Soil Treatment Final Report
Woods Industries Site
Yakima, Washington

Volume II —Appendices E and E-1

August 7, 1996

Prepared for:

BURLINGTON NORTHERN RAILROAD
Seattle, Washington

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ENVIRONMENTAL

APPENDIX E

Work Plan and Documents Completed for Soil Treatment Activities Table of Contents

E-1 Williams' Soil Treatment Plan
E-2 AAQIR
E-3 Ambient Air Monitoring Plan

APPENDIX E-1

Williams' Soil Treatment Plan

WILLIAMS ENVIRONMENTAL SERVICES, INC.

February 22, 1995

Ms. Lynda Priddy
Environmental Protection Specialist
Hazardous Waste Division
U.S. EPA Region X
1200 Sixth Avenue
Seattle, WA 98101

Re: Woods Industries Site
Yakima, Washington
Transmittal No.: 0087
Number of Pages: 1

Subject: Final Thermal Desorption Work Plan, Performance Test Plan, and Associated Appendices
Williams Project No. 0365-001-110

Dear Lynda:

Enclosed please find six (6) copies of the final Thermal Desorption Work Plan, Performance Test Plan, and all other appendices for the Woods Industries site in Yakima, Washington. All changes and corrections have been made pursuant to our conference calls and comment/response letters. Additionally, an updated, signed copy of the Site Specific Health and Safety Plan is included as Appendix E.

Should you have any questions, please call me at (404) 879-4854 or David Eagleton at (618) 281-7173.

Sincerely,

WILLIAMS ENVIRONMENTAL SERVICES, INC.

Greg Whetstone

Greg Whetstone
Project Engineer
GTW:pc

cc: Z. Lowell Taylor
Mark A. Fleri
George Harbour
David Eagleton (Burlington Environmental), 3 copies
Bruce Sheppard (Burlington Northern Railroad), 1 copy
Tom Backer (Preston and Gates), 1 copy

THERMAL DESORPTION WORK PLAN
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

PREPARED FOR:

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Submitted To:

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January 30, 1995

WILLIAMS PROJECT NO: 0365-001-110

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ACRONYMS

AAC	Acceptable Ambient Concentration
acfm	actual cubic feet per minute
AOC	Administrative Order on Consent
APCE	air pollution control equipment
ASTM	American Society for Testing and Materials
AWFSO	automatic waste feed shutoff
BHC	1,2,3,4,5,6-Hexachlorocyclohexane
BRA	Baseline Risk Assessment
Btu	British thermal unit
BNRR	Burlington Northern Railroad
CEM	Continuous emissions monitor
CFR	Code of Federal Regulations
CPVC	chlorinated polyvinyl chloride
DDT	1,1'-(2,2,2-Trichloroethylidene)bis[4-chlorobenzene]
EA	Ecological Assessment
gpm	gallons per minute
HAS	health and safety
HASP	Health and Safety Plan
ID	induced draft
ISCST-2	Industrial Source Complex Short Term air dispersion model
LDRs	Land Disposal Restrictions
LTTD	Low Temperature Thermal Desorption
mg/kg	milligrams per kilogram
NaOH	sodium hydroxide
NEC	National Electric Code
NFPA	National Fire Protection Association
NPL	National Priorities List
OCL	organochlorine
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
ppm$_V$	parts per million by volume
psig	pounds per square inch, gauge
PVC	polyvinyl chloride
QA/QC	Quality Assurance/Quality Control
RAO	Response Action Objectives
RI/FS	Remedial Investigation/Feasibility Study
scfm	standard cubic feet per minute
WOODS	WOODS Industries Site
THC	total hydrocarbons
TOC	total organic carbon
USEPA	United States Environmental Protection Agency
VO	vent open
w.c.	water column
Williams	Williams Environmental Services, Inc.

SECTION 1

INTRODUCTION

1.1 SITE DESCRIPTION AND HISTORY

The site is located in an industrial area in the city limits of Yakima, Washington, within the Northwest Quarter of the Northeast Quarter of Section 31, Township 13 North, Range 19 East, West Meridian (Figure 1, Site Location Map). The Woods Industries Site consists of two areas formerly leased from Burlington Northern Railroad (BNRR) to Woods Industries who sublet a portion of the site to Akland Irrigation. The entire area that was leased from BNRR covers approximately four acres.

The site is flat and includes the Crop King/Woods Industries buildings formerly used to formulate pesticides on the north part of the site and the buildings formerly used by Akland Irrigation for storage and retail of irrigation supplies on the south part of the site.

For approximately 50 years, BNRR and its predecessors leased the site to industrial lessees. The area leased by Woods Industries was used for the contract formulation of market-grade pesticides from technical-grade material from approximately 1938 until May 1985, when the lease was terminated by BNRR because of environmental concerns.

Waste from the formulation process and laboratory was discharged to a french drain/sump area on the site. The french drain/sump area was an excavated area with rows of vertically set, perforated drums sitting on and covered by timbers with approximately two feet of construction rubble and soil backfill leveled at grade.

The Akland Irrigation area of the site was used primarily for the sales, storage, and maintenance of irrigation equipment. The middle portion of the Akland Irrigation area contained two discharge lagoons. These lagoons were used to collect and discharge liquids carried by pipeline from the Woods Industries area. The lagoons were filled in with surrounding soil and debris including metal scraps, between approximately 1973 and 1977, based on interpretation of aerial photographs. The lagoon area was then used for storage of irrigation equipment. The sanitary wastes from the site were discharged to the public sanitary sewer system.

After Woods Industries' lease was terminated in May 1985, Woods Industries removed some personal property from the site, and BNRR assumed control of the property.

In December 1985, the U.S. Environmental Protection Agency (USEPA) issued a Removal Action Order, which, among other things, required that a detailed plan for site characterization be developed and executed. A site Characterization Plan was prepared and executed in 1986 by Morrison-Knudson Engineers, Inc., (MKE), BNRR's contractor at that time.

Based on the results of the preliminary site characterization, elevated concentrations of p,p'-DDD (DDD), p,p'-DDT (DDT), p,p'-DDE (DDE), lead, zinc, hexachlorobenzene, and bis(2-ethylhexyl)phthalate were found in soil samples collected from the site. This preliminary study concluded that DDT was the most widely spread of the pesticides in soil.

Pesticides, volatile organic compounds, and primary metals were detected in groundwater samples collected from five wells installed during this preliminary investigation.

RI Investigation Activities

The RI investigations were performed in accordance with the requirements of Consent Order Number 1087-03-18-106 as amended June 28, 1990, and the RI/FS Work Plans approved by the USEPA. The investigations were performed in two phases. Phase I was performed in 1990 and Phase II was performed mostly in 1991. Some additional tasks, such as disposal of drummed drill cuttings and well development water, were performed in 1992. In summary, the RI field tasks performed to evaluate groundwater impact included:

- installation of nine wells in addition to those installed during the preliminary investigation and groundwater sample collection from these nine wells and five existing on-site wells once in 1990 and 1991;
- collection of off-site groundwater samples from six commercial or residential wells.
- evaluation of site hydrogeologic characteristics on groundwater flow direction and formation material grain size; and
- analysis of groundwater samples for metals, volatile organic compounds, hexachlorobenzene, pesticides, and other parameters.

The RI field tasks performed to evaluate soil impact included:

- collection of surficial and subsurface soil samples;

- analysis of soil samples for metals, volatile organic compounds, hexachlorobenzene, pesticides, ethylene thio urea, and other parameters; and

- analysis of select soil samples for Toxicity Characteristic Leaching Procedure (TCLP) parameters for use in evaluating disposal and treatment options.

The RI field tasks performed to evaluate on-site buildings included:

- collection of composite samples from building interiors; and

- inspection and sampling of building contents for asbestos-containing materials.

Removal Actions

Removal actions to date consist of building demolition and soil removal activities and are described in the following paragraphs.

Building demolition removal activities, occurring in January and February 1993, were performed to reduce physical and toxic health hazards and to facilitate future site remediation. Building demolition activities are described in the Building Demolition Final Report dated March 26, 1993.

Soil removal activities occurring from March 29 through September 24, 1993, included the excavation and temporary storage of approximately 19,000 cubic yards of soil that presented a threat to groundwater, which also included the soils that present a toxic health hazard. This removal action reduced contaminant concentrations to acceptable levels under an industrial future-use scenario as defined under the State of Washington's Model Toxics Control Act (MTCA). Soil removal activities were performed in accordance with Administrative Order Number 1087-03-18-106 and are described in the Soil Removal Final Report dated October 13, 1993.

SECTION 2

PROJECT OVERVIEW AND ORGANIZATION

2.1 PROJECT OVERVIEW

Thermal desorption has been selected as the treatment alternative to complete the Removal Action activities and meet the requirements of the Response Action Objective (RAO) memorandum for the Woods Industries Site in Yakima, Washington. Williams will use their Low Temperature Thermal Desorption unit (LTTD) to treat approximately 19,000 tons of pesticide contaminated soil. The treated soil will then be sampled and analyzed. The results of these analyses will be compared to the treatment goals established for the soils exiting the thermal desorption process. Treated soils will be used as backfill on site. Oversized material is discussed in Section 3.5.1. Treatment goals for soils are described in Section 7.1, Table 7-1 and air emission goals are outlined in Table 7-2.

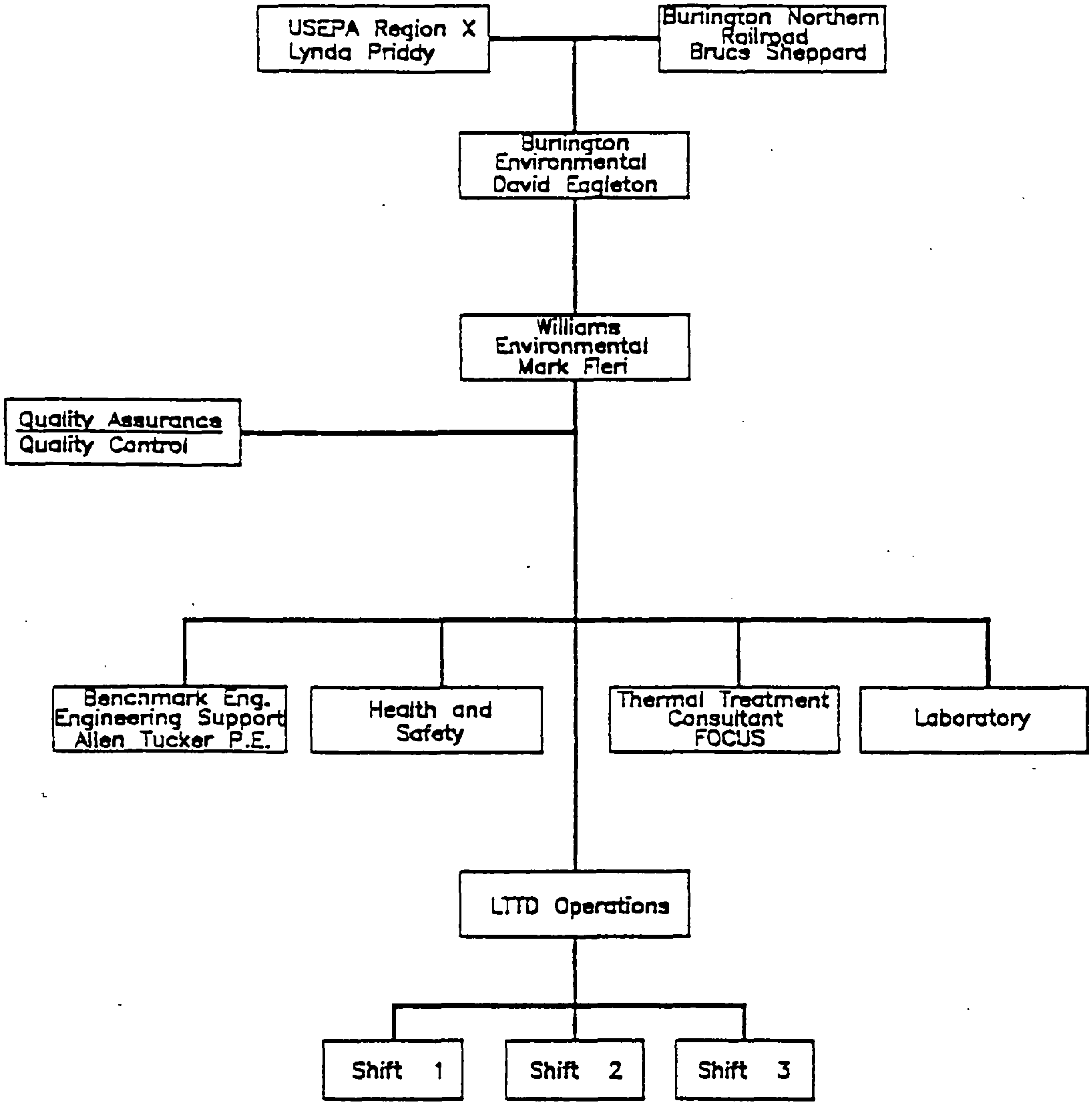
Following approval of the Thermal Desorption Work Plan by USEPA, and upon receipt of a notice to proceed from BNRR, Williams will begin mobilization of the LTTD system to the site in accordance with the schedule presented in Section 5.0.

After steady-state operations are achieved, a Performance Test will be conducted. Upon approval of the Performance Test Report by USEPA Region X, Williams will initiate full production of the LTTD system and complete the treatment of the contaminated soils. After the stockpiled soils and the soils below the stockpiles have been treated and laboratory confirmation received that all treated soils meet the cleanup criteria, the system will be decontaminated and demobilized from the site.

2.2 PROJECT ORGANIZATION

2.2.1 Organization Chart

The organizational structure for this project is presented in Figure 2-1. A summary of the responsibilities of each person or organization is presented in Section 2.2.3.



ORGANIZATIONAL STRUCTURE
FIGURE 2–1

2.2.2 Job and Organization Titles

Job and organizational titles for the key management individuals and organizations are as follows:

- WOODS Project Manager
- USEPA Region X
- Principal in Charge
- Quality Assurance/Quality Control (QA/QC) Manager
- Health and Safety Officer
- Project Manager
- Thermal Treatment Consultant
- Performance Test Subcontractor(s)
- Site Manager
- Shift Supervisor/Chief Operator
- LTTD Operators and Maintenance Personnel
- Material Handling and Service Personnel.

2.2.3 Relationship and Responsibilities of Organization

Responsibilities of Burlington Environmental and Williams will be similar to that of Burlington Environmental and Olympus for soil removal activities. Burlington Environmental will provide oversight and Williams will be the Contractor. Burlington Environmental will have an on-site coordinator. An independent Thermal Treatment Consultant will be used during the performance test activities and will be subcontracted under Williams. Williams will be responsible for all material handling associated with soil treatment which includes excavating beneath existing stockpiles and final site grading.

Sampling excavations beneath stockpiles and haul roads prior to demobilization will be the responsibility of Burlington Environmental. Implementation of the health and safety program will be the responsibility of Williams.

2.2.4 Job Descriptions for Williams' Personnel

Principal in Charge

The Principal in Charge (Dr. Z. L. Taylor) is the corporate officer with overall responsibility for the financial, operational, and health and safety aspects of the project. The Principal in Charge interacts with the client, regulatory agencies, and the Williams Project Manager as required.

QA/QC Manager

The responsibilities of Williams' QA/QC Manager are presented in Section 15.2.

Health and Safety Officer

The responsibilities of Williams' Health and Safety Officer are presented in Section 14.2.

Williams' Project Manager

The Project Manager is the key professional responsible for the day-to-day technical and administrative management of the project. He reports directly to the Principal-in-Charge and is responsible for day-to-day operations. He manages the job site administrative activities including purchasing, payroll, and other job records. Periodic and ongoing reports are prepared and distributed as required. Job cost and budget compliance are the responsibility of the Project Manager who will interface directly with the Corporate Controller on routine financial matters. He is responsible for all health and safety matters on-site but he is subject to audit and review of the corporate Health and Safety Officer. He is responsible for all testing and compliance matters, subject to the audit and review of the Corporate QA/QC Officer. He manages all subcontractors employed at the site including all performance testing personnel. He is responsible for sample collection, maintaining appropriate chain of custody forms, and recording analytical results as required. He is responsible for training and directing personnel to operate all equipment in compliance with safety standards and regulatory requirements. All site security and disciplinary matters are the responsibility of the Project Manager.

Thermal Treatment Consultant

The Thermal Treatment Consultant provides third party oversight during the performance test. This includes observation of sampling activities, review of monitoring and data collection procedures, and verification that the Thermal Treatment Plan is properly implemented. In addition, the Thermal Treatment Consultant will assist in identifying any irregularities or deficiencies associated with the test.

Performance Test Subcontractor

The Performance Test Subcontractor will provide the equipment and manpower required to sample and analyze the stack gas and soils streams in accordance with the approved performance testing plan. A performance test report will be prepared to document the results of the performance test.

Site Manager

The Site Manager will be responsible for on-site operations. The Site Manager will be on site full-time and dedicated to this project. His duties will include coordinating the activities of all facility personnel to meet the objective of safely processing the stockpiled soil and meeting all objectives described in the Thermal Desorption Work Plan. The Site Manager will control personnel requirements, training, and employee discipline. The Site Manager will be responsible for overseeing soil handling, desorption system operation, and all auxiliary operation duties. He will be responsible for maintaining spare parts, tools, and trained personnel for the repair and upkeep of the LTTD and associated equipment.

The Site Manager will be responsible for overseeing the safety and environmental control procedures to protect health and the environment. The Site Manager reports directly to the Project Manager.

Shift Supervisor

The Shift Supervisor will be responsible for the operation and for supervising the activities of Operators and Material Handlers. This person has the responsibility of maintaining safe and efficient operation of all soil handling and processing functions, including the movement of feed and treated soil to and from the LTTD system. Duties include coordinating soil handling and processing, analyzing problems, and responding to emergencies. On the off-shifts and weekends, the Shift Supervisor is responsible for all personnel and activities at the site.

The Shift Supervisor will maintain a safe operation by continuous review of the facility's operating procedures, housekeeping requirements, and OSHA and USEPA regulations. The Shift Supervisor will maintain effective communications with operating and management personnel. This will include reports of activities during the shift as well as other written and verbal communications pertinent to the completion of the job duties.

LTTD Operators, Assistant Operators, Maintenance and Health & Safety Personnel

Operators and Maintenance Personnel of the LTTD equipment will be trained to the following standards:

Receive job-specific training, such as operations of equipment, trouble shooting and maintenance.

Receive site-specific training in operation and maintenance of:

- Rotary dryer and soil feed mechanisms
- Baghouse
- Thermal oxidizer
- Treated soil handling equipment
- Auxiliary equipment
- Material handling equipment
- Emergency equipment.

A description of the job duties is as follows:

The employees assigned to this position will be responsible for the operation of the LTTD. Specific duties will be to:

- Feed soil to the dryer in accordance with prescribed operating conditions
- Monitor the process by means of control room instruments
- Make adjustments to controls as necessary to ensure proper operation
- Respond to system alarms in order to restore normal conditions or shut down operating units
- Record specified parameters in the operating log at the required frequencies
- Monitor the operation of the baghouse
- Operate the treated soil collection system
- Monitor the operation of fans and blowers
- Maintain equipment and instruments as required.
- Maintain accurate records of activities performed and processes monitored
- Maintain the workplace in a safe and orderly manner
- Perform other related duties as directed by supervisor.

Material Handling and Service Personnel

Employees working in this position will be trained to the following minimum standards:

- Receive all training designated as "job-specific"

- Complete site-specific training in the operation of material handling equipment, including:
    - Pumps, valves and related controls
    - Quick-connect hoses and manifolds
    - Screen operation
    - Conveyors and feeders
    - Front-end loaders, backhoes and fork lift trucks
    - Tractors and dump trucks
    - Sampling procedures and devices

- Proper use of facility safety procedures and equipment

- Proper use of spill control and cleanup equipment.

A description of the job duties for the material handling and service personnel includes the following:

- Maneuver trailers, fork lift trucks, front-end loaders, backhoes and dump trucks
- Collect and process soil samples
- Prepare soil for feeding by sorting and screening
- Keep records of job-related activities
- Maintain the workplace in a safe and orderly manner
- Maintain spill cleanup equipment in good condition
- Perform other related duties as directed by supervisor.

SECTION 3

PROCESS DESCRIPTION

3.1 GENERAL

The process described in this section employs Williams' Low Temperature Thermal Desorption Unit (LTTD). The process will treat soils at temperatures between approximately 700°F and 1100°F in order to volatilize the hazardous organic constituents in the soil and achieve cleanup levels as outlined in the Technical Specifications. A description of the major items of equipment which comprise Williams' LTTD is presented in Section 4.

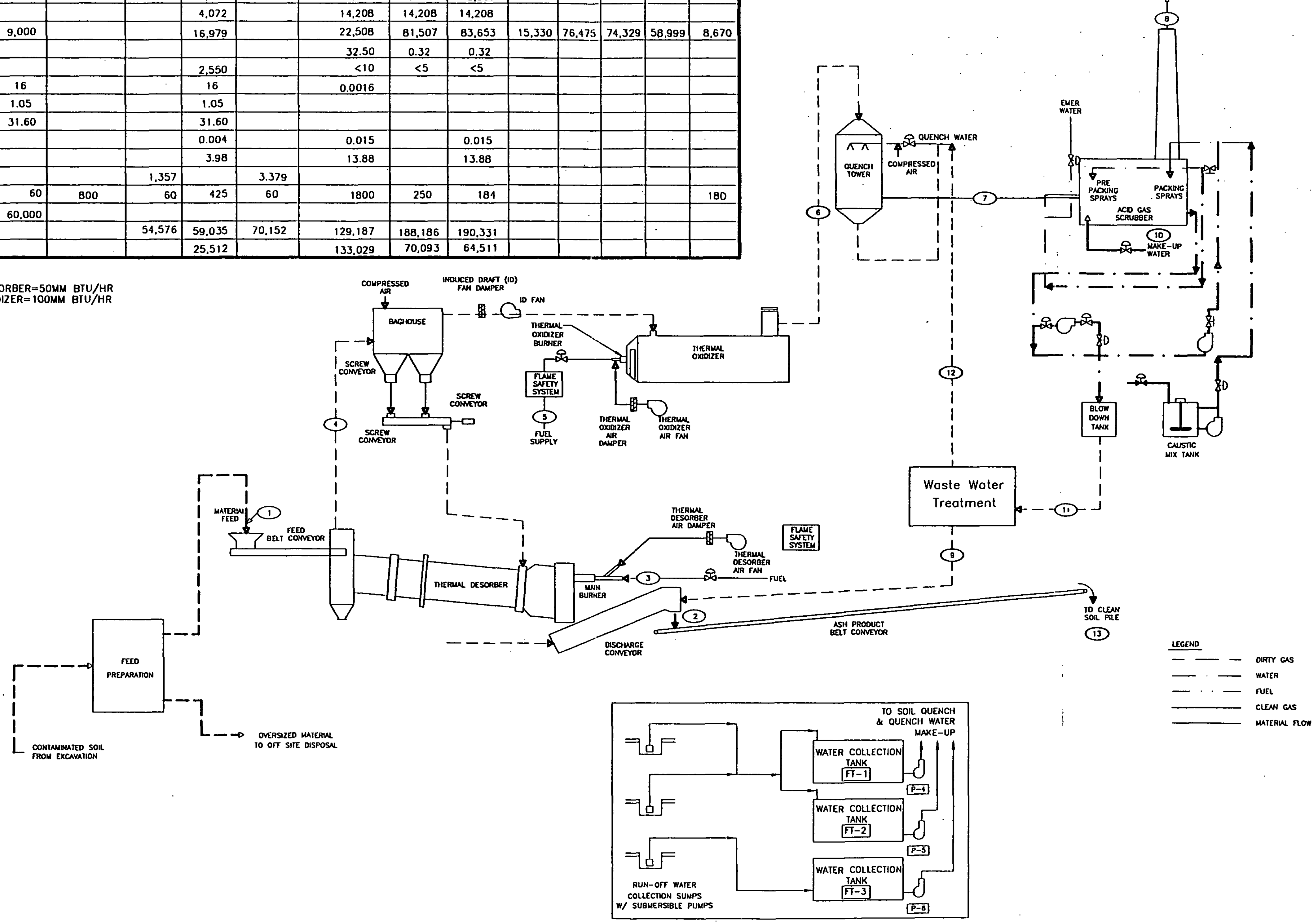
The thermal desorber will be used to volatilize moisture and organics contained in the excavated soil during this project. The off-gases from the desorber are then treated with a baghouse to remove particulate matter. Further removal of organics contained in the gas stream is accomplished by a thermal oxidizer. Following the oxidizer, a scrubber will remove 99% of the HCl present in the off-gases. A process flow diagram complete with a heat and material balance is shown in Figure 3.1.

3.2 FEED PROCESSING

The feed material for this project consists of soil which has been previously excavated and stockpiled on site and some soils located under the stockpile. The soil will be removed from the stockpile with a front-end loader and delivered to the feed unit (SF-FU) where it will be screened into a feed hopper. An apron feeder will move the soil from the hopper to a belt conveyor which will elevate the soil to the feed belt (SF-BC-4) at the desorber. The speed of the apron feeder is regulated from the control room and used to set the soil feed rate to the desorber at approximately 30 tons per hour. The feed belt contains a load cell for the continuous weighing of the feed soils. The instantaneous and cumulative weights are displayed in the control room. Testing procedures and sampling will be performed as outlined in the Performance Test Plan. Re-sampling/re-analysis/re-extraction may only be considered if problems in the analytical procedures or sampling procedures are identified; otherwise, soil piles that fail to meet cleanup standards will be re-treated. EPA will make the decision on whether another sample may be taken for a specific pile as opposed to a pile being re-treated. The failed pile will be moved from the verification holding area to the wastefeed stockpile area. The failed pile will be treated as the production schedule allows. The amount of re-treated material will be deducted monthly based on the production sheets. (One pile represents one day's production.)

	UNITS of MEASURE	① WASTE FEED	② TREATED SOIL	③ KILN BURNER	④ KILN OFFGAS	⑤ SECONDARY BURNER	⑥ SECONDARY OFFGAS	⑦ QUENCHER OFFGAS	⑧ STACK GAS	⑨ DUST CONTROL	⑩ MAKE UP WATER	⑪ BLOW DOWN	⑫ RECYCLE WATER	⑬ QUENCHED SOIL
DRY GAS	LB/HR			53,219	42,056	70,152	106,679	106,679	106,679					
DRY SOLIDS	LB/HR	51,000	43,350											43,350
THERMAL CAPACITY	MM BTU/HR			30		73								
N2	LB/HR			33,048	33,048	51,415	84,463	84,463	84,463					
O2	LB/HR			20,171	4,936	15,358	8,007	8,007	8,007					
CO2	LB/HR				4,072		14,208	14,208	14,208					
H20	LB/HR	9,000			16,979		22,508	81,507	83,653	15,330	76,475	74,329	58,999	8,670
HCL	LB/HR						32.50	0.32	0.32					
PARTICULATE	LB/HR				2,550		<10	<5	<5					
CARBON	LB/HR	16			16		0.0016							
HYDROGEN	LB/HR	1.05			1.05									
CHLORINE	LB/HR	31.60			31.60									
SO2	LB/HR				0.004		0.015		0.015					
NO2	LB/HR				3.98		13.88		13.88					
FUEL USAGE	LB/HR			1,357		3.379								
TEMPERATURE	degrees F	60	800	60	425	60	1800	250	184					180
TOTAL MASS SOLID	LB/HR	60,000												
TOTAL GAS MASS	LB/HR			54,576	59,035	70,152	129,187	188,186	190,331					
TOTAL GAS VOLUME	ACFM				25,512		133,029	70,093	64,511					

NOTE:
BURNER CAPACITY OF THERMAL DESORBER=50MM BTU/HR
BURNER CAPACITY OF THERMAL OXIDIZER=100MM BTU/HR



LTR.	DATE	REVISIONS	BY
-	MM/DD/YY	CREATED	JDL

Williams Environmental Services
WILLIAMS
2075 West Park Place
Stone Mountain, GA 30087
404/879-4107 (fax) 404/879-4831

TPU4

WOODS INDUSTRIES

PROCESS FLOW DIAGRAM
FOR 4TPU

4PFD

DATE 10/6/94
DIRECTORY: WES\JOBS\ACTIVE WOODS\DWGS
FILENAME 4PFD-WOO.dwg
DWG NO. FIG. 3-1

3.3 SOIL TREATMENT

A countercurrent thermal desorber (PC-RD) is used to volatilize the moisture and organic constituents from the soil. The desorber has internal flights to ensure intimate contact between the soils and desorbed gases. The soils enter at the same end where the exhaust gases leave. The exit gas temperature will not exceed 450°F. The actual gas exit temperature will be determined by the performance test. While the soil passes through the desorber, the soil temperature initially rises to 212°F as water is removed. After the moisture has been removed, the soils move toward the discharge end of the desorber where the soil temperature increases to approximately 800°F or greater. Since countercurrent flow is utilized, high exit soil temperatures can be readily obtained. The desorber is constructed of a special alloy designed specifically to withstand temperatures up to 1200°F.

The treated soils move through the dryer and enter the Dobson collar prior to exiting the rotary dryer. The Dobson collar is an expansion in the shell of the dryer to allow the baghouse fines to mix with the treated soils. The collar serves two purposes. The first purpose is to add additional residence time for the treatment of the baghouse fines so that a thorough and controlled treatment can be performed. The second purpose is to reduce the gas flow through the collar itself. The reduction of the gas flow prevents the baghouse fines from re-entraining into the gas stream and allows for further treatment. After exiting the Dobson Collar, the treated, conditioned soil enters into a pugmill where it is discharged to a belt conveyor for stacking. The treated soils are removed from the stacking area by a front-end loader to the verification holding area for subsequent analyses. After meeting the clean-up goals, the treated soils will be used as backfill on-site. Appendix S contains the correspondence to date on the description of the Dobson collar. Included in this appendix is a mechanical drawing, a program output of the calculated retention time in the collar and various correspondence that has resulted in the ultimate selection of the collar.

Heated air is provided to the desorber by a gas fired burner (PC-BR). This burner is located away from the dryer so that no direct oxidizing flame comes in contact with the soils. Combustion air for the burner is provided by a separate blower, but the overall draft is maintained by an I.D. fan (BH-ID) located after the baghouse. The pressure at the burner end of the desorber is monitored and the I.D. fan damper is regulated to maintain a negative pressure inside the desorber at all times.

3.4 GAS CLEANING

The gas stream leaving the desorber contains particulates, moisture, metals, acid gases and volatilized organics. This stream must be treated to remove the particulate and organic matter in order to achieve air emission standards before the gas is discharged to the atmosphere. A baghouse dust collector (BH-DC) and a thermal oxidizer (SC-TO) will be used to achieve these removals.

The baghouse utilizes a pulse jet type cleaning system. A maximum air to cloth ratio of 5:1 is provided. The polyimide bag material (P-84) provides excellent removal efficiency and has a maximum continuous operating temperature of 500°F.

The air from the desorber enters the baghouse below 450°F. After passing through the filter bags, the particulate free gas exits the baghouse at about 400°F.

The baghouse dust is removed from the baghouse hoppers by screw conveyors (BH-SC-1/5) which discharge into two other totally enclosed screw conveyors (BH-SC-6/7) for transfer to the Dobson Collar portion of the desorber. (See Section 3.3, Soil Treatment).

After removal of particulates, the gas stream enters the thermal oxidizer (SC-TO) where the oxidation of the volatile organic compounds occurs. The oxidation efficiency of the organics depends on the temperature inside the thermal oxidizer, the turbulence of the gases, and the retention time of the gases inside the thermal oxidizer chamber. The chamber is sized to provide sufficient retention time (> 2 seconds) at 1800°F and has a high intensity vortometric burner to provide the temperature and turbulence required to oxidize the organics. After the organics have been oxidized, the clean gases are quenched to reduce their temperature, then are passed through the scrubber to remove any further particulates and acid gases, and finally through the stack (AB-ST) to the atmosphere. The clean stack gases will be monitored using a continuous emissions monitoring (CEM) system (see Table 4.1).

3.5 PROCESS RESIDUAL STREAMS

The LTTD operation and associated tasks will generate the following residual streams:

- oversize debris too large for treatment (> 3 inches cube)
- treated soil prior to laboratory confirmation
- water collected from pad area runoff (such as operations pad area)
- scrubber water blowdown
- baghouse dust.

3.5.1 Oversized Material and Debris

Thermal desorption requires a significant amount of material handling. A cutoff size will be established through experience in handling the on-site soils to determine which material will be screened out. A Powerscreen with two levels of mesh grating (grid design) will be utilized for the screening operations. Through observations made during soil removal activities conducted at the site, BNRR and the USEPA are aware that the soil excavated and placed in the temporary soil storage piles contain approximately 35 to 45 percent "oversized material". This oversized material will not be treated by the thermal desorption process because it cannot be handled via the material handling equipment involved with the thermal desorption process.

As discussed in the Draft Feasibility Study, it is believed that contaminants adhere preferentially to finer particles (silts, clays and humic materials) and contamination of larger materials is related to the adhesion of finer particles to the exterior of larger ones. Observations made during soil removal activities at the site revealed that the exterior of the larger materials are relatively free of finer materials adhering to their surface.

To evaluate the disposition of the oversized material, with the USEPA's approval, BNRR has collected composite samples of oversized material which are in the process of being crushed and analyzed for several indicator chemicals.

The results of these analyses will be compared to the treatment goals established for the soils exiting the thermal desorption process which will be used as backfill on-site. BNRR understands that oversized material which is below the treatment goals will be suitable to be used as backfill without additional treatment.

Debris will be handled similarly as in building demolition and soil removal. Contaminated debris will be disposed of at Chemical Waste Management's Arlington, Oregon facility. Clean debris will be disposed of at a local sanitary landfill. The ultimate fate of the debris found at the Woods Site will be limited by the individual material's character and degree of contamination. Where appropriate, the material will be re-used or recycled. No visibly contaminated material will be recycled or disposed of in a sanitary or municipal landfill. If the material is believed to be contaminated based on visual observation, the material will be cleaned, if practical, or disposed of at a facility permitted to accept the waste as appropriate.

Williams anticipates hauling soils to a wastefeed stockpile as is shown in Figure 12-1. Engineering controls will be used to prevent fugitive dust emissions where applicable.

3.5.2 Treated Soil Prior to Laboratory Confirmation

Treated soils exit the rotary dryer and pass into the enclosed discharge screw conveyor to be re-moisturized. A negative pressure is maintained on the discharge conveyor to capture any steam from the re-moisturizing process. The treated, conditioned soil then discharges from the screw conveyor to a belt conveyor for stacking. The stacking conveyor is capable of producing treated soil piles in excess of 400 tons. The treated soils are removed from the stacking area by a front-end loader to the verification holding area for subsequent sampling and analysis. Sampling will occur after the treated soil has been conditioned with carbon treated water. While awaiting laboratory confirmation, soil piles remain within the confines of the containment area and are covered by plastic sheeting. The covering helps prevent dusting due to wind and runoff due to rain. Any runoff that may occur from the treated soil piles will be collected in a sump and further treated by the unit's aqueous phase carbon adsorption system. Sludgy material that settles in the sumps will be removed periodically, mixed with contaminated soil to reduce the moisture content, and reprocessed through the thermal desorption system. Any sludge collected after treatment of the contaminated soil has been completed will be placed in the dryer, heated to remove moisture, and then processed. Only minimal amounts of sludge are anticipated. After lab results have been obtained to confirm that the treated piles have passed analysis, the soils will be used as backfill on-site.

3.5.3 Run-off Water

Water collected as run-off from the pad area will be stored in three frac tanks located on the pad. This water may be used to supplement the water requirement for conditioning the treated soil, or for dust control on untreated material as applicable. The runoff water will be treated with carbon to ensure that the treated soil is not re-contaminated by this water. No sampling of this run-off water is necessary. Its acceptability is determined by the criteria that it does not affect treated soil quality. Carbon treated water will not be used for dust control or for dust suppression of the treated soils after the soil has been sampled and determined to comply with the clean-up levels. For soils that have already been confirmed as meeting clean-up levels, only city water or treated water that has been analyzed and approved may be used for dust control and conditioning of these soils. Untreated run-off water will not be used for dust control or conditioning of any treated soils. City water will be used for dust control of the haul roads. The spent carbon will be disposed of/regenerated at Westates Carbon's Parker, Arizona facility, or Westates Morgantown, West Virginia facility. Williams proposes to sample the carbon at a frequency of one sample per 1,000,000 gallons of water treated in order to determine whether it is spent. The estimated life span of the carbon units is in excess of four years.

3.5.4 Scrubber Water Blowdown

Effluent from the acid gas scrubber, or blowdown, will be routed to the aqueous phase carbon adsorption units where it will be treated in the same manner as run-off water collected from the pad area. Treatment with carbon will ensure that the treated soil is not re-contaminated by this water, which may be used to supplement the water requirement for conditioning the treated soil, and quench water for the gas stream. Carbon treated water will not be used for dust control or for dust suppression of the treated soils after the soil has been sampled and determined to comply with the clean-up levels. For soils that have already been confirmed as meeting clean-up levels, only city water or treated water that has been analyzed and approved may be used for dust control and conditioning of these soils. Untreated run-off water will not be used for dust control or conditioning with any treated soils. City water will be used for dust control of the haul roads.

3.5.5 Baghouse Dust

The baghouse, located prior to the oxidizer and other APCE, is the primary means of particulate removal for the system. Because of its position in the treatment process, there will be no buildup of soil particulate in the equipment subsequent to the baghouse. Particulate collected from the baghouse will be returned to the hot end of the rotary dryer for further treatment. The increased diameter at the hot end of the rotary dryer, from 8.5 feet to 10 feet, increases the soil residence time and provides lower air velocities to allow for further treatment of the particulate if residual contamination does exist. Both the soils and the soil particulate will receive full, controlled treatment before discharge from the rotary dryer. Following treatment, the soils will be analyzed to ensure that they meet established cleanup standards.

EPA has requested that Williams provide control of baghouse fines to the Dobson Collar so the flow of fines does not exceed the rate which was demonstrated during the performance test. Williams has agreed to install a dust flow monitor to measure the dust feed rate to the desorber and institute an AWFSO if the feed rate demonstrated during the performance test is exceeded. Williams has expressed concern that such a device will not work effectively. However, the EPA understands that technical problems may arise on-site that make it impossible for Williams to comply with requirements as delineated in this plan. If such a situation arises, EPA will work with Williams to resolve the problem, which may mean modification of a requirement.

Additionally, EPA has instructed Williams to stop the baghouse dust feed to the desorber in the case of any AWFSO. Both the EPA and Williams have legitimate concerns pertaining to the implications of stopping the dust feed to the desorber in the event of any AWFSO. As a compromise, based on the operation of the unit during clean soil shakedown, Williams will attempt to stop the dust feed in the desorber in the event of an AWFSO. Williams will conduct a "test" during clean soil shakedown in order to determine the length of time the baghouse dust feed to the desorber can be stopped before excessive dust buildup in the baghouse becomes a significant problem. Based on the results of this test, Williams will install a timer which will allow the dust feed to the desorber to restart after some approved length of time as demonstrated during the test. This action would prevent a buildup of dust in the baghouse in the event of a prolonged AWFSO. The exceptions to restarting the dust feed would be AWFSOs for ID fan failure, burner malfunction, power failure, positive pressure excursion, and low soil temperature.

SECTION 4

EQUIPMENT DESCRIPTION

The process equipment for this project is configured for six primary trailers plus auxiliary material handling and fuel storage units. The composition of each trailer is:

Trailer 1

The desorber unit includes the rotary dryer (PC-RD), feed belt (SF-BC-4), and thermal desorber burner (PC-BR).

Trailer 2

The baghouse unit includes the baghouse dust collector (BH-DC), baghouse discharge conveyors (BH-SC-1/5), dust transfer conveyors (BH-SC-6/7), I.D. damper (DF-2-B) and induced draft blower (BH-ID). Auxiliary equipment includes air compressors.

Trailer 3

The thermal oxidizer unit includes the thermal oxidizer (SC-TO) and thermal oxidizer burner (SC-BR).

Trailer 4

The control unit houses the control panel, data logger, PLC, CPU, and CEM analyzers. In addition, the motor control center and a small work shop area are contained in this trailer.

Auxiliary material handling equipment includes the feed processing unit (SF-FU), stacking conveyor and tool trailer.

Trailer 5

The scrubber unit includes the vertical packed bed acid absorber (AB-SCR).

Trailer 6

The quench trailer includes the quencher vessel (QU-V) and the stack (AB-ST).

4.1 EQUIPMENT DESCRIPTION

Figure 3.1 shows the process flow diagram of the LTTD with heat and mass balances. The system consists of a feed processing unit, thermal desorber, baghouse, thermal oxidizer, quench tower, induced draft fan, acid gas scrubber, emergency vent, burner systems, control trailer and soil feeding system. The pollution control system is state-of-the-art, with a baghouse, thermal oxidizer and acid gas scrubber. The system is designed to treat more than 40 tons per hour of soil at 15-20% moisture content and will meet the performance requirement for reducing the organochlorine (OCL) pesticide levels from contaminated soil at the Woods Industries Site. The major components of the system are described below.

Feed Processing Unit

Material handling can often be a major operational challenge in the thermal treatment process. Soils with high clay and moisture content are difficult to handle compared with sandy soils. The feed processing unit of the LTTD system is specially designed and built to handle difficult clays. Because operational parameters can be modified to accommodate variable feed conditions, mixing or blending of waste feed material is generally not required.

Contaminated soils at the Woods Industries site contain a large amount of cobbles. Other debris, such as metal bands and pipes may also be present. Therefore, the contaminated soil will be pre-screened prior to thermal desorption processing. A Powerscreen with two levels of grating will be utilized. Size screening enhances the efficiency of thermal treatment and protects the integrity of the feed and discharge systems of the unit. The material is initially screened to remove particles larger than three inches, as well as other large debris. The handling of oversized material is discussed in Section 3.5.1. Miscellaneous debris present in the stockpile, such as metal bands and pipes, will be handled similarly to that during soil removal and disposed of properly in a RCRA permitted landfill, tentatively Chemical Waste Management's Arlington, Oregon facility.

Screening of cobbles will take place in an exclusion zone area adjacent to the stockpiles. The area will be cleaned as necessary following completion of the screening operation. Should dusting be a significant problem, Williams will have the necessary equipment (tarps, etc.) on-site during shakedown to cover the screens if necessary.

The prescreened soil is delivered to the feed hopper by a front-end loader. The soil is re-screened through a bar grate, then passes into the hopper of the apron feeder (SF-FU) and onto the feed belt conveyor (SF-BC-4). Williams' material handling units are equipped with several different screen sizes. The screen size to be used during production operations will be selected on the optimum unit performance prior to the performance test. Measurements from the weigh belt scale provide the pay basis for the project. The speed of the drag chain on the apron feeder is adjustable to control the soil feed flow rate. The weigh belt conveyor transfers metered soils into the entrance breeching of the rotary dryer (PC-RD).

Handling of waste feed material will be kept to a minimum to prevent entrainment of dust and vapors in the air. Williams anticipates hauling untreated soils directly from the stockpiles to a wastefeed stockpile adjacent to the feed processing unit. Administrative controls such as speed limits and covering dump trucks during transport, if necessary, will be used to minimize fugitive dust emissions where applicable. Vibratory screening will be performed to separate cobbles and other debris from the stockpiles. Screening operations have the potential to create dust depending on soil conditions and characteristics, but Williams will make every effort to minimize fugitive dust emissions. It is not anticipated local exhaust ventilation will be required to meet the required levels of airborne concentrations of dust and vapors during the normal processing of feed material. Engineering controls, such as Williams covering the feed soil and stacking conveyors, will be implemented by Williams to further reduce the potential for fugitive emissions.

All operations will be closely monitored in accordance with the Health and Safety Plan and if airborne concentrations exceed 10 mg per cubic meter of air for dust or 5 ppm for vapors, additional control measures will be initiated.

Thermal Desorber

The thermal desorber (PC-RD) consists of a rotary dryer with internal flights for lifting and showering the solids through the hot gas stream. The repeated spilling action veils the material through the hot gas stream, raising the soil temperature between 400°F to 1000°F. The desired soil temperature depends on the physical characteristics of contamination and the cleanup levels required. Moisture is evaporated and hazardous waste constituents in the soil are volatilized or desorbed.

Operation of the dryer is countercurrent, with heat supplied by a direct-fired burner (PC-BR). Retention time in the dryer varies based on dryer speed and the slope of the unit, and is typically between 15 to 20 minutes. Countercurrent flow of gas and solids gives greater heat transfer efficiency with a given inlet-gas temperature. The discharge end of the rotary dryer is constructed of Inconel to withstand temperatures up to 1200°F. The system is flexible enough to process high moisture (up to 40%) and organic content (up to 10%) in the soil.

Treated soils exit the dryer through the discharge end, breeching into the discharge conveyor (AS-DC). The process soils are quenched in the pugmill to cool the material and suppress fugitive dust emissions. A stacking conveyor (AS-BC-4) is used to generate temporary treated soil stockpiles which are then sampled for verification analyses.

Gases exit the rotary dryer through the transition ductwork above the feed input. The temperature of the off-gases is monitored to prevent any condensation of organic compounds in the duct and the baghouse. Operation of the dryer at a rate of 30 tons per hour will require a fuel use of 1357 lb/hr of propane. The estimated amount of heat loss is 5 percent.

Dobson Collar

The Dobson Collar is an expansion in the shell of the dryer to allow the baghouse fines to mix with the treated soils. The dryer expands from the 8.5 foot diameter dryer to the 10.5 foot Dobson Collar which houses the conveying and mixing mechanism to mix the solids and baghouse fines. The collar serves two purposes. The first purpose is to add additional residence time for the treatment of the baghouse fines so that a thorough and controlled treatment can be performed. The second purpose is to reduce the gas flow through the collar itself. The reduction of the gas flow prevents the baghouse fines from re-entrainment into the gas stream and allows for further treatment. The retention time in the collar has been calculated at approximately eight to ten minutes. This will allow time for the dust to mix with soils in the dryer and to mix with hot gases from the dryer. Appendix S contains the correspondence to date on the description of the Dobson Collar. Included in this appendix is a mechanical drawing, a program output of the calculated retention time in the collar, and various correspondence that has resulted in the ultimate selection of the collar.

EPA has requested that Williams provide control of baghouse fines to the Dobson Collar so that the flow of fines does not exceed the rate which was demonstrated during the performance test. Williams believes that the flow of fines to the baghouse is directly proportional to the soil feed rate. Therefore, the baghouse fines entering the Dobson Collar at any time will be proportional to the feed rate. Williams believes that flow control of the baghouse fines to the Dobson Collar is unneccesary and will cause immense operational problems. If technical problems result from the use of flow control mechanisms, the EPA will work with Williams to resolve the problem, which may mean modification of a requirement. EPA will determine, in consultation with BNRR and Williams, whether the flow meter is working properly.

The baghouse hoppers are designed to direct the flow of fines to the screw conveyors and provide minimal capacity for fines accumulation. If a flow control strategy is implemented and a reduction of the fines is restricted to the collar based on the results of the performance test, accumulation of fines in the baghouse could possibly result. This occurrence would be self perpetuating (the accumulation of the fines would cause the screw conveyors to flow full causing the flow mechanism to slow down in order to accommodate the selected fines flow rate from the performance test) and would cause unit operations to be halted. Based on the operation of the unit during clean soil shakedown, Williams will attempt to stop the dust feed to the desorber in the event of an AWFSO. As agreed, Williams will conduct a "test" during clean soil shakedown in order to determine the length of time the baghouse dust feed to the desorber can be stopped before excessive dust buildup in the baghouse becomes a significant problem. Based on the results of this test, Williams will install a timer which will allow the dust feed to the desorber to restart after some approved length of time as demonstrated during the test. This action would prevent a buildup of dust in the baghouse in the event of a prolonged AWFSO. The exceptions to restarting the dust feed would be AWFSOs for ID fan failure, burner malfunction, power failure, positive pressure excursion, and low soil temperature.

Williams is presently gathering information for the design and manufacturing of the requested modifications from the EPA. The design will utilize a variable speed motor operated by a PID controller. The flow of the fines will be monitored by a solids flow meter which will be linked to the controller. The controller will have a read out which is accessible to the board room operator. The output from the flow meter will be continuously monitored and recorded. Use of the meter will be demonstrated during the shakedown period. Based on consultation among EPA, BNRR and Williams, if operation of the device proves unsuccessful during the shakedown period, the EPA will relieve Williams of the AWFSO requirement on baghouse fines for the remainder of the project.

Baghouse

Off-gases from the desorber are processed to remove particulates. Particulates in the gas stream are filtered in the baghouse (BH-DC). The baghouse is designed to give a maximum air to cloth ratio of 5:1 and provide above 99% efficiency for removal of particulates. The bag material is P-84, which can withstand temperatures in the range of 500°F and has excellent resistance to corrosive atmospheres.

The baghouse cleans by pulse jets of compressed air that expand the flexible bags and dislodge the filter cakes. Particulate collected from the baghouse will be returned to the hot end of the rotary dryer for further treatment. The increased diameter at the hot end of the rotary dryer increases soil residence time and provides lower air velocities to allow for further treatment of the particulate. This closes the solids loop in the treatment process.

The baghouse is the Best Available Control Technology (BACT) for controlling particulate emissions. Stack tests with P-84 fabric have demonstrated particulate loading of less than 0.05 gr/dscf, ensuring a significant margin of safety relative to the federal standard of 0.08 gr/dscf described in 40 CFR 264 Subpart O. For this project, Washington state requirements allow for a maximum particulate emission of 0.03 gr/dscf, corrected to 7% O_2. This is a much more stringent requirement than that set forth by RCRA. Additionally, a target emission rate of 30 ng/dscm is being set for dioxins and furans.

Thermal Oxidizer

The gases from the baghouse enter the oxidizer (SC-TO) where they are heated to the required temperature (permit condition) for about 2 seconds in a 4-6% oxygen rich atmosphere to assure complete oxidation of the OCL pesticides. The destruction of the pesticides in the flue gas depends on the residence time, turbulence and temperature. The oxidizer is sized to provide sufficient residence time and is installed with a high intensity burner to provide the turbulence necessary to oxidize chlorinated compounds. Oxidization of organic compounds yields carbon dioxide, water vapor, and hydrochloric acid (chlorinated compounds).

$C_xH_y + O_2 + N_2 \Rightarrow CO_2 + H_2O + O_2 + N_2$
$C_xH_yCl_z + O_2 + N_2 \Rightarrow CO_2 + H_2O + HCl + O_2 + N_2$

The thermal oxidizer unit is fabricated of 3/16 inch carbon steel and is approximately 12 feet in diameter and 87 feet long. The combustion chamber is insulated with a blanket of 1-inch thick K wool and 4-inch thick center-mounted ceramic Z block modules. Castable refractory lines the bottom of the chamber. The high intensity burner (SC-BR), mounted in the center of the chamber's end, has a rating of 97 million Btu/hr. Fuel usage for the thermal oxidizer will be 3379 lb/hr of propane at a feed rate of 30 tons per hour.

The temperature of the gas can be raised as high as 2100°F in the thermal oxidizer to ensure complete oxidation and destruction of chlorinated hydrocarbons. The operating temperature for this waste will be typically maintained at 1800°F. Gas residence time is greater than two seconds. Gases that exit through the oxidizer are cooled to adiabatic saturation temperature in the quench tower (QU-V). Destruction and removal efficiency for principal organic hazardous constituents (POHCs) in the thermal oxidizer will meet or exceed 99.99%.

Quench Tower

The quench tower (QU-V) is designed to reduce the flue gas temperature prior to its introduction into the scrubber. The quench is capable of removing more than 40 million Btu/hr from the flue gas stream by mixing with a large quantity of water. The quench is designed to handle more than 200,000 ACFM at 1800°F and reduce the flue gas temperature to approximately 185°F (the adiabatic saturation temperature). The spray headers will spray a total of 400 gpm of recirculated water, of which 60 to 80 gpm fresh water will be required for evaporation. Water will be purged from the quench at about 12 gallons per minute. This blowdown will be treated by the unit's wastewater treatment equipment prior to being reused in the process. Any solid material collected in the liquid bag filters will be introduced into the wastefeed stockpile for further treatment.

Acid Gas Scrubber

The acid gas scrubber (AB-SCR) is designed to neutralize any acids formed during the oxidation process. Particulates and acidic gases are effectively removed by a packed bed scrubber. The scrubber has a design capacity of approximately 190,000 ACFM. Caustic will be used as the neutralizing solution and the efficiency of the scrubber is greater than 99% for gaseous HCl. The material of construction is FRP, which is highly resistant to hydrochloric acid. The gases from the scrubber are discharged at adiabatic saturation temperature from the stack. The blowdown water from the scrubber will be used to quench the soil exiting the thermal desorber. Its acceptability is determined by the criteria that it does not affect treated soil quality. The mist eliminator mounted in the scrubber discharge end will remove the liquid carryover by the gas stream. Effluent from the LTTD scrubber will be routed to the aqueous phase carbon units.

Induced Draft Fan

An induced draft (ID) fan provides the driving force for the movement of gases in the system. It will maintain negative pressure in the thermal desorber and baghouse to prevent fugitive emissions.

Because of the ID fan's positioning in the treatment process, the remainder of the system (thermal oxidizer and APCE) will be under positive pressure. However, the level of control for fugitive emissions on the positive side of the ID fan will be equivalent to that provided on the negative side. Subsequent to the ID fan, there are no openings or access ports in the equipment prior to the stack from which fugitive emissions could occur. All flanges and joints are tightly sealed in order to prevent any leaks from the system. In addition, all equipment, including flanges and seals, will be visually inspected on a daily basis to ensure that no emissions are occurring from locations other than the stack.

Table 4.1 provides a description of the major equipment items which are referenced in Section 3 (Process Description) and Figure 3.1, Process Flow Diagram.

Water Treatment System

The water treatment system is designed to handle scrubber blowdown and water generated from run-off on-site. Williams proposes to use sump pumps located at the decon pad, wastefeed pad, and the verification holding pads to collect run-off rainwater. This water will be transferred by the sump pumps into a "collection tank" (capacity 20,000 gallons) where solids will be allowed time to settle. The water in the collection tank will then be filtered down to 200 µm prior to treatment by the Westates ASC 2000 carbon units. Each unit contains approximately 1200 lbs. of granular activated carbon. After treatment through the carbon unit the treated water is transferred to the process water tanks. The water from these frac tanks will be used during production to quench the treated soil and gas stream.

Table 4.1
Equipment Description and Specifications

Tag No.		
SF-FU	Feed Unit	
	Feed Hopper:	8.0 cubic yard
	Apron Feeder:	100 tons per hour capacity
	Belt Conveyor:	36" wide
	Drive(s):	Electric/hydraulic
SF-BC-4	Feed Belt	
	Type:	Belt conveyor with receiving hopper
	Belt Conveyor Width:	30" wide
	Drive:	8.9 hp electric, variable speed
	Belt Scale:	Instantaneous and cumulative, ton/hr
PC-RD	Thermal Desorber	
	Type:	Countercurrent rotary dryer
	Nominal Feed Rate:	40 tons/hr
	Drum Dimensions:	8'-6" Dia. x 40'-0" Long
	Dobson Collar:	10' diameter
	Drum Speed:	1.5 to 2.5 rpm, variable
	Drive:	100 hp electric, variable speed
PC-BR	Rotary Dryer Burner	
	Manufacturer:	Hauck Powerstar Model # SJP260
	Capacity:	49 mm BTU/hr
	Fuel:	Propane (or natural gas)
	Blower:	Hauck Turbo 50 hp @ 3500 scfm Hauck Tertiary 15 hp @ 8500 scfm
	Fuel Pump:	Blackmer #LGL1, 20 gpm, 3 hp, 1750 rpm
AS-DC	Discharge Conveyor	
	Type:	DRAGSLAT conveyor
	Drive:	10 hp

AS-PM Soil Conditioning Pugmill

Type: Continuous flow, double shaft
Capacity: 50 - 100 TPH, 12' length
Drive: Dual 30 hp motors/reducers
Dust Suppression: Water injection

AS-BC-4 Stacking Conveyor

Type: Enclosed belt conveyor
Stacking Radius: 50'
Belt Size: 30" wide x 60' long
Drive: 10 hp electric
Dust Control: Covers

BH-DC Baghouse Dust Collector

Type: Mobile pulse jet dust collector
Nominal Flowrate: 35,000 acfm
Filter Area: 9,975 square feet
Filter Material: P-84
Maximum Temperature: 510°F
Air to Cloth Ratio: 5:1 (maximum), 3.5:1 (design)

BH-SC-1/5 Baghouse Discharge Conveyors

Type: 12" screw conveyors (5)
Drive: 5 hp electric each

BH-SC-6/7 Dust Transfer Conveyors

Type: 12" screw conveyor (2)
Drive: 7.5 hp electric

BH-ID Induced Draft Blower

Type: Industrial radial blade centrifugal
Size: 29 inch inlet
Horsepower: 250 (dual 125s)
Nominal Flowrate: 35,000 acfm
Construction: Carbon Steel
Manufacturer and Model: Northern Blower Exhaust Fan
Damper: Multi-louvered

SC-TO **Thermal Oxidizer**

Volume:	5,899 cubic feet
Velocity:(cross sectional)	34.9 feet per second

SC-BR **Thermal Oxidizer Burner**

Manufacturer:	Hauck Powerstar Model # SJP 520
Capacity:	97 MM BTU/hr
Fuel:	Propane/Natural Gas
Blower:	Hauck Turbo, 100 hp, 7300 scfm Hauck Tertiary, 60 hp, 12,100 scfm
Fuel Pump:	Blackmer #LGL1, 20 gpm, 3 hp, 1750 rpm

AB-ST **Stack**

Inside Diameter:	60"
Exit Height (from grade):	70 ft

CEM **Continuous Emissions Monitoring System**

Model:	HC500-2D
Company:	Columbia Scientific Industries Corp.
Parameters:	Carbon monoxide, oxygen
Analyzers:	FID, NDIR, Paramagnetic

CH **Control House**

Type:	Enclosed, trailer mounted, climate controlled

PLC **Programmable Logic Controller**

Model:	SLC 500
Company:	Allen-Bradley Co.
Type:	Modular Rack System
Software:	Allen-Bradley Advanced Programming Software (APS)
Application:	Provides start-up sequencing and system interlock control

QU-V **Quench Tower**

Type:	Horizontal venturi wetted elbow
Capacity:	200,000 ACFM
Inlet Temp:	1800°F
Outlet Temp:	185°F
Coolant:	400 gpm

AB-SCR **Scrubber**

Type:	Vertical packed-bed acid absorber
Efficiency:	99% removal efficiency of HCL
Capacity:	190,000 ACFM
Mist Elimination:	Mesh-type 99% removal efficiency
Materials:	FRP/PPE/SS
Pumps:	(4) 20 hp

4.2 CONTROL SYSTEM DESCRIPTION

The control room for the LTTD is inside a mobile trailer. Three sides of the control room are glass paneled so the chief operator can simultaneously monitor the process variables and can also view the operations outside the control room. The equipment motors and pumps are started and stopped via START-STOP PULL BUTTONS located on the panel in the control room trailer. The control room is insulated and can be heated or cooled as per the requirement. The pressure in the control room is kept positive to prevent dusting from outside.

Process Variable Recording

Several process variables are continuously recorded. Among these are the waste soil feed rate; temperature at the exit of the dryer, thermal oxidizer and quencher; differential pressure across the baghouse; dryer draft; dryer soil discharge end hood pressure; and stack gas carbon monoxide concentration. A complete list of the process variables continuously recorded is shown in Table 6.2. This data is recorded by a Kaye Instruments Digistrip 4 Plus data logger. Descriptions and specifications for this model are included in Appendix B. In addition, stack gas flow rate will be monitored and recorded through correlations to the ID fan amperage.

The control strategy for the system is straight forward. The dryer exit gas temperature is controlled manually by the dryer fuel control valve to maintain the temperature less than 500°F. The thermal oxidizer exit temperature is automatically controlled by the burner fuel control valve to maintain temperature at the set point. The inlet gas temperature to the acid gas scrubber controls the quench tower water control valve to maintain the scrubber inlet gas temperature.

4.3 CONTINUOUS EMISSION MONITORING

The Continuous Emission Monitoring (CEM) system shall be installed and certified prior to operation of the LTTD to provide real time stack gas monitoring. The system, at a minimum, will monitor oxygen, carbon monoxide, and opacity. Stack sampling protocols for the O_2 and CO CEMs will be in accordance with 40 CFR, Part 266, Appendix IX.

The continuous monitoring instruments shall be integrated with the data management system. The monitoring data will be interfaced with the waste feed cut-off system so that the LTTD system is shutdown if emissions exceed the operational range established during the performance test. CEM specifications can be found in Appendix G.

4.4 KEY PERSONNEL OPERATING EQUIPMENT

Key operations personnel having primary responsibility for the LTTD are outlined below. Detailed resumes describing training and qualifications are provided in Appendix N.

a.	Testing/Startup	Mark Fleri
b.	Operations	Mark Fleri
c.	Maintenance	Mark Fleri
d.	Laboratory	Nate Heinrich, Mark Johnson
e.	Control Room	Mark Fleri
f.	Air Emission Testing	Mark Fleri
g.	Certification of Operation of Equipment	Mark Fleri
h.	Certification of Safety of Equipment	Ron Huggins

SECTION 5

PROJECT SCHEDULE

A preliminary work schedule is presented in Figure 5-1. All schedule activities are indexed based on the date that BNRR receives an approval from the USEPA. BNRR will issue a notice to proceed to Williams upon receipt of approval from the USEPA.

Site preparation activities will be completed and utilities will be installed during the initial five (5) weeks of the project. LTTD system mobilization will be initiated during the second week of the project. After a two (2) week setup period, startup will commence. Two weeks are allocated for startup.

Williams anticipates to begin startup operations with clean soils. After a thorough shakedown of the unit including its control systems and demonstration of the proposed AWFSOs, the unit will begin production with the contaminated soils to ready the unit and crew for the upcoming performance test.

During the performance test, contaminated soils in the roll-off boxes, including only pesticide contaminated soils, will be treated in the same manner as soil from production operations. No more than one-third of the contaminated soil will be treated during the performance test. Williams recognizes that treating contaminated soils for both the performance test, interim, and normal operations will not commence without approval from the EPA's OSC.

The LTTD system will treat contaminated soils during the startup and shakedown period for a total of not more than 360 operating hours. Operating hours include only that time when contaminated soil is being fed to the system. Approximately 192 hours are slated for shakedown of the unit with approximately 168 hours scheduled for certification of the CEM system. During the shakedown period, treated soil will be analyzed as per Table 9-2.

The performance test is scheduled to start as early as the second week after startup is initiated and no later than the third week after startup is initiated. Preliminary performance test results for particulate emissions will be available within a week after the completion of the performance test. A draft performance test report will be submitted to USEPA Region X within 28 days after the conclusion of the performance test, subject to the timely receipt of final analytical results. Between the conclusion of the performance test and the time that authorization is received from USEPA Region X for full production operations, soil processing will continue at a limited production rate. Operations will follow the feed restrictions as specified below, based on preliminary data and report submittals prior to submittal of the final performance test report and risk assessment addendum:

i. Day 0 - 50%, contingent on submittal within one week of the operating ranges portion of the performance test burn report, including a computer disk in a format which allows the data to be manipulated to perform a check on the calculations performed to establish the ranges, and to allow the adjustment of the ranges during the interim burning period to be at least as conservative as is reflective of the performance test operating conditions. Strip chart data would need to be digitized or somehow converted into a format which could be manipulated as described above.

ii. 60% after submittal of i. above, and:
   - particulate in the stack gas (preliminary)
   - HCl in the stack gas (preliminary)
   - Free chlorine in the stack gas (preliminary).

iii. 75% after submittal of i. and ii. above, and
   - particulate in the stack gas (final)
   - HCl in the stack gas (final)
   - Free chlorine in the stack gas (final)
   - Carbon dioxide and oxygen in the stack gas
   - Carbon monoxide in the stack gas
   - Moisture content in the stack gas
   - POHC in the feed soil, treated soil, scrubber blowdown, and the stack gas.

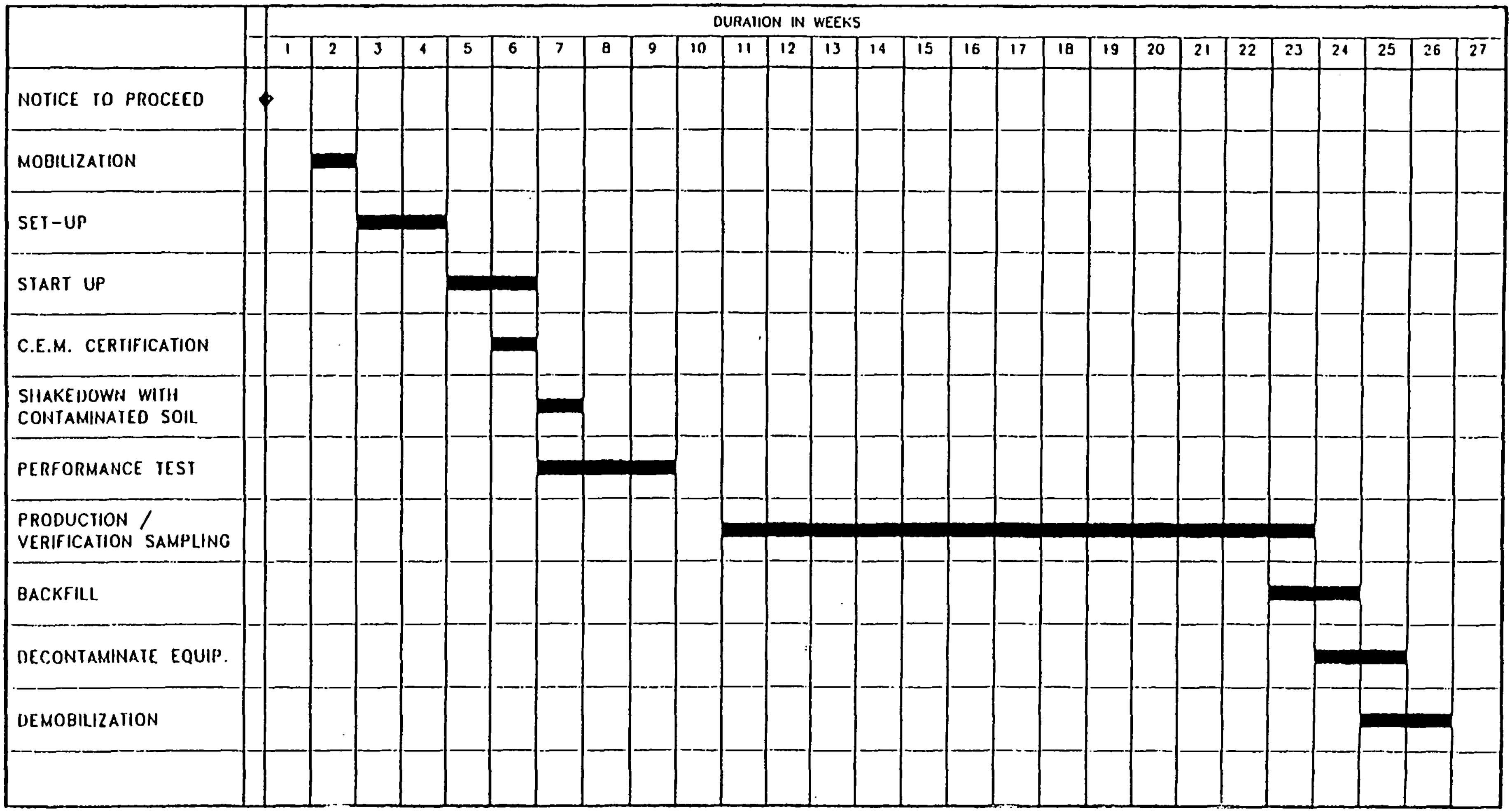
After authorization is received from USEPA Region X, which will be based on the final performance test report including the risk assessment, full scale production operations will be resumed. Production operations are projected to last for approximately 11 weeks based on the operating restrictions above. An additional 2 week period will be set aside for verification sampling. The projected operating schedule is based on 24 hours of operation per day for 7 days per week. Final selection of a daily operating schedule will be based on the results of the performance test as described in Section 7.2.

Two weeks are included in this schedule to accommodate the removal of soils beneath the northern and southern stockpiles.

Two weeks are included in the schedule for equipment and pad decontamination. An additional two weeks are included in the schedule for equipment demobilization.

The work schedule shows overlap for all activities which occur after startup. This is to accommodate startup problems which may occur and provide flexibility in the overall schedule.

FIGURE 5-1
WOODS INDUSTRIES SITE
PROJECT SCHEDULE



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PROJECT SCHEDULE

WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

AEB
3/4/94

SECTION 6

PROCESS CONTROL, MONITORING, AND EMERGENCY PROCEDURES

6.1 OVERVIEW

Williams has provided instrumentation for process control of feed rates, temperatures, pressures, burner efficiency, and gas stream contents. In addition, the system is designed to provide for the control and orderly management of any upset condition that may potentially occur during operations. This system also provides documentation of key operating variables to verify operating conditions. A description of startup, shakedown and shutdown procedures will be provided in the Operations and Maintenance (O&M) Manual, Appendix L.

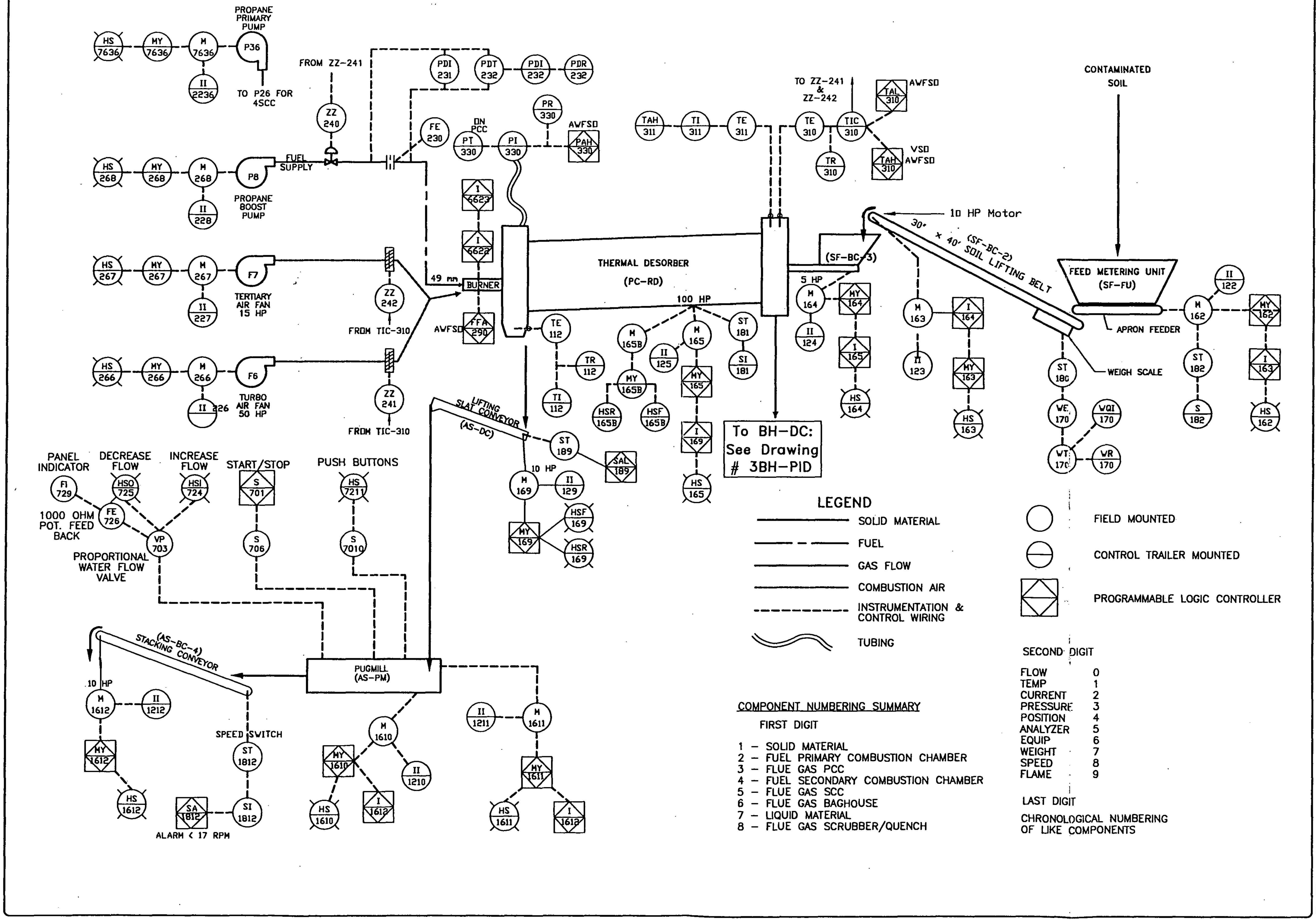
An industrial programmable logic controller (PLC) is provided for proper startup sequencing and system interlock control. An engineering "cut sheet" is provided in Appendix I.

The overall control system is shown on the process instrumentation and controls diagrams, Figures 6-1 through 6-4. The key process control parameters are shown in Table 6-1.

The feed rate of the soil is monitored by a weigh belt located on the feed conveyor. The readout in the control room gives instantaneous feed rate in tons per hour plus integrated totals. Pressures are registered on standard industrial pressure and vacuum gauges (magnahelics) for low pressures and draft with industrial Bourdon tube gauges for high pressures. Temperatures are measured by k-type thermocouples installed well into the oxidizer gases to obtain accurate temperature measurement.

Certain specific process upsets can create situations where timely actions are required to insure safety, protect equipment, and prevent the emission of particulates, gases, or liquids from the system at rates that exceed regulatory standards. Two automatic control actions are provided to address the most probable upsets, failures, or emergencies. These are Vent Opening (VO) and Automatic Waste Feed Shutoff (AWFSO). These events are listed in Table 6-2.

The VO action allows ambient air to be introduced into the process gas steam just prior to the baghouse. This is accomplished by opening a damper that supplies air to the main cross over duct before it enters the baghouse plenum chamber. The major purpose of the VO is to protect the air pollution control equipment (APCE) from high gas temperature excursions. The location of the vent is on the draft side of the I.D. Fan. This allows air to be introduced into the system while eliminating fugitive emissions.



