestrial Environments

The area around the Granite Mountain site is used for habitat by brown bear. Caribou and moose use areas due east (about 50 kilometers outside the site) for general habitat.

The Granite Mountain area consists of high ridges separated by narrow valleys and includes numerous mountain peaks. Vegetation on the ridge tops, rounded hills, and steep south-facing slopes consists of low shrubs, grasses, and lichens, supports wildlife including caribou, small mammals, and birds. The vegetation on north-facing hillsides and mountainsides, on foot slopes, and in drainageways includes low shrubs, sedges, mosses, and lichens. Rough mountain land occupies barren peaks, ridges, and talus slopes, commonly at higher elevations. It supports only scattered vegetation.

The vegetation within and around the Granite Mountain facility is characterized as bottom-land, spruce-poplar forest. Although this vegetation is common on well-drained soils that are found on river terraces, riverbanks, and recently abandoned stream channels, it may extend a few miles from such waterways toward the foothills and occupy entire valleys. The forests contain sizable and relatively vigorous white spruce and balsam poplar. Balsam quickly invades unvegetated floodplains and is replaced by white spruce in the successional process. Alaska paper birch is the

other dominant tree. Typical understory vegetation includes young trees, willows, roses, berries, ferns, bluejoint, fireweed, and various mosses.

Alpine tundra communities occur in mountainous areas and along well-drained rocky ridges. The soil is usually coarse, stony, and dry. Plants with a low growth form are typical of this exposed windswept habitat. Important plants include mountain avens, willows, and heather. Lichens, especially reindeer moss, and true mosses are common.

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3.0 TECHNICAL APPROACH OF PRELIMINARY ASSESSMENT/SITE INSPECTION

The following sections describe the PA/SI tasks that will be conducted during the field investigation at Granite Mountain RRS. Section 3.1 specifies the investigative approach including sampling activities, rationales, and locations. Section 3.2 describes specific investigations and sampling to be conducted at the individual IRP sites and AOCs.

3.1 FIELD INVESTIGATION APPROACH

To accomplish the objectives specified in Section 1.3, certain tasks have been determined to be necessary during the PA/SI fieldwork. The field investigations will be initiated with a field reconnaissance. The purpose of the reconnaissance activities is to verify the locations of all IRP sites and AOCs to be investigated; verify source area maps; verify and map surface features such as seeps, stained soils, or surface water drainage; and identify the locations of planned sampling points. During the June 1994 presurvey by Air Force personnel, all IRP sites and AOCs were initially identified and mapped. This site reconnaissance will be to verify information collected in June, orient the field team, and identify and map specific sampling locations.

The PA/SI data collection will generally be performed in two phases: (1) field surveys and collection of multimedia samples for screening-level analysis, and (2) collection of multimedia samples for laboratory analysis. The screening tasks include metal detector surveys at former disposal areas and field test kit analysis of soil and sediment samples. The collection of samples for laboratory analysis will be based on PA/SI project objectives and, in part, the results obtained from the screening level analysis.

The general approach will be to collect screening level data for field evaluation. Upon review of screening data, determinations can be made regarding the number and location of samples to be collected from various media for fixed laboratory analysis. The selection of samples for fixed laboratory analysis will be decided in the field based on visual observations and field test screening results. The types of samples anticipated for fixed laboratory analysis include surface soil, shallow subsurface soil, surface water, and sediment. One cistern that was used to collect water from natural springs for drinking water will also be sampled, if possible.

This section provides general information regarding the metal detector surveys, screening level analysis, and laboratory analysis. Specific information regarding the location and rationale for the collection of samples from specific IRP sites and AOCs is presented in Section 3.2.

3.1.1 Data Collection and Analysis

To aid in identifying contamination associated with each medium, metal detector surveys will be performed and screening level data will be collected at selected locations to provide qualitative information about the IRP site or AOC and to help provide direction regarding the location and collection of samples for laboratory analyses. Field surveys and screening analysis provide preliminary information regarding the presence of potential contaminants whereby the location(s) of laboratory samples can be more accurately assessed. Field screening analysis may minimize the number of laboratory samples required to be collected for the PA/SI. A

summary of field survey and a summary of the anticipated number of laboratory samples to be collected are provided in Table 3.1-1.

The field survey, screening data collection, and laboratory data collection activities include the following:

- metal detector surveys of all former disposal areas (landfills);
- collection and analysis of screening level data for PCBs and/or TPH at areas of suspected contamination;
- collection and fixed laboratory analysis of surface soil samples from areas of suspected contamination;
- collection and fixed laboratory analysis of shallow subsurface soil samples from areas of suspected subsurface contamination;
- collection and fixed laboratory analysis of surface water and sediment samples from seeps or drainages;
- collection and fixed laboratory analysis of water samples from one cistern used to collect water from natural springs for drinking water.

3.1.1.1 Metal Detector Survey

A metal detector survey will be performed to define the locations of metallic debris at former waste disposal areas, landfills, and dump areas. Based on the field reconnaissance, random areas will be measured to delineate the landfill boundaries.

3.1.1.2 Screening Analysis

Field test kits for rapid screening of TPH and PCBs in soils using immunoassay methods will be performed. In general, results from these test kits will be used to select samples for fixed laboratory analysis. The kits will help gather qualitative information about the AOC and the potential extent of contamination and will help determine the location of samples to be collected for fixed laboratory analysis. The field test kits will be used as described in the SAP.

3.1.1.3 Surface Soil/Sediment Sampling

The number of surface soil and sediment sampling points was preliminarily determined during the presurvey by Air Force personnel in June 1994. The exact number and location of surface soil or sediment samples will be determined after evaluating all information collected from the site reconnaissance and screening level activities.

Surface soil or sediment samples collected for screening analysis will be qualitatively field analyzed for VOCs, TPH, and PCBs. Qualitatively determining the presence of VOCs will be performed by using a photoionization detector (PID). Relative concentrations of TPH and PCBs will be assessed by means of field test kits using immunoassay techniques.

Table 3.1-1
Field Investigation Sample Summary
Granite Mountain RRS, Alaska

Site Designation	Site Type (1)	Metal Detector Survey (2)	Surface Water Samples	Sediment Samples	Surface Soil and Subsurface Soil Samples	Cistern Water Samples	Comment
OT001	POL				3		
LF002	LF	X			3		Stained surface soil.
AOC 1	LF	X	1	1	1		
AOC 2	LF	X	1		2		No visible soil stains. Seep located nearby.
AOC 3	LF	X			3		Stained surface soils.
AOC 4	LF	X	2		2		Stained surface soils, seep nearby.
AOC 5	POL				3		
AOC 6	POL				4		Stained soils.
AOC 7	POL		1		2		Stained soils near pipeline.
AOC 8	POL				3		Stained soils.
AOC 9	POL				4		Nearby vegetation stressed.
AOC 10	POL			1	2		Sediment sample in drainage ditch.
AOC 11	POL			1 (sludge)			Sludge sample from septic tank.
AOC 12	POL				6		
AOC 13	POL		1		2	1	Stained soils, well location.
AOC 14	LF	X	1	1	5		Seeps located nearby.
AOC 15	LF	X			3		Stained soils.
AOC 16	LF	X	1		3		Stained soils.
AOC 17	LF	X			2		
AOC 18	LF	X			1		
Background			3	1	2		Background samples to be collected if possible.
TOTAL		10	11	5	58	1	

NOTE:

(1)-LF=Landfill, or waste disposal site; POL=Petroleum, Oil, and Lubricants
(2)-Metal detector survey of all suspected past and present waste disposal sites
AOC-Area of Concern

Surface soil and sediment samples obtained for screening analysis will be collected as described in the SAP. Surface soil samples are those collected from the ground surface to 6 inches below ground surface.

Sediment samples will be collected from drainages, or seeps, and will be collected after surface water sampling at that same location has been completed as described in the SAP. Sediment samples will be collected primarily as co-located samples at surface water collection locations. However, it is anticipated that some drainages emanating from landfills, or other potentially contaminated areas, will not contain sufficient water to sample. At these locations, sediment samples will be collected to determine the presence or absence of contaminant migration from these areas.

Surface soil and sediment samples will be collected for laboratory analysis as shown in Table 3.1-2. These samples will be analyzed to quantitatively assess the type and concentration of contaminants present.

3.1.1.4 Subsurface Soil Sampling

Based on information gained from the June 1994 presurvey, the site reconnaissance, the metal detector survey, and surface soil screening analysis, shallow subsurface soil samples will be collected within areas identified as potentially containing subsurface contamination as described in the SAP. Shallow subsurface soil samples are those collected from 6 inches to 3 feet below ground surface.

Shallow subsurface soil samples collected for screening analysis will be qualitatively field analyzed for VOCs. Some shallow subsurface soil samples may also be screened for TPH and PCBs. Qualitatively determining the presence of VOCs will be performed by using a PID. Relative concentrations of TPH and PCBs will be assessed by means of field test kits using immunoassay techniques. The screening analysis of shallow subsurface soils will provide information regarding contaminant presence and extent and will help direct the possible location of additional samples to be collected for laboratory analyses.

In addition to screening level analysis, shallow subsurface soils will be collected for laboratory analysis as described in Table 3.1-2 to quantitatively assess the type and concentration of contamination. The exact location of each subsurface soil sample collected will be determined in the field. Samples will be collected as specified in the SAP.

3.1.1.5 Surface Water Samples

The number of surface water sampling points was preliminarily determined during the presurvey by Air Force personnel in June 1994. The exact number and location of surface water samples will be determined after evaluating all information collected from the site reconnaissance and screening level activities. These locations may include drainages, streams, springs, or seeps. Surface water samples will be collected according to the methods described in the SAP.

Surface water samples will be collected for laboratory analysis according to the methods described in Table 3.1-3. The analysis of surface water samples will be performed to quantitatively determine the type and concentration of contamination.

Table 3.1–2
Soil Analytical Summary
Granite Mountain RRS, Alaska

Site	DRO/GRO*	Volatile Organics	SVOC	Pesticides/ PCBs	ICP Metals and Hg	Total Per Site
OT001 White Alice	1	1	1	3		6
LF002 Soil Waste Disposal	3	3	3		3	12
AOC 1 Disposal Area A	2	2	2		2	8
AOC 2 Disposal Area B	2	2	2		2	8
AOC 3 Disposal Area C	3	3	3	1	3	13
AOC 4 Disposal Area D	2	2	2		2	8
AOC 5 Vehicle Maintenance	3	3	3	1	3	13
AOC 6 2–100 Barrel Diesel AST	4	4	4			12
AOC 7 3,100 Barrel AST	2	2	2			6
AOC 8 Temp. Air Terminal	3	3	3	1		10
AOC 9 Temp. Warm Storage	4	4	4	1		13
AOC 10 Runway/Raodway Oiling	3	3	3	3	3	15
AOC 11 Septic Tank	1	1	1		1	4

Table 3.1-2 Cont.
Soil Analytical Summary
Granite Mountain RRS, Alaska

Site	DRO/GRO *	Volatile Organics	SVOC	Pesticides/ PCBs	ICP Metals and Hg	Total Per Site
AOC 12 Small Day Tanks (6)	6	6	6	2		20
AOC 13 Water Pump House	2	2	2	1		7
AOC 14 Disposal Areas E, F, G	6	6	6		6	24
AOC 15 Disposal Area H	3	3	3		3	12
AOC 16 Disposal Area I	3	3	3		3	12
AOC 17 Disposal Area J	2	2	2		2	8
AOC 18 Disposal Area K	1	1	1		1	4
Background	3	3	3		3	12
Total	59	59	59	13	37	227

Notes:
AOC = Area of Concern
AST = Aboveground Storage Tank
DRO = Diesel Range Organics
GRO = Gasoline Range Organics
Hg = Mercury analyzed by CVAA
SVOC = Semivolatile Organic Compounds
PCB = Polychlorinated Biphenyl
* = Residual Range Organics will be analyzed in select soil samples
All soil samples will be analyzed for percent moisture content by ASTM D2216.

Table 3.1-3
Water Analytical Summary
Granite Mountain RRS, Alaska

Site	DRO/GRO	Volatile Organics	SVOC	ICP Metals and Hg	Total Per Site
OT001 White Alice					
LF002 Soil Waste Disposal					
AOC 1 Disposal Area A	1	1	1	1	4
AOC 2 Disposal Area B	1	1	1	1	4
AOC 3 Disposal Area C					
AOC 4 Disposal Area D	2	2	2	2	8
AOC 5 Vehicle Maintenance					
AOC 6 2-100 Barrel Diesel AST					
AOC 7 3,100 Barrel AST	1	1	1	1	4
AOC 8 Temp. Air Terminal					
AOC 9 Temp. Warm Storage					
AOC 10 Runway/Raodway Oiling					
AOC 11 Septic Tank					

Table 3.1-3 Cont.
Water Analytical Summary
Granite Mountain RRS, Alaska

Site	DRO/GRO	Volatile Organics	SVOC	ICP Metals and Hg	Total Per Site
AOC 12 Small Day Tanks (6)					
AOC 13 * Water Pump House	2	2	2	1	7
AOC 14 Disposal Areas E, F, G	1	1	1	1	4
AOC 15 Disposal Area H					
AOC 16 Disposal Area I	1	1	1	1	4
AOC 17 Disposal Area J					
AOC 18 Disposal Area K					
Background	3	3	3	3	12
Trip Blanks		3			3
Equipment Blanks	8	8	8	8	32
Duplicates	2	2	2	2	8
Total	22	25	22	21	90

Notes:
AOC=Area of Concern
AST=Aboveground Storage Tank
DRO=Diesel Range Organics
GRO=Gasoline Range Organics
Hg=Mercury Analyzed by CVAA
SVOC=Semivolatile Organic Compounds
*-Groundwater sample will not be analyzed for ICP metals or mercury

3.1.1.6 Cistern Samples

One abandoned cistern has been identified at AOC 13, the Water Pump House. It is anticipated that one grab sample will be taken from the cistern during the SI to determine anthropogenic impacts from Base operations. This sample will be analyzed for petroleum products, pesticides, and PCBs. The condition and integrity of the cistern is not known and will be determined during the site reconnaissance. The method for sample collection are described in the SAP. The sample will be collected for laboratory analysis as specified in Table 3.1-3.

3.2 SPECIFIC INVESTIGATIONS

The SI at Granite Mountain includes two IRP sites and 18 AOCs. The site and AOC numbers and names are listed below.

Sites

- OT001 White Alice Site; and
- LF002 Solid Waste Disposal Area.

Areas of Concern

- AOC 1 Former Disposal Area A (Upper Camp);
- AOC 2 Former Disposal Area B (Upper Camp);
- AOC 3 Former Disposal Area C (Lower Camp);
- AOC 4 Former Disposal Area D (Upper Camp) - received wastes from A, B, and C;
- AOC 5 Vehicle Maintenance Shop (Upper Camp);
- AOC 6 Two 100-Barrel Aboveground Diesel Tanks (Upper Camp) - includes fuel lines;
- AOC 7 3,100-Barrel Aboveground Diesel Tank (Lower Camp);
- AOC 8 Temporary Air Terminal Building (Lower Camp);
- AOC 9 Temporary Warm Storage (Lower Camp);
- AOC 10 Runway/Roadway Oiling (Upper and Lower Camp);
- AOC 11 Septic Tank (Upper Camp);
- AOC 12 Small Day Tanks (six) (Upper Camp);
- AOC 13 Water Pump House;
- AOC 14 Dumps/Former Disposal Areas E, F, and G (Mid Mountain);
- AOC 15 Dumps/Former Disposal H (Upper Camp) - White Alice Area;

- AOC 16 Dumps/Former Disposal I (Top Camp) - Former Shop Area (Second Summit);

- AOC 17 Dumps/Former Disposal J (Upper Camp) - South End of Runway; and

- AOC 18 Dumps/Former Disposal K (Lower Camp) - North End of Runway.

The sites and AOCs have been divided into two categories: landfills and petroleum, oils and lubricants (POLs). Specific investigations for the categories and each site or AOC is described below along with the site or AOC description, background, and technical approach including numbers of sample, sample media, and laboratory analyses.

3.2.1 Landfills

This category includes one IRP site and 9 AOCs that have been designated as landfills, disposal areas, or dumps. The site and AOC numbers and names included under this category are as follows:

- LF002 Solid Waste Disposal Area;
- AOC 1 Former Disposal Area A (Upper Camp);
- AOC 2 Former Disposal Area B (Upper Camp);
- AOC 3 Former Disposal Area C (Lower Camp);
- AOC 4 Former Disposal Area D (Upper Camp);
- AOC 14 Dump/Former Disposal Areas E, F, and G (Mid Mountain);
- AOC 15 Dump/Former Disposal Area H (White Alice Area);
- AOC 16 Dump/Former Disposal Area I (Upper Camp, Second Summit);
- AOC 17 Dump/Former Disposal Area J (Top Camp, South End of Runway);and
- AOC 18 Dump/Former Disposal Area (Lower Camp, North End of Runway).

A description of the site or AOC, background data, and the technical approach for each site and AOC is provided in the following subsections.

3.2.1.1 LF002 Solid Waste Disposal Area

Description. The Solid Waste Disposal Area is located south of the communication facility along the east side of the access road (HMTC 1989). This disposal area is approximately 2,000 feet south of the RRS (CH2M Hill 1994).

Background. This landfill was used while the RRS was operational (HMTC 1989). The facility was active between 1957 and 1981 but records do not indicate whether all solid waste was disposed of in this landfill during this time (CH2M Hill 1994).

The disposal area was reported to contain small pieces of miscellaneous scrap material and portions of the area appeared to have been regraded. Several stains were observed at this site during a PA conducted in 1988 (HMTC 1989). An Air Force memorandum dated 4 March 1993 indicates that waste was last disposed of at the permitted site on 20 October 1985. It was noted that debris may have been disposed of at a site on state land rather than at the solid waste landfill (CH2M Hill 1994).

Technical Approach. An initial walk around the perimeter of the waste disposal area will be conducted to identify stains, debris, or surficial features such as seeps,

standing water, and depressions in the ground. These observations will be recorded on a hand-drawn map or in the field logbook.

A metal survey will be conducted to locate buried metallic debris and to determine the extent of the debris. The size of the area will be measured at random locations to delineate the boundaries and recorded on a hand-drawn map.

During the June 1994 presurvey, stained surface soils were noted. Therefore, stained areas will be evaluated for sampling. Areas of interest may be selected as described in the SAP for field screening to determine potential sampling locations for fixed laboratory analysis.

The location of all samples and the sample identification number will be placed on a map of the site. The data collection point will be located using a Brunton compass and a fiberglass tape measure to tie the point to a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and a labeled wooden stake so that the sampling point can be revisited, if necessary.

It is estimated that up to three soil samples will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, SVOCs, and total metals analysis by ICP and mercury by Cold Vapor Atomic Absorption (AA).

3.2.1.2 AOC 1 Former Disposal Area A (Upper Camp)

Description. This former disposal area is located directly north of the Upper Camp area.

Background. In 1980 and 1983, the 5099th CEOS (now the 11th) shipped 1,100 drums of liquids from Disposal Area A to Elmendorf AFB. Disposal area debris was moved to AOC 4, Disposal Area D (CH2M Mill 1994). According to observations made during the 1988 PA (HMTC 1989), Disposal Area A appeared clean and regraded.

Technical Approach. An initial walk around the perimeter of the disposal area will be conducted to identify stains, debris, or surficial features such as seeps, standing water, and depressions in the ground. These observations will be recorded on a hand-drawn map or in the field logbook.

A metal survey will be conducted to locate metallic debris and to determine the extent of the debris. The size of the area will be measured at random locations to delineate the landfill boundaries and recorded on a hand-drawn map.

The location of all samples and the sample identification number will be placed on a map of the site. The data collection point will be located using a Brunton compass and a fiberglass tape measure to tie the point to a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary.

Although no stained areas were noted during the presurvey visit in June 1994, any areas of significant staining discovered during the August 1994 SI will be evaluated to determine if samples should be collected for fixed laboratory analysis. Soil samples may be collected for field screening to determine other potential sampling locations for fixed laboratory analysis. These sample locations will be selected in

the field from potential sources or contaminant migration pathways based on visual observations as described in the SAP.

It is estimated that one soil sample, one sediment sample, and one surface water sample (from nearby seep or from standing water) will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, SVOCs, and total metals analysis by ICP and mercury by Cold Vapor AA.

3.2.1.3 AOC 2 Former Disposal Area B (Upper Camp)

Description. This former disposal area is located directly west of the Upper Camp area.

Background. In 1980 and 1983, the 5099th CEOS shipped 200 drums of unknown material (possibly liquids) from Disposal Area B to Elmendorf AFB. Disposal area debris was moved to Disposal Area D (CH2M Hill 1994). According to observations made during the 1988 PA (HMTC 1989), Disposal Area B appeared clean and regraded.

Technical Approach. An initial walk around the perimeter of the disposal area will be conducted to identify stains, debris, or surficial features such as seeps, standing water, and depressions in the ground. These observations will be recorded on a hand-drawn map or in the field logbook.

A metal survey will be conducted to locate buried metallic debris, if any, and to determine the extent of the debris. The size of the area will be measured at random locations to delineate the landfill boundaries and recorded on a hand-drawn map.

Although no stains were noted during the presurvey visit in June 1994, any areas of significant staining discovered during the August 1994 SI will be evaluated for sampling. A nearby water seep observed during the presurvey visit in June 1994 will be sampled. Soil samples may be collected for field screening to determine other potential sampling locations for fixed laboratory analysis. These sample locations will be selected in the field from potential sources or contaminant migration pathways based on visual observations as described in the SAP.

The location of all samples and the sample identification number will be placed on a map of the site. The data collection point will be located using a Brunton compass and a fiberglass tape measure to tie the point into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary.

It is estimated that up to two soil samples and one surface water sample from a nearby seep will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, SVOCs, and total metals analysis by ICP and mercury by Cold Vapor AA.

3.2.1.4 AOC 3 Former Disposal Area C (Lower Camp)

Description. This former disposal area is located at the Lower Camp directly east of the runway. It is located south of the 3,100-Barrel Aboveground Storage Tank.

Background. In 1980 and 1983, the 5099th CEOS shipped 500 drums of liquids from Disposal Area C to Elmendorf AFB. According to observations made during the 1988 PA (HMTC 1989), Disposal Area C appeared clean and regraded.

Technical Approach. An initial walk around the perimeter of the disposal area will be conducted to identify stains, debris, or surficial features such as seeps, standing water, and depressions in the ground. These observations will be recorded on a hand-drawn map or in the field logbook.

A metal survey will be conducted to locate buried metallic debris, if any, and to determine the extent of the debris. The size of the area will be measured at random locations to delineate the landfill boundaries and recorded on a hand-drawn map.

During the June 1994 presurvey, stained surface soils were noted. Therefore, these stained areas will be evaluated for sampling. Areas of interest may be selected as described in the SAP for field screening to determine sampling locations for fixed laboratory analysis.

The location of all samples and the sample identification number will be placed on a map of the site. The data collections point will be located using Brunton compass and a fiberglass tape measure to tie the point into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible a labeled wooden stake so that the sampling point can be revisited, if necessary.

It is estimated that up to three soil samples will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, SVOCs, and total metals by ICP and mercury by Cold Vapor AA. One sample will be analyzed for pesticides and PCBs.

3.2.1.5 AOC 4 Former Disposal Area D (Upper Camp)

Description. This former disposal area is located south of the top Camp area along the road to the runway.

Background. In 1980 and 1983, the 5099th CEOS shipped drums of liquids from Disposal Areas A, B, and C to Elmendorf AFB. Debris from these areas was moved to Disposal Area D (CH2M Hill 1994).

Technical Approach. An initial walk around the perimeter of the disposal area will be conducted to identify stains, debris, or surficial features such as seeps, standing water, and depressions in the ground. These observations will be recorded on a hand-drawn map or in the field logbook.

A metal survey will be conducted to locate buried metallic debris and to determine the extent of the debris. The size of the area will be measured at random locations to delineate the landfill boundaries and recorded on a hand-drawn map.

During the June 1994 presurvey, stained surface soils and nearby water seeps were noted. These areas will be evaluated for sampling. Areas of interest may be selected as described in the SAP for field screening to determine sampling locations for fixed laboratory analysis.

The location of all samples and the sample identification number will be placed on a map of the site. The data collections point will be located using Brunton compass and a fiberglass tape measure to tie the point into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary.

It is estimated that up to two soil samples and two surface water samples will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, SVOCs, and total metals analysis by ICP and mercury by Cold Vapor AA.

3.2.1.6 AOC 14 Dump/Former Disposal Areas E, F and G (Mid-Mountain)

Description. This former disposal area is located east of the access road southeast of AOC 4, Former Disposal Area D.

Background. According to observations made during the presurvey, visit in June 1994, there are three possible disposal areas located along the hillside. It is speculated that one of these areas may have been the location of a vehicle maintenance shop. Water seeps were observed downgradient (south) of the disposal areas and metallic debris was observed in the disposal areas.

Technical Approach. An initial walk around the perimeter of the disposal area will be conducted to identify stains, debris, or surficial features such as seeps, standing water, and depressions in the ground. These observations will be recorded on a hand-drawn map or in the field logbook.

A metal survey will be conducted to locate buried metallic debris and to determine the extent of the debris. The size of the area will be measured at random locations to delineate the landfill boundaries and recorded on a hand-drawn map.

Although no stains were noted during the presurvey visit in June 1994, any areas of significant staining discovered during the August 1994 SI will be evaluated for sampling. Nearby water seeps observed during the presurvey visit in June 1994 will be sampled. In addition to these samples, soil samples may be collected for field screening to determine other potential sampling locations for fixed laboratory analysis. These locations will be selected in the field from potential sources or contaminant migration pathways based on visual observations as described in the SAP.

The location of all samples and the sample identification number will be placed on a map of the site. The data collection point will be located using a Brunton compass and a fiberglass tape measure to tie the point into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary.

It is estimated that up to five soil samples, one surface water sample from a nearby seep, and one sediment sample will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, SVOCs, and total metals analysis by ICP and mercury by Cold Vapor AA.

3.2.1.7 AOC 15 Dump/Former Disposal Area H (White Alice Area)

Description. This former disposal area is located south of AOC 11, Septic Tank at the Upper Camp.

Background. According to observations made during the presurvey visit in June 1994, there are stained soil and metallic debris located in this area.

Technical Approach. An initial walk around the perimeter of the disposal area will be conducted to identify stains, debris, or surficial features such as seeps, standing water, and depressions in the ground. These observations will be recorded on a hand-drawn map or in the field logbook.

A metal survey will be conducted to locate buried metallic debris and to determine the extent of the debris. The size of the area will be measured at random locations to delineate the landfill boundaries and recorded on a hand-drawn map.

During the June 1994 presurvey, stained surface soils and metallic debris were noted. Therefore, these stained areas will be evaluated for sampling. Areas of interest may be selected as described in the SAP for field screening to determine sampling locations for fixed laboratory analysis.

The location of all samples and the sample identification number will be placed on a map of the site. The data collection point will be located using a Brunton compass and a fiberglass tape measure to tie the point into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary

It is estimated that up to three soil samples will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, SVOCs, and total metals analysis by ICP and mercury by Cold Vapor AA.

3.2.1.8 AOC 16 Dump/Former Disposal Area I (Upper Camp, Second Summit)

Description. This former disposal area is located on top of the second summit near the Upper Camp.

Background. According to observations made during the presurvey visit in June 1994, there are stained soil and metallic debris located in this area. It is speculated that this area may have been the location of a maintenance shop.

Technical Approach. An initial walk around the perimeter of the disposal area will be conducted to visually identify stains, debris, or surficial features such as seeps, standing water, and depressions in the ground. These observations will be recorded on a hand-drawn map or in the field logbook.

A metal survey will be conducted to locate buried metallic debris and to determine the extent of the debris. The size of the area will be measured at random locations to delineate the landfill boundaries and recorded on a hand-drawn map.

During the June 1994 presurvey, stained surface soils and metallic debris were noted. Therefore, the stained areas will be evaluated for sampling. Areas of interest

may be selected as described in the SAP for field screening to determine sampling locations for fixed laboratory analysis.

The location of all samples and the sample identification number will be placed on a map of the site. The data collection point will be located using a Brunton compass and a fiberglass tape measure to tie the point into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod, and, if possible a labeled wooden stake so that the sampling point can be revisited, if necessary

It is estimated that up to three soil samples and one surface water sample will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, SVOCs, and total metals analysis by ICP and mercury by Cold Vapor AA.

3.2.1.9 AOC 17 Dump/Former Disposal Area J (Lower Camp, South End of Runway)

Description. This former disposal area is located west of the southern end of the runway.

Background. According to observations made during the presurvey visit in June 1994, there are debris, possibly from an airplane wreck, and surface pits that may contain buried drums.

Technical Approach. An initial walk around the perimeter of the disposal area will be conducted to identify stains, debris, or surficial features such as seeps, standing water, and depressions in the ground. These observations will be recorded on a hand-drawn map or in the field logbook.

A metal survey will be conducted to locate buried metallic debris, and to determine the extent of the disturbed soil. The size of the area will be measured at random locations to delineate the landfill boundaries and recorded on a hand-drawn map.

Although no stains were noted during the presurvey visit in June 1994, any areas of significant staining discovered during the August 1994 SI will be evaluated for sampling. No water seeps were noted during the June 1994 presurvey visit. Soil samples may be collected for field screening to determine other potential sampling locations for fixed laboratory analysis. These sample locations will be selected in the field from potential sources or contaminant migration pathways based on visual observations as described in the SAP.

The location of all samples and the sample identification number will be placed on a map of the site. The data collection point will be located using a Brunton compass and a fiberglass tape measure to tie the point into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary

It is estimated that up to two soil samples will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, SVOCs, and total metals analysis by ICP and mercury by Cold Vapor AA.

3.2.1.10 AOC 18 Dump/Former Disposal Area K (Lower Camp, North End of Runway)

Description. This former disposal area is located west of the runway near AOC 9, Temporary Warm Storage.

Background. According to observations made during the presurvey visit in June 1994, this may be a former dump area.

Technical Approach. An initial walk around the perimeter of the disposal area will be conducted to identify stains, debris, or surficial features such as seeps, standing water, and depressions in the ground. These observations will be recorded on a hand-drawn map or in the field logbook.

A metal survey will be conducted to locate buried metallic debris and to determine the extent of the debris. The size of the area will be measured at random to delineate the landfill boundaries and recorded on a hand-drawn map.

Although no stains were noted during the presurvey visit in June 1994, any areas of significant staining discovered during the August 1994 SI will be evaluated for sampling. No water seeps were observed during the presurvey visit in June 1994. Soil samples may be collected for field screening to determine other potential sampling locations for fixed laboratory analysis. These locations will be selected in the field from potential sources or contaminant migration pathways based on visual site observations as described in the SAP.

The location of all samples and the sample identification number will be placed on a map of the site. The data collection point will be located using a Brunton compass and a fiberglass tape measure to tie the point into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary

It is estimated that up to one soil sample will be collected for fixed laboratory analysis. This sample will be analyzed for DRO/GRO, VOCs, SVOCs, and total metals analysis by ICP and mercury by Cold Vapor AA.

3.2.2 Petroleum, Oils, and Lubricants (POLs)

This category includes one IRP site and nine AOC that have been designated as POLs. The site and AOC numbers and names included under this category are as follows:

- OT001 White Alice Site;
- AOC 5 Vehicle Maintenance Shop (Upper Camp);
- AOC 6 Two 100-Barrel Aboveground Diesel Tanks (Upper Camp);
- AOC 7 One 3,100-Barrel Aboveground Diesel Tank (Lower Camp);
- AOC 8 Temporary Air Terminal Building (Lower Camp);
- AOC 9 Temporary Warm Storage (Lower Camp);
- AOC 10 Runway/Roadway Oiling (Upper and Lower Camp);
- AOC 11 Septic Tank (Upper Camp);
- AOC 12 Small Day Tanks (6) (Upper Camp); and
- AOC 13 Water Pump House (Mid-Mountain).

A description of the site or AOC, background data, and the technical approach for each site and AOC is provided in the following subsections.

3.2.2.1 OT001 White Alice Site

Description. Site OT001 consists of the former WACS site (two 30-foot high disk antennas, and four 60-foot high tropospheric antennas and a Dormitory and Equipment Building, located at the Upper Camp.

Background. Suspected contaminants at this area include oils and PCBs.

Technical Approach. A visual inspection will be performed on the WACS and the areas adjacent to it. During the field inspection, areas of interest will be identified. These include stained areas, areas with stressed vegetation, groundwater seeps, and areas directly downgradient from potential sources.

Areas in which significantly stained soils are observed (such as the Bay Doors and antenna areas) will be sampled for laboratory analysis. If no areas of interest are identified, soil samples will be collected for field screening to determine potential sampling locations for fixed laboratory analysis. These locations will be selected in the field from potential sources or contaminant migration pathways based on visual observations as described in the SAP. Soil samples may be collected at the surface and at shallow subsurface depth based on field observations of the depth of potential contamination.

The locations of all samples and the sample identification numbers will be placed on a map of the site. The data collection points will be located using a Brunton compass and a fiberglass tape measure to tie the points into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary.

It is estimated that up to three soil samples will be collected for fixed laboratory analysis. These samples will be analyzed for pesticides and PCBs. In addition, one of the samples will be selected for fixed laboratory analysis of DRO/GRO, VOCs, and SVOCs.

3.2.2.2 AOC 5 Vehicle Maintenance Shop (Upper Camp)

Description. The Auto Maintenance Shop is located at the northwest corner of the Upper Camp area. A fuel tank is located on the south side of this building with a pipeline from the tanks leading to the southeast.

Background. The Vehicle Maintenance Shop was used to fix and refuel motor vehicles. Possible contaminants include petroleum products, paints, thinners, batteries, antifreeze, and degreasing solvents.

Technical Approach. A visual inspection will be performed on all fuel storage tanks, buildings housing fuel tanks, floor drain outfalls, and the areas adjacent to each potential source. During the field inspection, areas of interest will be identified. These include stained areas, areas with stressed vegetation, groundwater seeps, floor drain outfalls, or areas directly downgradient from potential sources.

Samples will be collected from areas of interest or, if no areas of interest are identified, soil samples will be collected for field screening to determine potential sampling locations for fixed laboratory analysis. These locations will be selected in the field from potential sources of contaminant migration pathways based on visual observations as described in the SAP. Soil samples may be collected at the surface and at shallow subsurface depth based on field observations of the depth of potential contamination.

The locations of all samples and the sample identification numbers will be placed on a map of the site. The data collection points will be located using a Brunton compass and a fiberglass tape measure to tie the points into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary.

It is estimated that up to three soil samples will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, SVOCs, and total metals analysis by ICP and mercury by Cold Vapor AA. One sample will be analyzed for pesticides and PCBs.

3.2.2.3 AOC 6 Two 100-Barrel Aboveground Diesel Tank (Upper Camp)

Description. This AOC is located near the Upper Camp Area, approximately 200 feet northeast of the Dormitory Building. The area consists of two 100-barrel aboveground diesel storage tanks.

Background. Contaminants that may have been spilled during loading or unloading or from spills or leaks include diesel and gasoline-range organics, oils and lubricants, and possible solvents.

Technical Approach. A visual inspection will be performed on all fuel storage tanks, buildings housing fuel tanks, floor drain outfalls, and the areas adjacent to each potential source. During the field inspection, areas of interest will be identified. These include stained areas, areas with stressed vegetation, groundwater seeps, floor drain outfalls, or areas directly downgradient from potential sources.

During the June 1994 presurvey, stained surface soils were noted. Therefore, these stained areas will be evaluated for sampling. Areas of interest may be selected as described in the SAP for field screening to determine sampling locations for fixed laboratory analysis. Soil samples may be collected at the surface and at shallow subsurface depth based on field observations of the depth of potential contamination.

The locations of all samples and the sample identification numbers will be placed on a map of the site. The data collection points will be located using a Brunton compass and a fiberglass tape measure to tie the points into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary.

It is estimated that up to four soil samples will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, and SVOCs.

3.2.2.4 AOC 7 One 3,100-Barrel Aboveground Diesel Tank (Lower Camp)

Description. This AOC is located at the Lower Camp Area east of the airstrip. It was composed of a 3,100-barrel aboveground diesel storage tank that has been removed.

Background. During Base operations, diesel spills are likely to have occurred during loading and unloading of fuel. It may be possible that other fuel products or solvents may have been stored in the tank at one time.

Technical Approach. A visual inspection will be performed on the fuel storage tank location and the areas adjacent to the potential source. During the field inspection, areas of interest will be identified. These include stained areas, areas with stressed vegetation, groundwater seeps, or areas directly downgradient from potential sources.

During the June 1994 presurvey, stained surface soils were noted near a pipeline. Therefore, these stained soils will be evaluated for sampling. Areas of interest may be selected as described in the SAP for field screening to determine sampling locations for fixed laboratory analysis. Soil samples may be collected at the surface and at shallow subsurface depth based on field observations of the depth of potential contamination.

The locations of all samples and the sample identification numbers will be placed on a map of the site. The data collection points will be located using a Brunton compass and a fiberglass tape measure to tie the points into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary.

It is estimated that up to two soil samples and a surface water sample will be collected for fixed laboratory analysis. Soil samples will be analyzed for DRO/GRO, VOCs, and SVOCs. Water samples will be analyzed for DRO/GRO, VOCs, SVOCs, and total metals analysis by ICP and mercury by Cold Vapor AA.

3.2.2.5 AOC 8 Temporary Air Terminal Building (Lower Camp)

Description. The Temporary Air Terminal is located at the Lower Camp Area directly west of the airstrip.

Background. Possible contamination related to the Terminal include fuels, PCBs from building electronics, solvents, thinners, oils and lubricants, and pesticides.

Technical Approach. A visual inspection will be performed in and around the structure including floor drain outfalls and the areas adjacent to the potential source. During the field inspection, areas of interest will be identified. These include stained areas, areas with stressed vegetation, groundwater seeps, floor drain outfalls, or areas directly downgradient from potential sources.

During the June 1994 presurvey, stained surface soils were noted. Therefore, these stained areas will be evaluated for sampling. Areas of interest may be selected as described in the SAP for field screening to determine sampling locations for fixed laboratory analysis. Soil samples may be collected at the surface and at shallow

subsurface depth based on field observations of the depth of potential contamination.

The locations of all samples and the sample identification numbers will be placed on a map of the site. The data collection points will be located using a Brunton compass and a fiberglass tape measure to tie the points into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary.

It is estimated that up to three soil samples will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, and SVOCs. In addition, one of the soil samples will be analyzed for pesticides and PCBs.

3.2.2.5 AOC 9 Temporary Warm Storage (Lower Camp)

Description. The AOC is located southwest of the Air Terminal and was used to store equipment and supplies.

Background. Possible contamination related to this AOC include fuels, PCBs from building electronics, solvents, thinners, oils and lubricants, and pesticides.

Technical Approach. A visual inspection will be performed in and around the structure including floor drain outfalls and the areas adjacent to the potential source. During the field inspection, areas of interest will be identified. These include stained areas, areas with stressed vegetation, groundwater seeps, floor drain outfalls, or areas directly downgradient from potential sources.

During the June 1994 presurvey, stressed vegetation was noted. Therefore, areas of interest near the stressed vegetation will be evaluated for sampling. If no areas of interest are identified, soil samples will be collected for field screening to determine other potential sampling locations for fixed laboratory analysis. These locations will be selected in the field from potential sources or contaminant migration pathways based on visual observations as described in the SAP. Soil samples may be collected at the surface and at shallow subsurface depth based on field observations of the depth of potential contamination.

The locations of all samples and the sample identification numbers will be placed on a map of the site. The data collection points will be located using a Brunton compass and a fiberglass tape measure to tie the points into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible a labeled wooden stake so that the sampling point can be revisited, if necessary.

It is estimated that up to four soil samples will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, and SVOCs. In addition, one of the soil samples will be analyzed for pesticides and PCBs.

3.2.2.6 AOC 10 Runway/Roadway Oiling (Upper and Lower Camp)

Description. The Runway is approximately 4,000 feet in length. It is located at the Lower Camp Area. A 3-mile long gravel road leads to the Upper Camp Radar Station.

Background. Reports indicate that recycled oils were placed on the runway and road to control dust. Possible contamination related to this AOC include oils and lubricants, PCBs and solvents in waste oil, and pesticides.

Technical Approach. A visual inspection will be performed on the Runway and the areas adjacent to the Runway. During the field inspection, areas of interest will be identified. These include stained areas, areas with stressed vegetation, groundwater seeps, and areas directly downgradient from potential sources.

Areas in which stained soils are observed will be evaluated for sampling. If no areas of interest are identified, soil samples will be collected for field screening to determine other potential sampling locations for fixed laboratory analysis. These locations will be selected in the field from potential sources of contaminant migration pathways based on visual observations as described in the SAP. Soil samples may be collected at the surface and at shallow subsurface depth based on field observations of the depth of potential contamination.

The locations of all samples and the sample identification numbers will be placed on a map of the site. The data collection points will be located using a Brunton compass and a fiberglass tape measure to tie the points into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary.

It is estimated that up to two soil samples and one sediment sample will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, SVOCs, pesticides and PCBs, and total metals by ICP and mercury by Cold Vapor AA.

3.2.2.7 AOC 11 Septic Tank (Upper Camp)

Description. The Septic Tank is located south of AOC 6, Two 100-Barrel Diesel Aboveground Storage Tanks.

Background. Potential contaminants include solvents and metals that may have been disposed of in the septic tank.

Technical Approach. A visual inspection will be performed on the Septic Tank and the areas adjacent to it. During the field inspection, areas of interest will be identified. These include stained areas, areas with stressed vegetation, groundwater seeps, and areas directly downgradient from potential sources.

The locations of all samples and the sample identification numbers will be placed on a map of the site. The data collection points will be located using a Brunton compass and a fiberglass tape measure to tie the points into a nearby structure or monument.

It is estimated that up to one sludge sample will be collected from inside the tank. The sample will be collected for fixed laboratory analysis. This sample will be analyzed for DRO/GRO, VOCs, SVOCs, and total metals analysis by ICP and mercury by Cold Vapor AA.

3.2.2.8 AOC 12 Small Day Tanks (six) (Upper Camp)

Description. The Small Day Tanks are located next to each White Alice Radio Antenna panel and by two additional antenna setups.

Background. Possible contamination related to these tanks include fuels solvents and PCBs that may have been in waste oils used for dust control.

Technical Approach. A visual inspection will be performed in and around each of the tanks and buildings housing the tank structure including floor drain outfalls and the areas adjacent to the potential source. During the field inspection, areas of interest will be identified. These include stained areas, areas with stressed vegetation, groundwater seeps, floor drain outfalls, or areas directly downgradient from potential sources.

Areas in which stained soils are observed will be evaluated for sampling. If no areas of concern are identified, soil samples will be collected for field screening to determine other potential sampling locations for fixed laboratory analysis. These locations will be selected in the field from potential sources or contaminant migration pathways based on visual observations as described in the SAP. Soil samples may be collected at the surface and at shallow subsurface depth based on field observations of the depth of potential contamination.

The locations of all samples and the sample identification numbers will be placed on a map of the site. The data collection points will be located using a Brunton compass and a fiberglass tape measure to tie the points into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary.

It is estimated that up to up to six soil samples will be collected for fixed laboratory analysis. These samples will be analyzed for DRO/GRO, VOCs, and SVOCs. In addition, two soil samples will be analyzed for pesticides and PCBs.

3.2.2.9 AOC 13 Water Pump House (Mid-Mountain)

Description. The Pump House is located to the east of the Access Road south of AOC 14, Former Disposal Areas E, F, and G.

Background. There is a generator located in the Pump House that may be a potential source of contamination from fuel spills.

Technical Approach. A visual inspection will be performed in and around the structure including floor drain outfalls and the areas adjacent to the potential source. During the field inspection, areas of interest will be identified. These include stained areas, areas with stressed vegetation, groundwater seeps, floor drain outfalls, or areas directly downgradient from potential sources.

During the June 1994 presurvey, stained surface soils were noted. These stained areas will be evaluated for sampling. Areas of interest may be selected as described in the SAP for field screening to determine sampling locations for fixed laboratory analysis. Soil samples may be collected at the surface and at shallow subsurface depth based on field observations of the depth of potential contamination.

The locations of all samples and the sample identification numbers will be placed on a map of the site. The data collection points will be located using a Brunton compass and a fiberglass tape measure to tie the points into a nearby structure or monument. In addition, all sampling locations will be clearly marked with a metal rod and, if possible, a labeled wooden stake so that the sampling point can be revisited, if necessary.

It is estimated that up to two soil samples, one surface water sample and one groundwater sample from the water well will be collected for fixed laboratory analysis. Soil samples will be analyzed for DRO/GRO, VOCs, and SVOCs. One soil sample will be analyzed for pesticides and PCBs. The surface water sample will be analyzed for DRO/GRO, VOCs, SVOCs, and total metals analysis by ICP and mercury by Cold Vapor AA. The Water Well sample will by analyzed for DRO/GRO, VOCs, and SVOCs.

4.0 PRELIMINARY ASSESSMENT/SITE INSPECTION REPORT

Following completion of field activities and receipt of all analytical results, a PA/SI report will be prepared. The PA/SI report will be prepared in accordance with EPA (EPA 1991) and Air Force (Air Force 1993) guidance. The report will include detailed discussions of the following:

- description of Granite Mountain RRS;
- operational history of Granite Mountain RRS;
- project activities, including the limited literature review, PA/SI field activities, waste management, field QA/QC, laboratory analysis, and data evaluation;
- physical setting, including geology, hydrology, hydrogeology, climate, and demography;
- discussion of analytical results;
- summary of analytical results in appropriate formats (i.e., tables, bar charts, figures, etc.);
- evaluation of whether any releases from the IRP sites or AOCs have occurred;
- evaluation of potential pathways and targets of concern for any identified releases;
- location map showing all IRP sites and AOCs, sampling locations, and potential areas of contamination; and
- recommendations for each IRP site or AOC.

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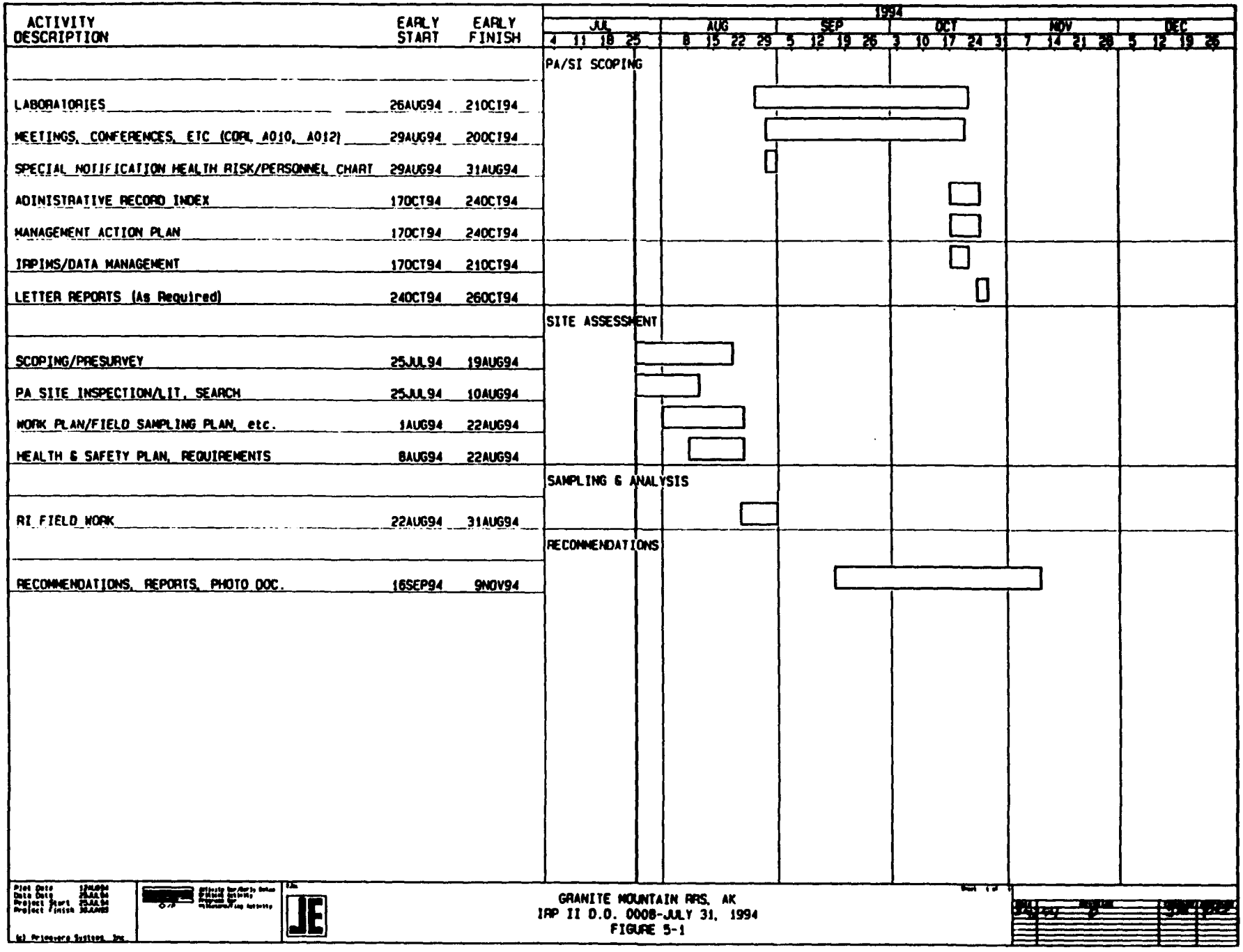
5.0 PROJECT SCHEDULE

The proposed project schedule for all technical activities is shown in Figure 5-1. A presurvey site visit was conducted by Air Force personnel in June 1994. Information obtained during this presurvey was used to finalize the Work Plan and SAP in preparation for the PA/SI field activities. Planning and coordination of the field activities began in late July 1994 and will continue through the finalization of the planning documents. Fieldwork will begin on 22 August 1994 and is expected to last approximately 10 days. Preparation of the PA/SI report will begin after fieldwork is complete.



GRANITE MOUNTAIN RRS, AK
IRP II D.O. 0008-JULY 31, 1994
FIGURE 5-1

6.0 REFERENCES

CH2M Hill. 1994 (January). *Preliminary Assessment, Granite Mountain.*

Hazardous Materials Technical Center. 1989 (April). *Installation Restoration Program, Preliminary Assessment, Granite Mountain Radio Relay Station, Alaska.*

U.S. Air Force. 1993 (September). *Handbook for the Installation Restoration Program Remedial Investigations and Feasibility Studies.* Headquarters, Air Force Center for Environmental Excellence.

U.S. Environmental Protection Agency. 1991 (September). *Guidance for Performing Preliminary Assessments Under CERCLA.* EPA/540/G-91/013.

U.S. Geological Survey. 1993. *Groundwater Site Inventory Database.*

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APPENDIX A

PCB CLEARANCE AND FINDING OF NO SIGNIFICANT CONTAMINATION CERTIFICATES FOR GRANITE MOUNTAIN RADIO RELAY STATION, ALASKA

Source: HMTC, 1989

2 DEC 1985

FINDING OF NO SIGNIFICANT CONTAMINATION

GRANITE MOUNTAIN RADIO RELAY SITE

This excess real property contains no known contamination as specified by the Resource Conservation and Recovery Act of 1976 (RCRA), as amended, the Toxic Substance Control Act of 1976, the Comprehensive Environmental Response, Compensation and Liability Act of 1980, the implementing Environmental Protection Agency, federal regulations (40 CFR 261, 262, 263, and 761), and the Federal Property Management Regulations (41 CFR 101).

Bill E. Slone

BILL E. SLONE, WS-13
Chief, Operating Engineers

DESCRIPTION OF SITE:

The parcel of land to be excessed is in NE 1/4, SEC 1, T. 1S., R. 13W., K.R.M. (Candle Quad).

The excess area is more specifically described at TAB-A of the Declaration of Excess.

PCB CLEARANCE CERTIFICATE

GRANITE MOUNTAIN RADIO RELAY SITE

This is to certify that a records check and an on-site inspection indicate that this property has been cleared of PCB materials or equipment in accordance with applicable State and Federal laws.

Bill E Slone

BILL E. SLONE, WS-13
Chief, Operating Engineers

DESCRIPTION OF SITE:

The parcel of land to be excessed is in NE 1/4, SEC 1, T. 1S., R. 13W., K.R.M. (Candle Quad).

The excess area is more specifically described at TAB-A of the Declaration of Excess.

Appendix B

Granite Mountain Test Pit Logs and Sieve Analyses

Source: CH2M Hill

DEPARTMENT OF THE ARMY
NORTH PACIFIC DIVISION
U.S. ARMY ENGINEER DISTRICT, ALASKA

EXPLORATION LOG

LOCATION (Coordinates or Station): 125' N, 40' E. of center point of Antenna No. 1.

DRILLING AGENCY: ☐ CORPS OF ENGINEERS ☐ OTHER

HOLE NO.	NAME OF DRILLER	WEATHER
FIELD TP-1 PERMANENT F-4	Clark	Pt Cloudy

TYPE OF HOLE	DEPTH TO	DEPTH DRILLED INTO	TOTAL DEPTH OF HOLE
TEST PIT ☐ AUGER HOLE ☐ CHURN DRILL ☐			4.5'

SIZE AND TYPE OF BIT	DATUM FOR ELEVATION SHOWN	TYPE OF EQUIPMENT
--	☐ TBM ☐ MSL.	Dozer, Pick & Shovel

TOTAL NO. OF SAMPLES	TYPE OF SAMPLES	DEPTH TO GROUND WATER	DATE HOLE STARTED	DATE HOLE COMPLETED
--	--	--	--	--

EL. TOP OF HOLE: [illegible].7 | LOGGED: R. Clark | Chief, Geology Section: [signature] | Chief, Foundations & Materials Branch: [signature] | Date: [illegible]

DEPTH FEET	% WATER CONTENT	SAMPLE NO.	SOIL LEGEND	CLASSIFICATION	MAX SIZE PARTICLE	FORMATION DESCRIPTION & REMARKS
1			GM	Silty sandy GRAVEL F-3	2'	Angular fragments of slightly weathered granite with silty sand in spaces between rock fragments; frozen, with ice wedges up to 1/4-inch thick; fill (?).
2						
3						
4			R	ROCK	3'	Fractured granite bedrock, fractures filled with silt ar ice wedges up to 1/4-inch thick.
5				Bottom of pit at 4.5 ft.		

NPA FORM DEC 1959 19 (REV)

PROJECT: AUTO MAINTENANCE SHOP GRANITE MOUNTAIN RRS

PERMANENT HOLE NO. Test Pit

FIGURE 1

NORTH PACIFIC DIVISION
U.S. ARMY ENGINEER DISTRICT, ALASKA

EXPLORATION LOG

N on ℄ of airstrip E.

DRILLING AGENCY ☐ CORPS OF ENGINEERS ☐ OTHER

HOLE NO.	NAME OF DRILLER	WEATHER
FIELD TP-2 PERMANENT F-5	Clark	Pt Cloudy

TYPE OF HOLE	DEPTH TO	DEPTH DRILLED INTO	TOTAL DEPTH OF HOLE
TEST PIT ☐ AUGER HOLE ☐ CHURN DRILL ☐			3

SIZE AND TYPE OF BIT	DATUM FOR ELEVATION SHOWN	TYPE OF EQUIPMENT
--	☑ TBM ☐ USC	Pick & Shovel

TOTAL NO OF SAMPLES	TYPE OF SAMPLES	DEPTH TO GROUND WATER	DATE HOLE STARTED	DATE HOLE COMPLETED
--	--	--	--	--

EL TOP OF HOLE	Recorded	Checked by Section	Chief of Party & Materials Engineer	Date
1393.9'	R. Clark	[illegible]	[illegible]	12 [illegible]

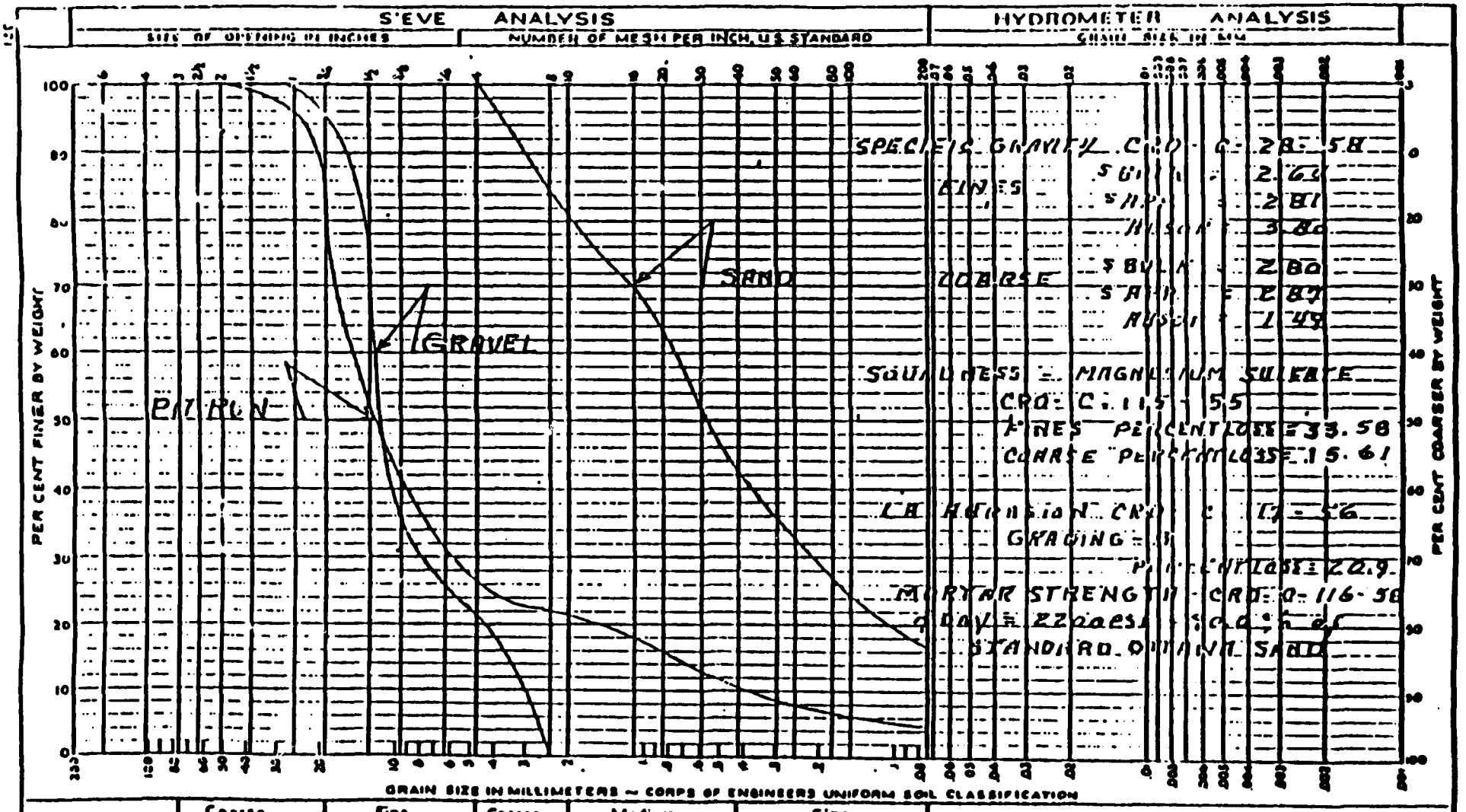
DEPTH IN FEET	WATER CONTENT	SAMPLE NO	SOIL LEGEND	CLASSIFICATION	MAX. SIZE PARTICLE	FORMATION DESCRIPTION & REMARKS
			ML	SILT		Abundant vegetation, plant debris; frozen, no visible
1			PT	PEAT		Plant debris, partly decomposed.
2			ML	Gravelly SILT P-4		Silt containg 30% angular to subrounded fragments of slightly weathered granite; frozen, no visible ice.
3						
4				Bottom of pit at 3.5 ft. Driller states refusal on granite bedrock at 3.5 ft.		

NPD ORM 19 (REV) 1959

PROJECT AUTO STORAGE BUILDING
GRANITE MOUNTAIN RRS

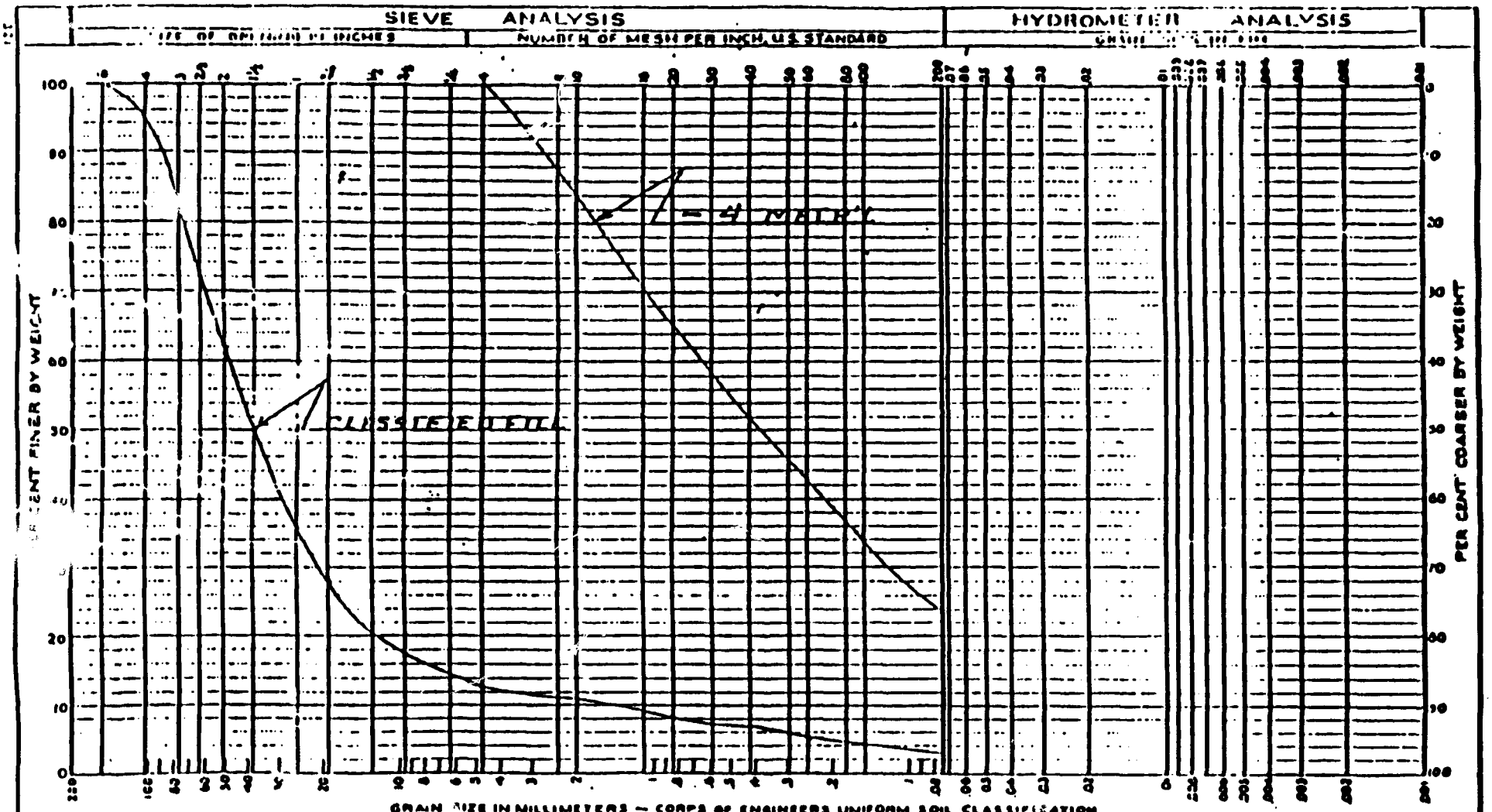
PERMANENT HOLE NO. [illegible]

FIGURE 2



SAMPLE NO	DEPTH - FT	CLASSIFICATION	NAT WC	LL	PI	
1		CONCRETE AGGREGATE				
NOTE:	Soundness: Percent loss in excess of 15% not allowed by Specification for Fine Aggregate					
	Mortar	Strength: 7 Day strength = 2200 PSI Percent of				
	Strength	less than 95% required by				

PROJECT GRANITE MT
Sample data BORROW
Sweepstakes Creek - Crusher Sta
Submitted by GEOLOGY file
Explorage sample No



SAMPLE NO	DEPTH - FT	CLASSIFICATION	W/ WC	LL	PI
3		SANDY GRAVEL GP - NES			

PROJECT GRANITE MT.
Sample data HARROW
Sweepstakes Creek - Tailing Pile
Submitted by GEOLOGY
Eagle sample No
W/O No

United States Air Force
611th Air Support Group
611th Civil Engineer Squadron

Elmendorf AFB, Alaska

FINAL

Granite Mountain RRS, Alaska

PRELIMINARY ASSESSMENT/ SITE INSPECTION SAMPLING & ANALYSIS PLAN

SEPTEMBER 1994

By:

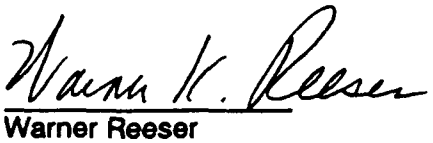
JACOBS ENGINEERING GROUP INC.
600 17th Street, Suite 1100N
Denver, CO 80202

PREFACE

This Sampling and Analysis Plan (SAP) describes the requirements for the expected tasks and activities needed to complete the investigation activities at Granite Mountain Radio Relay Station according to the requirements of Contract No. F41624-94-D-8046, Delivery Order 8, between the U.S. Air Force and Jacobs Engineering Group Inc. It was developed to make certain that all environmental data generated for the project are scientifically valid, defensible, comparable, and of known and acceptable precision and accuracy. The SAP has been prepared in accordance with format and content requirements, as applicable, of the *Handbook for the Installation Restoration Program Statements of Work* prepared by the Air Force Center for Environmental Excellence (AFCEE), Brooks Air Force Base, dated September 1993.

The Jacobs Engineering Group Inc. Project Manager for this contract is Ms. Joyce Miyagishima. The Contracting Officer's Representative for the AFCEE is Mr. Samer Karmi.

Approved:



Warner Reeser
Program Manager

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FIELD	GROUP	SUB-GROUP	IRP Sampling and Analysis Plan; Site Inspection, Granite Mountain Radio Relay Station, Alaska

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The site inspection (SI) will investigate sources at both the Upper Camp and Lower Camp, as well as assess the presence or absence of contaminants from the sources. Media to be sampled include surface water, surface soil, shallow subsurface soil, and sediment. Field screening techniques will be used, as well as the services of offsite laboratory.

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22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code)	22c. OFFICE SYMBOL
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NOTICE

This report has been prepared for the U. S. Air Force by Jacobs Engineering Group Inc. for the purpose of aiding in the implementation of a final remedial action plan under the Air Force Installation Restoration Program (IRP). As the report relates to actual or possible releases of potentially hazardous substances, its release before an Air Force final decision on remedial action may be in the public's interest. The limited objectives of this report and the ongoing nature of the IRP, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report, since subsequent facts may become known which may make this report premature or inaccurate. Acceptance of this report in performance of the contract under which it is prepared does not mean that the Air Force adopts the conclusions, recommendations or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the U.S. Air Force.

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TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

Page

List of Figures

List of Tables

List of Appendices

1.0 QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan (QAPP) is the first part of the Granite Mountain Radio Relay Station (RRS) Sampling and Analysis Plan (SAP) prepared by Jacobs Engineering Group Inc. (Jacobs). Section 2.0 of this document contains the Field Sampling Plan (FSP). The QAPP describes quality assurance (QA) and quality control (QC) procedures that will be performed during the 1994 fieldwork and laboratory analyses. The fieldwork and analyses will be conducted as part of the 1994 preliminary assessment/site investigation (PA/SI). These investigations are part of the U.S. Air Force (Air Force) Installation Restoration Program (IRP), which is administered by the Air Force Center for Environmental Excellence (AFCEE), Brooks Air Force Base (AFB). This QAPP is a companion document to the PA/SI Work Plan (Work Plan).

1.1 INTRODUCTION

The activities to be performed under the PA/SI at Granite Mountain RRS are designed to assess environmental conditions and evaluate existing sites and areas of concern (AOCs) through the collection of field data, including the collection of soil and water samples. These data are intended to support recommendations for further actions at Granite Mountain RRS; therefore, the data generated must comply with data quality deliverables suitable for a site assessment.

The FSP describes specific field operations including procedures for field sampling, sample handling, the field QA/QC program, and record keeping. Appendices for this SAP include Appendix A, Laboratory Quality Assurance Project Plan (LQAPP); Appendix B, Immunoassay Screening Instructions; Appendix C, Field Forms; and Appendix D, Instrument Operation Manuals.

1.1.1 The U.S. Air Force Installation Restoration Program

This SAP was prepared in accordance with all applicable Air Force and U.S. Environmental Protection Agency (EPA) guidance including EPA's *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, QAMS-005/80 (EPA 1980). As appropriate, this document follows the outline for Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) planning documents, as provided in the *Handbook For The Installation Restoration Program (IRP) Remedial Investigations/Feasibility Studies (RI/FS), Volume I*, (Air Force 1993) and the EPA manual, *Guidance for Performing Preliminary Assessments under CERCLA* (EPA 1991a). In addition, this document incorporates the requirements specified in the *Installation Restoration Program Information Management System (IRPIMS) Data Loading Handbook, Version 2.2* (Air Force 1991).

1.1.2 Purpose and Scope

The purpose of this QAPP is to define the QA and QC procedures that will be used to ensure data generated during the investigation are precise, accurate, representative, comparable, and complete. The SAP defines the function, specific responsibilities, and authorities for data quality. It also prescribes the requirements for ensuring that the environmental investigation for Granite Mountain RRS is planned and executed in a manner consistent with Air Force guidelines. The Work Plan describes the rationale for the proposed environmental sampling program, the

data needs and uses, and the overall objectives for the project. This QAPP provides guidance and specifications to ensure that the following are accomplished:

- A consistent framework is established for the generation of analytical data.
- Data quality goals are defined.
- Field measurements and laboratory analytical results are of known and acceptable quality and quantity (including precision and accuracy) through the use of standard methods; preventive maintenance; standardized calibration and analytical protocols; and QC measurements, reviews, and audits. Sample collection methods are performed in accordance with SOPs. Procedures are established to recognize out-of-control conditions and to correct these conditions.
- Actions are identified and implemented to ensure the validity of laboratory data.
- Procedures for record keeping, including sample tracking and chain of custody protocols, are established and followed.

1.2 PROJECT DESCRIPTION

The following subsections provide a brief description of Granite Mountain RRS field efforts and subcontractors that will contribute to the project activities. Details pertaining to the 1994 site inspection and project scope are described in the Work Plan.

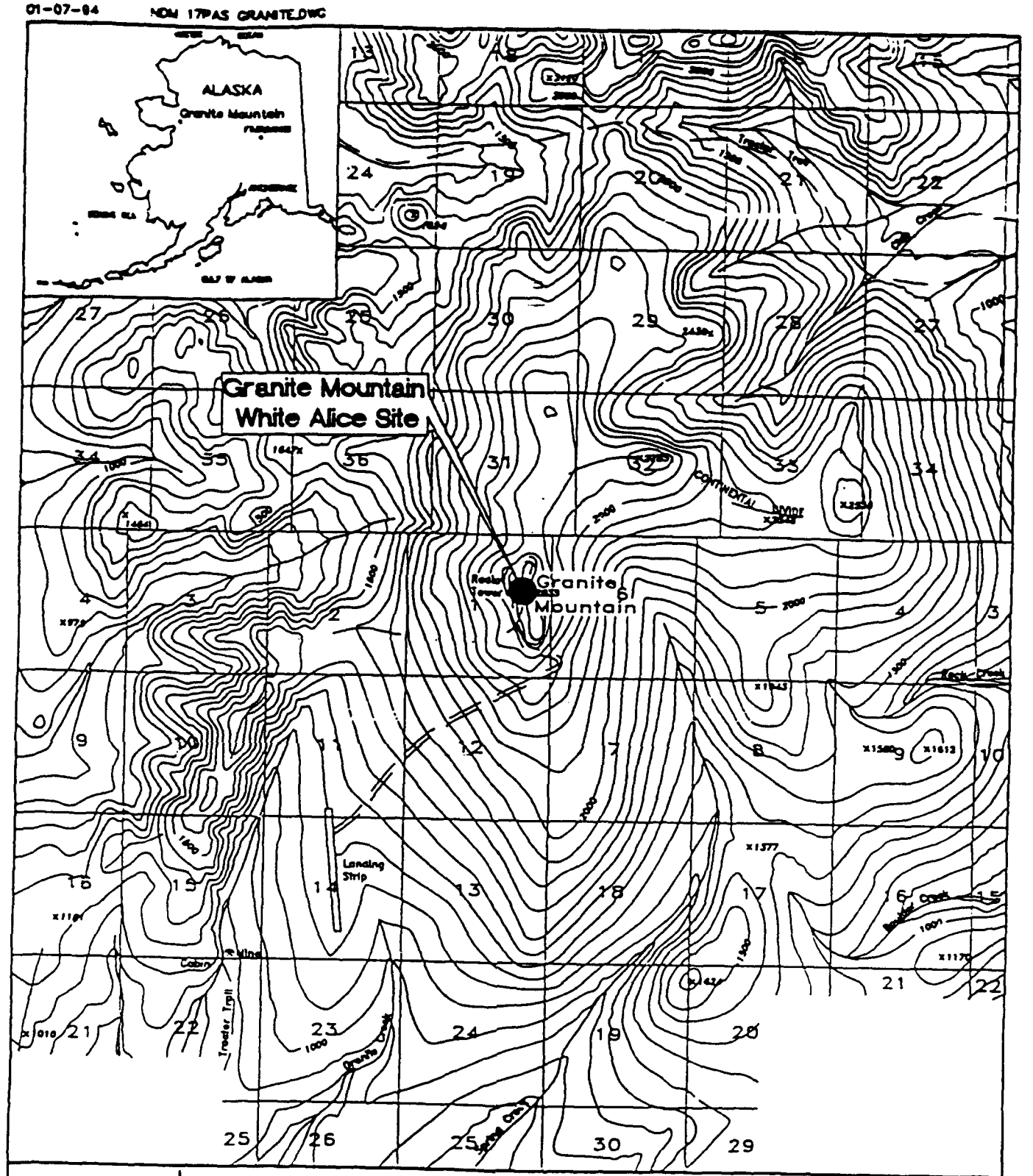
1.2.1 Site Background

Granite Mountain RRS is located on the isthmus of the Seward Peninsula north of Norton Bay, approximately 130 miles east of Nome and 12 miles north of Dime Landing, within the Second Judicial District, Alaska (Figure 1.2-1). The RRS is located in Sections 1, 11, 12, and 14, Township 1 South, Range 13 West, Kateel River Meridian. The 257.8 acre installation is composed of a 16.1 acre main site; a 4,000-foot (206.6 acre) long gravel runway; a well site; and an access road approximately 3.2 miles long with a water line right-of-way (Hazardous Material Testing Center [HMTC] 1989). The 16 acre main site area of the RRS, which includes several former disposal areas, is referred to as the Upper Camp. The Lower Camp, situated at an elevation approximately 1,600 feet below the Upper Camp, consists of the runway and various support structures.

The main site is composed of seven industrial buildings and 14 miscellaneous facilities including the following (HMTC 1989):

- 13,611 square foot composite building;
- 2,050 square foot vehicle maintenance shop;
- 1,408 square foot vehicle heated parking facility;
- 2,004 square foot dorm annex;
- small fire station;
- water supply building;
- two 30-foot high disk antennas;
- four 60-foot high tropospheric antennas;
- two fuel oil storage tanks; and
- one water storage tank.

01-07-94 NOW 17PAS GRANITE.DWG



SOURCE: USGS TOPOGRAPHIC QUAD SHEET CANDLE (B-5)

FIGURE 1.2-1
GRANITE MOUNTAIN
LOCATION MAP
GRANITE MOUNTAIN, ALASKA

To date, a total of two IRP sites and 18 AOCs have been identified at Granite Mountain RRS. These sites and AOCs have been subdivided into two categories: landfills and petroleum, oil, and lubricants (POL) spill areas.

Granite Mountain RRS was under construction from 1956 to 1957 and was activated on 25 May 1957. This RRS was a combined tropospheric scatter/TD-2 microwave station. It provided links to North River RRS, 108 miles away, with two 60-foot antennas; Anvil Mountain RRS, 130 miles away, with two 60-foot antennas; and Kotzebue RRS, 105 miles away, with a pair of 30-foot dish antennas (HMTC 1989).

Granite Mountain RRS was one of 31 White Alice Communication System (WACS) sites constructed in the 1950s. These sites enabled the Aircraft Control and Warning (AC&W) system sites to link with the Distant Early Warning (DEW-line) system and form a cohesive network relaying information back to Elmendorf AFB and Eielson AFB (HMTC 1989).

The 31 stations, including Granite Mountain RRS, became obsolete during the late 1960s with the development and implementation of satellite communication systems. Granite Mountain RRS was leased to Alascom in 1976. On 3 June 1981, a notice of intention to relinquish Granite Mountain RRS was forwarded to the Bureau of Land Management (BLM) (HMTC 1989).

According to previous reports, BLM currently uses various facilities at the site during the summer months as a headquarters site for firefighting operations conducted in the interior of Alaska. Also, the Federal Aviation Administration (FAA) operates a Single Frequency Outlet (SFO) at the communications facility (HMTC 1989, CH2M Hill 1994). The current use of Granite Mountain RRS by BLM and FAA will be verified during the site inspection scheduled for August 1994.

Previous IRP activities at Granite Mountain RRS were presented in the following reports:

- *Preliminary Assessment, Granite Mountain* (CH2M Hill 1994); and
- *Installation Restoration Program Preliminary Assessment - Granite Mountain Radio Relay Station, Alaska* (HMTC 1989).

These reports are discussed in more detail in the Granite Mountain RRS PA/SI Work Plan, the companion document to this SAP. Additionally, information from these reports was used to develop the field investigation approach for the PA/SI.

1.2.2 Project Scope and Objectives

Project objectives are described in detail in Section 1.3 of the Work Plan for the PA/SI Granite Mountain RRS, Alaska. The PA/SI will be conducted to accomplish the following:

- assess environmental conditions;
- evaluate existing sites and AOCs through collection of field data; and
- recommend further actions for each site or AOC.

These objectives will be met through laboratory analysis of environmental samples for potential contaminants and evaluation of analytical results and field measurements with respect to QC data. The ultimate goal of data collection, sample collection, and laboratory analysis is to determine whether any contaminants generated from installation activities have entered the environment and whether they may pose a risk to human health or the environment.

1.2.3 Subcontractors

The prime subcontractors that will contribute to the investigations at Granite Mountain RRS are identified in the following section. An offsite laboratory will perform chemical analyses on water and soil samples. Onsite qualitative field screening using immunoassay test kits will be performed by Jacobs' personnel. No drilling or data validation subcontractors will be used in conjunction with this investigation.

1.2.3.1 Fixed Analytical Laboratory

Commercial Testing & Engineering Co. (CT&E), Environmental Laboratory Services, located in Anchorage, Alaska, will conduct the analytical laboratory analyses and provide Air Force Level II data. The following chemical analyses will be performed by CT&E:

- volatile organic compounds (VOCs), SW8240, SW8260;
- organochlorine pesticides and polychlorinated biphenyls (PCBs), SW8080;
- total fuel hydrocarbons (gasoline-range organics [GRO], diesel-range organics [DRO], and residual range organics [RRO]), AK101 (modified), AK102 (modified), and AK103, respectively;
- semivolatile organic compounds (SVOCs), SW8270;
- total metals by inductively coupled plasma (ICP), SW6010; and
- total mercury by cold vapor atomic absorption (CVAA), SW7470 and SW7471.

CT&E has been audited by AFCEE to perform analytical services for Air Force projects. All samples sent offsite will be analyzed by CT&E. The laboratory will not be allowed to subcontract chemical analytical services for this project. In addition, CT&E will provide electronic deliverables compatible with the Jacobs Environmental Management System (JEMS) for generation of the Installation Restoration Program Information Management System (IRPIMS) electronic report.

1.2.3.2 Data Validation

Third party data validation will not be conducted in conjunction with this investigation. However, analytical data generated during this investigation shall undergo an internal data quality review as described in Section 1.9.4.

1.3 PROJECT ORGANIZATION AND RESPONSIBILITY

An organization chart that shows all key project personnel for implementing the field investigations has been prepared (Figure 1.3-1). An organization chart for the

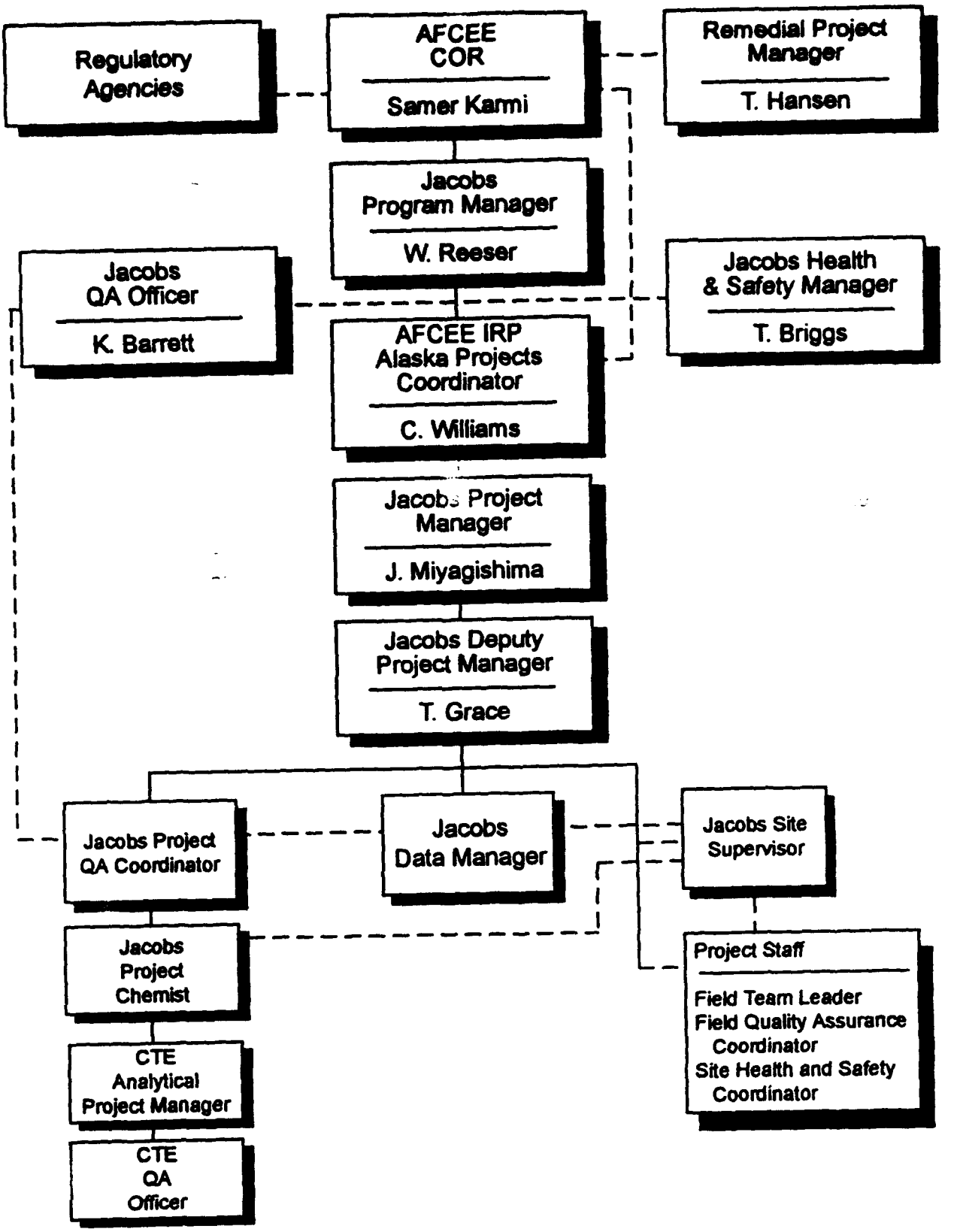


FIGURE 1.3-1
PROJECT ORGANIZATION CHART
1994 INVESTIGATION
GRANITE MOUNTAIN RRS, ALASKA

laboratory is included in Appendix A. The following are responsibilities of key personnel:

Contracting Officer Representative. The AFCEE Contracting Officer's Representative (COR) for Delivery Order No. 8 is Mr. Samer Karmi, who is located at Brooks AFB, Texas. The point of contact for this PA/SI (identified as the Remedial Project Manager) is Mr. Tim Hansen, who is located at Elmendorf AFB, Alaska. The Jacobs project team will coordinate all activities conducted under this delivery order with these Air Force representatives through the Jacobs Project Manager, Ms. Joyce Miyagishima, located at the Jacobs Denver, Colorado, office.

Jacobs Program Manager. The Jacobs Program Manager, Mr. Warner Reeser, has overall responsibility for work performed for the Air Force under this contract. The Program Manager will ensure high-quality work, make resources available, and approve all work under this delivery order. In addition, the Program Manager will review progress, anticipate and resolve problems, and ensure client satisfaction.

AFCEE IRP Alaska Projects Coordinator. The Jacobs Alaska Projects Coordinator, Mr. Chris Williams serves as the central point of contact between AFCEE's Alaska Team Chief and Jacobs Denver Operations Project Managers. The Jacobs Alaska Projects Coordinator is responsible for addressing and resolving Alaska-project issues with the AFCEE staff. In addition, he conducts frequent delivery order reviews, tracks major deliverables, monitors Alaska projects budgets and responds to programmatic issues.

Jacobs Project Manager. The Jacobs Project Manager, Ms. Joyce Miyagishima, has the day-to-day responsibility for all aspects of Jacobs work on Delivery Order No. 8. The Project Manager maintains close communication and coordinates all activities with the AFCEE COR and the point of contact for Granite Mountain RRS. She is responsible for identifying appropriate staff for each task and providing oversight of all work to ensure its successful completion. In addition, the Project Manager uses the information provided by Jacobs Project Controls and Accounting to track the progress of costs and schedules and prepare monthly summary reports for the COR.

Jacobs Deputy Project Manager. The Jacobs Deputy Project Manager, Mr. Tim Grace, will assist Ms. Miyagishima and act as the Alaska Point of Contact to the Air Force Remedial Project Manager, Mr. Tim Hansen.

Jacobs Quality Assurance Officer. The Jacobs QA Officer, Mr. Kris Barrett, will ensure that all work is performed according to the specifications of this SAP. Mr. Barrett will report to the Air Force and be responsible for all program quality assurance issues.

Jacobs Health and Safety Manager. The Health and Safety Manager will make certain that all work is performed in accordance with the approved Health and Safety Plan (HSP) and the provisions of the Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120 for worker health and safety. Dr. Terry Briggs, the Jacobs Health and Safety Manager, will provide assistance, oversight, and senior review of the HSP. The Health and Safety Manager or his designee will perform audits to make certain that fieldwork is conducted to the specifications of the HSP.

Jacobs Project Quality Assurance Coordinator. The Jacobs project QA Coordinator, Mr. Alan Alai, will ensure that all work is performed in accordance with the SAP. Mr. Alai will review the Jacobs Project Chemist's data quality review efforts, assist in performance of any laboratory audits, and report to the Jacobs Project Manager and Jacobs QA Officer.

Jacobs Project Chemist. The Jacobs Project Chemist, Ms. Gloria Beckman, will ensure that the laboratory is performing the analytical protocols and meeting quality control criteria as specified in the *IRP Handbook* (Air Force 1993), the SAP, SW-846, EPA, and State of Alaska methods. She will work with the Jacobs Data Manager and be responsible for producing the Granite Mountain project IRPIMS data deliverables. Ms. Beckman will report to both the Jacobs Project Manager and the Jacobs QA Coordinator. Additionally, she will perform laboratory audits and evaluate the laboratory generated data packages for completeness and validity, and serve as the primary point of contact for all analytical technical issues or chemistry-related issues that require resolution.

Jacobs Data Manager. The Jacobs Data Manager, Mr. Chris Skinner, will coordinate and oversee all field and office data formatting, processing, and reporting. He will ensure that all data reported to the Air Force meet requirements of the *Granite Mountain Statement of Work* (Air Force 1994) and the IRPIMS *Data Loading Handbook* (Air Force 1991). The Data Manager or his designee will process, merge, and report data acquired from the field with the corresponding data from laboratory analyses. Overall data integrity and security will be the responsibility of Mr. Skinner.

Commercial Testing & Engineering Project Manager. Mr. Thomas Clemetson has been assigned as the analytical laboratory Project Manager for CT&E. He will have ultimate responsibility for analytical performance, including adherence to contract requirements and QC requirements. Mr. Clemetson will serve as the primary laboratory contact person, and any change in the scope of work will be processed by him. He will monitor the progress and timeliness of the work and will review work orders and all laboratory reports.

As the analytical laboratory project manager, he is responsible for ensuring that corrective action has been taken to address problems identified by QC sample results or QA audit findings (Appendix A). Mr. Clemetson or his designee will have the responsibility for project administration, including assisting Jacobs with coordinating shipments of samples to the laboratory, sample receipt, project updates, sample bottle orders, and sample receiving. The CT&E Project Manager or designee will review and sign correspondence with Jacobs personnel.

Commercial Testing & Engineering Quality Assurance Manager. Ms. Cindy Hale is the Project QA Manager for CT&E. She has responsibility for coordination and oversight of this project-specific QA program, which includes preparing written documents defining QA/QC procedures, reviewing and approving laboratory QC procedures, supervising sample analysis operations, and overseeing interlaboratory testing programs and laboratory certifications. Ms. Hale will be responsible for implementing corrective actions and reporting to the Jacobs Project Manager concerning QA/QC procedures. She will also coordinate corrective actions associated with analytical problems. In addition, Ms. Hale will evaluate the effectiveness of the laboratory QA/QC program through audits.

Field Site Supervisor The Field Site Supervisor has the responsibility of ensuring that the field investigation portion of the project is performed in a manner that maximizes the data quality while maintaining a safe environment for the field crew. The Site Supervisor will be the primary communication link with people in Nome and will schedule all air charter service to the site. In addition, the Site Supervisor, or his designee, is responsible for reviewing all field sampling data forms for completeness, making decisions about sample locations, ensuring that samples are shipped on schedule, ensuring the overall objectives of the field program are met, and the Air Force Handbook procedures are followed in meeting these objectives. Mr. Tim Grace will be the Field Site Supervisor for this site.

Field Team Leader The Field Team Leader will have the responsibility for assisting the Field Site Supervisor in making certain that all sampling procedures are conducted in accordance with the specifications outlined in the Air Force Handbook, and that the field crews follow the procedures stated in the SAP. The Field Team Leader will be responsible for understanding and enforcing the technical aspects of the SAP, and will be responsible for ensuring that all variances to the plans are approved by the Field Site Supervisor and the Air Force representative prior to sampling. Mr. Ken Powell will be the Field Team Leader for this site.

QA Coordinator The QA Coordinator will be responsible for reviewing all documentation for completeness and correctness. In addition, the QA Coordinator will be responsible for ensuring that sample integrity is maintained throughout the field investigation. Mr. Chris Sundeen will be the QA Coordinator for this site.

Site Health and Safety Coordinator The Site Health and Safety Coordinator (SHSC) has the responsibility for ensuring that the procedures outlined in the site HSP are followed by all members of the field team. The SHSC will investigate all accidents or injuries that occur at Granite Mountain RRS and has the authority to stop all work onsite if deemed necessary for the protection of personnel. The SHSC will also provide a briefing to all field sampling crew members, as well Air Force personnel regarding site hazards before field activities Begin. Mr. Ed Gorove will be the Health and Safety Coordinator for this site.

1.4 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective for this investigation is to ensure that all decisions based on laboratory and field data are technically sound, statistically valid, and properly documented. The level of quality required for the laboratory analysis is equivalent to EPA Level IV. This type of analysis is characterized by rigorous QA/QC protocols and provides data of known quality. If needed, this type of data can be used for site characterization and risk assessment purposes. The laboratory is required to provide a data package equivalent to the 1988 EPA Contract Laboratory Program (CLP) (USEPA 1988a and 1988b) data package or QAPP specified deliverables, whichever is more inclusive. All summary forms and a portion of the raw data will require review by the Jacobs Project Chemist. Third party validation is not required under this investigation; however, all data will be evaluated by Jacobs before being reported to the Air Force.

The chemical laboratory analyses will be performed by an AFCEE audited laboratory in accordance with the requirements of the Air Force 1993 *IRP Handbook*, the *SAP*, and applicable methodologies. Any variances to the referenced methodology are stated in Appendix A. Variances will be approved by AFCEE before any analyses

are performed. Analytical data will be generated using EPA, State of Alaska, and other standard methods requirements.

The following onsite field tests will be conducted:

- rapid immunoassay screen for petroleum hydrocarbons;
- rapid immunoassay screen for PCBs;
- water-level measurement;
- immiscible layer measurement; and
- conductivity, pH, and temperature,.

All onsite activities which generate data will be performed using SOPs or manufacturer's instructions that detail the tested and proven procedures that are to be followed when conducting fieldwork. These procedures are detailed in the FSP. A discussion of the rapid screening immunoassay methodologies is presented in Section 2.2.3 of this SAP. Copies of the rapid screening methodologies are contained in Appendix B.

1.4.1 Definition of Criteria

The statistical acceptance criteria for the specific analyses used will be expressed in terms of precision, accuracy, representativeness, comparability, and completeness. The following are definitions for these terms:

Precision. Precision is defined as the degree of agreement between repeated measurements of the same parameter under prescribed, similar conditions. Precision, therefore, represents the repeatability of the measurement. The precision of a series of measurements can be expressed in terms of relative percent difference (RPD). Precision between matrix spikes and matrix spike duplicates is determined by calculating the RPD between the spike recoveries.

The RPD will be calculated as follows:

$$RPD = (D1 - D2)/([D1 + D2]/2) \times 100$$

where:

RPD = relative percent difference;
D1 = first duplicate value; and
D2 = second duplicate value.

Accuracy. Accuracy is the measure of the degree of agreement between an analyzed value and the true or accepted value, where it is known. For this document, accuracy will be statistically represented by calculating percent recovery (% R) of a known standard added to the sample of interest.

Percent recovery will be calculated as follows:

$$\% R = Q_d/Q_a \times 100$$

where:

% R = percent recovery;
Q_d = quantity determined by analysis; and
Q_a = true or accepted reference quantity or value.

Representativeness. Samples collected during field activities will represent the population from which they were collected. Representativeness is defined as the degree with which the data collected accurately and precisely characterize a population, a parameter of interest, variations at a sampling point, a process, or an environmental condition.

Comparability. Comparability, as used within this QAPP, is the confidence with which one data set can be compared with another. Each value reported for a given measurement should be similar to other values within the same data set and within other related data sets.

Completeness. Completeness, as it pertains to the laboratory and for the purposes of this QAPP, is defined as the ratio of the number of accepted and usable sample results to the total number of samples run with a specific analysis and/or on a specific matrix. In terms of sampling protocols, completeness is the ratio of the number of valid samples collected to the total number of samples required to be representative.

Completeness is expressed as a percent of the overall data that were generated and is calculated as follows:

$$C = V/T \times 100$$

where:

C = percent completeness;
V = number of measurements judged valid; and
T = total number of measurements.

1.4.2 Goals for Assessment Criteria

As specified in the *IRP Handbook* (Air Force 1993), accuracy and precision control limits will be established by the laboratory and will be unique to the laboratory performing the analysis.

The laboratory-established control limits will be evaluated at regular intervals, and scheduled control measurements will be taken to detect trends and out-of-limit values. The laboratory will maintain records of these activities. EPA CLP or method-specified control limits are unacceptable substitutions for laboratory-generated control limits, except when the laboratory limits are outside the method-specified limits. However, the laboratory must be in the process of performing corrective actions to bring their limits to within those of the published method.

Criteria assessment is discussed below.

Precision. Precision will be assessed by analyzing matrix spikes, duplicates, and field replicates; determining the RPD; and comparing the RPD with the acceptance criteria presented in Appendix A.

Accuracy. Laboratory accuracy will be assessed by analyzing instrument calibration verification standards, laboratory control samples, matrix spiked samples, surrogate spiked samples, and performance evaluation QC check samples. The degree of accuracy depends on the sample matrix, method of analysis, sample preparation method, and the analyte being determined. The concentration of the analyte relative to the detection limit is also a major factor in determining the accuracy of the measurement. The analytical laboratory will perform all analyses within the prescribed limits of accuracy required by the Air Force *IRP Handbook* (Air Force 1993a) or as described in this QAPP.

True values for field tests such as pH, specific conductance, temperature, and the immunoassay screens are not known for the program matrices and/or specific sampling locations. Therefore, the accuracy of the data produced by the field tests will be maintained and documented by performing proper instrument calibration and maintenance, and by following all appropriate SOPs in accordance with Jacobs' and manufacturer's instructions.

Representativeness. Sampling protocols are developed to ensure that the collected samples represent the media. Sample handling protocols (e.g., storage and transportation) are selected to protect the representativeness of the collected sample. Measurements will be made so that results are as representative of the media (e.g., air, soil, and water) and conditions being measured as possible. Proper documentation will establish that protocols have been followed and sample identification and integrity are ensured.

Procedures presented in the FSP address issues such as collecting surface water, groundwater, sediment, and soil samples; monitoring pH, specific conductance, and temperature during well purging and sampling; and using disposable sampling devices when possible. Additionally, representativeness of specific analyses will be achieved by the following means:

- selecting appropriate numbers of samples and locations to adequately characterize the actual and current site conditions;
- using appropriate sample procedures and equipment;
- selecting appropriate analytical methodologies that provide required detection limits;
- conducting the appropriate number of QC analyses to statistically verify proper functioning of the analytical method and equipment and the applicability of the methodology;
- documenting sampling activities and sampling locations in field logs, on chain-of-custody records, and in laboratory books that are signed and dated by sampling and analysis personnel; and
- using appropriate sample device decontamination techniques.

In addition, other QC samples, including matrix spikes/spike duplicates, will be analyzed as a part of the overall QA program. The QA program will help provide information on the representativeness of collected samples.

Comparability. To ensure data set comparability, the following steps will be taken:

- Instruments will be operated within their calibrated range, and appropriate analytical methodologies will be used. Analyses will be performed using standard EPA and State of Alaska methods.

- The laboratory will participate in the EPA performance evaluation studies (water pollution and water supply).

- Measurements that appear as "outliers" will be reassessed. The determination of outliers will be based on assessing a statistically significant data set. Not all outlier data are a result of laboratory error or sampling technique. Data which do not compare to other data sets (e.g., benzene, toluene, ethylbenzene, and xylene [BTEX] results from the SW8240 or SW8260 analyses do not match GRO analytical data) will require additional assessment. No data will be eliminated because of lack of comparability. These data will, however, require explanation.

- Traceable standards will be used by the laboratory whenever possible.

- Techniques used to collect samples for previous studies will be implemented when possible.

- Data will be reported in conventional and standard units.

Completeness. Laboratory completeness will be based on the total number of samples that are analyzed under controlled conditions that meet the IRP or laboratory-established precision and accuracy objectives, as applicable. Data produced by the laboratory should achieve completeness of greater than or equal to 90 percent for each method per matrix.

Field completeness is defined as the ratio of the number of valid samples to the total number of samples required to be representative. (The number of valid samples collected is determined during the Jacobs' internal data quality review process.) This process is described in Section 1.9.4.

Section 2.0 of this SAP describes specific field procedures to ensure the completeness of field-collected samples. Field QC samples, including trip blanks and decontamination rinsate blanks, will be collected to verify that sampling and decontamination procedures are not introducing trace constituents of concern.

1.5 SAMPLING PROCEDURES

Sampling protocols and sample handling are described in the following sections. Section 2.1 describes the types of field activities in more detail. The rationale for field activities that are proposed for each site is provided in the Work Plan.

1.5.1 Sampling Protocols

This section lists references and guidance documents used as the basis for preparing soil, sediment, floating product, and surface water and groundwater sample collection, handling, preservation, and shipping procedures. These procedures are designed to ensure that (1) samples are properly collected, (2) samples are labeled, preserved, and transported so that they represent field conditions, and (3) sampling results are repeatable.

1.5.2 Sample Handling

Sample handling procedures and documentation are discussed in Section 2.2.4. Tables 1.5-1 and 1.5-2 summarize the containers, preservation techniques, and holding times for solid and aqueous samples for the 1994 Granite Mountain RRS field investigation. Sample containers that are certified as analyte-free will be provided with the appropriate preservatives added by the laboratory. All samples collected for analysis of VOCs will be collected in a manner that reduces agitation and loss of volatile constituents.

1.6 SAMPLE CUSTODY

The following sections describe sample handling and identification, both in the field and at the laboratory. Detailed sample handling, identification, and custody procedures for the laboratory are described in the Laboratory Quality Assurance Project Plan (LQAPP) (Appendix A).

1.6.1 Field Operations

Procedures for establishing sample custody in the field and during shipment to the laboratory are identified in Section 2.2.5 of the FSP. The Jacobs Field QA Coordinator and the Field Site Supervisor will verify that all chain of custody forms are legible and complete. All samples will be secured in the field until relinquished for transport to the offsite laboratory. Custody procedures in the laboratories are described below.

1.6.2 *Fixed Laboratory Operations*

The following sections describe the sample handling techniques, sample identification methods, and sample custody records associated with the laboratory operations.

1.6.2.1 Sample Handling

Upon receipt of the samples, the laboratory will sign and keep copies of the air bill. The custody form will be signed. One copy of the signed custody form will be forwarded to the Jacobs Project Manager as verification of sample receipt. A second copy will be retained by the laboratory for their records. The temperature of the cooler will be measured and documented, and the condition of the samples will be documented. If any breaks occur or discrepancies arise between the custody form, sample tags, and requested analysis, the sample custodian will notify the QA Coordinator, Project Manager, or Site Manager within 24 hours. Any discrepancy or improper preservation will be noted by the laboratory as an out-of-control event, which will be documented and proper corrective action will be taken. The Site Supervisor or designee will be responsible for maintaining contact with the laboratory. However, due to the remoteness of the site, the Site Supervisor will not be able to communicate directly with the laboratory. Information will have to be relayed through the chartered air service contracted for the project.

1.6.2.2 Sample Identification

The sampling team will assign a unique sample number to each sample based on the information included in Section 2.2.4.1 of the FSP. If this number is not to be used by the laboratory, a cross-reference table that identifies the sample designation and the laboratory number will be provided.

TABLE 1.5–1
CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES
SOLID SAMPLES
GRANITE MOUNTAIN RRS, ALASKA

Parameter	Analytical Method	Containers[1]	Preservation Techniques[2]	Maximum Allowable Holding Times[3]
VOC	SW8240	120 ml (4 oz)	Cool, 4°C	14 days
Semivolatile Organic Compounds	SW8270	240 ml (8 oz)	Cool, 4°C	14 days until extraction 40 days after extraction
Organochlorine Pesticides & PCBs	SW8080	240 ml (8 oz)	Cool, 4°C	14 days until extraction 40 days after extraction
Metals, total	SW6010 SW7471	240 ml (8 oz)	Cool, 4°C	6 months – ICP metals 28 days – Mercury
Total Fuel Hydrocarbons Gasoline–Range Organics Diesel–Range Organics Residual–Range Organics	AK101 (Modified) and AK102 (Modified) AK103	240 ml (8 oz)	Cool, 4°C	Volatiles: 14 days Semivolatiles: 14 days until extraction 40 days after extraction

NOTE:

[1] Soil containers for all measurements are widemouthed glass jars with Teflon–lined caps. A double volume sample will periodically be sent to the laboratory for quality assurance/quality control tests.

[2] Sample preservation is performed immediately upon sample collection. Soil samples are cooled immediately to 4°C.

[3] Samples are analyzed as soon as possible after collection. Times listed are the maximum times samples are to be held before analysis and still considered valid. Samples collected for field screening are not preserved.

ICP = Inductively Coupled Plasma

ml = milliliter

oz = ounce

PCB = Polychlorinated biphenyl

VOC = Volatile Organic Compound

°C = degrees Celsius

TABLE 1.5-2
CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES
AQUEOUS SAMPLES
GRANITE MOUNTAIN RRS, ALASKA

Parameter	Analytical Method	Containers	Preservation Techniques[1]	Maximum Allowable Holding Times[2]
Volatile Organic Compounds	SW8260	2x40 ml, glass vial, Teflon-lined septum cap	Cool, 4°C, HCl to pH<2, 0.008% $Na_2S_2O_3$[3]	14 days
Semivolatile Organic Compounds	SW8270	2x1 L, amber glass jar, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$	7 days until extraction 40 days after extraction
Metals, total	SW6010 SW7470	500 ml, plastic or glass	HNO_3 to pH<2	6 months - ICP Metals 28 days - Mercury
Total Fuel Hydrocarbons Gasoline-Range Organics Diesel-Range Organics	AK101 (Modified) and AK102 (Modified)	2x1 L, glass jar, and 2x vials 40 ml Teflon-lined cap	Cool, 4°C	Volatiles: 7 days Semivolatiles: 7 days until extraction 40 days after extraction

NOTES:

1 Sample preservation is performed immediately upon sample collection.
HCl = hydrochloric acid. HNO_3 = nitric acid. $Na_2S_2O_3$ = sodium sulfate.

2 Samples are analyzed as soon as possible after collection. Times listed are maximum times samples are to be held before analysis and still considered valid. Samples collected for field screening are not preserved.

3 Preservation with 0.008% $Na_2S_2O_3$ is only required when residual chlorine is present.

L = Liter
ICP = Inductively Coupled Plasma
ml = Milliliter
°C = degrees Celsius

Samples will be analyzed by the laboratory in laboratory batch numbers not to exceed 20 samples. Sample batches may be smaller than 20 samples based on the number of samples the laboratory receives from the field team and the sample holding times. The numbering convention for the laboratory batches is discussed in Appendix A.

1.6.2.3 Sample Custody Records

Custody procedures will be followed in the laboratory from the time of sample receipt to the time of sample disposal. Signed custody records will be sent with the data package deliverable. Specific custody procedures for the laboratory to follow are described in the LQAPP (Appendix A).

1.7 CALIBRATION PROCEDURES AND FREQUENCY FOR FIELD EQUIPMENT

In order to meet data quality objectives, proper calibration procedures for all field measurements and field equipment will be performed at designated frequencies. These procedures are described in Section 2.3.

1.8 ANALYTICAL PROCEDURES

This section describes methods and procedures for the chemical analysis to be performed under this investigation. Reporting limits will be established for reagent (blank) water using procedures outlined in one of the following references:

- applicable analytical method (these are the methods specified by the Air Force for analysis of the various study analytes);
- 40 CFR 136, Appendix B;
- *Principles of Environmental Analysis* in Analytical Chemistry, Vol. 55, pp. 2210-2218, December 1983; and
- EPA CLP, latest Statement of Work (EPA 1988a and 1988b).

Any variances or deviations to the established method detection limits (MDLs) must be approved by the Jacobs Project Manager. Upon approval, the Jacobs Project Manager will request the variance on behalf of the laboratory for approval by the Air Force.

The procedures used to establish the detection limits for organic compounds will be performed before analyzing environmental samples and limits are verified once a year. The limits for metals are verified semiannually. Documentation to demonstrate the established detection limits will be provided by the laboratory for review by the Jacobs QA Officer before any sampling event. No sample analyses will be performed until the established detection limits are approved in writing by the Jacobs QA Officer. Definitions for MDL, quantitation limits, and reporting limits are presented in Appendix A.

The laboratory will not establish quantitation limits by multiplying the detection limits by an arbitrary factor.

1.8.1 Identification of Field Screening Methods

During the field investigation, field test kits will be used for rapid screening of petroleum hydrocarbons and PCBs in soils using immunoassay methods. Using these methods, standards, samples, and color change reagents are added to test tubes coated with chemicals specific to the analytes of interest. The concentration of these analytes in the unknown sample is then determined by comparing its color intensity with that of the standard. Copies of the User's Guide for these methods are included in Appendix B. Ten percent of all test kit environmental samples will be replicated. Five percent of the field screening samples will be collected for fixed laboratory analysis.

The following detection limits have been established by the manufacturer for petroleum hydrocarbons and PCBs in soils using immunoassay methodologies:

gasoline	10 parts per million (ppm)
other petroleum fuels	15 ppm

Arochlor 1248	1.0 ppm
Arochlor 1254	0.4 ppm
Arochlor 1260	0.4 ppm
Arochlor 1242	2.0 ppm
Arochlor 1232	4.0 ppm
Arochlor 1016	4.0 ppm

1.8.2 Identification of Laboratory Methods

The analytical method numbers, the source for each method, and the Air Force required maximum reporting limits for laboratory analyses are presented in Table 1.8-1. The laboratory established reporting limits for each method are provided in the LQAPP (Appendix A). Analytical procedures will be in accordance with those specified in the Air Force *IRP Handbook* (Air Force 1993), laboratory SOPs, and the analytical method. The LQAPP and SOPs provide the laboratory's established interpretation of the methodology. Corrective action and other QC measures identified in Appendix A will serve to demonstrate laboratory compliance with its QA program and Air Force requirements. The use of tables and flowchart will illustrate laboratory procedures and method interpretation.

Gas Chromatograph Methods. For gas chromatograph (GC) methods, analyte retention times and retention time windows will be established to accurately identify chromatographic peaks. Demonstration of appropriate retention time windows will be included in the laboratory data packages. The confirmation analyses will be performed to include all the necessary QC components and deliverables required by the method. The laboratory will identify the most reliable value and report that value as the primary quantitation. All analyses to be used for confirmation will be identified as such and reported. If it becomes necessary to confirm the presence and quantitation of a compound via GC/mass spectrometry (MS) methodology, the concentration of the chemical will be equal to or greater than the GC/MS MDL.

Tentatively Identified Compounds (TIC) will not be reported for the GC/MS analyses provided by the laboratory.