LEGEND

———	SOLID MATERIAL
— — —	FUEL
———	GAS FLOW
———	COMBUSTION AIR
- - - - -	INSTRUMENTATION & CONTROL WIRING
〰	TUBING
○	FIELD MOUNTED
⊖	CONTROL TRAILER MOUNTED
◇	PROGRAMMABLE LOGIC CONTROLLER

COMPONENT NUMBERING SUMMARY

FIRST DIGIT

1 – SOLID MATERIAL
2 – FUEL PRIMARY COMBUSTION CHAMBER
3 – FLUE GAS PCC
4 – FUEL SECONDARY COMBUSTION CHAMBER
5 – FLUE GAS SCC
6 – FLUE GAS BAGHOUSE
7 – LIQUID MATERIAL
8 – FLUE GAS SCRUBBER/QUENCH

SECOND DIGIT

FLOW	0
TEMP	1
CURRENT	2
PRESSURE	3
POSITION	4
ANALYZER	5
EQUIP	6
WEIGHT	7
SPEED	8
FLAME	9

LAST DIGIT

CHRONOLOGICAL NUMBERING OF LIKE COMPONENTS

LTR.	DATE	REVISIONS	BY
–	MM/DD/YY	CREATED	LEW

Williams Environmental Services
WILLIAMS
2075 West Park Place
Stone Mountain, GA 30087
404/879-4107 (fax) 404/879-4831

TPU4

Process & Instrumentation

PID for #4PCC

4PCC

DATE 10/28/94
FIGURE 6.1
DIRECTORY: \WESA\Equipmnt\ \4TPU\4PCC
FILENAME 4PCC-PID.dwg
DWG NO. 4PCC – PID

COMPONENT NUMBERING SUMMARY

FIRST DIGIT

1 – SOLID MATERIAL
2 – FUEL PRIMARY COMBUSTION CHAMBER
3 – FLUE GAS PCC
4 – FUEL SECONDARY COMBUSTION CHAMBER
5 – FLUE GAS SCC
6 – FLUE GAS BAGHOUSE
7 – LIQUID MATERIAL
8 – FLUE GAS SCRUBBER/QUENCH

LAST DIGIT

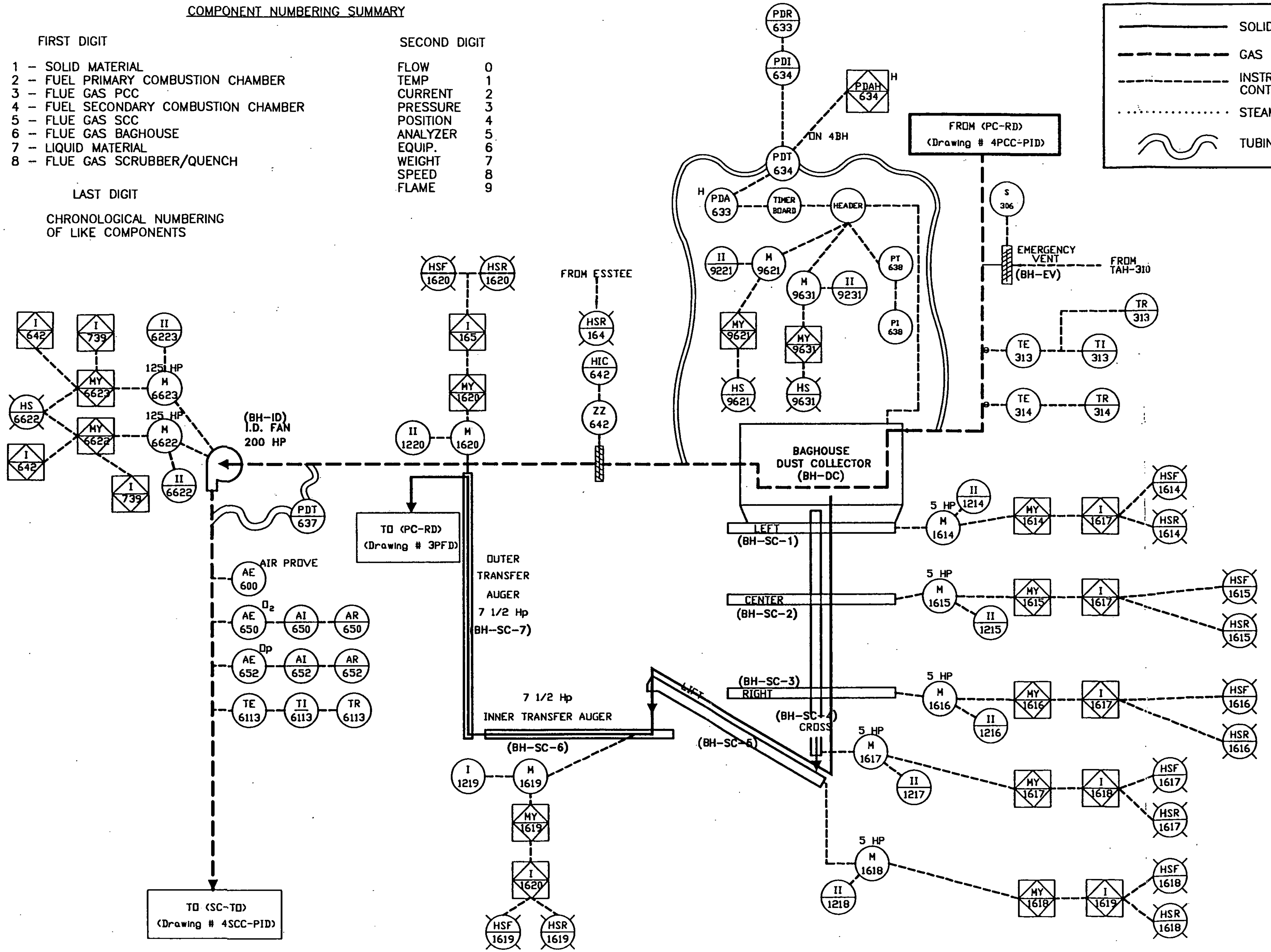
CHRONOLOGICAL NUMBERING
OF LIKE COMPONENTS

SECOND DIGIT

FLOW	0
TEMP	1
CURRENT	2
PRESSURE	3
POSITION	4
ANALYZER	5
EQUIP.	6
WEIGHT	7
SPEED	8
FLAME	9

LEGEND

———	SOLID MATERIAL
— — —	GAS FLOW
- - - -	INSTRUMENTATION & CONTROL WIRING
········	STEAM
∿∿	TUBING



LTR.	DATE	REVISIONS	BY
-	9/3/94	CREATED	LEV

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TPU4

PROCESS & INSTRUMENTATION

PID FOR #4 BAGHOUSE

4BH

DATE	10/28/94
FIGURE 6.2	
DIRECTORY:	\WES\Equipmnt\4TPU\4BH
FILENAME	4BH-PID.dwg
DWG NO.	4BH-PID

COMPONENT NUMBERING SUMMARY

FIRST DIGIT

- 1 – SOLID MATERIAL
- 2 – FUEL PRIMARY COMBUSTION CHAMBER
- 3 – FLUE GAS PCC
- 4 – FUEL SECONDARY COMBUSTION CHAMBER
- 5 – FLUE GAS SCC
- 6 – FLUE GAS BAGHOUSE
- 7 – LIQUID MATERIAL
- 8 – FLUE GAS SCRUBBER/QUENCH

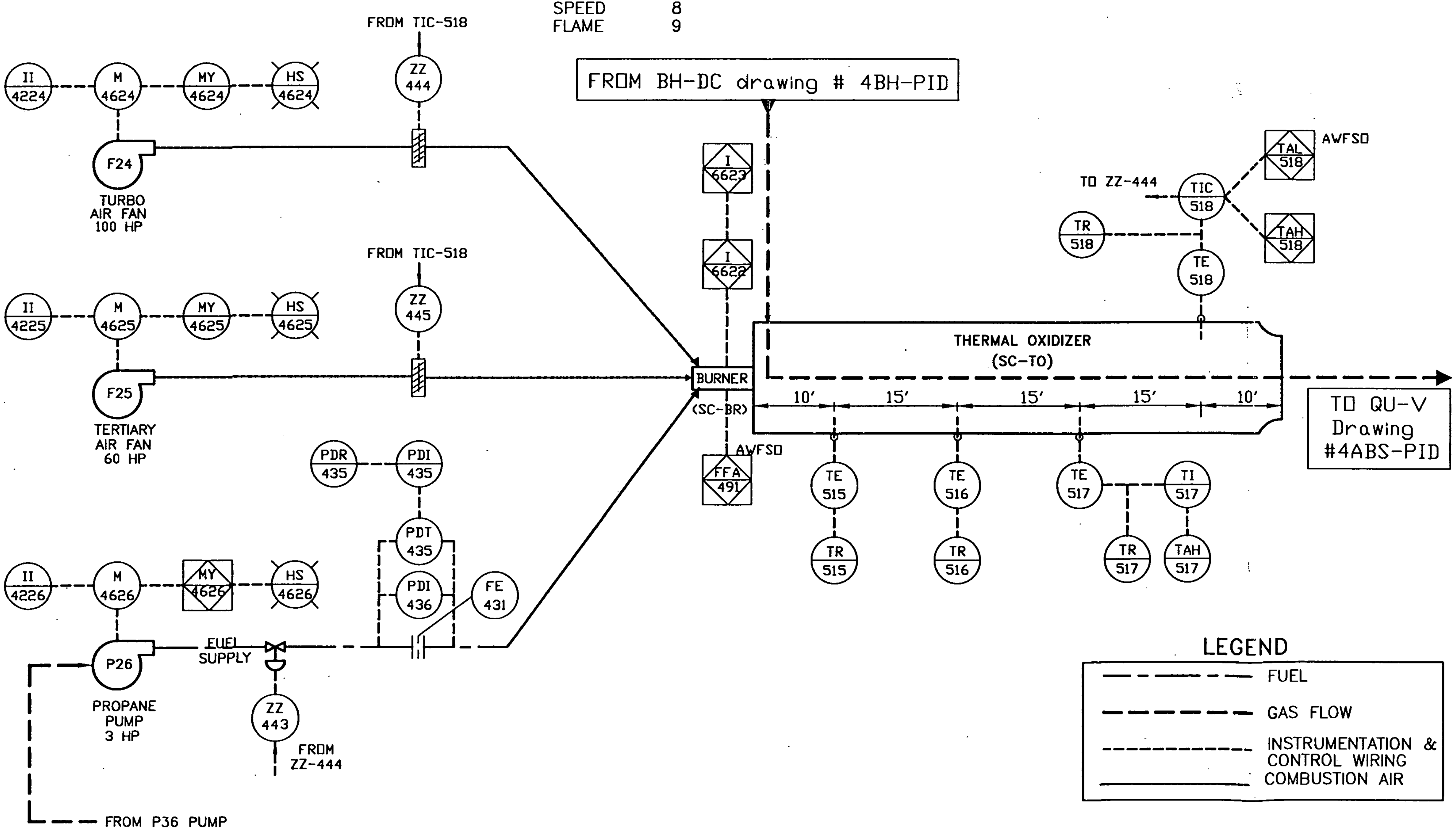
SECOND DIGIT

FLOW	0
TEMP	1
CURRENT	2
PRESSURE	3
POSITION	4
ANALYZER	5
EQUIP	6
WEIGHT	7
SPEED	8
FLAME	9

LAST DIGIT

CHRONOLOGICAL NUMBERING OF LIKE COMPONENTS

○	FIELD MOUNTED
⊖	CONTROL TRAILER MOUNTED
◇	PROGRAMMABLE LOGIC CONTROLLER



LEGEND

- – – – – FUEL
- — — — GAS FLOW
- - - - - - - - INSTRUMENTATION & CONTROL WIRING
- ——— COMBUSTION AIR

LTR.	DATE	REVISIONS	BY
-	6/3/94	CREATED	LEW

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WILLIAMS

TPU4

PROCESS & INSTRUMENTATION

PID FOR #4 SCC
(THERMAL OXIDIZER)

4SCC

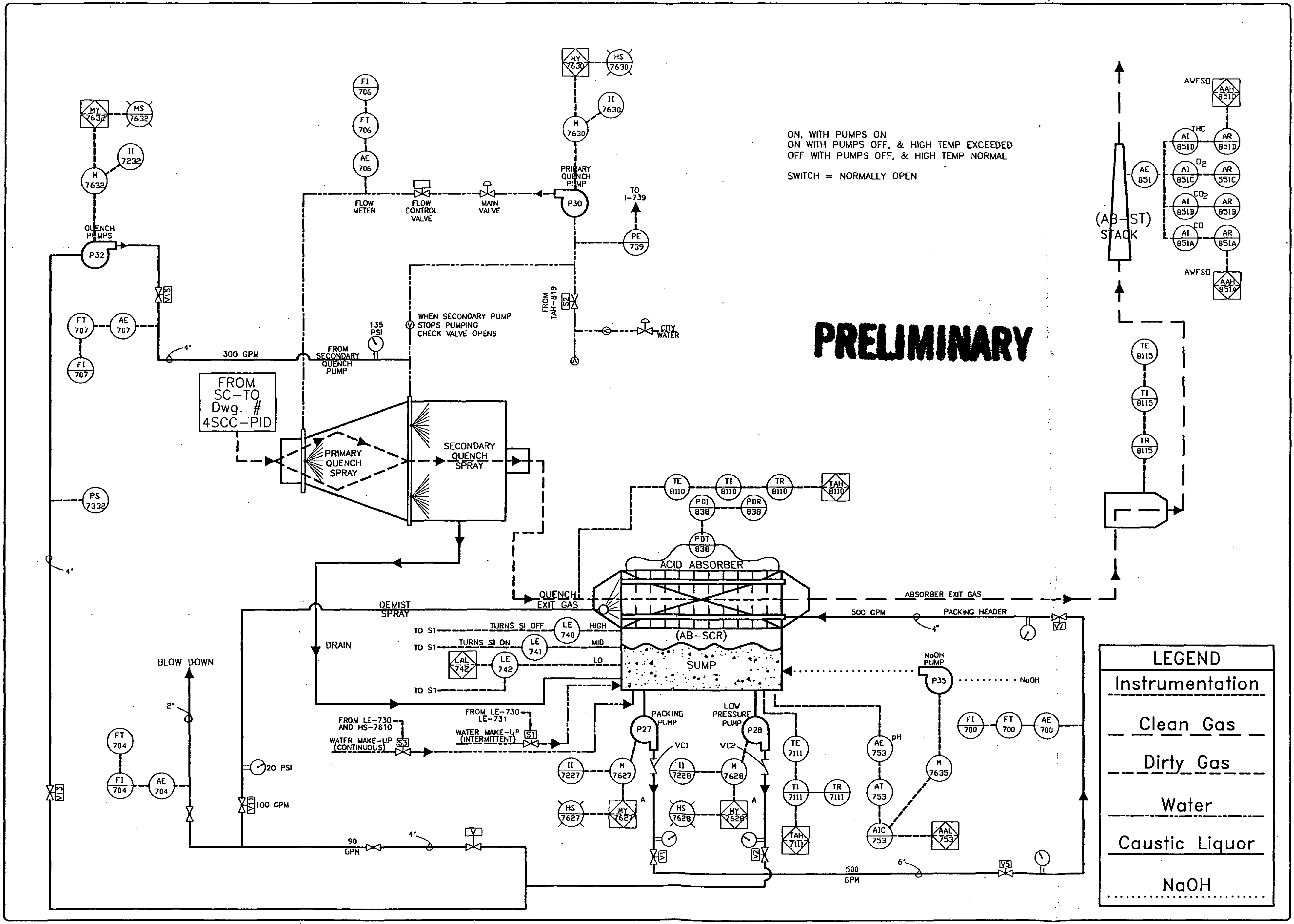
DATE	10/28/94

FIGURE 6.3

DIRECTORY: \WESA\Equipmnt\ \4TPU\4SCC

FILENAME	4SCC-PID.dwg

DWG NO. 4SCC-PID



PRELIMINARY

LTR.	DATE	REVISIONS	BY
-	9/5/94	CREATED	LEW

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TPU4

PROCESS & INSTRUMENTATION

PID FOR #4 ABS & #4QU
HORIZONTAL PACKED BED SCRUBBER

4ABS

DATE 11/23/94

FIGURE 6.4

DIRECTORY: \WES\Equipmnt\ \4TPU\4ABS
FILENAME 4ABS-PID.dwg
DWG NO. 4ABS-PID

The AWFSO action shuts down the feed belt conveyor to the rotary dryer. This is accomplished by interlocks in the control system. The major purpose of the AWFSO is to discontinue processing soil if process operating conditions are outside of established limits.

In addition to automatic controls described above, operators are trained to respond to any other abnormal process operating conditions. Potential abnormal operating conditions and operator responses are described below.

6.2 EMERGENCY OR UPSET CONDITIONS

Instrumentation is provided to monitor process conditions, to provide data for assuring compliance with regulatory requirements, and to assure appropriate process response, control, operations flexibility, safety interlocks, and shutdown features. The safety interlocks and shutdown features comprise a major portion of the control system. The conditions under which the Automatic Waste Feed Shut Off (AWFSO) system and vent opening (VO) operate are noted in Table 6.2. Emergency and redundant (backup) equipment are listed in Table 6.3.

6.3 EMERGENCY PROCEDURES

Certain specific process upsets can create situations where timely actions are required to ensure safety, protect equipment, or prevent the unauthorized emission of soils, gases or liquids from the system. Two automatic control actions are provided to address the most probable upsets, failures, or emergencies. These are the VO and AWFSO.

The VO action allows ambient air to be introduced into the process gas stream just prior to the baghouse. The VO is designed such that air may enter only from the outside, eliminating concerns of hot gases bypassing the air emissions train. This is accomplished by opening a damper to the main crossover duct before it enters the baghouse plenum chamber. The major purpose of the VO is to protect the gas train components from high temperature excursions. Since the VO is located prior to the induced draft fan, outside air is pulled into the system and passes through the air pollution control equipment. A negative draft is maintained throughout the process to prevent any fugitive emissions.

The AWFSO action shuts down the feed belt conveyor to the desorber as well as the baghouse dust transfer to the desorber. This is accomplished by interlocks in the control system. The major purpose of the AWFSO is to discontinue processing if conditions are outside acceptable limits for adequate treatment of the soil or gas streams. Demonstration of the AWFSOs will take place prior to the performance test and once per operating week thereafter unless an AWFSO occurs during production for that operating week. Should more than 7 AWFSOs occur within a one week period

(Friday to Friday), reasonable measures will be taken to contact Agency personnel to gain approval for re-start of the unit. Agency approval will also be sought for AWFSOs occurring as a result of ID fan failure.

Williams will also report to the EPA and make a reasonable effort to gain approval for restart in the event of a positive pressure excursion subsequent to the first week of contaminated soil shakedown. Prior to the end of the first week of contaminated soil shakedown, positive pressure excursions will be included as part of the seven (7) AWFSOs within one (1) operating week that require reporting and approval for restart.

In addition to the above procedures, several process upset conditions and their corresponding corrective actions have been identified for this project and may also be discussed in the Contingency Plan. These are described below with reference to instrument identification on Figures 6-1 through 6-4.

a. Partial or Complete Stoppage of Soil Feed

The stoppage of waste feed (if it is not observed by the operator) will be first identified as an increase in desorber exit gas temperature followed by a decrease in desorber pressure. An increase in desorber temperature is covered under (e). Should the feed be interrupted, the operator will idle the plant with heat in the system until feed is restored.

b. Soil Feed Rate Too High

The feed rate of soil will be approximately equal during each replicate test run. The maximum allowable soil mass feed rate will be determined from the average of the highest average soil feed rate demonstrated during each sampling run. In addition, the instantaneous feed rate data (one-minute values) will be evaluated and an instantaneous temperature limit will be set based on averaging the maximum hourly value from each hour of the test run and then averaging these three test run averages.. During normal production operation, soil feed will be shut off if the maximum soil feed rate value is exceeded, based on a 60-minute rolling average or if the instantaneous maximum level is exceeded. The rolling average soil temperature limit will not be activated during the first 20 minutes of operation after startup. An AWFSO for instantaneous feed rate is included as part of the interlock package. All process monitoring modes will be the same during the performance test and post test operations. The limits will be determined during the performance test.

c. Puffing or Sudden Occurrence of Fugitive Emissions

The desorber draft is monitored continuously. The operator will manually increase draft via the induced draft (I.D.) fan if the draft is less than -0.01" w.c. (water column).

d. Failure of Forced Air Supply

The Burner Management System (BMS) will automatically trip the burner if the forced draft fan fails.

e. Process Temperature Too High

An operating desorber off-gas temperature of about 425°F has been selected. When the temperature goes above the 425°F setpoint, there will be a proportional decrease in fuel to the desorber. If the temperature reaches a predetermined maximum value of 450°F, all fuel and waste feed flow will be stopped. If the temperature exceeds 500°F, a VO will occur.

A thermal oxidizer temperature of approximately 1800°F (permit condition) has been selected. If the temperature rises above 2000°F, the operator will manually begin to decrease the fuel to the burner. If the temperature is still increasing and exceeds 2100°F, then the thermal oxidizer burner will be shut-down causing both an AWFSO and the primary burner to be shut down, also. The 2100°F limit is to protect all down stream equipment.

f. Process Temperature Too Low

An operating desorber off-gas temperature setpoint of about 425°F has been selected. When the temperature goes below 425°F, there will be a proportional increase in fuel to the desorber. If the temperature reaches a predetermined minimum value of 250°F, waste feed flow will be stopped.

During the initial 20 minutes after startup, desorber off-gas temperature will be used instead of soil temperature to monitor system performance. Initially, this temperature will be set at 250ºF. However, if 250ºF proves to be too high during startup and shakedown, the suggested A2 limit will be re-evaluated.

The thermal oxidizer alarm temperature initially will be 1700°F. If the temperature falls below this level, an AWFSO will result. The final value for this parameter will be based on the time-weighted average during all runs of the performance test.

g. Soil Temperature Too Low

One performance test consisting of three replicate runs will be conducted at approximately the same thermal desorber exit soil temperature. Based on successful completion of the testing, the allowable operating limits will specify a minimum thermal desorber exit soil temperature equal to the average of the lowest average temperature demonstrated during each test run. Soil feed will be automatically shut off if the thermal desorber exit soil temperature falls below the minimum allowable value based on a 20-minute rolling average limit. In addition, an instantaneous minimum temperature will be established based on averaging the minimum hourly value from each hour of the test run and then averaging these three test run averages. The 20-minute rolling average limit will not be activated during the first 20 minutes of operation after startup. Instead, desorber off-gas temperature will be used as the alternate monitoring parameter during the initial 20 minutes after startup. Williams will install a 20 minute timer to ensure that the rolling average for soil temperature is activated.

h. Desorber Pressure Too High (Loss of Vacuum)

The desorber draft is monitored continuously. The operator will manually increase draft via the I.D. fan if the draft approaches -0.01" w.c. An instantaneous AWFSO will result if the draft is less than -0.01" w.c.

i. Baghouse Differential Pressure Too Low

A low baghouse differential pressure may be an indication of low gas flow or filter bag failure. This parameter will be continuously monitored, with a differential pressure less than 1" w.c. causing an AWFSO. If the differential pressure exceeds 2" w.c., it will revert to an A1 parameter.

j. High Reading of CO

Carbon Monoxide in the stack gas is an indication of poor combustion. CO spikes are frequently transitory and last less than three minutes in length even if no correction of the condition is made. If the CO concentration in the stack gas increases above 100 ppm_V, an AWFSO will result and an alarm will sound and the operators will respond by increasing the temperature and/or air flow. The operator will check the data logger and the strip charts to define the cause of the upset condition. The strip charts will be a visual indication of a trend leading to high CO. The waste material feed will be stopped if the CO concentration in the exit gas exceeds 100 ppm_V (corrected to seven percent O_2), based on a sixty-minute rolling average calculated by the data logger. The CO concentration in the stack gas will be recorded and monitored continuously. Excess feed will be represented by a fluctuation of desorber temperature, high pressure, high CO, etc., in the dryer. Each of the above triggers appropriate responses, as detailed in (b) and (d) of this section.

k. Sudden Loss of Refractory Lining

This is an unusual occurrence and is indicated by hot spots on the thermal oxidizer. It will signal the operator to perform an orderly system shutdown for inspection.

l. Increase in Quench Chamber Flue Gas Temperature

The quench chamber exit gas temperature will be monitored and recorded continuously. The operating setpoint is 200°F. Deviation from this setpoint will trigger a proportional increase or decrease in the water flow to the quench chamber, and if necessary, will start the emergency quench water pump. Should the temperature after the quench chamber exceed 250°F, the waste feed to the desorber will be automatically stopped. Should water flow to the spray tower be interrupted, an alarm will sound in the control trailer, the emergency water sprayer will be activated, the waste feed will be stopped automatically, the fuel feed will be shut off, the induced draft fan damper closed, and the induced draft fan shut down.

m. Partial or Complete Stoppage of Water or pH Control to the Scrubber

If this condition occurs, waste feed will be stopped, and water levels, pumps and alkaline solution supply systems will be inspected. If water recirculation stops, the vent will be opened.

n. Deposition of Solids in the Scrubber

This occurrence requires a shutdown to clean out the scrubber internals.

o. pH Value of Scrubber Water Outside of Specification

A pH monitoring and control system will adjust the caustic inlet flow rate to maintain the setpoint pH level of 8. Williams will establish a 20-minute rolling average based on the performance test, as well as an instantaneous value based on averaging the minimum hourly value from each hour of a test run and then averaging the three test run averages to determine the instantaneous AWFSO. If pH in the acid gas absorber deviates from specifications, the alkaline supply will be checked and restored as quickly as possible.

p. Oxygen in the Thermal Oxidizer Less Than 3%

Eight percent O_2 in the stack gas corresponds to approximately 55% more oxygen than that required for the stoichiometric reaction of the fuel and waste. A range of 25-75% excess air is considered proper for the combustion of VOC and hydrocarbons in the gas stream. The amount of O_2 in the stack gas will be monitored, and when it drops below 4.0% (approximately 25% excess air), an alarm will sound and the air flow will be increased proportionally. An instantaneous AWFSO will occur if the exit gas oxygen concentration falls below 3%. Based on results of the performance test, this A2 parameter may be re-evaluated.

q. Indication of Failure of the I.D. Fan

The fan operation will be monitored with an ammeter equipped with an alarm relay. If the induced draft fan fails, both the fuel and the waste feed flow will be stopped at once, and the emergency vent will open.

r. Failure of Treated Material Handling System

When the processed soil handling system fails, the operator will inspect the system and idle or shut down as necessary.

s. Power Failure

In the event of a power failure, feed and fuel are interrupted. This sequence also occurs when the induced draft fan stops.

t. External System Fire

ABC fire extinguishers will be strategically placed; however, the fire department will be called on any major system fires.

u. Burner System Safety Controls

The gas burner system includes a standard industrial interlock system that shuts the burner system down if:

* Flame is detected during pre-ignition,
* Pilot fails to ignite,
* Burner fails to ignite, or
* Loss of flame after ignition.

v. Additional Safety Interlocks

Several other events that will cause an AWFSO to occur include a minimum packed bed scrubber flowrate, maximum stack gas flowrate, and the air pollution control equipment purge rate. These rates will be monitored during the Performance Test and AWFSOs will be determined based on the results of those test runs. The APC recycle water flowrate and purge rate will be set based on the time-weighted average during all the runs of the performance test.

All AWFSOs and VOs are also explained in the Performance Test Plan. Table 3-2 summarizes the shut-off conditions, as well as Table 6.2 of the Work Plan.

Table 6.1
Key Process Parameters

Instrument Tag #	Parameter	Description	Typical Range	Normal Operating Conditions(1)	Upset Condition	Upset Condition	
						Cause	Result
TI-311	Temperature	Thermal desorber exit gas(a)	300-450°F	425°F	Low <250°F	High feed rate, increase in moisture content.	Poor desorption, condensation in baghouse.
					High >450°F High-High > 500°F	Low Feed rate, decrease in moisture content.	Damage to bag filter.
TI-112	Temperature	Soil discharge (a)	450-1000°F	800°F	Low <700°F(1) (20 minute rolling average)	Poor desorption, burner malfunction, feed rate too high, feed condition changed.	Low soil temperature
TI-518	Temperature	Thermal Oxidizer Outlet	1700-1900°F	1800°F	Low <1700°(2)F	Burner Malfunction. Moisture content high.	Low exit gas temperature,
				2100°F	High >2100°F	Fan failure. Low throughput.	High exit gas temperature, possible equipment damage.

(1) Based on average of lowest average temperature demonstrated during each test run.
(2) Based on time-weighted average of all test runs.

Table 6.1
Key Process Parameters
Continued

Instrument Tag #	Parameter	Description	Typical Range	Normal Operating Conditions	Upset Condition	Upset Condition Cause	Result
P-330	Pressure	Thermal Desorber burner end (a)	-0.01 to -0.1 inches of H_2O	-0.05 inches of H_2O	Low <-0.2	No feed	Low gas flows.
					High >-0.01	High feed moisture content	Dryer overpressure.
PDI-634	Pressure	Baghouse pressure differential	1 - 8 inches of H_2O	2 inches of H_2O	Low <1	Low gas flow Filter bag failure	Particulate emissions
					High >8	Filter bags blinded, flow obstruction. Low temperature.	Reduced throughput
PDI-637	Pressure	I.D. Fan pressure differential	12 - 20 inches of H_2O	17 inches of H_2O	Low (a)	Bypassing or filter bag failure.	
					High (a)	Flow obstruction in system. Reduced throughput.	

(a) Determined during clean soil shakedown, approved by agency, verified during performance test.

Table 6.1.
Key Process Parameters
Continued

Instrument Tag #	Parameter	Description	Typical Range	Normal Operating Conditions	Upset Condition	Upset Condition Cause	Result
P-228	Pressure	Compressed air header	80 - 120 psi	90 psi	Low < 80	Compressor failure/ leakage. Baghouse solenoid failure.	Engage standby compressor.
AI-851A	CO	Continuous Emission Monitor	0 - 3000 ppm	10 ppm 1 hr rolling average corrected to 7% O_2	High >100 (1 hr. rolling average)	Incomplete oxidation	AWFSO
AI-554	O2	Continuous Emission Monitor	3 - 25%	4%	Low < 3 High > 25	Air starved, burner adjustment Excess air, burner adjustment	See CO Excessive fuel Consumption
	Opacity	Continuous Emission Monitor		< 20%	High > 20	Bag leakage	Opacity Alarm

Table 6.2 Events Triggering Interlock Control System

ITEM	CONTROL ACTION
High quench tower outlet temperature Alarm at >200°F, AWFSO>250°F	AWFSO[4]
High acid gas scrubber temperature or loss of water flow, alarm at >200°F, AWFSO at 250°F	AWFSO
Loss of water to quench	AWFSO
Draft greater than -0.01" w.c. in thermal desorber	AWFSO[4]
Low scrubber pH, <4.0 (determined during performance test) 20 minute rolling average	AWFSO[4]
Low Scrubber pH (determined during performance test) Instantaneous	AWFSO[4]
CO >100 ppm, corrected to 7% O_2, 1 hour rolling average	AWFSO[4]
Thermal desorber exit soil temperature <700°F, (determined during performance test) 20 minute rolling average	AWFSO[4,5]
Thermal desorber exit soil temperature, Instantaneous (determined during shakedown, verified during performance test)	AWFSO[4,5]
Thermal desorber off-gas temperature >450°F	AWFSO[4]
Thermal desorber off-gas temperature >500°F	VO
Low thermal desorber off-gas temperature <250°F	AWFSO[4]
Thermal desorber and thermal oxidizer burner system failure	AWFSO[4]
Low thermal oxidizer exit gas oxygen concentration, Alarm at <4% O_2, AWFSO at <3% O_2	AWFSO[4]
Low thermal oxidizer exit gas temperature <1700°F (determined during performance test)	AWFSO[4]
High thermal oxidizer exit gas temperature >2100°F	AWFSO[4]

Table 6.2 Events Triggering Interlock Control System
(continued)

Low packed bed scrubber flowrate (determined during performance test)	AWFSO[4]
High stack gas flowrate (determined during Performance Test)	AWFSO[4]
Low APC purge rate (determined during performance test)	AWFSO[4]
High soil feed rate (determined during Performance Test) 60 minute rolling average	AWFSO[4]
High soil feed rate Instantaneous (determined during shakedown, verified during the Performance Test)[4]	AWFSO[4]
Baghouse dust feed rate (determined during shakedown, verified during the Performance Test)	AWFSO[4]
Baghouse differential pressure < 1" w.c.	AWFSO[4]
ID Fan failure	AWFSO[4]
Power failure	AWFSO[4]

NOTES:

1. VO = vent opening.
2. AWFSO = automatic waste feed shutoff.
3. In addition to automatic operation, both the AWFSO and VO can be activated manually at the operators' discretion in the event of an emergency.
4. Monitored continuously and recorded continuously except ID fan failure, power failure, loss of H_2O to quench.
5. The instantaneous AWFSO minimum soil temperature does not apply during the first 20 minutes after start-up.

Table 6.3

Emergency and Backup Equipment

ITEM	APPLICATION
Backup pumps	Process water supply Quench tower supply Scrubber makeup water
Backup compressor	Compressed air

SECTION 7

PERFORMANCE CRITERIA

7.1 OVERVIEW

Performance standards include cleanup criteria for treated soils and stack emission standards. Compliance with the performance standards will be demonstrated during the Performance Test and during Production Operations. Clean-up goals for treated soil are summarized in Table 7-1. This section presents an overview of performance standards that will be demonstrated, and the numerical values for each performance standard. Detailed information on the Performance Test Standards is described in the Performance Test Work Plan.

7.2 SOIL TREATMENT PERFORMANCE CRITERIA

The soil treatment performance standards are designed to satisfy all Removal Action based criteria as described below. Other performance criteria established by the USEPA related to the RI/FS will also be satisfied as discussed below.

7.2.1 OCL Pesticides and Metals

During the performance test, the levels of target compounds remaining in treated soil will be compared to previously established allowable cleanup goals listed in Table 7.1. The compounds are listed below.

- Aldrin
- alpha-BHC
- beta-BHC
- chlordane
- gamma-BHC
- p,p'-DDD
- p,p'-DDE
- Mercury
- Heptachlor
- Heptachlor epoxide
- Methoxychlor
- p,p'-DDT
- Dieldrin
- Endrin
- Hexachlorobenzene
- Toxaphene
- Arsenic
- Lead

Table 7.1 PROPOSED CLEANUP GOALS FOR SOIL
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

Parameter[1]	Goal (mg/kg)	
Aldrin	0.0588	
Arsenic[2]	20	
alpha-BHC	0.159	
beta-BHC	0.556	
gamma-BHC	0.769	
Chlordane	0.769	
p,p'-DDD	4.17	
p,p'-DDE	2.94	
p,p'-DDT	2.94	
Dieldrin	0.0625	
Endrin	24	
Heptachlor	0.2	
Heptachlor epoxide	0.1	
Hexachlorobenzene	0.6	
Lead[2]	250	✓
Mercury[2]	1	1.1
Methoxychlor	400	
Toxaphene	0.909	✓
Dioxins[3]	0.001	

1 Goals are based on Residential Method B. If soil cleanup levels are greater than Residential Method B, then institutional controls are required according to WAC 173-30-740 (1)(c)(iii).

2 Williams' unit does not treat metals and does not guarantee these clean-up levels for metals. If cleanup goals for metals are exceeded, the soil will be deposited as specified in the consent order.

3 As per the agreement between USEPA/BNRR, one soil sample will be collected during each performance test run for analysis. Sampling will be performed according to EPA's letter of April 20, 1994.

7.3 AIR EMISSION CRITERIA

The air pollution control equipment for the LTTD was designed to satisfy all Removal Action based criteria. Air emission limits will be based on Washington Administrative Code (WAC) Chapter 173-460, Controls for New Sources of Toxic Air Pollutants. Tentative compounds to be evaluated are listed in Table 7-2 while estimated air emissions and air emission limits are presented in Table 7-3.

TABLE 7-2

TENTATIVE COMPOUNDS TO BE EVALUATED

Organics (1)	Metals(2)	Products of Incomplete Combustion(3)	Criteria Pollutants
Aldrin	Antimony	*Acetone	CO
alpha-BHC	Arsenic	Acetonitrile	PM_{10}
beta-BHC	Barium	Acrylonitrile	HCl
gamma-BHC	Beryllium	*Benzaldehyde	Cl_2
Chlordane	Cadmium	*Benzene	SO_2
p,p'-DDD	Chromium	*Benzoic acid	NO_2
p,p'-DDE	Lead	Benzyl alcohol	
p,p'-DDT	Mercury	Camphene	
Dieldrin	Selenium	Chlorobenzene	
Endrin	Silver	Chloroethane	
Heptachlor	Thallium	*Chloroform	
Heptachlor epoxide	Nickel	Chloromethane	
Hexachlorobenzene		p,p'-DDE	
Methoxychlor		Dichlorobenzene	
Toxaphene		Dihydrofuranone	
		Ethanol	
		*Ethylbenzene	
		Hexachloropentadiene	
		*Methylene chloride	
		Methylphenol	
		Methylphenylether	
		Nitrobenzene	
		*Phenol	
		Styrene	
		*Toluene	
		Trichlorobenzene	
		Trichlorofluoromethane	
		*1,1,1-Trichloroethane	
		Trichloromethane	
		Vinyl Chloride	
		Xylene	
		Dioxins/furans	

(1) Listed are all organic indicator chemicals from the Baseline Risk Assessment (Burlington Environmental, 1992).

(2) Arsenic, lead, and mercury are indicator chemicals. Other metals will be evaluated if the soil pile sampling results indicate that emitted levels may exceed adjusted Tier 1 levels.

(3) PICs are based on past experience with similar technologies, literature review, and a structural analysis.

* Detected at FMC.

TABLE 7-3

LTTD PERFORMANCE CRITERIA FOR STACK EMISSIONS

PESTICIDES

Parameter	Avg. Conc. in Soil(1) (mg/kg)	Estimated Annual Constituent Ground Level Conc. (μg/m^3)(2)	Goal (μg/m^3)(3)
Aldrin	1.94	1.25E-06	0.0002
alpha-BHC	1.50	9.63E-07	0.64(5)
beta-BHC	3.00	1.93E-06	0.64(5)
gamma-BHC	1.87	1.20E-06	0.64(5)
Chlordane	4.48	2.88E-06	0.0027
p,p'-DDD	23.22	1.49E-05	(4)
p,p'-DDE	10.98	7.05E-06	(4)
p,p'-DDT	5.98	3.84E-06	0.01
Dieldrin	7.80	5.01E-06	0.0002
Endrin	2.99	1.92E-06	0.12(5)
Heptachlor	1.49	9.57E-07	0.00077
Heptachlor epoxide	4.92	3.16E-06	0.0004
Hexachlorobenzene	16.06	1.03E-05	0.002
Methoxychlor	57.05	1.49E-05	13.32(5)
Toxaphene	673.25	4.32E-04	0.003

(1) Based on arithmetic average of concentrations detected in the northern and southern stockpiles.

(2) Estimated from EPA Screen Model at 99.99% DRE.

(3) Goals are based on WAC Maximum Allowable Annual Ground-Level concentrations.

(4) By-product of DDT; unit risk factors needed to calculate regulatory limits were not available.

(5) Converted from a 24-hour average to an annual average by multiplying with a factor of 0.4.

TABLE 7-3
LTTD PERFORMANCE CRITERIA FOR STACK EMISSIONS
TIER I & TIER II LEVELS BASED ON NEW SAMPLING DATA - 30 TPH
ROLL-OFF BOXES

Metal	Avg. Conc. in Soil (mg/kg)	Feed Rate(1) (g/hr)	Tier I Limit (g/hr)	Pass/ Fail	Emission Rate(2) (g/hr)	Tier II (g/hr)	Pass/ Fail
Antimony	100	2721.6	240	F	272.2	240	F
Arsenic	5.1	138.8	1.9	F	13.88	1.9	F
Barium	290	7892.6	40,000	P	197.32	40,000	P
Beryllium	0.11	3.0	3.4	P	0.0075	3.4	P
Cadmium	0.84	22.9	4.6	F	2.29	4.6	P
Chromium	16.5	449.1	0.68	F	1.12	0.68	F
Lead	45.5	1238.3	72	F	123.83	72	F
Mercury	0.956	26.0	240	P	13.0	240	P
Silver	1.9	51.7	2400	P	2.59	2400	P
Thallium	< 0.2	< 5.4	240	P	< 0.54	240	P

SOUTHERN STOCKPILE

Metal	Avg. Conc. in Soil (mg/kg)	Feed Rate(1) (g/hr)	Tier I Limit (g/hr)	Pass/ Fail	Emission Rate(2) (g/hr)	Tier II Limit (g/hr)	Pass/ Fail
Antimony	40.2	1094.1	240	F	109.41	240	P
Arsenic	9.7	264.0	1.9	F	26.4	1.9	F
Barium	122	3320.4	40,000	P	83.01	40,000	P
Beryllium	0.10	2.7	3.4	P	0.0068	3.4	P
Cadmium[5]	ND	4.1	4.6	P	0.41	4.6	P
Chromium	17.3	470.8	0.68	F	1.18	0.68	F
Lead	44.7	1216.6	72	F	121.66	72	F
Mercury[5]	ND	1.4	240	P	0.7	240	P
Silver	3.1	84.4	2400	P	4.22	2400	P
Thallium	< 0.2	< 5.4	240	P	< 0.54	240	P

TABLE 7-3
LTTD PERFORMANCE CRITERIA FOR STACK EMISSIONS
(continued)

NORTHERN STOCKPILE

Metal	Avg. Conc. in Soil (mg/kg)	Feed Rate(1) (g/hr)	Tier I Limit (g/hr)	Pass/ Fail	Emission Rate(2) (g/hr)	Tier II Limit (g/hr)	Pass/ Fail
Antimony	< 40.0	< 1088.6	240	F	108.86	240	P
Arsenic	8.8	239.5	1.9	F	23.95	1.9	F
Barium	142	3864.7	40,000	P	96.62	40,000	P
Beryllium	0.18	4.9	3.4	F	0.012	3.4	P
Cadmium[5]	ND	4.1	4.6	P	0.41	4.6	P
Chromium	10.4	283.0	0.68	F	0.707	0.68	F
Lead	40.9	1113.1	72	F	111.31	72	F
Mercury	0.226	6.2	240	P	3.1	240	P
Silver	1.6	43.5	2400	P	2.18	2400	P
Thallium	< 0.2	< 5.4	240	P	< 0.54	240	P

(1) Based on 30 TPH feed rate

(2) Tier I and Tier II limits pursuant to 40 CFR 266.106

(3) Based on estimate of metals partitioning and APCE removal efficiencies, Guidance on Metals and HCl Controls for Hazardous Waste Incinerators, Volume IV of the Hazardous Waste Incinerator Guidance Series, August, 1989, EPA/530-SW-90-004.

(4) If Tier II limit is exceeded, site specific modeling and risk analysis (Tier III) must be performed.

(5) Detection limits for Cadmium & Mercury are: Cd 0.30 mg/kg, Hg 0.10 mg/kg. To determine the feed rate and the stack emission rate, one half the detection limit was used.

TABLE 7-3
LTTD PERFORMANCE CRITERIA FOR STACK EMISSIONS
TIER I & TIER II LEVELS BASED ON NEW SAMPLING DATA - 20 TPH
ROLL-OFF BOXES

Metal	Avg. Conc. in Soil (mg/kg)	Feed Rate(1) (g/hr)	Tier I Limit (g/hr)	Pass/ Fail	Emission Rate(2) (g/hr)	Tier II (g/hr)	Pass/ Fail
Antimony	100	1814.4	240	F	181.47	240	P
Arsenic	5.1	92.5	1.9	F	9.25	1.9	F
Barium	290	5261.7	40,000	P	131.55	40,000	P
Beryllium	0.11	2.0	3.4	P	0.0050	3.4	P
Cadmium	0.84	15.3	4.6	F	1.53	4.6	P
Chromium	16.5	299.4	0.68	F	0.74	0.68	F
Lead	45.5	825.5	72	F	82.55	72	F
Mercury	0.956	17.3	240	P	8.67	240	P
Silver	1.9	34.5	2400	P	1.73	2400	P
Thallium	< 0.2	< 3.6	240	P	< 0.36	240	P

SOUTHERN STOCKPILE

Metal	Avg. Conc. in Soil (mg/kg)	Feed Rate(1) (g/hr)	Tier I Limit (g/hr)	Pass/ Fail	Emission Rate(2) (g/hr)	Tier II Limit (g/hr)	Pass/ Fail
Antimony	40.2	729.4	240	F	72.94	240	P
Arsenic	9.7	176.0	1.9	F	17.6	1.9	F
Barium	122	2213.6	40,000	P	55.34	40,000	P
Beryllium	0.10	1.8	3.4	P	0.0045	3.4	P
Cadmium[5]	ND	2.7	4.6	P	0.27	4.6	P
Chromium	17.3	313.9	0.68	F	0.79	0.68	F
Lead	44.7	811.1	72	F	81.11	72	F
Mercury[5]	ND	0.9	240	P	0.45	240	P
Silver	3.1	56.3	2400	P	2.81	2400	P
Thallium	< 0.2	< 3.6	240	P	< 0.36	240	P

TABLE 7-3
LTTD PERFORMANCE CRITERIA FOR STACK EMISSIONS
(continued)

NORTHERN STOCKPILE

Metal	Avg. Conc. in Soil (mg/kg)	Feed Rate(1) (g/hr)	Tier I Limit (g/hr)	Pass/ Fail	Emission Rate(2) (g/hr)	Tier II Limit (g/hr)	Pass/ Fail
Antimony	< 40.0	< 725.7	240	F	72.57	240	P
Arsenic	8.8	159.7	1.9	F	15.97	1.9	F
Barium	142	2576.5	40,000	P	64.41	40,000	P
Beryllium	0.18	3.3	3.4	P	0.0080	3.4	P
Cadmium[5]	ND	2.7	4.6	P	0.27	4.6	P
Chromium	10.4	188.7	0.68	F	0.47	0.68	F
Lead	40.9	742.1	72	F	74.21	72	F
Mercury	0.226	4.1	240	P	2.07	240	P
Silver	1.6	29.0	2400	P	1.45	2400	P
Thallium	< 0.2	< 3.6	240	P	< 0.36	240	P

(1) Based on 20 TPH feed rate

(2) Tier I and Tier II limits pursuant to 40 CFR 266.106

(3) Based on estimate of metals partitioning and APCE removal efficiencies, Guidance on Metals and HCl Controls for Hazardous Waste Incinerators, Volume IV of the Hazardous Waste Incinerator Guidance Series, August, 1989, EPA/530-SW-90-004.

(4) If Tier II limit is exceeded, site specific modeling and risk analysis (Tier III) must be performed.

(5) Detection limits for Cadmium & Mercury are: Cd 0.30 mg/kg, Hg 0.10 mg/kg. To determine the feed rate and the stack emission rate, one half the detection limit was used.

TABLE 7-3
LTTD PERFORMANCE CRITERIA FOR STACK EMISSIONS
(continued)

ADDITIONAL PARAMETERS

Parameter	Estimated Emission[1]	Allowable Emission
HCl	0.32 lb/hr	4.0 lb/hr
Free Chlorine[2]	0 lb/hr	
Particulates	< 0.03 gr/dscf	0.03 gr/dscf (7.811 lb/hr)

(1) Estimated emission at 30 tons per hour.
(2) Emission based on assumption that all chlorine is converted to HCl.

SECTION 8

PERFORMANCE TEST PLAN

The Performance Test Plan is presented in Appendix A. The Performance Test will be conducted to determine operating conditions under which the LTTD system meets all soil treatment and air emissions criteria. These conditions will be used to set process operating parameter limits to ensure that all applicable soil treatment and stack emission standards are met during Production Operations.

The Performance Test will be conducted prior to Production Operations. An independent stack sampling subcontractor will be retained to collect all required stack samples. The subcontractor's qualifications will be submitted for USEPA review and made a part of the Thermal Desorption Work Plan after receipt of USEPA approval.

The Performance Test has been developed in conjunction with FOCUS Environmental. Details of the plan are similar to those outlined below.

- LTTD Startup/Shakedown;
- LTTD System Performance;
- Sampling, Analysis, and Monitoring Procedures;
- Test Schedule;
- Test Protocol;
- Planned Operating Conditions for the Emissions Control Equipment;
- Performance Test Objectives;
- QA/QC Procedures;
- Test Results; and
- Post Test Operation.

SECTION 9

SAMPLING, ANALYSIS AND MONITORING PLAN FOR PRODUCTION OPERATIONS

9.1 SAMPLING PLAN

During production operations, one (1) composite sample of the treated soil will be taken daily. This composite sample will consist of four grab samples, each taken at approximately six hour intervals during normal operations. This represents approximately one composite sample per every 580 tons of treated soil. The samples will be collected in compliance with EPA SW-846, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", using the procedure described in Table 9-1. For operations prior to the Performance Test, the sampling procedure outlined in Table 9-2 will be followed.

9.2 ANALYSIS PLAN

Each treated soil sample will be analyzed for the 18 indicator chemicals listed in Table 7.1 during the performance test and until a decision has been made by BNRR and the EPA to reduce the number of parameters to demonstrate that the clean-up goal criteria are being met.

9.3 MONITORING PLAN

The principal process and continuous emissions parameters that will be monitored are discussed in detail in Section 6. Table 6-1, Key Process Parameters, describes the process and emissions parameters that will be monitored during LTTD operations. Table 6-2 lists the parameters that will be continuously recorded during LTTD operations.

Table 9-1. Soil Sampling Procedures for Production Operations

---

Sample name: Treated soil

Locations: Discharge screw conveyor or treated soil stockpile

Equipment:
Scoops and containers
Wide-mouth glass jars
Gloves, eye protection, hard hat

Frequency: 6 hour intervals

Procedures: Treated Soil:
Collect an equal quantity of soil from the discharge screw conveyor or treated soil stockpile at each time interval with a scoop and transfer the grab sample to a container. At the end of each operating day, composite the sample in a container and transfer a portion to one 4 oz. container.

Each time grab sample is taken, record sampling time and approxmate weight of final samples on sample collection sheets.

Attach sample numbers to jars and vials and label with date, sample name and test-run number.

Sample coordinator accepts custody of samples and records sample numbers and collection data in field log book.

Samples are placed on ice in shipping container which is stored in the sample holding area separate from the container supply area.

References: Test Methods for Evaluating Solid Waste, SW846, Third Edition, 1986 revised 1990.

Table 9-2. Soil Sampling Procedures for Pre-Performance Test Operations

---

Sample name: Treated soil

Locations: Discharge screw conveyor or treated soil stockpile

Equipment:
Scoops and containers
Wide-mouth glass jars
Gloves, eye protection, hard hat

Frequency: 1 hour intervals

Procedures: Treated Soil:
Collect an equal quantity of soil from the discharge screw conveyor or treated soil stockpile at each time interval with a scoop and transfer the grab sample to a container. At the end of each operating day, composite the sample in a container and transfer a portion to one 4 oz. container.

Each time grab sample is taken, record sampling time and approxmate weight of final samples on sample collection sheets.

Attach sample numbers to jars and vials and label with date, sample name and test-run number.

Sample coordinator accepts custody of samples and records sample numbers and collection data in field log book.

Samples are placed on ice in shipping container which is stored in the sample holding area separate from the container supply area.

References: Test Methods for Evaluating Solid Waste, SW846, Third Edition, 1986 revised 1990.

SECTION 10

SECURITY PLAN

Once Williams begins 24-hour per day operations, security will be provided by Williams personnel. They will control entry to and exit from the facility and monitor the premises continuously. Williams will utilize the existing security fence to control access to the property.

Access to the site will be controlled by a locked gate/buzzer system. If the system fails to work, EPA will require a guard-attended entrance. It is the EPA's intent that site gates be locked at all times. However, an inside quick release system will be used for rapid exit from the site during emergencies.

The area containing the rotary dryer, the untreated soil stockpile, and the treated soil stockpile is defined as an exclusion zone as shown on Figure 12-1. All sides of the exclusion zone will be enclosed by a three foot high visibility fence. Access to the exclusion zone will be limited to the vehicle entrance and the decontamination (or interface) trailer. Two access gates are provided to include the main vehicle gate and an emergency gate. These gates will remain unlocked during normal operations.

All personnel, including both workers and visitors, will log in and out on daily forms in the office area. The office area is located outside of the exclusion zone. The log will note the time, name, company affiliation, and purpose of the visit (for visitors). Visitors are required to provide identification when they sign in. All vehicles will be parked in the designated parking area. No vehicles other than soil material handling equipment, service, and emergency vehicles will be allowed to enter the exclusion zone.

If a security violation occurs, the Williams Project Manager will prepare a security report that notes the time and date of the incident and a description of what happened.

There will be warning signs mounted on the outside of the perimeter fencing. They will be clearly visible from all avenues of approach from a distance of 25 feet. The signs will read:

DANGER - DO NOT ENTER - AUTHORIZED PERSONNEL ONLY

SECTION 11

SITE PREPARATION

11.1 GENERAL

Site preparation will be performed prior to mobilization of the LTTD system to provide access to the site and to construct an operations area for the unit. A parking area will be designated for personal vehicles. Parking will be provided outside the fenced area on Hansen's property. The parking area will also act as a barrier, preventing non-site related vehicles and persons from utilizing the area along the east fence line near the treated soil storage piles and the treatment equipment.

11.2 UTILITY CONNECTIONS

11.2.1 Electrical Connection

Williams will secure a temporary electrical service connection from the power company at an existing pole located inside the security fencing. An overhead service line will be run from the pole to the unit. Electrical requirements are:

• Phase:	3 phase
• Voltage:	480 volts
• Amperage:	1200 amps.

Electrical wiring to the motor control center will be hard wired in conduit conforming to the National Electric Code (NEC). Electrical and control umbilicals are routed to components through cable trays on the containment pad.

11.2.2 Installation of Piping

Potable water from the existing building one inch water supply line will be provided for use in temporary facilities, quenching of processed soil and off-gases, and decontamination. A temporary connection will also be made to the fire hydrant on site if more water is required than is available through the existing building line. Williams will arrange for metering and installation of a backflow preventer for the temporary connection with the City of Yakima water system. The potable water for LTTD operations will flow through buried polyvinyl chloride (PVC) pipe. The temporary piping crossing the site will be buried in a one foot deep trench. If necessary, engineering controls, such as heat tracing of the pipes, will be employed to ensure that the pipes remain operable during all weather conditions. The subsurface installation of the pipe will minimize obstruction of equipment operation in the area of the pipe. Potable water will also be piped to the personnel decontamination trailer, the quench, and rotary dryer discharge screw conveyor, and to a location where it will be available for equipment and containment pad wash down.

11.2.3 Fuel

Propane will be used as fuel for the system. Liquid propane will be obtained from a local supplier, who will install a 30,000 gallon portable propane tank. Temporary supports will be constructed for the tank. The temporary supports will conform to National Fire Protection Association (NFPA) standards. Propane will be supplied to the site by tank trucks.

11.2.4 Communications

Telephone lines will be provided to the office and control room. Two way portable radios will also be used by on-site personnel.

11.2.5 Sanitary Facilities

Sanitary chemical toilets will be provided on site, along with personnel decontamination facilities.

11.3 WORK PAD CONSTRUCTION

A concrete or asphalt work pad will be constructed on-site between the Akland building and the southern excavation area. The pad will serve several purposes, primarily providing a firm foundation for the LTTD. The pad will be approximately 38,000 ft^2 in size with a 6" curbing around the outer limits and between the various zones. The pad will help to contain spills and stormwater runoff. Additionally, it will prevent contamination of the area underneath the unit. The containment pad also aids in maintaining a cleaner work area during storm events, thus preventing deterioration of working conditions.

SECTION 12

MOBILIZATION

12.1 OPERATIONS PAD

The operations pad, or containment pad, is to be constructed on level ground between the Akland building and the southern excavation area. Much of the clearing and grading at the site was performed along with previous excavation activities. Therefore, the proposed area for construction of the pad should require very little preparation prior to installation of the pad. Additionally, small concrete pads currently exist at the site and may be incorporated into the operations pad for the LTTD.

As stated previously, the primary purpose of the pad is to provide a firm foundation for the LTTD. Another major reason for the operations pad is containment of spills and stormwater runoff. The outer limits of the pad, as well as the boundaries between the various work zones, will be guarded by 6" curbing. The curbing will prevent any spills or rainwater landing on the pad from leaving the area. Sumps located in each zone will collect water runoff on the pad and pump it to the unit's wastewater treatment system for cleaning. Minor sloping of the pad will cause all water to flow towards the sumps for collection and treatment.

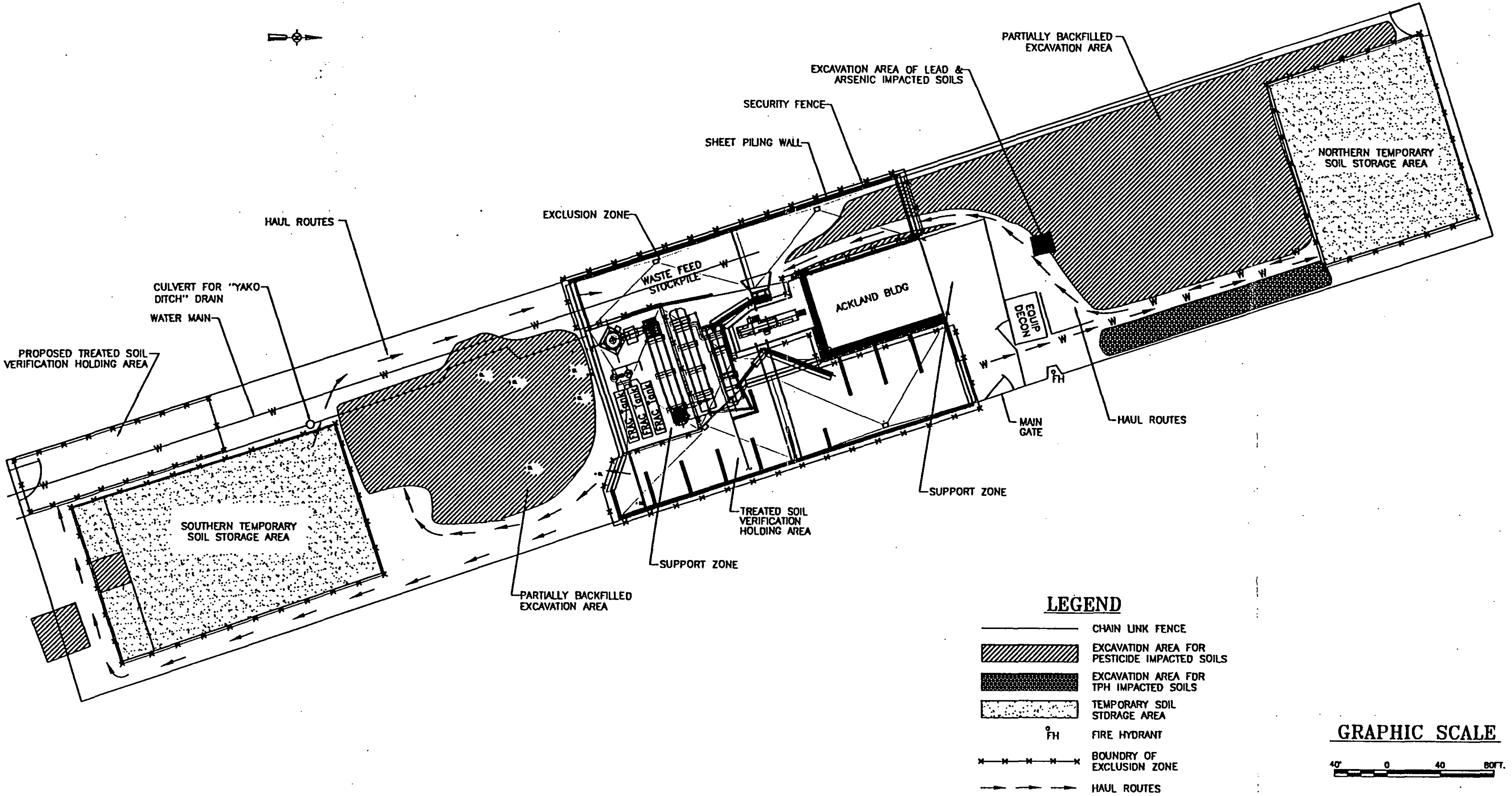
In addition to curbing, interior fencing will be used to separate the stockpiled waste, material and thermal desorber from the remainder of the operations pad and the other work zones.

12.2 FENCE INSTALLATION

The site will be divided into three zones; 1) exclusion zone, 2) contaminant reduction zone and 3) support zone. Zones will be established and clearly delineated. Figure 12-1, Site Layout, illustrates the orientation and approximate location of process equipment, support facilities and work zones. Figure 12-2 shows the equipment layout.

The exclusion zone includes the area around the rotary dryer and the adjacent area where active cleanup operations are performed as shown in Figure 12-1. The exclusion zone is separated from the other zones by a three foot high visibility fence. Entrance to the exclusion zone must be made through the decontamination trailer or vehicle entrance gate.

The contaminant reduction zone includes the personnel decontamination area, and areas of the work pad used for decontamination.



LEGEND

- —— CHAIN LINK FENCE
- ▨ EXCAVATION AREA FOR PESTICIDE IMPACTED SOILS
- ▩ EXCAVATION AREA FOR TPH IMPACTED SOILS
- ░ TEMPORARY SOIL STORAGE AREA
- FH FIRE HYDRANT
- —×—×—×— BOUNDRY OF EXCLUSION ZONE
- — → — → HAUL ROUTES

LTR.	DATE	REVISIONS	BY
–	9/5/94	CREATED	LEW

Williams Environmental Services
WILLIAMS
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Stone Mountain, GA 30087
404/879-4107 (fax) 404/879-4831

TPU4

WESI*TPU4 FOR WOODS JOB

SITE LAYOUT

SITE

DATE 11/15/94

FIGURE 12.1

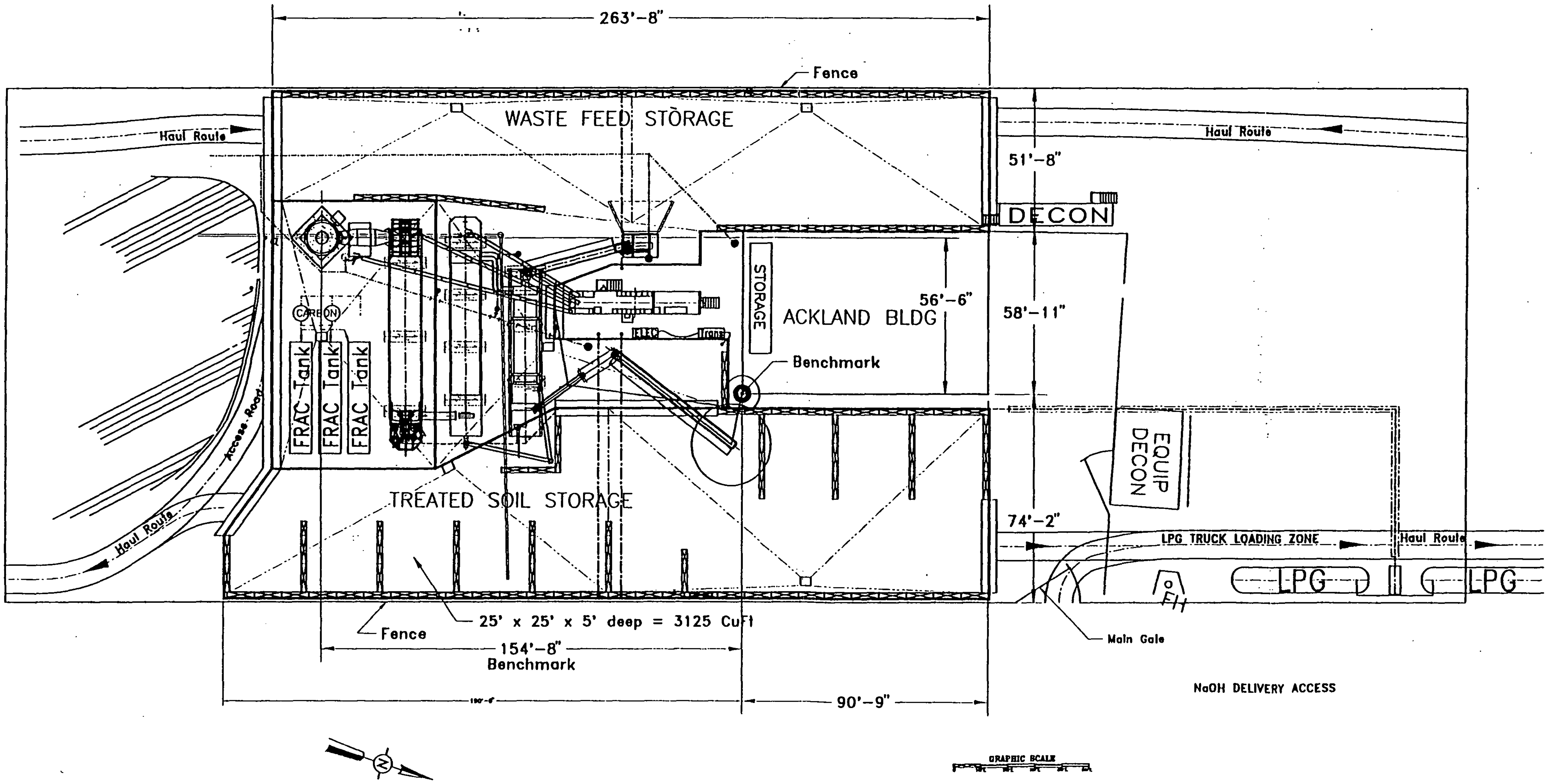
DIRECTORY: \WESI\JOBS\ACTIVE WOODS\DWGS

FILENAME WOD-SIT4.dwg

DWG NO. WOD-SIT4

NOTES:

CENTER OF SCRUBBER IS MASTER DATUM POINT.
ALL EQUIPMENT LOCATED PERPENDICULAR TO FENCES.
SEE DWG 4WODPAD2 FOR PAD DIMENSIONS
SEE DWG 4WODPAD3 FOR SECTION VIEWS



LTR.	DATE	REVISIONS	BY
-	9/5/94	CREATED	LCW

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WILLIAMS

TPU4

WESI*TPU4 FOR WOODS JOB

PAD LAYOUT

SITE

DATE 11/3/94

FIGURE 12.2

DIRECTORY: \WESI\JOBS\ACTIVE WOODS\DWGS

FILENAME 4WD-SITE.dwg

DWG NO. 4Woods Site

The support zone includes all other portions of the site not listed above which are used for storage and support functions, and the remaining area where the control trailer and air pollution control equipment are located.

12.3 LTTD UNIT MOBILIZATION

Upon receipt of notice to proceed, Williams will begin assembling equipment, materials, and supplies that will be required for shipment to the site. A progressive shipment scheme for items will be used, with equipment for the activities planned shipped as needed. The intent of this scheme is to minimize the accumulation of unnecessary material at the site, thus eliminating congestion that may adversely slow the equipment and facility installation process.

Supervision of the thermal desorption equipment piping and instrumentation will be provided by Williams personnel. Qualified local labor may be used to perform rigging and erection of the equipment.

12.3.1 Erection of Equipment

The first step in equipment erection is to position the trailer-mounted equipment on the work pad. Next, the rigid ductwork connecting the rotary dryer to the offgas treatment trailer is placed in position and connected. The ductwork from the baghouse to the thermal oxidizer is connected next. The stack will be assembled and then erected by crane. The soil discharge screw conveyor and the dust transfer conveyor are then installed. The feed processing unit will be positioned last.

12.3.2 Rotary Dryer Trailer

The rotary dryer and dryer feed conveyor are mounted on a single trailer. The trailer is positioned three feet from the curb as shown on the site drawing. The unit is leveled and chocked in place. All other trailers are placed relative to the location of the rotary dryer trailer. The soil discharge conveyor is delivered on a separate flatbed trailer and mounted on the dryer trailer at the site.

12.3.3 Baghouse Trailer

The baghouse trailer contains the baghouse and ID fan. This trailer is positioned parallel to the rotary dryer trailer. This trailer is separated from the rotary dryer trailer by a distance of approximately 8 feet to allow for connections and service.

The ductwork between the rotary dryer and baghouse/quench trailer, dust transfer conveyor, and electrical wiring will be connected. High temperature sealant will be used on all metal to metal ductwork joints. Electric wiring between trailers will be protected with portable cable trays.

12.3.4 Thermal Oxidizer Trailer

The thermal oxidizer will be delivered, placed on the work pad, and connected to the baghouse trailer by ductwork. The thermal oxidizer will be placed parallel to the baghouse trailer.

Two liquid-phase activated carbon adsorption columns will be skid mounted and delivered by truck. The columns will be placed adjacent to the baghouse trailer. The liquid-phase activated carbon adsorption columns will be connected to the scrubber blowdown system by chlorinated polyvinyl chloride (CPVC) piping. The piping will be protected from mechanical damage by piping trays similar to the electrical connections.

12.3.5 Acid Gas Scrubber/Quencher

The acid gas scrubber/quencher is trailer mounted and will be positioned parallel to the thermal oxidizer where the appropriate ductwork and electrical connection will be made.

12.3.6 Feed Unit

The feed unit is a separate mobile unit. This unit will be positioned to align its discharge with the feed conveyor on the rotary dryer unit.

12.3.7 Stack

The stack will be delivered to the site in sections. After the scrubber/quencher trailer is installed, the stack will be assembled and erected. Required foundations or guy wire anchors will be installed prior to erecting the stack.

12.4 STARTUP PROCEDURES

The following startup procedures will be followed to establish steady-state operation of the LTTD before soil is introduced to the system. The major tasks involved in a normal startup are as follows:

1. Prepare for safe startup.

2. Verify that utilities are connected and operational.

3. Verify that instrumentation and control systems are operational:

   - Check motor rotation
   - Check interlock system
   - Check manual override
   - Check CEM system

4. Start the ID fan and combustion air fans.

5. Start water to quench chamber.

6. Start discharge screw conveyor and rotary dryer rotation.

7. Start rotary dryer burner and set the burner on low fire.
   Start thermal oxidizer burner and set burner on low fire.

8. Start bringing rotary dryer exit gas operating temperature up to normal following heatup schedule. Raise temperature in automatic control mode.

9. Verify normal operation of air pollution control system.

10. When rotary dryer temperatures are in normal range, verify that all interlocks are clear for soil feed.

11. Start solids feed. Verify that soil discharge temperature stabilizes in normal range.

12.5 PAD AND EQUIPMENT DECONTAMINATION

After processing of the contaminated material is complete, (including processing of contaminated soils located under the stockpiles) preparation for demobilization will begin. All remaining soil residues will be removed from the LTTD unit. Decontamination will be limited to the work pad and equipment which comes into contact with the contaminated soil. Soil and sediments from the work pad will be processed prior to decontamination.

The feed system and stacking conveyor will be pressure cleaned. The discharge screw conveyor's cover will be removed for easy pressure cleaning.

All organic residues will be removed from the interior of the rotary dryer by heating the unit at 800°F for 1 hour. The exterior of the rotary dryer and the baghouse will be washed and pressure cleaned. The baghouse, because of its pulse jets of compressed air, will be free of residues and require no further decontamination. During operation, the pulsing frequency will be determined based on soil characteristics and the amount of carryover experienced. The baghouse will be inspected two (2) weeks after operations commence and monthly thereafter to ensure the bags are free of residue. The exterior surface of the quench chamber will be cleaned. Additionally, the interior of the scrubber will be cleaned of any residues. These residues will be tested for contamination and, if necessary, treated accordingly by Williams. The remaining pieces of equipment will require no further decontamination procedures other than washing and pressure cleaning of the exterior surfaces.

The containment pad will be given a final cleaning by high pressure wash. All decontamination water will be treated on-site by activated carbon adsorption, and applied to the treated soil to quench and remoisturize the soil or discharged to the sanitary sewer in accordance with the terms of a temporary City of Yakima wastewater discharge permit to be obtained by Williams.

The liquid phase carbon adsorption units will be removed from the site after decontamination of the exterior by washing and pressure cleaning. After removal from the site, the contents of the activated carbon system will be regenerated by Westates in accordance with all applicable regulations, or disposed of in accordance with all applicable regulations. Hazardous waste manifests will be completed for the spent activated carbon.

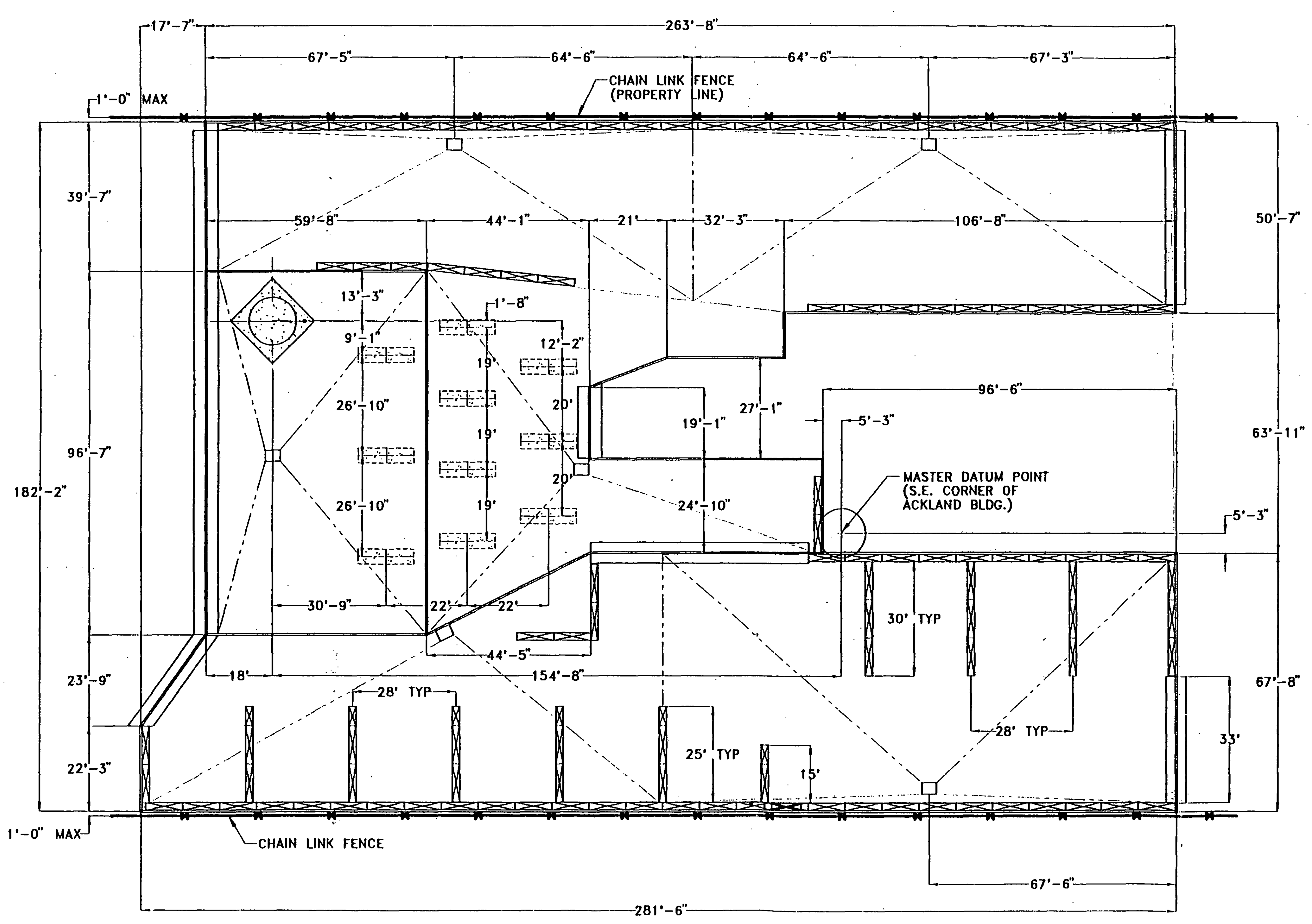
12.6 DEMOBILIZATION

Upon completion of decontamination activities and confirmation that cleanup criteria have been achieved, the thermal desorption system and support equipment installed by Williams will be dismantled and removed from the site. Equipment will be disassembled in reverse order of erection and promptly removed from the site. All construction debris generated by Williams will be removed by Williams.

Oversized material and debris, such as cobbles, plastic covers, and personal protective equipment (PPE), will be as per Section 3.5.1.

SEE DWG. 4WODPAD1 FOR NOTES & SECTION CUTS: Ⓐ
SEE DWG. 4WODPAD3 FOR SECTION VIEWS
NOTE: ALL DIMENSIONS ARE TO CENTERLINE, UNLESS OTHERWISE NOTED

GRAPHIC SCALE
0 10FT. 20FT. 30FT. 40FT. 50FT.



LTR.	DATE	REVISIONS	BY
-	1/24/94	CREATED	LSW

Williams Environmental Services
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TPU4

TPU #4 SOIL REMEDIATION UNIT

EQUIPMENT PAD
FOR WOODS SITE
DIMENSIONS

PAD

DATE	11/2/94

FIGURE 12.3

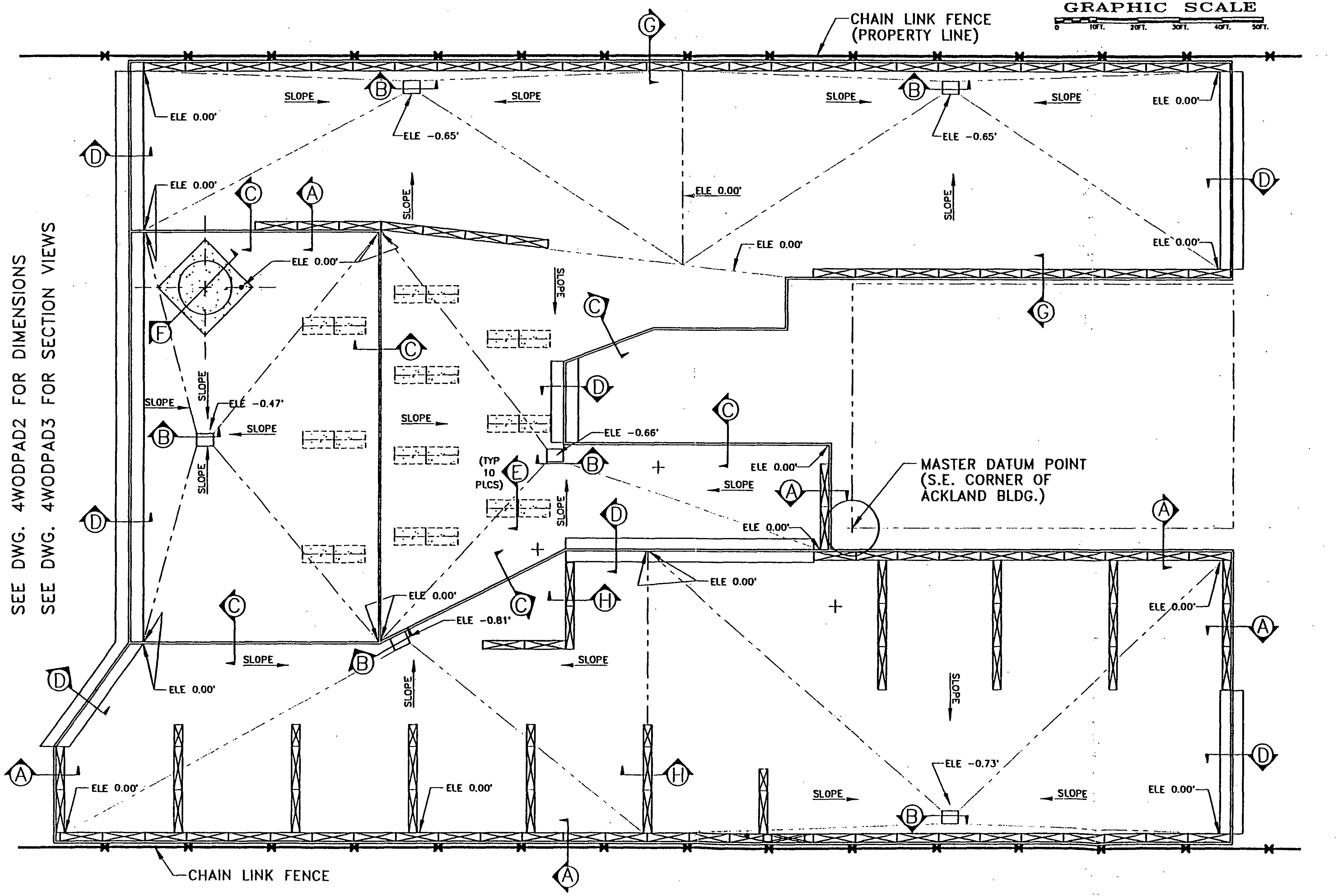
DIRECTORY: \WES\Jobs\Active\\Woods\Dwgs\

FILENAME 4WODPAD2.dwg

DWG NO.
PAD DIMS.

NOTES:

SLOPE OF SURFACES = 1% FOR LONGEST DISTANCE TO EACH SUMP



LTR.	DATE	REVISIONS	BY
-	1/24/94	CREATED	LEW

Williams Environmental Services

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TPU4

TPU #4 SOIL REMEDIATION UNIT

EQUIPMENT PAD
FOR WOODS SITE
PLAN VIEW

PAD

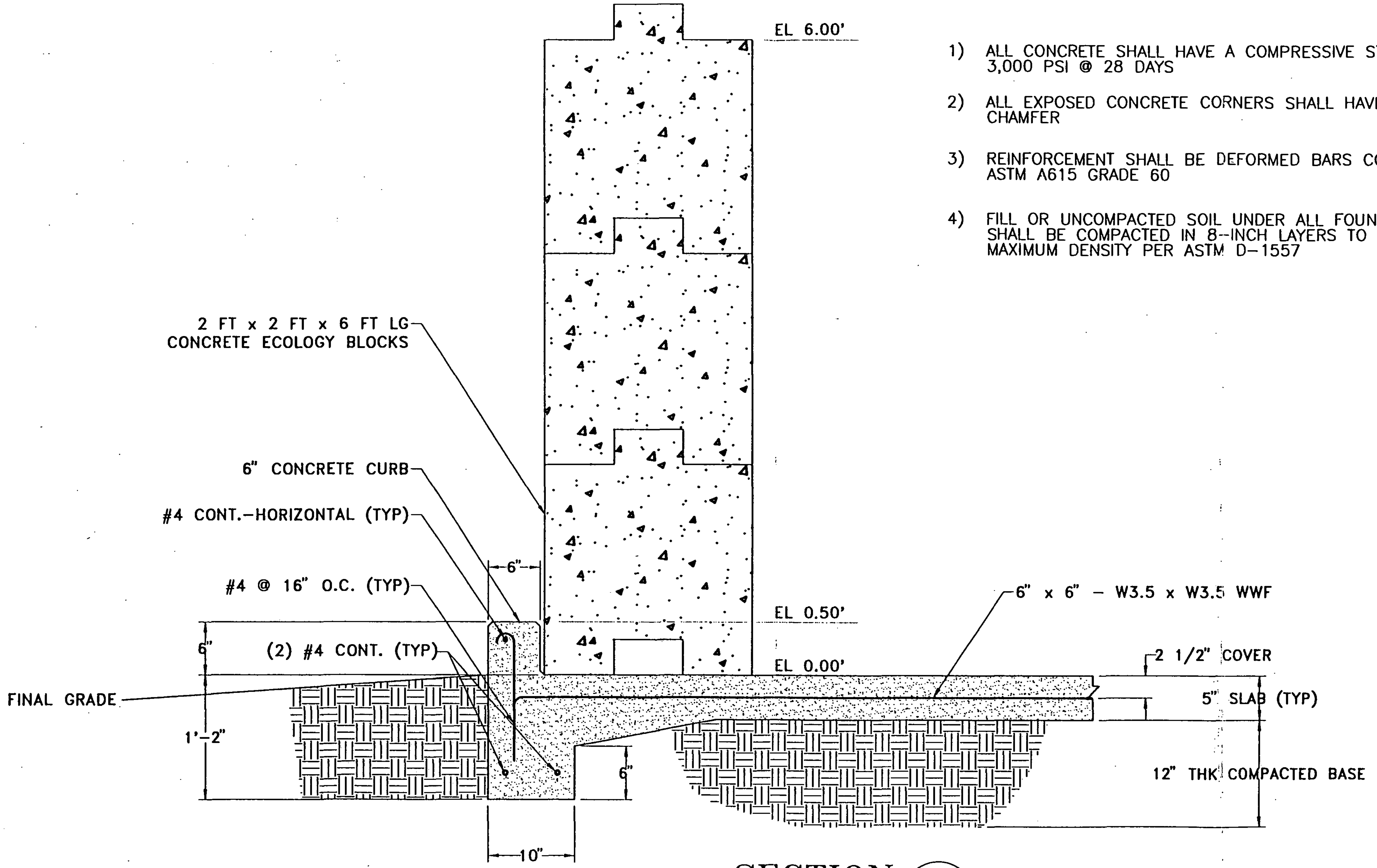
DATE	11/3/94
FIGURE 12.4	
DIRECTORY: \WESA\Jobs\Active\Woods\Dwgs\	
FILENAME	4WODPAD1.dwg
DWG NO. Woods Pad	

1) ALL CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 3,000 PSI @ 28 DAYS

2) ALL EXPOSED CONCRETE CORNERS SHALL HAVE A 1/2" CHAMFER

3) REINFORCEMENT SHALL BE DEFORMED BARS CONFORMING TO ASTM A615 GRADE 60

4) FILL OR UNCOMPACTED SOIL UNDER ALL FOUNDATIONS SHALL BE COMPACTED IN 8-INCH LAYERS TO 95% OF MAXIMUM DENSITY PER ASTM D-1557



SECTION (A)

TYPICAL CURBING DETAILS
WITH 6 FT CONCRETE BLOCK DIRT BARRIER

LTR.	DATE	REVISIONS	BY
-	11/4/94	CREATED	LEW

Williams Environmental Services

WILLIAMS

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TPU4

TPU #4 SOIL REMEDIATION UNIT

EQUIPMENT PAD
FOR WOODS SITE
SECTIONS FROM 4WODPAD1

PAD

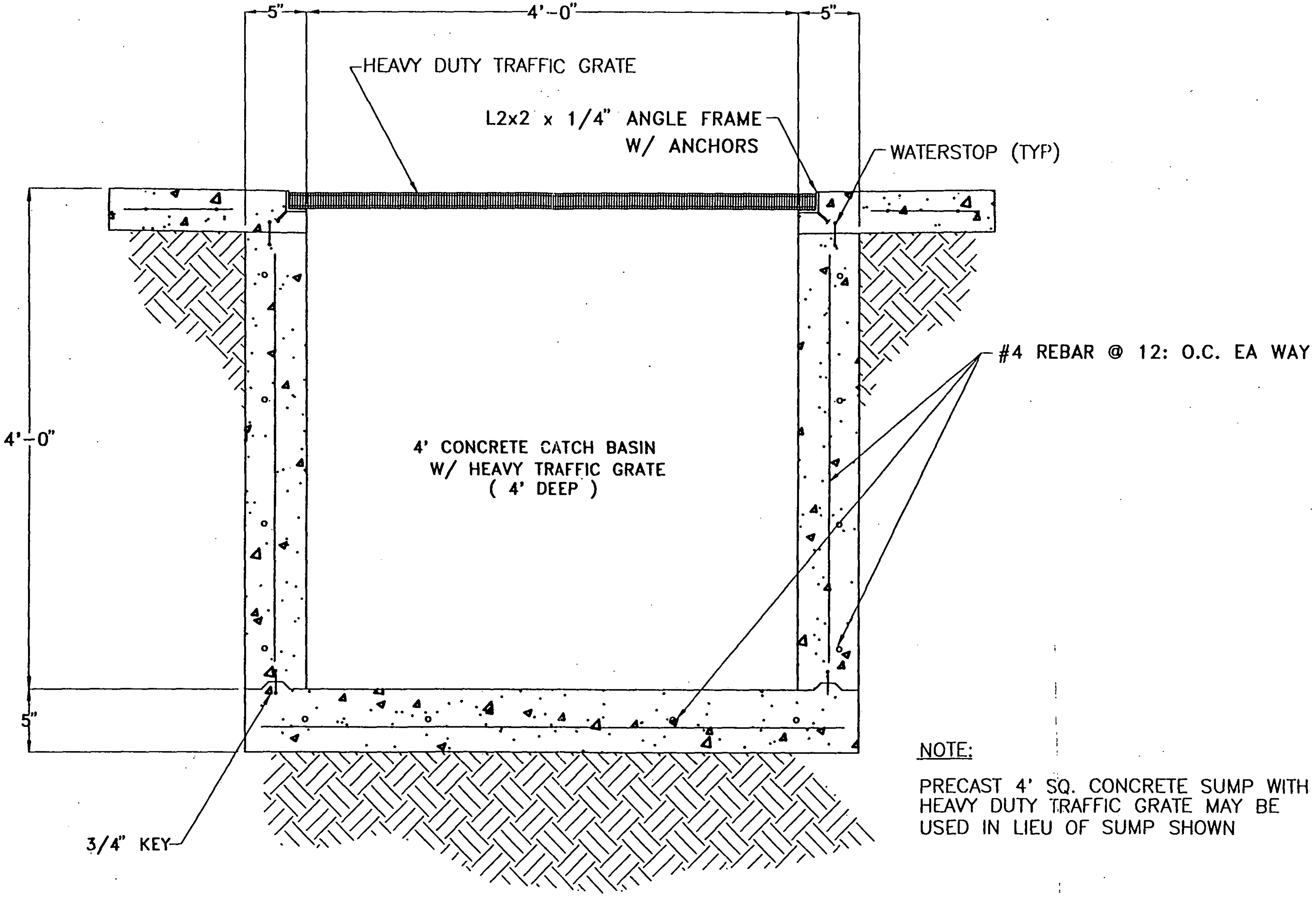
DATE 11/16/94

FIGURE 12.5

DIRECTORY: \WES\Jobs\Active\ \Woods\Dwgs\

FILENAME PAD-A.dwg

DWG NO.
SECTION A



NOTE:

PRECAST 4' SQ. CONCRETE SUMP WITH HEAVY DUTY TRAFFIC GRATE MAY BE USED IN LIEU OF SUMP SHOWN

SECTION B

TYPICAL SUMP DETAIL

LTR.	DATE	REVISIONS	BY
-	11/8/94	CREATED	LEW

Williams Environmental Services

WILLIAMS

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TPU4

TPU #4 SOIL REMEDIATION UNIT

EQUIPMENT PAD
FOR WOODS SITE
SECTIONS FROM 4WODPAD1

PAD

DATE 11/16/94

FIGURE 12.6

DIRECTORY: \WESI\Jobs\Active\ \Woods\Dwgs\

FILENAME PAD-B.dwg

DWG NO. SECTION B

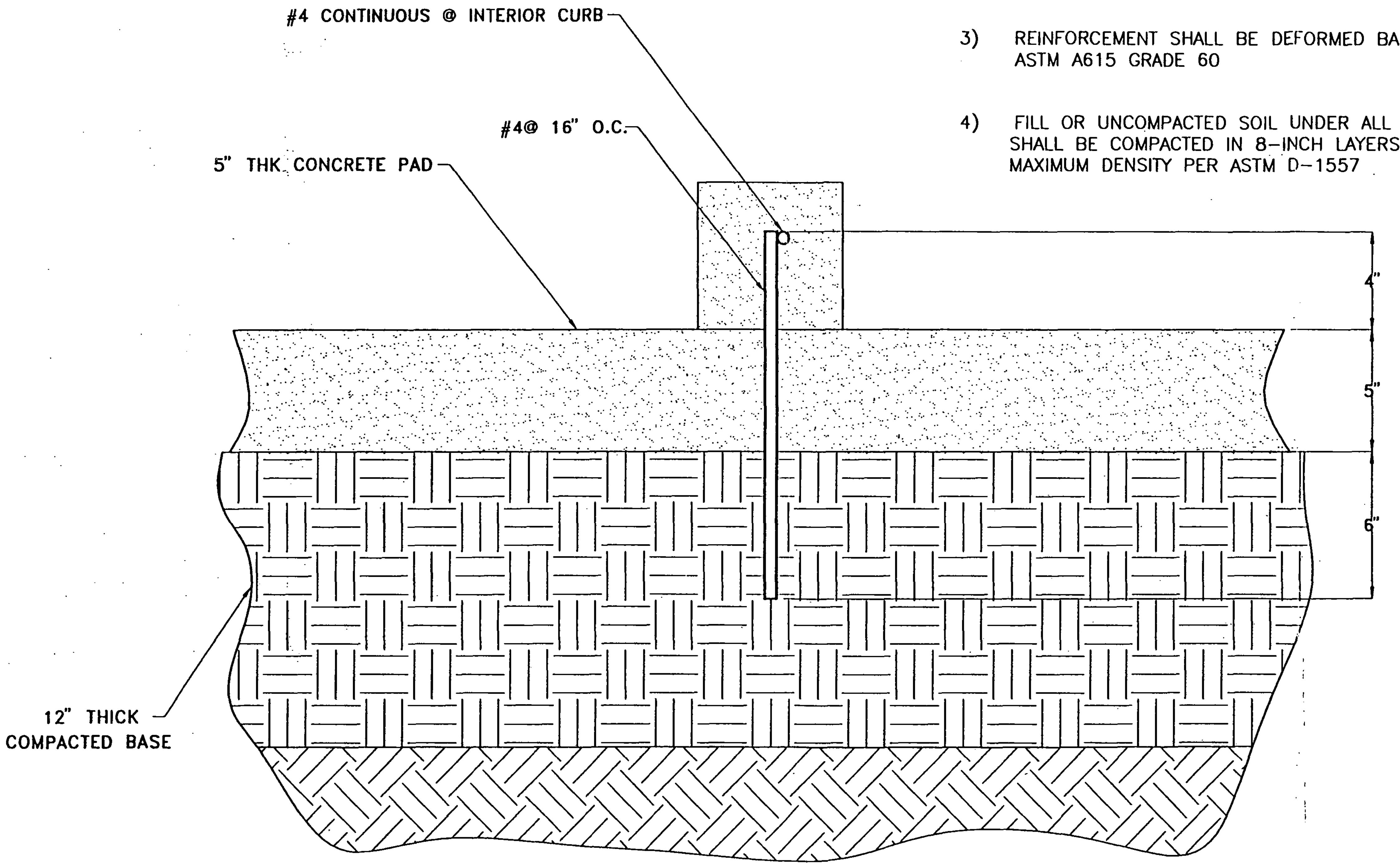
NOTES:

1) ALL CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 3,000 PSI @ 28 DAYS

2) ALL EXPOSED CONCRETE CORNERS SHALL HAVE A 1/2" CHAMFER

3) REINFORCEMENT SHALL BE DEFORMED BARS CONFORMING TO ASTM A615 GRADE 60

4) FILL OR UNCOMPACTED SOIL UNDER ALL FOUNDATIONS SHALL BE COMPACTED IN 8-INCH LAYERS TO 95% OF MAXIMUM DENSITY PER ASTM D-1557



SECTION C

TYPICAL CURBING DETAILS

LTR.	DATE	REVISIONS	BY
-	11/8/94	CREATED	LEW

Williams Environmental Services

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TPU4

TPU #4 SOIL REMEDIATION UNIT

EQUIPMENT PAD
FOR WOODS SITE
SECTIONS FROM 4WODPAD1

PAD

DATE 11/16/94

FIGURE 12.7

DIRECTORY: \WESA\Jobs\Active\ \Woods\Dwgs\

FILENAME PAD-C.dwg

DWG NO.
SECTION C

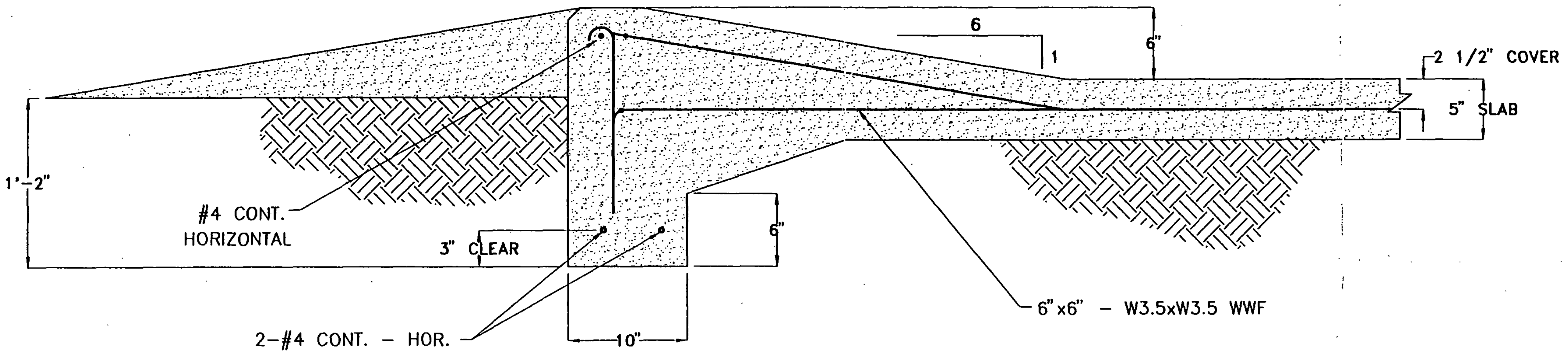
NOTES:

1) ALL CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 3,000 PSI @ 28 DAYS

2) ALL EXPOSED CONCRETE CORNERS SHALL HAVE A 1/2" CHAMFER

3) REINFORCEMENT SHALL BE DEFORMED BARS CONFORMING TO ASTM A615 GRADE 60

4) FILL OR UNCOMPACTED SOIL UNDER ALL FOUNDATIONS SHALL BE COMPACTED IN 8-INCH LAYERS TO 95% OF MAXIMUM DENSITY PER ASTM D-1557



SECTION D

TYPICAL ACCESS RAMP DETAIL

LTR.	DATE	REVISIONS	BY
-	11/8/94	CREATED	LEW

Williams Environmental Services
WILLIAMS
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Stone Mountain, GA 30087
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TPU4

TPU #4 SOIL REMEDIATION UNIT

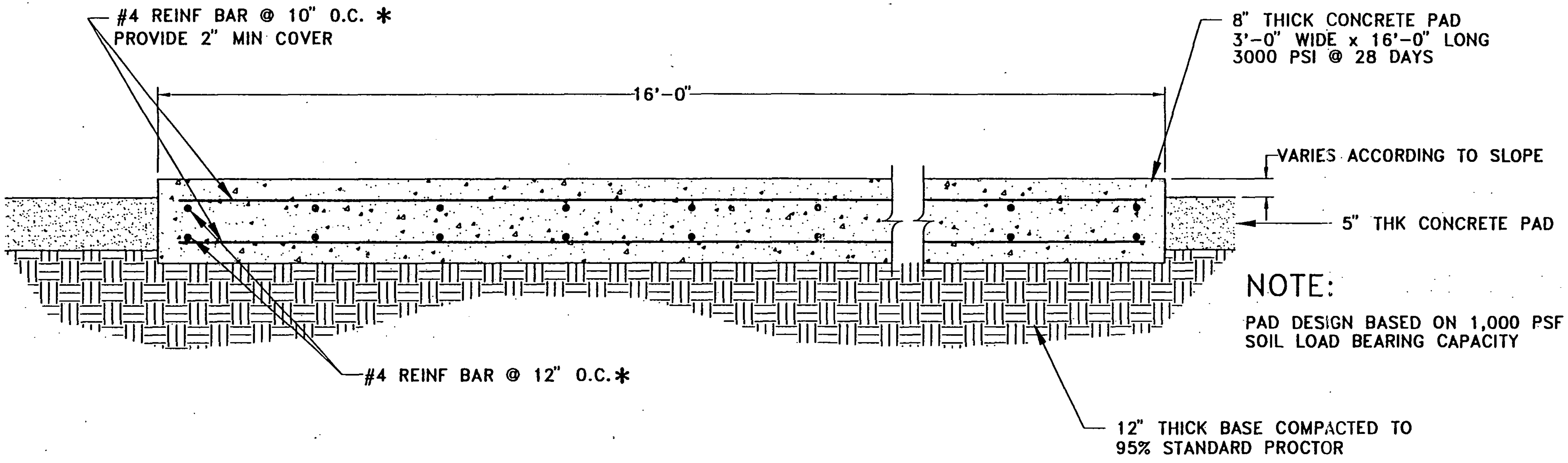
EQUIPMENT PAD
FOR WOODS SITE
SECTIONS FROM 4WODPAD1

PAD

DATE 11/16/94
FIGURE 12.8
DIRECTORY: \WESA\Jobs\Active\Woods\Dwgs\
FILENAME PAD-D.dwg
DWG NO. SECTION D

NOTES:

1. ALL CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 3,000 PSI @ 28 DAYS.
2. REINFORCEMENT SHALL BE DEFORMED BARS CONFORMING TO ASTM A615 GRADE 60.
3. ANCHOR BOLTS SHALL BE ASTM A307 GRADE A UNLESS OTHERWISE SPECIFIED OR REQUIRED.
4. ALL EXPOSED CONCRETE CORNERS SHALL HAVE A 1/2" CHAMFER.
5. FILL OR UNCOMPACTED SOIL UNDER ALL FOUNDATIONS SHALL BE COMPACTED IN 8-INCH LAYERS TO 95% OF MAXIMUM DENSITY PER ASTM D-1557



NOTE:

PAD DESIGN BASED ON 1,000 PSF SOIL LOAD BEARING CAPACITY

* REBAR IN CONCRETE TO BE DESIGNED BY PROFSIONAL ENGINEER

SECTION E

TYPICAL EQUIPMENT FOOTING DETAIL

LTR.	DATE	REVISIONS	BY	LEV
-	11/16/94	CREATED		

Williams Environmental Services
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TPU4

TPU #4 SOIL REMEDIATION UNIT

EQUIPMENT PAD
FOR WOODS SITE
SECTIONS FROM 4WODPAD1

PAD

DATE 11/16/94

FIGURE 12.9

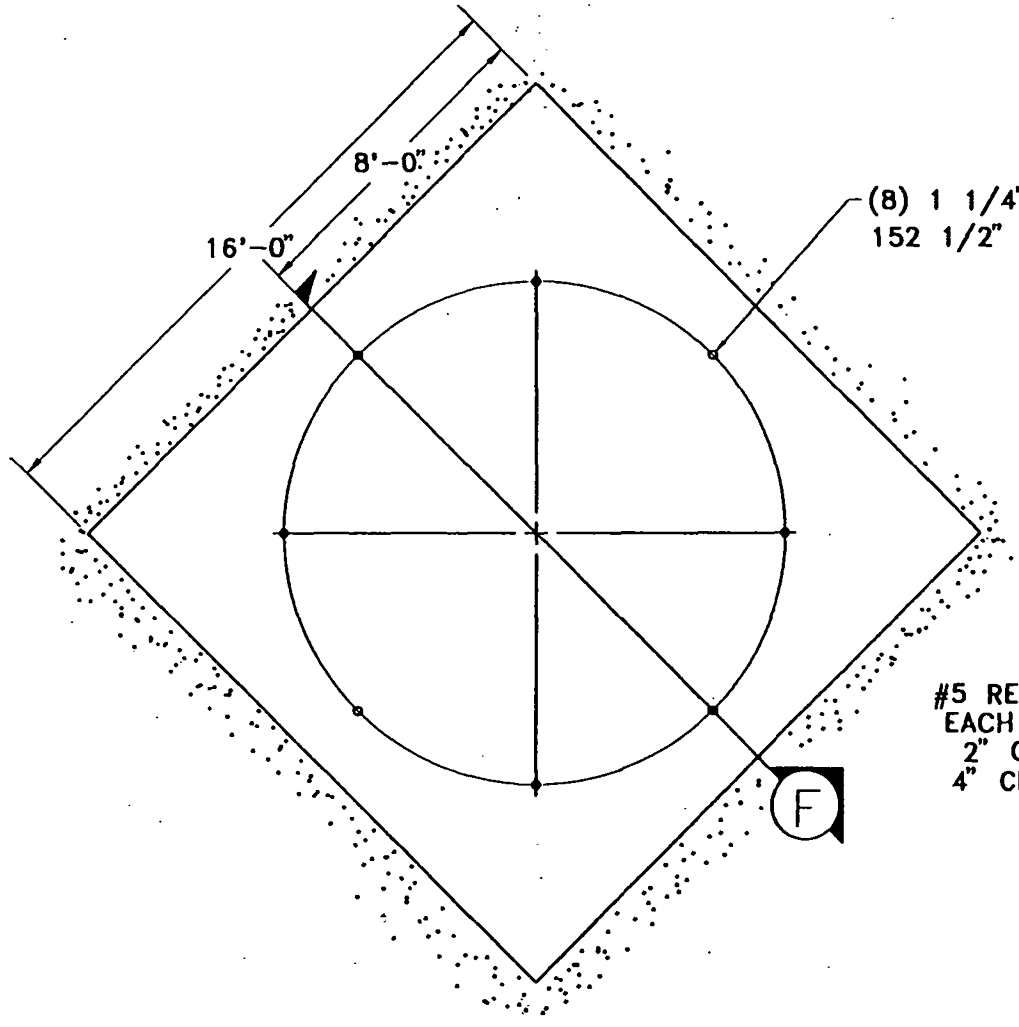
DIRECTORY: \WESA\Jobs\Active\ \Woods\Dwgs\

FILENAME PAD-E.dwg

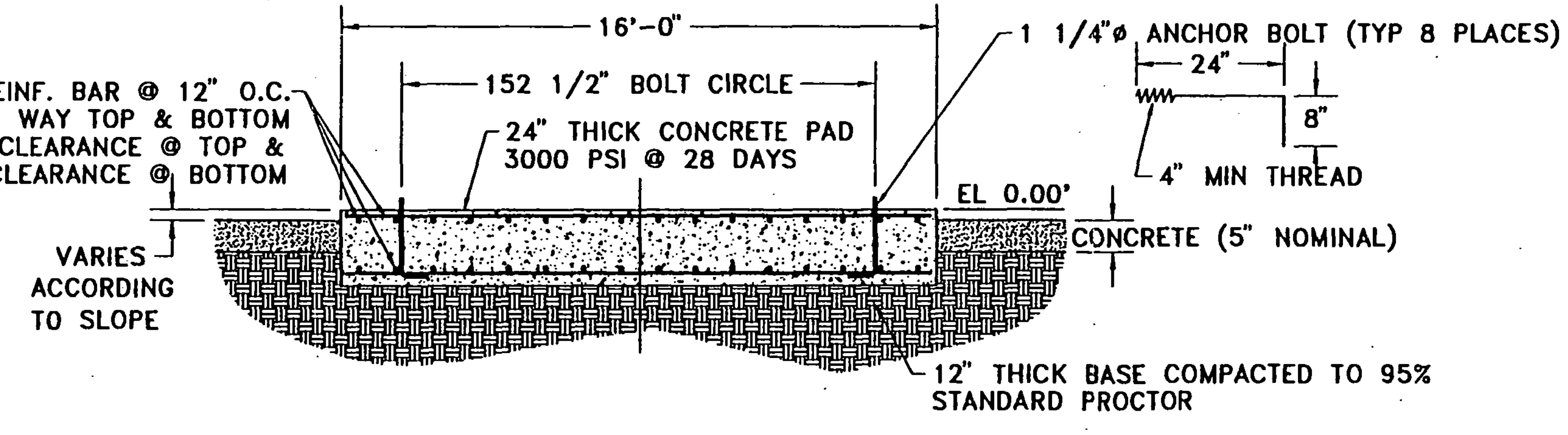
DWG NO. SECTION E

NOTES:

1. ALL CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 3,000 PSI @ 28 DAYS.
2. REINFORCEMENT SHALL BE DEFORMED BARS CONFORMING TO ASTM A615 GRADE 60.
3. ANCHOR BOLTS SHALL BE ASTM A307 GRADE A UNLESS OTHERWISE SPECIFIED OR REQUIRED.
4. ALL EXPOSED CONCRETE CORNERS SHALL HAVE A 1/2" CHAMFER.
5. FILL OR UNCOMPACTED SOIL UNDER ALL FOUNDATIONS SHALL BE COMPACTED IN 8-INCH LAYERS TO 95% OF MAXIMUM DENSITY PER ASTM D-1557



SCRUBBER FOUNDATION DETAIL



SECTION F

LTR.	DATE	REVISIONS	BY
-	MM/DD/YY	CREATED	JDL

Williams Environmental Services

WILLIAMS

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TPU4

WESI*TPU4 for WOODS Job

EQUIPMENT PAD
FOR WOODS SITE
SECTIONS FROM 4WODPAD1

SITE

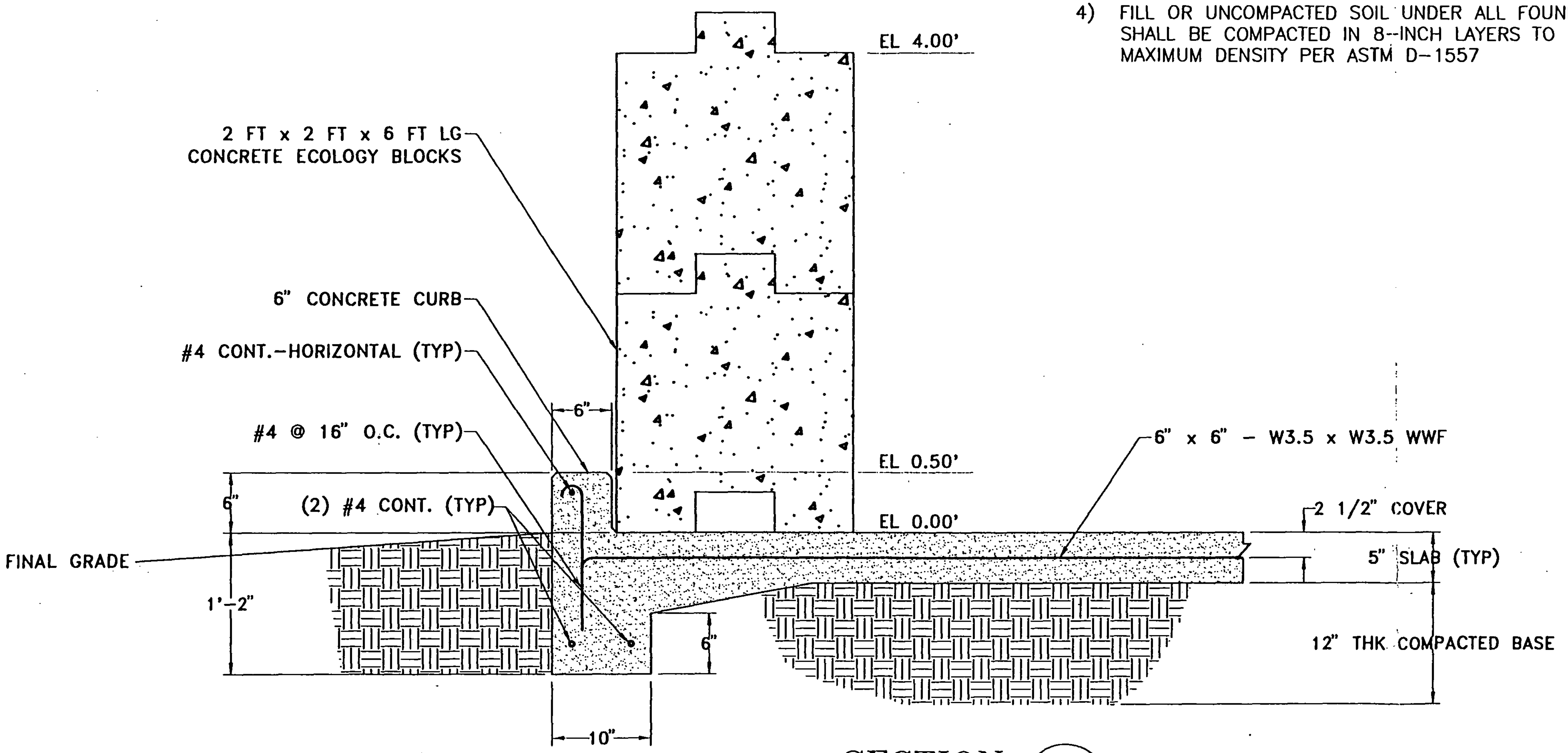
DATE 11/16/94
FIGURE 12.10
DIRECTORY: \WESI\Jobs\Active\Dwgs\
FILENAME PAD-F.dwg
DWG NO. DETAIL F

1) ALL CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 3,000 PSI @ 28 DAYS

2) ALL EXPOSED CONCRETE CORNERS SHALL HAVE A 1/2" CHAMFER

3) REINFORCEMENT SHALL BE DEFORMED BARS CONFORMING TO ASTM A615 GRADE 60

4) FILL OR UNCOMPACTED SOIL UNDER ALL FOUNDATIONS SHALL BE COMPACTED IN 8-INCH LAYERS TO 95% OF MAXIMUM DENSITY PER ASTM D-1557



SECTION G

TYPICAL CURBING DETAILS
WITH 6 FT CONCRETE BLOCK DIRT BARRIER

LTR.	DATE	REVISIONS	BY
-	11/07/94	CREATED	LEW

Williams Environmental Services
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Stone Mountain, GA 30087
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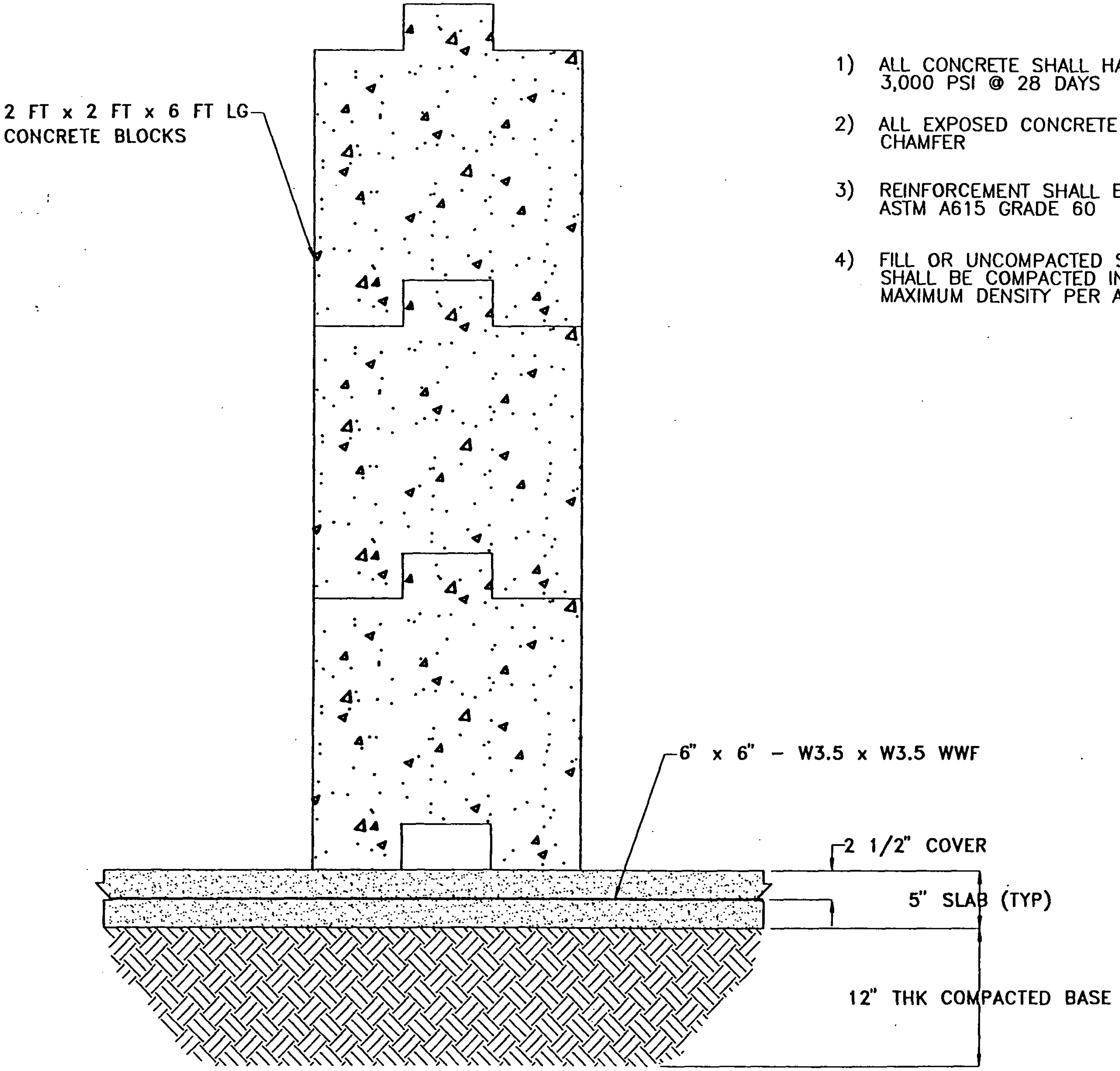
TPU4

TPU #4 SOIL REMEDIATION UNIT

EQUIPMENT PAD
FOR WOODS SITE
SECTIONS FROM 4WODPAD1

PAD

DATE 11/16/94
FIGURE 12.11
DIRECTORY: \WESA\Jobs\Active\Woods\Dwgs\
FILENAME PAD-G.dwg
DWG NO. SECTION G



1) ALL CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 3,000 PSI @ 28 DAYS

2) ALL EXPOSED CONCRETE CORNERS SHALL HAVE A 1/2" CHAMFER

3) REINFORCEMENT SHALL BE DEFORMED BARS CONFORMING TO ASTM A615 GRADE 60

4) FILL OR UNCOMPACTED SOIL UNDER ALL FOUNDATIONS SHALL BE COMPACTED IN 8-INCH LAYERS TO 95% OF MAXIMUM DENSITY PER ASTM D-1557

SECTION (H)

TYPICAL CURBING DETAILS
WITH 6 FT CONCRETE BLOCK DIRT BARRIER

LTR	DATE	REVISIONS	BY
-	11/8/94	CREATED	LSW

Williams Environmental Services
WILLIAMS
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Stone Mountain, GA 30087
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TPU4

TPU #4 SOIL REMEDIATION UNIT

EQUIPMENT PAD
FOR WOODS SITE
SECTIONS FROM 4WODPAD1

PAD

DATE 11/16/94

FIGURE 12.12

DIRECTORY: \WESI\Jobs\Active\Woods\Dwgs\

FILENAME PAD-H.dwg

DWG NO. SECTION H

SECTION 13

DUST CONTROL

Dust shall be minimized at all times, including non-working hours, weekends and holidays. Water spray will be applied from a water truck or other means as needed to control dust during soil handling and stockpiling operations. Additionally, material stockpiles will remain covered with polyethylene plastic sheeting when not directly involved in processing.

Soils disturbed during operations will be sprayed with water as necessary to control dust. A sprinkler system will be used to mitigate wind erosion of existing soils on site. Again, plastic sheeting will be used to cover any soil piles not directly involved in processing. The goals of the Dust Control Program are no visible dust, as well as prevention of air levels that raise risk concerns for the chemicals of concern at the site. Further details regarding dust control and its measurement are discussed in the Ambient Air Monitoring Plan submitted by Burlington Environmental.

SECTION 14

HEALTH AND SAFETY

14.1 GENERAL

This section of the Thermal Desorption Work Plan details Health and Safety requirements for Williams thermal desorption activities on the site.

Williams personnel must also abide by the practices and policies specified in this section which address special HASP concerns during thermal desorption activities. The Williams Health and Safety Plan can be found in Appendix E.

14.2 SAFETY ADMINISTRATION

Principal in Charge

Williams will have corporate authority for HASP matters for work performed in the thermal desorption work area which includes the exclusion, contaminant reduction, and support zones described in Section 12.2 of the Thermal Desorption Work Plan. The HAS Officer is responsible for the day to day safety operation, with the Principal in Charge ultimately responsible for safety issues. The Principal in Charge and HASP Officer are identified in Section 2.0 of the Thermal Desorption Work Plan, Project Overview and Organization.

Health and Safety Officer

The Health and Safety (HAS) Officer will be responsible for implementation of and compliance with the HASP. Each Shift Supervisor and the Site Manager will be responsible for ensuring that personnel under their management are informed of HASP hazards and properly instructed in procedures for protecting human health and the environment.

The HAS Officer has the authority to stop any operation that he perceives to be immediately hazardous to personnel. After stopping the operation, the Site Manager will be informed and an Unsafe Work Practice Report will be completed.

The HAS Officer is responsible for preparing all safety response actions and coordinating training programs. In the event of an emergency, he is responsible for managing response activities.

The HAS Officer is responsible for conducting inspections of equipment and operating procedures to ensure compliance with the HASP Plan. A formal report is required from inspections which become part of the formal record and report to management. All problems found during an inspection and action taken to resolve the problem are placed into the record.

14.3 INSPECTIONS

During inspection, the inspector looks for malfunctions, deterioration, operator errors, or equipment failure which may cause or lead to the release of hazardous constituents to the environment or may represent a threat to human health. In addition to visual inspections, the data provided by instrumentation (e.g., changes in temperature or flow, pressure drop, position of limit switches, etc.) will aid the operators in detecting leaks and unsafe conditions requiring further investigation. Table 14-1 summarizes the potential problem areas for each of the categories of equipment to be inspected.

The records of inspections performed, observations noted and actions taken will include the information specified in Table 14-1, as a minimum.

A system for scheduling inspections will be established to provide for conducting periodic inspections at the required intervals. The system will enable management to determine whether inspections are being conducted as scheduled and when action may be required to insure compliance with the inspection frequency. Completed checklists will be signed and dated by the inspector before they are filed for future reference.

Housekeeping inspections will also be conducted by Williams' site supervisory personnel at regular intervals.

14.4 PERSONAL PROTECTIVE EQUIPMENT

PPE will be required while working in the exclusion zone. The minimum level of protection will be modified Level D as described in the Health and Safety Plan (HASP), Appendix E. The decision to upgrade to Level C protection will be based on the presence of visible dust and results of air monitoring as also described in the HASP.

14.5 PERIMETER AIR MONITORING

During periods of active site work, including soil pretreatment and thermal desorption treatment of soil, air samples may be collected from four locations along the fence line surrounding the BNRR property. For further details, regarding all perimeter air monitoring activities, reference the HASP.

SECTION 15

PROJECT QUALITY ASSURANCE/QUALITY CONTROL

15.1 ORGANIZATION

All personnel will be responsible for continuous adherence to the procedures set forth by the Thermal Desorption Work Plan during performance of on-site work activities. In no case may work be performed in a manner that conflicts with the intent of, or the inherent safety and environmental cautions expressed in these procedures. After due warning, contractor personnel violating health and safety procedures will be dismissed from the site. The general site organizational structure is provided in Figure 2-1.

15.2 PROJECT QUALITY ASSURANCE/QUALITY CONTROL PLAN

QA/QC procedures are intended to meet the following construction objectives:

- Assure that the proposed work is accomplished according to the requirement of all applicable Work Plans.
- Specify inspection and record keeping requirements for compliance with applicable Work Plans.

Williams' QA/QC Manager will be responsible for:

- Implementation of QA/QC Plan.
- Scheduling and coordination of QA/QC inspection activities.
- Directing and supporting QA/QC inspection personnel in performance of observations and tasks.
- Instructing QA/QC inspection personnel and record keepers on requirements and procedures.
- Verifying that test data are adequately recorded and maintained and that raw data are properly recorded, validated and interpreted.
- Verifying that the QA/QC Plan conforms with the requirements of the applicable Work Plans.

The QA/QC Manager will serve as the primary contact between BNRR, Burlington Environmental and Williams for quality control issues. The QA/QC Manager will answer directly to Williams' Principle in Charge regarding compliance with quality control requirements.

The QA/QC Manager will employ supporting personnel as required for execution of the Contractor's Quality Control Plan. These personnel will be Williams' personnel familiar with construction techniques for LTTD operations and inspection and observation procedures. Supporting personnel shall be thoroughly familiar with testing equipment which may be required as part of their inspection activities. Equipment supplied shall be accurately calibrated and properly employed. The supporting personnel shall answer directly to and be responsible to the QA/QC Manager. Support personnel shall provide all data and documentation required for completion of the Daily QC reports.

Williams' employees or their subcontractor personnel will perform all laboratory testing that may be required.

The QA/QC Manager will be responsible for holding weekly quality control meetings. As part of this meeting, QA/QC work accomplished, progress, and deficiencies (if any) will be discussed.

The Daily Production Report (Figure 15-1) and LTTD Roundsheet (Figure 15-2) will be used to record daily activities. Readings for the LTTD Roundsheet will be collected at 60 minute intervals from the Kaye data logger. These reports, supplemented with applicable testing data and subcontracted testing reports, will be compiled to make up the Daily QA/QC Report. These reports will be maintained at the job site. Additionally, Figure 15-3 shows an example of the log maintained for documenting AWFSOs.

At the completion of any work activity, the QA/QC Manager will perform a completion inspection and develop a punchlist of items which do not conform to the Scope of Work and provide the list to the Site Manager for corrective or follow-up actions. Once these items have been corrected, a follow-up inspection will be made to confirm that these items have been corrected. The completion punchlist will be incorporated into the Daily QA/QC Report along with the records of re-inspections and completion of activities.

The Sampling and Analysis Plan presented in Section 9.0 further discusses the specific plans, procedures and quality control work to be executed as part of the Production Operations phase of the project. Implementation and management of the Sampling and Analysis Plan shall be the responsibility of the QA/QC Manager.

FIGURE 15-1

Williams
Environmental
Services, Inc.

Daily Production Report

Client ______________________________ WES Project No. ______________

Tons Processed This Date ______________________ Date ______________

Hours of Operation

	Start	Stop	Hours		Start	Stop	Hours
1				11			
2				12			
3				13			
4				14			
5				15			
6				16			
7				17			
8				18			
9				19			
10				20			

Total Hours of Operation ______________ Fuel Usage: Start ______________

Average Tons/Hour ______________ Finish ______________

Total Tons to Date ______________ Moisture Content ______________

Time and Reasons for Downtime

1 ______________________________

2 ______________________________

3 ______________________________

4 ______________________________

5 ______________________________

6 ______________________________

7 ______________________________

8 ______________________________

9 ______________________________

10 ______________________________

11 ______________________________

12 ______________________________

13 ______________________________

14 ______________________________

15 ______________________________

16 ______________________________

17 ______________________________

18 ______________________________

19 ______________________________

20 ______________________________

WES Verification By ______________________

FIGURE 15-2

WILLIAMS ENVIRONMENTAL SERVICES, INC. -- TPU ROUNDSHEET

CLIENT:
DATE:
LOCATION:
WILLIAMS PROJECT NUMBER:

PARAMETER	TIME											
KILN TEMPERATURE (F)												
TRANSITION DUCT TEMP. (F)												
SOIL TEMPERATURE (F)												
BAGHOUSE TEMPERATURE (F)												
SCC TEMPERATURE (F)												
SCRUBBER SUMP TEMP. (F)												
SCRUBBER INLET TEMP. (F)												
BAGHOUSE DELTA P (In. H2O)												
I. D. FAN (AMPS)												
KILN DELTA P (in. H2O)												
DRUM R.P.M.												
CUMULATIVE SCALE READING												
BAGHOUSE DUST RATE (TPH)												
PRIMARY FUEL METER (In. H2O)												
BURNER SETTING (%V.O.)												
SECONDARY FUEL METER												
BURNER SETTING (%V.O.)												
pH												
SCC OXYGEN (%)												
CO (ppm)												
APC PURGE RATE (GPM)												
APC RECYCLE FLOWRATE (GPM)												

FIGURE 15-3

WILLIAMS ENVIRONMENTAL SERVICES, INC.
AWFSO EXCURSION LOG

CLIENT:
LOCATION:
DATE:
WILLIAMS PROJECT NUMBER:

PARAMETER	INSTRUMENT NUMBER	TIME	ACTUAL VALUE	AWFSO VALUE	WASTE FEED (ON/OFF)	DOWN TIME	CAUSE OF EVENT	CORRECTIVE ACTION	RECORD OF REPORT (YES/NO)	TIME OF APPROVAL TO RESTART

SECTION 16

REMEDIAL ACTION CONTINGENCY PLAN

16.1 GENERAL

The Remedial Action Contingency Plan presented in this section sets forth the requirements for responding to emergencies that could occur during implementation of the Woods Industries Site remedies.

This Plan presents a discussion of emergency recognition and prevention, emergency response procedures, lines of authority, and evacuation procedures which would be implemented in the event of an emergency. All on-site personnel involved with implementation of the remedial activities must be familiar with the Remedial Action Contingency Plan described herein, and the specific Health and Safety Plan. A detailed emergency response/contingency plan is outlined in Section 13 of the HASP.

16.2 GENERAL RESPONSE CONSIDERATIONS

The Operations Manager for the remedial contractor shall be responsible for directing emergency response operations discussed in this Remedial Action Contingency Plan.

Due to the nature of the site remedy for soil, the emergencies that may arise include fires involving the LTTD, and water-related incidents such as spills of wastewater, flooding, etc. The following procedures would be implemented in the event of an emergency.

<u>Spill Containment Team</u>

A Spill Containment Team shall be designated and will consist of on-site personnel who respond to soil treatment spills. The Spill Containment Team will be comprised of trained and qualified employees.

Off-Site Personnel

Off-site personnel who may become involved in an emergency at the site include representatives of local, state, or federal organizations offering response or support to the emergency. Prior to initiating site remedial activities, Williams will make arrangements with the appropriate agencies (fire department, police, spill contractor, etc.) for support and shall advise these authorities of the types of emergencies that may arise. Prior to implementation of the site remedy, a contact person at each agency will be established and the following information will be provided to each:

- Site-specific hazards;
- Site emergency procedures; and
- Decontamination procedures.

Federal Response Organizations

Site emergencies involving significant chemical releases will be coordinated with the appropriate federal response organizations. The National Response Center (NRC) in Washington, D.C., has been established under the National Contingency Plan (NCP) to activate federal response by a National Response Team(s) (for USEPA Region X). The OSC is responsible for ensuring that necessary response actions are taken to protect the public and environment from the effects of a chemical release. Many federal agencies with specific technical expertise are available to the OSC.

To aid the Operations Manager, site personnel, and the OSC in taking action in response to an emergency, a Remedial Action Contingency Plan decision list has been developed and is presented below:

REMEDIAL ACTION CONTINGENCY PLAN
WOODS INDUSTRIES SITE

Whenever there is an imminent or actual emergency situation at the Woods Industries Site, the following steps will be taken:

1. The emergency will be immediately reported to the Operations Manager.

2. The Operations Manager will assess the emergency and identify:

    - The name, location, and telephone number of the appropriate external emergency agency(ies);
    - The nature of the emergency;
    - The existence of hazardous conditions - fire, explosion, spill, etc.;
    - The amount of material involved or released; and
    - The extent to which evacuation should occur.

3. The Operations Manager will notify all personnel on-site and activate appropriate response (e.g., spill containment/fire fighting team). The site roster will be verified.

4. All work may be stopped and evacuation initiated if appropriate.

5. The Operations Manager (or designated alternate) will notify the following parties:

	Phone #'s
Williams' Health and Safety Officer	800/247-4030
Williams' Project Manager, Mark Fleri	800/247-4030
BNRR Project Manager, Bruce Sheppard	206/467-3382
Burlington Environmental Project Manager, David Eagleton	618/281-7173

6. The Operations Manager will call the external emergency agencies as may be necessary.

City :	
Fire Department	911, 509/248-2100
Police Department	911, 509/248-1010
County Health Department	509/575-4040
Washington State Police	509/575-2320
Washington State Spill Hotline	509/575-2491
Lynda Priddy (On-Site Coordinator and Project Coordinator Region X)	206/553-1987
Cathy Massimino (EPA Tech. Adv.)	206/553-4153
National Response Center	800/424-8802
Chemtrec	800/424-9300
Poison Control Center of Washington	800/732-6985

16.3 EMERGENCY RECOGNITION AND PREVENTION

During implementation of the site remedies, individual on-site personnel should be constantly alert for indication of potentially hazardous or unsafe situations or conditions. In addition, personnel must be aware of signs or symptoms in themselves or others that may indicate hazardous conditions or exposure. Timely recognition of potentially hazardous conditions can avert an emergency. Daily safety meetings will be held prior to initiation of work to discuss the potential hazards associated with the week's work tasks. Emergency procedures and rest/work cycles will be reviewed at the weekly safety meetings. In addition, problems observed during the previous week's work should be discussed and corrected, if possible.

16.4 EMERGENCY RESPONSE PROCEDURES

The response to an emergency starts with the notification of trouble and continued after the emergency through the preparation of equipment and personnel for the next potential emergency. The stages of emergency response consist of notification, emergency evaluation, response action, follow-up, and documentation. The stages of emergency response are presented and discussed below in logical order.

Notification

Upon discovering the emergency, the Operations Manager will be responsible for notifying other on-site personnel of the emergency. A predetermined internal audio communications device (siren, whistle) will be activated to notify personnel to stop work activities, to lower background noise (if possible), and to initiate emergency procedures.

The on-site emergency response personnel (e.g. Spill Containment Team) will be notified and informed by the Operations Manager of the following information.

- Equipment and personnel resources required for hazard mitigation;

- Where and when did it happen and to whom;

- What is the extent of the damage; and

- What form of aid or response is required.

Response

At this stage of emergency response, the Operations Manager will decide the type of action required based on the available information. The response action(s) is then implemented. The Operations Manager will also designate on-site personnel responsibilities in order to accomplish the response actions. Response actions may include the following:

1) Enforcement of the Buddy System

No one will enter the exclusion zone or hazardous area without a partner. Line-of-sight contact between rescue/response personnel and support will be maintained.

2) Allocate Resources

Along with the designation of on-site personnel to aid in the rescue/response operations, the Operations Manager will also allocate on-site equipment to be used in the rescue/response operation.

3) Request Aid

The Operations Manager will contact off-site personnel and/or agencies as required to aid in the rescue/response operation.

4) Control

The Spill Containment Team will bring the hazardous situation under complete or temporary control. The intent of control is to prevent the spread and impact of the emergency. In the event of a fire, the Operations Manager will immediately call the City of Yakima Fire Department and decide if attempts should be made by on-site personnel to control the fire depending upon the degree of the fire. In the event of a spill or chemical release, the Spill Containment Team will contain the spill and prevent further migration by absorbent pads.

5) Stabilize

The Operations Manager or designated alternate(s) will administer medical procedures as required to injured personnel (see Health and Safety Plan) and the cause of the emergency will be attended to, if possible (i.e., turn off leaking valve, shut-down treatment system).

6) Evacuate

On-site personnel will be moved a safe distance upwind of the hazardous area. The emergency incident will be monitored for significant changes. The designated public safety personnel (city and state police, fire department) will be contacted when there is a potential or actual need to evacuate the off-site population. Evacuation of off-site personnel is the responsibility of government authorities.

7) Follow-Up Review

Prior to resuming normal site activities, on-site personnel must review the cause of the emergency and aid in the revision of this Remedial Action Contingency Plan and/or the Contractor's Remedial Action Contingency Plan according to new site conditions and events that took place during emergency response. Emergencies or accidents that result in any fatalities or five or more hospitalizations must be reported to OSHA.

8) Equipment

In response to an emergency, equipment will be necessary to rescue victims, protect response personnel, and to mitigate hazardous conditions (e.g., contain spills). Table 16.1, provided at the end of this section, presents a list of basic on-site equipment and supplies for emergency response. This list will be updated during the Remedial Design to include special equipment that should be obtained depending upon specific conditions or emergencies that may arise during implementation of the site remedies. After an emergency, site equipment and supplies must be restocked, repaired, or replaced as necessary.

9) Documentation

The Operations Manager will be responsible for documenting the events of the emergency. Documentation of the emergency may be used to prevent reoccurrence of the emergency and as evidence for potential legal actions. Documentation may be accomplished by the use of bound field notebook and written transcripts of tape recordings made during the emergency.

Documentation of an emergency should include the following:

- Chronological history of the emergency;
- Facts pertaining to the incident when they become available;
- Names and titles of personnel involved;
- Actions taken, orders and instructions given and received, and decisions made by the Operations Manager and other on-site and off-site personnel; and
- Potential exposures of on-site personnel.

16.5 EVACUATION ROUTES

In the event of severe emergency (e.g., fire or explosion), normal site exit routes may become blocked. Consideration will be given to the following factors when developing alternate evacuation routes:

- Upwind locations;
- Accessibility of potential routes;
- The development of two or more routes;
- Equipment necessary to mark-out routes; and
- The mobility of site personnel wearing protective equipment.

16.6 REMEDIAL ACTION CONTINGENCY PLAN FOR THERMAL TREATMENT

The Contingency Plan will be activated whenever there is an imminent or actual threat to human health or the environment from fire, explosion, or release of hazardous waste or constituents. The decision to implement the contingency plan rests with the emergency coordinator, but all other members of the site remediation team will also be familiarized with what constitutes "imminent or actual danger" in case they ever have to decide whether or not to contact the emergency coordinator. The following list is representative of emergency situations which could arise. It is not intended to be comprehensive or indicative of every emergency which could arise.

POSSIBLE EMERGENCY SITUATIONS

1. Fire or Explosion

   a. Fire damages thermal treatment unit;
   b. Fire spreads to waste stockpile;
   c. Fire spreads to control room;
   d. Use of water could result in contaminated run-off; and
   e. An explosion occurs, damaging equipment and causing a a material release.

2. Spill or Material Release

   a. Spill can be contained on-site, but potential exists for soil contamination;
   b. Material release was dispersive; potential soil contamination beyond "hot zone" or off-site, risk of inhalation or ingestion of contaminated soil; and
   c. Material release reached surface water; risk of soil and water traveling off-site.

EMERGENCY RESPONSE PROCEDURES

1) Notification

The person discovering the emergency situation will notify the emergency coordinator (either the Operations Manager or the Chief Operator). The emergency coordinator for the fire and police departments, local ambulance squads, hospital, and federal, state, and local agencies which would require notification will be posted in the field office and in the control room. Site personnel will be notified by voice instructions or two way radio. The emergency coordinator will designate an employee to wait by the facility entrance to direct outside emergency response teams to the proper area.

2) Assessment of Hazards

The emergency coordinator will be initially responsible for determining the direct and indirect hazards to human health and the environment. He will consider the nature of the release (to air, water, or soil), the quantity of material released, the approximate affected area, the potential for off-site exposure, and the potential for additional releases in the immediate future. This information will be transmitted to site personnel involved in the emergency response effort, management, and local emergency response agencies.

If the emergency coordinator determines that evacuation of local areas may be advisable, the appropriate local authorities will be notified, giving the name and telephone number of the reporter, name and address of the facility, time and type of incident, name and quantity of materials involved (to the extent known), the extent of any injuries, and the possible hazards to human health or the environment outside the facility.

3) Control Procedures

Potential emergencies include: fire or explosion, spills or material releases, or floods. Natural disasters such as hurricanes or tornadoes could fall into one of these categories depending upon the severity of the incident. During an emergency, the emergency coordinator must take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, recur, or spread to other hazardous waste storage areas to the facility. The emergency coordinator will have the authority to stop processes and operations, collect and contain released waste, and remove or isolate waste.

4) Fire or Explosion

Fire fighting efforts will be concentrated on containing a fire in the "exclusion zone" or preventing a fire at another part of the facility from reaching the equipment and material located in the "exclusion zone".

The following procedures will be followed in responding to a fire or explosion in the "exclusion zone" at the site remediation project:

- waste transfer operations will immediately cease.
- if the fire involves the thermal treatment equipment, emergency shutdown procedures will be initiated immediately.
- all Williams personnel not actively involved in fighting the fire will report to the office to be accounted for. Visitors will also report to the office.
- injured persons will be removed and emergency medical treatment will be secured.
- if the Operations Manager determines that outside assistance is needed, the coordinator or his designee will call the fire department.

Site evacuation may be necessary in the event of a major fire or explosion. All personnel will receive training in evacuation procedures and exit routes from their usual work areas.

5) Spills or Material Release

Given the nature and physical characteristics of the material being treated, there is virtually no potential for a catastrophic material release (as in an explosion which would disperse material over a wide area). Instead, any releases would be more likely to occur during material handling and would not ordinarily require activation of the Contingency Plan because they would involve limited quantities of material that would not pose a threat to human health or the environment. For completeness, the recommended procedures for responding to material releases are included in this section.

The most likely scenario for a release of the contaminated soil would occur during transport from the excavation to the staging area. Spilled material will be collected using the front-end loader and shovels (as needed) and will be returned to the contaminated soil stock pile for future processing.

Another possibility for a material release prior to treatment would occur in transferring soil from the staging area to the feed hopper. Again, the spilled soil would be collected with a front-end loader or shovels, as appropriate, and would be put into the feed hopper for thermal treatment.

The soil leaving the treatment unit is expected to be non-hazardous and will be stored in the verification holding area until chemical analyses confirm this assumption. If a batch of treated soil does not meet specifications, it will immediately be recycled through the treatment system. In transferring the material from the storage area back to the feed hopper, the potential exists for a material release. As with the untreated material, spills would be collected and placed in the feed hopper.

6) Flood

It is unlikely that the thermal treatment equipment, contaminated soil stockpile, or the clean soil storage pile would be subject to flooding. If the working areas were threatened by floodwaters during the site remediation, operations would be suspended, the contaminated stockpile would be compacted (if necessary), and portable equipment and vehicles would be moved to higher ground. The clean soil storage pile is not of concern as it contains only uncontaminated material.

7) Emergency Equipment

Table 16.1 lists the emergency equipment that will be maintained at the site. Emergency equipment will be inspected on a weekly basis. First aid supplies will be available at the office and will include the following items:

- bandage materials (adhesive strips, gauze pads and rolls, adhesive tape, butterfly bandages);

- antibacterial ointments;

- small splints; and

- aspirin.

Half face respirators with organic vapor canisters will be maintained in the control room. One will be provided for each employee; additional respirators will be maintained for visitors and emergency response personnel. Full face respirators will also be kept in the control room. Gloves and Tyvek™ suits will be provided for emergency use by visitors or emergency response agencies. Cotton flame-resistant clothing will be provided for work near hot surfaces.

TABLE 16.1
ON-SITE EMERGENCY EQUIPMENT

Item	Quantity	Physical Description	Location	Capabilities
Fire Extinguishing System	8	Portable general purpose fire extinguisher	Control room, office, decontamination trailer	First response to small fires
	1	35 gpm water system	Contaminant reduction zone	Supplemental water for fire fighting
Spill Control Equipment	2	Hand shovel	Control room	Dedicated solely to handling contaminated soil and treated residues
	1	Front-end loader	Contaminant reduction zone	Transferring large quantities of spilled soil or ash
Internal Communications Equipment				
Two Way Radio	3 sets	Hand-held, battery operated	Control room	Local, communication beyond voice range up to 500 ft.
External Communications Equipment				
Telephone	2	Standard rotary dial or push-button telephone	Control room, office	Summon local emergency response agencies

Item	Quantity	Physical Description	Location	Capabilities
	1	Mobile phone		Summon local emergency response agencies
Decontamination Equipment	12 minimum	Plastic drop cloths	Decontamination trailer	Protect surfaces from contaminated materials
	2	Wash tubs	Decontamination trailer	To hold disposed items
First Aid Equipment	1	First aid kit	Control room	Contains bandages, antibacterial ointments, small splints, aspirin, syrup of ipecac; for first response to injury
Protective Clothing and Equipment	1 per employee plus spares	Half-face respirators with canisters for organic vapors	Control room	Personal protection from low to moderate levels of organic vapors
	6	Full-face respirators with canisters for organic vapors	Control room	Personal protection from moderate to high levels of organic vapors
	6 suits*	Tyvek suits	Control room	To cover clothing, protection from dermal exposure to chemicals

Item	Quantity	Physical Description	Location	Capabilities
	2 sets	Cotton flame-proof clothing	Control room	To cover clothing, protection from hot surfaces
	12 pair minimum*	Outer gloves	Control room	To cover hands, protection from dermal exposure to chemicals
*Employee suits and gloves maintained separately				

APPENDIX A
PERFORMANCE TEST PLAN
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

SUBMITTED TO:

BURLINGTON NORTHERN RAILROAD
2000 FIRST INTERSTATE CENTER
999 THIRD AVENUE
YAKIMA, WASHINGTON 98104-1105

PREPARED FOR:

WILLIAMS ENVIRONMENTAL SERVICES, INC.
2075 WEST PARK PLACE
STONE MOUNTAIN, GEORGIA 30087

January 27, 1995
FOCUS PROJECT NO. 059312

PREPARED BY:

FOCUS ENVIRONMENTAL, INC.
9050 EXECUTIVE PARK DRIVE
SUITE A-202
KNOXVILLE, TENNESSEE 37923

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ACRONYMS AND ABBREVIATIONS

acfm	actual cubic feet per minute
APC	air pollution control
ASTM	American Society for Testing and Materials
AWFSO	Automatic Waste Feed Shutoff
BEI	Burlington Environmental, Inc.
BIF	Boilers and Industrial Furnaces
Btu	British thermal unit
CEM	continuous emissions monitor
CEMS	continuous emissions monitoring system
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CO	carbon monoxide
DRE	destruction and removal efficiency
EPA	Environmental Protection Agency
Focus	Focus Environmental, Inc.
gpm	gallons per minute
gr/dscf	grains per dry standard cubic foot
HCl	hydrogen chloride
hp	horsepower
ID	induced draft
lbs/hr	pounds per hour
LTTD	low temperature thermal desorption
mg/kg	milligrams per kilogram
M5	EPA Method 5
M23	EPA Method 23
MMT	EPA Multi-Metals Train
OCL	organochlorine
PCDDs	polychlorinated dibenzo-p-dioxins
PCDFs	polychlorinated dibenzofurans
POHC	principle organic hazardous constituent
p,p'-DDT	1,1'-(2,2,2-Trichloroethylidene)bis[4-chlorobenzene]
ppm$_v$	parts per million by volume
psig	pounds per square inch, gauge
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
TEQ	Total Equivalent 2,3,7,8-TCDD
TCDD	tetrachlorinated dibenzo-p-dioxins
USEPA	United States Environmental Protection Agency
WAC	Washington Administrative Code
w.c.	water column
Williams	Williams Environmental Services, Inc.

1.0 INTRODUCTION

As part of a Removal Action being performed by Burlington Northern Railroad, pursuant to a Removal Action Order issued by the U.S. Environmental Protection Agency (USEPA) in March, 1993, on-site treatment of approximately 19,000 tons of soil will be conducted at the Woods Industries site in Yakima, Washington. The project will be conducted using the Williams Environmental Services, Inc. (Williams) low temperature thermal desorption (LTTD) system.

A Thermal Desorption Work Plan (revised, March 14, 1994) has been prepared by Williams that describes the proposed plan for executing the entire project. This performance test plan has been prepared by Focus Environmental, Inc. to describe the test objectives, process equipment design features, process operating parameters, sampling procedures, analysis procedures, and monitoring procedures that will be used during the performance test program. Attachment 1 is a Quality Assurance Project Plan (QAPP) that describes quality assurance procedures that will be used during the performance test.

The soils are primarily contaminated with organochlorine (OCL) pesticides (hexachlorobenzene, p,p'-DDT, and dieldrin). Initial removal action activities conducted on-site included the demolition of buildings in January and February, 1993. From April to September, 1993, some contaminated soils were excavated and placed in temporary storage areas. Soils with high concentrations of OCL pesticides were stored in rolloff boxes.

The major mechanical components of the LTTD system consist of a soil pretreatment system (optional), soil feed system, a thermal desorber (rotary dryer-type), treated soil handling system, baghouse, induced draft (ID) fan, thermal oxidizer, quench, packed bed scrubber, stack, liquid-phase activated carbon units, auxiliary fuel supply system, and a process control, monitoring, and interlock system.

Following mobilization and erection of the LTTD system, the unit will undergo a shakedown period to confirm the proper operation of all mechanical, electrical, and instrument systems and to establish appropriate operating parameters. The system will initially be started up using clean soils until the proper operation of all system components are confirmed.

After proper mechanical, electrical, instrument, and process operations are confirmed, the system will initiate processing of contaminated materials. The objective of this phase of the startup will be to establish the optimum process conditions for treating the contaminated materials. A pretest consisting of one run will be conducted during this period to prepare for the performance test. The process operating conditions and sampling and analysis procedures for conducting the pretest run will be the same as the procedures that will be used during the performance test. The shakedown period will be limited to 360 hours unless additional hours are approved by USEPA Region X. The 360 hours includes only that time when contaminated soil is being fed to the system. A breakdown of the hours includes approximately 168 hours for certification of the CEM system, with the remaining 192 hours for shakedown and pretest of the unit. The system will be limited to treating no more than one third of the contaminated soils during the shakedown and performance test period.

Following the receipt of the pretest results, a performance test will be conducted which will consist of three replicate sampling runs. The goals of the performance test will be to demonstrate the ability of the LTTD system to reduce the concentrations of OCL pesticides in the soil and to meet applicable air emission control requirements. The performance test will be deemed successful if the requirements outlined below are met:

- The concentrations of organochlorine (OCL) pesticides (aldrin, alpha-BHC, beta-BHC, gamma-BHC, chlordane, p,p'-DDE, p,p'-DDD, p,p'-DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, methoxyclor, and toxaphene) and metals (As, Hg, and Pb) in the treated soil meets those specified in Washington State Model Toxic Control Act, Residential Method B. The cleanup goals are listed in Table 1-1.
- The concentration of 2,3,7,8-TCDD (TEQ) in the treated soil meets the agreed upon limits listed in Table 1-1.
- The ambient concentrations of OCL pesticides (aldrin, alpha-BHC, beta-BHC, gamma-BHC, chlordane, p,p'-DDE, p,p'-DDD, p,p'-DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, methoxyclor, and toxaphene) resulting from stack gas emissions must meet WAC maximum Acceptable Source Impact Levels (ASIL). Ground-level concentrations are calculated based on a dispersion factor resulting from stack height, stack gas velocity, and stack gas temperature. The allowable stack gas concentrations listed in Table 1-2 are based on the EPA SCREEN model and estimated stack gas data. More accurate allowable concentrations will be calculated when stack gas data from the performance test are available. If necessary, evaluation of stack gas emissions would be based upon site-specific modeling and/or 24-hour WAC Maximum Allowable Ground-Level Concentrations.
- The ambient concentrations of indicator metals (As, Hg, and Pb) resulting from stack gas emissions must meet WAC Maximum Allowable Annual Ground-Level Concentrations. In addition, ambient concentrations of any remaining metal of concern (Be, Cd, Cr, Ni, Sb, Ba, Se, Ag, Tl) must meet appropriate risk specific dose (RSD)(for carcinogens) or reference air concentrations (RAC)(for noncarcinogens) as specified by 40 CFR 266, Appendix IV and V. The estimated allowable stack gas concentrations are listed in Table 1-2.
- A 99.99 percent destruction and removal efficiency (DRE) of a principal organic hazardous constituent (POHC) is achieved per 40 CFR 264.343. A 99.99% DRE will be demonstrated by measuring the concentration of hexachlorobenzene in the feed soil and stack gas.

- The concentration of particulates in the stack gas is less than 0.03 grains per dry standard cubic feet (gr/dscf), corrected to 7 percent oxygen.
- The emission rates of hydrogen chloride (HCl) and chlorine (Cl_2) in the stack gas are controlled to meet the ambient air impact guidelines described in the Boilers and Industrial Furnaces (BIF) guidelines described in 40 CFR 266.107. In addition, if the feed rate of total chlorine would result in an emission rate of greater than 4 lbs/hr of hydrogen chloride (HCl) in the stack gas, 99% removal of HCl will be demonstrated.
- The concentration of carbon monoxide (CO) in the stack exhaust gas is less than 100 ppm_v, based on a 60 minutes rolling average.
- Risk evaluation results related to stack gas emissions including products of incomplete combustion (PICs) performed according to the methodology provided in the Ambient Air Quality Impact Report shows risk within or below the range of acceptable risk.

In addition to the above requirements, the stack gas will be sampled and analyzed for total polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (PCDDs/PCDFs), volatile organic compounds and semi-volatile organic compounds that are potential products of incomplete combustion (PICs). Total PCDDs/PCDFs will be calculated by adding all congeners from the tetra- through the octa- PCDD/PCDF groups. In addition, total equivalent (TEQ) 2,3,7,8 TCDD based on the relative potency of the isomers in accordance with USEPA guidelines will be calculated for use in risk evaluation. Risk evaluation will be made consistent with the methodology used in the Ambient Air Quality Impact Report (AAQIR) for the Woods Industries Site prepared by Burlington Environmental, Inc.

The performance test will consist of three replicate sampling runs. In the test, soil feed and operating conditions are designed to achieve the following goals:

- Establish maximum soil mass feed rate (target 30 tons/hr)
- Demonstrate minimum thermal desorber exit soil temperature (target 700° F)
- Demonstrate minimum thermal oxidizer exit gas temperature (target 1700° F)
- Demonstrate minimum Air Pollution Control (APC) system recycle water flow rate
- Demonstrate minimum APC system purge rate (target 12 gpm)
- Demonstrate minimum packed bed scrubber recycled water pH (target 4)
- Establish control limits for the LTTD and Air Pollution Control (APC) system operating parameters
- Establish maximum stack gas velocity by correlating the velocity to ID fan amperage
- Establish minimum oxygen concentration in the stack gas.

Stack sampling protocols for the performance test are summarized as follows:

- Particulates and HCl by EPA Method 5 (BIF Method 0050)
- OCL Pesticides and Semi-Volatile organics by EPA Modified Method 5 (SW-846 Method 0010).
- Volatile organics by EPA Volatile Organics Sampling Train (VOST SW-846 Method 0030)
- Metals by EPA Multiple Metals Train (EPA Draft Method 29)
- PCDDs/PCDFs by EPA Method 23 (EPA Method 23)
- Continuous emissions monitoring (CEM) for CO (EPA Method 10) and O2 (EPA Method 3A).

Specific references used in preparing the performance test plan include:

- Washington Administrative Codes 173-30-740(1)(c).
- Williams Environmental Services, Inc., "Thermal Desorption Work Plan", Woods Industries Site, Yakima, Washington..
- Burlington Environmental, Inc, "Ambient Air Quality Impact Report", Woods Industries Site, Yakima, Washington.
- USEPA, "Methods Manual for Compliance with the BIF Regulations", EPA/530-SW-91-010, December, 1990.
- USEPA, "Standards for Miscellaneous Treatment Units", Subpart X, 40 CFR 264.
- USEPA, "New Source Performance Standards, Test Methods and Procedures", Appendix A, 40 CFR 60.
- USEPA, "Test Methods for Evaluating Solid Waste", Third Edition, 1986, revised 1990.
- American Society for Testing and Materials, "Annual Book of ASTM Standards", latest annual edition.

Attachment 1 presents the Performance Test Quality Assurance Project Plan.

Table 1-1. Soil Cleanup Goals

Sampling Parameters	Soil Cleanup Goal[a] (mg/kg)
Pesticides	
Aldrin	0.0588
alpha-BHC	0.159
beta-BHC	0.556
gamma-BHC (lindane)	0.769
Chlordane	0.769
p'p'-DDD	4.17
p'p'-DDE	2.94
p'p'-DDT	2.94
Dieldrin	0.0625
Endrin	24
Heptachlor	0.222
Heptachlor epoxide	0.11
Hexachlorobenzene	0.625
Methoxychlor	400
Toxaphene	0.909
Dioxins/Furans (2,3,7,8-TCDD TEQ)[b]	0.001
Metals	
Arsenic	20
Lead	250
Mercury	1

[a] WAC 173-30-740 (1)(c)(iii), based on total metals concentrations

[b] BNRR/USEPA agreement

Table 1-2. Allowable Air Emission Limits

Sampling Parameters	Acceptable Source Impact Level (ASIL)[a] [Annual Average] (µg/m3)	Allowable Stack Gas Emission[b] [Annual Average] (µg/m3)
Pesticides		
Aldrin	0.0002	0.77
alpha-BHC[c]	0.64	2473.60
beta-BHC[c]	0.64	2473.60
gamma-BHC (lindane)[c]	0.64	2473.60
Chlordane	0.0027	10.44
p'p'-DDD	0.1	386.50
p'p'-DDE	(d)	–
p'p'-DDT	0.01	38.65
Dieldrin	0.0002	0.77
Endrin[c]	0.12	463.80
Heptachlor	0.00077	2.98
Heptachlor epoxide	0.000384	1.48
Hexachlorobenzene	0.002	7.73
Methoxychlor[c]	13.32	51481.80
Toxaphene	0.003	11.60
PCDDs/PCDFs		
2,3,7,8-TCDD (TEQ)	0.00000003	0.000116
Metals[e]		
Arsenic	0.00023	0.89
Beryllium	0.00042	1.62
Cadmium	0.00056	2.16
Chromium	0.000083	0.32
Silver[c]	0.12	463.80
Selenium[c]	0.28	1082.20
Nickel[c]	1.32	5101.80
Mercury[f]	0.3	1159.50
Lead[f]	0.09	347.85
Thallium[f]	0.5	1932.50
Barium[f]	50	193250.00
Antimony[f]	0.3	1159.50

Notes:

[a] (WAC) Chapter 173-460, Controls for New Sources of Toxic Air Pollutants

[b] Based on a dispersion factor [SCREEN Model] of 3,865

[c] Converted from a 24-hour average to an annual average by multiplying with a factor of 0.4

[d] By-product of DDT; unit risk factors needed to calculate regulatory limits were not available

[e] The more restrictive metals from either the Washington ASIL or the Reference Air Concentrations from 40 CFR 266, Appendix IV are listed

[f] Reference Air Concentrations from 40 CFR 266, Appendix IV

2.0 LTTD STARTUP/SHAKEDOWN

2.1 LTTD STARTUP

The LTTD will undergo a comprehensive startup and shakedown period prior to the performance test. During this period, the LTTD subsystem will be thoroughly tested to verify that all design criteria are met and that each subsystem, and the unit as a whole, will perform in a consistent and predictable manner. Also, during this period, the LTTD will be tested to determine various performance parameters in preparation for conducting the performance test.

2.2 LTTD SHAKEDOWN

Following the startup phase, a two-phase shakedown of the LTTD operation will be conducted. In the first phase, uncontaminated soils will be fed into the LTTD to evaluate system performance. When performance is deemed acceptable by Williams and Burlington Environmental, Inc. (BEI), the second phase of the shakedown will commence. Contaminated soils will be fed to bring the LTTD to a point of readiness for the pretest. A maximum of 360 hours of operating time on contaminated soil will be allowed during the Shakedown including the Pre-performance test run.

2.3 SHAKEDOWN CONDITIONS

The anticipated LTTD shakedown operating conditions are listed in Table 2-1. The range in shakedown operating conditions is intentionally broad to account for the expected operating envelope during this period. Minimum and maximum conditions are not outside of the range expected to be established by the performance test. Performance test operating conditions are targeted in a narrower range (See Table 3-25) to demonstrate minimum and maximum conditions. Treated soil will be sampled and analyzed to meet the cleanup goals as described in Table 1-1. One pre-performance test (pretest) run will be performed following the shakedown period. The pretest run conditions will be identical to the test runs during the performance test, and samples for the run will be collected and analyzed according to the methods described in Section 3.3. When analytical data from the pretest indicate that the LTTD will perform as planned, the performance test will be initiated. The anticipated time between the pretest and performance test as shown in Figure 3-11 is approximately 1 1/2 weeks.

Table 2-1. Planned Shakedown Operating Conditions [a]

Parameter	Test Conditions [b]
Thermal desorber soils feed rate (tons/hr)	20 – 30
Thermal desorber gas outlet temperature (°F)	250 – 450
Thermal desorber treated soil exit temperature (°F)	700 – 1,100
Thermal desorber pressure (inches w.c.)	−0.01 – −0.05
Propane feed rate (scf/hr)	As required
Thermal desorber combustion air flow rate (acfm)	9,000 – 13,000
Thermal oxidizer combustion air flow rate (acfm)	10,000 – 15,000
Thermal oxidizer gas outlet temperature (°F)	1,700 – 2,100
Quench outlet temperature (°F)	160 – 200
Packed bed scrubber recycle water pH	4 – 10
Baghouse differential pressure (inches w.c.)	1 – 10
ID fan current (amps)	(c)
APC recycle water flow rate (gpm)	(c)
APC purge rate (gpm)	4 – 16
CEMs carbon monoxide (ppm_V)	< 100

[a] All values are estimated ranges.

b See Table 3-26 for proposed data reduction method (instantaneous, rolling averages)

[c] Determined during clean soil shakedown, approved by Agency

3.0 PERFORMANCE TEST PLAN

3.1 OVERVIEW

The performance test plan includes the following components:

- Performance test objectives
- Detailed engineering description
- Sampling procedures
- Analytical procedures
- Monitoring procedures
- Performance test schedule
- Detailed performance test protocol
- Operating conditions for the emissions control equipment
- Allowable operating limits objectives
- Quality assurance/quality control procedures
- Performance test reports.

3.2 LTTD PERFORMANCE

Based upon the results of engineering analyses and experience in operating the LTTD, Williams believes that the conditions specified in this performance test plan will be adequate to ensure compliance with specified soil cleanup levels and all applicable guidance and regulation of process emissions.

A performance test of the LTTD system will be conducted to demonstrate the ability of the LTTD to effectively remove contaminants from the soil and meet stack gas emission limits. The LTTD system will be operated for 1 to 4 hours prior to the performance test on contaminated materials in order to establish equilibrium conditions within the system. Highly-contaminated soils, representing "worse-case" feed properties that are stored in rolloff boxes will be blended with other contaminated soils and used during the performance test. This combination of soils will therefore represent a worse-case, representative mixture of soils to be treated in the post-performance-test period.

3.3 DETAILED ENGINEERING DESCRIPTION

The LTTD will be used to thermally treat pesticides-contaminated soil. The LTTD process will treat soils at temperatures in the range of 700°F to 1100°F in order to volatilize pesticides in the soil. A detailed engineering description of the major equipment is presented in this section.

The primary thermal treatment component of the LTTD system is a natural gas or propane fired, countercurrent rotary dryer (thermal desorber) with internal flights. Soil is fed into the thermal desorber where the internal flights lift and spill the soil through the hot gas stream. Treated soil from the thermal desorber exits into a pugmill where it is water-cooled. The cooled soil drops onto a stacking conveyor and is conveyed to a temporary stockpile. Periodic grab samples of the treated soil are collected from the stacking conveyor. The grab samples are composited and analyzed.

The APC system consist of a baghouse, thermal oxidizer, quench, and packed bed scrubber. Entrained particulates in the thermal desorber offgas are removed by the baghouse. Volatilized pesticides from the thermal desorber offgas are destroyed in the thermal oxidizer. Following the oxidizer, a wet APC system is used to remove HCl and Cl_2 present in the off-gases. A block flow diagram of the LTTD system is shown in Figure 3-1. The block flow diagram begins where soil feed and auxiliary fuel are introduced into the thermal desorber and then traces the off-gases through the APC system.

Fugitive emissions from the thermal desorber and baghouse are controlled by maintaining negative pressure in this portion of the LTTD system. Following the ID Fan, in the positive pressure portion of the system, the system is designed to be leak-tight. Visual observation by the operator is made as part of the system inspection to assure that no fugitive emissions occur.

3.3.1 Manufacturer's Name and Model Number

The LTTD system was designed by Williams and is designated with the model number TPU #4. The thermal desorber, baghouse, quench, and packed bed scrubber components were manufactured according to Williams' specifications and do not have model numbers. The ID fan is manufactured by Northern Blower Exhaust Fan. The thermal desorber burner and thermal oxidizer burner systems were manufactured by Hauck.

3.3.2 Type of Thermal Desorber

The LTTD system consists of a soil pretreatment and feed system, countercurrent thermal desorber, treated soil cooling system, a baghouse, ID fan, thermal oxidizer, an adiabatic saturating water quench system, packed bed scrubber, and stack. Auxiliary systems include the fuel system, cooling water recirculation and treatment systems, and the process control, monitoring, and interlock system.

3.3.3 Linear Dimension and Cross-Sectional Areas of Thermal Desorber and Thermal Oxidizer

The internal dimensions of the thermal desorber are 8.5 feet in diameter by 40 feet long. Internal dimensions of the thermal oxidizer are 11 feet in diameter by 63 feet long, with a total volume of 5889 cubic feet.

3.3.4 Description of Soil Feed Systems

Feed soil is passed through a bar grate to the feed hopper of the apron feeder by a front end loader. The sized material is fed onto a belt conveyor by the apron feeder. The belt conveyor discharges the metered soil to a constant velocity belt conveyor equipped with a weigh cell for feed rate monitoring. The weigh belt conveyor discharges to the thermal desorber via the inlet breeching.

3.3.5 Description of the Auxiliary Fuel Systems

Propane will be used as the auxiliary fuel for maintaining the temperature requirements of both the thermal desorber and the thermal oxidizer. Liquid propane will be stored in a portable tank for use in the thermal desorber and thermal oxidizer burners.

3.3.6 Capacity of the Prime Mover

The LTTD system prime mover is an industrial radial blade centrifugal fan which produces a negative pressure in the thermal desorber and baghouse and a positive pressure in the thermal oxidizer, quench, packed bed scrubber, and stack. The fan, a Northern Blower Exhaust Fan, is rated at 250 horsepower (hp) and has a nominal flow rate of 35,000 acfm.

3.3.7 Burner Design

Both the thermal desorber and thermal oxidizer burner systems are manufactured by Hauck and are equipped with centrifugal blowers to supply ambient air to the burner for combustion of propane to maintain the temperature requirements of the thermal desorber and the thermal oxidizer.

Thermal Desorber Burner

The thermal desorber burner is equipped with a 50 hp Hauck combustion air blower and has a thermal output rating of 49 MM Btu/hr.

Thermal Oxidizer Burner

The thermal oxidizer burner is equipped with a 100 hp Hauck combustion air blower and has a thermal output rating of 97 MM Btu/hr.

3.3.8 Construction Materials

Materials of construction for major equipment are listed in Table 3-1.

3.3.9 Controls, Monitoring, and Interlock System

Controls System

The control room for the LTTD is dedicated to a mobile trailer. The control room contains controllers, indicators, and recorders for the control, monitoring, and recording of the key process variables including flow, temperature, pressure, and level for the entire LTTD and auxillary systems. Three sides of the control room are glass paneled so that process parameters can be monitored and field operations can be viewed simultaneously. Motors and pumps are started and stopped via start-stop pull buttons located on the panel of the control room trailer.

Monitoring System

Critical operating parameters are monitored to ensure that the LTTD is operated in compliance with allowable operating limits. Key operating parameters are interlocked with the soil feed system to automatically shut off soil feed if parameters deviate from the established operating limits. This interlock system prevents restart of the system until operating parameters are restored within the acceptable range and process alarms have been cleared.

In addition to the interlocks related to environmental controls, a combustion interlock system is provided to assure safe operation of the burners in the thermal desorber and thermal oxidizer. This system is described in Section 6.3 of the Workplan prepared by Williams Environmental, Inc.

A Kaye Digistrip 4 Plus Validator continuously logs soil feed rate; baghouse dust feed rate; treated soil discharge temperature; thermal desorber, thermal oxidizer, quench, and packed bed scrubber exit gas temperatures; baghouse differential pressure; APC recycle water flow rate and purge rate; packed bed scrubber recycle water pH; thermal desorber soil discharge end hood pressure; ID fan current; and stack gas carbon monoxide and oxygen concentrations. Descriptions and specifications for this recorder are included in the Appendix I of the thermal desorption work plan.

The Continuous Emission Monitoring (CEM) system is discussed separately later in this section.

Interlock System

Interlocks are initiated based on an instantaneous process value or on a combination of instantaneous and rolling averages generated by the control system. Where rolling averages are used, the control center accumulates the most recent data for the accumulation period for the desired process parameter and computes the arithmetic average of those values. As each additional one-minute data point for the process parameter is collected, the least recent one-minute of data in the accumulation period is discarded, and a new average is computed. Thus, a new rolling average data point is computed each minute.

Table 3-2 summarizes Automatic Waste Feed Shut off (AWFSO) conditions. A discussion of the AWFSO conditions is presented below:

Thermal Desorber Soil Feed Rate High: The instantaneous soil feed rate is continuously monitored each minute and the 60 minute rolling average is continuously calculated and recorded. The soil feed will be shut off if the rolling average allowable feed rate is exceeded or if the instantaneous maximum feed rate is exceeded.

Baghouse Dust Feed Rate High: The baghouse dust feed rate is continuously monitored each minute and the 60 minute rolling average is continuously calculated and recorded. The soil feed will be shut off if the rolling average allowable baghouse dust feed rate is exceeded or if the instantaneous maximum dust feed rate is exceeded.