GC Second-Column Analysis. The maximum number of second-column confirmational analyses will not exceed the specified number of sample analyses in

TABLE 1.8–1
FIXED LABORATORY REPORTING LIMITS
GRANITE MOUNTAIN RRS, ALASKA

Parameter	Method w=water s=soil	Analyte	Project Practical Quantitation Limit Water (µg/L)
Volatile Organic Compounds	SW8260(w)	Benzene	2.0
		Bromobenzene	5.0
		Bromodichloromethane	1.0
		Bromoform	2.0
		Bromomethane	10.0
		Carbon tetrachloride	1.0
		Chlorobenzene	2.0
		Chlorodibromomethane	1.0
		Chloroethane	5.0
		Chloroform	0.5
		1–Chlorohexane	5.0
		Dibromomethane	5.0
		1,2–Dichlorobenzene	2.0
		1,3–Dichlorobenzene	3.0
		1,4–Dichlorobenzene	2.0
		1,1–Dichloroethane	1.0
		1,2–Dichloroethane	1.0
		1,1–Dichloroethene	1.0
		trans–1,2–Dichloroethene	1.0
		cis–1,2–Dichloroethene	1.0
		1,2–Dichloropropane	1.0
		Ethylbenzene	2.0
		Methylene chloride	2.0
		Styrene	5.0
		1,1,2,2–Tetrachloroethane	1.0
		1,1,1,2–Tetrachloroethane	5.0
		Tetrachloroethene	1.0
		Toluene	2.0
		1,1,1–Trichloroethane	1.0
		1,1,2–Trichloroethane	1.0
		Trichloroethene	1.0
		Trichlorofluoromethane	1.0
		Vinyl chloride	2.0
		Xylenes (total)	2.0

TABLE 1.8-1 (continued)
FIXED LABORATORY REPORTING LIMITS
GRANITE MOUNTAIN RRS, ALASKA

Parameter	Method w=water s=soil	Analyte	Project Practical Quantitation Limit Soil/ Sediment (mg/kg)
Volatile Organic Compounds (continued)	SW8240 (s)	Acetone	0.100
		Benzene	0.005
		Bromodichloromethane	0.005
		Bromoform	0.005
		Bromomethane	0.010
		2-Butanone (MEK)	0.100
		Carbon disulfide	0.005
		Carbon tetrachloride	0.005
		Chlorobenzene	0.005
		Chlorodibromomethane	0.005
		Chloroethane	0.010
		2-Chloroethyl vinyl ether	0.010
		Chloroform	0.005
		Chloromethane	0.010
		1,1-Dichloroethane	0.005
		1,2-Dichloroethane	0.005
		1,1-Dichloroethene	0.005
		cis-1,2-dichloroethene	0.005
		trans-1,2-Dichloroethene	0.005
		1,2-Dichloropropane	0.005
		cis-1,3-Dichloropropene	0.005
		trans-1,3-Dichloropropene	0.005
		Ethylbenzene	0.005
		2-Hexanone	0.050
		Methylene Chloride	0.005
		4-Methyl-2-pentanone (MIBK)	0.050
		Styrene	0.005
		1,1,2,2-Tetrachloroethane	0.005
		Tetrachloroethene	0.005
		Toluene	0.005
		1,1,1-Trichloroethane	0.005
		1,1,2-Trichloroethane	0.005
		Trichloroethene	0.005
		Vinyl acetate	0.050
		Vinyl chloride	0.010
		Xylenes (total all isomers)	0.005

TABLE 1.8-1 (continued)
FIXED LABORATORY REPORTING LIMITS
GRANITE MOUNTAIN RRS, ALASKA

Parameter	Method w=water s=soil	Analyte	Project Practical Quantitation Limit Water (µg/L)	Project Practical Quantitation Limit Soil/Sediment (mg/kg)
Semivolatile Organic Compounds	SW3510/SW8270(w) SW3550/SW8270(s)	Base/Neutral Extractables		
		Acenaphthene	10	0.7
		Acenaphthylene	10	0.7
		Anthracene	10	0.7
		Benzo(a)anthracene	10	0.7
		Benzo(b)fluoranthene	10	0.7
		Benzo(ghi)perylene	10	0.7
		Benzo(a)pyrene	10	0.7
		Benzyl alcohol	20	1.3
		Bis(2-chloroethoxy) methane	10	0.7
		Bis(2-chloroethyl)ether	10	0.7
		Bis(2-chloroisopropyl) ether	10	0.7
		Bis(2-ethylhexyl)phthalate	10	0.7
		4-Bromophenyl phenylether	10	0.7
		Butyl benzyl phthalate	10	0.7
		4-Chloroaniline	20	1.3
		2-Chloronaphthalene	10	0.7
		4-Chlorophenyl phenylether	10	0.7
		Chrysene	10	0.7
		Dibenz(a,h)anthracene	10	0.7
		Dibenzofuran	10	0.7
		di-n-Butylphthalate	10	0.7
		1,2-Dichlorobenzene	10	0.7
		1,3-Dichlorobenzene	10	0.7
		1,4-Dichlorobenzene	10	0.7
		3,3'-Dichlorobenzidine	20	1.3
		Diethyl phthalate	10	0.7
		Dimethyl phthalate	10	0.7
		2,4-Dinitrotoluene	10	0.7
		2,6-Dinitrotoluene	10	0.7
		di-n-Octyl phthalate	10	0.7
		Fluoranthene	10	0.7
		Fluorene	10	0.7
		Hexachlorobenzene	10	0.7
		Hexachlorobutadiene	10	0.7
		Hexachlorocyclopentadiene	10	0.7
		Hexachloroethane	10	0.7

TABLE 1.8-1 (continued)
FIXED LABORATORY REPORTING LIMITS
GRANITE MOUNTAIN RRS, ALASKA

Parameter	Method w=water s=soil	Analyte	Project Practical Quantitation Limit Water (µg/L)	Project Practical Quantitation Limit Soil/Sediment (mg/kg)
Semivolatile Organic Compounds (Continued)	SW3510/SW8270(w) SW3550/SW8270(s) (Continued)	Indeno(1,2,3-cd)pyrene	10	0.7
		Isophorone	10	0.7
		2-Methylnaphthalene	10	0.7
		Naphthalene	10	0.7
		2-Nitroaniline	50	3.3
		3-Nitroaniline	50	3.3
		4-Nitroaniline	50	3.3
		Nitrobenzene	10	0.7
		n-Nitrosodiphenylamine	10	0.7
		n-Nitrosodipropylamine	10	0.7
		Phenanthrene	10	0.7
		Pyrene	10	0.7
		1,2,4-trichlorobenzene	10	0.7
		Acid Extractables		
		Benzoic acid	50	1.6
		4-Chloro-3-methylphenol	20	1.3
		2-Chlorophenol	10	0.3
		2,4-Dichlorophenol	10	0.3
		2,4-Dimethylphenol	10	0.3
		4,6-Dinitro-2-methylphenol	50	3.3
		2,4-Dinitrophenol	50	3.3
		2-Methylphenol	10	0.3
		4-Methylphenol	10	0.3
		2-Nitrophenol	10	0.3
		4-Nitrophenol	50	1.6
		Pentachlorophenol	50	3.3
		Phenol	10	0.3
		2,4,5-Trichlorophenol	50	3.3
		2,4,6-Trichlorophenol	10	0.3

TABLE 1.6–1 (continued)
FIXED LABORATORY REPORTING LIMITS
INDIAN MOUNTAIN LRRS, ALASKA

Parameter	Method w = water s = soil	Analyte	Project Practical Quantitation Limit Water (µg/L)	Soil/ Sediment (mg/kg)
Arsenic by GFAA	SW3020/SW7060 (w), (s)	Arsenic	0.005	NA
Lead by GFAA	SW3020/SW7421 (w), (s)	Lead	0.005	NA
Cadmium by GFAA	SW3020/SW7131 (w), (s)	Cadmium	0.001	NA
Chromium by GFAA	SW3020/SW7191 (w), (s)	Chromium	0.005	NA
Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs)	SW3510/SW8080(w) SW3550/SW8080(s)	Aldrin	NA	0.003
		alpha–BHC	NA	0.002
		beta–BHC	NA	0.004
		delta–BHC	NA	0.006
		gamma–BHC (Lindane)	NA	0.003
		Chlordane	NA	0.009
		4,4'–DDD	NA	0.007
		4,4'–DDE	NA	0.003
		4,4'–DDT	NA	0.008
		Dieldrin	NA	0.010
		Endosulfan I	NA	0.009
		Endosulfan II	NA	0.003
		Endosulfan sulfate	NA	0.040
		Endrin	NA	0.004
		Endrin aldehyde	NA	0.020
		Heptachlor	NA	0.002
		Heptachlor epoxide	NA	0.060
		Methoxychlor	NA	0.100
		Toxaphene	NA	0.200
		PCB–1016	NA	1.0
		PCB–1221	NA	1.0
		PCB–1232	NA	1.0
		PCB–1242	NA	1.0
		PCB–1248	NA	1.0
		PCB–1254	NA	1.0
		PCB–1260	NA	1.0
Total Fuel Hydrocarbons	AK101 (mod.) *	Gasoline – Range	100	1.0
	AK102 (mod.) **	Diesel – Range	1,000	10
			Water (mg/L)	Soil/ Sediment (mg/kg)
Inductively Coupled Plasma Screen for Metals	SW3005/SW6010 (W) SW3050/SW6010 (S)	Aluminum	0.5	50
		Antimony	0.4	40
		Arsenic	0.6	60
		Barium	0.02	2
		Beryllium	0.003	0.3
		Cadmium	0.04	4
		Calcium	0.1	10
		Chromium	0.07	7
		Cobalt	0.07	7
		Copper	0.06	6
		Iron	0.07	7
		Lead	0.5	50
		Magnesium	0.3	30
		Manganese	0.02	2
		Molybdenum	0.08	8
		Nickel	0.15	15
		Potassium	5	500
		Selenium	0.8	80
		Silver	0.07	7
		Sodium	0.3	30
		Thallium	4	40
		Vanadium	0.08	8
		Zinc	0.02	2
Mercury by Cold Vapor	SW7470 (W) SW7471 (S)	Mercury	0.001	0.1

TABLE 1.8–1 (continued)
FIXED LABORATORY REPORTING LIMITS
GRANITE MOUNTAIN RRS, ALASKA

References:

* Standard Operating Procedure, Gasoline Range Organics/BTEX for Eareckson AFB/AFCEE (Commercial Testing & Engineering Company, 1994).

** Standard Operating Procedure, Extractable Diesel Range Organics for Eareckson AFB/AFCEE (Commercial Testing & Engineering Company, 1994).

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

Notes:

BHC	=	benzene hexachloride
DDD	=	dichlorodiphenyldichloroethane
DDE	=	dichlorodiphenyldichloroethene
DDT	=	dichlorodiphenyltrichloroethane
GFAA	=	graphite furnace atomic absorption
mg/kg	=	milligrams per kilogram
mg/L	=	milligrams per liter
MEK	=	methyl ethyl ketone
MIBK	=	methyl isobutyl ketone
NA	=	not applicable
PCB	=	polychlorinated biphenyl
µg/kg	=	micrograms per kilogram
µg/L	=	micrograms per liter
----	=	not established

the Sample Analyses Summary tables in the FSP (Section 2.0). If the number of samples requiring second-column confirmation exceeds this allowance, the COR will be contacted. If GC/MS or a combination of second-column GC and GC/MS is used, the total cost of all such analyses for a particular parameter will not exceed the funding allowed for positive confirmation using only second-column GC.

All confirmation analyses will be reported in the data package and discussed in the laboratory case narrative. Data from both the first-column analysis and the second-column analysis will be reported for all compounds of interest within the scope of the specific method. The analysis that the laboratory considers most reliable will be identified by the laboratory as the primary analysis. Any compound not reported in the primary analysis, but found in the confirmation analysis, will be discussed in the laboratory case narrative. This discussion will identify those sample analyses that did not match the primary analysis and provide a rationale for the nonconformance (e.g., lack of sample homogeneity or potential laboratory contamination).

Hydrocarbon Range Organic Analyses. The requirements for the modified AK101 (GRO) and AK102 (DRO) analyses are presented in the laboratory SOPs for these methods (CT&E 1994a and 1994b), which are included in the LQAPP (Appendix A). CT&E will follow the criteria outlined in their laboratory SOPs. CT&E is a state-approved laboratory for these hydrocarbon methods. Method AK103 is also included in the LQAPP in Appendix A.

Solid Matrix Sample Analysis. All results will be reported on a dry weight basis for soil and sediment samples. The percent moisture will be reported for all solid samples. An adequate mass of solid will be used in the extraction and/or preparation phase to make certain that the detection limits are achieved. Samples that contain greater than 30 percent moisture will be noted in the laboratory case narrative, and any potential bias will be discussed.

The detection limits for all laboratory analyses will be established in accordance with Appendix B of 40 CFR Chapter 1, Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants. The documentation for all methods will be kept at the laboratory for review by the Jacobs QA Officer. This information will be verified for completeness and accuracy before any sample analyses. As necessary, this information will be provided to any subcontractors providing third-party validation.

Quantitation for all methods will be performed in accordance with the specific methodology. For GC analyses, all positive values will be quantitated using the average response factors or calibration factors from the initial calibration.

1.8.3 Practical Quantitation Limits

The following discussion defines the practical quantitation limit and the procedures for establishing practical quantitation limits (PQLs).

1.8.3.1 Terminology

The practical quantitation limit is the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine analysis as defined by AFCEE (Air Force 1993) and EPA (EPA 1986a). The PQLs for the compounds listed in Table 1.8-1 are identical to those found in the IRP handbook, with the exception of those presented for volatile organics by SW8260.

The laboratory cannot meet the *IRP Handbook* (Air Force 1993) PQLs for SW8260 water samples. The laboratory can meet the 1993 PQLs for SW8010/8020. Therefore, the laboratory has requested a variance that would substitute SW8010/8020 PQLs for the SW8260 PQLs. These are the PQLs presented in Table 1.8-1. Any additional variances requested by the laboratory are contained in Appendix A (LQAPP).

1.8.3.2 Procedures

The PQLs as defined above are verified by the laboratory with each initial calibration. The initial, multipoint calibration curve must include a standard at a concentration below the PQL values list in Table 1.8-1. All analytes reported must be present in the initial and continuing calibration standards and all calibration criteria specified must be met.

1.8.3.3 Values

The 1993 AFCEE PQLs that will be reported by the laboratory, with the exception of the approved variances, are applicable to the Granite Mountain PA/SI and are presented in Table 1.8-1.

1.8.4 Method Calibration for Laboratory

Calibration of laboratory instrumentation will be performed as specified in the analytical methodology. Sample analyses will only be conducted using calibrated equipment. Appendix A lists the calibration criteria for all analyses to be performed by the offsite laboratory.

For GC/MS methods, the response factor from the daily calibration standard will be used to quantitate target compounds. In cases where the sample analyses immediately follow the initial calibration and are within the 12-hour calibration time-frame of the MS tuning standard, the midpoint standard response factors will be used for quantitation. This standard must meet the criteria for daily calibration standard for these analyses to be acceptable.

1.8.5 Calibration Procedures

Calibration procedures for the laboratory instruments required for the specified analytical methods and information on the type of laboratory instruments is found in the LQAPP (Appendix A). Additional information on laboratory QC is found in Section 1.10.

The materials used for all calibration standards, internal standards, surrogate standards, and QC check samples will be from EPA-certified reference or National Institute of Standards and Technology (NIST) traceable reference standards for all organic and inorganic analyses, if available. The Jacobs QA Officer will verify that the appropriate standards will be used by the laboratory before any analytical work.

1.9 DATA REDUCTION, REVIEW, AND REPORTING

Data reduction, data quality review, and reporting procedures will include evaluating both the field data and laboratory analytical data package. The overall data QA

goals for the project can only be met if the data generated in the field and by the analytical laboratory can be demonstrated to be valid.

1.9.1 Data Management

Laboratory data will be presented in hard copy and computerized formats consistent with the *Statement of Work* (Air Force 1994) and the IRPIMS *Data Loading Handbook* (Air Force 1991).

A flowchart of the data management activities is presented in Figure 1.9-1.

The field team will collect the samples described in the FSP. After the team collects the samples, the sample documentation (sample tags, chain-of-custody records, etc.) will be completed as described in Section 2.2.4. QC checks will be conducted on the sample documentation. The sampler will correct mistakes by making a line through the mistake and printing the correct information next to it. The sampler will also initial and date the correction. A black waterproof pen will be used for all sample documentation. If the sample documentation is acceptable, the samples will be shipped to the offsite laboratory or will be kept by the samplers for field tests.

Because of the length of the sampling event (approximately one week), there will be no opportunity to resample if data are rejected. Jacobs intends to maintain contact with the laboratory during the entire sampling event to minimize data loss. The laboratory has been contracted to provide analyses within the extraction and analytical holding times.

1.9.2 Jacobs Environmental Management System

The Jacobs Environmental Management System (JEMS) is an integration of commercially available "off-the-shelf" hardware and software with a sample tracking and field data entry system developed by Jacobs. JEMS constitutes a corporate-wide system for Jacobs' environmental programs, providing a baseline of performance for data management and data interpretation/presentation.

JEMS consists of two subsystems:

- Environmental Database System (EDS); and
- Geographic Information System (GIS)/Geological Modeling System (GMS) Data Interpretational System (DIS).

For the Granite Mountain RRS PA/SI, it is anticipated that only the JEMS EDS subsystem will be used. However, the DIS subsystem can readily be incorporated into the program if its data interpretation/presentation applications are needed.

The EDS consists of a comprehensive data management application based on the Oracle Relational Data Base Management System. Functionally, the EQUIS database (licensed from Egret Technologies) receives electronic upload of location, sample, and lithologic data from the Jacobs Environmental Sampling System (JESS). The EQUIS system also receives electronic uploads of test and result data from the analytical laboratories through the Jacobs Laboratory Data Submission Handbook specifications. EQUIS loads the electronic data and processes it through extensive error checking and QC routines before "certifying" the data as acceptable to the main database.

To meet the needs of the Air Force IRP, the certified data will be exported in accordance with the file specification of the IRPIMS *Data Loading Handbook* (currently Version 2.2) and then processed through the IRPIMS Quality Control Tool before being submitted to the Air Force.

1.9.3 Data Reduction

Data reduction is the process of converting measurement system outputs into an expression of parameters and information from which conclusions about the site can be made. These processes must be performed accurately, and with accepte statistical techniques. All calculations and data entries will be checked during a C review to maintain the accuracy of this process.

The quantity of data generated from this investigation and previously collected data will be evaluated to determine the appropriate statistical techniques that can be applied to the data set. The statistical analysis may include classical statistics and geostatistical approaches. If necessary, additional data needs will be identified so that appropriate statistical techniques can be applied.

Statistical techniques will be applied to laboratory QC samples (such as matrix spikes and matrix spike duplicates, method blanks, surrogate spikes, and laboratory control samples) to assess the accuracy and precision of the data. The formulas for calculating the precision, or RPD, and accuracy, or percent recovery, are presented in Section 1.4.1. Accuracy and precision data will be used to determine analytical data errors introduced through analytical procedures.

In addition, the QC field samples (such as trip, equipment, and ambient blanks and duplicate or replicate samples) will be evaluated to determine any systematic or random errors introduced by field procedures.

1.9.4 Data Quality Assessment

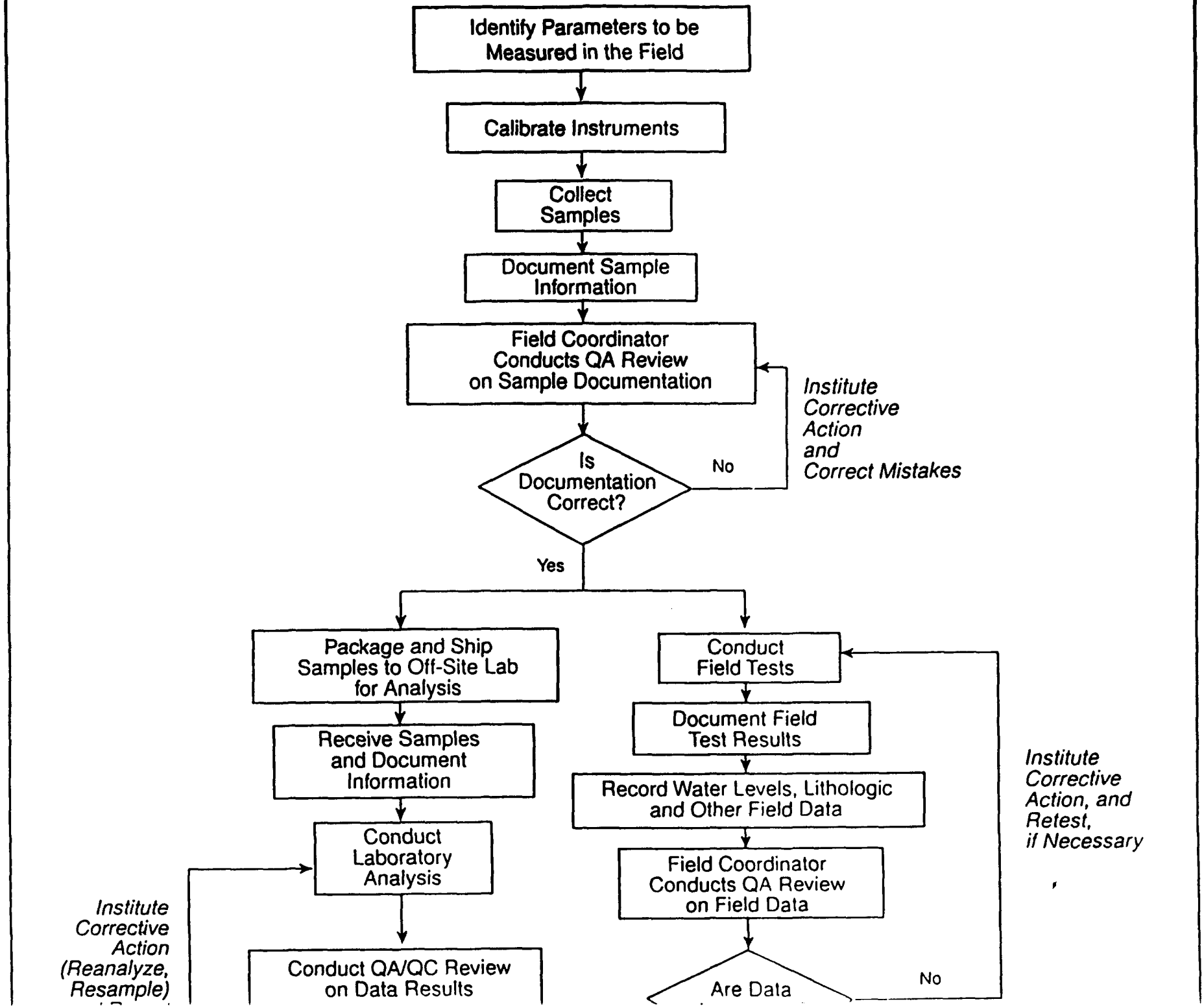
Data quality assessment involves reviewing the field records, maintaining proper laboratory record keeping, and assessing the laboratory data. These steps are discussed in the following sections.

1.9.4.1 Review of Field Records

Field records, at a minimum, will be evaluated for the following:

- completeness;
- identification of valid samples;
- correlation of field test data with previous results, if available;
- identification of anomalous field test data; and
- assessment of the accuracy and precision of the field test data and measurements.

The check of field record completeness will verify that (1) all requirements for field activities in this SAP have been fulfilled, (2) complete records exist for each field


Identify Parameters to be Measured in the Field
Calibrate Instruments
Collect Samples
Document Sample Information
Field Coordinator Conducts QA Review on Sample Documentation
Institute Corrective Action and Correct Mistakes
Is Documentation Correct?
No
Yes
Package and Ship Samples to Off-Site Lab for Analysis
Receive Samples and Document Information
Conduct Laboratory Analysis
Institute Corrective Action (Reanalyze, Resample)
Conduct QA/QC Review on Data Results
Conduct Field Tests
Document Field Test Results
Record Water Levels, Lithologic and Other Field Data
Field Coordinator Conducts QA Review on Field Data
Institute Corrective Action, and Retest, if Necessary
Are Data
No

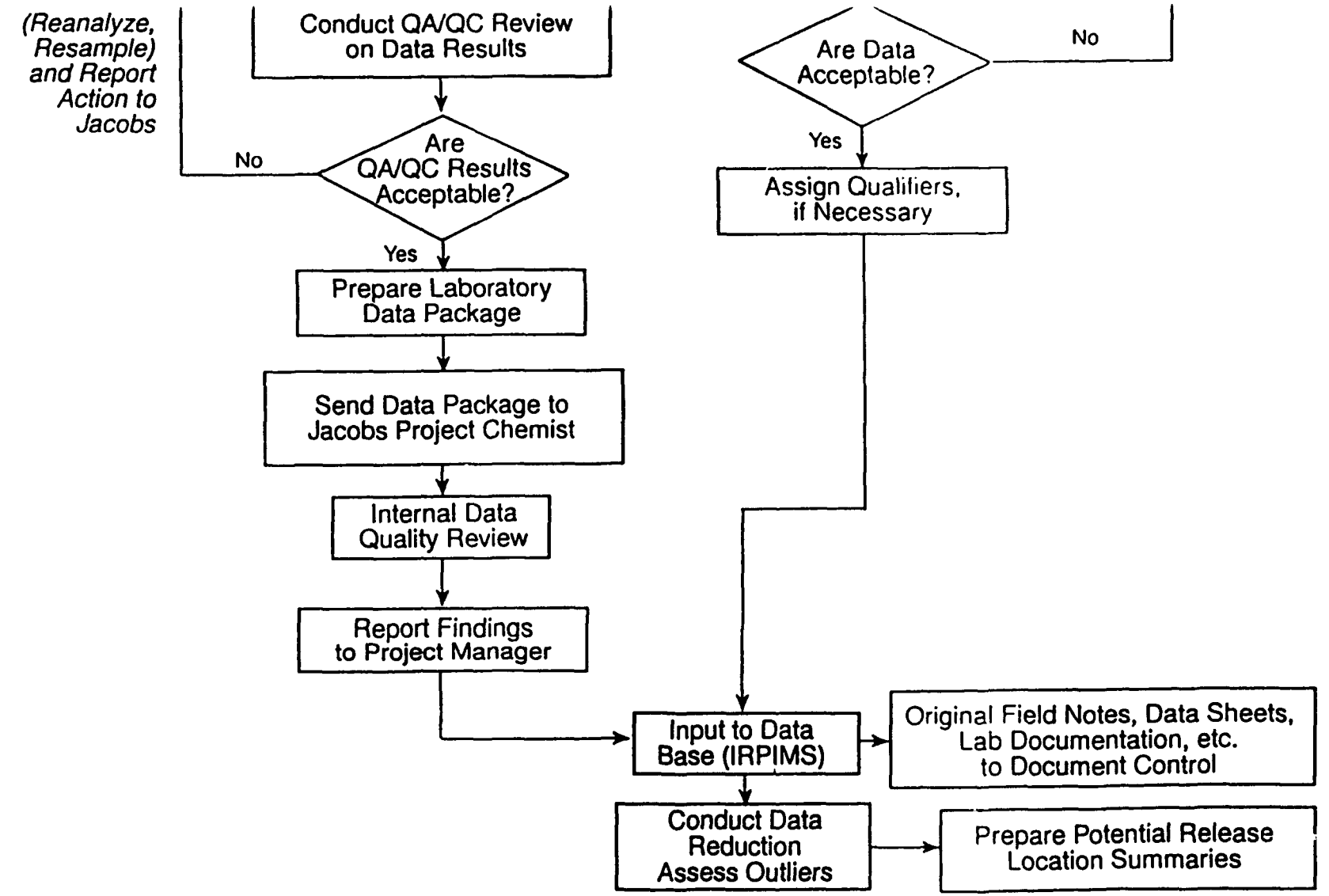


Figure 1.9-1
Data Management Flow Chart
Granite Mountain Radio Relay Station, Alaska

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activity, and (3) the procedures specified in program planning documents have been implemented. Field documentation will ensure verification of sample integrity and provide sufficient technical information to re-create each field event. The results of the completeness check should be documented. Environmental data affected by incomplete records will be identified in technical reports.

The identification of valid samples involves interpreting and evaluating the field records to detect problems affecting the representativeness of environmental samples. For example, photographs may show the presence or absence of sources of potential contamination, such as operation of combustion engines in the vicinity of sampling.

In addition, field documentation is another source of data for review. These judgments of sample validity will be documented in the technical report. Environmental data associated with poor or incorrect fieldwork and/or record keeping will be identified.

To the extent possible, anomalous field data will be identified and explained. The assessment of the quality of field measurements will be based on instrument calibration records and a review of any corrective action reports. The accuracy and precision of field measurements will be discussed.

1.9.4.2 Laboratory Record Keeping

Record keeping procedures for the laboratory are listed below and described in more detail in the LQAPP (Appendix A):

- The laboratory will maintain records sufficient to re-create each analytical event conducted. At a minimum, the records will contain the following:
  - chain-of-custody records;
  - initial and continuous calibration records including preparation of standards traceable to the original material and lot number;
  - instrument tuning records, if applicable;
  - method blank analyses;
  - internal standard results;
  - surrogate spiking and results (if required);
  - spike and spike duplicate records and results;
  - laboratory duplicate records and results (if done);
  - raw data including instrument printouts, laboratory bench work sheets and/or chromatograms with compound identification and quantitation reports; and
  - other QC samples and results (e.g., ICP interference check standards results, results of the matrix quantitation limit studies, and the results of blank spiking).

- The laboratory written procedures for each analytical method and QA/QC function are presented in the LQAPP (Appendix A).

- The following units of measure will be used for reporting analytical results:

  - water samples - inorganics and metals (milligrams per liter [mg/L]);

  - water samples - organics (micrograms per liter [µg/L]);

  - soil and sediment samples - organics, inorganics, and metals (milligrams per kilogram [mg/kg], dry basis);

- moisture content for each soil/sediment sample. The following equation for moisture content given in American Society for Testing and Materials (ASTM) D-2216 (ASTM 1988) will be used:

$$W = [(W_1-W_2)/(W_1-W_c)] \times 100$$

where:

W = moisture content, percent;
W_1 = weight of container and moist soil, grams;
W_2 = weight of container and oven-dried soil, grams; and
W_c = weight of container, grams.

1.9.4.3 Assessment of Laboratory Data

Third party validation will not be conducted on analytical data generated during this investigation. Therefore, Jacobs' internal data quality review has been expanded to include a data review by the Project Chemist. This data review will focus on the analytical data summary forms and laboratory-generated raw data to determine the quality of analytical results. This evaluation shall consist of the following:

- The field Chain-of-custody records will be reviewed to evaluate whether extraction/holding time criteria were met.

- The following summary forms will be evaluated for percent relative standard deviations, percent differences, percent recoveries, and RPDs: initial and continuing calibrations, surrogates, internal standards, Laboratory Control Samples (LCS), and matrix spikes. All reported results will be evaluated against the method requirements. These results will be recalculated from the raw data only if the results appear to be inaccurately reported.

- The extraction, digestion, and injection logs will be evaluated to verify that the method requirements are met and that the correct MDLs are reported and that the laboratory is meeting the maximum reporting limits required by AFCEE.

- Ten percent of all positive results will be recalculated from the raw data and verified against the results reported by the laboratory on the sample summary forms.

- A data quality review report summarizing the validity of the data and specifically addressing any gross violations of QC criteria that would be cause for rejection of the data will be provided as part of the PA/SI report.

- The data quality review report will be evaluated for completeness by the Jacobs Project QA Coordinator.

- Data qualifiers will not be added to the Jacobs' data. However, if required, the National Functional Guidelines (EPA 1988c, 1988d, and 1991b) will be used as a reference. The data review will identify any data requiring rejection or qualifiers on a qualitative basis.

1.9.5 Reporting

Analytical data will be reported in the PA/SI report. No Analytical Data Informal Technical Information Reports (ITIRs) as described in the Air Force *IRP Handbook* (Air Force 1993) will be submitted.

As part of the data submittal by the laboratory, data qualifiers will be assigned to sample results. These laboratory assigned qualifiers are presented below.

Laboratory Data Qualifiers for Organic Compounds

The following definitions of qualifiers will be used:

U Compound was analyzed for but was not detected.

J Value is estimated either for a tentatively identified compound, if applicable, or when a compound is present (spectral identification criteria are met, but the value is less than the method detection limit).

B Analyte was found in associated blank as well as in sample.

E Concentration exceeds calibration range of instrument.

D Compound in analysis at a secondary dilution factor.

A The tentatively identified compound is a suspected aldol-condensation product as applicable.

X Additional flags defined separately.

Laboratory Data Qualifiers for Inorganic Chemical Data

The following definitions of qualifiers will be used:

U Compound was analyzed for but was not detected.

E Value is estimated because of matrix interferences.

M Duplicate injection precision criteria were not met.

N Spiked sample recovery was not within control limits.

S As determined by the Method of Standard Additions (MSA).

W Postdigestion spike for furnace atomic absorption analysis is out of control limits; sample absorbance is less than 50 percent of spike absorbance.

* Duplicate analysis was not within control limits.

+ Correlation coefficient for MSA was less than 0.995.

1.10 INTERNAL QUALITY CONTROL CHECKS FOR FIELD AND LABORATORY OPERATIONS

Field and laboratory QC samples are defined below. The frequency for collection of field QC samples is discussed in Section 2.2.6. Field QC samples will apply only to those sample locations designated for laboratory analyses.

1.10.1 *Quality Control for Field Activities*

Below are field activities for QC. Information on specific QC sample numbers and intervals for their collection are in Section 2.2.6, Field Quality Control.

- Trip Blank. A VOC sample bottle is filled with ASTM Type II reagent-grade water in the laboratory or at an offsite location, transported to the site, handled like a sample, and returned to the laboratory for analysis. (Trip blanks are not to be opened in the field.) The trip blank for soils is Type II reagent-grade water. In this case, the laboratory will report the trip blank results (complete data package) with the associated soils data package.

- Ambient Conditions Blank. ASTM Type II reagent-grade water is poured into a sample container at the site, then is handled like a sample and transported to the laboratory for analysis of VOCs. The laboratory will report the ambient conditions blank results (complete data package) with the associated soil or water data package.

- Equipment Blank. ASTM Type II reagent-grade water is poured into or over the sampling device, transferred to sample bottles, and then transported to the laboratory for analysis. The laboratory will report the equipment blank results (complete data package) with the associated soil or water data package.

- Duplicate. Field duplicates are two co-located samples collected independently at a sampling location during a single sampling act. Field duplicates will be labeled so that laboratory personnel performing the analyses are not able to determine which samples are duplicates.

- Replicate. A replicate is a single sample that is homogenized and divided or split into two equal parts for analysis. Replicates are often called splits. Field replicates will be identified so that laboratory personnel are unable to distinguish them from other field samples. Replicates will not be used when collecting samples for volatile organic analysis.

Note: Type II reagent-grade water will be certified by the manufacturer to verify that (1) it is free of analytes and contaminants and (2) the electrical conductivity is less than 1.0 micromhos per centimeter (μmhos/cm) at 25 degrees Celsius (°C). Type II reagent-grade water will be stored in glass, stainless-steel, or Teflon containers.

Distilled water from supermarkets will not be used in place of Type II reagent-grade water.

When equipment water that meets the ASTM Type II criteria (via deionization and carbon filter) can be obtained or generated in the field, the field sampling team may substitute this material for Type II reagent-grade water.

1.10.2 Quality Control for Laboratory Activities

QC for laboratory activities consists of the following:

- Method Blank. Method blanks consist of analyte-free water or soil, processed in the exact manner as the samples within a batch using identical reagents and solvents. Method blanks are generated by the laboratory.

- Sample Matrix Spike. A sample that represents the matrix will be selected by the Jacobs Site Manager. The laboratory will spike this sample in duplicate (matrix spike and matrix spike duplicate) with analytes specified for each method by the laboratory. A minimum of one sample per 20 project samples will be selected for the matrix spike and matrix spike duplicate.

- Surrogate Spikes. Surrogate spikes are compounds that are added to every sample analyzed including the standards, blanks, matrix spikes, and QC check samples to assess the recovery of the method. Not all analytical methods are amenable to the use of surrogate spikes. Before any sampling event, any analyses that require surrogate spikes will be identified. All applicable surrogate recovery control limits will be reviewed for approval by the Jacobs Project Chemist.

- Standard Matrix Spike/QC Check Sample. A QC check sample consists of either an EPA reference or NIST traceable reference material. The QC check sample or standard matrix spike will be used to assess laboratory performance and to evaluate whether any systematic problems occurred during analysis. Any QC check sample that is found to be outside control criteria for any compound or analyte will require corrective action by the laboratory and reanalyses of all associated samples.

1.10.3 Laboratory Analytical Batches

Environmental samples will be grouped in specific analytical batches. Each batch will include sufficient calibration events and QC samples to allow the results of that batch to stand as an autonomous data set. That is, all associated data for an analytical batch will be reported with each data package. An analytical batch will consist of no more than 20 environmental samples. Laboratory QC samples will be used to assess the desired precision, accuracy, representativeness, comparability, and completeness of the data.

1.10.4 Control Limits

Appendix A presents the control limits for each analytical method. The summary includes the checks, their frequency, acceptance criteria, and the corrective action, if outliers occur. Additional information on laboratory QC is included in Appendix A.

1.11 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits for sampling and analysis may be conducted. Audits may include a review of field and laboratory QA systems and onsite review of equipment for sampling calibration and measurement. Audits may evaluate the capability and performance of project personnel, items, activities, and documentation. The audits will ensure and document that QC measures are being used to provide data of acceptable quality and that subsequent calculations, interpretation and other project output are checked and validated. Scheduled and unscheduled audits will be conducted. System and performance audits may be conducted by the Jacobs QA Officer or his designee. The QA Officer or designee will audit fieldwork and review the project documentation.

During a system audit, the entire QA process is evaluated. The project or field team organization is reviewed for compliance with the proposed organization and clarity of assigned responsibility. Qualifications of personnel assigned to the project will be reviewed to make certain that assigned responsibility, skill, and training are properly matched.

A system audit may be conducted on all components of a measurement system to determine proper selection and use. The system audit includes evaluation of both field and laboratory procedures.

During a performance audit, proper execution of SOPs or QC procedures is evaluated. The audit will address whether field equipment and analytical instruments are selected and used to meet requirements specified by the project objectives stated in this QAPP. Equipment and facilities provided for personnel health and safety may also be evaluated. Calibration procedures for field instruments will also be audited.

A review of analytical methodology with respect to data requirements for the project will be performed. An onsite observation of analytical technique, data reduction, and record keeping may be performed, if necessary.

QA audits are conducted at the request of project management or the Air Force. A written report of a QA project audit will include the following:

- an assessment of project team status in each major project area;
- clear statements of areas requiring improvement or problems to be corrected;
- recommendations and assistance regarding proposed corrective actions or system improvements; and
- a timetable for any corrective action required.

The Jacobs QA Officer will be responsible for the coordination of audits and the disposition of audit records.

1.12 PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES

Preventive maintenance procedures are established to make certain that laboratory and field instrumentation perform their intended functions. Instrument maintenance records for both laboratory and field instrumentation will be kept in permanently

bound notebooks assigned to each individual instrument. Field equipment maintenance procedures are discussed in Section 2.3.

Preventive maintenance is a crucial element of the QA program in any laboratory. Analysts will perform routine preventive maintenance such as replacing minor parts, cleaning exterior components, and providing the instruments with a clean, climate-controlled environment. Major instruments, such as GCs, atomic absorption (AA) spectrophotometers, ICPs, analytical balances, and GC/MS systems, will be maintained under commercial service contracts or by qualified in-house service technicians. All instrument maintenance is recorded in the associated instrument logbook for reference and verification of scheduled maintenance.

Instruments will be constantly monitored by using daily calibration, sensitivity, and response checks to determine when nonscheduled maintenance is required. In the event that an instrument does fail, every effort will be made to meet obligations to clients concerning holding times and analysis due dates.

Laboratory support systems such as the deionized water supplies, refrigerators, and ovens will also be monitored and serviced regularly. In many instances, the improper functioning of such basic equipment as a refrigerator is enough to invalidate costly data. The laboratory QA program has been designed to minimize data loss by monitoring and recording the functioning of these systems, allowing rapid correction of any malfunction before data loss can occur. Maintenance schedules and a list of critical spare parts for the laboratory are included in the LQAPP (Appendix A).

1.13 FIELD AND LABORATORY PROCEDURES TO BE USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

Formulas for determining data accuracy, precision, and completeness are presented in Section 1.4.1.

Data quality assessments will make certain that generated data are accurate and consistent with project objectives. The quality of the data will be assessed based on precision, accuracy, representativeness, consistency, and completeness.

Before data collection, sampling and analysis procedures will be evaluated with regard to their ability to generate appropriate, technically acceptable information required to achieve project objectives.

During data collection, results will be assessed to make certain that (1) the selected procedures are efficient and effective and (2) the data generated provide sufficient information to achieve project objectives. The appropriateness of the precision and accuracy of selected measurement systems will also be evaluated. In general, data evaluation will be based on performance audits, results of spiked sample analyses, and review of completeness objectives.

Following completion of data collection activities, an assessment of the adequacy of the database generated with regard to completing project objectives will be performed by the Jacobs Project Manager and QA Officer. Recommendations for improved QC will be developed, if appropriate. If data gaps are identified, the Jacobs QA Officer may recommend the collection of additional raw data to fully support the project's findings and recommendations.

The quality of data generated during analysis will be assessed through the use of laboratory control charts and QA reviews by the chemists and the laboratory supervisor. The quality of the data will be verified during the Jacobs internal data quality review. In addition, the quantity of data generated from this investigation and previously collected data will be evaluated to determine the appropriate statistical techniques that may be applied to the data.

Specific aspects of documentation, analytical procedures, and office procedures that will be assessed were discussed in Section 1.9.

1.14 QUALITY ASSURANCE REPORTS

The following subsections discuss QA reporting procedures and QA reporting scope and content.

1.14.1 Reporting Procedure

The Jacobs QA Officer or his designee may, at the request of the Air Force, prepare QA reports that document all audited field or laboratory QC activities. These reports will be submitted to the Project Manager upon completion of fieldwork.

1.14.2 Reporting Scope and Content

If a QA report is requested, the Jacobs QA Officer or designated auditor will prepare the report. Information in the report may include the following:

- QA activities and quality of collected data;
- equipment calibration and preventive maintenance activities;
- results of data precision and accuracy calculations;
- evaluation of data completeness and contract compliance;
- field and/or laboratory QA problems and recommended and/or implemented corrective actions;
- results of QA audit findings;
- project status and anticipated completion dates for important tasks; and
- any changes to procedures documented in the QAPP.

Summary audit reports may be prepared after each task is completed to inform the staff and management of QA status. A final audit report for the project will include the following:

- periodic assessment of measurement data accuracy, precision, and completeness;
- results of performance audits and/or systems audits;
- significant QA problems and recommended solutions for future projects; and

- status of solutions to any problems previously identified.

Any incidents requiring corrective action will be documented. The summary of findings will be factual, concise, and complete. These reports will be addressed to the Jacobs Project Manager and QA Officer.

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2.0 FIELD SAMPLING PLAN

This Field sampling Plan (FSP) prepared by Jacobs describes procedures that will be used to conduct environmental sampling activities as part of the 1994 field investigation for Granite Mountain Radio Relay Station (RRS), Alaska. The description and rationale for the field activities are described in the Work Plan for Granite Mountain RRS, Alaska. This FSP is a companion document to the Work Plan. The FSP was prepared based on guidance found in the *Handbook for the Installation Restoration Program Remedial Investigations and Feasibility Studies* (Air Force 1993). The following sections describe the procedures and requirements for field operations, environmental sampling, field measurements, field QA/QC, and record keeping during the 1994 field investigation.

2.1 FIELD OPERATIONS

Granite Mountain RRS is in a remote location approximately 130 miles northeast of Nome, Alaska. Figure 2.1-1 shows the general location of the site. The site is divided into a Lower Camp, consisting of a 4,000-foot gravel landing strip, a temporary warm storage building, and a temporary air terminal, and an Upper Camp consisting of a dormitory building, an equipment building, and the four panel White Alice Communications System (WACS) radio antenna. Figures 2.1-2 and 2.1-3 show the general layout of the site, and the two IRP sites and 18 Areas of Concern (AOCs) to be investigated during the 1994 field effort.

The field investigation at Granite Mountain RRS will include the following activities:

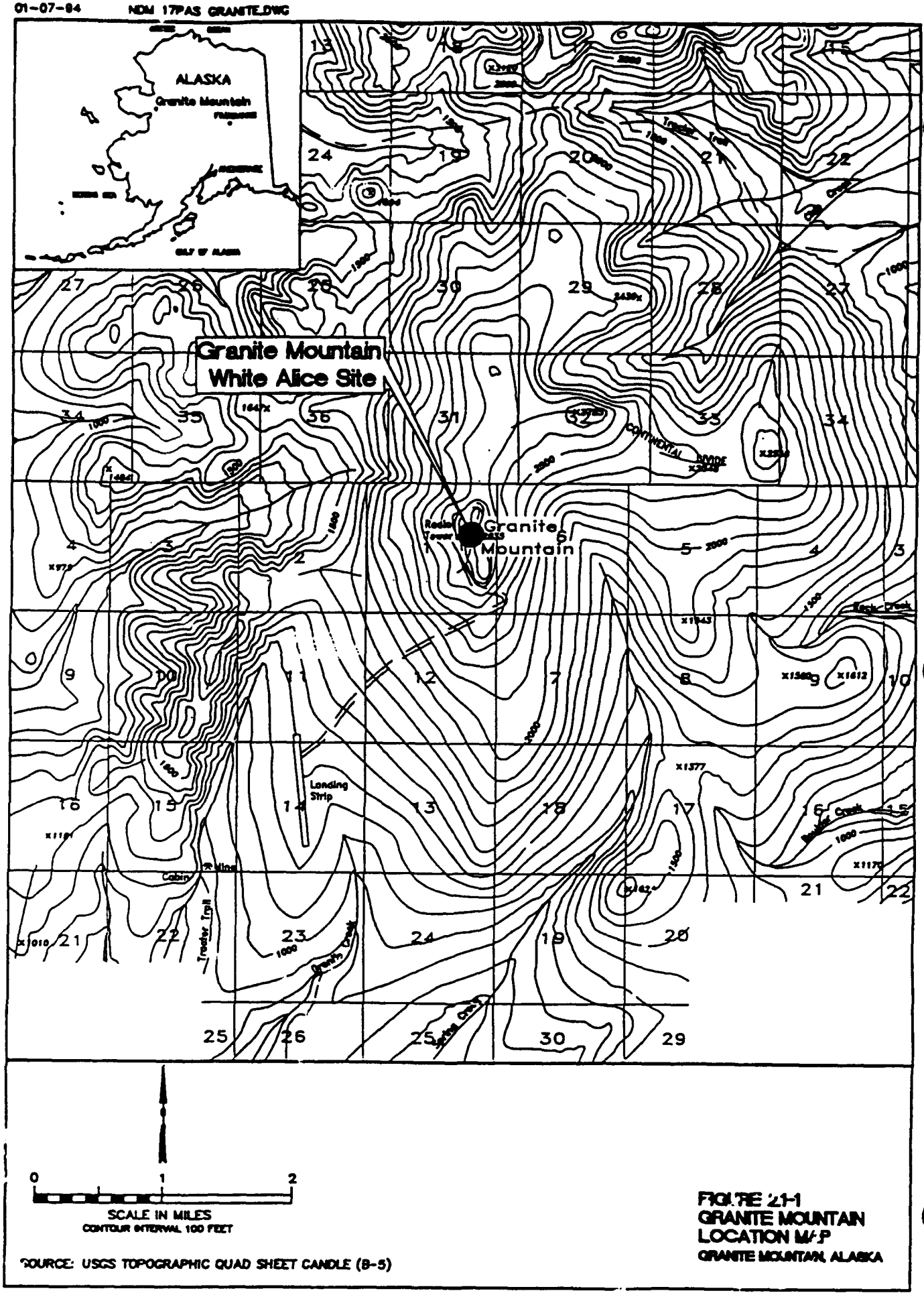
- site reconnaissance, preparation, and restoration;
- metal detector surveys;
- surface soil, shallow subsurface soil, surface water, and sediment sampling; and
- groundwater sampling at one existing water supply well.

Associated activities include geologic and location mapping, equipment decontamination, and waste handling. The following subsections describe the procedures for field activities.

2.1.1 Site Reconnaissance, Preparation, and Restoration Procedures

Site Reconnaissance. An initial site reconnaissance was conducted by Air Force personnel in June 1994. Many of the plans outlined in this FSP have been based on the information obtained during this site visit. Additional reconnaissance activities will be completed during the start-up of the field sampling effort so that personnel from Jacobs can become acquainted with the two IRP sites and 18 AOCs. The following tasks will be performed during the site reconnaissance. Details on specific tasks listed below are included in this FSP.

- Locate known source areas based on aerial photographs, previous data, literature, and field observations.
- Field verify planning document maps.



SOURCE: USGS TOPOGRAPHIC QUAD SHEET CANDLE (B-5)

FIGURE 21-1
GRANITE MOUNTAIN
LOCATION MAP
GRANITE MOUNTAIN, ALASKA

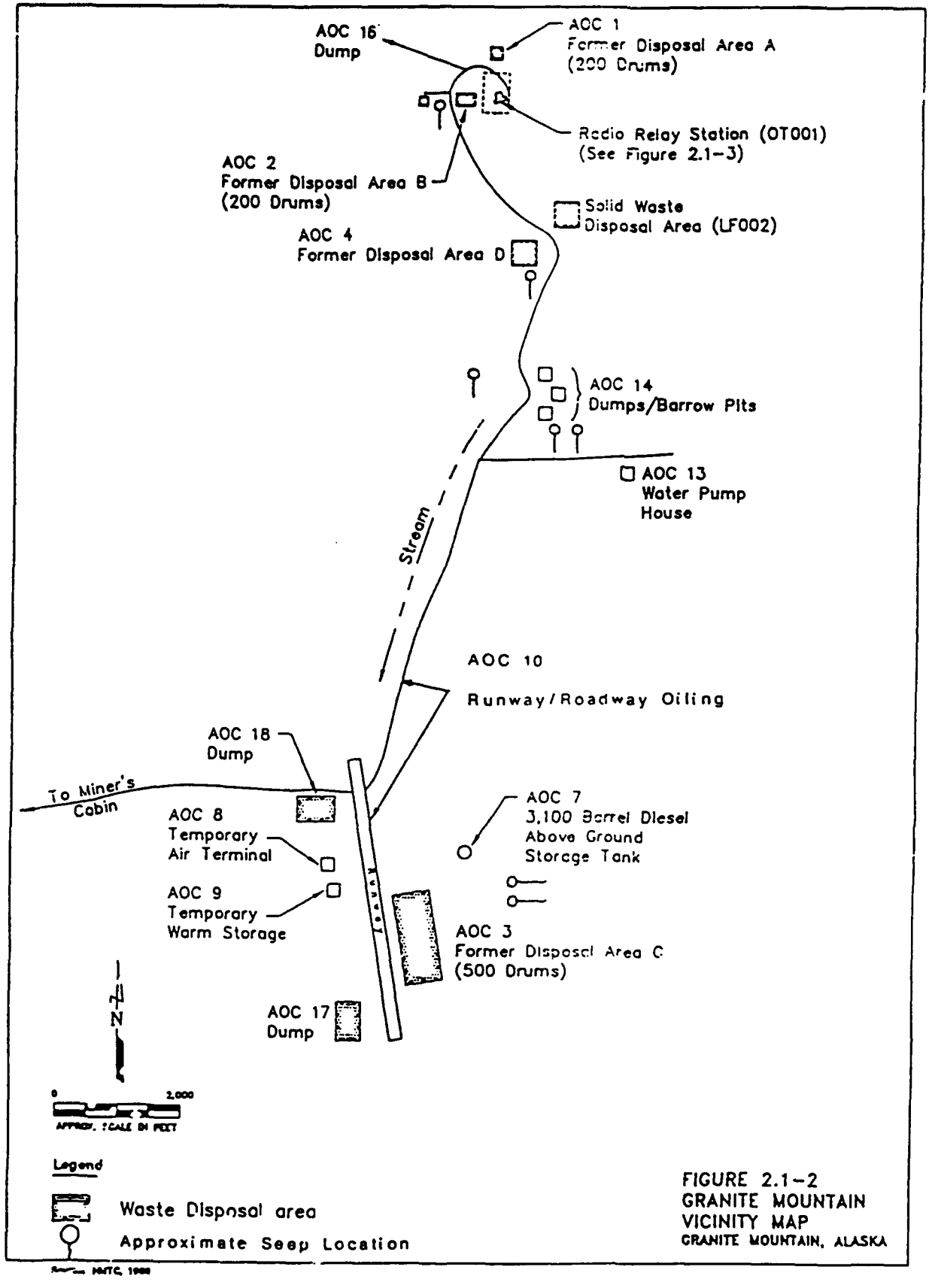


FIGURE 2.1-2
GRANITE MOUNTAIN
VICINITY MAP
GRANITE MOUNTAIN, ALASKA

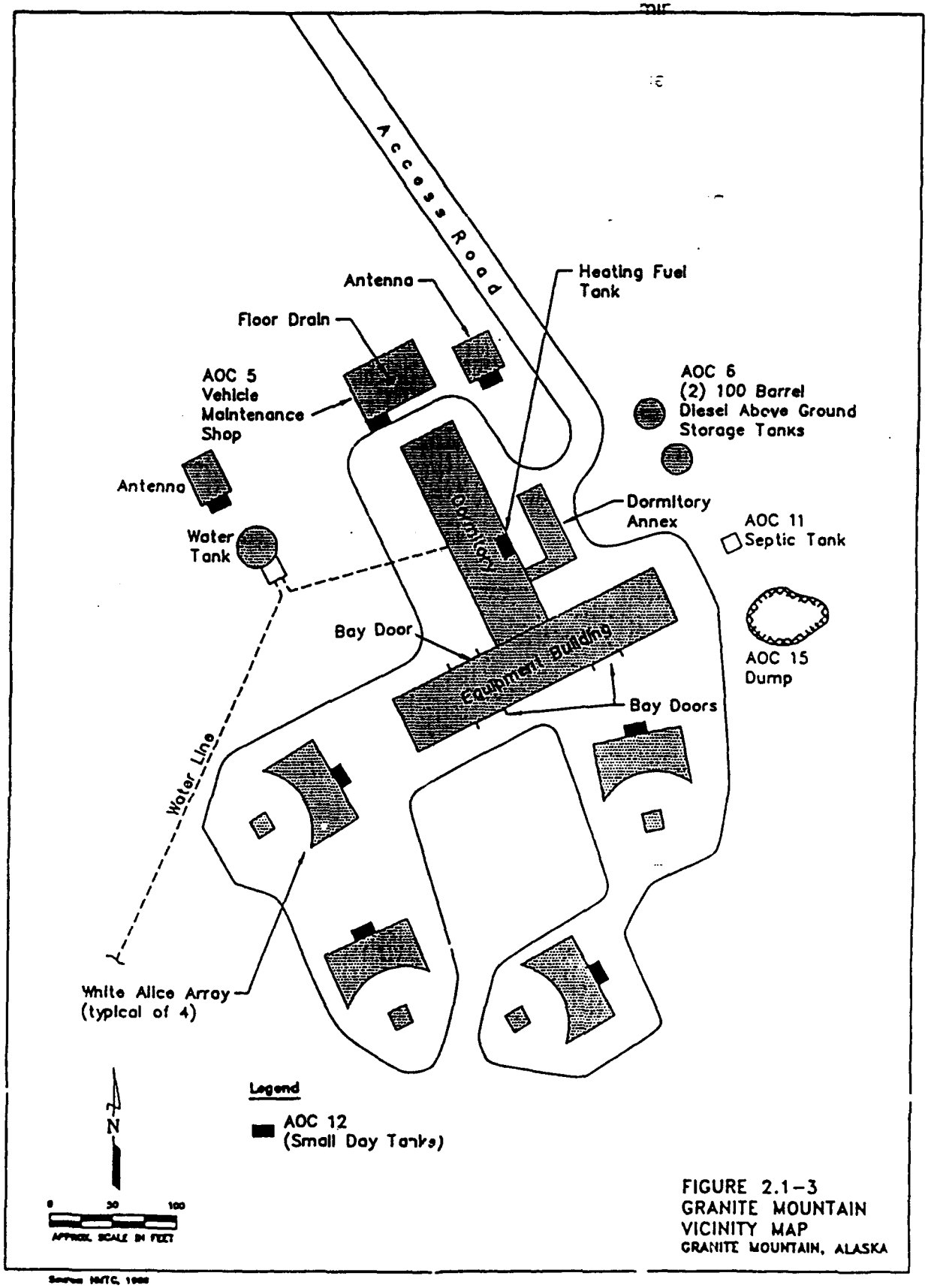


FIGURE 2.1-3
GRANITE MOUNTAIN
VICINITY MAP
GRANITE MOUNTAIN, ALASKA

Source: HNTC, 1988

- Confirm source area boundaries and locations with a metal detector survey.
- Locate surface water features including groundwater seeps and surface water drainages.
- Locate proposed sampling locations.
- Document field reconnaissance findings.
- Evaluate observations and update maps.

Preparation. Site preparation tasks will be completed concurrently with the site reconnaissance activities. These tasks will include the following:

- Receive and stage field equipment and supplies.
- Setup sampling packages and decontamination facilities.
- Prepare vehicles for field crew use.
- Prepare living quarters for the field crew.

Site Restoration. Each sample location will be restored as nearly as possible to its preinvestigation condition. Unused or surplus materials, supplies, and waste material will be removed from each sample location as the work is completed at that area. Equipment staging, temporary storage, and living quarters will be restored to original conditions. All materials and equipment that are brought to the site will be removed at the conclusion of the field investigation. A short section of steel reinforcement rod will be placed at all sample locations, along with a wooden stake (if possible). The wooden stake will be labelled with the sample identification number for future reference. These markers will be left at the site to assist in locating these areas for future activities, if needed.

2.1.2 Metal Detector Survey

A metal detector survey will be conducted prior to sample collection activities at all suspected waste disposal sites. The survey will be completed to assess the presence of buried metallic debris, specifically drums containing waste products or materials of unknown composition. However, the metal detector survey will not distinguish the extent of subsurface disturbance or contamination.

2.1.3 Equipment Decontamination

All equipment will be decontaminated in accordance with *IRP Handbook*, Section 2.1.1.3 (Air Force 1993).

All equipment that may directly or indirectly contact samples will be decontaminated before and after each use. This equipment may include bailers, hand augers, water level indicators, and stainless-steel spoons. Decontamination will consist of a potable water (flown in periodically by the air charter service) and Liquinox or Alconox wash, followed by a ASTM Type II reagent-grade water rinse, and a pesticide-grade methanol, and pesticide-grade hexane solvent rinse.

All sampling equipment will be allowed to air dry before reuse. Equipment will be placed on a clean surface such as laboratory-grade (oil-free) aluminum foil. (If the sampling device will not be used immediately after decontamination, it will be wrapped in laboratory-grade aluminum foil.)

2.1.4 Waste Handling

Because of the limited scope of this field effort, it is not anticipated that a large amount of investigation-derived waste will be generated. A minimum amount of wastewater will be generated during decontamination of field sampling equipment. Decontamination water will consist of potable water and Liquinox or Alconox, and will be discharged at the site at the conclusion of the sampling effort in accordance with EPA guidance (EPA 1992). If, however, gross contamination is encountered during the field sampling effort, decontamination water will be containerized in 5-gallon gas cans and returned to Elmendorf AFB. This water will be treated as hazardous waste. A limited amount of purge water will be generated during the sampling of one well at the site. Before sampling of the well, a photoionization detector will be used to determine if organic vapors are present within the well casing. If no organic vapors are detected, the purge water will be released to the surrounding area. If high levels of organic vapors are detected within the well casing, a grab sample will be collected without purging the well.

All hexane and methanol used for decontamination will be kept separate from the water/Liquinox or Alconox solution, and left to evaporate. All hexane and methanol that does not evaporate will also be returned to Elmendorf and treated as hazardous waste.

All other investigation-derived waste such as used Tyvek, rubber gloves, paper towels, tape, plastic sheeting, aluminum foil, and leftover waste from personnel living at the site will be placed in plastic bags and returned to Nome. At Nome, the waste will be deposited in trash receptacles. Personal protective equipment that has become grossly contaminated will be returned to Elmendorf AFB and treated as hazardous waste. Based on the site reconnaissance conducted by the Air Force, no high levels of contamination are anticipated.

2.1.5 Field Operations Summary

Table 2.1-1 summarizes the planned field survey and sampling activities, including the estimated number of samples to be collected from each site for fixed lab analysis. Also included in the table is a column with an estimation of the sites at which field screening test kits may be used to identify TPH and PCB contamination. In general, field screening for TPH contamination will not be used where obvious signs of soil staining exist, because samples in these areas will automatically be submitted to the fixed laboratory for analysis. A discussion of the contaminants of concern, and the physical description of each site can be found in the Work Plan for Granite Mountain RRS.

In general, the field activities will include the following:

- preliminary site reconnaissance to locate or verify known source areas, verify field maps, and refine sampling locations by visual inspections and use of field test kits for TPH and PCB contamination;

- metal detector survey to verify landfill, dump, and drum burial boundaries, and locate buried metallic objects;

Table 2.1-1
Field Investigation Sample Summary
Granite Mountain RRS, Alaska

Site Designation	Site Type (1)	Metal Detector Survey (2)	Surface Water Samples	Sediment Samples	Surface Soil and Subsurface Soil Samples	Cistern Water Samples	Comment
OT001	POL				3		
LF002	LF	X			3		Stained surface soil.
AOC 1	LF	X	1	1	1		
AOC 2	LF	X	1		2		No visible soil stains. Seep located nearby.
AOC 3	LF	X			3		Stained surface soils.
AOC 4	LF	X	2		2		Stained surface soils, seep nearby.
AOC 5	POL				3		
AOC 6	POL				4		Stained soils.
AOC 7	POL		1		2		Stained soils near pipeline.
AOC 8	POL				3		Stained soils.
AOC 9	POL				4		Nearby vegetation stressed.
AOC 10	POL			1	2		Sediment sample in drainage ditch.
AOC 11	POL			1 (sludge)			Sludge sample from septic tank.
AOC 12	POL				6		
AOC 13	POL		1		2	1	Stained soils, well location.
AOC 14	LF	X	1	1	5		Seeps located nearby.
AOC 15	LF	X			3		Stained soils.
AOC 16	LF	X	1		3		Stained soils.
AOC 17	LF	X			2		
AOC 18	LF	X			1		
Background			3	1	2		Background samples to be collected if possible.
TOTAL		10	11	5	56	1	

NOTE:
(1) - LF = Landfill, or waste disposal site; POL = Petroleum, Oil, and Lubricants
(2) - Metal detector survey of all suspected past and present waste disposal sites
AOC - Area of Concern

- surface soil collection to detect the potential of a release of constituents to surface soils;

- subsurface soil collection to detect the presence or absence of potential contamination in shallow subsurface soils;

- surface water, groundwater seep, and sediment sample collection to detect the potential release or migration of constituents to surface waters, groundwater, and sediments;

- groundwater monitoring and sample collection at one water supply well to provide information concerning the potential impacts at the well by the constituents of concern at the site; and

- background soil and water sample collection.

2.2 ENVIRONMENTAL SAMPLING

This section describes the field sampling methods for various environmental media and procedures for sample handling and quality control (QC) that are required for the field investigation at the Granite Mountain RRS. All sampling activities conducted at the site will be documented on field forms or in field logbooks. Examples of the field forms to be used for sampling activities at Granite Mountain RRS are included in Appendix C.

2.2.1 Sampling Approach

The following subsections describe sample collection procedures for groundwater, surface water, sediment, and surface and subsurface soil.

A limited number of environmental samples will be collected from each AOC at the Granite Mountain site. To adequately assess the presence or absence of contamination at each site, field surveys will be performed and screening level data will be collected to provide qualitative information about source areas and contamination, and to help provide direction regarding the location and collection of samples for fixed laboratory analyses. Field surveys and screening analysis provide preliminary information regarding potential contaminant distribution so that the locations of potentially contaminated soil samples can be selected for laboratory analysis. This step minimizes the number of fixed laboratory samples required to characterize the site. Field screening test kits will be used onsite to analyze for PCBs and TPH contamination at selected areas based on visual observations made during the site investigation. Test kits will be used in areas where visible staining is not evident to determine if contamination exists, or in areas of staining to determine the analyte suite for laboratory analysis. Many areas in which visible staining of soils exists will be evaluated for sampling. The decision to collect samples for the fixed lab will be made in the field based on visual observations, field screening conducted with test kits and/or a photoionization detector, historical information about the site, areas downgradient from sources of potential contamination, or random locations surrounding a specific source. Field screening test kits will not be used to analyze surface water samples. Because surface water at the site may be encountered infrequently, all surface water samples will be submitted to the fixed laboratory for analysis. The one water sample to be collected from the water cistern

will be analyzed to determine anthropogenic impacts from Base operations. This sample will be analyzed for petroleum-related constituents.

Samples collected for field testing will follow the same general collection methods although containers will not be preserved, and a chain-of-custody will not be required. Field test samples will be labeled and stored in a cooler containing ice and will be screened at the end of each days activities.

The technical approach for the field investigation will be determined by the physical characteristics of each AOC site. Soil samples will be collected using stainless-steel spoons. Shallow (less than 3 feet below ground surface) subsurface soil samples will be collected from the cuttings or from the auger head after the target depth has been achieved. Depth of subsurface soil samples will be determined in the field based on observed staining, odor, or refusal of the auger. It is anticipated that difficulties may be encountered reaching the desired depth because of boulders and large cobbles located throughout the site. If refusal is met prior to reaching the desired sampling depth, a second attempt will be made nearby the first, and a third nearby the first two if necessary. A limited number of background samples will be collected for a determination of baseline concentrations in the area. These samples will be collected in undisturbed areas away from the main facility. Specific sampling procedures will be addressed in Section 2.2.2 of this FSP.

All AOCs at the Granite Mountain site can generally divided into two categories; landfills/buried waste disposal sites, and POL storage/fuel spill sites.

Table 2.1-1 lists each of the landfills to be investigated during field activities. Also included in the table are the anticipated number of samples to be collected for fixed laboratory analysis and the proposed media.

The following procedures will be followed for the field investigation of each landfill site:

- An initial walk through of the suspected area of buried waste will be performed to determine areas of special interest such as visible staining of soils, metallic debris, or areas of seeps/standing water.

- After a visual inspection of the site, a metal detector will be used to perform a survey to determine the presence and extent of buried metallic debris (waste drums). Random measurements will be taken around the landfill to delineate its boundaries.

- During sampling activities, an HNu photoionization detector will be used to screen for organic vapors at the sample location. Screening data will be recorded on the field sampling data sheet for the sample location.

- Field test kits will be used to sample areas with visual signs of contamination or areas downgradient of potential sources, or at random locations throughout the landfill area. Samples will be collected and analyzed in the field using immunoassay test kits. Field screening analysis will be performed for either PCBs or TPH, or both, depending on the site's suspected contamination. The exact analysis to be performed will be determined in the field.

- Soil samples will be collected at the surface, and at a shallow subsurface depth based on the soil conditions. A surface water/sediment sample will be collected

at all seeps or areas of standing water. Surface water samples will automatically be submitted to the fixed laboratory for analysis.

- The location of all samples collected at each landfill site will be placed on a map of the site, along with the sample identification number. The data collection point will be located using a Brunton compass and a fiberglass tape measure to tie the point into any nearby structure or monument (if possible). This will aid in the preparation of site maps for future document production and planning. In addition, all sampling locations will be clearly marked with a steel reinforcing rod or wooden stake so that the sampling point can be revisited if necessary, and can be located for the establishment of survey coordinates in the future.

- Based on the results of the field screening analysis, additional samples may be collected for fixed laboratory analysis. The number and location of fixed laboratory samples will be determined in the field.

Table 2.1-1 lists each of the POL storage/fuel spill sites to be investigated during field activities. Also included on the table are the anticipated number of samples to be collected for fixed laboratory analysis and the proposed media. In general, arctic grade diesel is believed to be the main contaminant at each of the sites.

The following general procedures will be followed in the investigation of POL storage/fuel spill sites:

- A visual inspection will be performed on all fuel storage tanks, buildings housing storage tanks, floor drain outfalls, and the areas adjacent to each potential source. During the field inspection, areas of interest will be staked for sampling. These areas may be stained soils, areas of stressed vegetation, groundwater seeps, floor drain outfalls, or areas directly downgradient from potential sources.

- During sampling activities, an HNu photoionization detector will be used to screen for organic vapors at the sample location. Screening data will be recorded on the field sampling data sheet for the sample location.

- Field test kits will be used to sample areas with visual signs of contamination, or downgradient from potential sources of contamination, or at random locations throughout each site. Each sample will be collected and analyzed in the field using immunoassay test kits. Field screening analysis will be performed for either PCBs or TPH, or both, depending on the site's contamination history.

- Soil samples will be collected at the surface, and at a shallow subsurface depth based on the soil conditions. A surface water/sediment sample will be collected at all seeps or areas of standing water. Surface water samples will automatically be submitted to the fixed laboratory for analysis.

- The location of all samples collected at each site will be placed on a map of the site. The data collection point will be located using a Brunton compass and a fiberglass tape measure to tie the point into any nearby structure or monument (if possible). This will aid in the preparation of site maps for future document production and planning. In addition, all sampling locations will be clearly marked with a steel reinforcing rod or wooden stake so that the sampling point can be revisited if necessary, and can be located for the establishment of survey coordinates in the future.

- Based on the results of the field screening analysis, additional samples may be collected for fixed laboratory analysis. The number and location of fixed laboratory samples will be determined in the field.

2.2.2 Sampling Procedures

The following subsections detail the procedures and equipment to be used for the completion of the 1994 field sampling effort at Granite Mountain RRS. Specifications and operating instructions for all instruments to be used are included in Appendix D.

2.2.2.1 Metal Detector Survey

Metal detector surveys will be performed in an effort to help define locations and boundaries of former waste accumulation areas, landfills, and dump areas. A metal detector survey will also be used to determine the presence of metallic debris in landfill areas and in areas of disturbed soil.

It is anticipated that buried metal may be detected at various locations. Preliminary survey results will be evaluated to determine the usability of results and the value of performing larger surveys. The survey will be conducted in a methodical manner so that coverage of the entire site will be accomplished.

A Schonstedt Model MAC-51B magnetic locator will be used to perform the survey.

2.2.2.2 Cistern Water Sampling Procedures

Water samples for fixed laboratory analysis will be collected from one cistern located at the site. During the site visit conducted by the Air Force in June 1994, the cistern was observed to be approximately 2 feet in diameter and possibly 8 to 10 feet in depth. Water was observed at approximately 3 feet below ground surface. A grab sample of the water within the cistern will be collected for the sole purpose of determining presence or absence of contamination within the cistern.

When the cistern seal is removed, the air in the breathing zone and in the cistern will be measured for total organic vapors with a photoionization detector. If organic vapors are detected, procedures provided in the site Health and Safety Plan (HSP) will be followed. An HNu Model HW-101 instrument will be used for the field screening of organic vapors.

Static fluid levels, including immiscible light nonaqueous-phase liquids (LNAPLs), dense nonaqueous-phase liquids (DNAPLs), and total cistern depth will be measured using an Oil Recovery Systems (ORS) oil/water interface probe and the information will be recorded in the field logbook and on the field forms. The condition of the cistern will also be recorded, and a general determination of the volume of water contained in the cistern will be calculated. The calculation will be recorded in the field logbook and on a groundwater sampling form. Examples of these forms are included in Appendix C.

A Teflon bailer and a Teflon coated stainless-steel bailer line will be used to sample the cistern, if possible. Samples will be collected in order of decreasing analyte volatility. For example, samples destined for volatile organic compound analysis will be collected before those for semivolatile organic compound analysis.

Sampling of the cistern will be performed in a manner that minimizes agitation of sediment, if any, in the cistern. Equipment will not be allowed to free fall into the cistern. A Horiba Model U-10 Water Quality Meter will be used for water parameter measurements to be collected with the sample. Details for field parameter meter use, calibration, and duplicate measurements are provided in Section 2.3.

2.2.2.3 Surface Water Sampling Procedures

Surface water samples will be collected from ponds, drainages, springs, and seeps. All samples will be collected in a manner that does not cause cross contamination.

The following procedures apply to all surface water sample collection:

- surface water samples will be collected before sediment samples to be collected at the same location;
- pH, specific conductance, salinity, dissolved oxygen, and temperature measurements will be collected at each surface water sampling location;
- specific characteristics such as size of water body, depth, turbidity and overall appearance will be recorded in the field log book;
- all samples will be stored and shipped in a cooler packed with ice;
- sample locations and identification numbers will be marked with a flag or stake; and
- sample locations will be recorded on project maps, and if possible, located with a compass and tape from a nearby structure or monument.

All surface water sampling equipment will be decontaminated between sampling locations according to the procedures specified in Section 2.1.3.

Samples collected from shallow depths will be obtained by submerging a stainless-steel, Teflon, or glass container into the pond, stream, or drainage or by holding the container under the water discharge point of a seep or spring. The container will be submerged in a manner that minimizes agitation of sediment and the water sample. If a seep or spring has minimal discharge flow, gravel, boulders, and soil may be removed to make the area more accessible and sufficient time allowed to elapse before sampling to allow sediment and debris to settle. Depending on site-specific conditions and spring or seep accessibility, points may not be sampled if the discharge is not sufficient to collect a sample in a manner that does not cause sediment agitation and cross contamination between media and sampling locations.

2.2.2.4 Surface Soil Sampling Procedures

Surface soil samples will be collected from soils that are 0 to 6 inches below ground surface. Samples will be collected using a decontaminated stainless-steel scoop or trowel. Soil layers will be removed to the desired depth and the sample collected. The soil will be transferred to the appropriate sample containers. Gravel, rock, and vegetation will be excluded from samples. All sampling equipment will be decontaminated between sample locations as described in Section 2.1.3.

Unusual surface conditions that may affect chemical analysis will be documented in the field log book. Examples of such conditions include the following:

- obvious deposition of contaminated or clean soil at the site;
- evidence of chemical releases; and
- soil discoloration, unusual condition of vegetation, etc.

2.2.2.5 Subsurface Soil Sampling Procedures

An attempt will be made to collect shallow subsurface soil samples (0.5 to 3 feet below ground surface, but above bedrock or permafrost) using a stainless-steel hand auger if visual soil staining is present. Sampling devices will be decontaminated according to procedures described in Section 2.1.3. It is anticipated, however, that the presence of boulders and cobbles in certain locations will limit the depth to which a hand auger will reach. In some instances, a hand shovel and a pick may be used to dislodge soils to a desired depth before a sample can be collected. As a second alternative, a post hole digging device may be used. Once the desired depth is reached, a stainless-steel spoon will be used to scrape soil from the walls of the pit. The sample will then be collected from the fresh surface.

2.2.2.6 Sediment Sampling Procedures

Depending on conditions at the sample location, different methods may be used to collect sediment samples from ponds, drainages, springs, and seeps.

If the liquid layer overlying the sediment in drainages, and ponds is sufficiently shallow or is not present, the sediment will be sampled directly using a stainless-steel scoop, trowel, or spoon to transfer the material directly to the sample container. This method will also be used to collect sediment from around spring and seep discharge points. Gravel, boulders, soil, and vegetation will be removed where necessary to access underlying sediment.

If the liquid layer is not shallow enough for the above method, a stainless-steel, Teflon, or glass cup will be used to collect a sediment sample. Water will be carefully poured from the container to limit agitation or loss of sediment. The remaining sediment will be transferred to the sample container.

Sediment sampling devices will be decontaminated according to procedures described in Section 2.1.3. Sediment samples will be collected after surface water sampling has been completed. The order of sediment sampling will begin with the farthest downgradient sample and move progressively upgradient to avoid cross contamination between locations and media.

2.2.3 Test Kit Screening

During the field investigation, field test kits for rapid screening of TPH and PCBs in soils using immunoassay methods will be performed. The test kits come with all materials, equipment, and supplies to perform tests at two different detection levels as preset by the factory (e.g., diesel at 200 and 1000 ppm; PCBs [Arochlor 1260] at 10 and 50 ppm). Higher detection limits other than specified above can be achieved by additional dilution. Each test kit allows for analysis of four (TPH) or five (PCB) separate samples.

Although some variation between the TPH and PCB test kits exist, both are similar in use as briefly summarized below. The kits have several "phases" of procedures to be performed. For example, phase one includes extraction and preparation of the sample (weighing, extracting, and filtering); phase two includes sample and standard preparation; phase three is the actual immunoassay; and phase four is the interpretation of the results. Appendix B includes detailed procedures on TPH and PCB test kit operation, as well as typical detection limits for TPH components (diesel, kerosene, etc.) and Arochlor congeners.

The screening data will be used for two primary purposes: (1) to identify the presence or absence of contamination at each site; (2) to help identify target areas for select samples to be sent to the laboratory for analysis; and 3) to identify analytical parameters for the laboratory. If field screening indicates the presence of contamination, samples will be collected and sent to the laboratory for analysis. It is anticipated that approximately 12 field test kits will be used during the field investigation. Seven kits will be used for TPH analysis, and five kits will be used for PCB analysis.

2.2.4 Sample Handling

Tables 1.5-1 and 1.5-2 in Section 1.0 of this SAP present the types of sample containers, sample volumes, methods of preservation, and sample holding times that will be used to collect laboratory samples. Sample containers, preserved for each analysis, will be supplied by the analytical laboratory. The pH of nonvolatile, preserved samples will be checked using pH paper. If the pH is not equal to, or less than 2, acid will be added. If the pH is consistently above 2, extra acid will be added to all containers before sample collection. The following subsections describe sample identification, packaging, and shipping.

2.2.4.1 Sample Identification

Field identifiers will be assigned to all environmental and QC samples and will appear on the sample labels, chain-of-custody forms, field sampling forms, and field logbooks. All samples collected during the field investigation will have identifiers compatible with IRPIMS. IRPIMS is a relational database maintained by the Air Force to store, analyze, and report information used for the Air Force Environmental Restoration Division (Air Force 1991).

Specifically, the IRPIMS compatible identifiers will consist of the following:

- Air Force Installation Identification. This unique identifier is assigned to a location within an Air Force installation, plant, or base. For Granite Mountain RRS, the Air Force installation identification is GRANMT.

- Location Identification. The location identification is a unique identifier assigned to a sampling location within an Air Force installation where measurements or samples are taken.

- Log Date. The log date is the date that a sample is collected, a field test performed, or a QC sample created.

- Sample Matrix. The following IRPIMS sampling matrix codes will be used:

LF	Floating Product	WG	Groundwater
SE	Sediment	WQ	Water QC Matrix
SO	Soil	WS	Surface Water
SQ	Soil QC Matrix	WW	Wastewater

- Sample Type. Coded value identifying the type of QC sample collected.

N	Normal Environmental Sample	EB	Equipment Blank
FD	Field Duplicate	TB	Trip Blank
AB	Ambient Blank		

- Sample Depth. Sample depth is the depth in feet from the ground surface at which a sample is collected. All values will be positive. This value will only be used for shallow subsurface soil samples.

The unique Jacobs sample identifiers will be created for each sample and entered in the data management system. An example of the field identifier for one surface soil sample collected at the second sampling point located at AOC 1 follows:

SO-AOC01-SS02

An example of the field identifier for a surface water sample collected at the first sample location at AOC 14 follows:

WS-AOC14-SW01

2.2.4.2 Sample Packaging and Shipping

Immediately after samples are collected and labeled for offsite laboratory analysis, they will be placed in a cooler with ice. Each sample container will be sealed in a plastic bag. The samples will be packed with shock-absorbent materials, such as bubble wrap and vermiculite, to prevent movement of sample containers during transport. The cooler will be packed with sealed ice packs and sealed with packaging tape. Custody tape will be affixed over the cooler lid to prevent or indicate tampering.

Coolers will be picked up at Granite Mountain by charter air service and delivered to an airline in Nome for transfer to the fixed laboratory in Anchorage.

Sample Labels. Sample labels are necessary to prevent misidentification of samples. Each sample container will have a sample label attached. Where necessary, the label will be protected from water and solvents with clear tape. Each label will contain the following information:

- names of sample collectors;
- date and time of collection;
- place of collection;
- sample number;
- analysis required; and
- preservative.

Sample Packaging. Samples and ice will be placed in a cooler along with the appropriate chain-of-custody records. The chain-of-custody sample log sheet(s) will be completed in indelible ink, placed in a resealable plastic bag, and taped to the inside lid of the cooler. Each collected sample fraction contained in the cooler will be specified on the chain-of-custody records by the field sampling identification number. Sample containers will be packaged to minimize potential breakage. Sample packaging for offsite laboratory shipping will meet Air Force and U.S. Department of Transportation (DOT) requirements.

Shipping Containers. At least three bands of strapping tape will be wrapped completely around the cooler to secure the lid. The cooler will be sealed with evidence tape and labeled "Fragile" and "This End Up" on all four sides. The containers will be shipped to the laboratory for analysis in accordance with DOT regulations and procedures. Shipping air bills will be properly completed; copies will be retained and placed in the project file.

Chain-of-Custody Record. A chain-of-custody record will be completed for every cooler containing fixed laboratory samples and will accompany every shipment of samples to the laboratory to establish the documentation necessary to trace sample possession from time of collection. An example of the chain-of-custody record is shown in Appendix C. The record will contain the following information:

- sample or station identification number;
- signature of collector, sampler, or recorder;
- date and time of collection;
- place of collection;
- sample matrix;
- number of containers making up the sample;
- analysis requested for sample;
- additional notes pertaining to suspected high contaminant concentrations;
- signatures of persons involved in chain of custody; and
- inclusive dates of possession.

The laboratory portion of the form will be completed by the designated laboratory personnel and will contain the following information:

- name of person receiving the sample;
- laboratory sample number;
- date of sample receipt;
- analyses requested; and
- sample condition and temperature.

Transfer of Custody and Shipment. Samples will be accompanied by chain-of-custody records. When transferring the samples, individuals relinquishing and receiving the samples will sign, date, and note the time on the chain-of-custody record. The field coordinator will notify the laboratory coordinator when samples are shipped to the offsite laboratory for analysis.

2.2.5 Sample Custody

As discussed in Section 2.2.4.2, a chain-of-custody record will accompany samples to the laboratory. The chain-of-custody record is included in Appendix C. A sample label will be affixed to the outside of the sample container immediately following sample collection. The sample label will prevent misidentification of samples.

The completed chain-of-custody record will be returned promptly to Jacobs by laboratory personnel when samples have been received and the form has been completed. The original chain-of-custody record will become a permanent part of the project records. The chain-of-custody record has four carbonless sheets. Copies will be distributed as follows:

- white and canary: analytical laboratory;
- pink: data management; and
- goldenrod: field file copy.

A sample is in a person's custody if any one of the following occurs:

- It is in that individual's possession.
- It is in an individual's view after being in their possession.
- It is in an individual's physical possession and then locked or otherwise sealed to prevent tampering.
- It is kept in a secure area that is restricted to authorized personnel only.

2.2.6 Field Quality Control

The types of field QC samples that will be sent to the laboratory for analysis include the following:

Trip Blanks. A trip blank consists of ASTM Type II reagent-grade water in a 40-milliliter (mL) vial. The laboratory prepares the trip blanks under controlled conditions and ships the blanks to the site with the precleaned sample containers. The trip blank, which consists of three vials, accompanies the sample cooler throughout the sample collection effort and is handled as a field sample. The trip blank vials are sent back to the laboratory with each cooler containing samples that will be analyzed for volatile organic compounds. The purpose of the trip blank is to determine whether cross contamination between samples occurs during shipment to the laboratory. Trip blank samples are not opened in the field. Only vials that have remained intact will be sent to the laboratory for analysis. Trip blanks are included in both water and soil/sediment shipment containers containing samples for volatile organic compound analysis.

Ambient Blanks. The purpose of the ambient blank is to determine whether ambient conditions are affecting field sample results. Because of the location of the site and the lack of surrounding activity, it is not anticipated that this will be a concern at Granite Mountain RRS; therefore, it is likely that no ambient blanks will be collected during this field effort. Ambient blanks will be collected if the field crew feels that unanticipated circumstances warrant the collection of the blank sample.

Duplicate Samples. Duplicate samples are two samples collected independently at a sampling location during a single act of sampling. Field duplicate samples will be collected to assess the variations in field sampling methods and contaminant concentrations within a like sample. Duplicate samples will be collected in the same type of containers and analyzed for the same parameters as the primary sample. The duplicate samples will have unique sample identification numbers so that the laboratory cannot distinguish the duplicate sample from primary samples. Care will

be taken to make certain that the samples represent the matrix sampled. The number of duplicate samples will equal 10 percent of the number water samples. No duplicate soil samples will be collected during this field effort.

Equipment Blank. Equipment blanks are collected following decontamination of field sampling equipment. ASTM Type II water is poured or pumped through the sampling equipment, collected into sample containers, and analyzed for the same parameters as the samples that were collected using the equipment. The purpose of the equipment blank is to evaluate the decontamination process and determine if it is sufficient to prevent cross contamination between sample locations. One equipment blank will be collected for every 10 samples collected during the field activity by each of the two sampling teams. However, a maximum of one equipment blank sample will be collected by each team per day regardless of the number of samples collected during that day.

2.2.7 Sample Analysis Summary

Tables 2.2-1 and 2.2-2 summarize the analytical methods and the estimated numbers of fixed laboratory samples that will be collected during the 1994 field effort for each site. The exact number of field samples cannot be provided because sample collection is dependent on conditions encountered at the site and the results of the field screening test kit analysis. Table 2.2-2 also summarizes the number and type of field QC samples to be collected based on the number of environmental samples to be collected. The number of QC samples is dependent on the number of field samples collected and shipped to the laboratory and is therefore presented as an estimate.

2.3 FIELD MEASUREMENTS

The following sections discuss the field measurements that will be performed during the 1994 field investigation and sampling. Field measurement equipment, equipment calibration, and equipment maintenance are also described. Instrument calibration and operation manuals are included in Appendix D. All field measurements will follow procedures in the *IRP Handbook* (Air Force 1993) and equipment operating manuals.

2.3.1 Parameters

The following field measurements will be performed during sampling activities and recorded in field logbooks or on sampling forms.

Organic Vapor Analysis. During sampling, the air in the breathing zone (and within the well casing at the one well to be sampled) will be checked with an HNu for organic vapors. If organic vapors are detected, procedures provided in the HSP will be followed.

Metal Detector. Metal detector surveys will be performed during site reconnaissance activities to define source area boundaries, and to determine the presence of buried debris.

Water-Level Measurement. The groundwater level will be measured to within 0.01 foot at the well where a groundwater sample will be collected. The total depth of the well will also be measured.

Table 2.2–1
Soil Analytical Summary
Granite Mountain RRS, Alaska

Site	DRO/GRO*	Volatile Organics	SVOC	Pesticides/ PCBs	ICP Metals and Hg	Total Per Site
OT001 White Alice	1	1	1	3		6
LF002 Soil Waste Disposal	3	3	3		3	12
AOC 1 Disposal Area A	2	2	2		2	8
AOC 2 Disposal Area B	2	2	2		2	8
AOC 3 Disposal Area C	3	3	3	1	3	13
AOC 4 Disposal Area D	2	2	2		2	8
AOC 5 Vehicle Maintenance	3	3	3	1	3	13
AOC 6 2–100 Barrel Diesel AST	4	4	4			12
AOC 7 3,100 Barrel AST	2	2	2			6
AOC 8 Temp. Air Terminal	3	3	3	1		10
AOC 9 Temp. Warm Storage	4	4	4	1		13
AOC 10 Runway/Raodway Oiling	3	3	3	3	3	15
AOC 11 Septic Tank	1	1	1		1	4

Table 2.2–1 Cont.
Soil Analytical Summary
Granite Mountain RRS, Alaska

Site	DRO/GRO *	Volatile Organics	SVOC	Pesticides/ PCBs	ICP Metals and Hg	Total Per Site
AOC 12 Small Day Tanks (6)	6	6	6	2		20
AOC 13 Water Pump House	2	2	2	1		7
AOC 14 Disposal Areas E, F, G	6	6	6		6	24
AOC 15 Disposal Area H	3	3	3		3	12
AOC 16 Disposal Area I	3	3	3		3	12
AOC 17 Disposal Area J	2	2	2		2	8
AOC 18 Disposal Area K	1	1	1		1	4
Background	3	3	3		3	12
Total	59	59	59	13	37	227

Notes:
AOC = Area of Concern
AST = Aboveground Storage Tank
DRO = Diesel Range Organics
GRO = Gasoline Range Organics
Hg = Mercury analyzed by CVAA
SVOC = Semivolatile Organic Compounds
PCB = Polychlorinated Biphenyl
* = Residual Range Organics will be analyzed in select soil samples
All soil samples will be analyzed for percent moisture content by ASTM D2216.

Table 2.2-2
Water Analytical Summary
Granite Mountain RRS, Alaska

Site	DRO/GRO	Volatile Organics	SVOC	ICP Metals and Hg	Total Per Site
OT001 White Alice					
LF002 Soil Waste Disposal					
AOC 1 Disposal Area A	1	1	1	1	4
AOC 2 Disposal Area B	1	1	1	1	4
AOC 3 Disposal Area C					
AOC 4 Disposal Area D	2	2	2	2	8
AOC 5 Vehicle Maintenance					
AOC 6 2-100 Barrel Diesel AST					
AOC 7 3,100 Barrel AST	1	1	1	1	4
AOC 8 Temp. Air Terminal					
AOC 9 Temp. Warm Storage					
AOC 10 Runway/Raodway Oiling					
AOC 11 Septic Tank					

Table 2.2-2 Cont.
Water Analytical Summary
Granite Mountain RRS, Alaska

Site	DRO/GRO	Volatile Organics	SVOC	ICP Metals and Hg	Total Per Site
AOC 12 Small Day Tanks (6)					
AOC 13 * Water Pump House	2	2	2	1	7
AOC 14 Disposal Areas E, F, G	1	1	1	1	4
AOC 15 Disposal Area H					
AOC 16 Disposal Area I	1	1	1	1	4
AOC 17 Disposal Area J					
AOC 18 Disposal Area K					
Background	3	3	3	3	12
Trip Blanks		3			3
Equipment Blanks	8	8	8	8	32
Duplicates	2	2	2	2	6
Total	22	25	22	21	90

Notes:
AOC=Area of Concern
AST=Aboveground Storage Tank
DRO=Diesel Range Organics
GRO=Gasoline Range Organics
Hg=Mercury Analyzed by CVAA
SVOC=Semivolatile Organic Compounds
*-Groundwater sample will not be analyzed for ICP metals or mercury

Immiscible Layer Measurement. Groundwater that is sampled at the well will be monitored for an immiscible layer using an interface probe. Depth to the layer and layer thicknesses will be measured to within 0.01 foot.

Conductivity, Salinity, pH, Temperature, Dissolved Oxygen, and Turbidity. These water quality parameters will be measured using a single instrument for each surface water sample, seep sample, and groundwater sample.

TPH and PCBs. Field test kits that use immunoassay methods will be used to obtain qualitative concentrations of these constituents in soil and groundwater samples.

2.3.2 Equipment Calibration

To meet data quality objectives, proper calibration procedures for field equipment will be followed as described in the manufacturer's instrument manuals and the *IRP Handbook* (Air Force 1993). Calibration is not necessary for the immunoassay test kits, the metal detector, or the water level indicator. Table 2.3-1 lists the required calibration frequency of the field instruments as stated in the user manuals.

2.3.2.1 Calibration Frequencies

Daily, and in some cases more frequent, calibration of equipment will provide QA checks on all equipment used during implementation of the 1994 field investigation. Each instrument will have an individual identification number affixed. This number will be transcribed on field data records when using a particular instrument for a sampling event. All calibration, repair, and service records will be kept in individual logbooks. Equipment that consistently falls out of calibration or exceeds manufacturer's critical limits will be appropriately repaired or replaced with an alternate that will be brought to the site as a precautionary measure.

2.3.2.2 Calibration Procedures

Photoionization Detector. These instruments require calibration on a daily basis. The photoionization detector instruments will be calibrated using isobutylene span gas of known concentration. Calibration will be performed according to the manufacturer's recommendations and will be recorded in a logbook. All adjustments to the instrument settings will be recorded in the field book. Routine maintenance consists of battery charging, to maintain that the instrument is ready to use when required, and occasional lamp or fan cleaning.

Interface Probe. The audible tones are checked by immersing the probe in water and oil. The tape is calibrated annually by using a surveyor's steel tape to adjust for stretching of the calibrated line. Additional batteries will be brought to the site to ensure against failure.

Electrical Conductivity, Salinity, pH, Temperature, Dissolved Oxygen, and Turbidity Meter. A single instrument will be used to measure all six of these parameters. This instrument will be calibrated prior to sampling on a daily basis. It may be calibrated either manually or automatically using a four-parameter auto-calibration solution.

Table 2.3-1
Summary of Calibration and Internal Quality Control for Field Instruments
Granite Mountain RRS, Alaska

Instrument	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptable Criteria	Corrective Action
HNu Photoionization Detector, HW101	Volatile Organics	Calibrate	Daily	10% of scale	Recalibrate Repair/Replace
MAC 51B Metal Detector	Buried Objects	Test Operation	Each Sample Area	Operational	Repair/Replace
Horiba U-10 Water Quality Meter	pH	Calibrate Duplicate Analysis	Daily 10%	+/- 0.1 pH units RPD <20%	Recalibrate Third value, Recalibrate
	Temperature	Duplicate Analysis	10%	RPD <20%	Third value, Recalibrate
	Conductivity	Calibrate Duplicate Analysis	Daily 10%	+/- 10 millimhos/cm RPD <20%	Recalibrate Third value, Recalibrate
	Turbidity	Calibrate Duplicate Analysis	Daily 10%	+/- 10 NTUs RPD <20%	Recalibrate Third value, Recalibrate
	Dissolved Oxygen	Calibrate	Daily	+/- 0.1mg/L	Recalibrate
	Salinity	Duplicate Analysis	10%	RPD <20%	Third value, Recalibrate
EnSys TPH	Petroleum Hydrocarbons	Duplicate Analysis	10%	RPD <20%	Third value
EnSys PCB	PCBs	Duplicate Analysis	10%	RPD <20%	Third value

Notes:
cm=Centimeter
PCBs=Polychlorinated Biphenyls
RPD=Relative Percent Difference
TPH=Total Petroleum Hydrocarbons
%=Percent
<=Less Than

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2.3.3 Equipment Maintenance

Field measurement equipment will be maintained according to the manufacturer's recommended procedures provided in the operations manual for each instrument. Copies of these manuals are included in Appendix D.

On a routine basis, instrument electrodes will be inspected for scratches, cracks, salt crystal buildup, and membrane/junction deposits. Probes will be cleaned with nonphosphate detergent and water.

2.3.4 Decontamination

Field measurement equipment will be kept free of contamination. Instruments, such as the interface probe, that contact water to be sampled will be decontaminated following the procedures for sampling equipment described in Section 2.1.3. Instruments that are sensitive to soap and solvents, like the combination pH meter, will be rinsed with potable water and ASTM Type II reagent-grade water. The probes will be cleaned daily and stored overnight according to the manufacturer's recommended procedures.

2.4 FIELD QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

To ensure that sampling and other field activities will meet the data quality objectives, QC checks will be implemented for parameters measured in the field. Table 2.3-1 summarizes the field methods, QC checks, frequencies, acceptance criteria, and corrective actions to be taken by the field personnel. All QC check information will be recorded in project-specific field notebooks.

2.4.1 Control Parameters

Several parameters will be controlled during the field operations, sampling, and measurement activities. As described in Section 2.3, calibration of field instruments and operational checks will be conducted periodically. The frequency of the field control check duplicates will be a minimum of 10 percent of all field measurements. Temperature, pH, specific conductance, salinity, dissolved oxygen, and turbidity will be checked at the same frequency. As applicable, the materials used to verify the measurements will be from certified sources. Instrument use, maintenance, and calibration will follow manufacturer's and *IRP Handbook* (Air Force 1993) guidance.

2.4.2 Control Limits

Duplicate field instrument measurements will be considered suspect when a difference of greater than 20 percent is observed. For the pH measurements, field readings that vary more than 0.1 Standard Units will be considered suspect.

2.4.3 Corrective Actions

The corrective action required for field instruments used to measure temperature, pH, conductivity, salinity, DO, and turbidity will include recalibrating and remeasuring the parameter. Corrective action for all field instruments will involve a review of the operator's manual.

2.5 RECORD KEEPING

All documentation related to field activities will follow procedures in the *IRP Handbook* (Air Force 1993). These procedures include recording the details of each activity in field log books and field sampling forms prepared for the Granite Mountain RRS field investigation.

The following two primary types of information are associated with the field investigation:

- information used to manage, monitor, and document project performance; and
- technical data required for, or generated by, a specific investigation task or activity.

These and other types of information such as project records will be kept in the Jacobs document control file for Air Force projects in Denver, Colorado. Access to the file is restricted, and documents are entered into the file by a trained document control clerk. Field records will be kept and maintained by field crew personnel in sufficient detail to recreate all sampling and measurement activities. Field logbooks will be waterproof and permanently bound with sequentially numbered pages. Copies of the forms that will be used during the 1994 field investigation are included in Appendix C.

All field personnel will be responsible for keeping accurate records of each field task performed. Field records will be of sufficient detail to relocate all sampling locations and measurement activities. The field coordinator will be responsible for ensuring that all pertinent paperwork is filled out before the completion of the field task/sampling event. For all field activities, the following information will be included in field logbooks:

- location;
- date and time;
- identity of field personnel;
- field equipment and calibration information;
- weather conditions;
- sample type and collection method;
- sample preservation;
- detailed sample location;
- sample volume;
- chain-of-custody form and sample numbers;
- QA/QC samples; and

- identification of conditions that could affect sample integrity or representativeness.

Daily Logs. Field logs summarizing daily activities (Appendix C) and the field logbook will be used to record sampling activities each day. Entries in the field logs will include the following information:

- name of author, date, and time of entry;
- location of activity;
- names and affiliations of personnel onsite;
- sample collection or measurement methods;
- number of samples collected;
- sample identification numbers; and
- field observations and comments.

Sufficient information will be recorded in the field logbook to reconstruct the sampling event, if necessary.

Correction of Documentation. Original entries recorded in field logbooks, chain-of-custody records, and other forms will be written in indelible ink. None of these documents will be altered, destroyed, or discarded, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on a document assigned to one individual, that individual will make corrections by drawing a line through the error, entering the correct information, and initialing and dating the change. The erroneous information will not be obliterated. Any subsequent error(s) discovered on a document will be corrected by the person who made the entry or the Jacobs Project Manager. All corrections must be initialed and dated.

2.6 REMOTE SITE LOGISTICAL INFORMATION

Because of the remote location and absence of support facilities at the abandoned Granite Mountain RRS site, this section of the FSP is intended to outline plans for the successful completion of the field effort, and to ensure high-quality data are collected within the limited time available for the field effort. It is anticipated that the site's remote location will necessitate a high degree of planning to ensure the success of the project. As such, this section will highlight the internal procedures and methods of task accomplishment that are currently being planned by the field crew members.

2.6.1 Field Team Organization/Personnel

It is proposed that five Jacobs employees take part in the field investigation and sampling effort at Granite Mountain RRS. This will enable two complete sampling crews of two people each, and a Field Site Supervisor to assist in scheduling, review of field sampling forms, perform field test kit analysis, locate additional data gaps for sampling, and provide a communication link with the air charter service in Nome in case of an emergency. In addition, two Air Force representatives will be onsite two aid in sampling strategy and oversight of the overall investigation effort.

Project Manager The Project Manager will have overall responsibility for the planning and execution of the project. These duties will include maintaining the project budget, writing and reviewing the planning documents, establishing a

schedule for the completion of the project, providing technical assistance to meet the project goals, to coordinate with the Air Force to insure that the project is progressing as planned, and to make decisions regarding the overall project objectives. Ms. Joyce Miyagishima will be the Project Manager for this site.

Field Site Supervisor The Field Site Supervisor has the responsibility of ensuring that the field investigation portion of the project is performed in a manner that maximizes the data quality while maintaining a safe environment for the field crew. The Site Supervisor will be the primary communication link with people in Nome and will schedule all air charter service to the site. In addition, the Site Supervisor, or his designee, is responsible for reviewing all field sampling data forms for completeness, making decisions about sample locations, ensuring that samples are shipped on schedule, ensuring the overall objectives of the field program are met, and the Air Force Handbook procedures are followed in meeting these objectives. Mr. Tim Grace will be the Field Site Supervisor for this site.

Field Team Leader The Field Team Leader will have the responsibility for assisting the Field Site Supervisor in making certain that all sampling procedures are conducted in accordance with the specifications outlined in the Air Force Handbook, and that the field crews follow the procedures stated in the SAP. The Field Team Leader will be responsible for understanding and enforcing the technical aspects of the SAP, and will be responsible for ensuring that all variances to the plans are approved by the Field Site Supervisor and the Air Force representative prior to sampling. Mr. Ken Powell will be the Field Team Leader for this site.

QA Coordinator The QA Coordinator will be responsible for reviewing all documentation for completeness and correctness. In addition, the QA Coordinator will be responsible for ensuring that sample integrity is maintained throughout the field investigation. Mr. Chris Sundeen will be the QA Coordinator for this site.

Site Health and Safety Coordinator The Site Health and Safety Coordinator (SHSC) has the responsibility for ensuring that the procedures outlined in the site HSP are followed by all members of the field team. The SHSC will investigate all accidents or injuries that occur at Granite Mountain RRS and has the authority to stop all work onsite if deemed necessary for the protection of personnel. The SHSC will also provide a briefing to all field sampling crew members, as well Air Force personnel regarding site hazards before field activities Begin. Mr. Ed Gorove will be the Health and Safety Coordinator for this site.

2.6.2 Transportation

Field crew members will travel from Anchorage to Nome via Alaska Airlines. At Nome, equipment, supplies, and personnel will be loaded onto chartered aircraft for transport to Granite Mountain. It is anticipated that two flights will be required to transport all personnel and supplies to the site. During the estimated seven to 10 days required for the field effort, approximately two additional flights will be made to transport supplies into Granite Mountain (potable water, gasoline, food etc.). These flights will be scheduled for days in which sample coolers are ready to be shipped back to Nome. In Nome, the coolers will be delivered to Alaska Airlines for transport to Anchorage, where they will be picked up and delivered to the analytical laboratory. The Field Site Supervisor will be in daily communication with the aircraft charter service to schedule delivery and pick-up so that all sample holding times can be met.

Miscellaneous trash generated from sampling activities will also be picked up at this time. This process will ensure that the site remains clean and does not attract wildlife.

The exact aircraft to be used for the transport of personnel, supplies, and equipment will be a Beech 18 or a Piper Navajo (personnel), and a Caravan (cargo). The aircraft used during the sampling effort to transport samples will be a Cessna 207 or a Piper Navajo. Decisions regarding aircraft usability will be the responsibility of the Field Site Supervisor who will be in communication with the air charter service.

At the conclusion of the field investigation, all equipment and supplies will be transported back to Nome. In addition, up to two people may travel back to Nome a day before the rest of the crew if they are no longer needed at the site. These people will coordinate the transfer of equipment from the charter service to the transport returning to Anchorage.

While at Granite Mountain RRS, field crew members will have two or three all terrain vehicles (ATVs). These vehicles will be used to transport personnel and equipment to all sampling sites.

Gasoline brought to the site to be used in generators and vehicles will be left for use by the owner of the cabin in which field crew members will be staying. These arrangements will be agreed to by the owner of the cabin before the field investigation.

2.6.3 Living Quarters

All field personnel (five Jacobs, two Air Force) will stay in the miner's cabin approximately 2 miles from the site. The cabin is equipped with sleeping arrangements for five people, and an additional four sleeping cots will be available. The cabin also comes equipped with a propane stove. As much as possible, Jacobs personnel will prepare nonperishable food prior to arriving at the site. It is anticipated that personnel will alternate the cooking duties, and that preparing meals in advance will greatly reduce the amount of effort required for cooking.

In addition, some sort of portable shower facilities may be available Although primitive, the shower will allow field crew members to clean off potentially contaminated soils before eating and sleeping as dictated in the site HSP.

2.6.4 Site Layout/Setup

It is proposed that a portable structure (approximately 12 feet by 24 feet) will be erected near the landing strip at Granite Mountain. The building will house a generator that is capable of powering portable lights and a freezer for sampling ice. All sample preparation, storage, and shipping will be coordinated at this building. The building will contain a folding table and some chairs to complete the required paperwork and to review field forms. The freezer will contain 1-gallon cubitainers of ice for sample preservation. All equipment calibration activities will also be performed in the portable structure.

A second generator will be located at the miner's cabin to power lights and to charge radios or other field equipment.

It is anticipated that one decontamination station will be established near the portable structure at the Lower Camp, and a second decontamination station will be established at the Upper Camp. Enough sampling supplies will be available so that several samples can be collected and equipment can be decontaminated at one time. This procedure will eliminate the need to transport decontamination supplies to each sampling location.

2.6.5 Communication

An aircraft radio will be leased from the air charter service for use during the field effort at Granite Mountain RRS. A radio will be required so that a constant communication link can be maintained with the air charter service in Nome. Personnel with the air charter service will be given the telephone numbers for the Jacobs offices in Anchorage and Denver and instructed to call periodically or send messages via fax machine to update the progress of the field program, or request supplies or equipment.

Onsite communication will be conducted via two-way radios carried by each field crew. Each radio will be capable of reaching the Field Site Supervisor, or the other sampling team at all times while at the facility. Each radio will require charging at the conclusion of the days activities.

2.6.6 Emergencies

Emergency procedures are outlined in the site HSP for Granite Mountain RRS. In general, all circumstances that may create an emergency situation at the site will be studied thoroughly, and decisions regarding action will be made jointly among the field crew. The Site Field Supervisor will call the air charter service on a daily basis to maintain an appropriate level of readiness in case of unexpected emergencies. If an accident occurs, the individual field crew member will be flown from the site immediately, if required.

All field crew members (including Air Force personnel) will be given detailed instructions on the proper used of the aircraft radio so that communication can be initiated in the event of an emergency.

3.0 REFERENCES

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APPENDIX A

Fixed Laboratory Quality Assurance Project Plan

PRELIMINARY CHEMISTRY VARIANCE REQUESTS
1994 QUALITY ASSURANCE PROJECT PLAN
ANALYTICAL VARIANCE REQUESTS

GRANITE MOUNTAIN, ALASKA

The following list of variances are for chemistry issues associated with the 1994 sampling and Analysis Plan, specifically Section 1.0, the Quality Assurance Project Plan. The variance requests have been organized into two sections. The first being variances to the 1993 IRP AFCEE Handbook. The second section presents variances to the Alaska Hydrocarbon methods, AK101 and AK102. The fixed laboratory currently on line to support the 1994 field program is Commercial Testing and Engineering laboratory located in Anchorage, Alaska.

Part I IRP Handbook Variances

1) The laboratory cannot meet the SW8260 minimum water response factor (0.25) requirement for bromoform. The laboratory purges 15 milliliters (mls) of sample in an effort to generate lower detection limits that cannot be obtained by purging 5 mls of sample. The minimum response factor can be obtained when purging 5 mls of water. Purging more sample decreases the purge efficiency of the purge and trap system for some analytes. The laboratory can meet a minimum response of 0.18 when purging 15 mls. The EPA contract written specifically for low level water analyses, 25 ml purge, requires a minimum response factor of 0.05 for bromoform.

2) Chlordane and toxaphene laboratory control samples (LCSs) will not be analyzed unless the associated SW8080 samples have positive results for these compounds. If a positive result for either of these compounds is detected the associated samples will be reextracted with the required LCS and reanalyzed within SW8080 specific holding time limits.

3) The SW8080 aroclors, 1260, 1254, and 1242 are routinely analyzed as continuing calibration verification (CCV) and LCS samples. The remaining four aroclors will be included as CCVs and LCSs only when positive results for these aroclors are detected in the samples. The laboratory will reextract samples with the associated LCSs and reanalyze all affected samples and LCSs within the specific SW8080 holding time limits. Additionally, the laboratory will provide documentation that details the retention time windows and responses initially established, for all SW8080 aroclors, prior to the analysis of any samples.

4) Practical quantitation limits (PQLs) in the 1993 Handbook for inductively coupled plasma (ICP) analysis (SW6010) of calcium, sodium, beryllium, and zinc will be exceeded. The laboratory can report PQLs for these metals at the following limits 0.20, 0.50, and 0.010, and 0.050 mg/L in water; and 20, 50, 1, and 5 mg/kg in soil, respectively. A variance is required for beryllium due to interfering analytes that are typically found in environmental samples. Commercial Testing & Engineering, Inc. (CT&E) requested variance for calcium and sodium due to the naturally occurring levels of these analytes in the environment. The instrument detection levels for these metals will be below the PQLs (see Attachment B), but the variance is required in cases during analysis where the laboratory may encounter these concerns.

   All PQLs are below the maximum contaminant levels (MCLs) except for beryllium. The MCL for beryllium is 0.004 mg/L. If a lower PQL is required for beryllium the laboratory can reach the 1993 Handbook PQL using graphite furnace atomic absorption.

5) CT&E cannot analyze thallium by ICP method SW6010. However, CT&E can provide a thallium PQL which meets the AFCEE required PQL using method SW7841.

6) CT&E has determined that the PQLs for SW8260 listed in the 1993 handbook (Table 2-3, pages 2-3, 2-46 to 2-47) can not be met based on laboratory established method detection limits. The laboratory has determined that the PQLs for methods SW8010 and SW8020 can more be appropriately applied to the SW8260 analytes. The laboratory can meet the AFCEE SW8010/SW8020 PQLs

7) CT&E does not routinely analyze for 1-chlorohexane by method SW8260 and would like to remove this compound from the SW8260 analyte list.

Part 2 State of Alaskan Hydrocarbon Requirement Variances

1) The AK101 field surrogate, 4-bromofluorobenzene, will not be added to samples in the field as required by the method. The surrogate will be added by the analyst prior to sample analysis in the fixed laboratory.

2) AK101 soil samples will not be methanol preserved in the field as required by the method. The soil samples will be methanol extracted by the laboratory prior to analysis.

3) Second column confirmation is an SW846 requirement for GC analyses. However, second column confirmation is not required for multi-component GC analytes and will not be performed for positive identification of AK101 GRO results. This is not a requirement of the QAPP Addendum or AK101 method.

4) Second column confirmation is an SW846 requirement for GC analyses. However, second column confirmation is not required for multi-component GC analytes and will not be performed for positive identification of AK102 DRO results. This is not a requirement of the QAPP Addendum or AK102 method.

5) The BTEX by SW8240 soil samples will not be field methanol preserved as is required by the state of Alaska for BTEX samples associated with petroleum contaminated sites. The laboratory will purge 5 grams of the soil samples in order to achieve the AFCEE required detection limits. If an extraction is performed, the extraction multiplication factor will raise the soil PQLs above the AFCEE required maximum detection limits. Methanol extractions will only be performed on soil samples by the laboratory, when target compound results exceed calibration linearity and the extraction is needed to dilute these compounds into the instrument linear range.

6) A 20 percent mass discrimination criterion cannot be met with the present laboratory conditions for method AK103 because of the limited amount of time for method development. It appears that the longer the system has to stabilize the closer it will come to meeting the 20 percent criterion. However, due to the short time frame for sampling and analysis, a 50 percent mass discrimination criterion will be used.

Calibration Table

Analysis	Concentration (PPM)						PQL soil	PQL water
Ak102	10	50	400	800	1500	4000	4.0 (50:10)	0.1 (1000:10)
Pesticide	0.01	0.05	0.1	0.5	1.0		0.002 (50:1)	0.0001 (1000:1)
PCB	0.1	1.0	5.0	10	25	50	0.02 (50:1)	0.001 (1000:1)
SVOA	20	50	80	120	160	200	2.0 (50:1)	0.1 (1000:1)

Analysis	Concentration (PPB)					
8240 (VKA Instr.)	5	10	50	70	100	
8240 (VJA Instr.)	5	10	50	100	150	
AK101	45.6	228	456	683	1140	2280
8260	0.5	1.0	5.0	10	20	

1994 FIELD SAMPLING PLAN
TECHNICAL VARIANCE REQUEST

GRANITE MOUNTAIN RADIO RELAY STATION, ALASKA

The following presents a list of items and accompanying rationale for variance from the 1993 U.S. Air Force Handbook for the Installation Restoration Program (IRP) Remedial Investigations and Feasibility Studies (RI/FS).

Although required by the Handbood, reagent-grade water will not be purchased or stored in glass, stainless steel, or Teflon containers. Jacobs is not aware of any reasonably priced sources of reagent grade water that comes in any of these containers.

Containers for soil analysis will be collected in 4 oz. glass jars, not 8 oz. glass jars, because the sample volume contained in a 4 oz. glass jar provides more than sufficient volume of soil for laboratory analysis by ICP metals and mercury by Cold Vapor Atomic Absorption.

General changes to the number of field quality control samples that will be collected are requested as follows.

Ambient Blanks. Ambient blanks will only be collected if obvious sources of atmospheric contamination are observed during volatile organic compound sampling.

Equipment Blanks. The number of equipment rinsate blanks for fixed laboratory analysis will be reduced from one per day per field team to one with every 10 samples collected per field team not to exceed one per day per field team.

Field Replicates. Replicate samples are used for solid media such as soils and sediments. Replicates samples of soil or sediment will not be collected for during the SI because of the difficulty of correlating replicate sample results due to the lack of homogeneity that is achieved during sample collection and sample analysis.

Laboratory Quality

Assurance Project

Plan

AFCEE Project - Granite Mountain Radio Relay Station, AK
Reference 1993 AFCEE Handbook

Approvals

Name: Eugene Yonkin
Title: Vice President/General Manager

Signature: _____ Date: 9-2-94

Name: Stephen Ede
Title: Technical Director

Signature: _____ Date: 9-2-94

Name: Michael Utley
Title: QA/QC Manager

Signature: _____ Date: 9-2-94

Table of Contents

Appendices

Required Containers, Preservatives, & Holding Times Chart
(Table 2-1, *1993 AFCEE Handbook*, pp. 2-25 - 2-27)
JEMS Electronic Deliverables
(*JEMS Laboratory Data Submission Handbook*, Version 2.1, pp. 01 - 27)
Gasoline Range Organics (AK 101) SOP
Diesel Range Organics (AK102) SOP
Residual Range Organics (AK103) SOP
SGS Code of Practice
Commercial Testing & Engineering C uality Policy
Variance Letters

1.0 Program Description

1.1 Introduction

This manual addresses the responsibilities and interactions of the Quality Assurance (QA) Department within the laboratory of Commercial Testing & Engineering Co., Environmental Laboratory Services (herein referred to as CT&E ELS).

1.1.1 Scope

CT&E ELS provides environmental analytical services for a variety of clientele. The analytical data generated may be used to monitor a production process, to ascertain the consequences of environmental pollution, or to monitor cleanup efforts.

1.1.2 Purpose

The purpose of a QA Plan is to provide guidelines and establish processes by which ongoing laboratory procedures can be monitored. The existence of these guidelines and processes will assure that laboratory procedures are up to date and generate *accurate, precise* and *complete legally defensible data*. All data must conform to federal and state regulations as well as to client specifications. The QA Plan can also be used to:

1. Assist the client in obtaining representative, controlled samples.
2. Receive those samples and record their progress from sampling to analysis to disposal.
3. Ascertain the desired level of Data Deliverables Package and generate client reports, via hardcopy or digitally (JEMS), at the requested level. (See figure 8A, p.78)
4. Monitor sample analysis and initiate corrective action when nonconformance is detected in data or analytical procedures.
5. Verify data integrity and completeness.
6. Outline and initiate ongoing training of personnel in the areas of:
   - Instrumentation
   - Standard operating procedures
   - QA/QC responsibilities
7. Issue QC reports to management.

2.0 Program Organization and Responsibilities (See figure 2A, p.6)

2.1 Purpose

In order to function smoothly and generate data of the required quality all personnel must:

1. Understand CT&E's Quality Policy, SGS's Code of Practice, and CT&E's Code of Business Conduct. (See Appendices 6 and 7)
2. Understand the necessity for quality control.
3. Accept their level of responsibility for quality control.
4. Obtain the skills to perform specific analyses.

2.2 Specific Responsibilities

2.2.1 Vice President / Laboratory General Manager

The Vice President/Laboratory General Manager exercises ultimate authority over the quality assurance program, personnel, equipment maintenence program, laboratory supplies program and laboratory production. Some authority may be delegated to appropriate individuals depending upon their specific areas of responsibility and expertise.

2.2.2 Technical Director

Directs the technical operation of all departments. Writes and/or approves all analytical procedures utilized by chemists and technicians. Directly responsible for the accuracy of test results, acquisition of new instruments, method development and modification, and laboratory quality control. He directs clients in proper techniques and methods necessary to properly fulfill the requirements of governmental regulatory agencies. Supervises and trains personnel in new techniques and trouble-shoots analytical problem areas.

2.2.3 Production Manager

The Production Manager is responsible for maintaining sample control status from receipt to disposal. Coordinates workorder sample distribution to each department supervisor and assigns project due dates. Maintains the status of project files during analytical and review processes and reassigns personnel or authorizes overtime to complete a particular project. This person is also responsible for hiring and terminating personnel and directly overseeing Project Managers.