Thermal Desorber Pressure High: The pressure in the thermal desorber is continuously monitored and maintained at a negative value to minimize fugitive emissions. Soil feed to the desorber will be instantaneously shut off if the pressure exceeds the high set point.

Thermal Desorber Exit Soil Temperature Low: Removal of organics from the soil is controlled by the temperature and residence time of the soil in the thermal desorber. The thermal desorber exit soil temperature is monitored continuously each minute. The soil feed rate will be automatically shut off if the 20-minute rolling average soil temperature falls below its minimum allowable value or if the temperature falls below its instantaneous minimum allowable value. Neither the 20-minute rolling average nor the instantaneous limitations will be in effect in the first 20 minutes of operation after startup.

Thermal Desorber Exit Gas Temperature High: The thermal desorber exit gas temperature is continuously monitored each minute and maintained in an operating range which ensures organics removal efficiency as well as protection of the downstream baghouse and ID Fan. If the exit gas temperature exceeds the high set point an instantaneous shut off of soil feed will occur automatically at 450° F.

Thermal Desorber Exit Gas Temperature Low: The thermal desorber exit gas temperature is continuously monitored each minute and maintained in an operating range which ensures organics removal efficiency as well as protection of the downstream baghouse and ID Fan. If the exit gas temperature falls below the low set point an instantaneous shut off of soil feed will occur automatically at 250°F.

Thermal Oxidizer Exit Gas Temperature Low: The thermal oxidizer exit gas temperature is continuously monitored each minute and maintained in an operating range which ensures high organics destruction efficiency as well as protection of downstream equipment. If the exit gas temperature falls below its instantaneous minimum allowed value, soil feed to the thermal desorber will be automatically shut off.

Thermal Oxidizer Exit Gas Temperature High: The thermal oxidizer exit gas temperature is continuously monitored each minute and maintained in an operating range which ensures high organics destruction efficiency as well as protection of downstream equipment. If the exit gas temperature exceeds the high set point, soil feed to the thermal desorber and all auxiliary fuel to the LTTD will be instantaneously shut off.

Quench Exit Gas Temperature High: The temperature of the gas exiting the quench is continuously monitored each minute and maintained below a safe limit to ensure proper quench operation and to provide thermal protection for the quench and downstream equipment. If the quench exit gas temperature exceeds the high set point, soil feed and all auxiliary fuel to the LTTD will be instantaneously shut off.

Stack Gas Carbon Monoxide High: The concentration of carbon monoxide (CO) in the stack gas is continuously monitored each minute, corrected to 7% Oxygen and the 60-minute rolling average of the corrected value is continuously monitored and recorded. If the 60-minute rolling average exceeds the high set point for CO concentration, soil feed will be automatically shut off.

Stack Gas Oxygen Low: The concentration of oxygen (O2) in the stack gas is continuously monitored each minute. If the O2 concentration falls below the minimum allowable limit, soil feed will be automatically shut off.

ID Fan Current High: The ID fan current is continuously monitored to ensure that the fan is operating properly and has the necessary headroom to respond to fluctuations in the system pressure profile. ID fan current will be correlated to combustion gas exit velocity during the shakedown period and the performance test. The operating limit will initially be established during the shakedown on clean soil and approved by the agency prior to start-up with contaminated soil. The final limit will be based upon the performance test. The ID fan setpoint for post performance test operation will be set at the highest run-average amperage demonstrated for the 3 performance test runs. If the ID fan current exceeds the allowable maximum value, soil feed to the thermal desorber will be automatically shut off.

APC Recycle Water Flow Rate Low: The APC system recycle water flow rate is continuously monitored each minute to ensure performance of the packed bed scrubber. The operating limit will initially be established during the shakedown on clean soil and approved by the agency prior to start-up with contaminated soil. The final limit will be based upon the performance test. If the APC recycle water flow rate falls below the allowable minimum limit, soil feed will be automatically shut off.

APC Purge Rate Low: The APC system purge rate is continuously monitored each minute to ensure continuous removal of dissolved solids. If the APC purge rate falls below the allowable minimum flow rate, soil feed will be automatically shut off.

Baghouse Differential Pressure Low: Differential pressure is the key indicator of a properly operating baghouse. Fabric rupture in the baghouse will be indicated by a low differential pressure across the baghouse. Soil feed will be instantaneously shut off if the differential pressure falls below the set point.

Packed Bed Scrubber Recycled Water pH Low: pH of the recycled water from the scrubber system is continuously monitored each minute and adjusted to ensure adequate acid gas absorption. In addition, the 20-minute rolling average will be calculated and recorded. If either the rolling average or instantaneous pH of the recycled water falls below the allowable minimum value, soil feed to the thermal desorber will be automatically shut off.

3.3.10 Stack Gas Monitoring

The continuous emission monitoring (CEM) system consists of sample probes, sample delivery and conditioning apparatus, and a gas analyzer to provide real time stack gas monitoring. Continuous monitoring of stack gas emissions will be conducted for CO and O2. CO concentration will be measured by a non-dispersive infrared analyzer. O2 will be measured using paramagnetic technology. The CEM system will report data to various control room instruments and the process variable recorder and will activate elements of the LTTD interlock/AWFSO system.

3.3.11 Offgas Treatment Equipment

The LTTD gas conditioning and treatment equipment is shown in Figure 3-1 and includes the following equipment:

- Baghouse
- ID fan
- Thermal oxidizer
- Quench
- Packed bed scrubber
- Stack.

Particulates that are entrained in the thermal desorber exit gas are captured in the baghouse. The baghouse utilizes a pulse jet cleaning system to dislodge captured particulate from the fabric bag surfaces. Dislodged particulates fall by gravity to a hopper which utilizes a screw conveyor to transfer the solids to the hot zone of the thermal desorber. The baghouse solids will be heated to approximately 800°F by mixing with soil discharged from the thermal desorber.

Baghouse exit gases flow through the ID fan to the thermal oxidizer which combusts the organics present in the gas stream. The thermal oxidizer is designed to provide a high temperature oxidative environment with sufficient gas turbulence and residence time (approximately 2 seconds at 1800°F) to achieve high organic destruction efficiencies.

The thermal oxidizer exit gas is cooled to approximately 175°F and humidified to its saturation point by direct contact with recycled and fresh water sprays in the quench. The purpose of the quench process is to cool and condition the gas stream to make it amenable to acid gas absorption in the downstream packed bed scrubber.

The packed bed scrubber removes acid gases from the gas stream exiting the quench. The packed bed scrubber utilizes packing material and water sprays to provide a large liquid surface area for absorption of acid gases into the liquid phase. The pH of the recycled liquid stream is continuously monitored and adjusted with an alkaline (sodium hydroxide) solution. Dissolved solids are continuously purged from the system to minimize any carryover of particulate generating materials.

Scrubber exit gases are discharged to a stack measuring 60 inches in diameter and 70 feet tall. The stack is equipped with one CEM port, two sets of sampling ports, two sampling platforms, and a ladder to facilitate emission testing.

3.3.12 Location of Temperature, Pressure, and Flow Indicating and Control Devices

The LTTD control room contains controllers, indicators, and recorders for the control, monitoring, and recording of the key process variables including flow, temperature, pressure, and level for the entire LTTD and auxiliary systems. Three sides of the control room are glass paneled so that process parameters can be monitored and field operations can be viewed simultaneously. Motors and pumps are started and stopped via start-stop pull buttons located on the panel of the control room trailer. The control room is insulated and can be heated or cooled as necessary. A positive pressure is maintained inside the control room to minimize dust infiltration.

Table 3-3 summarizes the key instrumentation on the LTTD system including pressure, temperature, and flow monitoring devices. Figure 3-2 shows the approximate location of the major process instruments and monitoring devices. Instrument tag references refer to Table 3-2.

Soil Feed Rate (WE-170)

The soil feed rate to the thermal desorber is measured by a weigh cell located on the soil feed belt conveyor. Instantaneous one-minute values and the 60-minute rolling average feed rate are continuously recorded.

Baghouse Dust Feed Rate (TBD)

The baghouse dust feed rate to the thermal desorber will be measured by a mass flow meter located in the baghouse dust feed conveyor. Instantaneous one-minute values and the 60-minute rolling average feed rate are continuously recorded.

Thermal Desorber Exit Gas Temperature (TIC-310)

The thermal desorber exit gas temperature is continuously monitored by a thermocouple element. Instantaneous values of exit gas temperature are continuously recorded.

Thermal Desorber Pressure (PI-330)

A pressure sensor located in the thermal desorber constantly monitors gas pressure. The thermal desorber gas pressure is continuously recorded in the control room.

Thermal Desorber Exit Soil Temperature (TE-112)

The thermal desorber exit soil temperature is continuously monitored by a thermocouple element. Instantaneous one-minute values and the 20-minute rolling average temperature are continuously recorded.

Thermal Oxidizer Exit Gas Temperature (TIC-518)

The thermal oxidizer exit gas temperature is continuously monitored by a thermocouple element. The instantaneous one-minute temperature is continuously recorded.

Quench Outlet Gas Temperature (TI-819)

The quench outlet gas temperature is continuously monitored by a thermocouple element.

Baghouse Inlet Gas Temperature (TI-313)

A thermocouple in the baghouse outlet ducting continuously monitors the baghouse outlet temperature.

Baghouse Differential Pressure (PDI-633)

The differential pressure across the baghouse is continuously monitored by a pressure sensor. If a low differential pressure event occurs, the AWFSO system is activated and the event is recorded.

APC System Water Supply Pressure (PE-739)

Fresh water supply pressure is continuously monitored by a pressure sensor to ensure the flow of water for gas cooling and scrubbing.

APC System Recycle Water Flow Rate (FT-700, FT-701, FT-706, FT-707)

The APC system recycle flow rate is continuously monitored with a flow meter and recorded. If the scrubber water flow rate falls below the minimum allowable limit, the AWFSO system is activated and the event is recorded.

APC Purge Rate (FI-704)

The APC system purge rate is continuously monitored with a flow meter and recorded. If the system purge rate falls below the minimum allowable limit, the AWFSO system is activated and the event is recorded.

ID Fan Current (II-6622, II-6623)

Amperage to the ID fan is continuously monitored with an ammeter and recorded. If the ID fan amperage exceeds the maximum allowable limit, the AWFSO system is activated and the event is recorded.

Packed Bed Scrubber Recycle pH (AIC-753)

A pH meter continuously measures the pH of the packed bed scrubber water. Instantaneous and 20-minute rolling average values are continously recorded. If the pH fall below the minimum allowable limit, the AWFSO system is activated and the event is recorded.

Oxygen Concentration (AIC-851C)

A stack gas sample is continuously withdrawn through a sample extraction and conditioning system and transported to an oxygen analyzer utilizing paramagnetic technology. O2 concentrations are monitored continuously each minute and recorded. If the instantaneous O2 concentration falls below the established minimum allowable limit, the AWFSO system is activated and the event is recorded.

Carbon Monoxide Concentration (AIC-851A)

A stack gas sample is continuously withdrawn through a sample extraction and conditioning system and transported to a non-dispersive infrared analyzer for analysis. CO concentrations are monitored continuously each minute, corrected to 7% O2 and the 60-minute rolling average corrected CO concentration is recorded. The CO analyzer and process variable recorder are located in the control room. If the 60-minute rolling average exceeds the maximum allowable limit, the AWFSO system is activated and the event is recorded.

3.4 SAMPLING, ANALYSIS, AND MONITORING PROCEDURES

3.4.1 Sampling Locations and Procedures

The locations where performance test samples are collected from the LTTD system are shown schematically in Figure 3-3.

The sampling equipment and the procedures for collecting samples at each location are summarized in Table 3-4. Sampling frequency and reference methods are also included. Additional details regarding each sampling location are discussed below. The numbers following each heading refer to the sampling locations shown in Figure 3-3 and in Table 3-4.

Feed soil (1)

The feed soil sample will be collected from the conveyor belt entering the thermal desorber. Feed soil sampling procedures are described in Table 3-5.

Treated Soil (2)

Treated soil samples will be collected from the stacking conveyor after the point of addition of blowdown water. Treated soil sampling procedures are described in Table 3-6.

Stack Gases (3)

Stack sampling will be conducted at the stack during each performance test run. The exhaust stack is designed for isokinetic sampling. Figures 3-4 and 3-5 show the planned stack configuration and sampling point locations. The following sampling systems will be used during the performance test:

- An EPA Method 5 (BIF Method 0050, Figure 3-6) sampling train will be used to collect particulates, HCl, and Cl_2. Details of the sampling method are presented in Table 3-7.
- An EPA Method 23 (EPA Method 23, Figure 3-7) sampling train will be used to collect PCDDs/PCDFs. Details of the sampling method are presented in Table 3-8.
- An EPA Multiple metals (EPA Draft Method 29, Figure 3-8) sampling train will be used to collect metals (As, Be, Cd, total Cr, Ni, Sb, Ba, Pb, Hg, Se, Ag. amd Tl). Details of the sampling method are presented in Table 3-9.
- An EPA Modified Method 5 (SW-846 Method 0010, Figure 3-9) sampling train will be used to collect OCL pesticides and semi-volatile organic compounds. Details of the sampling method are presented in Table 3-10.
- An EPA Volatile Organic Sampling Train (VOST SW-846 Method 0030, Figure 3-10) will be used to collect volatile organic compounds. Details of the sampling method are presented in Table 3-11.

All stack sampling activities will be performed simultaneously during each test run.

Continuous Emissions Monitor (4)

Continuous monitoring of the stack gases will be conducted during the performance test for CO and O2. Table 3-12 briefly discusses the stack gas continuous emissions monitoring procedures.

Scrubber Water Blowdown (5)

Scrubber water blowdown samples will be collected from a sample tap in the scrubber water blowdown line. Scrubber water blowdown sampling procedures are described in Table 3-12A.

3.4.2 Analytical Procedures

The analyses planned for each performance test sample are listed in Table 3-13. The analytical procedures and reference methods for these analyses are summarized in Table 3-14. Detailed procedures for preparing and analyzing the collected samples are presented in Tables 3-15 through 3-24.

3.5 PERFORMANCE TEST SCHEDULE

3.5.1 Schedule

A general schedule for the test is shown in Figure 3-11. As the time approaches to conduct the actual performance test, a more detailed schedule will be developed. Williams will notify EPA Region X at least 2 weeks prior to commencement of the performance test.

3.5.2 Duration of Each Performance Test

One performance test is planned, consisting of three replicate sampling runs. Each sampling run is expected to last about 3 to 4 hours. Prior to the actual sampling time, the thermal desorber will be fed soil for a period of 1 to 4 hours before each sampling run is initiated. This will establish steady operation at process test conditions. For planning purposes, a twelve hour period has been assumed for operations at performance test conditions during each test day. This schedule includes contingencies for unanticipated delays during test execution. According to the present schedule, it is planned to conduct testing over a three day period. However, unanticipated mechanical problems with the LTTD or sampling equipment could extend this period.

3.5.3 Quantity of Soil to be Treated

The amount of soil treated during the shakedown pretest and performance test will be limited to a maximum of one-third of the contaminated site soils. Up to 360 tons of pesticides-contaminated soils will be treated during each test run (total of 12 hours/run), for a maximum of 1080 tons for the entire performance test. The LTTD will be operating approximately 12 hours per day during the performance test.

3.6 DETAILED PERFORMANCE TEST PROTOCOL

3.6.1 Soil Characterization

The soil to be treated is contaminated with OCL pesticides, primarily with p,p'-DDT, hexachlorobenzene, and dieldrin. The soils with the highest concentrations are stored in five roll-off boxes. These soils representing approximately 10% of the total feed planned during the performance test will be blended (1/10) with other contaminated soil to form about 1080 tons of material to be used during the performance test. Further detail regarding soil characterization is provided in the Work Plan prepared by Williams Environmental, Inc.

3.6.2 POHC Selection Rationale

Hexachlorobenzene has been selected as the POHC to demonstrate 99.99% DRE during the performance test. Hexachlorobenzene and p,p'-DDT are the most prevalent contaminants on site. At the level of hexachlorobenzene that is anticipated to be present in the performance test feed soil mixture, no spiking of POHC will be required to demonstrate 99.99% DRE. An example calculation is provided in Appendix S of the Work Plan.

Hexachlorobenzene has been selected as the POHC because it is the most difficult contaminant to treat. It is also the highest ranking (No. 31 - 33) POHC, according to the University of Dayton's Thermal Stability Index, among all the contaminants on site. p,p'-DDT is ranked 175 - 178 in the Thermal Stability Index. The University of Dayton's Thermal Stability Ranking is described in the "EPA Guidance on Setting Permit Conditions and Reporting Trial Burn Results", EPA/625/6-89/019, January 1989.

3.6.3 Performance Test Protocol and Operating Conditions

The performance test will be conducted to demonstrate the LTTD system's treatment capabilities. All testing will follow EPA Methods. The performance test protocol has been developed to optimize the testing such that the test will demonstrate all critical parameters anticipated as the allowable operating limits.

The performance test will demonstrate the following capabilities of the LTTD system:

- Demonstrating 99.99% DRE for hexachlorobenzene
- Maximum soil feed rate
- Compliance with soil cleanup criteria established for the site
- Compliance with particulates, HCl, and Cl_2 emission standards
- Compliance with WAC guidelines for the contaminants of concern
- Compliance with CO emissions concentration standards.
- Compliance with acceptable health based limits for emissions based on the risk assessment/air quality document.

Table 3-25 summarizes the planned operating conditions (temperatures, flow rates, pressures, etc.) for the performance test. The table presents anticipated ranges, maximum, or low conditions planned for the testing. It is anticipated that some degree of fluctuation will occur during the performance test just as in normal operation.

3.6.4 Thermal Desorption Temperature Ranges

The planned normal operating temperatures for the thermal desorber and thermal oxidizer are listed in Table 3-25. Since some degree of fluctuation will occur during operations, it is anticipated that a temperature range will be established as an allowable operating condition. Table 3-26 lists the anticipated operating conditions for the LTTD, with the minimum and maximum operating temperatures for the thermal desorber.

3.6.5 Soil Feed Rates

A contaminated soil feed rate of 20 to 30 tons/hr is planned for the LTTD. The feed rate is dependent on the moisture concentration, handling characteristics, and pre-treatment requirements of the contaminated soil. The maximum feed rate will be established during shakedown and confirmed during the performance test.

3.6.6 Stack Gas Velocity Indicator

A maximum stack gas velocity will be established during the shakedown period and confirmed during the performance test. The stack gas velocity will be measured with a pitot tube according to EPA Method 5. The corresponding amperage on the ID Fan will be used as an indication of stack gas velocity.

3.6.7 Organic Chlorine Content

Assuming an average pesticide concentration of 3,150 ppm in the contaminated soil, and 60% chlorine concentration in the pesticide, at 30 tons/hr of waste feed, the maximum anticipated chlorine feed rate will be 116.6 lbs/hr.. Stack gases will be sampled according to EPA Method 5 and analyzed using Ion chromatography. Compliance with ambient air impact guidelines described in the BIF regulations (40 CFR 266.107) will be demonstrated. The total organic chlorine content of the feed soil will be measured during the performance test and the % removal of hydrogen chloride will be measured to show compliance with the required 99%. The organic chlorine content of the soil during normal operations is anticipated to be about one-half the content demonstrated during performance testing.

3.7 DESCRIPTION AND PLANNED OPERATING CONDITIONS FOR THE EMISSIONS CONTROL EQUIPMENT

The components of the emission control equipment are described in Section 3.3.11. The operating condition ranges for normal operation and the performance test are shown in Table 3-25.

During normal operation, the system temperatures, flow rates and pressure drops will typically fluctuate. These fluctuations are also expected to occur during the performance test.

3.8 PERFORMANCE TEST OBJECTIVES

The objective of this section is to propose those parameters for which Williams requests operating limits to be established. During the performance test, each of these parameters will be monitored and recorded. If the required stack emissions and soil treatment performance standards are achieved, Williams requests that operating parameter limits be established within the range of conditions that are demonstrated during the performance test.

Table 3-26 summarizes the expected allowable operating condition limits. The following sections present a discussion of each anticipated allowable operating parameter limit.

3.8.1 Control Parameter Categories

Williams anticipates that allowable operating limits will be established for a number of process control parameters based on the process conditions demonstrated during the performance test. Control parameters are grouped into three categories:

- Group A parameters are continuously monitored and are interlocked with the automatic soil feed shut off system. Interruption of soil feed will be automatic if Group A limits are exceeded. Because these parameters may fluctuate during normal operation, rolling averages may be used in triggering the soil feed shut off interlocks. The rolling averages are used to prevent unnecessary interruption of system operations and minimize short-term fluctuations in system performance.

  Most Group A parameter limits will be established from the performance test operating data, and will be used to ensure that the LTTD system operating conditions are not significantly less rigorous than those demonstrated during the performance test. These parameters are called Group A-1 parameters. During the testing periods, interlocks for Group A-1 parameters will be set at lower or higher values than those listed in Table 3-25 to allow for a sufficient operating range during the performance test.

  For the other Group A parameters, allowable operating limits are established based on operational safety and good operating practice considerations rather than on the performance test operating conditions. These parameters are referred to as Group A-2 parameters. An example of a Group A-2 parameter is the maximum quench exit gas temperature.

- Group B parameters do not require continuous monitoring and are not interlocked with the automatic soil feed shut off system. Operating records are required to ensure that these parameters are not exceeded. No Group B parameter limits wil be established for this project. All parameters will either be Group A or C.

- The Group C parameter limits are set independently of performance test conditions. These limits are based on equipment manufacturers' design and operating specifications and are thus considered good operating practice. Group C parameters do not require continuous monitoring and are not interlocked with the automatic soil feed shut off system.

In the discussion of each allowable operating limit parameter below, an indication is given of the appropriate control parameter category. The discussion also defines how the limit for each parameter will be established.

3.8.2 Group A-1 Parameters

Maximum Soil Feed Rate

The feed rate of soil will be approximately equal during each replicate test run. The maximum allowable rolling-average soil mass feed rate will be determined based on the average over all test runs of the highest 60-minute average value for each test run. In addition, the instantaneous feed rate data (one-minute values) will be evaluated to establish the range of the data. The maximum instantanous soil mass feed rate will be determined based upon the average over all test runs of the highest instantaneous value for each test run. During normal production operation, soil feed will be shut off if the maximum soil feed rate value is exceeded, based on a 60-minute rolling average or if the instantaneous maximum level is exceeded.

Maximum Dust Feed Rate

Baghouse dust is returned to the thermal desorber on an intermittent basis. The rate of return will be measured continuously during the performance test. The maximum allowable rolling-average baghouse dust feed rate will be determined based on the average over all test runs of the highest 60-minute average value for each test run. In addition, the instantaneous dust feed rate data will be evaluated to establish the range of the data. The maximum instantanous baghouse dust feed rate will be determined based upon the average over all test runs of the highest instantaneous value for each test run. During normal production operation, soil feed will be shut off if the maximum baghouse dust feed rate value is exceeded, based on a 60-minute rolling average or if the instantaneous maximum level is exceeded.

Minimum Thermal Desorber Exit Soil Temperature

One performance test consisting of three replicate runs will be conducted at approximately the same thermal desorber exit soil temperature. Based on successful completion of the testing, the allowable operating limits should specify a minimum thermal desorber rolling-average exit soil temperature based on the average over all test runs of the lowest 20-minute average value for each test run. Soil feed will be automatically shut off if the thermal desorber exit soil temperature falls below the minimum allowable value based on a 20-minute rolling average limit. In addition an instantaneous minimum temperature will be established based upon a review of the instantaneous temperature data from the performance test. The minimum instantanous exit soil temperature will be determined based upon the average over all test runs of the lowest instantaneous value for each test run. Neither the 20-minute rolling average nor the instantaneous limits will be activated during the first 20 minutes of operation after startup. Desorber off-gas temperature will be used as an alternative A-1 parameter during this first 20 minutes of operation after startup. Initially this alternate temperature limit will be set at 250°F. The final alternate limit will be based upon the performance test.

Minimum Thermal Oxidizer Exit Gas Temperature

The destruction efficiency of pesticides in the stack gas is a function of the temperature of the combustion gases in the thermal oxidizer. Therefore, Williams expects a minimum thermal oxidizer temperature to be set based on the time-weighted average during all test runs of the performance test. During normal operation, soil feed will automatically be shutoff based upon an instantaneous minimum allowable temperature.

Maximum Stack Gas Carbon Monoxide Concentration

The concentration of CO in the stack gas is an indication of the combustion efficiency of the thermal oxidizer. A high CO concentration may result in poor DRE. Therefore, a maximum CO concentration of 100 ppm_v corrected to 7% O2 in the stack gas is proposed, based on a 60-minute rolling average.

Minimum APC Recycle Water Flow Rate

A minimum APC recycle water flow rate will be established based upon the time-weighted average of the test data. An automatic shut off of the soil feed will be activated during normal operation based upon an instantaneous minimum allowable recycle water flow.

Packed Bed Scrubber Recycle Water pH

The pH of the packed bed scrubber water will be normally be maintained between 4 and 10. High pH will result in excessive use of caustic and low pH may result in equipment corrosion. The minimum 20-minute rolling average and instantaneous pH will be established during the performance test. The minimum 20-minute rolling average limit will be set based upon the average over all test runs of the lowest 20-minute average value for each test run. The instantaneous minimum limit will be set based upon the average over all test runs of the lowest instantaneous value for each test run. An AWFSO will be instantaneous if the pH falls below either the 20-minute rolling average limit or the instantaneous minimum allowable limit during normal operation.

Minimum APC Purge Rate

The optimum APC purge rate will be evaluated during the LTTD shakedown. The minimum APC purge rate will be established during the performance test based upon the time-weighted average during all the runs of the performance test.

Maximum ID Fan Current

A maximum stack gas velocity will be established during the performance test. The stack gas velocity will be measured with a pitot tube according to EPA Method 5. The corresponding amperage on the ID Fan will be used as an indication of stack gas velocity. The maximum ID Fan amperage will be established during the performance test based upon the time-weighted average of the three test runs.

3.8.3 Group A-2 Parameters

Thermal Desorber Pressure High

The thermal desorber will be maintained below atmospheric pressure at any time soil is being fed into the system in order to control fugitive emissions. Williams anticipates a maximum allowable limit on the thermal desorber pressure of -0.01 inches of water column. This condition will not necessarily be demonstrated during the performance test, but should be set based on good operating practice. Soil feed will be automatically shut off if the thermal desorber pressure exceeds -0.01 inches of water column.

Maximum Thermal Desorber Exit Gas Temperature

The temperature of the thermal desorber exit gas will not exceed 450 °F during the performance test. An instantaneous (AWFSO) will be set at a temperature of 450°F. This condition will not be demonstrated during the performance test.

Thermal Desorber Exit Gas Temperature Low

The pesticide removal efficiency of the LTTD is a function of the soil temperature, not the exit gas temperature. However, a low thermal desorber exit gas temperature may be an indication of a problem within the burner management system. Under normal operation soil feed to the LTTD will be shut off instantaneously if the exit gas temperature falls below the low set point of 250°F.

Thermal Oxidizer Exit Gas Temperature High

In order to protect downstream APC system, a high thermal oxidizer exit gas temperature will instantly cut-off the soil feed and auxiliary fuel to the LTTD system. This high temperature is based on manufacturer's specification and will not be demonstrated during the performance testing. An instantaneous AWFSO will be set at a temperature of 2100° F.

Baghouse Differential Pressure Low

A low baghouse differential pressure during normal operations may be an indication of bag failure. If bag failure is not detected, there is potential of fouling downstream equipment with entrained particulates. In order to protect downstream equipment, a low baghouse differential pressure will instantly shut off the soil feed and all auxiliary fuel to the LTTD. It is anticipated that the minimum limit will be established at 1 inch w.c. It is expected that the test will be run near this limit but not actually demonstrated. If the baghouse differential pressure exceeds 2 inches w.c. during the performance these the limit will be established based upon the time-weighted average during all test runs.

Quench Exit Gas Temperature High

A maximum quench exit gas temperature allowable limit of 250 °F is anticipated based on equipment protection considerations and good operating practice for the quench. This value will not be demonstrated during the performance test, for equipment protection reasons. The soil feed and all auxiliary fuel to the LTTD will be immediately shut off if the quench exit gas temperature exceeds 250° F.

Minimum Stack Gas Oxygen Concentration

A minimum oxygen concentration will be established at 3%. An automatic shut off of the soil feed will be activated during normal operation based upon an instantaneous minimum allowable oxygen concentration. Based on the rusults of the testing, this parameter may be re-evaluated.

Burner System Failure

The burner system is continuously monitored during normal operations. A burner system failure indicated at the burner management system will automatically shut off the soil feed system.

ID Fan Failure

ID Fan failure is indicated by a low amperage and will automatically shut off the soil feed and all auxiliary fuel to the LTTD instantly.

Power Failure

In the unlikely event of a total power failure, the soil feed system will automatically be shut off. All auxiliary fuel to the LTTD will be shut off instantly.

3.8.4 Group B Parameters

There are no group B parameters to be established.

3.8.5 Group C Parameters

APC System Water Supply Pressure

The APC system water supply pressure will be maintained above 20 psig to ensure that water will be available for cooling and/or scrubbing purposes.

3.9 QUALITY ASSURANCE AND QUALITY CONTROL PROCEDURES

The Performance Test Quality Assurance Project Plan is presented in Attachment 1 to the Performance Test Plan.

3.10 PERFORMANCE TEST RESULTS

A draft performance test report will be submitted to EPA Region X within 18 days after completion of the performance test, subject to timely receipt of laboratory analysis. A final performance test report containing the results of the performance test will be submitted to EPA Region X within 60 days after completion of the performance test, subject to the timely receipt of the complete laboratory analysis package. Operation during the post performance test period is discussed in Section 4.0.

The performance test report will contain the following information:

- Concentration of OCL pesticides (aldrin, alpha-BHC, beta-BHC, gamma-BHC, chlordane, p,p'-DDE, p,p'-DDD, p,p'-DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, methoxyclor, and toxaphene) in the feed and treated soils.
- Concentration and mass of the 18 parameters listed in Table 1-1, (excluding PCDD/PCDF), in the scrubber water.
- Concentration of OCL pesticides (aldrin, alpha-BHC, beta-BHC, gamma-BHC, chlordane, p,p'-DDE, p,p'-DDD, p,p'-DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, methoxyclor, and toxaphene) in the stack gas.
- Computation of DRE of hexachlorobenzene.
- Concentration of total PCDDs/PCDFs (tetra through octa congeners) in the stack gas and associated calculated total equivalent concentration of 2,3,7,8 - TCDD.
- Concentration of total metals (As, Be, Cd, Cr. Ni, Sb, Ba, Pb, Hg, Se, Ag and Tl) in the feed and treated soil.
- Mass emission of metals (As, Be, Cd, Cr. Ni, Sb, Ba, Pb, Hg, Se, Ag and Tl) in the stack gas.
- Computation of particulate, HCl, and Cl_2 emissions.
- Concentration of volatile and semi-volatile organic compounds detected in the stack gas.
- All operating records related to A1 and A2 operating conditions summarized to justify suggested operating limits.
- Other information specified in the performance test plan.
- All associated QA data as described by the QAPP (Attachment 1).
- A risk assessment addendum reflecting the results of the performance test.

Table 3-1. Materials of Construction of Major Equipment

Component	Construction Materials
Thermal Desorber	Carbon steel Stainless steel
Thermal Oxidizer Refractory	Ceramic fiber modules
Quench	Stainless Steel
Baghouse	P-84 fabric bags Carbon steel shell
Packed Bed Scrubber	FRP/PPE
ID fan	Carbon steel
Stack	Carbon steel

Table 3-2. Automatic Waste Feed Shutoff Conditions

Control Parameters[a]	Instrument[a] Number	Cutoff Condition	Value	Comments
Soil feed rate (ton/hr)	WQI-170	High	> 30	60-minute rolling average AWFSO
Soil feed rate (ton/hr)	WQI-170	High	(b)	Instantaneous AWFSO
Baghouse dust feed rate (tons/hr)	TBD	High	> 3	60-minute rolling average AWFSO
Baghouse dust feed rate (tons/hr)	TBD	High	(b)	Instantaneous AWFSO
Thermal desorber pressure (inches w.c.)	PI-330	High	> -0.01	Instantaneous AWFSO
Thermal desorber exit soil temperature (°F)[c]	TI-112	Low	< 700	20-minute rolling average AWFSO
Thermal desorber exit soil temperature (°F)[c]	TI-112	Low	(b)	Instantaneous AWFSO
Alternative measure of performance initial 20 minutes			(d)	
Thermal desorber exit gas temperature (°F)	TIC-310	High	> 450	Instantaneous AWFSO
Thermal desorber exit gas temperature (°F)	TIC-310	High-high	> 500	Instantaneous VO
Thermal desorber exit gas temperature (°F)	TIC-310	Low	< 250	Instantaneous AWFSO
Thermal oxidizer exit gas temperature (°F)	TIC-518	Low	< 1,700	Instantaneous AWFSO
Thermal oxidizer exit gas temperature (oF)	TIC-518	High	> 2,100	Instantaneous AWFSO
Quench exit gas temperature (°F)	TI-819	High	> 250	Instantaneous AWFSO
Stack gas carbon monoxide (ppmv)	AIC-851A	High	> 100	60-minute rolling average AWFSO
Stack gas oxygen (%)	AIC-851C	Low	< 3	Instantaneous AWFSO
ID Fan current (amp)	II-6622,6623	High	(d)	Instantaneous AWFSO
APC recycle water flow rate	FT-700,701 FT-706,707	Low	(d)	Instantaneous AWFSO
APC purge rate (gpm)	FI-704	Low	(d)	Instantaneous AWFSO
Baghouse differential pressure (inches w.c.)	PDI-633	Low	< 1	Instantaneous AWFSO
Packed bed scrubber recycled water pH	AIC-753	Low	(b)	20-minute rolling average AWFSO
Packed bed scrubber recycled water pH	AIC-753	Low	< 4	Instantaneous AWFSO
ID Fan failure	II-6622,6623	-	-	Instantaneous AWFSO
Burner system failure	NA	(e)	-	Instantaneous AWFSO
Power failure	NA	(f)	-	Instantaneous AWFSO

Notes:

a See Figure 6-1 of the Thermal Desorption Work Plan for locations of major process instruments

b Determined during performance test

c Limits not in effect during first 20 minutes of operation

d Determined during clean soil shakedown, approved by agency, verified during performance test

e Burner management system flame out indication

f Programmable logic controller power failure indication

Table 3-3. Major Process Instruments

Monitored Parameter (Location)	Instrument[a] Number	Measuring[b] Device	Measurement[c] Frequency	Recording[c] Frequency	Calibration Frequency	Testing[d] Frequency
Thermal Desorber						
Soil feed rate	WE-170	Weigh cell	Continuous	Continuous *	Monthly	Weekly
Baghouse dust rate	TBD	Flowmeter	Continuous	Continuous *	Monthly	Weekly
Thermal desorber exit gas temperature	TIC-310	Thermocouple	Continuous	Continuous *	Annual	Weekly
Thermal desorber pressure	PI-330	Pressure sensor	Continuous	Continuous *	Quarterly	Weekly
Thermal desorber exit soil temperature	TE-112	Thermocouple	Continuous	Continuous *	Annual	Weekly
Thermal oxidizer						
Thermal oxidizer exit gas temperature	TIC-518	Thermocouple	Continuous	Continuous *	Annual	Weekly
APC System						
Quench exit gas temperature	TI-819	Thermocouple	Continuous	Continuous *	Annual	Weekly
Baghouse inlet gas temperature	TI-313	Thermocouple	Continuous	Continuous*	Quarterly	Weekly
Baghouse differential pressure	PDI-633	Pressure sensor	Continuous	Continuous*	Quarterly	Weekly
APC system water supply pressure	PE-739	Pressure sensor	Continuous		Quarterly	Weekly
APC recycle water flow rate	FI-700/701 FI-706/707	Flowmeter	Continuous	Continuous*	Annual	Weekly
APC purge rate	FI-704	Flowmeter	Continuous	Continuous *	Annual	Weekly
ID fan current	II-6622/6623	Ammeter	Continuous	Continuous *	Annual	Weekly
Packed bed scrubber recycle pH	AIC-753	pH meter	Continuous	Continuous*	Monthly	Weekly
Stack gas CEM						
Oxygen	AIC-851C	Paramagnetic Technology	Continuous	Continuous*	Daily/Quarterly	Weekly
Carbon Monoxide	AIC-851A	Non-Dispersive Infrared Analyzer	Continuous	Continuous *	Daily/Quarterly	Weekly

* - Recorded via strip charts

a See Figure 3-2 for locations of major process instruments

b Type of actual sensing device used to generate signal

c Monitoring and recording funtions are integrated with the control system

d Testing of related waste feed cutoff system and/or alarms. See Section 7.0 for details of alarm and waste feed cutoff system testing.

Table 3-4. Performance Test Sample Collection Locations, Equipment, and Methods

Location	Sample Name	Sampling Location	Sampling Equipment	Sample Size	General Procedure/Frequency	Reference a Method
1	Feed soil (metals, OCL pesticides, heating value, moisture, ash, total choride)	Feed Conveyor	4-ounce scoops, 8-ounce glass jars 2-gallon bucket, ceramic pestle	8-ounce (4)	Grab sample every 15 minutes and place in 2-gallon bucket; fill four 8-ounce glass jars from well mixed composite in 2-gallon bucket at the end of each run.	SW-846, Chapter 9
2	Treated soil (metals, OCL pesticides, dioxins/furans)	Stacking Conveyor	4-ounce scoops, 8-ounce glass jars 2-gallon bucket, ceramic pestle	8-ounce (4)	Grab sample every 15 minutes and place in 2-gallon bucket; fill four 8-ounce glass jars from well mixed composite in 2-gallon bucket at the end of each run.	SW-846, Chapter 9, Method 8290 for dioxins/furans
3A	Stack gas M5	Stack Port	EPA M5 sampling train modified for collection of HCl/Cl_2	Two-hour sample	Collect integrated sample for particulates, HCl/Cl_2, and moisture; measure stack gas velocity, pressure and temperature, collect bag samples for oxygen and carbon dioxide.	EPA Methods 1 through 5; SW-846 Method 0050
3B	Stack gas M23	Stack Port	EPA M23 sampling train	Minimum 3 dry standard cubic meters	Collect integrated sample for PCDDs/PCDFs, and moisture; measure stack gas velocity, pressure and temperature; collect bag samples for oxygen and carbon dioxide.	EPA Methods 1 through 5 and Method 23
3C	Stack gas MM5	Stack Port	EPA MM5 sampling train	Minimum 3 dry standard cubic meters	Collect integrated sample for OCL pesticides, semivolatile organics, and moisture; measure stack gas velocity, pressure and temperature; collect bag samples for oxygen and carbon dioxide.	EPA Methods 1 through 5; SW-846 Method 0010
3D	Stack gas MMT	Stack Port	EPA multi-metals sampling train	Minimum 1.25 dry standard cubic meters	Collect integrated sample for metals and moisture; measure stack gas velocity, pressure and temperature; collect bag samples for oxygen and carbon dioxide.	EPA Methods 1 through 5; BIF Guidance Draft Method 29

Table 3-4. Performance Test Sample Collection Locations, Equipment, and Methods

Location	Sample Name	Sampling Location	Sampling Equipment	Sample Size	General Procedure/Frequency	Reference a Method
3E	Stack gas VOST	Stack Port	EPA VOST sampling train	At least 20 minutes per tube pair at selected sampling rate	Collect four pairs of sorbent tubes for volatile organics during each run.	SW-846 Method 0030
4	Stack gas CEMS	Stack Port	Continuous emissions monitoring system	Continuous	Continuously monitor stack gas for carbon monoxide and oxygen	EPA Methods 10 & 3A, BIF Guidance
5	Scrubber Blowdown	Tap in Pipeline	4 liter glass bottle 1 liter glass bottles (Teflon-lined lids)	1 liter (3) (Each run)	Collect a 500 ml grab sample every 30 minutes and transfer to the 4 liter glass bottle Fill the 1 liter sample bottles from the 4 liter bottle at the end of each run	ASTM E 300-86, Sections 23 & 24

a "EPA Method" refers to New Source Performance Standards, Test Methods and Procedures, Appendix A, 40 CFR 60.
"SW-846" refers to Test Methods for Evaluating Solid Waste, Third Edition, 1986, Revised 1990.
ASTM" refers to American Society for Testing and Materials, Annual Book of ASTM Standards, Annual Series
"BIF Guidance" refers to Methods Manual for Compliance with the BIF Regulations, EPA/530-SW-91-010, December 1990.

Table 3-5. Feed Soil Sampling Procedure

Sample name:	Feed soil
Sampler:	Process sampling team
Locations:	Feed conveyor belt (BC-1-P)
Equipment:	4-ounce scoops Ceramic pestle Large spoon 2 gallon bucket 8 ounce glass jars with lids (4) Gloves, eye protection, hard hat
Frequency:	15-minute intervals
Procedures:	Collect an equal quantity of soil from the feed conveyor belt at each time interval with a 4-ounce scoop and transfer the grab sample to the 2-gallon bucket. Each time a grab sample is taken, record the sampling time and approximate weight of the grab sample on a sample collection sheet. At the end of the performance test run, crush the soil in the bucket using the ceramic pestle. Mix the soil by hand using the large spoon. Use a 4-ounce scoop to transfer the sample from the 2-gallon bucket to the four 8-ounce jars. After each sampling run, decontaminate all sampling equipment by rinsing with clean water. At the end of the test, following final decontamination of the sampling equipment, rinse the equipment again with clean water and collect the equipment rinse in a sample jar. Attach sample numbers to jars and label with date, sample name and test-run number. Process Sampling Coordinator accepts custody of samples and records sample numbers and collection data in field log book. Samples are placed on ice in a shipping container which is stored in the sample holding area separate from the container supply area.
References:	Test Methods for Evaluating Solid Waste, SW846, Third Edition, 1986 revised 1990.

Table 3-6. Treated Soil Sampling Procedure

Sample name:	Treated soil
Sampler:	Process sampling team
Locations:	Stacking conveyor (BC-2-P)
Equipment:	4-ounce scoops 2-gallon bucket Ceramic pestle Large spoon Ladle 3 foot long, 1-inch diameter dowel rod 8 ounce glass jars with lids (3) Gloves, eye protection, hard hat
Frequency:	15-minute intervals
Procedures:	Soil on the stacking conveyor is hot and emits steam and should be sampled with caution. Use duct tape to tape the ladle to the dowel rod to make a long handled sample collection device. Collect an equal quantity of soil from the stacking conveyor belt (at a location after the treated water has been added to the soil for conditioning) at each time interval with the ladle at a location after the addition of the treated water. Use a 4-ounce scoop and transfer a portion of the grab sample from the ladle to the 2-gallon bucket. Each time a grab sample is taken, record the sampling time and approximate weight of the grab sample on a sample collection sheet. At the end of the performance test run, crush the soil in the bucket using the ceramic pestle. Mix the soil by hand using the large spoon. Use a 4-ounce scoop to transfer the sample from the 2-gallon bucket to the four 8-ounce jars. After each sampling run, decontaminate all sampling equipment by rinsing with clean water. At the end of the test, following final decontamination of the sampling equipment, rinse the equipment again with clean water and collect the equipment rinse in a sample jar. Attach sample numbers to jars and label with date, sample name and test-run number. Process Sampling Coordinator accepts custody of samples and records sample numbers and collection data in field log book. Samples are placed on ice in a shipping container which is stored in the sample holding area separate from the container supply area.
References:	Test Methods for Evaluating Solid Waste, SW846, Third Edition, 1986 revised 1990.

Table 3-7. Stack Gas Particulate, Hydrogen Chloride, and Chlorine Sampling Procedure

Sample name:	Stack gas M5
Sampler:	Stack sampling team
Locations:	Stack
Equipment:	EPA Method 5 sampling train modified for the collection of acid gases; petri dish with tared particulate filter; polyethylene sample jars with lids, graduated cylinder, balance.
Frequency:	Continuous during a test run; three runs to complete test. A minimum of 2 hours sampling time will be completed during each run.
Procedures:	Stack gases will be isokinetically sampled to collect particulate matter on a filter, and to collect hydrogen chloride and chlorine in absorbing solutions. The particulate weight will be determined gravimetrically, and the chloride content of the absorbing solutions will be quantitatively determined by ion chromatography.

Sample point locations are determined in accordance with EPA Method 1. An initial traverse is made with a pitot tube at each sample point following EPA Method 2 to establish stack gas velocity profile, temperature, and flow rate, and to check for cyclonic flow (cyclonic flow will be checked only on the first day of testing). EPA Method 3, employing an Orsat analyzer, will be used to determine stack gas oxygen, carbon dioxide, and dry molecular weight. EPA Method 4 will be followed to determine the stack gas moisture content. EPA Method 5 procedures are followed for pretest and post-test leak checks, isokinetic sampling rate, filter changeouts (if needed), and data recording.

The sampling train utilizes a heated particulate filter and a series of seven chilled impingers. Impinger 1 is used as a condensate collector and contains 50 ml of 0.1N sulfuric acid solution; impingers 2 and 3 will each contain 100 ml of a 0.1N sulfuric acid solution; impinger 4 will be empty; impingers 5 and 6 will each contain 100 ml of a 0.1 N sodium hydroxide solution; impinger 7 will contain 200 to 300 g of indicating silica gel, weighed to within 0.5 g.

After sampling, the probe will be removed from the stack and the nozzle will be covered. External particulate matter will be wiped off the probe. It will then be disconnected from the train and both ends capped. The probe and the filter and impinger assembly are transported to the sample recovery area. The samples are recovered as follows:

- Particulate Filter -- The particulate filter is removed from its holder and placed into its original petri dish (Container No. 1) which is sealed with tape and placed in a plastic bag.
- Front Half Rinse -- The internal surfaces of the nozzle, probe, and front half of the filter holder are cleaned by rinsing, brushing, and final rinsing with acetone into a separate sample jar (Container No. 2).
- Acid Impinger Liquid -- The liquid contents of impingers 1, 2, 3, and 4 are measured to the nearest milliliter or weighed to the nearest 0.5 g and placed into a sample bottle (Container No. 3). Each acid impinger and all connecting glassware, including the back half of the filter holder, is rinsed with deionized water, and the rinse is added to Container No. 3.

Table 3-7. (Continued)

- Alkaline Impinger Liquid -- The liquid contents of impingers 5 and 6 are measured to the nearest milliliter or weighed to the nearest 0.5 g and placed into a sample bottle (Container No. 4). Each impinger and all connecting glassware is rinsed with deionized water, and the rinse is added to Container No. 4.
- Silica Gel -- The silica gel contents of impinger 7 are weighed to the nearest 0.5 g.
- Samples of the deionized water, acetone, sulfuric acid solution, and sodium hydroxide solution are taken for reagent blanks once during the test.

All of the sample containers will be assigned numbers and labeled with date and test-run number. The samples will be turned over to the sample coordinator who will record the appropriate data in the field logbook and pack the samples in shipping containers. Samples will be stored in the sample holding area separate from the container supply area.

References: EPA Methods 1, 2, 3, 4, and 5, Appendix A, Test Methods and Procedures, New Source Performance Standards, 40 CFR 60.

Methods Manual for Complying with the BIF Regulations, USEPA/530-SW-91-010, Method 0050, December, 1990.

Table 3-8. Stack Gas PCDDs/PCDFs Sampling Procedure

Sample name:	Stack Gas Method 23
Sampler:	Stack sampling team
Locations:	Exhaust stack
Equipment:	EPA Method 23 sampling train, five impingers; one XAD-2 adsorbent resin trap; aluminum foil; glass jars with Teflon-lined lids; petri dish with tared particulate filter; balance; glass graduated cylinder.
Frequency:	Continuous during a test run; three runs to complete test. A minimum of 3 dry standard cubic meters of sample will be collected during each run.
Procedures:	A stack gas sample will be collected on a particulate filter and the XAD-2 adsorbent resin trap. The sample will be extracted from the filter and resin, separated by gas chromatography, and quantitatively analyzed by mass spectrometry for PCDDs and PCDFs. Stack sampling point locations are determined in accordance with EPA Method 1. An initial traverse is made with a pitot tube at each sample point following EPA Method 2 to establish stack gas velocity profile, temperature, and flow rate, and to check for cyclonic flow (cyclonic flow will be checked only on the first day of testing). EPA Method 3, employing an Orsat analyzer, will be used to determine stack gas oxygen, carbon dioxide, and dry molecular weight. EPA Method 4 will be followed to determine the stack gas moisture content. EPA Method 5 procedures are followed for pretest and post-test leak checks, isokinetic sampling rate, filter changeouts (if needed), and data recording. During leak checks, an activated charcoal filter will be placed on the end of the sample probe to ensure that no ambient contaminants are allowed to enter the train. The Method 23 train utilizes a heated particulate filter, a condenser, an XAD-2 adsorbent resin trap, a condensate impinger, two deionized water impingers, an empty impinger, and a silica gel impinger. The condenser is cooled by a recirculating water system that controls the temperature of the gas entering the XAD-2 adsorbent resin trap and the impingers. All five impingers are placed in an ice bath. All train components, reagents, and cleaning solutions will be specially prepared, according to the procedures specified in the methods referenced below, to prevent contamination and ensure that representative samples are obtained. The following is a brief description of the preparation of the adsorbent resin: XAD-2 resin will be cleaned by water rinses followed by soxhlet extractions with water, methanol, and methylene chloride. Next, the XAD-2 resin will be dried using a flow of inert gas. An extract from a portion of the prepared XAD-2 resin will be analyzed to confirm that it is free of significant background contamination. The adsorbent traps will then be loaded with approximately 35 g of the XAD-2 resin, packed with glass wool, and charged with 100 µl of an isotopically labeled PCDD/PCDF surrogate standard solution to ensure accurate quantitative measurements. The ends of the adsorbent trap will be capped, wrapped in aluminum foil, sealed in a zip lock bag, and packed in an insulated cold chest.

Table 3-8. (Continued)

Field assembly of the sampling train will take place in an area free from organic contaminants. Train components will be handled so that exposure to ambient conditions will be minimized. No sealant grease will be used in assembling the train.

A clean and inspected filter will be placed in the filter holder. Impinger 1 will be empty; impingers 2 and 3 will each contain 100 ml of deionized water; impinger 4 will be empty; and impinger 5 will be loaded with 200 to 300 g of pre-weighed silica gel. Before each sampling run, the Stack Sampling Coordinator will supply the XAD-2 adsorbent resin trap to the stack sampling team for installation into the train. The condenser recirculation pump will be turned on and proper XAD-2 adsorbent resin trap gas entry temperature (maximum 68 °F) will be assured before sampling begins.

After sampling, the probe will be removed from the stack and the nozzle will be sealed with aluminum foil. External particulate matter will be wiped off the probe. It will then be disconnected from the train and both ends capped. The probe and impinger assembly will be transported to the sample recovery area. The samples will be recovered as follows:

- Particulate Filter -- The particulate filter is removed from its holder and placed into its original petri dish (Container No. 1) which is sealed with tape and placed in a plastic bag.
- XAD-2 Adsorbent Resin Trap -- The XAD-2 adsorbent resin trap is removed from the train, and both ends of the trap are capped. The trap is then labeled, covered with aluminum foil, sealed in a plastic bag and stored in an insulated cold chest.
- Front Half Rinse -- The internal surfaces of the nozzle, probe, front half of the filter holder, and any connecting tubing or glassware is brushed and rinsed three times with acetone, and then rinsed three more times methylene chloride. As an alternate, triple rinsing with a 50/50 acetone/methylene chloride solution may be substituted for the separate rinses. All rinses are placed into a glass sample bottle (Container No. 2).
- Back Half Rinse -- The back half of the filter holder and the connecting line between the holder and the condenser are rinsed three times with acetone. The connecting line is soaked in three separate portions of methylene chloride for 5 minutes each. If a separate condenser and adsorbent trap are used, the condenser will be rinsed and soaked in the same manner as the connecting line. All rinses and soaking liquid will be transferred to container No. 2.
- Toluene rinse -- The methylene chloride soaking procedures for the Front Half and Back Half Rinses will be repeated substituting toluene as the solvent. The toluene soaking solution will be collected in a separate glass sample bottle (Container No. 3).
- Impinger water -- The liquid contents of impingers 1 through 4 are measured to the nearest milliliter or weighed to the nearest 0.5 g and discarded.
- Silica Gel -- The silica gel contents of impinger 5 are weighed to the nearest 0.5 g.

Table 3-8. (Continued)

	• Samples of the acetone, methylene chloride, and toluene are collected as reagent blanks once during the test. Once during the test program, a blank train will be prepared, set up at the sampling location, and leak tested at the beginning and end of one of the runs. The particulate filter holder and probe will be heated for the duration of the sampling period, but no gas will pass through the train. The nozzle will be capped with aluminum foil and the exit end of the last impinger will be sealed with a ground glass cap. The train will remain assembled at the sampling location for a period equivalent to one test run. The blank train samples will be recovered using the procedures described above. All of the sample containers will be assigned numbers and labeled with the date and test-run number. The samples will be turned over to the Stack Sampling Coordinator who will record the appropriate data in the field logbook and pack the samples in insulated cold chests. Samples will be stored in the sample holding area separate from the container supply area.
References:	EPA Methods 1, 2, 3, 4, 5 and 23, Appendix A, Test Methods and Procedures, New Source Performance Standards, 40 CFR 60.

Table 3-9. Stack Gas Metals Sampling Procedure

Sample name: Stack gas MMT

Sampler: Stack sampling team

Locations: Stack

Equipment: EPA Multiple Metals sampling train; petri dish with particulate filter; glass and polyethylene sample jars with Teflon-lined lids, graduated cylinder, balance.

Frequency: Continuous during a test run; three runs to complete test. A minimum of 1.25 dry standard cubic meters of sample will be collected.

Procedures: Stack gases will be isokinetically sampled to collect the metals As, Be, Cd, total Cr, Ni, Sb, Ba, Pb, Hg, Se, Ag, and Tl on a filter and in absorbing solutions.

Sample point locations are determined in accordance with EPA Method 1. An initial traverse is made with a pitot tube at each sample point following EPA Method 2 to establish stack gas velocity profile, temperature, and flow rate, and to check for cyclonic flow (cyclonic flow will be checked only on the first day of testing). EPA Method 3, employing an Orsat analyzer, will be used to determine stack gas oxygen, carbon dioxide, and dry molecular weight. EPA Method 4 will be followed to determine the stack gas moisture content. EPA Method 5 procedures are followed for pretest and post-test leak checks, isokinetic sampling rate, filter changeouts (if needed), and data recording.

The sampling train utilizes a heated, low metals content filter and a series of chilled impingers. The first impinger is an optional condensate trap. If the condensate trap is used, it will initially be empty. Impingers 2 and 3 will each contain 100 ml of a 5% nitric acid/10% hydrogen peroxide (5% HNO_3/10% H_2O_2) solution; impinger 4 will be empty; impingers 5 and 6 will each contain 100 ml of a 4% potassium permanganate/10% sulfuric acid (4% $KMnO_4$/10% H_2SO_4) solution; and impinger 7 will contain 200 to 300 g of indicating silica gel weighed to the nearest 0.5 g.

After sampling, the probe will be removed from the stack and the nozzle will be covered. External particulate matter will be wiped off the probe. It will then be disconnected from the train and both ends capped. The probe and the filter and impinger assembly are transported to the sample recovery area. The samples are recovered as follows:

- Particulate Filter -- The particulate filter is removed from its holder and placed into its original petri dish which is sealed with tape and placed in a plastic bag (Container No. 1).
- Probe Rinse -- The internal surfaces of the nozzle, probe, and front half of the filter holder are cleaned by rinsing, brushing, and final rinsing with exactly 100 ml of 0.1N nitric acid into a separate sample jar (Container No. 2).
- Impingers 1, 2, and 3 -- The liquid contents of impingers 1, 2, and 3 are volumetrically measured to the nearest 0.5 ml or weighed to the nearest 0.5 g and placed into a separate sample bottle (Container No. 3). The impingers, the filter support, the back half of the filter housing, and connecting glassware are then rinsed with exactly 100 ml of 0.1N nitric acid solution and the rinse is added to the sample bottle.
- Impingers 4, 5, and 6 -- The liquid contents of impinger 4 are measured to the nearest 0.5 ml and placed into a separate container (Container No. 4a). Impinger No. 4 is then rinsed with exactly 100 ml of 0.1N nitric acid solution and the rinse is added to Container No. 4a. The liquid contents of impingers 5 and 6 are measured to the nearest 0.5 ml and placed into a

separate container (Container No. 4b). Impingers 5 and 6 and any connecting glassware are then rinsed a minimum of three times using a total of exactly 100 ml of fresh acidified potassium permanganate solution, and the rinses are added to Container No. 4b, being careful to also transfer any loose precipitated materials into the container. Tripple rinsing of Impingers 5 and 6 is then repeated using a total of exactly 100 ml of water. The water rinses are also placed into Container No. 4b. If visible deposits remain in Impingers 5 or 6 following the water rinses, they are rinsed with 25 ml of 8 N hydrochloric acid, and the rinse is placed into a separate container (Container No. 4c) which contains 200 ml of water.

- Silica Gel – The silica gel contents of the fourth impinger are weighed to the nearest 0.5 g.
- The following reagent blank samples will be collected once during the test program: 300 ml of the 0.1 N nitric acid solution; 100 ml of the water used in sample recovery; 200 ml of the nitric acid/hydrogen peroxide reagent solution; 100 ml of the acidified potassium permanganate solution; and three unused particulate filters. If impingers 5 and 6 are rinsed with HCl, then a 25 ml blank sample of the 8 N HCl solution is also collected and added to 200 ml of water in a separate container.
- Once during the test program, a blank train (without a filter) will be set up in a clean area and then recovered using the procedures described above. This blank train, along with two of the three filter blanks collected with the reagents, will be used for a matrix spike and matrix spike duplicate for QA/QC purposes.

All of the sample containers will be assigned numbers and labeled with date and test-run number. The samples will be turned over to the Sample Coordinator who will record the appropriate data in the field log book and pack the samples in shipping containers. Samples will be stored in the sample holding area separate from the container supply area.

References: USEPA Methods 1, 2, 3, 4, 5, and Draft Method 29 Appendix A, Test Methods and Procedures, New Source Performance Standards, 40 CFR 60.

"Methodology for the Determination of Metals Emissions in Exhaust Gases from Hazardous Waste Incineration and Similar Combustion Processes." EPA Methods Manual for Compliance with the BIF Regulations, USEPA/530-SW-91-010, December 1990.

Table 3-10. Stack Gas OCL Pesticides and Semivolatile Organics Sampling Procedure

Sample name:	Stack Gas MM5
Sampler:	Stack sampling team
Locations:	Exhaust stack
Equipment:	USEPA Modified Method 5 (MM5) sampling train, five impingers; one XAD-2 adsorbent resin trap; aluminum foil; glass jars with Teflon-lined lids; petri dish with tared particulate filter; balance; glass graduated cylinder.
Frequency:	Continuous during a test run; three runs to complete test. A minimum of 3 dry standard cubic meters of sample will be collected during each run.
Procedures:	A stack gas sample will be isokinetically collected on a particulate filter, in the impinger solutions, and on the XAD-2 adsorbent resin trap.

Stack sampling point locations are determined in accordance with USEPA Method 1. An initial traverse is made with a pitot tube at each sample point following USEPA Method 2 to establish stack gas velocity profile, temperature, and flow rate, and to check for cyclonic flow (cyclonic flow will be checked only on the first day of testing). USEPA Method 3, employing an Orsat analyzer, will be used to determine stack gas oxygen, carbon dioxide, and dry molecular weight. USEPA Method 4 will be followed to determine the stack gas moisture content. USEPA Method 5 procedures are followed for pretest and post-test leak checks, isokinetic sampling rate, filter changeouts (if needed), and data recording. During leak checks, an activated charcoal filter will be placed on the end of the sample probe to ensure that no ambient contaminants are allowed to enter the train.

The MM5 train utilizes a heated particulate filter, a condenser, an XAD-2 adsorbent resin trap, a condensate impinger, two deionized water impingers, an empty impinger, and a silica gel impinger. The condenser is cooled by a recirculating water system that controls the temperature of the gas entering the XAD-2 adsorbent resin trap and the impingers. All five impingers are placed in an ice bath.

All train components, reagents, and cleaning solutions will be specially prepared, according to the procedures specified in the methods referenced below, to prevent contamination and ensure that representative samples are obtained. The following is a brief description of the preparation of the adsorbent resin:

> XAD-2 resin will be cleaned by water rinses followed by soxhlet extractions with water, methanol, and methylene chloride. Next, the XAD-2 resin will be dried using a flow of inert gas. An extract from a portion of the prepared XAD-2 resin will be analyzed to confirm that it is free of significant background contamination. The adsorbent traps will then be loaded with approximately 35 g of the XAD-2 resin and packed with glass wool. The ends of the adsorbent trap will be capped, wrapped in aluminum foil, sealed in a zip lock bag, and packed in an insulated cold chest.

Field assembly of the sampling train will take place in an area free from organic contaminants. Train components will be handled so that exposure to ambient conditions will be minimized. No sealant grease will be used in assembling the train.

Table 3-10. Stack Gas OCL Pesticides and Semivolatile Organics Sampling Procedure (Continued)

A clean and inspected filter will be placed in the filter holder. Impingers 1 and 4 will be empty; impingers 2 and 3 will each contain 100 ml of organic free deionized water; and impinger 5 will be loaded with 200 to 300 g of pre-weighed silica gel. Before each sampling run, the Stack Sampling Coordinator will supply the XAD-2 adsorbent resin trap to the stack sampling team for installation into the train. The condenser recirculation pump will be turned on and proper XAD-2 adsorbent resin trap gas entry temperature (maximum 68°F) will be assured before sampling begins.

After sampling, the probe will be removed from the stack and the nozzle will be sealed with aluminum foil. External particulate matter will be wiped off the probe. It will then be disconnected from the train and both ends capped. The probe and impinger assembly will be transported to the sample recovery area. The samples will be recovered as follows:

- Particulate Filter -- The particulate filter is removed from its holder and placed into its original petri dish (Container No. 1) which is sealed with tape and placed in a plastic bag.
- Front Half Rinse -- The internal surfaces of the nozzle, probe, front half of the filter holder, and any connecting tubing or glassware is brushed and rinsed three times with a solution of methanol/methylene chloride (1:1;v/v). All rinses are placed into a glass sample bottle (Container No. 2).
- Back Half Rinse -- Sample train components from the back half of the particulated filter to the XAD-2 resin adsorbent trap are rinsed thoroughly with methanol/methylene chloride (1:1;v/v). All rinses and soaking liquid will be transferred to Container No. 2.
- XAD-2 Adsorbent Resin Trap -- The XAD-2 adsorbent resin trap is removed from the train, and both ends of the trap are capped. The trap is then labeled, covered with aluminum foil, sealed in a plastic bag and stored in an insulated cold chest (Container No. 3).
- Condensate Impinger -- Measure the condensate collected in impinger 1 to the nearest milliliter or to the nearest 0.5 g. Transfer this liquid into a glass sample bottle (Container 4). Also, inspect the back half of the particulate filter holder for condensate (filter condensate). If condensate is observed, transfer the condensate from the filter holder and measure the volume and/or weight as described above. Add this liquid to the glass sample bottle containing the knockout trap condensate (Container No. 4).
- Impinger water -- The liquid contents of impingers 2 through 4 are measured to the nearest milliliter or weighed to the nearest 0.5 g and transferred to Container No. 4.
- Silica Gel -- The silica gel contents of impinger 5 are weighed to the nearest 0.5 g.

- Samples of the methanol, methylene chloride, and water are collected as reagent blanks once during the test.

Table 3-10. Stack Gas OCL Pesticides and Semivolatile Organics Sampling Procedure (Continued)

	Once during the test program, a blank train will be prepared, set up at the sampling location, and leak tested at the beginning and end of one of the runs. The particulate filter holder and probe will be heated for the duration of the sampling period, but no gas will pass through the train. The nozzle will be capped with aluminum foil and the exit end of the last impinger will be sealed with a ground glass cap. The train will remain assembled at the sampling location for a period equivalent to one test run. The blank train samples will be recovered using the procedures described above. All of the sample containers will be assigned numbers and labeled with the date and test-run number. The samples will be turned over to the Stack Sampling Coordinator who will record the appropriate data in the field logbook and pack the samples in insulated cold chests. Samples will be stored in the sample holding area separate from the container supply area.
References:	USEPA Methods 1, 2, 3, 4, and 5, Appendix A, Test Methods and Procedures, New Source Performance Standards, 40 CFR 60. Test Methods for Evaluating Solid Wastes, Method 0010, SW-846, Third Edition, November 1986, and updates.

Table 3-11. Stack Gas Volatile Organics Sampling Procedure

Sample name:	Stack gas VOST
Sampler:	Stack sampling team
Locations:	Exhaust stack
Equipment:	Volatile organic sampling train (VOST): sorbent tubes, glass culture tubes with Teflon lined screw caps, aluminum foil, glass VOA vials (40 ml) with plastic screw caps, screw capped glass container.
Frequency:	Continuous with replacement of sorbent tube pairs every 20 to 40 minutes depending on selected sample flow rate.
Procedures:	Stack gases will be sampled at a controlled rate to collect volatile organic compounds on adsorbent resin.

The sampling train utilizes a glass-lined probe followed by an isolation valve, a water-cooled glass condenser, a sorbent tube containing Tenax resin, an empty impinger for condensate collection, a second water-cooled glass condenser, a second sorbent tube containing Tenax resin and petroleum-based charcoal, a silica drying tube, a rotameter, sampling pump, and dry gas meter.

Sorbent Tube Preparation -- The procedures for preparing, storing, and analyzing the tubes will be those described in Method 0030 referenced below. As described in the method, sorbent material (Tenax resin and charcoal) will be soxhlet extracted, vacuum dried, thermally conditioned with organic-free nitrogen, and loaded into tubes. Each sorbent tube will be labeled with an identification number.

The sorbent tubes will be protected from contamination by placing them in culture tubes that contain clean charcoal. The tubes will be stored in a cooler at 4°C in an area free from sources of organic contamination. The tubes will be packed separately and kept cold in insulated containers during transfer to the test site.

At the test site, the tubes are stored cold until needed for a test.

Before each replicate sampling run, the sample coordinator will supply the resin tubes, including a field blank, to a stack sampling team member conducting the VOST sampling. At the end of each run, the sample coordinator will recover the tubes along with the sample collection sheet. The samples will be replaced in cold storage for return shipment and the sample coordinator will make the appropriate notations in the field log book.

VOST Operation -- The sample collection procedures will be as described in the EPA protocol referenced below. As described in the protocol, the dry gas meter will be calibrated before arriving at the test site, and the sample train will be cleaned and assembled before installing the resin tubes. The caps to the tubes will be stored in a clean glass jar while the tubes are in the train. The train will then be leak tested at 10 in. Hg in such a manner as to prevent exposure of the train components to the ambient air.

Before sampling, ice water will be circulated through the condensers and the probe will be purged of ambient air and inserted into the stack. The probe will be heated to 130 to 150°C (266 to 302°F). Four pairs of tubes will be collected during each test run.

After collecting the samples, the tube pair will be removed from the VOST; end caps replaced; labeled, returned to the culture tubes, and returned to cold storage. Samples of the condensate water will be collected in VOA vials with no headspace. If there is not

Table 3-11. Stack Gas Volatile Organics Sampling Procedure (Continued)

enough condensate to fill a VOA vial, enough organic-free water will be added to fill the container.

Quality control samples for the VOST are collected as follows:

- One tube pair will be collected during each sampling run as a field blank
- One tube pair will be collected with each shipment of tubes to the laboratory as a trip blank
- One tube pair will remain in the laboratory as a laboratory blank.

During the sampling run, the end caps from the field blank tubes will be removed to simulate the handling of the test tubes. The ends will remain open for approximately 10 minutes.

Samples will be stored at or below 4° C in shipping packages which will be kept in an area away from other high concentration samples. If shipped by truck, the samples will be stored away from other chemicals or from where automotive exhaust fumes could become concentrated.

The sample collection data shown in the reference method will be recorded for each tube pair.

References: Test Methods for Evaluating Solid Wastes, Method 0030, SW-846, Third Edition, November 1986, and updates.

Table 3-12. Stack Gas Continuous Emissions Monitoring Procedure

Sample name:	Stack gas CEMS
Sampler:	Monitoring system operator
Components:	Probe, sample conditioning system, analyzer
Location:	Stack
Frequency:	Continuous during each sampling run; three runs to complete each test.
Procedures:	Continuously monitor the following stack gas constituents: • Carbon monoxide by non-dispersive infrared (NDIR) analyzer (USEPA Method 10 and BIF Guidance) • Oxygen by paramagnetic technology (USEPA Method 3A, and BIF Guidance)
References:	USEPA Performance Specifications 2, 3, and 4, Appendix B, Test Methods and Procedures, New Source Performance Standards, 40 CFR 60. USEPA Methods 3A and 10, Appendix A, Test Methods and Procedures, New Source Performance Standards, 40 CFR 60. "Performance Specifications for Continuous Monitoring of Carbon Monoxide and Oxygen for Incinerators, Boilers, and Industrial Furnaces Burning Hazardous Waste", 40 CFR 266, Appendix IX.

Table 3-12A. Scrubber Blowdown Sampling Procedure

Sample name: Scrubber blowdown

Sampler: Process sampling team

Locations: Sample tap on pipe line

Equipment: Glass graduated cylinder
4 liter glass bottle
1 liter glass bottles with Teflon-lined lids
Gloves, eye protection

Frequency: 30-minute intervals during each run.

Procedures: Purge tap by allowing a small amount of liquid to flow into a waste container, rinse graduated cylinder with liquid and discard to container; collect approximately 500 ml of sample in graduated cylinder and transfer to 4 liter glass bottle at each time interval.

At the end of the run, mix the sample in the 4 liter bottle and fill 1 liter bottles from the 4 liter bottle as follows:

1 - Total metals
1 - OCL Pesticides
1 - Archive

Attach sample numbers to bottles and label with date, sample name and test-run number.

The Sample Custodian accepts custody of samples and records numbers and collection data in a field log book.

Samples are placed on ice in a shipping container which is stored in the sample holding area separate from the container supply area.

References: ASTM E 300-86, Section 23 and 24, American Society for Testing and Materials, Annual Book of ASTM Standards, Philadelphia, Pennsylvania, Annual Series.

Table 3-13. Analyses Planned for Performance Test Samples

Sample Name	Analyses
Feed soil	OCL pesticides (aldrin, alpha-BHC, beta-BHC, gamma-BHC, chlordane, p,p'-DDE, p,p'-DDD, p,4'-DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, methoxyclor, and toxaphene), total metals (As, Be, Cd, Cr, Ni, Sb, Ba, Pb, Hg, Se, Ag, Tl), moisture, chloride, ash, heating value
Treated soil	OCL pesticides (aldrin, alpha-BHC, beta-BHC, gamma-BHC, chlordane, p,p'-DDE, p,p'-DDD, p,4'-DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, methoxyclor, and toxaphene), total metals (As, Be, Cd, Cr, Ni, Sb, Ba, Pb, Hg, Se, Ag, Tl), PCDDs/PCDFs
Scubber Blowdown	OCL pesticides (aldrin, alpha-BHC, beta-BHC, gamma-BHC, chlordane, p,p'-DDE, p,p'-DDD, p,4'-DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, methoxyclor, and toxaphene), total metals (As, Pb, and Hg)
Stack gas M5	Particulate, HCl, Cl_2, moisture, oxygen, carbon dioxide, temperature, flow rate
Stack gas M23	PCDDs/PCDFs, moisture, oxygen, carbon dioxide, temperature, flow rate
Stack gas MM5	OCL pesticides (aldrin, alpha-BHC, beta-BHC, gamma-BHC, chlordane, p,p'-DDE, p,p'-DDD, p,4'-DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, methoxyclor, and toxaphene), semi-volatile organics, moisture, oxygen, carbon dioxide, temperature, flow rate
Stack gas VOST	Volatile organics
Stack gas MMT	Metals (As, Be, Cd, Cr, Ni, Sb, Ba, Pb, Hg, Se, Ag, Tl)
Stack gas CEMS [a]	Carbon monoxide, oxygen

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[a] Continuous monitors used during the performance test are permanently installed monitors that will be used throughout normal operation.

Table 3-14. Summary of Analytical Procedures and Methods

Sample Name	Analysis	Total Field Samples for Analysis	Preparation Method a	Analytical Method a	Analytical b Responsibility
Feed soil	OCL Pesticidesc	3	Solvent extraction (SW846-3500 series)	GC/ECD (SW846-8080)	ACL
	Total Metals	3	Acid Digestion (SW846-3050 or 3051)	ICP (SW846-6010) CVAAS (SW846-7471)	ACL
	Moisture	3	N/A	Evaporation (ASTM D 3173)	ACL
	Chloride	3	Bomb Combustion (SW846-5050)	Ion chromatography (SW846-9056)	ACL
	Ash	3	N/A	Ignition (ASTM D 3174)	ACL
	Heating value	3	N/A	ASTM Method D 2015	ACL
Treated soil	OCL Pesticides	3	Solvent extraction (SW846-3500 series)	GC/ECD (SW846-8080)	ACL
	Total Metals	3	Acid Digestion (SW846-3050 or 3051)	ICP (SW846-6010) CVASS (SW846-7471)	ACL
	PCDD/PCDF	3	Solvent extraction (SW846-8290)	HRGC/HRMS (SW846-8290)	ACL
Scrubber Blowdown	OCL Pesticides	3	Solvent extraction (SW846-3500 series)	GC/ECD (SW846-8080)	ACL
	Total Metals	3	Acid Digestion (SW846 3010)	ICP (SW846-6010) CVASS (SW846-7471)	ACL
Stack gas M5	Particulate	3	Evaporate/Dessicate	Gravimetric (EPA Method 5)	SSC
	HCl/Cl2	3	NA	Ion Chromatography (BIF Method 9057)	ACL
	Moisture	3	NA	Gravimetric (EPA Method 5)	SSC
	Temperature	NA	NA	Thermocouple (EPA Method 5)	SSC
	Velocity	NA	NA	Pitot tube (EPA Method 5)	SSC
	Oxygen, carbon dioxide	(d)	NA	Orsat (EPA Method 3)	SSC
Stack gas M23	PCDDs and PCDFs (filter, XAD-2, acetone/ methylene chloride/ toluene rinse)	3	Solvent extraction (EPA Method 23)	GC/MS (EPA Method 23)	ACL
	Moisture	3	NA	Gravimetric (EPA Method 5)	SSC
	Temperature	NA	NA	Thermocouple (EPA Method 5)	SSC
	Velocity	NA	NA	Pitot tube (EPA Method 5)	SSC
	Oxygen, carbon dioxide	(d)	NA	Orsat (EPA Method 3)	SSC

(Continued)

Table 3-14. Summary of Analytical Procedures and Methods

Sample Name	Analysis	Total Field Samples for Analysis	Preparation Method a	Analytical Method a	Analytical b Responsibility
Stack gas MMT	Metals	3	Acid Digestion (BIF Guidance)	ICP (SW846-6010) or GFAAS (SW846-7000 series) CVAAS (SW846-7471)	ACL
	Moisture	3	NA	Gravimetric (EPA Method 5)	SSC
	Temperature	NA	NA	Thermocouple (EPA Method 5)	SSC
	Velocity	NA	NA	Pitot tube (EPA Method 5)	SSC
	Oxygen, carbon dioxide	(d)	NA	Orsat (EPA Method 3)	SSC
Stack gas VOST	Volatile Organics	18	Thermal desorption, trap (SW846-5040)	GC/MS (SW846-5040)	ACL
Stack gas MM5	OCL Pesticides (filter, XAD-2, methanol/ methylene chloride rinse, condensate/imp. water)	3	Solvent extraction (SW846-3500 series)	GC/ECD (SW846-8080)	ACL
	Semivolatile Organics	3	Solvent extraction (SW846-3500 series)	GC/MS (SW846-8270) Full scan + 10 highest peaks	ACL
	Moisture	3	NA	Gravimetric (EPA Method 5)	SSC
	Temperature	NA	NA	Thermocouple (EPA Method 5)	SSC
	Velocity	NA	NA	Pitot tube (EPA Method 5)	SSC
	Oxygen, carbon dioxide	(d)	NA	Orsat (EPA Method 3)	SSC
Stack Gas CEMs	Carbon Monoxide	(e)	NA	Continuous NDIR (EPA Method 10, BIF Guidance)	Williams
	Oxygen	(e)	NA	Paramagnetic technology (EPA Method 3A, BIF Guidance)	Williams

a "SW846" refers to Test Methods for Evaluating Solid Waste, Third Edition, 1986 revised 1990.
"EPA Method" refers to New Source Performance Standards, Test Methods and Procedures, Appendix A, 40 CFR 60.
"BIF Method" refers to Methods Manual for Compliance with the BIF Regulations - Burning Hazardous Waste in Boilers and Industrial Furnaces, EPA/530-SW-91-010.

b ACL = Analytical contract laboratory SSC = Stack sampling contractor Williams = Williams Environmental Services, Inc.

c OCL Pesticides = Hexachlorobenzene, aldrin, alpha-BHC, beta-BHC, Lindane, alpha-chlordane, p'p'-DDE, heptachlor p'p'-DDD, p'p'-DDT, dieldrin, heptachlor epoxide, endrin, toxaphene.

d Gas bag samples collected during each stack traverse for Orsat analysis.

e CEMS sampling and analysis is continuous during each run.

Table 3-15. Analysis of OCL Pesticides in Soil

Matrices:	Feed Soil Treated Soil
Holding Time:	Collection to extraction = 14 days Extraction to analysis = 40 days
Procedures:	Extract sample using SW-846 3540 or 3550 as appropriate. Add surrogate (dibutylchlorendate), process through cleanup as necessary, and proceed with GC/ECD analysis per SW-846 Method 8080 for feed soil and treated soil for the following pesticides: aldrin, alpha-BHC, beta-BHC, gamma-BHC, chlordane, p,p'-DDE, p,p'-DDD, p,p'-DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, methoxyclor, and toxaphene.
References:	Method 8080, GC Method for Organochlorine Pesticides and PCBs; SW-846, 3rd ed., 1986 revised 1990. Method 3540 and 3550, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., November 1986 and updates.

Table 3-15A. Analysis of PCDD/PCDF in Soil

Matrices:	Treated Soil
Holding Time:	Collection to extraction = 14 days Extraction to analysis = 40 days
Procedures:	Extract sample using matrix specific procedure per SW-846 8290. Add the specified amounts of each of the nine isotopically labeled PCDDs/PCDFs, process through cleanup as necessary, and proceed with HRGC/HRMS analysis per SW-846 Method 8290. The extract will be anlayzed for the quantification of dioxin/furans and results will be reported for the 17 congeners required to caluculate a dioxin/furan toxicity equivalency value.
References:	Method 8290, HRGC/HRMS Method for Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs); SW-846, 3rd ed., 1986 revised 1992.

Table 3-16. Analysis of Metals in Soil

Matrices:	Feed soil Treated soil
Holding Time:	40 days
Procedures:	Feed and treated soil samples will be acid digested according to SW-846 method 3050 or method 3051. The digestion solutions will be analyzed for As, Be, Cd, Cr, Ni, Sb, Ba, Pb, Se, Ag, and Tl by inductively coupled plasma emission spectroscopy (ICP) using SW-846 method 6010. Feed soil and treated soil will be analyzed for Hg by manual cold vapor atomic absorption Spectroscopy (CVAAS) according to SW-846 Method 7471.
References:	Methods 3050, 3051, 6010, and 7471, Test Methods for Evaluating Solid Waste, SW-846, Third Edition, November 1986, and Updates.

Table 3-17. Analysis of Soil Characteristics

Matrices: Feed Soil

Moisture Determination: Moisture is determined by establishing the loss in weight of the sample when heated under rigidly controlled conditions of temperature, time, atmosphere, sample weight, and equipment specifications. A portion of sample is placed into an oven at 104 - 110° C for one hour, then cooled in a desiccator and weighed again. ASTM Method D 3173 procedures are used.

Ash Content: Ash content is determined by weighing the residue remaining after burning the sample under rigidly controlled conditions of temperature, time, atmosphere, sample weight, and equipment specifications. The sample is pulverized and a weighed portion is placed into a weighed capsule. The capsule is placed into a cold muffle furnace and heated to 450 - 500 °C in one hour. Heating is continued such that the temperature reaches 700 - 750° C by the end of the second hour. The sample is then held at 700 - 750 °C for two additional hours, or until a constant weight is reached. ASTM Method D 3174 procedures are used.

Chlorine Content: The sample is combusted in an oxygen bomb according to SW-846 Method 5050, and the rinse solution is analyzed for chloride using ion chromatography according to SW-846 Method 9056.

Heating Value: The sample will be thoroughly mixed, and a portion will be combusted in an adiabatic bomb calorimeter according to ASTM Method D 2015.

References: Method D 3173, D 3174, and D 2015, American Society of Testing and Materials, Annual Book of ASTM, Philadelphia, PA.