2.2.4 QA/QC Manager

Under the direction of the Vice President/Laboratory General Manager and the Technical Director, the QA/QC Manager is responsible for the following:

1. Development and implementation of an overall QA Plan for the laboratory.
2. Daily monitoring of laboratory Quality Control.*
3. Establish and interpret QC charts[1] to detect trends that might indicate a developing problem in a particular method or instrument.*
4. Maintenance of QC charts and data.*
5. Perform statistical analysis of QC data.
6. Establish and maintain data bases that accurately reflect instrument and method performance.*
7. Notify area supervisors of data generation or procedural QC errors and aid in taking corrective action. All corrective actions will be documented. (See Section 12.0, p.79)
8. Supervise in-house proficiency training, testing, and evaluation.*
9. Monitor preparation and verification of analytical standards.*
10. Assist analysts and area supervisors in preparing and updating Standard Operating Procedures (SOP).
11. Distribute current SOP's to appropriate personnel.
12. Distribute client and governmental agency performance evaluation samples
13. Develop and administer in-house blind and double blind audit procedures
14. Monitor routine maintenance of instruments.*
15. Monitor sample holding times.
16. Issue monthly reports to the Vice President / Laboratory General Manager and the Technical Director concerning the QA/QC program.
17. Establish effective and efficient communicative channels with clients.*

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[1] Handbook of Quality Assurance for the Analytical Chemistry Laboratory, by P. Dux, Ph.D., Chapter 3

* Shared functions of Group Leaders and individual analysts.

2.2.5 Project Manager

Responsible for answering all client questions regarding technical project specifications. Maintains status of all project analyses during analytical and review processes Interprets data quality objectives and result data.

2.2.6 Sample Control Manager

The Sample Control Manager will be responsible for the following:

1. Provide clients with sample containers, and when appropriate, proper preservative solutions.
2. Receive samples from clients, make sure they are preserved properly, inspect them and note any irregularities.
3. Receive and inspect the client Chain-of-Custody form and note any irregularities. Log in the samples and initiate the CT&E ELS Chain-of-Custody procedure which assumes sample custody.
4. Supervise storage and handling of samples to ensure compliance with time constraints dictated by QC requirements.
5. Serve as the contact person for client inquiries concerning sample receipt, storage and preservation.

2.2.7 Additional Personnel: Responsibilities and Guidelines

QA/QC Officer: Monitors the Quality Assurance activities of the laboratory; summarizes and reports Quality Control Data; and coordinates double blind samples, blind samples and inter-laboratory samples under the direction of the QA/QC Manager.

QA/QC Deputy Officer: Assists the QA/QC Officer in the performance of his duties and assumes the necessary responsibilities in his/her absence.

Sample Custodian: Performs the on-going sample receipt, storage and handling activities; monitors the sample flow, maintains sample control log book and monitors sample disposal.

Organic Chemist Supervisor: Directs the technical operation of the organic department, develops work schedules, supervises and trains personnel. Oversees gas chromatographic analysis of volatile and semivolatile organic contaminants, pesticides, herbicides, and trihalomethanes for drinking water, water pollution and SW 846 programs, as well as polychlorinated biphenyls in water, soil and oil.

Organic Chemist: Performs gas chromatographic analysis of volatile and semivolatile organic contaminants, pesticides and herbicides, and polychlorinated biphenyls in water, soil and oil.

Organic Chemist-Alternating: Performs sample extractions for analysis by the organic chemist. The alternating organic chemist works on an *as-needed* basis and is supervised by the organic chemist supervisor.

Petroleum Chemist: Performs analysis of petroleum based fuels and lubricants according to A.S.T.M., U.O.P., or other industry specifications.

Petroleum Technician: Performs analysis of petroleum based fuels and lubricants, and maintains the Lube Oil Monitoring Program.

Hazardous Materials Chemist: Directs the technical operation of the proper disposal of laboratory generated hazardous waste, develops work schedules, and supervises and trains personnel.

Inorganic/Analytical Section Supervisor: Directs the technical operation of the inorganic department, develops work schedules, and supervises and trains personnel.

Inorganic Chemist-Hydride/Cold Vapor Specialist: Performs analysis for arsenic and selenium by hydride generation and mercury by the cold vapor technique for drinking water and waste water. Performs other inorganic chemical analyses as required.

Technical-GFAA/ICP Specialist: Performs inorganic chemical analysis of drinking water, waste water, and soil by graphite furnace AA and ICP technology.

Technicians: Perform analysis of water and waste water for minerals, nutrients, solids, etc., by automated Technicon and manual methods; performs oil and grease extractions and analysis on water, waste water, and soil.

Managers and supervisors have the authority to accept or reject data based upon defined QC criteria. Data outside of normal limits may be accepted if technical reasons justify such action. Reasons for accepting data outside of normal limits and initiating a corrective action should both be recorded.

Administrative Organization

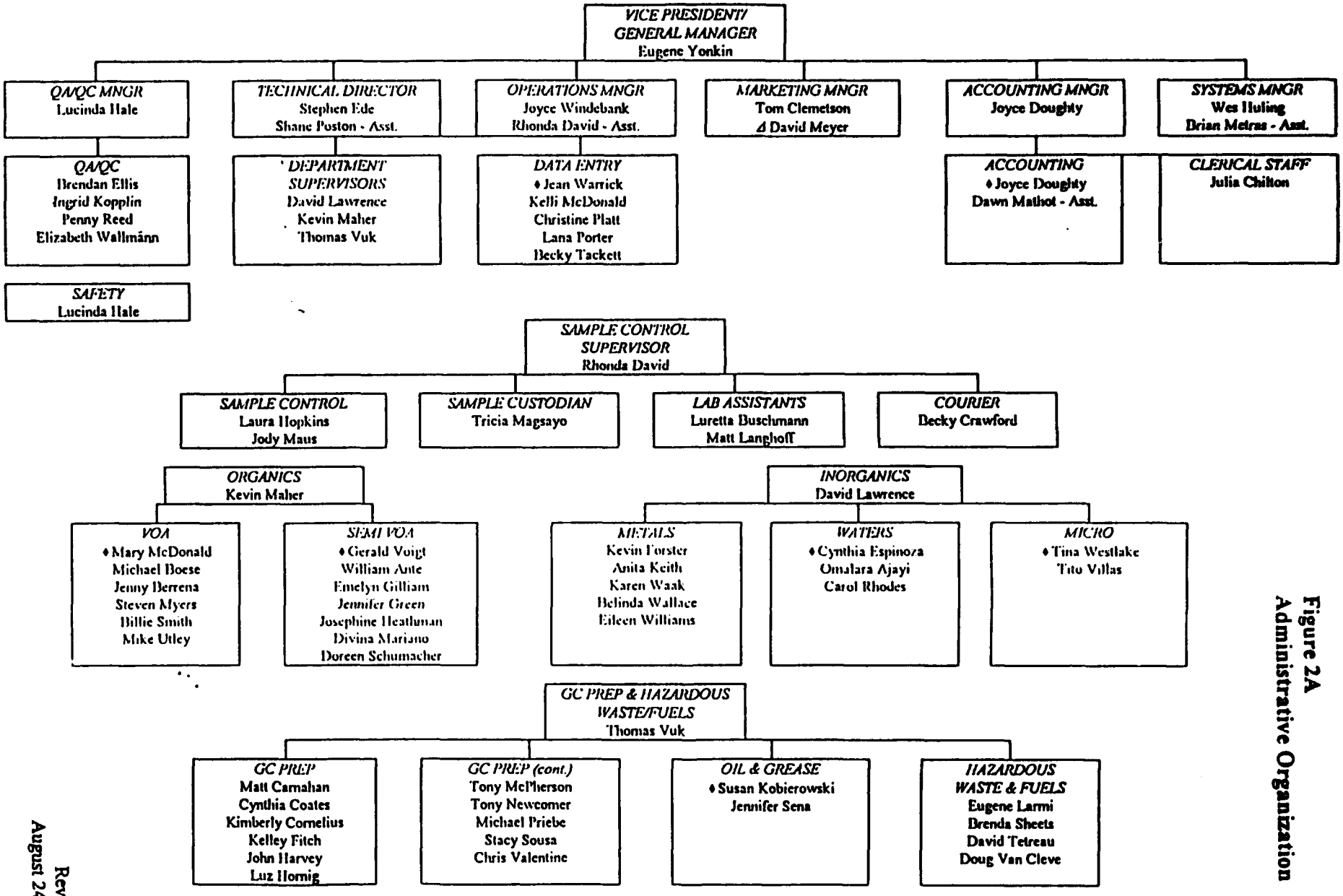

Figure 2A
Administrative Organization

Δ Fairbank[illegible]ice
♦ Lead Per[illegible]l

3.0 Quality Assurance Objectives

In order to establish criteria by which the quality of data generated by an analytical lab can be both ascertained and ensured, several terms need to be defined. These terms describe the quantitative and qualitative goals of the laboratoty.

3.1 Quantitative QA Objectives

1. Precision - The agreement between a set of replicate measurements without an assumption of knowledge of the true value. It is a measure of the variability in repeated measurements of the sample compared to the average value. The precision assessment should represent the variability of sampling, sample handling, preservation and storage of the environmental measurement data.

2. Accuracy - A measure of how close an individual measurement or an average of a number of measurements is to the true value.

3. Completeness - The measure of how the amount of valid data obtained from a measurement system compares to the expected amount. Completeness is calculated after the study has been completed and is expressed as a decimal or as percent usable data (percent usable data = usable data divided by total possible data).

3.2. Qualitative QA Objectives

1. Representativeness - The degree to which data accurately represents a particular characteristic of a population or an environmental parameter.

2. Comparability - The confidence with which one data set can be compared to another data set.

Precision and accuracy are established by internal policies of the laboratory and EPA guidelines. In no instance would the precision criteria of the laboratory be less than those defined by EPA guidelines. Completeness and representativeness of data are established in conjunction with the client who supplies the samples. Representativeness is intimately tied with the sampling protocol used by the client. Comparability is ensured by the calibration procedures instituted for each instrument and method.

4.0 Sampling Procedures

The responsibility for collecting and transporting samples to CT&E ELS resides solely with the client. In cases where the sampling is performed by CT&E ELS personnel, a sampling plan is first reviewed and approved by the client. Data quality is directly related to proper sampling procedures. CT&E ELS will provide consultation and assistance in designing sampling protocols to see that field procedures ensure the following:

1. That samples contain no foreign material and accurately represent the site from where the samples are extracted.
2. That samples are:

    - of adequate size.
    - collected in containers appropriate for the sample and the analysis being requested.
    - properly preserved in terms of pH and temperature during transport.

3. That contamination does not occur during transport.
4. That accurate records are generated and kept regarding on-site conditions, such as maps of sampling sites, labeling of samples and weather conditions.
5. That monitoring instruments are working properly.
6. That sampling containers are properly cleaned.
7. That samples arrive at CTE ELS in a timely manner.

Upon request, CT&E ELS will supply containers that are properly cleaned, labeled, and preserved for sample collection. The client will supply label information which must match the information on the Chain-of-Custody. Sample holding times begin at the time of sampling. Appendix 1 lists information regarding holding times, appropriate containers, preservative solutions and minimum sample volumes or weights. (See Figure 4A, p.9 for Sample Kits).

Commercial Testing & Engineering Co.
Environmental Laboratory Services

5633 B Street
Anchorage, AK 99518-1600
Tel: (907) 562-2343
Fax: (907) 561-5301

Figure 4A
Sample Kits

SAMPLE KITS & EQUIPMENT

Sample Kit to be: Picked up ☐ Date: _____ Time: _____
Shipped ☐ Method of Shipment: _____
☐ Express Mail (state S amount): _____

If priority/air method used, please specify reason: _____

Airbill #: _____ ☐ Copy given to accounting

Date of Order: _____
Client: _____
Ordered by: _____
Phone: _____ Fax: _____

Ship to: _____
Attn: _____

Project Description: _____

# of Sample(s)	Matrix	Test Code	Parameter/Method	Container Type & Size	Quantity	Preserv-ative

Special Instructions: _____

Include Ice Packs: Yes ☐ No ☐
Ice Chest: Size _____ Amount _____ Cooler No(s). _____

Coolers not returned with samples will be billed to Client !!

Request taken by: _____
Checked by: _____

Packed by: _____

****IMPORTANT NOTE TO CLIENT****
Please fill out this form completely
Analysis cannot be done without this information.

5.0 Sample Custody

5.1 Field Custody

Samples should provide a fair representation of the media being sampled. The sampling supervisor/project manager should try to determine the quantity and type of samples and the sample location prior to actual field work. Samples should be handled by as few people as possible to minimize potential contingencies.

The field sampler will be solely responsible for the care and custody of all samples collected until the time of transfer or until the samples are properly dispatched.

A written record will be kept of sampling activities in a bound book. In addition to a log of all samples collected and all monitoring instrument readings, information on items such as weather conditions, sampling techniques, and other appropriate information regarding on-site conditions at the site of sampling will be recorded. Changes in the visual appearance of samples, odors, notable characteristics of the materials being sampled, and other observations made during sampling will be recorded. Sample tags shall be completed for each sample with waterproof ink.

The original Chain-of-Custody Record will identify the transported contents and will accompany the shipment. The field sampling supervisor shall have possession of a copy of the Chain-of Custody Record. Samples shall be properly packaged for shipment and dispatched to the laboratory. Packages sent via US Postal Service must be sent by registered mail -- return receipt requested. Shipment via a common courier must be accompanied by a Bill of Lading. All postal receipts and bills of lading must be retained as part of the permanent record.

A sample is considered to be in the possession of a person if:

1. It is in that person's physical possession.
2. It is in view of that person after that person has accepted receipt of it and has physical possession of it.
3. That person has placed it in a secure area.

The three previous items are all qualifiers until:

4. That person has relinquished it to someone else who fulfills any of the above requirements.

5.2 Laboratory Custody

The Sample Custodian will accept custody of the shipped samples and will verify that the information on the sample tags matches the Chain-of-Custody Records, as well as note any discrepancies. Intact Chain-of-Custody forms must accompany all samples. All pertinent information such as shipment, pick-up, courier, etc., will be noted. The custodian will then enter the sample tag data onto a numbered Work Order and all tags/samples will be labeled with the corresponding Work Order number. Sample log-in for Chain-of-Custody projects will be the responsibility of the Sample Control Assistant.

Any samples which show signs of pressure build up are to be noted on the Work Order. Containers showing such signs will be labeled "Caution" so that the sample will be handled as potentially dangerous. Samples indicated as hazardous will be handled as follows:

1. Examination of Shipping Container: The sample control assistant will examine the shipping container (cooler or carton used for transporting samples) and record the following information on the Chain-of-Custody Sample Log-in Sheet.

   - Presence/absence of custody seal(s) (i.e. tape, strapping) on the shipping container.
   - Condition of custody seal (i.e. intact, broken).

   Note: No more than one case or project may be recorded per form.

2. Open Shipping Container: The sample control assistant will open the shipping container in a controlled area specified for hazardous samples, remove the enclosed sample documents and record the following information on the CT&E ELS Chain-of-Custody Sample Log-in Sheet:

   - Presence/absence of the Chain-of-Custody records, field or sample notes.
     Note: If a Chain-of-Custody Record does not accompany samples at the time of receipt, then an internal laboratory Chain-of-Custody is filled out with the client. The client is fully responsible for the integrity of this document.
   - Presence/absence of air bills and/or bill of lading documenting shipment of samples.
   - Seals broken on shipping or individual containers.

3. Remove Sample Containers from Shipping Container: The Sample Control Manager or Assistant will remove sample containers and record the following information on the Chain-of-Custody Sample Log-in Sheet:

- Condition of sample container (intact, broken, leaking, etc.).
- Presence/absence of sample tags.
- Consistency of enclosed records compared with ID's on enclosed samples.

The Sample Custodian is responsible for tracking the *Internal Chain of Custody.* They will distribute samples to the appropriate analysts and will record the names of the individuals who received the samples in a bound logbook. Laboratory personnel will be responsible for the care and custody of samples while in their possession.

When sample analysis and necessary quality assurance checks have been completed in the laboratory, the unused portion of the sample will be disposed of properly; or it will be retained after analyses are completed until such time that it is determined that the remaining portions are no longer required. All identifying tags, data sheets, and laboratory information will be retained as part of the permanent records. (See Figure 5A, p.13 for a sample of CT&E ELS' Chain-of-Custody form)

5.2.1 Transfer of Chain-of-Custody and Shipment of Evidence Samples

All evidence samples must be accompanied by a Chain-of-Custody record. When transferring the possession of samples, the individual relinquishing possession and the individual receiving possession will both sign, date, and note the time on the Chain-of-Custody record. The Chain of Custody records transfer of custody of samples from sampler to another individual or company or from the sampler to the analytical laboratory. If samples are split with another facility or governmental agency, a separate Chain-of-Custody must be prepared for those samples and should be marked indicating with whom the samples were split.

Commercial Testing & Engineering Co.
Environmental Laboratory Services

CHAIN OF CUSTODY

PO#: _____ CT&E Ref: _____

Reports to:

_____
_____
_____
_____

Phone: _____ Fax: _____

Invoice to:

_____
_____
_____
_____

Laboratory: Page __ of __

Commercial Testing & Engineernig Co.
5633 "B" Street
Anchorage, AK 99518
Phone (907) 562-2343 Fax: (907) 561-5301

Contact person for questions concerning these samples: _____ Phone: _____ Fax: _____

Special Instructions: _____

_____

Project Name/Number

Sampled By:

Lab #	Sample #	Date/Time Sampled	# of Containers	Sample Matrix										Comments

Sample Receipt:	Relinquished By:	Relinquished By:	Relinquished By:
Number of Containers	Signature Time:	Signature: Time:	Signature: Time:
COC Seals/Intact Y/N/NA	Printed Name Date:	Printed Name: Date:	Printed Name: Date:
Temperature	Received By:	Received By:	Received at Laboratory By:
Turnaround Required	Signature Time:	Signature Time:	Signature: Time:
Data Deliverables Required Level I Level II Level III	Printed Name: Date:	Printed Name Date:	Printed Name: Date:

Figure 5A
Chain-of-Custody Form

6.0 Quality Control Measures and Calibration Procedures

6.1 Introduction

Several factors are important in generating high quality data:

1. The quality and purity of the reagents used.
2. Proper cleaning of containers and glassware.
3 Initial and continuing calibration of instruments.

6.2 Reagents

The quality of data generated in an analytical laboratory is directly related to the quality and purity of the reagents/solvents used in preparing samples and calibrating instruments. These reagents/solvents fall into four categories:

1. Solvents used in sample extraction.
2. Reagents used in sample digestion.
3. Internal spike/surrogate compounds.
4. Instrument tuning/calibration reagents.

Unyielding efforts are made to acquire, maintain and verify reagents of the highest quality. In order to ensure the highest quality and purity, all chemicals and reagents acquired by CT&E ELS are of ACS certified Reagent Grade or better, purchased through reliable commercial sources, or in other cases, the NIST or the EPA. If it is necessary for a particular method or procedure, "Ultrex" or spectrochemical grade reagents are purchased. Lower grade reagents may be acceptable for some procedures.

When a particular method requires reagents, it is the responsibility of the area supervisor to order the proper grade through the purchasing agent. The area supervisor is responsible for checking these reagents and making sure they are used only for the stated purposes.

6.2.1 Receipt and Storage

All chemicals are inspected and dated at the time of arrival. There are four areas of storage:

1. Those items currently in use for analytical needs are stored in the lab area.

2. Flammables, solvents, and liquid hazardous materials are stored in a regulated room meeting code requirements (i.e. explosion proof lighting, ventilation, spill kit, etc.).
3. Reagent chemicals in powder form are stored in a separate room in storage cabinets marked with the appropriate safety information and identification.
4. Temperature sensitive reagents and standards are stored in a refrigerator or freezer.

The purchasing agent is responsible for the transfer of all MSD[S]heets (Material Safety Data Sheet) to the laboratory Safety Officer to be added in the employee library.

6.2.2 Reagent Quality Control

All solvents (i.e. methylene chloride or MTBE) are analyzed for purity by subjecting a solvent blank to the analytical method corresponding to its intended use. The solvent's purity is then monitored periodically through the analysis of glassware blanks. Any reagent will be discarded at the first sign of decomposition or contamination.

The analyst is responsible for checking expiration dates and discarding out-of-date reagents.

Water is considered to be *laboratory grade* (equivalent to EPA Type II) when it has been passed through a charcoal filter to remove organic constituents and then through a deionizing column. The quality of the water is routinely monitored against established acceptance criteria for each analysis. Minimum monitoring consists of measuring the conductivity. To further ensure the quality of water, method blanks are performed with each analysis. Deionizing cartridges are changed when conductivity exceeds 2 µmhos/cm or when indicated by the results of the method blanks.

6.2.3 Glassware and Bottle Preparation

For sampling purposes CT&E ELS only uses new bottles. Bottles are discarded after being used to collect a sample. Detergents used for glassware cleaning are non-phosphate detergents. New bottles and glassware are prepared as indicated unless method protocol requires an alternate procedure.

6.2.3.1 Laboratory Glassware Cleaning Procedures

1. Glassware Preparation for Organic Analysis:
   - A. Rinse with methanol as soon as possible after use.
   - B. Place in hot detergent soaking bath.
     1) Water should be 50 degrees C or greater.
     2) Synthetic detergent (i.e. dish washing, Alconox, etc.)
   - C. Rinse with hot water.
   - D. Soak in oxidizing agent.
   - E. Repeat step C.
   - F. Rinse with DI water.
   - G. Rinse with Methanol.
   - H. Store clean glassware upside-down in designated solvent-glassware cabinet.
   - I. Rinse immediately before use with extraction solvent.

2. Glassware Preparation for Metals Analysis
   - A. Soak glassware in detergent (EPA approved Alconox or equivalent).
   - B. Rinse thoroughly with tap water.
   - C. Rinse with 1:1 Nitric acid (HNO3).
   - D. Repeat step B.
   - E. Rinse with 1:1 Hydrochloric acid (HCl).
   - F. Repeat step B.
   - G. Rinse thoroughly with Type II water (DI).
   - H. Store clean glassware upside-down in designated metals glassware cabinet.

3. Oil & Grease Glassware
   - A. Detergent wash, rinse at least 3 times with tap water.
   - B. Remove organic residue with methylene chloride* rinse.
   - C. Follow with alternating detergent and methylene chloride* rinse as needed.
   - D. Rinse at least 3 times with tap water.
   - E. Follow with at least 3 times with laboratory grade water.
   - F. Dry in Muffle Furnace.
   - G Rinse at least 3 times with Freon* (1,1,2-trichlorotrifluoroethane).
   - H. Run an IR blank and label the bottle.

**Dispose of acetone, methylene chloride and freon in proper waste solvent containers.*

6.2.4 Standard Solutions

Standard solutions prepared by analysts for in-house use are recorded in a log book along with such information as the supplier, lot number, grade, concentration (and all values used to make the calculation), method of preparation, preparer's name, the date of preparation and the anticipated expiration date. Standard solutions are then validated prior to use. Standard solutions are monitored for deterioration and discarded if such signs as color changes, precipitation, or concentration changes are detected. Solutions known or found to be light sensitive are stored in brown glass bottles.

Standard solutions are prepared for a variety of purposes:

1. Trace metal analysis

   These are prepared from analytical grade metals or salts, dissolved in laboratory grade water and preserved at the correct pH using high grade nitric or sulfuric acid. If available, standards traceable to the NIST may be purchased from a reputable vendor.

2. Organic analysis

   Solvents should be of *pesticide* grade or better and show no interference under the analytical method. Standards should be purchased from vendors able to cite NIST standards.

6.3 Instrument Calibration and Frequency

Instruments must be properly calibrated before valid data can be obtained. In order to ensure that data continues to be valid, calibration checks must be incorporated into the Standard Operating Procedure (SOP) for each analysis method and instrument. Calibration must be planned in such a way as to establish detection limits (See Section 6.3.1, p.18), and to determine the range of linear response of the instrument. Compounds whose concentrations exceed the calibration range of the instrument will be notated with an *E* qualifier. Calibration, initial, operational, and periodic will be performed according to the guidelines of the manufacturer, the requirements of the analytical method, and/or special requirements of client contracts.

6.3.1 General Principles

1. Instrument failure

Any time an instrument fails to calibrate properly, the area supervisor should be notified. No analyses will be run until:

- the problem is identified.
- the problem is corrected.
- the instrument calibrates within acceptable limits.

2. Tuning

Some instruments (i.e. GC/MS) require tuning before use and at specified maximum time intervals during analysis. This involves use of a specific compound, or set of compounds, that allow the analyst to adjust the instrument to deliver spectra that conform to one another on an ongoing basis and to other instruments. This procedure should be specified in detail in the instrument SOP and not deviated from. Tuning should be recorded in log books for each instrument.

3. Operational

There are usually three parts to instrument calibration:

- Initial Calibration - Part one is the multiple point calibration of each instrument using a set of standards appropriate to the instrument and analysis. All analyses that are reported will be present in the calibration standards used.
- CCV - Part two is a set of standards run before any analysis and at set maximum intervals during analysis. The purpose is to establish the linear detection range of the instrument and to periodically ensure that it has not drifted.
- LCS - Part three involves calibration standards added to a sample run. These ensure that first, the instrument is performing up to standards, and second, that analytes have not been lost during preparation (See Section 7.1, p.22). These standards are an independent stock from those used for initial calibration.

6.3.2 Specific Instrument Calibration (Refer to Figures on pages 27-66)

1. Organics/Pesticides

GC/MS

Before any analyses are run each day, the GC/MS is first tuned using bromofluorobenzene (BFB) for volatiles and decafluorotriphenylphosphine (DFTPP) for semivolatiles. No analyses are run until the instrument meets method specific criteria for initial tuning.
The instrument is then calibrated using certain key compounds. Five concentrations of the analytes in question are injected and instrument response determined for each compound and for concentration. The data developed is then used to establish:

- the linear detection range for each analyte .
- the retention window for each analyte

Frequency of tuning and analyte calibration are specified in the SOP for the instrument.

Gas Chromatograph

Before any analyses are run the linear response ranges of the gas chromatograph and the retention times of the analytes are determined using a set of five concentrations of each compound. One of these concentrations should be near the detection limit of the analysis. If the concentration of a compound is found to be above this linear range it must be properly diluted and reanalyzed. The linear response range is confirmed on a regular basis as specified by the method. If a calibration check does not meet criteria, the instrument is recalibrated and any samples analyzed since the last conforming calibration are reanalyzed.
For Pesticides analysis by GC/ECD, column degradation is checked prior to analyses by injecting a mid-point standard containing only 4,4-DDT and Endrin. These two compounds are easily degraded if the injection port or front of the column is dirty.

2. Metals

Inductively Coupled Argon Plasma Spectrophotometer (ICP)

The linear response range of the ICP is established quarterly using linear range verification standards. A minimum of a blank and three data points are used for each metal to be analyzed. The calibration curve is then confirmed on a daily basis using a minimum of two standards -- one of which is a calibration blank. Calibration is monitored using continuous calibration standards inserted into the analysis stream every 10 samples, or once for every set of samples -- whichever is more frequent. Independent standards are purchased from separate vendors and/or prepared by different analysts in order to assure quality control. (See discussion of standards, Section 7.1, p.22) Calibration verification standards (CVS) are interspersed during an analysis run in order to maintain a close check on calibration. Any time CVS specifications are not met, the system is recalibrated and all samples analyzed since the last acceptable calibration check is reanalyzed.

The ICP spectrometer simultaneously analyzes a wide range of elements. This can lead to interelement and matrix interferences. To verify that the instrument is free of interelement interferences an interelement check standard is analyzed at the beginning and end of each analytical run. Freedom from matrix effects is verified by diluting one sample from each run or one in 20 samples (4:1), and the diluted sample analyzed. Results corrected for dilution should be within 10% of the original value. If correlation is poor, the concentration is determined by the method of standard additions.

Atomic Absorption Spectrophotometer (AAS)

As with other instruments, it is necessary to develop a standard curve for the AAS by analyzing a calibration blank and a minimum of three standard solutions of known concentration. The curve is verified using a sample from an independent source with a concentration near the middle of the calibration range. Check standards near the middle of the range should be run at least once in every ten samples. If a check sample is out of bounds the curve is recalibrated and any samples run since the last conforming calibration check are reanalyzed. Absence of matrix effects is verified by the same techniques used in ICP.

Balances

Balances are calibrated at least once a day and more frequently if necessary. Each balance has a daily calibration log book. Weights of NIST class "S" or better are used in calibration.

Thermometers

Thermometers are calibrated annually using an NIST Certified thermometer. The temperature for each thermostatically controlled device is maintained and recorded daily to meet all regulatory requirements. Corrective action for temperatures that are out of control are addressed immediately. The thermometers used for measuring the temperature of samples at the time of receipt are calibrated monthly.

7.0 Analytical Procedures

7.1 A Typical Analysis Sequence

The following is a typical sequence in the analysis of a set of samples. There may be variations from one instrument to another or one method to another. In some methods, or for some instruments, more than one sample may be run at step 6. (See further discussion of Internal Quality Control Checks, Section 9.0, p.73)

1. Calibration Blanks
2. Calibration Standards
3. Matrix Blank
4. Calibration Verification Standard
5. Quality Control Sample or Laboratory Control Sample
6. Sample
7. Sample Duplicate
8. Sample Spike
9. Calibration Blank
10. Calibration Verification Standard
11. Repeat steps 1-10 for subsequent samples until end of run
12. Close run with Quality Control Sample

7.1.1 Calibration

The following section defines and/or describes the calibration steps/terms.

Calibration Blanks

The Calibration blank is used to create a base line in the instrument or to help prepare the calibration curve. The calibration blank will be made from laboratory grade water and shall contain all reagents in the same volumes as the samples being analyzed. The calibration blank will be run each time the instrument is calibrated and at a 10% frequency thereafter.
Note: Not applicable to GC.

Calibration Standards

Calibration standards are prepared according to method specifications. Unless otherwise specified, a minimum of five calibration standards will be prepared for organics and a minimum of three calibration standards will be prepared for inorganics in graduated amounts to cover the optimum performance range. For organics, the low standard will be below the AFCEE Practical Detection Limit (PQL). For inorganics, the low standard will be below the CT&E PQL.

Continuing Calibration Verification Standard (CCV)

The accuracy of the initial calibration shall be verified for every analyte unless otherwise specified in the analytical method. The CCV will be made from EPA or other certified solutions and come from a different source than those used for calibration. When measurements exceed the established acceptance limits, the analysis will be terminated, the problem corrected, the instrument recalibrated and the calibration reverified

Quality Control Sample (QCS)

The Quality Control Sample, prepared from an EPA or other certified solution, will be analyzed at a minimum of one for every twenty samples. This QC sample will have a known true value and acceptance limits. The result of the QC Sample must fall within the specified acceptance limits.

If results are outside the control limits, one repeat determination will be made. If results remain outside the control limits, the analysis will be terminated, the problem corrected, and all analyses reanalyzed since the satisfactory QCS will be reevaluated.

Results of the QCS will be recorded in the analyst's notebook and plotted on an analyte QC control chart.

Calibration Standards, CVS and QCS are all prepared from reagents obtained from separate lots or different sources.

Laboratory Control Sample (LCS)

The Laboratory Control Sample, prepared from an EPA or other certified solution, will be extracted when applicable and analyzed at a minimum of one for every batch of no more than twenty samples. The LCS will have a known true value and acceptance limits. The result of the LCS must fall within the specified acceptance limits.

If results are outside the control limits, one repeat determination will be made. If results remain outside the control limits, the analysis will be terminated, the problem corrected, and extractions/analyses will be repeated.

Results of the LCS will be recorded in the QC Summary.

Continuing Calibration Verification Standards and Laboratory Control Samples are all prepared from reagents obtained from separate lots or different sources.

7.1.2 Definitions of Quality Control Additions

This section defines and explains the Quality Control additions to samples and analytical runs. These additions serve several functions:

1. To demonstrate that the accuracy and precision of the analysis is within acceptable limits.
2. To provide data on which statistical analyses can be performed.
3. To detect nonconformance in sampling, sample handling, sample preparation, or instrument performance.

Trip Blank

A trip blank is a preserved sample containing laboratory grade water that is transported to the sampling site. The sample is carried unopened through all phases of the sampling process and is transported with the actual samples that are collected The purpose of the trip blank is to reveal any sample contamination that occurs during collection or transport. Trip Blank results are reported to the client with the sample analytical data package. Corrections to the analytical data are not performed in the laboratory based on analysis of the trip blank.

Note: Trip Blanks are project-specific and are only done when included in the sampling plan.

Field Blank

A field blank is a sample of laboratory grade water that is prepared in the field at the sampling site and is treated exactly as the samples being collected. The purpose is to detect possible background contamination that may affect the sample concentration Results of the field blank analysis are reported to the client with the sample analytical data package. Corrections to the analytical data are not performed in the laboratory based on analysis of the field blank.

Note: Field Blanks are project-specific and are only done when included in the sampling plan.

Matrix Blank (Reagent Blank)

The matrix blank consists of deionized water collectively processed with a set of samples and analyzed with them. Its purpose is to detect contamination from glassware, reagents or solvents used in the extraction/digestion procedure. If contamination is detected, the results will be used as follows:

1. If the matrix blank is less than the PQL, no corrective action is necessary.
2. If the matrix blank is greater than the PQL, evaluate the samples to determine if a corrective action is necessary.
3. A permanent record of these values will be maintained.

Glassware Blank

Before use, all glassware is rinsed with the solvents to be used in the extraction. These rinses are combined and analyzed along with the samples extracted in the glassware.

Matrix Duplicate

The matrix duplicate is used to assess the effect that the matrix has on the precision of an analysis. In this process, a field sample is divided into two separate parts. These parts are then analyzed identically, but separately, and the results compared to give a measure of the precision. The results are reported as a relative percent difference (RPD). (See equation in Section 10.2, p.75)

Matrix Spike

The sample matrix can have an effect on the recovery of analytes. This effect is best evaluated by adding a known concentration of the analytes in question to the sample matrix or a similar matrix. The spiked matrix is taken through the entire analytical process and the recoveries of the analytes are calculated. The recovery is reported as percent recovery. (See equation in section 10.3, p.76)

If spike or spike duplicate recovery is not within limits, the data of all samples associated with that spike will be notated with the letter *N* in the QC summary and a note made in the case narrative of the QC package. When the concentration of the analyte in the sample is greater than 0.1%, no spike of the analyte is required. In such cases, spike recovery will not be considered and the data will be reported without a note.

Matrix Spike Duplicate

A matrix spike duplicate is a field sample that has been divided into two parts -- each of which is spiked with known concentrations of analytes. This sample is used to assess the precision and accuracy of an analysis. Results are expressed as RPD and %Recovery.

Note: If Sample Spike and Sample Spike Duplicate recoveries and RPD's do not meet QA criteria, then they are compared with the results of the laboratory control sample to determine whether there is a matrix effect. If the Laboratory Control Sample meets QA criteria, then it will be notated in the QC summary that the Sample Spike and Sample Spike Duplicate did not meet QA criteria due to matrix interference.

Surrogate Standards

Surrogate standards are organic compounds similar in behavior to analytes which are not normally found in environmental samples. The surrogate standard should elute within the retention time window of the analytes of interest. They are added to samples requiring GC and/or GC/MS analysis and are used to assess matrix effects on recovery. As such, surrogates serve a function similar to a matrix spike and are evaluated in the same manner.

Standard Additions

Standard additions is the practice of adding a series of three known concentrations of an analyte to a field sample. These samples are then analyzed and instrument response is plotted (vertical axis) against the known concentration of the added analyte (horizontal axis). The plot is then extrapolated back to zero instrument response. The point of interception on the abscissa is the concentration of the unknown analyte. The abscissa on the left of the ordinate is scaled the same as on the right side, but in the opposite direction. The following limitations should be noted[2]:

1. Instrument response must be linear over the range of concentrations used. For best results, the slope of the standard additions plot should be nearly the same as the slope of the calibration curve.
2. The effect of the interference should not vary as the concentration changes, and the standard addition should respond in a manner similar to the analyte.

[2]Environmental Quality Control, EPA SW-846, Revision 0, September 1986, Section 8.7

Figure 7A$_1$ Metals by SW3005

Internal Quality Control Procedures

Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
SW3005	Method Blank	1 per Batch	Elemental concentration must be less than the respective PQLs.	1. Redigest method blank and all associated samples. 2. Reanalyze method blank and all associated samples.
	Duplicate Sample	1 per 10 samples or 1 per batch	Dup RPD <20%	1. If RPD is out of control, redigest and reanalyze all associated samples. 2. If RPD is still out of control, flag as sample being non-homogeneous
	Spiked Sample	1 per 10 samples or 1 per batch	Recovery +/- 25%	1. Evaluate LCS; if in control, then flag as matrix interference.
	LCS	1 per 20 samples or 1 per batch	Recovery +/- 25%	1. If out of control, one repeat determination will be made. 2. If results remain outside limits, the analysis will be terminated and extraction/ analyses repeated.

We are currently establishing laboratory quality control limits for spike and LCS recoveries.

Internal Quality Control Procedures

Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
SW3010	Method Blank	1 per Batch	Elemental concentration must be less than the respective PQLs.	1. Redigest method blank and all associated samples. 2. Reanalyze method blank and all associated samples.
	Duplicate Sample	1 per 10 samples or 1 per batch	Dup RPD <20%	1. If RPD is out of control, redigest and reanalyze all associated samples. 2. If RPD is still out of control, flag as sample being non-homogeneous.
	Spiked Sample	1 per 10 samples or 1 per batch	Recovery +/- 25%	1. Evaluate LCS; if in control, then flag as matrix interference.
	LCS	1 per 20 samples or 1 per batch	Recovery +/- 25%	1. If out of control, one repeat determination will be made. 2. If results remain outside limits, the analysis will be terminated and extraction/ analyses repeated.

We are currently establishing laboratory quality control limits for spike and LCS recoveries.

Internal Quality Control Procedures

Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
SW3020	Method Blank	1 per Batch	Elemental concentration must be less than the respective PQLs.	1. Redigest method blank and all associated samples. 2. Reanalyze method blank and all associated samples.
	Duplicate Sample	1 per 10 samples or 1 per batch	Dup RPD < 20%	1. If RPD is out of control, redigest and reanalyze all associated samples. 2. If RPD is still out of control, flag as sample being non-homogeneous.
	Spiked Sample	1 per 10 samples or 1 per batch	Recovery +/- 15%	1. LCS; if in c hen flag as matrix interference.
	LCS	1 per 20 samples or 1 per batch	Recovery +/- 15%	1. If out of control, one repeat determination will be made. 2. If results remain outside limits, the analysis will be terminated and extraction/ analyses repeated.

We are currently establishing laboratory quality control limits for spike and LCS recoveries.

Figure $7A_4$ Metals by SW3050

Internal Quality Control Procedures

Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
SW3050	Method Blank	1 per Batch	Elemental concentration must be less than the respective PQLs.	1. Redigest method blank and all associated samples. 2. Reanalyze method blank and all associated samples.
	Duplicate Sample	1 per 10 samples or 1 per batch	Dup RPD < 20%	1. If RPD is out of control, redigest and reanalyze all associated samples. 2. If RPD is still out of control, flag as sample being non-homogeneous.
	Spiked Sample	1 per 10 samples or 1 per batch	Recovery +/- 15% (GF) Recovery +/- 25% (ICP)	1. Evaluate LCS; if in control, then flag as matrix interference.
	LCS	1 per 20 samples or 1 per batch	Recovery +/- 15% (GF) Recovery +/- 25% (ICP)	1. If out of control, one repeat determination will be made. 2. If results remain outside limits, the analysis will be terminated and extraction/ analyses repeated.

We are currently establishing laboratory quality control limits for spike and LCS recoveries.

Figure 7A$_5$ Metals by SW6010

Internal Quality Control Procedures

Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
SW6010	Calibration Blank	After calibration &	Concentration less than	1. Restandardize and
		1 per 10 sample	PQL	repeat analysis of all
		readings.		associated samples.
	Calibration	1 per 10 sample	Recovery +/- 10%	1. Restandardize and repeat
	Verification Std.	readings		analysis of all associated
	(CVS/CCV)			samples.
	Quality Control	1 per analysis	Recovery +/- 10%	1. Restandardize and
	Standard (QC)			repeat analysis of all
				associated samples.
	High Standard	1 per analysis	Recovery +/- 5%	1. Restandardize and
				repeat analysis of all
				associated samples.
	Initial Calibration	1 per analysis	Recovery +/- 10%	1. Restandardize and
	Verification Std.			repeat analysis of all
				associated samples.
	Interference Check	1. After calibration.	Recovery +/- 20%	1. Restandardize and
	Solution	2. At end of		repeat analysis of all
		analysis or		associated samples
		every 8 hours;		
		whichever is		
		more frequent.		
	Multipoint	1. Daily	No correlation coefcnt	1. Find source of problem
	Calibration		acceptance criteria;	and correct.
			calibration acceptance is	2. Repeat calibration.
			based on high standard	
			readback +/- 5%	

We are currently establishing laboratory quality control limits for spike and LCS recoveries.

Figure $7A_6$ Metals by SW7000

Internal Quality Control Procedures

Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
SW7000	Calibration Blank	After each	Concentration less than	1. Restandardize and
		calibration and 1	PQL	repeat analysis of all
		per 10 sample		associated samples.
		readings.		
	Calibration	1 per 10 sample	Recovery +/- 10%	1. Restandardize and
	Verification Std.	readings		repeat analysis of all
	(CVS/CCV)			associated samples.
	Quality Control	1 per 10 sample	Recovery +/- 15%	1. Restandardize and
	Standard (QC)	readings		repeat analysis of all
				associated samples.
	Multipoint	1. Daily	Correlation coefficient	1. Find source of problem
	Calibration		r>=0.995	and correct.
				2. Repeat calibration.

We are currently establishing laboratory quality control limits for spike and LCS recoveries.

Figure 7A$_7$ Metals by SW7470

Internal Quality Control Procedures

Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
SW7470	Calibration Blank	After calibration &	Concentration less than	1. Restandardize and
		1 per 10 sample	PQL	repeat analysis of all
		readings.		associated samples.
	Calibration	1 per 10 sample	Recovery 87 - 121%	1. Restandardize and
	Verification Std.	readings		repeat analysis of all
	(CVS/CCV)			associated samples.
	Quality Control	1 per 10 sample	Recovery +/- 20%	1. Restandardize and
	Standard (QC)	readings		repeat analysis of all
				associated samples.
	Duplicate Sample	1 per 10 samples	Dup RPD < 20%	1. Redigest and repeat
				analysis of all
				associated samples.
	Spiked Sample	1 per 10 samples	Recovery +/- 15%	1. Evaluate LCS; if in
		or 1 per batch		control, then flag as
				matrix interference.
	LCS	1 per 20 samples	Recovery +/- 15%	1. Analysis will be terminated
		or 1 per batch		and extraction/analyses
				repeated.
	Multipoint	1. Daily	Correlation coefficient	1. Find source of problem
	Calibration		r>=0.995	and correct.
				2. Repeat calibration.

We are currently establishing laboratory quality control limits for spike and LCS recoveries.

Figure $7A_8$ Metals by SW7471

Internal Quality Control Procedures

Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
SW7471	Calibration Blank	After calibration &	Concentration less than	1. Restandardize and
		1 per 10 sample	PQL	repeat analysis of all
		readings.		associated samples.
	Calibration	1 per 10 sample	Recovery 87 - 121%	1. Restandardize and
	Verification Std.	readings		repeat analysis of all
	(CVS/CCV)			associated samples.
	Quality Control	1 per 10 sample	Recovery +/- 20%	1. Restandardize and
	Standard (QC)	readings		repeat analysis of all
				associated samples.
	Duplicate Sample	1 per 10 samples	Dup RPD < 20%	1. Redigest and repeat
				analysis of all
				associated samples.
	Spiked Sample	1 per 10 samples	Recovery +/- 15%	1. Evaluate LCS; if in
		or 1 per batch		control, then flag as
				matrix interference.
	LCS	1 per 20 samples	Recovery +/- 15%	1. Analysis will be terminated
		or 1 per batch		and extraction/analyses
				repeated.
	Multipoint	1. Daily	Correlation coefficient	1. Find source of problem
	Calibration		r>=0.995	and correct.
				2. Repeat calibration.

We are currently establishing laboratory quality control limits for spike and LCS recoveries.

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Figure 7B Pesticides by EPA 8080

Quality Control Limits

Method	Parameter	Continuing Calibration Verification	Frequency	Acceptance Criteria	Corrective Act
SW 846 8080	Organochlorine Pesticides & Polychlorinated biphenyls	Continuing Calibration Verification	Every 24 hrs. and 1 every 10 samples; & at end of run	+/- 15% Recovery	1. Find source of problem 2.Repeat analysis 3. Recalibrate if needed
		Instrument Blanks	Every 24 hrs.	Below Practical Quant. Limit	1. Note in QC Summary 2. Evaluate data and repaeat extraction/analysis if necessary
		Extraction Blanks	1 per extr. batch of no greater than 20 samples	Below Practical Quantification Limit	1. Note in QC Summary 2. Evaluate data & repeat extr./analysis if necessary
		Matrix Spike Matrix Spike Duplicate	1 per extraction batch of no greater than 20 samples	See page 43	1. Check LCS recovery 2. If LCS is in control note in QC Summary as possib matrix interference
		Surrogate	Every Sample	One of two surrogates 70%-130% (water) 70%-130% (soil)	1. Repeat instr. analysis 2. If replicate analysis confirms first, reextract and reanalyze 3. If reextraction confirms first, note in QC Summary as possible matrix interference
		Laboratory Control Sample	1 per extraction batch of no greater than 20 samples	See Current Study	1. Repeat instr. analysis to rule out malinjection 2. If replicate analysis confirms first, reextract/ reanalyze entire batch
		Multipoint Calibration	After instrument adjustment	RSD of average respnse factor <20%; R^2>0.995	1. Find source of problem and correct 2. Repeat calibration

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Laboratory Control Limits for Matrix Spikes, Matrix Spike Duplicates, and Surrogates

Analytical Method	Spiking Compounds	Spike Concentration		Laboratory Established Control Limits			
				Percent Recovery (%)		RPD (%)	
		Water (µg/mL)	Soil (mg/kg)	Water	Soil	Water	Soil
EPA 8080	A-BHC	5	5	75 - 106	84 - 126	21	24
PEST	GAMMA-BHC (LINDANE)	5	5	80 - 108	87 - 125	16	20
	B-BHC	5	5	80 - 108	88 - 126	18	18
	HEPTACHLOR	5	5	73 - 111	83 - 131	17	22
	D-BHC	5	5	75 - 114	91 - 124	23	19
	ALDRIN	5	5	71 - 104	83 - 126	23	22
	HEPTACHLOR EPOXIDE	5	5	80 - 108	86 - 126	14	18
	ENDOSULFAN I	5	5	78 - 102	77 - 121	12	18
	4,4-DDE	5	5	82 - 110	87 - 126	16	23
	DIELDRIN	5	5	83 - 112	85 - 129	14	24
	ENDRIN	5	5	83 - 115	80 - 138	14	31
	4,4-DDD	5	5	83 - 118	88 - 131	13	26
	ENDOSULFAN II	5	5	82 - 112	83 - 126	15	24
	4,4-DDT	5	5	82 - 113	80 - 135	14	39
	ENDRIN ALDEHYDE	5	5	82 - 124	88 - 129	15	24
	ENDOSULFAN SULFATE	5	5	80 - 126	84 - 131	20	25
	METHOXYCHLOR	5	5	82 - 126	75 - 144	15	47
	TOXAPHENE	5	5	41 - 126*	41 - 126*	25*	25*
	CHLORODANE	5	5	45 - 119*	45 - 119*	25*	25*
	Surrogate:						
	Tetra chloro-m-Xylene	10	10	66 - 134**	66 - 134**		
	Decachlorobiphenyl	10	10	66 - 134**	66 - 134**		

* - Indicates use of method established limits; we are currently generating these limits for our laboratory.
**-Indicates laboratory generated limits.

PCB LCS LIMIT STUDY
JULY 1994

Instrument ID: ECD#2
Matrix: Soil and Water

	COMPOUND		
	AROCLOR 1260	AROCLOR 1242	AROCLOR 1254
LCL%	8*	39*	29*
UCL%	127*	150*	131*

	COMPOUND			
	AROCLOR 1016	AROCLOR 1248	AROCLOR 1232	AROCLOR 12
LCL%	50*	38*	10*	
UCL%	114*	158*	215*	1

UCL% = [TC + (3 * STD DEV)]/TC (99% Confidence)
LCL% = [TC - (3 * STD DEV)]/TC (99% Confidence)

TC = True Concentration

* - Indicates use of method specified control limits; we are currently generating laboratory limits for this analysis.

Laboratory Control Limits for Matrix Spikes, Matrix Spike Duplicates, and Surrogates

Analytical Method	Spiking Compounds	Spike Concentration		Laboratory Established Control Limits			
		Water (µg/mL)	Soil* (mg/kg)	Percent Recovery (%)		RPD (%)	
				Water	Soil	Water	Soil
EPA 8080	1242 Aroclor	10	0.2	76 - 116	71 - 130	17	16
	Surrogates:						
	Tetra chloro-m-Xylene	10	10	66 - 134**	66 - 134**		
	Decachlorobiphenyl	10	10	66 - 134**	66 - 134**		

* - Indicates use of method established limits; we are currently generating these limits for our laboratory.
**-Indicates laboratory generated limits.

Figure 7D VOA by EPA 8240

Quality Control Limits

Method	Parameter	Continuing Calibration Verification	Frequency	Acceptance Criteria	Corrective Action
EPA 8240	Volatile Organic Compounds	Continuing Calibration Verif. Stds.	Every 12 hrs.	< 25% D of response factor from 5 point avg response factor	1. Find source of problem 2.Repeat analysis 3. Recalibrate if needed
		Laboratory Control Sample	Every 24 hrs. or 1 per analytical batch of no greater than 20 samples	See page 46 for criteria	1. Repeat instr. analysis to rule out malinjection 2. If replicate analysis confirms first, reextract/ reanalyze entire batch
		Instrument Blanks	Every 12 hrs.	Below Practical Quantification Lmt	1. Note in QC Summary 2. Evaluate data and repaeat extraction/analysis if necessary
		Extraction Blank	1 per extraction batch of no greater than 20 samples	Below Practical Quantification Limit	1. Note in QC Summary 2. Evaluate data & repeat extr./analysis if necessary
		Matrix Spike Matrix Spike Duplicate	1 per analytical batch of no greater than 20 samples	See page 47 for criteria	1. Check LCS recovery 2. If LCS is in control note in QC Summary as possible matrix interference
		Surrogate	Every Sample	See page 47 for criteria	1. Repeat instrument analysis 2. If replicate analysis confirms first, reextract and reanalyze 3. If reextraction confirms first, note in QC Summary as possible matrix interference
		Multipoint Calibration	After instrument adjustment	<30% RSD	1. Find source of problem and correct 2. Repeat calibration

EPA 8240 COMPOUND LIST

NUMBER	COMPOUND
1	*BROMOCHLOROMETHANE
2	CHLOROMETHANE
3	VINYL CHLORIDE
4	BROMOMETHANE
5	CHLOROETHANE
6	1,1-DICHLOROETHENE
7	CARBON DISULFIDE
8	ACETONE
9	METHYLENE CHLORIDE
10	trans-1,2-DICHLOROETHENE
11	1,1-DICHLOROETHANE
13	CHLOROFORM
14	d4-1,2-DICHLOROETHANE (SURR)
15	1,2-DICHLOROETHANE
16	*1,4-DIFLUOROBENZENE
17	VINYL ACETATE
18	2-BUTANONE
19	1,1,1-TRICHLOROETHANE
20	CARBONTETRACHLORIDE
21	BENZENE
22	TRICHLOROETHENE
23	1,2-DICHLOROPROPANE
24	BROMODICHLOROMETHANE
25	2-CHLOROETHYLVINYL ETHER
26	cis-1,3-DICHLOROPROPENE
27	trans-1,3-DICHLOROPROPENE
28	1,1,2-TRICHLOROETHANE
29	DIBROMOCHLOROMETHANE
30	BROMOFORM
31	*d5-CHLOROBENZENE
32	2-HEXANONE
33	MIBK
34	d8-TOLUENE(SURR)
35	TOLUENE
36	TETRACHLOROETHENE
37	CHLOROBENZENE
38	ETHYLBENZENE
39	P,M-XYLENE
40	O-XYLENE
41	STYRENE
42	BROMOFLUOROBENZENE (SURR)
43	1,1,2,2-TETRACHLOROETHANE
44	1,3-DICHLOROBENZENE
45	1,4-DICHLOROBENZENE
46	1,2-DICHLOROBENZENE

8240 LCS LIMIT STUDY
JULY 1994

Instrument ID: VKA
Matix: Soil and Water

Compound Number	LCL%	UCL%
2	D*	273*
3	D*	251*
4	D*	242*
5	70*	150*
6	D*	234*
7	80*	120*
8	75*	180*
9	D*	221*
10	54*	156*
11	59*	155*
13	51*	138*
15	49*	155*
17	10*	250*
18	12*	150*
19	52*	162*
20	70*	140*
21	37*	151*
22	71*	157*
23	D*	210*
24	35*	155*
25	D*	305*
26	D*	227*
27	17*	183*
28	52*	150*
29	53*	159*
30	45*	169*
32	66*	140*
33	75*	140*
35	47*	150*
36	64*	148*
37	37*	160*
38	37*	162*
39	80*	120*
40	80*	120*
41	80*	120*
43	46*	157*
44	59*	156*
45	18*	190*
46	18*	190*

UCL% = [TC + (3 * STD DEV)]/TC (99% Confidence)
LCL% = [TC - (3 * STD DEV)]/TC (99% Confidence)

TC = True Concentration

Missing compounds are internal standards.

Laboratory Control Limits for Matrix Spikes, Matrix Spike Duplicates, and Surrogates

Analytical Method	Spiking Compounds	Spike Concentration		Laboratory Established Control Limits			
				Percent Recovery (%)		RPD (%)	
		Water (µg/L)	Soil (µg/kg)	Water	Soil	Water	Soil
EPA 8240	CHLOROMETHANE	20	20	D - 273*	D - 273*	20*	20*
	VINYL CHLORIDE	20	20	D - 251*	D - 251*	20*	20*
	BROMOMETHANE	20	20	D - 242*	D - 242*	20*	20*
	CHLOROETHANE	20	20	70 - 150*	70 - 150*	20*	20*
	1,1-DICHLOROETHENE	20	20	D - 234*	D - 234*	12.5	20*
	CARBON DISULFIDE	20	20	80 - 120*	80 - 120*	20*	20*
	ACETONE	20	20	75 - 180*	75 - 180*	20*	20*
	METHYLENE CHLORIDE	20	20	D - 221*	D - 221*	20*	20*
	trans-1,2-DICHLOROETHENE	20	20	54 - 156*	54 - 156*	20*	20*
	1,1-DICHLOROETHANE	20	20	59 - 155*	59 - 155*	20*	20*
	CHLOROFORM	20	20	51 - 138*	51 - 138*	20*	20*
	1,2-DICHLOROETHANE	20	20	49 - 155*	49 - 155*	20*	20*
	VINYL ACETATE	20	20	10 - 250*	10 - 250*	20*	20*
	2-BUTANONE	20	20	12 - 150*	12 - 150*	20*	20*
	1,1,1-TRICHLOROETHANE	20	20	52 - 162*	52 - 162*	20*	20*
	CARBONTETRACHLORIDE	20	20	70 - 140*	70 - 140*	20*	20*
	BENZENE	20	20	37 - 151*	37 - 151*	6.2	20*
	TRICHLOROETHENE	20	20	71 - 157*	71 - 157*	7.0	20*
	1,2-DICHLOROPROPANE	20	20	D - 210*	D - 210*	20*	20*
	BROMODICHLOROMETHANE	20	20	35 - 155*	35 - 155*	20*	20*
	cis-1,3-DICHLOROPROPENE	20	20	D - 227*	D - 227*	20*	20*
	trans-1,3-DICHLOROPROPENE	20	20	17 - 183*	17 - 183*	20*	20*
	1,1,2-TRICHLOROETHANE	20	20	52 - 150*	52 - 150*	20*	20*
	DIBROMOCHLOROMETHANE	20	20	53 - 159*	53 - 159*	20*	20*
	BROMOFORM	20	20	45 - 169*	45 - 169*	20*	20*
	2-HEXANONE	20	20	66 - 140*	66 - 140*	20*	20*
	MIBK	20	20	75 - 140*	75 - 140*	20*	20*
	TOLUENE	20	20	47 - 150*	47 - 150*	8.8	20*
	TETRACHLOROETHENE	20	20	64 - 148*	64 - 148*	20*	20*
	CHLOROBENZENE	20	20	37 - 160*	37 - 160*	6.5	20*
	ETHYLBENZENE	20	20	37 - 162*	37 - 162*	20*	20*
	P,M-XYLENE	20	20	80 - 120*	80 - 120*	20*	20*
	O-XYLENE	20	20	80 - 120*	80 - 120*	20*	20*
	STYRENE	20	20	80 - 120*	80 - 120*	20*	20*
	1,1,2,2-TETRACHLOROETHANE	20	20	46 - 157*	46 - 157*	20*	20*
	1,3-DICHLOROBENZENE	20	20	59 - 156*	59 - 156*	20*	20*
	1,4-DICHLOROBENZENE	20	20	18 - 190*	18 - 190*	20*	20*
	1,2-DICHLOROBENZENE	20	20	18 - 190*	18 - 190*	20*	20*
	Surrogates:						
	d4-1,2-dichloroethane	50	50	74 - 121*	74 - 121*		
	d8-Toluene	50	50	70 - 121*	70 - 121*		
	Bromofluorobenzene	50	50	81 - 117*	81 - 117*		

● Indicates use of method established limits; we are currently generating these limits in our laboratory.

Figure 7E VOA by EPA 8260

Quality Control Limits

Method	Parameter	Continuing Calibration Verification	Frequency	Acceptance Criteria	Corrective Actio
EPA 8260	Volatile Organic Compounds	Continuing Calibration Verif. Stds.	Every 12 hrs.	< 25% D of response factor from 5 point avg response factor	1. Find source of problem 2.Repeat analysis 3. Recalibrate if needed
		Laboratory Control Sample	Every 24 hrs. or 1 per analytical batch of no greater than 20 samples	+/- 30% Recovery	1. Repeat instr. analysis to rule out malinjection 2. If replicate analysis confirms first, reextract/ reanalyze entire batch
		Instrument Blanks	Every 12 hrs.	Below Practical Quantification Lmt	1. Note in QC Summary 2. Evaluate data and repaeat extraction/analysis if necessary
		Extraction Blank	1 per extraction batch of no greater than 20 samples	Below Practical Quantification Limit	1. Note in QC Summary 2. Evaluate data & repeat extr./analysis if necessa
		Matrix Spike Matrix Spike Duplicate	1 per extraction batch of no greater than 20 samples	See page 51 for criteria	1. Check LCS recovery 2. If LCS is in control note in QC Summary as possible matrix interference
		Surrogate	Every Sample	See page 51 for criteria	1. Repeat instrument analysis 2. If replicate analysis confirms first, reextract and reanalyze 3. If reextraction confirms first, note in QC Summary as possible matrix interference
		Multipoint Calibration	After instrument adjustment	<30% RSD	1. Find source of problem and correct 2. Repeat calibration

EPA 8260 COMPOUND LIST

NUMBER	COMPOUND
2)	dichlorodifluoromethane
3)	chloromethane
4)	vinyl chloride
5)	bromomethane
6)	chloroethane
7)	trichlorofluoromethane
8)	1,1-dichloroethene
11)	methylene chloride
12)	trans-1,2-dichloroethene
13)	1,1-dichloroethane
15)	2,2-dichloropropane
17)	cis-1,2-dichloroethene
18)	bromochloromethane
19)	chloroform
20)	1,1,1-trichloroethane
21)	carbon tetrachloride
22)	1,1-dichloropropene
23)	d4-1,2-Dichloroethane(Surr)
24)	benzene
25)	1,2-dichloroethane
26)	trichloroethene
27)	1,2-dichloropropane
28)	dibromomethane
29)	bromodichloromethane
31)	cis-1,3-dichloropropene
33)	d8-Toluene(Surr)
34)	toluene
35)	trans-1,3-dichloropropene
36)	1,1,2-trichloroethane
37)	tetrachloroethene
38)	1,3-dichloropropane
40)	dibromochloromethane
41)	1,2-dibromomethane
43)	chlorobenzene
44)	1,1,1,2-tetrachloroethane
45)	ethylbenzene
46)	P & M-Xylene
47)	o-xylene
48)	styrene
49)	bromoform
50)	isopropylbenzene
51)	4-bromofluorobenzene(Surr)
52)	bromobenzene
53)	1,1,2,2-tetrachloroethane
54)	1,2,3-trichloropropane
55)	n-propylbenzene
56)	2-chlorotoluene
57)	4-chlorotoluene

NUMBER	COMPOUND
58)	1,3,5-trimethylbenzene
59)	tert-butylbenzene
60)	1,2,4-trimethylbenzene
61)	sec-butylbenzene
62)	1,3-dichlorobenzene
63)	4-isopropyltoluene
64)	1,4-dichlorobenzene
66)	1,2-dichlorobenzene
67)	n-butylbenzene
68)	1,2-dibromo-3-chloropropane
69)	1,2,4-trichlorobenzene
70)	hexachlorobutadiene
71)	naphthalene
72)	1,2,3-trichlorobenzene

8260 LCS LIMIT STUDY
JULY 1994

Instrument ID: VLA
Matix: Soil and Water

Compound Number	LCL%	UCL%
3	80*	120*
4	80*	120*
5	80*	120*
6	80*	120*
8	80*	120*
9	80*	120*
10	80*	120*
11	80*	120*
12	80*	120*
13	80*	120*
14	80*	120*
16	80*	120*
18	80*	120*
19	80*	120*
20	80*	120*
21	80*	120*
23	80*	120*
24	80*	120*
25	80*	120*
26	80*	120*
27	80*	120*
29	80*	120*
30	80*	120*
31	80*	120*
32	80*	120*
33	80*	120*
34	80*	120*
35	80*	120*
36	80*	120*
37	80*	120*
39	80*	120*
40	80*	120*
42	80*	120*
43	80*	120*
45	80*	120*
46	80*	120*
47	80*	120*
48	80*	120*
49	80*	120*
51	80*	120*
53	80*	120*
62	80*	120*
64	80*	120*
66	80*	120*

UCL% = [TC + (3 * STD DEV)]/TC (99% Confidence)
LCL% = [TC - (3 * STD DEV)]/TC (99% Confidence)

TC = True Concentration

* - Indicates use of method specified control limits; we are currently generating laboratory limits for this analysis.

Laboratory Control Limits for Matrix Spikes, Matrix Spike Duplicates, and Surrogates

Analytical Method	Spiking Compounds	Spike Concentration Water (ng/mL)	Laboratory Established Control Limits Percent Recovery (%) Water	Laboratory Established Control Limits RPD (%) Water
EPA 8260	CHLOROMETHANE	10	80 - 120*	20*
	VINYL CHLORIDE	10	80 - 120*	20*
	BROMOMETHANE	10	80 - 120*	20*
	CHLOROETHANE	10	80 - 120*	20*
	1,1-DICHLOROETHENE	10	80 - 120*	20*
	METHYLENE CHLORIDE	10	80 - 120*	20*
	trans-1,2-DICHLOROETHENE	10	80 - 120*	20*
	1,1-DICHLOROETHANE	10	80 - 120*	20*
	CHLOROFORM	10	80 - 120*	20*
	1,1,1-TRICHLOROETHANE	10	80 - 120*	20*
	CARBONTETRACHLORIDE	10	80 - 120*	20*
	BENZENE	10	80 - 120*	20*
	1,2-DICHLOROETHANE	10	80 - 120*	20*
	TRICHLOROETHENE	10	80 - 120*	20*
	1,2-DICHLOROPROPANE	10	80 - 120*	20*
	BROMODICHLOROMETHANE	10	80 - 120*	20*
	2-CHLOROETHYLVINYL ETHER	10	80 - 120*	20*
	cis-1,3-DICHLOROPROPENE	10	80 - 120*	20*
	TOLUENE	10	80 - 120*	20*
	trans-1,3-DICHLOROPROPENE	10	80 - 120*	20*
	1,1,2-TRICHLOROETHANE	10	80 - 120*	20*
	TETRACHLOROETHENE	10	80 - 120*	20*
	DIBROMOCHLOROMETHANE	10	80 - 120*	20*
	CHLOROBENZENE	10	80 - 120*	20*
	ETHYLBENZENE	10	80 - 120*	20*
	P,M-XYLENE	10	80 - 120*	20*
	O-XYLENE	10	80 - 120*	20*
	STYRENE	10	80 - 120*	20*
	BROMOFORM	10	80 - 120*	20*
	1,1,2,2-TETRACHLOROETHANE	10	80 - 120*	20*
	1,3-DICHLOROBENZENE	10	80 - 120*	20*
	1,4-DICHLOROBENZENE	10	80 - 120*	20*
	1,2-DICHLOROBENZENE	10	80 - 120*	20*
		10	80 - 120*	20*
	Surrogate:			
	d4-1,2 Dichloroethane	10	86 - 115*	
	d5-Chlorobenzene	10	86 - 118*	
	d4-1,2 dichlorobenzene	10	88 - 110	

* - Indicates use of method established limits; we are currently generating these limits for our laboratory.

Laboratory Control Limits for Matrix Spikes, Matrix Spike Duplicates, and Surrogates

Analytical Method	Spiking Compounds	Spike Concentration Water (ng/mL)	Laboratory Established Control Limits Percent Recovery (%) Water	Laboratory Established Control Limits RPD (%) Water
EPA 8260	dichlorodifluoromethane	10	70 - 130*	20*
	chloromethane	10	70 - 130*	20*
	vinyl chloride	10	70 - 130*	20*
	bromomethane	10	70 - 130*	20*
	chloroethane	10	70 - 130*	20*
	trichlorofluoromethane	10	70 - 130*	20*
	1,1-dichloroethene	10	70 - 130*	20*
	methylene chloride	10	70 - 130*	20*
	trans-1,2-dichloroethene	10	70 - 130*	20*
	1,1-dichloroethane	10	70 - 130*	20*
	2,2-dichloropropane	10	70 - 130*	20*
	cis-1,2-dichloroethene	10	70 - 130*	20*
	bromochloromethane	10	70 - 130*	20*
	chloroform	10	70 - 130*	20*
	1,1,1-trichloroethane	10	70 - 130*	20*
	carbon tetrachloride	10	70 - 130*	20*
	1,1-dichloropropene	10	70 - 130*	20*
	benzene	10	70 - 130*	20*
	1,2-dichloroethane	10	70 - 130*	20*
	trichloroethene	10	70 - 130*	20*
	1,2-dichloropropane	10	70 - 130*	20*
	dibromomethane	10	70 - 130*	20*
	bromodichloromethane	10	70 - 130*	20*
	cis-1,3-dichloropropene	10	70 - 130*	20*
	toluene	10	70 - 130*	20*
	trans-1,3-dichloropropene	10	70 - 130*	20*
	1,1,2-trichloroethane	10	70 - 130*	20*
	tetrachloroethene	10	70 - 130*	20*
	1,3-dichloropropane	10	70 - 130*	20*
	dibromochloromethane	10	70 - 130*	20*
	1,2-dibromomethane	10	70 - 130*	20*
	chlorobenzene	10	70 - 130*	20*
	1,1,1,2-tetrachloroethane	10	70 - 130*	20*
	ethylbenzene	10	70 - 130*	20*
	P & M-Xylene	10	70 - 130*	20*
	o-xylene	10	70 - 130*	20*
	styrene	10	70 - 130*	20*
	bromoform	10	70 - 130*	20*
	isopropylbenzene	10	70 - 130*	20*
	bromobenzene	10	70 - 130*	20*
	1,1,2,2-tetrachloroethane	10	70 - 130*	20*
	1,2,3-trichloropropane	10	70 - 130*	20*
	n-propylbenzene	10	70 - 130*	20*

Laboratory Control Limits for Matrix Spikes, Matrix Spike Duplicates, and Surrogates

Analytical Method	Spiking Compounds	Spike Concentration Water (ng/mL)	Laboratory Established Control Limits Percent Recovery (%) Water	Laboratory Established Control Limits RPD (%) Water
EPA 8260	2-chlorotoluene	10	70 - 130*	20*
(Cont.)	4-chlorotoluene	10	70 - 130*	20*
	1,3,5-trimethylbenzene	10	70 - 130*	20*
	tert-butylbenzene	10	70 - 130*	20*
	1,2,4-trimethylbenzene	10	70 - 130*	20*
	sec-butylbenzene	10	70 - 130*	20*
	1,3-dichlorobenzene	10	70 - 130*	20*
	4-isopropyltoluene	10	70 - 130*	20*
	1,4-dichlorobenzene	10	70 - 130*	20*
	1,2-dichlorobenzene	10	70 - 130*	20*
	n-butylbenzene	10	70 - 130*	20*
	1,2-dibromo-3-chloropropa	10	70 - 130*	20*
	1,2,4-trichlorobenzene	10	70 - 130*	20*
	hexachlorobutadiene	10	70 - 130*	20*
	naphthalene	10	70 - 130*	20*
	1,2,3-trichlorobenzene	10	70 - 130*	20*
	Surrogate:			
	d4-1,2 Dichloroethane	10	86 - 115*	
	d5-Chlorobenzene	10	86 - 118*	
	d4-1,2 dichlorobenzene	10	88 - 110*	

* - Indicates use of method established limits; we are currently generating these limits for our laboratory.

Figure 7C Gasoline Range Organics by AK101

Quality Control Limits

Method	Parameter	Continuing Cal Ver	Frequency	Acceptance Criteria	Corrective Act
AFCEE (AK101)	Gasoline Range Organics	Continuing Calibration Verif Stds	Every 24 hrs	RSD<20% for avg respns factor +/- 20% Recov	1. Find source of problem 2.Repeat analysis 3. Recalibrate if needed
		Laboratory Control Standard	1 per ten client samples and at end of analytical sequence	+/- 20% Recovery	1. Repeat instr. analysis t rule out malinjection 2. If replicate analysis confirms first, reextract/ reanalyze entire batch
		Laboratory Control Sample	1 per analytical batch of no greater than 20 samples	+/- 20% Recovery	1. Repeat instr. analysis t rule out malinjection 2. If replicate analysis confirms first, reextract/ reanalyze entire batch
		Instrument Blanks	Every 12 hrs	Below Practical Quant. Lmt.	1. Note in QC Summary 2. Evaluate data & repeat extr/analysis if nece
		Extraction Blank	1 per extr. batch of no greater than 20 samples	Below Practical Quantification Limit	1. Note in QC Summary 2. Evaluate data & repeat extr./analysis if necessary
		Matrix Spike Matrix Spike Duplicate	1 per analytical batch of no greater than 20 samples	See page 54 for criteria	1. Check LCS recovery 2. If LCS is in control note in QC Sum as possible mtx interference
		Surrogate	Every Sample	See page 54 for criteria	1. Repeat instr. analysis 2. If replicate analysis confirms 1st,reext&reanly 3. If reextraction confirms first, note in QC Summary as possible matrix interference
		Multipoint Calibration	After instrument adjustment	RSD of average respnse factor <20%; R^2>0.995	1. Find source of problem and correct 2. Repeat calibrati

8015 LABORATORY CONTROL STANDARD LIMIT STUDY
JULY 1994

Instrument ID: VCA
LCL level: 500ppb
Matrix: Water

Run #	GRO
1	507.00
2	492.00
3	480.00
4	460.50
5	489.50
6	500.00
7	487.00
8	478.50
9	465.00
10	465.00
11	473.50
12	472.00
13	508.50
14	486.50
15	482.00
16	468.50
17	480.00
18	476.50
19	463.50
20	473.50
AVG REC	96.1%
UCL%	108.3%
LCL%	91.7%

UCL% = [TC + (3 * STD DEV)]/TC (99% Confidence)
LCL% = [TC - (3 * STD DEV)]/TC (99% Confidence)

TC = True Concentration = 500ppb

* - Indicates use of method specified control limits; we are currently generating laboratory limits for this analysis.

Laboratory Control Sample Limits for Matrix Spikes, Matrix Spike Duplicates, and Surrogates

Analytical Method	Spiking Compounds	Spike Concentration		Laboratory Established Control Limits			
		Water (µg/mL)	Soil (mg/kg)	Percent Recovery (%)		RPD (%)	
				Water	Soil	Water	Soil
AK101	Gasoline Range Organics	500	500	80 - 120*	84 - 113	13	10
	Surrogate:						
	aaa-Trifluorotoluene	0.0462	0.0462	94 - 102	85 - 106		
	Bromofluorobenzene	0.0493	0.0493	87 - 104	79 - 111		

* - Indicates use of method established limits; we are currently generating these limits for our laboratory.

Figure 7F Diesel Range Organics by AK102

Quality Control Limits

Method	Parameter	Continuing Cal Ver	Frequency	Acceptance Criteria	Corrective Action
AFCEE (AK102)	Diesel Range Hydrocarbons	Continuing Calibration Verif Stnds	Every 24 hrs.	RPD < 25% from initial calibration	1. Find source of problem 2.Repeat analysis 3. Recalibrate if needed
		Instrument Blanks	Every 24 hrs.	Below Practical Quantification Limit	1. Note in QC Summary 2. Evaluate data & repeat ext/analysis if necessary
		Extraction Blank	1 per extr batch of no greater than 20 samples	Below Practical Quantification Lmt	1. Note in QC Summary 2. Evaluate data & repeat extr./analysis if necessary
		Matrix Spike Matrix Spike Duplicate	1 per extraction batch of no greater than 20 samples	See page 57 for criteria	1. Check LCS recovery 2. If LCS is in control note in QC Sum as possible mtx interference
		Surrogate	Every Sample	See page 57 for criteria	1. Repeat instr. analysis 2. If replicate analysis confirms first, reext&reanly 3. If reextraction confirms first, note in QC Sum as possible mtrx interference
		Laboratory Control Sample	1 per analytical batch of no greater than 20 samples	+/- 25% Recovery	1. Repeat instr. analysis to rule out malinjection 2. If replicate analysis confirms first, reextract/ reanalyze entire batch
		Laboratory Control Standard	1 per ten client samples and at end of analytical sequence	See page 56 for criteria	1. Repeat instr. analysis to rule out malinjection 2. If replicate analysis confirms first, reextract/ reanalyze entire batch
		Multipoint Calibration	After instrument adjustment	RSD of average response factor <25%; R^2>0.995	1. Find source of problem and correct 2. Repeat calibration

8100 LCS STUDY
JULY 1994

Instrument ID: SAF
Matrix: Soil and Water

COMPOUND	LCL	UCL
Diesel Range Organics	75*	125*

UCL% = [TC + (3 * STD DEV)]/TC (99% Confidence)
LCL% = [TC - (3 * STD DEV)]/TC (99% Confidence)

TC = True Concentration

* - Indicates use of method specified limits; we are currently generating laboratory limits for this analysis.

Laboratory Control Limits for Matrix Spikes, Matrix Spike Duplicates, and Surrogates

Analytical Method	Spiking Compounds	Spike Concentration		Laboratory Established Control Limits			
		Water (µg/mL)	Soil (mg/kg)	Percent Recovery (%)		RPD (%)	
				Water	Soil	Water	Soil
EPA 8100M	Diesel Range Organics	398.5	398.5	71 - 106	84 - 113	13	10
	Surrogate:						
	o-Terphenyl	502	502	71 - 102	51 - 105		

Figure 7G Residual Range Organics by AK103

Quality Control Limits

Method	Parameter	Continuing Cal Ver	Frequency	Acceptance Criteria	Corrective Acti
AFCEE (AK103)	Residual Range Organics	Continuing Calibration Verification Standards	Every 24 hrs.	RPD < 25% from initial calibration	1. Find source of problem 2.Repeat analysis 3. Recalibrate if needed
		Instrument Blanks	Every 24 hrs.	Below Practical Quantification Limit	1. Note in QC Summary 2. Evaluate data & repeat extr/analysis if necessary
		Extraction Blank	1 per extr batch of no greater than 20 samples	Below Practical Quantification Lmt	1. Note in QC Summary 2. Evaluate data & repeat extr./analysis if necessary
		Matrix Spike Matrix Spike Duplicate	1 per extraction batch of no greater than 20 samples	See page 60 for criteria	1. Check LCS recovery 2. If LCS is in control note in QC Sum as possible mtx interference
		Surrogate	Every Sample	1 surrogate 50%-140% (soil)	1. Repeat instr. analys 2. If replicate analysis confirms 1st, reext&reanly 3. If reextraction confirms first, note in QC Sum as possible mtrx interference
		Laboratory Control Sample	1 per analytical batch of no greater than 20 samples	+/- 25% Recovery	1. Repeat instr. analysis to rule out malinjection 2. If replicate analysis confirms first, reextract/ reanalyze entire batch
		Laboratory Control Standard	1 per ten client samples and at end of analytical sequence	+/- 25% Recovery	1. Repeat instr. analysis to rule out malinjection 2. If replicate analysis confirms first, reextract/ reanalyze entire batch
		Multipoint Calibration	After instr adjustmt	RSD of avg resp fctr <25%; R^2>0.995	1. Find source prob&corct 2. Repeat calibratior

AK103 LCS STUDY
JULY 1994

Instrument ID: SAF
Matrix: Soil

COMPOUND	LCL	UCL
Residual Range Organics	75%*	125%*

UCL% = [TC + (3 * STD DEV)]/TC (99% Confidence)
LCL% = [TC - (3 * STD DEV)]/TC (99% Confidence)

TC = True Concentration

* - Indicates use of method specified limits; we are currently generating laboratory limits for this analysis.

Laboratory Control Limits for Matrix Spikes, Matrix Spike Duplicates, and Surrogates

Analytical Method	Spiking Compounds	Spike Concentration		Laboratory Established Control Limits			
			Soil (mg/kg)	Percent Recovery (%)		RPD (%)	
					Soil		Soil
AK103	Residual Range Organics		700*		50 - 140*		>40
	Surrogate:						
	d62-Tricontane		500*		50 - 140*		

* All values indicated as method criteria are not yet established. AK102 criteria will be used.

Figure 7H Semi-Volatile Organics by EPA 8270

Quality Control Limits

Method	Parameter	Continuing Calibration Verification	Frequency	Acceptance Criteria	Corrective Action
EPA 8270	Semi-Volatile Organics	Continuing Calibration Verif Standards	Every 12 hrs.	<30% D from 5 point average response factor	1. Find source of problem 2. Repeat analysis 3. Recalibrate if needed
		Instrument Blanks	Every 12 hrs.	Below Practical Quantification Limit	1. Note in QC Summary 2. Evaluate data and repeat extraction/analysis if necessary
		Extraction Blank	1 per extr batch of no greater than 20 samples	Below Practical Quantification Lmt	1. Note in QC Summary 2. Evaluate data & repeat extr./analysis if necessary
		Matrix Spike Matrix Spike Duplicate	1 per extraction batch of no greater than 20 samples	See pages 65 - 66 for criteria	1. Check LCS recovery 2. If LCS is in control note in QC Summary as possible matrix interference
		Surrogate	Every Sample	See attached page.	1. Repeat instr analysis 2. If replicate analysis confirms first, reextract and reanalyze 3. If reextraction confirms first, note QC Summary as possible mtrx interference
		Laboratory Control Sample	1 per extraction batch of no more than 20 samples	See attached page.	1. Repeat instr. analysis to rule out malinjection 2. If replicate analysis confirms first, reextract/ reanalyze entire batch
		Multipoint Calibration	After instrument adjustment	<30% RSD	1. Find source of problem and correct 2. Repeat calibration

Figure 7H (cont.)

EPA 8270 Surrogate Recovery Limits

Base/Neutral Extractables	% Recovery Limits water	soil
Nitrobenzene-d5	35-114	23-120
2-Fluorobiphenyl	43-116	30-115
Terphenyl-d14	33-141	18-137
Acid Extractables		
Phenol-d5	10-94	24-113
2-Fluorophenol	21-100	25-121
2,4,6-Tribromophenol	10-123	19-122

EPA 8270 COMPOUND LIST

NUMBER	COMPOUND	NUMBER	COMPOUND
1	1,4-Dichlorobenzene-d4	49	Dibenzofuran
2	Pyridine	50	Diethylphthalate
3	N-Nitrosodimethylamine	51	4-Chlorophenyl-phenylether
4	ANILINE	52	Fluorene
5	2-Fluorophenol (SURROGATE)	53	4-Nitroaniline
6	Phenol-d6 (SURROGATE)	54	Phenanthrene-d10
7	Phenol	55	4,6-Dinitro-2-methylphenol
8	bis(2-Chloroethyl)ether	56	N-Nitrosodiphenylamine
9	2-Chlorophenol	57	Azobenzene
10	1,3-Dichlorobenzene	58	2,4,6-Tribromophenol (SURR)
11	1,4-Dichlorobenzene	59	4-Bromophenyl-phenylether
12	Benzyl alcohol	60	Hexachlorobenzene
13	1,2-Dichlorobenzene	61	Pentachlorophenol
14	2-Methylphenol	62	Phenanthrene
15	bis(2-Chloroisopropyl)ether	63	Anthracene
16	4-Methylphenol	64	Di-n-butylphthalate
17	N-Nitroso-di-n-propylamine	65	Fluoranthene
18	Hexachloroethane	66	Chrysene-d12
19	Naphthalene-d8	67	Pyrene
20	Nitrobenzene-d5 (SURR)	68	Terphenyl-d14 (SURR)
21	Nitrobenzene	69	Butylbenzylphthalate
22	Isophorone	70	3,3'-Dichlorobenzidine
23	2-Nitrophenol	71	Benzo(a)anthracene
24	2,4-Dimethylphenol	72	Chrysene
25	Benzoic acid	73	Bis(2-Ethylhexyl)phthalate
26	bis(2-Chloroethoxy)methane	74	Perylene-d12
27	2,4-Dichlorophenol	75	Di-n-octylphthalate
28	1,2,4-Trichlorobenzene	76	Benzo(b)fluoranthene
29	Naphthalene	77	Benzo(k)fluoranthene
30	4-Chloroaniline	78	Benzo(a)pyrene
31	Hexachlorobutadiene	79	Indeno(1,2,3-cd)pyrene
32	4-Chloro-3-methylphenol	80	Dibenz(a,h)anthracene
33	2-Methylnaphthalene	81	Benzo(g,h,i)perylene
34	Acenaphthene-d10		
35	Hexachlorocyclopentadiene		
36	2,4,6-Trichlorophenol		
37	2,4,5-Trichlorophenol		
38	2-Chloronaphthalene		
39	2-Fluorobiphenyl (SURROGATE)		
40	2-Nitroaniline		
41	Dimethylphthalate		
42	Acenaphthylene		
43	2,6-Dinitrotoluene		
44	3-Nitroaniline		
45	Acenaphthene		
46	2,4-Dinitrophenol		
47	4-Nitrophenol		
48	2,4-dinitrotoluene		

8270 LCS LIMIT STUDY
JULY 1994

Instrument ID: VKA
Matix: Soil and Water

Compound Number	LCL%	UCL%
1	80*	120*
2	80*	120*
3	80*	120*
4	80*	120*
5	80*	120*
6	80*	120*
7	80*	120*
8	80*	120*
9	80*	120*
10	80*	120*
11	80*	120*
12	80*	120*
13	80*	120*
14	80*	120*
15	80*	120*
16	80*	120*
17	80*	120*
18	80*	120*
19	80*	120*
20	80*	120*
21	80*	120*
22	80*	120*
23	80*	120*
24	80*	120*
25	80*	120*
26	80*	120*
27	80*	120*
28	80*	120*
29	80*	120*
30	80*	120*
31	80*	120*
32	80*	120*
33	80*	120*
34	80*	120*
35	80*	120*
36	80*	120*
37	80*	120*
38	80*	120*
39	80*	120*
40	80*	120*
41	80*	120*
42	80*	120*
43	80*	120*
44	80*	120*
45	80*	120*
46	80*	120*

UCL% = [TC + (3 * STD DEV)]/TC (99% Confidence)
LCL% = [TC - (3 * STD DEV)]/TC (99% Confidence)

TC = True Concentration

Compound Number	LCL%	UCL%
47	80*	120*
48	80*	120*
49	80*	120*
50	80*	120*
51	80*	120*
52	80*	120*
53	80*	120*
54	80*	120*
55	80*	120*
56	80*	120*
57	80*	120*
58	80*	120*
59	80*	120*
60	80*	120*
61	80*	120*
62	80*	120*
63	80*	120*
64	80*	120*
65	80*	120*
66	80*	120*
67	80*	120*
68	80*	120*
69	80*	120*
70	80*	120*
71	80*	120*
72	80*	120*
73	80*	120*
74	80*	120*
75	80*	120*
76	80*	120*
77	80*	120*
78	80*	120*
79	80*	120*
80	80*	120*
81	80*	120*

* - Indicates use of method specified control limits; we are currently generating laboratory limits for this analysis.

Laboratory Control Limits for Matrix Spikes, Matrix Spike Duplicates, and Surrogates

Analytical Method	Spiking Compounds	Spike Concentration		Laboratory Established Control Limits			
				Percent Recovery (%)		RPD (%)	
		Water (µg/L)	Soil (µg/kg)	Water	Soil	Water	Soil
EPA 8270	1,4-Dichlorobenzene-d4	100	100	*	*	*	*
	Pyridine	100	100	*	*	*	*
	N-Nitrosodimethylamine	100	100	*	*	*	*
	Analine	100	100	*	*	*	*
	Phenol	100	100	18 - 63	29 - 96	86	16
	bis(2-Chloroethyl)ether	100	100	*	*	*	*
	2-Chlorophenol	100	100	28 - 90	27 - 85	105	64
	1,3-Dichlorobenzene	100	100	*	*	*	*
	1,4-Dichlorobenzene	100	100	22 - 58	26 - 78	31	72
	Benzyl alcohol	100	100	*	*	*	*
	1,2-Dichlorobenzene	100	100	*	*	*	*
	2-Methylphenol	100	100	*	*	*	*
	bis(2-Chloroisopropyl)ether	100	100	*	*	*	*
	4-Methylphenol	100	100	*	*	*	*
	N-Nitroso-di-n-propylamine	100	100	33 - 96	31 - 100	51	61
	Hexachloroethane	100	100	*	*	*	*
	Naphthalene-d8	100	100	*	*	*	*
	Nitrobenzene	100	100	*	*	*	*
	Isophorone	100	100	*	*	*	*
	2-Nitrophenol	100	100	*	*	*	*
	2,4-Dimethylphenol	100	100	*	*	*	*
	Benzoic acid	100	100	*	*	*	*
	bis(2-Chloroethoxy)methane	100	100	*	*	*	*
	2,4-Dichlorophenol	100	100	*	*	*	*
	1,2,4-Trichlorobenzene	100	100	24 - 66	28 - 84	46	71
	Naphthalene	100	100	*	*	*	*
	4-Chloroaniline	100	100	*	*	*	*
	Hexachlorobutadiene	100	100	*	*	*	*
	4-Chloro-3-methylphenol	100	100	43 - 89	41 - 89	45	62
	2-Methylnaphthalene	100	100	*	*	*	*
	Acenaphthene-d10	100	100	*	*	*	*
	Hexachlorocyclopentadiene	100	100	*	*	*	*
	2,4,6-Trichlorophenol	100	100	*	*	*	*
	2,4,5-Trichlorophenol	100	100	*	*	*	*
	2-Chloronaphthalene	100	100	*	*	*	*
	2-Nitroaniline	100	100	*	*	*	*
	Dimethylphthalate	100	100	*	*	*	*
	Acenaphthylene	100	100	*	*	*	*
	2,6-Dinitrotoluene	100	100	*	*	*	*
	3-Nitroaniline	100	100	*	*	*	*
	Acenaphthene	100	100	43 - 81	39 - 86	22	64
	2,4-Dinitrophenol	100	100	*	*	*	*
	4-Nitrophenol	100	100	D - 76*	20 - 120	212	61
	2,4-dinitrotoluene	100	100	48 - 91	40 - 86	30	61
	Dibenzofuran	100	100	*	*	*	*
	Diethylphthalate	100	100	*	*	*	*
	4-Chlorophenyl-phenylether	100	100	*	*	*	*
	Fluorene	100	100	*	*	*	*

Laboratory Control Limits for Matrix Spikes, Matrix Spike Duplicates, and Surrogates

Analytical Method	Spiking Compounds	Spike Concentration		Laboratory Established Control Limits			
				Percent Recovery (%)		RPD (%)	
		Water (µg/L)	Soil (µg/kg)	Water	Soil	Water	Soil
EPA 8270	4-Nitroaniline	100	100	*	*	*	*
(cont.)	Phenanthrene-d10	100	100	*	*	*	*
	4,6-Dinitro-2-methylphenol	100	100	*	*	*	*
	N-Nitrosodiphenylamine	100	100	*	*	*	*
	Azobenzene	100	100	*	*	*	*
	4-Bromophenyl-phenylether	100	100	*	*	*	*
	Hexachlorobenzene	100	100	*	*	*	*
	Pentachlorophenol	100	100	14 - 125	41 - 113	203	45
	Phenanthrene	100	100	*	*	*	*
	Anthracene	100	100	*	*	*	*
	Di-n-butylphthalate	100	100	D - 88	43 - 181	71	58
	Fluoranthene	100	100	*	*	*	*
	Chrysene-d12	100	100	*	*	*	*
	Pyrene	100	100	39 - 87	39 - 91	26	68
	Butylbenzylphthalate	100	100	*	*	*	*
	3,3'-Dichlorobenzidine	100	100	*	*	*	*
	Benzo(a)anthracene	100	100	*	*	*	*
	Chrysene	100	100	*	*	*	*
	Bis(2-Ethylhexyl)phthalate	100	100	*	*	*	*
	Perylene-d12	100	100	*	*	*	*
	Di-n-octylphthalate	100	100	*	*	*	*
	Benzo(b)fluoranthene	100	100	*	*	*	*
	Benzo(k)fluoranthene	100	100	*	*	*	*
	Benzo(a)pyrene	100	100	*	*	*	*
	Indeno(1,2,3-cd)pyrene	100	100	*	*	*	*
	Dibenz(a,h)anthracene	100	100	*	*	*	*
	Benzo(g,h,i)perylene	100	100	*	*	*	*
	Surrogates:						
	2-Fluorophenol	100	100	21 - 100	25 - 121		
	Phenol-d5	100	100	10 - 94	24 - 113		
	Nitrobenzene-d5	100	100	35 - 114	23 - 120		
	2-Fluorobiphenyl	100	100	43 - 116	30 - 115		
	2,4,6-Tribromophenol	100	100	10 - 123	19 - 122		
	Terphenyl-d14	100	100	33 - 141	18 - 137		

* - Indicates use of method established limits; we are currently generating these limits in our laboratory. See method 8270A table 6 for established limits (p. 37).

8.0 Data Reduction, Validation, and Reporting

This section will detail three methods:

1. How analytical data is reduced to a form easily used by the client.
2. How the data is validated.
3. How the data is reported.

8.1 Data Reduction and Validation

8.1.1 The Analyst

At CT&E ELS, data reduction and validation begin with the specific area supervisor (group leader). This person reviews the laboratory generated workorder and makes sure that all the required paperwork is complete and accounted for. If nothing is found to be missing, the samples become available to the analyst. The analyst then checks to make sure that the samples have been properly prepared (digested/extracted) according to the guidelines set forth in the method SOP. Only then is the analysis performed.

Once the analysis of a set of samples is complete, the analyst performs the necessary calculations (data reduction) to bring the data into final form. The calculations involved with metals analysis by ICP will be different than those for total petroleum hydrocarbons by IR -- so this process is dependent upon the actual analysis. Nevertheless, a general principle can be given: Instrument response usually gives an average concentration of analytes in the solution being analyzed. The analyst must then calculate the concentrations of analytes in the field sample either in mass/mass or mass/volume by taking into consideration the particular dilution that has been applied during preparation. In addition to these calculations, the analyst checks to make sure:

1. That calibration of the instrument was and remained within guidelines throughout the analysis.
2. That qualitative identification of analytes is correct.
3. That quantitative results are correct and complete.
4. That the analysis conforms to the client request.
5. That QC samples are within control limits.

8.1.2 Peer Review

The analyst turns the analytical data over to a qualified peer who has also been trained to perform the analysis being reviewed. The peer's review will consist of the same items listed in section 8.1.1, p.67.

8.1.3 The Area Supervisor

The area supervisor takes charge of the data package and checks all calculations and verifies other aspects of the analysis by confirming that the:

1. Chain-of-Custody is complete.
2. Holding Times have been met.
3. Analysis is complete and accurate according to the client contract.
4. Data is ready to be incorporated into the final report.

If any errors or omissions are detected, the supervisor reviews the data with the analyst to determine if corrections or reanalyses are necessary.

8.1.4 QC Department

The area supervisor passes control of the data package to the QC department where it is again reviewed. When the QC Department is satisfied that all calculations are correct and complete, the data is entered into a database report matrix on a computer and a report is generated. A case narrative is prepared and included with the data package. This report is then returned to the area supervisor for final departmental approval.

8.1.5 Technical Director

After the area supervisor has completed his/her final review, the data is routed to the laboratory Technical Director. The laboratory Technical Director perfoms a final review and issues the report to the client. All persons involved in the chain of review have the authority to reject any data that falls outside of QC limits and can authorize reanalysis if necessary.

8.2 Data Reporting (Hard copy)

CT&E ELS issues three levels of hard copy Data Deliverables Packages. The Laboratory Fee Schedule provides additional details about the packages available to clients along with associated costs. In summary, the Quality Control Data Deliverable Reports may contain any or all of what follows:

General Background

- Cover Page
- Table of Contents
- Case Narrative
  - The analytical batch number and the analysis performed
  - A description of any quality control issues associated with analytical batch
  - A cross reference table of field sample numbers and laboratory sample numbers
- Glossary of Qualifiers

Analytical Results

- Sample Result Sheets

Analysis Sections

For GC/MS Methods (SW8240,SW8260 and SW8270 and SW 8280):

- Extraction benchsheets
- Instrument injection log sheets
- Instrument tune data (ion abundance table) including criteria summary, associated standards, laboratory QC and sample numbers
- Spectra and mass listings
- Continuing calibration data
  - Response factors and percent difference summaries
  - Quantitation reports
  - Chromatograms
- Initial calibration data
  - Response factors and relative standard deviation summaries
  - Quantitation reports
  - Chromatograms

- Sample data
  - Result summary reports
  - Quantitation reports
  - Chromatograms
  - Mass spectra for all positive results
- Laboratory QC (method blanks, MS/MSD, LCS/LCSD and check samples)
  - Summary reports
  - Quantitation reports
  - Chromatograms

For GC methods (SW8080, AK101, AK102, and AK103):

- Extraction benchsheets
- Instument injection log sheets
- Continuing calibration data
  - Response factors (or calibration factors) and percent difference summaries
  - Quantitation reports
  - Chromatograms
- Initial calibration data
  - Response factors (or calibration factors) and relative standard deviation summaries
  - Quantitation reports
  - Chromatograms
- Sample data (primary and confirmational analyses)
  - Result summary reports
  - Quantitation reports
  - Chromatograms
- Laboratory QC (method blanks, MS/MSD, LCS/LCSD and check samples
  - Summary reports
  - Quantitation reports
  - Chromatograms
- Other specific State of Alaska Requirements for AK101, AK102, and AK103

For metals SW6010/SW7000 series and wet chemisty:

- Digestion/preparation benchsheet
- Instrument run logs
- Calibration (ICV, CCV)
  - Summary forms
  - Raw data
- Instrument printouts
- Batch quality control results
- Laboratory QC (method blanks, MS/MSD, LCS/ LCSD and check samples)
  - Summary reports
  - Quantitation reports

For geotechnical analyses:

- Sample summary and raw data
- Quality control summary and raw data
- Laboratory SOP

8.3 Data Reporting (Digital)

For JEMS Electronic Deliverable's requirements please see Appendices, section 2.

Figure 8A
Data Deliverable Levels Chart

Quality Assurance Data Deliverables

CT&E ELS maintains a QA/QC Department dedicated to ensuring that all analyses performed produce legally defensible data. Accuracy and precision are met through strict adherence to State and EPA protocol and comprehensive internal review procedures. The table below describes what is provided for AFCEE Data Deliverables.

Section	Contents	AFCEE Data Deliverables
General Background	Cover Page	X
	Table Of Contents	X
	Case Narrative	X
	Chains of Custody	X
	Glossary of Qualifiers	X
Analytical Results	Sample Result Sheets	X
Analysis Sections	QC Summary Page & Tables	X
	QC Data Tables	X
	Raw Analytical Data	X

9.0 Internal Quality Control Checks

9.1 Purpose

CT&E ELS has internal quality control checks to monitor data quality. These checks take several forms:

1. The processing of QC samples to assure that the data generated during the analysis of samples satisfies established criteria for accuracy and precision -- that laboratory processes are *in control*.
2. The processing of QC samples needed to ascertain the effect a sample matrix has on data generated. Demonstrate what steps, if any, are necessary to correct those effects.
3. Data validation to assure that all calculations are complete, correct, and accurately reported.
4. Data verification to eliminate transcription or typographical errors.

9.1.1 Procedures to Assess Data Accuracy and Precision

Mathematical treatment of data, in regards to precision and accuracy, will be addressed in sections 10.2 and 10.3, pp.75-76. CT&E ELS' general procedures for evaluating accuracy and precision are given below. (See definitions in sections 7.1.1 and 7.1.2, pp.22-25; and acceptance criteria in figures on pages 27-66.)

1. Known standards are processed to determine the linear response range of the instrument, method and analyte.
2. Matrix blanks are prepared and analyzed with every run or one for every 20 samples; whichever is the more frequent.
3. Calibration Verification Standards are run at a minimum 10% frequency rate for inorganics; and typically once per day, prior to any analyses, for organics.
4. Quality Control Samples are included once per run.
5. Calibration Blanks are run at a minimum 10% frequency rate.
6. One sample in every 20 is analyzed in duplicate.
7. All samples analyzed by GC or GCMS are spiked with surrogate compounds.
8. Field and Trip Blanks are analyzed upon client request.

9.1.1.1 Procedural Checks

1. Check Samples assure that the linear range calibration curve is correct. All concentrations of analytes must fall within this linear range. Any analytes that fall outside of the linear range are diluted to bring them into compliance.
2. Matrix Blanks are checked for interferences. The concentration of analytes in the matrix should not be high enough to significantly alter calculations of unknown values. If they are the source of interference, the error must be determined and corrected. If necessary, all samples should be reanalyzed.
3. The Percent Recovery of spike/surrogate samples is calculated and compared with in-house acceptable limits. Appropriate corrective action is taken if nonconformance is found.
4. The RPD of duplicate samples is calculated and compared with acceptable limits. Corrective action is taken if appropriate.
5. Field blanks are checked for contamination and reported to the client.

10.0 Calculation of Data Quality Indicators

10.1 Introduction

The effectiveness of the QA program at CT&E ELS is measured by the quality of data generated. The quality of data is judged by its *precision, accuracy, completeness, representativeness,* and *comparability.* (Terms defined in Section 3, p.7)
There are mathematical relationships by which precision, accuracy, and completeness can be measured. These will be discussed below.

10.2 Precision

As defined earlier, precision is a measure of how reproducible a measurement is. That is, if the same quantity is measured a number of times, how closely are the data values grouped? Standard deviation is the most commonly used measure of precision. Standard deviation is calculated using the equation below.

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(Xi - \overline{X})^2}$$

Where s is standard deviation of a quantity X measured n times. It should be noted that there is an inverse relationship between standard deviation and precision. The larger the standard deviation, the more imprecise the measurements. If an error in data collection is truly random, 68.3% of the measurements will fall within +/- one standard deviation of the mean and 95.5% will fall +/- within two standard deviations of the mean. There is one difficulty that arises: when doing chemical analyses of environmental samples, it is not usually feasible to evaluate the large number of samples necessary to use standard deviation or even the *student* t-factor.

Generally, sample duplicates are used to determine the precision of an analysis (See Section 7.1.2, p.24). The measure of precision used for analysis is relative percent difference (RPD).

$$RPD = \frac{(D1 - D2)}{(D1 + D2)/2} \times 100$$

Where RPD = relative percent difference
D1 = sample value and D2 = sample duplicate value
When RPD's have been determined for enough samples (i.e. 10+), the average RPD and standard deviation of RPD can be calculated. Control charts to detect out of control trends can be constructed from this data. The limit of acceptability is usually set at ±2 standard deviations.

10.3 Accuracy

Accuracy is a measure of how close a measured value is to a true value. Unfortunately, for field samples the true value is unknown. It is, in fact, the quantity that ideally will be established. It is possible, however, to measure the accuracy of measurements using matrix spikes (See Section 7.1.2, p.24). The recovery of spiked analytes (or surrogates) is monitored and used to calculate percent recovery as a measure of the accuracy of the measuring system.

$$\%R = \frac{(SSR - SR)}{SA} \times 100$$

Where %R = the percent recovery
SSR = the analytically determined spiked sample concentration
SR = the analytically determined sample concentration
SA = the true concentration of the spike

The true concentration of the spike (SA) is calculated as follows.

$$SA = \frac{\text{spike concentration in mg/L} \times \text{volume of spike in mL}}{\text{volume of sample in mL} + \text{volume of spike in mL}}$$

When %R's have been determined for enough samples (again about 10 or so), mean percent recovery and standard deviation of percent recovery can be calculated and used to create control charts for evaluation of out-of-control trends in accuracy. Control limits are usually set the same as in control of precision (±2 S).

10.4 Completeness

Field Completeness and Lab Completeness

Completeness of a study involves two parameters: First, the study must contain all of the QC check analyses necessary to verify precision and accuracy; second, the data generated must meet all of the stated goals of the client. When possible, the percent of usable data should be calculated as follows:

$$\text{Completeness} = \frac{\text{valid data obtained}}{\text{total data planned}} \times 100$$

10.5 Detection Limits

Instruments have an inherent sensitivity in the detection of analytes. That sensitivity is expressed in terms of detection limits and will vary from one instrument to another, from one method to another, and from one analyte to another. It is necessary to establish those limits before using an instrument and to monitor them on an ongoing basis during analysis. The SOP for an instrument or a method must define the means by which detection limits are established. Definitions of instrument detection limits (IDL), method detection limits (MDL), and practical quantitation limits (PQL) are given below.

The *IDL* of an instrument is the minimum signal strength above background that an instrument can detect at a specified confidence level. It is measured by analyzing replicate blank samples.

[1] *MDL* - the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte.

For operational purposes, when it is necessary to determine the MDL in the matrix, the MDL should be determined by multiplying the appropriate one-sided 99% t-statistic by the standard deviation obtained from a minimum of three(seven for CT&E) analyses of a matrix spike containing the analyte of interest at a concentration three to five times the estimated MDL. See SW-846, 3rd Edition, for values and calculations.

The *PQL* is the lowest level that can be reliably measured within specified limits of precision and accuracy during routine laboratory operating conditions. CT&E will report 1993 AFCEE PQL's except for the variances otherwise specified (See Appendix #8).

[1] Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition, Final Update I, July 1992, pp. 25 - 26.

11.0 Preventive Maintenance

Analytical instruments and equipment require routine and non-routine maintenance.

11.1 Routine

Routine maintenance is performed by the instrument operator as described in the preventive maintenance procedures of the operator's manual or instrument SOP. Typically, the following preventive maintenance activities will be performed:

1. Check instrument sensitivity and response daily or prior to each use as described in the operator's manual, SOP, or analytical method. This may include:

    - Daily Calibration
    - Wave Length Checks
    - Gas Flow Measurements/Leak Checks
    - Proper Energy Levels
    - Zeroing and Full Scale Operation

2. Incubators and refrigerators are checked daily for proper temperature and readings are kept in log-books. If the temperature deviates from tolerance ranges, immediate adjustments are made.
3. Exhaust hoods are checked monthly. Flow rates are recorded. Minimum exhaust flow rates are established and recorded for each hood.

11.2 Non-routine

Non-routine maintenance is performed by qualified service technicians or by operators, depending on manufacturer's specifications.

11.3 Responsibilities

Area supervisors are responsible for preventive maintenance within their departments. Records of preventive maintenance will become part of a permanent record for each instrument. Area supervisors are also responsible for monitoring an inventory of spare parts for each instrument. Spare parts are defined as: *Expendable parts as well as those parts subject to wear and/or breakage*. A sufficient inventory will be kept on hand to reduce down-time.

12.0 Corrective Action

Corrective action becomes necessary whenever nonconformance is detected in any analytical system. Nonconformance is any event or result that is outside previously established control limits. There are many points at which nonconformance may be detected.

1. The Analyst
2. Peer Review
3. Supervisor Review
4. QC Review
5. Management Review
6. Client Review

12.1 The Analyst

Laboratory personnel are alerted to analytical problems with the use of a Corrective Action Form. A Corrective Action form is necessary if any or all of the following occur:

1. QC data is outside the warning or acceptable window for precision and/or accuracy.
2. Blanks, QC samples, or calibration samples contain contaminants above acceptable levels.
3. Undesirable trends are detected in spike recoveries or RPD's between duplicates.
4. Unusual changes are observed in detection limits.

Corrective action procedures are often handled at the bench level by the analyst. The analyst reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, etc. There is no substitute for experienced analysts in the detection of nonconformance at this level, and the vast majority of problems will be detected and corrected without intervention of the QC Department. When a corrective action is initiated, copies of the form are distributed for review to the area supervisor, laboratory Technical Director and QC Manager. A copy of the corrective action is also kept with any workorder files associated with the out of control event. If the problem persists or cannot be identified, the matter is referred to the area supervisor, the laboratory Technical Director, and/or the QA Department for further investigation.

12.2 QC Review

Nonconformance of the type covered earlier should normally be detected and corrected before QC review is initiated. When such an event occurs, a report is submitted to the QC Department and the Laboratory Technical Director about the problem, how it was detected, and what corrective action was taken to alleviate problem (See Figure 12A, p.81). QC review is in place:

1. To review data and catch errors of the above type that are not detected by the analyst.
2. To receive reports about and approve corrective actions taken to correct nonconformance.
3. To perform statistical analysis of data generated in order to detect more subtle out-of-control trends.
4. To administer the laboratory analysis audit program.
5. To address, research, and answer client inquiries concerning data quality.

Errored conditions detected at any point will be fully investigated. Once resolved, full documentation of corrective actions will be filed with the QC Department, the Laboratory Director, and the Technical Director. If necessary, the area supervisor will be notified of actions taken. Recommendations will be made to the area supervisors concerning retraining of the analyst involved or modifying the method used.

Figure 12A
Corrective Action Form

CORRECTIVE ACTION
For Errors and Omissions

Chem Lab Ref#: _____ Date: _____
Instrument(s): _____ Method(s): _____

TO BE COMPLETED BY CLIENT SERVICE MANAGER

Client Notified: _____ Date/Time: _____
Contact Name: _____ Notified By: _____
Comments: _____

Describe problem to include: How problem was detected, nature of problem, what corrective action was taken, etc.

What recomendations do you have to avoid similar problems in the future? _____

What steps were taken to avoid similar problems? _____

Standard Operation Procedure Edited by: _____ Date: _____

Documented by: _____ Date: _____
Supervisor: _____ Date: _____
Technical Director: _____ Date: _____

Routing: ☐ SCE ☐ LLH ☐ WO File ☐ Department Supervisor for SOP Edit

13.0 Performance and System Audits

13.1 Certifications

CT&E ELS is certified by the Alaska Department of Environmental Conservation, The US Army Corps of Engineers, and provisionally certified with AFCEE for the analysis of drinking water, and solid and hazardous waste in the areas of:

- Inorganic Chemicals
- Organic Chemicals
- Pesticides
- Physical Contaminants
- Microbiological Analysis
- Trihalomethanes

These certifications are done in accordance with EPA regulations. These regulations include an on-site evaluation of the laboratory by ADEC, AFCEE, and the Corps of Engineers to ensure that equipment, personnel, and laboratory techniques are in conformance to EPA guidelines.

13.2 External Audits

Unknown check samples are submitted to the laboratory by EPA, the Corps of Engineers, and clients for analysis. The purpose of these external audits is to identify those laboratories that can generate acceptable analytical data Results of these audits are evaluated by the testing agency and must fall within an acceptable range of analytical performance. Failure to obtain acceptable results can result in decertification.

13.3 Internal Audits

In addition to external audits conducted by certifying agencies or clients, CT&E ELS conducts the following internal audits:

1. Blind samples are introduced into the analysis stream to evaluate personnel and methods on an ongoing basis.
2. Double Blind audit samples are introduced on an as-needed basis when concerns arise about a particular analysis, the method, the instrument, or the analyst. This often includes blank samples to test for false positive results.

In order to maintain quality control on an ongoing basis, laboratory control samples prepared from EPA or reference laboratory, samples are analyzed with each batch for most analytes. Data must fall within specified confidence limits.

14.0 Quality Assurance Reports to Management

Quality Assurance Reports to management are intended to keep management abreast of Quality Assurance Program developments. Reports will be performed on a monthly basis and will generally include:

1. Results of external and internal audits.
2. Performance evaluation scores.
3. Problems encountered and corrective action taken.
4. Results of site visits by regulatory agencies and clients.
5. Performance on contracts.
6. Holding time violations.
7. Recommendations.

15.0 Laboratory Safety

Safety is one of the most important elements in the operation of an analytical laboratory. CT&E ELS is fully committed to providing a safe working environment and enforcing procedures which will ensure the health and safety of each employee.

15.1 Safety Protection

Two of the major hazards in an analytical laboratory are the potential for physical injury and exposure to hazardous chemicals. These two hazards are controlled by the use of personal protective equipment and a strict protocol for material handling.

1. Personal Protection Equipment

- Safety glasses with side shields will be worn at all times in the laboratory.
- Chemical splash goggles and/or face shields will be worn when handling hazardous liquids.
- Respirators will be worn when handling highly hazardous chemicals.
- Overalls and shoe covers will be worn when handling highly hazardous materials.
- Gloves will be worn when handling hazardous materials.
- Wearing contact lenses is strictly prohibited in the lab.

2. Laboratory Operating Procedures

- Materials spilled onto the floors will be cleaned up immediately using approved disposal protocols.
- Obstructions from movement will not be allowed in walkways or working areas that may cause tripping, falling, or any harm to an individual.
- Hazard warning signs will be posted at all locations where there is a potential safety or health hazard.
- All personnel will be informed of the hazards in their work places.
- Hazardous materials will be handled in containment devices such as fume hoods or fume absorbers.
- Laboratory personnel will not store food, eat, drink, or smoke in the laboratory.

15.2 Safety Equipment

The following requirements are intended to ensure that laboratory equipment is operated and handled so as to prevent injury.

1. All electrical equipment should be grounded.
2. Multiple extension outlets must not be overloaded(total amperage demand).
3. Electrical cords will be selected so as to prevent overloading.
4. All cylinders of compressed gas will be secured to prevent falling and will be only transported on transport dollies.
5. All belts and pulleys will be covered or shielded from personal contact.
6. All cylinders and transfer lines containing flammable gases will not be tampered with or overridden at any time.
7. Fume hood face velocities will be recorded monthly in a log and corrective action will be taken if they indicate less than 100 cfm.

15.3 Fire Safety

1. Fire extinguishers (A,B,C, and Halon) will be placed in all laboratory and chemical storage areas.
2. Fire extinguishers will be checked annually and refilled if necessary.
3. Flammable liquids will be stored in the flammable storage area or in flammable liquid storage cabinets in laboratory areas.
4. No more than 60 gallons of flammable liquid may be stored in a cabinet or in the laboratory.
5. Water reactive chemicals and oxidizers will be stored separately.
6. Waste flammable liquids will be stored in 5 gallon flammable liquid cans.
7. Flammable liquids will not be handled near open flame or other ignition sources.
8. Evacuation route diagrams will be posted.

15.4 Safety Training

All personnel will receive monthly training via seminars, professional training programs or videotapes in the following areas:

1. Hazardous chemical handling
2. General safety (multiple topics)

16.0 Disposal of Laboratory Chemicals and Samples

CT&E ELS maintains a Waste Disposal Program for safe and environmentally sound disposal of laboratory waste in small quantities. Disposal practices are followed in accordance with the Resource Conservation and Recovery Act (RCRA) as well as other Federal, State, and Municipal requirements. Laboratory personnel responsible for waste removal must review these guidelines. In particular, the definition of a hazardous waste, the specific substances listed as hazardous, generator requirements and exclusions, and proper shipping and documentation procedures are critically observed. CT&E ELS provides safety and training programs in monthly safety meetings regarding procedures to follow in the treatment and disposal of designated laboratory waste.

16.1 Summary of the Waste Disposal Program

1. The necessary classification of the waste for shipping and manifestation is addressed by its common or generic chemical name and by D.O.T. guidelines.
2. Various types of waste are listed and defined in a manner necessary to segregate them for recovery, pretreatment, and/or disposal.
3. Procedures are noted for the recovery of materials, or to render them non-hazardous and amenable to a municipal landfill or in-house disposal, or to prepare them for disposal in an authorized chemical waste disposal site.
4. Each type of waste is designated a specific recovery or pretreatment and disposal method. In most cases, disposal alternatives are offered.

17.0 Personnel Training

Intra-laboratory training programs and on the job training include:

- Study of Standard Operating Procedures and references.
- Observation of experienced operators/analyst.
- Performing analyses under direct supervision of experienced personnel.
- Analyzing blind QC samples prepared by the Quality Assurance personnel.

Quality assurance training is coordinated by the Quality Assurance Manager.