Method 5050 and 9056, Test Methods for Evaluating Solid Waste, SW-846, Third Edition, November 1986, and updates.

Table 3-17A Analysis of Pesticides in Scrubber Blowdown

Matrices:	Scrubber blowdown
Procedure:	Extract liquid samples using SW-846 Method 3510 or 3520 as appropriate. Process through cleanup as necessary, and proceed with GC/ECD analysis per SW-846 Method 8080.
References:	Method 8080, GC Method for Organochlorine Pesticides and PCBs; SW-846, 3rd ed., 1986 revised 1990. Method 3510, Separatory Funnel Liquid-Liquid Extraction, SW-846, 3rd ed., 1986 and updates. Method 3520, Continous Liquid Extraction, SW-846, 3rd ed., 1986 and updates.

Table 3-17B. Analysis of Metals in Scrubber Blowdown

Matrices	Scrubber blowdown
Procedures:	Aqueous samples will be acid digested according to SW-846 Method 3010. The digestion solution will be analyzed for As and Pb inductively coupled plasma emission spectroscopy (ICP) using SW-846 Method 6010. If needed, the samples will be analyzed using graphite furnace atomic absorption spectroscopy (GFAAS) using SW-846 7000-series methods. For determination of Hg content, the digestion solution will be analyzed by cold vapor atomic absorption spectroscopy (CVAAS) using SW-846 Method 7470.
References:	Methods 3010, 6010 and 7000-series, Test Methods for Evaluating Solid Waste, SW-846, Third Edition, November 1986 and Updates.

Table 3-18. Analysis of Particulates in M5 Samples

Matrices:	Particulate filter (quartz or teflon) Front Half Rinse (acetone)
Holding Time:	40 days
Procedures:	The M5 train front half rinse will be evaporated to dryness at ambient temperature and pressure, desiccated for 24 hours, and the residue weight determined to the nearest 0.1 mg. The particulate filter will be oven dried at 105°C (220°F) for 2 to 3 hours and the weight determined to the nearest 0.1 mg.
References:	EPA Method 5, Appendix A, Test Methods and Procedures, New Source Performance Standards, 40 CFR 60.

Table 3-19. Analysis of Hydrogen Chloride and Chlorine in M5 Samples

Matrices:	Acid Impinger Liquid - Sulfuric acid solution (Container No. 3) for HCl analysis Alkaline Impinger Liquid - Sodium hydroxide solution (Container No. 4) for Cl_2 analysis
Holding Time:	28 days
Procedure:	M5 impinger samples will be analyzed for hydrogen chloride and chlorine using ion chromatography.
Reference:	Method 300.0, The Determination of Inorganic Anions in Water by Ion Chromatography, EPA-600/4-84, 017, March 1984. Protocol for Analysis of Samples from HCl/Cl_2 Emission Sampling Trains (Method 9057), Methods Manual for Compliance with the BIF Regulations, EPA/530-SW-91-010, December 1990.

Table 3-20. Determination of Stack Gas Moisture Content

Matrices:	Impinger water Silica gel trap
Holding Time:	None, perform upon collection
Procedures:	Increase in volume of impinger water will be measured by weighing to the nearest 0.5 g. Increase in weight of silica gel will be measured to the nearest 0.5 g. Stack gas moisture content will be calculated using equations provided in method referenced below.
References:	EPA Methods 4 and 5, Appendix A, Test Methods and Procedures, New Source Performance Standards, 40 CFR 60.

Table 3-21. Analysis of PCDDs/PCDFs in M23 Samples

Matrices:
Filter (glass fiber) - Container No. 1
Front and back half rinses (acetone/methylene chloride) - Container No. 2
Toluene rinse of Back Half - Container No. 3
Adsorbent resin (XAD-2 resin)/glass wool

Holding Time: 7 days to extraction, 40 days to analysis.

Procedures: Liquid and solid samples will be prepared for extraction, extracted, and analyzed using appropriate methods as referenced below.

The M23 train front and back half acetone/methylene chloride rinses (Container No. 2) are concentrated in a rotary evaporator apparatus and the residue is added to the particulate filter (Container No. 1) and the XAD-2 resin/glass wool. The evaporator residue, particulate filter, and adsorbent resin/glass wool are spiked with internal standards, and soxhlet extracted.

The extract is split for the following analyses:

- Extract 1: PCDDs/PCDFs
- Extract 2: Archive.

The extracts are analyzed as follows:

Extract 1: Dioxin/furan Quantification
Extract 1 will be processed through cleanup as necessary and analyzed according to USEPA Method 23 for quantitation of dioxins and furans. Analytical results will be reported for the 17 congeners required to calculate a dioxin/furan toxicity equivalence value. Results will also be reported for all tetra through octa congeners.

Extract 2: Archive
Extract 2 will be archived and used if necessary.

Following addition of the internal standard solution, the back half toluene rinse (Container No. 3) is concentrated using the rotary evaporator apparatus. The evaporator residue is soxlet extracted. The extract is then analyzed separately as described for Extract 1 above.

References: Methods 3540 and 8290, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., 1986 revised 1990.

EPA Method 23, New Source Performance Standards, Test Methods and Procedures, Appendix A, 40 CFR 60.

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Table 3-21A. Comparison of Allowable Stack Gas PCDD/PCDF Concentrations with Stack Gas PCDD/PCDF Concentrations Calculated Using Detection Limits

Isomer No.	PCDD/PCDF Compound	Detection Limit (pg/sample)	Estimated Stack (a,b,c) Concentration (ug/dscm)	2,3,7,8-TCDD Toxicity Equivalence Factor	Estimated Stack Concentration Toxic Equivalents (ug/dscm)	Estimated Emission Rate as 2,3,7,8-TCDD (g/s)
	PCDDs					
1	2,3,7,8-TCDD	8.3	2.76E-06	1	2.76E-06	2.72E-14
	Other TCDD	0	0.00E+00			
	Total TCDD	8.3	2.76E-06			
2	1,2,3,7,8-PeCDD	4.8	1.60E-06	0.5	7.99E-07	7.87E-15
	Other PeCDD	4.1	1.37E-06			
	Total PeCDD	8.9	2.96E-06			
3	1,2,3,4,7,8-HxCDD	5.4	1.80E-06	0.10	1.80E-07	1.77E-15
4	1,2,3,6,7,8-HxCDD	4.9	1.63E-06	0.10	1.63E-07	1.61E-15
5	1,2,3,7,8,9-HxCDD	4.6	1.53E-06	0.10	1.53E-07	1.51E-15
	Other HxCDD	0	0.00E+00			
	Total HxCDD	14.9	4.96E-06			
6	1,2,3,4,6,7,8-HpCDD	8.5	2.83E-06	0.01	2.83E-08	2.79E-16
	Other HpCDD	8.5	2.83E-06			
	Total HpCDD	8.5	2.83E-06			
7	OCDD	28	9.33E-06	0.001	9.33E-09	9.18E-17
Total PCDDs(d)		68.6	2.29E-05		4.10E-06	4.04E-14
	PCDFs					
8	2,3,7,8-TCDF	5	1.67E-06	0.1	1.67E-07	1.64E-15
	Other TCDF	0	0.00E+00			
	Total TCDF	5	1.67E-06			
9	1,2,3,7,8-PeCDF	8.1	2.70E-06	0.05	1.35E-07	1.33E-15
10	2,3,4,7,8-PeCDF	8.1	2.70E-06	0.5	1.35E-06	1.33E-14
	Other PeCDF	0	0.00E+00			
	Total PeCDF	8.1	2.70E-06			
11	1,2,3,4,7,8-HxCDF	4.1	1.37E-06	0.1	1.37E-07	1.34E-15
12	1,2,3,6,7,8-HxCDF	1.3	4.33E-07	0.1	4.33E-08	4.26E-16
13	2,3,4,6,7,8-HxCDF	1.9	6.33E-07	0.1	6.33E-08	6.23E-16
14	1,2,3,7,8,9-HxCDF	1.7	5.66E-07	0.1	5.66E-08	5.58E-16
	Other HxCDF	0	0.00E+00			
	Total HxCDF	4.1	1.37E-06			
15	1,2,3,4,6,7,8-HpCDF	6.4	2.13E-06	0.001	2.13E-09	2.10E-17
16	1,2,3,4,7,8,9-HpCDF	6.7	2.23E-06	0.001	2.23E-09	2.20E-17
	Other HpCDF	0	0.00E+00			
	Total HpCDF	6.7	2.23E-06			
17	OCDF	13	4.33E-06	0.001	4.33E-09	4.26E-17
Total PCDFs(e)		36.9	1.23E-05		1.96E-06	1.93E-14
Total PCDD/PCDF		105.5	3.51E-05		6.06E-06	5.96E-14
Allowable stack gas concentration					1.16E-04	
Allowable minus estimated actual stack gas concentration					1.16E-04	

(a) Stack gas sample volume	106.00	dry standard cubic feet
	3.00	dry standard cubic meters
(b) Stack gas flow rate	20,860	dry standard cubic feet per minute
	9.85	dry standard cubic meters per second

(c) If the sum of the detection limits of the individual isomers for a given dioxin or furan exceeded the detection limit of the total it was assumed that these individual isomers, when added, constituted the entire total so that any contribution to the total by "other" isomers would be zero.

(d) Total PCDDs = Total TCDD + Total PeCDD + Total HxCDD + Total HpCDD + OCDD

(e) Total PCDFs = Total TCDF + Total PeCDF + Total HxCDF + Total HpCDF + OCDF

Table 3-22. Analysis of Stack Gas Metal Samples

Matrices:	Particulate filter - Container No. 1 Probe rinse (nitric acid) - Container No. 2 Nitric acid/hydrogen peroxide impinger solution - Container No. 3 Pottasium permaganate/sulfuric acid solution - Containers No. 4a, 4b, and 4c
Holding Time:	40 days
Procedures:	The sampling train probe rinse, particulate filter, nitric acid/hydrogen peroxide impinger solution, and their rinses will be digested separately according to methods referenced below. The probe rinse digestion solution, filter digestion solution, and nitric acid/hydrogen peroxide digestion solution will be analyzed for As, Be, Cd, Cr, Ni, Sb, Ba, Pb, Se, Ag, and Tl by inductively coupled argon plasma emission spectroscopy (ICAP) according to SW-846 Method 6010. If individual metals are found at concentrations below approximately 2 ug/ml, the digestion solutions may be analyzed by graphite furnace atomic absorption (GFAA) spectroscopy according to the SW-846 7000-series methods referenced below. An aliquot of the nitric acid/hydrogen peroxide impinger solution and the pottasium permaganate/sulfuric acid solution will be analyzed separately for Hg by manual cold vapor atomic absorption (CVAA) according to SW-846 Method 7471. The results of the component analyses will be summed to give the metals content in the gas sample.
References:	Methods 3010, 6010, and 7000-series, Test Methods for Evaluating Solid Waste, SW-846, Third Edition, November 1986, and Updates. "Methodology for the Determination of Metal Emissions in Exhaust Gases from Hazardous Waste Incineration and Similar Combustion Processes." EPA Methods Manual for Compliance with the BIF Regulations, EPA/530-SW-91-010, December 1990.

Table 3-22A. Comparison of Allowable Stack Gas Metals Concentrations with Stack Gas Metals Concentrations Calculated Using Detection Limits

Metal	Analytical Method	Detection Limit (ug per sample)	Estimated Stack Gas Conc. (a) (ug/dscm)	Estimated Mass Emission Rate (g/s)	Allowable Stack Gas Concentration (ug/m3)	Allowable Stack Gas Concentration Minus the Estimated Actual Conc. (ug/m3)
Antimony	ICP	34.5	11.50	1.13E-04	1160	1148
Arsenic	GFAA	1.2	0.4	3.94E-06	0.890	0.49
Barium	ICP	2.4	0.8	7.88E-06	193250	193249
Beryllium	ICP	0.3	0.11	1.08E-06	1.62	1.51
Cadmium	ICP	4.5	1.5	1.48E-05	2.16	0.66
Chromium	GFAA	0.9	0.3	2.95E-06	0.320	0.020
Lead	ICP	45.3	15.10	1.49E-04	347.85	333
Mercury	CVAA	16.8	5.60	5.51E-05	1160	1154
Nickel	ICP	16.2	5.40	5.32E-05	5102	5096
Silver	ICP	7.8	2.60	2.56E-05	464	461
Thallium	ICP	43.2	14.40	1.42E-04	1932.5	1918
Zinc	ICP	2.4	0.80	7.88E-06	NA	NA
Total Metals		132.4	< 106.27	< 1.05E-03		
Total Detected Metals		175.6	141.0	1.39E-03		

MMT Stack Sampling Parameters	
Stack gas flow, dscfm	20,860
,acfm	65,000
,dscm/sec	9.85
Stack gas temp, deg F	185
Sampling vol, dscf	44.00
, dscm	1.25
Stack gas moisture, vol%	55.0

(a) In-stack method detection limits from Part 266 Appendix IX, Method 29.
NA = Not Available
ICP = Inductively Coupled Plasma
GFAA = Graphite Furnace Atomic Absorption
CVAA = Cold Vapor Atomic Absorption

Table 3-23. Analysis of OCL Pesticides and Semi-volatile Organics in MM5 Samples

Matrices:	Particulate filter - Container No. 1. Combined front half and back half rinse (methanol/methylene chloride) - Container No. 2. XAD-2 resin trap - Container No. 3 Condensate and impinger water - Container No. 4
Holding Time:	Extract within 7 days; Analyze within 40 days of extraction.
Procedures:	Liquid and solid samples will be prepared for extraction, extracted, and analyzed using appropriate methods as referenced below. All samples are to be spiked with surrogate standards as received from the field prior to any sample manupulations. The MM5 train combined front half and back half rinse, and the extract from the impinger water are concentrated in a rotary evaporator apparatus and the residue is added to the particulate filter and the XAD-2 resin/glass wool. The combined evaporator residue, particulate filter, and adsorbent resin/glass wool are spiked with surrogate standards, and soxhlet extracted. The extract is processed through cleanup as necessary and split into three portions. The extract is analyzed as follows: **Extract 1: OCL Pesticides** One of the portions will be analyzed according to SW-846 Method 8080 for OCL Pesticides analysis (aldrin, alpha-BHC, beta-BHC, gamma-BHC, chlordane, p,p'-DDE, p,p'-DDD, p,p'-DDT, dieldrin, endrin, heptachlor epoxide, hexachlorobenzene, methoxyclor, and toxaphene). **Extract 2: Semi-volatile organics** The second portion from of the extract will be used for analysis of semi-volatile organics according to SW846 Method 8270 by placing the analytical system in full scan mode (full scan plus 10 highest peaks will be identified) and comparing the mass spectra obtained to the NBS library of mass spectral data for organic compounds. **Extract 3: Archive** Extract 3 will be archived and used if necessary.
References:	Methods 3540, 8080 and 8270, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., 1986 revised 1990.

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Table 3-23A. Comparison of Allowable Stack Gas OCL Concentrations with Stack Gas OCL Concentrations Calculated Using Detection Limits

Pesticide	Detection Limit (ug per sample)	Estimated Stack Concentration (ug/dscm) (a)	Estimated Mass Emission Rate (g/s) (b)	Allowable Stack Gas Concentration (ug/m3)	Allowable Stack Gas Concentration Minus the Estimated Actual Conc. (ug/m3)
Aldrin	0.20	0.07	6.56E-07	0.77	0.703
alpha-BHC	0.094	0.03	3.08E-07	2473.6	2474
beta-BHC	0.32	0.11	1.05E-06	2473.6	2473
gamma-BHC	0.20	0.07	6.56E-07	2473.6	2474
Chlordane	0.20	0.07	6.56E-07	10.44	10
4,4'-DDD	0.40	0.13	1.31E-06	386.5	386
4,4'-DDE	0.40	0.13	1.31E-06	NA	NA
4,4'-DDT	0.40	0.13	1.31E-06	38.65	39
Dieldrin	0.40	0.13	1.31E-06	0.77	0.637
Endosulfan I	0.20	0.07	6.56E-07	NA	NA
Endosulfan II	0.40	0.13	1.31E-06	NA	NA
Endrin	0.40	0.13	1.31E-06	463.8	464
Endrin ketone	0.40	0.13	1.31E-06	NA	NA
Heptachlor	0.20	0.07	6.56E-07	2.98	2.9
Heptachlor epoxide	0.20	0.07	6.56E-07	1.48	1.4
Methoxychlor	2.0	0.67	6.56E-06	51481.8	51481
Toxaphene	4.0	1.33	1.31E-05	11.6	10.3
Hexachlorobenzene	1	0.33	3.28E-06	7.73	7.4

NA = Not available

(a) Stack gas required sample volume
106.00 dry standard cubic feet
3.00 dry standard cubic meters

(b) Stack gas estimated flow rate
65,000 actual cubic feet per minute
185 deg F,. stack gas temperature
0.55 volume fraction moisture
29,250 dry acfm
20,860 dry scfm
9.85 dry standard cubic meters per second

Table 3-24. Analysis of Volatile Organics in VOST Samples

Matrices: VOST sorbent resins (charcoal/Tenax)
VOST condensate (water)

Holding Time: 14 days

Quantitation: 10 ng/sample

Procedures: VOST tube contents will be spiked with the appropriate surrogates and internal standards, thermally desorbed, bubbled through organic-free water, and trapped on an analytical absorbent trap.

VOST tubes will be analyzed separately for breakthrough determination.

Analysis will be conducted by GC/MS according to SW-846 Method 5040 for volatile organics.

Condensate samples will be analyzed directly using a purge-and-trap device and GC/MS according to SW-846 method 8240. Analysis will be for the complete method list of volatile organic compounds plus the 10 highest peaks.

References: Method 5040, Protocol for Analysis of Sorbent Cartridges from Volatile Organic Sampling Train, SW-846, Third Edition, November 1986, and Updates.

Method 8240, Volatile Organics by GC/MS, SW-846, Third Edition, November 1986, and Updates.

Table 3-25. Planned Performance Test Operating Ranges

Parameter	Test Conditions [a]
Soils feed rate (ton/hr)	20-30
Baghouse dust feed rate (tons/hr)	2-3
Propane feed rate (scf/hr)	As required
Thermal desorber combustion air flow rate (acfm)	9000 - 13000
Thermal oxidizer combustion air flow rate (acfm)	10000 - 15000
Thermal desorber gas outlet temperature (°F)	425
Thermal desorber treated soil exit temperature (°F)	800
Thermal oxidizer gas outlet temperature (°F)	1800
Quench outlet temperature (°F)	160 - 200
Packed bed scrubber recycle water pH	4 - 10
Thermal desorber pressure (inches w.c.)	< -0.01
Baghouse differential pressure (inches w.c.)	2
ID fan current (amps)	(b)
APC recycle water flow rate (gpm)	(b)
APC purge rate (gpm)	4 - 16
CEMs oxygen (%)	3 - 8
CEMs carbon monoxide (ppm_v)	< 100

[a] All values are estimated ranges. Final values will be determined from the performance test results.

[b] To be determined during clean soil shakedown, approved by agency, verified during performance test

Table 3-26. Anticipated Allowable Operating Conditions

Control Parameters [a]	Value	Comments [b]
GROUP A1 PARAMETERS		
Maximum thermal desorber soil feed rate (ton/hr)	30	60-minute rolling average AWFSO
Maximum thermal desorber soil feed rate (ton/hr)	(c)	Instantaneous AWFSO
Maximum baghouse dust feed rate (ton/hr)	3	60-minute rolling average AWFSO
Maximum baghouse dust feed rate (ton/hr)	(c)	Instantaneous AWFSO
Minimum thermal desorber exit soil temperature (°F)[d]	700	20-minute rolling average AWFSO
Minimum thermal desorber exit soil temperature (°F)[d]	(c)	Instantaneous AWFSO
Minimum thermal desorber exit gas temperature (°F)	250	Instantaneous AWFSO
As Alternative measure initial 20 minutes	(e)	
Minimum thermal oxidizer exit gas temperature (°F)	1,700	Instantaneous AWFSO
Maximum stack gas carbon monoxide (ppm$_V$)	100	60-minute rolling average AWFSO
Minimum packed bed scrubber recycle water pH	(c)	20-minute rolling average AWFSO
Minimum packed bed scrubber recycle water pH	4	Instantaneous AWFSO
Minimum APC recycle water flow rate	(e)	Instantaneous AWFSO
Minimum APC purge (gpm)	(e)	Instantaneous AWFSO
Maximum ID Fan current (amp)	(e)	Instantaneous AWFSO
GROUP A2 PARAMETERS		
Maximum thermal desorber pressure (inches w.c.)	-0.01	Instantaneous AWFSO
Minimum thermal desorber exit gas temperature (°F)	250	Instantaneous AWFSO
Maximum thermal desorber exit gas temperature (°F)	450	Instantaneous AWFSO
Maximum thermal desorber exit gas temperature (°F)	500	Instantaneous VO
Maximum thermal oxidizer exit gas temperature (°F)	2100	Instantaneous AWFSO
Minimum baghouse differential pressure (inches w.c.)	1	Instantaneous AWFSO
Maximum quench exit gas temperature (°F)	250	Instantaneous AWFSO
I.D. Fan failure	–	Instantaneous AWFSO
Burner system failure	–	Instantaneous AWFCO
Power failure	–	Instantaneous AWFSO
Minimum stack gas oxygen (%)	3	Instantaneous AWFSO
GROUP C PARAMETERS		
Minimum APC system water supply pressure (psig)	20	

[a] Group A parameters are continuously monitored and are interlocked with the automatic waste feed cutoff system.
Group A1 parameters are established from the performance test results.
Group A2 parameters are based on safety and/or good operating practice considerations.

Group C parameters do not require continuous monitoring and are not interlocked with the automatic waste feed cutoff system. Values are established independently of performance test conditions.

[b] AWFSO = Automatic waste feed shutoff

[c] To be determined during performance test

[d] Limits not in effect during first 20 minutes of operation

[e] <u>To be verified during clean soil shakedown, approved by agency, with final determination during perforn</u>

PTF3-1 11/11/93 8:08pm STATION 1

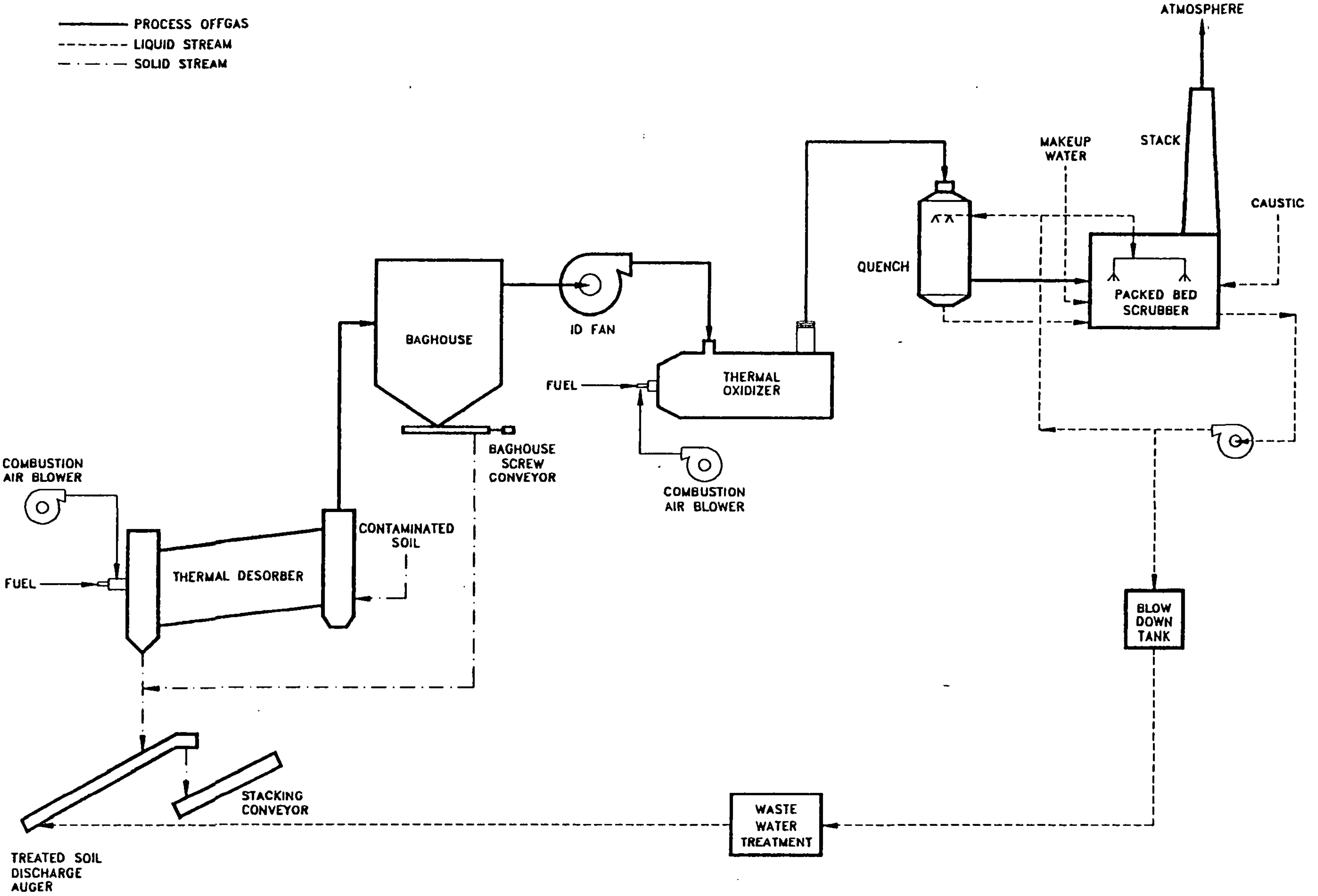

Figure 3-1. LTTD Block Flow Diagram

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PTF3-2 11/11/93 3:42pm STATION 1

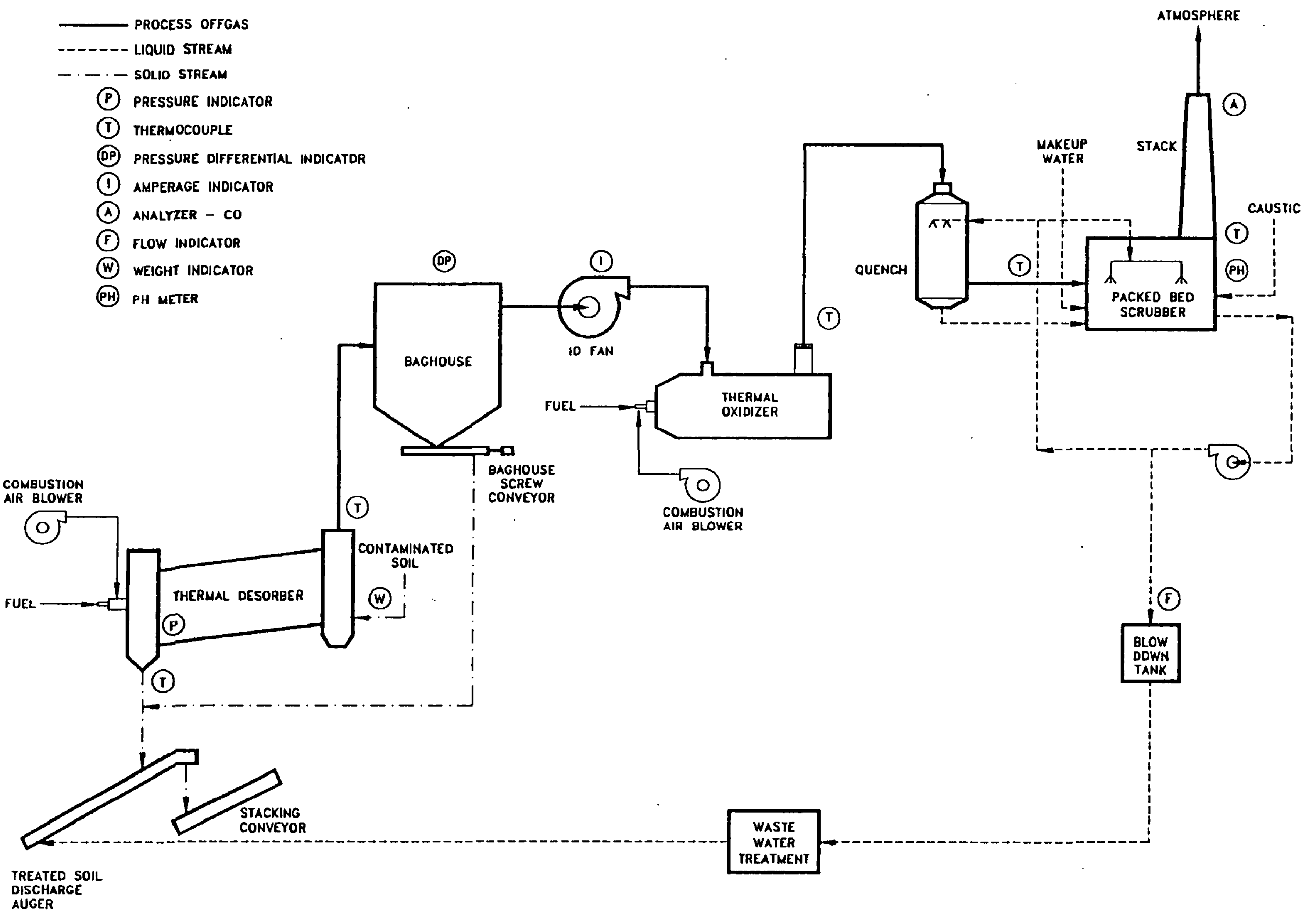


Figure 3–2. Locations of Major Process Instruments

REV. 0	11/11/93	PTF3-2	059312

PTF3-3 01/27/95 8:04am STATION 1

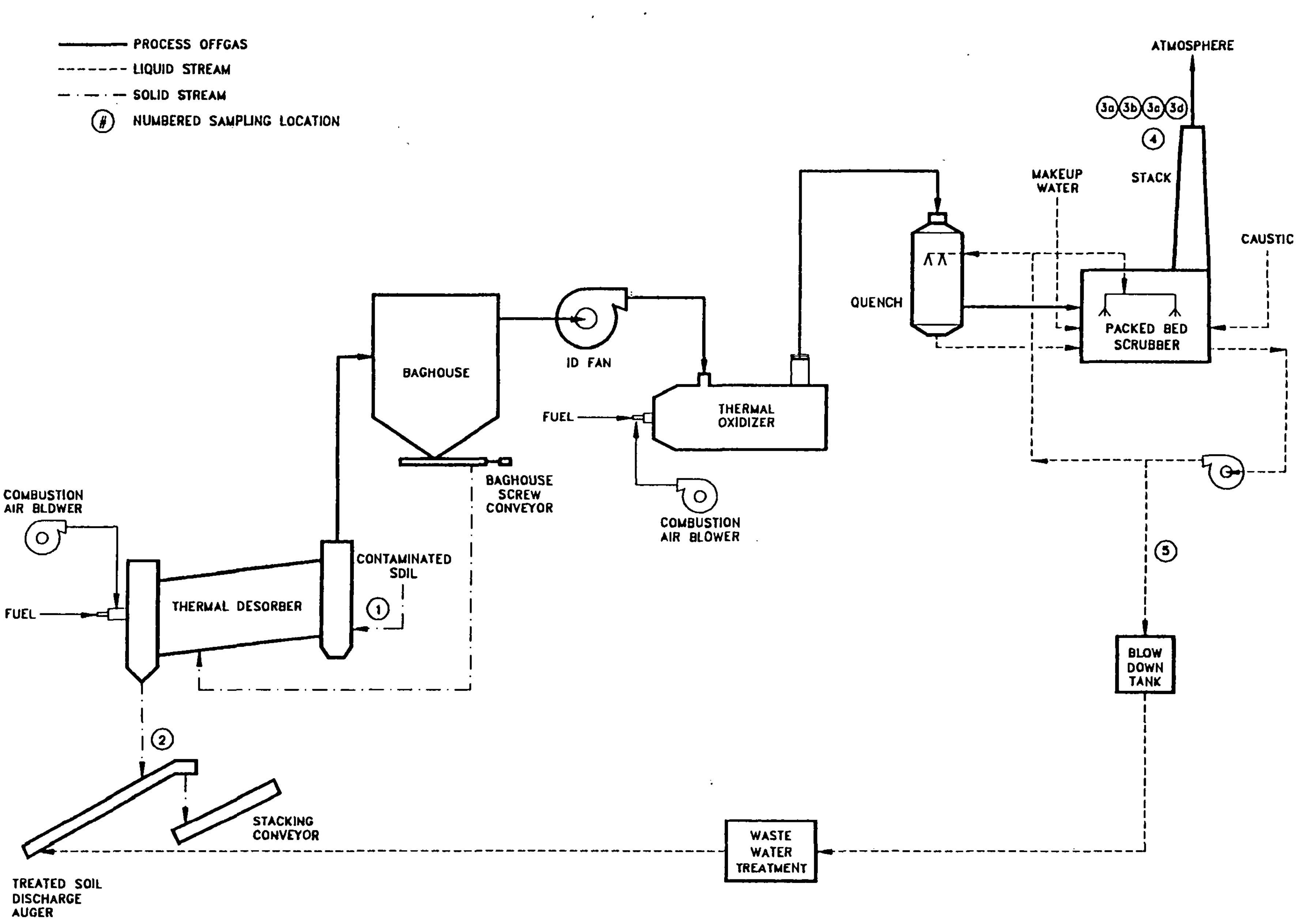


Figure 3-3. Performance Test Sampling Locations

REV. 0	01/27/95	PTF3-3	059312

PTF3-4 02/18/94 [illegible] STATION 1

NOTE:
CEM SAMPLING PORT IS LOCATED AT LOWER STACK ELEVATION AND IS NOT SHOWN.

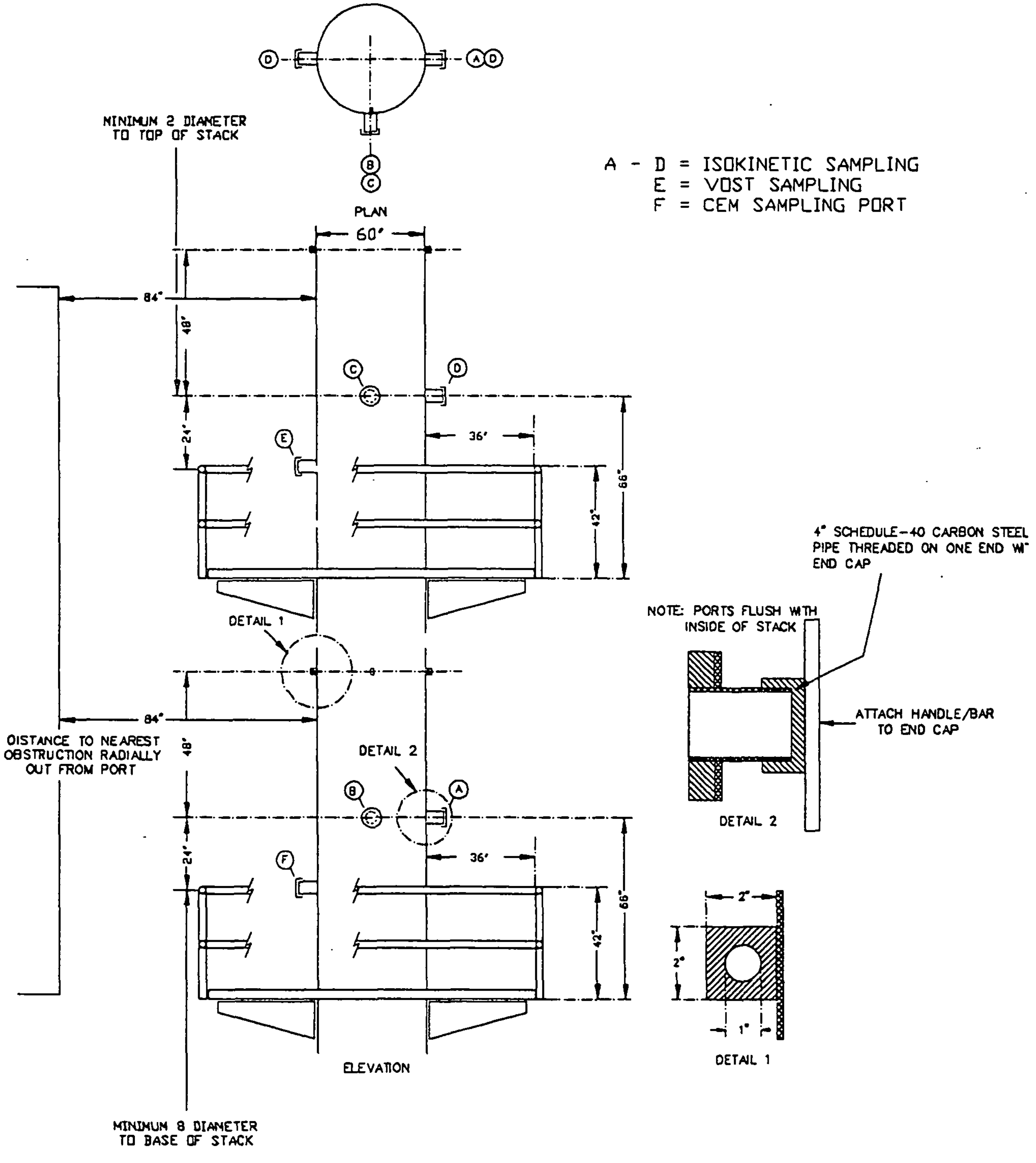
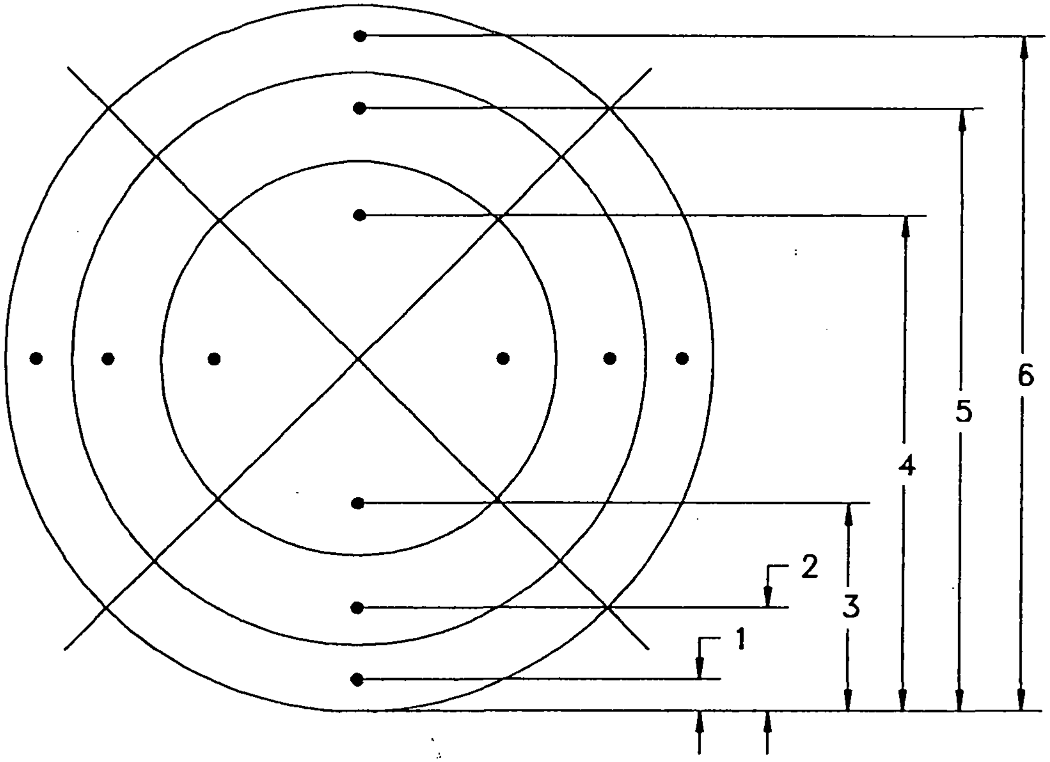


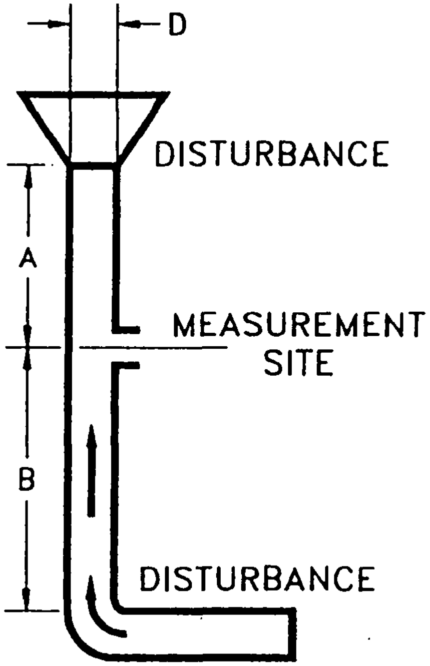
Figure 3–4. Stack Sampling Location Details

REV. 0	02/18/94	PTF3-4	059312

TRAVERSE POINT	DISTANCE % of diameter	DISTANCE (inches)
1	4.4	2 5/8"
2	14.6	8 3/4"
3	29.6	17 3/4"
4	70.4	42 1/4"
5	85.4	51 1/4"
6	95.6	57 3/8"

	LINEAR DIMENSION (a)		DUCT DIAMETERS	
PORTS	A, B	C, D	A, B	C, D
A	20	10	4	2
B	40	50	8	10
D	5	5		

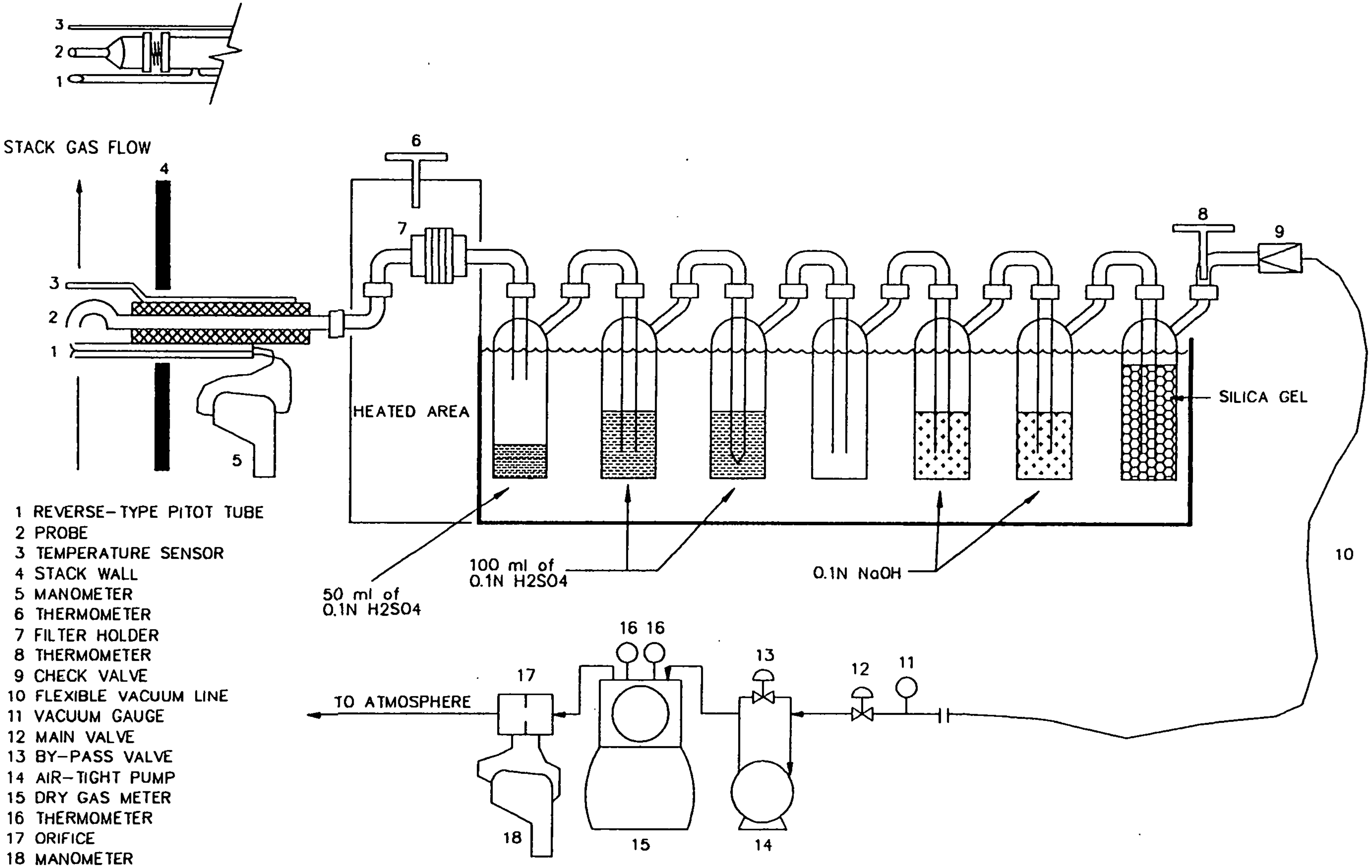




NOTE (a) - SEE FIGURE 3-4.

Figure 3-5. Isokinetic Sampling Locations

PTF3-6 02/18/94 9:43pm STATION 1



1 REVERSE-TYPE PITOT TUBE
2 PROBE
3 TEMPERATURE SENSOR
4 STACK WALL
5 MANOMETER
6 THERMOMETER
7 FILTER HOLDER
8 THERMOMETER
9 CHECK VALVE
10 FLEXIBLE VACUUM LINE
11 VACUUM GAUGE
12 MAIN VALVE
13 BY-PASS VALVE
14 AIR-TIGHT PUMP
15 DRY GAS METER
16 THERMOMETER
17 ORIFICE
18 MANOMETER

Figure 3-6. EPA Method 5 Sampling Train (M5)

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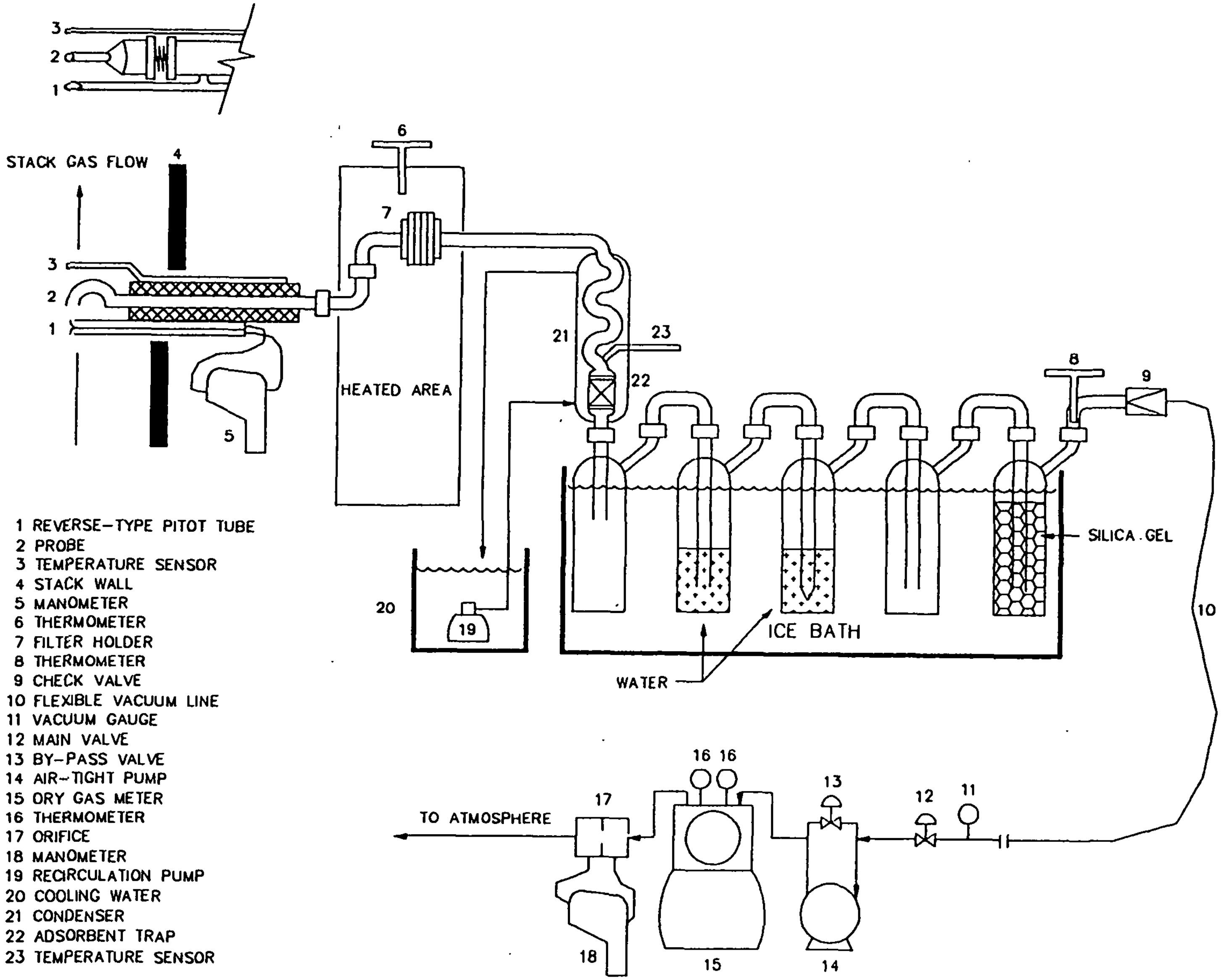
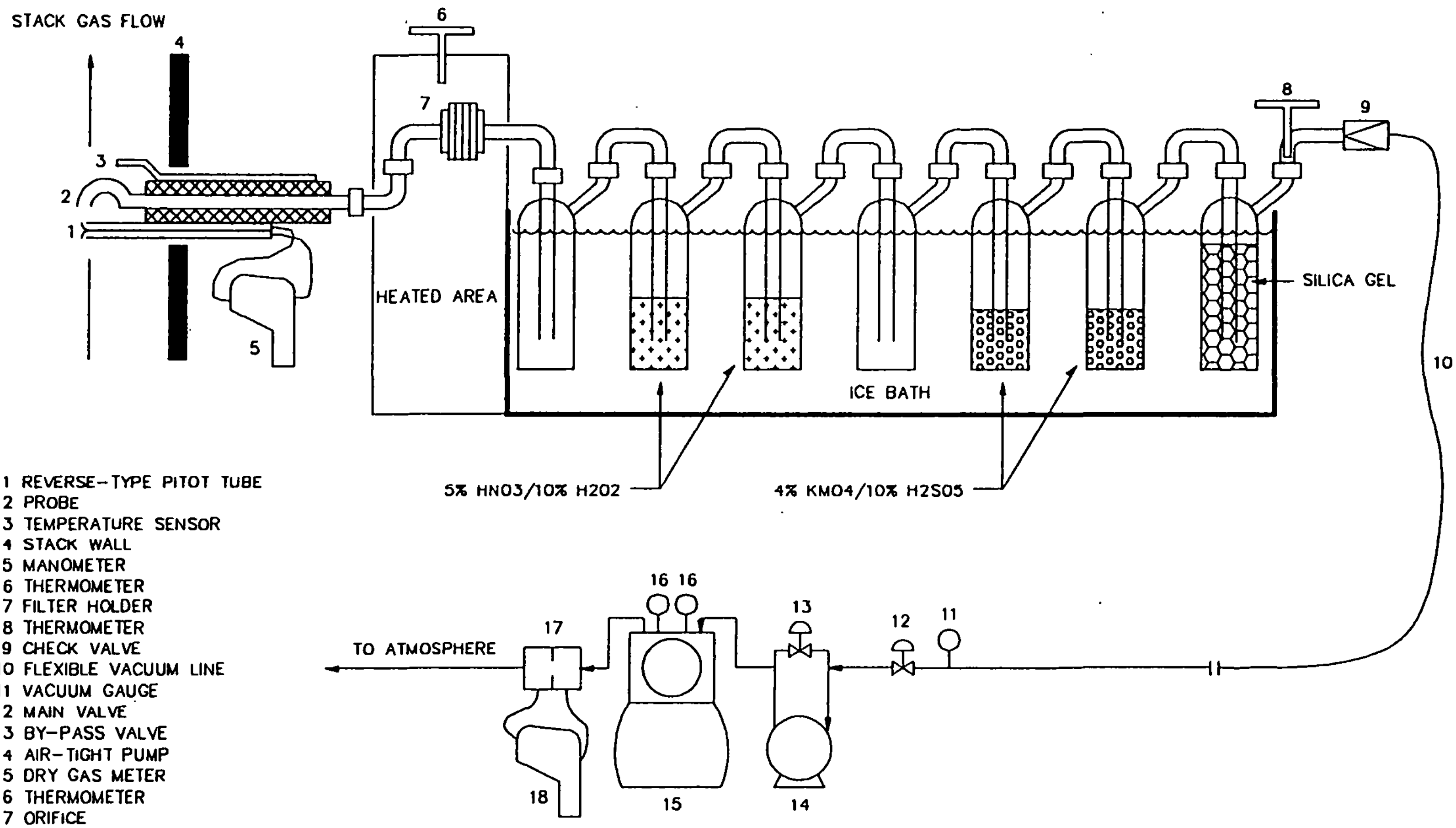


1 REVERSE-TYPE PITOT TUBE
2 PROBE
3 TEMPERATURE SENSOR
4 STACK WALL
5 MANOMETER
6 THERMOMETER
7 FILTER HOLDER
8 THERMOMETER
9 CHECK VALVE
10 FLEXIBLE VACUUM LINE
11 VACUUM GAUGE
12 MAIN VALVE
13 BY-PASS VALVE
14 AIR-TIGHT PUMP
15 DRY GAS METER
16 THERMOMETER
17 ORIFICE
18 MANOMETER
19 RECIRCULATION PUMP
20 COOLING WATER
21 CONDENSER
22 ADSORBENT TRAP
23 TEMPERATURE SENSOR

Figure 3-7. EPA Method 23 Sampling Train

REV. 0	04/27/94	PTF3-7	059312

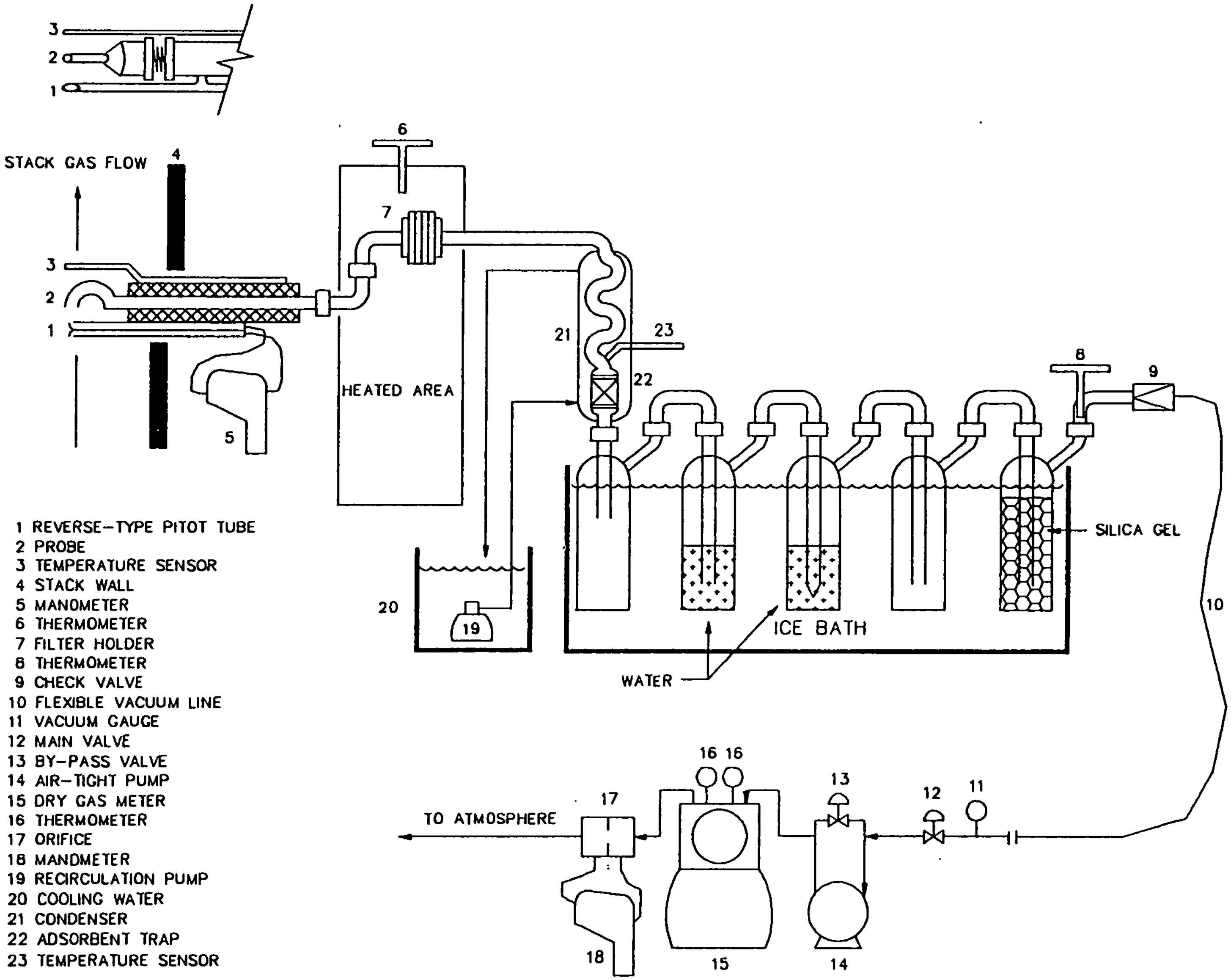


1 REVERSE-TYPE PITOT TUBE
2 PROBE
3 TEMPERATURE SENSOR
4 STACK WALL
5 MANOMETER
6 THERMOMETER
7 FILTER HOLDER
8 THERMOMETER
9 CHECK VALVE
10 FLEXIBLE VACUUM LINE
11 VACUUM GAUGE
12 MAIN VALVE
13 BY-PASS VALVE
14 AIR-TIGHT PUMP
15 DRY GAS METER
16 THERMOMETER
17 ORIFICE
18 MANOMETER
19 RECIRCULATION PUMP
20 COOLING WATER
21 CONDENSER
22 ADSORBENT TRAP

Figure 3-8. EPA Multi-Metals (MMT) Sampling Train

REV. 0	02/18/94	PTF3-8	059312

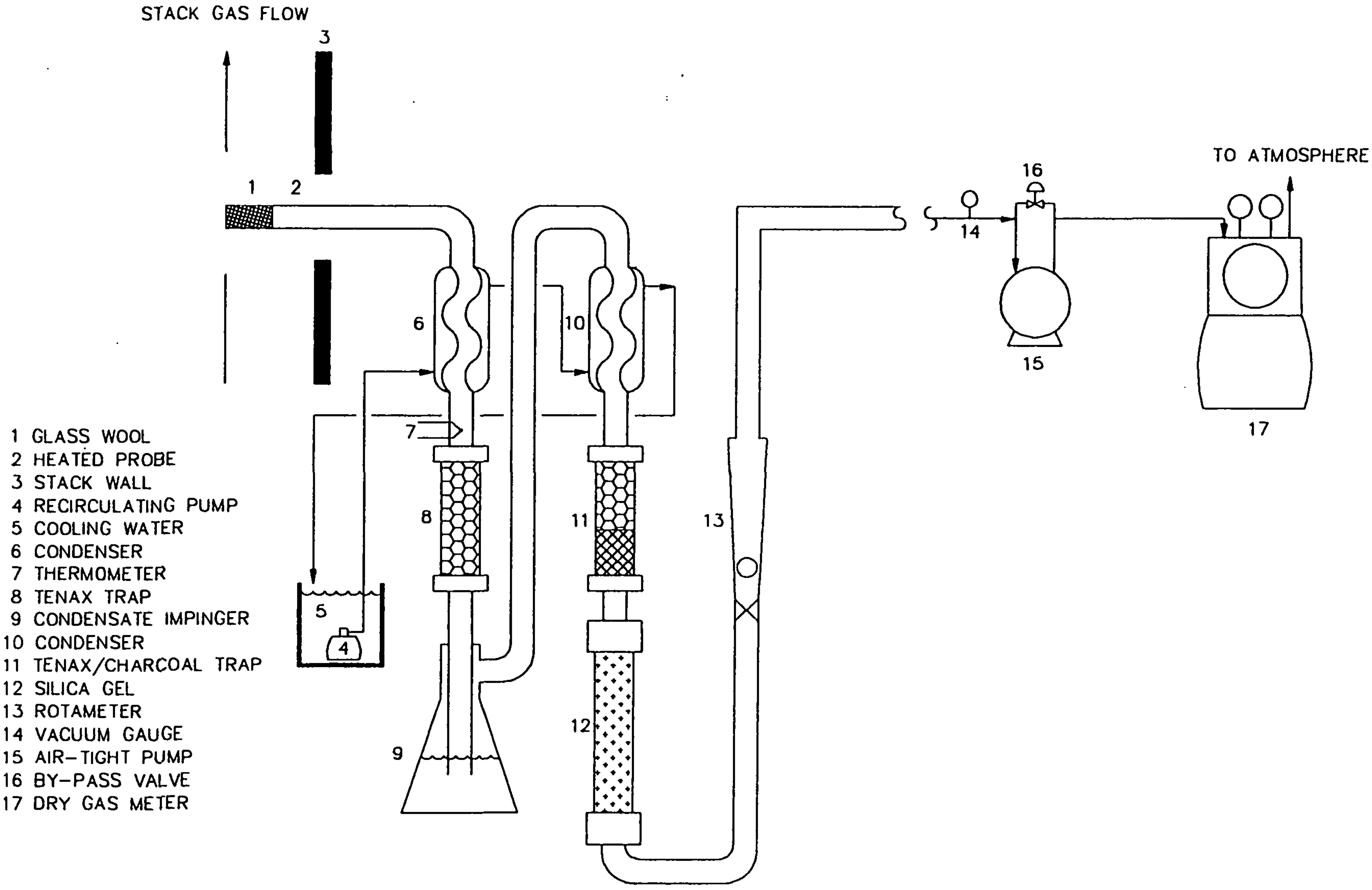
PTF3-9 02/18/94 3:03pm STATION 1



1 REVERSE-TYPE PITOT TUBE
2 PROBE
3 TEMPERATURE SENSOR
4 STACK WALL
5 MANOMETER
6 THERMOMETER
7 FILTER HOLDER
8 THERMOMETER
9 CHECK VALVE
10 FLEXIBLE VACUUM LINE
11 VACUUM GAUGE
12 MAIN VALVE
13 BY-PASS VALVE
14 AIR-TIGHT PUMP
15 DRY GAS METER
16 THERMOMETER
17 ORIFICE
18 MANOMETER
19 RECIRCULATION PUMP
20 COOLING WATER
21 CONDENSER
22 ADSORBENT TRAP
23 TEMPERATURE SENSOR

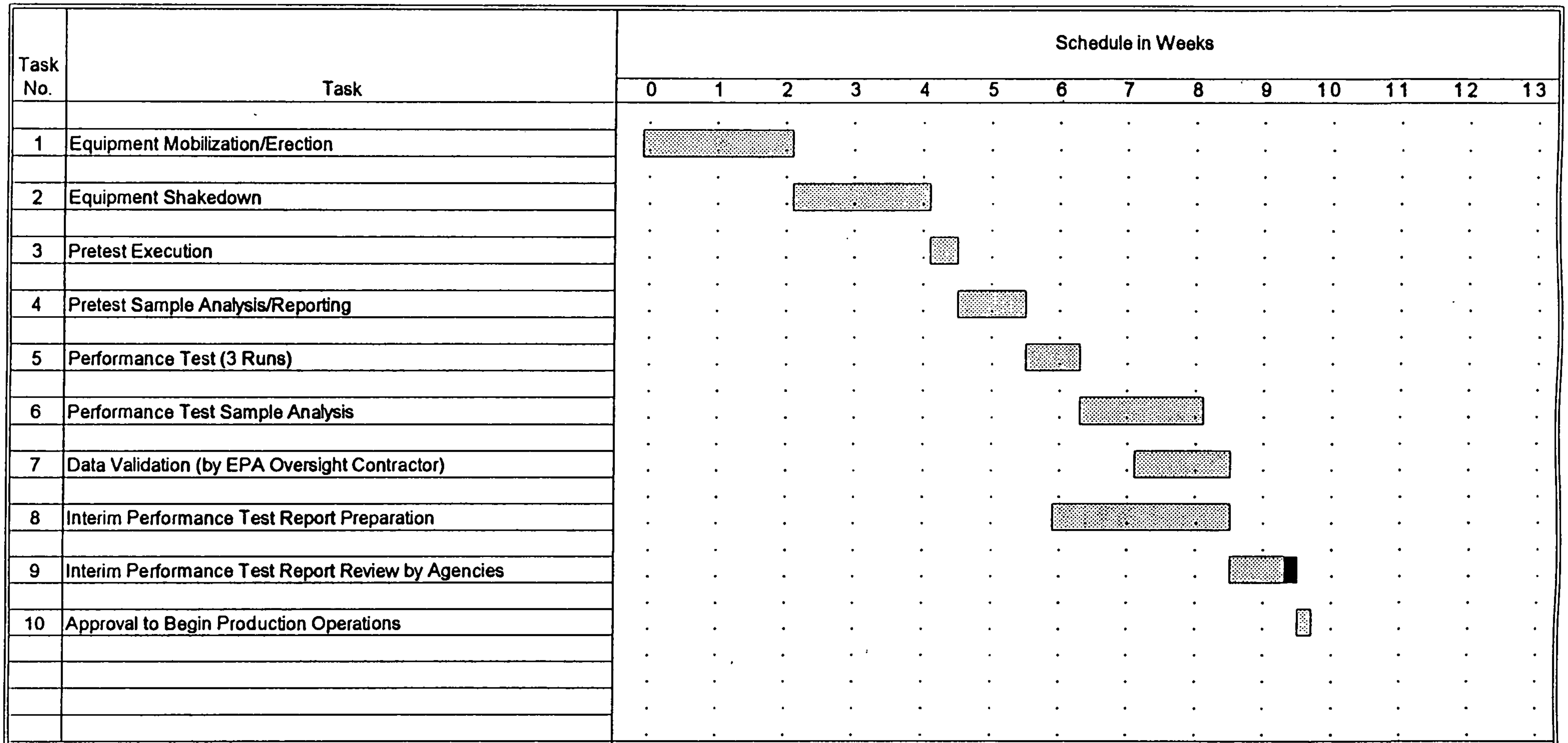
Figure 3-9. EPA Modified Method 5 Sampling Train

REV. 0	02/18/94	PTF3-9	059312



1 GLASS WOOL
2 HEATED PROBE
3 STACK WALL
4 RECIRCULATING PUMP
5 COOLING WATER
6 CONDENSER
7 THERMOMETER
8 TENAX TRAP
9 CONDENSATE IMPINGER
10 CONDENSER
11 TENAX/CHARCOAL TRAP
12 SILICA GEL
13 ROTAMETER
14 VACUUM GAUGE
15 AIR-TIGHT PUMP
16 BY-PASS VALVE
17 DRY GAS METER

Figure 3-10. EPA Volatile Organic Sampling Train (VOST)



Task No.	Task
1	Equipment Mobilization/Erection
2	Equipment Shakedown
3	Pretest Execution
4	Pretest Sample Analysis/Reporting
5	Performance Test (3 Runs)
6	Performance Test Sample Analysis
7	Data Validation (by EPA Oversight Contractor)
8	Interim Performance Test Report Preparation
9	Interim Performance Test Report Review by Agencies
10	Approval to Begin Production Operations

Client: Williams Environmental Services, Inc.
Location: Stone Mountain, GA

Thermal Desorption System Perform
Woods Industries Site
Yakima, Washington

File: PTF3-11.WK1
Project No. 059312
Engr: SKG
Date: 02/18/94

Submitted By: Focus Environmental, Inc.

Figure 3-11. Project Schedule - Pretest an

Activity ▨
Review Meeting ■

4.0 POST PERFORMANCE TEST OPERATION

Following completion of the performance test, the LTTD system will operate at 50% of the contaminated soil feed rate demonstrated during the performance test, based on the maximum run average of the three runs. This is contingent on submittal within one week of the operating data collected during the performance test. The data will be submitted in a form that is manipulatable and easily summarized to establish and justify the interim operating conditions. Operation will be increased to 60% following submittal of preliminary stack gas particulate, HCl and free chlorine data showing acceptable levels of emission. Operation will be increased to 75% following submittal of final stack gas particulate, HCl, free chlorine, carbon monoxide, carbon dioxide, oxygen and moisture data in the stack gas; and POHC fate data. Full production operations will resume following submittal to and approval by Region X of the final Performance Test Report, which includes a complete laboratory data package and the risk assessment addendum.

5.0 MONITORING

During the treatment of contaminated soil, monitoring of several parameters will be conducted. The monitored parameters and the monitoring frequency are discussed in Section 3.3.12 of the performance test plan.

6.0 LTTD INSPECTION

The LTTD and associated equipment will be visually inspected daily during operation for fugitive emissions, leaks, spills, and signs of tampering. Additional details concerning inspections are included in Section 14.3 of the Thermal Desorption Work Plan.

7.0 WASTE FEED SHUT OFF

During normal operation, the soil feed shut off system as described in Section 3.3.9 will be functioning any time soil is being introduced into the thermal desorber.

Williams will perform weekly testing of all alarms associated with soil feed shut offs. Weekly testing will be conducted for all contact points and final outputs to the soil feed shut offs. Manual logs will be kept to document the alarm and automatic soil feed shut off system testing.

If the LTTD is not routinely operating, the alarm and soil feed shut off system will be functionally tested just prior to start-up of the LTTD, and then on the weekly functional testing schedule, as described above, during the operating period.

ATTACHMENT 1
QUALITY ASSURANCE PROJECT PLAN
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

SUBMITTED TO:

BURLINGTON NORTHERN RAILROAD
2000 FIRST INTERSTATE CENTER
999 THIRD AVENUE
YAKIMA, WASHINGTON 98104-1105

PREPARED FOR:

WILLIAMS ENVIRONMENTAL SERVICES, INC.
2075 WEST PARK PLACE
STONE MOUNTAIN, GEORGIA 30087

January 27, 1995
FOCUS PROJECT NO. 059312

PREPARED BY:

FOCUS ENVIRONMENTAL, INC.
9050 EXECUTIVE PARK DRIVE
SUITE A-202
KNOXVILLE, TENNESSEE 37923

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ATTACHMENTS

1. STACK GAS SAMPLING FIELD DATA COLLECTION FORMS
2. CHAIN OF CUSTODY FORMS
3. LABORATORY REQUEST FOR ANALYSIS FORMS

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ACRONYMS AND ABBREVIATIONS

A	percent accuracy
APC	air pollution control
As	arsenic
ASTM	American Society for Testing and Materials
AWFSO	Automatic Waste Feed Shutoff
BEI	Burlington Environmental, Inc.
BIF	boilers and industrial furnaces
C	percent completeness
CEM	continuous emissions monitor
CEMS	continuous emissions monitoring system
CFR	Code of Federal Regulations
Cl_2	chlorine
CO	carbon monoxide
DRE	destruction and removal efficiency
GC/ECD	gas chromatography/electron capture detector
GC/MS	gas chromatograph/mass spectrometer
gr/dscf	grains per dry standard cubic feet
HCl	hydrogen chloride
Hg	mercury
LAC	Laboratory Analysis Coordinator
LTTD	low temperature thermal desorption
M23	EPA Method 23
M5	EPA Method 5
MMT	EPA Multiple Metals Train
N	amount of native material
OCL	organochlorine
Pb	lead
PCDD	polychlorinated dibenzo-p-dioxins
PCDF	polychlorinated dibenzofurans
POHC	principal organic hazardous constituent
ppm_v	parts per million, by volume
PSC	Process Sampling Coordinator
PTM	Performance Test Manager
QA	quality assurance
QAO	quality assurance officer
QAPP	Quality Assurance Project Plan
QC	quality control
R	percent recovery
RP	range percent
RPM	EPA Remedial Project Manager
RSD	relative standard deviation
S	amount of spiked material
SSC	Stack Sampling Coordinator
USEPA	United States Environmental Protection Agency
WAC	Washington Administrative Code
Williams	Williams Environmental Services, Inc.
X	experimentally determined value

1.0 PROJECT TITLE AND PLAN APPROVALS

1.1 PROJECT TITLE: WOODS INDUSTRIES PERFORMANCE TEST

1.2 APPROVALS

EPA Remedial Project Manager	Date
Williams Project Manager	Date
Quality Assurance Officer	Date
Performance Test Manager	Date
Process Sampling Coordinator	Date
Stack Sampling Coordinator	Date
Laboratory Analysis Coordinator	Date
Laboratory Analysis Coordinator	Date

2.0 PROJECT DESCRIPTION

Williams Environmental Services (Williams) has proposed the use of an innovative technology, low temperature thermal desorption (LTTD), to treat pesticides-contaminated soils at the Woods Industries site (Woods). The goals of the performance test will be to demonstrate the ability of the LTTD system to reduce the concentrations of OCL pesticides in the soil and to meet applicable air emission control requirements. The performance test will be deemed successful if the requirements outlined below are met:

- The concentrations of organochlorine (OCL) pesticides (aldrin, alpha-BHC, beta-BHC, gamma-BHC, chlordane, p,p'-DDE, p,p'-DDD, p,p'-DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, methoxyclor, and toxaphene) and metals (As, Hg, and Pb) in the treated soil meets those specified in Washington State Model Toxic Control Act, Residential Method B. The cleanup goals are listed in Table 1-1.
- The ambient concentrations of OCL pesticides (aldrin, alpha-BHC, beta-BHC, gamma-BHC, chlordane, p,p'-DDE, p,p'-DDD, p,p'-DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, methoxyclor, and toxaphene) resulting from stack gas emissions must meet WAC maximum Acceptable Source Impact Levels (ASIL). Ground-level concentrations are calculated based on a dispersion factor resulting from stack height, stack gas velocity, and stack gas temperature. The allowable stack gas concentrations listed in Table 1-2 are based on the EPA SCREEN model and estimated stack gas data. More accurate allowable concentrations will be calculated when stack gas data from the performance test are available.
- The ambient concentrations of indicator metals (As, Hg, and Pb) resulting from stack gas emissions must meet WAC Maximum Allowable Annual Ground-Level Concentrations. In addition, ambient concentrations of any remaining metal of concern (Be, Cd, Cr, Ni, Sb, Ba, Se, Ag, Tl) must meet appropriate risk specific dose (RSD)(for carcinogens) or reference air concentrations (RAC)(for noncarcinogens) as specified by 40 CFR 266, Appendix IV and V. The estimated allowable stack gas concentrations are listed in Table 1-2.
- The concentration of 2,3,7,8-TCDD (TEQ) in the treated soil meets the agreed upon limits listed in Table 1-1.
- A 99.99 percent destruction and removal efficiency (DRE) of a principal organic hazardous constituent (POHC) is achieved per 40 CFR 264.343. A 99.99% DRE will be demonstrated by measuring the concentration of hexachlorobenzene in the feed soil and stack gas.
- The concentration of particulates in the stack gas is less than 0.03 grains per dry standard cubic feet (gr/dscf), corrected to 7 percent oxygen.
- The emission rates of hydrogen chloride (HCl) and chlorine (Cl_2) in the stack gas are controlled to meet the ambient air impact guidelines described in the Boilers and Industrial Furnaces (BIF) guidelines described in 40 CFR 266.107. In addition, if the feed rate of total chlorine would result in an emission rate of greater than 4 lbs/hr of hydrogen chloride (HCl) in the stack gas, 99% removal of HCl will be demonstrated.

- The concentration of carbon monoxide (CO) in the stack exhaust gas is less than 100 ppm_v, based on a 60 minutes rolling average.
- Risk evaluation results related to stack gas emissions including products of incomplete combustion (PICs) performed according to the methodology provided in the Ambient Air Quality Impact Report shows risk within or below the range of acceptable risk.

In addition to the above requirements, the stack gas will be sampled and analyzed for total polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (PCDDs/PCDFs), volatile organic compounds and semi-volatile organic compounds that are potential products of incomplete combustion (PICs). Total PCDDs/PCDFs will be calculated by adding all congeners from the tetra- through the octa- PCDD/PCDF groups. In addition, total equivalent 2,3,7,8 TCDD based on the relative potency of the isomers in accordance with USEPA guidelines will be calculated for use in risk evaluation. Risk evaluation will be made consistent with the methodology used in the Ambient Air Quality Impact Report (AAQIR) for the Woods Industries Site prepared by Burlington Environmental, Inc.

The performance test will consist of three replicate sampling runs. In the test, soil feed and operating conditions are designed to achieve the following goals:

- Establish maximum soil mass feed rate (target 20-30 tons/hr)
- Demonstrate minimum thermal desorber exit soil temperature (target 700° F)
- Demonstrate minimum thermal oxidizer exit gas temperature (target 1700° F)
- Demonstrate minimum Air Pollution Control (APC) system recycle water flow rate
- Demonstrate minimum APC system purge rate (target 12 gpm)
- Demonstrate minimum packed bed scrubber recycled water pH (target 4)
- Establish control limits for the LTTD and Air Pollution Control (APC) system operating parameters
- Establish maximum stack gas velocity by correlating the velocity to ID fan amperage
- Establish minimum oxygen concentration in the stack gas.

Stack sampling protocols for the performance test are summarized as follows:

- Particulates and HCl by EPA Method 5 (BIF Method 0050)
- OCL Pesticides and semi-Volatile organics by EPA Modified Method 5 (SW-846 Method 0010).

- Volatile organics by EPA Volatile Organics Sampling Train (VOST SW-846 Method 0030)
- Metals by EPA Multiple Metals Train (EPA Draft Method 29)
- PCDDs/PCDFs by EPA Method 23 (EPA Method 23)
- Continuous emissions monitoring (CEM) for CO (EPA Method 10) and O2 (EPA Method 3A).

The Quality Assurance Project Plan (QAPP) describes the procedures that will be implemented to ensure that quality data are acquired during the performance test. The QAPP is based on the guidelines described in Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans EPA-600/4-83-004, Feb 1983. The QA/QC procedures specific to the stack gas sampling and analytical contractor(s) will be incorporated into this plan, as needed.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The remedial activities at the Woods Industries site are being performed under the oversight of EPA Region X. The EPA Remedial Project Manager (RPM) will be onsite during the performance test. Other regulatory observers from EPA Region X, EPA technical assistance groups, EPA oversight contractors, and state and local agencies may also be at the site during the performance test.

The performance test program will be performed by a project team consisting of representatives of Burlington Environmental, Inc. (BEI), Williams, and a group of subcontractors. The stack testing for this project will be conducted by a subcontractor who is experienced in the testing of thermal treatment systems. Analytical services will be provided by one or more analytical laboratory subcontractors. A performance testing consultant will serve as the Performance Test Manager (PTM). The overall project organization and lines of responsibility are shown in Figure 3-1. Names of personnel who have been already been selected for the project team are included on this Figure. Since all contractors have not been selected at this time, some individuals will be added at the time of contractor selection.

The BEI Project Manager has overall responsibility for coordinating site activities. He will have oversight responsibilities for Williams' operations during the LTTD system testing.

The Williams Principal in Charge is the corporate officer with overall responsibility for the financial, operational, and health and safety aspects of the project. The Principal in Charge interacts with the client, regulatory agencies, and the Williams Project Manager as required.