Appendices

1. Required Containers, Preservatives, and Holding Times
   (Table 2-1, *1993 AFCEE Handbook*, pp. 2-25 - 2-27)

2. JEMS Electronic Deliverables
   (*JEMS Laboratory Data Submission Handbook*, Version 2.1, pp. 01 - 27)

3. Gasoline Range Organics (AK101) SOP

4. Diesel Range Organics (AK102) SOP

5. Residual Range Organics (AK103) SOP

6. SGS Code of Practice

7. Commercial Testing and Engineering Company's Quality Policy

8. Variance Letters

Table 2-1. Requirements for Containers, Preservation Techniques, Sample Volumes, and Holding Times

Name	Methods of Analysis	Container[1]	Preservation[2,3]	Minimum Sample Volume or Weight	Maximum Holding Time
Inorganic tests					
Alkalinity (Field Test)	A2320	P,G	None Required	50 mL	Analyze immediately
Alkalinity (Lab Test)	A2320	P,G	4°C	50 mL	14 days
Common Anions	SW9056	P,G	None Required	50 mL	28 days for Br,F,CL,SO_4; 48 hrs for NO_3,NO_2,PO_4
Cyanide, Total, and Amenable to Chlorination	SW9010	P,G,T	4°C,NaOH to pH<12[2] 0.6 g ascorbic acid	500 mL or 4 ounces	14 days (water and soil)
Filterable Residue	E160.1	P,G	4°C	100 mL	7 days
Non-Filterable Residue	E160.2	P,G	4°C	100 mL	7 days
Hydrogen Ion (pH) w/s (Field Test)	SW9040/ SW9045	P,G	None Required	N/A	Analyze immediately
Nitrogen, Nitrate + Nitrite	E353.1	P,G	4°C, H_2SO_4 to pH<2	500 mL	28 days
Specific Conductance (Field Test)	SW9050	P,G	None Required	N/A	Analyze immediately
Temperature	E170.1	P,G	None Required	N/A	Analyze immediately
Total Organic Carbon	SW9060	P,G,T	4°C, HCl or H_2SO_4 to pH<2[2]	500 mL or 4 ounces	28 days (water and soil)
Metals					
Chromium VI	SW7196	P,G,T	4°C	500 mL or 8 ounces	24 hours (water and soil)[4]
Mercury	SW7470, SW7471	P,G,T	HNO_3 to pH<2[2], 4°C	500 mL or 8 ounces	28 days (water and soil)
Metals, except Chromium VI and Mercury	SW6010 and SW-846 atomic absorption methods	P,G,T	HNO_3 to pH<2[2], 4°C	500 mL or 8 ounces	180 days (water and soil)
Organic Tests	E418.1[5]				
Petroleum Hydrocarbons		G,T	4°C,[2] H_2SO_4 to pH<2	1 Liter or 8 ounces	Water and soil—28 days
Fuel Hydrocarbons Volatile	SW8015 (modified)	G, Teflon-lined Septum T	4°C,[2] HCl to pH<2	2x40 mL or 4 ounces	14 days (water and soil) 7 days if unpreserved by acid

Table 2-1. Requirements for Containers, Preservation Techniques, Sample Volumes, and Holding Times (Continued)

Extractable	SW8015 (modified)	G,amber,T	4°C	1 liter or 8 ounces	Water-7 days until extraction; 40 days after extraction Soil-14 days until extraction; 40 days after extraction
Aromatic Volatile Organics	SW8020	G,Teflon-lined, Septum, T	4°C, HCl to pH<2[2] 0008% $Na_2S_2O_3$	2x40 mL or 4 ounces	14 days (water and soil), 7 days unpreserved by acid
Chlorinated Herbicides	SW8150	G, Teflon-lined, Cap, I	4°C, pH 5-9	1 liter or 8 ounces	Water-7 days until extraction; 40 days after extraction Soil-14 days until extraction; 40 days after extraction
Pesticides and Polychlorinated Biphenyls (PCBs)	SW8080, SW8140	G, Teflon-lined, Cap T	4°C, pH 5-9	1 liter or 8 ounces	Water-7 days until extraction; 40 days after extraction Soil-14 days until extraction; 40 days after extraction
Phenols	SW8040	G, Teflon-lined, Cap T	4°C, 0.008% $Na_2S_2O_3$	1 liter or 8 ounces	Water-7 days until extraction; 40 days after extraction Soil-14 days until extraction; 40 days after extraction
Semivolatile Organics	SW8270	G, Teflon-lined Cap, T	4°C, 0.008% $Na_2S_2O_3$	1 liter or 8 ounces	Water-7 days until extraction; 40 days after extraction Soil-14 days until extraction; 40 days after extraction
Volatile Organics	SW8240, SW8015(mod), SW8010 SW8260	G, Teflon-lined Septum, T	4°C, 0.008% $Na_2S_2O_3$ (HCl to pH<2[2] for volatile aromatics by SW8240)[2] and SW8260	2 x 40 mL or 4 ounces	14 days (water and soil); 7 days unpreserved by acid
Polycyclic Aromatic Hydrocarbons (PAHs)	SW8310	G, Teflon-lined Cap, T	4°C, store in dark, 0.008% $Na_2S_2O_3$	1 liter or 8 ounces	Water-7 days until extraction; 40 days after extraction Soil-14 days until extraction; 40 days after extraction
Carbamate Pesticides	SW8314	G, Teflon-lined Cap, T	4°C, 0.008% $Na_2S_2O_3$	1 liter or 8 ounces	Water-7 days until extraction; 40 days after extraction Soil-14 days until extraction; 40 days after extraction
Dioxins	SW8280 SW8290	G, Teflon-lined Cap, T	4°C, 0.008% $Na_2S_2O_3$	1 liter or 8 ounces	Water and soils-30 days until extraction; 45 days after extraction
1,2-dibromoethane	ES04	G, Teflon-lined Cap, T	4°C, 0.008% $Na_2S_2O_3$	2 x 40 mL	Water-28 days

Table 2-1. Requirements for Containers, Preservation Techniques, Sample Volumes, and Holding Times (Concluded)

Radiological Tests					
Alpha, Beta, and Radium	SW9310, SW9315, SW9320	P, G, T	HNO_3 to pH<2[2]	2 liters or 16 ounces	180 days
Toxicity Characteristic Leaching Procedure (TCLP)	SW1311	G, teflon-lined cap, T	Cool, 4°C	1 liter or 8 ounces	Volatiles-14 days to TCLP extraction; 14 days after extraction Semivolatiles-14 days to TCLP extraction; 40 days after prep. extraction Mercury-28 days to TCLP extraction; 28 days after extraction Metals-180 days to TCLP extraction; 180 days after extraction
Explosive Residues	SW-8330	P, G, T	Cool, 4°C	1 liter or 8 ounces	Water-7 days to extraction Soils-14 days to extraction Analysis-within 40 days after extraction

1. Polythylene (P); Glass (G); Brass sleeves in the sample barrel, sometimes called California Brass (T).
2. No pH adjustment for soil.
3. Preservation with 0.008% $Na_2S_2O_3$ is only required when residual chlorine is present.
4. Holding time for chromium VI in soils has not been established. The recommended holding time for extracting into water is 48 hours. The sample must be analyzed within 24 hours of extraction.
5. The use of E418.1 requires specific AFCEE approval. See Section 2.2.

JACOBS ENGINEERING GROUP INC.

JEMS Laboratory Data Submission Handbook

Version 2.1

30 August 1993

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Table of Contents

Revision history

This is version 2.1 of this document. Substantive revisions from the previous version are noted with a vertical bar in the outside margin. Deletions are shown in the body of the document in ~~strike-through~~ text and insertions in double-underscore text. In some cases, for readability, there will only be a single note for an entire section that has been added that is in this distinctive revision format.

Version 1.1

- Trivial typographical errors.
- Incorporating 20 August 1992 memo, *"Modifications and clarifications to JEMS Laboratory Data Submission Handbook."*
- Revision and clarification on *qc_type* field.

Version 1.2

- Widening of *control_num* field. The field title is now "Container Control Number."
- Widening of the *dilution* field, which can now handle dilution up to 999,999.99.
- Revision of the definitions and VVLs for the *lab_qual, lab_qual_o, val_qual* and *val_qual_rc* fields.
- Addition of *val_id* field.
- Removal of IRPIMS-based VVLs from Appendix B. These values are available in a separate report from JEG, or on diskette in Xbase format.
- Addition of "Miscellany" subsection in Section 2 on various data questions which have been raised.
- Better definition of *dc!_flag* field.

Version 2.0

- Further clarifications in text.
- Additional indicators for the Required column in Appendix A (page 11).
- Inclusion of the LDSH version in the README file and diskette label.
- Use "LABQC" as Container Control Number for laboratory QC results.
- If no extraction is done, the appropriate fields in the Data file should be left blank.
- Most "time" fields in the Data file are now required.
- The dilution factor field is now required.
- Inclusion of surrogate spike flag.
- Inclusion of sample matrix field.
- Making the result precision mandatory.
- Addition of Comment file.
- Instructions for handling samples run through multiple analytical batches.
- Modification of *spike_val* field for certain QC.

Version 2.1

- Incorporation of memos *"Typos in LDSH 2.0"* (9 March 1993), *"Clarifications to LDSH 2.0"* (4 May 1993) and *"Change to LDSH 2.0"* (9 July 1993).

- Inclusion of more explanations of different aspect of the data deliverables.
- Use *A-Z* as *qc_type* sequences after *1-9*.
- No new substantive changes.

1. Introduction

The Jacobs Environmental Management System (JEMS) is a relational database system maintained by Jacobs Engineering Group Inc. (JEG) to store, analyze, and report on information on environmental samples for Jacobs clients.

JEMS represents the linkage of location and sample acquisition data with the analytical results of those samples. Location and sample acquisition data are obtained from field personnel directly. Analytical results are provided by laboratories. There are considerable efficiencies resulting from input of analytical results to JEMS in an electronic format:

- ***Reduced data entry time***
- ***Reduced data entry costs***
- ***Reduced data entry errors***

Laboratories providing analytical services to JEG are therefore required to submit their analytical results to JEG in an electronic format compatible with JEMS. The purpose of this *JEMS Laboratory Data Submission Handbook* (LDSH) is to define the file formats and assist laboratories in creating file submissions. To that end, it is organized as follows:

- Section 1, this introduction, describes JEMS in general terms.
- Section 2 describes the requirements for the files to be submitted, including rules on file naming and structure.
- Section 3 describes the data submission requirements for physically moving the files to JEMS.
- Appendix A describes in detail the structure of each of the files to be transmitted.
- Appendix B describes the fields in the files in greater detail, indicating formats and valid values to be used. ~~Valid Values to be used in certain of the fields~~.
- Appendix C cross-references JEMS data fields to those in the US Air Force Installation Restoration Program Information Management System (IRPIMS) data structure.

Any questions related to creating files should be coordinated through the Jacobs Project Date Manager and directed to the JEMS Customer Manager~~System Administrator~~. Questions and comments regarding this handbook, and proposed additions to the Valid Value Lists, should be submitted in writing to the same party.

Acknowledgments are made to Jim Stanley of the JEG Corporate MIS Department; John Moorman, Jim Powers, Lisa Carlson, and Ron Munsee of the JEG Pasadena Environmental Programs group; Michael Pallesen and Spencer Preston of Egret Technologies; and all others who contributed to this document.

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2. Data requirements

This section provides the format and content specifications for the JEMS files, followed by explicit requirements for the data entry of files.

JEMS data will be submitted in three different file formats:

- The **README file**, identifying the contents of the diskette. There will be only one README file per diskette.
- The **Data file**, containing analytical results. There may be more than one Data file per diskette.
- The **Comment file**, containing comments on tests or results in a corresponding Data file. There can be up to one Comment file per Data file on the diskette.

2.1. The README file

This file contains a set of records identifying the contents of a diskette. It should be named "README," with no extension. A README file must be included on every disk submitted to JEG.

Unlike the Data files, the structure of the README file varies from record to record. The layout of this file is given in Appendix A, page 16.

2.2. Data files

These files contain analytical,results. ***Each record in the files identifies a unique analytical result***, including information on the sample and tests which generated the result. This test data must be repeated in each pertinent record (i.e., the test data is ***not normalized***); though this is less efficient in disk space, it provides unequivocal identification between analytical result, test and sample.

The structure for Data files is given in Appendix A on page 14.

2.2.1. Files and samples

Multiple Data files may be submitted on a single diskette. Each one must be listed in the README file, described above.

A Data file may contain results for multiple samples.

The results for a given sample (as identified by a Container Control Number on the Chain of Custody) should be, but need not be, submitted within the same file.

2.2.2. File names

All Data files submitted from a lab for a given project must be uniquely named. Data files must be named in a specific format:
"yymmddss.JEM" where

yymmdd is the date the file is generated, using numeric, zero-padded representations for the year (yy), month (mm) and day (dd).

Note that this is a different date format than that used for data in the Data files.

ss is a sequence number, beginning with 01, to allow for multiple files to be generated in a particular day.

.JEM is the literal string "JEM", used as an identifying extension for all such Data files submitted to JEMS.

So, for example, the file `92081202.JEM` would be the second (02) JEMS Data file (.JEM) generated by the lab on 12 August 1992 (920812). The first file submitted that day (or the only one,

if only one were generated) would be named `92081201.JEM`.

2.2.3 Resubmitted Data files

If Data files are to be resubmitted with corrections, it is not necessary to resubmit all records in a file. Labs may resubmit just those records which need correction. Labs may, at their discretion, resubmit entire Data files; this is not required, however.

However, a given resubmission file must contain ***only records from one original file.*** Resubmitted records from more than one file may not be submitted in the same file.

Files containing resubmitted data must be named as described above in Section 2.2.2. Resubmitted files must be given ***new names*** reflecting the new file generation date. A resubmission file must not be given the same name as the original file which contained the data.

The README file must include a cross-reference between the original Data file and the resubmitted Data file. This cross-reference is accomplished by entering the name of the original submission file in the *data_file_o* field of the record identifying the submission. An example is included with the README file layout on page 16.

The README file should also indicate Data files which have accompanying Comment files. This is done with an asterisk after the name of the Data file.

2.3. Comment files

These files contain comments on analyses or analytical results on a corresponding Data file.

These are meant to be abbreviated ad hoc comments. More extensive comments should be included in the hardcopy report submitted to JEG. Where appropriate, the *lab_qual* and *lab_qual_o* fields of the Data file can be used for standardized comments.

The structure for Comment files is given in Appendix A on page 17.

2.3.1. Files, samples, tests, results and comments

Only one comment line may be entered that applies to a given sample's test as a whole, and only one comment line may be entered that applies to a given sample's test's analytical result. For example:

Sample A is run on test T1 and produces 12 results. The Comment file could have up to 13 lines relating to this data: one for the test as a whole, and one for each result.

Comments are not required for every record in the corresponding Data file. A Comment file must be associated with only one Data file. If there are no comments for the records of a given Data file, no Comment file need be submitted. However, Comment files should be in the same delivery batch as their corresponding Data files (preferably on the same diskette).

A corrective action Comment (*comm_type="C"*) must be submitted where corrective action is taken.

2.3.2. File names

All Comment files submitted from a lab for a given project must be uniquely named, based on their associated Data file. Comment files must be named in a specific format: "`yymmddss.JEC`" where:

`yymmddss` is the same sequence number as the corresponding Data file.

`.JEC` is the literal string "JEC", used as an identifying extension for all such Comment files submitted to JEMS.

So, for example, the file `92081202.JEC` would be the Comment file associated with the Data file 92081202.JEM.

2.3.3 Resubmitted comments

If a result record from a Data file is resubmitted, and it had a corresponding comment in the initial

submission, the Comment file record does not need to be resubmitted, unless a change is being made in the comment.

New or changed comments in a Comment file must be submitted with a corresponding resubmission of the Data file result records. In this case, the Comment file with the change would be renamed as the Data file is for resubmission. Following this reasoning, it is clear that a given Comment file resubmission must contain only records from one original Comment file, and that resubmitted records from more than one Comment file may not be combined into a new file.

2.4. General data requirements

Loading ASCII file submissions into JEMS requires absolute adherence to each of the following file, record and field requirements. Contractors are required to follow these instructions. ***Data file submissions with protocol errors will be returned for corrections and resubmission, and will not be considered to have met contractual obligations.***

2.4.1. Files, records and fields

Each JEMS ASCII file is made up of one or more lines of data. Each line of data is equivalent to a single record in the file. Each record is made up of distinct fields of information. Each field is assigned a specific location in the line. These field positions are defined in Appendix A of this document, starting on page 11. These file specifications shall be followed for entering each record of information in the specified file.

2.4.2. Records must be self-sufficient

A data record must not be dependent on another record or file for data. The data in each record is independent. Actual valid data must be entered in ***each record***. Do not enter data that refers to another record, e.g., entering a record in the Data File that says, "see record number 10 above," or "same as above." Each record must be capable of standing on its own, as if it were stored in its own individual file.

2.4.3. Use the Valid Value Lists

The Valid Value Lists in Appendix B, page 19, provide data which are required to be entered in fields where codes, abbreviations, labels, and names have been assigned. ***Contractors are required to use the Valid Value Lists provided by JEG and must not enter in JEMS file submissions any values not provided by JEG.*** Any questions or problems related to data entry and proposed additions to the valid value lists should be addressed in writing, coordinated through the Project Manager, to the JEMS System Administrator.

Even in cases where a third party is responsible for modifying Valid Value Lists utilized by JEG (e.g., the IRPIMS Help Desk defining IRP VVLs), JEG must be informed ***in writing*** of any modified or new codes obtained by the lab directly from the third party. Where additional valid values are obtained through another client of the laboratory, they should be verified by the lab with the governing issuing agency, and such verification communicated to Jacobs.

2.4.4. Leave out column names and headings

For clarification and illustration, this document sometimes uses the descriptive names of fields or columns. However, ***do not enter column headings or field names in JEMS files.*** This information is not part of the file.

2.4.5. Don't add left margins

Do not make left margins. Every record in every file starts in the farthest left position in the record, ***column 1***. When entering data using a spreadsheet program to build your files, set your left margin as 0, and your right margin at the end position of the last field in the record (e.g., if the last field has start and end positions of 156-157, then the right margin must be 157).

2.4.6. Use spaces, not tabs

Do not enter tabs or use the tab key. Tab characters will be read as data and interfere with accurate loading of the submitted files.

If you have completed entering data within a field, and have not yet reached the end of the field (e.g., you have entered "JACOBS" in a 10-character field), then use the space bar to insert sufficient space characters to reach the beginning of the next field.

2.4.7. Use no blank records

When creating a JEMS file, the first record or row in the file, and every subsequent record or row, must contain valid data. ***No blank or empty rows or records are permitted in JEMS files.***

The only exception to this is that it is permissible to include a single blank or non-data record at the *end* of a Data file to denote the end of that file. This is not required, however, and at no time may a blank or non-data record be included in a file anywhere but as the last record.

2.4.8. Do not duplicate records

Each record within a file must be unique. Records which have exactly the same data in every field are regarded as duplicate records and should be corrected accordingly.

2.4.9. All fields are required

Enter valid data for every field and only the fields described in the specifications. Do not add, delete or omit any fields. JEG requires that no additional or non-requested information be entered in JEMS file submissions. The lab must not delete or omit any JEMS data field. If a field is not indicated as required in the file specifications table, and the information is available, it must be entered. If the information is not available, space characters must be entered in the specified field.

2.4.10. Position data as shown

The exact placement of each character in a record is stated in the file specifications under the column heading "Start-End Positions." Each character occupies one position or space in the record. Start and end position numbers are specified for two reasons:

- To give the size of the required data field: *(end - start + 1)* bytes.
- To give the ***exact character positions where the applicable data must be placed in the file record.***

2.4.11. Single character fields

Single character fields have the same start and end position number. Put the one character of data in that position in the field.

2.5. Software to use to produce these files

Labs may use any software product they wish to produce the defined electronic files, so long as the files match this document's specifications. Anything which will produce ASCII column-delimited files (e.g., Borland dBASE, Lotus 1-2-3) may be used. This specification is concerned solely with the nature of the output.

2.6. Data Issues

This section discusses some specific data questions which have been raised.

2.6.1. Data qualifiers

JEMS currently requires three general classes of data qualifiers be provided by labs.[1] These roughly parallel each other, but each provides uniquely formatted information for Jacobs usage and client deliveries.

[1] Lab validators have their own fields for qualification codes, *val_qual* and *val_qual_rc*.

dcl_level: This field provides a basic "data confidence level" based on the source of the analytical results, distinguishing, for example, between field and lab analysis. See page 20.

lab_qual: This is the most detailed results qualifier, derived from EPA CLP results qualifiers. Non-CLP (lab-idiosyncratic) qualifiers of this sort should be put in the *lab_qual_o* field. See page 21.

parvq: This is a more general results qualifier, based on the Air Force IRP field of the same name. See page 23.

All of these fields are required.

Note that further comments and qualifiers on results can be included in the Comment file.

2.6.2. Tentatively Identified Compounds

Tentatively Identified Compounds (TICs) should be reported electronically only when they can be explicitly related to an existing *analyte* code. For example, on jobs where IRPIMS PARLABELs are being used (*anl_type*=AFI), TICs should only be included in the electronic deliverable for explicit compounds or analytes possessing a valid PARLABEL, not for vague families of compounds. Such groupings or families should be noted, however, in whatever hardcopy result deliverables are provided JEG.

TIC results should be noted using the appropriate codes in *parvq* and *lab_qual*.

2.6.3. Quantitation and detection limits

The text in this section has been moved to Appendix B under the *detect* and *pquant* fields (pages 20 and 23, respectively)

2.6.4. Laboratory QC batches

Lab QC is performed in batches that do not necessarily correlate with particular Jacobs projects or particular deliverables (i.e., a particular deliverable from the lab may partially belong to a lab batch which produces records on another deliverable).

To insure that data can be correlated properly, laboratory QC results from a given analytical batch should be transmitted ***once, and only once, for each Jacobs project number*** being delivered.

Example:

JEG project *proj_num*	Sample # *control_num*	Disk	Lab batch *lab_batch*
01A00100	AB-0000001	1	001
01A00100	AB-0000002	2	001
01A00100	AB-0000003	1	002
58B99900	AX-0000100	3	001
58B99900	AX-0000101	3	002
22A22200	BD-0000025	4	001

Six samples from three different Jacobs projects have ended up in two different lab batches. The results for the samples in the first project are returned in two different disks. The other two projects are on their own disks (since a disk must hold data for only one JEG project). The distribution of the results within multiple files on the disk are not important.

The following is how the lab QC for each batch would be returned:

Disk 1: Batch 001 for 01A00100
Batch 002 for 01A00100

Disk 2: None[2]

Disk 3: Batch 001 for 58B99900
Batch 002 for 58B99900

Disk 4: Batch 001 for 22A22200

Thus, the lab QC results for Batch 001 would be reported in three different disks, but only once for each project.

[2]Batch 001 has already been reported for project 01A00100.

2.6.5. Multiple analytical batch samples

There are occasions in which a given sample may be split into multiple analytical batches for a given test, e.g., if blank contamination is found for certain analytes. The following are guidelines for submitting results data for these analyses:

1. Unless instructed otherwise, laboratories should submit only one analytical result for a particular test on a sample.[3]

   Where a test is run on a sample multiple times in different analytical batches (as identified by the *lab_batch* field in the Data file), only one record per analyte for all of those tests should be submitted.

   For example:

   Sample S is put into Analytical Batch L1 and run through method M, which produces twenty analytical results. Upon review, the lab identifies blank contamination on three of those results, and reruns method M on sample S, giving it Analytical Batch L2.

   The lab should report in the Data file the seventeen non-contaminated records from L1, and the three re-run results from L2.

2. The exception to #1 above is that the results from surrogate spikes should be reported for all applicable batches. To extend the above example:

   There are 4 surrogates for method M. The 4 surrogate results would be reported back for L1 and again for L2.

2.6.6. Laboratory QC data

The information in this section was moved in LDSH 2.1 to Appendix B under *control_num* (page 19) and *spike_val* (page 25).

2.6.7. Significant figures and rounding

The same number of significant figures and rounding methods will be used on both LDSH deliverables and hardcopy deliverables. It is not allowable to report a result of, for example, "0.510" in the hardcopy and "0.5" in the LDSH data.

[3] For gas chromatographic (GC) results, one result for each column reported and a "primary" result should be reported, the records identified through the *pvcode* field.

3. Submitting JEMS files

This section specifies the general requirements for submitting files to JEMS and provides an example of how files would be prepared as the data are generated. Data will be submitted on a labeled diskette. Each diskette will consist of a "README" file identifying the contents of the disk, and one or more analytical Data files, as defined below.

3.1. Disk format requirements

Data must be submitted to JEG on diskette, meeting the following requirements:

- MS-DOS format.
- 3½" size.
- 1.44Mb Double Sided, High Density format.

References below to diskettes include the above requirements.

3.2. External labeling of diskettes

Each diskette will be externally labeled with the following information:

- Laboratory ID
- Project number
- Jacobs charge number
- Date of submission
- The version of the LDSH by which the disk data is formatted.
- List of Data files on diskette (those with Comment files should be flagged with an asterisk)

With the exception of the list of Data files, the format of the label will be identical to that of the README file, as described on pages 3 and 16. For example:

LABXXXXXXX	93061801.JEM
99D00747	93061802.JEM*
JC12345	93061803.JEM
23-JUN-93	93062001.JEM*
2.0	93062301.JEM*
	93062302.JEM

3.3. Transmittal letter

A transmittal letter will accompany each diskette submission, specifically stating the contents of each diskette, per the diskette external labels.

This may be simply be a printout of the README file for each disk.

3.4. Other requirements

All other submission requirements will be made per contractual agreements.

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Appendix A—File layouts

This appendix includes the layouts for the two different files used in JEMS (README and Data files). All files submitted to JEMS must follow these formats.

The file layouts are presented in tables on the following pages with these column headings:

Record Number gives the record that the field is on in the README file. This column is not given in the Data file layout.

Field Name gives a reference name for the JEMS data field. This name is for reference only. ***Do not use these field names or any column headings in files submitted to JEG.***

Start-End Positions states the exact positions to enter the first through last characters of the field. Begin data entry for each field in the start position. If the data entered is shorter than the field width, enter space characters in the remaining positions of the field, including the end position. If the data to be entered is longer than the field width, truncate it to a unique identifier or significant value.

Pg indicates a page number in this manual for more information on the field, including lists of valid values.

Req indicates if data is required in this field through one of the following codes:

- ✔ The field is required and that data ***must*** be submitted by labs for it.
- ✍ The field is to be used only by lab validators.
- ★ The field is required for some records, as described in the Definition column or in Appendix B.
- B A blank value is meaningful. Data must be submitted for such a field, but one of the results of that data may be an empty or blank field. Review the VVL for the field for more information.

If a field is not marked as required, ***data must be provided by the lab if the lab has it available.*** Only if the data is not required and the lab does not have it available should a field be left blank.

Fields not marked as required as a general rule may be required by specific projects. Laboratories should consult with Jacobs project personnel for such added requirements.

Format shows the format that the data in the field should follow.

[An] defines an alphanumeric field *n* positions wide. All alphabetic characters should be in UPPER CASE *only*. It is Jacobs intention to use upper case for all fields defined in this document. Any exceptions will be noted. If the alphanumeric data does not fill the field, it should be left-justified (data starting in the first byte), with spaces padding out the rest of the width. For example, on an "A5" field:

`abc1_` is wrong because of the lower case letters.

`_ABC1` is wrong because it is not left-justified.

`ABC1_` is correct.

[Nn.d] defines a numeric field. The format is defined similarly to that in Xbase languages, describing a field *n* bytes wide total (including the decimal point), with *d* digits after the decimal point. Values extending beyond the number of decimal places must be rounded appropriately. The decimal point is included and must

go in the byte defined (one more from the right than *d* indicates). Undefined digits may be replaced with spaces or zeros. For integer values, with no decimal points or places, *d* should be "0". For example, with "N6.2":

99_999 is wrong because too many places are given beyond the decimal point.

99_9__ is wrong because the decimal point is not in the fourth byte.

_99_9_ is correct.

099_90 is also correct.

[D9] defines a date field, in the standard Oracle form dd-mmm-yy using a zero-padded day (dd), the capitalized first three letters of the month name (mmm), and the last two digits of the year (yy), each separated by dashes, taking up a total of nine bytes. The dashes are required. E.g., for 5 January, 1993:

01/05/93_ is wrong because it does not match the dd-mmm-yy format.

05JAN93__ is wrong because the dashes are missing.

05-Jan-93 is wrong because it is in mixed case.

5-JAN-93_ is wrong because the date must be two digits, zero-padded if necessary.

05-JAN-93 is correct.

[T4] defines a time field in the format hhmm, i.e., in hours (hh) and minutes (mm), taking up a total of four bytes. Neither colons nor seconds should be included. Time should be expressed in 24-hour military time format, and in local time for the laboratory. Thus, for 1:12 p.m.,

112_ is wrong because the hours must be two digits, zero-padded if necessary.

0112 is wrong because the time must be in 24-hour format.

13:12 is wrong because no colon should be included (making the field too long).

1312 is correct.

Definition gives the full field title, followed by a description of the data to be entered in the field. Further definition for VVL fields can be found in Appendix B, page 19.

The README file layout

For an explanation of this file, see page 3. For an explanation of the column headings, see page 11. Note that each of the first five records has its own layout, and that the sixth record and beyond share the same layout.

Record Number	Field Name	Start-End Positions	Format	Definition
1	lab_id	1-10	A10	**Laboratory ID.** Identifying name or code for laboratory. This is a Valid Value List item; see Appendix B.
2	proj_num	1-8	A8	**JEG Project Number.** Jacobs Engineering project number under which analysis was done, in the format aaaaaaaa. This will be provided to labs by JEG.
3	charge_num	1-7	A7	**JEG Charge Number.** Jacobs Engineering charge number, for internal accounting purposes. This will be provided to labs by JEG.
4	sub_date	1-9	D9	**Data Submission Date.** Date the data is submitted to JEG by the laboratory.
5	ldsh_ver	1-3	N3.1	**LDSH Version.** The version of the LDSH which was used to format this file.
6 , etc.	data_file	1-12	A12	**Data File Name.** Name of a Data file submitted on the diskette. The format of the file name is discussed on page 3.
6, etc.	comment	13-13	A1	**Comment Flag.** If the Data files has a corresponding Comment file, insert an asterisk ("*") in this field.
6 , etc.	data_file_o	15-26	A12	**Original Data File Name.** If the Data file in field *data_file* is a corrected resubmission of a previous Data file, this field must contain the name of that previous Data file. Otherwise, this field will contain ASCII space characters.

The following is a sample of what the README file will contain. Each line is a record; note that the fifth record onward are Data file names, and that the ninth record represents a resubmission and includes the requisite cross-reference to the original submission. Note also three Data files which have corresponding Comment files (as indicated by an asterisk).

```
LABXXXXXXX
99D00747
JC12345
05-JAN-93
2.0
93010201.JEM
93010202.JEM*
93010203.JEM*
93010401.JEM* 92122801.JEM
93010501.JEM
93010502.JEM
```

The Data file layout

This file is further explained on page 3. For an explanation of the column headings, see page 11. The Pg column is new, replacing a previous indicator of a VVL list. Note that each record of the file must be laid out as follows.

Field Name	Req	Start-End Positions	Format	Definition	Pg
lab_id	✔	1-10	A10	**Laboratory ID.** Identifying name or code for laboratory.	21
proj_num	✔	11-18	A8	**JEG Project Number.** Jacobs Engineering project number under which analysis was done, in the format aaaaaaaa. This will be provided to labs by JEG.	
surrogate	✔	19-19	A1	**Surrogate Result Flag.** Indicate if the particular analytical result on that record is a surrogate spike compound.	25
matrix	✔	20-20	A1	**Sample Matrix:** Indicate the matrix of the sample producing this result.	22
control_num	✔	21-40	A20	**Container Control Number.** Identifier for the sample provided to lab by JEG. For QC samples synthesized in the lab, put "LABQC" in this field.	19
test_mthd	✔	41-50	A10	**Analytical Method Code.** Coded value representing the method of analysis of the given parameter.	25
lab_snum	✔	51-65	A15	**Laboratory Sample ID.** Identifier assigned to the sample by a lab and included in the reporting of the results.	22
prep_mthd	✔B	64-73	A10	**Preparation Method Code.** Coded value identifying the method used to extract the sample for a particular analysis. Use "NONE" if no prep/extraction was done, or "METHOD" where the prep/extraction method is dictated by the analytical method. ~~Leaving this field blank indicates that no extraction was done.~~	23
lab_extr_d	✔B	76-84	D9	**Extraction Date.** Date that the extraction or preparation is made from the sample. Leaving this field blank indicates that no extraction was done.	
lab_extr_t	✔B	85-88	T4	**Extraction Time.** Time that the extraction or preparation was made from the sample, upon completion of the extraction. Leaving this field blank indicates that no extraction was done.	
lab_recvd	✔	89-97	D9	**Lab Received Date.** Date the lab received the sample, or the date that the lab created the analytical QC sample.	
lab_anal_d	✔	98-106	D9	**Analysis Date.** Date the sample or extract is analyzed in the lab.	
lab_anal_t	✔	107-110	T4	**Analysis Time.** Time the sample or extract is analyzed in the lab, upon completion of the analysis. Note that this is a required field as of LDSH 2.0.	
lab_batch	✔	111-122	A12	**Laboratory Batch Number.** The batch designator of an autonomous group of environmental samples and associated QC samples analyzed by a test.	8, 21
units	✔	123-132	A10	**Units of Measure.** Units of measure used to report the parameter value.	25
basis	✔	133-133	A1	**Basis.** For tissue or solid samples, enter whether results are reported on a wet or dry basis.	19
analyte	✔	134-145	A12	**Analyte Code.** Coded number for analyte or parameter, using the coding system defined in the *anl_type* field.	19
value	✔	146-159	N14.4	**Parameter Value.** Actual analytical value for a given parameter (analytical result), reported in units consistent with the *units* field.	

(Continues)

(The Data file layout, cont.)

Field Name	Req	Start-End Positions	Format	Definition	Pg
sigdig	✔	160-160	N1.0	**Parameter Value Significant Digits.** Precision in significant digits of the parameter value. Note that this a required field as of LDSH 2.0.	
detect	✔ B	161-169	N9.4	**Lab Detection Limit.** Minimum detectable quantity of a parameter based on conditions of the particular result record. Enter space characters for results such as pH and temperature that have no detection limit.	20
detect_sd		170-170	N1.0	**Lab Detection Limit Significant Digits.** Precision in significant digits of *detect* field value. The entry must reflect any dilutions beyond those called for in the analytical method description.	
pquant		171-179	N9.4	**Practical Quantitation Level.** Level above which quantitative results may be obtained with a specific degree of confidence.	23
pquant_sd		180-180	N1.0	**Practical Quantitation Level Significant Digits.** Precision in significant digits of the *pquant* field value.	
spike_val	✔	181-194	N14.4	**Spiked Parameter Value.** The amount of the record's analyte spiked into the sample. . It is required for some lab QC and surrogate spike results.	8
dcl_flag		195-195	A1	**Data Confidence Level.** Flag to indicate data confidence level, based on laboratory process and QC.	6, 20
lab_qual	✔B	196-200	A5	**Lab Result Qualifier.** Coded information concerning the numeric result or the lack of a numeric result.	6, 21
lab_qual_o		201-205	A5	**Lab Qualifier (Other).** Qualifier information using laboratory qualifier codes not in the VVL for *lab_qual*. .	22
val_qual	✔ B	206-210	A5	**Validator Result Qualifier.** Coded information concerning the numeric result or the lack of a numeric result. *Only to be filled in by lab validator.*	26
val_qual_rc		211-215	A5	**Validator Qualifier Reason Code.** Additional qualifier information, particularly the reason. *Only to be filled in by lab validator.*	26
qc_type	★	216-219	A4	**Lab QC Sample Type.** Coded value identifying the QC type of QC samples. Required for all lab QC results only.	24
dilution	✔	220-228	N9.2	**Dilution Factor.** The numeric factor by which the sample was diluted as part of the preparation process. If no dilution is done, then the dilution factor is 1.	20
pvcode	✔	229-230	A2	**Parameter Value Classification Code.** Coded value representing whether the parameter is the primary or confirming result. Use the code "PR" for all results except gas chromatographic (GC) results.	23
parvq	✔	231-232	A2	**Parameter Value Qualifier.** Coded value qualifying the analytical results field (*value*). This field should be filled in every record.	6, 23
parun		233-244	N12.4	**Parameter Value Uncertainty.** The uncertainty of a measured value due to a measuring technique, expressed as plus or minus some value.	
parunprc		245-245	N1.0	**Parameter Value Uncertainty Precision.** Number of significant digits in the *parun* field value.	
anl_type	✔	246-249	A4	**Analyte ID System.** The coding system used for identifying analytes, i.e., what system the *analyte* field is expressed in.	19

(Continues)

(The Data file layout, cont.)

Field Name	Req	Start-End Positions	Format	Definition	Pg
val_id	✓	250-254	A5	**Validator ID.** Identifying name or code for lab validating firm. *Only to be filled in by validator.*	25
climit_min	✓	255-258	N4	**Control Limit (Minimum).** Minimum percent recovery (accuracy criteria) of spikes for this matrix, test method and analyte.	
climit_max	✓	259-262	N4	**Control Limit (Maximum).** Maximum acceptable percent recovery (accuracy criteria) of spikes for this matrix, test method and analyte.	
max_rpd	✓	263-266	N4	**Maximum RPD.** Precision criteria in percent for control limits on spiked analytes on this matrix, test method and analyte.	
instrument	✓	267-286 ~~284~~	A20	***Instrument ID.*** Identification code for laboratory instrument used in this analysis.	21
calib_ref	✓	287-306 ~~285-304~~	A20	**Calibration Reference Number.** Reference number to the last calibration made on *instrument*.	19

The Comment file layout

For an explanation of this file, see page 4. For an explanation of the column headings, see page 11. The first ten fields represent a unique key pointing to a specific result record in the corresponding Data file. These fields have the same name as their counterparts in the Data file, and have abbreviated descriptions; you can see the full descriptions starting on page 14.

Comments for an entire particular test can be indicated by wildcards ("*") in the *analyte* and *pvccode* fields. For gas chromatographic (GC) tests, comments will usually need be addressed to the primary result (*pvccode* = "PR") only, though specific comments on particular column results (*pvccode* = "1C" or "2C" etc.) can be provided.

Each record of the file must be laid out as follows.

Field Name	Req	Start-End Positions	Format	Definition	Pg
lab_id	✔	1-10	A10	**Laboratory ID.**	21
proj_num	✔	11-18	A8	**JEG Project Number.**	
control_num	✔	19-38	A20	**Container Control Number.**	19
test_mthd	✔	39-48	A10	**Analytical Method Code.**	25
lab_snum	✔	49-63	A15	**Laboratory Sample ID.**	22
prep_mthd	✔B	64-73	A10	**Preparation Method Code.**	22
lab_batch	✔	74-85	A12	**Laboratory Batch Number.**	21
qc_type	★	86-89	A4	**Lab QC Sample Type.**	24
analyte	✔	90-101	A12	**Analyte Code.** Coded number for analyte or parameter, using the coding system used in the Data file. If an asterisk (*) is entered here, the comment applies to the test as a whole and to all resulting analyte records.	19
pvccode	✔	102-103	A2	**Parameter Value Classification Code.** Coded value representing whether the parameter referred to in the Data file is the primary or confirming result. If an asterisk (*) is entered here, the comment applies to the test as a whole and to all resulting analyte records.	23
comm_type	✔	104-104	A1	**Comment Type.** Coded letter describing the type of comment this record represents.	19
comment	✔	105-164	A60	**Comment.** Abbreviated comment. Lengthier comments should be included in hardcopy reports. Standardized comments can be included in *lab_qual* or *lab_qual_o* fields of the Data file.	

(This page intentionally left blank.)

Appendix B—Field definitions

This appendix includes additional information on the definition, usage, and valid values for various fields in Appendix A, ordered by field name.

A number of fields have lengthy Valid Value Lists (VVLs), which are available on a separate document. These are indicated with the text [VVL]. ***If other codes are to be used, prior approval must be obtained from JEG.***

analyte

Analyte Code.

[VVL]

This is the coded description of the analytical result material. It should be coded based on the *anl_type* scheme. Non-standard additions to these schemes (e.g., added CAS numbers) must be submitted to JEG in writing and obtain approval prior to their submission.

In the Comment file, an additional value of an asterisk ("*") can be used in this field, to represent that the comment refers to all result records for that specific test.

anl_type

Analyte Type.

Laboratories will be instructed on a given Jacobs project as to the allowable coding scheme(s). Use of any other ID scheme must have prior approval by JEG.

Code	Scheme
CAS	CAS Number
AFI	US Air Force IRPIMS PARLABEL

basis

Basis.

This field represents the basis (wet or dry) for reporting tissue or solid samples. Enter "X" for other results. In general, unless otherwise specified by Jacobs project personnel, solid and tissue samples should be reported on a dry basis.

Note that the *basis* relates to the *matrix* field in the result record, as shown on page 22.

Code	Scheme
D	Solid/tissue sample reported on a dry basis.
W	Solid/tissue sample reported on a wet basis.
X	Other.

calib_ref

Calibration Reference Number.

This field is used to further track down any result problems associated with a particular instrument, as identified in the *instrument* field (page 21). Where no particular number is used by the lab, enter the date of the last calibration. Where the instruments are not calibrated, enter "NA".

comm_type

Comment Type.

This field indicates the type of comment on that record of the Comment file.

Code	Definition
G	General comment (everything that is not one of the others below).
C	Corrective Action.

control_num

Container Control Number (CCN).

(This explanatory text was added to this section in LDSH 2.1.)

This is an for sample container groups submitted to the lab by Jacobs. It can be derived from the sample label or the Chain of Custody. The field should be filled in as follows:

a. For environmental samples submitted by Jacobs to the lab, the CCN is on the container labels and on the Chain of Custody.

b. Where lab QC is derived from an environmental sample (e.g., a matrix spike), that original sample's CCN must be included in the result records for that lab QC.

c. Where lab QC is synthesized by the laboratory (e.g., a lab blank), the word "LABQC" must be put in the *control_num* field.

In summary, the following *control_num* values should be used based on the *qc_type* of the record:

QC type *qc_type*	Control number *control_num*
BS/SD: Blank spike/duplicate	"LABQC"
LB: Lab blank	"LABQC"
MS/SD: Matrix spike/duplicate	As in original
LR: Lab replicate	As in original
RM/RD: Reference material/-duplicate	"LABQC"
Other	As provided

dcl_flag

Data Confidence Level.

This field reflects result qualification based on the source of the analytical data. The codes are derived from the *US EPA Data Quality Objectives for Remedial Response Activities* (EPA/540/G-87/003, 3/87; pp. 4-9ff.) descriptors of analytical level, with the addition of two other values to account for uncertain data.

Code	Definition
Q	Questionable origin.
H	Historic data. Origin unknown.
1	Field screening or analysis with portable instruments.
2	Field analysis with more sophisticated instruments or mobile lab.
3	Standard lab methods at an offsite lab.
4	CLP routine analytical services (RAS) at an off-site CLP lab following CLP protocols.
5	Special, non-standard analytic service, including CLP special analytical services (SAS).

See also section 2.6.1, page 6.

detect

Laboratory Detection Limit.

(This further explanatory text was first included in LDSH 2.1.)

This is the minimum detectable quantity of an analyte for the particular lab batch, as influenced by lab conditions, analytical method, or field conditions. The limit should be that which applies to the result in the specific record, and should account for any dilutions done on a sample beyond those normally called for in the analytical method.

It is not required where inapplicable (e.g., for pH or temperature), or for surrogate spike analytes.

Base method detection limits are established for each project based on Jacobs client requirements. Laboratories should contact Jacobs project personnel for specific detection limit requirements.

Where an analyte's *value* is below *detect*, the *lab_qual* field should have a "U" and the *parvq* field an "ND".

dilution

Dilution factor.

(This further explanatory text was first included in LDSH 2.1.)

This field contains the factor by which the sample was diluted beyond that called for in the standard analytical protocol. If, for example, the original sample is 100ml, and enough solvent is added to make the total volume equal to 1000ml, then *dilution* is 10.00. Where no dilution is done beyond the analytical protocol, a dilution factor of 1.0 should be entered.

instrument

Instrument ID.

(This further explanatory text was first included in LDSH 2.1.)

This field contains an instrument number, serial number, or some other means of identifying the particular instrument the test was run on. This is for the purpose of tracking down any result problems associated with a particular instrument. Where the small size, commonality, or disposability of the test instrument (e.g., pH meters, thermometers) do not lend themselves to an instrument ID, enter "NA".

See also the *calib_ref* field on page 19.

lab_batch

Laboratory Batch Number.

This field is used to relate QC data to data from environmental samples. Samples must be identified by a lab batch number (lot control number) to designate a group of samples sharing the same QC data for a test. This group is equivalent to the EPA SW-846 concept of "Analytical Batch":

> *Samples which are analyzed together with the same method sequence and the same lots f reagents and with the manipulations common to each sample within the same time period or in continuous sequential time periods. Samples in each batch should be of similar composition.*[4]

For example, three environmental samples come into the lab, and are run on a particular test, along with a matrix spike and spike duplicate of one sample, and a blank spike. These would be considered a complete laboratory lot and given a common *lab_batch* number.

There is no required convention for numbering lab batches. Any scheme that properly associates analytical results from the same test batch is acceptable. However, note that this number must be unique within a JEG project *(proj_num)*, at the very least. It is not acceptable to repeat this number each day, month, etc., or to have any other field (such as date) necessary for this number to uniquely group a particular set of laboratory/analytical batch results.

See page 8, section 2.6.5, for information on reporting samples run through multiple lab batches.

lab_id

Laboratory ID.

[VVL]

This is a short code for the submitting laboratory.

lab_qual

Laboratory Result Qualifier.

Laboratories should use this field to qualify results using the following codes. More than one code may be placed in this field. Other qualifying codes not on this list should be put in the *lab_qual_o* field. No qualifiers should be included in the *lab_qual* field for analytical results other than organics or inorganics (such as pH or temperature); any qualifiers for such results should also be put in the *lab_qual_o* field. Definition of analytes as organic, inorganic or other may be confirmed with Jacobs project personnel. Note that, though this is a required field, ***the lack of a code in this field is meaningful,*** representing an unqualified result.

These definitions are summarized from the *US EPA CLP Statement of Work for Organics Analysis* (OLM01.0-6, 6/91) and the *US EPA CLP Statement of Work for Inorganics Analysis* (ILM01.0), which should be considered the authoritative definitions for the codes in this field.

[4] EPA SW-846 rev 0, Sept. 1986, section 1.1.8.

Code	Definition

Inorganics

B	Reported value was below the Contract Required Detection Limit (CRDL), but greater than or equal to the Instrument Detection Limit (IDL).
E	Estimated, due to interference, e.g., CN, color interference.
M	Duplicate injection precision was not met.
N	Spiked sample recovery was not within control limits.
S	The reported value was determined by the Method of Standard Additions (MSA).
U	The analyte was analyzed for but not detected.
W	Post-digestion spike for Furnace AA analysis was out of control limits, while sample absorbance was less than 50% of spike absorbance.
*	Duplicate analysis was not within control limits.
+	Correlation coefficient of MSA was less than 0.995.
(blank)	Unqualified result.

Note that "S", "W" and "+" are mutually exclusive, and may not occur on the same record.

Organics

A	A TIC is a suspected aldol-condensation product, possibly generated during analysis, e.g., MEK acetone production during TCLP prep.
B	Analyte was found in the associated blank as well as the sample for the record shown. Possible blank contamination. This flag may not be combined with the "U" flag.
C	Pesticide, where the identification was confirmed by GC/MS.
D	Compound was identified at a secondary dilution factor, e.g., after a sample got an "E" qualifier.
J	Estimated value below quantitation limit.
N	Presumptive evidence of a compound. Use for all TICs.
P	Pesticide/Aroclor target analyte, where there is greater than 25% difference for detected concentrations between two GC columns.
U	Compound was analyzed for but not detected. This flag may not be combined with the "B" flag.
(blank)	Unqualified result.

Note that the "U" and "B" qualifiers are mutually exclusive, and may not occur on the same record.

See also section 2.6.1, *"Data qualifiers,"* page 6, and 2.6.2, *"Tentatively Identified Compounds,"* page 7.

lab_qual_o

Lab Qualifier (Other)

This field is used for qualifier codes used by the lab which are not in the VVL for *lab_qual*. Written explanation of these codes must be provided to Jacobs Engineering.

lab_snum

Lab Sample Number

This field is used for the identification code associated by the lab with the sample when received or generated.

This clarification was incorporated as of LDSH 2.1, initially specified in the memo *"Clarifications to LDSH 2.0"* on 4 May 1993.

Laboratory sample numbers, as reported to JEG in the *lab_snum* field of the Data file (page 22), must *uniquely* identify a sample *independent* of the *qc_type* field., i.e., the *qc_type* field shouldn't be considered part of the key to associate results to a given *lab_snum*. For example:

a. If a field sample (*qc_type* = N1) has a matrix spike sample (*qc_type* = MS1) derived from it, that matrix spike sample must have a different lab sample number than the original field sample.

b. If a matrix spike duplicate (*qc_type* = SD1) is pulled from the sample in (a) as well, it must have a unique lab sample number from both the N1 and MS1 sample.

c. If two QC samples are synthesized by the lab, e.g., a blank spike and a blank spike

duplicate (*qc_type* = BS1 and BD1, respectively), each of these must have a unique lab sample number.

d. If a fraction of a sample is re-run in another lab batch (e.g., after blank contamination is detected), or where multiple GC column results are being detected, it is *not* necessary to change the laboratory sample number. The *lab_batch* and *pvccode* fields will uniquely identify the result.

If this uniqueness is not currently part of the laboratory's sample numbering scheme, it is suggested that the *qc_type* field (or a codified version thereof) be appended to the current lab sample number when reported in the *lab_snum* field.

matrix

Sample Matrix

This code indicates the matrix of the sample which has produced this result record.

For laboratory QC, use the actual matrix of the QC sample, not that of the associated sample.

Unless otherwise instructed by Jacobs project personnel, the matrix reported should dictate the basis field as indicated (see page 19).

Code	Matrix is...	Basis should be...
W	Water/aqueous	X
S	Solid/soil	D or W
A	Air/gaseous	X
T	Tissue	D or W

parvq

Parameter Value Qualifier.

[VVL]

Note that this field parallels the *lab_qual* field, though with less detail.

See also section 2.6.1, *"Data qualifiers,"* page 6, and 2.6.2, *"Tentatively Identified Compounds,"* page 7.

pquant

Practical Quantitation Level.

(This further explanatory text was first included in LDSH 2.1.)

This is the level above which quantitative results may be obtained with a specific degree of confidence. It should take into account the same variable factors as the *detect* field, and so is applicable to the specific record it is found in.

It is not required where inapplicable (e.g., for pH or temperature), or for surrogate spike analytes.

Quantitation limits are established on the same basis as detection limits. Laboratories should contact project personnel for particulars.

Where *value* is at or above *detect*, but below *pquant*, then the *lab_qual* field should be "J" for organics or "B" for inorganics.

prep_mthd

Preparation Method Code.

[VVL]

Where no preparation or extraction is performed, a *prep_mthd* of "NONE" should be entered. Where the extraction is dictated by the analytical method, a *prep_mthd* of "METHOD" should be included.

pvccode

Parameter Value Classification Code.

Positive gas chromatographic results must be confirmed by testing the same sample on a different GC column. For each analyte subject to confirmation, three records must be provided: the ***first column*** result, the ***second column*** result, and the ***primary*** result (the labs considered opinion of the "true" analyte confirmation). For example, if peaks overlap (coelute) on one column, the lab would report the concentration from the other column as the primary result. If a *third column* is used, it must be reported as well. The primary result will be a duplicate of the first or second column results. When submitting

these three records, they must be distinguished by using the appropriate code.

Where results are non-detects, only the primary result need be submitted.

Code	Name
1C	First column result.
2C	Second column result.
3C	Third column result.
PR	Primary result.
MS	Confirmed by GC/MS Method.

qc_type

Lab QC Sample Type.

This code describes the purpose of the sample. Labs should use these codes to identify QC samples prepared at the lab to evaluate analytical conditions and precision. These lab samples must be uniquely identified, since two or more of the same type may be analyzed at the same time, e.g., LR1 and LR2.

The following further explanation was substantially expanded in LDSH 2.1, as originally communicated in the memo *"Clarifications to LDSH 2.0,"* 4 May 1993. For readability, it is not given in this distinctive revision format.

The QC samples are identified in this field with one of the prefixes given below, and then a single sequential digit or letter (shown as *n* below, representing 1-9, then A-Z) for any samples of the same type prepared on the same day. The sequence number for a particular qc_type code must be incremented for each instance of a particular QC type generated by the lab ***for a given Jacobs project on a given day***. This requirement is independent of any unique assignment of *lab_snum*.

The first nine of a given type of QC for the day should use the sequence "1" through "9". The tenth should use "A" for the sequence, followed by "B", etc.

For example:

Two Jacobs samples for project 99G04700 come in to Lab X. On 5 January a matrix spike is crated from each of these samples. These must be given a qc_type *of "MS1" and "MS2".*

Later that same day, a sample for Jacobs project 01G12300 comes in. A matrix spike is created from this. It is given a qc_type *of "MS1" because it is the first MS created for that project on that day. Still later that same day, another sample for Jacobs project 99G04700 comes in. A matrix spike is created for it. it is given the* qc_type *of "MS3", as it is the third matrix spike for the lab on that project on that date.*

A matrix spike is taken off of that last sample on following day. This one is given a qc_type *of "MS1", as it is the first taken on that project that day.*

We thus end up with the following:

Project number *Proj_num*	Lab received *Lab_recvd*	QC type *qc_type*
99G04700	05-Jan-94	MS1
99G04700	05-Jan-94	MS2
99G04700	05-Jan-94	MS3
99G04700	06-Jan-94	MS1
01G12300	05-Jan-94	MS1

A blank value in this field indicates that it is not a laboratory QC sample. Thus, though this is a required field, a blank value is acceptable and meaningful.

Code	Name
BS*n*	Blank Spike: A measurement of a known concentration of an analyte of interest to check analytical accuracy.
BD*n*	Blank Spike Duplicate: The second of a pair of blank spike samples to check precision and accuracy of analysis.
RM*n*	Reference Material: Known external reference material with well-established properties used to calibrate apparatus or assess measurement methods.
KD*n*	Known Duplicate: A second analysis of a Reference Material (RM) sample.
LB*n*	Lab Blank: Blank sample to detect contamination of samples in lab.
LR*n*	Lab Replicate: Split of sample to check precision of analysis.

MSn — Matrix Spike: A normal sample with a known amount of target analyte added in the lab to check accuracy of analysis.

SDn — Matrix Spike Duplicate: The second of a pair of matrix spikes to check precision and accuracy of analysis.

spike_val

Spiked Parameter Value.

(This explanatory text was included here in LDSH 2.1)

This field represents the amount of *analyte* (in *units*) which was spiked, or added, into this particular sample prior to analysis. The lab should ***not*** include the amount recovered in this field. Actual quantities for *spike_val* and *value* should be used, rather than percent recoveries. The exceptions is for surrogate spikes, where, if percentages are used, the *spike_val* should be 100 and the *value* should be the percentage recover (with *units* as "PERCENT").

For results which were not spike analytes, a *spike_val* of zero (0.0000) should be used.

The following values, then, should be in *spike_val*, based on the *qc_type* field:

QC type *qc_type*	Spiked value *spike_val*
BS/BD: Blank spike/duplicate	Amount added
LB: Lab blank	"0.0000"
MS/SD: Matrix spike/duplicate	Amount added
LR: Lab replicate	"0.0000"
RM/RD: Reference matenal-/duplicate	Amount known
Surrogate spike result	Amount added
Other	"0.0000"

surrogate

Surrogate Spike Flag

This field indicates if the analyte for the given analytical result record is a surrogate spike analyte.

Code	Definition
T	The analyte is a surrogate spike for this sample and test.
F	The analyte is not a surrogate spike.

test_mthd

Analytical Test Method Code.

[VVL]

units

Units of Measure.

[VVL]

As a general rule, the following units will be used for reporting analytical results. Exceptions should be clearly documented and approved by Jacobs project personnel.

Sample type	Test type	Units
Water	inorganics, metals	MG/L
Water	organics	UG/L
Water	radioactivity	PCI/L
Water	TCLP	MG/L
Soil/sediment	inorganics, metals	MG/KG
Soil/sediment	organics	UG/KG
Soil/sediment	radioactivity	PCI/KG
Soil/sediment	TCLP	MG/L
Soil Gas	GC, GC/MS	PPB
Soil Gas	OVA, HNu	PPM

val_id

Validator ID.

[VVL]

The value to be used by each validator will be provided by Jacobs Engineering.

val_qual

Validator Result Qualifier.

Validating firms should use these codes to qualify results they are providing. Note that, although this is a required field, a blank value is meaningful, indicating that the result is unqualified.

These definitions are summarized from the *US EPA CLP National Functional Guidelines for Organics Data Review (Draft 12/90, Revised 6/91)* and the *US EPA Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses (7/1/88)*, which should be considered the authoritative definitions. The codes may only be combined as shown.

Further reason codes (or sub-codes) should be stored in the *val_qual_rc* field.

Code	Qualification
U	Material was analyzed for, but not detected above the level in the *value* field. The *value* is either the sample quantitation limit or the sample detection limit.
J	The analyte was positively identified. The *value* is an estimated quantity.
N	The analysis indicates presumptive evidence for a tentative identification of the analyte. *This code is inapplicable for inorganic results.*
NJ	The analysis indicates presumptive evidence for a tentative identification of the analyte. The *value* field holds the estimated quantity. *This code is inapplicable for inorganic results.*
R	The data are unusable. The analyte may or may not be present.
UJ	The material was analyzed for, but not detected above the quantitation limit. The value is an estimate, and may be inaccurate or imprecise.
(blank)	Unqualified result

val_qual_rc

Validator Qualifier Reason Code.

Validators should place reason codes or sub-codes for the codes in *val_qual* in this field. There is no VVL for this field, but all values should be agreed upon by and provided to Jacobs Engineering.

Appendix C—JEMS/IRPIMS cross-reference

This appendix cross-references JEMS data field names to, where applicable, the appropriate Air Force IRPIMS field. The cross-reference is provided to provide more information for labs on field contents and layouts.

Further information on the IRPIMS fields can be found in the IRPIMS DLH.

JEMS field	IRPIMS file	IRPIMS field
analyte	BCHRES	PARLABEL
anl_type	-	-
basis	BCHTEST	BASIS
calib_ref	-	-
comm_type	-	-
comment	-	-
climit_min	-	-
climit_max	-	-
control_num	-	-
dcl_flag	-	-
detect	BCHRES	LABDL
detect_sd	BCHRES	LABDLPRC
dilution	-	-
instrument	-	-
lab_anal_d	BCHTEST	ANADATE
lab_anal_t	BCHTEST	ANATIME
lab_batch	BCHSAMP	LABLOTCTL
lab_extrc_d	BCHTEST	EXTDATE
lab_extrc_t	BCHTEST	EXTTIME
lab_id	BCHTEST	LABCODE
lab_qual	-	-
lab_qual_o	-	-
lab_recvd	-	-
lab_snum	BCHTEST	LABSAMPID
matrix	-	-
max_rpd	-	-
parun	BCHRES	PARUN
parunprc	BCHRES	PARUNPRC
parvq	BCHRES	PARVQ
pquant	BCHRES	PQLEVEL
pquant_sd	BCHRES	PQLEVELPRC
prep_mthd	BCHTEST	EXMCODE
proj_num	-	-
pvccode	BCHTEST	PVCCODE
qc_type	BCHSAMP	SACODE
sigdig	BCHRES	PARPRC
spike_val	BCHRES	EXPECTED
surrogate	-	-
test_mthd	BCHTEST	ANMCODE
units	BCHRES	UTMCODE
val_id	-	-
val_qual	-	-
val_qual_rc	-	-
value	BCHRES	PARVAL

JACOBS ENGINEERING GROUP INC.

ATTACHMENT 2

SHIPPING REQUIREMENTS

TO

ANCHORAGE, ALASKA

ATTACHMENT 2

SHIPPING REQUIREMENTS

All equipment, materials, and supplies required during the 1994 field effort at Eareckson AS shall be classified as either cargo or as hazardous cargo as defined by DOT and Air Force regulations. In general, reagents, standards, preservatives, and gases, if required, fall into the latter classification, and will require shipment from Elmendorf AFB in Anchorage, AK, to Eareckson on a military cargo only aircraft. Procedures for these materials are discussed below.

Standards, Reagents, Preservatives, etc.

- Materials shall be in UN boxes, or at a minimum, labeled with UN numbers.
- Material Data Safety Sheets (MSDS) shall accompany each type of chemical.
- Materials shall be segregated by like/compatible chemicals and bonded on pallets.

Gases

- Cylinders shall be rust free.
- Cylinders shall have outlet port plugged with plastic cap.
- Cylinders shall have metal valve covers.
- MSDS shall accompany each type of gas.
- Gases must be segregated by gas type (flammable and nonflammable), and bonded together on pallets.

Jacobs personnel will arrange for delivery of all standard and hazardous cargo from Anchorage to Eareckson AS, provided the cargo is received in Anchorage by 22 July 1994; the Subcontractor is responsible for shipment to Anchorage, AK. Jacobs anticipates shipment of all standard cargo on weather wrapped pallets using military aircraft. Shipment of all cargo should arrive in Anchorage between 18 and 22 July 1994 at the following address:

Jacobs Engineering Group Inc.
c/o Chris Williams/Brent Hudson
500 L Street, Suite 302
Anchorage, AK 99501
(907) 278-9991
(907) 276-0500

All hazardous cargo, with the exception of gases, can also be received at the above address provided the previously discussed procedures are met. Due to the weight and volume of the gases, if required, arrangements should be made by the Subcontractor through Jacobs to have these delivered directly to Elmendorf AFB at the following address:

11th CEOS/CEOR/Jacobs Engineering Group Inc.
21885 2nd Street
Elmendorf AFB, AK
Attn: Mark Mobley
(907) 552-1617

Because outside temporary storage will be required prior to shipment to Eareckson AS, the pallets of gases or other equipment should be securely covered by visqueen or an equivalent material, such as a weather proof rap. The gases, if required, should also arrive between 18 and 22 July 1993.

JACOBS ENGINEERING GROUP INC.

SUBCONTRACT NO.

EXHIBIT B

DELIVERY REQUIREMENTS

1.0 WRITTEN RECORDS

The Subcontractor shall provide a written record of all significant conferences, meetings, discussions, telephone conversations, etc. with Government/Jacobs representatives relative to this Subcontract in which the Subcontractor and/or designated representative(s) thereof participated. These records shall be dated and shall identify the subcontract number, and paragraph reference if applicable, participating personnel, subject discussed, and conclusions reached. The Subcontractor shall forward to the Jacobs' Subcontract Manager designated in Section II, Article IV, as soon as possible (not to exceed 10 calendar days), a reproducible copy of the records.

2.0 INSPECTION AND ACCEPTANCE

2.1 Review and Deliverables. The deliverables and drafts of deliverables will be reviewed by Jacobs for content and adequacy.

2.2 Deliverable distribution shall be in accordance with Exhibit D.

2.3 Acceptance will be made in writing by the Jacobs' Subcontract Manager.

3.0 DELIVERY REQUIREMENTS

3.1 The Subcontractor shall furnish in accordance with the Statement of Work, Exhibit A, all necessary personnel and equipment to accomplish the specified work.

3.2 A data package deliverable to be provided by the Subcontractor's laboratory shall include the following:

- Cross-reference with field sample ID and field laboratory ID, if applicable.
- Sample result summary forms to include detected and undetected results (detection limits). The sample ID, date of analysis, dilution factor and units shall be included on these forms.

3.3 No later than 45 days after the completion of the project, the laboratory shall provide a complete data package to include the following:

- A case narrative listing the sample analyses performed in chronological order, a brief description of analytical methodology and quality control measures and description of the analytical problems, as applicable. The case narrative may be written to include the entire field laboratory program.
- Copies of all chain-of-custody records.

- Summary forms for calibration standard analyses, method blank summary forms, matrix spike and matrix spike duplicate (MS/MSD) summary forms, blank spike and blank spike duplicate summary forms and QC sample summary forms.

- Hard copies of all raw data.

3.4 A written report of the analytical test results, along with all applicable laboratory QA/QC data, must be produced WITHIN THIRTY (30) DAYS after receipt of the sample in the laboratory.

4.0 DATA DELIVERABLES

Level I: The price listed in Section II, Article VI for each analytical method includes the cost of processing, reducing, and delivering the following process data:

4.1 A copy of the signed chain-of-custody form showing date and time of sample receipt in laboratory.

4.2 A cross-reference of field sample number to laboratory sample number.

4.3 A cross-reference to identify applicable laboratory QC samples with the field sample.

4.4 A glossary to define the symbols and terms used in the laboratory report.

4.5 Sample collection, extraction and analysis data.

4.6 A list of the instrument and method detection limits.

4.7 A list of practical quantitation limits.

4.8 A sample data summary (the analytical results of the sample)

4.9 A QA/QC summary report, providing data on method blanks, check samples, surrogate recoveries, laboratory duplicates, matrix spikes, matrix spike duplicates, whichever are applicable to the particular method. The QA/QC summary report shall also list laboratory control limits and discuss the corrective actions taken whenever laboratory control limits are exceeded.

4.10 For GC analyses, a separate data summary report shall be provided for each confirmational analysis.

Level II: Under certain circumstances, the government may require a process report equivalent to an Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) report, as described in the most current EPA CLP statement of work. The CLP process report requirement is an incremental cost in addition to providing the Level I process report described in paragraph above.

6.0 STORAGE REQUIREMENTS

Laboratories shall archive all analytical data for a minimum of five (5) years.

SUBCONTRACT NO.

EXHIBIT C

INVOICING REQUIREMENTS

1.0 INVOICING

1.1 The Subcontractor shall submit all invoices for payment to:

Ms. Mary Anne Kaiser
Subcontract Administrator
Jacobs Engineering Group Inc.
600 17th Street, Suite 1100N
Denver, CO 80202

1.2 Payments will be authorized following receipt, inspection, approval and acceptance of Reports/Deliverables by Jacobs' Program Manager.

1.3 Invoice and all accompanying back-ups must be submitted in triplicate unless otherwise authorized by the Subcontract Manager. Back-ups shall include all Chain-of-Custodies for each sampling method.

1.4 Jacobs shall pay the Subcontractor upon submission of the properly completed forms (see 2.0 below) in accordance with the requirements of this Exhibit. All other invoices shall be returned to the Subcontractor. Improperly completed or incomplete forms are also subject to return for correction/completion.

1.5 The amounts shall be computed per line item on the "Payment Report" sheet as prescribed in Section II, Schedule Article VI, including description, method number, type of analysis, unit of measure, unit price, quantity, and extended price of services performed.

1.6 The invoice shall include the name and address of the Subcontractor to whom payment is to be sent (must be the same as that in the Subcontract or in a proper notice of assignment).

1.7 The invoice shall include any other information or documentation required by other requirements of the Subcontract (such as evidence of shipment).

2.0 FORMS

2.1 The Subcontractor shall utilize "Application and Certification for Payment" and its continuation sheet "Payment Report" forms.

2.2 Jacobs "Final Release Form" shall be submitted with the Subcontractor's application for final payment.

Date: ______

ATTACHMENTA

APPLICATION AND CERTIFICATE FOR PAYMENT

SUBCONTRACTOR

Name and Address: ______ | Application No.: ______

Subcontract/Purchase Order No.: ______ | Point of Contact: ______ | Period From: ______

Jacobs Project No.: ______ | Telephone No.: ______ | To: ______

MODIFICATION SUMMARY

MODIFICATIONS APPROVED BY CONTRACTOR THROUGH LAST APPLICATION		ADDITIONS	DEDUCTIONS
TOTAL			
MODIFICATIONS SINCE LAST APPLICATION			
Modification Number	Date Approved		
TOTAL			
NET CHANGES BY MODIFICATIONS			

SUBCONTRACTORS'S APPLICATION FOR PAYMENT

Application is made to Contractor for Payment, as shown below, in connection with the Subcontract. The Attachment A Continuation Sheet – Payment is attached. Issuance, Issuance, payment and acceptance of payment are without prejudice to any rights of Contractor under the Subcontract.

The present status of the account for this Subcontract is as follows:

1. ORIGINAL SUBCONTRACT NOT-TO-EXCEED AMOUNT $ ______
2. NET CHANGE BY MODIFICATION $ ______
3. CURRENT SUBCONTRACT NOT-TO-EXCEED AMOUNT $ ______
4. TOTAL EARNED TO DATE $ ______
5. TOTAL RETAINAGE $ ______
6. TOTAL EARNED LESS RETAINAGE $ ______
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT $ ______
8. CURRENT PAYMENT DUE $ ______

CERTIFICATE FOR PAYMENT

The undersigned Subcontractor certifies that to the best of Subcontractor's knowledge, information and belief the work covered by this Application for Payment has been completed in accordance with the Subcontract Documents, that all amounts have been paid by Subcontractor for Work for which previous Certificates for Payment were issued and payments received from Contractor, and that current payment shown herein is now due.

SUBCONTRACTOR:

By: ______ Date: ______

RECEIVING REPORT

Items invoiced for have been received and are approved for payment:

______ Project Manager ______ Date

Project No. ______ WBS Code ______

This invoice is consistent with the terms, conditions and pricing schedule and is approved for payment.

______ Contract Administrator ______ Date

Date: _____

ATTACHMENT A

CONTINUATION SHEET

APPLICATION AND CERTIFICATE FOR PAYMENT – PAYMENT REPORT

Subcontractor: _____
Subcontract/Purchase Order Number: _____
Jacobs Project Number: _____

Application Number: _____
Period From: _____
To: _____

Item Number	Description of Work (and WBS Code if applicable)	Unit of Measure	Unit Prices	Billing This Period		Billing Cumulative		Authorized Thru Mod	
				Quantity	Amount	Quantity	Amount	Quantity	Amount
	RENTAL OF THE FOLLOWING :								

ATTACHMENT B

FINAL RELEASE FORM

TO: JACOBS ENGINEERING GROUP INC.
600 Seventeenth St., Suite 1100N
Denver, CO 80202
Attention: Mary Anne Kaiser

Subcontractor:_____

Subcontract No.:_____

Jacobs Project No. :_____

This release is made in accordance with the provisions of the Subcontract including any and all Modifications thereto.

In consideration of payments made heretofore, or to be made, by Jacobs to the Subcontractor for labor, materials, and services furnished by the Subcontractor in the performance of above referenced Subcontract, the Subcontractor hereby unconditionally releases Jacobs, the Customer and the Owner, their officers, agents, employees, assigns or heirs from any and all claims whatsoever arising out of, or during, the performance of said Subcontract, other than such claims, if any, that have the consent of Jacobs, the Customer and the Owner as being specifically excepted from the terms of this Release, stated as follows: (if none, so state)

None

Subcontractor further certifies that all labor, materials and services furnished in connection with the performance of said Subcontract and all applicable state and federal payroll taxes and payroll insurance have been paid.

Executed this _____ day of _____ , 19 ___ .

WITNESSES (TWO WITNESSES REQUIRED):

1._____
Signature

_____
Name

_____
Address

2._____
Signature

_____
Name

_____
Address

By:

_____
Subcontractor

_____
Address

_____

_____
Signature

_____
Name

_____
Title

SGS	Commercial Testing & Engineering Company Environmental Laboratory Services Standard Operating Procedure	
S.O.P. Title: Gasoline Range Organics/ BTEX for Eareckson AFB/AFCEE		
Method No: AK101.0/8020	**Revision No:** 0	
General Reference: SW846	**Specific Reference:** Ak. 101/EPA 8020	
CT&E Branch Number: 046	**Page:** 1 **of** 11	

Approved By: _____ *Date:* 8-10-94
Section Supervisor

Approved By: _____ *Date Effective:* 8-10-94
Technical Director

1.0. SOP Approval and Use

This SOP has been peer reviewed for compliance with referenced method requirements and the CT&E Environmental Laboratory Services quality assurance document. Any modifications to this S.O.P. must be reviewed and approved before being incorporated into this updated, consecutively numbered revision.

2.0. Scope and Application:

This method is used to determine the concentration of gasoline range organics and various purgeable aromatics in water, soil, sludge and oils

3.0. Summary of Method:

This method employs a gas chromatograph for the determination of volatile petroleum fractions such as gasoline and benzene, toluene, ethyl benzene, and xylenes. Helium, an inert gas, is bubbled through a 5 ml of sample extract and reagent water or water sample contained in a specially designed purging chamber at ambient temperature. This serves to transfer purgeable hydrocarbons from the liquid to the vapor phase. The vapor is then swept to a sorbent trap where the hydrocarbons are trapped. Once purging is complete, the trap is then heated and back flushed with helium, desorbing the hydrocarbons onto the gas chromatograph column. The gas chromatograph is temperature programmed to separate the hydrocarbons that are then detected with a photo ionization detector (PID) and flame ionization detector (FID) in series. Quantification of gasoline range organics is based upon the FID response to a blended commercial gasoline standard.

4.0. **Interferences:**

4.1. Impurities in the purge gas and organic compounds outgassing from the plumbing ahead of the trap account for the majority of the contamination problems. The analytical system is demonstrated to be free from contamination under the conditions of analysis by running laboratory reagent blanks each day. Teflon tubing, Teflon thread sealants and flow controllers without rubber components should be used in the purge and trap system to avoid contamination.

4.2. Samples can be contaminated by diffusion of volatile organics through the septum seal during shipment and storage. A trip blank for every ten sample prepared from reagent water and carried through the sampling and handling protocol can serve as a check on such contamination.

4.3. Carryover contamination can occur when high level and low level samples are sequentially analyzed. The sample syringes and purging device are rinsed with reagent water between samples. Following unusually concentrated samples, a blank is run to check for cross contamination.

4.4 High levels of heavier petroleum products such as diesel fuel may contain volatile components producing a response within the retention time range for gasoline. Other organic compounds including chlorinated solvents, ketones, and ethers are measurable and GRO results include these compounds.

5.0. Sample Handling:

Samples are received from clients and refrigerated upon arrival at 4°C until analysis. Sample custodian is responsible for tracking the samples. All soil samples are extracted as soon as possible after reciept and analyzed within 14 days of collection date. Soil aliquots for volatiles are removed and extracted before any other analyses and water samples are refrigerated in a location isolated from other samples, standards, and solvents.

6.0. **Apparatus:**

6.1. Glassware

6.1.1. 40 ml and 15 ml glass VOA vials with Teflon-lined septa and screw caps.

6.1.2. 10 ml, 50 ml and 100 ml glass class A volumetrics with g glass stoppers.

6.1.3. 18 x 150 mm borosilicate glass Pyrex disposable culture tubes. (CAT NO. 6082[illegible] 660)

6.2. Syringes

6.2.1. 5 ml Hamilton 1005TLL Syringe. (Supelco #2-0999)

6.2.2. Micro syringes: 10, 25, 50, 100, 500, 1000 uL. (Supelco, Hamilton 1000 Series Gas Tight, High Performance)

6.3. Analytical balance, capable of accurately weighing to the nearest 0.0001 g .

6.4. Stainless Steel Spatula for scooping out soil samples.

6.5. Aluminum weigh dishes for percent solids.

6.6. Multi-Purging Module, OI Corporation MPM 16

6.7. Purge and Trap Concentrator, OI Corporation 4460A with #3 Trap. See Table 1 for 4460A conditions.

6.8. Gas Chromatograph, Hewlett Packard 5890 Series II. See Table 2 for temperature program and flow rates.

6.8.1. Capillary column, J&W DB624, 30M x 0.53 mm Column performance is evaluated by calculating the Separation Number of nonane and octane.

6.8.2. Photo ionization Detector, OI Corporation 4430.

6.8.3. Flame Ionization Detector, OI Corporation 4410.

6.0. **Apparatus (continued):**

6.8.4 Millennium 2020 Chromatography Workstation, (Waters Division of MILLIPORE) for data retrieval, archiving and manipulation (or equivalent).

7.0. **Reagents:**

7.1. Ottowa Sand: used for LCS, solvent blanks and soil matrix blanks.

7.2. Reagent Water: de ionized water boiled for one hour to remove organic components. Tested to ensure no components are above MDL of analysis.

7.3. Methanol: High purity for purge and trap analysis. Tested to ensure no components are above MDL of analysis.

7.4. Stock Standard Solutions: All standards are prepared in methanol (7.2) according to the guidelines in SW846. Standards are stored without head space in vol[illegible]eezer. Standards are made up every six months and checked regularly to assu[illegible]ntegrity.

7.4.1 Internal Standard/ Surrogate Standard: Internal Standard used for BTEX Analysis is 1-cholor-4-fluorobenzene. Surrogate Standard used is trifluorotoluene and 4-bromofluorobenzene.

7.4.2 Continuing Calibration Verification standard (CCV): The gasoline calibration standard is an equal weight mixture of local gasolines, to include Mapco Unleaded, Mapco Leaded, Tesoro Unleaded and Tesoro Super Unleaded. Make up working solution at a concentration of about 200 mg/l.

7.4.3 Continuing Calibration Verification standard (CCV): The BTEX Calibration Standard: Use Restek Corp. Method 8020A Calibration Mix (Cat. #30064). Make up working standard at a concentration of 50 mg/l for each component.

7.4.4. Laboratory Control Standard (LCS): Use Restek Corp. Unleaded Gasoline Composite Standard (Cat. #30081). Make up working standard at a concentration of 125 mg/l. This standard is run several times on a mass spec to quantitate the BTEX components so it can be used as a quality control check.

7.0. **Reagents:**

7.4.5. Gasoline Alkane Standard (GAS): Use AccuStandard Gasoline Range Hydrocarbons (GRH-001S). Make up working standard at a concentration of 10 mg/l for each component. The GAS is a ten component blend and is used as the window defining mix for GRO and the LCS for BTEX.

7.4.6. Spike Standard: Use Sigma-Aldrich Gasoline (39,863-2). Make up working standard at a concentration of 100 mg/l. This standard is also run by mass spec several times to quantitate the BTEX components so it can be used as the spike.

7.4.7. Normal Alkane Standard (NAS): This standard is an equal weight mixture of hexane, heptane, octane, nonane and decane. This standard is used to evaluate column performance by calculating the separation number and column resolution. Refer to section 12 for separation number calculations.

8.0. Calibration:

8.1. The GC system should be should be set up as in Section 6. The trap should be conditioned for at least 10 minutes prior to use each day and the MPM should be free of contamination. It is helpful to run a series of blank waters overnight before calibrating.

8.2. Using the external standard calibration procedure, first run a GRO curve, using the CCV, of five points with concentration levels above the detection limit and covering the linear range of the instrument (40 to 2000 ppb). Then run a BTEX curve, using the internal calibration procedure, of five points (1.25 to 200 ppb for each component).

8.2.1 Prepare final solutions of CCV and BTEX Standard directly in a 5 ml glass syringe and add 10 ul of Internal Standard/Surrogate to each dilution. Dilutions are prepared by filling the 5 ml syringe with blank water and adding standards using a micro syringe inserted beneath the water. Inject the prepared dilution into a sparge tube and put onto the MPM-16. These steps should be performed as quickly as possible to reduce loss of volatiles.

8.0 Calibration (continued):

8.3. After calibration curves are run, calculate the response factors and their % Relative Standard Deviations. If the % RSD of the GRO curve is less then 25% the curve can be considered linear and if the %RSD of each BTEX component is less than 20% the curves can be considered linear. Use the average response factor for each component to check the daily CCV response factors. The daily CCV response factor must be ± 25% form the initial average response factor for GRO and ±15% for each BTEX component.

8.4. The accuracy of the calibration curve and precision of the instrument must be confirmed by running the LCS four times. The GRO and BTEX components should be ±20% of the expected concentrations. Calculate the average recovery and the standard deviation for each analyte.

8.5. At the start of each work day, the calibration curve for GRO is verified by running a continuing calibration standard (CCV). The response factor of the CCV must be ±25% of the inital calibration average response factors. BTEX curves are verified with the LCS that is run every ten samples and at the end of each run.

8.6. Retention Time Windows: During the 72 hours following a calibration choose three standards (CCVor LCS) to calculate the retention time windows. The window is defined as ± three times the standard deviation of the absolute retention time for each component. If the standard deviation for an analyte is zero, use ±0.05 min. as a retention time window. The retention time windows are calculated whenever a new column is installed and at a minimum of once a year.

8.7 The GRO Integration Range is from 2-methyl pentane (C_6) to 1,2,4,trimethylbenzene(C_9)

9.0 Extraction: (if applicable)

9.1. Water samples are analyzed directly by purge and trap. 5.0 ml of sample is collected with a glass syringe. If a sample is suspected to contain gasoline it should be diluted before running to prevent any contamination of the purge and trap system.

9.2. Soil samples are extracted with 5 ml of methanol according to the SOP for extracting volatile samples.

9.3 Oil samples are extracted in the same manner as soils but weigh out one gram or less of sample.

10.0. **Analysis:**

10.1. Bake out trap daily for ten minutes prior to running any samples and clean any previously used stations on the MPM-16 with two rinses of organic free water.

10.2. Volatiles are introduced into the gas chromatograph by purge and trap(4460A) and analyzed with a PID and FID.

10.2.1. For water and water soluble waste samples: Most waters can be analyzed directly. Remove the plunger from a 5 ml glass syringe and rinse with reagent water. Rinse the syringe barrel with sample water and then fill the syringe to overflowing. Replace the plunger, compress the sample forcing out any trapped air and measure out 5 ml. Back off the plunger to create a small air bubble and introduce 10 µl of surrogate/internal standard into the water. Inject sample with surrogate and internal standard into a culture tube and put onto MPM-16. These steps should be performed as quickly as possible to reduce volatile losses. Save excess sample in a 15 ml glass vial with Teflon lined septum with no head space. Some highly contaminated samples may need to be diluted to prevent contamination of the pruge and trap system.

10.2.2. For soil, sludge and oil samples: Rinse the barrel of a glass 5 ml syringe with reagent water and fill the syringe with 5 ml of reagent water minus the amount of sample extract to be added, i.e. if 100 µl of soil extract is to be used adjust the reagent water to 4.90 ml. Add 10 µl of surrogate/internal standard directly to the syringe in the same manner as for a water sample. Then add the aliquot of sample methanol extract to the reagent water/surrogate/internal standard and put the tube on the MPM-16. The maximum amount of methanol extract that can be added is 100 µl. This corresponds to a detection limit of 1.00 ppm for soils. Soils are reported on a dry weight basis, therefore the percent of solids must be determined to calculate the dilution factor.

10.3. Data is acquired using Millennium software. All samples need to be listed and set to aquire on the Sample Queue screen in the order in which they are set up on the MPM-16. The sample list also needs to be identified on the Execute Method screen and started then okayed.

10.0. **Analysis (continued):**

10.4. The 4460A then can be started by clicking the red and black buttons so both red lights are lit. The 4460A should then begin to purge the sample on the station numbered on the MPM-16 and continue through dry purge, desorb, bake and to the next sample on the next station. The 4460A program and temperatures should already be set as in Table 1.

10.5. The Gas Chromatograph will begin when the 4460A is in the desorb mode and runs through the temperature program listed in Table 2. The 4460A holds the next sample in the desorb ready mode until the GC program is complete and the oven cools to the initial temperature.

10.6. Millennium aquires, integrates and saves the results for each sample. If any components are not within the calibration's range, another dilution must be run if possible without contaminating the GC system.

11.0. Quality Control:

11.1. A reagent water and surrogate/internal standard blank is analyzed at the start of each working day to show the purge and trap system is contaminate free. All components should be below the practical quantification limit.

11.2. Blanks should also follow suspected high contaminated samples to show no carryover. Blanks should be run on stations that previously contained highly contaminated samples until components are below practical quantification limit.

11.3. A GRO CCV is analyzed daily to confirm the calibration curve. The GRO concentration must be $\pm$20 % of the true concentration and the response factor must be $\pm$25 % of the average response factor from the initial calibration.

11.4. A QC sample using the gasoline alkane standard analyze daily to check the BTEX calibration and establish the daily retention time windows for both BTEX and GRO. The BTEX concentrations must be $\pm$20 % of the true concentrations and the BTEX response factors must be $\pm$15 % of the calibrations average response factors.

11.5. A methanol/Soil Blank is analyzed daily to establish that the methanol used in extracting samples is free of any BTEX and GRO components.

11.0 **Quality Control (continued):**

11.6. Every twenty samples a Spike (25 µl Spike standard, 10 µl Surrogate/Internal Standard, and 100 µl blank soil extract) and Spike Duplicate are analyzed. The concentrations of all components should be ±20 % of true concentrations (see 8020 Table 3 for minimum QC acceptance criteria) and have a RPD <25. Monthly a spike control chart must be created for each compound including UCL, LCL, average and daily spike concentrations.

11.7. Every ten samples and at the end of each sequence a LCS must be analyzed.The Laboratory will demonstrate the ability to meet or be within method established performance criteria. Method established criteria will be used to evaluate performance. The recovery limits will not exceed ±20 % of the true concentration.

11.8. Surrogate recoveries: The Laboratory will demonstrate the ability to meet or be within method established performance criteria. Method established criteria will be used to evaluate performance. The recovery limits will not exceed ±20 % of the accepted value.T surrogates in this method are suseptable to matrix interferance.

12.0 Calculations:

Dilution Factor for soils:

wet weight(g) x % solids = True weight(g)
wet weight(g) - true weight(g) = moisture

$$\text{Dilution Factor} = \frac{\text{moisture} + 5\text{ ml methanol}}{\text{True weight}} \times \frac{5\text{ ml water}}{\text{ml of sample extract added}}$$

Dilution Factor for oils:

$$\text{Dilution Factor} = \frac{5\text{ ml methanol}}{\text{wt of sample}} \times \frac{5\text{ ml water}}{\text{ml of sample extract added}}$$

Final Concentration:

Final concentration = solution concentration x dilution factor

Solution Concentration:

Solution concentration is determined by the software from component area in the chromatogram and the calibration linear equation.

12.0. **Calculations (continued):**

Separation Number for Column performance:

$$SN = \frac{\text{Retention Time of octane - Retention Time of nonane}}{\text{Width of nonane at 1/2 height + Width of octane at 1/2 height}} - 1$$

13.0. **Safety:**

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined However, each chemical compound should be treated as a potential health hazard. Exposure to these chemicals must be reduced to the lowest possible level by whatever means available. A reference file of material safety data sheets and other safety information is available in the QC office.

14.0. Flow Chart:

See attached chart.

15.0. Current MDL Study:

See attached study.

16.0. Calibration Curve:

See attached curves.

17.0. **Practical Quantification Limits:**

17.1 The PQL for waters is 0.020 mg/l. The PQL for soils is 1.00 mg/kg (dry weight). The PQL is variable due to sample matrix.

18.0 **Daily Sequence of Events:**

18.1. Review previous days run for contaminated stations and samples requir...g re-runs.

18.2. Set up QC run for the day, consisting of:

a Water blank - to ensure the water being used is not contaminated.

b. CVS - to ensure that the calibration for GRO remains valid.

c QC - to ensure that the calibration for BTEX remains valid.

d. Matrix Blank - to ensure that the methanol used for extractions is not contaminated.

e. Matrix Spike - to ensure repeatability and verify the calibration is acceptable for extracted soils.

f. Matrix Spike Dup - to ensure repeatability and verify the calibration is acceptable for extracted soils.

18.3. Verify that the QC package meets QC goals.

Sample analysis begins if all QC meets criteria. If problems arise, corrective action will be taken according to SOP corrective action outline.

18.4. Set up sample run with LCS after every 10th sample or 12 hours after CVS, whichever is earlier.

SGS	Commercial Testing & Engineering Company Environmental Laboratory Services Standard Operating Procedure	
S.O.P. Title: Extractable Diesel Range Organics for Eareckson AFB/AFCEE		
Method No: AK102	Revision No: 0	
General Reference: EPA SW846	Specific Reference: ADEC AK102	
CT&E Branch Number: 046	Page: 1 of 12	

Approved By: _____ *Date:* 8-10-94
Section Supervisor

Approved By: _____ *Date Effective:* 8-10-94
Technical Director

1.0 SOP Approval and Use

This SOP has been peer reviewed for compliance with referenced method requirements and the CT&E Environmental Laboratory Services quality assurance document. Any modifications to this S.O.P. must be reviewed and approved before being incorporated into this updated, consecutively numbered revision.

2.0 Scope and Application:

Provides a GC method for determining the concentration of diesel range organics (C10-C24) in water and soil samples. For example:

Diesel Fuel #1	Jet Fuel A JA50	Crude Oil	Desolvit
Diesel Fuel #2	Jet Fuel B JP4	Kerosene	Clean Away
Arctic Diesel			

3.0 Summary of Method:

This standard operating procedure provides gas chromatographic conditions for the analysis of diesel range organics (Extractable Petroleum Hydrocarbons). Upon completion of extraction procedures, the concentration of diesel range organics are determined by Gas Chromatography employing a Flame Ionization Detector. The Laboratory will demonstrate the ability to meet or be within method established performance criteria. Method established criteria will be used to evaluate performance.

4.0. Interferences:

4.1. Contamination due to sample carryover can occur whenever high-level samples are sequentially analyzed. To reduce carryover, the sample syringe must be rinsed out between samples with solvent (MeCl2). Whenever a highly concentrated sample is encountered it should be followed by a solvent blank to check for cross contamination.

4.2. Biogenic organic interferences may be encountered in the diesel range, especially in humic soils. The diesel range organics results should include these compounds with a qualifier of suspect patterns.

5.0. Sample Handling:

5.1. Water samples should be kept in a one liter glass Qorpak bottle and soil samples should be kept in a core tube or glass jar. Both should be cooled to four degrees Celsius.

5.2. Samples must be extracted within seven days of sampling for water and fourteen days for soil. Extracts must be analyzed within forty days following extraction.

6.0. Apparatus:

Instrument: HP 5890 Series II Gas Chromatograph. Accessories. JW DB-5 Capillary Column 30m x 0.53 mm ID, 1.5 micron film thickness, 8 ml/min helium carrier, 20 ml/min make-up. Flame Ionization Detector with 30 ml/min hydrogen, and 430 ml/min air. HP Chemstation Data System.

7.0. Reagents:

7.1 Ottowa sand: used for LCS, solvent blanks and soil matrix blanks.

7.2. Solvents: Acetone, Methylene Chloride, Methanol. ACS reagent grade solvents must be used in all tests unless otherwise indicated.

7.3. Sodium Sulfate (Anhydrous). Granular. Heat treated in a shallow tray at 400 C for minimum of four hours to remove phthalates and other interferences.

7.0. Reagents (continued):

7.4. Stock Standards: Stock standards are prepared by diluting commercial diesel or petroleum products from neat. Transfer the stock standard solution to a Teflon screw cap. Store at four degrees C. Stock standard solution should be checked frequently for signs of degradation or evaporation, especially prior to preparing calibration standard from them. Stock standards must be replaced after six months, or sooner, if comparison with check standards indicates a problem.

7.5. Calibration Standards: A minimum of five calibration standards for each parameter of interest should be prepared through dilution of the stock standards with methylene chloride. One of the concentrations should be above, but near the method detection limit. The remaining concentration levels should correspond to the expected range of concentrations found in real samples or should define the working range of the GC. Calibration solutions must be replaced after three months, or sooner, if comparison with check standards indicates a problem.

7.6. Surrogate: The analyst should monitor the performance of the extraction, cleanup, analytical system, and the effectiveness of the method in dealing with each sample matrix. This is done by spiking each sample, blank, spike, spike duplicate and LCS with Ortho-Terphenyl (OTP) surrogate.

7.7. Reagent Storage and Shelf Life: All stock and working solutions are to be kept on the freezer when not in use. After each use the meniscus is to be marked and dated on the vial to show any evaporation. If concentration of a standard is suspected, the solution should be discarded. After three months any working solution should be discarded.

7.8. Disposal of Reagents: Submit waste reagents and standards to hazardous waste officer.

8.0. Calibration:

8.1. Establish gas chromatographic operating parameters equivalent to those indicated in section four. Prepare calibration standards as indicated below and calibrate using the external standard technique.

8.0 Calibration (continued):

8.2. Stock Standards: Prepare a stock standard solution by blending equal weights of DF1, DF2, Arctic Diesel or kerosene. Transfer the stock standard solution to a Teflon lined screw cap bottle. Store at four degrees Celsius. Stock standards must be replaced after one year, or sooner, if comparison with check standards indicates a problem.

8.3. Calibration Standards: A minimum of five calibration standards should be prepared through dilution of the stock standard. The concentrations of the standards should include a point near the Instrument PQL and should define the working range of the detector.

8.4. The calibration method will be done by the external standard method. The following criteria will need to be met for the calibration to be considered valid.

8.4.1 The % RSD for the average response factors for the calibration standards will be le than 20%.

8.4.2 The corrolation coefficient of the best fit line will be greater than 0.995

8.4.3 The above criteria will also apply to the surrogate calibration.

9.0 Extraction:

9.1 Soil sample extraction: Equipment: Soxhlet apparatus, Turbo Vap tubes, short stem funnel, water bath temperature controlled at 50 degrees C and a pressure between 10 - 14 psi.

9.1.1. Weigh out 10-50 grams of soil into a weighing dish. Weigh out a percent solids sample. Weigh out 10-50 grams of blank soil for a blank, spike, and spike duplicate once per day or once per 20 samples, whichever comes first. For each sample note in the lab book if a hydrocarbon odor or biogenics are present or if the sample is clay.

9.1.2. Mix muffle furnaced sodium sulfate with the soil sample to dry it. The sample should have a dry, granular consistency.

9.1.3. All glassware that comes in contact with the sample must be blanked before it can b used. Blank glassware by rinsing with Methanol then $MeCl_2$ twice. Save the second $MeCl_2$ rinse as a glass blank.

9.0. **Extraction (continued):**

9.1.4. Pour dried sample into a Thimble which has been baked for 15 minutes. (The thimbles are baked to remove pthalates.

9.1.5. Fill the blanked round bottom flask with approximately 300 ml of methylene chloride. Also add two blanked boiling beads. Connect concentrator to flask.

9.1.6. Add one ml O-Terphenyl surrogate (600 µg/ml) to each sample. Add one ml of the blend spike solution (4000 µg/ml) to the spike, spike duplicate and LCS samples.

9.1.7 Place thimble which holds sample into the appropriate concentrator. Concentrator apparatus should be numbered with sample ID.

9.1.8 Add one ml of OTP surrogate working solution to each sample, spike, spikedup, LCS, and blank directly into the thimble

9.1.9 Place each soxhlet apparatus on hotplate and connect to the cooling system. Be sure the cooling system is in operation before the hotplates are turned on.

9.1.10. Reflux samples for at least four hours

9.1.11. All glassware that comes in contact with the sample must be blanked before it can be used. Blank glassware by rinsing with Methanol then $MeCl_2$ twice. Save the second $MeCl_2$ rinse as a glass blank.

9.1.12. After refluxing decant the sample into a blanked Turbo Vap tube through a funnel containing glass wool and muffle furnaced sodium sulfate. Rinse the soxhlet apparatus with two small portions (20 mls) of $MeCl_2$ and decant rinsing into the funnel. Rinse funnel with additional $MeCl_2$

9.1.13. Concentrate the samples to a final volume of 1.0 mls in Turbo Vap apparatus.

9.1.14. Enter percent solid values in the lab book and calculate sample dry weights and dilution factors. Submit an auto sample vial of the final extract along with a copy of the appropriate paperwork to the instrument analyst. Save an additional auto sample vial as an archive and store in the archive refrigerator.

9.0. Extraction (continued):

9.1.15. Rinse all used glassware with methanol to remove any contaminants before giving it to the dishwasher.

9.2. Water Sample Extraction: Equipment: 2000 ml separatory funnel for each sample, 1000 ml graduated cylinder, along with all of the glassware necessary for a soil extraction.

9.2.1. If more than one liter of sample is provided, use an entire liter (1000 mls) for the extraction. If less than one liter of sample is provided, do not archive any of the sample, but use the entire amount. Mark the meniscus on the original sample jar and pour the sample into the separatory funnel.

9.2.2. All glassware must be blanked before it can be used. Blank glassware by rinsing with Methanol, $MeCl_2$ twice. Save the second $MeCl_2$ rinse as a glass blank.

9.2.3. Prepare a blank, spike, and spike duplicate using 1000 mls of DI water. Extract one per day or one per twenty samples, whichever is greater. Add one ml O-Terphenyl surrogate (600 µg/ml) to every sample. To the spike, spike duplicate and LCS add one ml of the blend solution (4000 µg/ml).

9.2.4. Add 60 mls of $MeCl_2$ to the original sample jar, rinse and pour the $MeCl_2$ into the sample in the separatory funnel. Fill the original sample jar with water to the mark made for the meniscus of the original sample. Pour this water into a graduated cylinder and record the volume of sample used for the extraction.

9.0 Extraction (continued):

9.2.5 Shake the separatory funnel for two minutes, venting frequently. Let stand for ten minutes to ensure complete separation. Drain the lower layer ($MeCl_2$) into a labeled Turbo Vap tube through a funnel packed with glass wool and muffle furnaced sodium sulfate. Rinse the sodium sulfate twice with small amounts of $MeCl_2$.

9.2.6. If an emulsion layer thicker than one inch is present, drain the emulsion into Teflon centrifuge vials and centrifuge to obtain separation. Put the aqueous layer back into the separatory funnel and the $MeCl_2$ layer into the Turbo Vap tube.

9.2.7. Repeat the extraction process two more times, each time collecting the $MeCl_2$ layer into the Turbo Vap tube.

9.2.8 Concentrate the sample to a final volume of 1.0 mls.

9.2.9. Place samples in auto sample vials and submit them to the analyst along with the completed paperwork. Save an additional auto sample vial as an archive and the remaining extract in a scintillation vial in the archive refrigerator. Do the numbering of sample glassware one at a time and double check all the numbers/labels in order to avoid sample switch.

10.0 Analysis:

10.1. Data Acquisition: Samples are placed in auto injector vials, sealed and loaded sequentially into the sample trays. The software allows the analyst to input for each sample, the name of the sample, the instrument method and multiplier. Sequences must be acquired into a subdirectory denoted by the date of analysis.

10.2. Data analysis: Retention time windows are checked against the alkane reference standard for that analytical batch. Peaks which fall within this window are tentatively identified as diesel range organics. Attached is a sample data package.

10.3. Post analysis: Retain auto sample vials for thirty days and extract archives for one year. Dispose of extracts as chlorinated waste.

11.0. **Quality Control:**

11.1. Continuing Calibration Verification Standard (CCV): The blend of diesel range components (DF1,DF2,and kerosene) will be run every 24 hours to verify the initial calibration. The acceptance criteria is less then 25% RPD of the daily response factor from the initial calibration average response factor .

11.2. Surrogates: The analyst should monitor the performance of the extraction, cleanup, analytical system, and the effectiveness of the method in dealing with each matrix by adding to each sample, matrix spike, spike duplicate, matrix blank and LCS the Ortho-Terphenyl (OTP) surrogate. The Laboratory will demonstrate annually the ability to meet or be within method established performance criteria. Method established criteria will be used to evaluate performance. The recovery limits will not exceed 60% - 130% in water and 50% - 140% in soil.

11.3. Laboratory Control Sample (LCS): The laboratory control sample will be a blend of the same diesel range components as the CCV, but blended independently. This is done since there is no separate source for these components available. The LCS will be carried through the extraction/analysis process with the samples. Blank soil or client sample will be used for the LCS when soils are analyzed. The Laboratory will demonstrate annually the ability to meet or be within method established performance criteria. Method established criteria will be used to evaluate performance. The limits will not exceed +/- 25% recovery from accepted concentration. LCS frequency will be every twenty project samples, or every 24 hours .

11.4. Spike/Spike Duplicates: In order to monitor matrix effects on the method, a known concentration of method analytes must be added to two aliquots of a matrix. This must be performed every twenty samples extracted/analyzed or on a daily basis. The Laboratory will demonstrate annually the ability to meet or be within method established performance criteria (ADEC QAPP for UST sites). Method established criteria will be used to evaluate performance. The limits will not exceed 60% - 130%, with a relative percent difference of 30% in water and 50% - 140% with a relative percent difference of 40% in soil.

11.0. **Quality Control (continued):**

11.5. Laboratory Control Standard: A mix of all alkanes from and including C10 to C24. A certified diesel standard is also acceptable. The laboratory control sample will be run at a frequency of 1 every 24 hours and at the end of the 24 hour sequence. The Laboratory will demonstrate annually the ability to meet or be within method established performance criteria. Method established criteria will be used to evaluate performance. The limits will not exceed 75% to 125%.

12.0. **Calculations:**

Let x = Concentration of the sample in µg/ml or mg/kg (dry weight).

x = R.F.(from 5 point calibration) x (Area) (Dilution factor)

13.0. Safety:

13.1. The toxicity, or carcinogenicity, of each reagent used in this method has not been precisely defined. However, each chemical compound should be treated as a potential health hazard. General laboratory safety practices must be followed at all times.

13.2. References:

13.2.1. ADEC Draft, method for the determination of Diesel Range Organics.

13.2.2. ADEC UST Draft Quality Assurance Program Plan.

13.2.3. US EPA SW 846 Modified 8100 Method.

13.2.4. US EPA SW 846 Method 8000.

13.2.5. US EPA SW 846 Chapter Two.

14.0. **Flow Chart:**

See Attached.

15.0. **Current MDL Study:**

See Attached.

16.0. **Calibration Curve:**

See Attached.

17.0. **Practical Quantification Limits:**

For soil it is 4.00 mg/Kg, for water it is 0.100 mg/Liter. PQL are variable due to sample matrix.

18.0. **Daily Sequence of Events for EPH Analytical Batch:**

18.1. If necessary change injection liner and septa. Run 4 $MeCl_2$ blanks after the change to insure no artifacts are present from the new liner or septa.

18.2. Run $MeCl_2$ instrument blank to prove GC System is free from contamination.

18.3. Run C10-C24 alkane standard to verify integration window.

18.4. Run blend of DF1, DF2, Arctic Diesel or Kerosene to check initial calibration (CCV).

18.5. Run surrogate calibration check.

18.6. Run extraction glassware blank.

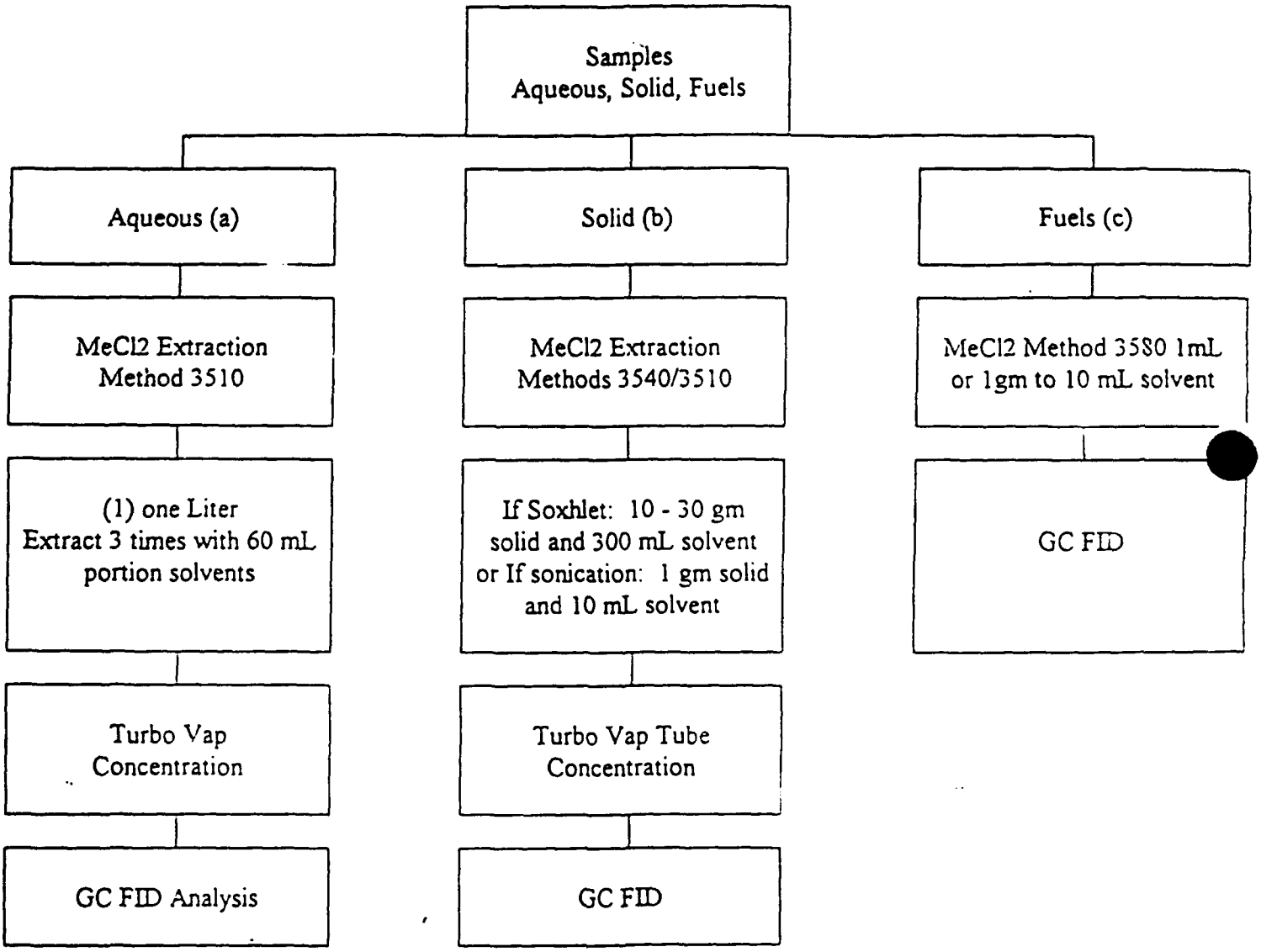
18.7. Run extraction solvent blank.

18.8. Run LCS.

18.9. Run Matrix spike.

18.10. Run Matrix spike duplicate.

18.11. Sample analysis begins if all QC meets criteria. If problems arise, corrective actions will be taken according to laboratory QAPP corrective action outline.


Samples
Aqueous, Solid, Fuels
Aqueous (a)
Solid (b)
Fuels (c)
MeCl2 Extraction
Method 3510
MeCl2 Extraction
Methods 3540/3510
MeCl2 Method 3580 1mL
or 1gm to 10 mL solvent
(1) one Liter
Extract 3 times with 60 mL
portion solvents
If Soxhlet: 10 - 30 gm
solid and 300 mL solvent
or If sonication: 1 gm solid
and 10 mL solvent
GC FID
Turbo Vap
Concentration
Turbo Vap Tube
Concentration
GC FID Analysis
GC FID

Performance Criteria AK102
on "old" std - preliminary check

9.2.2.1 Solvent - C_{10} resolution ---ok

9.2.2.2 Mass discrimination

(C17 at 552 (originally) vs C24 at 420 (originally))

Area C17 = 247952

Area C24 = 186571

80% of Area (C17) = 198361

Multiplier (C17/C24) = 552/420

80% C17		C24 x Multiplier		100% C17
198361	<	245207	<	247952

---ok

9.2.2.3 Separation

(C12 at 537 (originally) vs C13 at 582 (originally))

RT of C12 = 10.676 RT of C13 = 12.066

Area C12 = 170133 Area C13 = 200853

Height C12 = 64566 Height C13 = 75438

Multiplier (C12/C13) = 537/582

$$W_h = 0.940 \left(\frac{A_p}{h_p}\right) 10^{-3}$$

$$W_{\frac{1}{2}(C12)} = 0.940 \left(\frac{170133}{64566}\right) 10^{-3} \longrightarrow 0.0247692$$

$$\text{adj } W_{\frac{1}{2}(C13)} = 0.940 \left(\frac{200853}{75438}\right) 10^{-3} \left(\frac{537}{582}\right) \longrightarrow 0.0230923$$

$$T_z = \left[\frac{(12.066 - 10.676)}{(0.0230923 + 0.0247692)}\right] - 1 \longrightarrow 28$$

---ok

1-W-6-1

Analyte	Chem Service Stock	Conc.
C_{10} = 0.2158 g	Lot 37-128A	540 ppm
C_{11} = 0.2356 g	Lot 40-74B	590 ppm
C_{12} = 0.2147 g	Lot 45-132A	537 ppm
C_{13} = 0.2326 g	Lot 33-146D	582 ppm
C_{14} = 0.2378 g	Lot 45-106A	595 ppm
C_{15} = 0.2176 g	Lot 44-79B	544 ppm
C_{16} = 0.2578 g	Lot 36-132A	645 ppm
C_{17} = 0.06629 g	Lot 52-79A	552 ppm
C_{18} = 0.05450 g	Lot 37-43C	454 ppm
C_{19} = 0.0547 g	Lot 41-148C	456 ppm
C_{20} = 0.0555 g	Lot 40-82B	463 ppm
C_{21} = 0.6446 g	Lot 127-109A	538 ppm
C_{22} = 0.06644 g	Lot 23-16R	553 ppm
C_{23} = 0.06276 g	Lot 44-2A	523 ppm
C_{24} = 0.1504 g	Lot 23-16D	1201 ppm
C_{25} = 0.0505 g	Lot 52-87A	421 ppm

C_{10} - C_{17} diluted to 10.0 mL with Lot HK 257

C_{18} - C_{25} diluted to 3.0 mL with

2.5 mL of each diluted to 180 mL together.

gives final conc above

1-W-6-2 dilute 1-W-6-1 by 10

gives ~ 90 ppm to each component. -INT.

W-6-3 BTEX SPIKE 500 uL of 200 ppm → 10 mL MeOH

100 ppm final

[redacted]

REVIEWED BY _____

External Standard Report

Data File Name : G:\ORGANICS\SEMI_VOA\SAF0723\0811\002F0101.D
Operator : DOREEN & BILL
Instrument : EPH #1
Sample Name : C10-25 10PPM/ALK
Run Time Bar Code:
Acquired on : 11 Aug 94 09:26 AM
Report Created on: 11 Aug 94 10:21 AM
Last Recalib on : 10 AUG 94 01:53 PM
Multiplier : 1

"old" std, 10ppm/alkane approx.

Page Number : 1
Vial Number : 2
Injection Number : 1
Sequence Line : 1
Instrument Method: AK102T2.MTH
Analysis Method : AK102T2.MTH
Sample Amount : 0
ISTD Amount :

Sig. 1 in G:\ORGANICS\SEMI_VOA\SAF0723\0811\002F0101.D

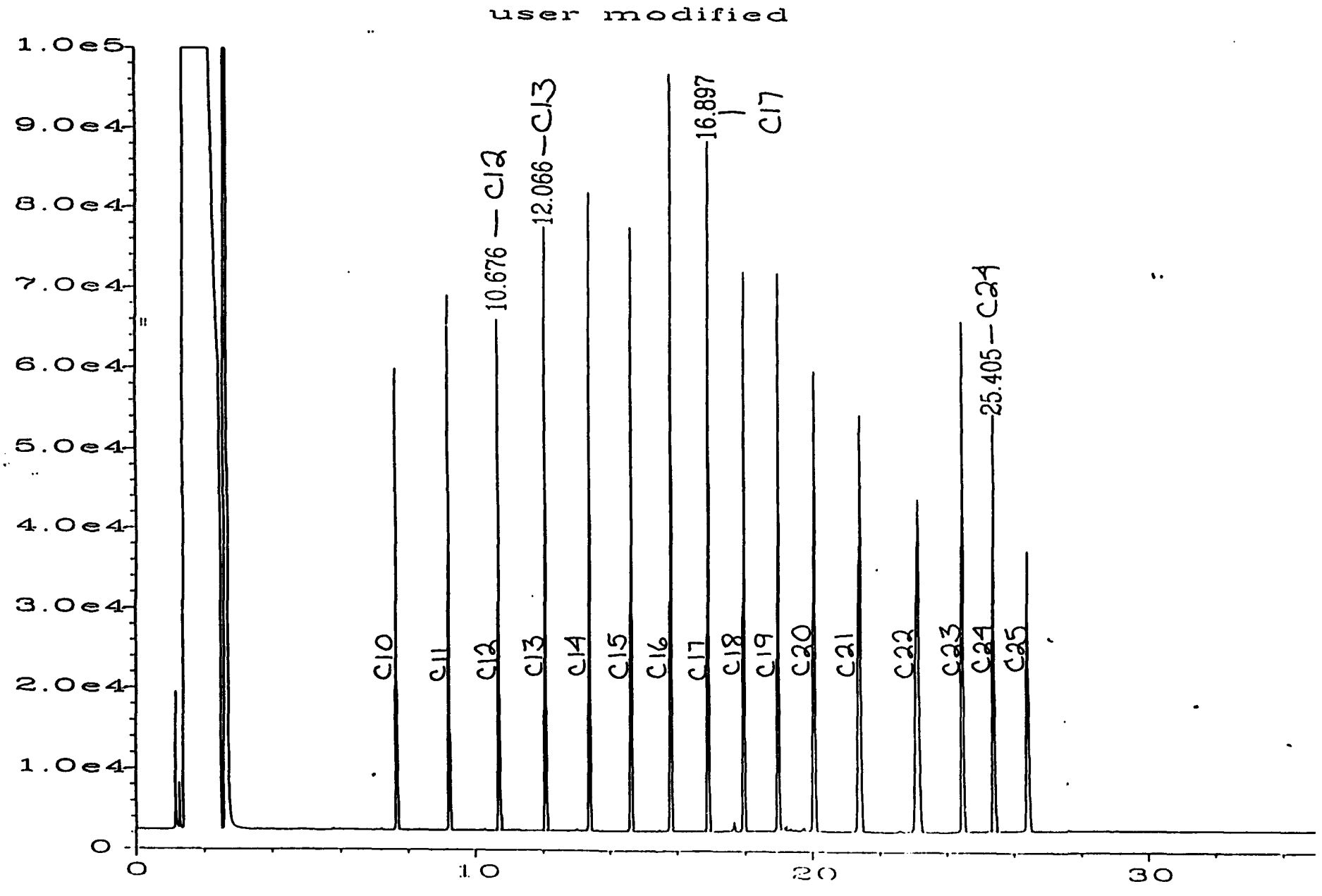
Ret Time	Height	Type	Width	Ref#	ng/ul	Name
10.676	64566	FF	0.044	1	535.647	DIESEL C12
12.066	75438	FF	0.044	1	749848.9	DIESEL C13
16.897	86413	FF	0.048	1	3575.338	DIESEL C17
19.103	* not found *			1		O-TERPHENYL SURROGATE
25.405	52247	FF	0.060	1	519333.0	DIESEL C24

Not all calibrated peaks were found

User Modified

Sig. 1 in G:\ORGANICS\SEMI_VOA\SAF0723\0811\002F0101.D
user modified

Peak#	Ret Time	Type	Width	Area	Start Time	End Time
1	10.676	FF	0.044	170133 C12	10.607	10.757
2	12.066	FF	0.044	200853 C13	11.993	12.146
3	16.897	FF	0.048	247952 C17	16.826	16.978
4	25.405	FF	0.060	186571 C24	25.323	25.499



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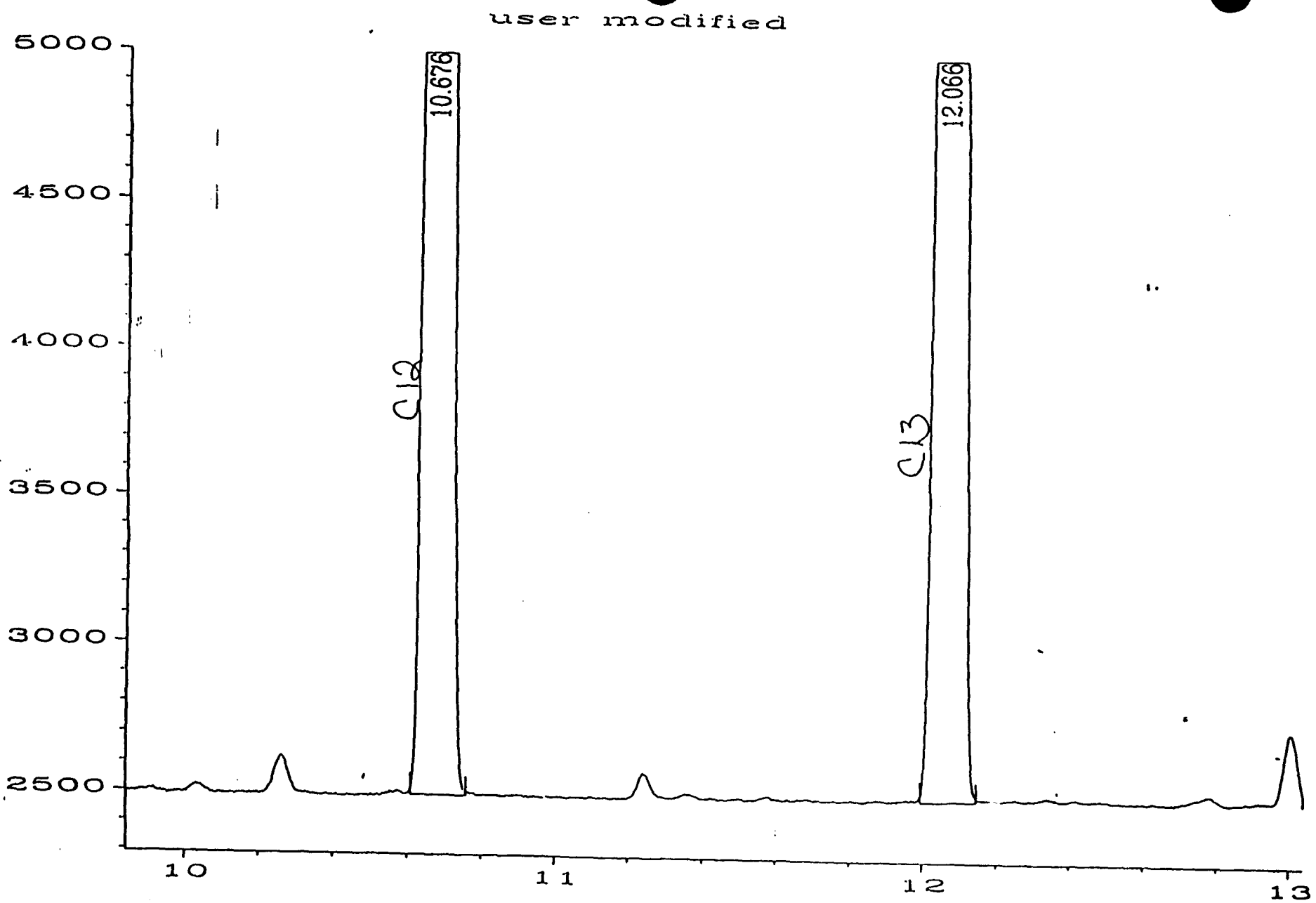

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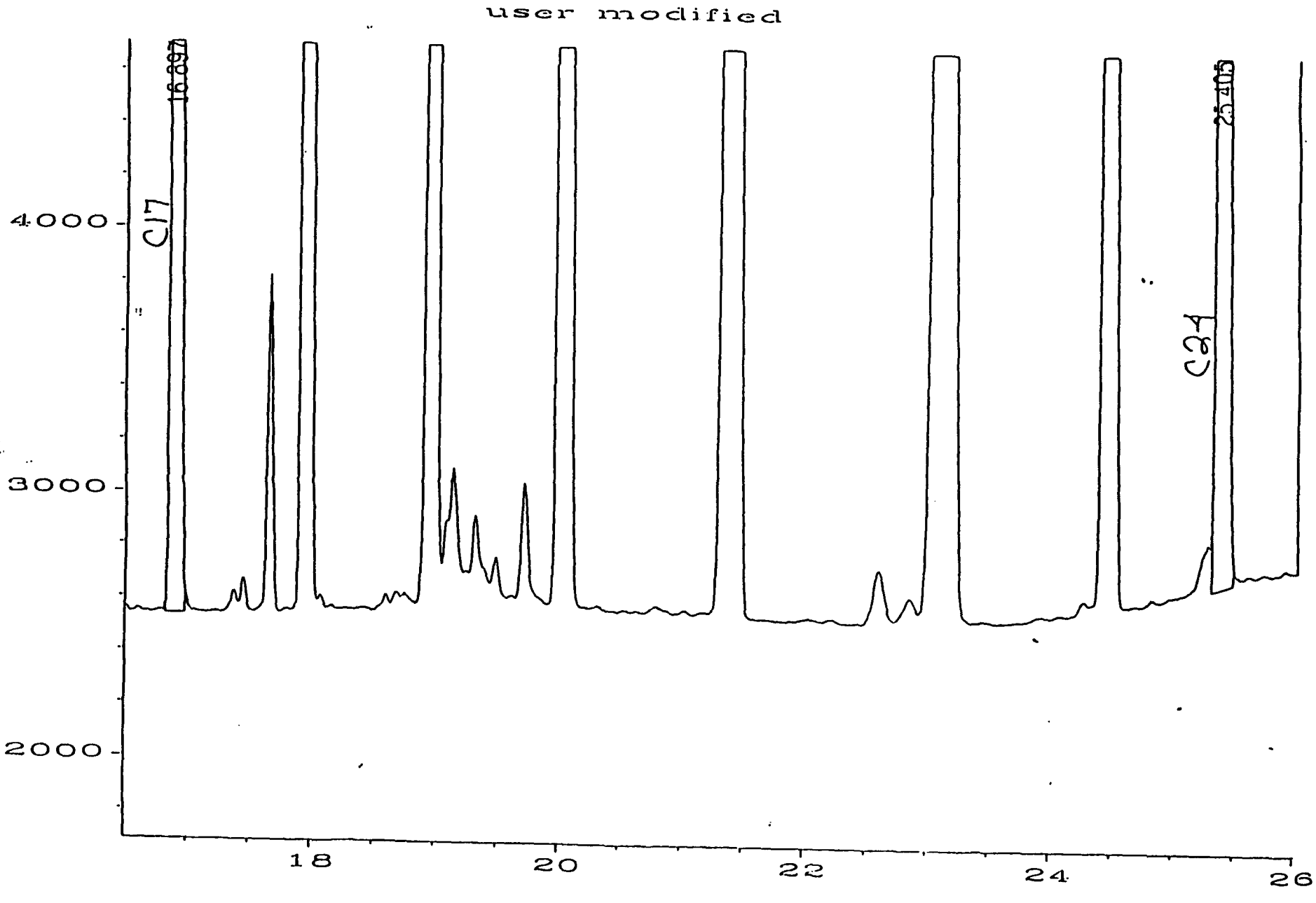

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SGS	Commercial Testing & Engineering Company Environmental Laboratory Services Stand: Operating Procedure	
S.O.P. Title: Extractable Residual Range Organics for AFCEE		
Method No: AK103	**Revision No:** 0	
General Reference: EPA SW846	**Specific Reference:** ADEC AK103	
CT&E Branch Number: 046	**Page:** 1 of 9	

Approved By: _____ *Date:* 9-23-94
Section Supervisor

Approved By: _____ *Date Effective:* 9-23-94
Technical Director

1.0 SOP Approval and Use

This SOP has been peer reviewed for compliance with referenced method requirements and the CT&E Environmental Laboratory Services quality assurance document. Any modifications to this S.O.P. must be reviewed and approved before being incorporated into this updated, consecutively numbered revision.

2.0 Scope and Application:

This GC method provides for determining the concentration of residual range organics (C25 to C45) in soil samples. Target products of this method include motor oil, lubricating oil, and other heavy petroleum products. ADEC established PQL for this method is 100 mg/kg in soil (dry wieght).

3.0 Summary of Method:

This standard operating procedure provides gas chromatographic conditions for the analysis of residual range organics. Upon completion of extraction procedures, the concentration of residual range organics are determined by Gas Chromatography employing a Flame Ionization Detector. The Laboratory will demonstrate the ability to meet or be within method established performance criteria. Method established criteria will be used to evaluate performance.

SGS	Commercial Testing & Engineering Company Environmental Laboratory Services Standard Operating Procedure	
S.O.P. Title:	Extractable Residual Range Organics for AFCEE	
Method No:	AK103	**Revision No:** 0
General Reference:	EPA SW846	**Specific Reference:** ADEC AK103
CT&E Branch Number:	046	**Page:** 2 of 9

4.0. **Interferences:**

4 1. Contamination due to sample carryover can occur whenever high-level samples are sequentially analyzed. To reduce carryover, the sample syringe must be rinsed out between samples with solvent (MeCl2). Whenever a highly concentrated sample is encountered it should be followed by a solvent blank to check for contamination.

4 2. Biogenic organic interferences may be encountered in the residual range, especially in humic soils The residual range organics results should include comments for suspect patterns.

5.0. **Sample Handling:**

5.1. Samples must be extracted within fourteen days of sampling for soil. Extracts must be analyzed within forty days following extraction.

6.0. **Apparatus:**

Instrument: HP 5890 Series II Gas Chromatograph. Accessories: JW DB-5ht Capillary Column 30m x 0 323 mm ID or JW DB-5ht 15m x 0.25mm ID, flame ionization detector. HP Chemstation Data System.

7 0. **Reagents:**

7 1 Blank soil (granusol silica quartz #8): used for LCS, soil matrix blanks, and matrix spikes

7 2. Solvents: Carbon Disulfide and Methylene Chloride. ACS reagent grade solvents should be used in all tests.

7.3. Sodium Sulfate (Anhydrous). Granular. Heat treated in a shallow tray at 400 C for minimum of four hours to remove phthalates and other organic interferences.

7 4 Stock Standards: Stock standards are prepared by diluting neat material or certified solutions. These standards are stored at four degrees C. Stock standard solution should be checked frequently for signs of degradation or evaporation, especially prior to preparing calibration standard from them. Stock standards must be replaced after six months, or sooner, if comparison with check standards indicates a problem.

SGS	Commercial Testing & Engineering Company Environmental Laboratory Services Standard Operating Procedure	
S.O.P. Title:	Extractable Residual Range Organics for AFCEE	
Method No: AK103		**Revision No:** 0
General Reference: EPA SW846		**Specific Reference:** ADEC AK103
CT&E Branch Number: 046		**Page:** 3 of 9

7.0 **Reagents(continued):**

7.5. Surrogate: (n-Tricontane-d62) The analyst should monitor the performance of the extraction, cleanup,and analytical system. This is done by spiking each sample, blank, spike, spike duplicate and LCS with the dTC surrogate.

7.6 Reagent Storage and Shelf Life: All stock and working solutions should be stored at 4 degrees C when not in use. After each use the meniscus is to be marked and dated on the vial to show any evaporation. If concentration of a standard is suspected, the solution should be discarded. After six months any working solution should be discarded.

7.7. Disposal of Reagents: Submit waste reagents and standards to hazardous waste officer.

8.0. **Calibration:**

8.1. Establish gas chromatographic operating parameters equivalent to those indicated in section four. Prepare calibration standards as indicated in AK103 9.2.1 using 30w, 40w, and 50w motor oils. Calibrate using the external standard technique.

8.2. Calibration Stock Standard: Prepare the calibration standard stock solution by blending equal volumes of 30w,40w,and 50 w motor oils. The blend of componets is then diluted in methylene chloride.

8.3. Calibration Standards: A minimum of three calibration standards should be prepared through dilution of the calibration stock standard. The concentrations of the standards should include a point below the AFCEE PQL and the other calibration levels should define the linear range of the detector.

8.4. The following criteria will need to be met for all method calibrations.

8.4.1 The % RSD for the average response factors for the calibration standards will be les than 25%. If the less than 25% is met the average R.F. can be substuted for a calibration curve and linearity thru the origin can be assumed.

8.4.2 The R^2 coefficient of the best fit line will be greater than 0.995 if a linear calibration curve is used.

SGS	Commercial Testing & Engineering Company Environmental Laboratory Services Standard Operating Procedure	
S.O.P. Title:	Extractable Residual Range Organics for AFCEE	
Method No:	AK103	**Revision No:** 0
General Reference:	EPA SW846	**Specific Reference:** ADEC AK103
CT&E Branch Number: 046		**Page:** 4 of 9

9.0 **Extraction:**

9.1. Soil sample extraction: Equipment: Soxhlet apparatus, Turbo Vap tubes, short stem funnel, water bath temperature controlled at 50 degrees C and a pressure between 10 - 14 psi.

9.1.1. Decant any excess water from the sample, weigh out 10-50 grams of soil into a weighing dish. Weigh out a percent solids sample. Weigh out 10-50 grams of blank soil for a blank, LCS, spike, and spike duplicate once per day or once per 20 samples, whichever comes first. For each sample note in the lab book if a hydrocarbon odor or biogenics are present or if the sample is clay.

9.1.2. Mix muffle furnaced sodium sulfate with the soil sample to dry it. The sample should have a dry, granular consistency.

9.1.3 All glassware that comes in contact with the sample must be blanked before it can be used. Blank glassware by rinsing with Methanol then $MeCl_2$ twice. Save the second $MeCl_2$ rinse as a glass blank.

9.1.4. Pour dried sample into a Thimble which has been baked for 15 minutes. (The thimbles are baked to remove pthalates.

9.1.5 Fill the blanked round bottom flask with approximately 300 ml of methylene chloride. Also add two blanked boiling beads. Connect concentrator to flask.

9.1.6 Place thimble which holds sample into the appropriate concentrator. Concentrator apparatus should be numbered with sample ID.

9.1.7. Add one ml dTC surrogate solution to each sample, blank, LCS, spike, and spike duplicate.

9.1.8 Add one ml of the LCS standard solution to the spike, spike duplicate and LCS samples.

9.1.9 Place each soxhlet apparatus on hotplate and connect to the cooling system. Be sure the cooling system is in operation before the hotplates are turned on.

9.1.10. Reflux samples for at least four hours.

SGS	Commercial Testing & Engineering Company Environmental Laboratory Services Standard Operating Procedure	
S.O.P. Title:	Extractable Residual Range Organics for AFCEE	
Method No: AK103		**Revision No:** 0
General Reference: EPA SW846		**Specific Reference:** ADEC AK103
CT&E Branch Number: 046		**Page:** 5 of 9

9.0. **Extraction (continued):**

9.1.11. All glassware that comes in contact with the sample must be blanked before it can be used. Blank glassware by rinsing with Methanol then $MeCl_2$ twice. Save the second $MeCl_2$ rinse as a glass blank.

9.1.12. After refluxing decant the sample into a blanked Turbo Vap tube through a funnel containing glass wool and muffle furnaced sodium sulfate. Rinse the soxhlet apparatus with two small portions (20 mls) of $MeCl_2$ and decant rinsing into the funnel. Rinse funnel with additional $MeCl_2$.

9.1.13. Concentrate the samples to a final volume of 1.0 mls in Turbo Vap apparatus. If a precipitate forms or the extract stops concentrating, the final volume will be higher (5 - 10 mls).

9.1.14. Enter percent solid values in the lab book and calculate sample dry weights and dilution factors. Submit an auto sample vial of the final extract along with a copy of the appropriate paperwork to the instrument analyst.

9.1.15. Rinse all used glassware with methanol to remove any contaminants before giving it to the dishwasher.

10.0 **Analysis:**

10.1. Data Acquisition: Samples are placed in auto injector vials, sealed and loaded sequentially into the sample trays. The software allows the analyst to input for each sample, the name of the sample, the instrument method and multiplier. Sequences must be acquired into a subdirectory denoted by the date of analysis.

10.2. Data analysis: Retention time windows are checked against the alkane reference standard for that analytical batch (C25 to C44). All peaks resolved and unresolved which elute fror the start of C25 to the end of C44 are tentatively identified as residual range organics. The time window within this alkane group is used for all calibration and quantitation. Integration will be done by horizontal baseline projection from the C25 peak. No correctio for baseline rise will be done.

10.3. Post analysis: Retain auto sample vials for forty days. Dispose of extracts as chlorinat waste after this time.

11.0 **Quality Control:**

11.1. Continuing Calibration Verification Standard (CCV): The blend of residual range components (30w, 40w, 50w oil) will be run every 24 hours to verify the initial calibration. The acceptance criteria is less then 25% Difference of the daily response factor from the initial calibration average response factor .

11.2. Surrogates: The analyst should monitor the performance of the extraction, cleanup, analytical system, and the effectiveness of the method in dealing with each matrix by adding to each sample, matrix spike, spike duplicate, matrix blank and LCS the dTC surrogate. The Laboratory will demonstrate annually the ability to meet or be within method established performance criteria. Since no method established criteria is available at this time, the recovery limits for AK102 will be used. The recovery will not exceed 50% - 140% in soil.

11.3. Laboratory Control Standard: The laboratory control standard will be a blend of the same residual range components as the CCV, but blended independently. This is done since there is no separate source for these components available.. The laboratory control standard will be run at a frequency of 1 per 20 samples and at the end of the 24 hour analytical sequence. The Laboratory will demonstrate annually the ability to meet or be within method established performance criteria. Method established criteria will be used to evaluate performance. The limits will not exceed 75% to 125%.

11.4. Laboratory Control Sample (LCS): The laboratory control sample is a Blank soil or a client blank sample to which the laboratory control standard has been added. The LCS will be carried through the extraction/analysis process with the samples. The Laboratory will demonstrate annually the ability to meet or be within method established performance criteria. Method established criteria will be used to evaluate performance. Since no method established criteria is available at this time, the recovery limits for AK102 will be used. The limits will not exceed +/- 25% recovery from accepted concentration. LCS frequency will be one for every extraction batch of no more then twenty project samples.

11.5. Spike/Spike Duplicates: In order to monitor matrix effects on the method, the LCS must be added to two aliquots of a matrix. This must be performed every extraction batch of no more then twenty samples. The Laboratory will demonstrate annually the ability to meet or be within method established performance criteria (ADEC QAPP for UST sites). Method established criteria will be used to evaluate performance. Since no method established criteria is available at this time, the recovery limits for AK102 will be used. The limits will not exceed 50% - 140% with a relative percent difference of 40% in soil.

12.0 **Calculations:**

Let x = Concentration of the sample in µg/ml or mg/kg (dry weight).

x = R.F.(from multi-point calibration) x (Area) (Dilution factor)

13.0 **Safety:**

13.1. The toxicity, or carcinogenicity, of each reagent used in this method has not been precisely defined. However, each chemical compound should be treated as a potential health hazard. General laboratory safety practices must be followed at all times

13.2. References:

13.2.1. ADEC Draft, method for the determination of Residual Range Organics.

13.2.2. ADEC UST Draft Quality Assurance Program Plan.

13.2.3. US EPA SW 846 3540

13.2.4 US EPA SW 846 Method 8000.

13.2.5. US EPA SW 846 Chapter Two.

14.0. **Flow Chart:** See attached

15.0. **Current MDL Study:** not available at this time

16.0. **Calibration Curve:** See attached

17.0. **Practical Quantification Limits:**

For soil it is 100 mg/Kg dry weight basis. PQL are variable due to sample matrix.

SGS	Commercial Testing & Engineering Company Environmental Laboratory Services Standard Operating Procedure

S.O.P. Title: Extractable Residual Range Organics for AFCEE	
Method No: AK103	**Revision No:** 0
General Reference: EPA SW846	**Specific Reference:** ADEC AK103
CT&E Branch Number: 046	**Page:** 8 of 9

18.0. **Daily Sequence of Events for RRO Analytical Batch:**

18.1. If necessary change injection liner and septa. Run 4 $MeCl_2$ blanks after the change to insure no artifacts are present from the new liner or septa.

18.2. Run $MeCl_2$ instrument blank to prove GC System is free from contamination.

18.3. Run C25-C44 alkane standard to verify integration window.

18.4. Run blend of 30w, 40w, 50w motor oil to check initial calibration (CCV).

18.5. Run surrogate calibration check.

18.6. Run extraction glassware blank.

18.7. Run extraction solvent blank.

18.8. Run Laboratory control standard.

18.9. Run Laboratory control sample.

18.10. Run Matrix spike.

18.11. Run Matrix spike duplicate.

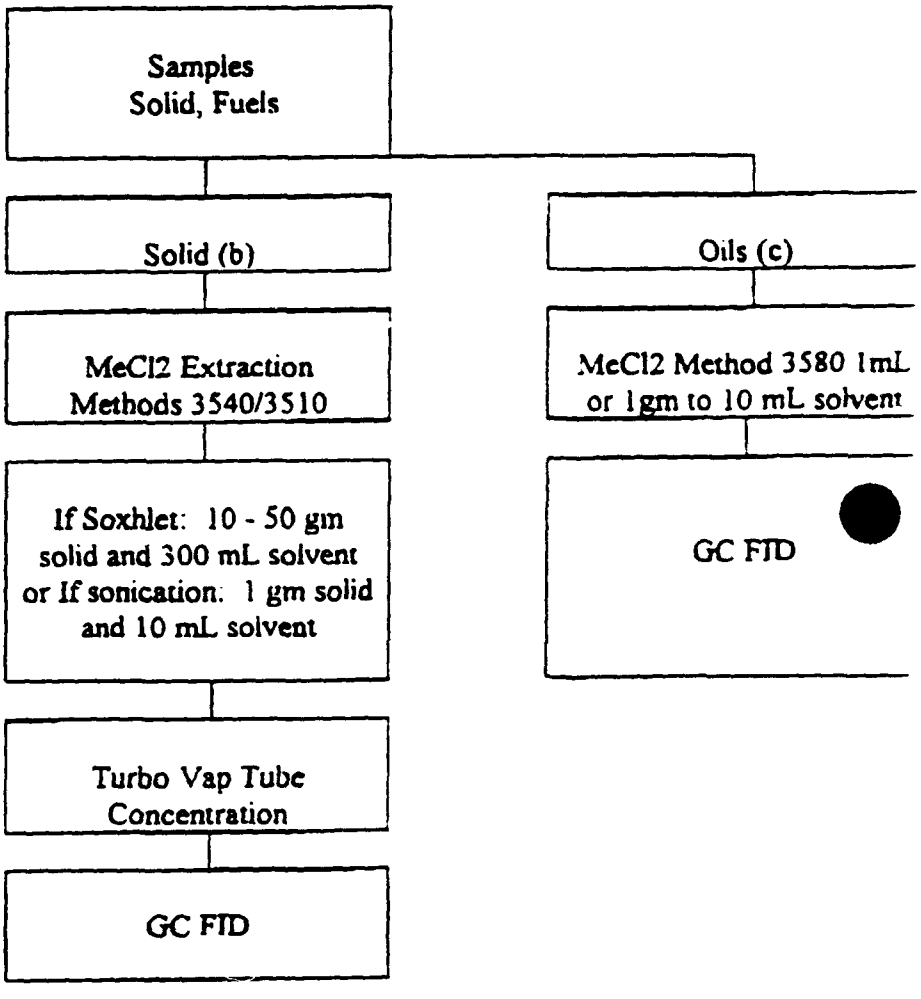
18.12. Sample analysis begins if all QC meets criteria. If problems arise, corrective actions will be taken according to laboratory QAPP corrective action outline.

18.13. Run Laboratory control standard at the end of the analytical sequence.

SGS

Commercial Testing & Engineering Company
Environmental Laboratory Services
Standard Operating Procedure

S.O.P. Title: *Extractable Residual Range Organics for AFCEE*	
Method No: AK103	**Revision No:** 0
General Reference: EPA SW846	**Specific Reference:** ADEC AK103
CT&E Branch Number: 046	**Page:** 9 of 9



COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • (708) 953-9300 • FAX: (708) 953-9306

SGS GROUP CODE OF PRACTICE

As the world leader in the inspection business, members of the SGS Group should project and live up to an image of an organization whose professionalism and integrity can be relied upon by the Clients we serve, the authorities in the countries in which we operate and by the financial and other institutions who handle our documents.

The quality of our services must be of the highest order. This covers all aspects of our operations: Commercial, Administrative and Technical.

Quality is a corporate commitment within the SGS Group. It is the individual and joint responsibility of all employees of the SGS Group.

There are ten basic rules to remember at all times:

1. As leaders in our profession, we must not only think but also act as the best and therefore provide a superior Quality of service.
2. Minimizing risks and protecting Client's interests is our "raison d'etre" (reason for existence).
3. Only work which can be competently and professionally handled by the resources available to the organization should be sought and accepted.
4. We must avoid the SGS Group's being placed into a position of conflict of interest when carrying out our tasks on behalf of Clients.
5. We must work to recognized standards, Company practices and respect all legitimate instructions from Clients.
6. We have to keep Clients informed without delay of all major developments and issue complete, factual and unambiguous reports promptly.
7. The confidentiality of information must be respected at all times.
8. All employees must act loyally and honestly in carrying out the policy and instructions of the SGS Group and not undermine its image or reputation in any way.
9. We must rectify shortcomings and take action to correct situations which cause unsatisfactory performance.
10. To be and to remain the best, we have to be innovative and adapt our services to Clients' needs without compromising the Quality of our services.

SINCE 1908

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 212-B, LOMBARD, ILLINOIS 60148 • (708) 953-9300 • FAX: (708) 953-9306

QUALITY POLICY

"QUALITY IS OUR BUSINESS"

Commercial Testing & Engineering Co. is totally committed to the policy of providing our clients with QUALITY services and products, that conform to valid, mutually-agreed requirements, so that we are recognized as the leader in client satisfaction in each of our markets.

Each of us is personally responsible for the QUALITY of his own work. This means knowing and understanding the requirements of each task we undertake, doing the job right the first time, and initiating action to change requirements which are invalid or cannot be met.

To accomplish this we will:

1. Implement Total Quality Management practices and conform to the SGS Group "Code of Practice".
2. Regard QUALITY management as critical to business success, and hold employees at all levels accountable for QUALITY.
3. Continuously measure the progress we are making in meeting valid client requirements and expectations.
4. Provide the specific means by which all employees can freely identify and eliminate obstacles to improving the QUALITY of their own work.
5. Train all employees in the principles and methods of QUALITY improvement.
6. Involve all employees as active participants in a team effort, based on mutual trust and respect, to continuously improve our service and product QUALITY through Total Quality Management practices.
7. Recognize both individual and group QUALITY improvement achievements.

M.A. Hildon, Ph.D.
President

Commercial Testing & Engineering Co.
Environmental Laboratory Services

5633 B Street
Anchorage, AK 99518-1600
Tel: (907) 562-2343
Fax: (907) 561-5301

August 9, 1994

Ms. Gloria Beckman
Jacobs Engineering Group Inc.
600 Seventeenth Street, Suite 1100N
Denver, CO 80202

Dear Gloria,

Commercial Testing & Engineering Co. would like to request the following variances from the AFCEE 1993 Handbook for the Granite Mountain project:

1) The laboratory cannot meet the SW8260 minimum water response factor (0.25) requirement for bromoform. The laboratory purges 15 milliliters (mls) of sample in an effort to generate lower detection limits that cannot be obtained by purging 5 mls. The minimum response factor can be obtained when purging 5 mls. Purging more sample decreases the purge efficiency of the purge and trap system for some analytes. The laboratory can meet a minimum response factor of 0.18 when purging 15 mls. The EPA contract written specifically for low level water analysis, 25 mls purge volume, requires a minimum response factor of 0.05 for bromoform.

2) Chlordane and toxaphene laboratory control samples (LCSs) will not be analyzed unless the associated SW8080 samples have positive results for these compounds. If a positive result for either of these compounds is detected, the associated samples will be reextracted with the required LCS and reanalyzed within SW8080 specific hold times.

3) The SW8080 aroclors, 1260, 1254, and 1242 are routinely analyzed as continuing calibration verification (CCV) and LCS samples. The remaining four aroclors will be included as CCVs and LCSs only when the associated SW8080 samples have positive results for these compounds. If a positive result for these compounds is detected, the associated samples will be reextracted with the required LCS and reanalyzed within

SW8080 specific hold times. Additionally, the laboratory will provide documentation that details the retention time windows and responses initially established for all SW8080 aroclors prior to the analysis of any samples.

4) For inorganic analysis of As, Cr, and Pb the low standard of the multipoint calibration curve will be at the PQL specified in the AFCEE 1993 Handbook. For organic analyses the calibration standards will be at levels in accordance with SW846 guidelines or Alaska methods when applicable (See attached table of calibration ranges).

5) The laboratory cannot meet the 1993 AFCEE Handbook PQLs for SW8260 water samples. The laboratory can meet the 1993 PQLs for SW8010/8020. The Laboratory requests that AFCEE SW8010/8020 PQLs be substituted for AFCEE SW8260 PQLs.

6) The laboratory does not routinely analyze for 1-Chlorohexane by SW8260. The laboratory requests that this compound be removed from the AFCEE SW8260 target compound list.

The following are State of Alaska hydrocarbon requirement variances:

1) The Ak101 field surrogate, 4-bromofluorobenzene, will not be added to the samples in the field as required by the method. The surrogate will be added by the analyst prior to the sample analysis in the fixed laboratory.

2) Ak101 soil samples will not be methanol preserved in the field as required by the method. The soil samples will be extracted by the laboratory prior to sample analysis.

3) Second column confirmation is an SW846 requirement for G.C. analysis. However, second column confirmation is not required for multi-component G.C. analytes and will not be performed for positive identification of Ak101 GRO results. This is not a requirement of the QAPP addendum or of Ak101 method.

4) Second column confirmation is an SW846 requirement for G.C. analysis. However, second column confirmation is not required for multi-component G.C. analytes and will not be performed for positive identification of Ak102 DRO results. This is not a requirement of the QAPP addendum or of Ak102 method.

5) The BTEX by 8240 soil samples will not be methanol preserved in the field as required by the State of Alaska for BTEX samples associated with petroleum contaminated sites. The laboratory will purge 5 grams of the soil samples in order to achieve the AFCEE required detection limits. If an extraction is performed, the extraction multiplication factor will raise the soil PQLs above the AFCEE required maximum detection limits. Methanol extractions will only be performed on soil samples by the

laboratory, when target compounds exceed calibration range or interferences from other compounds will affect target analyte detection. The extraction is needed to dilute these compounds into the instrument linear range.

The following are Jacobs requirement variances.

1) The laboratory requests the following data points be waived for the JEMs Deliverables.
   a) Result Uncertainty (PARUN)
   b) Parameter Uncertainty Significant Figures (PARUNPRC)
   c) Detection Limit Significant Digits (DETEC_SD)
   d) Practical Quantification Significant Digits (PQUANT_SD)

Sincerely,

Cindy Hale

Cindy Hale
Quality Control Manager

Calibration Table

Analysis	Concentration (PPM)						PQL soil	PQL water
Ak102	10	50	400	800	1500	4000	4.0 (50:10)	0.1 (1000:10)
Pesticide	0.01	0.05	0.1	0.5	1.0		0.002 (50:1)	0.0001 (1000:1)
PCB	0.1	1.0	5.0	10	25	50	0.02 (50:1)	0.001 (1000:1)
SVOA	20	50	80	120	160	200	2.0 (50:1)	0.1 (1000:1)

Analysis	Concentration (PPB)					
8240 (VKA Instr.)	5	10	50	70	100	
8240 (VJA Instr.)	5	10	50	100	150	
AK101	45.6	228	456	683	1140	2280
8260	0.5	1.0	5.0	10	20	

Commercial Testing & Engineering Co.
Environmental Laboratory Services

5633 B Street
Anchorage, AK 99518-1600
Tel: (907) 562-2343
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August 19, 1994

Ms. Gloria Beckman
Jacobs Engineering Group Inc.
600 Seventeenth Street, Suite 1100N
Denver, CO 90202

Dear Gloria,

Commercial Testing & Engineering Co. would like to request the following additional variances from the 1993 IRP AFCEE Handbook for the Granite Mountain project.

SW 6010 Analysis:

1) We are unable to meet the Handbook PQLs for Be. The IDL determined using reagent water is below the PQL; however, the presence of interfering analytes typically found in environmental samples makes it necessary to raise the PQL. We are requesting a PQL for Be of 0.010 mg/L in water and 1 mg/Kg in soil.

2) Naturally occurring levels of Ca and Na are much greater than the AFCEE PQLs, and are common background contaminants. We are requesting a PQL for Ca of 0.20 mg/L in water and 20 mg/Kg in soil. We are requesting a PQL for Na of 0.50 mg/L in water and 50 mg/Kg in soil.

3) We are unable to meet the PQL for Zn due to background contamination. We are requesting a PQL for Zn of 0.050 mg/L in water and 5 mg/Kg in soil.

Sincerely,

Cindy Hale
Quality Control Manager

cc: Jacobs file

APPENDIX B

Instructions for the Use of Immunoassay Field Test Kits for TPH and PCB Screening

Part #10915 Rev. 3

PETRO RISC® SOIL TEST SYSTEM

RAPID IMMUNOASSAY SCREEN

User's Guide
Multiple Level Test

This method correctly identifies 95% of samples that are petroleum fuels-free and those containing 10 ppm gasoline and 15 ppm for other petroleum fuels. A sample that develops less color than the standard is interpreted as positive. It contains petroleum fuels. A sample that develops more color than the standard is interpreted as negative. It contains less than 10 ppm gasoline or 15 ppm other petroleum fuels.

IMPORTANT NOTICE

This test system should be used only under the supervision of a technically qualified individual who is capable of understanding any potential health and environmental risks of this product as identified in the product literature. The components must only be used for the analysis of soil samples for the presence of petroleum hydrocarbons. After use, the kits must be disposed of in accordance with applicable federal and local regulations.

TROUBLE SHOOTER GUIDE

Wash Step- lack of vigorous washing may result in false positives or negatives depending on whether the wash error was committed on standard or sample tubes. *Solution*: make sure that the operator washes four times vigorously.

Pipette Calibration- an out-of-calibration pipette may result in false positives or negatives depending on whether the amount is greater or less than the specified transfer volume. *Solution*: check the calibration at least daily and after any extreme mechanical shock (such as dropping). **An indication that the pipette is out of calibration is if the gold barrel is loose and will turn.** (When set on 30 µl there should be about 1/4 of an inch between the white plunger and the end of the clear pipette tip.)

Air bubbles in the pipette or diluter- the presence of air bubbles in the pipette tip when transfering extracts may result in false positives or negatives depending on whether the error was committed on standard or sample tubes. *Solution*: quickly examine the pipette tip each time an aliquot is withdrawn and go back to the source and take another aliquot to displace the bubble if neccessary. Bubbles in the diluter can be in the tip or plunger assembly.

Mixing- lack of thorough mixing, when instructed, can cause inconsistent results. *Solution*: observe the mixing times in the instructions and to mix with sufficient force to ensure that the liquid is mixed.

Timing- it important to follow the timing steps in the instructions carefully. The incubation step in the antibody tubes can vary a bit without harm to the test (± 5 minutes). The color development step timing is critical and should be no less than 2 minutes and no greater than 3 minutes.

Addition of Drops- it is important to carefully count the drops added in the color development steps. The addition of ±1 drop to the instructed 5 drops can cause variability in the results RIGHT AROUND THE DETECTION LEVELS OF INTEREST. One drop less would result in a darker color (a less dilute solution) which could result in a false negative. One drop more could result in a lighter color (a more dilute solution) and result in a false positive.

Wiping the Tubes- wiping of the tubes should be done before they are read in the spectrophotometer because smudges and fingerprints on the tubes can give potentially false negative readings.

Mixing Lot #'s- never mix lots! Each kit's components are QC'd together for optimal performance and may give inaccurate results with the components from other kits, that are not of the same lot #. Also, the user must NEVER mix components from different types of kits (ex: Petro kit buffer tubes can't be used with a PAH kit).

Storage and Operating Temperatures- temperature requirements are very important and should be strictly adhered to. This information can be found in the kit User's Guide.

Shelf-life- each kit label contains the kit expiration date. To achieve accurate results, kits must be used prior to expiration.

READ TO AVOID COSTLY MISTAKES

SAMPLE DILUTION DIAGRAM

1. The sample dilution procedure in the instructions is for standard detection levels. The following diagram represents the sample dilution procedure for all other detection levels

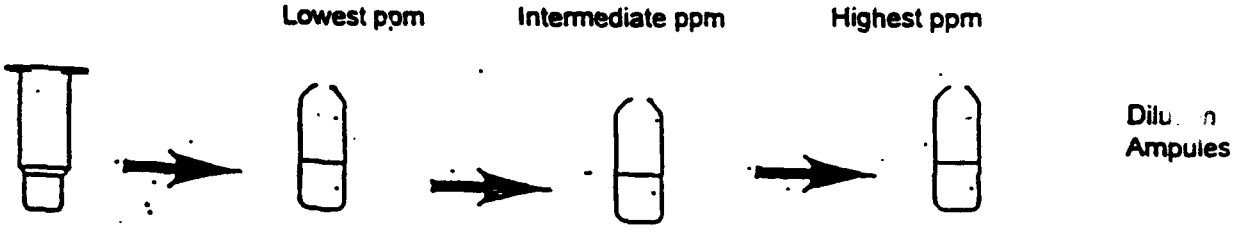
2. Your kit may include extra dilution ampules to reach high detection levels.

3. EVERY AMPULE PROVIDED MUST BE USED!

If there are any questions concerning the dilution procedure please call Technical Services before running the samples to help avoid costly mistakes.

1-800-242-7472 or 919-941-5509 (X144, 148 or 149).

EXAMPLE:



NOTE: YOUR ORDER MAY INCLUDE ADDIT'ONAL AMPULES IN ORDER TO ACHIEVE YOUR TEST LEVELS. ALWAYS TRANSFER FILTERED SAMPLE TO THE DILUTION AMPULE LABELLED WITH THE LOWEST PPM LEVEL AND THEN TRANSFER FROM IT TO THE NEXT HIGHER LEVEL DILUTION AMPULE .

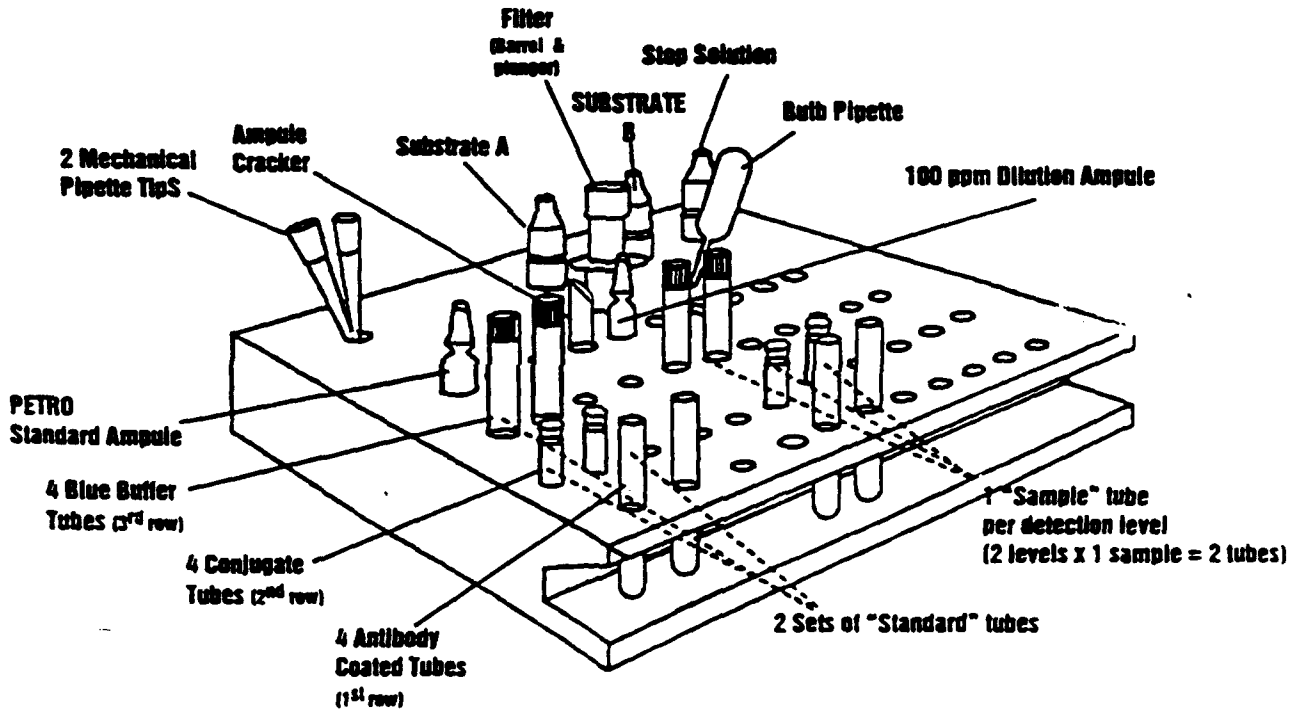
WORKSTATION SET-UP

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WORKSTATION SET-UP

- ☐ Mechanical pipette tip
- ☐ Stop solution
- ☐ PETRO standard ampule
- ☐ 4 Conjugate tubes
- ☐ Substrate A
- ☐ Filtration barrel & plunger
- ☐ 100 ppm dilution ampule
- ☐ 4 antibody coated tubes
- ☐ Substrate B
- ☐ Bulb pipette
- ☐ 4 blue buffer tubes

See reverse for individual component illustrations
Workstation shows components for 1 sample tested at 2 levels



READ BEFORE PROCEEDING

- Follow diagram above to setup workstation.
- Items that you will need that are not provided in the test kit include:
  a permanent marking pen, laboratory tissue (or paper towels), a liquid waste container, and disposable gloves.
- Do not expose reagents to direct sunlight.
- This User's Guide was written for analyzing soil samples for gasoline at 10 and 100 ppm. The detection level for diesel is 15 ppm. See table on page 9 for sensitivity to other compounds.

PHASE ONE EXTRACTION & PREPARATION OF THE SAMPL

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WEIGH SAMPLE

1a Open methanol crimp top vial and pour the entire contents into the extraction jar.

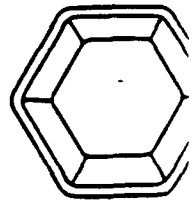
1b Place unused weigh boat on pan balance.

1c Press ON/MEMORY button on pan balance. Balance will beep and display 0.0.

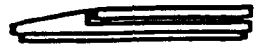
1d Weigh out 10 ± 0.1 grams of soil.

1e If balance turns off prior to completing weighing, use empty weigh boat to retare, then continue.

Methanol Crimp Top Vial



Weigh Boat



Pan balance

Wooden spatula

EXTRACT PETROLEUM HYDROCARBONS

2a Using wooden spatula, transfer 10 grams of soil from weigh boat into extraction jar.

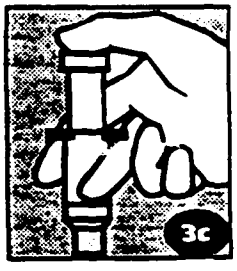
2b Recap extraction jar tightly and shake vigorously for one minute.

2c Allow to settle for one minute.

Repeat steps **1a - 2c** for each sample to be tested.

Sample extraction jar

FILTER SAMPLE



3a Disassemble filtration plunger from filtration barrel.

3b Insert bulb pipette into top (liquid) layer in extraction jar and draw up sample. Transfer at least ½ bulb capacity into filtration barrel. **Do not use more than one full bulb.**

3c Press plunger firmly into barrel until adequate filtered sample is available (place on table and press if necessary).

Repeat steps **3a - 3c** for each sample to be tested.

Filtration plunger

Bulb pipette

Filtration barrel

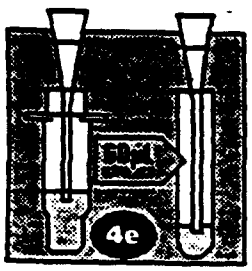
PHASE TWO SAMPLE AND STANDARD PREPARATION

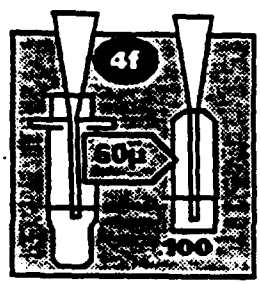
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

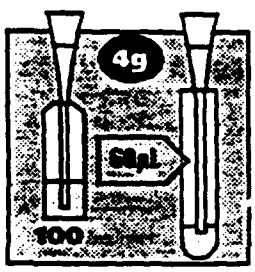
READ BEFORE PROCEEDING

- Label the conjugate and antibody coated tubes with a permanent marking pen.
- "Shake tubes" means to thoroughly mix the contents with special care not to spill or splash.

DILUTE AND BUFFER SAMPLE FOR 10 PPM AND 100 PPM DETECTION LEVELS







4a Open dilution ampule by slipping ampule cracker over top, and then breaking top at scored neck.

4b Uncap enough blue buffer, conjugate, and antibody coated tubes for **Samples** and **Standards**.

4c Empty a blue buffer tube into each conjugate tube.

4d Assemble new tip onto mechanical pipette.

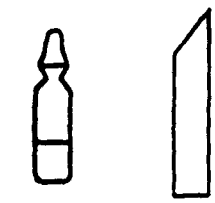
4e Withdraw 60 µL of sample from filter unit using mechanical pipette and dispense below the liquid level in **10 ppm** conjugate tube. Wipe mechanical pipette tip.

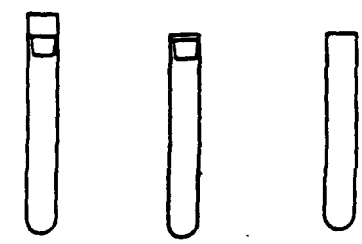
4f Withdraw 60 µL of filtered sample from the filter unit and dispense below the liquid level in the **100 ppm** dilution ampule. Shake ampule for 5 seconds.

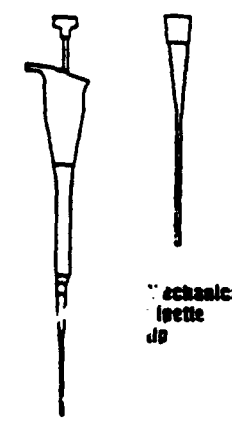
4g Withdraw 60 µL of diluted sample from **100 ppm** dilution ampule and dispense below the liquid level in **100 ppm** conjugate tube.

4h Discard mechanical pipette tip.

Repeat steps **4a - 4h** for each sample to be tested.





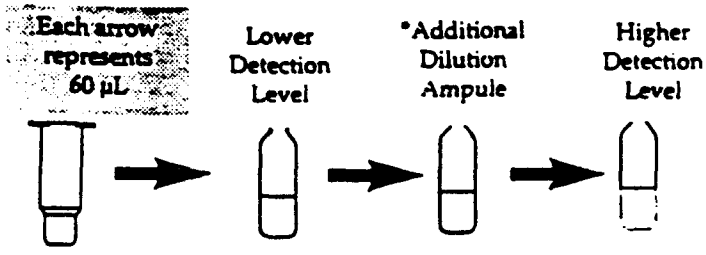


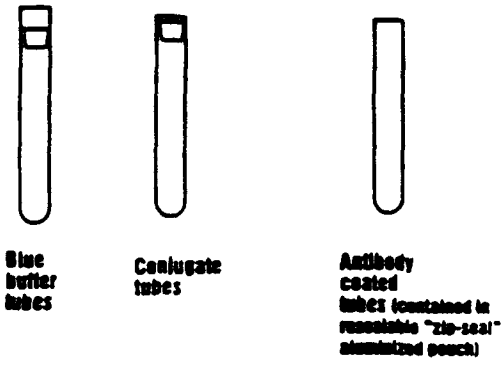
PHASE TWO SAMPLE AND STANDARD PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

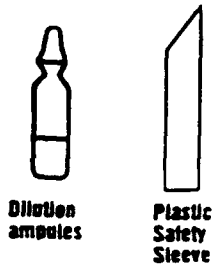
DILUTE AND BUFFER SAMPLE FOR NONSTANDARD DETECTION LEVELS

- This prodecure replaces the one outlined in Steps 4e-4h for tests designed for detection levels other than 10 and 100 ppm. Follow steps 4a-4d.
- Always transfer 60 µL from filter unit to the lowest level dilution ampule. Then, transfer 60 µL from lower to next higher dilution ampule. Continue until 60 µL has been transferred to highest level dilution ampule.
- Always withdraw and dispense solution with mechanical pipette tip below the liquid level.

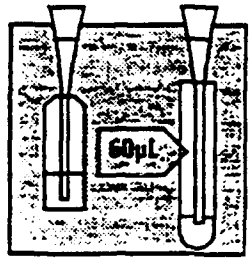




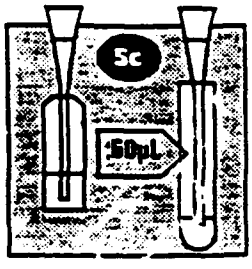
*You may be provided with additional dilution ampules.



- Select the dilution ampules representing your desired detection levels. Transfer 60 µL from each selected dilution ampule to appropriate conjugate tube
- Wipe mechanical pipette tip after dispensing into conjugate tube.
- If after reviewing this User's Guide you still have questions, contact technical support at 800-242-7472.



BUFFER STANDARDS



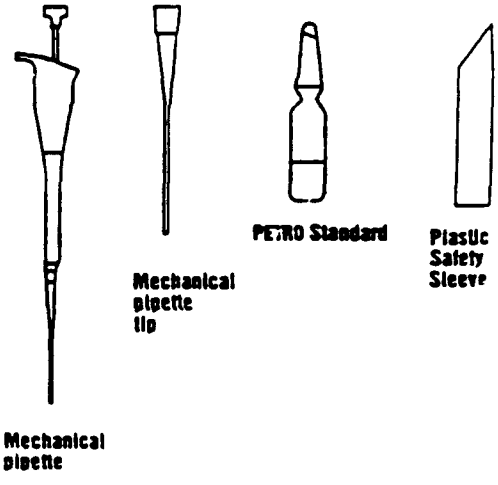
5a Assemble new tip onto mechanical pipette.

5b Open PETRO Standard ampule.

5c Withdraw 60 µL of PETRO Standard and dispense below the liquid level in Standard conjugate tube. Wipe mechanical pipette tip.

5d Repeat step **5c** for the 2nd Standard.

5e Shake all conjugate tubes for 5 seconds.



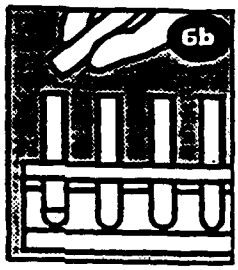
PHASE THREE THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- This phase of the procedure requires critical timing and care in handling the antibody coated tubes.

INCUBATION



6a Set timer for exactly 10 minutes.

6b Start timing and immediately pour solution from each conjugate tube into appropriate antibody coated tube.

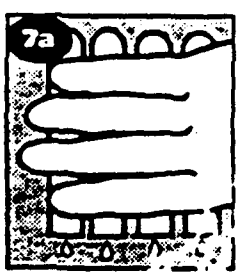
6c Let tubes stand exactly 10 minutes.

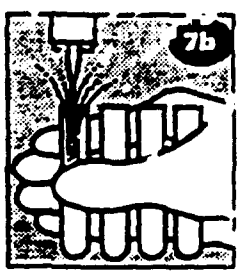
READ BEFORE PROCEEDING

WASH PROCEDURE

- Washing must be done vigorously and with force.
- Place nozzle just above antibody coated tube, squeeze bottle to fill each tube with a vigorous stream and empty into liquid waste container.
- The wash solution is a harmless, dilute solution of detergent. Do not hesitate to wash vigorously even if the solution contacts gloved hands.

WASHING

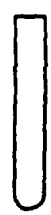




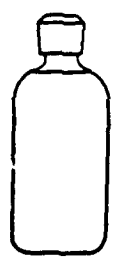
7a After the 10 minute incubation, empty antibody coated tubes into liquid waste container.

7b Wash antibody coated tubes by vigorously filling and emptying a total of 4 times.

7c Tap antibody coated tubes upside down on paper towels to remove excess liquid. Residual foam in the tubes will not interfere with test results.



Antibody coated tubes (contained in resealable "zip-seal" aluminized pouch)



Wash Bottle

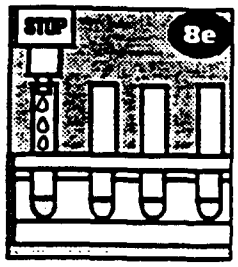
PHASE THREE THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Keep Substrate dropper bottles vertical and direct each drop to bottom of antibody coated tubes. Addition of more or less than 5 drops may give inaccurate results.
- This phase requires accurate timing.

COLOR DEVELOPMENT



8a Add 5 drops of Substrate A (yellow cap) to each antibody coated tube.

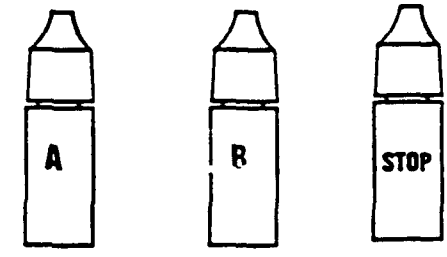
8b Set timer for exactly 2 ½ minutes.

8c Start timer and immediately add 5 drops of Substrate B (green cap) to each antibody coated tube.

8d Shake all tubes for 5 seconds. Solution will turn blue in some or all antibody coated tubes.

8e Stop reaction at end of 2 ½ minutes by adding 5 drops of Stop Solution (red cap).

Note: Blue solution will turn yellow when Stop Solution is added.

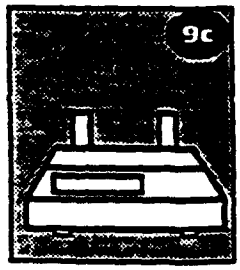


Substrate A Substrate B Stop

PHASE FOUR INTERPRETATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SELECT DARKER STANDARD



9a Wipe outside of all antibody coated tubes.

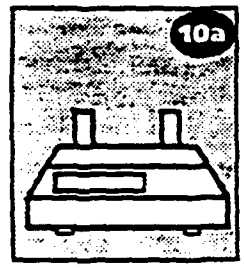
9b Place both Standard tubes in photometer.

9c S[illegible]s until the p[illegible]eter reading is negative or zero. Record reading. If reading is greater than 0.2 in magnitude (+ or -), results are outside of QC limits. Retest the sample(s).

9d Remove and discard tube in right well. The tube in the left well is the darker standard.

INTERPRET RESULTS

10a Place 10 ppm tube in right well of photometer and record reading.



If photometer reading is negative or zero, petroleum hydrocarbons are present.

If photometer reading is positive, concentration of petroleum hydrocarbons is less than 10 ppm.

See table on page 9 for specific detection levels.

10b Place 100 ppm tube in right well of photometer and record reading shown on display.

If photometer reading is negative or zero, petroleum hydrocarbons are present.

If photometer reading is positive, concentration of gasoline or petroleum fuel is less than 100 ppm.

QUALITY CONTROL

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

How It Works

Standards, Samples, and color-change reagents are added to test tubes coated with a chemical specific to petroleum fuels. The concentration of petroleum fuel in an unknown Sample is determined by comparing its color intensity with that of a Standard.

Note: petroleum fuel concentration is inversely proportional to color intensity; the lighter the color development of the sample, the higher the concentration of petroleum fuel.

Quality Control

Standard precautions for maintaining quality control:

- Do not use reagents or test tubes from one Test System with reagents or test tubes from another Test System.
- Do not use the Test System after its expiration date.
- Each analysis must include 2 Standards, with no more than a total of 12 antibody coated tubes.
- Do not exceed incubation periods prescribed by the specific steps.
- Results may not be valid if photometer reading for Standards exceeds 0.2 in magnitude.

Storage and Handling Precautions

- Wear protective gloves and eyewear.
- Store kit at room temperature and out of direct sunlight (less than 80°F).
- Keep aluminized pouch (containing unused antibody coated tubes) sealed when not in use.
- If liquid from the extraction jar, or PETRO Standard comes into contact with eyes, wash thoroughly with cold water and seek immediate medical attention.
- Operate test at temperatures greater than 15° C/60° F and less than 39° C/10[illegible]° F.
- After use, dispose of kit components in accordance with applicable federal and local regulations.

System Description

Each PETRO RISC® Soil Test System contains enough material to perform four complete tests, each at 10 and 10 ppm.

The PETRO RISC® Soil Test is divided into four phases. T instructions and notes should be reviewed before proceeding with each phase.

Hotline Assistance

If you need assistance or are missing necessary Test Syste materials, call toll free: 1-800-242-RISC (7472).

Validation and Warranty Information

Product claims are based on validation studies carried ou under controlled conditions. Data has been collected in accordance with valid statistical methods and the product has undergone quality control tests of each manufactured lot.

Gasoline-free soil and soil containing 10 ppm of gasoline were tested with the EnSys PETRO RISC® analytical method. The method correctly identified 95% of these samples. A sample that has developed less color than the standard is interpreted as positive. It contains gasoline.

Diesel fuel-free soil and soil containing 15 ppm of diesel fuel were tested with the EnSys PETRO RISC® analytical method. The method correctly identified 95% of these samples. A sample that has developed less color than the standard is interpreted as positive. It contains diesel fuel.

The company does not guarantee that the results with the PETRO RISC® Soil Test System will always agree with instrument-based analytical laboratory methods. All analytical methods, both field and laboratory, need to be subject to the appropriate quality control procedures.

EnSys, Inc. warrants that this product conforms to the descriptions contained herein. No other warranties, whether expressed or implied, including warranties of merchantability and of fitness for a particular purpose shal apply to this product.

EnSys, Inc. neither assumes nor authorizes any representative or other person to assume for it any obligation or liability other than such as is expressly set forth herein.

Under no circumstances shall EnSys, Inc. be liable for incidental or consequential damages res[illegible]ing from the use or handling of this product.

MECHANICAL PIPETTE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

HOW TO OPERATE THE MECHANICAL PIPETTE

To Set Or Adjust Volume

Remove push-button cap and use it to loosen volume lock screw. Turn lower part of push-button to adjust volume up or down. Meter should read "060". Tighten volume lock screw and replace push-button cap.

To Assemble Pipette Tip

Slide larger mounting end of pipette tip onto end of pipette. Holding tip in place, press push-button until plunger rod enters pipette tip. Ensure no gap exists between piston and plunger rod (see illustration).

To Withdraw Sample

With tip mounted in position on pipette, press push-button to first stop and hold it.

Place tip at bottom of liquid sample and slowly release push-button to withdraw measured sample. Ensure that no bubbles exist in liquid portion of sample. If bubbles exist, dispense sample and re-withdraw sample.

To Dispense Sample

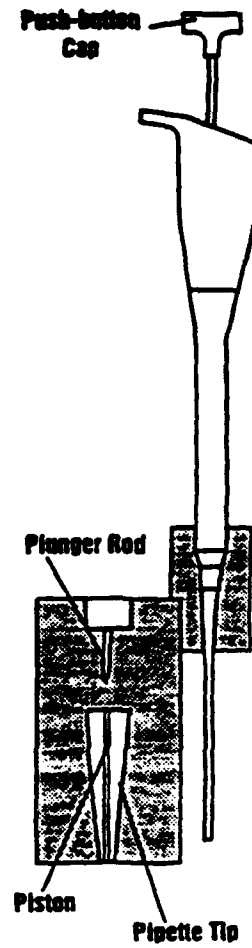
Place tip into dispensing vessel (immersing end of the tip if vessel contains liquid) and slowly press push-button to first stop. (Do not push to second stop or tip will eject).

Remove tip from vessel and release push-button.

To Eject Tip

Press push-button to second stop. Tip is ejected.

For additional information regarding operation and use of pipette, please refer to your pipette manual.



TEST SENSITIVITY

The PETRO RISC® Soil Test System has sensitivities to the following chemicals at the stated levels.

	Concentration necessary to give a positive result greater than 95% of the time (ppm)
Petroleum Fuels.	
Gasoline	10
Diesel	15
#2 Fuel Oil	15
Kerosene	15
Jet Fuel A	15
Jet Fuel JP-4	15
#6 Fuel Oil	25
Other Compounds:	
Mineral Spirits	40

For a complete table of sensitivities, consult the PETRO RISC® Soil Test System Technical Guide.

Data for PETRO RISc™ Soil Test

Operator: _____ Date: _____ Location: _____

Sample ID	ΔOD standards	OD sample ppm	Interpret.	OD sample ppm	Interpret.	Notes

Rev. 5 9/1/93

ENSYS INC.
ENVIRONMENTAL PRODUCTS

PCB RISC® SOIL TEST SYSTEM

RAPID IMMUNOASSAY SCREEN

User's Guide

IMPORTANT NOTICE

This method correctly identifies 95% of samples that are PCB-free and those containing 1 ppm or greater of PCBs. A sample that develops less color than the standard is interpreted as positive. It contains PCBs. A sample that develops more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

This test system should be used only under the supervision of a technically qualified individual who is capable of understanding any potential health and environmental risks of this product as identified in the product literature. The components must only be used for the analysis of soil samples for the presence of polychlorinated biphenyls. After use, the kits must be disposed of in accordance with applicable federal and local regulations.

TROUBLE SHOOTER GUIDE

Wash Step- lack of vigorous washing may result in false positives or negatives depending on whether the wash error was committed on standard or sample tubes. *Solution*: make sure that the operator washes four times vigorously.

Pipette Calibration- an out-of-calibration pipette may result in false positives or negatives depending on whether the amount is greater or less than the specified transfer volume. *Solution*: check the calibration at least daily and after any extreme mechanical shock (such as dropping). An indication that the pipette is out of calibration is if the gold barrel is loose and will turn. (When set on 30 ml there should be about 1/4 of an inch between the white plunger and the end of the clear pipette tip.)

Air bubbles in the pipette or diluter- the presence of air bubbles in the pipette tip when transfering extracts may result in false positives or negatives depending on whether the error was committed on standard or sample tubes. *Solution*: quickly examine the pipette tip each time an aliquot is withdrawn and go back to the source and take another aliquot to displace the bubble if neccessary. Bubbles in the diluter can be in the tip or plunger assembly.

Mixing- lack of thorough mixing, when instructed, can cause inconsistent results. *Solution*: observe the mixing times in the instructions and to mix with sufficient force to ensure that the liquid is mixed.

Timing- it important to follow the timing steps in the instructions carefully. The incubation step in the antibody tubes can vary a bit without harm to the test (± 5 minutes). The color development step timing is critical and should be no less than 2 minutes and no greater than 3 minutes.

Addition of Drops- it is important to carefully count the drops added in the color development steps. The addition of ±1 drop to the instructed 5 drops can cause variability in the results RIGHT AROUND THE DETECTION LEVELS OF INTEREST. One drop less would result in a darker color (a less dilute solution) which could result in a false negative. One drop more could result in a lighter color (a more dilute solution) and result in a false positive.

Wiping the Tubes- wiping of the tubes should be done before they are read in the spectrophotometer because smudges and fingerprints on the tubes can give potentially false negative readings.

Mixing Lot #'s- never mix lots! Each kit's components are QC'd together for optimal performance and may give inaccurate results with the components from other kits, that are not of the same lot #. Also, the user must NEVER mix components from different types of kits (ex: Petro kit buffer tubes can't be used with a PAH kit).

Storage and Operating Temperatures- temperature requirements are very important and should be strictly adhered to. This information can be found in the kit User's Guide.

Shelf-life- each kit label contains the kit expiration date. To achieve accurate results, kits must be used prior to expiration.

WORKSTATION SET-UP

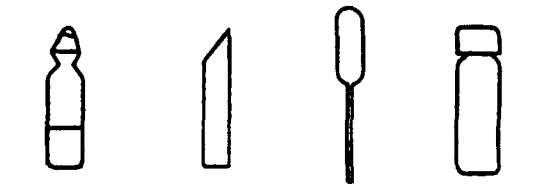
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Follow diagram below to setup workstation.
- Items that you will need that are not provided in the test kit include: a permanent marking pen, laboratory tissue (or paper towels), a liquid waste container, disposable gloves.
- Do not expose reagents to direct sunlight.
- Do not attempt to run more that 12 tubes, two of which must be Standard tubes.
- Operate test at temperatures greater than 4°C / 40°F and less than 32°C /90°F.
- See table on page 9 for sensitivity to various aroclors.

TEST PREPARATION

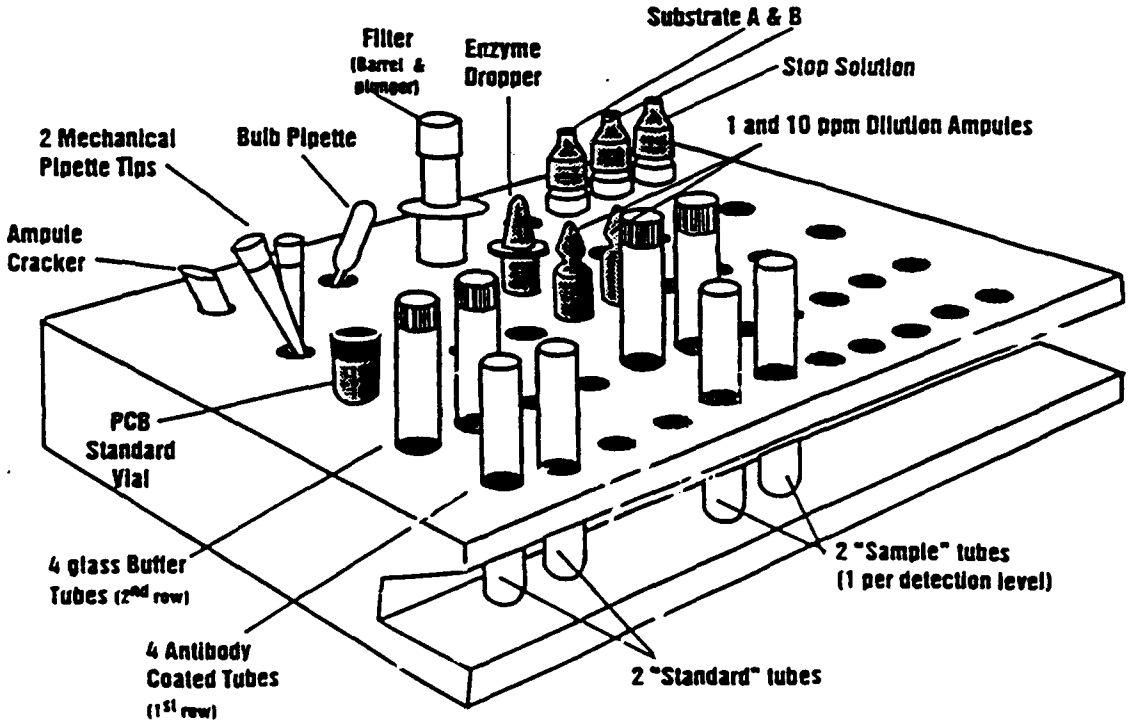
- Label amber vial "PCB Standard", and the current date, Standard is usable for up to 2 weeks from this date. Open PCB Standard ampule by slipping ampule cracker over top, and then breaking tip at scored neck. Transfer to empty amber vial with bulb pipette. Always cap tightly when finished using Standard.



PCB Standard | Ampule Cracker | Bulb Pipette | Amber Vial

WORKSTATION SET-UP (Workstation shows components for 1 sample tested at 2 levels)

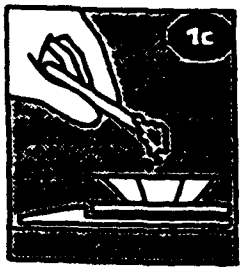
- ☐ Mechanical pipette tips
- ☐ Enzyme dropper
- ☐ PCB standard vial
- ☐ Substrate A
- ☐ Filtration barrel & plunger
- ☐ 1 and 10 ppm dilution ampules
- ☐ Substrate B
- ☐ Bulb pipette
- ☐ 4 glass buffer tubes
- ☐ Stop solution
- ☐ Ampule cracker
- ☐ 4 antibody coated tubes



PHASE 1 EXTRACTION & PREPARATION OF THE SAMPLE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WEIGH SAMPLE

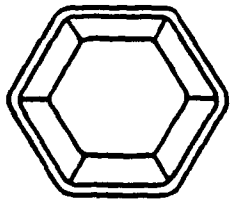


1a Place unused weigh boat on pan balance.

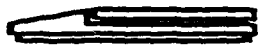
1b Press ON/MEMORY button on pan balance. Balance will beep and display 0.0.

1c Weigh out 10 ± 0.1 grams of soil.

1d If balance turns off prior to completing weighing, use empty weigh boat to retare, then continue.



Weigh Boat



Pan balance

Wooden spatula

EXTRACT PCBS

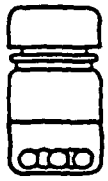
2a Uncap extraction jar and place on a flat surface. Without contacting solvent puncture foil seal with ampule cracker or sharp object. Peel the remainder of the seal off extraction jar.

2b Using wooden spatula, transfer 10 grams of soil from weigh boat into extraction jar.

2c Recap extraction jar tightly and shake vigorously for one minute.

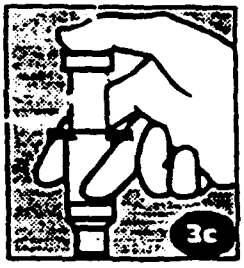
2d Allow to settle for one minute.

Repeat steps 1a - 2c for each sample to be tested.



Extraction jar

FILTER SAMPLE



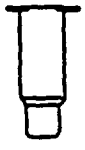
3a Disassemble filtration plunger from filtration barrel.

3b Insert bulb pipette into top (liquid) layer in extraction jar and draw up sample. Transfer at least ½ bulb capacity into filtration barrel. Do not use more than one full bulb.

3c Press plunger firmly into barrel until adequate filtered sample is available (place on table and press if necessary).

Repeat steps 3a - 3c for each sample to be tested.

Filtration plunger



Filtration barrel

Bulb pipette

READ TO AVOID COSTLY MISTAKES

SAMPLE DILUTION DIAGRAM

1. The sample dilution procedure on the next page is for standard detection levels. The following diagram represents the sample dilution procedure for all other detection levels

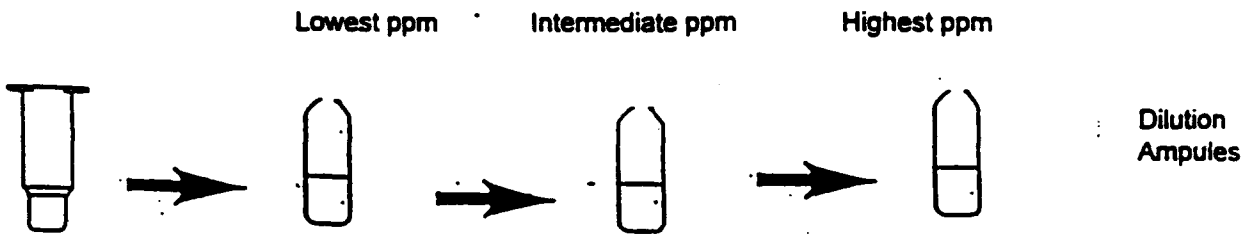
2. Your kit may include extra dilution ampules to reach high detection levels.

3. EVERY AMPULE PROVIDED MUST BE USED!

If there are any questions concerning the dilution procedure please call Technical Services *before running the samples to help avoid costly mistakes.*

1-800-242-7472 or 919-941-5509 (X144, 148 or 149).

EXAMPLE:



NOTE: YOUR ORDER MAY INCLUDE ADDITIONAL AMPULES IN ORDER TO ACHIEVE YOUR TEST LEVELS. ALWAYS TRANSFER FILTERED SAMPLE TO THE DILUTION AMPULE LABELLED WITH THE LOWEST PPM LEVEL AND THEN TRANSFER FROM IT TO THE NEXT HIGHER LEVEL DILUTION AMPULE .

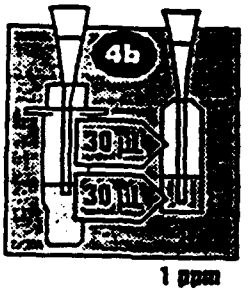
PHASE 2 SAMPLE & STANDARD PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

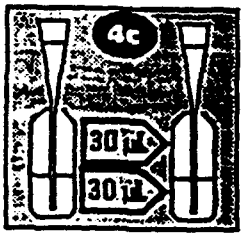
READ BEFORE PROCEEDING

- Tap glass buffer tubes vigorously on hard surface to release buffer trapped in cap.
- Label the glass buffer and plastic antibody coated tubes with a permanent marking pen. Uncap glass buffer tubes.
- When using the mechanical pipette always withdraw and dispense below the liquid level.
- "Shake tubes" means to thoroughly mix the contents with special care not to spill or splash.

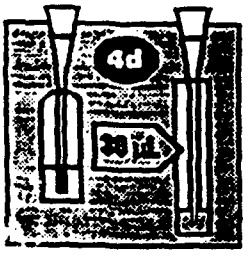
DILUTE SAMPLES AND STANDARDS

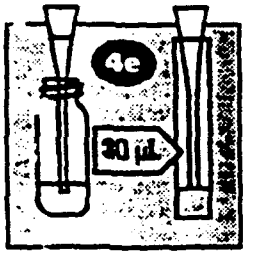


1 ppm



1 ppm 10 ppm





PCB Standard

4a Open 1 and 10 ppm* dilution ampules by slipping ampule cracker over top, and then breaking top at scored neck.

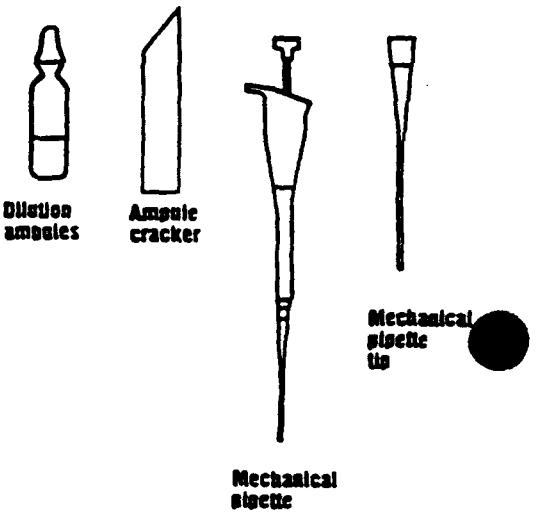
4b Withdraw 30 µL of filtered sample using mechanical pipette and dispense below the liquid level in "1 ppm" dilution ampule. Repeat to transfer a total of 60 µL; gently shake ampule from side to side for 5 seconds to mix thoroughly.

4c Withdraw 30 µL from the "1 ppm" dilution ampule using mechanical pipette and dispense below the liquid level in "10 ppm" dilution ampule. Repeat to transfer a total of 60 µL; gently shake ampule from side to side for 5 seconds to mix thoroughly.

4d Transfer 30 µL from each dilution ampule into a glass buffer tube. Always wipe tip after dispensing into buffer tube.

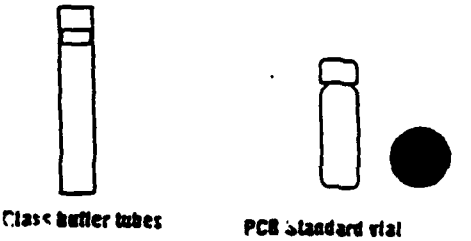
4e Assemble new pipette tip on mechanical pipette and transfer 30 µL from Standard vial into two glass buffer tubes. Immediately replace cap on PCB Standard vial.

4f Shake all glass buffer tubes for 5 seconds.



* For other test concentrations, follow steps 4b - 4d, transferring from lowest level dilution ampul to higher level dilution ampules. You may be provided with additional dilution ampules to achieve higher test concentrations.

If you need assistance call technical support 1-800-242-7472



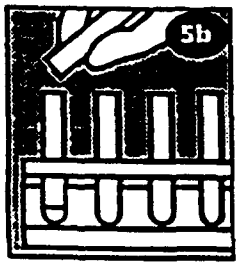
PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- This phase of the procedure requires critical timing and care in handling the antibody coated tubes.

INCUBATION I



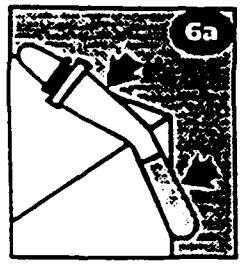
5a Set timer for exactly 10 minutes.

5b Start timing and immediately pour solution from each glass buffer tube into appropriate antibody coated tube. Tap glass tube on antibody coated tube to remove solution.

5c Shake all tubes for 5 seconds.

Antibody coated tubes (contained in resealable "zip-seal" aluminized pouch)

PREPARE ENZYME DROPPER

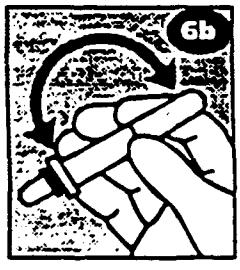


6a Crush glass ampule contained within enzyme dropper by pressing tube against hard edge.

6b Mix enzyme by turning dropper end-over-end 5 times. Do not shake.

6c Remove seal from enzyme dropper.

Repeat steps 6a - 6c to prepare one enzyme dropper for every 5 antibody coated tubes.

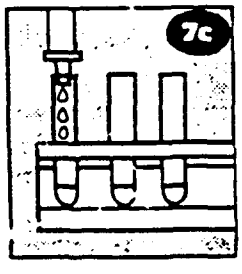


Enzyme dropper

INCUBATION II

7a Dispense first drop from enzyme dropper into liquid waste container.

Note: before dispensing drops, tap capped tip on hard surface to avoid dispensing air bubbles.



7b After the 10 minute incubation, set timer for 5 minutes.

7c Immediately dispense 3 drops of enzyme into each antibody coated tube by squeezing the dropper.

7d Shake antibody coated tubes for 5 seconds.

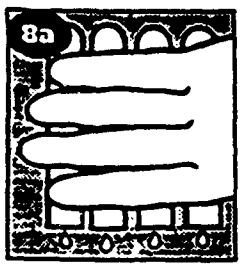
PHASE 3 THE IMMUNOASSAY

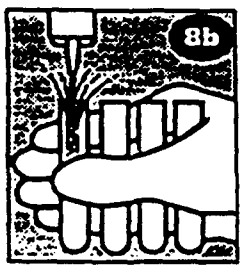
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING
WASH PROCEDURE

- An accurate test requires a virgorous wash accomplished by directing a strong stream into the antibody coated tubes.
- The wash solution is a harmless, dilute solution of detergent.

WASH



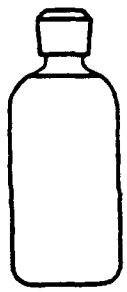


8a After the 5 minute incubation (a total of 15 minutes), empty antibody coated tubes into liquid waste container.

8b Wash antibody coated tubes by vigorously filling and emptying a total of 4 times.

8c Tap antibody coated tubes upside down on paper towels to remove excess liquid. Residual foam in the tubes will not interfere with test results.

Note: When running up to 12 antibody coated tubes, tubes can be washed in two groups - one group immediately following the other group.



Wash bottle

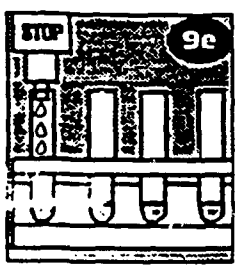
READ BEFORE PROCEEDING

- Keep Substrate dropper bottles vertical and direct each drop to bottom of antibody coated tubes. Addition of more or less than 5 drops may give inaccurate results.
- This phase requires accurate timing.

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

COLOR DEVELOPMENT



9a Add 5 drops of Substrate A (yellow cap) to each antibody coated tube.

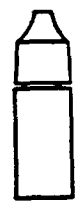
9b Set timer for exactly 2 ½ minutes.

9c Start timer and immediately add 5 drops of Substrate B (green cap) to each antibody coated tube.

9d Shake all tubes for 5 seconds. Solution will turn blue in some or all antibody coated tubes.

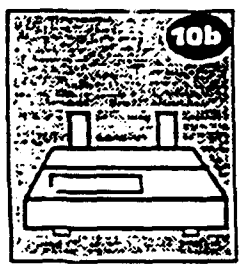
9e Stop reaction at end of 2 ½ minutes by adding 5 drops of Stop Solution (red cap).

Note: Blue solution will turn yellow when Stop Solution is added.



Substrate bottles (A, B, & Stop Solution)

SELECT STANDARD



10a Wipe outside of all antibody coated tubes.

10b Place both Standard tubes in photometer.

10c Switch tubes until the photometer reading is negative or zero. Record reading.

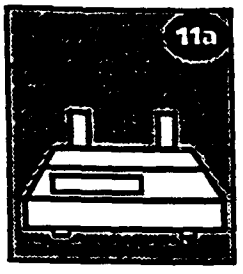
If reading is greater than 0.3 in magnitude (+ or -), results are outside QC limits. Retest the sample(s).

10d Remove and discard tube in right well. The tube in the left well is the darker standard.

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

MEASURE SAMPLE



11a Place 1 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 1 ppm.

11b Place 10 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 10 ppm.

AROCLOR SENSITIVITY

Aroclor	Lowest Detection Level
1248	1.0 ppm
1254	0.4 ppm
1260	0.4 ppm
1242	2.0 ppm
1232	4.0 ppm
1016	4.0 ppm

QUALITY CONTROL

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

System Description

Each PCB RISc Soil Test System contains enough material to perform four complete tests, each at two detection levels, if desired.

The PCB RISc Soil Test is divided into three phases. The instructions and notes should be reviewed before proceeding with each phase.

Hotline Assistance

If you need assistance or are missing necessary Test System materials, call toll free: 1-800-242-RISC (7472).

Validation and Warranty Information

Product claims are based on validation studies carried out under controlled conditions. Data has been collected in accordance with valid statistical methods and the product has undergone quality control tests of each manufactured lot.

PCB-free soil and soil containing 1 ppm or greater of PCBs were tested with the EnSys PCB RISc analytical method. The method correctly identified 95% of these samples. A sample that has developed less color than the standard is interpreted as positive. It contains PCBs. A sample that has developed more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

The company does not guarantee that the results with the PCB RISc Soil Test System will always agree with instrument-based analytical laboratory methods. All analytical methods, both field and laboratory, need to be subject to the appropriate quality control procedures.

EnSys, Inc. warrants that this product conforms to the descriptions contained herein. No other warranties, whether expressed or implied, including warranties of merchantability and of fitness for a particular purpose shall apply to this product.

EnSys, Inc. neither assumes nor authorizes any representative or other person to assume for it any obligation or liability other than such as is expressly set forth herein.

Under no circumstances shall EnSys, Inc. be liable for incidental or consequential damages resulting from the use or handling of this product.

How It Works

Standards, Samples, and color-change reagents are added to test tubes, coated with a chemical specific to PCBs. The concentration of PCBs in an unknown Sample is determined comparing its color intensity with that of a Standard.

Note: PCB concentration is inversely proportional to color intensity; the lighter the color development of the sample, the higher the concentration of PCBs.

Quality Control

Standard precautions for maintaining quality control:

- Do not use reagents or test tubes from one Test System with reagents or test tubes from another Test System.
- Do not use the Test System after any portion has passed its expiration date.
- Do not attempt the test using more than 12 antibody coated tubes (two of which are Standards) at the same time.
- Do not exceed incubation periods prescribed by the special steps.
- Always dispense correct number of drops and wash the number of times indicated in this guide.
- Use EPA Method 8080 or Code of Federal Regulations Title 40, Part 136, Appendix A, Method 680 to confirm results.

Storage and Handling Precautions

- Wear protective gloves and eyewear.
- Store kit at room temperature and out of direct sunlight (less than 80°F).
- Keep aluminized pouch (containing unused antibody coated tubes) sealed when not in use.
- If Stop Solution or liquid from the extraction jar comes into contact with eyes, wash thoroughly with cold water and seek immediate medical attention.
- Standard Solution contains PCBs. Test samples may contain PCBs. Handle with care.

MECHANICAL PIPETTE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

HOW TO OPERATE THE MECHANICAL PIPETTE

To Set Or Adjust Volume

Remove push-button cap and use it to loosen volume lock screw. Turn lower part of push-button to adjust volume up or down. Meter should read "030". Tighten volume lock screw and replace push-button cap.

To Assemble Pipette Tip

Slide larger mounting end of pipette tip onto end of pipette. Holding tip in place, press push-button until plunger rod enters pipette tip. Ensure no gap exists between piston and plunger rod (see illustration).

To Withdraw Sample

With tip mounted in position on pipette, press push-button to first stop and hold it.

Place tip at bottom of liquid sample and slowly release push-button to withdraw measured sample. Ensure that no bubbles exist in liquid portion of sample. If bubbles exist, dispense sample and re-withdraw sample.

To Dispense Sample

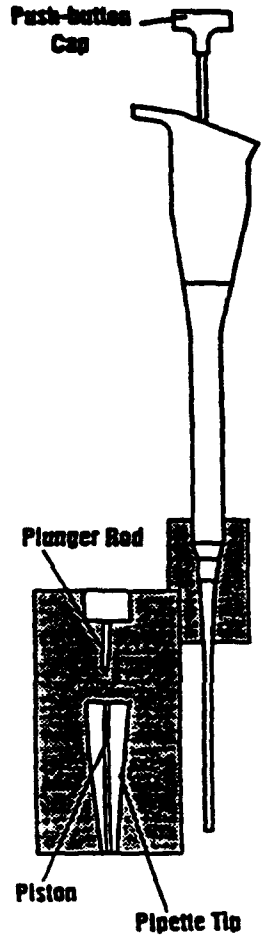
Place tip into dispensing vessel (immersing end of the tip if vessel contains liquid) and slowly press push-button to first stop. (Do not push to second stop or tip will eject).

Remove tip from vessel and release push-button.

To Eject Tip

Press push-button to second stop. Tip is ejected.

For additional information regarding operation and use of pipette, please refer to your pipette manual.



APPENDIX C
Field Forms

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME:	LABORATORY NAME & ADDRESS:
PROJECT NUMBER:	
WBS CODE:	SUBCONTRACT / D.O. No.

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT

COMMENTS:

COLLECTED & RELEASED BY	DATE / /	TIME :	TURNAROUND TIME		
RECEIVED BY	DATE / /	TIME :	RELINQUISHED BY	DATE / /	TIME :
RECORD RETURNED BY	DATE / /	TIME :			
			SHIPPING NUMBER:		

INFORMATION IN THIS SECTION

FOR JACOBS USE ONLY

LOCATION	FIELD	LAB	RECEIPT

SAMPLING COMMENTS:

JE

JACOBS ENGINEERING GROUP INC.
DENVER, CO (303) 595-8855

DAILY REGISTER

PROJECT NO: 05G46600
PROJECT NAME: Granite Mountain
PLACE:_____
DATE(S):_____

	NAME	TITLE	COMPANY	ONSITE LOCATION
1				
2				
3				
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5				
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24				
25				

RECORD OF PHOTOGRAPHS
GRANITE MOUNTAIN RRS
PROJECT NUMBER 05G46600

Film Type _____ Roll No. _____
ASA Number _____

Photo No.	Date	Time	Photographer	Weather Conditions	Location	Description of Photograph
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						
19.						
20.						
21.						
22.						
23.						
24.						

_____
Signature of Photographer

SEDIMENT/SURFACE SOIL/SUBSURFACE SOIL SAMPLING FIELD DATA FORM

PROJECT NAME: GRANITE MOUNTAIN RRS
PROJECT NUMBER: 05G46600
SITE ID: _____
SAMPLE ID: _____
DATE: _____ START TIME: _____ FINISH TIME: _____
WEATHER: _____
FIELD SAMPLING TEAM:

↑ N

_____

_____

_____

SAMPLING LOCATION:

_____

_____

COMPOSITE: YES/NO COMPOSITE DESCRIPTION: _____

DEPTH OF SAMPLING INTERVAL: _____ VOLUME COLLECTED: _____

HEADSPACE READINGS: _____

DESCRIPTION OF SOIL MATERIALS:

MOISTURE CONTENT: _____

COLOR: _____

USCS CODE: _____

OTHER : _____

FIELD TEST KIT SCREENING RESULTS:

TPH: _____ PCB: _____

DATE AND TIME OF
TEST KIT SCREENING _____

COMPLETED BY:

_____

PRINT NAME SIGNATURE DATE

CHECKED BY:

_____

PRINT NAME SIGNATURE DATE

SURFACE WATER/SEEP SAMPLING FIELD DATA FORM

Location Sketch ↑ N

PROJECT NAME: Granite Mountain RRS PROJECT NUMBER: 05G46600

LOCATION: _____ SAMPLE NUMBER: _____

SAMPLE COLLECTION DATE: _____ SAMPLE COLLECTION TIME: _____

SAMPLERS: _____

FIXED/FIELD LAB (circle):

SAMPLING TECHNIQUE: BUCKET: ___ BEAKER/DIPPER: ___ IMMERSION: ___

SAMPLED FROM: SHORE: ___ WADED: ___ OTHER: ___

SAMPLING LOCATION: STREAM: ___ LAKE/POND: ___ TIDAL POD: ___

POOL: ___ SEEP: ___ CREEK: ___ OTHER: ___

FLOW RATE (if applicable): _____ gpm MEASURED: _____ ESTIMATED: _____

WEATHER CONDITIONS: _____

FIELD ANALYTICAL PARAMETERS:

Sample No. & QC Type	Redox Pot (mV)	Water Temp (°F/°C)	Dissolved Oxygen (mg/L)	pH S.U.	Salinity (%)	Specific Conduct. (mS/cm)	Turbidity (NTU)

QC TYPE: REAL: ___ MS: ___ MSD: ___ LR: ___ DUP: ___ RNS: ___

COMMENTS: _____

_____

Field QC By: _____ Date: _____
Print Name Signature

Site Supervisor QC By: _____ Date: _____
Print Name Signature

(win) sf\granite\swsform 8/10/94

GROUNDWATER SAMPLING DATA SHEET

Project Name: Indian Mountain LRRS
Site ID: _____
Project Number: 05G46200
Date: _____ Start Time: _____ Finish Time: _____
Sampled By: _____

Well Number: _____
Well Type: (i.e., Monitor, Extraction) _____
Well Material: (i.e., PVC, St. Steel) _____
Well Integrity _____
HNU Reading: _____

WELL PURGING

PURGE VOLUME

Borehole Radius (in feet) = _____ inches/12 inches per foot = _____
Total depth of borehole (in feet BTOC) = _____
Water Level Depth (in feet BTOC) = _____
Casing Radius (in feet) = _____ inches/12 inches per foot = _____
Total depth of casing (in feet BTOC) = _____
Number of well volumes to be purged (# Vols.) = _____

PURGE METHOD

_____ Bailer – Type: _____ _____
Pump Type:
_____ Submersible _____ Centrifugal _____ Bladder
_____ Other – Type: _____
Immiscible Phase Detection: ___Yes ___No __LNAPL __DNAPL
Depth to top (ft.) _____ Depth to bottom (ft.) _____
Thickness (ft.) _____

PURGE VOLUME CALCULATION

Borehole Volume (gallons) = 3.14 X (_____ Borehole radius (ft.))² X (_____ Total Depth of Borehole (ft.) – _____ Water Level (ft.)) X 7.48 gallons/ft³
= _____ gallons

Casing Volume (gallons) = 3.14 X (_____ Casing radius (ft.))² X (_____ Total Depth of Casing (ft.) – _____ Water Level (ft.)) X 7.48 gallons/ft³
= _____ gallons

Total Purge Volume = (_____ Borehole Volume (gal.) – _____ Casing Volume (gal.)) X 0.45 + _____ Casing Volume (gal.) x _____ # volumes = _____ gallons Tot. Purge Volume

PURGE TIME

_____ Start _____ Stop _____ Elapsed

PURGE RATE

Initial _____ gpm

ACTUAL PURGE VOLUME

_____ gallons

FIELD PARAMETER MEASUREMENT

Minutes Since Pumping Began	Volume Purged	pH	Cond. (umhos/cm)	T ___ °C ___ °F	Turbidity (ntu)	Other	Minutes Since Pumping Began	Volume Purged	pH	Cond. (umhos/cm)	T ___ °C ___ °F	Turbidity (ntu)	Other

Meter IDs Horiba: Pump: Others:
Observations During Purging (Well Conditions, Color, Odor): _____
Discharge Water Disposal: Sanitary Sewer ___ Storm Sewer ___ Drum ___ (No._____) Other: _____

WELL SAMPLING

SAMPLING METHOD

___Bailer – Type: _____
___Submersible ___Centrifugal ___Bladder: Pump No. _____
___Grab – Type: _____
___Other – Type: _____

SAMPLING DISTRIBUTION Sample Date: _____ Start Time: _____ Finish Time: _____

Sample No.	Volume/Cont.	Analysis Requested	Preservatives	Lab ID	Comments

QUALITY CONTROL SAMPLES

Duplicate Samples

Original Sample No.	Dup. Sample No.

Blank Samples

Type	Sample No.

Other Samples

Type	Sample No.

Field QC By: _____ Date: _____

APPENDIX D

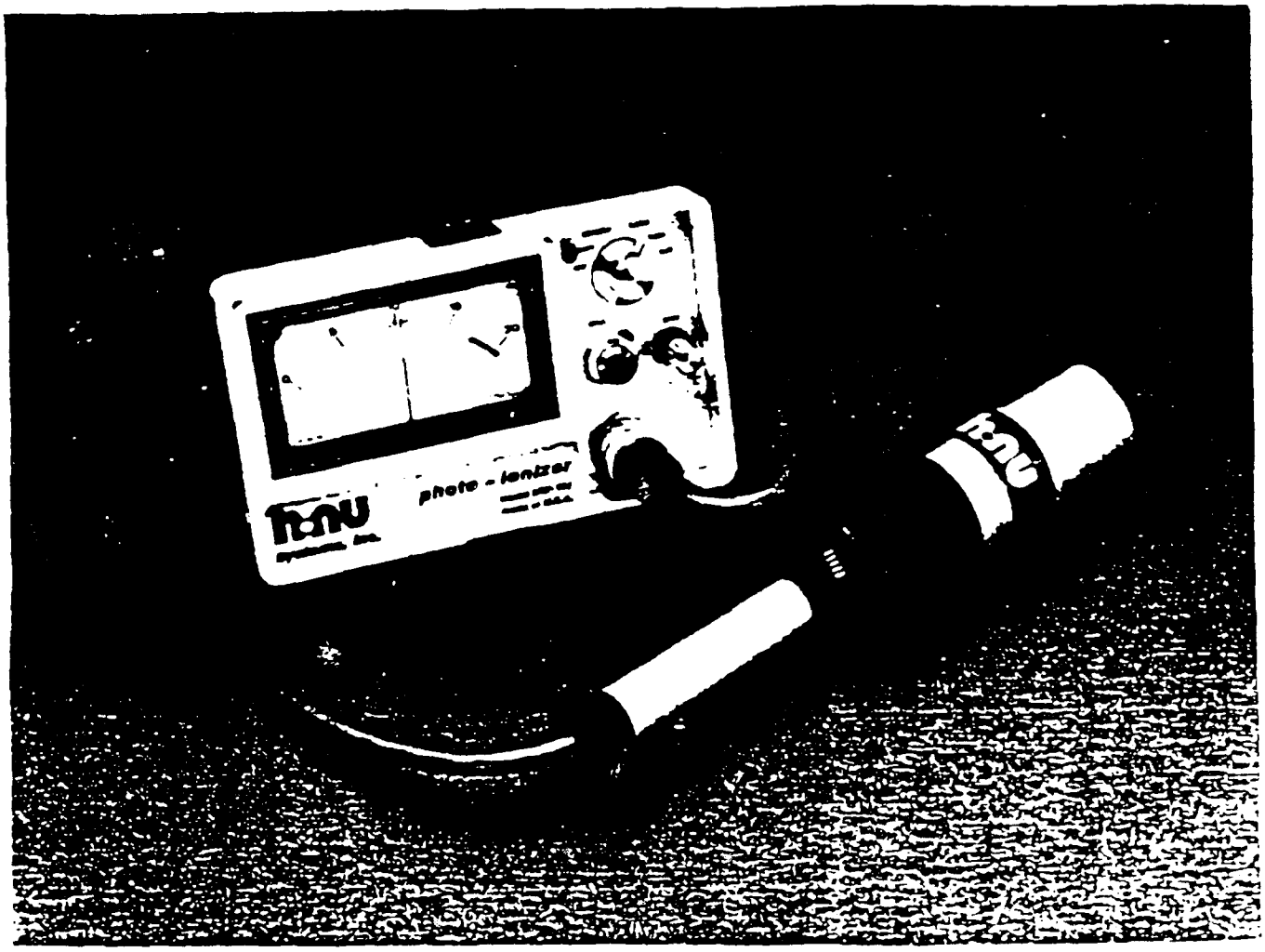
Instrument Operation Manuals

HNU

Model HW 101

INSTRUMENT MANUAL

INSTRUCTION MANUAL 970334



hnu

MODEL HW-101

Portable Hazardous Waste Analyzer

Preliminary Version

Published in the U.S.A.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must at all times observe all safety regulations. Do not replace components or make any adjustments inside the equipment with the high voltage supply turned on. Under certain conditions, dangerous potentials may exist when the power control is in the OFF position, due to charges retained by capacitors. To avoid casualties, always remove power and discharge and ground a circuit before touching it.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances should any person reach into the equipment for the purpose of servicing or adjusting except in the presence of someone who is capable of rendering aid.

RESUSCITATION

Personnel working with or near high voltage should be familiar with modern methods of resuscitation. Such information may be obtained from the Bureau Medicine and Surgery.

The following warnings appear in the text in this volume, and are repeated here for emphasis.

WARNINGS: Do not observe the light source closer than 6 inches. When necessary, observe only briefly. Continued exposure to ultraviolet energy generated by the light source can be harmful to eyesight.

A high reading on the meter should be cause for protective action since the instrument measures gases in the vicinity of the operator.

Turn the function switch on the control panel to the OFF position before disassembly. Otherwise, high voltages of -1200 VDC, will be present.

Use great care when operating the analyzer with the readout assembly outside the case due to the presence of -1200 V DC.

When conducting tests on analyzer in open condition, exercise great care due to presence of high voltage.

CHAPTER 1

GENERAL INFORMATION AND SAFETY PRECAUTIONS

1-1 SAFETY PRECAUTIONS

Safety precautions to be exercised in the use and repair of this equipment are described in the Safety Summary in the front section of this manual.

1-2 INTRODUCTION

This manual describes the operation, maintenance and parts list for the Photoionization Analyzer, Model HW 101, HNU Systems Inc., 160 Charlemont St., Newton, MA 02161, tel: 617-964-6690.

1-3 EQUIPMENT DESCRIPTION

The Photoionization Analyzer is a portable instrument used to detect and measure the concentration of a variety of hydrocarbon gases in various atmospheres. The analyzer consists of a probe and a readout assembly (see Figure 1-1). The probe contains the sensing and amplifying circuitry; the readout assembly contains the meter indicator, controls, and power supply.

Reference data on the analyzer is given in Table 1-1. Physical characteristics of the equipment are given in Table 1-2.

Characteristics of equipment required for maintenance and calibration are given in Table 1-3.

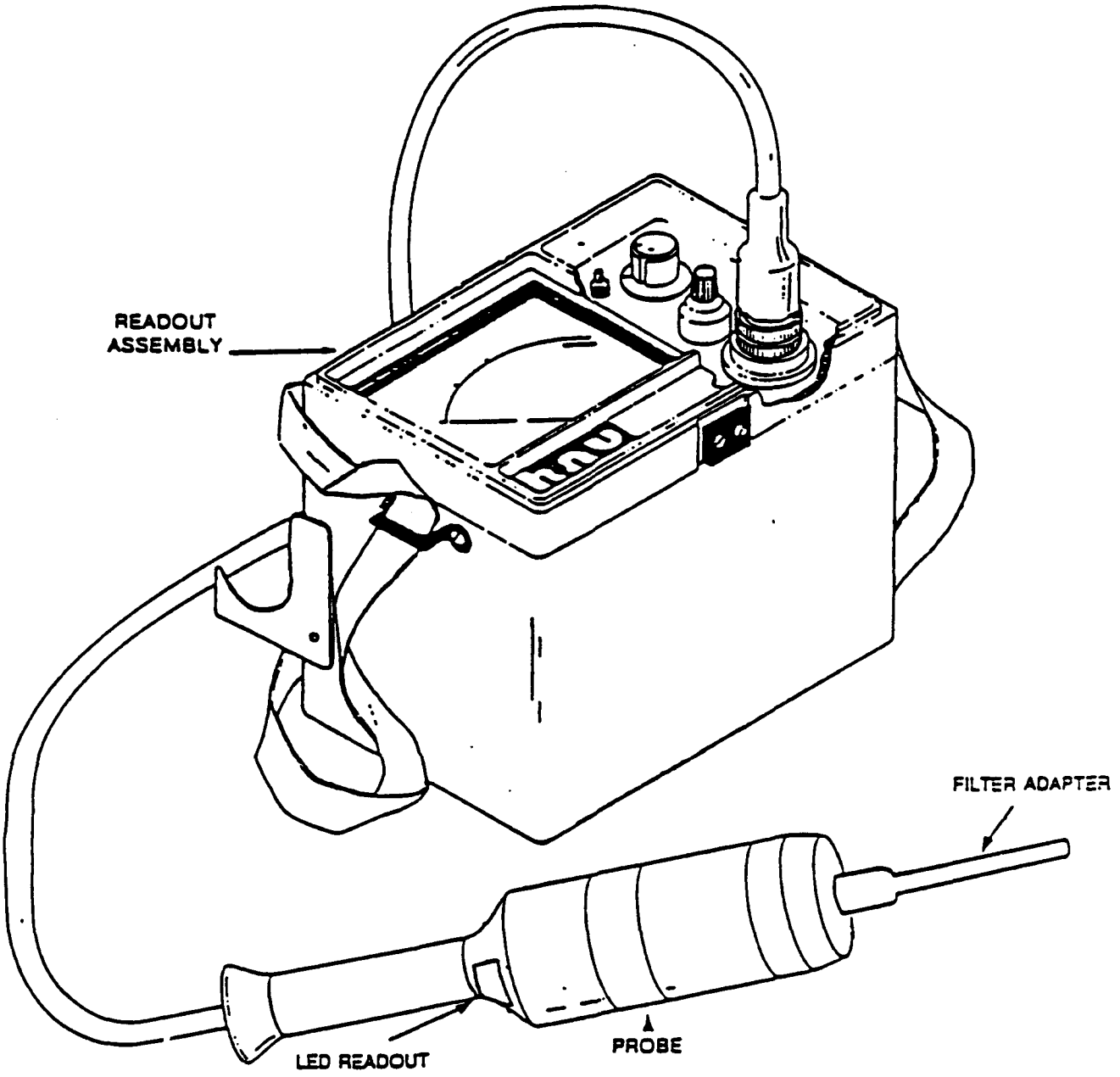


FIGURE 1-1
PHOTOIONIZATION ANALYZER
OPERATING CONDITION

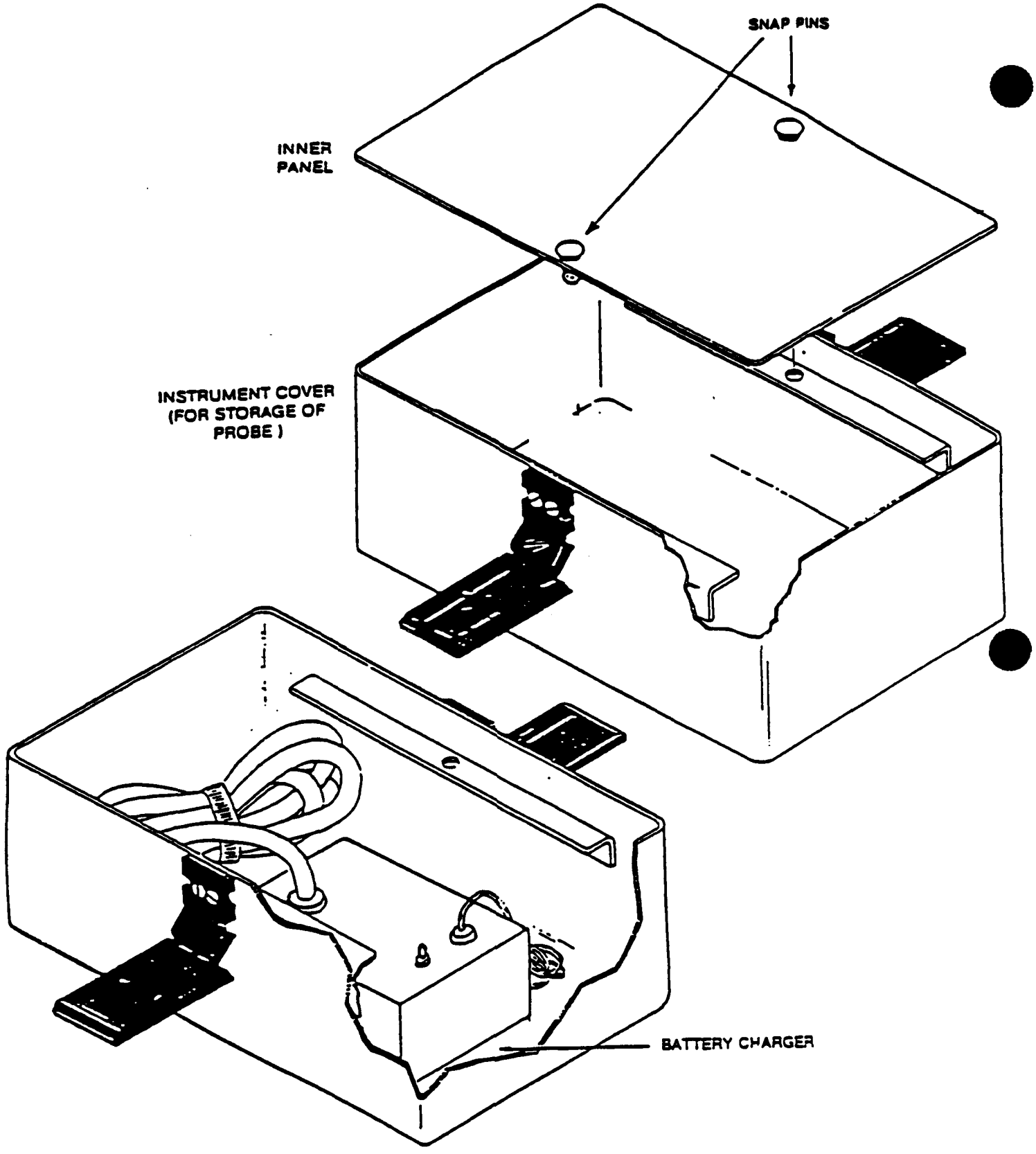


FIGURE 1-2
BATTERY CHARGER STORAGE

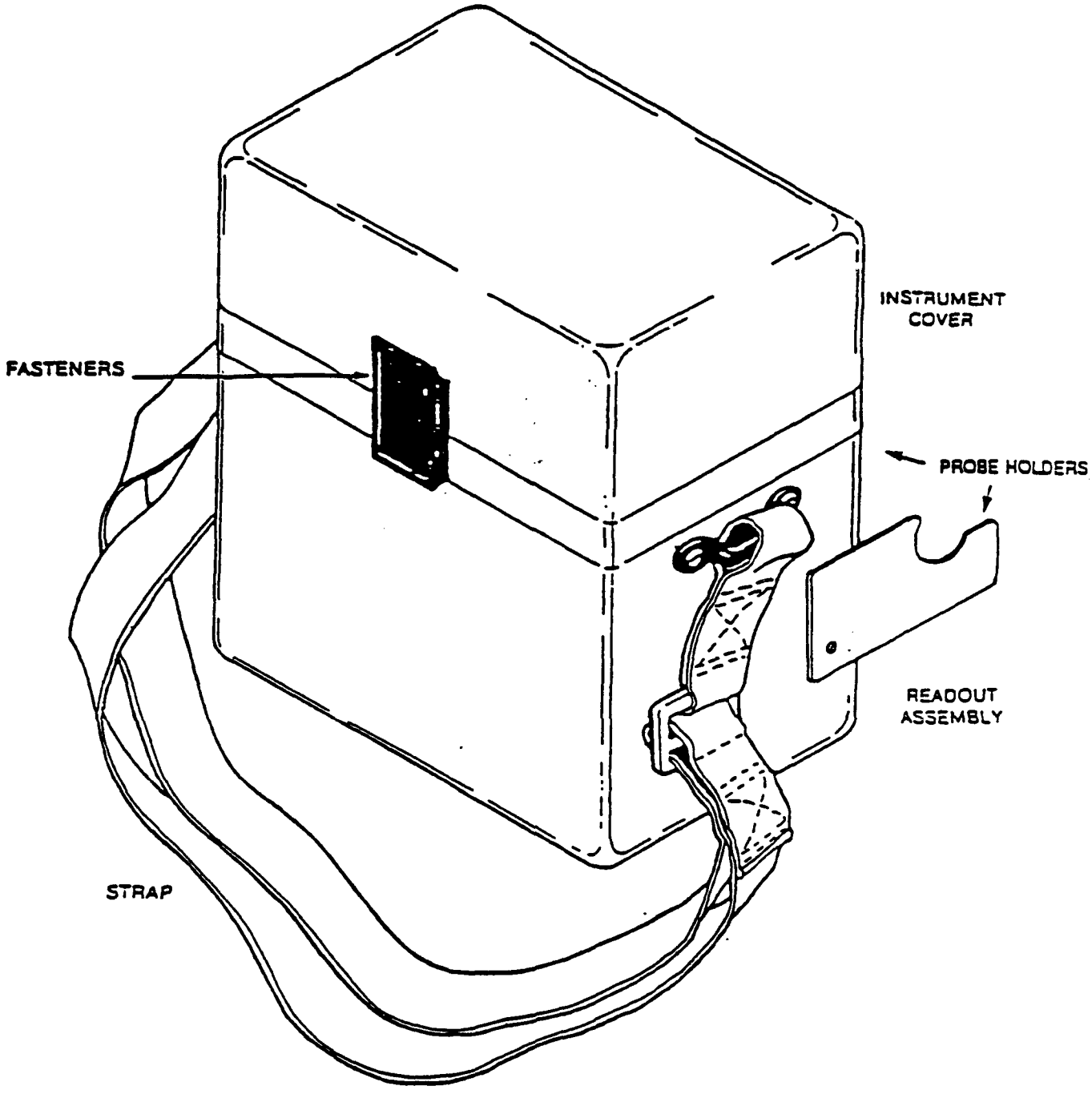


FIGURE 1-3
PHOTOIONIZATION ANALYZER
STORED CONDITION

TABLE 1-1

REFERENCE DATA

a) DESCRIPTION

Trace Gas Analazer	HNU Systems, Inc. Photoionization Analyzer Model HW 101

b) FUNCTIONAL CHARACTERISTICS (see NOTE)

Detection Range *	0.1 to 2000 ppm (parts per million by volume)
Minimum Detection Level *	0.1 ppm
Maximum Sensitivity *	0 to 20 ppm FSD (Full Scale Deflection)
Repeatability *	plus or minus 1% of FSD
Linear Range *	0.1 to 400 ppm
Useful Range *	0.1 to 2000 ppm
Response Time	Less than 5 seconds to 90% of FSD
Ambient Humidity	up to 90% RH
Operating Temperature Ambient	0 to 40 degrees C.
Operating Time on Battery	Approximately 10 hours
Battery Recharge Time after normal use	Approximately 6 hours
Battery Charger Power	120V AC, single phase, 50-60 cycle, 1.5 Amps

NOTE: Items marked with asterisk valid when span control set at 9.8 and measuring benzene. Values will vary for other compounds and conditions.

TABLE 1-2

EQUIPMENT SUPPLIED

Quan.	Name	Overall Dims CM (inches)	Weight Kg. (lbs)	Volume cm3 (cu ft.)
1	Photoionization Analyzer (stored condition)	21W x 13D x 24H (8 1/4 x 5 3/16 x 9 1/2)	4.7 (10.28)	6552 (0.23)
	Probe Assembly	6.0 Diam x 34.3L (2 3/8 x 13 1/2)	1.2 (2.7)	636 (0.023)
	Readout Assembly	21W x 13D x 16.5H (8 1/4 x 5 3/16 x 6 1/2)	3.4 (7.5)	4504 (0.16)
1	Battery Charger with cord	7.3W x 8.0D x 10.2L (2 7/8 x 3 1/8 x 4)	0.4 (0.9)	596 (0.021)

TABLE 1-3

EQUIPMENT REQUIRED, NOT SUPPLIED

Test Equipment Category (name)	Representative Test Eq. Model No.	Equipment Test Parameters	Application
Container/ Calib. Gas	HNU Systems Inc. cylinder, No. 101-350	Lightweight disposable steel cylinder containing 30 liters (3.6 cubic feet) at 300 lb/in2 and 70 oF. Contents to be 100 ppm of isobutylene in zero air +/- 10% -- rated concentration listed on cylinder.	Calibration
Regulator	HNU Systems Inc. regulator, NO. 101-351	Single stage regulator, flow preset at factory, 200-300 cc per minute, gage indicates pressure of tank contents	Calibration
Voltmeter	Multimeter, digital type	0 - 1500 V DC	Maintenance
Tubing	Latex	0.187 ID and 0.250 OD	Calibration
Compound, lamp cleaning	HNU part No. PA 101534-A1		Maintenance

CHAPTER 2

OPERATION

2-1 INTRODUCTION

The Photoionization analyzer is a portable instrument used to detect the concentration of a variety of trace gases in an atmosphere. The principal elements consist of a probe and a readout assembly. Associated elements consist of a battery charger and carrying straps.