The Williams Project Manager is responsible for coordinating LTTD operations with the test team and providing liaison with the EPA Remedial Project Manager (RPM) during testing. Some of his responsibilities include:

- Working with the PTM in planning and implementing the Performance Test Plan
- Preparing the LTTD system for testing
- Calibrating instruments prior to the test
- Testing automatic waste feed shut offs (AWFSOs) prior to the test
- Operating the LTTD system at planned test conditions

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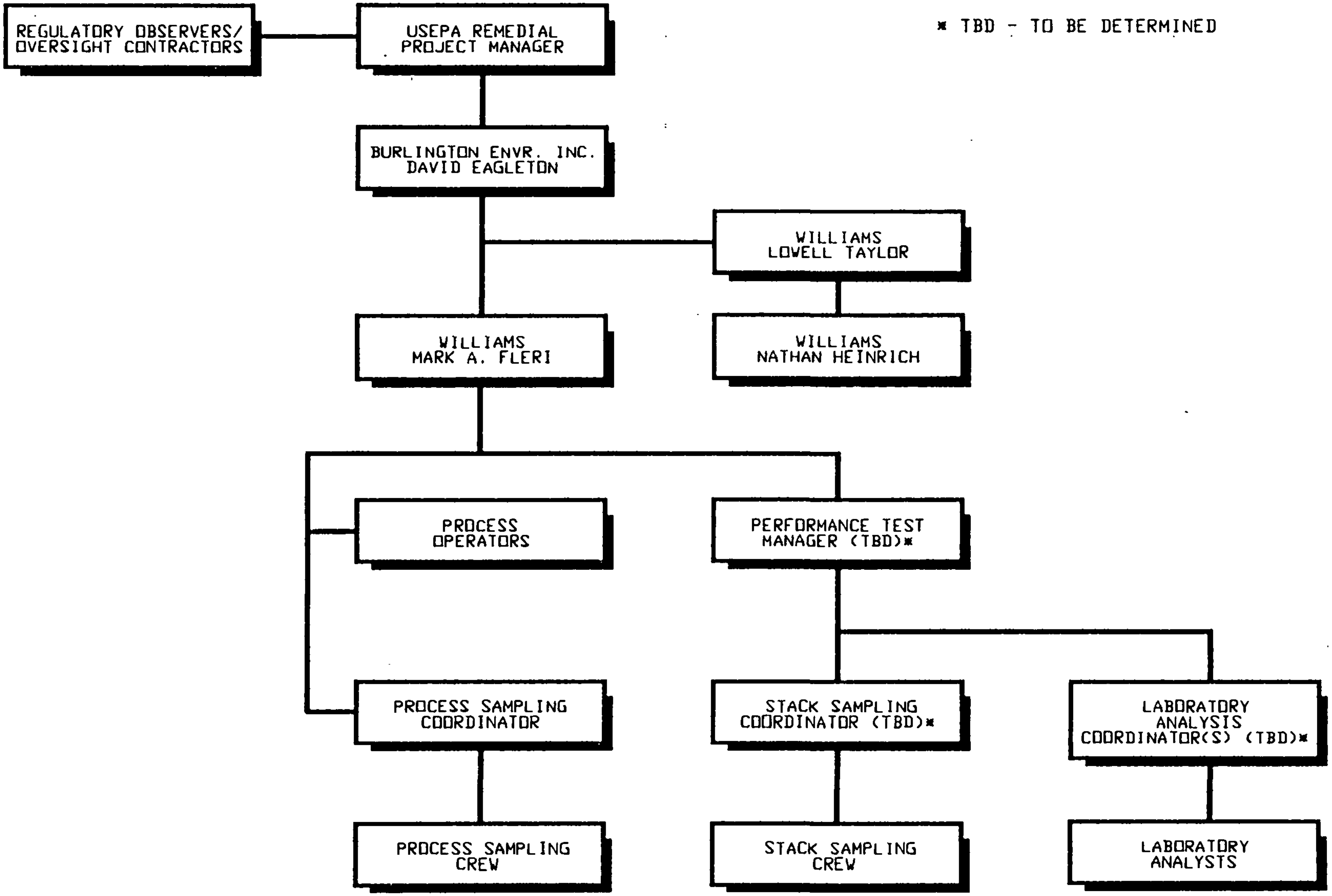

* TBD - TO BE DETERMINED

Figure 3-1. Performance Test Project Organization and Responsibility

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- Recording LTTD process data required by the test plans
- Coordinating LTTD operational activities with the Stack Testing Manager through communication with the PTM
- Certifying sections of the performance test report that document the process operations.

The PTM will be responsible for the development of the performance test plan and performance test report and for coordinating activities among various project team members. Specific responsibilities will include:

- Developing the Performance Test Plan
- Coordinating reviews of the Performance Test Plan and QAPP by all performance test participants prior to the performance test
- Ensuring compliance with the Performance Test Plan and the QAPP by all project team members during the performance test
- Assisting the Williams Project Manager in interfacing with the EPA RPM and other regulatory observers/oversight contractors during the performance test
- Providing coordination between the Williams Project Manager and the Stack Sampling Coordinator during the performance test
- Providing field review of process operating logs, Performance Test Sample Collection Sheets, stack sampling logs, chain of custody forms, and request for analysis forms
- Interfacing with the Laboratory Analysis Coordinators while samples are being analyzed
- Interfacing with the Stack Sampling Coordinator while the performance test stack sampling data is being reduced
- Supervising production of the Performance Test Report
- Certifying the overall performance test results and Performance Test Report
- Coordinating review of the Performance Test Report with regulatory agency personnel

A Quality Assurance Officer (QAO) who reports to the Williams Principal in Charge will also be appointed whose responsibilities will include:

- Reviewing QA/QC activities and communicating the results of those activities to the appropriate personnel
- Making recommendations to the Williams Principal in Charge if problems are detected
- Ensuring that appropriate corrective actions are taken if problems are detected
- Conducting or coordinating any required audits of field or laboratory procedures to ensure compliance with the Performance Test Plan and QAPP
- Verifying that test data are adequately recorded and maintained and that raw data are properly recorded, validated, and interpreted.

A Process Sampling Coordinator (PSC) will be appointed who will have the following responsibilities:

- Preparing and shipping soil sampling equipment, soil sample containers, and shipping containers to the test site
- Assigning and recording soil sample numbers
- Reviewing and approving Performance Test Sample Collection Sheets
- Documenting stack sampling activities in a field logbook
- Directing and/or participating in soil sampling activities
- Overseeing preservation of soil samples in the field
- Preparing soil samples and packaging them for shipment to the laboratory
- Preparing chain of custody and request for analysis forms for soil samples
- Shipping soil samples to the laboratory.

A Stack Sampling Coordinator (SSC) will be appointed who will have the following responsibilities:

- Preparing and shipping stack sampling equipment and stack sample containers, and stack sample shipping container to the test site
- Assigning and recording stack sample numbers
- Preparing and calibrating stack sampling equipment
- Directing stack sampling activities
- Recording field test data required by the Performance Test Plan or stack sampling methods
- Reviewing and approving all field data sheets
- Completing chain-of-custody forms and request for analysis forms for stack samples
- Overseeing preservation of stack samples in the field
- Labeling stack samples and preparing them for shipment to the laboratory
- Shipping stack samples to the analytical laboratory
- Reducing stack sampling data and performing all calculations and QA activities required by the sampling methods
- Preparing a draft and final report of stack sampling activities.

One Laboratory Analysis Coordinator (LAC) will be appointed for each laboratory that provides analytical services for the project. His/her responsibilities will include:

- Receiving, verifying, and documenting that incoming field samples correspond to the chain-of-custody information
- Maintaining records of incoming samples
- Tracking samples through processing, analysis, and disposal
- Preparing QC samples for analysis during the project

- Verifying that personnel are trained and qualified in specified laboratory QC and analytical procedures
- Verifying that laboratory QC and analytical procedures are being followed as specified in the QA/QC Plan
- Reviewing QC and sample data during analysis and determining if repeat samples or analyses are needed
- Submitting certified QC and sample analysis results and data packages to the PTM
- Archiving analytical data.

4.0 QUALITY ASSURANCE OBJECTIVES

QA objectives for precision, accuracy, and completeness are addressed in this section. Procedures and formulas for determining accuracy and precision are discussed in Section 13.0 of this document. The following definitions briefly describe the QA objectives of precision, accuracy, and completeness:

Accuracy: The degree of agreement of a measurement (or an average of measurements of the same parameter) X, with an accepted reference or true value, T. Accuracy is usually expressed as the difference between the two values, X - T, or the difference as a percentage of the reference or true value, 100 (X - T)/T, and sometimes expressed as a ratio, X/T. In some cases, accuracy is described as the percentage recovery of a known quantity of material added to a sample prior to analysis. Accuracy is a measure of the bias in a system.

Precision: A measure of mutual agreement among individual measurements of the same property, usually under "prescribed similar conditions." Various measures of precision exist depending on the prescribed similar conditions. If the number of samples is less than 4, the precision is described as range percent from the average of replicate measured values for analysis of the same parameter. If the number of samples is four or greater, precision is best described in terms of relative standard deviation.

Completeness: A measure of the amount of valid data obtained compared to the amount expected to be collected under normal conditions. Completeness is usually expressed as a percentage.

When experience, established methods of analysis, and homogeneous sample matrices are all present in a project, QA objectives can be stated with some degree of confidence that they can be achieved. Predetermined tolerance limits for the overall precision and accuracy of sampling and analysis cannot be established before the collection of field samples. Therefore, the establishment of QA objectives for a particular performance test project must rely heavily on spike recovery and results of duplicate analyses or samples analyzed before the collection of actual performance test samples.

Data quality objectives for the measurement parameters associated with this project are presented in Table 4-1. Precision estimates presented in the table represent variability for replicate measurements of the same parameters, expressed in terms of range percent or relative standard deviation, as appropriate. Accuracy values include components of both random error and bias, expressed as a percentage of the true value (for reference materials) or percent analyte recovery (for spiked samples).

Table 4-1. Specific Objectives for Data Quality

Test Parameter(s)	Matrix/ Test Series	Method of Determination	Frequency	Accuracy	Precision
OCL Pesticides (SW846-8080)	Feed soil Treated soil Scrubber Blowdown	Duplicate analysis	One sample per matrix	NA	< 35 RP if concentration > 5 times the detection limit, otherwise < 50 RP
		Surrogate (dibutylchlorendate) spiked before sample preparation	One matrix spike and matrix spike duplicate per each matrix	50 - 130% (recovery)	< 35 RP of surrogate recovery
	Blanks	Method blank carried through all sample prep. and analysis steps	Once per sample batch	<5% of analyte concentrations or < 2 times detection limit	
Metals (total) (SW846-6010 and 7471)	Feed soil Treated soil Scrubber Blowdown	Duplicate analysis	One sample per matrix	NA	< 35 RP for results > lowest calibration standard
		One sample from a run spiked at 10 times the detection limit	One sample per matrix	70 - 130% recovery	NA
	Blanks	Method blank carried through all sample prep. and analysis steps	Once per sample batch	<5% of analyte concentrations or < 2 times detection limit	
Heating Value Ash Content Moisture Chlorine Content	Feed soil	Duplicate analysis	One sample per matrix	NA	<10 RP
		Known material	Once per sample batch	90 - 110% of reference value of known material	NA
HCl/Cl2 (SW846-9057)	Stack gas M5 impinger samples	H_2SO_4 and NaOH impinger solutions post spiked at < 3 times native level	Once per performance test	85 - 115% (recovery)	NA
		Duplicate analysis on H_2SO_4 and NaOH impinger solutions	Once per performance test	NA	< 25 RP if concentration > 5 times DL, otherwise < 50
	Blank	Method blank carried through all sample preparation	Once per performance test	<5% of analyte concentrations or < 2 times detection limit	
Oxygen and Carbon Dioxide	Stack gas M5, M23 bag samples	Single analysis of ambient air	Prior to sample analysis	98 -102% (assuming air at 20.8% oxygen)	NA
		Triplicate analysis of test samples	Each sample	NA	< 2 RP

Table 4-1. Specific Objectives for Data Quality

Test Parameter(s)	Matrix/ Test Series	Method of Determination	Frequency	Accuracy	Precision
PCDD's/PCDFs EPA Method 23 (SW846-8290)	Stack gas M23 train samples and blank M23 train	Sorbent resin is spiked with surrogates prior to sample collection	Every sorbent cartridge	70 - 130 % (recovery)	< 30% RSD of surrogate recoveries
		Train components are spiked with internal standards prior to analysis	Every train component	40 - 130% (recovery) for tetra- through hexa-chlorinated homologues, 25 - 130% recovery for hepta and octa homologues	< 60% RSD of surrogate recoveries
	Blank M23 train sample	Method blank for each train component	Once per performance test	<5% of analyte concentrations or < 2 times detection limit	
	Audit	Audit provided by regulatory agency	Once per test	80 - 120% of true value	NA
PCDDs/PCDFs (SW846 8290)	Treated soil	Duplicate analysis	Once per test run	NA	<25 RP
		Surrogates spiked before sample preparation	Every sample	40 - 135%(recovery)	NA
	Blank	Method blank carried through all sample preparation	Once per test	<5% of analyte concentrations or < 2 times detection limit	
		Surrogates spiked before sample preparation	Once per test	40 - 135%(recovery)	NA
	Rinsate	Surrogates spiked before sample preparation	Once per test	40 - 135%(recovery)	NA
OCL Pesticides (SW846-8080)	Stack gas MM5 train samples	Duplicate analysis of all train components from the run with the highest pesticide concentration	Once per performance test	NA	< 50 RP if pesticide concentration is above lowest calibration standard; < 100 RP in all other cases
		Surrogate (dibutyl chlorendate) spiked before sample preparation	Every sample	50 - 150% (recovery)	< 40 RP of surrrogate recovery
	Blank MM5 train sample	Method blank for each train component	Once per performance test	<5% of analyte concentrations or < 2 times detection limit	

Table 4-1. Specific Objectives for Data Quality

Test Parameter(s)	Matrix/ Test Series	Method of Determination	Frequency	Accuracy	Precision
Semivolatile Organic (SW846-8270)	Stack gas MM5 train samples	Duplicate analysis of all train components from one run	Once per performance test	NA	< 50 RP if target compound concentration is above lowest calibration standard; <100RP in all other cases
		Spiked with isotopical labeled surrogates before sample analysis	Every sample	50 - 150% (recovery)	< 40 RP of surrogate recovery
	Blank MM5 train sample	Method blank for each train component	Once per performance test	Verify noncontamination of field samples	
Metals (SW 846-6010, 7000-series)	Stack gas MMT samples	One sample preparation from each train component is analyzed and then spiked at 10 times the detection limit	Once per performance test per component	70 - 130% recovery	NA
	Standards	Duplicate preparation and analysis of NIST standard reference filters	Once per performance test	75 - 125% of true value	< 35 RP
	Blanks	Duplicate preparation and analysis of complete blank sampling trains spiked at 10 times the DL	Once per performance test except mercury For mercury, once per sample matrix	70 - 130% recovery	< 35 RP except mercury For mercury <25 RP
		Analysis of method blanks	Once per performance test	Evaluated on a case-by-case basis	
Volatile Organics (SW846-8240)	Pre-analysis VOST tube demonstration	Analysis of 4 tubes spiked with standard independent of calibration standards @ 100 ng	Demonstrate prior to sample analysis	75-125% recovery	< 25% RSD between spike recoveries
	VOST Samples	Spike each VOST tube sample with surrogates	Every VOST tube sample	50-150% recovery	<35% RSD of sample recovery
		Condensate spiked with surrogates	Every condensate sample	50-150% recovery	<35% RSD of sample recovery
	Blanks	Field blanks to verify lack of field contamination	1 pair for 6 samples	< lowest standard	NA

Table 4-1. Specific Objectives for Data Quality

Test Parameter(s)	Matrix/ Test Series	Method of Determination	Frequency	Accuracy	Precision
Volatile Organics (SW846-8240) (Continued)	Blanks (Continued)	Trip blanks to verify no cross-combination in shipping or storage	1 pair with each shipment; analyzed only if field only if field blanks contaminated	< lowest standard	
		Lab blanks (prepared in same batch as field tubes and archived)	1 pair per day; analyzed only if trip blanks are contaminated	< lowest standard	
		System blanks to verify no laboratory contamination	Daily, before analysis of samples and between high-level samples	< lowest standard	
	Audit	Analysis of sample from EPA audit cylinder	Once per performance test	50-150% of true value	NA
Carbon monoxide	Stack gas CEMS	Calibration error, 3 points (Low and High Range)	Once prior to performance test	± 5% of span	NA
		Calibration checks, high and low range	Daily during perfromance test	Within 3% of span	NA
		Relative accuracy test	Once prior to performance test	Within the greater of 10ppm or 10% of reference method	NA
		Calibration drift test, high and low range, 7-day period, 24 hour test	Once prior to performance test	NA	Within 3% of span
Oxygen	Stack gas CEMS	Calibration error, 3 points	Once prior to performance test	< 0.5% Oxygen	Within 0.5% Oxygen
		Calibration checks, high and low range	Daily during perfromance test	Within 0.5% Oxygen	NA
		Relative accuracy test	Once prior to performance test	Incorporated into CO relative accuracy test	
		Calibration drift test, 7-day period, 24 hour test	Once prior to performance test	Within 0.5% Oxygen	NA

Explanation of abbreviations:
NA - Not Applicable; RSD - Relative Standard Deviation; RP - Range Percent

Data completeness represents the percentage of valid data collected from the total number of valid tests conducted. As it applies to a performance test program, data must be essentially 100 percent complete, in that three valid test runs are needed for each test condition. Because the possibility exists that a sample may be lost or broken, the data from each individual analytical parameter may not be 100 percent complete for all test runs. This may not, however, necessarily invalidate a run. With this in mind, it is difficult, if not impossible to establish numeric values for data completeness for each parameter. The completeness objective of this performance test program is to generate sufficient data for the regulatory agencies to judge the performance of the LTTD system.

A number of procedures will be used to meet the precision and accuracy objectives of the analytical program. All sampling and analytical activities will be conducted following referenced procedures. All reference materials used as calibration standards, surrogate compounds, or laboratory control samples will be of the highest purity commercially available, usually greater than 98 percent. The instruments used in the analysis will be verified each day that samples are analyzed as described in Sections 8.0 and 11.0 of this QA document. Assessment of data precision and accuracy will be accomplished by evaluating the results from analysis of standards, reagent or method blanks, field and trip blanks, duplicate samples, and matrix or surrogate spiked samples.

The QA/QC program will focus upon controlling measurement error within these estimated limits of measurement uncertainty. It should be noted that these limits are estimates which are, in most cases, described in the referenced analytical methods. They represent the range of results which can be expected from these methods based on actual field sampling results and laboratory-based QA/QC studies. Therefore, it is reasonable to expect that the measurement errors associated with this project will be within the objectives shown in Table 4-1.

If ongoing QA/QC procedures reveal that a measurement's error has exceeded the estimated data quality limits, the source of the excessive error will be identified and corrective action will be taken, as described in Section 14.0. If data fall outside the acceptable range of precision and accuracy, even after corrective action has been taken, those data points will be flagged in the final report. The precision and accuracy for those measurements will be reported as determined using the actual data. Also, alternative procedures (either sampling or analytical) may be considered and recommended if possible. Any changes or additions would necessarily be agreed to by all parties before implementation.

The analytical laboratory conducting the analysis of the performance test samples will be required to have standard procedures for preparing, reviewing, and controlling distribution of analytical procedures.

5.0 SAMPLING PROCEDURES

The stack sampling procedures will be implemented by a subcontractor with demonstrated experience in successfully conducting performance stack tests for compliance with applicable regulations. The contractor will be responsible for implementing the detailed stack sampling and analytical procedures which are defined in the Performance Test Plan, as they are approved by the regulatory agency.

Process sampling will be coordinated and conducted by Williams personnel. Williams will be responsible for implementing the detailed sampling procedures which are defined in the Performance Test Plan, as they are approved by the regulatory agency.

Performance test samples will be taken for the following process streams:

- Soil feed
- Treated soil
- Scrubber blowdown
- Stack gas.

Sampling point locations are shown in Figure 3-3 of the Performance Test Plan

The sample collection equipment, procedures, frequency, and methods for the performance test are summarized in Table 3-4 of the Performance Test Plan. Detailed descriptions of these procedures are presented in the Performance Test Plan, Section 3.4.1, which are incorporated here by reference. Table 5-1 summarizes all samples to be collected during the performance test including those related to the QA/QC (duplicates, replicates, spikes, audits and blanks).

Table 5-1 Summary of QA/QC Samples

Sample Matrix	Routine Samples or Field Splits (a) (No. per Run)	Field Duplicates (a) (No. per Run)	Number of Runs	Total Samples Collected During Test
Feed soil				
Physical properties	1	0	3	3
OCL pesticides	1	0	3	3
Total metals	1	0	3	3
Archive	1	0	3	3
Sampling equipment rinse blank	NA	NA	NA	1
Subtotal	4	0	3	13
Treated soil				
Physical properties	1	0	3	3
OCL pesticides	1	0	3	3
Total metals	1	0	3	3
Dioxins and furans	1	1	3	6
Archive	1	0	3	3
Sampling equipment rinse blank	NA	NA	NA	1
Subtotal	5	1	3	19
Scrubber Blowdown				
OCL pesticides	1	0	3	3
Total metals	1	0	3	3
Archive	1	1	3	6
Sampling equipment rinse blank	NA	NA	NA	1
Subtotal	3	1	3	13
Stack Gas M5				
Filter	1	0	3	3
Front half rinse	1	0	3	3
Acid impinger liquid	1	0	3	3
Alkaline impinger liquid	1	0	3	3
Deionized water reagent blank	NA	NA	NA	1
Acetone reagent blank	NA	NA	NA	1
Sulfuric acid solution reagent blank	NA	NA	NA	1
Sodium hydroxide solution reagent blank	NA	NA	NA	1
Subtotal	4	0	3	16
Stack Gas M23				
Filter	1	0	3	3
Resin trap	1	0	3	3
Acetone/methylene chloride rinses	1	0	3	3
Toluene rinses	1	0	3	3
Filter (blank train)	NA	NA	NA	1
Resin trap (blank train)	NA	NA	NA	1
Acetone/methylene chloride rinses (blank train)	NA	NA	NA	1
Toluene rinses (blank train)	NA	NA	NA	1
Filter blank	NA	NA	NA	1
Resin trap blank	NA	NA	NA	1
Acetone/methylene chloride reagent blank	NA	NA	NA	1
Toluene reagent blank	NA	NA	NA	1
Subtotal	4	0	3	19

Table 5-1 Summary of QA/QC Samples

Sample Matrix	Routine Samples or Field Splits (a) (No. per Run)	Field Duplicates (a) (No. per Run)	Number of Runs	Total Samples Collected During Test
Stack Gas MM5				
Filter	1	0	3	3
Resin trap	1	0	3	3
Acetone/methylene chloride rinses	1	0	3	3
Impinger liquid	1	0	3	3
Filter (blank train)	NA	NA	NA	1
Resin trap (blank train)	NA	NA	NA	1
Acetone/methylene chloride rinses (blank train)	NA	NA	NA	1
Impinger liquid (blank train)	NA	NA	NA	1
Filter blank	NA	NA	NA	1
Resin trap blank	NA	NA	NA	1
Acetone/methylene chloride reagent blank	NA	NA	NA	1
Water reagent blank	NA	NA	NA	1
Subtotal	4	0	3	19
Stack Gas MMT				
Filter	1	0	3	3
Nitric acid probe rinse	1	0	3	3
Impinger 1, 2, & 3 solution and rinses	1	0	3	3
Impinger 4 solution and rinse	1	0	3	3
Impinger 5 & 6 solution and rinse	1	0	3	3
Impinger 5 & 6 HCl rinse (if used)	1	0	3	3
Filter blank	NA	NA	NA	3
Nitric acid probe rinse (blank train)	NA	NA	NA	1
Impinger 1, 2, & 3 solution and rinse (blank train)	NA	NA	NA	1
Impinger 4 solution and rinse (blank train)	NA	NA	NA	1
Impinger 5 & 6 solution and rinse (blank train)	NA	NA	NA	1
Impinger 5 & 6 HCl rinse (if used) (blank train)	NA	NA	NA	1
Nitric acid solution reagent blank	NA	NA	NA	1
Water reagent blank	NA	NA	NA	1
Nitric acid/hydrogen peroxide solution reagent blank	NA	NA	NA	1
Acidified potassium permanganate solution reagent b	NA	NA	NA	1
HCl solution reagent blank (if used)	NA	NA	NA	1
Subtotal	6	0	3	31
Stack Gas VOST				
Tenax resin tube	4	0	3	12
Tenax resin/charcoal tube	4	0	3	12
Condensate	1	0	3	3
Tenax resin tube field blank	1	0	3	3
Tenax resin/charcoal tube field balnk	1	0	3	3
Tenax resin tube trip blank	NA	NA	NA	1
Tenax resin/charcoal tube trip blank	NA	NA	NA	1
Tenax resin tube laboratory blank	NA	NA	NA	1
Tenax resin/charcoal tube laboratory blank	NA	NA	NA	1
Tenax resin tube audit samples	NA	NA	NA	3
Tenax resin/charcoal tube audit samples	NA	NA	NA	3
Subtotal	11	0	3	43
TOTAL	37	2	3	154

(a) "Field Splits" are separate portions of the same sample, placed into individual containers.
"Filed Duplicates" are separate samples collected from the same sampling point.

6.0 SAMPLE CUSTODY

Stack sample custody will be the responsibility of the SSC from the time of sample collection until the samples are shipped to the analytical laboratory. Process sample (soils) will be the responsibility of the PSC from the time of sample collection until the samples are shipped to the analytical laboratory. After samples are received at the laboratories, custody will be maintained by the LAC(s).

Samples will be kept in appropriate containers labeled to uniquely identify each sample. An example sample collection sheet, shown in Figure 6-1, will provide an inventory and field sampling record of each process sample collected during field operations. A set of sample collection forms for stack sampling activities will be provided by the stack sampling coordinator once the stack sampling contractor is chosen. These forms will be amended to this QAPP as Attachment 1.

Chain of custody record forms will provide the formal custody record. A "Request for Analysis" form, describing the analyses to be performed on each sample, will accompany samples to the laboratory. Both Chain of Custody and Request for Analysis forms will be provided by the LAC(s) once the analytical contractor is chosen. These forms will be amended to this QAPP as Attachments 2 and 3 respectively.

Samples will be kept on ice as appropriate in an ice chest and will be shipped to the analytical laboratory in a secured chest. Chain of custody forms will be executed and retained as follows:

- One copy retained by the PTM
- One copy retained by the sampling team collecting the data
- One copy sent separately to the analytical laboratory.

The LAC(s) will inventory each shipment of samples and sign and date the original chain of custody form. He will then make a note on the custody form of any discrepancy in the number of samples or breakage of samples. The PTM and the QAO will be notified immediately of any problems identified with shipped samples. All samples will be logged into the contractor's laboratory information management system to track sample information. The laboratory will maintain custody of the samples for a minimum of 60 days after reporting or until notification for release is received from the PTM. A final copy of the completed chain of custody forms will be forwarded to the PTM for inclusion in the final report.

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Figure 6-1. Performance Test Sample Collection Sheet

A. Sample Information:

Comments

Sample Type/Name: ____________________
Sample No(s): ____________________
Run No.: ____________________
Sample Amount(s): ____________________
Number of Samples: ____________________
Collection Date/Time: ____________________

B. Sampling Location:

Comments

Process Area: ____________________
Location Description: ____________________
Sample Description: ____________________
Hazard Category: ____________________

C. Sampling Equipment:

Comments

Type: ____________________

D. Sample Form (circle one):

Comments

Liquid   Solid   Semi-Solid

E. Sample Container (check one):

Comments

________ 4 ounce glass jar   ________ 16 ounce glass jar
________ 8 ounce glass jar   ________ 32 ounce glass jar

________ Other ____________________

F. Preservative (circle one):

Comments

Yes   No   If so, what type: ____________________

G. Sample Composited?:

Comments

Yes   No

Composite No. 1: Time: __________ Amount: __________
Composite No. 2: Time: __________ Amount: __________
Composite No. 3: Time: __________ Amount: __________
Composite No. 4: Time: __________ Amount: __________
Composite No. 5: Time: __________ Amount: __________
Composite No. 6: Time: __________ Amount: __________
Composite No. 7: Time: __________ Amount: __________
Composite No. 8: Time: __________ Amount: __________
Composite No. 9: Time: __________ Amount: __________
Composite No. 10: Time: __________ Amount: __________
Composite No. 11: Time: __________ Amount: __________
Composite No. 12: Time: __________ Amount: __________
Composite No. 13: Time: __________ Amount: __________
Composite No. 14: Time: __________ Amount: __________
Composite No. 15: Time: __________ Amount: __________
Composite No. 16: Time: __________ Amount: __________

H. Approval:

Sampler's Signature: ____________________ Date: __________

Sampling Coordinator's Signature: ____________________ Date: __________

7.0 CALIBRATION PROCEDURES AND FREQUENCY

The objective of this section is to assure that LTTD process instruments, gas sampling equipment, and analytical instruments are performing properly before conducting the performance test and analyzing performance test samples. Equipment and instruments used to generate data for determining compliance with performance requirements or to establish quantitative allowable operating limits will be calibrated prior to and/or during the performance test as necessary.

The calibration procedures are separated into three groups according to the personnel who will perform them. The process instruments will be calibrated by Williams operational personnel, stack sampling equipment by the stack testing subcontractor, and analytical instruments by laboratory personnel. The calibration procedures for each of these groups are described in the following subsections.

7.1 LTTD PROCESS INSTRUMENTS

The following LTTD process instruments will be checked, tested and/or calibrated before the performance test.

- Feed conveyor feed weigh cell
- Baghouse dust flow meter
- Thermal desorber exit gas temperature monitor
- Thermal desorber exit soil temperature monitor
- Thermal desorber pressure monitor
- Thermal oxidizer exit gas temperature
- Baghouse differential pressure gauge
- Quench exit gas temperature thermocouple
- APC system recycle water flowmeter
- Quench/packed bed scrubber liquid pH probe
- APC system water supply pressure gauge
- APC system purge rate flow meter
- ID Fan ammeter
- Stack gas CO monitor
- Stack gas O2 monitor.

The calibration procedures for each specific instrument are summarized in Table 7-1. The procedures will be performed within the time periods (frequencies) shown in the table.

Table 7-1. Summary of Process Instrument Calibration Procedures, Acceptance Criteria, and Frequency

Instrument	Type	Calibration Procedure	Acceptance Criteria	Frequency
FLOW				
Feed soil Baghouse Dust APC Purge APC Recycle water	Weigh cell Flow meter Flow meter Flow meter	Perform calibration procedures based on manufacturer's recommendation	± 1.0% Span	Within 1 month of performance test
TEMPERATURE				
Thermal desorber exit gas Thermal desorber exit soil Thermal oxid. temperature Baghouse exit gas Quench exit gas Packed scrubber exit gas	Thermocouple	Check thermocouple type and condition; use standard thermocouple simulator to generate a millivolt signal from the ANSI standard thermocouple tables corresponding to a given temperature; adjust output signal to generate the proper temperature readout.	± 2.5% span	Within 1 month of performance test
PRESSURE GAUGES				
Thermal desorber Quench recycle flow APC water supply Baghouse DP ID Fan DP	Pressure Transmitter Pressure switch	Use standard pressure calibrator or manometer to generate a signal corresponding to pressure signaldata given by the manufacturer.	± 2% of span	Within 1 month of performance test
CEM SYSTEM				
General	NA	System Audit	Review calibration, check data, inspect recording system, panel lights, sample transport and interface system	Daily during performance test
		Calibration check (High and Low Range)	Average deviation from mean within 3% of span	Daily during performance test

Table 7–2. Sampling Equipment Calibration Requirements

Equipment	Acceptance Limits	Measurement Frequency/Method	Corrective Actions	References
Wet Test Meter	Capacity > 3.4 m^3/hr (120 ft^3/hr) accuracy within ±1%	Calibrate initially, and then yearly by liquid displacement.	Adjust until specifications are met, or return to manufacturer.	Section 5.3.1, Method 5 (a)
Dry Gas Meter EPA Methods (a)	$Yi = Y \pm 0.02(Y)$	Calibrate vs wet test meter initially, and when post–test check exceeds $Y \pm 0.05$.	Repair or Replace and then recalibrate.	Section 5.3.1 – 5.3.3, Method 5(a)
Thermometers	Impinger thermometer ±1°C (2°F); Dry gas meter thermometer, ±3°C (5.4°F) over range; Stack temperature sensor, ±1.5% of absolute temperature.	Calibrate each initially as a separate component against a mercury–in–glass thermometer.	Adjust; determine a constant correction factor or reject.	Section 4.3, Method 2 (a)
Barometer	± 2.5 mm (0.1 inches) Hg of mercury–in–glass barometer	Calibrate vs mercury–in–glass barometer initially; check before and after each field test.	Adjust to agree with a certified barometer.	Section 5.7, Method 5 (a)
Probe Heating System	Capable of maintaining 120°C ± 14°C (248° ± 25°F) at a flow rate of 21 l/min (0.71 ft^3/min)	Calibrate component by APTD–0576(11) initially, if constructed by APTD–0581 (0) or use published calibration curves	Repair or replace and verify the calibration.	Section 5.4, Method 5 (a)
Probe Nozzle	Average of 3 ID measurements of nozzle; difference between high and low < 0.1 mm (0.004 inches)	Use a micrometer to measure to nearest 0.025 mm (0.001 inches)	Recalibrate, reshape and sharpen when nozzle becomes nicked, dented or corroded.	Section 5.1, Method 5 (a)
Analytical Balance	± 1 mg of Class–S weights	Check with Class–S weights upon receipt and daily before each use	Adjust or repair.	Section 2.3.3, Method 5 (a)

Table 7-2. (Continued)

Equipment	Acceptance Limits	Measurement Frequency/Method	Corrective Actions	References
Type S pitot tube and/or probe	All dimension specifications met	Calibrate initially and visually inspect test	Use pitot tubes that meet factory opening specifications; repair or replace as required.	Section 4.1, Method 2 (a)
Stack gas temperature measurement system	Capable of measuring within 1.5% of minimum stack gas temperature	Calibrate initially and after each field test	Adjust to agree with Hg bulb thermometer, or construct a calibration curve to correct the readings.	Section 4.3, Method 2 (a)
Differential pressure gauge (does not include manometers)	Agree within ± 5% of inclined manometers	Calibrate initially and after each field test	Adjust differential pressure using correction factor; repair or replace with inclined manometer.	Section 2.2, Method 2 (a)

Note:

a) New Source Performance Standards, Test Methods and Procedures, Appendix A, 40 CFR 60

The CEM system is included in the process equipment group because the calibration and operation of this instrument are under the direction of Williams personnel. The process CEM system is a continuous analyzer that will be tested before the performance test to allow time for adjustments and a repeat test if necessary. The performance acceptance criteria are listed in Table 7-1 for the CEM. The performance acceptance test will be conducted when the process is operating under normal conditions.

7.2 STACK GAS SAMPLING EQUIPMENT

The stack testing personnel will check, test and/or calibrate the following sampling equipment:

- Dry gas meters
- Probe and filter heating systems
- Temperature measurement systems
- Pitot tubes
- Probe nozzles
- Analytical balances.

The sampling equipment calibration requirements are summarized in Table 7-2. The requirements are detailed in the referenced methods.

The calibration procedures performed and the results will be documented in logbooks and on special forms. Copies of the required information will be included in the performance test report.

7.3 LABORATORY ANALYTICAL EQUIPMENT

The laboratory instruments will be calibrated as specified by the appropriate method before analyzing the performance test samples. The calibration procedures are based on instructions in the referenced analytical methods. For practical reasons, the analytical instrument calibration procedures are summarized with the internal quality control checks in Table 10-1 of Section 10.0. The calibrations performed and the results will be reported as appropriate to assure the quality of data in the performance test sample analysis report.

8.0 ANALYTICAL PROCEDURES

The analytical procedures will be implemented by a contract laboratory, selected at Williams' and/or the client's discretion, which has demonstrated experience in analyzing samples for the parameters identified in the Performance Test Plan. The analysis parameters, sample matrices, number of samples, and analytical reference methods are summarized in Table 3-11 and 3-12 of the Performance Test Plan.

Standard methods will be employed for the analyses of all collected samples, whenever possible. The analytical methods referenced in Table 3-12 of the Performance Test Plan are described in the following documents:

- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, US EPA Publication No. SW-846, 3rd edition, 1986 revised 1990.
- *New Source Performance Standards*, Test Methods and Procedures, Appendix A, 40 CFR 60.
- *Methods Manual for Complying with the BIF Regulations*, EPA/530-SW-91-010, December, 1990.
- *Annual Book of ASTM Standards*, American Society for Testing and Materials, latest annual edition.

Additional details on the analytical procedures are presented in the Performance Test Plan, Section 3.4, which are incorporated here by reference.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

The overall data reduction, validation, and reporting flow scheme for the performance test is presented in Figure 9-1. Reduction of data obtained from this performance test will involve using the sampling and analysis results to calculate the values for various process and performance parameters, such as feed rates and emission rates.

The results of sample analysis will be reported in terms of mass per unit volume and converted to total mass per sample and emission rates in mass per unit time.

The initial step in the data validation will consist of verification of all calculations involved in reduction of sampling and analytical data. The analytical data will be reviewed using EPA Functional Guidelines when applicable, or using the specific method's QC requirements. Next, the data will be investigated for consistency of the results within and between tests. For example, comparisons will be made of stack gas flow rates, stack gas temperatures, and sampling system operating conditions. Analytical data will be reviewed to identify variations in composition from sample to sample among replicate runs. Where unexplainable variations appear, calculations will again be checked for errors, and the sample collection and analytical procedures will be reviewed to identify any causes for the inconsistencies. Any calculation errors will be corrected and anomalies in the sampling or analytical procedures will be documented and reported in the final performance test report.

Automatic data processing procedures will be used to calculate emission rates. These procedures will be checked manually at least once for each set of equations by the SSC. Manual checks of procedures will be documented and retained in the project files.

9.1 TREATMENT OF OUTLYING DATA AND MEASUREMENTS BELOW DETECTION LIMITS

All data collected in the study will be considered valid, with the following qualifications, and will be reported. If anomalous results are obtained, every effort will be made to identify any problems in the sample collection, sample preparation, and/or analysis which could have contributed to the anomaly. If any problems have occurred, they will be reported with the results in question, and may serve to qualify the significance of the result(s).

In instances where the analyte concentration in the analyzed sample is below the limit of quantitation, a "less than" value will be reported for the sample. One half of this quantitation limit will be used to calculate

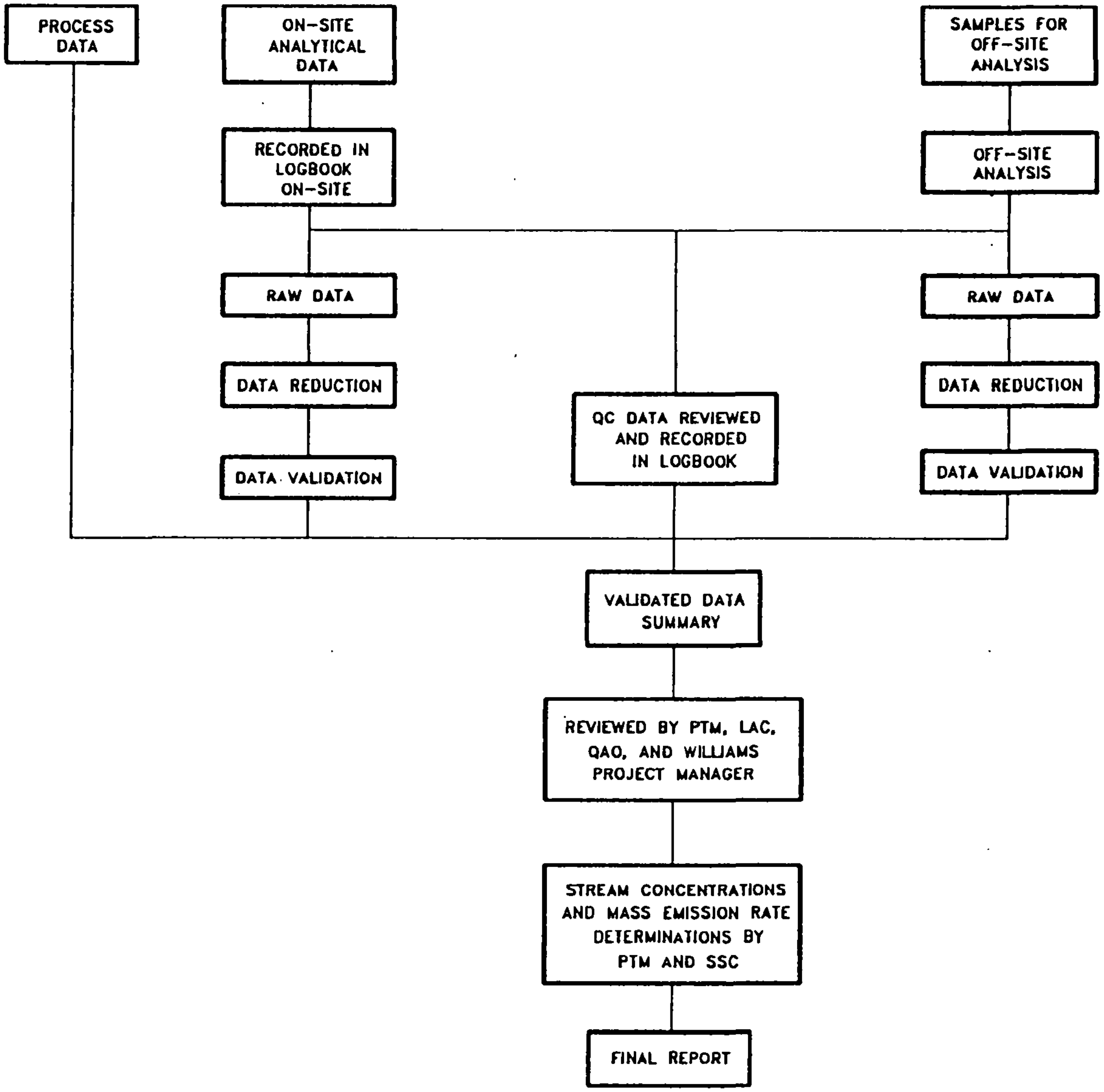

Figure 9-1. Overall Data Reduction, Validation, and Reporting Flow Scheme

an emission level. This computed emission level will be reported as a "less than" value. Quantitation limits will vary with sample type and the level of interference in the sample.

The performance test report will include, as a minimum, the following information:

- Executive summary
- Introduction
- Performance test objectives
- Sampling plan overview
- Performance test results
- QA/QC summary
- Recommended operating conditions.

The performance test report will also include a series of appendices that will contain the following information:

- Process sampling data logs
- Stack sampling field data and results
- Stack sampling instrument calibration results
- Process operating/monitoring data summaries
- Continuous emissions monitoring records
- Continuous monitoring instrument strip charts
- Analytical certificates
- Process instrument calibration records
- Example calculations
- QA program results summary.

All original and supporting information will be retained in Williams' project files for a period of 3 years from the performance test. The project files will include field logbooks, original records of LTTD process conditions, performance calculation work sheets, sample traceability records, analytical instrument output documents, analytical results calculations, and QA program documentation. Copies of all records will be maintained by the organization that generated the original record and one copy will be provided to Williams for archiving.

10.0 INTERNAL QUALITY CONTROL CHECKS

Blanks of all reagents and solvents used in the field for sample recovery will be taken, as well as method blanks to assess possible field or laboratory contamination. Field blanks and trip blanks will be collected for the M23. Samples of an extract taken from the adsorbent resins used in M23 trains will be analyzed to ensure that the resins are free from significant background contamination. Alternately, prepared resins will be purchased from a supplier who will certify the lack of contamination. Process parameter measurements (temperatures, flows, etc.) will consist of reading the appropriate instrument (thermocouple readout, flowmeter, etc.), which will be calibrated before the test.

Internal QC determinations will be performed by analysis of various blanks, standards, spikes, and duplicates. Table 4-1 in Section 4.0 summarizes the QC samples planned for verifying analytical results. The analytical equipment QC control checks, frequencies, acceptance criteria, and corrective actions are summarized in Table 10-1. The QC information in Tables 4-1 and 10-1 will be reviewed before the performance test and revised at that time if needed to ensure the quality of the performance test data.

Table 10-1. Summary of Laboratory Analytical Quality Control Checks, Frequencies, Acceptance Criteria, and Corrective Action

Parameter/ Method	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
OCL Pesticides (GC/ECD Analysis)	Linearity check (multi-point cal.)	Once before sample analysis and once every 72 hours	Refer to SW846 Methods 8080 and 8000A	(1) Repeat linearity check (2) If still unacceptable, make necessary adjustments (3) Repeat linearity check
	Single point check	once every 12 hours (middle concentration standard after each group of 10 samples)	Refer to SW846 Methods 8080 and 8000A	(1) Repeat single point check (2) If still unacceptable, perform new multipoint calibration
	Retention time window	Daily	Refer to SW846 Methods 8080 and 8000A	Flag data
	Surrogate spike analysis	Every sample	Refer to SW846 Methods 8080 and 8000A	(1) Check calibration and standards. (2) Check instrument (3) Repeat analysis (4) Flag data
	Internal standard	Every sample	Refer to SW846 Methods 8080 and 8000A	Flag data
	Extraction blanks	Once per extraction lot (□ 20 samples)	Refer to SW846 Methods 8080 and 8000A	Used to assess memory effects
	Injection blanks	Once every 12 hours	Refer to SW846 Methods 8080 and 8000A	Follow laboratory standard procedures
	Matrix spike duplicate samples	5% or < 20 per batch	Refer to SW846 Methods 8080 and 8000A	(1) Run check standard (2) Correct problem (3) Flag data
Chloride (Ion Chromatograph)	Multi-point calibration	Initially and as required	r>=0.995	(1) Check calculations (2) Recalibrate
	Initial calibration verification	Prior to sample analysis	+/-10% from expected concentration	(1) Check calculations (2) Rerun ICV (3) Recalculate as necessary
	Single-point calibration	After every 10 samples and end of run	+/- 10% from expected concentration	(1) Check calculations (2) Rerun ICV (3) Recalculate as necessary

Table 10-1. Summary of Laboratory Analytical Quality Control Checks, Frequencies, Acceptance Criteria, and Corrective Action

Parameter/ Method	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
Chloride (Ion Chromatograph)	Calibration blank	Daily and after each ICV and CCV	<detection limit	(1) Rerun (2) Clean system (3) Rerun sample back to last blank
	Reference standard	Prior to sample analysis	+/- 10% from expected concentration	(1) Check calculations (2) Rerun reference standard (3) Rerun ICV
Volatile Organics, Semivolatile Organics, PCDDs/PCDFs, (GC/MS Analysis)	Mass scale calibration using PFTBA	As needed	Manufacturer specifications	Repeat calibration
	Ion abundance/intensity check	Beginning of each 12-hour shift	Refer to SW846 Methods 8240, 8270, 8290, & 8000A	Repeat calibration
	Linearity check (multi-point cal.)	Once before sample analysis	Refer to SW846 Methods 8240, 8270, 8290, & 8000A	(1) Repeat linearity check (2) If still unacceptable, make necessary adjustments (3) Repeat linearity check
	Single point check	Daily (beginning of each 12-hr shift)	Refer to SW846 Methods 8240, 8270, 8290, & 8000A	(1) Repeat single point check (2) If still unacceptable, perform new multipoint calibration
	Retention time window	Daily	Refer to SW846 Methods 8240, 8270, 8290, & 8000A	Flag data
	Surrogate spike analysis	Every sample	Refer to SW846 Methods 8240, 8270, 8290, & 8000A	(1) Check calibration and standards (2) Check instrument (3) Repeat analysis (4) Flag data
	Internal standard	Every sample	Refer to SW846 Methods 8240, 8270, 8290, & 8000A	Flag data
	Extraction blanks	Once per extraction lot (□ 20 samples)	Refer to SW846 Methods 8240, 8270, 8290, & 8000A	Used to assess memory effects
	Matrix spike duplicate samples	5% or < 20 per batch	Refer to SW846 Methods 8240, 8270, 8290, & 8000A	(1) Run check standard (2) Correct problem (3) Flag data

Table 10-1. Summary of Laboratory Analytical Quality Control Checks, Frequencies, Acceptance Criteria, and Corrective Action

Parameter/ Method	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
Metals (ICP)	Calibration (1-point for each mixed standard solution)	Before analytical run	Manufacturers specifications	Repeat calibration
	Check standard	1 out of 10 samples and at end of run	± 10% of standard	(1) Repeat check (2) Repeat calibration
	Matrix spike	1 per batch	± 25% of actual	Flag data
	Matrix spike duplicate	1 per batch	± 25% of actual	Flag data
	Calibration blank	1 out of 10 samples and at end of run	Refer to method SW846 Method 6010	(1) Terminate analysis (2) Correct problem (3) Recalibrate
	Reagent blank	1 at beginning of analysis	Refer to method SW846 Method 6010	Use to correct data
Metals (GFAAS)	Calibration (blank, 3 standards)	Daily	Manufacturers specifications	Repeat calibration
	Check standard	1 per 10 samples	± 20% of standard	(1) Repeat check (2) Repeat calibration
	Matrix spike	1 per batch	± 25% recovery	Analyze by standard additions
	Matrix spike duplicate	1 per batch	± 25% recovery	Analyze by standard additions
	Blank	1 per sample batch	None	Use to correct data
Particulate Matter, Moisture	Balance calibration with Class-S wts	Before each use	± 1 mg	Adjust or repair

11.0 PERFORMANCE AND SYSTEM AUDITS

Field sampling performance audits will be accomplished through observation of the sampling operations by the regulatory agency representatives and the PTM.

Analytical performance audits will consist primarily of replicate analyses of field samples and the scheduled analysis of blanks, spikes, and standards using the analytical methods identified in Section 9.0 of this document. If deemed necessary by the PTM and QAO, standard reference materials or performance evaluation samples will be submitted for analysis as unknowns.

A system audit will be performed before any new laboratory experimental procedures are implemented that are not described in standard analytical protocols. This audit may be performed by the PTM, Laboratory Analysis Coordinator, QAO, or another designee of the Williams Project Manager. The audit may include an on-site inspection and review of the analytical operations and the associated QA activities being employed, review of results of Method Detection Limit studies, review of analytical results from audit samples, or other QA procedures. Additionally, the PTM, Laboratory Analysis Coordinator(s), and QAO will frequently review data to ensure that all required QC checks are being made and that evaluation criteria are being followed.

12.0 PREVENTIVE MAINTENANCE

Preventive maintenance of sampling and analytical equipment used during the project will be performed according to the procedures and schedules set forth in manufacturers' maintenance manuals and as described in appropriate parts of standard methods.

All preventive maintenance performed will be recorded in a service record log for each instrument. The log shall include a signature and date. If the performance of the instrument could have been affected by the maintenance procedure, calibration check samples (where appropriate) will be analyzed and the results recorded in the record notebook before any samples are analyzed. Whenever parts are replaced, the serial number of the new part (if available) or an assigned serial number will be logged into the maintenance record notebook. When parts are replaced, audit samples shall be analyzed to demonstrate correct operation of the system.

13.0 PROCEDURES FOR ASSESSING DATA ACCURACY AND PRECISION

The QA activities implemented in this study will provide a basis for assessing the accuracy and precision of the analytical measurements. Section 4.0 discusses the QA activities that will generate the accuracy and precision data for each sample type. The generalized forms of the equations that will be used to calculate accuracy and precision are presented below.

13.1 ACCURACY

When a reference standard material is used in the analysis, percent Accuracy (A) will be calculated as follows:

$$A = \frac{\text{Found concentration}}{\text{True concentration}} \times 100 \qquad \text{Equation 13-1}$$

Percent analyte Recovery (R) will be calculated as follows:

$$R = \frac{(X-N)}{S} \times 100 \qquad \text{Equation 13-2}$$

where X is the experimentally determined value, N is the amount of native material in the sample, and S is the amount of spiked material of the species being measured. Recoveries are used to determine accuracy when standards are not available.

13.2 PRECISION

When less than four analyses of the same parameter are available, precision will be calculated as a Range Percent (RP) from the average of replicate measurements according to:

$$RP = \frac{(X1 - X2)}{\text{Average X}} \times 100 \qquad \text{Equation 13-3}$$

Where X1 and X2 are the highest and lowest results of replicate measurements.

Where 4 or more analyses of the same parameter are available, the precision will be determined as the Relative Standard Deviation (RSD) according to:

$$RSD = \frac{\text{Standard deviation}}{\text{Average X}} \times 100 \qquad \text{Equation 13-4}$$

13.3 COMPLETENESS

Percent Completeness (C) is calculated as:

$$C = \frac{\text{Number of Valid Results}}{\text{Total Number of Samples}} \times 100 \qquad \text{Equation 13-5}$$

14.0 CORRECTIVE ACTION

The need for corrective action occurs when a circumstance arises that threatens the quality of the data output. For corrective action to be initiated, awareness of a problem must exist. In most instances, the personnel conducting the field work and the laboratory analyses are in the best position to recognize a problem or nonconformance that will affect data quality. Keen awareness on their part can frequently detect minor instrument changes, drifts, or malfunctions which can be corrected. If major problems arise, sampling and laboratory personnel are in the best position to decide upon the proper corrective action and initiate it immediately, thus minimizing data loss. Therefore, the field sampling and laboratory analysis personnel will have prime responsibility for recognizing a nonconformance. Each nonconformance shall be documented by the personnel identifying it or originating the corrective action. For this purpose, a variance log, testing procedure record, notice of equipment calibration failure, results of laboratory analysis QC tests, audit report, internal memorandum, or letter shall be used as appropriate. Documentation shall include:

- Identification of the individual(s) identifying or originating the nonconformance
- Description of the nonconformance
- Any required approval signatures
- Method(s) for correcting the nonconformance (corrective action) or description of the variance granted
- Schedule for completing corrective action.

Documentation in the form of a nonconformance report shall be made available to project and laboratory management and the QAO. It is the responsibility of the PTM, LAC(s), and/or QAO to notify appropriate personnel of the nonconformance. Samples affected will be listed on the nonconformance report.

Decisions on whether to take corrective action and what action(s) to take will be made by the PTM, LAC(s), and/or QAO. When a corrective action is taken by any of the operations or analytical laboratory personnel, they will be responsible for notifying the QAO so that, if deemed necessary, QA surveillance of the affected sampling or analysis system can be intensified. Nonconformance and corrective action reports will become part of the performance test report or the supporting data files that are submitted to the regulatory agencies.

A second recognition level of the need for corrective action will be determined by the QAO. The QAO is responsible for determining the need for corrective action based on the results of the audits described in Section 11.0 and from review of the QA data generated during the study. The QAO will be responsible for initiating corrective action by immediately notifying the PTM during the sample analysis phase. The appropriate manager will then be responsible for instituting corrective action and ensuring that the corrective actions produce the desired results.

Ultimately, the personnel performing and checking the sampling and analysis procedures and results must participate in decisions to take correct actions. To reach the proper decision, each individual must understand the program objectives and data quality required to meet these objectives. Data quality objectives for this program are presented in Section 4.0. All personnel involved in the analytical components of this project will receive an approved copy of this QA Plan and will be informed of these objectives. Each individual will have a responsibility to notify the respective PSC, SSC, LAC whenever a measurement system is not yielding data within these objectives.

If a situation arises requiring corrective action, the following closed-loop corrective action system will be used:

- Define the problem
- Assign responsibility for investigating the problem
- Investigate and determine the cause of the problem
- Determine corrective action course to eliminate the problem
- Assign responsibility for implementing the corrective action
- Determine the effectiveness of the corrective action and implement the correction
- Verify that the corrective action has eliminated the problem
- If not completely successful, loop back to first step.

Soil Treatment Final Report
Woods Industries Site
Yakima, Washington

Volume II —Appendices E and E-1

August 7, 1996

Prepared for:

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Seattle, Washington

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Columbia, Illinois 62236-0230

Project 12883088

PHILIP
ENVIRONMENTAL

MILTON ROY

INFRARED GAS ANALYZER

MODELS 3300 & 3400

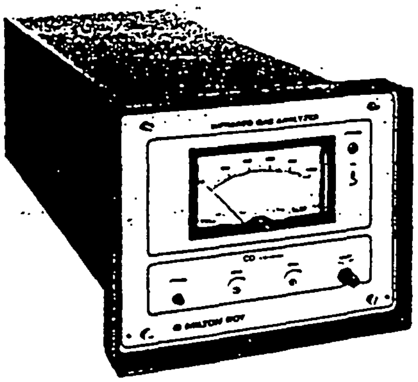
No optical or mechanical adjustments ■

Single beam optics ■

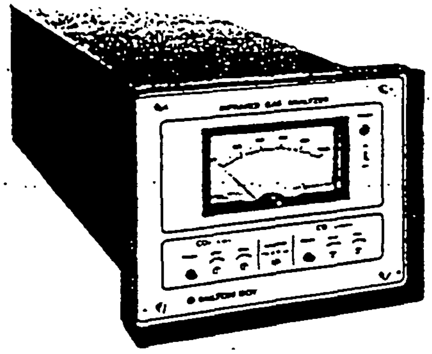
alog or ig. Readout ■

Modular nstruction for maintenance ■

sensitivity to vibration ■



Model 3300
Single Component Dual Range



Model 3400
Dual Component Single Range

The simplicity of single beam optics design — made possible by the Microflow Detector — results in highly stable, reliable analyzers of unmatched analytical performance, requiring no optical adjustments and only the simplest maintenance.

Principle of Operation

The analyzer uses a technique based on the infrared absorption characteristics of gases to measure gas concentration. Use of an efficient single beam design results in good long-term stability.

A single beam of infrared energy is modulated and passed through a sample cell containing the gas to be measured. The beam emerges attenuated by the amount of energy absorbed by the gas(es) in the sample. Changes in the concentration of the gas(es) result in changes of the intensity of the beam. The remaining energy in the beam is passed serially through two cavities of an infrared detector, a mass-flow sensor filled with gas of the type to be measured.

Changes in the intensity of the beam change the pressure differential between the cavities and consequently the balance of the electrical bridge in the detector circuit.

Electronic processing and linearization of the imbalance signal are used to generate an electrical output signal linearly proportional to the concentration of the gas measured.

Standard Applications

Combustion Efficiency
- Burners & Boilers (CO, CO_2)
- Commercial Ovens (CO, CO_2)

Controlled Atmospheres
- Heat treating (CO, CO_2, CH_4)
- Greenhouses (CO_2)
- Fermentation (CO_2)
- Air Liquification (CO_2)

Process Chemical Gas Analysis

Respiration Studies
- Single Breath Lung Diffusion (CO)

Stack Gases

Total Organic Carbon Analysis (TOC)

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PROCESS & ENVIRONMENTAL INSTRUMENTS DIVISION

5. Repairs, replacements, adjustments and service performed out-of-warranty shall be charged to the customer at the then current prices for parts, labor, transportation and subsistence.

6. This warranty attaches to the instrument itself and is not limited to the original purchaser.

7. In no event will CSI have any obligation or liability for damages, including but not limited to, consequential damage arising out of, or in connection with, the use or performance of equipment or accessories. No other warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose will apply to equipment or accessories.

8. This warranty constitutes the full understanding of the manufacturer and buyer, and no terms, conditions, understanding or agreement professing to modify or vary the terms hereof shall be binding unless hereafter made in writing and signed by an authorized official of CSI.

All price revisions and design modification privileges reserved.

WARRANTY

1. Except as otherwise indicated, all instruments and stack systems manufactured and sold by Columbia Scientific Industries Corporation (CSI) are guaranteed for a period of one year from date of shipment from the factory against defects in materials and workmanship of those parts manufactured by CSI, and then, only when operated, serviced and maintained in accordance with the instruction manual. Those parts not manufactured by CSI are guaranteed only to the extent that they are covered by a warranty of original manufacturer. Permeation tubes are warranted for six (6) months. Spare parts and accessories, except expendables, are warranted for ninety (90) days. Expendables such as batteries, sample holders, fuses and indicating lamps are not covered by this warranty.

2. The warranty is voided by the following:

a) Injection into CSI stack systems or CSI ambient air monitoring or calibrating equipment, of gas mixtures containing reactive suspended matter or molecules yielding and depositing liquids, tars, solids and other non-gaseous residues.

b) Injection of caustic solutions into the hydrogen lines of CSI hydrocarbon monitors by a malfunctioning hydrogen generator.

c) Damage to CSI Accelerating Rate Calorimeters or Quantitative Reaction Calorimeters caused by samples that detonate, deflagrate or otherwise escape the confines of the sample holder.

d) Damage to stack sampling probes caused by severe corrosion.

e) Damage caused by incorrect installation, by misuse, or by mishandling.

3. Warranty service requests must be received by CSI within the warranty period. Upon notification by the purchaser, CSI will correct defects coming within the scope of this warranty by repairing or replacing the defective unit either at the CSI factory or at the customer's site, at CSI's option. Return shipment of items to CSI must be authorized by a CSI representative and is at customer's expense.

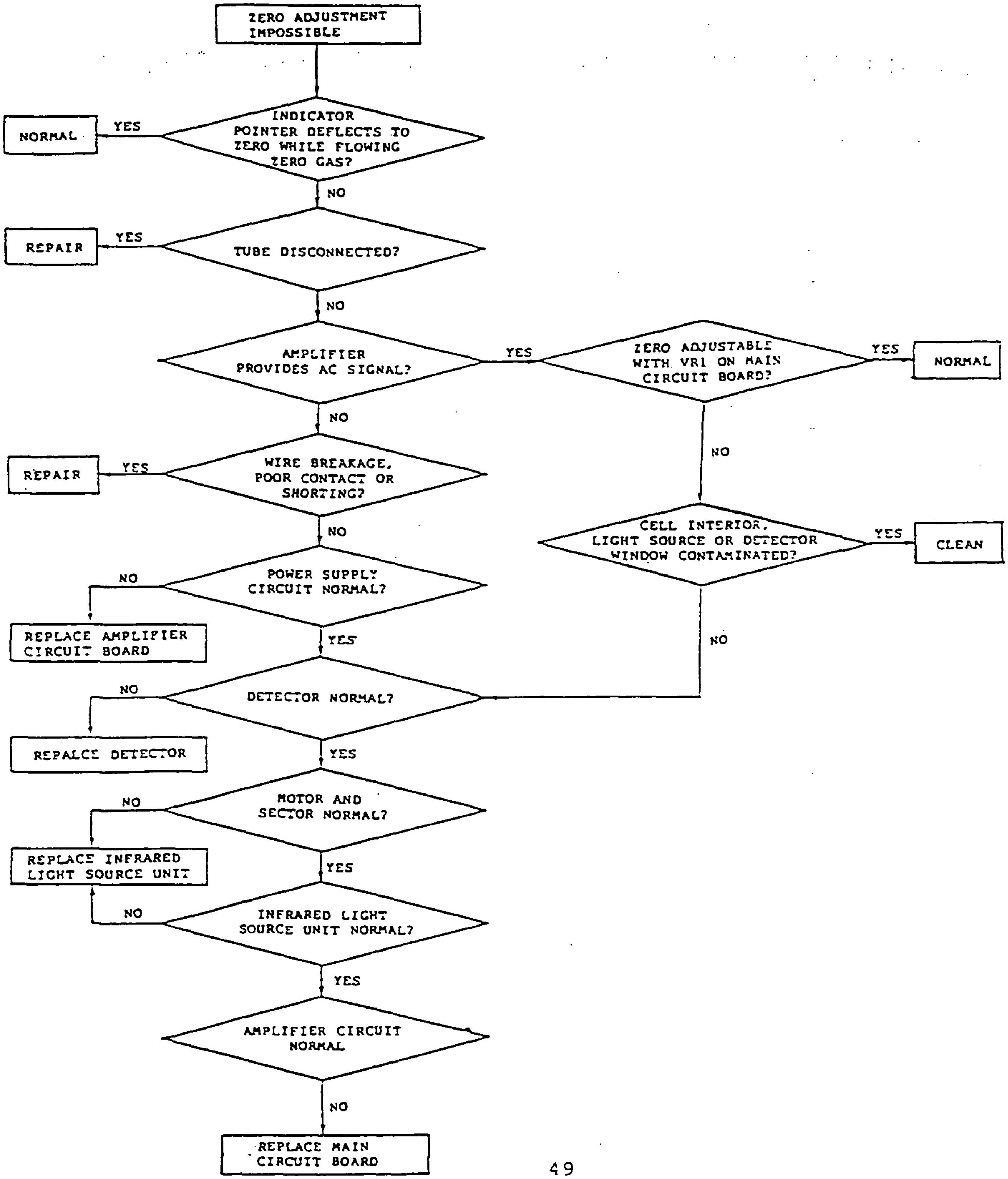
4. Instruments and systems which have been repaired or replaced during their warranty period are themselves guaranteed for only the remaining unexpired portion of their original warranty period. Parts and accessories, including stack probes, umbilicals and permeation tubes, will receive their full warranty period from the date of replacement even if the instrument or system warranty period should expire.

7. WARRANTY

The Warranty Statement appears on the following two pages.

TROUBLESHOOTING CHARTS (Continued)

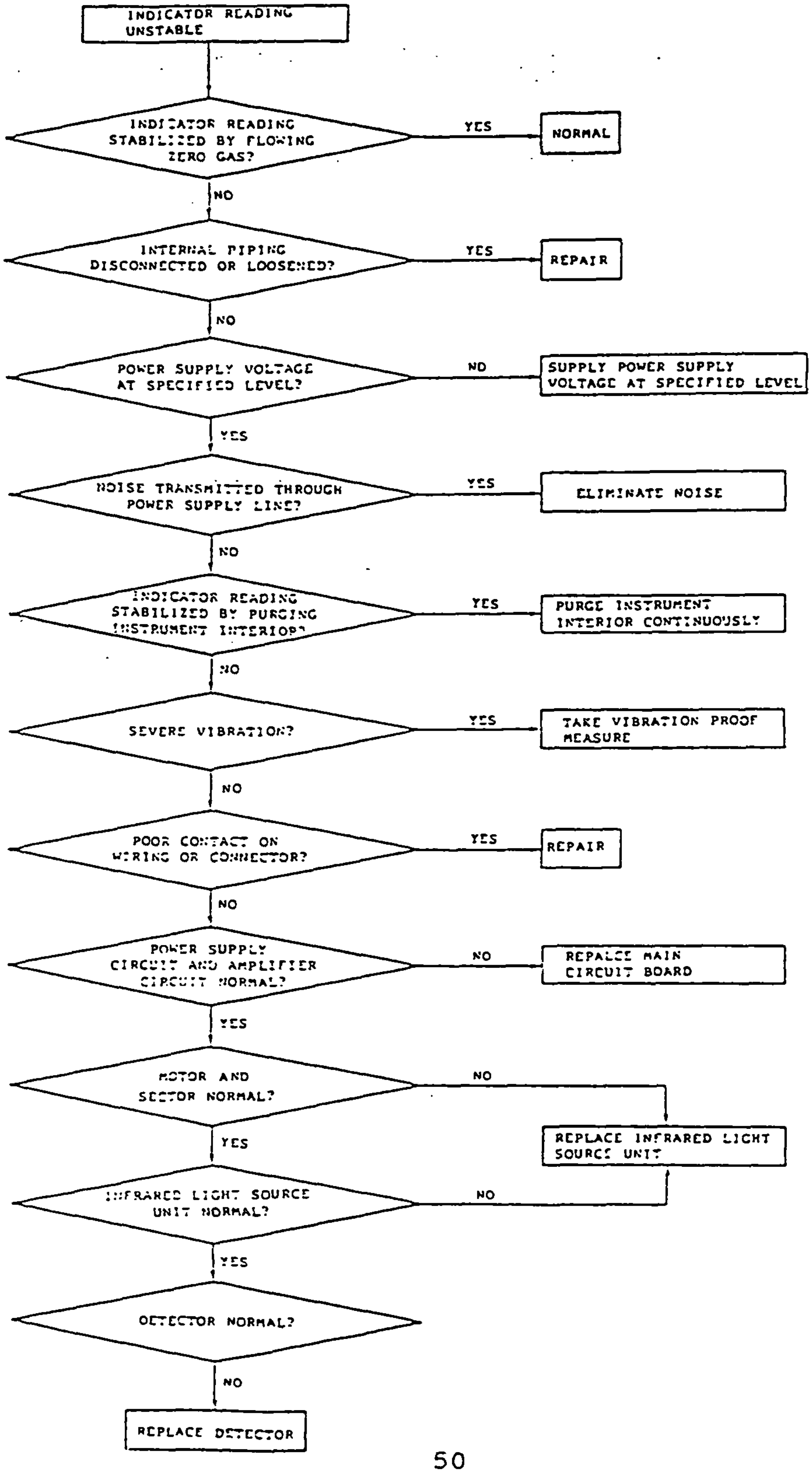
Chart 2: Unable to Adjust Front Panel Zero



TROUBLESHOOTING GUIDE (Continued)

TROUBLESHOOTING CHARTS (Continued)

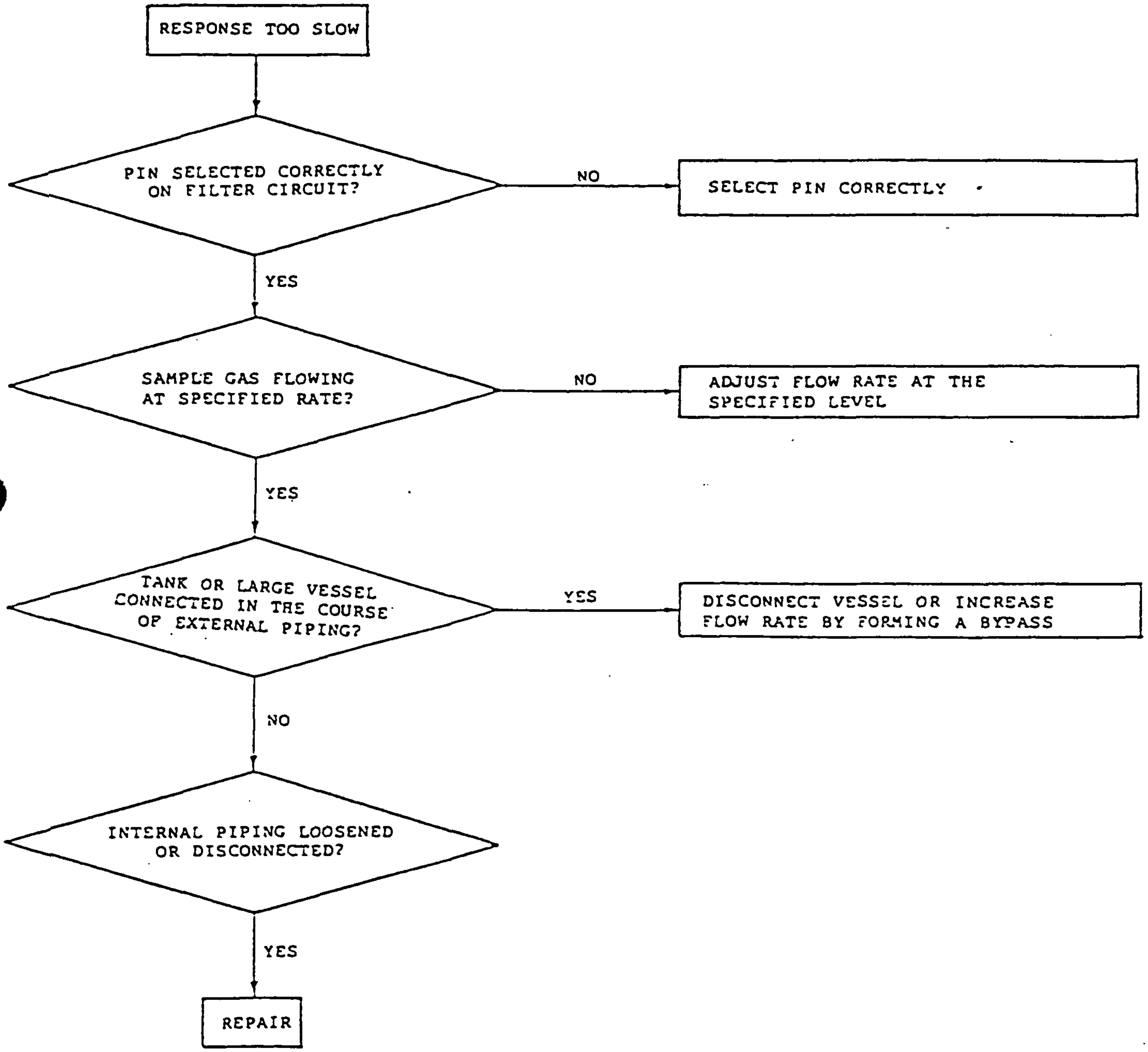
Chart 3: Unstable Indicator Readings



TROUBLESHOOTING GUIDE (Continued)

TROUBLESHOOTING CHARTS (Continued)

Chart 4: Response Too Slow



TROUBLESHOOTING GUIDE (Continued)

TROUBLESHOOTING CHARTS (Continued)

Chart 5: Resetting at Zero Too Slow

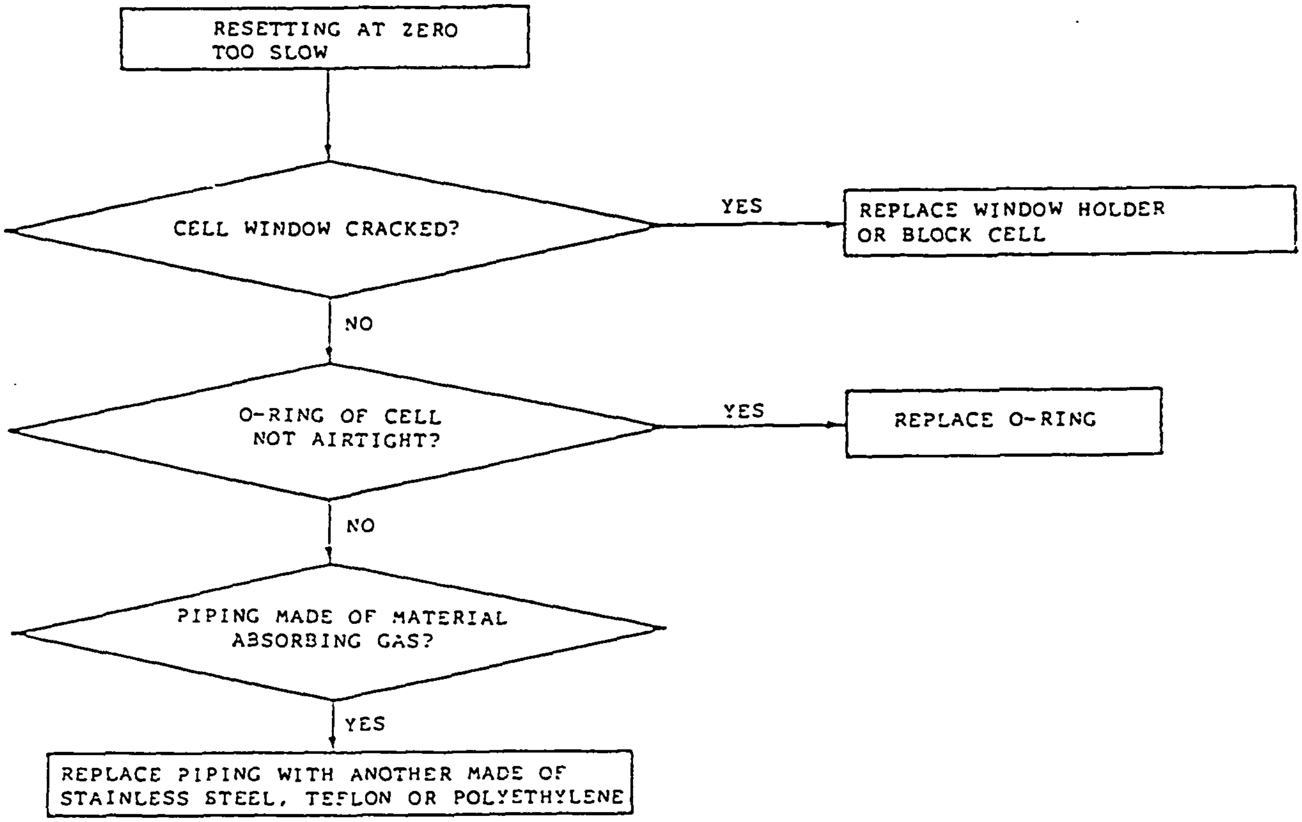
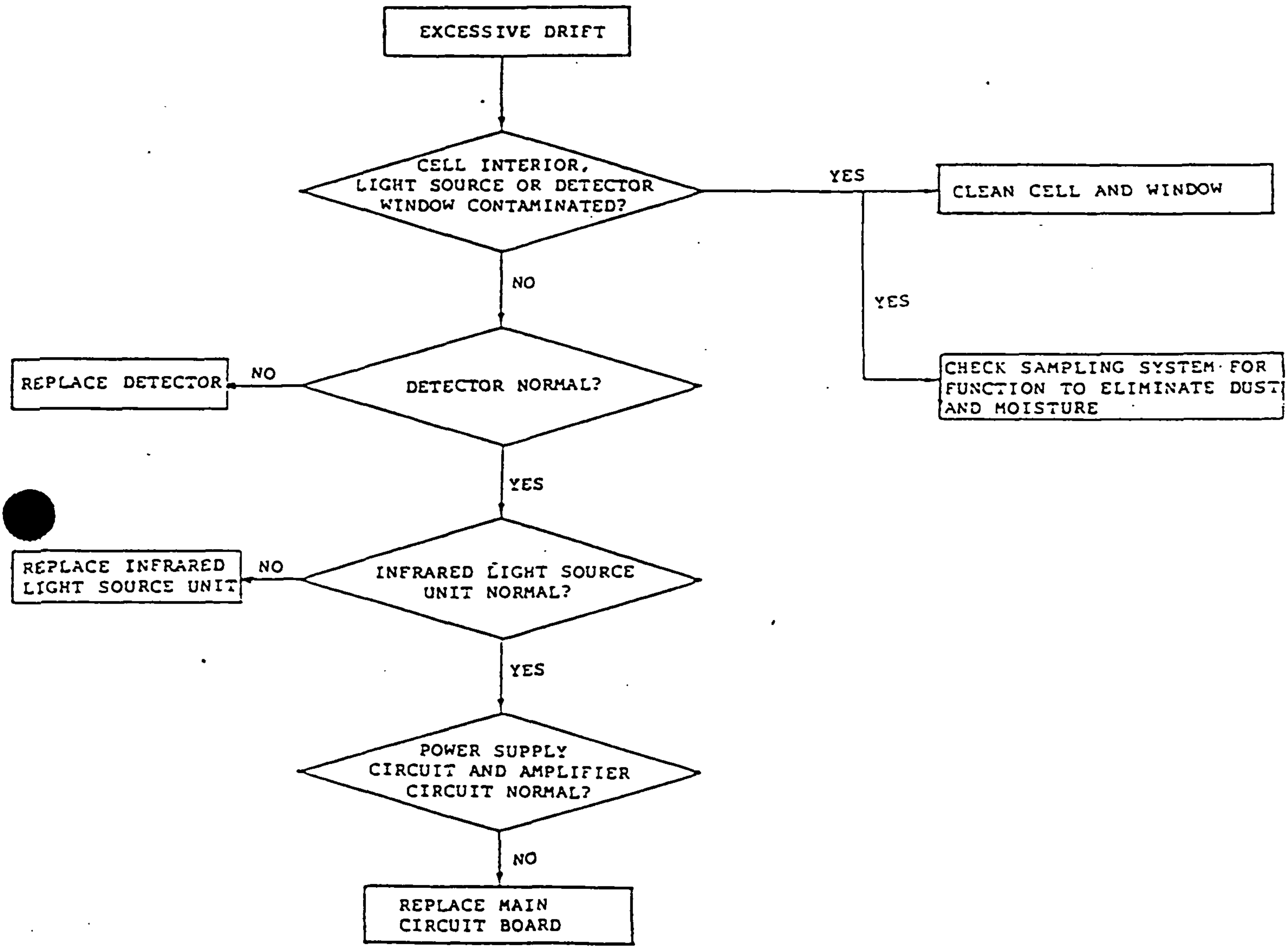


Chart 6: Excessive Drift



CHECK OUT AND REPAIR

1. **Detector**
(Refer to Item 15 of Figure 12)

Symptom: Unable to adjust Front Panel Zero

Trouble: Mass flow sensor damaged, Bridge Resistor defective, or Detector leaking gas.

Tests:

a. The mass flow sensor and Bridge Resistor (Item 1 16 in Figure 12) are normal when DC voltages of about 1.5 to 2.0 V appear between Terminals 1 and 3, and 2 and 3, on the bridge circuit board. These two voltage readings should be within 0.1 V of each other.

b. Connect an oscilloscope between Test Points A1 and M2, on the Main Circuit Board. If readings in "A" above are normal, but an AC waveform (of about 10 Hz is not seen at A1, then the gas is probably leaking from the Detector. Detector should be replaced.

c. If the voltage readings in "A" above are not normal, turn OFF the Power Switch. Uncouple the Detector connector CN1, and disconnect the bridge resistor.

Test the resistance value of the mass flow sensor by measuring the resistance between the Terminals 1 and 3, and 2 and 3, on the Bridge Circuit Board. If the reading is between 25 and 50 ohms, the mass flow sensor is normal and the Bridge Resistor is probably defective. If the value approaches infinity, the sensor is defective and should be replaced.

Replacement:

a. To replace the Detector Assembly with a new unit refer to Figure 12. With instruments using a Pipe type Sample Cell, the Detector is retained by screws from the bottom. It is necessary to first remove the entire Optical Bench.

b. After replacing the Detector, adjust the detector voltage to the specified value. Readjust Zero and Span.

CHECKOUT AND REPAIR

2. Infrared Light Source
(Item 5 in Figure 12, and Figure 13)

Symptom: Readings always negative or output unstable.

Trouble: Infrared Light Source defective or leaking gas.

Tests:

a. Turn the Power Switch OFF. Disconnect one lead from the two pin connector providing power to the Infrared Light Source. Measure the resistance across the Light Source. The reading should be about 38 ohms. If the reading approaches infinity, the Light Source is open. (The instrument output drifts in a negative direction as the resistance decreases).

b. The Indicator may also drift due to gases from the atmosphere leaking into the Light Source.

NOTE

Low concentration CO_2 analyzers may drift due to atmospheric CO_2 penetrating the gaps between the components of the Optical Bench. See page 16, "Influence of Atmospheric CO_2 and Purging".