2-2 CONTROLS AND INDICATORS

The controls and indicators are located on the panel of the readout assembly (see Figure 2-1) and are listed and described in Tables 2-1 and 2-2.

2-3 OPERATING PROCEDURES

The following are the procedures to be used in operating the analyzer:

a. Unclamp the cover from the main readout assembly.

b. Connect the probe cable to the 12 pin keyed connector on the readout assembly panel.

c. Screw the filter nozzle securely into the probe end cap. NOTE: This must be in place for proper operation.

d. Set the span control as specified by the initial factory calibration or by subsequent calibrations (see Section 4-4).

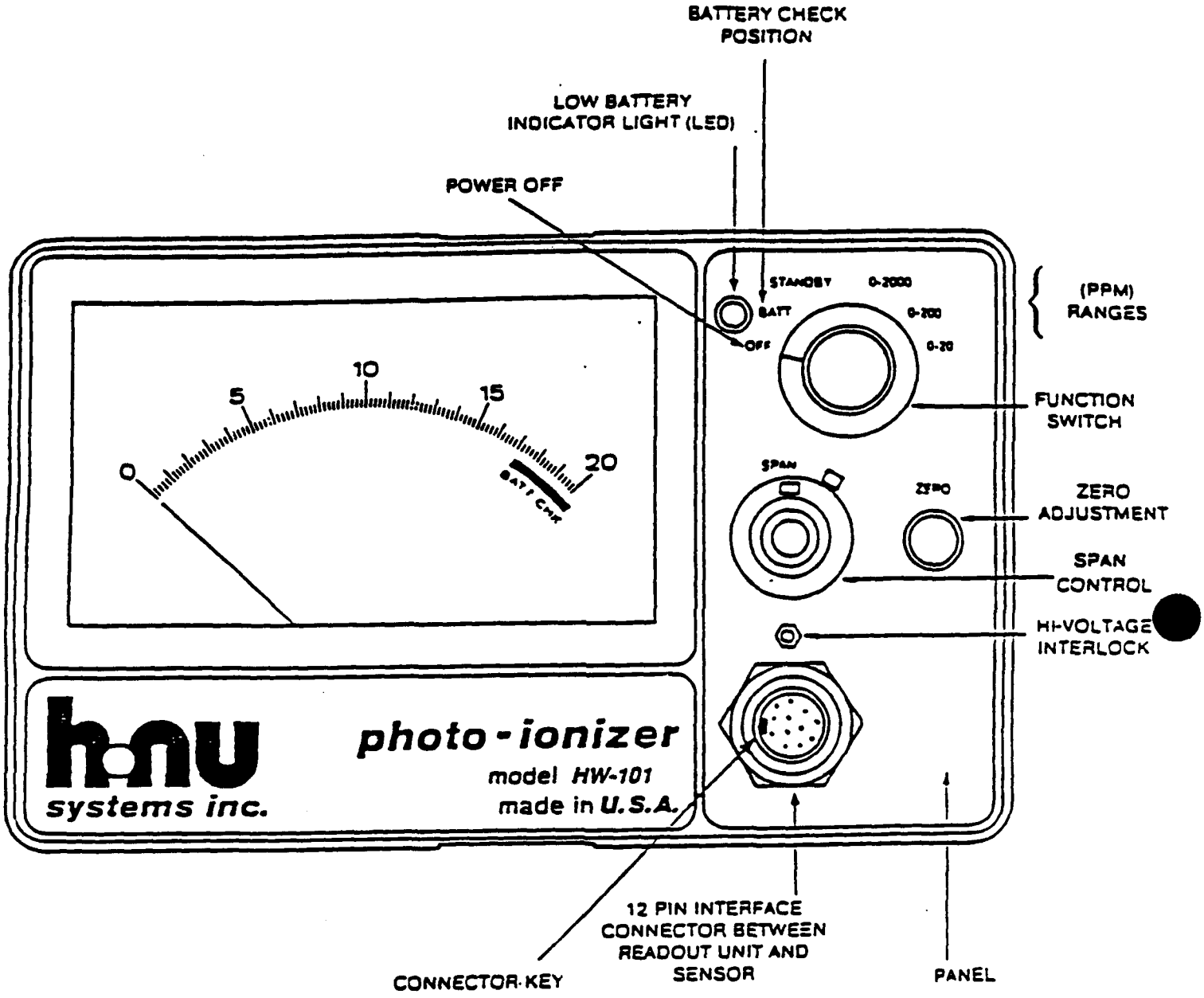


FIGURE 2-1
CONTROLS AND INDICATORS

e. Turn the function switch to the BATT (battery check) position. The needle on the meter will go to the green zone if the battery is fully charged. If the needle is below the green zone or if the Low Battery Indicator comes on, the battery must be recharged before the analyzer is to be used.

f. Turn the function switch to the STANDBY position. Turn the zero adjustment until the meter needle is at zero.

g. Calibrate the instrument as necessary (see para. 4.4).

h. Turn the function switch to the appropriate operating position. Start with the 0-2000 position and then switch to the more sensitive ranges as required to give the best resolution and upscale display.

The analyzer is now operational.

i. Hold the probe so that the nozzle is at the point where the measurement is to be made.

The instrument measures the concentration by drawing the gas in at the end of the nozzle, passing it through an ionization chamber, and discharging the gas at the end of the probe opposite from the tip.

CAUTION

The probe will draw samples from low pressure areas, i.e., from ductwork, or from any distance, and will draw in water.

DO NOT IMMERSE NOZZLE IN LIQUIDS!!
DO NOT IMMERSE NOZZLE IN DIRT, AS FRITTED FILTER WILL CLOG!

WARNING

A high reading should be cause for protective action since the instrument measures gases in the vicinity of the operator.

Take the reading or readings as desired being aware that air currents or drafts in the vicinity of the probe tip may cause fluctuations, and a stable reading may not be possible under these conditions. Change the function switch scale ranges as required.

Samples may be drawn from some distance as the pump is somewhat powerful.

WARNING

Do not dead head the pump as the vacuum in the ion chamber will change affecting an accurate reading.

j. When not conducting measurements and when analyzer is to be kept in readiness state, turn function switch to OFF position.

k. Check battery condition as required by turning the function switch to BATT position. Normal operating time between recharging is 8 to 10 hours. If the Low Battery Indicator comes on, turn analyzer off and recharge.

CAUTION

Use only in an emergency with a low battery when on battery charge. See para. 4.2.

l. After completion of each operating period turn function switch to OFF position, and recharge battery.

m. When not operating, leave analyzer in assembled condition, and connected to battery charger.

n. When transporting, disassemble probe readout assembly. Protect nozzle from dust and dirt.

2-4 SPECIAL PRECAUTIONS

2-4.1 ELECTROMAGNETIC RADIATION

The analyzer is well protected against interference from electromagnetic radiation so no errors normally occur from such sources, such as large electric motors, transformers, switching stations, electromagnets, etc. In an extreme case very close to a highly radiating source, the possibility of such an effect can be determined and corrected by the following procedure. Zero the analyzer in an electrically quiet area with the function switch in the STANDBY position. Then move the analyzer to the questionable area with the switch still in the STANDBY position. If AC pick up is occurring, the meter will indicate the magnitude of the error. The measurement in the operating position can then be compensated by subtracting this value.

TABLE 2-1

CONTROLS

Name	Position	Function
Function Switch		Controls the operation of the analyzer
	OFF	All operations OFF
	BATT (Battery check)	Check the condition of the battery. If the needle on the meter is in the green arc, the battery is charged. If the needle is not in the green arc the battery should be recharged. Can be done in any position, best in OFF, see directions on charger.
	STANDBY	All electronics ON, ultraviolet (UV) light source OFF. This position conserves power and extends battery life. This position is used to set the analyzer zero position. (i.e. no UV light, no signal.)
	0-2000	Sets range of meter at 0-2000 ppm.
	0-200	Sets range of meter at 0-200 ppm.
	0-20	Sets range of meter at 0-20 ppm,
Probe LED Bar Graph Display		Provides relative indication of meter reading (concentration). Each LED of the Bargraph Display represents 10% of the full scale setting of the range switch.
ZERO		With the function switch in STANDBY position, this control is used to adjust the analyzer to read zero.

Name	Position	Function
SPAN		This control is used to set the sensitivity of the amplifier to make the meter give direct readings of the trace gas concentrations in ppm.
		This control is a vernier control. The whole number of the setting appears in the window of the control, decimal parts appear on the dial. A lock on the control secures it in a specific setting.
HI-VOLTAGE INTERLOCK	---	This is a normally open push button switch.
	Open	Switch is open when cable not connected, causing high voltage for the UV lamp to be disconnected from the 12 pin connector for the probe as a safety precaution.
	Closed	Switch is closed when the probe cable is connected to the readout panel. This connects high voltage to the socket. This switch is automatically closed when the cable is attached by the pressure of the cable connector on the switch push button. This switch may also be closed manually during maintenance checks of the readout assembly without the probe cable attached.

NOTE: See Figure 2-1 for locations

TABLE 2-2

INDICATORS/CONNECTORS

Name	Function
Low Battery indicator (LED)	Illuminates after approximately 10 hours. Do not attempt to take readings when this light is on.
Probe Connector	12 pin connector for cable between the readout assembly and the probe.
Meter/ Probe L.E.D.	Indicates concentration of measured gas.

NOTE: See Figure 2-1 for location.

CHAPTER 3

FUNCTIONAL DESCRIPTION

3-1 PRINCIPLE OF OPERATION

The analyzer measures the concentration of trace gases present in the atmosphere by using the principle of photoioization. Photoionization occurs when an atom or molecule absorbs light of sufficient energy to cause an electron to leave and create a positive ion. This will occur when the ionization potential of the molecule is less than the energy of the photon. The ionization potential of a molecule is that energy in electron volts (eV) required to free an electron. In the HW 101, the source of photons is an ultraviolet lamp with an energy of 10.2 eV.

The detection process in this analyzer is shown in Fig. 3-1. Sample gases enter through the nozzle into the ion chamber. The ultraviolet lamp generates photons with an energy of 10.2 eV and these enter the ion chamber. Ionization occurs for those molecules having ionization potentials less than 10.2 eV.

A positive biased electrode causes these positive ions to travel to a collector in the chamber. Here ions create a current proportional to concentration at the collector which is then amplified and the signal displayed on the meter.

The amount of ionization occuring, and thus the input signal to the amplifier, is proportional to the amount of trace gas present in the ion chamber and to the ionization sensitivity of that gas.

Gases that will be ionized are those with ionization potentials of 10.2 eV or less. Typical gases that will be ionized and their potentials are listed in Table 3-1. These gases will thus be detected and measured with this analyzer.

The ion chamber is kept at reduced pressure to minimize effects of humidity and other gases.

Gases having ionization potentials higher than approximately 10.2 eV will not be ionized by this analyzer. Examples of th#se and their potentials are listed in Table 3-2. As can be seen from the table the ionization potential of the major components of air, i.e., oxygen, nitrogen, carbon dioxide, and of methane and freons, range from about 12.0 eV to about 15.6 eV and will thus not be ionized by photons from the 10.2 eV lamp.

When the analyzer is used to measure a mixture of gases, such as hydrocarbons in air, a calibration gas is selected to approximate the average response of the components to be measured. In this case, isobutylene is the compound whose response best approximates these hydrocarbons.

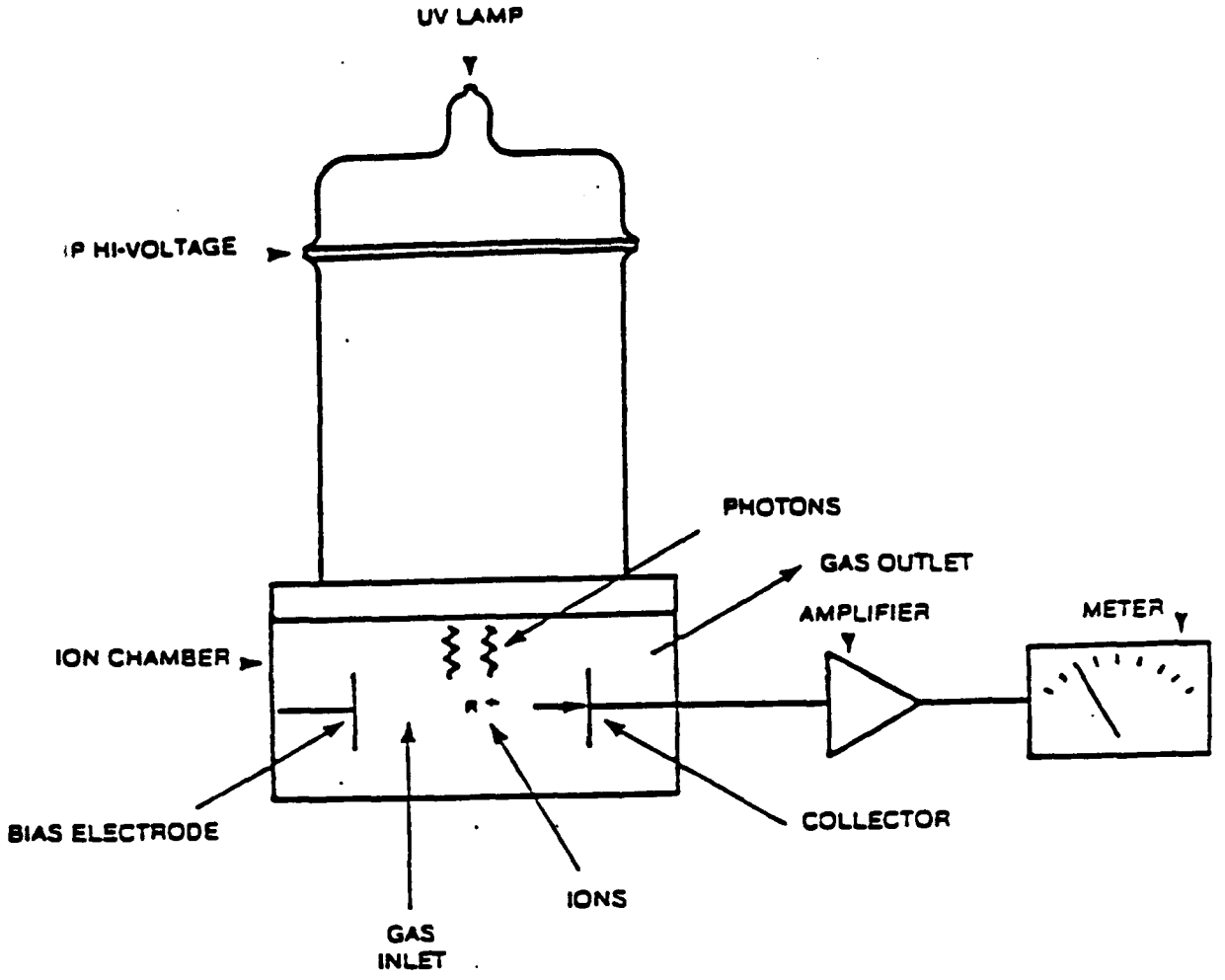


FIGURE 3-1
DETECTION PROCESS

TABLE 3-1

TYPICAL GASES THAT WILL BE IONIZED BY THE ANALYZER

Gas	Ionization Potential (eV)
Xylene	8.56
Toluene	8.82
Cyclohexanone	9.14
Benzene	9.25
Isobutylene	9.44
Trichloroethylene	9.45
Methyl ethyl ketone	9.53
Tetrahydrofuran	9.54
Acetone	9.69
Vinyl chloride	10.00
Ammonia	10.15
Isopropanol	10.17
Hexane	10.18
Ethanol	10.48

TABLE 3-2

TYPICAL GASES THAT WILL NOT BE IONIZED BY THE ANALYZER

Gas	Ionization Potential (eV)
Methanol	10.85
Nitromethane	11.08
Methyl chloride	11.28
Chlorine (Cl2)	11.48
Methyl chloroform	11.5
Freon 11	11.77
Freon 113	11.78
Genetron (101)	11.98
Freon 114	approx. 12
Oxygen (02)	12.1
Acetonitrile	12.22
Freon 12	12.31
Freon 13	12.91
Methane (CH4)	12.98
Carbon dioxide (C02)	13.79
Carbon monoxide (CO)	14.01
Hydrogen	15.426
Nitrogen (N2)	15.6

3-2 EQUIPMENT DESCRIPTION

The components of the analyzer are located in the probe and the readout assembly (see Fig. 3-2 and 3-3). The ion chamber, UV light source, amplifier board, pump and filter nozzle are located in the probe assembly. The battery, the power supply board, and the meter are located in the readout assembly. The probe and the readout assembly are connected by an 800 cm (32") cable.

The pump draws gas in through the filter and orifice located in the filter nozzle, through the ion chamber, and then discharges it through the hollow exhaust screw in the handle. The flow rate is approximately 175 to 275 cubic centimeters per minute. A general variation in the flow rate will not affect the measurement. A major obstruction to the flow, however, will prevent proper readings and lengthen response time, by changing the vacuum in ion chamber.

The output signal from the ion chamber goes to the amplifier and through the cable to the meter on the readout assembly.

Voltage for the light source, ion chamber, amplifier and pump is provided from a DC converter on the power supply board. The battery provides the source of power for the converter. The positive side of the battery is grounded.

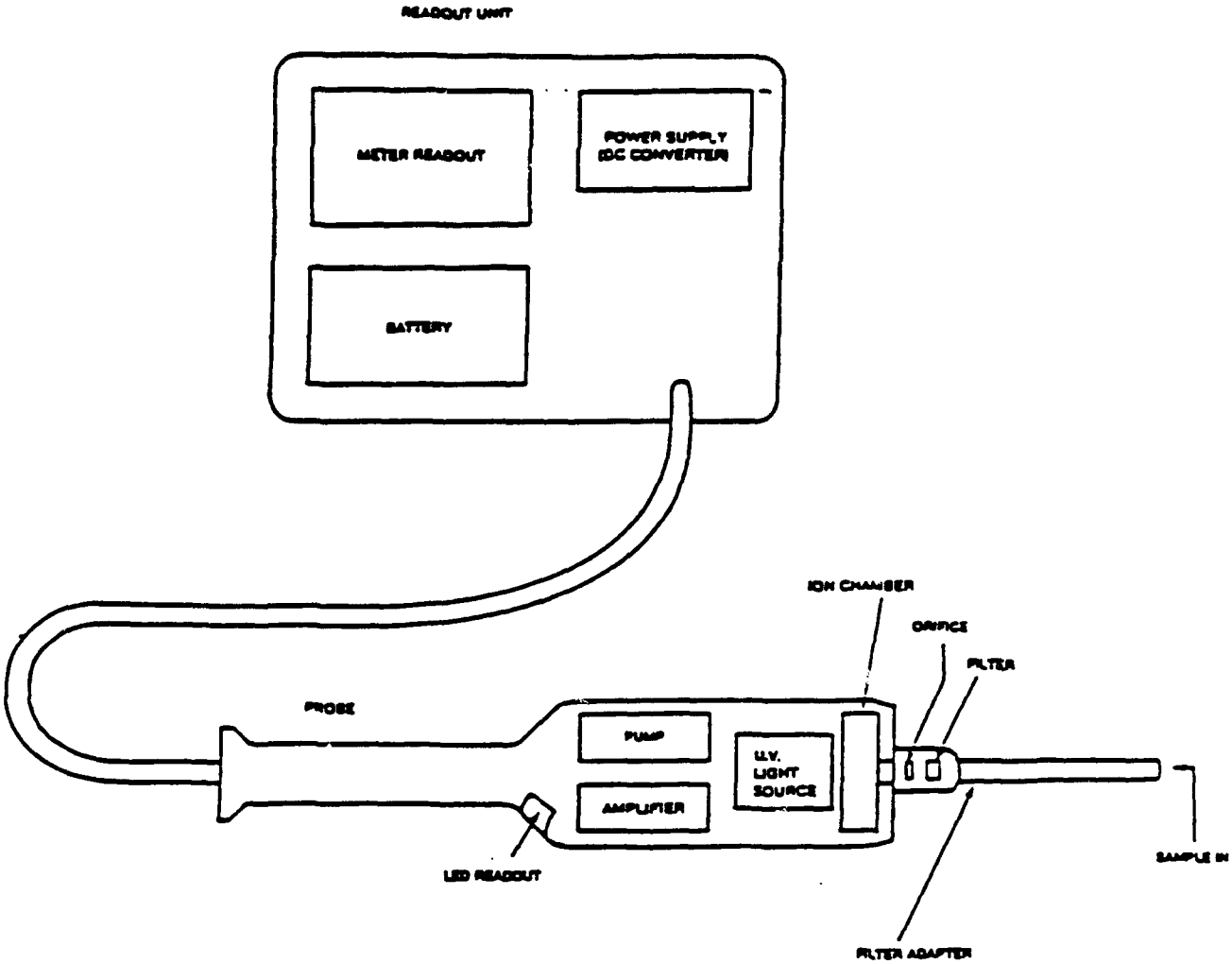
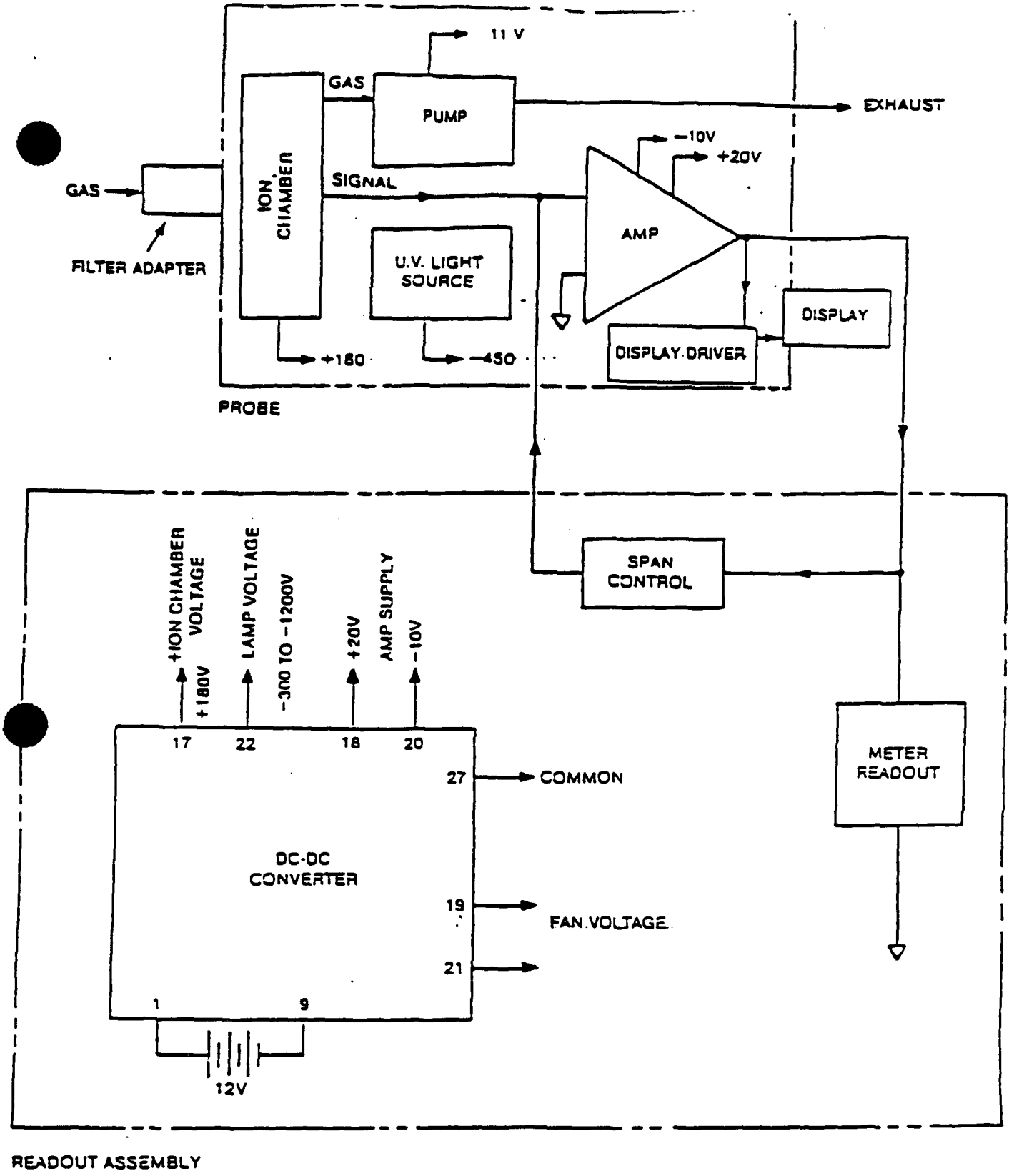


FIGURE 3-2
BLOCK DIAGRAM
COMPONENT LOCATION



NOTE ALL VOLTAGES SHOWN ARE NOMINAL VALUES.

FIGURE 3-3
BLOCK DIAGRAM
ELECTRICAL CONNECTIONS

CHAPTER 4

SCHEDULED MAINTENANCE

4-1 INTRODUCTION

Scheduled maintenance actions for the analyzer are those listed in Table 4-1.

4-2 BATTERY CHARGE

Check the battery charge as described in paragraph 2-3g. If the battery is low as indicated by the meter reading or the warning indicator LED, it is necessary to recharge the battery.

To charge the battery, first insert the mini phone plug of the charger into the jack, J6, on the side of the bezel adjacent to the meter. Then insert the charger plug into a 120 VAC single phase, 50-60 cycle outlet. To ensure that the charger is functioning, turn the function switch, S1, to the battery check (BATT position. The meter should deflect full scale if the charger is working, leave the function switch in the OFF position.

The analyzer can be operated, however, while charging by turning the function switch to the desired position. Such usage will extend the time required to completely recharge the battery. A normal full recharge of the battery from low voltage level as indicated by the warning light takes about 6 hours.

4-3 UV LAMP AND ION CHAMBER

During periods of operation of the analyzer, moisture or other foreign matter could be drawn into the probe forming deposits on the surface of the UV lamp or in the ion chamber. These deposits would interfere with the ionization process and cause erroneous readings. Cleaning can be accomplished as follows:

Disassemble the probe as described in Paragraph 6-2.1

WARNING

Turn the function switch on the control panel to the OFF position before disassembly. Otherwise, high voltage of 1200 VDC will be present.

First, clean the lamp with a mild detergent and wipe dry. Then, the ion chamber can be inspected for dust or particulate deposits. If such matter is present, the assembly can be gently swirled in ethanol or isopropanol and dried gently at 50 - 60 degrees C for approximately a half hour. No liquid must be present at reassembly as this would affect the performance.

Reassemble the probe as described in paragraph 6-2.1 and check calibration of the analyzer (see Section 4-4).

If the calibration is still not satisfactory, disassemble the probe again and clean the lamp with the special HNU cleaning compound (see Table 1-3). As this is a rigorous cleaning procedure it should be done only after the more gentle cleaning is tried as described above. Do not clean the ion chamber with this special cleaning compound. Do not clean 11.7 ev lamps with this compound, a special cleaning compound is available for 11.7 lamps.

Reassemble the probe, check to see if the lamp is on before reattaching the filter nozzle (see WARNING, Section 2-3j), and calibrate the analyzer (see Section 4-4).

4-4 CALIBRATION

The analyzer is calibrated by use of a cylinder and a regulator (see Table 1-3). The cylinder contains a calibration gas consisting of a mixture of isobutylene in zero air. Isobutylene is non-toxic and safe to use in confined areas. There are no listed exposure levels at any concentration.

The regulator sets and controls the flow rate of gas to the analyzer at a value preset at the factory.

The analyzer is connected to the output of the regulator with a short piece (butt connected) of flexible tubing (see Figure 4-1). It is important to use clean tubing since contaminated .tubing will adversely affect the calibration readings.

Set the function switch on the analyzer at the desired ppm range position. The gas from the regulator will flow thru the probe. The ispbutylene level in the calibration gas is specifically selected for the analyzer. The desired ppm level to be indicated on the meter is given on the cylinder label.

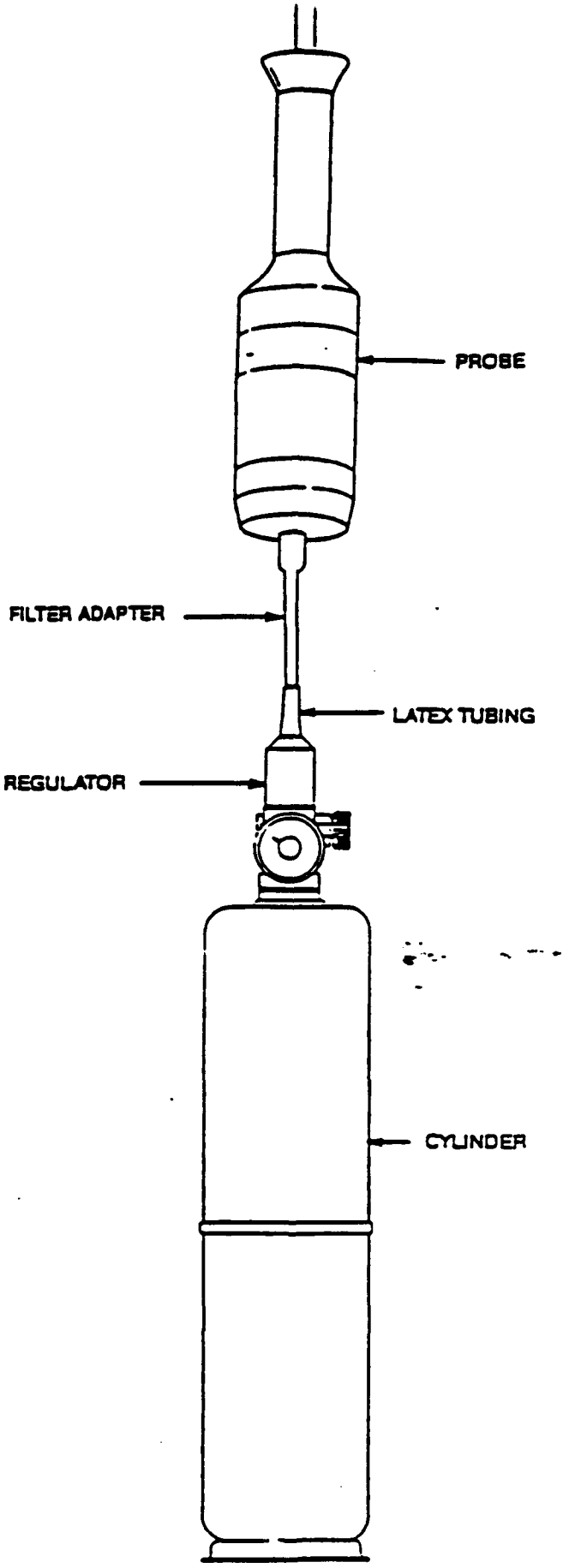


FIGURE 4-1
CALIBRATION TEST SET UP

Adjust the span control so the meter reads the specified value. Turn the function switch back to the STANDBY position. Check and reset the zero setting if necessary. If this setting is changed, recheck the calibration setting.

NOTE: To conserve calibration gas, this cylinder should be opened until a steady reading is secured and any adjustment is made (1 min.). This is the most effecient use of the calibration gas cylinder. Do not use the cylinder below about 30 PSIG as the reading can deviate up to 10% from the rated value. Safely discard the disposable cylinder when empty. If questions arise about disposal, this cylinder contained 99.99% pure air with 100ppm Isobutylene (non-toxic, non-flammable impurity).

If the span setting resulting from calibration is 0.0 or if the calibration cannot be achieved then the lamp must be cleaned (see Section 4-3 and 6-2.1).

If the analyzer still cannot be calibrated (the lamp may be ON but the output too low) or if the lamp has failed it must be replaced.

To replace the lamp, disassemble the probe, remove the old lamp, install a new one and reassemble. Set the SPAN pot to 8.0. Remove the readout assembly case (see Section 6-2.2). Locate the gain control potentiometer, R48, on the power supply board as shown on Figure 5-2. Recalibrate the analyzer adjusting this potentiometer, R48, with a small screwdriver to obtain the specified ppm reading.

If the analyzer still cannot be calibrated, it is possible that it may be leaking. The HW 101 normally operates at approximately 775 mbars +/- 30 mbars, and if not reassembled properly can leak.

NOTES:

1) The screws holding the end cap are special screws with rubber gaskets in the head.

2) The ion chamber has a special gasket on the screen retainer.

3) The filter nozzle must have its gasket in place where it connects with the probe. (The filter nozzle should not be disassembled either for filter replacement or general cleaning)

WARNING

Use great care when operating the analyzer with readout assembly outside the case due to the presence of -1200 V DC.

When calibration is accomplished, turn the analyzer OFF and replace the readout assembly in its case.

Adjustment of R48 potentiometer is used only when a new lamp is installed. At all other times adjustment is accomplished using the SPAN control potentiometer.

TABLE 4-1

SCHEDULED MAINTENANCE ACTION INDEX

Periodicity	Maintenance Action	Reference para
As required	Battery recharge	4-2
Monthly (or as required)	UV Lamp and Ion Chamber	4-3
Daily	Calibration	4-4

CHAPTER 5

TROUBLESHOOTING

5.1 INTRODUCTION

The initial step of any troubleshooting is a thorough visual inspection to look for possible loose or open connections, shorts, dust or other obvious conditions.

Detailed troubleshooting for fault location and correction is accomplished by steps outlined in the following.

Disassembly and reassembly as may be required for checking the equipment or replacing parts are described in Chapter 6.

WARNING

Turn the function switch on the control panel to the OFF position before disassembly. Otherwise high voltage of -1200 VDC will be present.

WARNING

Do not observe the light source closer than 6 inches. When necessary, observe only briefly. Continued exposure to ultraviolet energy generated by the light source can be harmful to eyesight

WARNING

When conducting tests on analyzer in open condition, exercise great care due to presence of high voltage.

TABLE 5-1

TROUBLESHOOTING DATA

Symptom	Probable Cause	Corrective Action
1. Meter indicates low battery	a. Battery charge low	1) Recharge battery, check meter with function switch in BATT position to ensure the charger is operating properly (See Table 2-1)
	b. Battery dead	1) Disconnect battery and check with voltohmeter. Should read -11 to -15 V DC. Replace if dead. (See Section 6-2.2)
	c. Blown fuse (F1, 2A, Fig. 3-3)	1) Check fuse. If blown, check low battery for evidence of shorts in wiring, then replace fuse.
	d. Bad connections	1) Check wiring connections. Repair poor or bad connections.
	e. Broken meter movement	1) Tip instrument rapidly from side to side. Meter needle should move freely, and return to zero. If faulty, replace with new meter.
2. Low battery	a. Power supply defective.	1) Check power supply voltages (see Figure 5-2 and Table 5-6). If in error replace control assembly.

3. UV Lamp not ON	a. High Voltage interlock (Microswitch S2) at probe cable connector on readout assy not operating	1) Check by applying pressure to switch plunger with cable in place. Adjust hex screw on side of cable connector, if required to increase throw of switch plunger.
	b. High voltage supply out or faulty.	1) Check high voltage output on power supply board (pad 22). If voltage not correct (See Table 5-3) replace control assembly.
	c. Lamp not making proper connection with high voltage	1) Remove lamp, clean and tighten contacts, re-install lamp.
	d. Lamp faulty	1) Replace lamp.
	e. Short in high voltage lines.	1) Check wiring from power supply board to probe cable connector (J3 pin D) to UV lamp contacts (D1). Remove any shorts.
4. Pump not running	a. Pump stuck	1) Disassemble probe and clean passages with care.
	b. Pump connections faulty	1) Check for wiring connections at pump motor and at probe cable connector. Repair as required.
	c. Low or dead battery	1) Check battery output (power supply board, pad 8) Recharge or replace battery as required.
	d. Pump voltage not correct	1) Check pump voltage (power supply board pads 19 and 21, probe cable pins A and C). If not correct, replace control assembly.

Symptom	Probable Cause	Corrective Action
		2) If pump voltages correct, replace pump.
5. Meter does not respond.	a. Dirty or open probe connection.	1) Clean and tighten or resolder connections in probe.
	b. Broken meter movement.	1) See 1-e-1 above.
	c. Dirty or open connections to meter	1) Clean and tighten connections at meter.
	d. Low or dead battery	1) See 4-c-1 above.
	e. Blown fuse	1) See 1-a-1 above.
6. Meter does not return to zero in STANDBY	a. Broken meter movement	1) See 1-e-1 above.
	b. Dirty or open connections to meter	1) See 5-c-1 above.
	c. Dirty or open connections in probe.	1) See 5-a-1 above.
	d. Zero adjust faulty	1) Rotate zero adjust pot (see Fig. 2-1) (R50, Fig. 3-4). Check pot output at meter probe connector (J3 pins B and L). If voltage does not vary, replace zero adjust pot.
	e. Amplifier faulty	1) Rotate zero adjust pot.Check amplifier output at power supply PCB (Pad 11), amplifier board connector (P2/J2 pin E), or probe connector (P3/J3 pin E), or observe meter. If voltage level on meter does not respond, replace amplifier board.

Symptom	Probable Cause	Corrective Action
	f. Ion chamber shorted	1) Clean ion chamber. (See para. 4-3) Recheck analyzer operation in returning to zero at STANDBY. 2) Replace ion chamber.
7. Meter readings high or low.	a. Incorrect calibration	1) Recalibrate (see para 4-4).
	b. Lamp dirty.	1) Clean lamp (see para 4-3).
	c. Contamination in ion chamber.	1) Clean ion chamber (see para. 4-3).
	d. 0 ring leaking or missing	1) Check 0 rings and adjacent surfaces (see para. 6-2.1).
	e. Power supply board faulty.	1) Check power supply board outputs. (pads 17, 20, and 22 Table 5-3). If voltages not correct, replace control assembly.
	f. Dirty or loose connections.	1) Clean or tighten connections at amplifier board, probe cable, and meter.
	g. Probe may be leaking	1) Place finger over filter nozzle inlet and check flow at the exhaust. There should be no flow. 2) Remove filter nozzle and place finger over inlet and recheck flow at exhaust. There should be no flow. 3) If still leaking, remove end cap and ion chamber and block inlet to pump at small "O" ring on retainer. There should be no flow. If still leaking at this point, call HNU Service Department.

Symptom	Probable Cause	Corrective Action
8. Meter erratic, unstable or non-repeatable	a. Loose cable connection	1) Check cable connection at control panel. Observe meter. Tighten cable as required.
	b. Dirty or loose meter connections	1) Check meter connections. Clean and tighten as required.
	c. Contamination in ion chamber.	1) Clean ion chamber. (see para. 4-3).
	d. Power supply board	1) See 7-D-1 above.
	e. Unstable or noisy	1) Observe lamp (Important see *Warning, Section 2-3j*). If operation not steady, replace lamp.
	f. Function switch in high gain, most sensitive position (i.e., 0-20ppm)	1) Unstable meter operation is common with function switch in most sensitive position. Turn switch to less sensitive position if desirable.
	g. Pump not operating properly.	1) See 7G
	h. Gas flow slow or	1) See 4-a-1 above.
	i. Meter contacts dirty or loose.	1) Clean and tighten contacts
	j. Electromagnetic interference	1) See 2-4.2
	h. Hi Voltage Interblock	1) See 3-A-1
9. Drifting meter readings	a. Ion Chamber contaminated.	1) Clean ion chamber. (See para. 4-3)
10. LED Readout on probe	a. Out completely Meter OK	
	b. Some segments out	

TABLE 5-2

TROUBLESHOOTING INDEX

Functional Area	Troubleshooting alignment / adjustment (Table 5-2 Para.)	Diagram (Fig. No.)	Functional Description (Para.)
Battery	1,4,5	3-4	3-2
Controls/Circuitry	5,6,7,8,9	3-4	3-2
Meter	1,5,6,7,8	3-4	3-2
Power Supply	2,3,4,7,8	3-4	3-2
Pump	4,8	3-4	3-2
Lamp	3,7,8	3-4	3-2
Ion Chamber	6,7,8	3-4	3-2,3-2
Filter Nozzle			
LED Readout			

TABLE 5-3

PAD DATA, POWER SUPPLY PCB

Pad No.	Signal Name	Voltage (Vdc)
1	Battery Positive(+)	0
2	Ground	0
3	Battery Charger (+)	0
4	Low Battery Indicator	
5	Low Battery Indicator	
6	Hi-Volt Relay Disconnect -Pump Ground	-12(See Note)
7	Battery Charger (-)	-11 to - 15
8	Battery negative (-)	-11 to - 15
9	Battery negative (-)	-11 to - 15
10	Hi-Volt relay disconnect	0 or -12
11	Amplifier Signal	0 to -5
12	Signal divider for span control	0 to -5
13	" " " "	"
14	" " " " "	"
15	" " " " "	"
16	" " " " "	"
17	Ion chamber accelerating voltage	+180
18	Zero adjust voltage power	+18 to +21
19	Not Used	
20	Amplifier Power	-9.5 to10.5
21	Pump Power	-10.nominal (see NOTE)
22	UV Lamp	up to -1200 (see para32)
23	Output Signal to Meter	0 to -5
24	Battery Check Voltage	-11 to -15
25	Not Used	
26	Signal Feedback	0 to -5
27	Ground	0
28	Ground	0
29	Not Used	
30	Ground	0
31	Ground	0

NOTE: Differential voltage for pump between pads 21(+) and 6(-) will be between 9.0 and 11.0 volts DC.

TABLE 5-4

PIN DATA, AMPLIFIER PCB, P2/J2

Pin #	Signal Name	Voltage (V DC)
A	Ground	0
B	Span Control Setting	varying
C	Zero Adjust	varying
D	Amplifier Power	-9.5 to -10.5
E	Amplifier Signal	0 to -15.0
F	Zero Adjust Voltage	+18 to +21
3	Zero Adjust	varying

TABLE 5-5

PIN DATA, PROBE CABLE, P3/J3

Pin #	Signal Name	Voltage (V DC)
A	Pump Ground	-12 nominal
B	Zero Adjust	varying
C	Pump Power	-1.0 nominal
D	UV Lamp	up to -1200 (see para. 3-2)
E	Amplifier Signal	0 to -5.0
F	Ground	0
H	Span Control Setting	varying
J	Ground	0
K	Zero adjust Voltage	+18 to +21
L	Zero Adjust	varying
M	Ion Chamber accelerating voltage	+180
N	Amplifier Power	-9.5 to -10.5

NOTE: Differential potential for pump between pins C(+) and A(-) will be between 9.0 and 11.0 Volts DC.

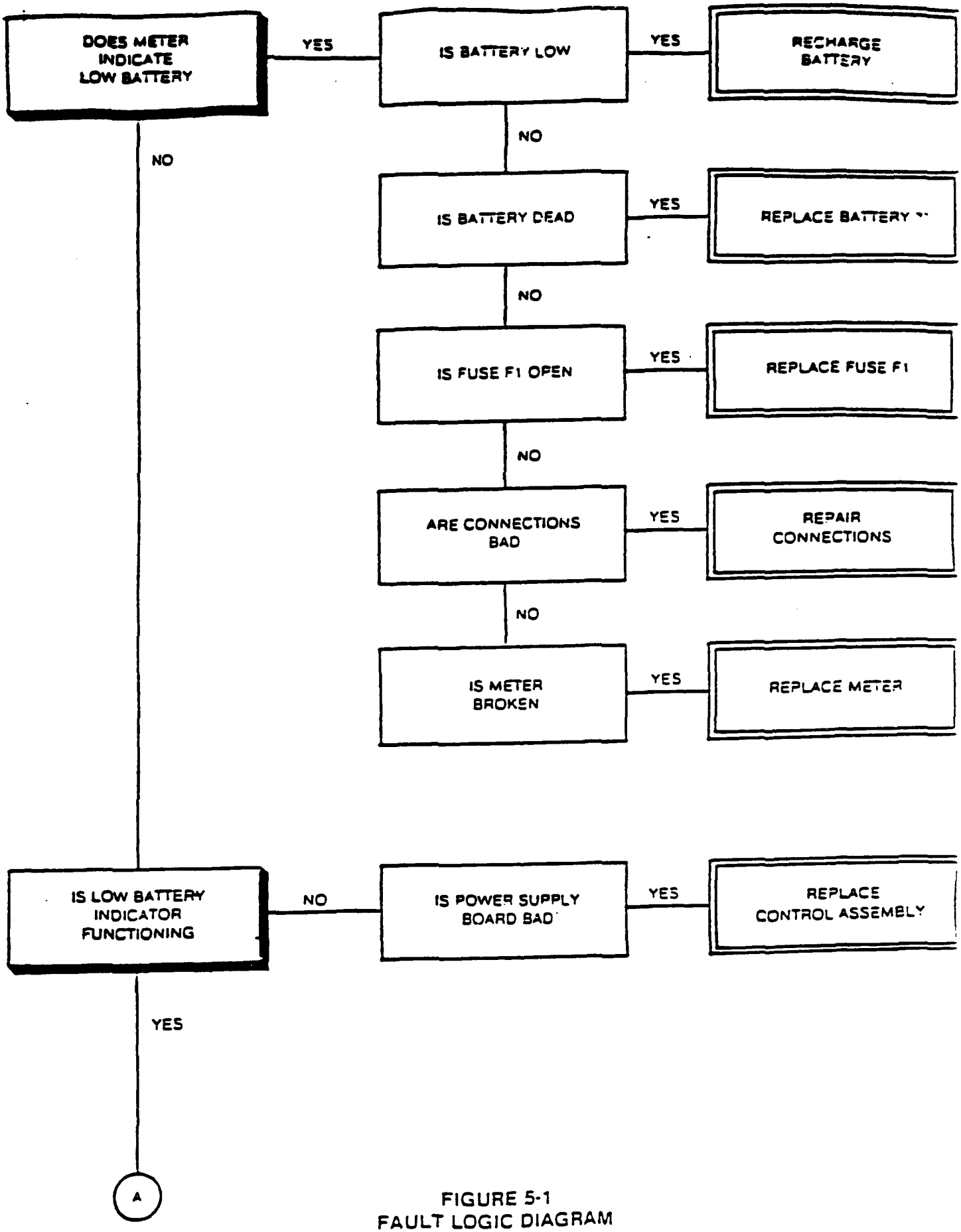
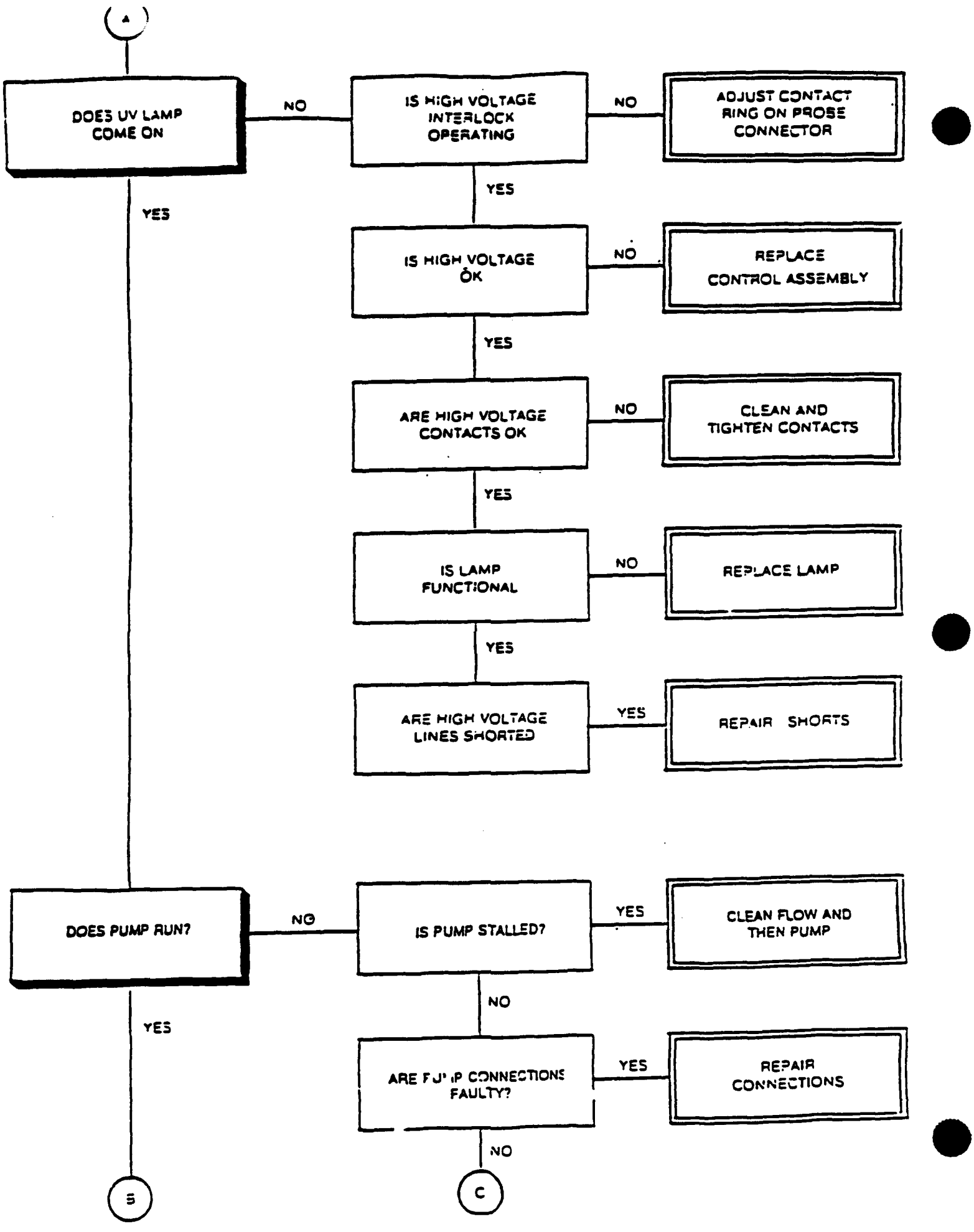
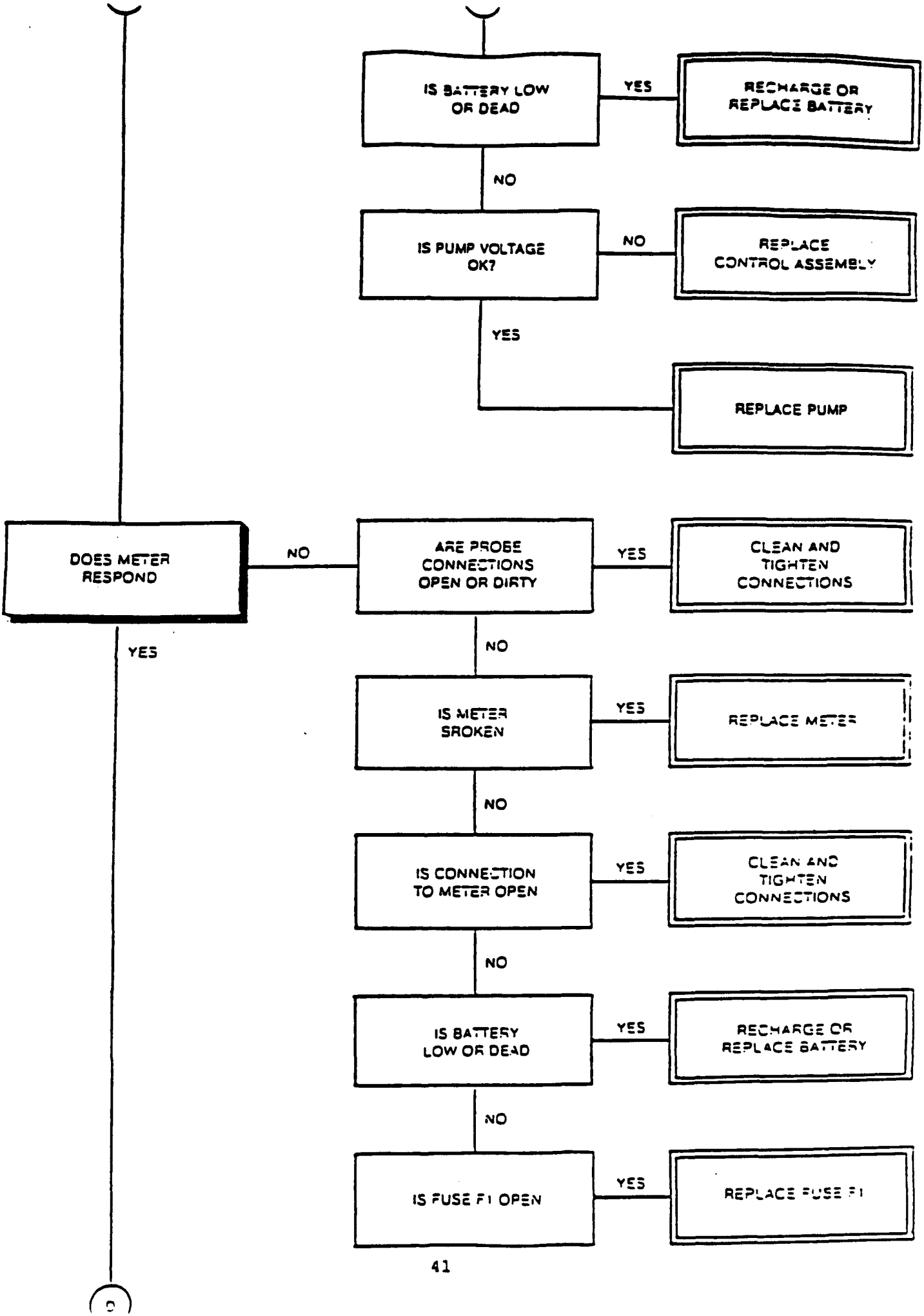
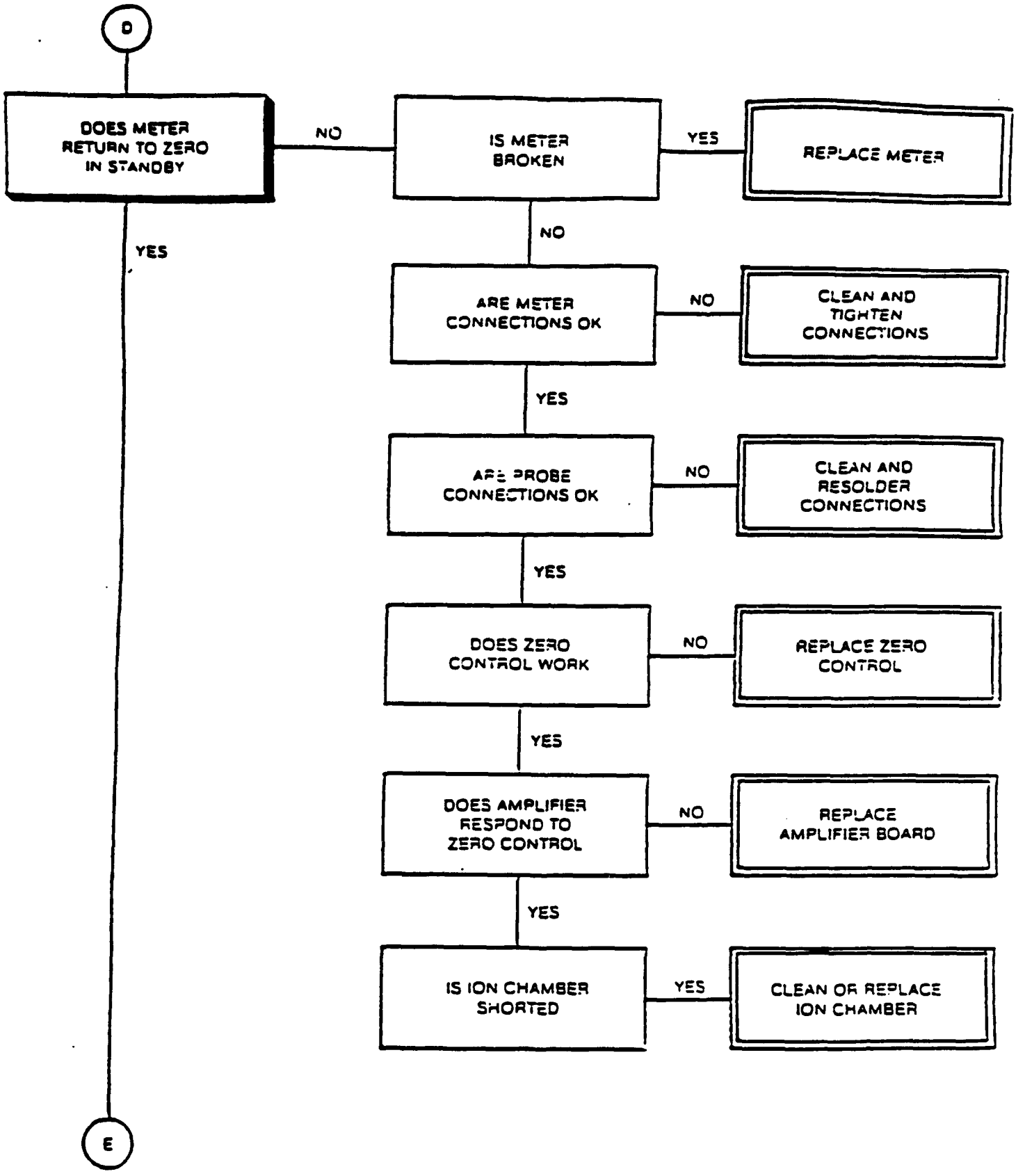
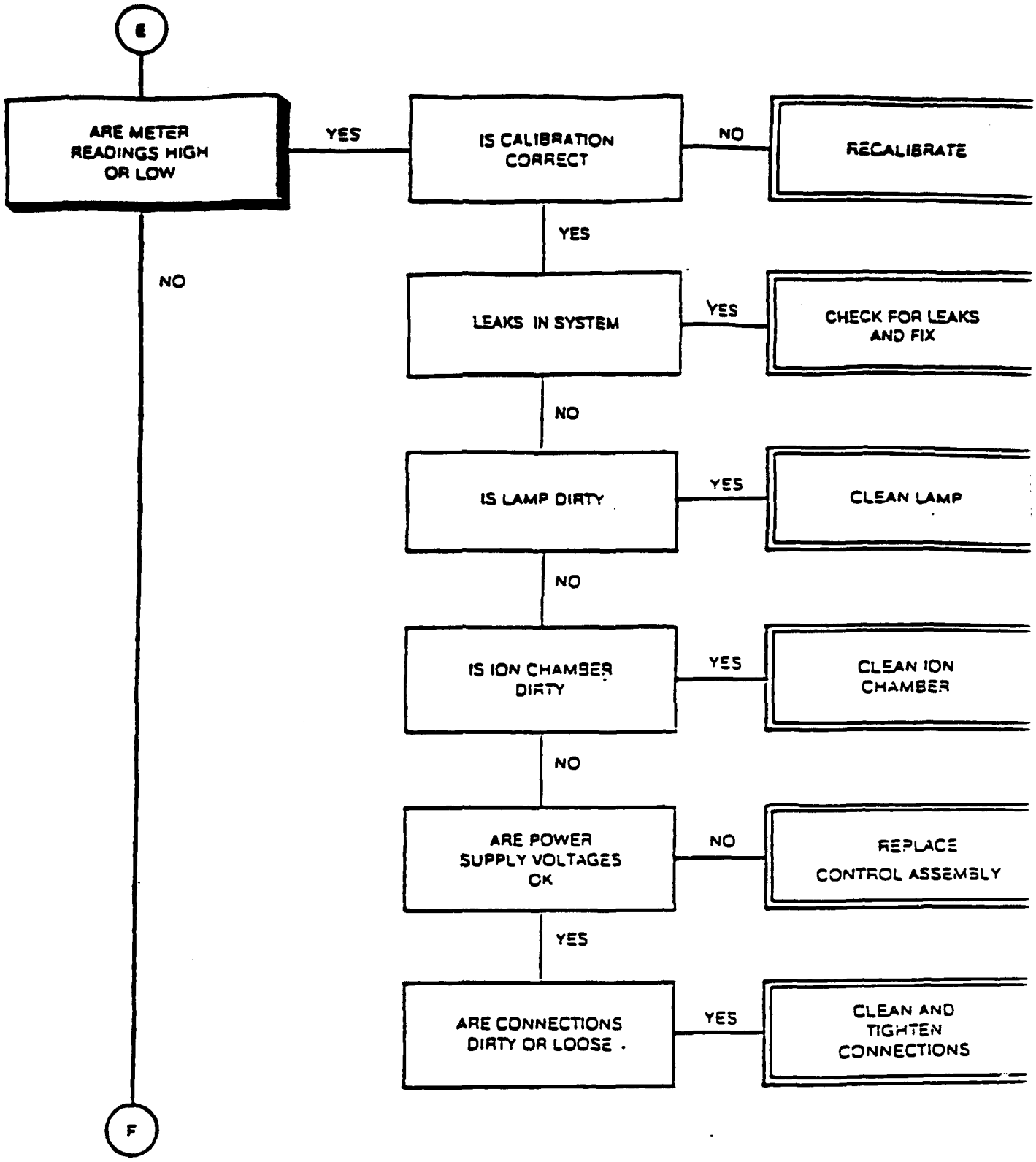


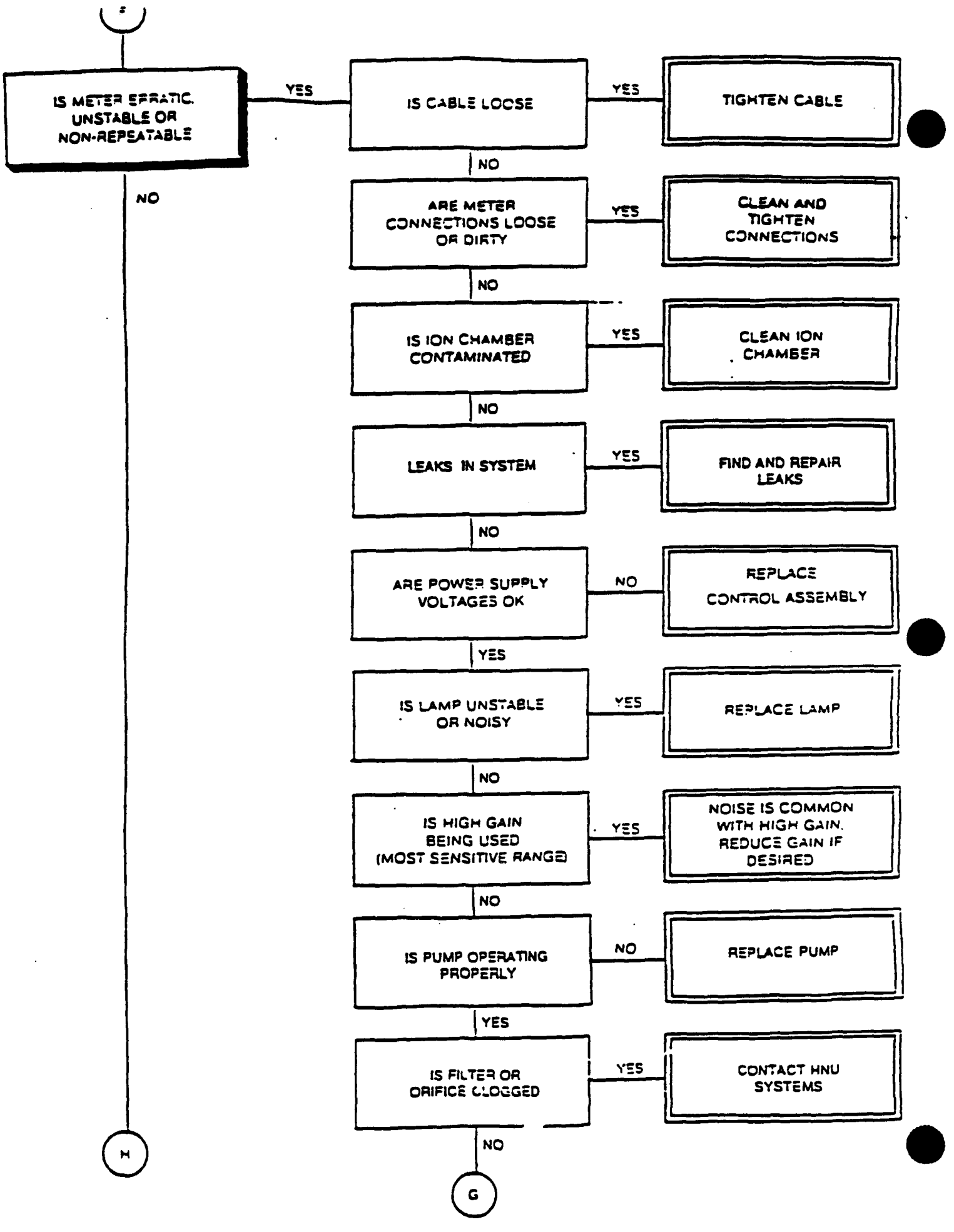
FIGURE 5-1
FAULT LOGIC DIAGRAM

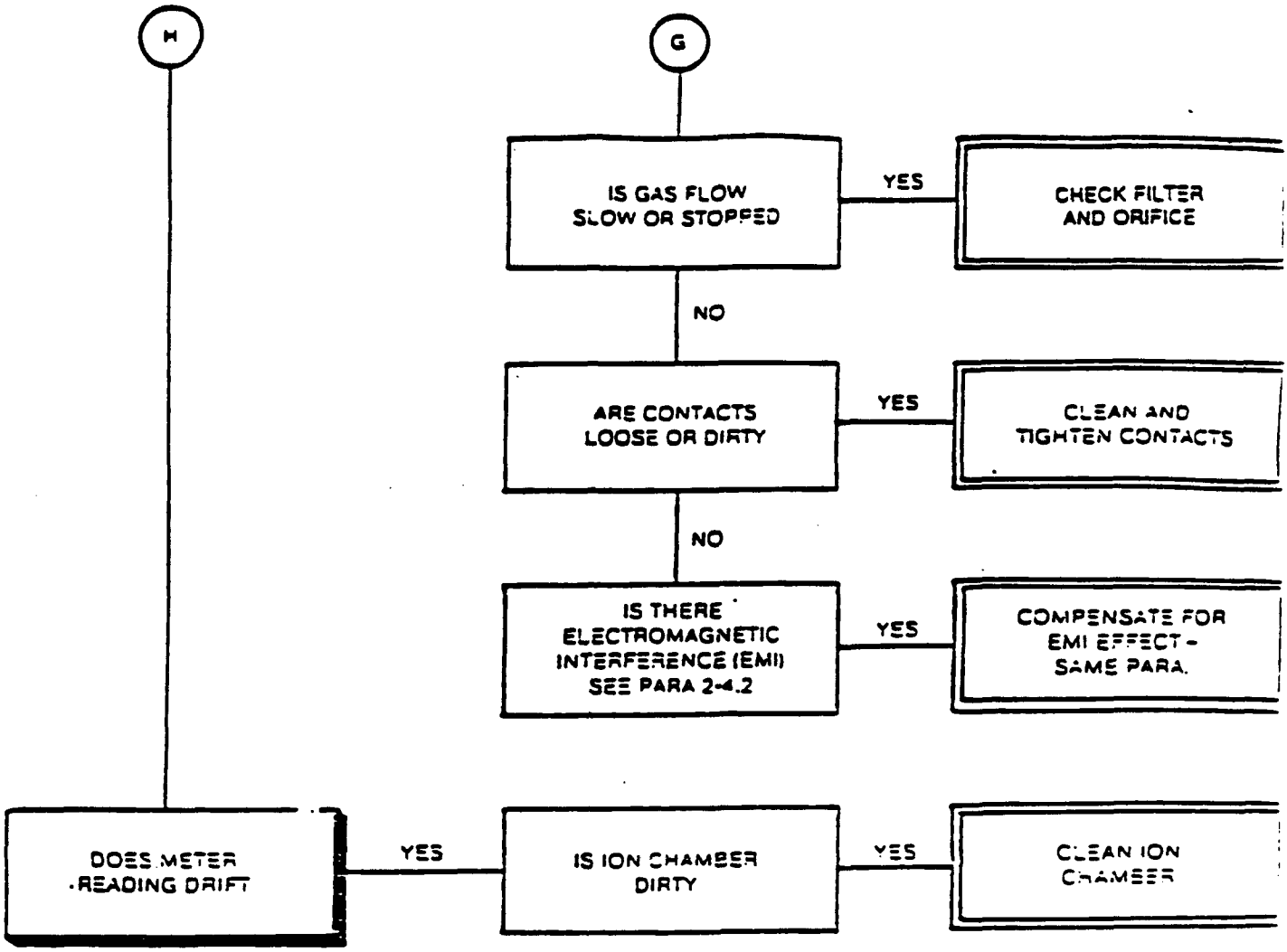

A
DOES UV LAMP COME ON
NO
IS HIGH VOLTAGE INTERLOCK OPERATING
NO
ADJUST CONTACT RING ON PROBE CONNECTOR
YES
YES
IS HIGH VOLTAGE OK
NO
REPLACE CONTROL ASSEMBLY
YES
ARE HIGH VOLTAGE CONTACTS OK
NO
CLEAN AND TIGHTEN CONTACTS
YES
IS LAMP FUNCTIONAL
NO
REPLACE LAMP
YES
ARE HIGH VOLTAGE LINES SHORTED
YES
REPAIR SHORTS
DOES PUMP RUN?
NO
IS PUMP STALLED?
YES
CLEAN FLOW AND THEN PUMP
YES
NO
ARE PUMP CONNECTIONS FAULTY?
YES
REPAIR CONNECTIONS
NO
B
C


IS BATTERY LOW OR DEAD
YES
RECHARGE OR REPLACE BATTERY
NO
IS PUMP VOLTAGE OK?
NO
REPLACE CONTROL ASSEMBLY
YES
REPLACE PUMP
DOES METER RESPOND
NO
ARE PROBE CONNECTIONS OPEN OR DIRTY
YES
CLEAN AND TIGHTEN CONNECTIONS
YES
NO
IS METER SROKEN
YES
REPLACE METER
NO
IS CONNECTION TO METER OPEN
YES
CLEAN AND TIGHTEN CONNECTIONS
NO
IS BATTERY LOW OR DEAD
YES
RECHARGE OR REPLACE BATTERY
NO
IS FUSE F1 OPEN
YES
REPLACE FUSE F1


D
DOES METER RETURN TO ZERO IN STANDBY
NO
IS METER BROKEN
YES
REPLACE METER
NO
YES
ARE METER CONNECTIONS OK
NO
CLEAN AND TIGHTEN CONNECTIONS
YES
ARE PROBE CONNECTIONS OK
NO
CLEAN AND RESOLDER CONNECTIONS
YES
DOES ZERO CONTROL WORK
NO
REPLACE ZERO CONTROL
YES
DOES AMPLIFIER RESPOND TO ZERO CONTROL
NO
REPLACE AMPLIFIER BOARD
YES
IS ION CHAMBER SHORTED
YES
CLEAN OR REPLACE ION CHAMBER
E


E
ARE METER READINGS HIGH OR LOW
YES
IS CALIBRATION CORRECT
NO
RECALIBRATE
YES
NO
LEAKS IN SYSTEM
YES
CHECK FOR LEAKS AND FIX
NO
IS LAMP DIRTY
YES
CLEAN LAMP
NO
IS ION CHAMBER DIRTY
YES
CLEAN ION CHAMBER
NO
ARE POWER SUPPLY VOLTAGES OK
NO
REPLACE CONTROL ASSEMBLY
YES
ARE CONNECTIONS DIRTY OR LOOSE
YES
CLEAN AND TIGHTEN CONNECTIONS
F


IS METER ERRATIC. UNSTABLE OR NON-REPEATABLE
YES
IS CABLE LOOSE
YES
TIGHTEN CABLE
NO
NO
ARE METER CONNECTIONS LOOSE OR DIRTY
YES
CLEAN AND TIGHTEN CONNECTIONS
NO
IS ION CHAMBER CONTAMINATED
YES
CLEAN ION CHAMBER
NO
LEAKS IN SYSTEM
YES
FIND AND REPAIR LEAKS
NO
ARE POWER SUPPLY VOLTAGES OK
NO
REPLACE CONTROL ASSEMBLY
YES
IS LAMP UNSTABLE OR NOISY
YES
REPLACE LAMP
NO
IS HIGH GAIN BEING USED (MOST SENSITIVE RANGE)
YES
NOISE IS COMMON WITH HIGH GAIN. REDUCE GAIN IF DESIRED
NO
IS PUMP OPERATING PROPERLY
NO
REPLACE PUMP
YES
IS FILTER OR ORIFICE CLOGGED
YES
CONTACT HNU SYSTEMS
NO
H
G



Note: For further details, see Table 5-1.

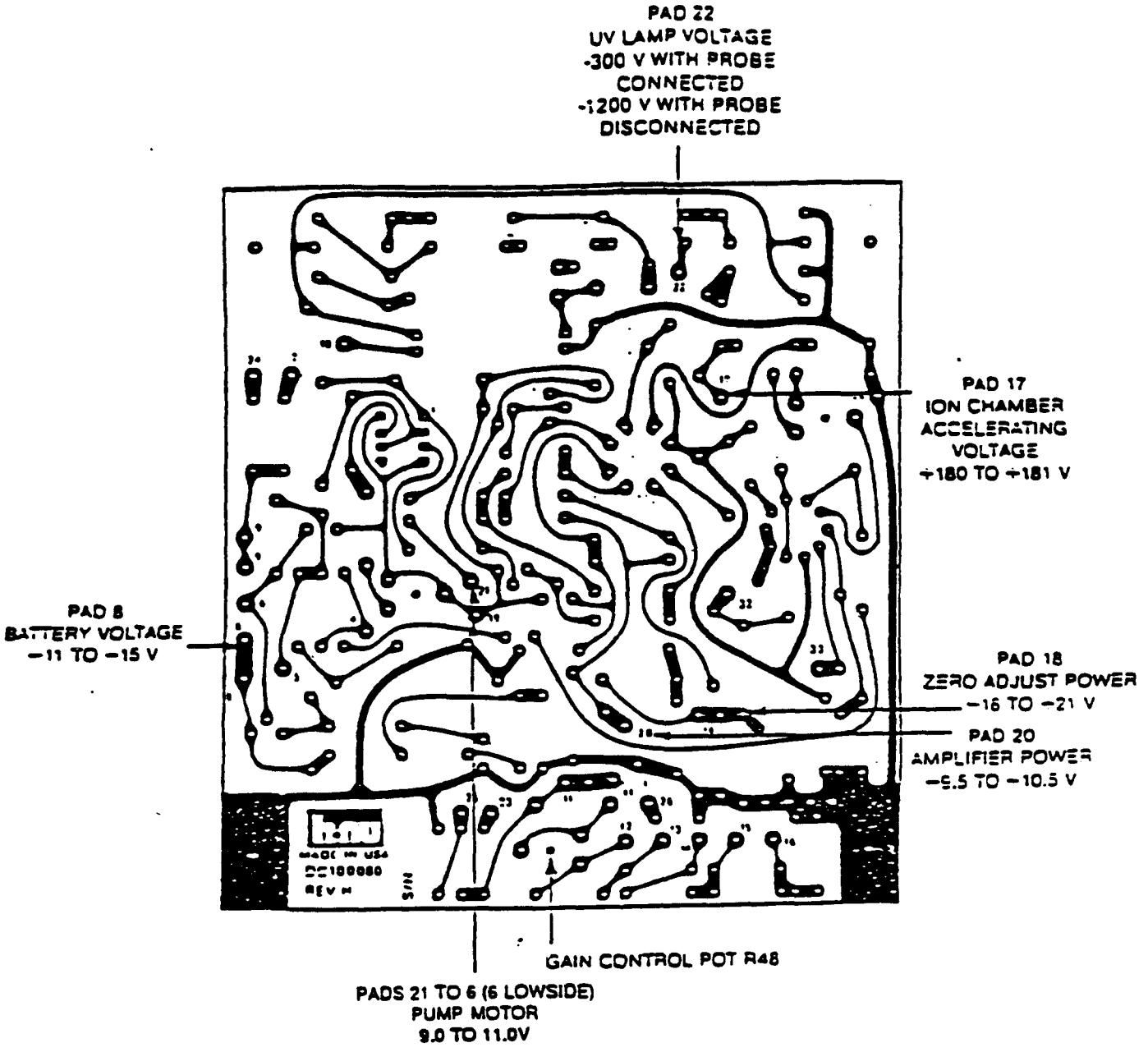


FIGURE 5-2
TEST POINTS
POWER SUPPLY PCB

CHAPTER 6

CORRECTIVE MAINTENANCE

6-1 INTRODUCTION

The scope and function of corrective maintenance of the analyzer consists of the disassembly, replacement of component parts and subassemblies and the reassembly. All adjustments and calibrations are described in chapters 2 through 5.

6-2 EQUIPMENT DISASSMBLY/REASSEMBLY

Disassembly and reassembly of the analyzer for maintenance and part replacement can be accomplished as follows.

6-2.1 PROBE ASSEMBLY

WARNING

Turn the function switch on the control panel to the OFF position before disassembly. Otherwise high voltage of -1200 VDC, will be present.

Disconnect the probe cable connector at the readout assembly.

Hold the lamp housing with the black end cap upright. Loosen the screws on the top of the end cap, separate the end cap and ion chamber from the lamp and lamp housing.

CAUTION

Care must be taken so that the ion chamber does not fall out of the end cap or the light source does not fall out of the lamp housing.

Be sure to retain all "O" rings and gaskets to ensure leak tight reassembly.

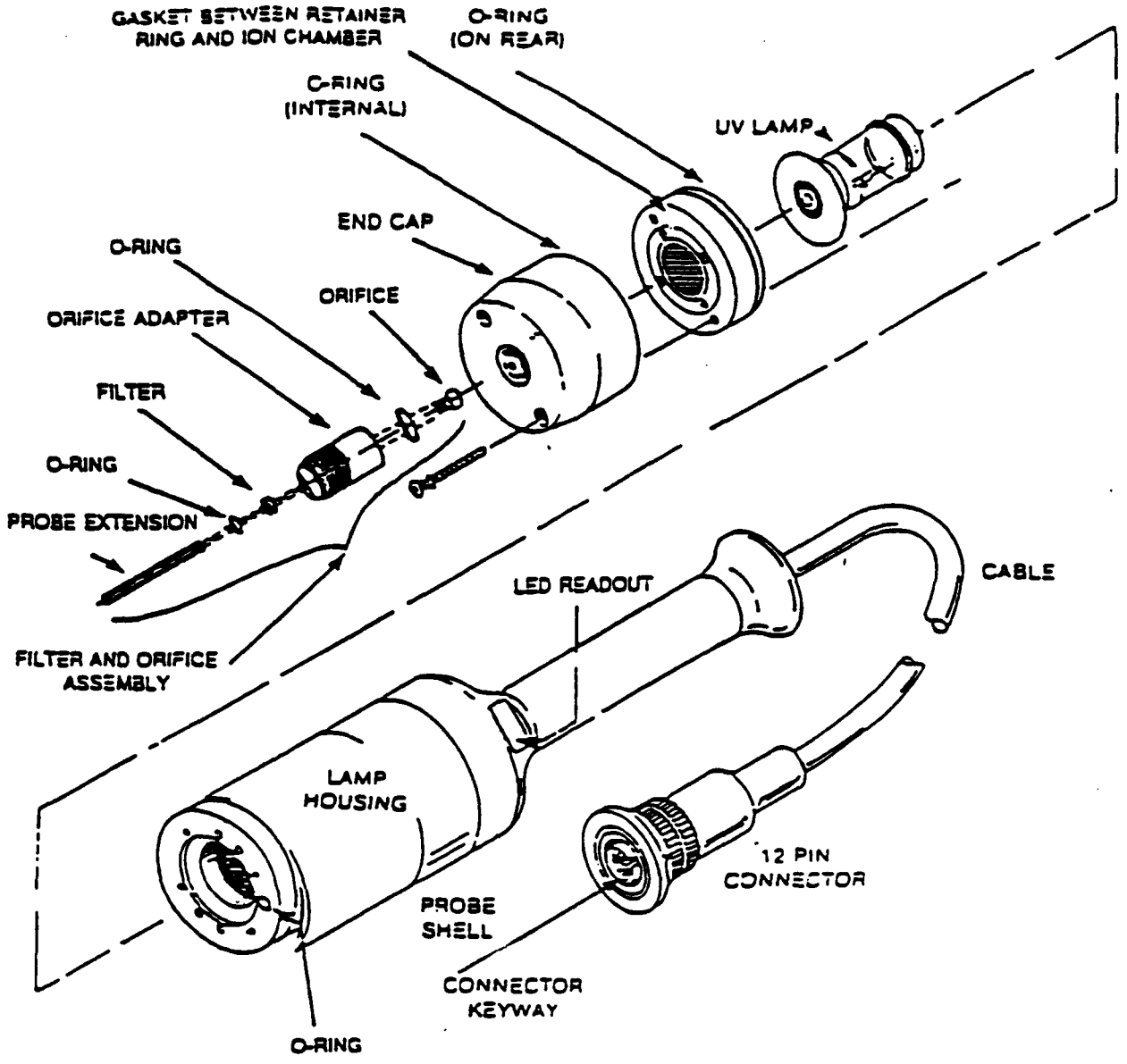


FIGURE 6-1
PROBE ASSEMBLY

Turn the end cap over in the hand. Tap lightly on the top. The ion chamber should fall out of the end cap.

Place one hand over the top of the lamp housing and tilt slightly. The lamp will slide out of the housing.

Clean or replace the lamp as required (see Section 4-3 for lamp cleaning).

Remove any dust or particles that may be deposited in the sample passages by gently blowing, or by lightly brushing with a camels hair brush. Extreme care is required to prevent damage to the pump.

Inspect the surfaces adjacent to the O-rings for evidence of leakage. Replace any O-rings where such evidence appears. A special tool is required to remove the lamp housing from the probe. Contact HNU Systems.

The amplifier board can be removed from the lamp source housing subassembly, (see Fig. 6-2) by unsnapping the coaxial connector, J1, and then removing the retaining screw. The amplifier board will then slide out of the housing assembly.

Reassemble the probe by first sliding the lamp back into the lamp housing. Place the ion chamber on top of the lamp housing, making sure that the contacts are properly aligned, and "O" rings are seated correctly. The ion chamber fits only one way.

Place the end cap on top of the ion chamber and replace the two screws. Tighten the screws enough to seal the O-ring. Check to be sure the assembly is leak tight by blocking the sample inlet and checking for no-flow at the exhaust.

CAUTION

Check ion chamber alignment. It only fits one way.

Align the 12 pin probe connector to the readout assembly and reconnect with a twisting motion until a click occurs. Check to ensure the high voltage microswitch is properly depressed.

Perform zero adjustment (Section 2-3, steps f thru h) and calibrate (Section 4-4) after probe repair, lamp replacement, or probe replacement.

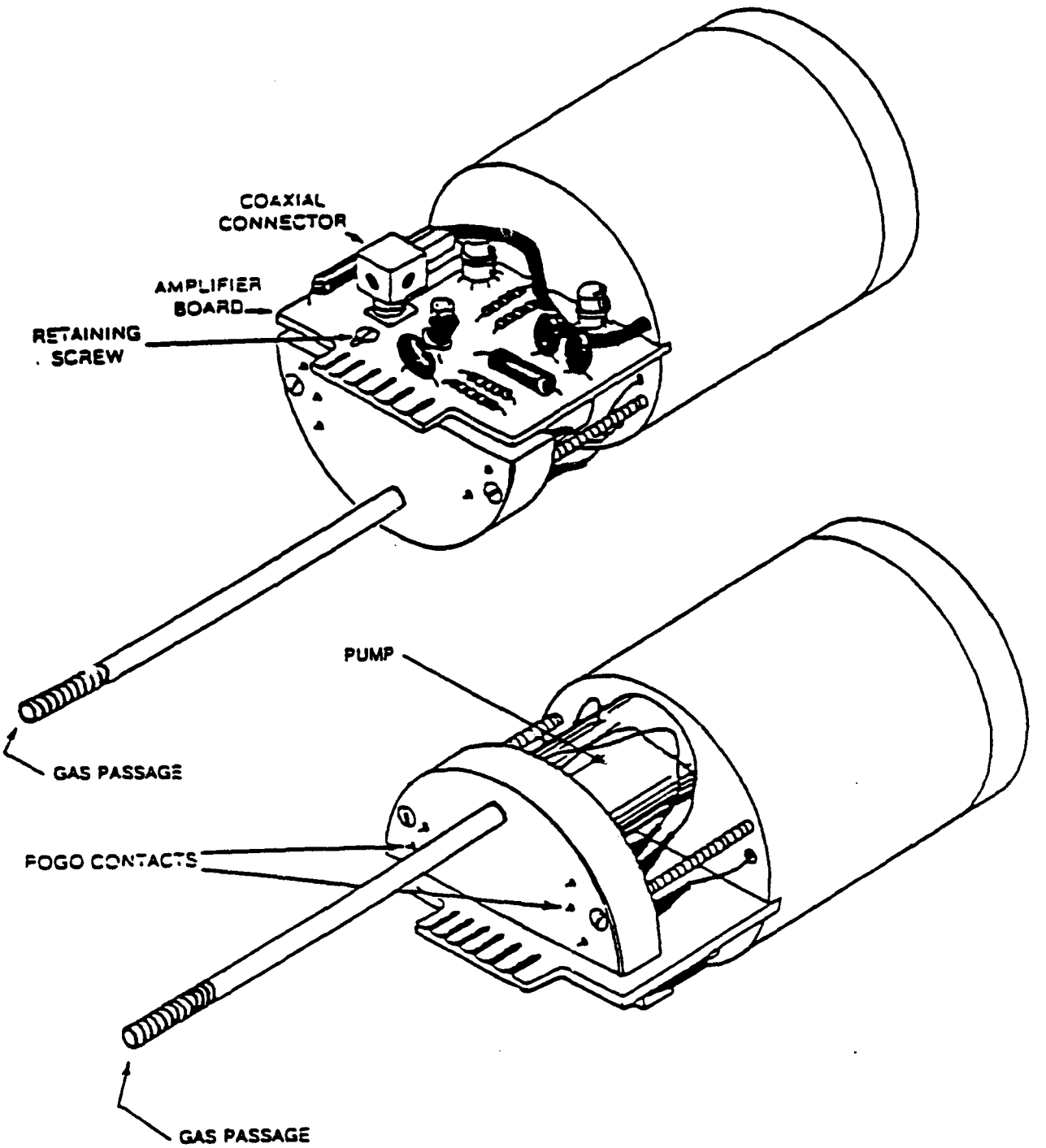


FIGURE 6-2
LIGHT SOURCE
SUBASSEMBLY

6-2.2 READOUT ASSEMBLY

WARNING

Turn the function switch on the control panel to the OFF position before disassembly. Otherwise, high voltage of -1200 VDC will be present.

Disconnect the probe cable connection. Loosen the screw on the bottom of the case and, holding the instrument by the bezel, remove the case. (See Fig. 6-3). Remove and replace the subassemlies as follows:

a. Control assembly - The control assembly is bonded to the bezel and is not removable.

b. Meter - The meter may be removed and replaced by the following steps. (Maintain sealing gasket in original location)

1) Disconnect the leads from the meter.

2) Remove 2 screws from clamps holding meter in place.

3) Loosen 2 nuts on clamps.

4) Move clamps inward to clear opening.

5) Move bezel with meter forward out of assembly.

6) Transfer the clamps to the new meter.

7) Reverse steps 1) thru 6) to install new meter.

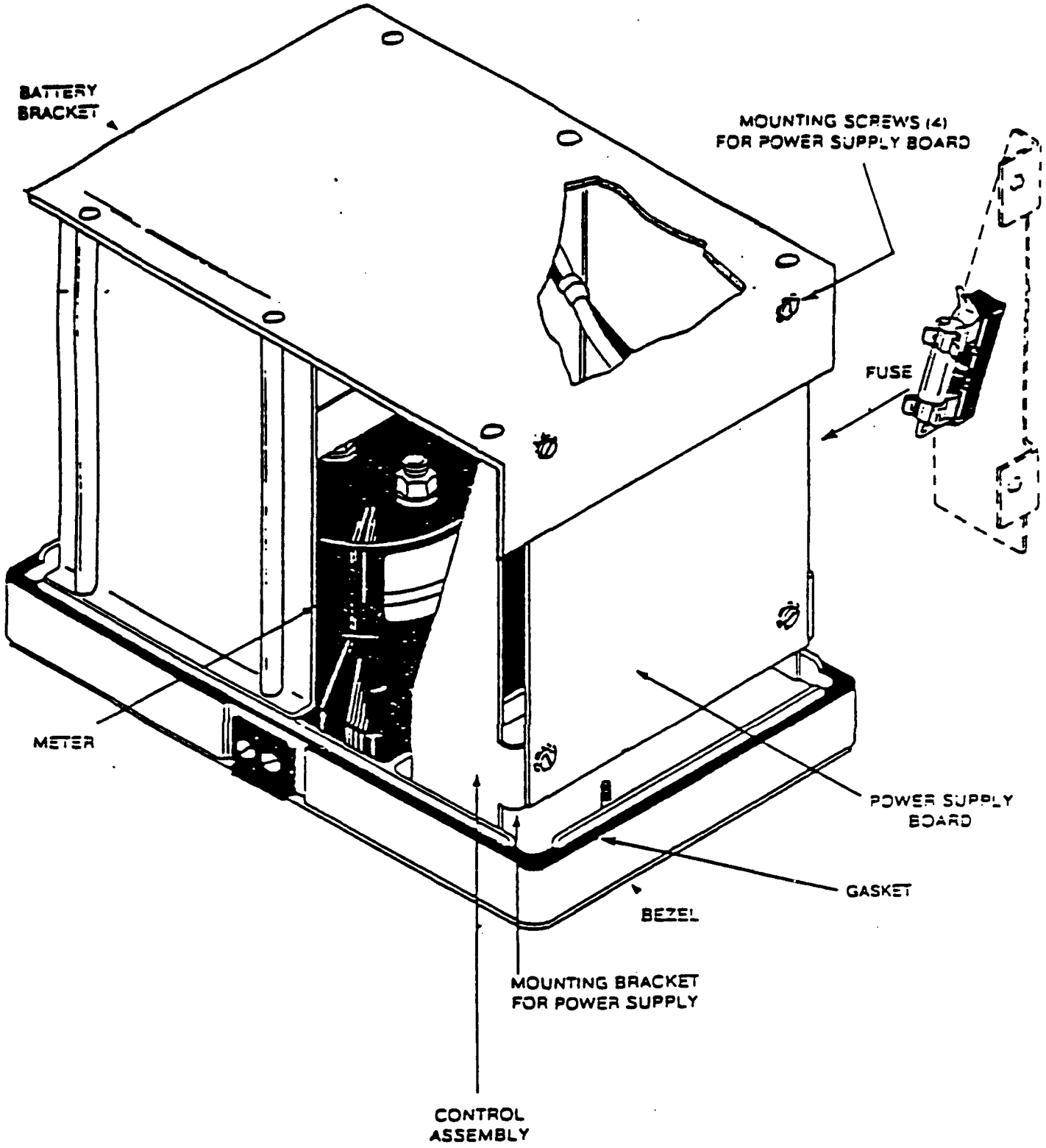


FIGURE 6-3
READOUT ASSEMBLY

c. Battery - The battery may be removed and replaced by the following steps:

1) Disconnect the molex connector to the battery.

2) Remove 4 screws on battery bracket holding battery in place.

3) Remove battery from the bracket on the end away from the control assembly.

4) Install new battery by reversing steps 1) thu 3) above.

5) On the power suply board, turn R53 (see Figure 5-2) a 20 turn 10k potentiometer, fully counter clockwise.

6) Charge the battery until fully charged (approx. 2 hrs).

7) Operate the analyzer on one of the three ppm range settings for 4 1/2 hours.

8) Adjust R53 (see Figure 5-2) in a clockwise direction until the low battery LED indicator just comes on.

9) Recharge the battery. The analyzer will now operate for 10 hours before the low battery indicator comes on.

GROUP ASSEMBLY PARTS LIST

Figure & Index No.	Part Number	Description 1 2 3 4 5 6 7	Units per Assy
1	AC103981	Probe assembly: provides gas detection	1
2	AD103960	Shell and cable assy: consists of shell, base, handle, knob cable and connector	1
3	DA100049-1	Exhaust screw	1
4	AC103980	Lamp Housing: provides housing p ifie PCB	1
		light source (lamp)	1
6	AB100008-A1	Pump Assy	1
7	AB102256-A1	Amplifier PCB	1
8	AD103983	Ion chamber assy	1
9	DB100053-1	End cap	1
10		Screw: end cap assy, 6-32 x 1 1/4 pin head, with internal tooth standard washer #6, both stainless steel	2
11	DB104124	Probe extension: 8" length	1
12	568-020	O-Ring: Ion chamber seal, 1" O.D., 70 Duro ARP, (90512)	1
13	568-012	O-Ring: Extension seal, 7/16" ID 70 Duro ARP, (90512)	1
14	568-005	O-Ring: seal, 7/32" OD, 70 Duro, ARP, (90512)	1
15	568-002	O-Ring: seal, 13/16" OD, 70 Duro, ARP, (90512)	1

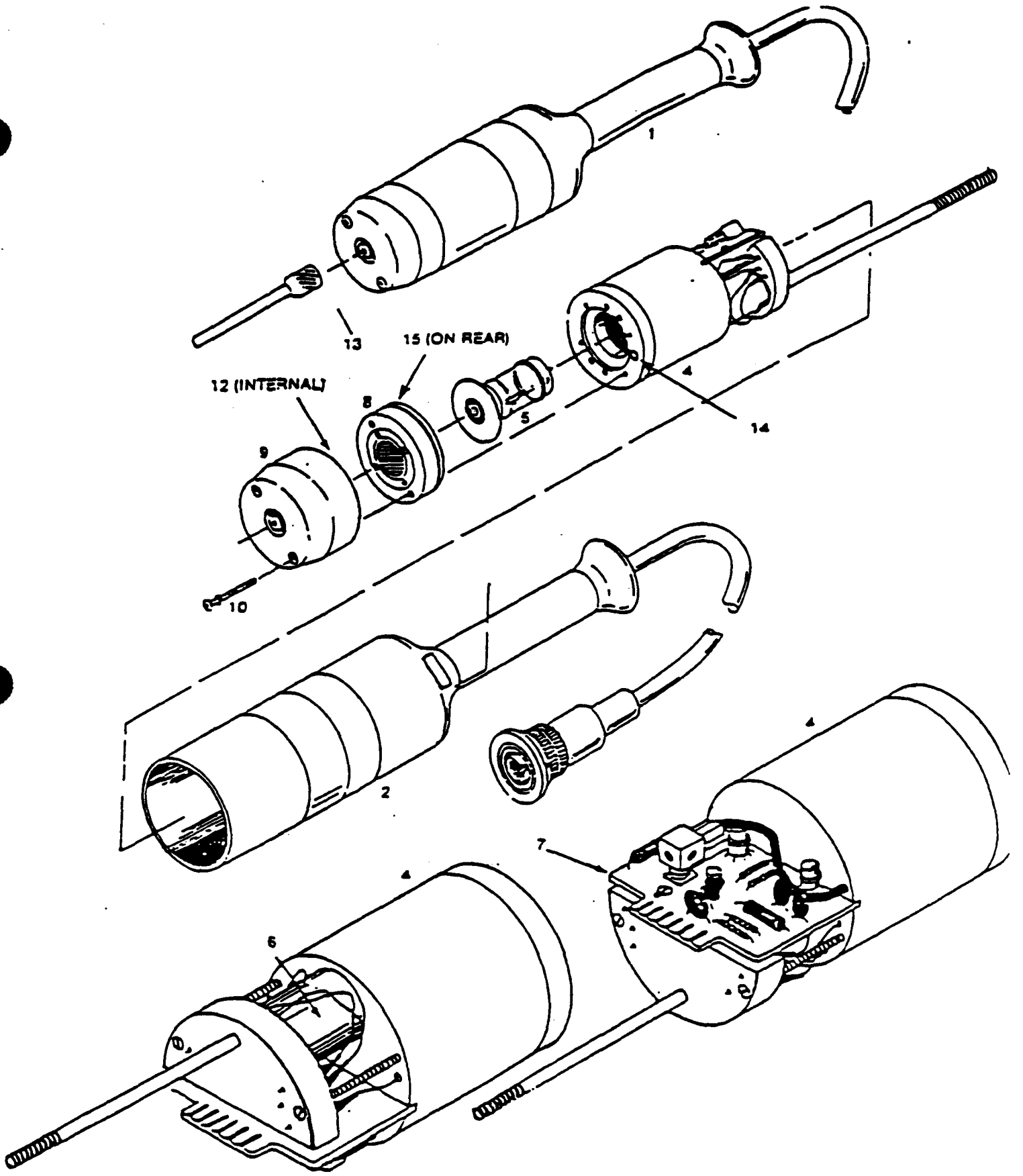


FIGURE 7-1

PARTS LOCATION, PROBE

GROUP ASSEMBLY PARTS LIST

Figure & Index	Part Number	Description 1 2 3 4 5 6 7	Units Per Assy
7-2	AC103959	Readout assy: provides control and indications	1
	AC103961	Meter & Bezel Assy	
1	DC#00012-1	Meter: 4 1/2" (11.3 cm.), Taut band movement, graduated 0-5-10-15-20 division	1
2	AB100086-A1	Switch: Function switch, rotary 6 position, (Ref Des: S1)	1
3	DA101816-1	Potentiometer: span control, 10 turn 100K, Spectrol #534 (02111) (Ref Des: R51)	1
4	DA100029-1	Potentiometer: zero adjust turn, 10K, CTS #VA45R103A (23223) (Ref Des: R50)	1
5	AC103963	Control assy: consists of bracket power supply PCB, cable fuse and power jack	1
6		Fuse: 2A, Bussman #AGC-2 (71400) or Fusetron #MDL-2 (07689) (Ref Des: F1)	1
7	AA100011-A1	Battery: 12 V dc, 2.5 ampere-hours (Ref Des B1)	1
7-3 1	DB100017-1	Strap, neck: supports readout assy from neck of operator when in use	1
2	DB100018-1	Strap, waist: secures readout assy to waist of operator when in use	1
3	AC102269-A1	Charger, battery: 15.0 V dc, 120 Vac, 1ph input,	1
4	DD102240	Case, cover	1
5	DB100050-1	Case, readout assy	1
	AC103953	Display Driver Board Assy	
	AB103905	Low Bat Board Assy	

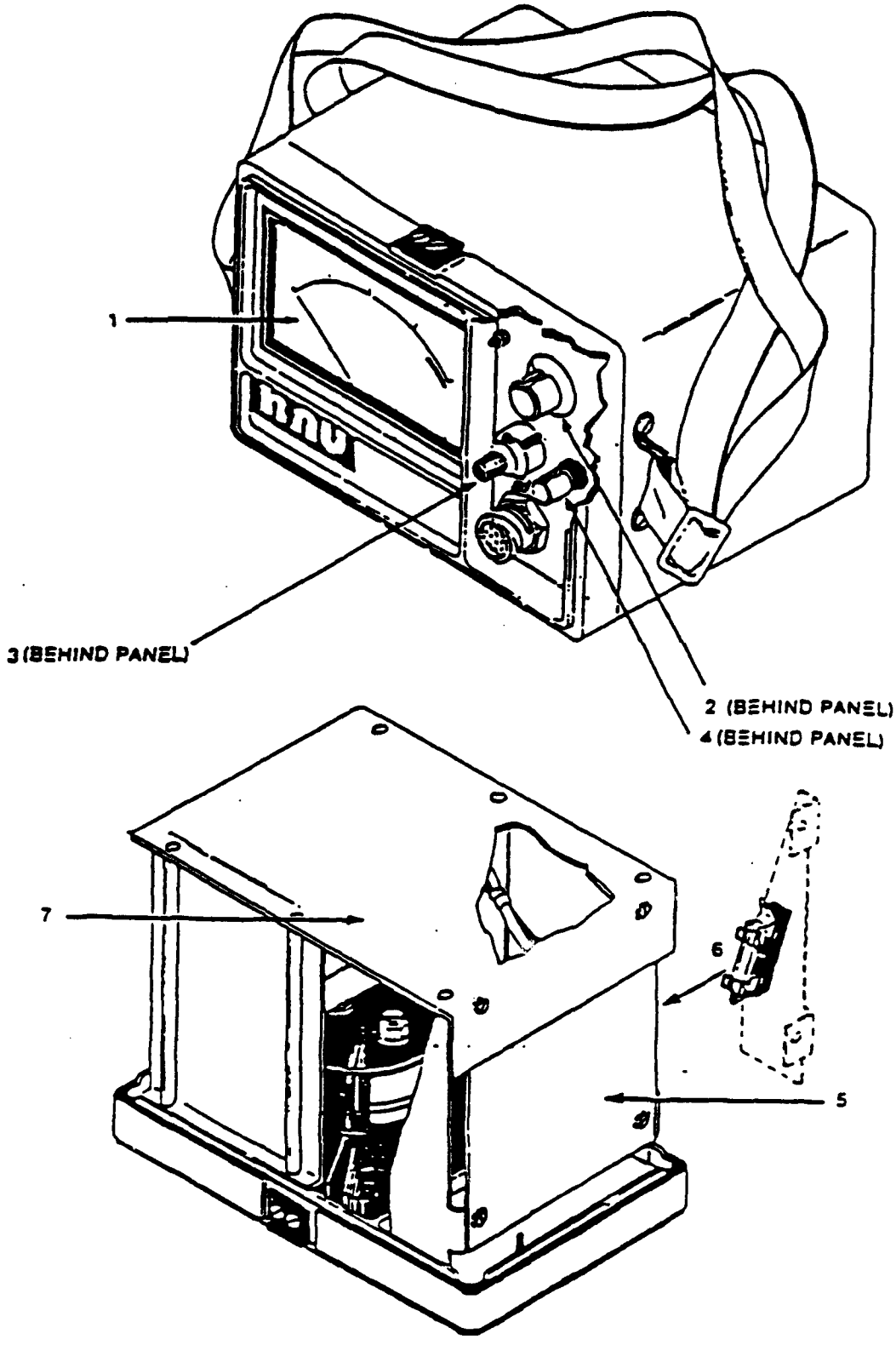


FIGURE 7-2
PARTS LOCATION, READOUT ASSEMBLY

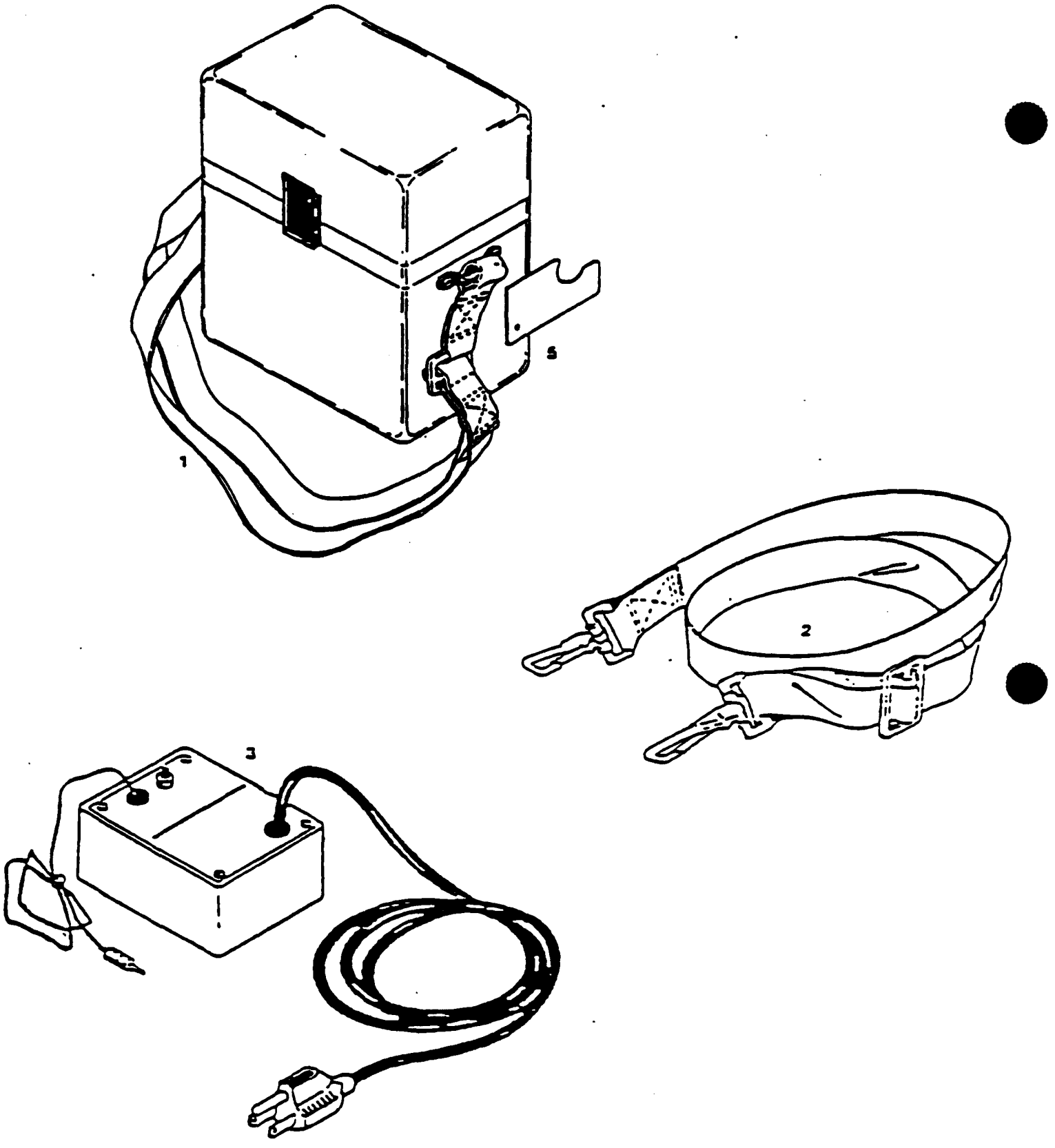


FIGURE 7-3
PARTS LOCATION, OUTER ASSEMBLY

REFERENCE DESIGNATION INDEX

Reference Designation	Part Number
B1	AA100011-A1
F1	AGC-2 or MDL-2
RS0	DA100029-1, VA45R103A
RS1	DA101816-1, 534
S1	AB100086-A1

AVAILABLE SPARE PARTS KITS

PA100010-A1	O-Ring Kit: Contains two each of 568-020, 568-012, 568-005 and 568-002
PA-102743-A1	Five Piece Spare Parts Kit: Contains one each of PA100009-A1 UV light source, AA100011-A1 Battery, AB102256-A1 Amplifier PCB, AC102260-A1 Control Assembly and PA100010-A1 O-Ring Kit.
PA-102744-A1	Three Piece Spare Parts Kit: Contains one each of PA100009-A1 UC light source, AA100011-A1 Battery and PA100010-A1 O-Ring Kit.

Instruction Manual

Model MAC-51B
Magnetic and Cable Locator

Manufactured By
Schonstedt Instrument Company
1775 Wiehle Avenue
Reston, Virginia 22090

Phone (703) 471-1050
TWX 710-833-9880
FAX (703) 471-1795

Printed July 1991

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (cont.)

Section I
General

Introduction

The MAC-51B Magnetic and Cable Locator is a light-weight, dual-mode instrument designed for detecting buried iron and steel objects and tracing underground cables and pipes. The system consists of two major units: a transmitter and a dual-function receiver. Both units use alkaline C-cell batteries that provide up to 100 hours of operation.

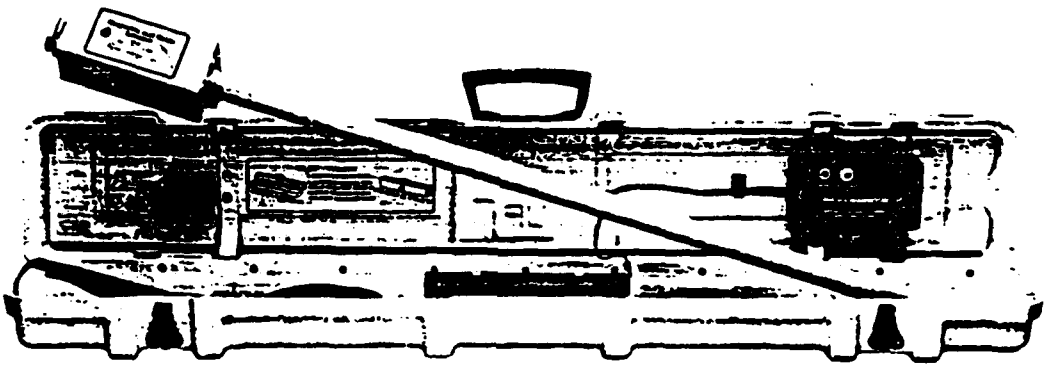


Figure 1-1. MAC-51B Magnetic and Cable Locator

Cable Locator Mode

When used in the cable locator mode, the transmitter generates a distinctive ac signal which is applied to the cable or pipe. The receiver is used to detect and trace the signal as it travels along the cable/pipe. A siren-like tone from the receiver is easily identified as the tracing signal. The approximate depth of an underground cable can be determined using the 45° null-point triangulation method. Operation of the MAC-51B in the cable locator mode is explained in Sections IV and V.

Magnetic Locator Mode

The receiver is the only unit required for operation in the magnetic mode. Set the receiver M/C function switch to "M", adjust the sensitivity control, and you have the best magnetic locator available. Operation of the magnetic locator mode is explained in Sections II and III.

Switching from cable locator mode to magnetic locator mode while tracing a cable is a unique method for unscrambling ground clutter. Gas and water pipes in the immediate vicinity of a cable can emit parasitic signals that distort the identification null. In the magnetic mode cast-iron water pipes and gas lines can be identified quickly and even classified as to type by the conventional spacing of joints, which provide the strongest signals.

Standard Accessories

Basic accessories supplied with the MAC-51B include a headphone jack, a spare batteries holder and a conductive cable assembly with ground stake. An inductive signal clamp, mini transmitter and headphones are available as options.

Optional Inductive Signal Clamp

This option increases the versatility of the MAC-51B by providing a convenient method of selectively applying the trace signal to cables or conductors covered with nonmetallic insulation.

It applies a strong trace signal to only the conductor that it is clamped around. This positive identification allows a specific cable to be traced even when located in congested areas containing cables, water and gas lines or other conductors that may emit lower level parasitic trace signals.

Operation is simple and easy. Plug the clamp lead into the transmitter accessory jack and close the clamp around the cable. No ground connection is required. Hook-up can be made to all standard metallic cable types up to three inches in diameter.

Optional Mini Transmitter

The Model MT-1 is a miniature solid-state transmitter (3 in. × 1 in.) used in combination with a MAC-51B receiver to trace nonmetallic pipes, pinpoint obstructions, and locate concrete septic tanks.

As the MT-1 (Mole) is pushed through a buried nonmetallic pipe, it emits a signal that can be detected at depths up to 18 feet by using the MAC-51B receiver.

The Mole has a concave surface so it can be taped to a plumber's snake, and a ¼-inch tapped hole for end mounting.

One AAA penlight alkaline battery provides up to 30 hours of operation. The battery cap also serves as the On/Off switch. Power is turned off by rotating the battery cap counterclockwise until the battery moves when the MT-1 is shaken.

MAC-51B SPECIFICATIONS

TRANSMITTER

Operating Voltage	12 Volts (eight alkaline C-Cell batteries)
Battery Life	75 hours intermittent operation at 70°F
Output Frequency	32.5 kHz modulated at 382 Hz, pulsed at 4.8 Hz (inductive or conductive)
Audio Indicator	2.58 kHz pulsed at 4.8 Hz
Weight	Approximately 5.5 lb. (2.5 kg.)
Operating Temperature	– 13°F to 140°F (– 25°C to 60°C)
Overall Size	43.5 in. × 7 in. × 5 in. (110.5 cm. × 17.8 cm. × 12.7 cm.)

RECEIVER

Operating Voltage	6 Volts (4 alkaline C-Cell batteries)
Battery Life	100 hours intermittent operation at 70°F
Output Frequency	Approximately 40 Hz idling tone from speaker. Frequency of pulsing tone increases (or decreases) with signal intensity.
Weight	Approximately 3 lb. (1.36 kg.)
Operating Temperature	– 13°F to 140°F (– 25°C to 60°C)
Overall Length	42.3 in. (107.4 cm.)
Waterproof Length	34.5 in. (87.6 cm.)
Nominal Sensor Spacing	20 in. (50.8 cm.)

(Specifications subject to change without notice)

Section II
Magnetic Locator Operation

Theory of Operation

In the magnetic locator mode, the MAC-51B receiver responds when the magnetic field strength at the two sensors, which are 20 inches apart, is different. This response consists of a change in the idling frequency of the signal emitted from the speaker.

Figure 2-1 illustrates an application of the locator in which it is used to detect an iron marker of the type used for property line identification. The magnetic field of the marker is stronger at sensor A than it is at sensor B. As a result, the frequency of the signal on the speaker is higher than the 40 Hz idling frequency which exists when the field strength is the same at both sensors.

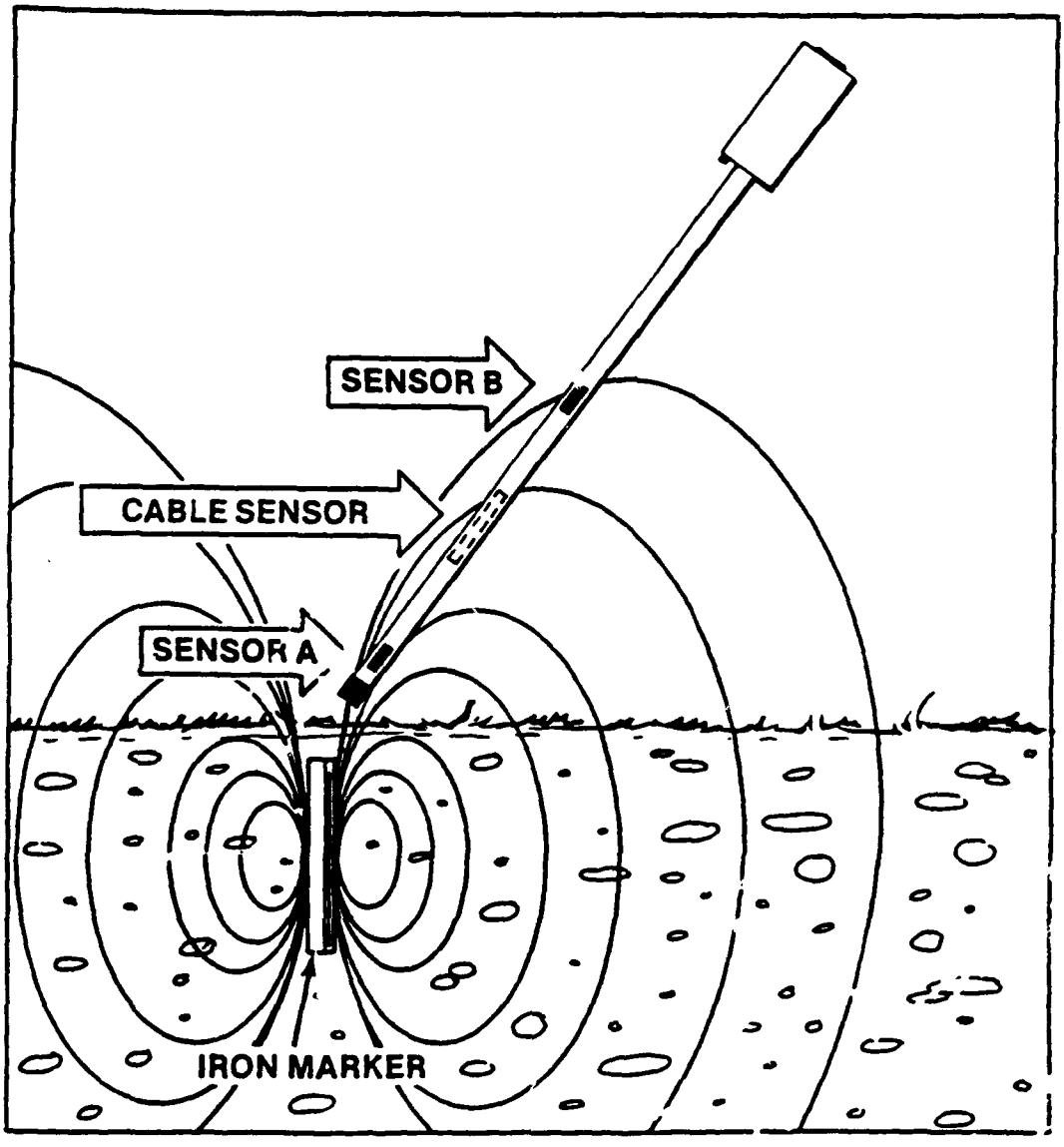


Figure 2-1. Detecting Magnetic Field of an Iron Marker

Function Selection, Turn-On and Initial Sensitivity Setting

Set the M/C Function switch to M and adjust the ON/OFF-Sensitivity control for mid-position as shown in Figure 2-2. With the knob in this position, the sensitivity is set for what is referred to as the Normal Range.

In most areas the locator can be oriented in any direction without producing a significant change in the frequency of the tone from its idling rate. However, in some areas where magnetic disturbances are encountered from nearby structures, rocks, sand or trash, the control should be adjusted for lower sensitivity as illustrated in Figure 2-3.

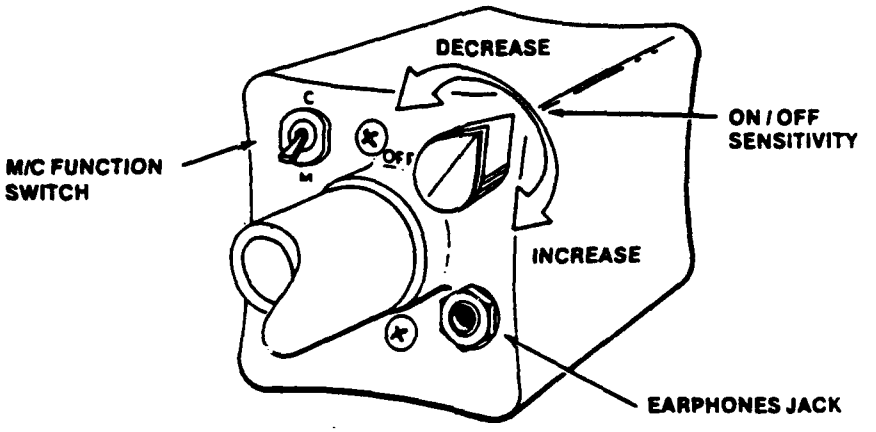


Figure 2-2. Sensitivity Set for Normal Range

Low Sensitivity Operation

Unwanted background signals due to nearby magnetic objects may require that the effective range of the locator be reduced. This is accomplished by turning the sensitivity knob in a counter-clockwise direction. Reduced range is useful for pinpointing the location of a strongly magnetized marker.

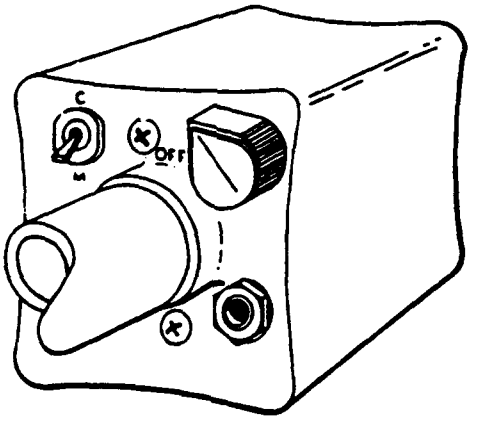


Figure 2-3. Sensitivity Set for Low Range

High Sensitivity Operation

The sensitivity of the locator is increased by turning the sensitivity knob in a clockwise direction. A high sensitivity setting imposes some constraints on operating methods. The locator tone will vary in frequency depending on the instrument's orientation relative to the Earth's magnetic field.

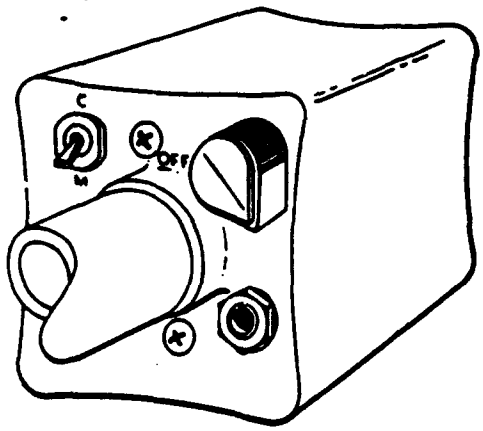


Figure 2-4. Sensitivity Set for High Range

Search Procedure

Set the sensitivity control for normal operation and hold the locator just below the large end as illustrated in Figure 2-5. Because the upper sensor is located near the area where the locator is usually held, wrist watches may produce unwanted changes in the signal frequency. Therefore, a watch worn on the the wrist of the hand holding the locator should be removed. Avoid bringing the locator close to your shoes, since they might contain magnetic material.

To obtain maximum area coverage, the locator should be swept from side-to-side with the small end of the instrument kept close to the ground. A higher frequency tone from the speaker will be heard when the locator is within range of an iron or steel object.

When using a high sensitivity setting, avoid turning the locator about its long axis. This may produce tonal variations in the output signal because of sensor misalignment.

The presence of a ferromagnetic object will be indicated by a change in the tone of the output frequency.

Figure 2-5. Searching with the Locator

Section III
Magnetic Locator Application Notes

Basic Signal Patterns

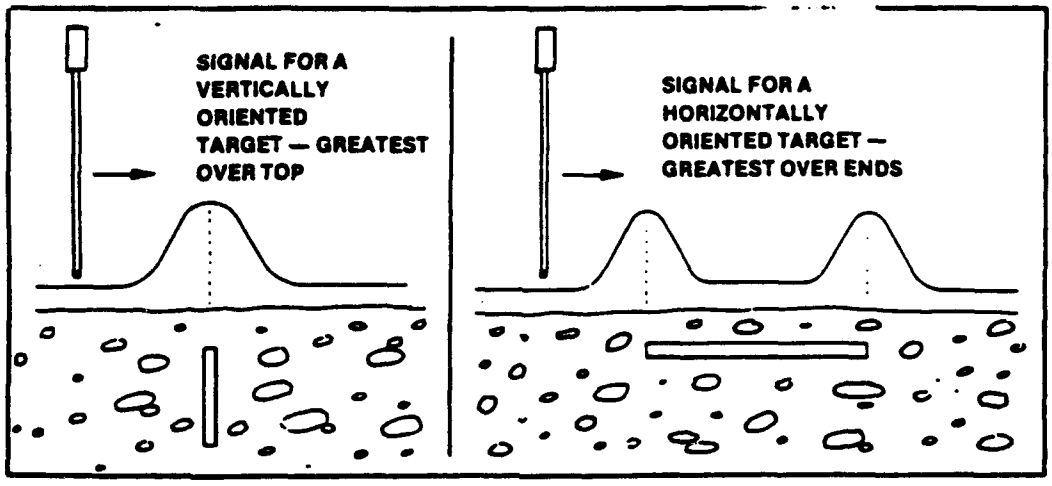


Figure 3-1. Signals from Vertical and Horizontal Targets

After you have detected the presence of a target, hold the locator vertically and move it back and forth in an "X" pattern. The peak signal occurs directly over a vertical target, and over the ends of a horizontal target.

The "X" pattern is ideal for pinpointing small objects. A 1-1/4-inch PK nail buried up to 8 inches can be located so precisely with this technique that it can be uncovered using a 1/2-inch star drill.

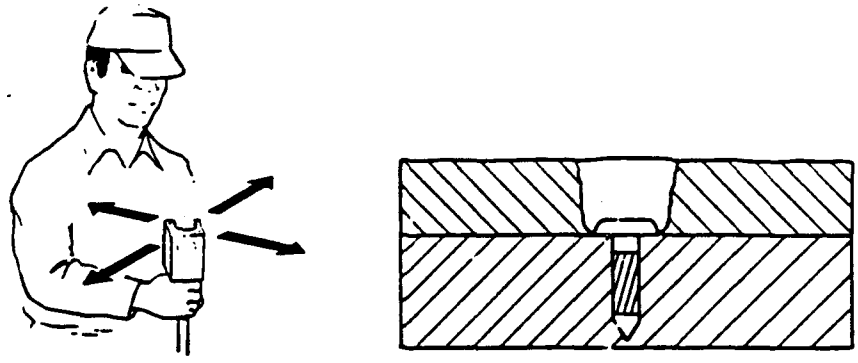


Figure 3-2. "X" Pattern Provides Precision Locating

If you find more than one signal in the vicinity of a target, just raise the locator several inches higher. Any signal that disappears when the locator is raised is probably not coming from the actual target. The signal from a rusty bolt or other small item will decrease much faster with distance than the signal from a larger target such as a corner marker. An 18-inch length of ¾-inch pipe can be located at depths up to 7 feet.

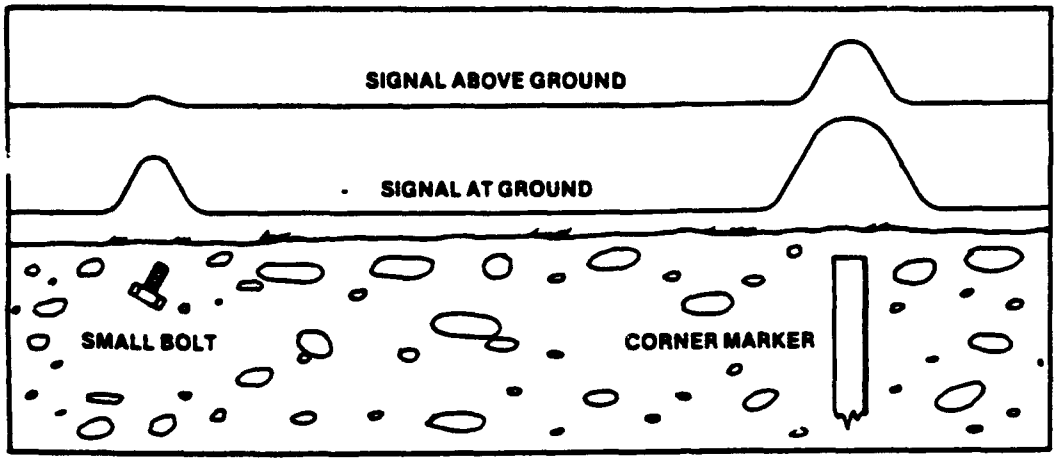


Figure 3-3. Raising the Locator Eliminates Unwanted Signals

Strongly Magnetized Markers

A strongly magnetized marker at or near the surface may provide location information that is misleading.

The heavy line in Figure 3-4 represents the variation in tone frequency when the locator is moved over the marker. When moving the instrument from **A** to **B**, the frequency of the tone increases and then suddenly decreases at **B**. From just beyond **B** the frequency of the tone increases sharply, becomes very high directly over the marker and decreases just before reaching **C**. From **C** to **D** the pattern is the reverse of that from **A** to **B**. It is obvious that the locator must enter the **B-C** region. Otherwise the marker might be assumed to be between **A** and **B** or **C** and **D**.

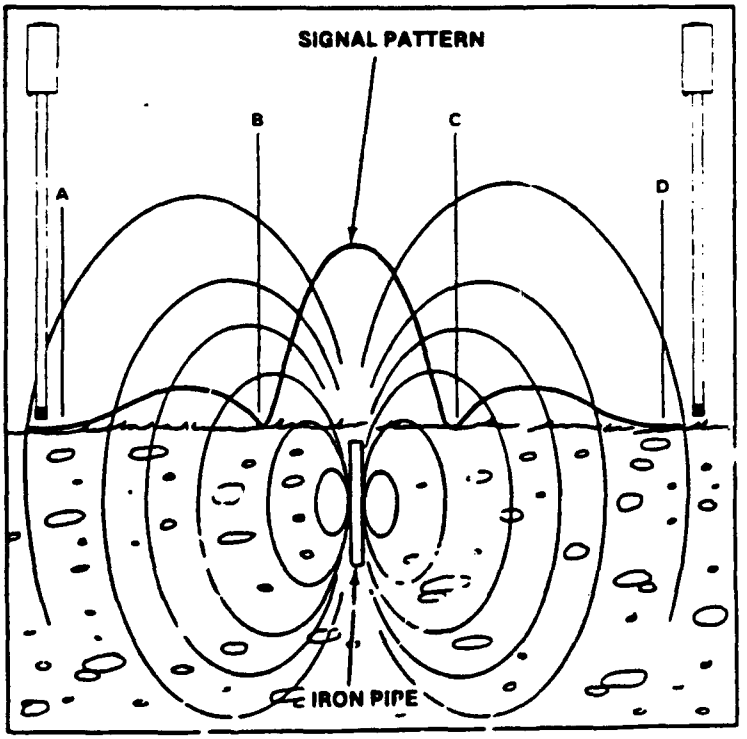


Figure 3-4. Signal Pattern From a Strongly Magnetized Marker

This phenomenon is explained by the fact that the locator is sensitive to the magnetic field components parallel to its long axis. At points B and C the field is perpendicular to the locator so no high frequency is produced at these points.

Locating Manholes, Septic Tanks and Water Wells

The magnetic field is strongest at the edge of a shallow manhole cover. Turn the sensitivity down all the way and you can easily trace the edge of covers near the surface. Locating depth ranges up to 8 feet.

The great length of a well casing provides a strong field at the surface that makes it easy to locate casings buried up to 15 feet deep.

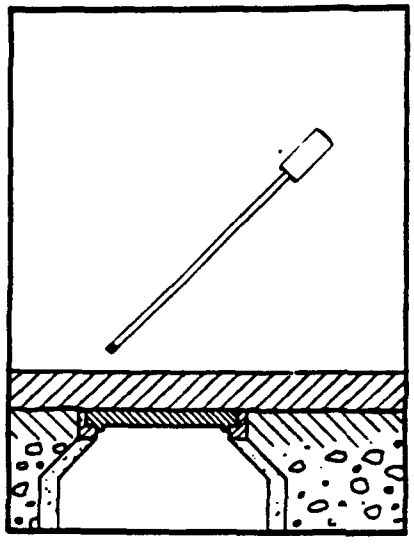


Figure 3-5. Locating Manhole Covers

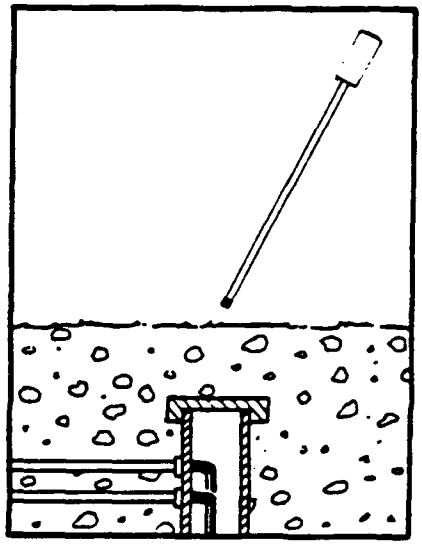


Figure 3-6. Locating Water Well Casings

The MAC-51B receiver can be used to precisely locate the metal handles or reinforcing bars on septic tank covers at depths up to 4 feet.

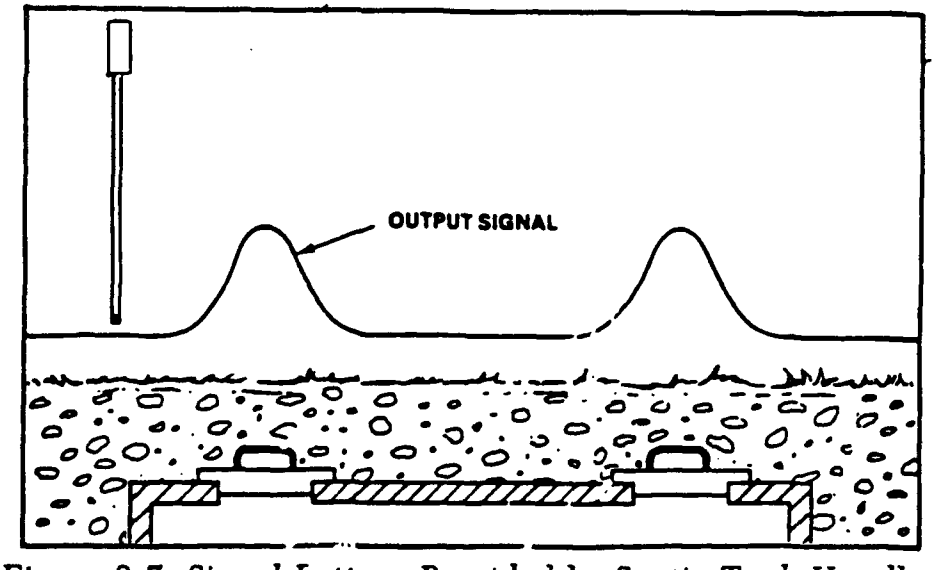


Figure 3-7. Signal Pattern Provided by Septic Tank Handles

Locating Objects under Snow or Water and Tracing Barbed Wire

The locator can be used in flooded areas—just keep the electronic unit out of the water.

Snow poses no problem. Thrust the locator into the snow as deep as necessary to locate the target.

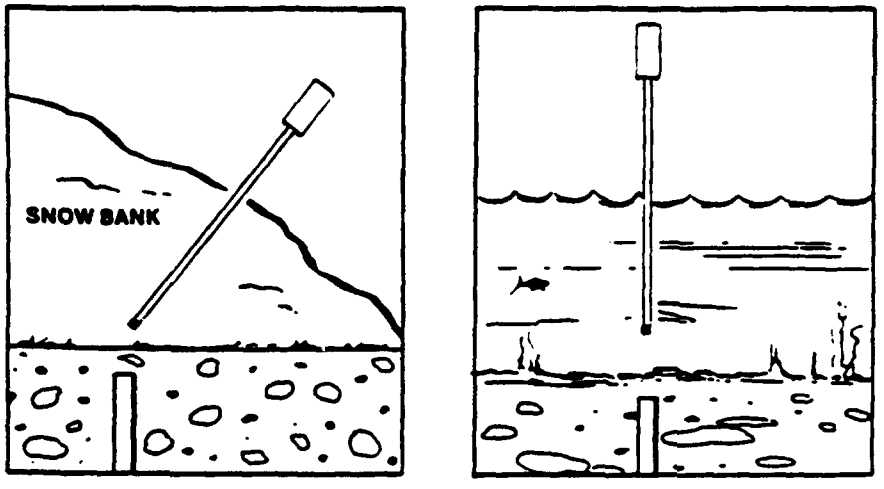


Figure 3-8. Locating Objects under Snow or Water

You can often trace barbed wire (from old fence lines) buried just beneath the surface. Even if the wire is only a trail of rust, it can still be detected near the surface. Tip the locator a little lower than usual—but not parallel with the ground.

First, examine trees for bench marks and bits of embedded barbed wire. Then hold the locator parallel with the direction of the wire.

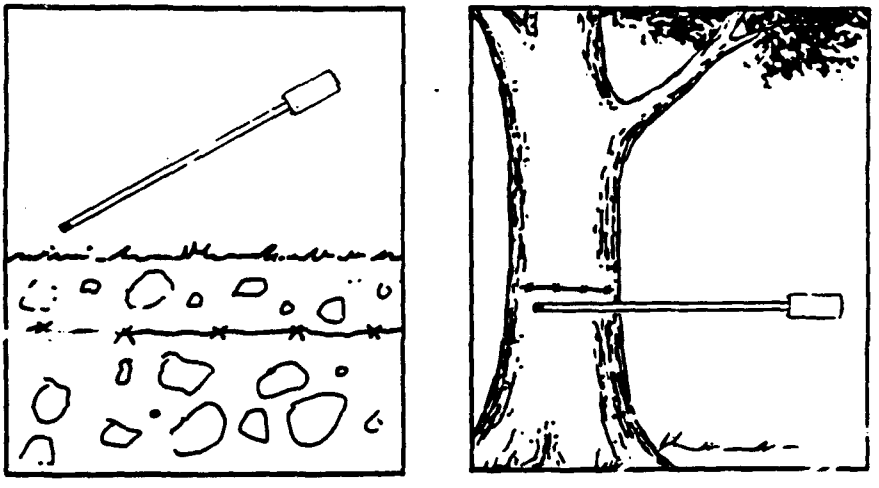


Figure 3-9. Tracing Barbed Wire from Old Fence Lines

Searching Areas Along a Chain Link Fence

Searching in the vicinity of a chain link fence requires a reduced sensitivity setting and also some control over the orientation of the locator. As illustrated in Figure 3-10, position the locator horizontally with its long axis perpendicular to the fence. This ensures that the upper sensor is kept away from the fence.

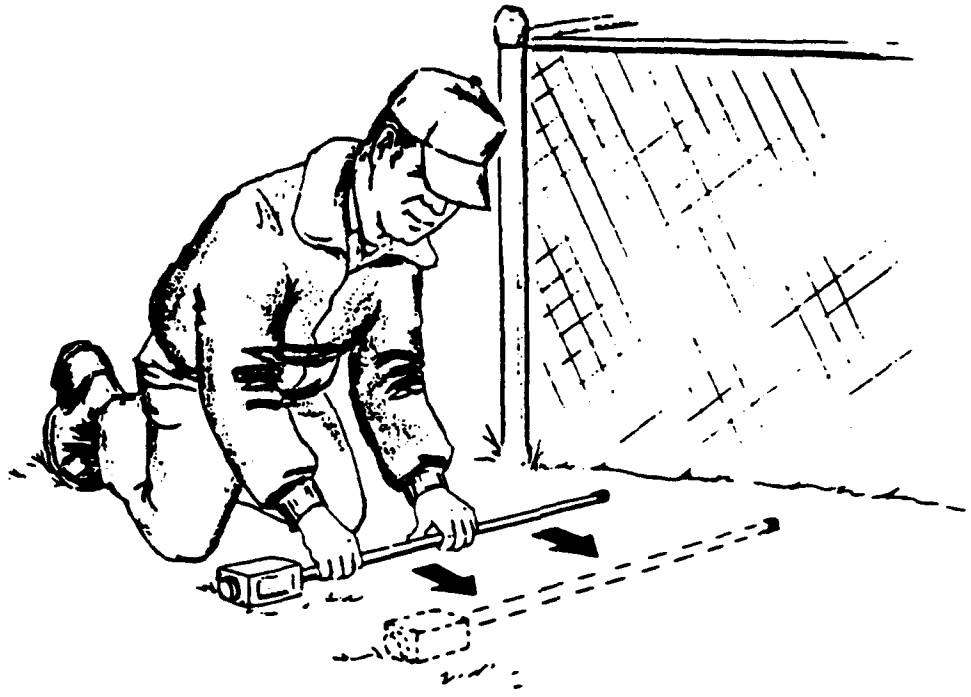


Figure 3-10. Searching in the Vicinity of a Chain Link Fence

Perform the search by moving along the fence, keeping the end a constant distance from the fence. When a point 1-5/8 inches from the end of the locator is directly over the stake, the signal will drop abruptly as shown in Figure 3-11. Any variation in the position of the locator will produce an abrupt rise in the frequency of the tone.

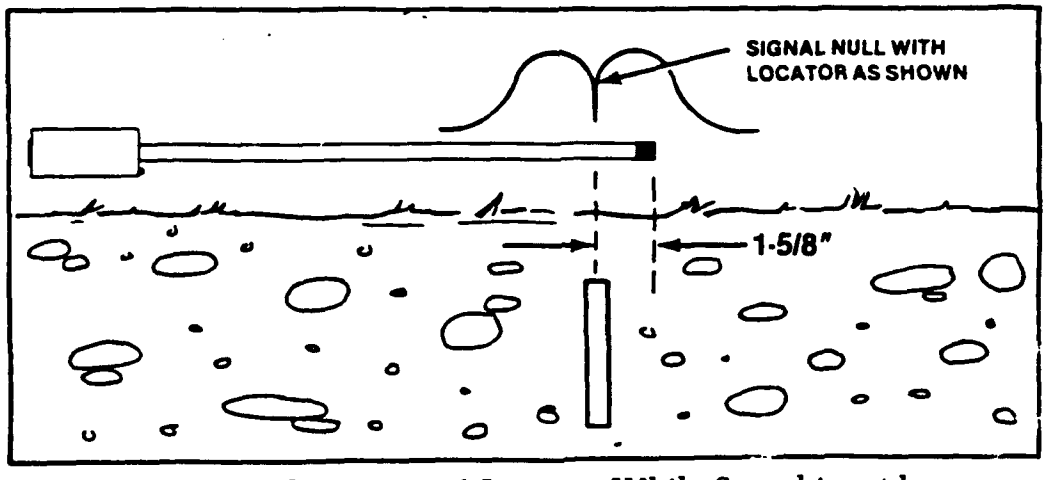


Figure 3-11. Placement of Locator While Searching Along a Chain Link Fence

Locating Valve Boxes

Both the valve and its casing, when iron, provide strong magnetic fields which make them easy to locate. Plastic enclosures containing magnets are easily located at depths of 6 feet or more.

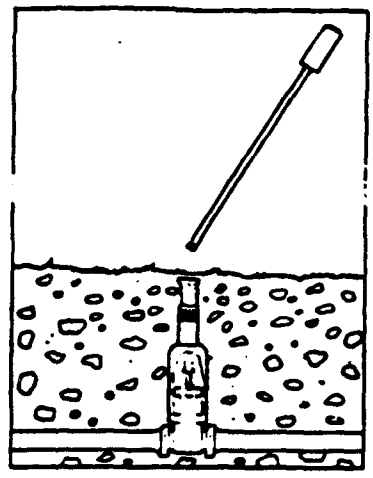


Figure 3-12. Locating Valve Boxes and Casings

Locating Cast-Iron Pipes

As illustrated in Figure 3-13, cast-iron pipes produce the strongest magnetic signals at their joints.

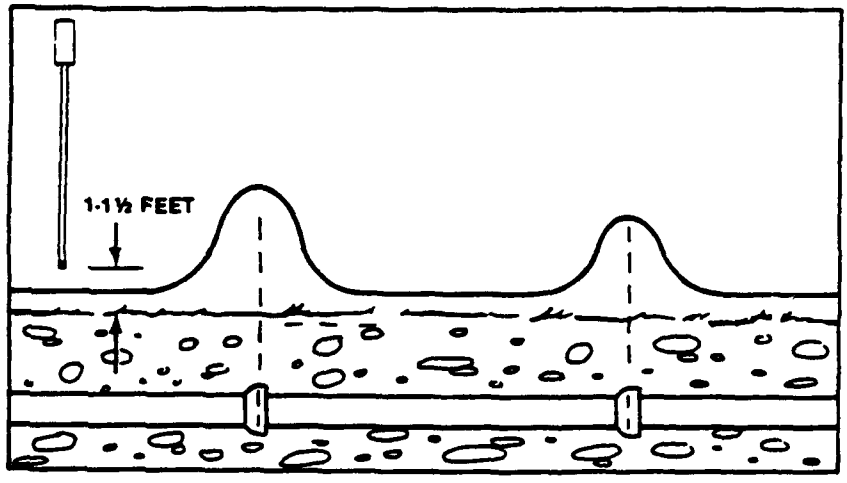


Figure 3-13. Signal Pattern Provided by Cast-Iron Pipes

The initial search should be performed as follows:

1. Adjust the sensitivity level for maximum.
2. Hold the locator vertically approximately 1 to 1-1/2 feet above the surface.
3. Walk along without turning or tilting the locator.
4. Mark the locations where the maximum signal levels occur.
5. Return to an area of maximum signal strength and hold the locator several inches above the surface. The sensitivity will probably have to be reduced during this second pass. Four-inch pipes can be located at depths up to 8 feet.

Locating Steel Drums

As shown in Figure 3-14, the MAC-51B's signal pattern will vary depending on the vertical or horizontal orientation of the drum and also how deep it is buried. A fifty-five gallon drum can be located at depths up to 8 feet.

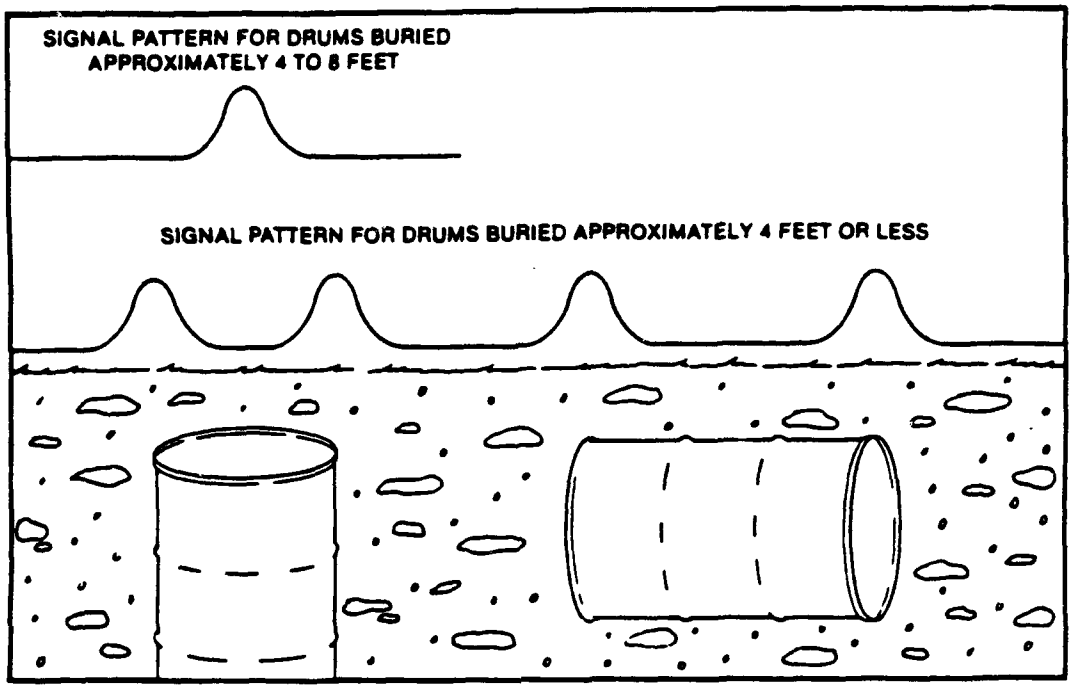


Figure 3-14. Signal Pattern Provided by Steel Drums

Additional Applications

1. The military and many local and state police departments use the MAC-51B to detect buried ordnance and discarded weapons.
2. People drilling in an area where hazardous materials might be encountered use the MAC-51B to search the area prior to drilling. Other Schonstedt gradiometers are available that can be lowered down the hole for periodic checks as drilling progresses.

Other Notes

1. A burbling sound indicates the presence of an energized power line.
2. The instrument will not detect nonmagnetic materials such as gold, silver, copper, brass and aluminum.

Section IV
Cable Locator Operation

Theory of Operation

In the cable locator mode, the receiver must be used in combination with the transmitter which is housed in the carrying case.

As illustrated in Figure 4-1, the transmitter is placed over and in line with the target cable/pipe. An alternating current induced into the cable/pipe produces a signal that is detected with the receiver. The transmitter emits a steady beeping sound to indicate that it is operating, and the receiver emits a siren-like sound that is easily identified as the induced tracing signal.

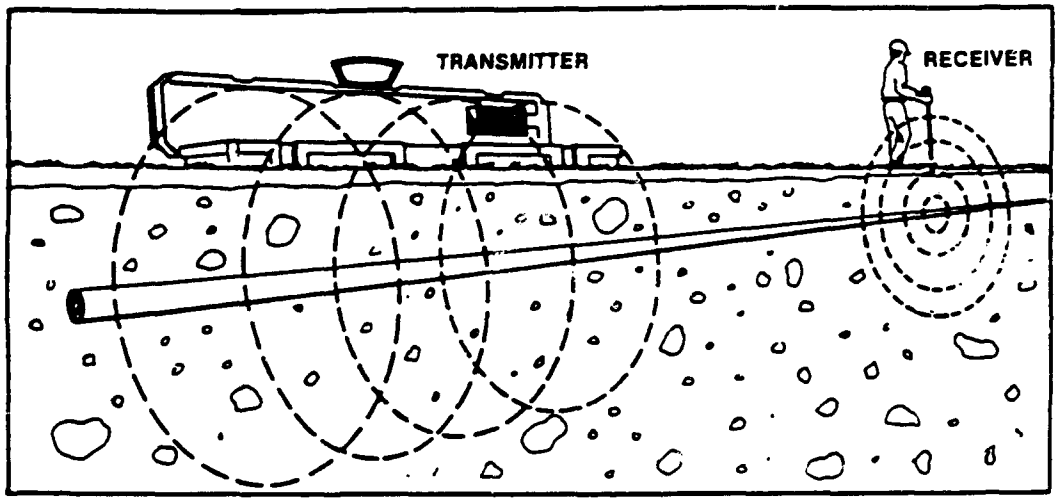


Figure 4-1. Transmitter and Receiver Placement

The tracing current generates an alternating circumferential field around the cable. This alternating field induces a signal into the receiver's sensor. As the receiver is moved back and forth across the cable in a search pattern, the pitch of the audio output from the receiver increases and decreases.

The heavy line in Figure 4-2 represents the increase and decrease in pitch of the audio signal as the receiver is moved back and forth over an energized cable. Moving from A to D causes the pitch to increase to a maximum at B and decrease to a minimum directly over the target. At C the pitch again increases and then decreases at D.

The MAC-51F can be used to trace any long conductive element such as an anode string or metallized warning tape as well as cable and pipe.

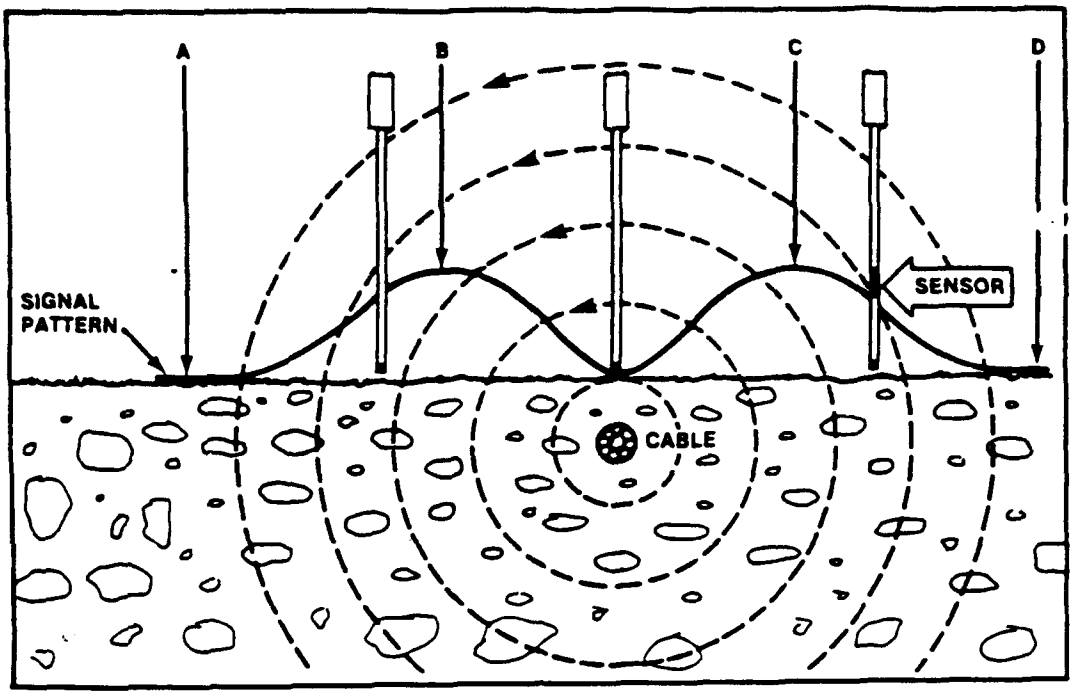


Figure 4-2. Signal Pattern from a Tracing Signal

NOTE
For convenience, all targets will be referred to as lines throughout Sections IV and V.

Transmitter, Turn-On and Battery Check

Set the ON/OFF switch to ON and listen for a steady beeping sound. If a beeping is not heard, the batteries must be replaced as described on page 6-3.

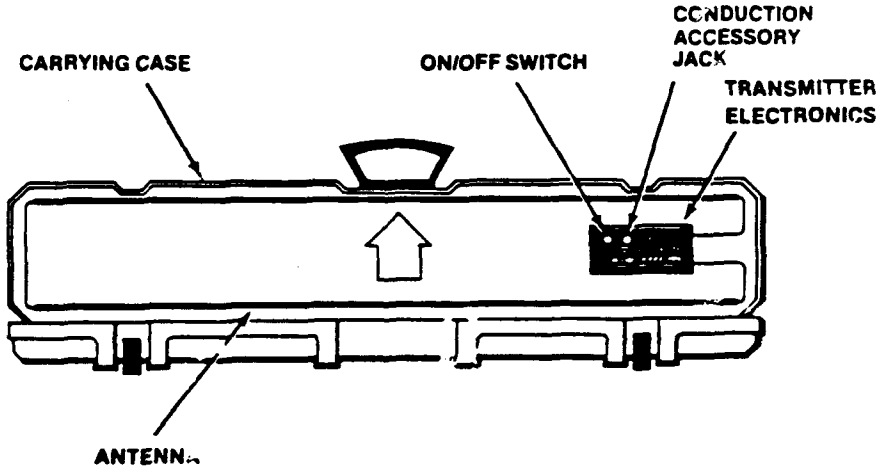


Figure 4-3. Transmitter Controls

Transmitter, Inductive Mode

The most common line excitation mode is inductive. With the cover open and the arrow pointing up, place the transmitter over the line as illustrated in Figure 4-4. The arrow must be pointing up. Turn the transmitter ON/OFF switch to ON and you will hear a steady beeping sound. If not, replace the batteries.

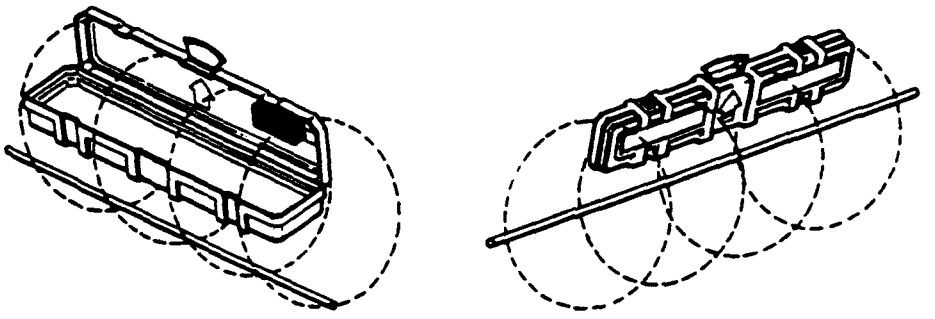


Figure 4-4. Transmitter Operating Positions

Transmitter, Conductive Mode

If an exposed section of a target gas or water pipe is accessible, the tracing signal can be applied directly to the target line.

Plug the conductive cable assembly into the transmitter accessory jack and turn the power switch to ON. (Inserting the plug automatically disables the inductive transmitter and applies exciting current to the cable clips.) Connect one cable clip to a conductive portion of the line. Drive the ground stake into the soil off to the side of the line and attach the other clip to the stake. A good electrical contact between the clips, the line, and the ground stake is very important.

WARNING

Clipping to power lines is dangerous and should not be done. Insulation on the clip is not designed to protect against power line voltages.

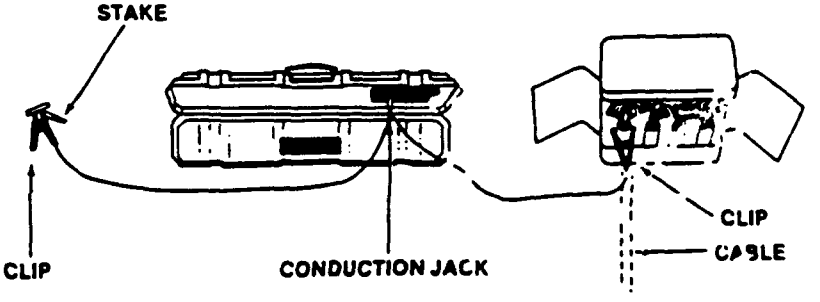


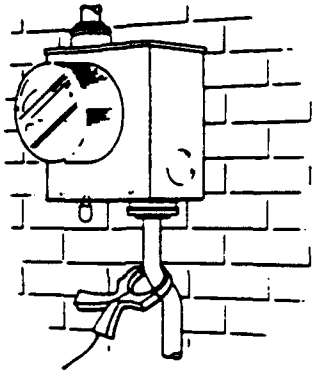
Figure 4-5. Transmitter Hookup for Conductive Operation

Transmitter, Inductive Signal Clamp Mode

The inductive signal clamp (optional) provides a convenient method of applying the tracing signal to electrical cables covered with nonmetalic insulation. Plug the clamp lead into the transmitter accessory jack on the transmitter and close the clamp around the cable. No ground connection is required. It can be applied to cables up to three inches in diameter.

WARNING

Clamping around any power line involves hazard. Exercise caution. Under no circumstances clamp around high tension lines (lines carrying greater than 220 V). High tension voltage can jump to the operator through the insulation and down the wire.



Receiver, Function Selection and Turn-On

Set the M/C switch to C and adjust the ON/OFF-Sensitivity control for mid-position as shown in Figure 4-7. The volume level is preset. If the receiver is turned on when located within 15 feet of the transmitter, the receiver's speaker will emit a siren-like sound indicating that the receiver is picking up the tracing signal directly from the transmitter through the air.

The sensitivity will have to be increased as the distance between the receiver and transmitter increases.

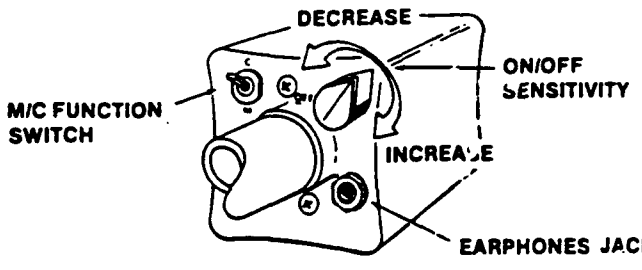


Figure 4-7. Sensitivity Set for Normal Range

Receiver, Sensitivity Settings

The right sensitivity level must be used to obtain a proper null. A null is the audio signature that lets the operator know when he is positioned directly over the target line. If the sensitivity level is set too low, the null between the two signal peaks (highest audio pitch) will cover too large an area, making it difficult to trace the line. If the sensitivity is set too high, the null will be too short and not heard. Setting the sensitivity to get the null width as illustrated by the medium sensitivity curve in Figure 4-8 is the secret to successful tracing.

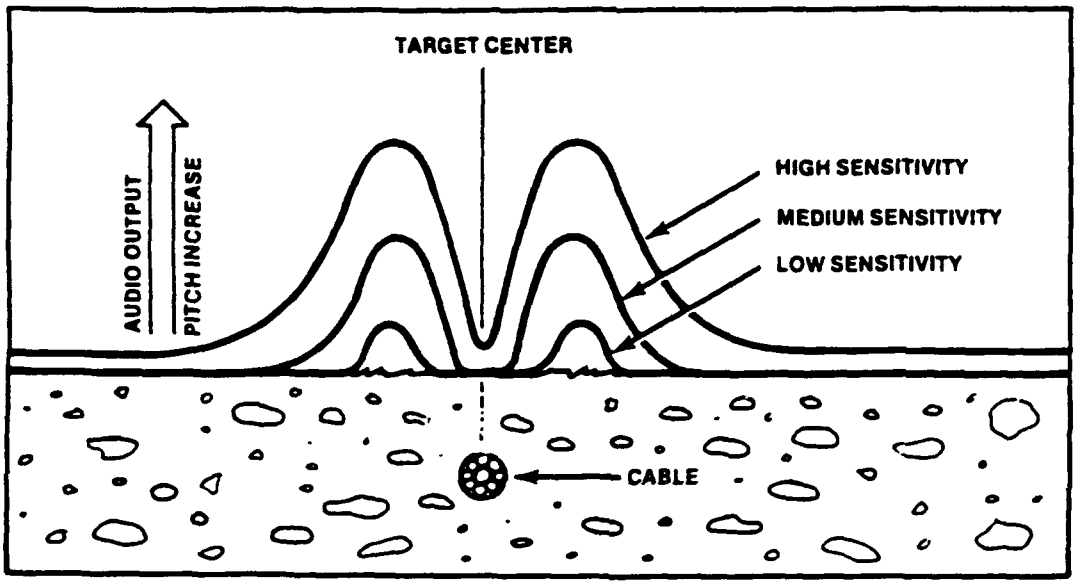


Figure 4-8. Null Shape Versus Sensitivity Setting

Tracing, Inductive Mode

Position the transmitter over the target line and turn the power switch to ON. A steady beeping will be heard that indicates the transmitter is operational. Move approximately 30 feet away from the transmitter along the suspected target line before turning on the receiver. This will ensure that the receiver is not receiving the signal through the air directly from the transmitter. Set the receiver function switch to C and adjust the sensitivity control to obtain a medium pitch signal. Hold the receiver just below the large end as illustrated in Figure 4-9.

NOTE

Do not swing the receiver. The null appears over the target only when the receiver is held in a vertical position. If it is held at an angle, the null will not indicate the true location of the target line.

Holding it in a vertical position with the sensor end close to the ground, move it back and forth across the line. Readjust the sensitivity until a sharp null (minimum pitch) is obtained. The null occurs directly over the line. As you move away from the transmitter the sensitivity level will have to be increased.

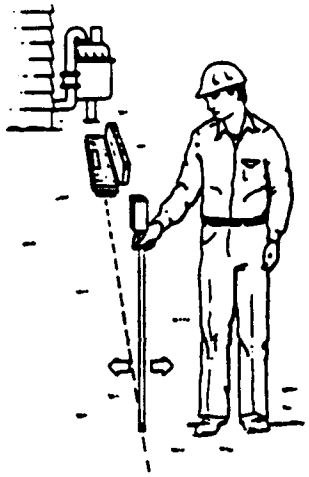


Figure 4-9. Inductive Mode Tracing

Tracing, Conductive Mode

In this mode the transmitter is physically connected to an exposed conductive section of the target line using the conductive cable assembly and the ground stake. After the two clips are connected to the line and to the ground stake (good electrical contacts are essential), the procedure for using the transmitter and the receiver is the same as for the inductive mode except that tracing can be started right next to the transmitter.

WARNING

Clipping to power lines is dangerous and should not be done. Insulation on the clip is not designed to protect against power line voltages.

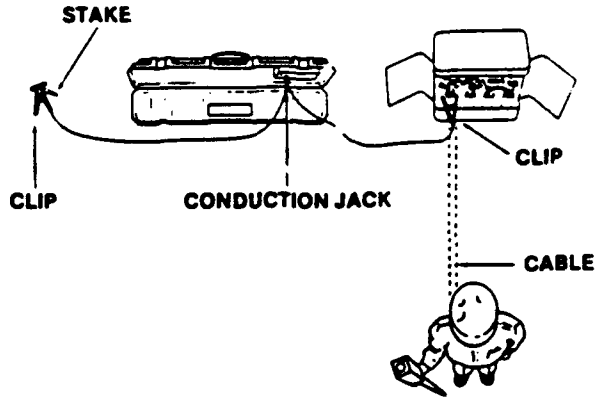


Figure 4-10. Conductive Mode Tracing

Section V
Cable Locator Application Notes

Inductive Coupling

Induction is the easiest and quickest way of applying the tracing signal to a conductor and provides a signal strong enough to trace most lines. Induction does not require access to an exposed section of the line which very often is not available. However, an induced signal is not as strong as a conductively applied signal and will fade quickly as distance from the transmitter increases when electrically poor or leaky conductors such as gas and water pipes are being traced. Any time a tracing signal is induced on a target line, the same signal will be induced on nearby utility lines which may cause some confusion when trying to identify the null.

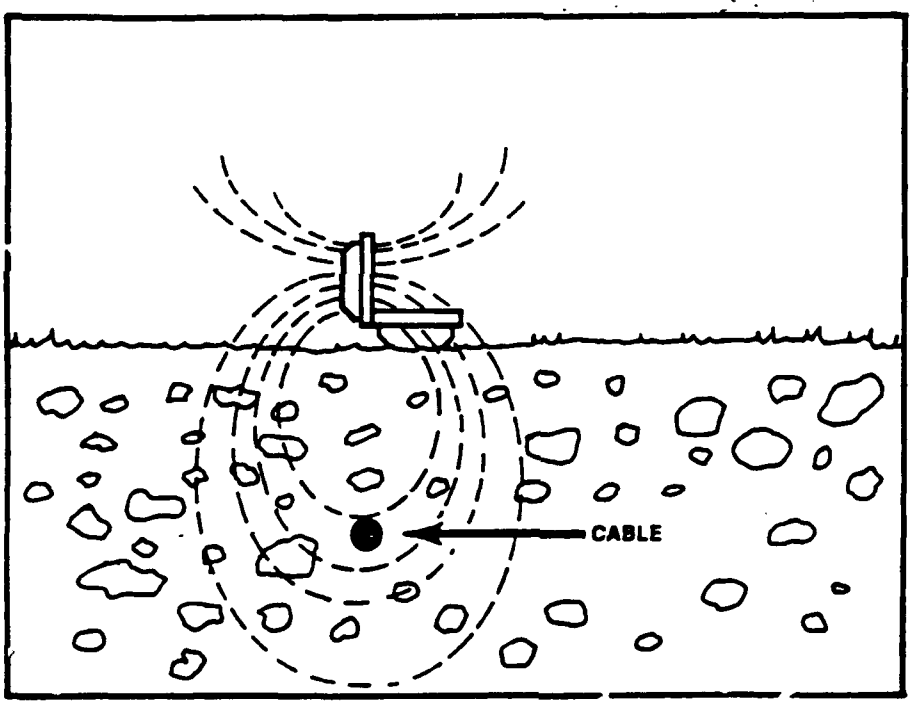


Figure 5-1. Inductive Coupling Setup

Conductive Coupling

This is the most reliable way of applying the tracing signal. A good electrical contact between the clip and the conductive portion of the target line is essential. If necessary, use a file to clean off rust or paint to ensure a good electrical connection. Electrical contact must also be made to the ground using the supplied stake. For the best results, drive the stake into the ground as far off to the side of the line as the connecting cable will permit. (See Figure 5-2)

WARNING

Clipping to power lines is dangerous and should not be done. Insulation on the clip is not designed to protect against power line voltages.

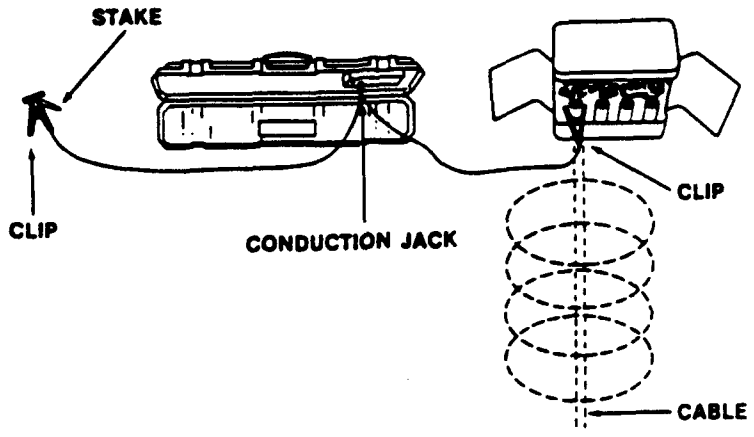


Figure 5-2. Conductive Coupling Setup

Dealing with Clutter Signals

When operating in the inductive mode, an effective method of reducing interference caused by parasitic signals from an adjacent line is to find a second spot on the line that has a good clean null (equal strength lobes on both sides). Move the transmitter to this spot. Confirm that this is the target line by back-tracking with the receiver to the first site of the transmitter and checking for a null. This procedure of leapfrogging the transmitter is also the standard method for extending the tracing range on electrically poor or leaky lines.

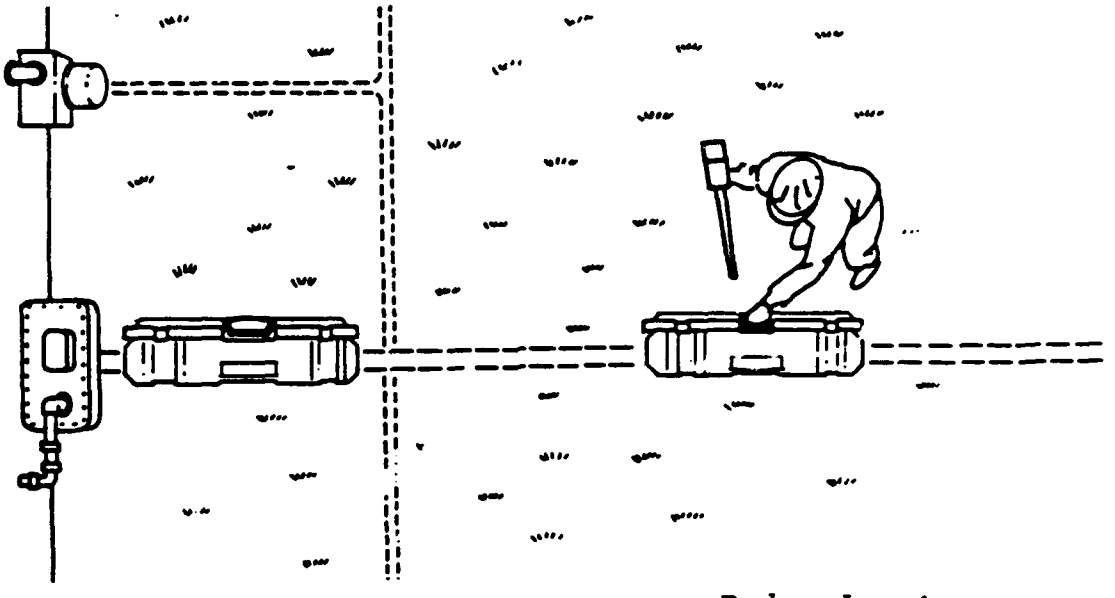


Figure 5-3. Repositioning Transmitter to Reduce Interference

Single-Lobe Identification

A second line parallel to the line being traced will emit a parasitic signal but at a reduced strength. Interaction of these signals results in unequal side lobes, which cause a large null off to one side of the target line as indicated by signal pattern curve A in Figure 5-4. To accurately trace a line under this condition will require practice. An alternate method is to hold the receiver in a horizontal position perpendicular to the line and listen for a single high pitch audio signal that occurs directly over the line as indicated by signal pattern B.

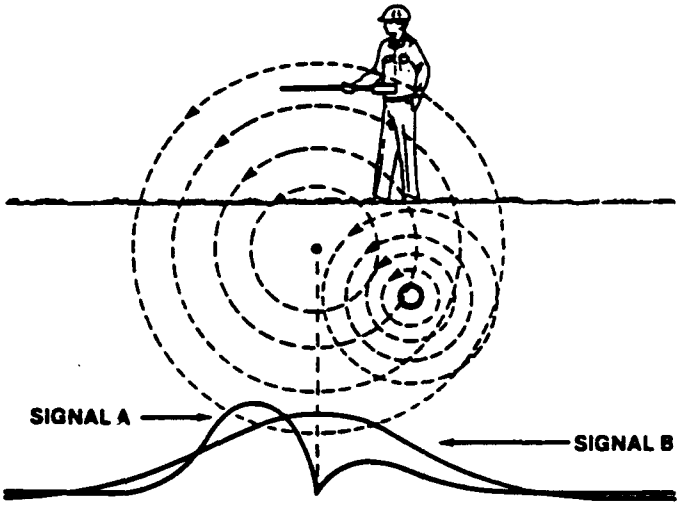


Figure 5-4. Single Lobe Identification Technique

Bends and Junctions

A variation of the two-line, single-lobe identification problem just described occurs when the line being traced has a bend or junction. As the receiver is brought near a bend or junction, the tracing signal becomes difficult to interpret. When this occurs, walk a 20-foot circle around the spot where the signal becomes confusing to detect the null that will indicate the line's new direction. However, to be certain that it is the new direction and not a junction, complete the circle to check for a second null that will indicate if the line has a branch.

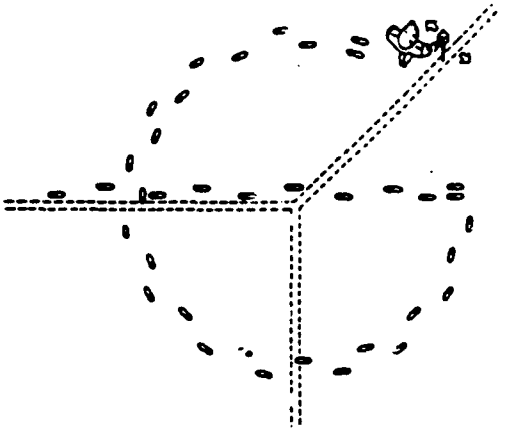


Figure 5-5. Identification of Bends and Junctions

Signal Spreading

Target lines that are poorly insulated from ground such as gas pipes, water pipes and anode strings may cause signal spreading to occur over long distances from the transmitter, even when using the conductive mode. This condition is prevalent when ground water is present. The signal also spreads to nearby lines and into the soil itself. When this situation is encountered, the transmitter must be moved closer to the section of the line to be traced and the conductive mode used if possible.

Signal spreading can also occur even when lines are well insulated. The tracing signal can travel into buildings via the ground or the shield of a line and transfer to the shields of other lines leaving the building. Signal spreading can be minimized by placing the transmitter as far as possible from the building.

Magnetic Locator Function

The MAC-51B has a unique feature designed to help the operator unscramble underground clutter. It is the option of switching to the magnetic mode for a second indication of what category of targets are in the immediate vicinity. In this mode cast-iron water and gas pipes can be readily identified and even classified as to type by the conventional spacing of joints. Power mains and some 60 Hz service drops can also be identified by a burbling sound that peaks when the receiver is directly over the power line. As the operator becomes more familiar with the MAC-51B System, switching between the M and C functions when clutter is encountered will become an invaluable tracing aid.

Isolators and Signal Path Continuity

The tracer current must travel in a closed loop. When it leaves the line being traced, it loops back, one way or another, to the beginning of the line. If the current cannot complete its loop the locating system will not operate. The operator should be aware of this system requirement when tracing lines that have electrical isolators installed.

Electrical isolators are sometimes placed in a gas line at the meter to provide an electrically open circuit which stops the flow of galvanic current and reduces corrosion. To inductively excite this type of line by placing the transmitter close to the meter, a shorting wire must be placed on the pipe to bypass the isolator. This allows the tracer current to return to the pipe through the earth ground of the building. An alternate method is to move the transmitter down the line a few yards away from the building to a point where the gas pipe riser provides a current return path.

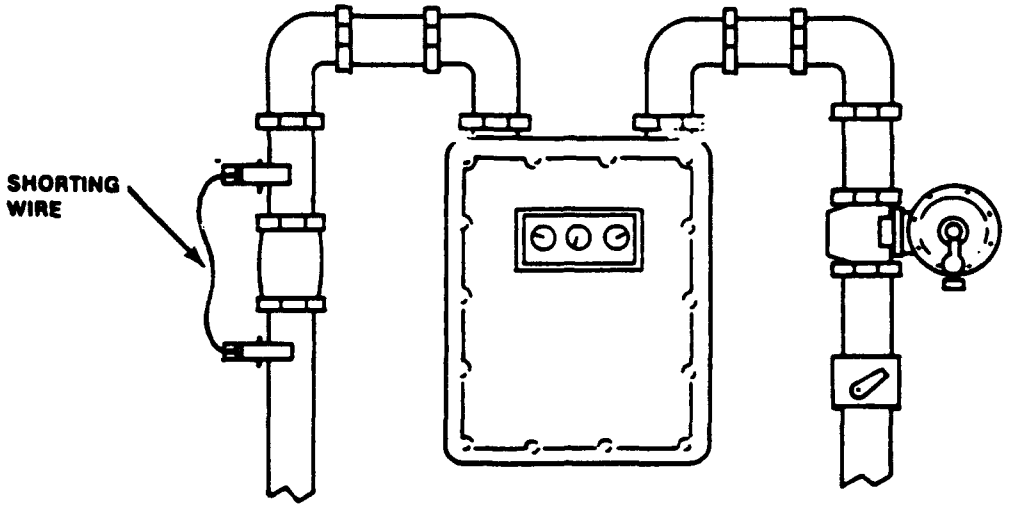


Figure 5-6. Gas Line Isolator Bypassed with Shorting Wire

Isolators and Inductive Excitation

Electrical isolation sometimes occurs inadvertently on phone cables entering a pedestal because the cable's shield is not grounded. In most jurisdictions, grounding the shield inside the pedestal is not required unless the cable shares a trench with power cables. If there is no ground wire, it is recommended that a wire and clips, as shown in Figure 5-7, be connected from the cable shield to the pedestal before using the inductive mode to excite the target cable. This will greatly improve the strength of the inducted tracing signal.

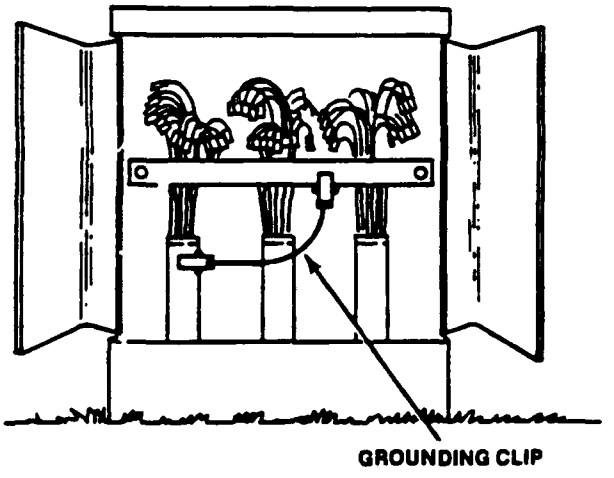


Figure 5-7. Pedestal with Grounding Clip Installed

Isolators and Conductive Excitation

When using the conductive mode to trace a phone cable from a pedestal, electrical isolation of the shield is an advantage. If a ground wire is providing a good path from the shield to earth ground through the pedestal, the trace current will use it to complete the return loop to the transmitter grounding stake instead of going down the target line. So if there is a ground wire in place, disconnect it from the pedestal before connecting the conductive cable clip to the shield to ensure that a strong tracer current is applied to the cable.

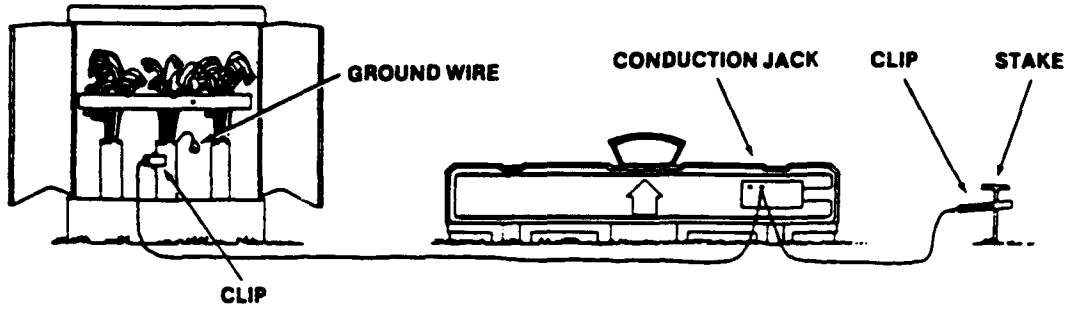


Figure 5-8. Pedestal with Groundwire Removed

Determining Target Depth by Triangulation

The receiver can be used in the traditional triangulation method to determine the approximate depth of a target as illustrated in Figure 5-9. However, when using this method it is necessary to take into account the fact that the center of the cable-sensor is located 11 inches up the receiver tube from the black tip.

When the position of the target has been determined by the null, mark the spot (#1) on the ground. Hold the receiver tip on the ground at this spot, slant the instrument at a 45° angle and slowly move directly back, to one side, from the target until a second null is obtained. Now mark a spot (#2) on the ground that is directly below a point 11 inches up the receiver tube from the black tip. Measure the distance between spot # 1 and spot #2. This measurement indicates the approximate depth of the target.

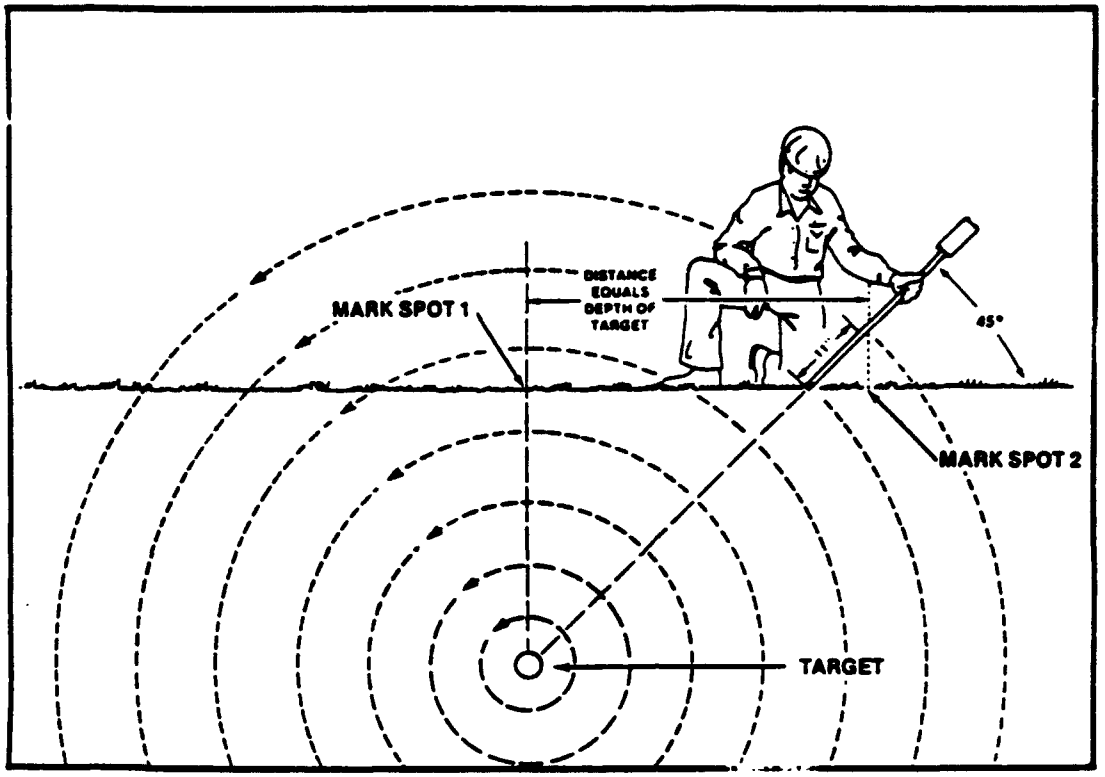


Figure 5-9. Determining Approximate Depth of Target

NOTE

Depth readings should be taken on both sides of the line at a spot where the lobes have the same signal strength. This procedure will help reduce any error in depth estimation caused by a distorted tracing signal due to interference.

Section VI
Maintenance

The MAC-51B system is built to give trouble-free operation. Normally, maintenance is limited to the occasional replacement of batteries. In the event that a malfunction does occur, refer to the appropriate trouble-shooting guide on page 6-4. They list a few possible problems that can generally be corrected in the field so that you will be able to continue using the locator without interruption.

Replacement of Receiver Batteries

The receiver is powered by four C-cell batteries carried in a battery holder illustrated in the exploded view of the electronic assembly. Access to the batteries is obtained by removing the two knurled nuts and sliding off the cover.

The four batteries are connected in series. The proper polarities for the batteries are shown on the battery holder. **Batteries must be removed and installed as shown in Figure 6-2.**

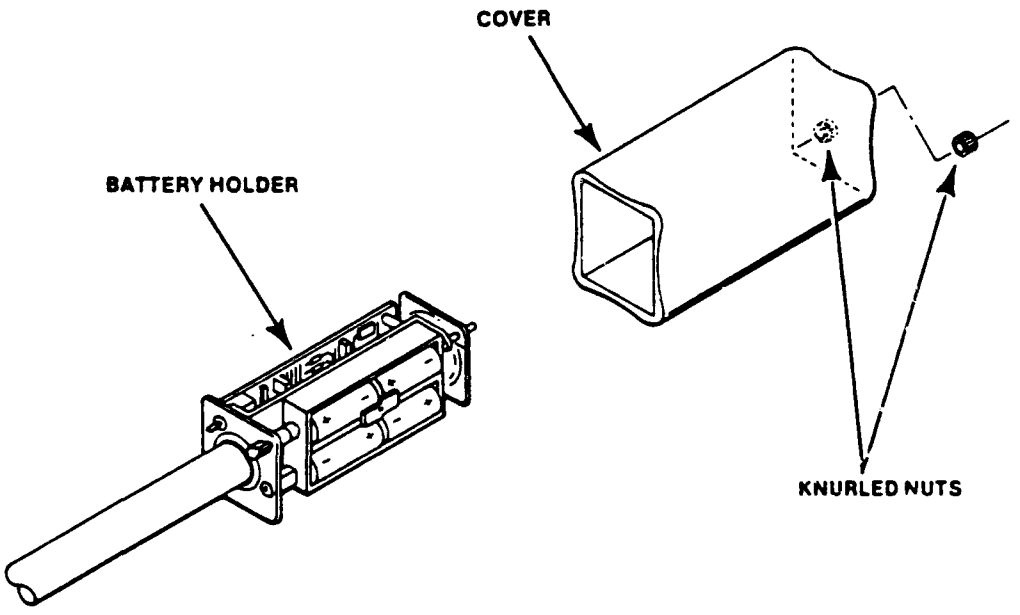
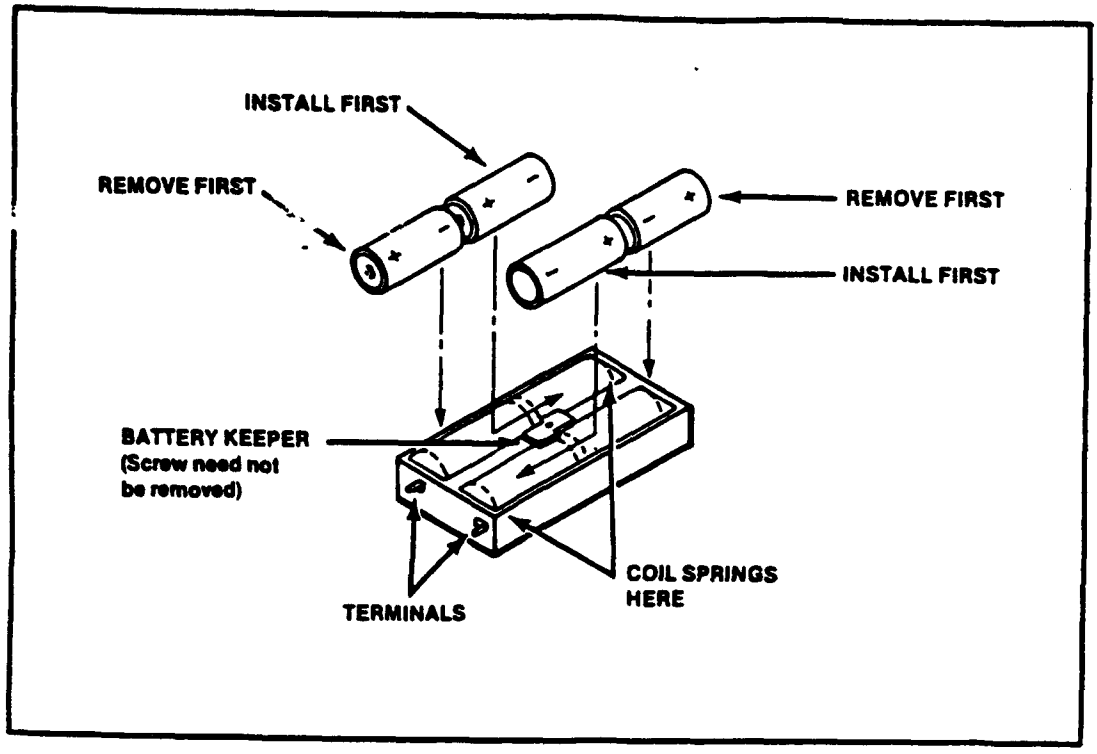


Figure 6-1. Exploded View of Receiver Electronic Unit



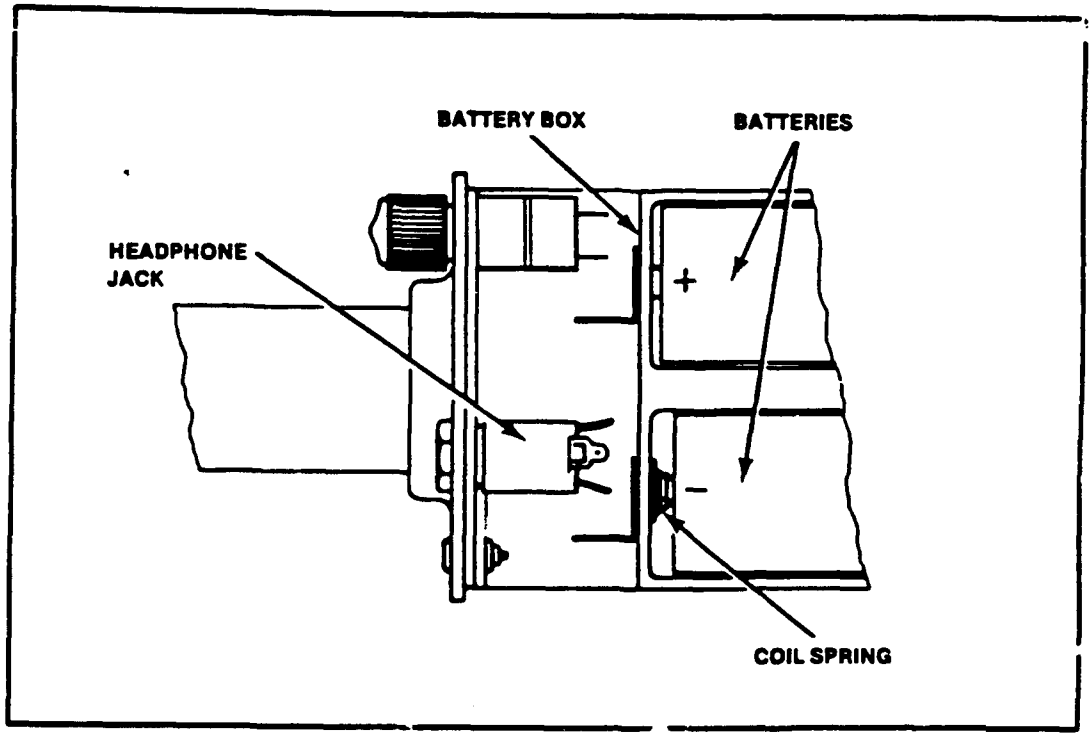


Figure 6-2. Replacement of Receiver Batteries

Replacement of Transmitter Batteries

The transmitter is powered by eight alkaline C-cell batteries located in a battery holder. Access to the batteries, as illustrated in Figure 6-3, is obtained by removing the two knurled nuts, the battery holder cover, and the spare battery holder. The eight batteries are connected in series. The proper polarities for the batteries, their removal, and installation sequence are indicated below. **Batteries must be removed and installed in the order shown.**

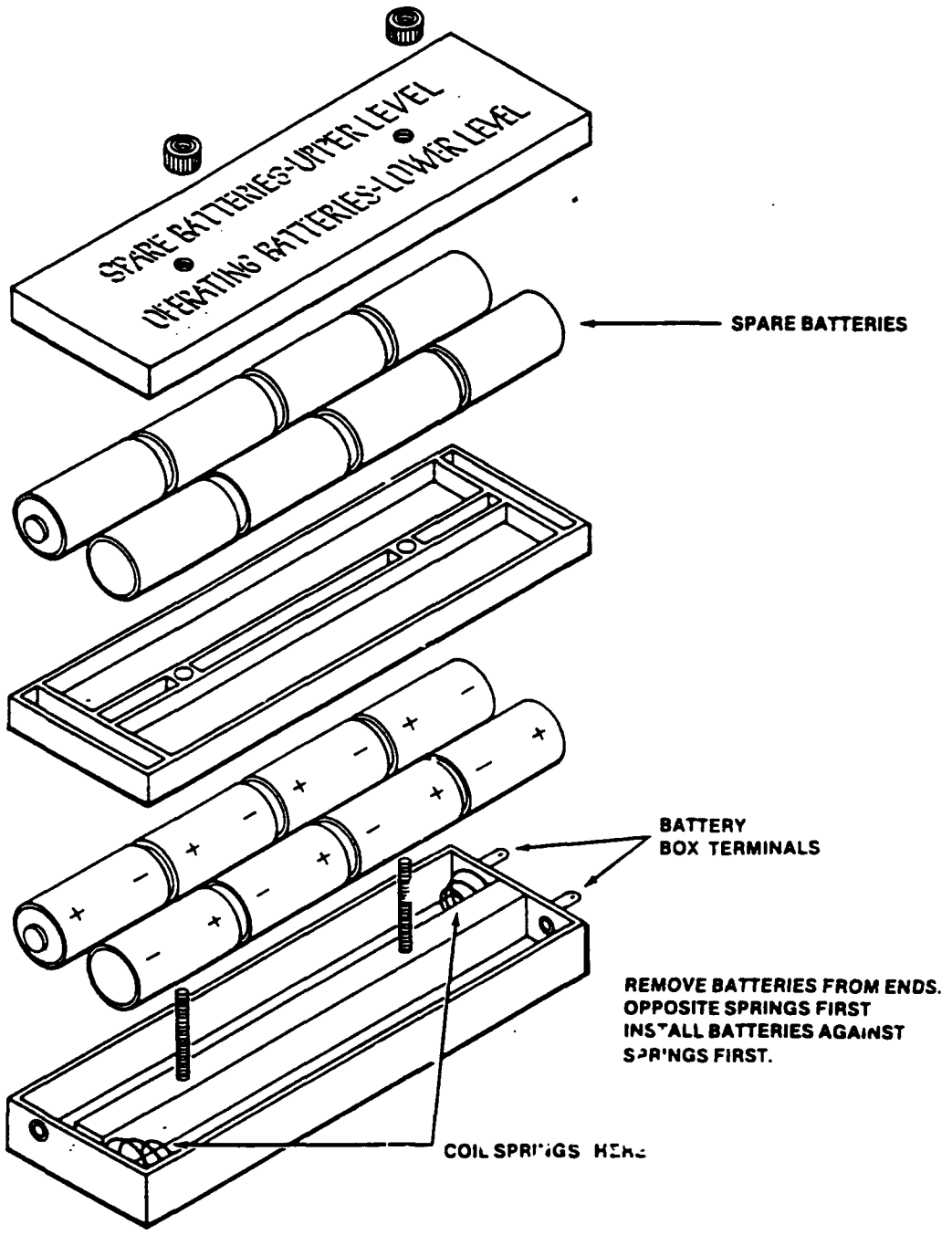


Figure 6-3. Replacement of Transmitter Batteries

RECEIVER TROUBLESHOOTING GUIDE

Symptom	Possible Cause	How to Check	How to Fix
Dead	Dead Batteries.	Replace.	Replace.
	Batteries not making contact.	Check for contact corrosion.	Clean Contacts.
	Broken Wires.	Visually inspect.	Resolder.
Intermittent	Batteries not making good contact.	Check for corrosion.	Clean Contacts.
No sound	Speaker terminals shorted to cover.	Visual.	Bend terminals.

TRANSMITTER TROUBLESHOOTING GUIDE

Sympton	Possible Cause	How to Check	How to Fix
No Sound	Dead Batteries.	Replace.	Replace.
	Batteries not making contact.	Check for contact corrosion.	Clean Contacts.
	Broken wires.	Visually inspect.	Resolder.
Intermittent Sound	Batteries not making contact.	Check for corrosion.	Clean contacts.

SERVICE INFORMATION

If your locator needs service, please return it to the factory along with the following information: Name, Address, Where Purchased, Date and Description of Trouble(s). A telephone estimate will be provided prior to service work being done. See shipping information on Page 6-7.

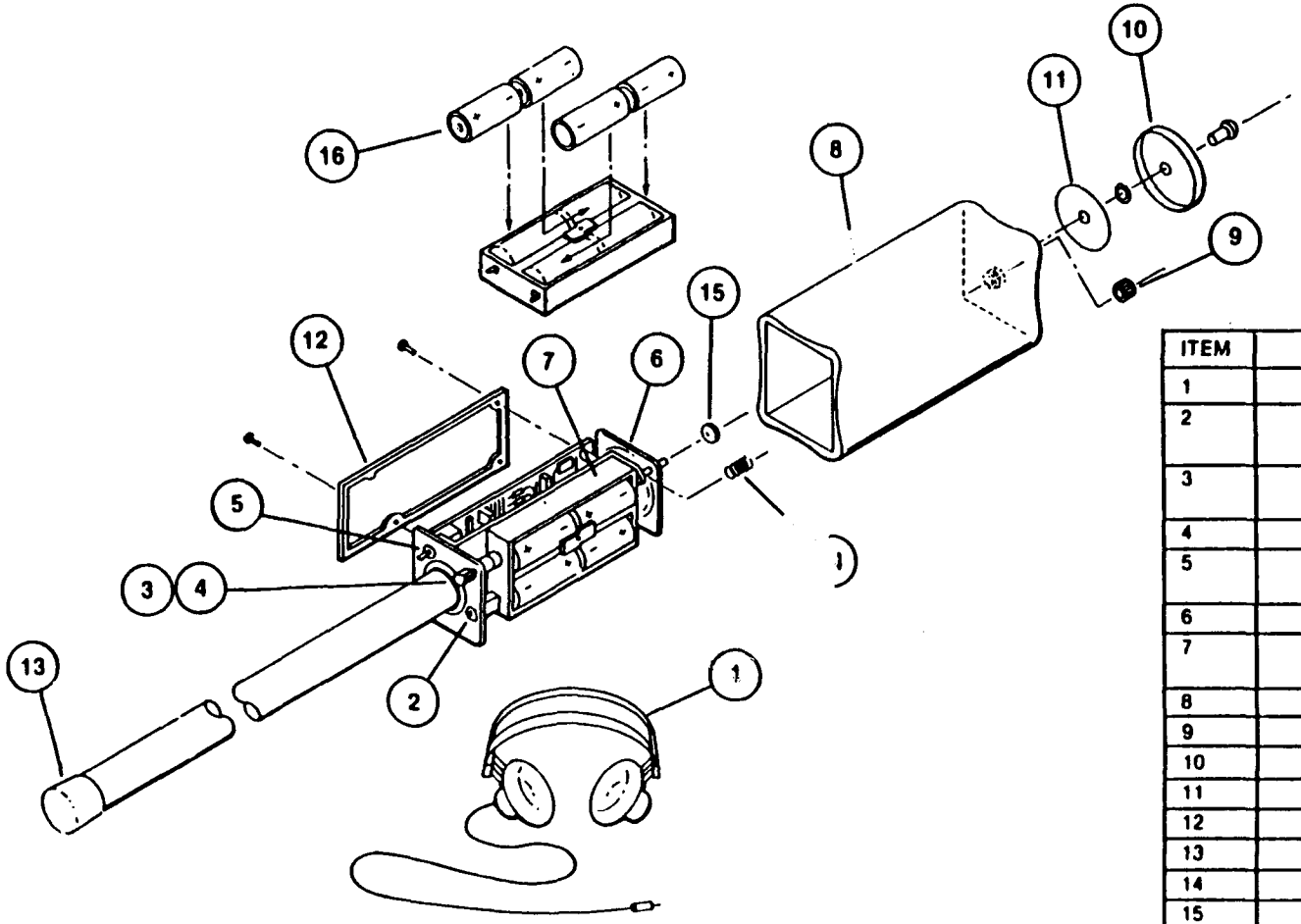
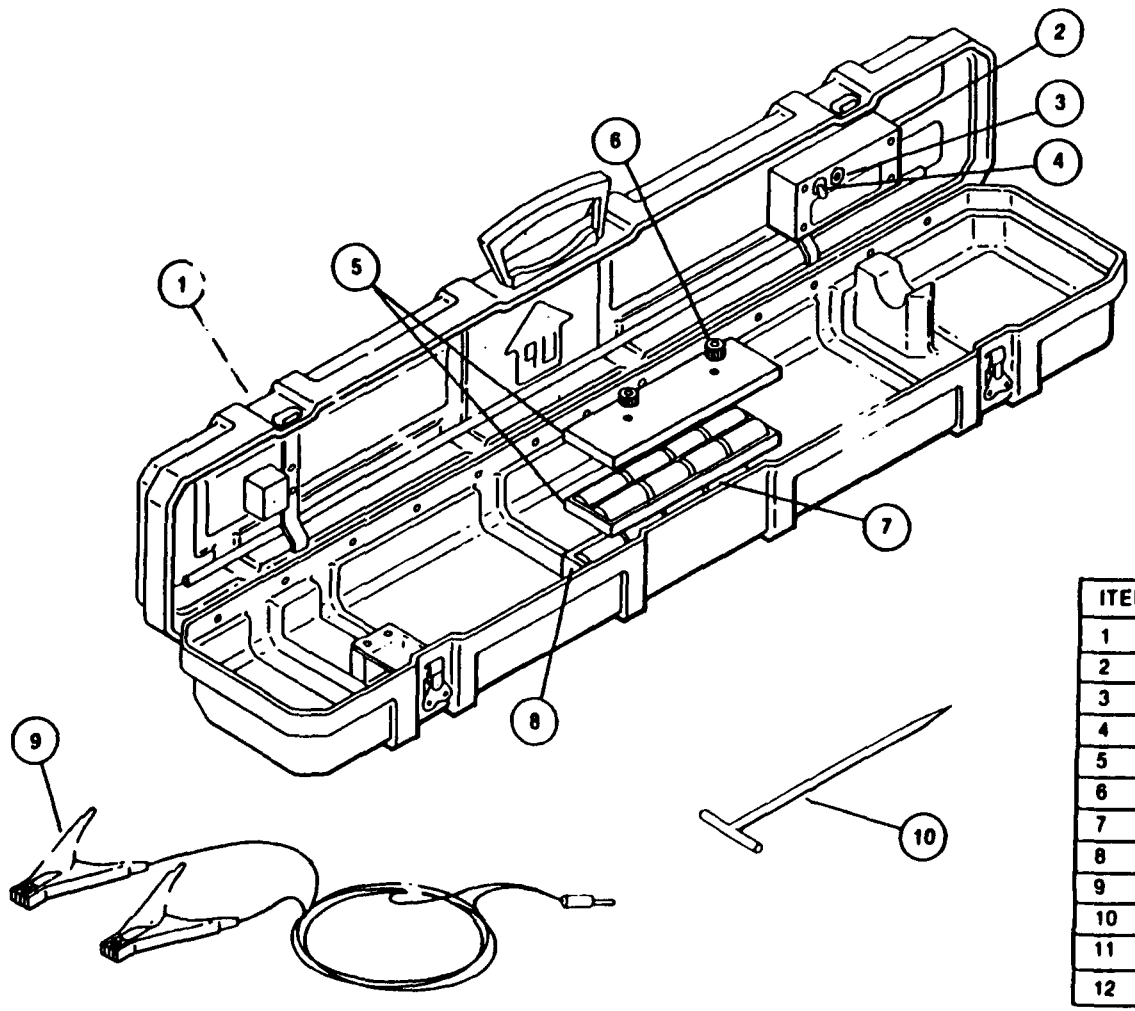


Figure 6-4. MAC-51B Receiver Repair Parts

ITEM	PART NO.	DESCRIPTION
1	H30006	HEADSET*
2	207245	PHONE JACK J10012 WITH WIRES
3	207179	SENSITIVITY CONTROL S35065 WITH WIRES
4	K20011	KNOB
5	207269 B55004	OPTION SWITCH BUSHING BUSHING EXTENDER
6	206003	SPEAKER MOD.
7	207173	BATT. HOLDER AND CHASSIS ASSY.
8	207271	COVER
9	K20021	KNURLED NUT (2 REQ'D)
10	207215	CAP
11	202006	SCREEN
12	301655	PROTECTOR
13	T60003	TIP
14	S56002	SPRING (2 REQ'D)
15	R40016	"O" RING (2 REQ'D)
16	B11009	BATTERY ("C" SIZE, 4 REQ'D)

*OPTIONAL



ITEM	PART NO.	DESCRIPTION
1	500321	CASE
2	301725	ELECTRONICS BOX
3	J10009	JACK
4	S35030	SWITCH
5	207242	BATTERY HO ER
6	205252	KNURLED NU REQ'D
7	B11009	BATTERY C TYPE, 4 REQ'D
8	301729	BATTERY CASE
9	301781	CONDUCTIVE CLAMP
10	207200	GROUND SPIKE
11	301646	CLIP*
12	MT-1	MINI TRANSMITTER(MOLE)*

*OPTIONAL

Figure 6-5. MAC-51B Transmitter Repair Parts

LIMITED WARRANTY

The Schonstedt Instrument Company (Schonstedt) warrants each product of its manufacture to be free from defects in material and workmanship subject to the following terms and conditions. The warranty is effective for one year after shipment by Schonstedt to the original purchaser.

Our obligation under the warranty is limited to servicing or adjusting any product returned to the factory for this purpose and to replacing any defective part thereof. Such product must be returned by the original purchaser, transportation charges prepaid, with proof in writing, to our satisfaction, of the defect. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. Prior to repair in this instance, a cost estimate will be submitted. Service or shipping information will be furnished upon notification of the difficulty encountered. Model and serial numbers must be supplied by user. Batteries are specifically excluded under the warranty.

Schonstedt shall not be liable for any injury to persons or property or for any other special or consequential damages sustained or expenses incurred by reason of the use of any Schonstedt product.

FOR SERVICE OR REPAIR

Please ship locator (in its case to):

Schonstedt Instrument Company
1775 Wiehle Avenue
Reston, VA 22090

PATENTS

Manufactured under the following Patents: United States: 2,916,696, 2,981,885; 3.894,283; 3,909,704; 3,961,245; 3,977,072; 4,110,689; 4,161,568; 4,163,677; 4,258,320; 4,388,592 and Design 255552. Canada: 637,963; 673,375; 1,006,915; 1,037,121; 1,141,003, 1,177,891 and 1,206,091. Great Britain: 1,446,741; 1,446,742; 1,494,865 and 2,012,430B. France: 2,205,671 and 81 12295. Germany: 25 51 968.0-09; 25 55 630; and 29 01 163. Japan: 1,595,127 and 1,413,844. Other patents pending.

ORS
ENVIRONMENTAL
EQUIPMENT
A DIV. OF GROUNDWATER TECHNOLOGY, INC.

Depth Meter

ORS ENVIRONMENTAL EQUIPMENT

INTERFACE PROBE USER GUIDE & MANUAL

TABLE OF CONTENTS

Factory Mutual System

Approved

Factory Mutual Approval applies to Interface Probe model numbers [illegible], [illegible] and [illegible].

Rev 2
10/25/[illegible]
[illegible]

SECTION 1: SYSTEM DESCRIPTION

The ORS Environmental Equipment Interface Probe is a hand held, battery powered device for measuring depth to water or oil in tanks or wells. The Interface Probe can be used in numerous applications including measuring oil and water levels in monitoring wells, detecting tank leakage and obtaining accurate measurements of water levels in cascading wells. The system is Factory Mutual approved for Class 1, Division 1, Group D applications.

This manual applies to Interface Probes with ORS part numbers 1068013, 1068017 and 1068018. These three models differ only in the graduations on the front/back of their measuring tapes. Measuring tape alternatives are as follows: # 1068013 (Engineering/Metric), # 1068017 (Metric/Engineering), # 1068018 (English/Metric). Engineering scales are in decimal feet, Metric scales are in millimeters and English scales are in inches.

The Interface Probe consists of an oil/water sensing probe, a measuring tape/probe cable and a housing into which the tape and probe can be withdrawn when not in use. See below for a more detailed explanation of these components, and see Fig. 1, p. 2 for a drawing of the entire assembly.

1.1 System Components

1.1.1 Probe

The probe is a 1" (25 mm) diameter cylinder which can be used in wells as small as 1-1/8" (29 mm) in diameter. The probe contains two different sensor units, one for detecting the liquid/air interface, and one for distinguishing between water and hydrocarbon. The liquid sensor is an optical prism located on the end of the probe. This sensor detects liquid by reacting to the differences in the indices of refraction of air and liquids. An infrared light source is internally reflected to an infrared detector by a prism on the face of the sensor. When the prism becomes immersed in liquid, the light beam is refracted away from the detector. To determine if the liquid is conductive (water), or nonconductive (hydrocarbon), a small Intrinsically Safe electrical current is passed between two electrodes on the sensor. Current flow will occur only in conductive fluids such as water. The Interface Probe is capable of measuring oil slicks less than 1/16 of an inch (1.6 mm) in thickness.

1.1.2 Measuring Tape

The specially coated measuring tape connects the probe with the housing assembly and provides an accurate means of measuring the distance from the well head or tank port to the air/water, air/oil or oil/water interface. The tape also contains all the wires running between the probe and the circuitry in the housing assembly.

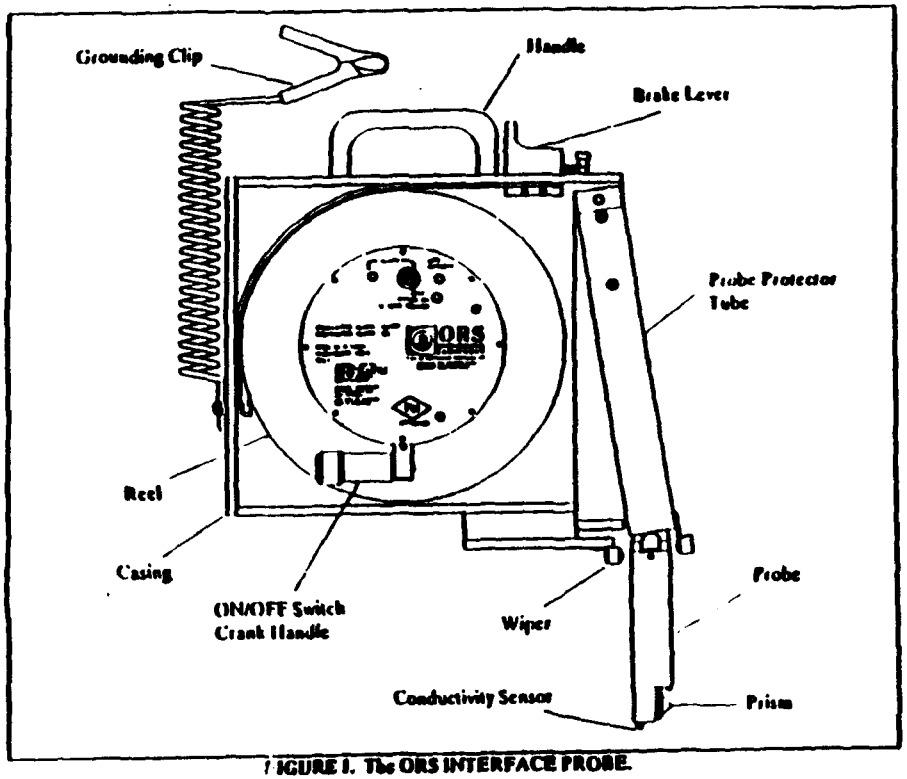


FIGURE 1. The ORS INTERFACE PROBE.

1.1.3 Housing Assembly

The components of the weatherproof NEMA 3 housing assembly are shown in Fig. 1, p. 2. The housing includes a casing and reel to protect and deploy the measuring tape and probe. The housing also has a Low Battery indicator, a visual/audible alarm and a test button for the alarm. A grounding clip is attached to the housing.

1.2 Intrinsic Safety & Approval

The intrinsic safety and approval of the Interface Probe is subject to the following requirements.

- Batteries must be changed only in a non-hazardous location.
- Batteries must be Duracell Type MN1500 (size AA). Substitution will impair intrinsic safety and void approval.

- When in operation, the unit must be grounded with the grounding clip provided.
- Substitution of components will impair intrinsic safety and void approval.

SECTION 2: SYSTEM INSTALLATION

Attach grounding clip to a confirmed ground before lowering the probe. No further installation is required.

SECTION 3: SYSTEM OPERATION

3.1 Taking A Measurement

WARNING: BEFORE ACTIVATING THE PROBE, ATTACH THE GROUNDING CLIP TO A SUITABLE EARTH GROUN..

3.1.1 To turn the unit on, unfold the crank handle away from the reel housing (See Fig. 1, p. 2). This activates a power switch inside the reel.

3.1.2 To verify that the unit is operational, press the test button on the face plate. If the power is ON, the visual/audible alarm will be activated. A low battery condition will cause the Low Battery indicator to be illuminated.

IMPORTANT: BEFORE REPLACING BATTERIES, READ WARNING IN SECTION 1.2 ABOVE.

3.1.3 To release the probe, pull the protector tube outward from the reel casing. To lower the probe, tilt the front of the reel housing forward and press the brake release. The brake release is located just forward of the handle. The tape will reel out as long as the brake release is depressed.

Note: The tape should not be allowed to rub against the well casing.

3.1.4 When the probe contacts liquid, the visual/audible alarm on the reel will be activated. An oscillating alarm indicates water, a continuous alarm indicates hydrocarbon. To determine the exact thickness of a hydrocarbon layer, the probe should be slowly lowered to the air/hydrocarbon interface until the alarm is activated. With the probe at the exact point where the alarm comes on, read the numbers on the tape to determine the distance from the top of the tank or well to the air/hydrocarbon interface. Next, lower the probe through the hydrocarbon layer and well into the water. An oscillating alarm will be obtained. The probe should then be raised slowly to the hydrocarbon/water interface until

APPENDIX A

INTERFACE PROBE CHEMICAL RESISTANCE CHART

The compatibility of the Interface Probe with various chemicals is listed in the table on the following pages. For chemicals not listed, please consult the factory.

Chemical resistance is rated as follows:

A = Good: At 20 degrees C

B = Fair: Slight attack and absorption. Inspect and rinse after use.

C = Poor: Use ORS Environmental Equipment's Chemical Interface Probe.

* Indicates that the probe material has not been tested specifically with that chemical but the results can be predicted from tests with similar chemicals.

A summary of the resistance of the sensing head to water, organic and inorganic chemicals is given below.

WATER

The probe is not attacked chemically by water.

INORGANIC CHEMICALS

The probe is unaffected by most inorganic reagents. Aqueous solutions do not generally damage the prism, although it may be temporarily softened by absorbed water. The prism is attacked by concentrated oxidizing mineral acids (nitric, sulfuric, hydrochloric) at room temperature but is not affected by more dilute acids. Resistance to alkalis is good.

ORGANIC CHEMICALS

In general, aliphatic hydrocarbons, alcohols, benzene, petroleum spirits, aliphatic organic acids, oils and fats do not attack the prism. Slight absorption may occur but does not usually cause degradation. The prism is attacked in highly polar organic solvents such as dimethysulphoxide, aromatic amines, nitrobenzene, and certain chlorinated hydrocarbons such as dichloromethane and chloroform.

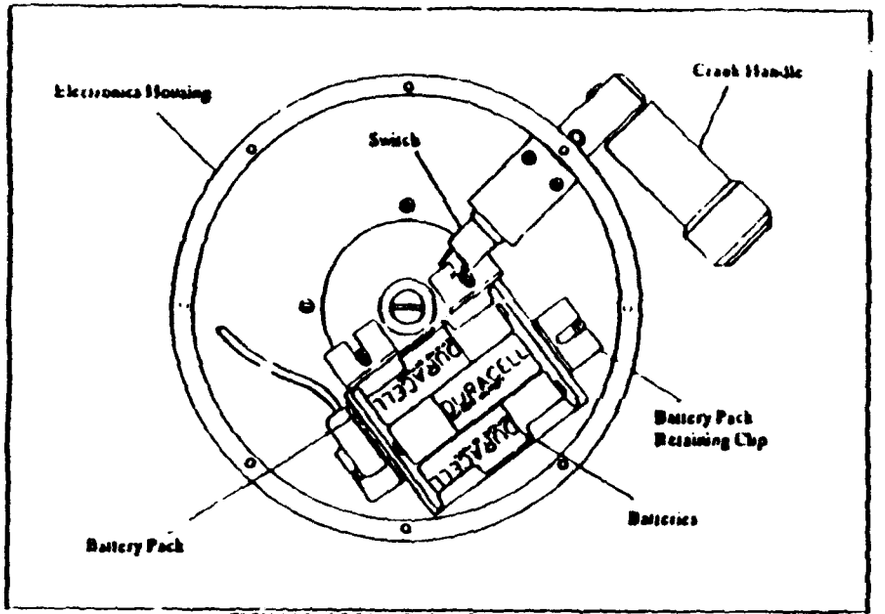


FIGURE 2. ORS INTERFACE PROBE Battery Pack.

the point is re ed where the alarm changes from oscillating to continuous. The thickness the hydrocarbon layer is determined by subtracting the first reading from t second reading.

Remember: The most accurate results are obtained by moving the probe as slowly as possible.

3.1.5 After taking a measurement, snap the protector tube shut so that the wiper rests against the tape. Release the brake and slowly reel in the tape until the probe is just below the wiper. Do not allow the probe to bottom out against the wiper, as this will apply stress to the tape. Next, open the protector tube and gently reel the probe 2/3 of the way into the tube. Forcibly reeling the probe all the way into the tube may stress or break the measuring tape. Now, turn the entire Interface Probe assembly upside down so that the probe falls the rest of the way into the protector tube. Make sure that the probe is entirely within the protector tube. Finally, close the protector tube.

The Interface Probe is equipped with an automatic shutoff circuit. If the probe has not sensed liquid within 3 minutes from the time power is applied the unit will automatically switch to a low power mode. This prevents battery drain should the power be left on accidentally. To restore power, place the handle in the OFF position and then back to the ON position.

SECTION 4: SYSTEM MAINTENANCE

The Interface Probe is designed to be virtually maintenance free. The only maintenance required is cleaning of the reel and probe and periodic replacement of the batteries.

After every measurement, the probe should be washed in Alconox detergent, rinsed in distilled water, washed again in Alconox and rinsed for a final time in distilled water. Also clean all accessible parts of the reel assembly. Before replacing the batteries, read the cautions in Section 1.2.

CAUTION: NEVER USE ACETONE OR ANY KETONE AS A CLEANER. DOING SO COULD CAUSE PERMANENT DAMAGE TO THE PRISM.

SECTION 5: SYSTEM TROUBLESHOOTING

The Interface Probe is a sealed unit and is not easily repaired in the field. With the exception of replacing a damaged prism (see below), any major malfunction should be referred to the Repair Department, ORS Environmental Equipment.

To remove a damaged prism, use a 3/4" (19 mm) wrench (hex socket 6 point) and unthread the prism assembly from the probe bottom. A replacement prism assembly (consisting of a prism and an O-ring) is available by ordering Part Number 20600010.

NOTE: To prevent water from entering the prism cavity, carefully dry the probe before removing the old prism. Throughout the prism removal and replacement procedure, hold the probe with the prism pointed downward.

To install the new prism assembly, simply thread the prism into place and secure finger tight. Then use a 3/4" (19 mm) wrench to firmly seat the O-ring. Be careful not to overtighten.

CHEMICAL	RESULTS
Acetaldehyde	C
Acetic acid glacial	A
Acetic acid- 10%	A
Acetone	C
Aluminium salts	A*
Ammonia- 880	A
Ammonium hydroxide- 10%	A
Ammonium chloride- 10%	A
Amyl acetate	B
Aniline	C
"Arcton" propellants	A*
Aviation hydraulic fluid	B
Aviation spirit	A
Barium salts	A*
Benzaldehyde	C
Benzene	A
Benzoic acid	A
Benzene sulfonic acid	A*
Bleach	A
Boric acid	A*
Brake fluid	B
Brine	A
Butane	A
Butanol	A
Butyl acetate	B*
Calcium nitrate	A
Calcium hypochlorite	A
Carbon disulphide	B*
Carbon tetrachloride	A
Chlorine	C
Chlorobenzene	C
Chloroform	C
Chlorosulfonic acid	C*
Chromic acid	A
Citric acid	A
Cooking oil	A
Copper sulfate	A
Creosote	A
Cresols	C
Cyclohexane	A
Cyclohexanol	A
Cyclohexanone	C
Detergent solutions	A
Dibutyl phthalate	A
Dichlorobenzene	C
Dichloroethane	C
Dichloroethelyne	B
Diesel oil	A
Diethylamine	A
Dimethyl formamide	C
Dioctyl phthalate	A
Dioxane	B*
Edible fats & oils	A
Ethanol	A
Ethyl acetate	C
Ethyl alcohol	A
Ethylene glycol	A
Ferric chloride	A
Formaldehyde	A
Formic acid	A
Gasolene (premium)	A
Glycerol	A
Heptane	A
Hexane	A
Hydrochloric acid- 10%	A
Hydrochloric acid (conc.)	A
Hydrogen peroxide	A
Hydrogen sulfide	A
Iodine	B
Isopropanol	A
Iso-octane	A
Kerosene	A
Lactic acid	A*
Lead acetate	A*
Linseed oil	A
Magnesium sulfate	A
Mercuric chloride	A*
Mercurous chloride	A*
Mercury	A*
Methanol	A
Methyl ethyl ketone	C
Methyl chloride	C
Milk	A
Motor oil	A
Nickel salts	A*
Nitric acid- 10%	A
Nitric acid (conc.)	C
Nitrobenzene	C
Oils (vegetable)	A
Oleic acid	A*
Oleum	C
Oxalic acid	A
Perchloroethylene	C
Petrol	A
Petroleum ether	A
Phenols	C
Potassium hydroxide- 10%	A
Potassium hydroxide- 50%	A
Propane	A*
Pyridine	C
Silicon fluids	A
Silver nitrate	A
Soap solution	A
Sodium chloride	A
Sodium hydroxide- 10%	A
Sodium hydroxide- 50%	A
Sodium hypochlorite	A*
Sulfur dioxide	B
Sulfuric acid- 10%	A
Sulfuric acid (conc.)	C
Sulfurous acid	C*
Tar	A*
Tartaric acid	A*
Tetrahydrofuran	C
Toluene	C
Transformer oil	A
Trichloroethylene	B
Turpentine	A
Vaseline	A*
Varnish	A
Water	A
Wax	A*
White spirit	A
Wines & spirits	A*
Xylene	B
Zinc salts	A*

ORS ENVIRONMENTAL EQUIPMENT
RETURN POLICY

Permission is required to return equipment to the ORS Environmental Equipment factory in Greenville, NH. A Return Authorization Number will be issued upon receipt of your request to return, which should include reasons for the return. Your return shipment to us must have this R.A.# clearly marked on the outside of each package.

Proof of date of purchase is required for processing of all warranty requests.

This policy applies to both equipment sales and repair orders.

FOR A RETURN AUTHORIZATION, PLEASE CALL OUR SERVICE DEPARTMENT AT 800-228-2310 or 603-878-2500.

Equipment Decontamination

Prior to return, all equipment must be thoroughly cleaned and decontaminated. During decontamination, personnel should wear protective clothing and observe the cautions outlined below.

ORS reserves the right to refuse any equipment not properly decontaminated. ORS may also choose to decontaminate equipment at a fee which will be applied to the repair invoice.

Decontamination Solutions

The determination of what decontamination solution to use should be based on the types of contaminants present and the materials to be decontaminated. The fabrics of protective clothing are made of organic polymers which may be dissolved or destroyed by organic solvents. The metals and gaskets of tools may be damaged by overly acidic or basic compounds. Some decontamination solvents should be entirely avoided. The toxicity or physical hazards associated with using some once commonly used decontamination solutions can be as potentially dangerous as the site contaminants.

It is important to be certain that the decon solution, the contaminant, and the material to be cleaned are all compatible with each other. If they are not, it is possible to produce toxic or flammable gases, heat, splattering, bubbling, fire, or explosion. If an uncommonly used method and/or chemical solution is being considered for decontamination, it is important to consult with an experienced chemist to ensure chemical compatibility.

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common decontamination solutions are listed below along with the contaminants re effective against:

ıtion	Effective Against
r	Short-chain hydrocarbons, inorganic compounds, salts, some organic acids, other polar compounds.
e Acids	Basic (caustic or alkaline) compounds, amines, hydrazines
ıe Bases	Acidic compounds, phenols, thiols, some nitro- and sulfonic compounds.
ınic Solvents	Nonpolar compounds (such as some organic compounds)

use of organic solvents is not recommended because 1) organic solvents can per-te and/or degrade the protective clothing, and 2) they are generally toxic and may lt in unnecessary employee exposure to hazardous chemicals.

:n in doubt, use a dish washing liquid detergent. As a decontamination solution, it is lily available, is the safest of all the above, and is usually strong enough if used erously.

: use of steam can also be effective for decontamination. A water-lazer (pressurized er) is exceptionally valuable.

: following substances are noted for their particular efficiency in removing certain ıtaminants or for decontaminating certain types of equipment.

lution	Effective Against
netone	PCB Contamination (since penetone may also remove paint, it is a good idea to spot-test before use)
quinox	Contaminated pumps
ory liquid	Oils
luted HTH	Cyanides
adiac	Low level radioactivity
opropanol	Biological agents (should not be used on rubber products since it will break down rubber)
Hexane	Certain types of lab or sampling equipment (use of hexane is discouraged due to its flammability and toxicity)
Zep	General purpose cleaning
Alconox	General purpose cleaning

Decontamination Solutions to Avoid

Some decontamination solutions should be avoided because of their toxicity, flammability, or harmful effects to the environment.

Halogenated hydrocarbons, such as carbon tetrachloride, should not be used because of their toxicity, possible incompatibility, and some because of their flammability.

Organic decontamination solutions should not be used on personal protective equipment (PPE) because they may degrade the rubber or other materials comprising the PPE.

Mercurials are sometimes used for sterilization. They should be avoided because of their toxicity.

Chemical leaching, polymerization, and halogen stripping should all be avoided because of possible complications during decontamination.

Sand blasting, a method of physical removal, should be avoided because the sand used on the contaminated object usually needs to be disposed of as hazardous waste, a very costly proposition. Also, sand-blasting exposes personnel to silica, a carcinogen.

Freon is known to be particularly effective for the cleansing of PCB's, but its effect on the ozone layer is extremely harmful. Its use should be discouraged.

Strong acids or bases should not be used when cleaning metals and gaskets of tools or other equipment because of the possibility of corrosion.

Disposal of Decontamination Solutions and Waste Water

All solutions and water used for decontamination must be collected. If lab analyses indicate that the water and/or solutions exceed allowable contamination levels, they must be treated as hazardous waste. Alternatively, the solutions and water may be treated on-site to lower the contamination levels and render them nonhazardous.

Containers such as 55-gallon drums should be available for storage of wastes.

Spent decontamination solutions can be collected by using heavy-duty plastic sheets, visqueen sheets, kiddie pools, or if needed, a larger containment basin. The decontamination of equipment must be performed on the sheets or in the basins. They could

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be placed on a slight angle so that the spent decontamination solutions drain into a collection basin or drum.

Recommended Supplies for Decontamination of Personnel, Clothing, and Equipment

The list below contains recommendations for supplies which should be on hand for the decontamination of personnel, clothing and equipment. Depending on the site activities, not all of these items may be needed. Alternatively, some additional items not listed here may be required.