Replacement:

a. Disconnect both leads from the two pin terminal block. Unplug the Chopper Motor connector. Remove the two screws retaining the Light Source Assembly to the base plate. Separate and replace the Light Source.

b. After replacement, readjust the Zero Level and Span Controls.

3. Chopper

Symptom: Indicator output unstable, or scale out of calibration.

Trouble: Rotation abnormal.

Tests:

a. Turn the Power Switch ON. Listen for rubbing noises as the blade rotates. Remove the Infrared Light Source and protective cover. If necessary, bend the blade slightly to prevent contact with adjacent component. Take care not to damage the blade as it is manufactured from very thin material. No adjustment is normally required.

b. With the Power ON, and the motor shaft does not rotate, disconnect the motor power supply connector and check that 100 VAC is being supplied to the connector. If present, check the motor shaft and rotor for contact with an adjacent part. If the motor rotates freely by hand, but still does not rotate under power, the motor itself is defective.

Replacement:

a. When the Chopper Motor is defective, the Light Source Assembly as a whole must be replaced.

4. Sample Cell, Detector Window, & Infrared Light Source Window

Symptom: Zero adjustment impossible.

Trouble: Cell or Window badly contaminated.

Test:

a. Remove the Sample Cell. Check the cell and Windows for contamination. If contamination is seen, carefully wipe off contaminant with a soft cloth soaked with alcohol. Take care not to injure the windows as they are very fragile. (See also Section VI, Disassembly Procedures).

CHECKOUT AND REPAIR (Continued)

5. **Tubing**

Symptom: Indicator reading unstable or response too slow.

Trouble: Tubing loosened, disconnected, or clogged.

Tests:
- a. Firmly reconnect the disconnected or loosened tubing or connections.
- b. With tubing disconnected from Sample Cell, use clean high pressure air to blow out restriction.

6. **Main Circuit Board**

A. **Power Supply Circuits**

Tests:
- a. Output voltages from the Power Transformer should read approximately 18 VAC and 100 VAC (See Figure 26 or 27).
- b. DC voltage on the aluminum electrolytic capacitor of the Power Supply should be approximately 22 V.
- c. Positive Power Supply line voltage between Test Points A6 and M1 should be 14V +/- 0.05 VDC (See Figure 23).
- d. Negative Power Supply line voltage between Test Points A7 and M1 should be -15 V +/- 1.0 VDC.
- e. Detector Power Supply voltage between Test Points A8 and M1 should be the voltage level specified for that specific Detector.

CHECKOUT AND REPAIR (Continued)

B. **Amplifier Circuits**
(Refer to Figure 23 or 24)

Tests:

a. Verify the the power supply circuits are as specified above.

b. AC Amplifier:

1. Connect an Oscilloscope across Test Points A2 and M1 and observe the AC waveform. Flow Zero Gas and adjust VR1 for about 6V peak to peak (see Figure 18).

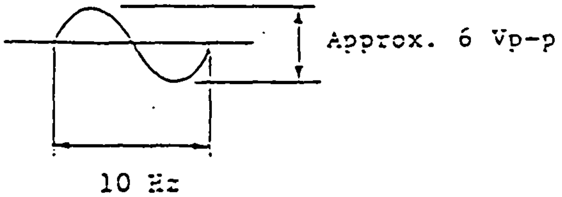


Figure 18: Test Waveform - AC Amplifier

2. If no signal is present at A2, or the signal is not as described in Figure 18, check between Test Points A1 and M1. A 10 Hz AC signal (V1) should be seen. If this is normal, then the AC amplifier Q1 is normal and the AC amplifier Q2 or VR1 is defective.

3. If an AC waveform is not seen across A1 and M1, measure the voltage Vd between Terminals 4 and 5 of the Bridge Circuit Board on the Detector Assembly. Compare with the voltage V1 measured between Test Points A1 and M1. If jumpers J1 to J2 and J4 to J5 are connected, V1 should equal Vd x 22. If J1 to J3 and J4 to J6 are connected, V1 should equal Vd x 100. If Q1 appears normal, check the Detector.

c. Demodulator Circuit

With Zero Gas flowing, the waveform across Test Points A3 and M1 should be as in Figure 19.

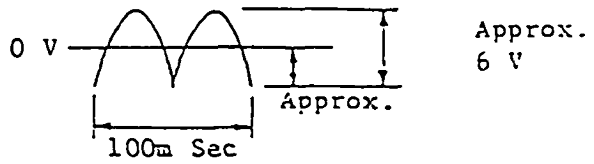


Figure 19: Test Waveform - Demodulator Circuit

d. Dc Amplifier Circuit

Flow Zero Gas and depress the Front Panel Span Check Switch. Voltage across Test Points A4 and M1 should be approximately 0.9 VDC. If the AC amplifiers and demodulator are working normally, and this voltage is not present, DC Amplifier Q4 is probably defective.

e. Buffer Amplifiers

Flow Zero Gas and depress the Front Panel Span Check Switch. Voltage across Test Points A5 and M1, and Output Selection Jumper E4, and Test Point M1 should both be approximately 0.9 V. If either of these voltages is not present, and the previous tests "a" through "d" are normal, the Buffer Amplifier Q5 is probably defective.

SECTION VIII

SCHEMATIC AND ASSEMBLY DIAGRAMS

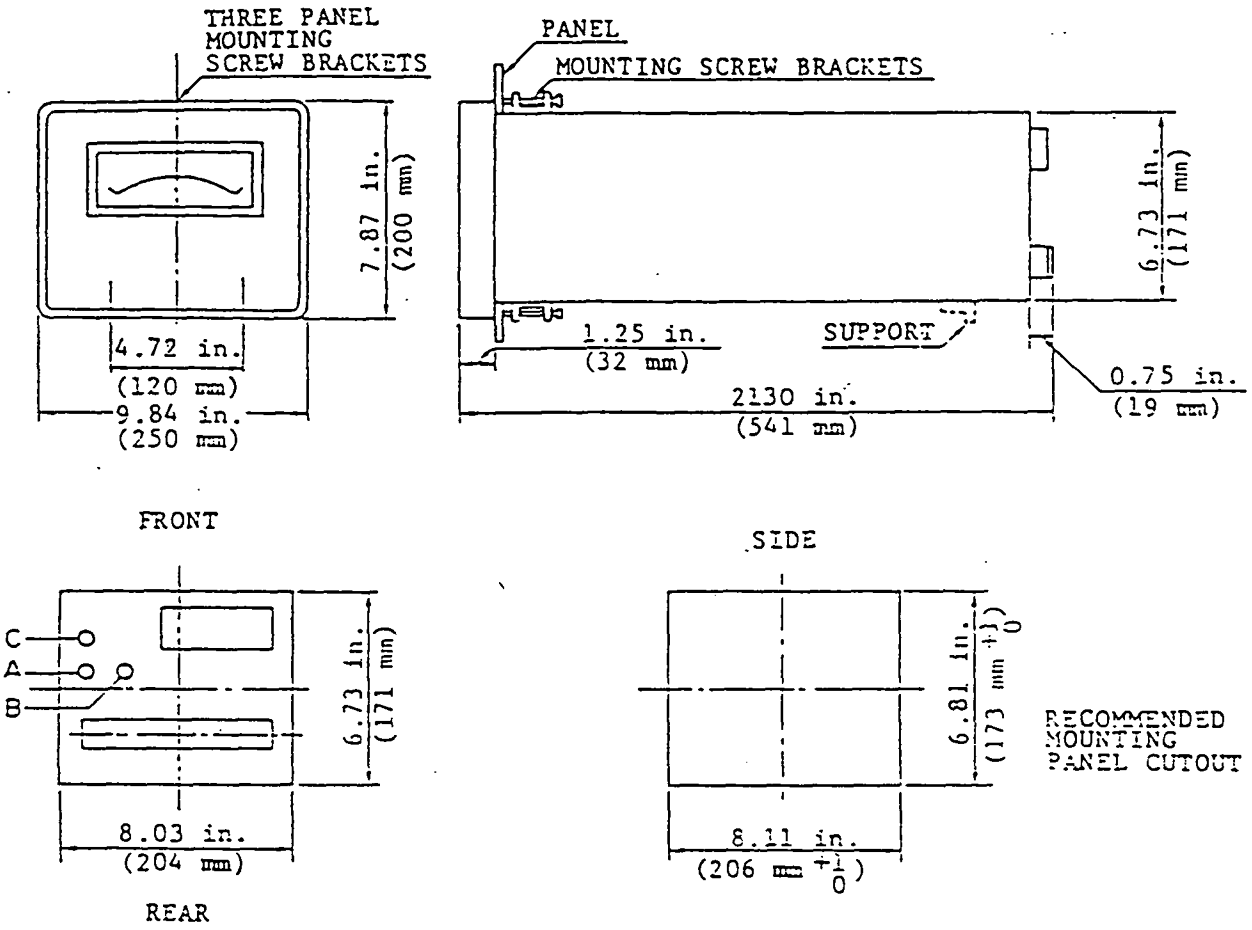


Figure 20: Outline and Mounting Dimensions

SCHEMATIC AND ASSEMBLY DIAGRAMS (Continued)

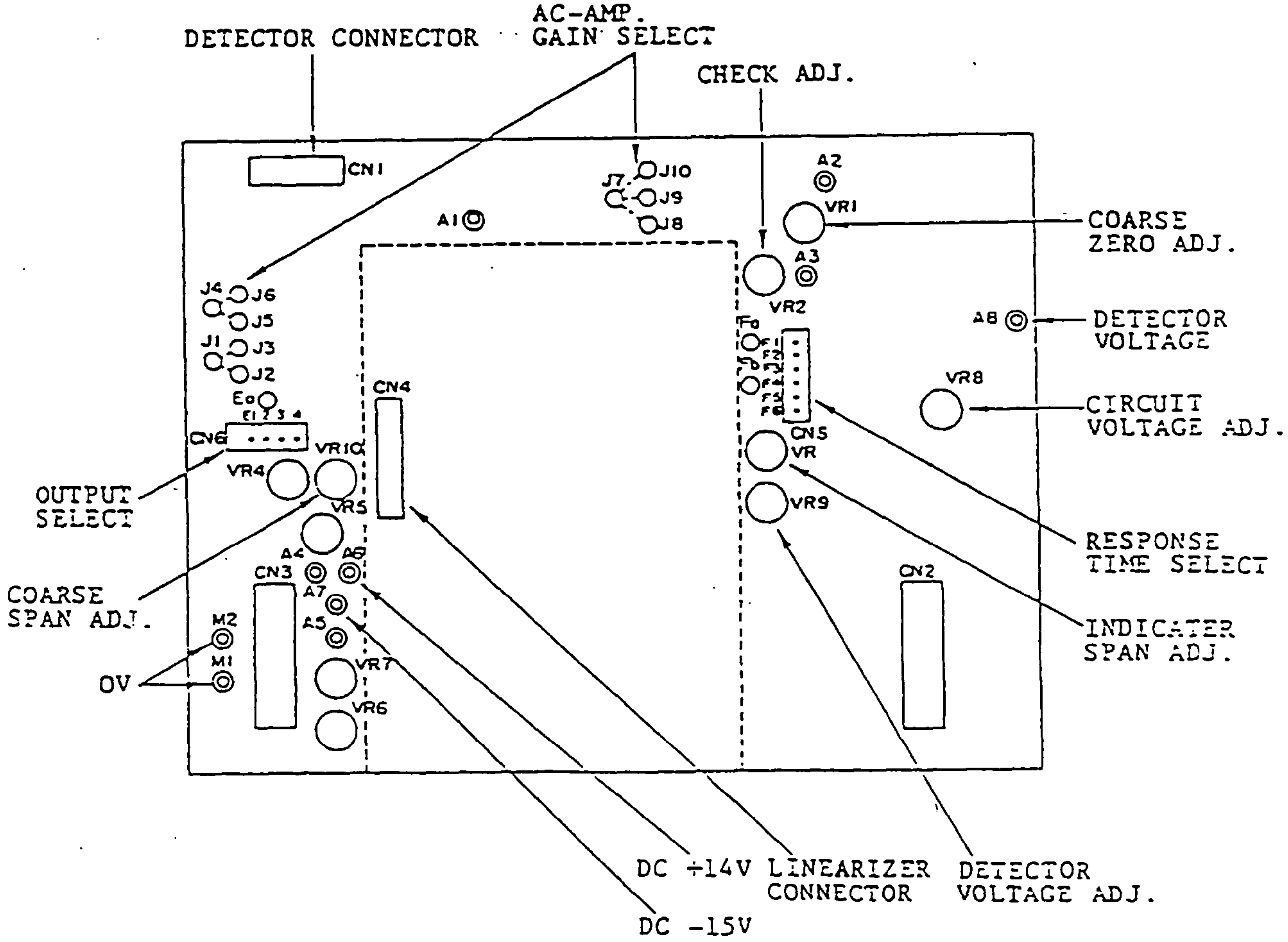


Figure 21: Main Circuit Board Layout (3300 and 3400)

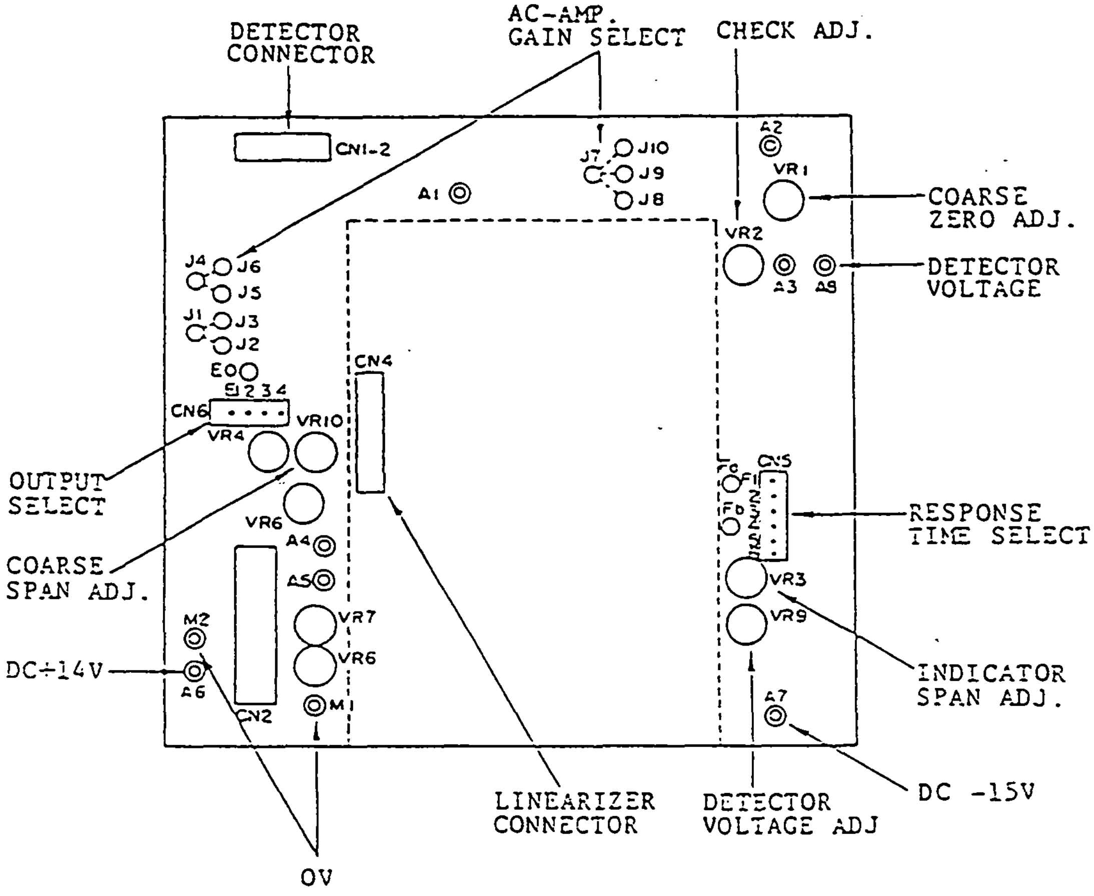


Figure 22: Circuit Board Layout for Second Gas Component (Model 3400 Only)

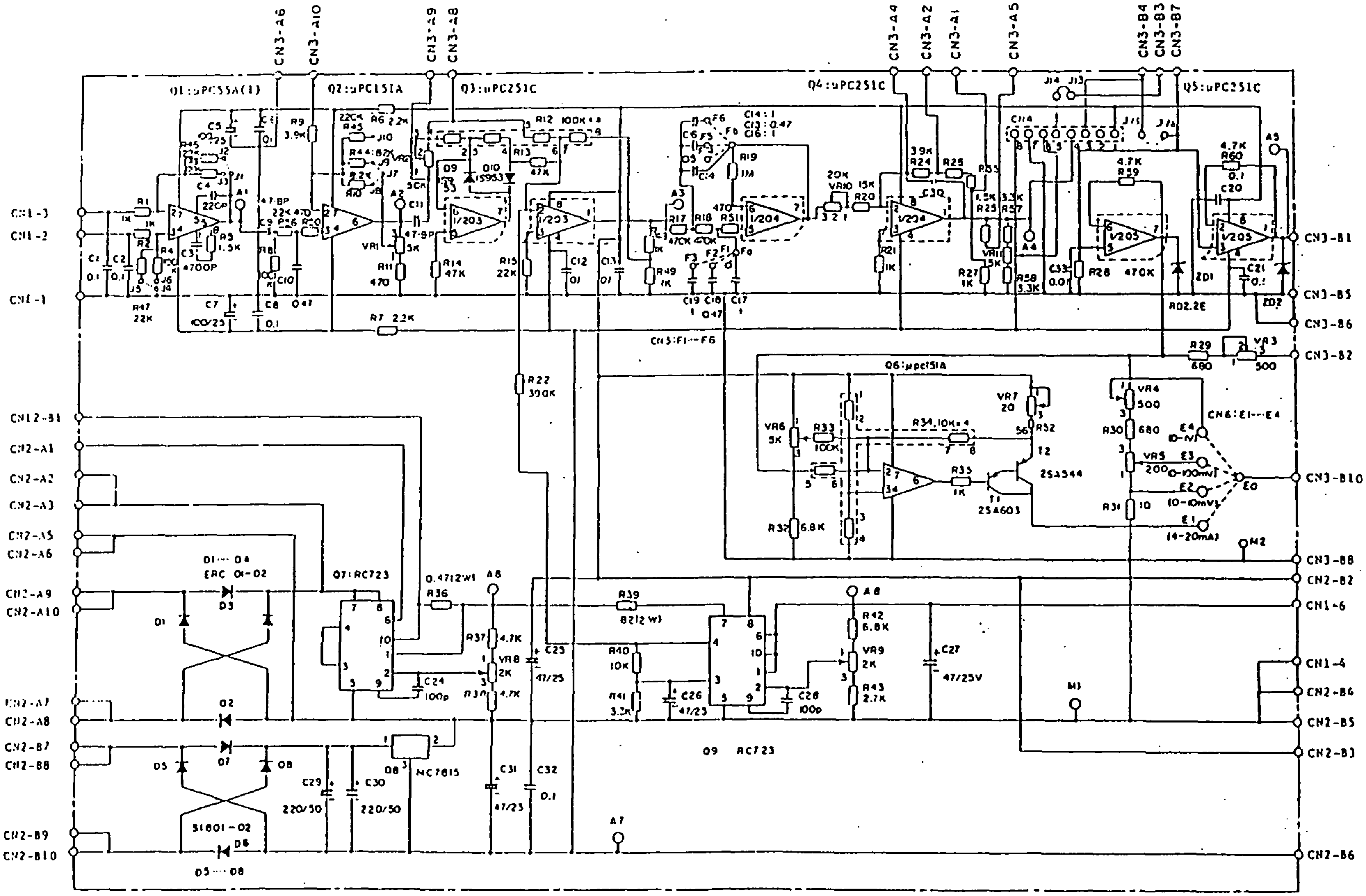


Figure 23: Detailed Schematic Diagram of Main Circuit Board
(3300 and 3400)

SCHEMATIC AND ASSEMBLY DIAGRAMS (Continued)

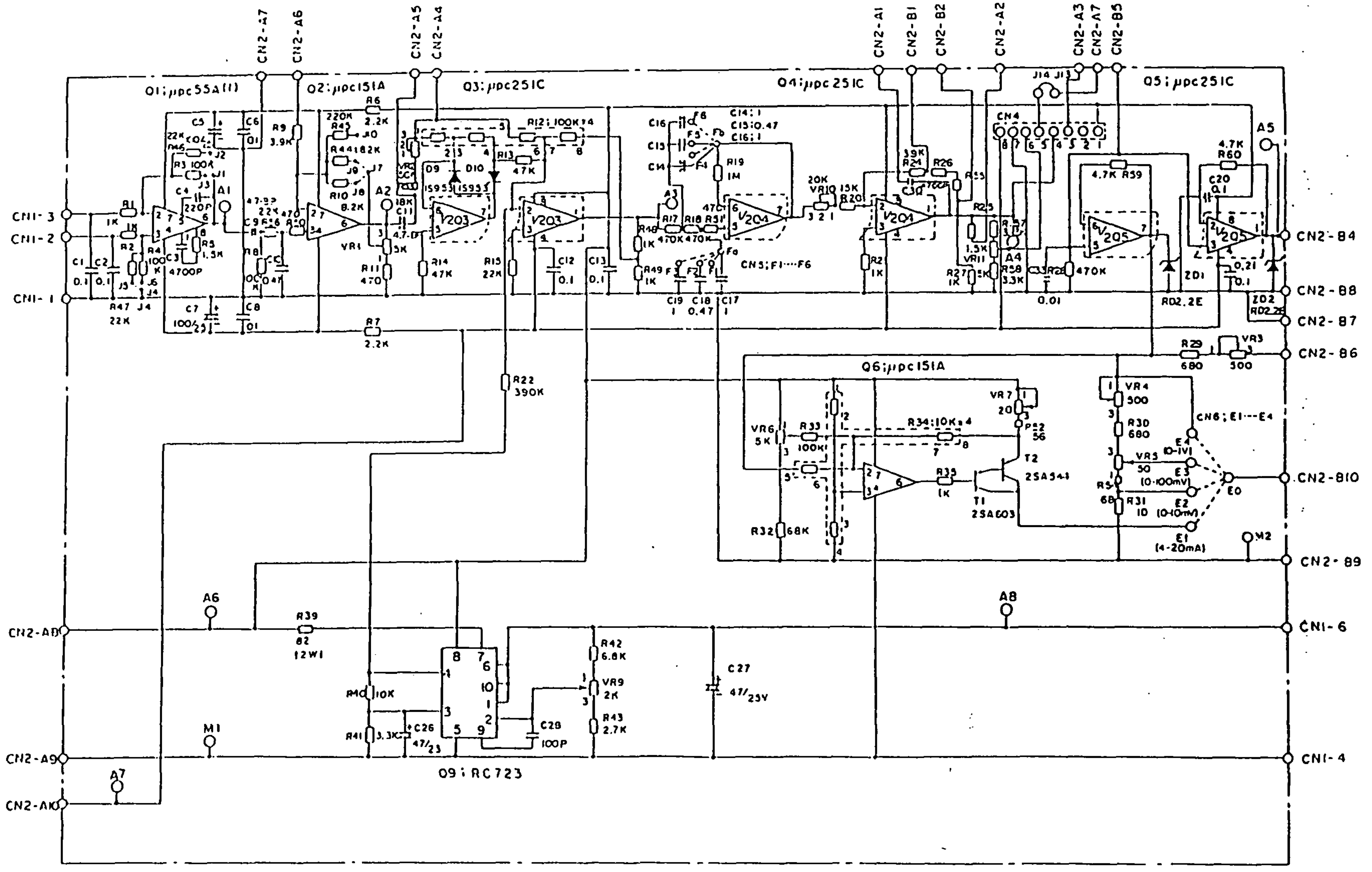


Figure 24: Detailed Schematic of Second Gas Component Circuit Board (Model 3400 only)

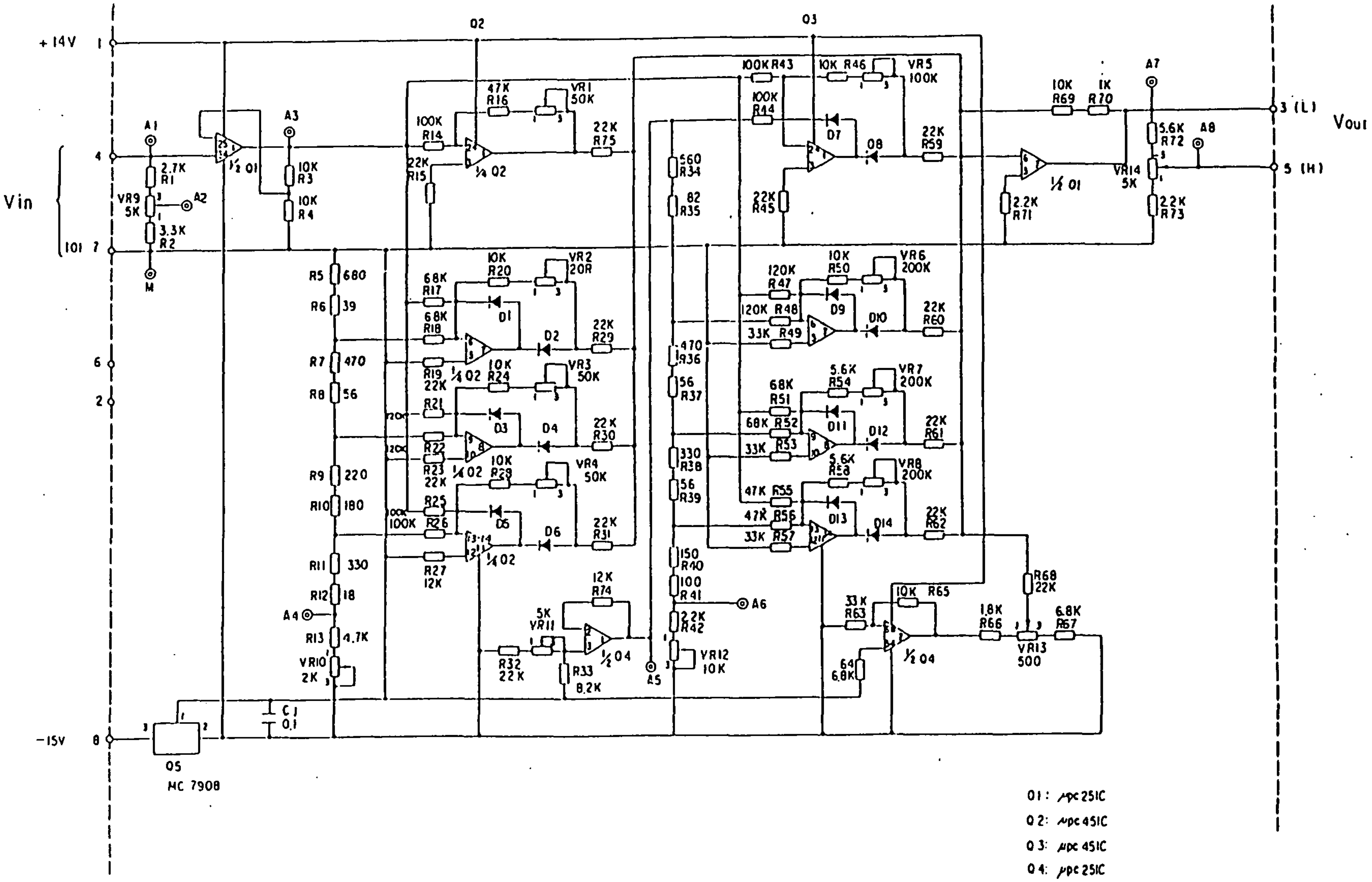


Figure 25: Detailed Schematic Diagram of Linearizer Circuit Board

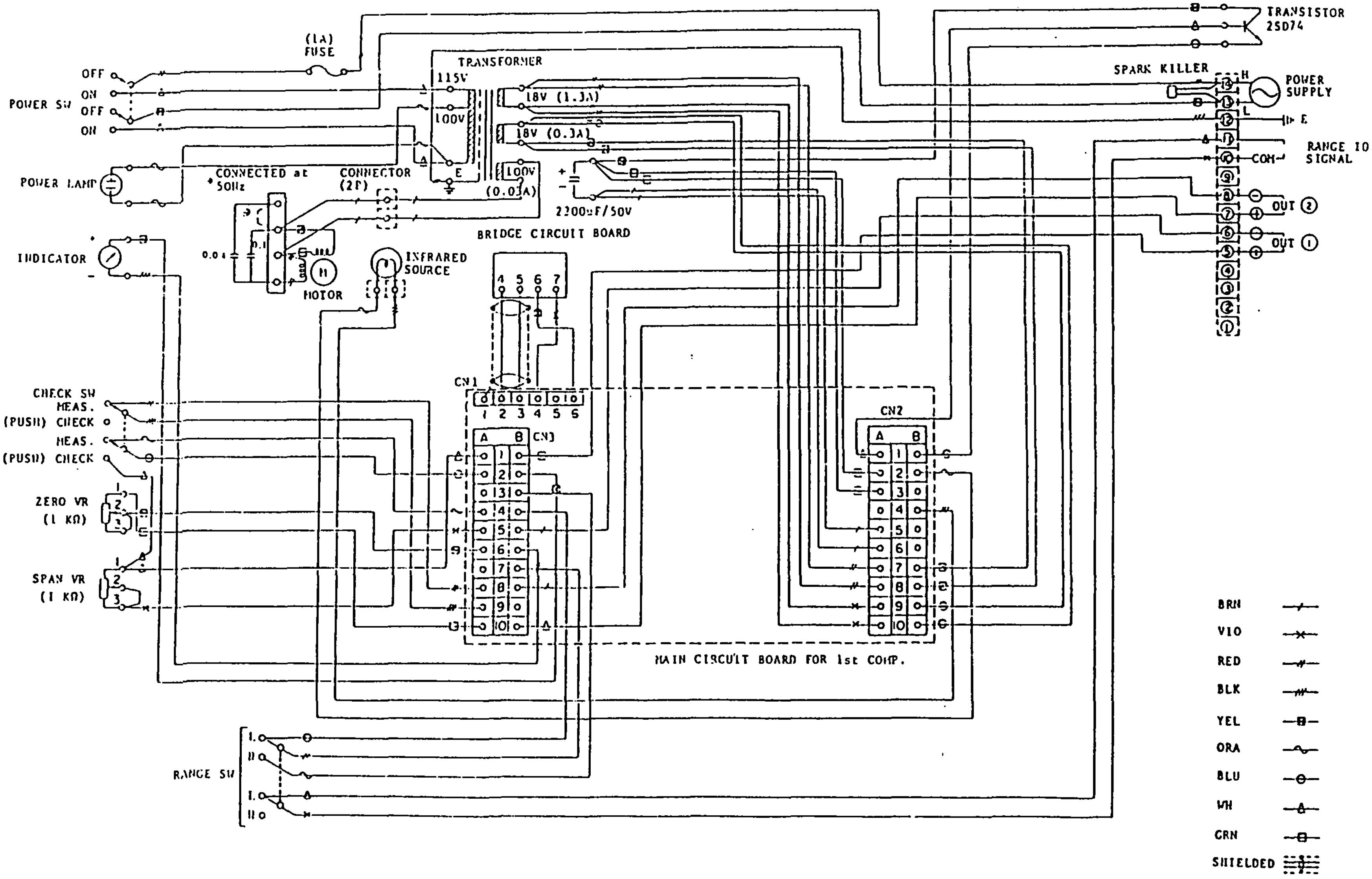


Figure 26: Detailed Schematic Diagram of Chassis Wiring (Model 3300)

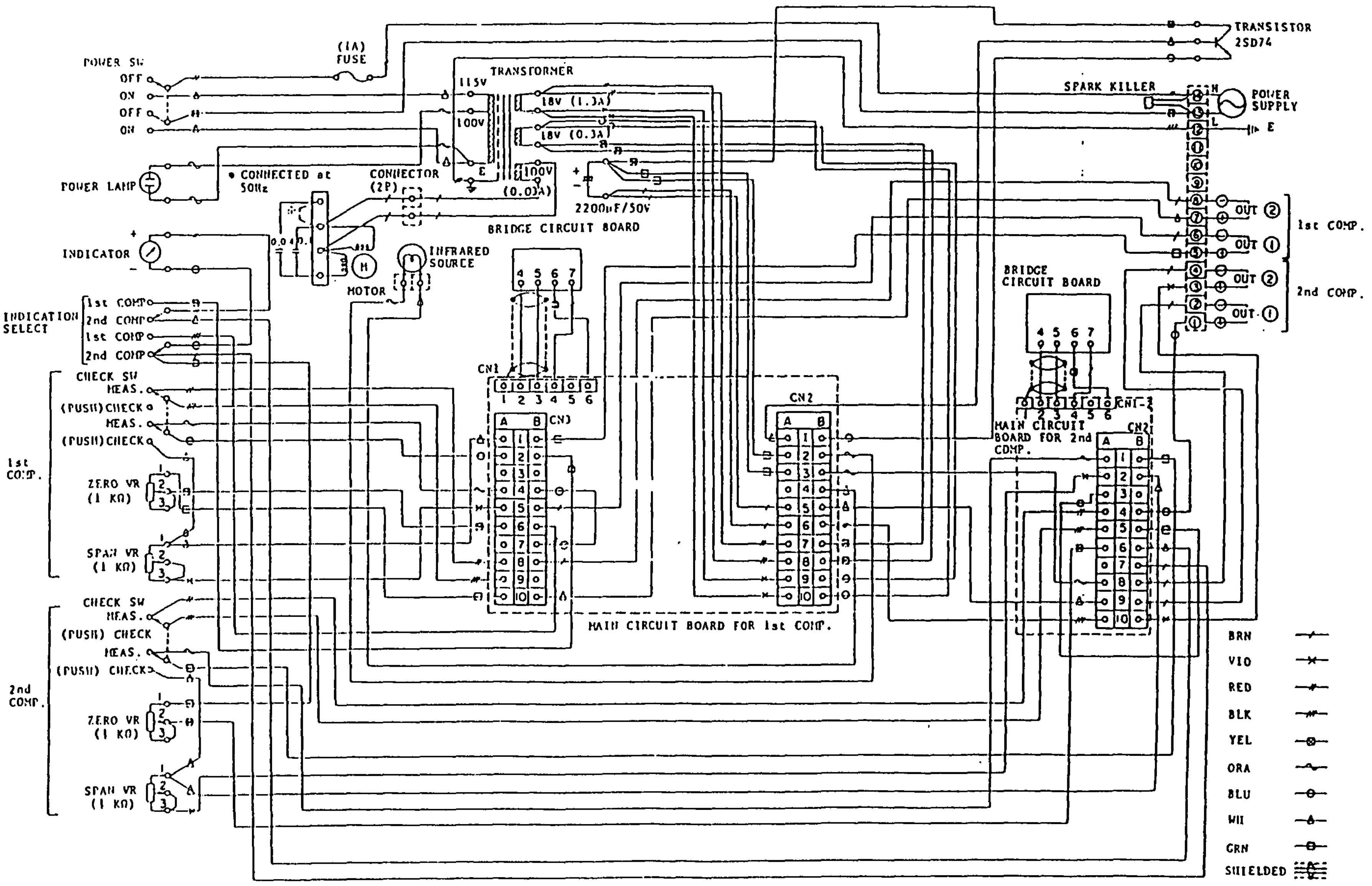
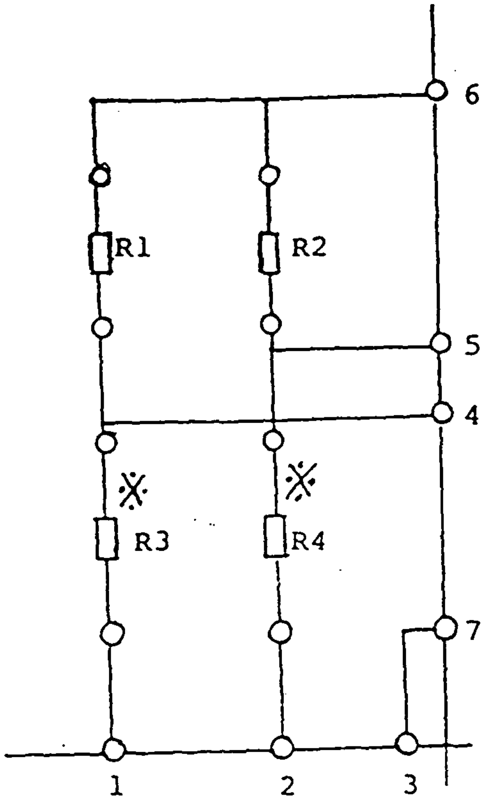


Figure 27: Detailed Schematic Diagram of Chassis Wiring (Model 3400)



※ R3 and R4 are for balance adjustment and shorted if unnecessary.

FIGURE 28

Figure 29

Comp.		Range (%)	Range Ratio	Cell Length (mm)							Detector	Optical Filter
				4	8	16	32	64	125	250		
CO	1	0-0.05/0.1	1:2							0	CO - L	0
	2	0-0.1 /0.2	1:2							0	M	0
	3	0-0.2 /0.5	1:2.5						0		M	0
	4	0-0.5 /1	1:2					0			M	0
	5	0-1 /2	1:2				0				M	0
	6	0-2 /5	1:2.5		0						M	0
	7	0-5 /10	1:2	0							M	0
	8	0-10 /20	1:2			0					H	0
CO_2	1	0-0.05/0.1	1:2							0	CO_2 - L	
	2	0-0.1 /0.2	1:2					0			L	
	3	0-0.2 /0.5	1:2.5				0				L	
	4	0-0.5 /1	1:2			0					L	
	5	0-1 /2	1:2		0						L	
	6	0-2 /5	1:2.5	0							L	
	7	0-5 /10	1:2			0					H	
	8	0-10 /20	1.2		0						H	
CH_4	1	--------	-----	-	-	-	-	-	-	-	--------	------
	2	0-0.1 /0.2	1:2							0	CH_4 - L	0
	3	0-0.2 /0.5	1:2.5							0	M	
	4	0-0.5 /1	1:2						0		M	
	5	0-1 /2	1:2					0			M	
	6	0-2 /5	1:2.5			0					M	
	7	0-5 /10	1:2		0						M	
	8	0-10 /20	1:2	0							M	

Note 1: Cell and detector for each measuring range should be selected according to the above table. If the ranges are not in the same zone enclosed by the wide line, it is necessary to change the detector besides the cell in changing the range.

1420B

Oxygen Analyser
Instruction Manual

Ref No. 01420/001B/0
Order as part No. 01420001B

Servomex

Section 1. DESCRIPTION

1.1 General

The Servomex 1400B series of gas analysers comprises two base units, the 1410B analyser using dual wavelength, single beam infrared technique and the 1420B oxygen analyser using paramagnetic technology. This manual describes the 1420B oxygen analyser.

The 1400B series may be fitted into a twin unit 19" rack mounted case, a bench top case or a single unit case for flush panel mounting.

The 1420B has voltage and current outputs, multiple ranges, oxygen level alarms, flow alarm and remote range indication.

A version of the analyser is available for oxygen purity measurements.

Included with the analyser are the following accessories:

Fuses	- 2531-0526
Filters	- 2377-3608
'D' connectors	
Manual	- 01420001B
IEC Power connector.	

A 31/2 digit green LED indicates the oxygen content to 0.1% resolution.

WARNING

This analyser is not suitable for use in hazardous areas or for measuring flammable sample gases.

1.2 Principles of Operation

The 1420B oxygen analyser measures the paramagnetic susceptibility of the sample gas by means of a magneto-dynamic type measuring cell.

Oxygen is virtually unique in being a paramagnetic gas, this means that it is attracted into a magnetic field. In the Servomex measuring cell the oxygen concentration is detected by means of a dumb-bell mounted on a torque suspension in a strong, non-linear magnetic field. The higher the concentration of oxygen the greater this dumb-bell is deflected from its rest position. This deflection is detected by an optical system and twin photo-cells connected to an amplifier. Around the dumb-bell is a coil of wire. A current is passed through this coil to return the dumb-bell to its original position. The current is measured and is proportional to the oxygen concentration.

1.4 Use With Toxic or Flammable Gases

1.4.1 Toxic Gases

If the analyser is used with sample gases which may be toxic, asphyxiant or otherwise harmful to health then adequate precautions should be taken to ensure safe installation and operation.

These precautions could, for example, include ensuring good quality sample piping to reduce the possibility of leaks, regular leak checking of the analyser and sample piping, minimum sample pressure, adequate ventilation of enclosed spaces and the possibility of monitoring for toxic levels.

The analyser vent should be piped to a well ventilated area.

1.4.2 Flammable Gases

WARNING

This analyser is not suitable for use in hazardous areas or for measuring flammable sample gases.

Consult Servomex for details of analysers which may be more suitable for measuring sample gases which can be toxic or flammable.

1.5 Specification

Performance Specification (typical)

Repeatability:	Better than ±0.1% O_2 under constant conditions (measured at the IV electrical output).
Temperature coefficient:	±0.005% O2 ±0.04% of reading(on display) per degree C change from calibration temperature.
Response Time:	Less than 15 seconds to 90%. At point when flow alarm is triggered the response time will be approximately 50 seconds

Electrical

AC Supply:	88 to 264V, 47 to 440Hz.
Power required:	50VA.

Environmental Limits

Operating ambient temperature:	0 to +45°C (32 to 113°F) 0 to 40°C (32 to 104°F, bench top case)
Storage temperature range:	-20 to +70 C (-4 to 158 F)
Relative humidity:	0-85%, non-condensing.
Sunlight:	Protect from direct sunlight which may cause the interior of the analyser to overheat.
Vibration:	Protect the analyser from excessive vibration.
EMC:	Complies with EN 50022(1987) CLASS A for conducted interference and radiated electric field.

1.6 Product Identification

A label is fitted to the rear panel giving the model and serial numbers. It is of the form 1420B/701/NNNN where NNNN is the serial number

SECTION 2. INSTALLATION

Installation Overview

2.1 Unpack the analyser

2.2 Set-up output ranges and oxygen level alarm functions

2.3 Install analyser

2.4 Make electrical connections

2.5 Make gas connections

2.6 Calibrate

2.1 General

Unpack the instrument and inspect the unit for signs of damage during transit. If any damage is evident, inform Servomex or their agents immediately

Accurate and secure installation will minimise maintenance and instrument breakdown and will provide reliable service.

The location should be vibration free and be subject to minimal fluctuations in ambient temperature.

WARNING

The installer must be satisfied that the analyser installation conforms to the relevant safety requirements and that the installation is safe for any extremes of conditions which may be experienced in the operating environment of the analyser.

2.2 Setting-up Ranges and Alarm Functions

It is necessary to set links inside the analyser to set the desired ranges of the analogue output and the correct operation of the oxygen alarms.

Note: The analyser display will always indicate 0-100% O_2.

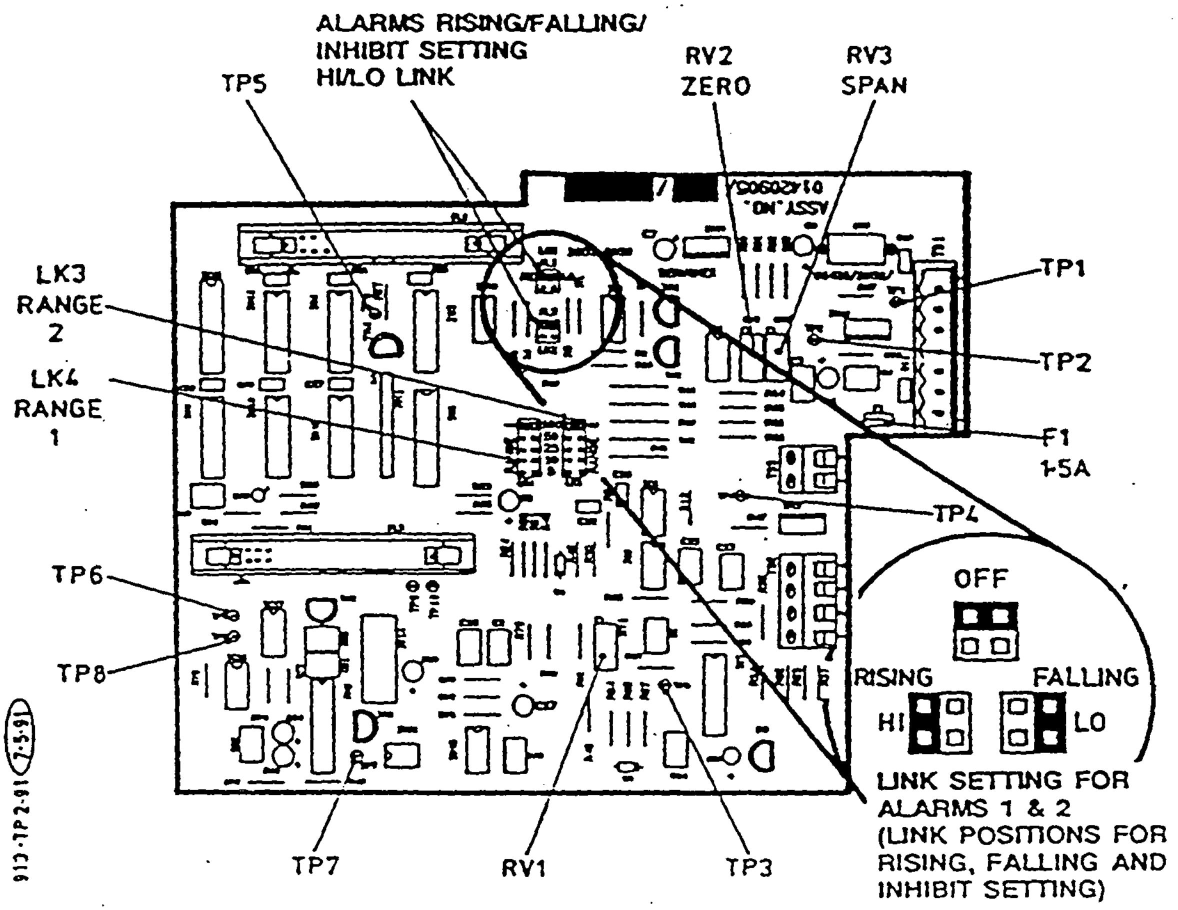


Figure 2.1 Range Changing and Alarm Function Setting

2.3 Installation

The analyser can be installed in a 19in relay rack, flush panel mounted or in a bench top case. See figure 2.2 for dimensions.

The location should be vibration free and be subject to minimal fluctuations in ambient temperature.

There should be access to the rear of the analyser for making gas and electrical connections.

If the analyser is being used to measure sample gases which are toxic then the analyser should be well ventilated to prevent a high concentration of dangerous gas occurring. It may also be advisable to fit appropriate monitoring equipment to warn of sample leaks.

2.4 Electrical Supply Connections

WARNING

Since an isolating switch is not fitted to this instrument it is necessary to ensure that the electricity supply is fitted with a switch to disconnect the instrument. The instrument cases must be connected to earth (ground) at all times.

Electrical supply connection is made to the IEC type connector on the rear of the analyser. The supply voltage can be in the range 88 to 264V, 47 to 440Hz. There is no voltage setting required. If a centre tapped electrical power supply is used (eg 55-0-55V) then both poles must be switched and fused.

On installations where the electrical supply is not referenced to ground an isolating transformer must be fitted and its secondary winding suitably grounded.

When installed in the Servomex 19 inch rack case it is necessary to earth (ground) the case to one or both of the analysers using the earth connections and earth studs on the rear of the instrument.

2.4.2 Alarm Connections

Alarm connections are made to the 'D' plug on the rear of the analyser. See Figure 2.4 for details. Contacts are rated at 1A/110Vac max, non-inductive.

The alarm relay contacts (PL5) must not be connected to a supply exceeding 110V ac rms, and careful wiring within the 'D' connector is required to maintain the insulation and clearances.

Ensure case is earthed (grounded) when relays are connected to a supply exceeding 50V ac or 120V dc.

2.5 Sample Gas Connections

Pipework and fittings used for gas connections should be degreased and suitable for oxygen service.

Connections are made to the pipes on the rear of the analyser. 'Sample In' and 'Sample Out' are labelled.

Gas connection can be made with flexible tubing suitable for the push-on 6.4mm (1/4in) OD connector. Sample gas connections can also be made with 1/4in compression fittings.

Note that response time will be increased by long lengths of sample tubing.

Sample pressures are given in the specification - see Section 1.5. Pressure regulation should be incorporated in the sample line to ensure these values are not exceeded.

If the gas being sampled is excessively dusty or has high humidity it will be necessary to install external filters or dryers.

2.6 Analyser Exhaust

The exhaust from the analyser must not be constricted. If the exhaust is piped away then, to avoid a backpressure in the measuring cell, the diameter of the piping used should be greater than the inlet piping.

If the analyser exhausts into a confined space there may be a danger of a build-up of harmful gases. In such cases the analyser vent should piped to a place with good ventilation.

2.7 Calibration Gases.

WARNING

Nitrogen is an asphyxiant and must not be used in confined spaces without adequate ventilation.

All gas cylinders must be fitted with a regulator to limit the delivery pressure to the values above and an appropriate output pressure gauge. This will prevent serious over pressurising of the analyser and damage to the measuring cell.

All gas cylinders must be fastened securely.

SECTION 3. OPERATION

3.1 Controls

See Fig 3.1 for location of the controls.

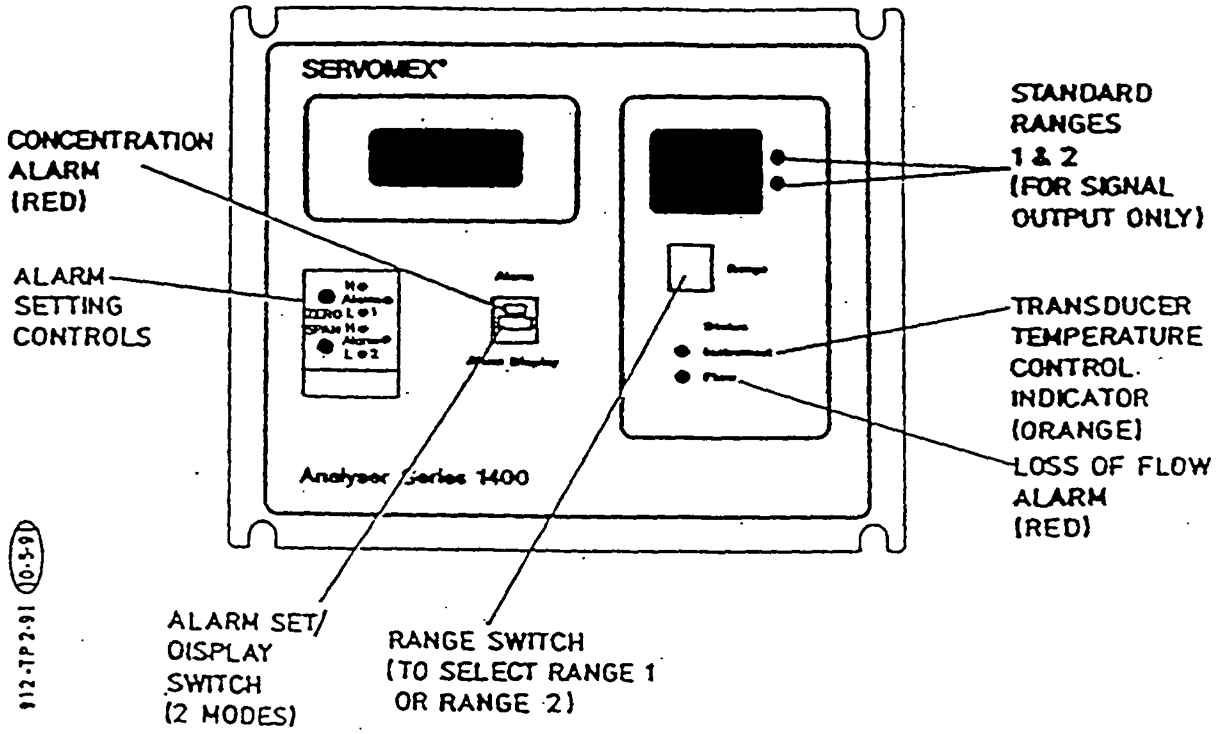


Figure 3.1 Front Panel Controls and Indicators

3.2 Calibration

The analyser should be allowed to warm-up for 3 hours before it is calibrated.

3.2.1 Setting the Zero

Introduce zero gas (normally high purity nitrogen) at a pressure of less than 10 psig to the gas inlet on rear panel of the analyser. Adjust the Zero control, located behind the flip down panel below the display, to give a reading of 0.0 on the display. If the range of adjustment is inadequate then the transducer zero will need resetting (See Section 4.2.4).

3.2.2 Setting the Span

Introduce clean, dry air at a pressure of less than 10 psig to the gas inlet on the rear panel. Adjust the Span control, located behind the flip down panel below the display, to give a reading of 20.9 on the display.

If using a calibration gas other than air then set the span calibration to the value of the calibration gas.

In the alarm condition the red LED incorporated in the alarm switch will flash. The LED beside the relevant alarm control will also flash. The upper LED indicates a high oxygen alarm, the lower LED indicates a low oxygen alarm. The relevant relay will also go to the alarm condition.

Alarms are cleared when the oxygen concentration returns to a non-alarming value.

3.5 Flow Alarm.

The analyser incorporates a pressure switch to detect satisfactory sample flow. If the flow fails or the sample inlet or outlet becomes blocked then the yellow 'Flow' LED will flash and the 'Flow' alarm relay will go to the alarm condition.

This alarm is cleared when flow returns to normal.

3.6 Instrument Status

The measuring cell is heated. The red LED on the front panel illuminates when the heater is on. During warm-up the lamp remains on continuously, but will flash when the temperature has stabilised.

3.7 Vent Pressure

The pressure at the analyser vent connection is the same as that in the measuring cell. The analyser determines the partial pressure of oxygen. Pressure changes occurring since the last calibration cause a proportional change in the oxygen reading unless the back pressure regulator is fitted.

See Section 2.6 for information about safe venting of exhaust gases.

3.8 Routine Maintenance

Frequency Of Calibration

The frequency of calibration required will depend upon the operating requirement for accuracy and upon environmental conditions. The following is a guide which can be modified in the light of operating experience in particular circumstances.

Weekly: Adjust the Span.
Monthly: Adjust the Zero then the Span.

Changing The Filter

Check the filter. The filter element is removed by unscrewing the large filter knob on the rear panel of the analyser. Discard the old element if dirty or wet and fit a new filter element (part no. 2377-3608) then check that sample pre-conditioning is adequate.

FID TOTAL HYDROCARBON ANALYZER
MODEL HC500-2D

Operation, Maintenance, and Parts Manual

P/N 972-9001

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February 1990
Rev --

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1. INTRODUCTION

The Columbia Scientific Industries Corporation (CSI) Model HC500-2D Total Hydrocarbon Analyzer is a self-contained system for monitoring ambient concentrations of total hydrocarbons.

Sample air is introduced directly into an FID detector to yield a total hydrocarbon reading which is stored in an electrical circuit.

The hydrocarbon detection system utilizes the well established technique of flame ionization. Hydrocarbons passing through the hydrogen rich flame are converted to ions. An electrostatic field in the burner causes these ions to migrate and collect on an electrode. An electric current is produced which is proportional to the concentration of ions collected.

The design of the Model HC500-2D was implemented with the emphasis focused on obtaining stable and reliable performance and ease of service and maintenance. Precise pneumatic and thermal control of critical elements and the utilization of proven solid state circuitry contribute to the performance characteristics of the instrument.

In addition to the basic HC500-2D, CSI provides a variety of options and accessories to meet most user's requirements. Section 10 describes these.

2. PRINCIPLE OF OPERATION

The CSI Flame Ionization Detector (FID) is based on the ionization of hydrocarbon molecules in a hydrogen hyperventilated flame. Hydrocarbons are fragmented by the flame to carbon radicals, e.g. CH . These radicals react with oxygen radicals to form positive carbon ions and electrons. The positive ions can undergo further reactions with water molecules to produce hydronium ions.

The following equations summarize some of the possible reactions:

$$\mathrm{CxHy} \longrightarrow \mathrm{CH}\cdot$$

$$\mathrm{CH}\cdot + \mathrm{O}\cdot \longrightarrow \mathrm{CHO}^+ + e^-$$

$$\mathrm{CHO}^+ + \mathrm{H_2O} \longrightarrow \mathrm{H_3O}^+ + \mathrm{CO}$$

An 84 volt battery is used to produce an electrostatic field between the ionization probe inside the burner chamber and the burner block. This causes the electrons to migrate to the positively charged probe, and the positive ions to the burner block. The resulting current is proportional to the ions collected. An electrometer amplifier converts the current to voltage which is fed to the amplifier output recorder jacks.

The FID detector is designed to optimize the sensitivity and stability of these reactions. Sample air is drawn into the detector block by means of a vacuum pump. Hydrogen is supplied under a slight pressure from a cylinder or hydrogen generator. Both these gas streams are controlled and regulated to provide stable flow rates to the burner.

3. SPECIFICATIONS

Performance Specifications

	Hydrocarbon FID Detector
Ranges:	0-10 ppm 0-50 ppm 0-100 ppm 0-500 ppm 0-1000 ppm
Minimum Detectable Sensitivity:	0.1 ppm CH4
Noise:	±0.05 ppm CH4
Lag Time:	Less than 15 seconds
Rise Time to 90%:	Less than 30 seconds
Fall Time to 10%:	Less than 30 seconds
Updating Time (Switching Time):	5 minutes
Total cycle time:	10 minutes
Precision:	±1% FS
Zero Drift:	±2% FS/day ±3% FS/3 days
Span Drift:	±2% FS/day ±3% FS/3 days
Linearity:	±1% FS
Selectable Time Constants:	1 second or 10 seconds

Operational Specifications

Unattended Operation: (No adjustment of flow or electrical systems)	7 days
Sample Flow Rate:	Approx. 200 ml/min
Hydrogen Flow Rate:	Approx. 140 ml/min
Power Requirements:	115 ±10 Vac (50-60 Hz) 250 watts
Recorder Outputs:	0-100 mV 0-1 V 4-20 ma (optional) 0-10 V (optional)

Relative Humidity:	5-95%
Ambient Temperature Range:	10-40 deg C

Configurational Specifications

Weight:	40 lbs. (18 kg)
Case Dimensions:	17"W x 20"L x 12 1/4"H (43cm W x 51cm L x 31.1cm H)
Mounting Available:	Bench Rack (optional)
Sample Pump:	Internal (external w/230 V option)

4. DESCRIPTION

The analyzer is a completely self-contained unit comprised of three basic subsystems: 1) the pneumatic network, 2) FID burner assembly, and 3) the associated electronics. Figure 4.1 is a top view of the analyzer interior illustrating these subsystems and some of the major components. The subsystems described below, together with the front and rear panels.

4.1 Pneumatic Network

Figure 4.2 presents the pneumatic network of the analyzer without any options. Sample air can be introduced into the analyzer by two paths. In one case, the sample enters through the rear panel port marked "METERED INLET" and flows through a calibrated rotameter to a tee. In this mode the rotameter can cause hold-up of some hydrocarbons and produce a longer response time. Therefore it is recommended that this pneumatic path is used only during setting up of the analyzer and to check the air flow rate.

In the normal sampling mode, the sample is introduced through the port marked "SAMPLE INLET" which by-passes the rotameter and goes directly to the tee. (Note: One of these ports must be capped for proper operation.) From the tee the sample air passes through a pneumatic line into the burner block to yield the total hydrocarbon analysis. Hydrogen, from a 60 psig source, enters through the rear panel port marked "HYDROGEN". The hydrogen passes through a flow controlling pressure regulator, capillary combination and then through a calibrated rotameter to the burner block. The burner block exhaust gas passes through a heated and temperature controlled needle valve which controls the exhaust gas flow rate. Air is drawn into the analyzer from a hypodermic needle inserted in the "DILUTION AIR" port. This air mixes with the exhaust gases downstream of the valve to prevent condensation of moisture in the exhaust system and reduce the hydrogen gas concentration. The pump expels the burner and dilution air gas mixture out the "EXHAUST" port.

Figure 4.3 shows the Pneumatic Network with Options. Both SV1 and SV2 are supplied with Option HC26A, Remote Manual Zero/Span with Status,and HC-11B, Automatic Zero/Span/Sample Control. With the Mode switch in the "SAMPLE" position, sample air comes into the sample inlet, passes through the de-energized SV1 then directly to the burner block. Either by placing the mode switch in "ZERO" or pressing the air flow button, SV1 will be energized, closing the sample inlet. This causes air to travel from the "ZERO AIR" inlet through the rotameter, through the de-energized SV2, SV1, and then directly to the burner block. When the Mode switch is in "CALIBRATE" position SV1 and SV2 are energized causing the gas at the "SPAN GAS" port on the rear panel to be drawn into the analyzer and through the burner block.

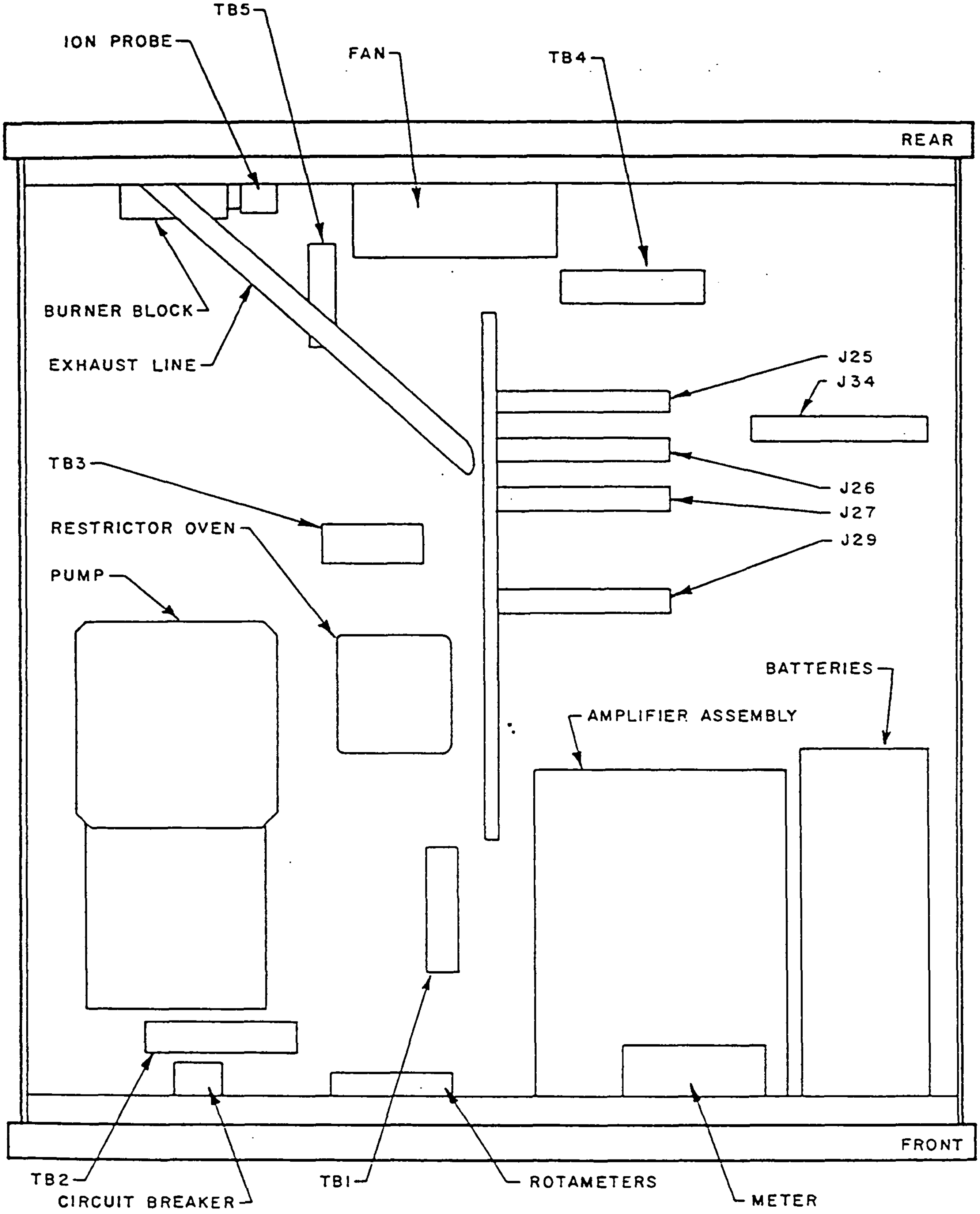


Figure 4.1 Internal Top View of HC500-2D

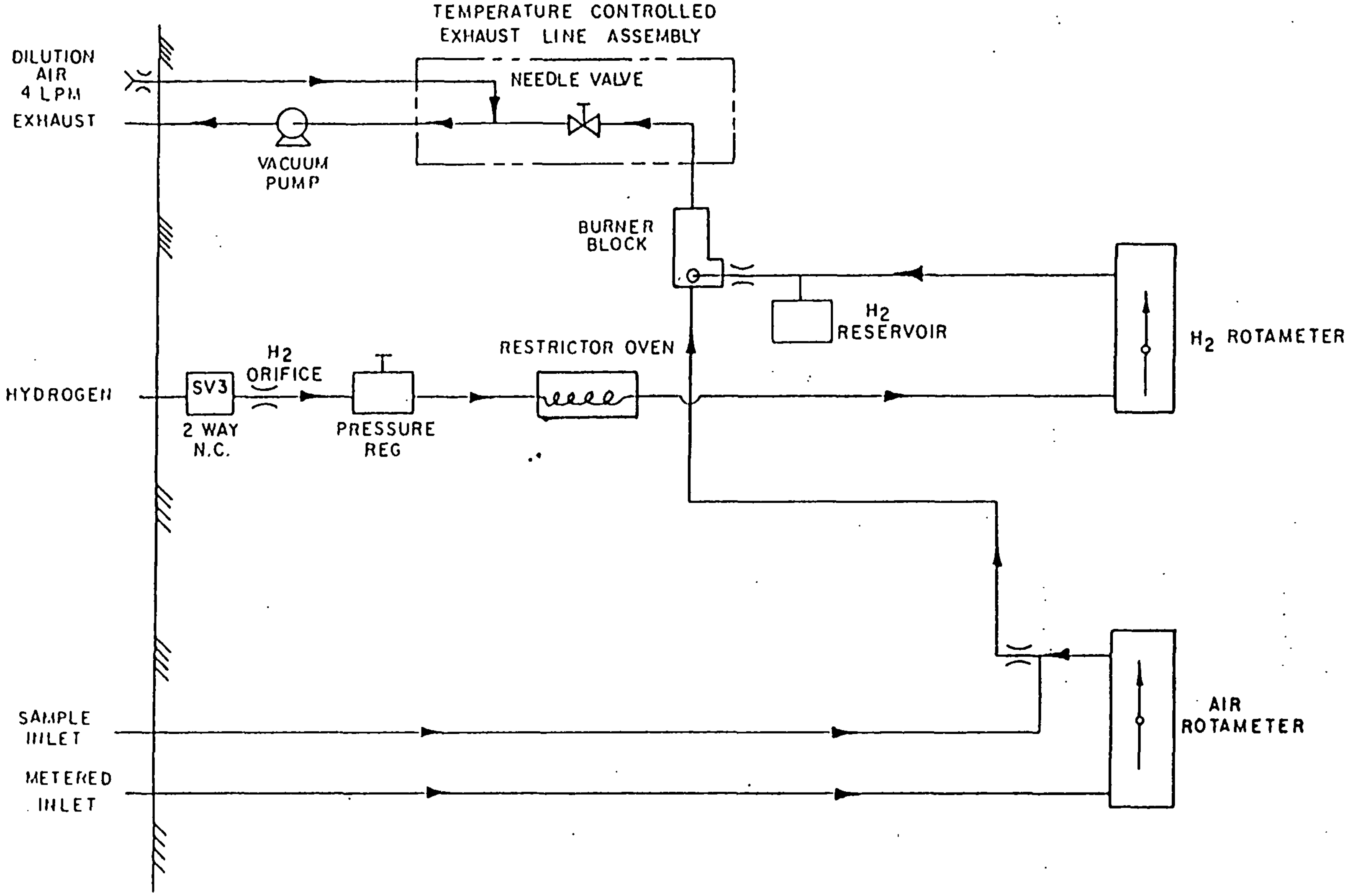


Figure 4.2 Pneumatic System of HC500-2D w/o Options

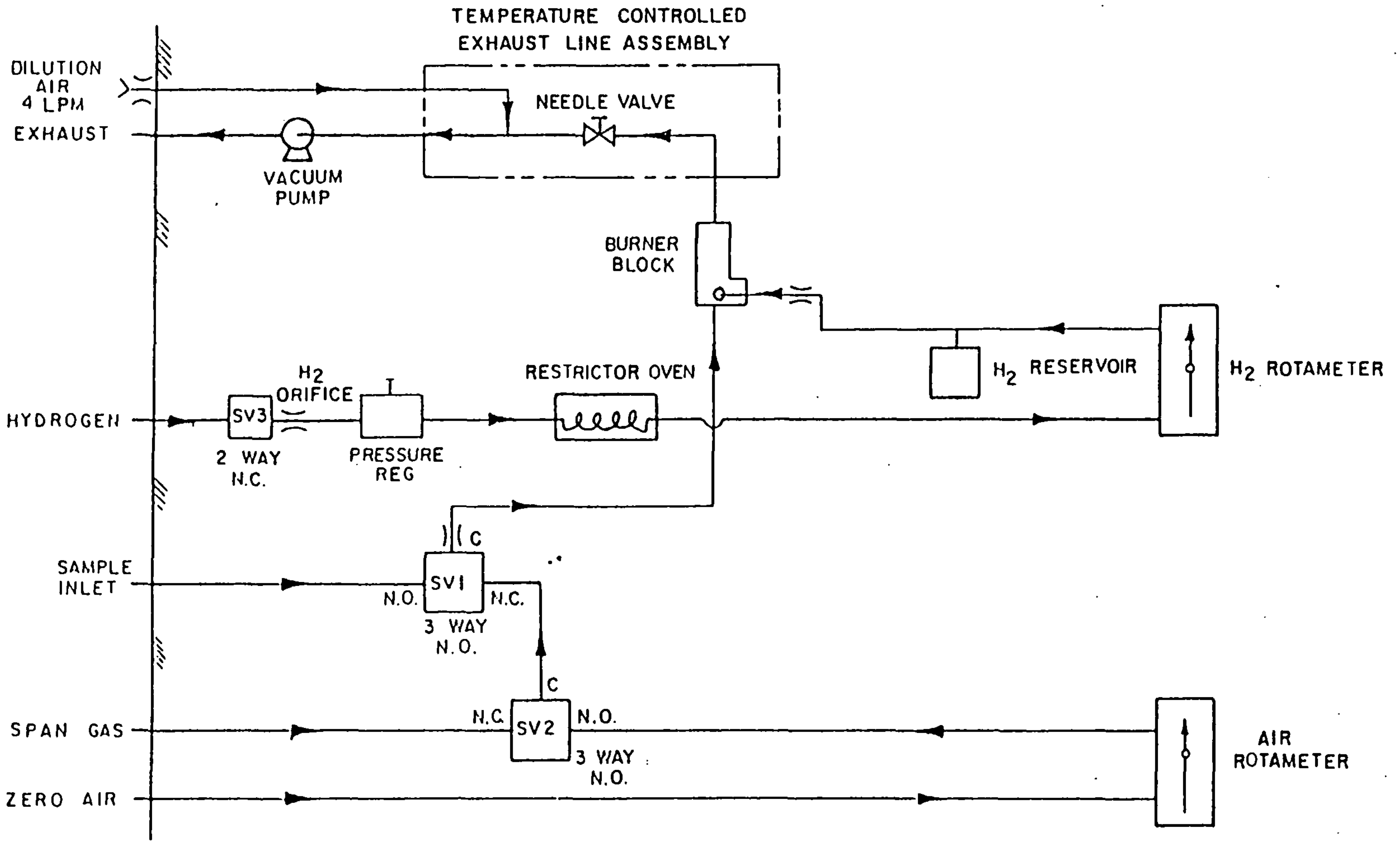


Figure 4.3 Pneumatic System of HC500-2D with Options

(1) Pneumatic Lines

The sample stream lines are 1/8" OD standard wall Teflon* tubing with stainless steel connectors. The hydrogen stream lines are 1/8" OD Teflon and stainless steel lines. Exhaust lines from the burner block are 1/4" OD stainless steel and polyethylene tubing. The stainless steel line from the burner block to the needle valve is heated and temperature controlled to avoid moisture condensation and to provide stable flow conditions.

(2) Rotameters

Flow rate measurement by rotameters is provided for both air and hydrogen streams. The rotameters are calibrated at the factory for the recommended flow setting. The setting value is printed on the rotameter glass cover near the bottom of each rotameter and also on the calibration curve supplied with each analyzer. Figures 4.4 and 4.5 illustrate typical flow rate vs rotameter curves.

(3) Needle Valve

The needle valve is used to set and control the gas flow rate from the burner block to exhaust. The valve functions as a heated and temperature controlled critical orifice to provide stable flows in the burner block. The temperature is approximately 105 deg C to prevent moisture condensation. An iron-constantan thermocouple is provided to monitor this temperature at the rear panel.

(4) Dilution Air System

The dilution air system consists of a 1/4" OD stainless steel line in which the inlet is capped with a rubber septum pierced with a #18 one inch long hypodermic needle. This system supplies approximately 4 lpm of dilution air into the exhaust system, for H2 dilution to a non-combustible mixture.

(5) Hydrogen Pressure Regulator

The HC500-2D uses a hydrogen regulator to set the hydrogen flow rate and also maintain a constant downstream pressure. This regulator is a special model which maintains a constant pressure from ambient temperatures of 10 to 40 deg C. The regulator should not be disassembled nor cleaned by flushing with solvent or air.

---

*DuPont registered trademark

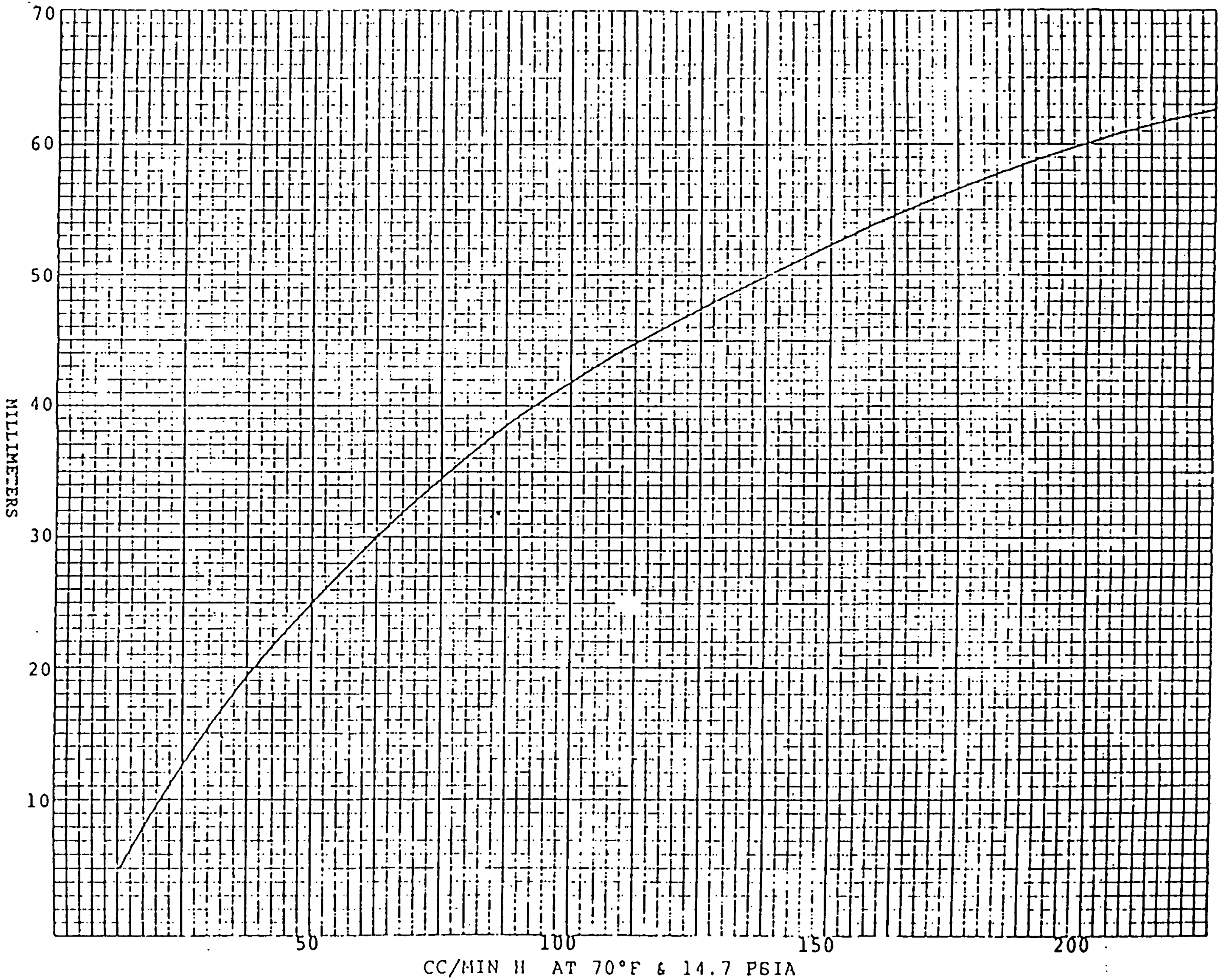


FIGURE 4.4 Hydrogen Calibration Curve (Nominal)

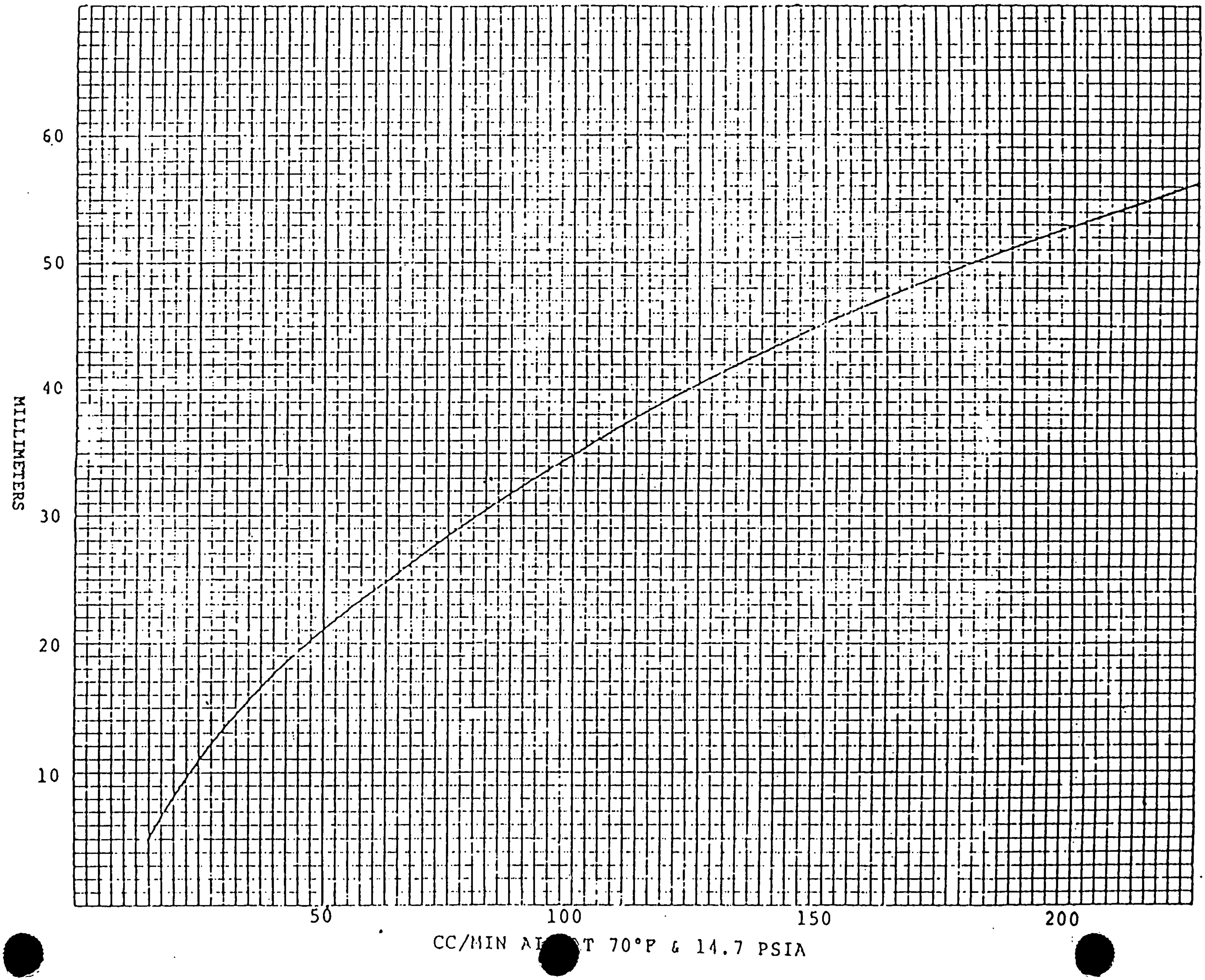


FIGURE 4.5 Air Calibration Curve (Nominal)

(6) Flow Restrictor Capillary

The hydrogen flow is further controlled by a stainless steel restrictor capillary. The capillary is temperature controlled to provide stable flow within the specified ambient temperature range. An iron-constantan thermocouple is provided to monitor this temperature at the rear panel.