- Drop cloths of plastic or other suitable material, such as visqueen, for heavily contaminated equipment.
- Disposal collection containers, such as drums or suitably lined trash cans for disposable clothing and heavily contaminated personal protective clothing or equipment to be discarded.
- Lined box with adsorbents for wiping or rinsing off gross contaminants and liquid contaminants.
- Wash tubs of sufficient size to enable workers to place booted foot in and wash off contaminants (without a drain or with a drain connected to a collection tank or appropriate treatment system).
- Rinse tubs of sufficient size to enable workers to place booted foot in and hold the solution used to rinse the wash solutions and contaminants after washing (without a drain or with a drain connected to a collection tank or appropriate treatment system)
- Wash solutions selected to wash off and reduce the hazards associated with the contaminated wash and rinse solutions.
- Rinse solution (usually water) to remove contaminants and contaminated wash solutions.
- Long-handled soft-bristled brushes to help wash and rinse off contaminants.
- Lockers and cabinets for storage of decontaminated clothing and equipment.
- Storage containers for contaminated wash and rinse solutions.
- Plastic sheeting, sealed pads with drains, or other appropriate method for containing and collecting contaminated wash and rinse water spilled during decontamination.
- Shower facilities for full body wash or, at a minimum, personal wash sinks (with drains connected to collection tank or appropriate treatment system).
- Soap or wash solution, wash cloths and towels.
- Clean clothing and personal item storage lockers and/or closets.

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Standard Equipment Limited Warranty

All references to the Customer herein shall mean the Customer or the Lessee as applicable

(a) ORS Environmental Equipment, a Division of Groundwater Technology, Inc. (ORS), warrants that any Equipment which it manufactures will be free from substantial defects in material and workmanship for a period of one (1) year from the date such goods are delivered to a carrier by ORS for shipment to the Customer

(b) The Customer agrees that the liability of ORS hereunder shall be limited to replacing, repairing or issuing credit for, at ORS's discretion, any Equipment which is returned F.O.B. ORS's plant within the applicable term of the warranty, provided that (i) upon examination of the Equipment ORS determines that the alleged defect constitutes a substantial defect, and (ii) the warranty made hereunder is not invalid pursuant to Section (d) hereof. The Customer agrees that such replacement, repair or credit shall be its sole and exclusive remedies hereunder. For purposes hereof, a substantial defect shall mean any defect which prevents the Equipment from operating in accordance with ORS's published specifications. In the event that ORS determines that Equipment which is no longer manufactured by it contains a substantial defect and the warranty covering the defective equipment is not invalid pursuant to Section (d) hereof, the Purchaser's sole and exclusive remedy hereunder shall be the repair of such Equipment or the replacement of such Equipment with new equipment at ORS's discretion. In no case is Equipment to be returned by the Customer without first submitting a warranty claim in writing to ORS and obtaining a return authorization number from ORS. Equipment which is repaired or replaced pursuant to this warranty shall continue to be warranted for the unexpired portion of the warranty term applicable to the Equipment so repaired or replaced. ORS shall make the final determination as to the existence or cause of any alleged defect

(c) The foregoing warranty shall not be valid (i) if the alleged defect is the result of abuse, misuse, accident, alteration, neglect or unauthorized repair; (ii) if ORS requires installation of the Equipment by specifically approved ORS employee and such installation is not effected, or the Equipment is otherwise installed improperly; or (iii) if the Equipment is resold by the Customer. Any repair shall be deemed unauthorized unless it is made (i) by ORS or a duly authorized agent of ORS or (ii) with the written consent of ORS.

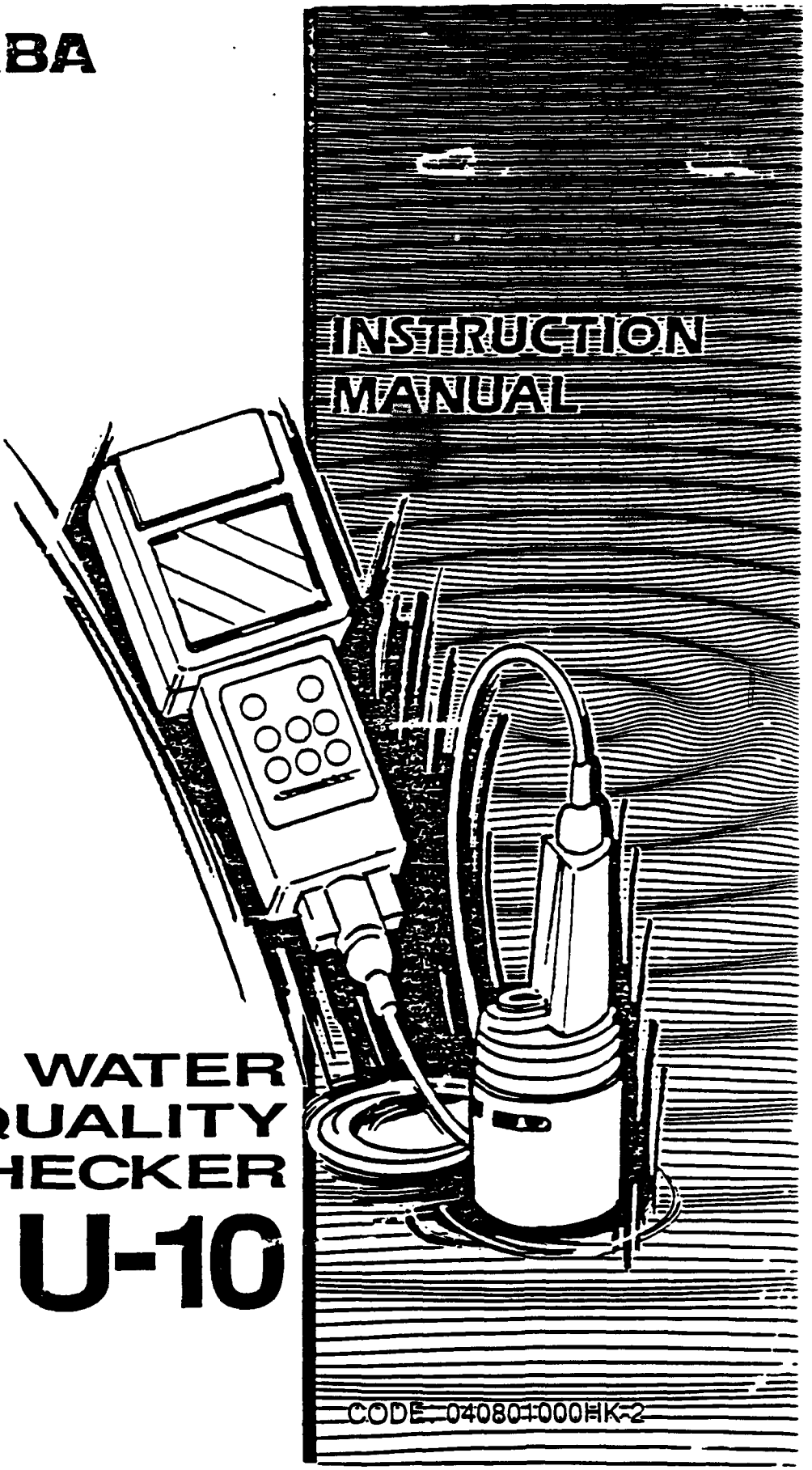
(d) The operating efficiency of treatment, abatement, and recovery Equipment and systems is affected by factors extrinsic to their manufacture, including operating environment and such conditions of use as contaminant and related substance build-up, the frequency and type of operator maintenance and other external variables. For these reasons, specific levels of performance cannot be guaranteed for such Equipment and systems

(e) **THIS WARRANTY IS THE SOLE WARRANTY MADE BY ORS TO THE CUSTOMER AND IS IN LIEU OF ALL OTHER WARRANTIES OR OBLIGATIONS, EXPRESS OR IMPLIED. ORS EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

(f) **THE CUSTOMER AGREES THAT IN NO EVENT SHALL ORS BE LIABLE FOR SPECIAL, INCIDENTAL, INDIRECT, EXEMPLARY OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS OR LOSS OF USE OR ANY OTHER ECONOMIC LOSS, WHETHER BASED ON CONTRACT, TORT OR ANY OTHER LEGAL THEORY.**

(g) **THE REMEDIES PROVIDED HEREIN ARE CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES**

HORIBA



WATER QUALITY CHECKER U-10

CODE 04080-000HK-2

INSTRUCTION MANUAL

for

U-10

WATER QUALITY CHECKER

DATE: OCTOBER 1990

Revised October 1991

HORIBA INSTRUMENTS INCORPORATED

HORIBA INSTRUMENTS INC.
17671 ARMSTRONG
IRVINE INDUSTRIAL COMPLEX
IRVINE, CALIFORNIA 92714
TELEPHONE 714/250-4811

WARNING

The DO sensor contains a strong alkaline solution. Should any of this solution come in contact with your clothing or skin, wash it away immediately with plenty of water.

Be especially careful not to allow any of the alkaline liquid in the DO sensor to get in your eyes.

The U-10 Water Quality Checker is a state-of-the-art instrument for simultaneous multiparameter measurement of water quality. The HORIBA U-10 measures six different parameters of water samples: *pH*, *conductivity*, *turbidity*, *dissolved oxygen*, *temperature*, and *salinity*.

The U-10 is compact enough to be held in one hand while taking measurements. It has a large easy-to-read LCD readout. Measurements are taken simply by immersing the probe right into the water sample.

The U-10 is extremely versatile and sophisticated, yet easy to use. You will find it a valuable addition to on-site water control operations, whatever your needs—from testing factory discharges to urban drainage, river water, lake and marsh water, aquatic culture tanks, agricultural water supplies, and sea water.

To get the most out of your U-10 Water Quality Checker please read and this *Instruction Manual* carefully before you begin to take measurements.

Note that Horiba cannot be held responsible for any equipment malfunction or failure should the U-10 Water Quality Checker be operated incorrectly or in a manner other than specified in this *Instruction Manual*.

Horiba's aim is to produce the best possible equipment and documentation for our products. We welcome comments, questions, or suggestions for improvement concerning both our products and the accompanying documentation, such as this *Instruction Manual*.

First edition: July, 1991

CONTENTS

Section 4 Data Storage and Printout

Section 5 Daily Maintenance and Troubleshooting

Section 6 Reference Materials

Contents of Tables

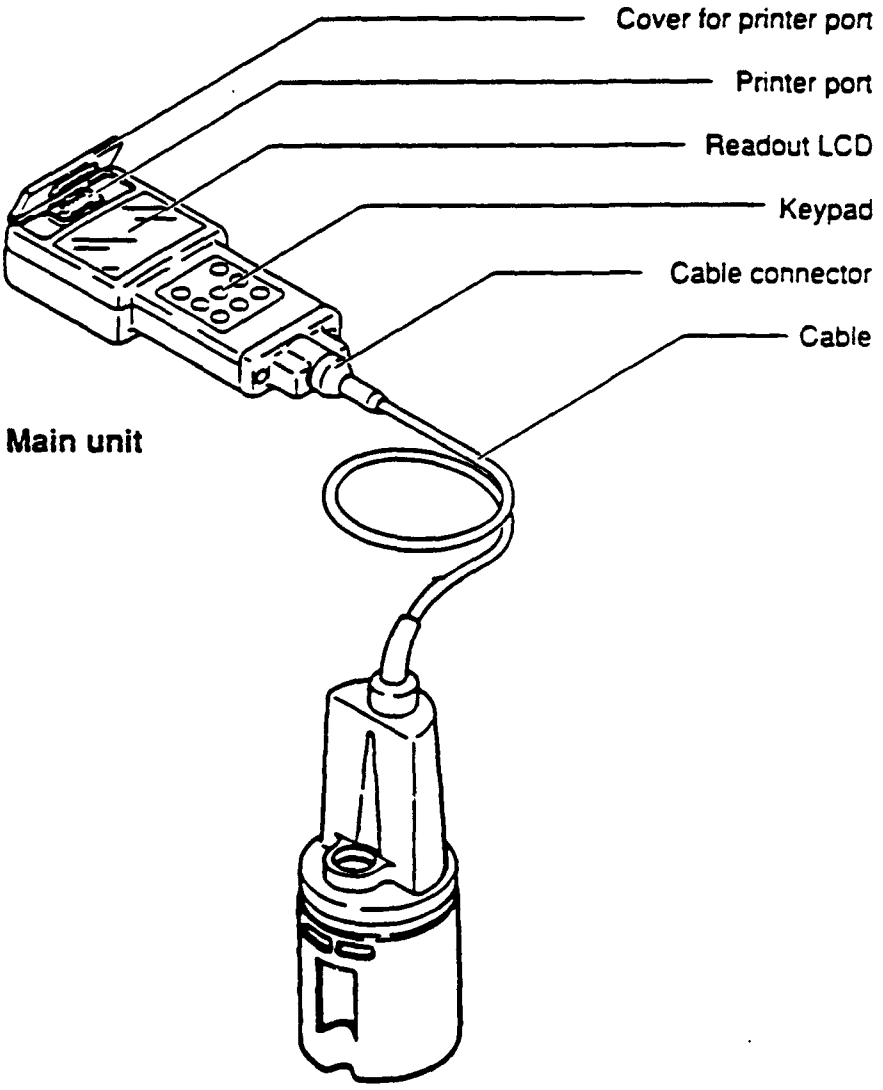
Section 1

Getting Started

This section first gives an overview of the U-10. It then shows how to set up the your U-10 by inserting the DO sensor and the battery. Finally, it lists important precautions to be taken when using your U-10 Water Checker.

Configuration of the U-10

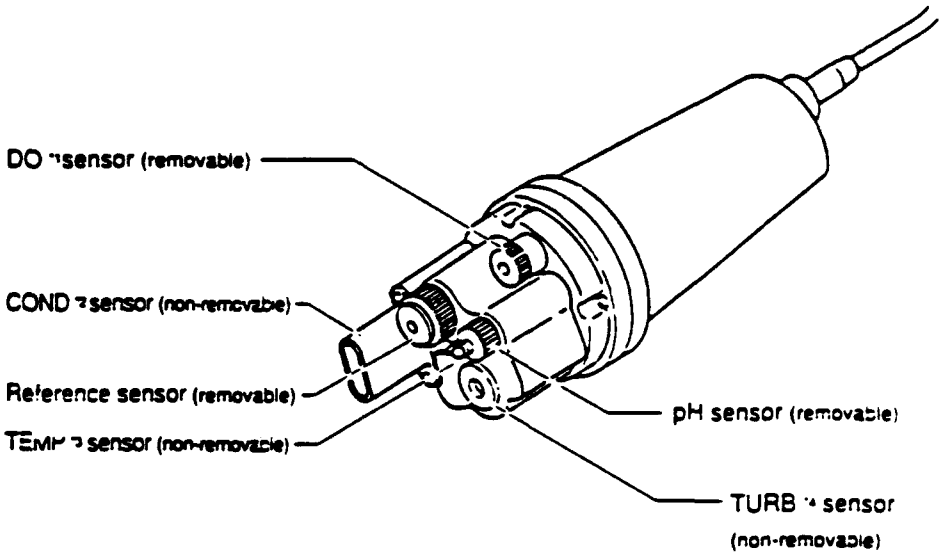
Main unit

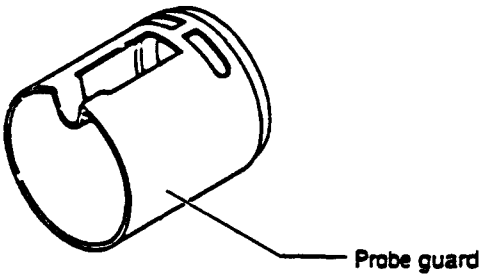


Main unit

Probe

Probe

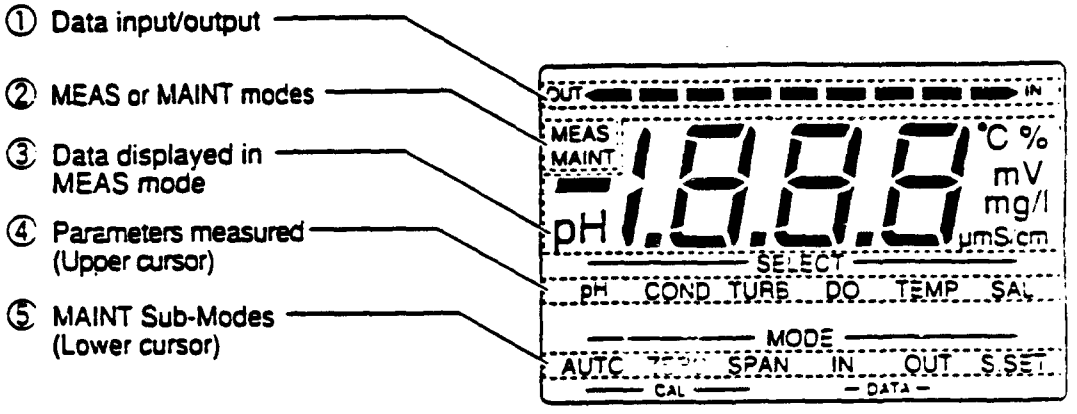




*1 DO : Dissolved oxygen
*2 COND : Conduectivity
*3 TEMP : Temprature
*4 TURB : Turbidity

The Readout

The readout is an easy-to-read LCD. The readout has two main functions: (1) it displays the results of measurements, and (2) it serves as a message board to show the operating status of the U-10.



① Data input/output

OUT Data output

IN Data input

② MEAS or MAINT modes

The U-10 may be in one of two modes: Measurement (MEAS) mode or Maintenance mode.

MEAS the U-10 is ready to make 6-parameter measurements

MAINT the U-10 is ready for other operations, e.g., calibration, data input/recall, or salinity setting

③ Data displayed in MEAS mode

- 6-parameter results:
  pH, conductivity, turbidity, DO, temperature, and salinity
- Designated value for salinity setting
- Error codes

④ Parameters measured

Value displayed on readout is highlighted by upper cursor.

pH	pH
COND	Conductivity
TURB	Turbidity
DO	Dissolved-Oxygen
TEMP	Temperature
SAL	Salinity

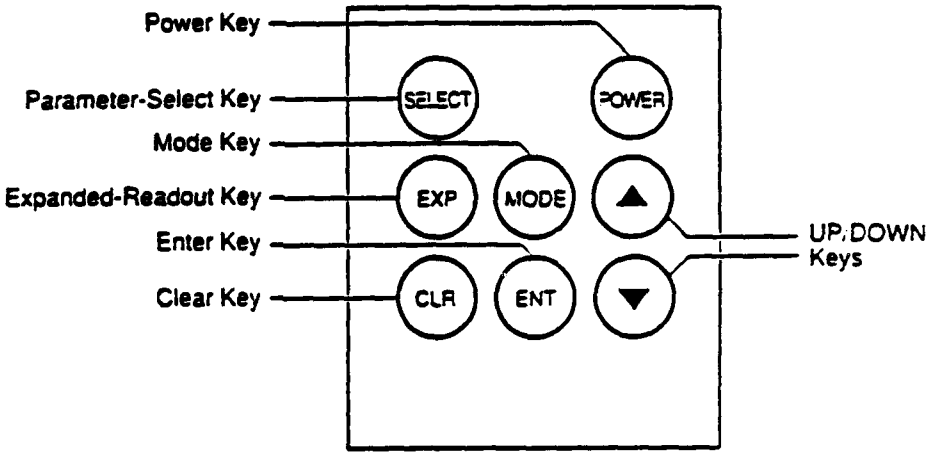
⑤ MAINT Sub-Modes

One of six Sub-Modes selected is highlighted by lower cursor.

AUTO	Automatic 1-point calibration
ZERO	Manual zero calibration
SPAN	Manual span calibration
IN	Data input
OUT	Data output (recall)
S.SET	Salinity setting correction

The Keypad

The U-10 is operated by the keypad on the main unit, which has eight surface-sealed keys, as illustrated.



POWER

Power Key (POWER)
Turns the main unit ON/OFF.

When this key is pressed to turn the U-10 ON, the readout comes in the MEAS mode, showing the parameter last displayed in the previous measurement. If the U-10 is left with the power ON for 30 minutes without any of the keys being activated operated, the power will be turned OFF automatically.

SELECT

Parameter-Select Key (SELECT)
Use this key to move the upper cursor to the measured parameter you want to show on the readout. It toggles through the six parameters in order:

pH → COND → TURB → DO → TEMP → SAL

MODE

Mode Key (MODE)
Toggles back and forth between MEAS and MAINT modes. When in the MAINT mode, this key toggles the lower cursor through the six maintenance Sub-Modes.

AUTO → ZERO → SPAN → IN → OUT → S.SET

Expanded-Readout Key (EXP)
Toggles between (1) standard readout value and (2) expanded readout, for greater resolution, with decimal point moved one digit to the left.

Enter Key (ENT)
This acts like the RETURN Key or Enter Key on a computer keyboard. The U-10 Enter Key has four main functions, depending on which mode the unit is in.

1. In the AUTO Sub-Mode: Press this key to start automatic calibration.
2. In either the ZERO or SPAN Sub-Modes: Used in manual calibration to set the value for the standard solution being used.
3. In the IN Sub-Mode: Inputs data being measured to memory.
4. In the OUT Sub-Mode: Recalls values from one of the 20 Data-Set Nos. that is now shown on the readout. Prints data when a printer is connected.

Clear Key (CLR)
This acts like the ESCAPE Key on a computer keyboard. It has three main functions, depending on which mode the unit is in.

1. In the AUTO Sub-Mode: Aborts the auto-calibration now in progress.
2. In the IN Sub-Mode: Deletes data in memory from all 20 Data-Sets.
3. When the readout shows an error code: Clears the error code from the readout.

UP/DOWN keys
Use these keys to select values when in one of the MAINT Sub-Modes. They have two main functions.

1. In either the ZERO or SPAN Sub-Modes: Use these keys to select value for the standard solution.
2. In the OUT mode: Used to toggle through the 20 Data-Set Nos. to select the one you wish to recall.

Setting up the U-10

Inserting the DO sensor

WARNING

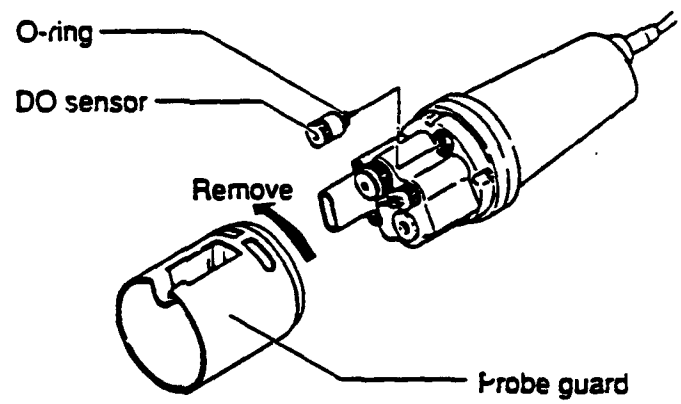
The DO sensor contains a strong alkaline solution. Should any of this solution come in contact with your clothing or skin, wash it away immediately with plenty of water. Be especially careful not to allow any of the liquid in the DO sensor to get in your eyes.

The Dissolved-Oxygen (DO) sensor has a delicate membrane that can easily be ruptured. For safety's sake, the U-10 is shipped to you with the DO sensor packed separately. You should insert the DO sensor when you unpack your U-10 unit.

1. Make sure that the DO sensor has the correct O-ring, as shown.

2. First, fit the DO sensor lightly into its socket, and then put on the probe guard to align it correctly.

3. Then, tighten the DO sensor securely to the probe body. When doing this, be especially careful not to damage the membrane, which is located in the front of the DO sensor.



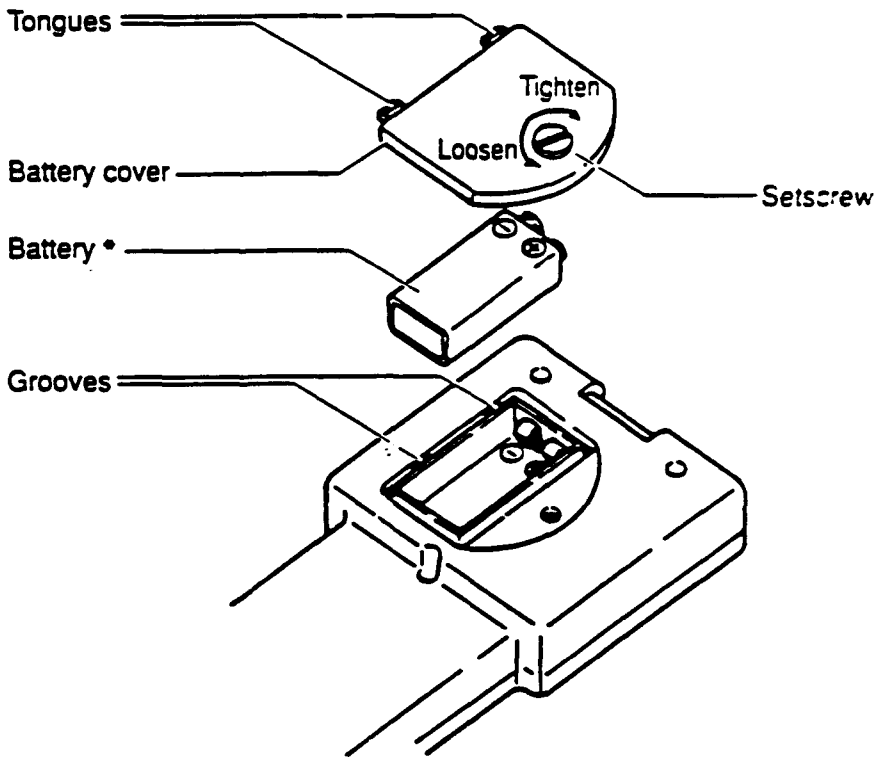
Inserting the battery

The U-10 is shipped from the factory with the battery packed separately.

The battery may be inserted by loosening the set-screw on the battery cover and pulling up the cover. Make sure that the plus and minus poles of the battery match the terminals correctly.

If the readout shows the message $Er\ 1$, it means that the battery is defective or exhausted and should be replaced.

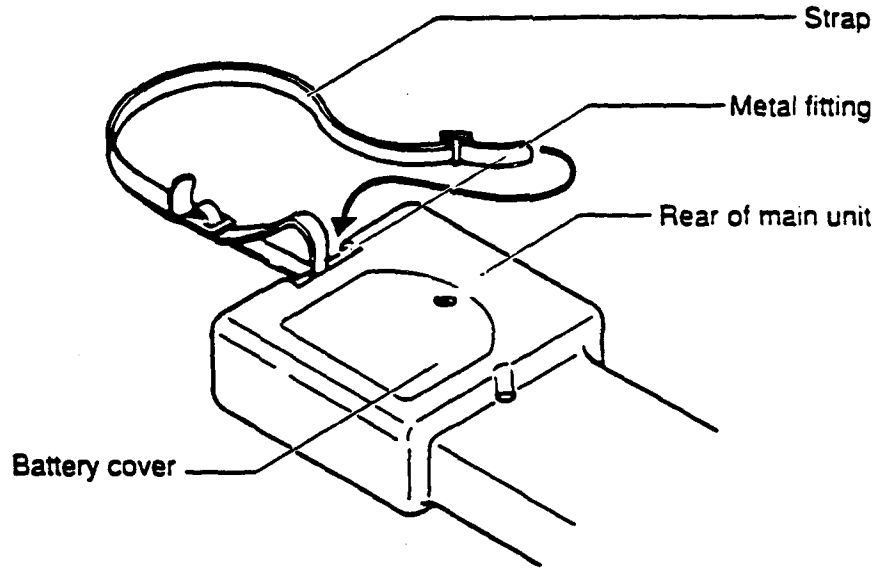
If you are replacing the battery and already have data stored in the U-10 memory that you wish to save, be sure to turn OFF the POWER Key before you remove the old battery. This will assure that data stored in memory will be maintained by the internal backup battery.



• Use the 9V-battery.

Attaching the carrying strap

Hook both ends of the strap through the metal fitting on back of the main unit, as illustrated.



Section 2

Making Measurements

Making a measurement with the U-10 Water Checker is extremely simple. Just turn on the power and place the probe in the sample of water you wish to measure.

All six parameters are measured simultaneously.

These parameters may be stored in memory, printed out, or viewed one-by-one on the LCD readout. For printing and data storage, see the appropriate sections following this one. To view the parameters one-by-one on the readout, use the SELECT Key to toggle the upper cursor through them.

While the U-10 is both rugged and precise, the key to accurate measurements is cleanliness and frequent calibration. It is essential to clean the U-10 thoroughly after each measurement, and it is recommended that you re-calibrate your U-10 as frequently as possible. For best results, you should recalibrate it before each measurement session. Cleaning and calibration procedures are described below in this section and in the following one.

How to make a measurement

1 Turn the power on

2 Gently place the probe into the water sample.

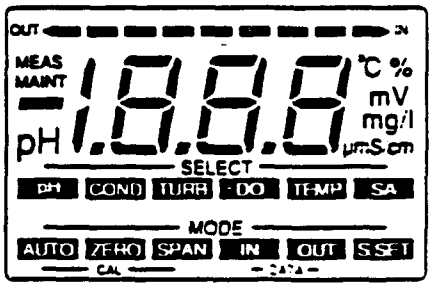
Basically, that's all there is to it: just turn it on and put the probe in the sample. Of course, the U-10 can do many sophisticated things with the sample data, and for best results, you should be careful about calibrating the unit and maintaining it in good condition. This is explained in detail below and in the next section.

Be careful!
Never drop or throw the probe into the water. It is a precision instrument containing five delicate sensors and five pre-amps; you can damage it beyond repair by unnecessarily rough handling.

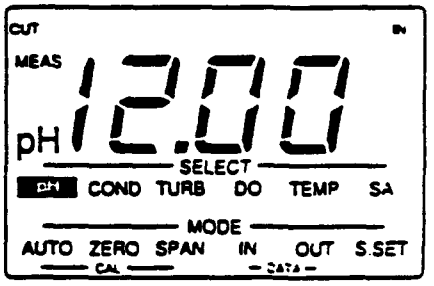
Initial readout

POWER

When you first turn the power on, the U-10 will be in the MEAS mode, the readout will look like this, with all the LCD segments activated.



After about two seconds, the readout will change to show that a new measurement is being made. The readout will show the last parameter that the upper cursor was on when the previous measurement was made, i.e., pH as illustrated here.



(Expanded readout shown)

The display of the decimal point in the readout mode will also be in the same format as was selected with the EXP Key in the previous measurement, i.e., standard or expanded (as illustrated here).

Select the parameter you want shown on the readout

All six parameters are automatically measured at once. Use the SELECT Key to toggle the upper cursor to the parameter you want.

pH	: pH
COND	: Conductivity
TURB	: Turbidity
DO	: Dissolved oxygen
TEMP	: Temperature
SAL	: Salinity

To get a uniform reading, slowly move the probe up and down to circulate the water through it. (Move it 1 foot (30 cm) per sec.) Then wait for the readout to stabilize while doing this.

Expanded readout

EXP

Use the EXP readout mode when you wish to see the results with one additional decimal place of accuracy. The EXP Key toggles the readout back and forth between standard to expanded display. The table below shows the result of using the EXP readout mode for each of the six parameters.

Table 1. Accuracy of expanded readout

Parameter	Range of measurement	Accuracy	
		Standard readout	Expanded readout
pH	0-14 pH	0.1 pH	0.01 pH
COND	0-1 mS/cm	0.01 mS/cm	0.001 mS/cm
	1-10 mS/cm	0.1 mS/cm	0.01 mS/cm
	10-100 mS/cm	1 mS/cm	0.1 mS/cm
TURB	0-800 NTU	10 NTU	1 NTU
DO	0-19.9 mg/l	0.1 mg/l	0.01 mg/l
TEMP	0-50°C	1°C	0.1°C
SAL	0-4%	0.1%	0.01%

Note that the salinity parameter is the only value not measured directly with its own sensor. The U-10 obtains salinity by converting the conductivity value. If large amounts of conductive ions other than salt-water components are present in the sample, an error may occur. Be cautious when interpreting the salinity results.

Measuring fresh water or salt water?

The U-10 can be set to the salinity for either fresh water or salt water when measuring DO. This is done by using the S.SET Sub-Mode.

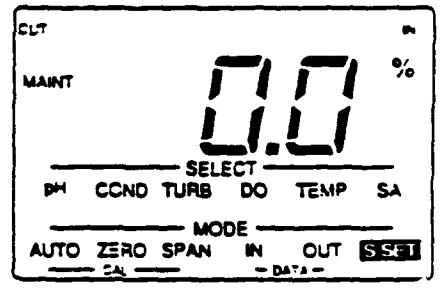
Measuring fresh water

MODE

First, use the MODE Key to put the U-10 in the MAINT mode. Keep pressing the MODE Key to toggle the lower cursor to the S.SET Sub-Mode.

▲
▼

Once you are in the S.SET Sub-Mode, use the UP/DOWN Keys to select the salinity value. For fresh water, set the salinity to 0.0%.



ENT

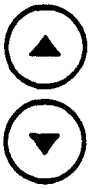
Finally, press the ENT Key to complete the salinity setting while in the S.SET Sub-Mode.

MODE

When the salinity setting has been made, switch back to the MEAS mode by pressing the the MODE Key.

Measuring salt water

First, use the MODE Key to put the U-10 in the MAINT mode. Keep pressing the MODE Key to toggle the lower cursor to the S.SET Sub-Mode.



For salt w ater, set it to *A i.e.*, for auto-salinity.

The *A* setting should be sufficient for measurements of normal sea water with a salinity value close to 3.3%. For sea water of an unusual salinity, however, and where the value is otherwise known, you may wish set the value manually to any salinity within the range of 0.0%-4.0%. (You may also possibly want to use a manual setting if, for example, the COND sensor is malfunctioning but it is still desirable to take readings of the other parameters.)

Finally, press the ENT Key to complete the salinity setting while in the S.SET Sub-Mode.

When the salinity setting has been made, switch back to the MEAS mode by pressing the the MODE Key.

After measurement: Cleaning and storing the U-10

Turn OFF the power.

Wash the probe thoroughly with tap water. Be sure to flush off all of sample solution from the probe.

Storing the U-10 for brief periods, *i.e.*, about 1 week or less:

Fill the calibration beaker with tap water and fit the probe over it.

For longer storage

The pH sensor must always be kept moist. Fill the small rubber cap with water and use it to cover the pH sensor.

The KCl internal solution in the pH reference sensor may seep out over time. Place vinyl tape around the O-ring portion to prevent this.

If you are going to store the U-10 for a prolonged period without using it, remove the battery from the main unit.

Section 3

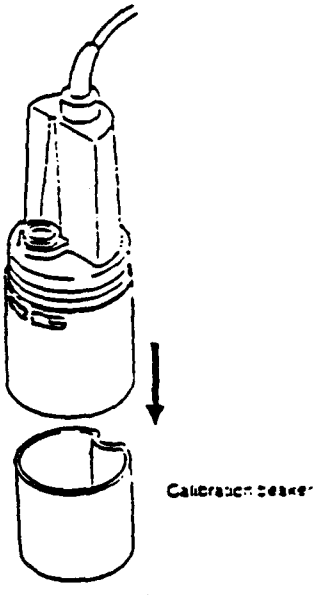
Calibrating the U-10

The U-10 Water Checker may be calibrated either manually or automatically. The 4-parameter auto-calibration procedure is quite handy and should be sufficient for most measurement operations.
Manual calibration for each of the four parameters is more accurate but, of course, also more time-consuming. This method should be used for difficult measurements or where more than normal precision is required. The manual calibration procedure is explained below in detail, following the description of the auto-calibration procedure.
The auto-calibration procedure is extremely simple. The U-10 Water Checker uses just a single solution to do a simultaneous calibration of four parameters: *pH, COND, TURB,* and *DO.* Your U-10 comes with a bottle of standard phthalate pH solution and a calibration beaker for this purpose.

Auto-calibration procedure

Fill the calibration beaker to about 2/3 with the standard solution. Note the line on the beaker.

Fit the probe over the beaker, as illustrated. Note that the beaker is specially shaped to prevent the DO sensor from being immersed in the standard solution. This is because the DO auto-calibration is done using atmospheric air.



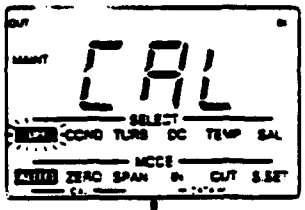
MODE

With the power on, press the MODE Key to put the unit into the MAINT mode. The lower cursor should be on the AUTO Sub-Mode; if it is not, use the MODE Key to move the lower cursor to AUTO.

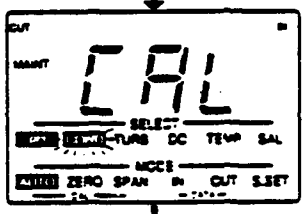
ENT

With the lower cursor on AUTO, press the ENT Key. The readout will show CAL. Wait a moment, and the upper cursor will gradually move across the four auto-calibration parameters one-by-one: *pH, COND, TURB,* and *DO.* When the calibration is complete, the readout will briefly show End and then will switch to the MEAS mode.

The upper cursor will blink while the auto-calibration is being made. When the auto-calibration has stabilized, the upper cursor will stop blinking.



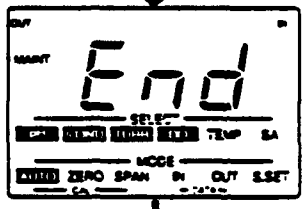
First, pH is being auto-calibrated



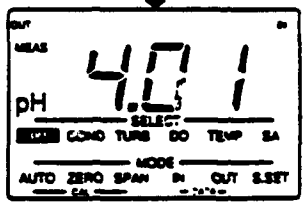
Then, COND is being auto-calibrated

Next, TURB is being auto-calibrated

Finally, DO is being auto-calibrated



Auto-calibration now ends

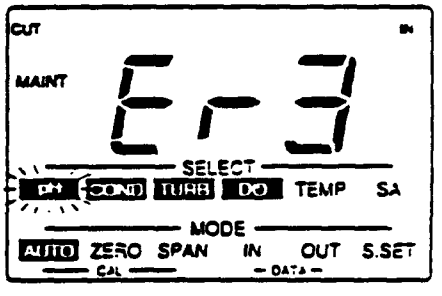


And the readout switches to the MEAS mode

Note: If you wish to abort the auto-calibration for any reason, press the CLR Key. The parameters auto-calibrated so far will be in memory.

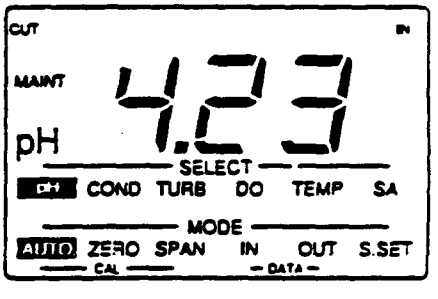
Auto-calibration error

After the DO auto-calibration, if the unit does not switch to the MEAS mode as it should, and the readout shows either Er3 or Er4, an auto-calibration error has occurred. Parameters will blink where an error occurred.



pH auto-calibration error

If this happens, re-do the auto-calibration. First, press the CLR Key to cancel the error code.

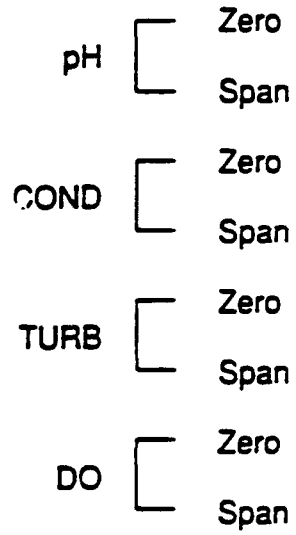


Then press the ENT Key to re-start the auto-calibration. Restart the auto-calibration beginning again with pH.

Manual (2-point) calibration procedures

For normal measurements, the 4-parameter auto-calibration described above is sufficiently accurate. However, you may wish to do a parameter-by-parameter, 2-point manual calibration of one or more of the four parameters. This is recommended either for high-accuracy measurements, especially when using the expanded readout mode. It is necessary if a new probe is being used for the *first time*.

Parameters to be calibrated manually.



pH calibration

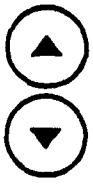
1. Zero calibration

Wash the probe 2-3 times, using de-ionized or distilled water. Place it in a beaker of pH 7 standard solution, i.e., a neutral phosphate standard solution.

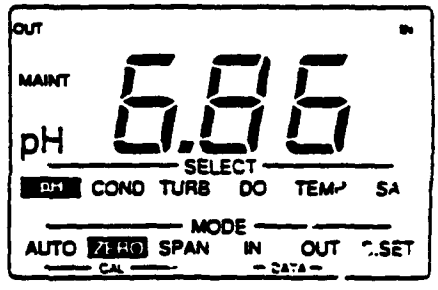
1. With the power on, press the MODE Key to put the unit into the MAINT mode.

2. Press the MODE Key again to move the lower cursor to ZERO.

3. Use the SELECT Key to move the upper cursor to pH.



4. When the readout has stabilized, use the UP/DOWN Keys to select the value of the pH 7 standard solution at the temperature of the sample. Refer to Table 2 for pH values of standard solutions at various temperatures.



5. Press the ENT Key to complete the zero calibration for pH.

2. Span calibration

Again, wash the probe 2-3 times in de-ionized or distilled water. This time, place it in a beaker of either pH4 or pH9 standard solution.

1. Use the MODE Key to move the lower cursor to SPAN.

2. As in Step 4. above in zero calibration, when the readout has stabilized, use the UP/DOWN Keys to select the value of the standard solution (i.e., either pH4 or pH9) at the temperature of the sample. Again, refer to Table 2 for pH values of standard solutions at various temperatures.

3. Press the ENT Key to complete the span calibration for pH.

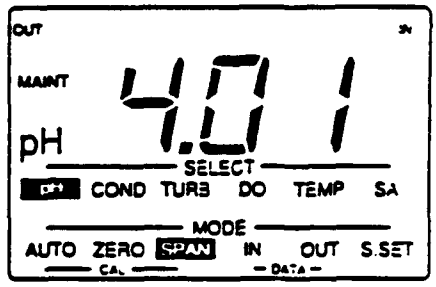


Table 2 pH values of standard solutions at various temperatures*

Temperature ℃ / F°	pH2[a]	pH4[b]	pH7[c]	pH9[d]	pH10[e]	pH12[f]
0 / 32	1.67	4.01	6.98	9.46	10.32	13.43
5 / 41	1.67	4.01	6.95	9.39	10.25	13.21
10 / 50	1.67	4.00	6.92	9.33	10.18	13.00
15 / 59	1.67	4.00	6.90	9.27	10.12	12.81
20 / 68	1.68	4.00	6.88	9.22	10.06	12.63
25 / 77	1.68	4.01	6.86	9.18	10.01	12.45
30 / 86	1.69	4.01	6.85	9.14	9.97	12.30
35 / 95	1.69	4.02	6.84	9.10	9.93	12.14
40 / 104	1.70	4.03	6.84	9.07	9.89	11.99
45 / 113	1.70	4.04	6.83	9.04	9.86	11.84
	1.71	4.06	6.83	9.01	9.83	11.70

a : oxalate, b : phthalate, c : neutral phosphate, d : borax,
e : carbonate, f : Sat.calcium hydroxide solution

* These pH valves are for Japanese standard solutions. Should you prefer to use different standard solutions, be save to make the proper adjustments in calibration.

COND calibration

The U-10 can measure conductivity in the range of 0-100 mS/cm. Depending on the sample concentration, however, the U-10 automatically selects the proper range out of its three possible ranges of 0-1 mS/cm, 1-10 mS/cm, and 10-100 mS/cm.

Therefore, if you are doing a manual calibration for COND, this must be done for each of the three ranges. However, since the zero point is common for all three ranges, only the three one-point span calibrations need be done separately.

Preparing the standard solution for COND span calibration

This procedure uses a potassium chloride standard solution. For greater accuracy, the solution should be freshly prepared each time. If it is unavoidable to use a stored solution, be sure to keep it tightly capped in a polyethylene or hard glass bottle. The shelf life of this solution is six months. Date-stamp the bottle for reference. Never use a KCl standard solution that has been stored for more than six months: the calibration accuracy may be adversely affected.

Use potassium chloride powder of the best quality commercially available. Dry the powder for two hours at 105°C, and cool it down, in a desiccator. Weigh out an appropriate amount of dried and cooled potassium chloride powder according to the table below. Make the potassium chloride standard solution as shown.

Table 3 Making the potassium chloride standard solution

KCl standard solution	Conductivity* mS/cm	KCl weight g	Range to be calibrated mS/cm
0.005N	0.718	0.373	0-1
0.05N	6.67	3.73	1-10
0.5N	58.7	37.28	10-100

* Temperature of solution: 25°C

To prepare the standard solution, use a 1-liter volumetric flask. First, dissolve the KCl in a small amount of de-ionized or distilled water. Then fill the flask with de-ionized or distilled water up to the 1-liter line. Finally, shake the solution to mix it thoroughly.

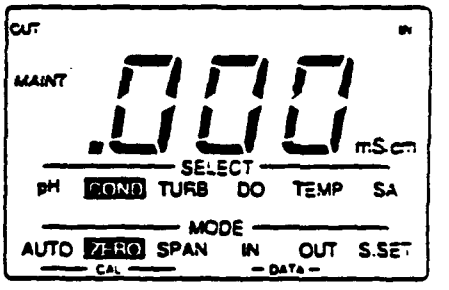
1. Zero calibration

Wash the probe 2-3 times, using de-ionized or distilled water. Shake the probe to remove any water droplets from the COND electrode. Then allow it dry to dry exposed to fresh air.

1. Use the MODE Key to move the lower cursor to ZERO.

2. Use the SELECT Key to move the upper cursor to COND.

3. Use the UP/DOWN Keys to set the readout to 0.0

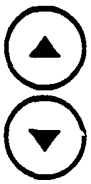


4. Press the ENT Key. This completes the zero calibration for COND.

2. Span calibration

Once again, wash the probe 2-3 times using de-ionized or distilled water. Following this, wash it a further 2-3 times in the KCl standard solution you have prepared. Then place the probe in a beaker of the KCl solution maintained at a temperature of 25±5°C.

1. Use the MODE Key to move the lower cursor to SPAN.



2. After the readout stabilizes, as you did for the pH calibration, use the UP/DOWN Keys to select set the value of the KCl standard solution, referring to the KCl table.

3. Press the ENT Key to complete the span calibration for this COND range.

4. Repeat this procedure for the three ranges, using each of three values of KCl standard solutions.

TURB calibration

Wash the probe 2-3 times, using de-ionized or distilled water. For the span calibration, use a prepared span solution. For the turbidity zero calibration, use de-ionized or distilled water.

Preparing the standard solution for TURB span calibration

1. Weigh out 5.0 g of hydrazine sulfate.
2. Dissolve this in 400 m*l* of de-ionized or distilled water.
3. Then weigh out 50 g of hexamethylenetetramine, and dissolve it in 400 m*l* of de-ionized or distilled water.
4. Mix these two solutions, add enough de-ionized or distilled water to make 1,000 m*l*, and stir the mixed solution thoroughly.
5. Allow this solution to stand for 24 hours at a temperature of 25±3°C.

   The turbidity of this solution is equivalent to 4000 NTUs. The shelf-life of this solution is six months; i.e., this 4,000-NTU value will remain accurate for a maximum of six months.

   Each time you carry out this calibration, it is necessary to dilute the 4,000-NTU standard solution to prepare an 800-NTU standard solution for calibration. To do this, measure out 50 m*l* of the 4,000-NTU solution into a 250-m*l* measuring flask.

   It is recommended that you use a rubber pipette aspirator for this. Then add de-ionized or distilled water up to the 250-m*l* line.

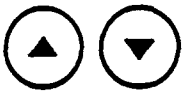
   The standard solution used here for the turbidity calibration will precipitate easily. Therefore, be sure to stir the solution thoroughly before use.

1. Zero calibration

Wash the probe thoroughly 2-3 times using de-ionized or distilled water. Shake off excess water droplets, and then place it in a beaker of de-ionized or distilled water.

1. Use the MODE Key to move the lower cursor to ZERO.

2. Use the SELECT Key to move the upper cursor to TURB.



3. After the readout has stabilized, set it to 0.0, using the UP/DOWN Keys.

4. Press the ENT Key to complete the zero calibration for TURB.

2. Span calibration

Wash the probe thoroughly, using de-ionized or distilled water. Shake off excess water droplets. Then place it in a beaker of the 800-NTU solution you have prepared for this purpose.

1. Stir this 800-NTU span standard solution thoroughly.

2. Use the MODE Key to move the lower cursor to SPAN.

3. After readout has stabilized, i.e., about 60 to 90 seconds, set the readout to "800" NTU, which is the value for this standard solution.

4. Press the ENT Key to complete the span calibration for TURB.

DO calibration

A zero standard solution is used for the DO zero calibration. An oxygen-saturated span solution is used for the DO span calibration.

Preparing the standard solution

Zero solution
Add about 50g of sodium sulfite to 1,000 m*l* of water (either de-ionized water or tap water will do). Stir this mixture thoroughly until completely dissolved.

Span solution
Put 1 or 2 liters of water in a container (either de-ionized water or tap water will do). Use an air pump to bubble air through the solution until it is oxygen-saturated.

1. Zero calibration

Wash the probe 2-3 times in tap water, and place it in the zero standard solution.

1. Use the MODE Key to move the lower cursor to ZERO.

2. Use the SELECT Key to move the upper cursor to DO.

3. After the readout has stabilized, set it to 0.0, using the UP/DOWN Keys.

4. Press the ENT Key. This completes the zero calibration for DO.

2. Span calibration

Wash the probe 2-3 times in tap water, and put it in the span standard solution.

1. First, be sure the U-10 is set for fresh water readings. To do this, set the S.SET Sub-Mode to 0.0%.

2. Then, use the MODE Key to move the lower cursor to SPAN.

3. After the readout has stabilized, while slowly moving the probe up and down in the solution, set the readout value to the appropriate DO value for the temperature of this solution. For DO values at various temperatures, refer to Table 4.

4. Press the ENT Key to complete the span calibration for DO.

Table 4 Amounts of saturated dissolved oxygen in water at various temperatures, salinity = 0.0%

Temperature °C	DO in mg/l	Temperature °C	DO in mg/l
0	14.16	21	8.68
1	13.77	22	8.53
2	13.40	23	8.39
3	13.04	24	8.25
4	12.70	25	8.11
5	12.37	26	7.99
6	12.06	27	7.87
7	11.75	28	7.75
8	11.47	29	7.64
9	11.19	30	7.53
10	10.92	31	7.42
11	10.67	32	7.32
12	10.43	33	7.22
13	10.20	34	7.13
14	9.97	35	7.04
15	9.76	36	6.94
16	9.56	37	6.86
17	9.37	38	6.76
18	9.18	39	6.68
19	9.01	40	6.59
20	8.84		

Section 4

Data Storage and Printout

The U-10 can store up to 20 sets of data, 120 data points, of the values measured for each of the six parameters: pH, COND, TURB, DO, TEMP, and SALINITY. Values stored in memory can be recalled to the readout as desired.

If a printer is connected to the U-10 printer port, whenever a Data-Set is either stored in memory or recalled to the readout, it can also be simultaneously output to the printer.

Storing data

MODE

1. Press the MODE Key to put the U-10 in the MAINT mode.

MODE

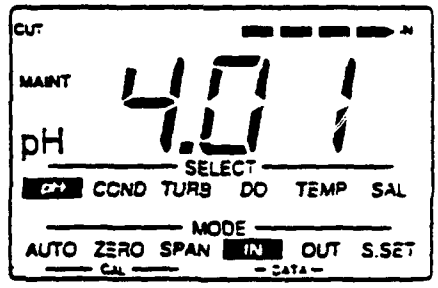
2. *Continue to press the* MODE Key to move the lower cursor to IN, the *Input* Sub-Mode.

SELECT

3. Use the SELECT Key to move the upper cursor to the parameter you wish to see on the readout.

ENT

4. When the readout stabilizes on a value, press the ENT Key. This will automatically input the set of six parameters for this measurement into memory.



The readout will first show the Data-Set No. for about two seconds. At the top right-hand corner, a dashed arrow points to IN, showing that data is being input. Then each parameter is automatically read into memory, one-by-one from pH to salinity. The upper cursor skips along to show this. If a printer is connected, these six values will also be printed out at the same time.

The upper cursor then returns to pH, with the U-10 still in the IN Sub-Mode.

ENT

5. You may now continue and input another set of data: simply press the ENT Key again.

The Data-Set No. will automatically advance one digit, and the next set of six parameters will be read into memory in the same manner. This procedure can be repeated for up to a total of 20 Data-Sets.

If 20 Data-Sets have been read into memory, the storage capacity is full and no more data may be input. The U-10 will beep three times to indicate the memory is full.

6. To return the readout to the previous setting in the MEAS mode, press the MODE Key again.

Recalling Data

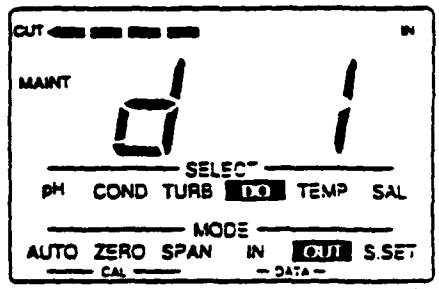
MODE

1. Press the MODE Key to put the U-10 in the MAINT mode.

MODE

2. Continue to press the MODE Key to move the lower cursor to OUT, the *Output* Sub-Mode. The readout will show d.1, meaning Data-Set No. 1.

   At the top left-hand corner, a dashed arrow points to OUT, showing that data can be output now to the readout.



▲

▼

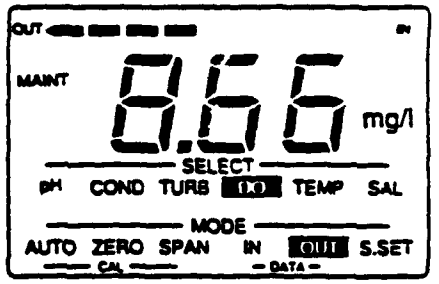
3. Use the UP/DOWN Keys to display the Data-Set No. of the values you wish to recall.

SELECT

4. Use the SELECT Key to move the upper cursor to the parameter you wish to view.

ENT

5. Press the ENT Key to display the data on the readout.

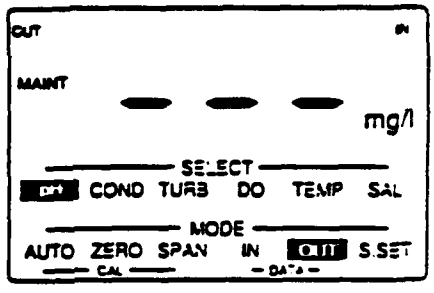


If a printer is connected, all six parameters in this Data-Set will also be printed out at the same time.

ENT

6. When the ENT Key is pressed again, the next Data-Set No. is displayed in order, i.e., *d2*, if two data sets are in memory. At this point, you can either press the ENT Key again to view the contents of this Data-Set, or you can use the UP/DOWN Keys to go up or down to another Data-Set No.

   If a particular Data-Set is empty, three dashes appear on the readout.



MODE

7. To return the readout to the previous setting in the MEAS mode, press the MODE Key again.

Deleting data

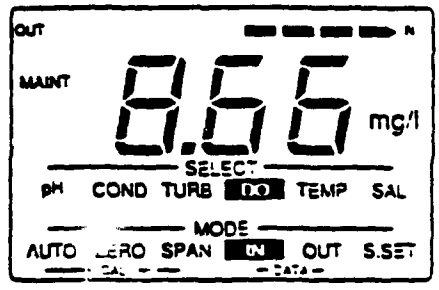
Set the U-10 as if you were going to input data:

MODE

1. Press the MODE Key to put the U-10 in the MAINT mode.

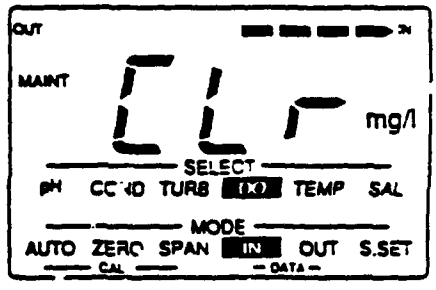
MODE

2. Continue to press the MODE Key to move the lower cursor to IN, the Input Sub-Mode.



CLR

3. Then, to erase all the data from all the Data-Sets in memory, press the CLR Key. The readout will show the message CLr for about two seconds.

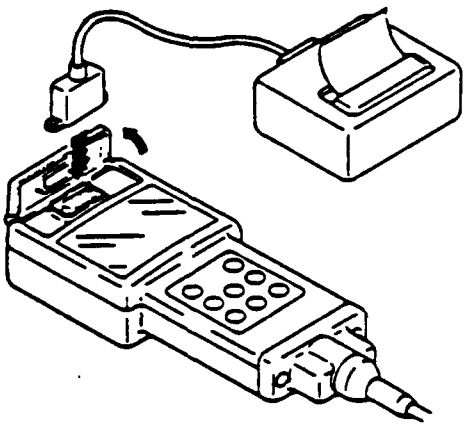


Be careful!
You cannot delete individual Data-Sets. The CLR Key always erases all data from memory.

Printing out data

If a printer is connected to the U-10 printer port, whenever a Data-Set is either stored in memory or recalled to the readout, it is also simultaneously output to the printer.

The U-10 printer port is a standard Centronics parallel port. To connect a parallel printer to the U-10: Open the rubber printer-port cover, located directly over the readout on the main unit, and connect the printer cable.



Note:
When a printer is not being used, disconnect the cable from the U-10 printer port, and close the cover tightly.

- **Sample printout**

```
NO. 1 DATE  /  /
 pH      5.0
 COND    1.5    mS/cm
 TURB  390      NTU
 DO      0.5    mg/l
 TEMP   23      °C
 SAL     3.8    %
NO. 2 DATE  /  /
 pH      3.1
 COND    1.3    mS/cm
 TURB  270      NTU
 DO      0.7    mg/l
 TEMP   25      °C
 SAL     0.1    %
NO. 3 DATE  /  /
 pH      3.1
```

Section 5

Daily Maintenance and Troubleshooting

For accurate measurements and prevention of malfunction, routine careful maintenance of the U-10 is important. In particular, failure to maintain the sensors properly can lead to serious trouble or incorrect measurements. The U-10 is provided with error-code functions for the ready detection of potential problems.

Error Codes

The U-10 has an easy-to-understand error message function so you can spot trouble readily. Error codes are displayed on the readout and the unit will beep if an error occurs.
(Note that if you press an incorrect sequence of keys, the unit will beep three times to indicate you have pushed the wrong key.)

Error Code	Cause	Action
Bad battery		
Er 1	• Defective or low battery	• Replace battery
Failure in main unit		
Er2	• Malfunction of memory backup IC	• Push POWER Key to turn the U-10 ON again. If this error code is still displayed, contact your Horiba dealer for repair or replacement.
Zero-calibration error		
Er3	*for all parameters*	
	• Poor connection in probe-to-main-unit cable	• Connect the cable securely.
	• Water in one of the sensor sockets	• Dry out the sensor sockets.
	• Temperature of sample exceeds maximum scale of U-10	• Replace the probe.
	for pH	
	• Contaminated pH sensor.	• Clean the pH sensor.
	• Improper concentration of KCl internal solution in pH reference sensor	• Replace the pH reference sensor KCl internal solution.
	for COND	
	• Contaminated COND sensor	• Clean the sensor, using tooth brush and neutral detergent.
	for TURB	
	• Contaminated or defective LED sensor	• Clean out the tube containing the LED turbidity sensor, using test tube brush and neutral detergent. Never use an abrasive detergent cleanser for this.

Error Code	Cause	Action
	for DO	
	• Broken DO sensor membrane.	• Check the LED turbidity sensor. If it defective, the entire probe must be replaced. Check DO sensor. If defective, replace.
Span-calibration error		
Er 4	*for all parameters*	
	• Poor connection in probe-to-main-unit cable	• Connect the cable securely.
	• Water in one of the sensor sockets	• Dry out the sensor sockets.
	• Temperature of sample exceeds maximum scale of U-10	• Replace the probe.
	for pH	
	• Contaminated pH sensor.	• Clean the pH sensor.
	• Improper concentration of KCl internal solution in pH reference sensor	• Replace the pH reference sensor KCl internal solution.
	for COND	
	• Contaminated COND sensor	• Clean the sensor, using tooth brush and neutral detergent.
	for TURB	
	• Contaminated or defective LED sensor	• Clean out the tube containing the LED turbidity sensor, using test tube brush and neutral detergent. Never use an abrasive detergent cleanser for this. • Check the LED turbidity sensor. If it defective, the entire probe must be replaced.

Error Code	Cause	Action
Span-calibration error Er 4	*DO Auto-calibration* • Broken DO sensor membrane.	• Check DO sensor membrane. If defective, replace.
	• Excessive difference between DO sensor temperature and atmospheric temperature.	• Leave DO sensor in atmosphere for 30-60 min.
	DO aqueous solution calibration • Broken DO sensor membrane.	• Check DO sensor membrane. If defective, replace.
	• Contaminated electrode.	• Clean the electrode using a soft brush, taking care not to scratch membrane.
	• Insufficient agitation of solution.	• Agitation solution thoroughly.
Memory full Er 5	• Data-sets for 20 samples are already in memory.	• To delete all data from memory, put the U-10 in the IN Sub-Mode mode and press the CLR Key.
Printer error Er 6	• Jammed printer paper.	• Eliminate jamming of printer paper.
	• Poor cable connection .	• Replace the cable.
	• Wrong printer.	• Use proper parallel Centronics printer.
	• Defective printer.	• Replace the printer as necessary.

Normal probe maintenance

Washing the turbidity sensor

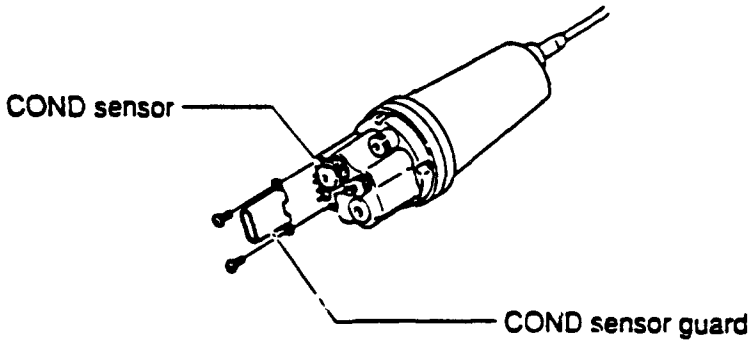
The sensor is a glass tube. Wash out the tube and remove stains carefully, using tap water and a test tube brush.

Be careful not to scratch the inside of the glass tube. Never use abrasive detergents or cleansers.

Cleaning the conductivity sensor

Remove COND sensor guard, and carefully use a soft brush to clean off any dust from the sensor unit.

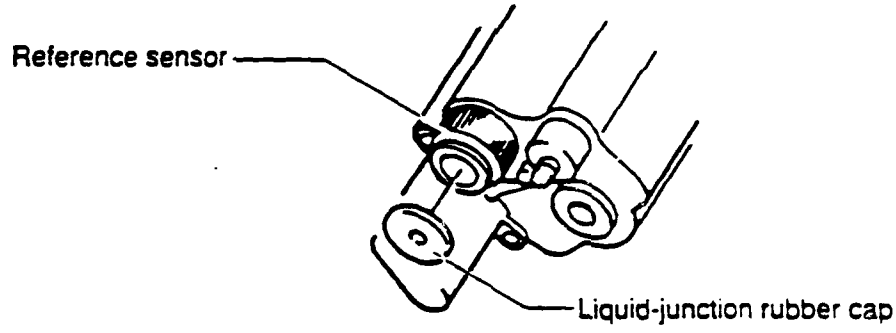
Be sure to replace the COND sensor guard before taking measurements.



Recharging the reference sensor with reference solution

Recharge the reference sensor with reference solution about once every two months, as follows.

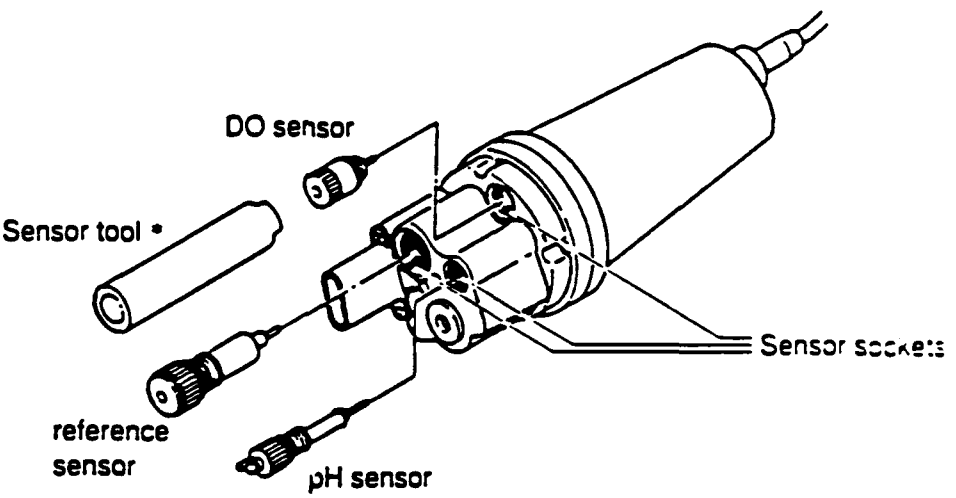
1. Remove the liquid-junction rubber cap from the reference sensor, and pour out the old solution.
2. Fill the reference sensor completely with new reference solution. Make sure there are no air bubbles.
3. Replace the liquid-junction rubber cap.
4. Carefully wash off all excess reference solution from the probe.



Replacing faulty sensors

Three of the U-10's sensors are replaceable: the *pH sensor*, the *reference sensor*, and the *DO sensor*.
These may be replaced as follows.

1. Wipe off any water droplets from the probe.
2. Remove faulty sensor.
3. Insert the new sensor carefully with your fingers.
4. Be careful not to let the sensor sockets get wet.

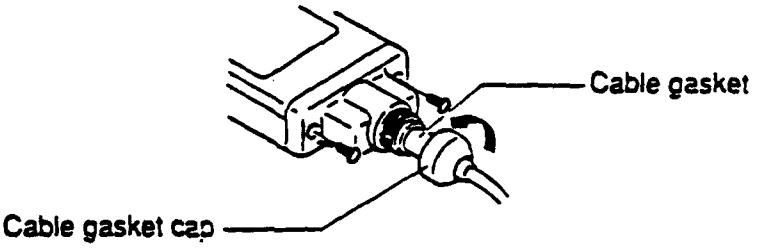


• When replacing the DO sensor, use the sensor tool *provided as an accessary.*

Replacing a faulty probe

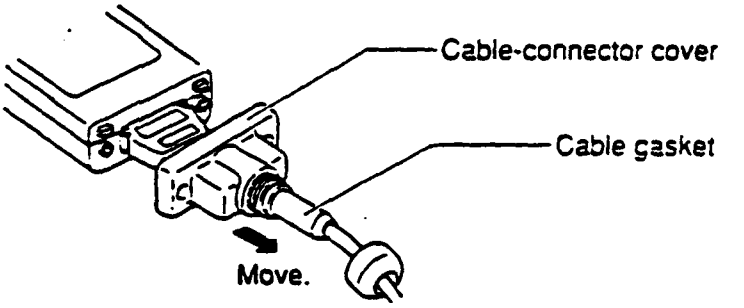
Disconnect the cable from the main unit

1. Loosen the cable gasket cap, and remove cap from gasket.



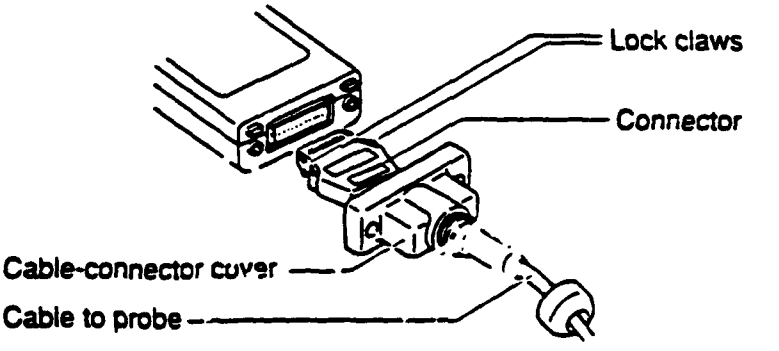
2. Slide back the gasket.

3. Back off the two screws on the cable-connector cover.



4. Slide off the cable-connector cover to expose the connector lock claws.

5. Press lock claws on both sides with your fingers to release the connector. Pull out the connector from the main unit.



Connect the new probe

1. Insert the connector until it clicks.
2. Re-attach the cable-connector cover to the main unit.
3. Slide the cable gasket toward the cable-connector cover, and screw on the cable gasket cap.

Before you use a new probe for the first time, it is necessary to calibrate it manually for all four parameters. Refer to Section 3, "Calibrating the U-10," for instructions on manual calibration.

Section 6

Reference Materials

The following descriptive information is provided for a better understanding of the U-10 Water Checker and its functions.

Reference Materials

Conductivity (COND)

Principle of measurement

Conductivity is an index of the flow of electrical current in a substance.

Salts dissolved in water are separated into cations and anions. Such a solution is called an electrolytic solution. An electrolytic solution has the property of allowing the flow of current according to Ohm's law. This property is referred to *ionic conductivity*, since current flow is due to ion movement in an electrolytic solution. Metals, on the other hand, allow the flow of current by means of electrons. This property is called *electronic conductivity*, which is distinguished from ionic conductivity.

A cube 1 cm on each side, as each shown in Fig. 1, is used to demonstrate an electrolytic solution. Two electrode plates are placed on opposite sides, and the cube is filled with a solution. If the resistance between these two electrode plates represented by r (Ω), the conductivity of the solution L (S.cm^{-1}) is $L=1/r$. *S*, stand for *Siemens*, a unit of measurement of conductance.

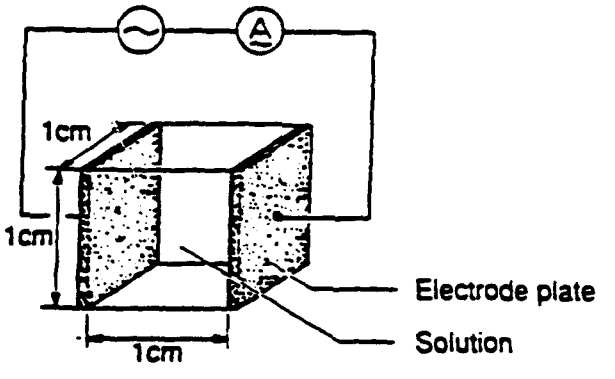


Fig. 1 Definition of conductivity

The most general method for measuring conductivity is based on the above principle, and is called the 2-electrode method. In this method, to take a measurement, it is necessary to allow flow of alternating current between the two electrode plates.

If direct current is sent between them, it will cause causes electroplating or decomposition, i.e., polarization; this results in inaccurate measurement of conductivity.

Even a flow of alternating current will also cause a certain amount of polarization. Measures must be taken to minimize the effect of this polarization, such as the application of platinum black plating to the electrode surfaces. In spite of such measures, however, the effect of polarization cannot be neglected in conductivity measurements of a high-conductivity solution. This makes accurate measurement difficult. Furthermore, depositions or stains on the electrode surfaces can cause a large apparent resistance, also making accurate conductivity measurement difficult.

The U-10 Water Checker has adopted the 4-electrode method to overcome these disadvantages of the the 2-electrode method. As shown in **Fig. 2**, the U-10 Water Checker uses two voltage-detecting electrodes and two voltage-applying electrodes, for a total of total four electrodes.

The voltage-detecting electrodes are for detecting AC voltage, and the voltage-applying electrodes are for applying AC voltage.

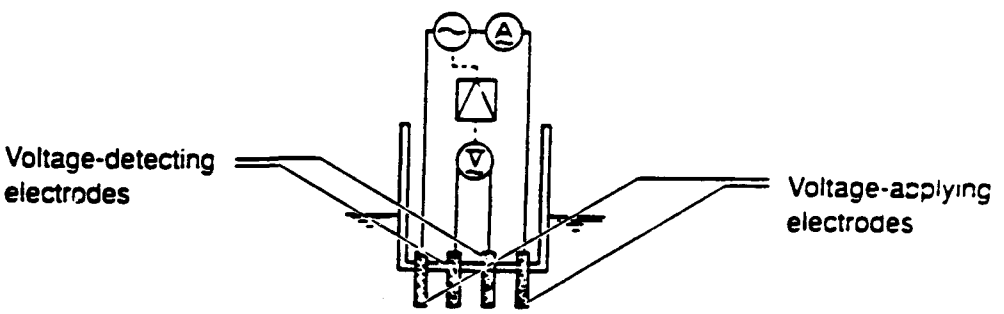


Fig. 2 Principle of the 4-electrode method

Let us assume that the current, *I(A)*, flows in a sample of conductivity *L* -- under automatic control of the voltage-applying electrodes -- so that the voltage at the voltage detecting-electrodes, *E(V)*, remains constant at all times. Then, the resistance of the sample, *R* (Ω), across the voltage-detecting electrodes is *R=E/I*. The resistance, *R*, of the sample is inversely proportional to its conductivity, *L*. That is, the conductivity, *L*, is proportional to the current, *I*. Accordingly, calibration of a standard solution of known conductivity, *Ls*, enables calculation of conductivity of a sample according to the formula *L=Ls(I/Is)* from the relation of *L:Ls=I:Is*.

Even in the 4-electrode method, polarization occurs, since *AC* current flows in the voltage-applying electrodes. The voltage-detecting electrodes are, however, free from the effects of polarization, since they are separated from the voltage-applying electrodes, and furthermore, current flow is negligible. Therefore, the 4-electrode method is an excellent method to enable measurement of conductivity covering a very high range.

Temperature compensation

In general, the conductivity of a solution varies largely with its temperature. The conductivity of a solution depends on ionic conductivity, described earlier. As the temperature rises, conductivity becomes higher, since ions begin to move more actively.

The temperature coefficient shows the change in % of conductivity per °C, with a certain temperature taken as the reference temperature. This is expressed in units of %/°C. The temperature coefficient assumes the premise that the conductivity of a sample changes linearly according to temperature. Strictly speaking, with actual samples, however, conductivity changes along a curve.

Furthermore, these curves form different shapes depending on the type of sample. In the ranges of smaller temperature changes, however, samples are said to have the temperature coefficient of 2%/°C; this holds for most samples, except in certain special cases. The U-10 Water Checker uses an automatic temperature conversion function to calculate conductivity at 25°C at a temperature coefficient of 2%/°C, based on the measured value of the temperature. Results are displayed on the readout. The U-10's temperature conversion function is based on the following formula.

$$L_{25}=Lt/\{1+0.02(t-25)\}$$

Where,

- L_{25}: Conductivity of solution converted to 25°C (value displayed on U-10)
- t: Temperature of solution at time of measurement (°C)
- Lt: Conductivity of solution at t (°C)

Turbidity (TURB)

Principle of measurement

From among several types of turbidity-measuring methods available, the U-10 uses the light-absorption-scattering method, shown in Fig. 3.
Irradiation of a beam of light onto a sample brings about separation of the beam into (1) the light transmitted by the solution and (2) the light scattered by turbidity components in the sample. In the light-absorption-scattering method, the intensity of both transmitted light and the scattered light are measured using separate receptors, and the turbidity is obtained based on the ratio of the two.

With the U-10, the light source is a pulse-lighting infrared-emission diode. The scattered light is measured at a point 30° offset from the light source. This light-absorption-scattering method has several advantages, including the fact that (1) the actual color of the sample fluid has little effect on the measurement of turbidity, (2) fluctuations in light quantity from the light source are easily compensated for, and (3) it allows the U-10 to be operated with relatively low power consumption.

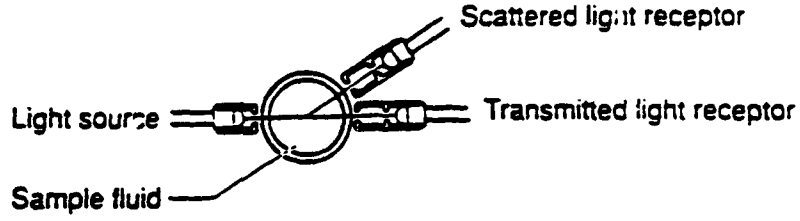


Fig. 3 Principle of the light-absorption-scattering method

NTUs (Nephelometric Turbidity Units)

For the calibration of turbidity, the U-10 uses a standard formazine solution.

Kaolin has been the conventional standard solution for many years. However, the composition of kaolin solutions often vary depending on the country of origin, and turbidity varies with the degree of purify. Furthermore, there is often individual error in preparing the solution. Kaolin is thus known for bringing about very large disparity in measurement results. As a turbidity standard solution, formazine standard solution is now increasingly being used internationally. In view of these facts, the U-10 uses the formazine standard solution for its calibration of turbidity.

In addition, the U-10 uses *NTUs* as the unit of turbidity. Other units conventionally used are formazine degrees and *FTUs*. When the measurement of turbidity is based on the phenomenon of scattering, the use of *NTUs* is preferable, and in fact, these are being used increasingly. It should be noted that *NTUs* used as turbidity units of the formazine standard solution are equivalent to formazine degrees and to *FTUs*.

Salinity (SAL)

The U-10 is designed to measure salinity as well as the other parameters.

Note that the "salinity" referred to here is the salinity of sea water. There is a constant relation between conductivity and salinity at certain temperatures.

Therefore, if data on the conductivity and temperature are available, the corresponding salinity is known. In other words, the salinity measurement of the U-10 is based on the principle of calculating the salt content, making use of the measured values of conductivity and temperature.

Note carefully, therefore, that measured results of all substances whose conductivity is detected are displayed as salinity. For example, the measured result is displayed as NaCl concentration, even if in fact the sample component is, for example, hydrochloric acid (HCl).

Temperature measurement in the U-10

Temperature changes in water have extreme biological effects on the life cycles of fish and seaweed, as well as on that of the minute organisms that cleanse the water of organic pollutants. In general, as the temperature of water increases, the amount of oxygen dissolved in the water decreases and there is a tendency for the amount of pollutants to increase.

The U-10 uses a thermistor to measure temperature. A thermistor also measures the change in electrical resistance accompany changes in temperature; these changes in resistance are measured by the thermistor and are used to calculate the temperature.

This temperature data is used by the U-10 in four different ways: (1) in pH temperature compensation, (2) in conductivity temperature conversion, (3) in the calculation of salinity, and (4) in dissolved-oxygen temperature compensation.

Dissolved-Oxygen (DO)

Principle of measurement

The "DO" referred to here means the concentration of oxygen dissolved in water.

Dissolved oxygen is essential to self-purification of rivers and seas, as well as to living of aquatic organisms and fish. Therefore, measurement of DO is vital in both waste-water treatment and water quality control.

Fig. 4 shows the principle of measurement using a DO sensor.

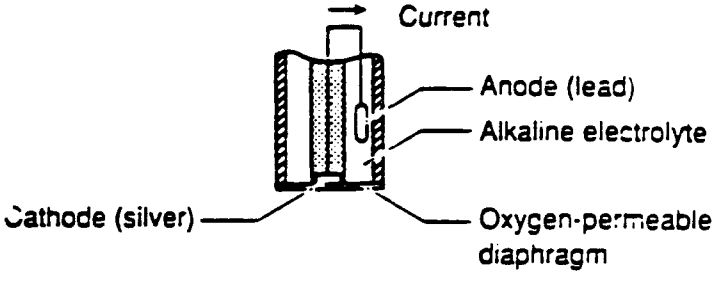


Fig. 4 Principle of DO sensor

A noble metal (silver) is fitted closely to an oxygen-permeable diaphragm to make the cathode; a base metal (lead) is used as the anode. Both are immersed in an alkaline electrolyte with the anode-to-cathode external circuit complete. Oxygen diffusing through the oxygen-permeable diaphragm causes a reduction reaction at the cathode; this allows flow of current in the external circuit:

$$O_2 + 2H_2O + 4e^- = 4OH^-$$

At the anode, oxidation reaction occurs as follows:

$$2Pb = 2Pb^{2-} + 4e^-$$

The current is proportional to the quantity of oxygen diffusing through the oxygen-permeable diaphragm. Accordingly, measurement of the current makes the DO in a sample known.

The DO measuring method based on this principle is called the *diaphragm-electrode method*. This method allows convenient measurement of DO, especially when compared with chemical-analysis methods, which need complicated pre-treatment to eliminate the effects of oxidizing or reducing substances.

DO correction for salinity

When a solution and air are in contact and in complete equilibrium (saturated), DO:C[mg/*l*] in the solution, and the oxygen partial-pressure:Ps[MPa] in air are in the following relation:

$$C = Ps/H$$

H[*MPa*/(mg/*l*)] is referred to as Henry's constant, which depends on the composition of the solution. In general, *C* becomes smaller as the salinity in the solution increases, since *H* becomes larger.

A DO sensor is intended to detect *Ps* in theabove expression. Therefore, the DO measurement of an aqueous solution containing salt would be in error if the DO electrode were standardized either on air-saturated pure water or on air. To settle this problem, it is necessary to correct the DO reading based on the salinity of the sample.

Conventional DO meters make this salinity correction by inputting a known salinity value. This poses no problems if the salinity of the sample is known. In practice, however, the salinity of the sample usually not known, unless measured by a device such as the U-10. Therefore, until now, DO meters have not been practical, even if they were provided with a salinity-correcting function.

The U-10 is capable of measuring the salinity of a sample and automatically correcting the DO reading for the amount salinity measured in the sample.

pH

Principle of measurement

The following is the basic equation for obtaining pH:

$$pH = -\log aH^-$$

Where,

aH- : the activity of hydrogen ions

If a thin glass membrane is used to separate two liquids of differing pH values, an electric current will be generated in proportion to the difference between these two pH values. The value of this electrical current, *E(V)* , is shown by the folowing Nernst equation:

$$E = 0.0001983T\ (pH_i - pH_o) + e$$

Where,

T : the temperature of the liquids

pH_i : the pH of the internal liquid (i.e., inside the glass membrane)

pH_o : the pH of the sample liquid (i.e., the iliquid outside the glass membrane)

e : the irregular electrical potential difference

A conventional glass electrode for measuring pH contains a fluid inside the electrode with a pH of 7. If this is used to measure a sample that also has a pH value of 7, the irregular electrical potential difference will be closc to 0V. Consequently, when a glass pH electrode is immersed in an acid solution, a positive electric current is generated; when it is immersed in an alkaline solution, a negative electric current is generated.

For actual use in a pH meter, a pair of referance electrodes with extremely stable characteristics is used. These are configured as shown in Fig. 5. As shown in Fig. 5, it can be seen that the electrical potentials generated in the internal electrodes, *E'* and *E"*, are canceled out by each other, so that the only electrical potential difference obtained is the current generated by the glass membrane, *E*, through the resistance of the membrane, *r*, and transmitted to terminals *G* and *R*.

In pH meters a readout of this voltage between the two terminals is obtained by increasing it with an amplifier. In actual practice, the pH meter is first calibrated using a standard reference solution of known pH, then the pH of the sample liquied is measured.

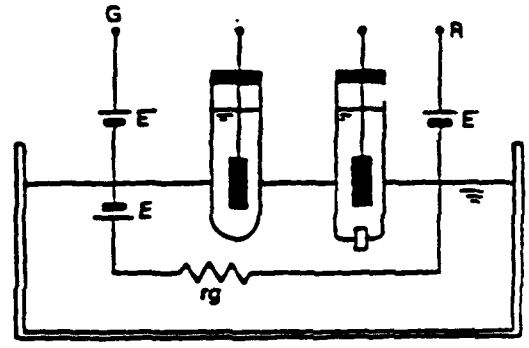


Fig. 5 Principle for Measuring pH

Specifications

pH

Principle	Glass electrode
Range	pH0-14
Resolution	Standard : 0.1pH
	Expanded : 0.01pH
Repeatability	±0.05pH
Temperature compensation	0°-50°C
Readout	LCD
Calibration	1-point auto (Zero)
	Manual 2-point

Temperature of the sample

Principle	Thermistor
Range	0°-50°C
Resolution	Standard : 1°C
	Expanded : 0.1°C
Repeatability	±0.3°C
Temperature compensation	—
Readout	LCD
Calibration	—

DO

Principle	Membrane galvanic cell
Range	0-19.9mg/*l*
Resolution	Standard : 0.1mg/*l*
	Expanded : 0.01mg/*l*
Repeatability	±0.1mg/*l*
Temperature compensation	0°-40°C
Readout	LCD
Calibration	1-point auto (Span)
	Manual 2-point

Conductivity

Principle	4-electrode
Range	0-100ms/cm
Resolution	Standard: 0-1mS/cm : 0.01mS/cm 0-10mS/cm : 0.1mS/cm 10-100mS/cm : 1mS/cm Expanded: 0-1mS/cm : 0.01mS/cm 0-10mS/cm : 0.1mS/cm 10-100mS/cm : 1mS/cm
Repeatability	±1%/F.S. within each measurement range
Temperature compensation	0°-50°C
Readout	LCD
Calibration	1-point auto (Span) Manual 2-point

Turbidity

Principle	Scattered/Transmitted light
Range	0-800 NTU
Resolution	Standard : 10 NTU Expanded : 1 NTU
Repeatability	±3%/F.S.
Temperature compensation	—
Readout	LCD
Calibration	1-point auto (Zero) Manual 2-point

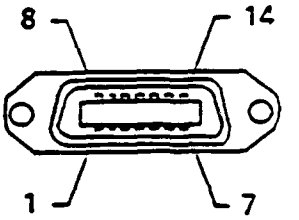
Salinity

Principle	Conversion based on conductivity
Range	0-4%
Resolution	Standard : 0.1% Expanded : 0.01%
Repeatability	±0.1%
Temperature compensation	0°-30°C
Readout	LCD
Calibration	—

Common specification

Data storage	Max. 20 samples
Printer output	Centronics specs.
Power	Battery 9V, with auto power-off function
Operating temperature	0°-45°C
Weight	Main unit: Approx. 400g Probe, with 2-m cable: Approx. 800g

- Output connector pin layout



Pin No.	Name	Pin No.	Name
1	STB	8	DB_8
2	DB_0	9	DB_7
3	DB_1	10	Not used
4	DB_2	11	BUSY
5	DB_3	12	Not used
6	DB_4	13	Not used
7	DB_5	14	GND

Parts List

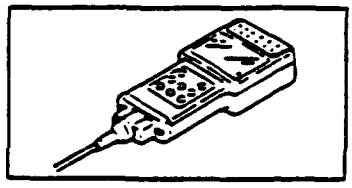
The following expendable parts are available from Horiba for the U-10 Water Checker.

Part name	Model No.	Details	Order P/No.
Probe			9037-0047-00
pH sensor	#7112		9037-0048-00
DO sensor	#7542	Special design for the U-10	9037-0049-00
pH reference sensor		Special design for the U-10	9037-0050-00
Liquid junction (1 pair)	#7210		9037-0051-00
KCl internal solution for ph reference sensor	#330	3.3 mol / l gel type, 250 ml	9037-0052-00
pH standard solution pH2	100-2		9003-0015-00
pH standard solution pH4	100-4	Special design for U-10 automatic calibration	9003-0016-00
pH standard solution pH7	100-7		9003-0017-00
pH standard solution pH9	100-9		9003-0018-00
Calibration beaker		Special design for U-10 automatic calibration	9037-0053-00

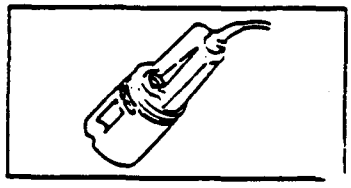
Unpacking the U-10

The following items are included with your U-10 Water Quality Checker.
When you unpack the probe and main unit, confirm that all the other accessories are included as well.

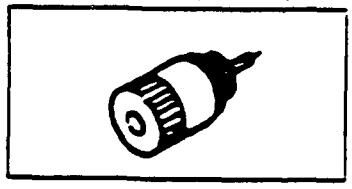
- Main unit



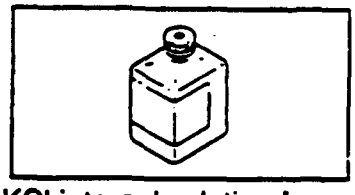
- Probe



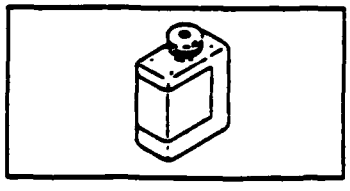
- Dissolved-Oxygen (DO) sensor: 1 unit (boxed)



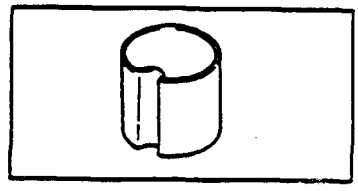
- Standard solution (Phthalate pH standard solution): 1 500 m*l* bottle



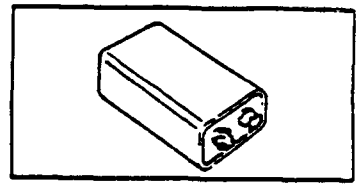
- KCl internal solution for reference sensor: 1 250m*l* bottle



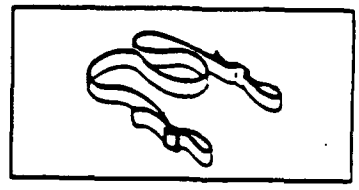
- Calibration breaker



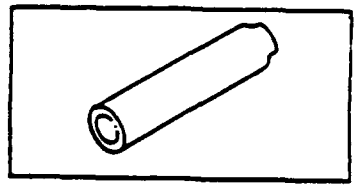
- 9V battery



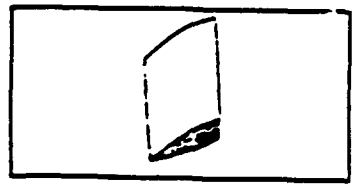
- Carrying strap for main unit strap



- DO sensor tool

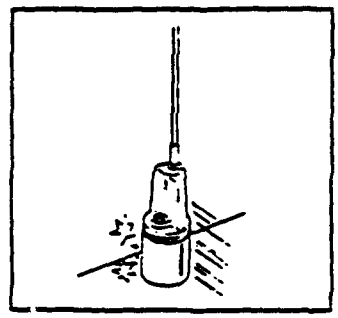


- This Instruction Manual

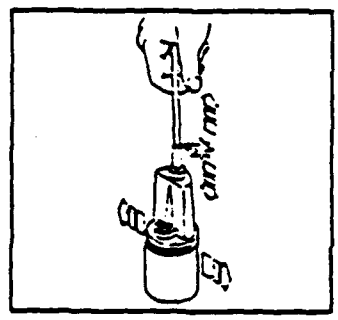


Precautions when using the U-10

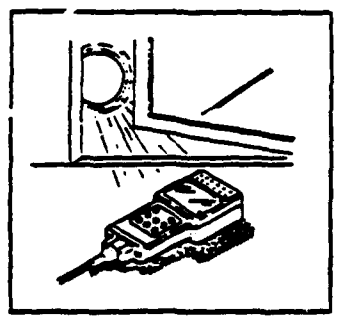
The U-10 Water Quality Checker is carefully designed for trouble-free operation. However, it is a sophisticated electronic instrument, and it can be damaged if used carelessly. Please read the following precautions and observe them when using your U-10 Water Checker.



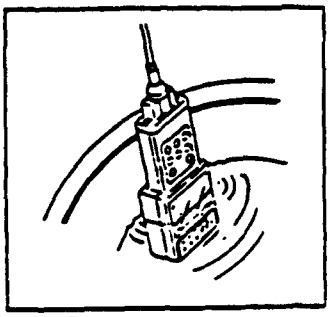
- Do not swing or jerk the probe by its cable.
- Do not subject the cable connector to stress by pulling or stretching it.



- Do not drop the either the U-10 probe or main unit. Never subject either component to sudden impact.

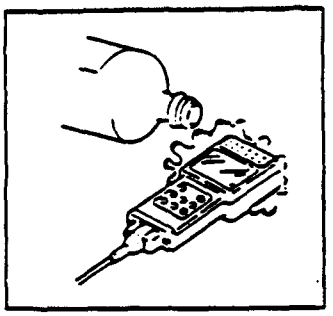


- Do not store the U-10 where may be exposed to prolonged direct sunlight. Never leave the U-10 inside a vehicle with the windows closed.



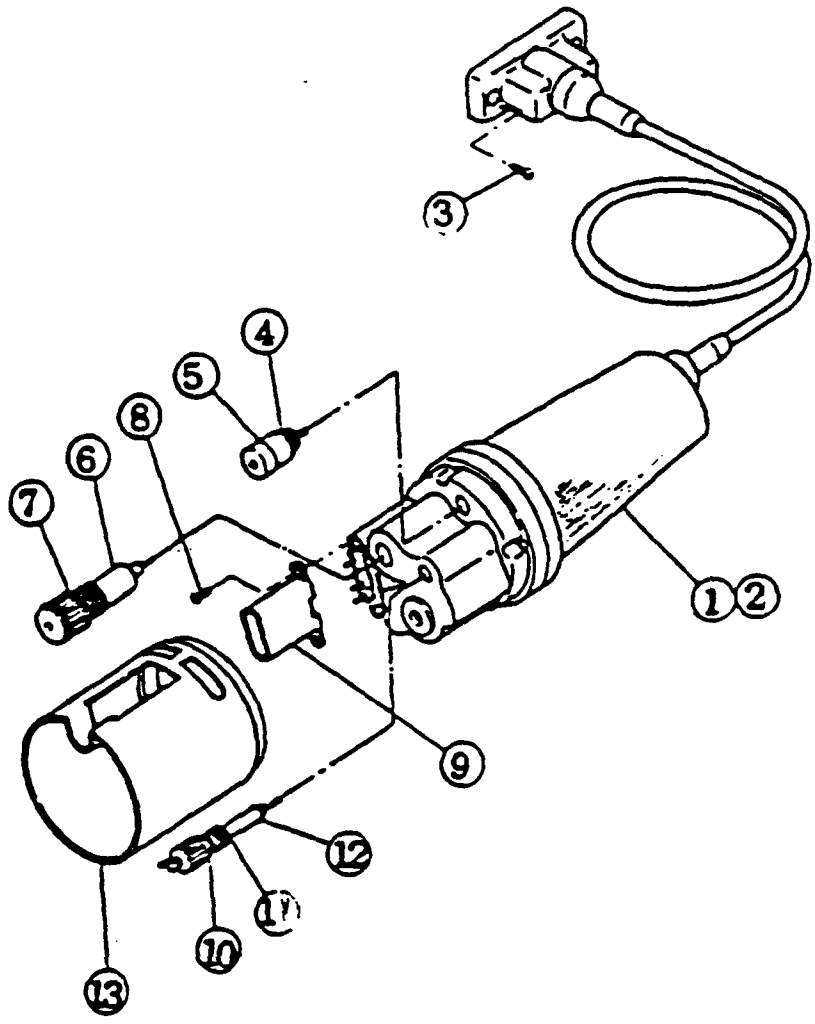
- Never immerse the main unit directly in water.

  The main unit is water-resistant and may be safely used in the rain; however, it is not of waterproof construction. Immersing the main unit in water or any other liquid can damage the internal electronic circuits



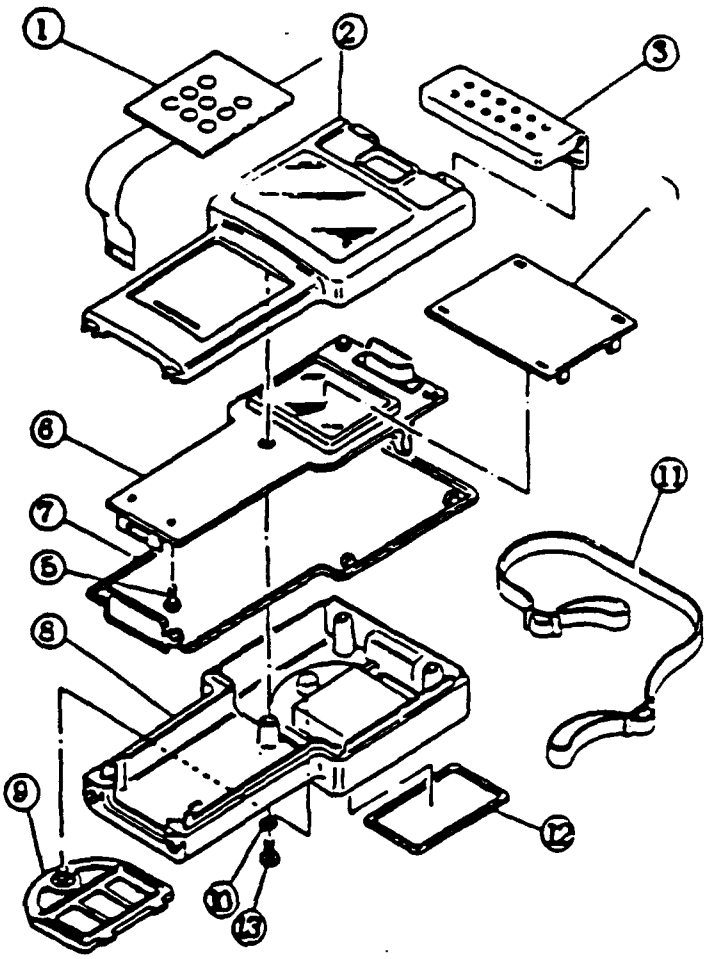
- Never allow any organic solvent to come in contact with either the probe or the main unit. This includes such liquids as methylethyl ketone (MEK) and acetone.

  (The probe is made of polyphenylene ether (PPE); the main unit case is acrylic resin.)



PARTS LIST U-10 SENSOR Drawing No. S410157-03

No.	HII P/N	Description
1.	362177	Sensor assembly with 2 meter cable
2.	362283	Sensor assembly with 10 meter cable
3.	362193	Screw, panhead - J1SB1111 M3x 6(S-ZN3)
4.	362194	O-ring - NOK S 11.2(SI)
5.	362174	DO Tip - U-10 sensor
6.	362175	Reference Tip - U-10 sensor
7.	362195	O-Ring, S18 - NOK S18 FPM
8.	362196	Screw, panhead - M3-6L SUS304
9.	362197	Cond guard - U-10 sensor
10.	360249	O-Ring, P9 - B2401 P9 FPM
11.	362176	PH Tip - U-10 sensor
12.	380169	O-Ring , P5 - B2401 P5 FPM
13.	362198	Protecting tube - U10 Sensor



PARTS LIST U-10 METER for Drawing No. S410156-03

No.	HII P/N	Description
1.	362181	Sheet Switch - Water checker U-10
2.	3612182	Case assembly, top - U-10
3.	362183	PRT Cover - U-10Meter
4.	362184	Window, LCD - U-10 H357887-01
5.	362185	Tapping screws, M3X 6(S-ZN3)
6.	362186	PCB Assembly
7.	362187	Case packing - U-10 meter
8.	362188	Case assembly, bottom
9.	362189	Cover assembly, BAT - U-10
10.	362190	Seal washer - U-10 Meter
11.	362191	Meter strap - U-10 20X1300 T=1.8
12.	362192	Battery packing - U-10 meter
13.	362193	Screw, panhead J1SB1111 M3X 6(S-ZN3)

Index

7E

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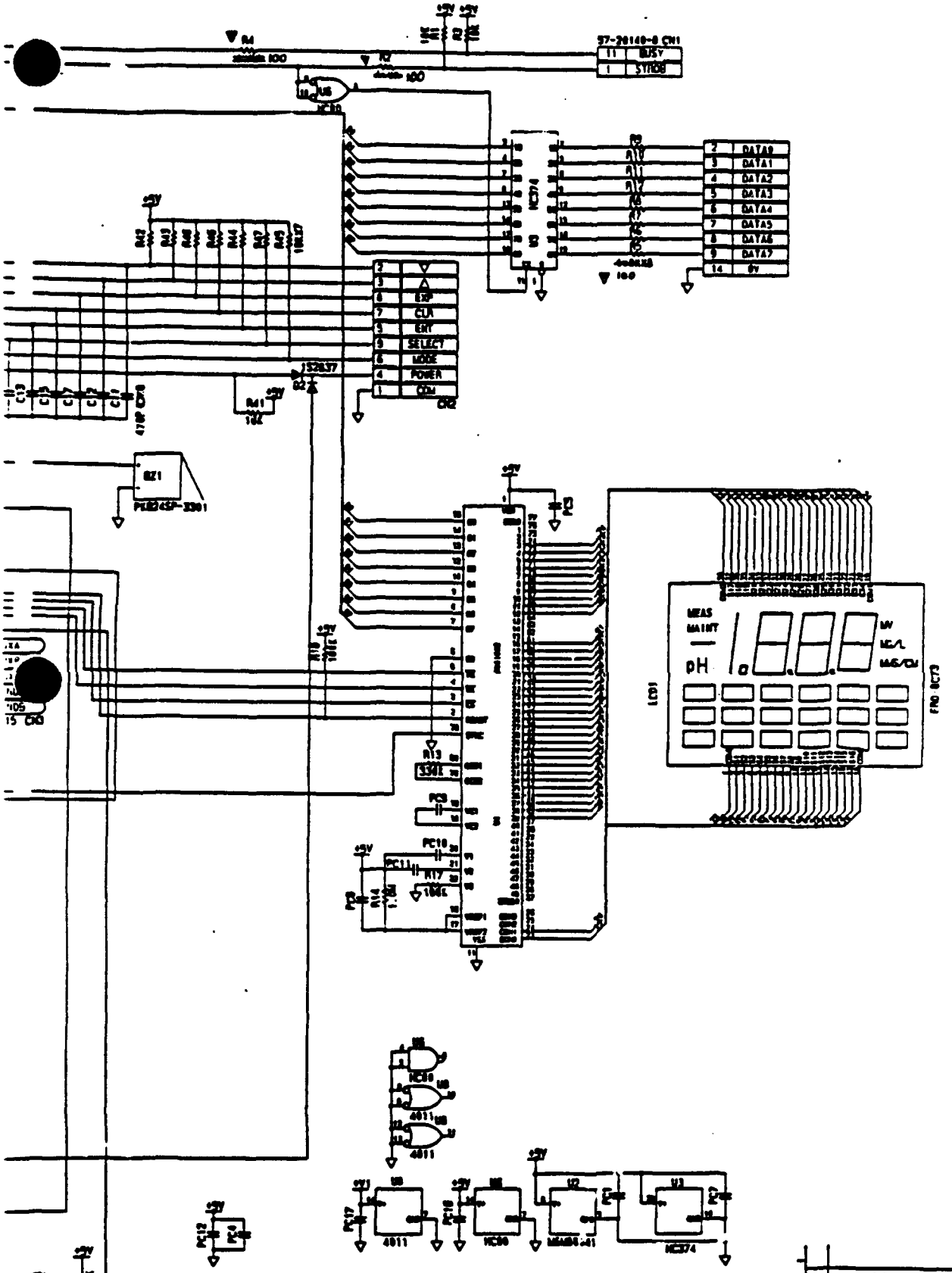
Fax: (81) 3-3861-8259

71



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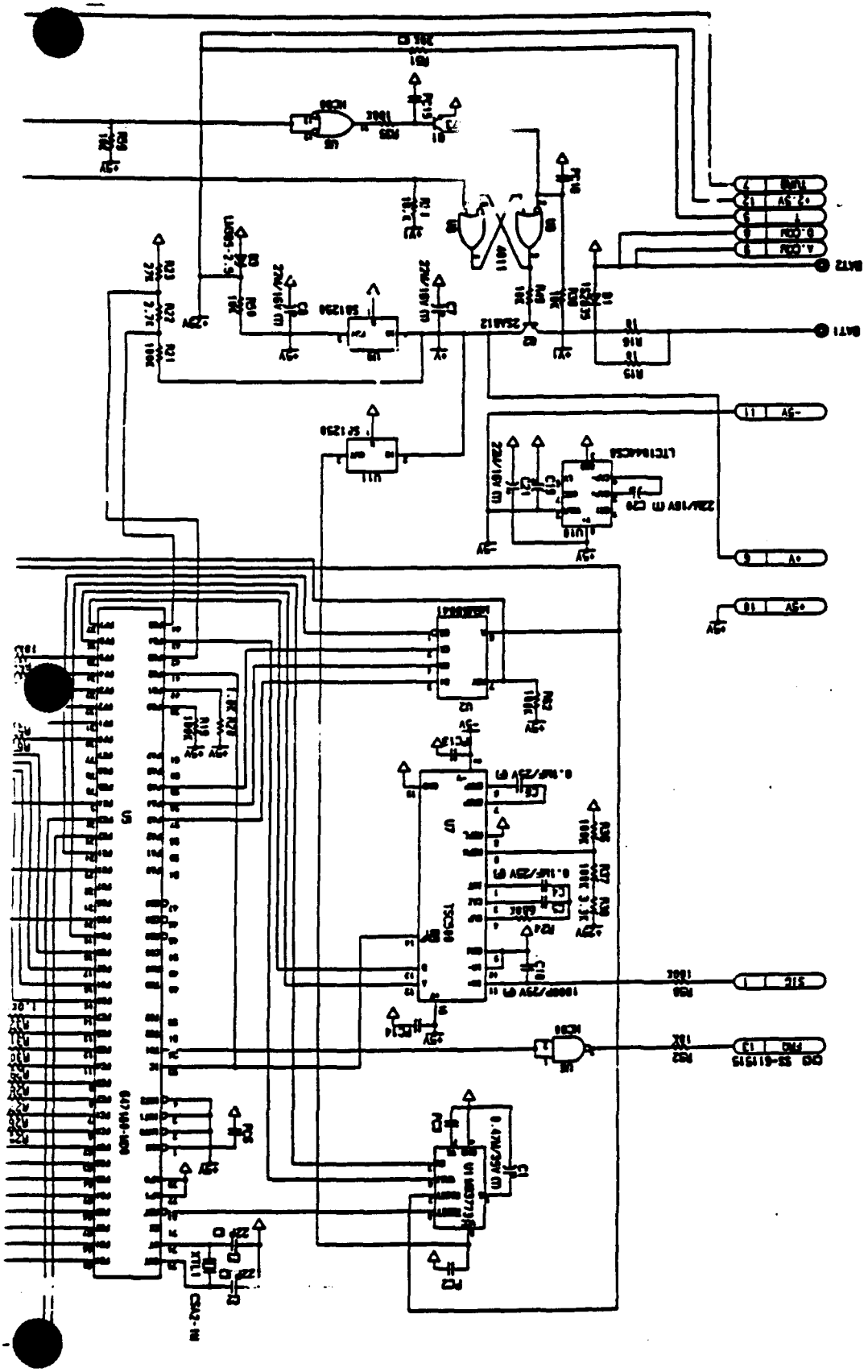
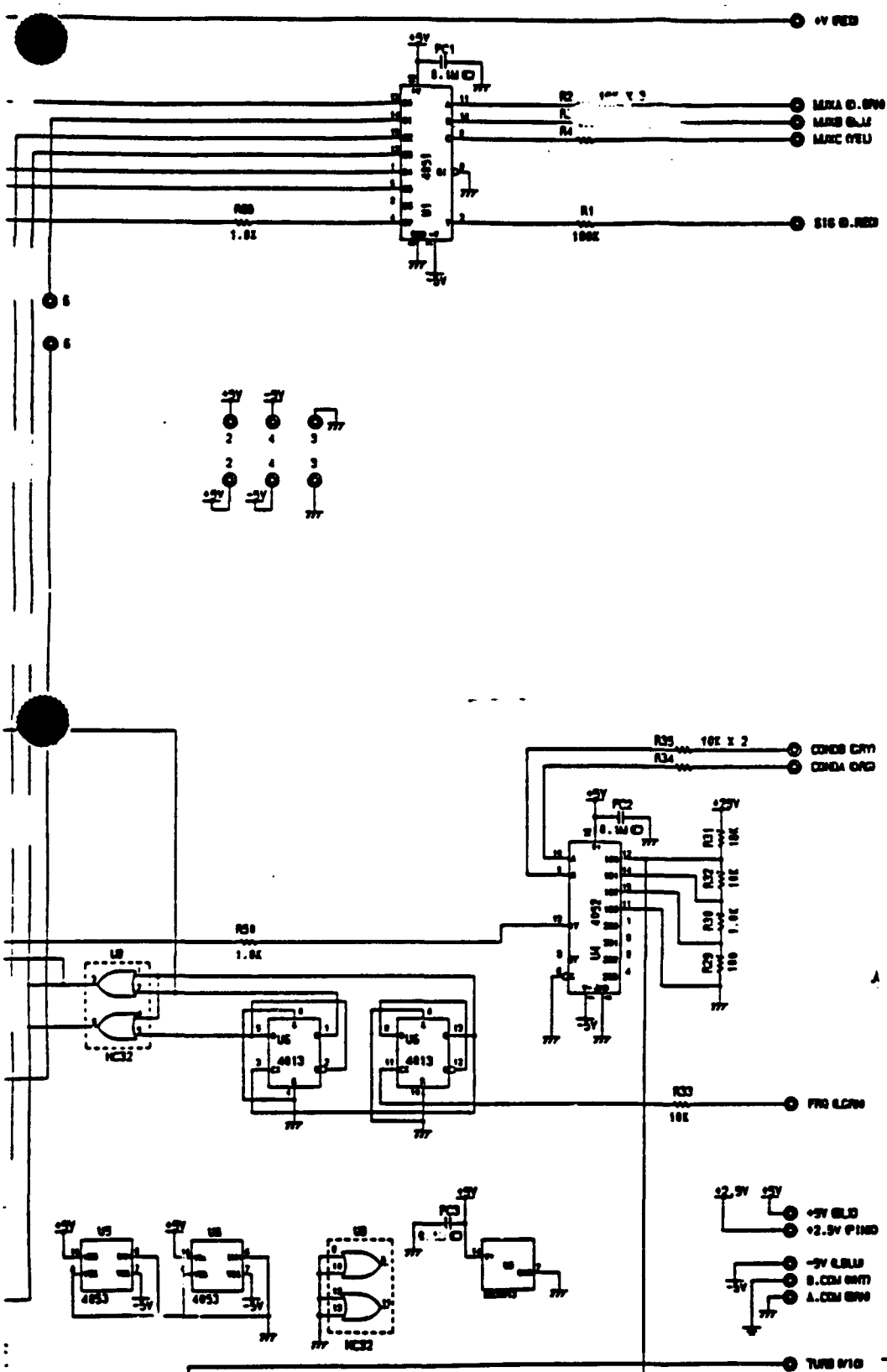
DRAWN	CHECKED	APPROVED	DATE



CAD DRAWING NO. A.
V234424

E1



NO.	SPEC.	PART NO.	NOTES
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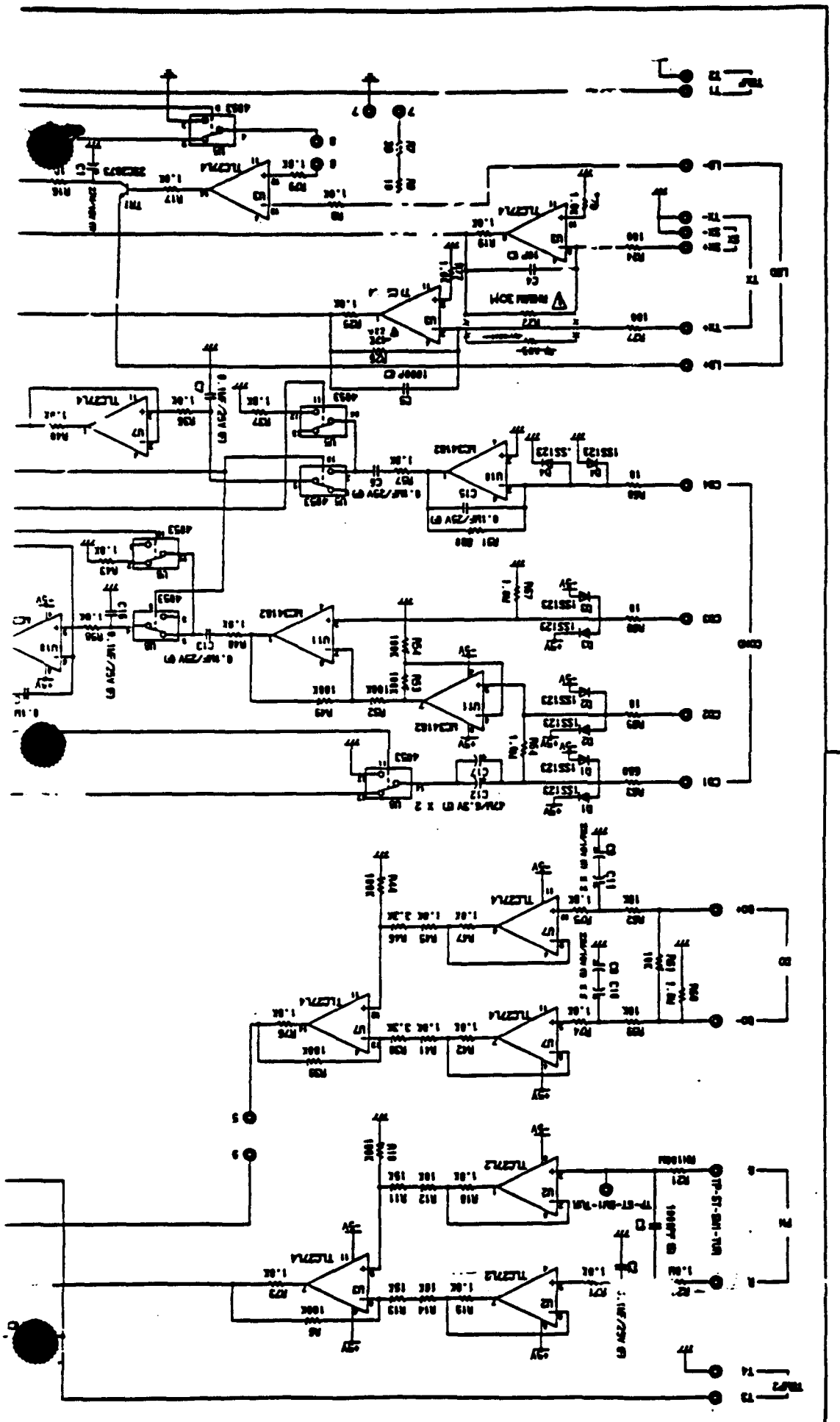
REVISED			SCALE	CAD DRAWING NO.
DRAWN	CHECKED	APPROVED		V234138 B
J. Imai	J. Imai	H. Okuma	DATE 1995. 7. 12	



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