(7) Hydrogen Solenoid Valve

A normally closed, 50/60 Hz, 115 Vac solenoid valve (SV3); located on the rear panel is used to provide internal shut-off of the hydrogen flow if the flame is not lit or if there is a power failure. It is energized when the ignitor button is pushed or a flame-on condition is indicated.

(8) Hydrogen Flow Limiter

The elbow connected to the outlet of the hydrogen solenoid contains an orifice to limit the hydrogen flow should a leak develop within the analyzer and a filter to protect the hydrogen flow system from particulate contamination.

4.2 FID Burner Assembly

Figure 4.6 shows an interior view of the FID burner block. Its function is to produce a stable burning condition for the flame to promote the formation of ions from hydrocarbon molecules. Sample air is introduced through the bottom inlet and hydrogen through the side inlet of the burner block. The two gas streams pass through a special burner tip where they mix and provide a stable diffusion flame. The combustion products are exhausted out of the top of the block. An ignition plug is positioned just above the hydrogen inlet port. A cartridge heater is inserted into the block just below the hydrogen inlet and maintains the block at approximately 105 deg C. Its temperature is monitored by a thermocouple attached to the block.

The ionization probe for collection of the ions is inserted into the block on the side opposite ignition plug.

A flame-out sensor, consisting of a thermocouple mounted on a round metal plate, is attached to the backside of the block. The front side of the block is covered by a metal plate.

4.3 Associated Electronics

Figure 8.1 gives the wiring schematic for the analyzer including the options. Figure 4.7 shows the position of the electronic boards with pin locations.

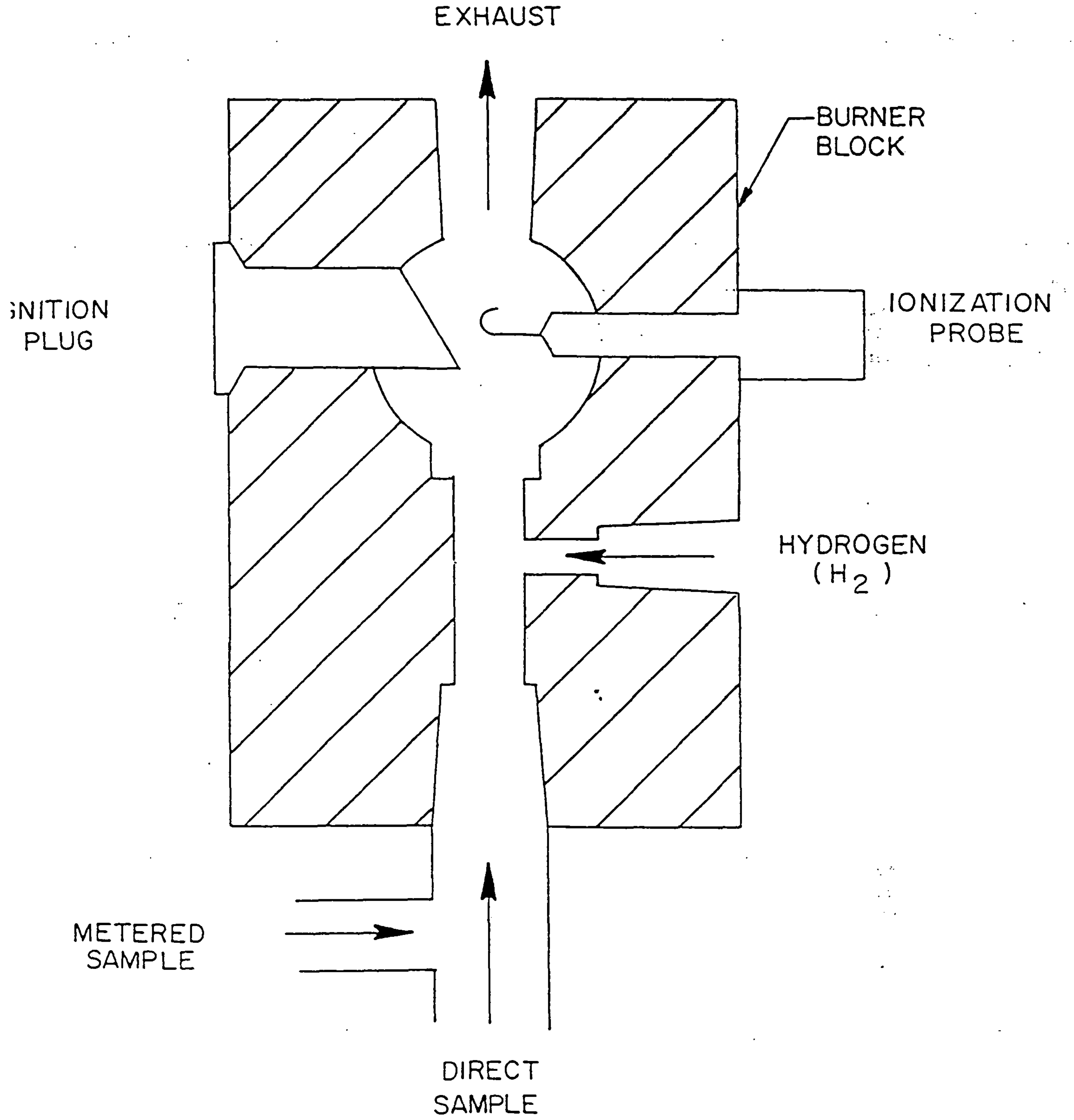


Figure 4.6 Interior View of the Burner Block

The basic tasks of the analyzer electronic system are to process the signal emanating from the FID detector for readout, to temperature-control the air and hydrogen pneumatic systems, to supply power to the subsystems, and to detect flame-out condition.

A functional block diagram of the electronic system is shown in Figure 4.8. A well regulated low voltage power supply provides ±15 Vdc for the electrometer amplifier, flame-out indicator, and output amplifier.

In the FID electrical system mercury batteries are used to apply an 84 volt positive potential to the ionization probe. The current produced at the probe is fed via the battery to an electrometer amplifier (J1) which converts the current to a voltage. The amplifier is adjustable so that the output may represent up to 5 decades of input current. The amplifier output is fed through the output Amplifier circuit for the total hydrocarbon analysis.

(1) Temperature Controllers (J26, 27)

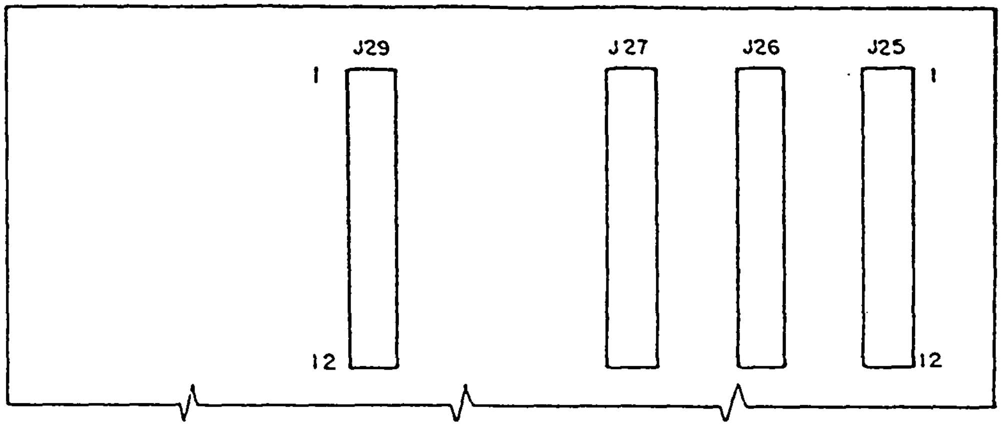
The temperature control boards utilize a local oscillator, controlled by a thermistor sensor to supply a drive signal for an a.c. switching device and thus provide proportional control. Switching of the triac is performed at the zero a.c. level to reduce R.F.I. effects. Each board has an adjustable resistor (R6) to set the temperature control point. The J27 board controls the temperature of the exhaust gas line and provides power to the heaters for both the burner block and exhaust assembly. The J26 board controls the temperature of the hydrogen capillary oven.

(2) Flame-out Detector (J29)

The flame-out detector circuit is a multi-function device. It detects the absence of a flame through the amplification of a thermocouple signal and contains circuitry for a re-light signal.

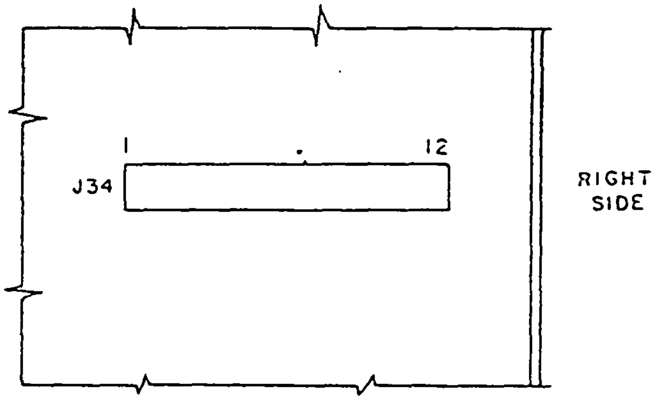
(3) Auto Reignite

A timer and relay in the instrument initiate the automatic ignition sequence after a flame-out has occurred. When flame-out is detected, a signal from the flame-out board (J29) causes K3 to de-energize. This activates the 10 minute timer motor. Cams connected to the motor shaft set the ignition sequence by controlling the closure of switches. The sequence gives switch closure for 30 seconds and switch open for 2.8 minutes. When the flame is on, K1 and K3 are energized. This stops the operation of the motor and ignition sequence. The wiring for this function is shown in Figure 8.1.



J25 — ±15VDC POWER SUPPLY
J26 — RESTRICTOR OVEN TEMP CONTROLLER
J27 — EXHAUST TEMP CONTROLLER
J29 — FLAME OUT INDICATOR

VIEWED FROM RIGHT SIDE OF UNIT



J34 — OUTPUT AMPLIFIER

VIEWED FROM TOP OF UNIT

Figure 4.7 Electronic Boards with Pin Locations

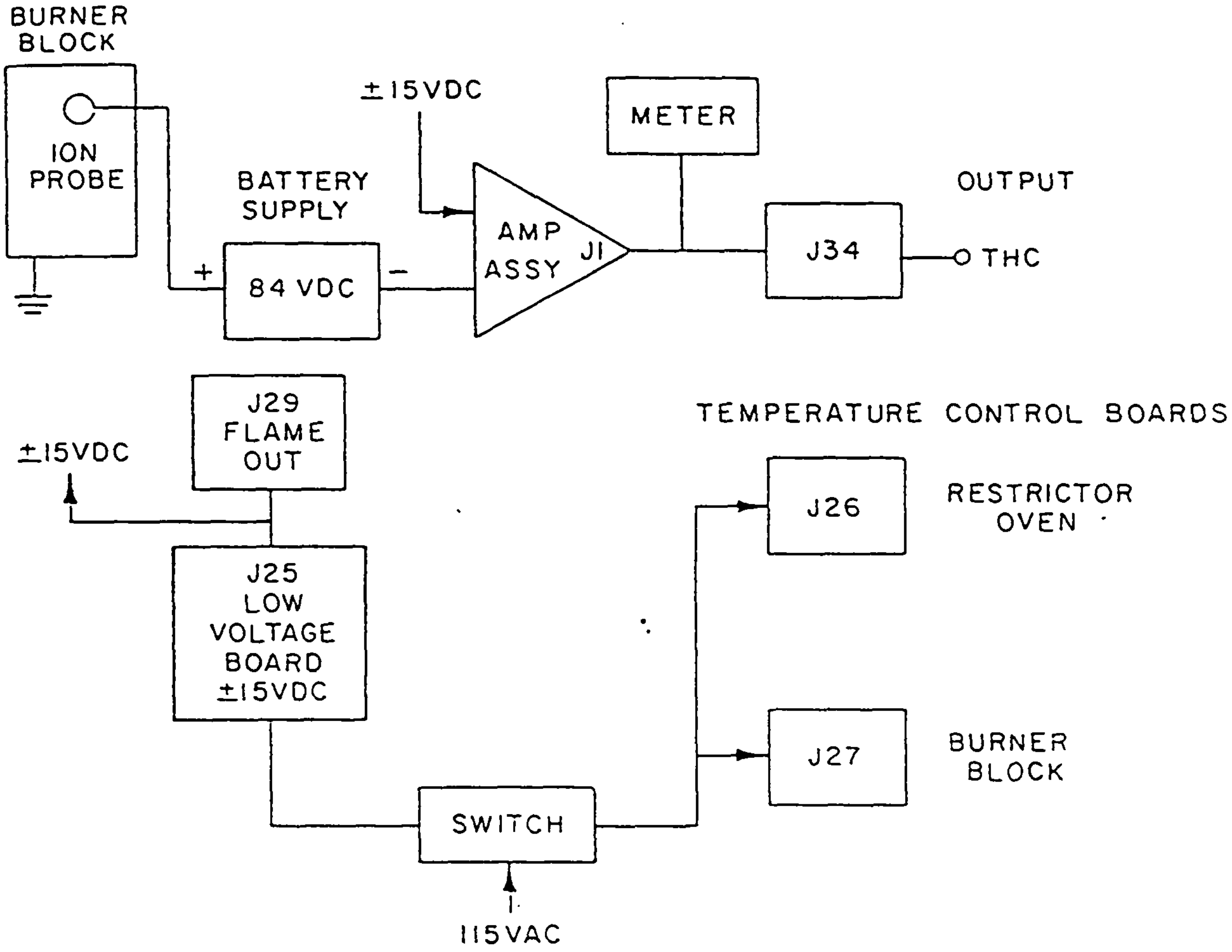


Figure 4.8 Block Diagram of Electronic System

(4) Power Supply (J25)

A low voltage supply (±15 Vdc) comprises the power supply subsystem. The ±15 volt supply provides power to the bulk of the electronic systems.

(5) FID Battery Source

The FID battery source consists of two 42 volt mercury batteries connected in series to provide the 84 Vdc potential in the FID detector circuit.

(6) FID Amplifier (J1)

The FID amplifier is a current to voltage converter which has a high input impedance characteristic. It is capable of providing a 1 volt output for 1×10^{-12} amps of input current with low noise and drift. This amplifier provides a 0-10 volt output level. The input zero adjust (R15) is used to adjust any voltage offset of the input amplifier (A1) to zero.

(7) Output Amplifier (J34)

This board employs a simple voltage divider network which takes a 10 Vdc input on pin 12 and supplies a 100 mV output on pin 4 and a 1.0 Vdc output on pin 5. This board is in the signal path between the Amplifier Assembly and the recorder output on the rear panel of the HC500-2D.

4.4 Front Panel

Figure 4.9 shows the front view of the analyzer with optional features included.

(1) Power Switch/Circuit Breaker

The power switch/circuit breaker is circumscribed by the region labeled "POWER" at the lower left hand corner of the panel. In the "ON" position, the switch is lit and provides 115 Vac to the analyzer. An internal circuit breaker will automatically turn the power off if a short occurs in the analyzer.

(2) Mode Switch (Option HC-26A or HC-11B)

The analyzer operational mode is controlled by the three position switch circumscribed by the region labeled "MODE" directly above the power switch. With the switch in "SAMPLE" position air introduced into the "SAMPLE INLET" port is analyzed. In the "ZERO" position, air is introduced into the analyzer through the "ZERO AIR" port. In the "CALIBRATE" position, air introduced into the "SPAN GAS" port is analyzed. Indicator lights are provided to show the position of the switch.

(3) Flow Controls and Indicators

All controls and indicators for making gas flow adjustments and measurements are circumscribed in the region labeled "FLOW".

a) Hydrogen Flow Adjust

The hydrogen flow is adjusted by the knob labeled "H ". Clockwise turn increases the flow rate.

b) Hydrogen Rotameter

The hydrogen flow rate is indicated by the rotameter labeled "H ". The flow rate is set properly when the center of the ball is at the value marked near the bottom of the rotameter or given on the calibration curve.

c) Air Flow Adjust

The air flow is adjusted by the knob labeled "AIR". Clockwise turn decreases the flow rate.

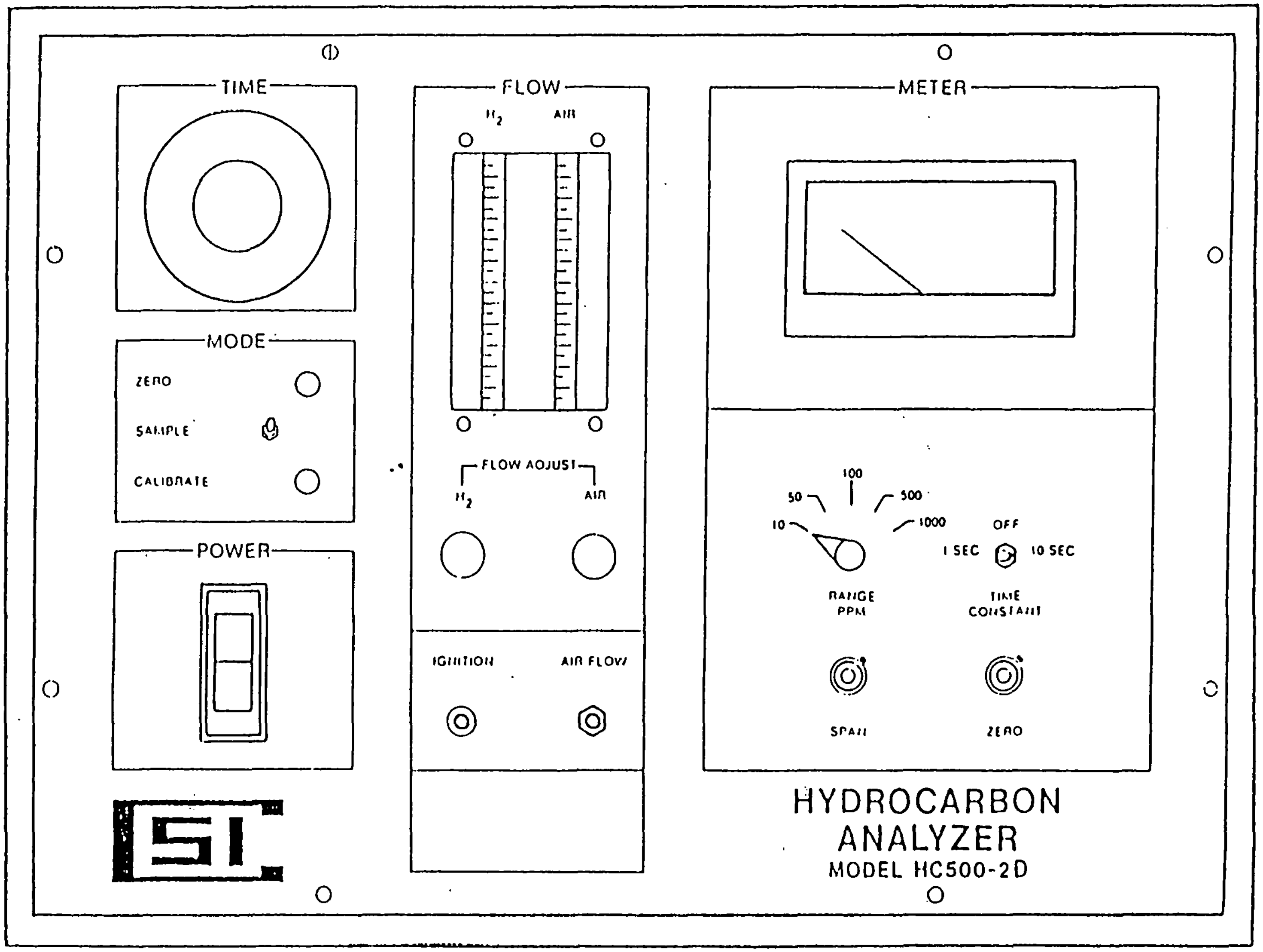


Figure 4.9 Front View of Analyzer

d) Air Rotameter

The air flow rate is indicated by the rotameter labeled "AIR". The flow rate is set properly when the center of the ball is at the value marked near the bottom of the rotameter or given on the calibration curve.

e) Air Flow (Option HC-26A or HC-11B)

This button is used when the air flow rate is to be read. Depressing and holding the button in energizes solenoid valve SV1, and causes air from the "ZERO AIR" port to pass through the "AIR" rotameter to the detector system.

(4) Ignition Button

The button marked "IGNITION", located in the circumscribed "FLOW" region, is used to ignite the flame. Depressing the button supplies power to the ignition plug in the burner block. When the indicator light in the button is lit, there is a "flame-out" condition, that is the flame is not burning. This button should not be pushed until the operation procedure is read.

(5) Electronic Controls and Indicators

Controls and indicators for making electronic adjustments or readings are circumscribed in the region labeled "METER".

a) Meter

The meter is used to indicate the hydrocarbon concentration in ppm of the air being burned in the analyzer. It is a 0-50 ua meter.

b) Range

The "RANGE" selector switch is used to set the output of the FID system. There are five selectable ranges 0-10, 0-50, 0-100, 0-500 and 0-1000 ppm hydrocarbon.

c) Time Constant Switch

A three position toggle switch is located at the right of the "RANGE" switch. It is used to minimize the output noise of the FID system when using the sensitive scales. The center "OFF" position bypasses this function. The "1 SEC" and "10 SEC" positions introduce a time constant into the output circuitry. The "10 SEC" position provides the lowest noise level in the output.

d) Zero

The "ZERO" knob, located to the bottom right of the "RANGE" is used to set the baseline for the FID output. This control is a ten turn potentiometer that provides 2 x 10 amps of buckout or suppression. Turning clockwise will increase the baseline signal. A locking device on the right side of the knob should be released, by pushing the lever counterclockwise, when setting this knob.

e) Span

The "SPAN" knob is used to adjust the output of the analyzer to the value of the span or calibration gas when that gas is being introduced into the analyzer and after the zero has been set. Turning clockwise will increase the gain or span output. A locking device on the right side of the knob should be released, by pushing the lever counterclockwise, when setting this knob.

(6) Timer Control (Option HC-11B)

The indicator dial located in the area labeled "TIME" is used to set the time to initiate the automatic calibration cycle. The dial is marked off in divisions representing 24 hours. When the "0" on the dial is adjacent to the mark under the word "TIME" the cycle will begin.

4.5 Rear Panel

Figure 4.10 shows the rear view of the analyzer.

(1) Electrical Connectors

a) Temperature Output Jacks

The jacks labeled "THERMOCOUPLES" are provided to monitor the temperature of the exhaust line, capillary oven and burner block. The temperature outputs are iron-constantan thermocouples. [Iron (white wire) is positive and constantan (red wire) is negative].

b) Power Cord

The analyzer power cord is located at the lower left hand corner of the rear panel. It can be plugged into a 110 ±10 Vac, 50/60 Hz source.

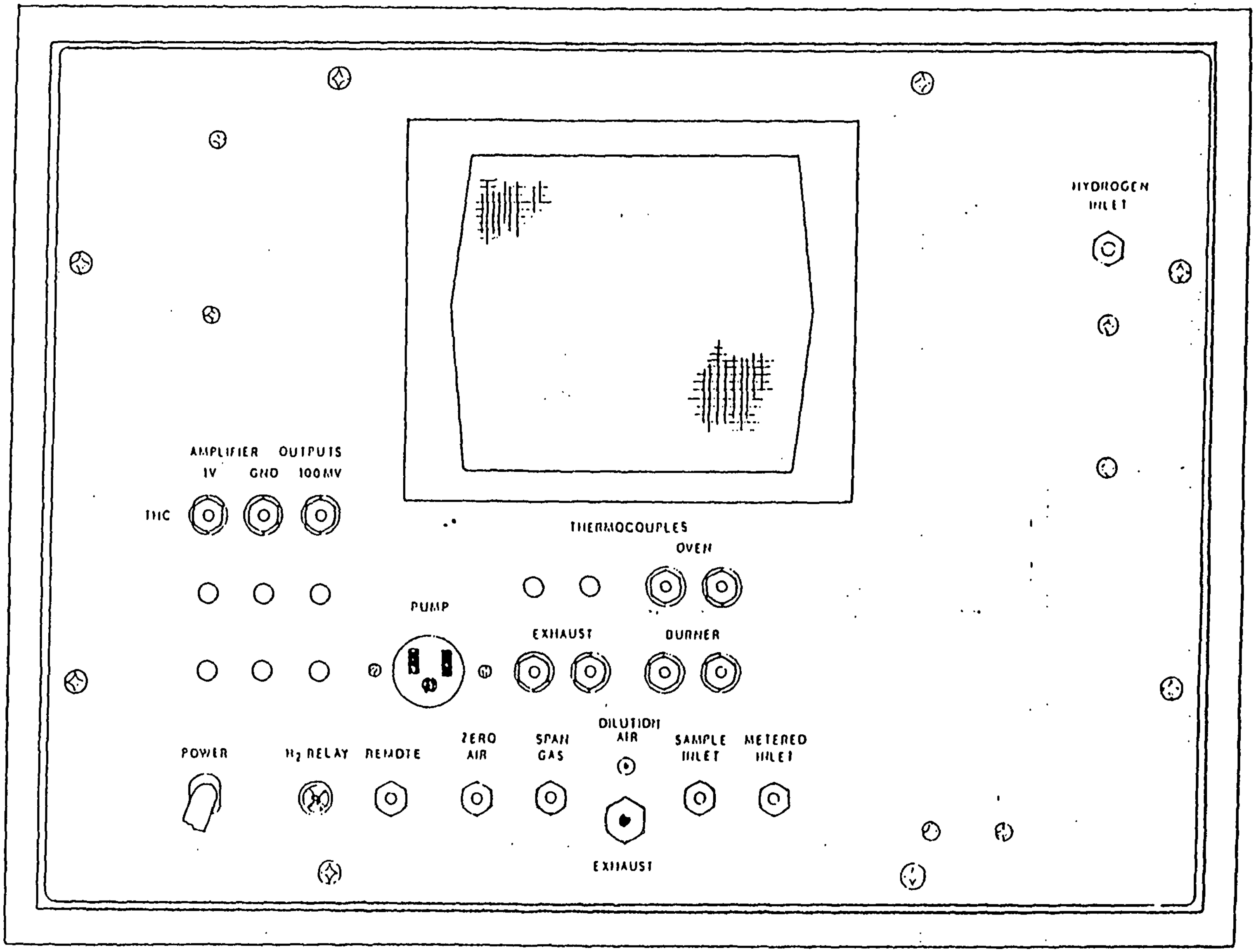


Figure 4.10 Rear View of Analyzer

c) Recorder Outputs

There are three jacks for the total hydrogren channel. The jacks are color coded: The black jack (common or ground) is used with either the red or white jacks for 0-1 volt or 0-100 mV full scale output, respectively.

d) Hydrogen Shut-Off Valve Connector

A 9-pin electrical connector labeled "H Relay" is provided for energizing an external hydrogen shut-off solenoid valve. Wiring of the connector is shown in Figure 8.1.

(2) Gas Line Connectors

a) The hydrogen gas inlet fitting is located near the upper right-hand corner and labeled "HYDROGEN INLET".

b) The sample air inlet is the fitting labeled "SAMPLE INLET".

c) Analyzers without Option HC-26A or HC-11B are provided with the fitting labeled "METERED INLET". This is used to determine the air flow rate.

d) The calibration gas inlet fitting (provided only with Option HC-26A or HC-11B) is labeled "SPAN GAS".

e) The zero air inlet fitting (provided only with Options HC-26A or HC-11B is labeled "ZERO AIR".

f) The analyzer exhaust 1/4" fitting is located at the center bottom edge of the rear panel and labeled "EXHAUST".

g) The dilution air enters through the tube opening at the center bottom edge of the rear panel and labeled "DILUTION AIR". This must be capped with a septum and a hypodermic needle inserted in the septum before operation.

(3) Cooling Fan

The cooling fan with screen is located at the center upper half of the rear panel.

5. OPERATION

Operation of the analyzer is a relatively simple task after initial set up. It requires only readout and operational adjustments for continuous operation.

5.1 Set-Up Procedure

Prior to start-up and operation of the analyzer, it is essential to prepare the system as follows:

1. Place Power Switch in "OFF" position. Remove analog meter shorting clip. Reinstall clip when shipping analyzer.

2. Connect 1/8" OD Teflon sample line to port on rear panel marked "METERED INLET". Analyzers with options HC-26A or HC-11B, connect sample line to port labeled "SAMPLE INLET".

3. If analyzer has Option HC-26A or HC-11B connect 1/8" OD Teflon line from zero and span sources to respective ports on rear panel marked "ZERO" and "SPAN".

> NOTE: These sources ("SAMPLE", "METERED", "SPAN" and "ZERO") must be vented sources or have close to one atmosphere pressure to avoid damage to analyzer.

4. Connect 1/8" OD hydrogen supply line to port on rear panel marked "HYDROGEN INLET". If an external hydrogen shut off valve is to be used, connect wires to electrical plug located on rear panel marked "H2 RELAY". See wiring diagram for pin connections.

CAUTION: HYDROGEN IS A FLAMMABLE GAS. USE METAL TUBING AND CHECK FOR LEAKS AT ALL CONNECTIONS. USE A HYDROGEN CYLINDER REGULATOR WITH A LIMITING ORIFICE. IF THE HYDROGEN CYLINDER IS NOT IN AN OPEN AREA, THE REGULATOR SAFETY RELIEF PORT SHOULD BE VENTED TO THE OUTSIDE.

5. Cap rear panel port marked "DILUTION AIR" with rubber septum cap and insert hypodermic needle supplied with instrument through center of septum.

6. If desired, vent analyzer exhaust to another location. Connect 1/4" OD line to port on rear panel labeled "EXHAUST".

7. Connect recorder or other readout device to corresponding output jacks on rear panel.

8. Connect power cord to 115 Vac, 50/60 Hz power source.

5.2 Start-Up Procedure

After completion of the set-up procedure, the analyzer is ready for start-up as follows:

1. Set front panel functional switches as follows:

a) "RANGE" to 1000 ppm.
b) "TIME CONSTANT" to "OFF" position.
c) "ZERO ADJUST" to 10.0 position (fully clockwise).

2. With hydrogen source shut off, push "POWER" switch to "ON" position. The "POWER" and "IGNITION" switches should light.

3. Adjust air flow so that the "AIR" rotameter ball is set at 6.0.

> NOTE: With Options HC-26A or HC-11B place the calibrate switch in "ZERO" position to read the air flow.
>
> CAUTION: The Air Control is a metering control only and should not be used as a shut-off valve. If the control is used to close off flow, particularly while the unit is warm, the valve may be damaged. The air control should always be left open.

4. Allow the burner chamber assembly to warm up for 15 minutes. The automatic temperature controller is factory set to warm up the assembly and maintain the proper operating temperature level.

5. Adjust the hydrogen supply inlet pressure to 60 psig.

6. Readjust the air flow rate to an "AIR" rotameter setting of 6.0.

7. Depress the "IGNITION" button, after a couple of seconds quickly set the hydrogen flow to read approximately 5.0 on the "HYDROGEN" rotameter and after a couple of seconds release the "IGNITION" button. The "IGNITION" button should not be lit.

> NOTE: The analyzer will automatically light itself, however both the hydrogen and air flows must be set manually as above. The ignition button will not be lit during automatic ignition attempts. It will remain off if lighting is successful and come back on if unsuccessful.
>
> CAUTION: When turning the hydrogen off, close the flow control only to the point that the ball just attains a zero reading. If the flow control valve is closed beyond this point, the valve may be damaged.
>
> NOTE: If the "IGNITION" button is still lit, the flame is not burning. Repeat steps 3 through 7.

CAUTION: Never push the "IGNITION" button with the hydrogen flowing as this may cause an explosion in the burner chamber which could damage the ignitor.

NOTE: If ignition does not occur after several attempts, open the air valve another full turn counterclockwise prior to repeating the start-up procedure.

5.3 Operating Procedure

At the conclusion of the start-up procedure the analyzer is ready for operation.

1. After ignition, set the air and hydrogen flows to the values listed on the calibration curves supplied with the analyzer or printed on the front panel near the bottom of each rotameter.

2. Allow 15 minutes for the internal temperature of the instrument to stabilize and reset the hydrogen and air flows as before.

3. Set the Range and Time Constant switches to the desired positions.

4. Set the zero baseline as follows: with the zero air entering sample inlet (or with Option HC-26A or HC-11B the Mode switch in "ZERO" position and zero air line connected to the "ZERO" inlet) set the meter on the front panel to read zero with the "ZERO" adjust pot on the front panel.

5. Connect the sample air line to "SAMPLE INLET" port and securely cap the "METERED INLET" port (place "MODE" switch in the "SAMPLE" position with analyzers having Option HC-26A or HC-11B).

6. If the analyzer has Option HC-11B set "TIME" dial to desired position (see instructions for setting switch in section 10).

7. The analyzer is now ready for sampling. The "SPAN" has been preset at the factory and should not be adjusted unless the analyzer is to be calibrated. A dynamic calibration of the analyzer may be performed as described in section 5.4.

5.4 Calibration Procedures

Each individual analyzer is calibrated at the factory prior to shipment and calibration curves supplied with it. These curves contain operating conditions specific to the unit. Typical curves are shown in Figures 5.1 and 5.2.

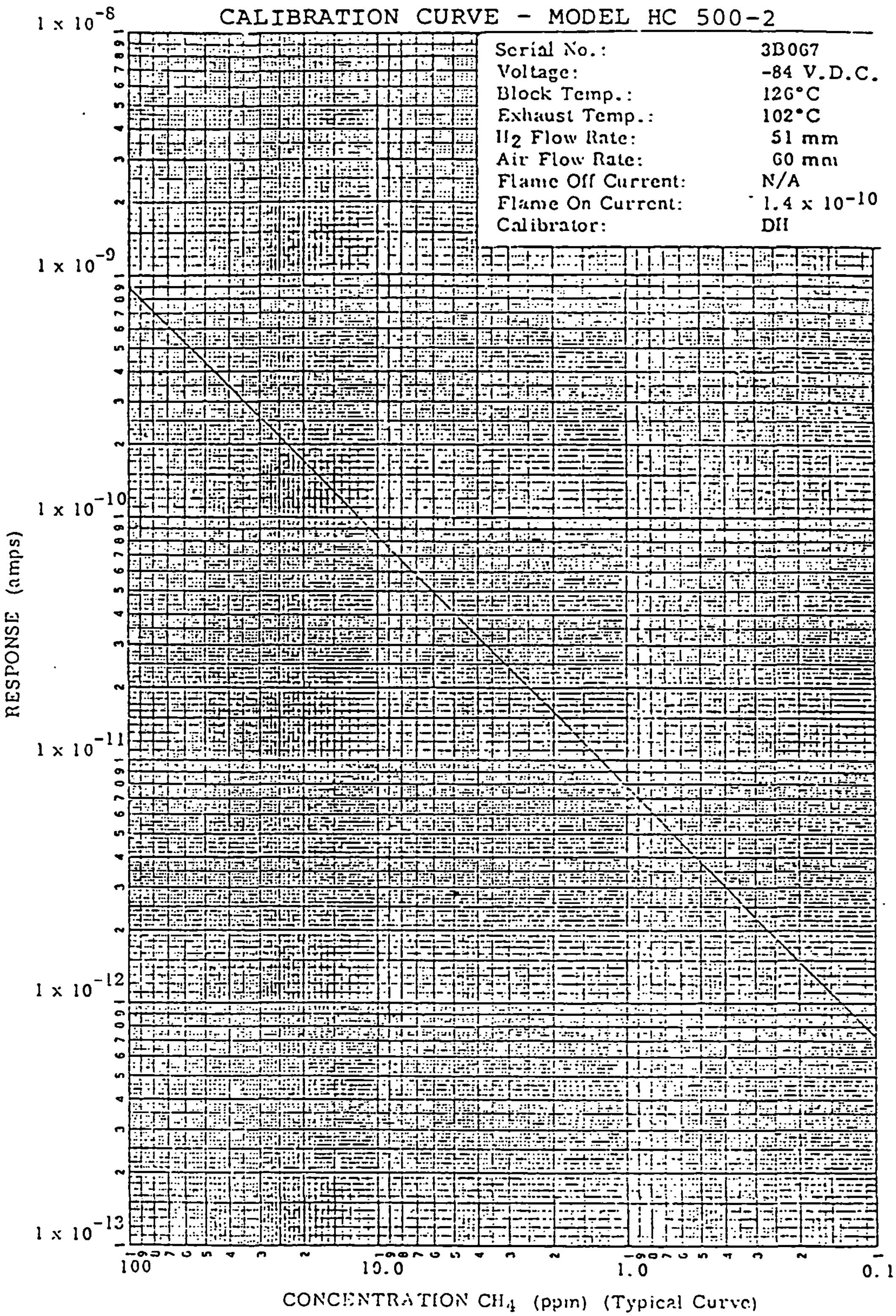


Figure 5.1 Typical FID Calibration Curve
(0.1 to 100 ppm methane)

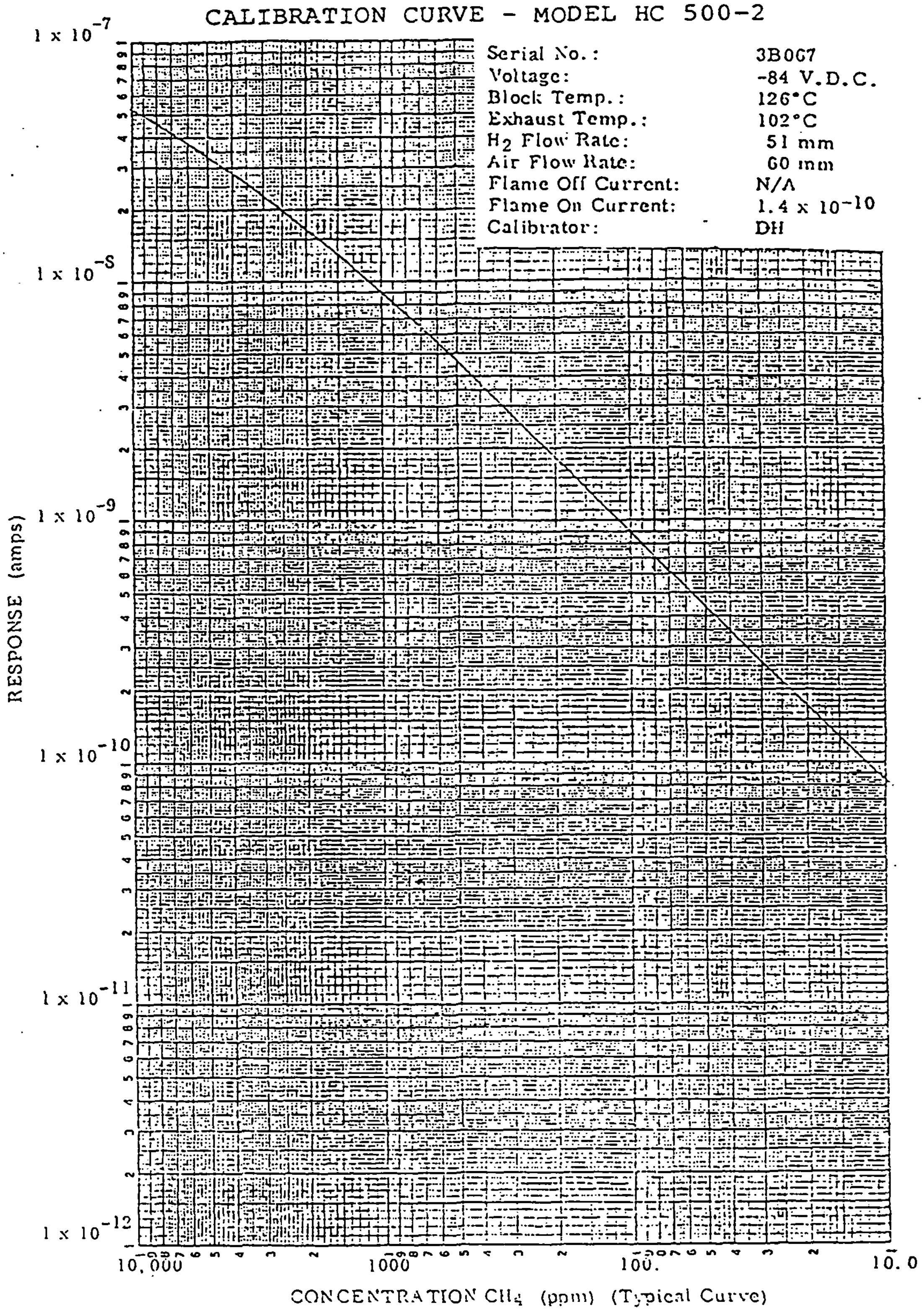


Figure 5.2 Typical FID Calibration Curve
(10.0 to 10,000 ppm methane)

(1) Calibration Curve

The calibration curve is the ion probe current response to sample hydrocarbon concentration levels referenced to "ZERO AIR", i.e. air scrubbed of hydrocarbon compounds.

NOTE: Air supply lines usually contain hydrocarbons unless filtered. A list and definition of the calibration curve parameters are given below:

a) Serial No. - Number assigned to the specific analyzer. Number also given on rear panel of analyzer.

b) Voltage - The voltage of the ion probe.

c) Oven Temperature and Exhaust Temperature - the temperature of the restrictor oven and exhaust line can be measured. Thermocouples are iron-constantan.

d) H Flow Rate and Air Flow Rate - the recommended rotameter settings for hydrogen and air.

e) Flame-Off Current - the analyzer residual baseline with the flame off.

f) Flame-On Current - the analyzer residual baseline reference established by sampling "ZERO AIR". Flame-on current must be subtracted from signal reading to obtain a high degree of accuracy at low hydrocarbon concentrations. If no buckout or "ZERO" control is used, the flame-on current specified is directly subtracted from the analyzer output to obtain the hydrocarbon concentration level. In setting the "ZERO" control, zero air must be introduced into the analyzer. This is required because room air contains small amounts of hydrocarbon compounds which increase the actual reading. This zero air reading may then be reduced by using the "ZERO" control and establishing a new baseline.

g) Calibrator - initials of person who performed the test.

(2) Dynamic Calibration

The instrument can be calibrated dynamically by using a zero air source and methane span gas source. The procedure is as follows:

a) Set air and hydrogen flows to the settings given on the specification sheets.

b) Introduce zero air to analyzer. (Mode switch in zero position with Option HC-26A or HC-11B).

c) While in the direct mode use "ZERO" adjust pot to set THC output.

d) Set "RANGE" switch to appropriate position for concentration of methane span gas to be used.

e) Introduce methane span gas to analyzer. (Mode switch to calibrate position with Option HC-26A or HC-11B).

f) Adjust span knob so that output reads methane value.

g) Repeat steps b, c, d and e several times until zero and span are repeatable.

5.5 Shut-Down Procedure

To shut down the unit for a short time, turn off the hydrogen flow at the hydrogen tank. Do not switch off sample pump until all hydrogen has been bled from system. The electronics may be left on. For longer periods of time turn off the main power switch. If the unit is to be moved, shipped, or stored, disconnect the gas lines and electrical connections on the rear panel. Protect the ports, both from thread damage and dirt in the lines. Swagelok caps are suggested. Remove the #18 hypodermic needle from the dilution port to keep it from being bent. This can be taped to the unit to prevent loss. The shipping box the unit came in or its equivalent is recommended for optimum protection.

6. MAINTENANCE

The analyzer maintenance requirements are primarily associated with the pneumatic subsystem and the burner assembly. The recommended maintenance schedule is given in Table 6.1. The cleaning and replacement procedures are given below.

6.1 Pneumatic Sampling Network

Under most operating conditions, the sample cleanliness level determines the maintenance frequency. The wearout or replacement times of the elements listed below are rated for continuous operation of the analyzer in a reasonably clean environment.

(1) Teflon Lines

The Teflon lines must be periodically replaced or cleaned. Over long term continuous operating periods the sample line may accumulate deposits which can impede the sample air flow rate and/or interact with the sample gas. The frequency of replacement is dependent upon the average condition of the sample ingested. However, CSI recommends replacement or cleaning every 12 months.

If lines are replaced, remove all lines with their fittings. Cut new lines to the same dimensions as the old lines and use new fittings when installing the new lines. The lines can be cleaned by removing them and pulling a good, fresh degreasing solvent (e.g. Freon) through the lines at a high velocity. Thoroughly dry lines before reassembly.

NOTE: Use only Teflon tubing for replacement that has been purged of impurities.

CAUTION: Be sure all hydrogen gas has been flushed with air before removing the lines and all new lines are properly retightened.

(2) Flow Restrictor Capillary

It is important that the flow restrictor capillary be free of dirt to maintain a stable flow. The capillary should be replaced only when hydrogen flow cannot be maintained and other components are proven to be functioning correctly. Be sure the hydrogen source flow and detector temperature are stable, the hydrogen and exhaust orifices are clean, and there are no leaks, before replacing the capillary.

Table 6.1 Recommended Maintenance Schedule

ITEM	ANNUAL MAINTENANCE	BIENNIAL MAINTENANCE
Pneumatic Sampling System:		
Teflon Lines	Replace*	
Flow Resictor Capillary	Replace	
Rotameters	Clean*	
Hydrogen Regulator		Replace
Dilution Air Orifice	Replace*	
FID Burner Assembly:		
Burner Chamber	Clean*	
Chassis, Fan Assembly:		
Air Filter	Clean*	
FID Detector Batteries	Replace	
Pump		Replace

*NOTE: These items may require maintenance more often, depending on cleanliness of its environment and the exposure rate.

(3) Rotameters

Rotameters should be cleaned every 12 months, or when the ball does not move freely when adjusting the flow. To clean, remove both inlet and outlet lines and flush with Freon or similar degreasing solvent.

(4) Hydrogen Regulator

The hydrogen regulator should be replaced every 24 months. To replace, remove inlet and outlet lines and the front panel securing nut. Remove regulator and replace new one in reverse manner. Replace with only a regulator from CSI as this is a special regulator.

CAUTION: Be sure to flush all hydrogen from lines before removing the lines and that all lines are properly retightened.

(5) Dilution Air Orifice

The orifice is a size #18 hypodermic needle 1 inch long, which controls the 4 liters/min flow of dilution air. The needle and septum should be replaced every 12 months.

6.2 FID Burner Assembly

(1) Burner Chamber

The burner chamber will periodically require cleaning. If loss of sensitivity is noticed it should be suspected that the unit is dirty. Some units have functioned continuously for over 30 months without cleaning being necessary. To clean the detector, follow this procedure:

a) Remove the ac power supply cord from the electrical power source. Unlock the eight screws from the sides of the cover and lift the cover off.

b) Disconnect the hydrogen inlet, air inlet and exhaust air outlet line at the burner block and cap the hydrogen inlet with a Swagelok plug (P/N 200-P).

c) Connect to the burner exhaust port a liquid suction apparatus, such as a water aspirator with a suitable trap, to flush the liquid through the burner chamber.

d) Inject distilled water into the burner block (a length of Teflon line with a 1/8" Swagelok fitting will help in this step).

e) repeat the purging operation using reagent grade acetone.

f) Connect a clean air supply to the air inlet and purge the system for a period of approximately 10 minutes or until no trace of acetone is detectable in the exhaust.

g) Plug in the ac power supply to a power source, place "POWER" switch to the "ON" position, and continue clean air flushing.

<u>CAUTION:</u> Disable Auto Re-ignite function (remove K3). Do not actuate the ignition switch during the cleaning procedure, as this may cause damage to the glow plug.

h) Allow the unit to operate for one (1) hour. This should completely dry out all internal components in the burner chamber and sample and exhaust lines.

i) Following the drying period, reconnect the hydrogen line to the burner chamber. Perform a leak test by removing the exhaust line from the top of the burner block and capping it. Also cap all the air inlet ports. Attach a hydrogen* supply line to the "HYDROGEN INLET" port. Adjust inlet pressure to 5 psig and open the hydrogen flow control valve. Any displacement of the float in the H rotameter indicates a leak in the system. An initial displacement and return of the float to 0 mm is normal when the H valve is opened and does not indicate a leak.

j) After finding and stopping the leaks, if any, reconnect the lines as before. The analyzer is now ready for start-up procedure.

6.3 Chassis, Fan Assembly

(1) Air Filter

The air filter for the chassis ventilating fan should be cleaned every 12 months or as needed. Shut off the power to the analyzer and remove the filter. Wash it in warm detergent solution and recoat with ROTRON filter oil or equivalent.

6.4 Electronics

The electronics of the analyzer are essentially trouble free and, except for the FID batteries, should not require periodic maintenance. However, should the amplifier need replacing it will need recalibration. The recalibration should be attempted only by qualified people with the proper equipment.

*Helium may be substituted for hydrogen for purposes of safety, though no problem has been encountered to date using hydrogen and exercising general safety practices.

(1) Battery Replacement

The two mercury batteries should be replaced every 12 months. Replace batteries by the following procedure:

a) Unplug analyzer from wall socket and remove cover.

b) Remove two screws on top cover of battery holder (located on bottom right side just behind front panel).

c) Remove holder cover and lift out Teflon wrapped batteries. Care must be taken not to break the resistor attached to the snap-on connectors.

d) Remove Teflon protective insulation and disconnect batteries from snap-on connectors.

e) Replace new batteries in reverse order.

(2) Electronic Alignment

All voltages are measured with respect to chassis ground unless otherwise noted.

a) Turn on power and remove the analyzer cover.

b) Set the ZERO control on the front panel fully clockwise and the RANGE control to the 500 ppm position.

c) Connect a current source (KEITHLEY MODEL 261 or equivalent) to the amplifier input jack (J2). Set the current for zero or any current less than 1 x 10 amps.

d) Monitor pin 12 of J34 with a d.c. digital voltmeter (Fluke Model 801 or equivalent) and adjust R15 on the amplifier board (J1) for 0.000 volts.

e) Set the RANGE control on the front panel to 10 ppm and set the current source for a reading of 10 volts on the DVM at J34, pin 12.

f) Adjust R24 of the amplifier board (J1) until the front panel meter reads full scale.

g) Measure voltage at J15 rear panel and adjust R4 on output amp board (J34) for 1.000 Volt, and adjust R3 for 100mV at J17 on rear panel.

This completes the electronic alignment. Disconnect the current source and digital voltmeter, connect the cable from the battery to the amplifier at J2. The instrument is now ready for operation.

7. TROUBLE SHOOTING PROCEDURES

The analyzer is designed to provide trouble-free continuous operation. However, in the event of a problem or malfunction, the trouble shooting procedure listed below presents an orderly sequence of tasks to locate and correct the instrument malfunction.

Symptom	Probable Cause	Corrective Action
1. Power switch "ON" but does not light.	No power to analyzer.	Check power at 115 Vac outlet. Be sure plug is securely in outlet.
	Defective fuse.	Replace fuse.
	Burnt out indicator bulb.	Replace power switch.
	Defective transformer.	Replace isolation transformer.
2. Power switch will not stay in "ON" position.	Short in electrical system.	Find and fix electrical problem.
3. Ignition switch does not light with flame out.	Defective light.	Replace ignition switch.
	Open circuit.	Repair loose or broken wires.
	Defective relay (K1).	Replace relay if it does not make a click sound when "IGNITION" button is pushed
	Loose or defective flame-out board.	Check to see if board is properly set in place. Replace defective board.
	Defective transformer.	If secondary output of T1 transformer is not 6.3 Vac, replace transformer.

	Defective temperature sensor.	Disconnect lines to thermocouple. If higher than 500 ohms, replace thermocouple.
4. Ignition button remains lit after being pushed.	Flame not burning.	See symptom #7, "Analyzer fails to ignite".
5. Air flow absent, incorrect, or unstable.	Defective vacuum pump.	Check vacuum system (should be capable of maintaining 5 l/min flow rate at 370 Torr), if not, replace pump.
	Wrong flow setting.	Set air flow to recommended value.
	Dirt in flow system.	Isolate source by disconnecting, starting at analyzer inlet and working towards pump.
	Leak in flow system.	Retighten fittings and caps. Check lines for small holes.
	Moisture in exhaust line.	If exhaust line is warm (about 90 deg C at thermocouple) allow analyzer to run for 10 min to dry line; if not dry replace exhaust line.
	Defective flow control valve(s).	Replace valve(s)
	Dilution air orifice clogged or septum leaking.	Replace needle and/or septum.

	Loss of temperature control.	See symptom #12 "No or incorrect temperature control".
6. Hydrogen flow absent, incorrect or unstable.	Hydrogen source empty or not producing sufficient hydrogen.	Replace hydrogen source or its regulator. Set regulator on hydrogen source at 30 psig and open all related valves.
	Hydrogen shut-off valve not energized.	Check voltage for 110 Vac to valve when "IGNITION" button pushed.
	Internal hydrogen regulator defective.	Replace regulator.
	Flow system problems.	See discussion above on air flow problems.
7. Analyzer fails to ignite.	Improper hydrogen or air flow.	Set flow as recommended.
	Insufficient purge.	Open flow control valves until rotameters are set at 6.0, and allow gases to purge for 30 seconds.
	Temperature too low.	Check temperature by inserting temp. indicator into thermocouple terminals at rear of instrument. The exhaust temperature should read above 90 deg C, and block temperature

		above 90 deg C. If temperature indicator is not available, remove instrument cover and feel exhaust line which should be warm.
	Ignitor glow plug defective.	Remove flame-out indicator board from J29 connector and measure resistance between pin 11 on J29 connector and chassis (ground). If resistance is not in the order of 20 ohms replace ignition plug and O-ring.
	Loose or defective flame-out board.(J29).	Be sure board is properly in its socket. Measure voltage between test point on board and chassis(ground). If flame is off, voltage should be -1.5 to -2.0 volts. If flame is on, voltage should be 4.0 volts or higher. Adjust R3 for proper voltage or replace board If voltage is not between 5-10 Vdc, when flame is lit replace board.
8.No output at meter but power switch lights.	Flame not burning.	If "IGNITION" button is lit relight flame per instructions

Loose electronic board or connections.	Insure all boards are securely in place. Check for loose wires or connectors.
Defective meter.	If the recorder output and current across terminal leads to meter are good, replace meter.
No power to low voltage power supply board.	Remove low voltage power supply board from J25 connector. Measure across pin 4 and pin 9 for 115 Vac, if missing check for loose wire at connector or electrical leads to connector.
Defective low voltage power supply board.	Check J25 connector (with board in place) for +15 Vdc across pin 11 and chassis (ground) and for -15 Vdc across pin 2 and chassis. If missing either voltage, replace board.
Defective batteries.	Remove "PROBE" (+) and "AMP"(-) connectors from battery holder (located at bottom front right). Measure voltage between the center pins of the two connectors on battery holder. If not 80 ±5 Vdc replace batteries inside holder.

	Defective amplifier assembly.	Connect an external calibrator to the amplifier input to determine if amplifier functions.
9.No output to recorder.	Defective output amplifier.	Replace amp board or look for broken wires
10.Loss of analyzer sensitivity and/or noisy operation.	Flows not set properly.	Set air and hydrogen flows to recommended values.
	Leaks in flow system.	Retighten fittings. Check lines for small holes.
	Dirty burner block.	Clean burner block per instructions.
	Impure hydrogen.	Replace source if noise increases greatly with small increase in hydrogen flow rate.
	Loss of temperature control.	See symptom #12 "No or incorrect temperature control".
11.Unstable or incorrect zero.	Zero or span source spent or incorrect.	Verify or replace source.
	Leak in zero air system.	Locate leak and fix.
	Solenoid valve(s) defective for analyzers with Options HC-26A or HC-11B.	Replace valve(s)
	Contaminated or clogged air lines.	Replace or clean air flow lines.

	Flows set improperly.	Set air and hydrogen flows to recommended values.
	Zero and span controls not set up properly.	Recalibrate instrument per instructions.
	Dirty burner block.	Clean burner block per instructions.
	Defective battery.	See symptom #3 "No Output".
12.Temperature control inoperative or incorrect.	Defective heaters.	A)Burner block heater: Disconnect plug P4 (located on burner assembly) Measure resistance between connector contacts H and F If there is no continuity or resistance is greater than 500 ohms, replace heater. B) Exhaust heater: Remove temp controller from connector J27 and unplug P4. Measure the resistance between pins H and F on the plug. If there is no continuity or resistance is greater than 500 ohms, replace heater. C) Restrictor Oven: Remove low temp controller from connector J26. Measure resistance between TB3-3 and TB3-4. If

	there is no continuity or resistance is greater than 500 ohms, replace heater.
Defective thermistor.	A) Exhaust Thermistor: Remove high temp control board from connector J27. Measure resistance across contacts 1 and 9. If resistance is not approx. 100K ohms at 25 deg C replace thermistor. B) Restrictor Oven: Remove low temp control board from connector J26. Measure resistance between contacts 1 and 9. If resistance is not approx. 4K ohms at 25 deg C replace thermistor.
Defective temperature control board.	The exhaust temp control (J27) and capillary oven (J26) boards may be checked as follows: Measure the input voltage 115 Vac, between contacts 2 and 10 (neutral) for each board connector. If missing, check for broken or loose wires. If present, measure the voltage

between contacts 6 and 10 (neutral) or each connector. The voltage should show variations during one min. of measuring. If not, replace board.

NOTE: Heaters and thermistor should be checked and found good before this step.

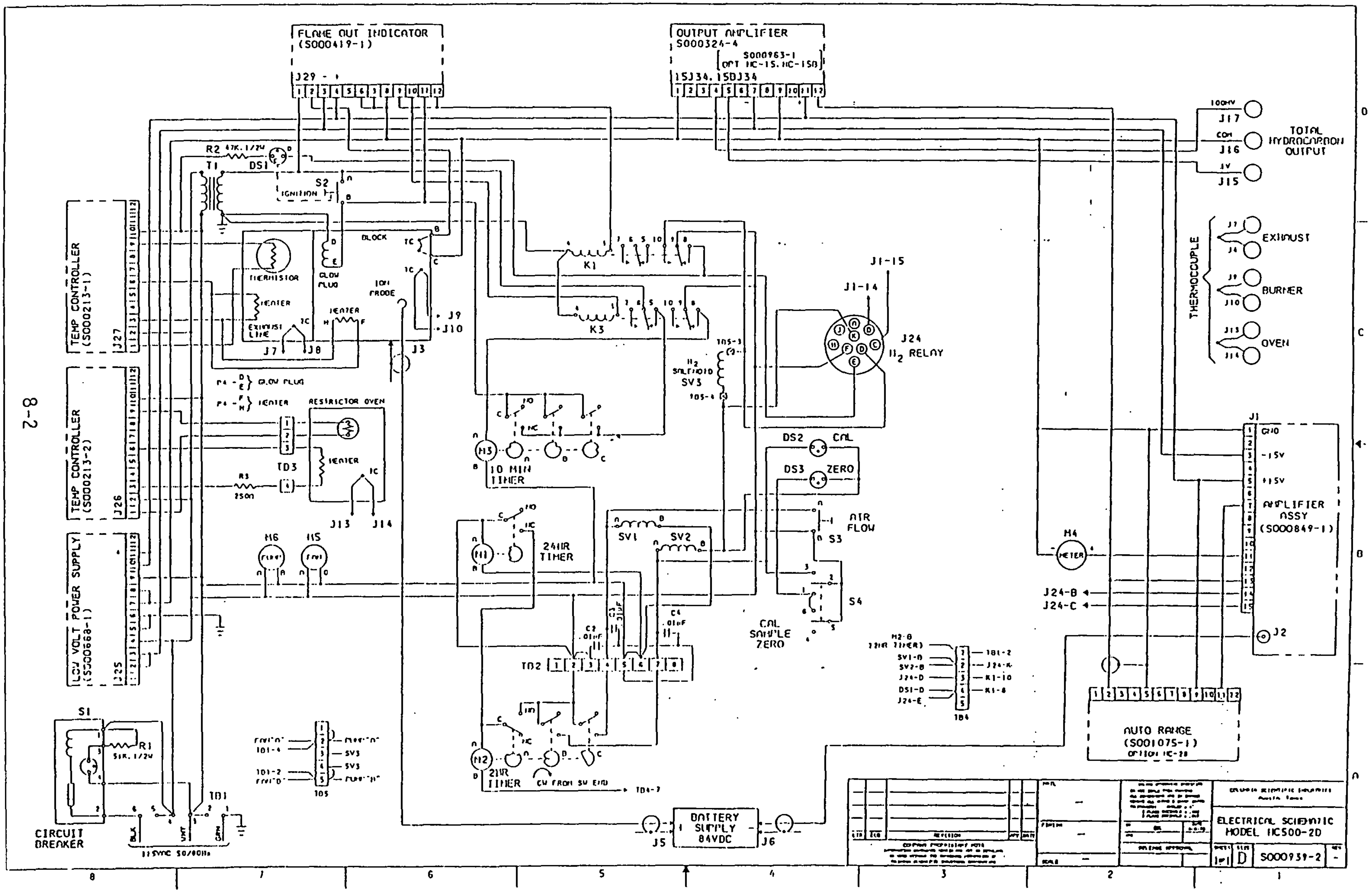
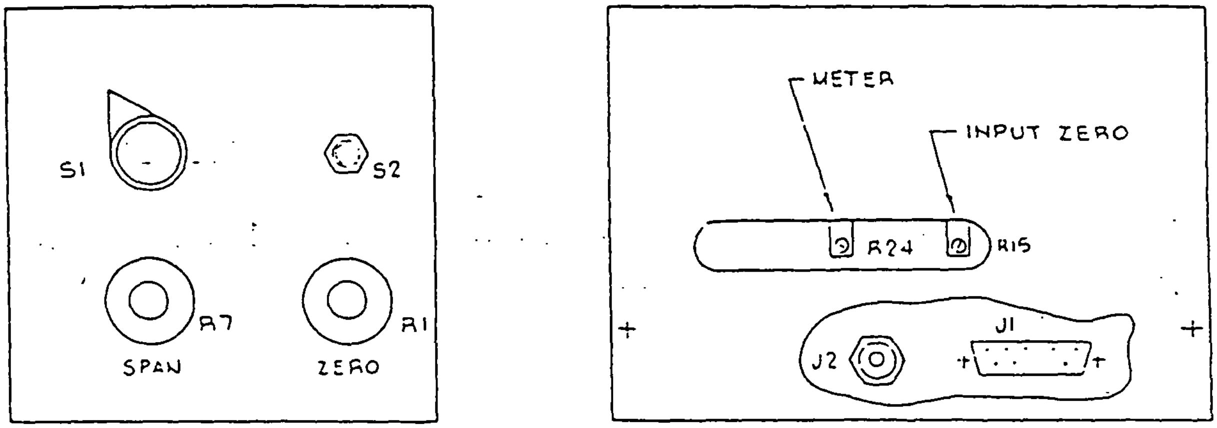


Figure 8.1 Wiring Schematic for HC500-2D



FRONT VIEW

SIDE VIEW

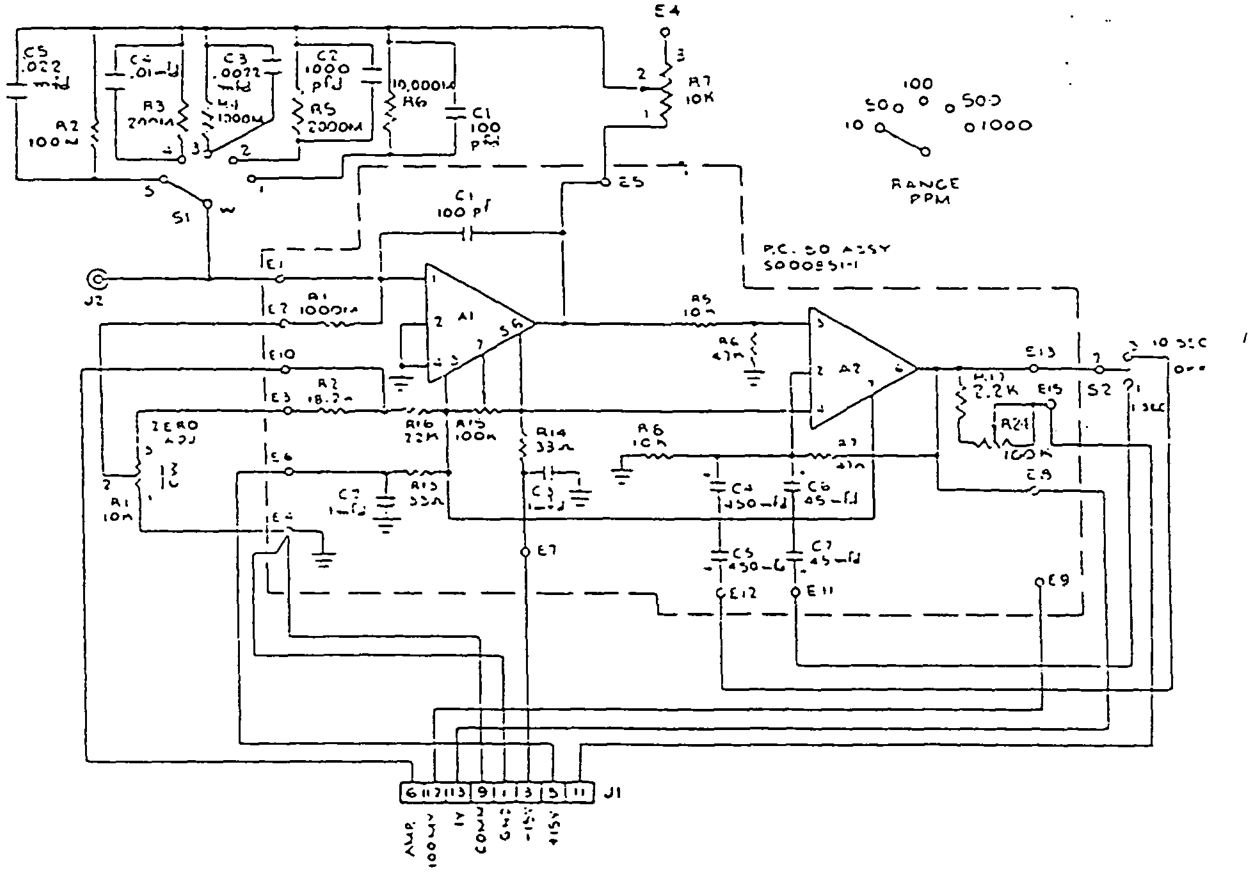
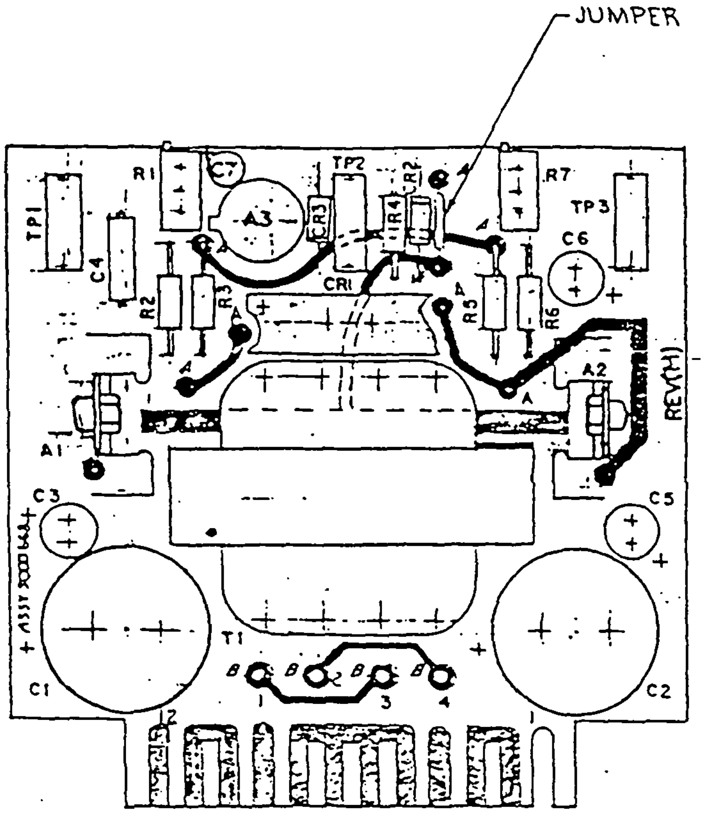
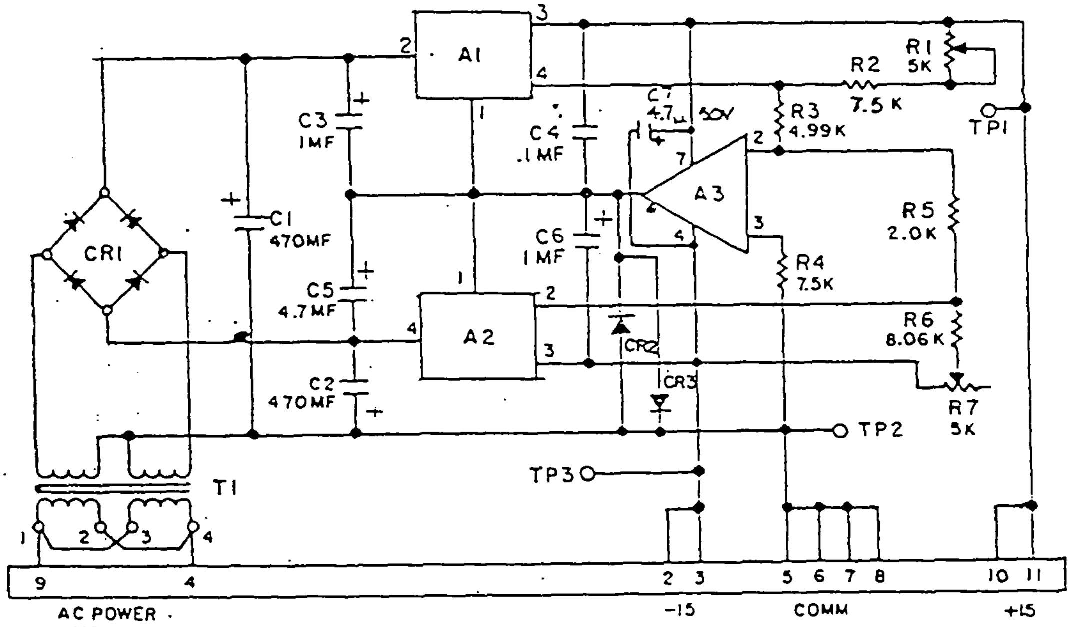


FIGURE 8.2 Amplifier Assembly



COMPONENT SIDE



ELECTRICAL SCHEMATIC
(DASH -1)

FIGURE 8.3 ±15 Vdc Power Supply Board

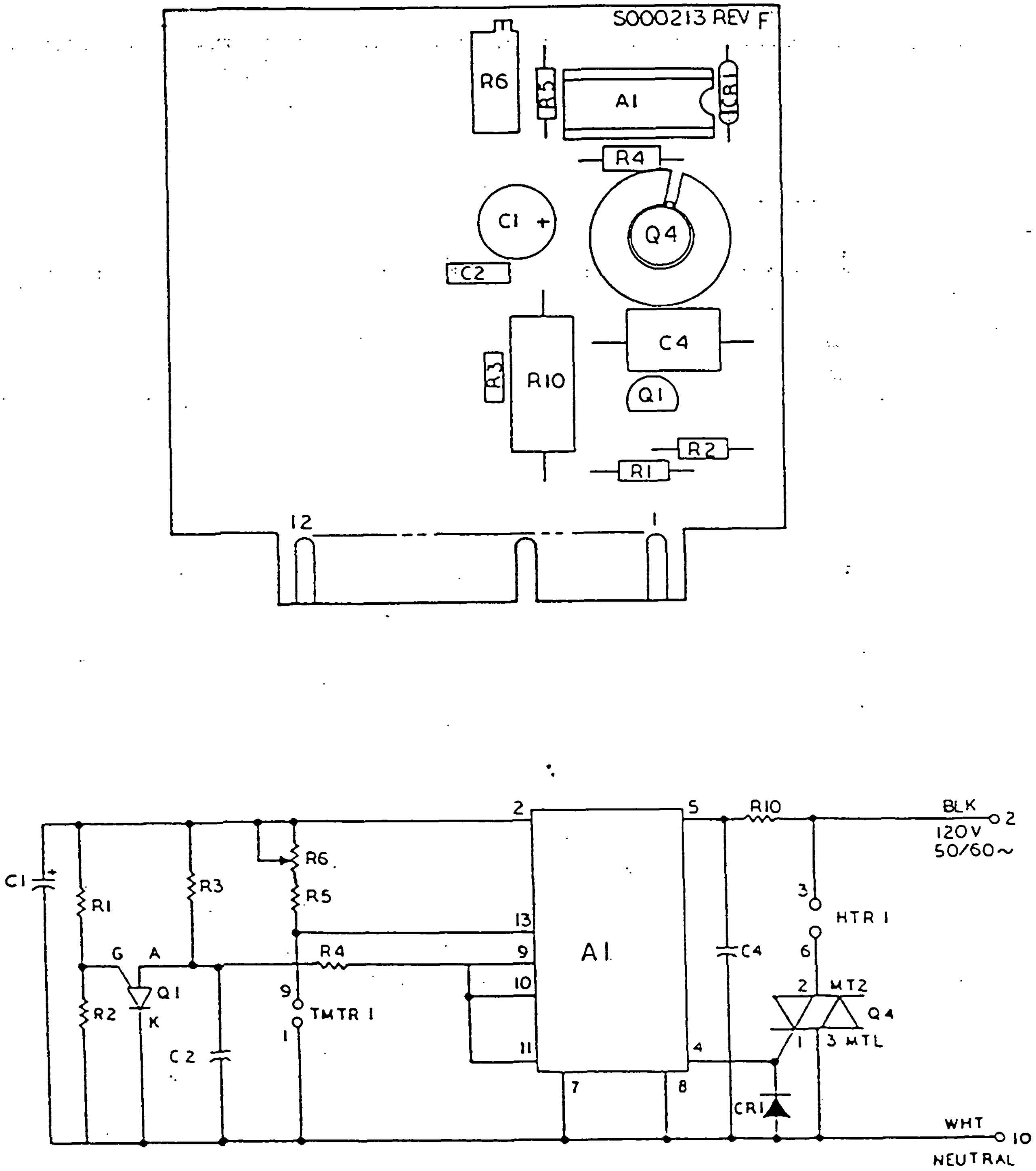


FIGURE 8.4 Temperature Control Module

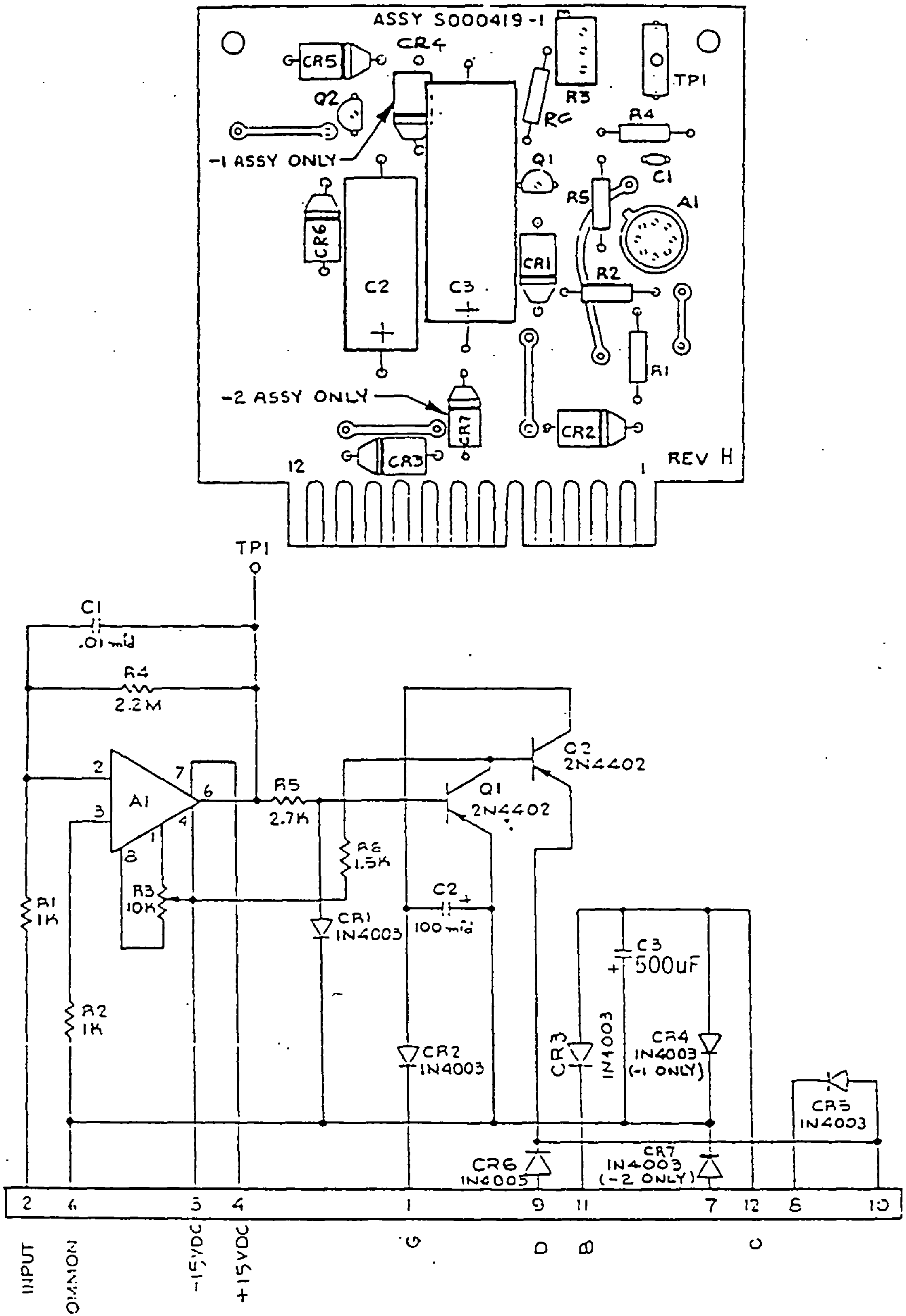
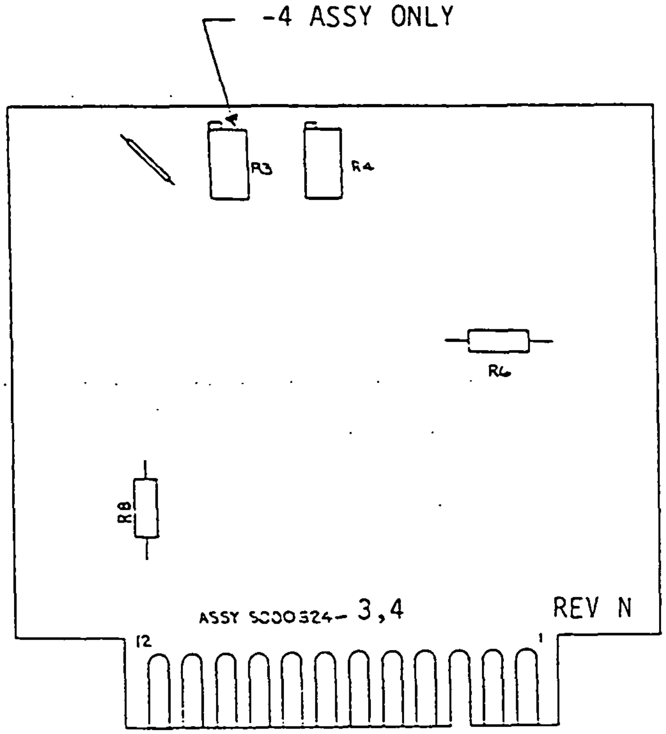
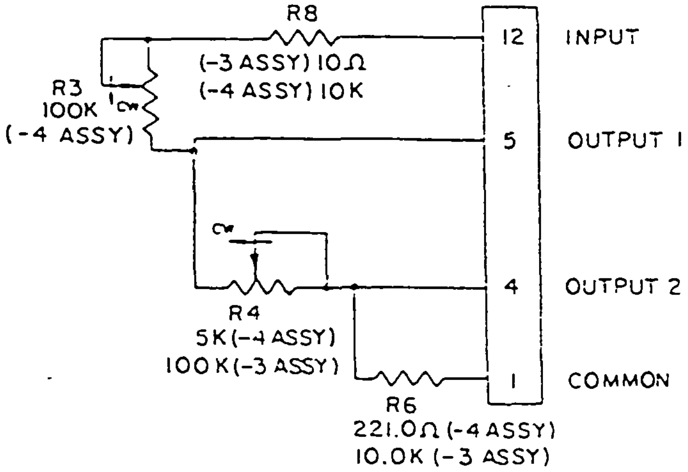


FIGURE 8.5 Flame-Out Module





-3 AND-4 SCHEMATIC

Figure 8.6 Output Amplifier, S000324-4 (J34)

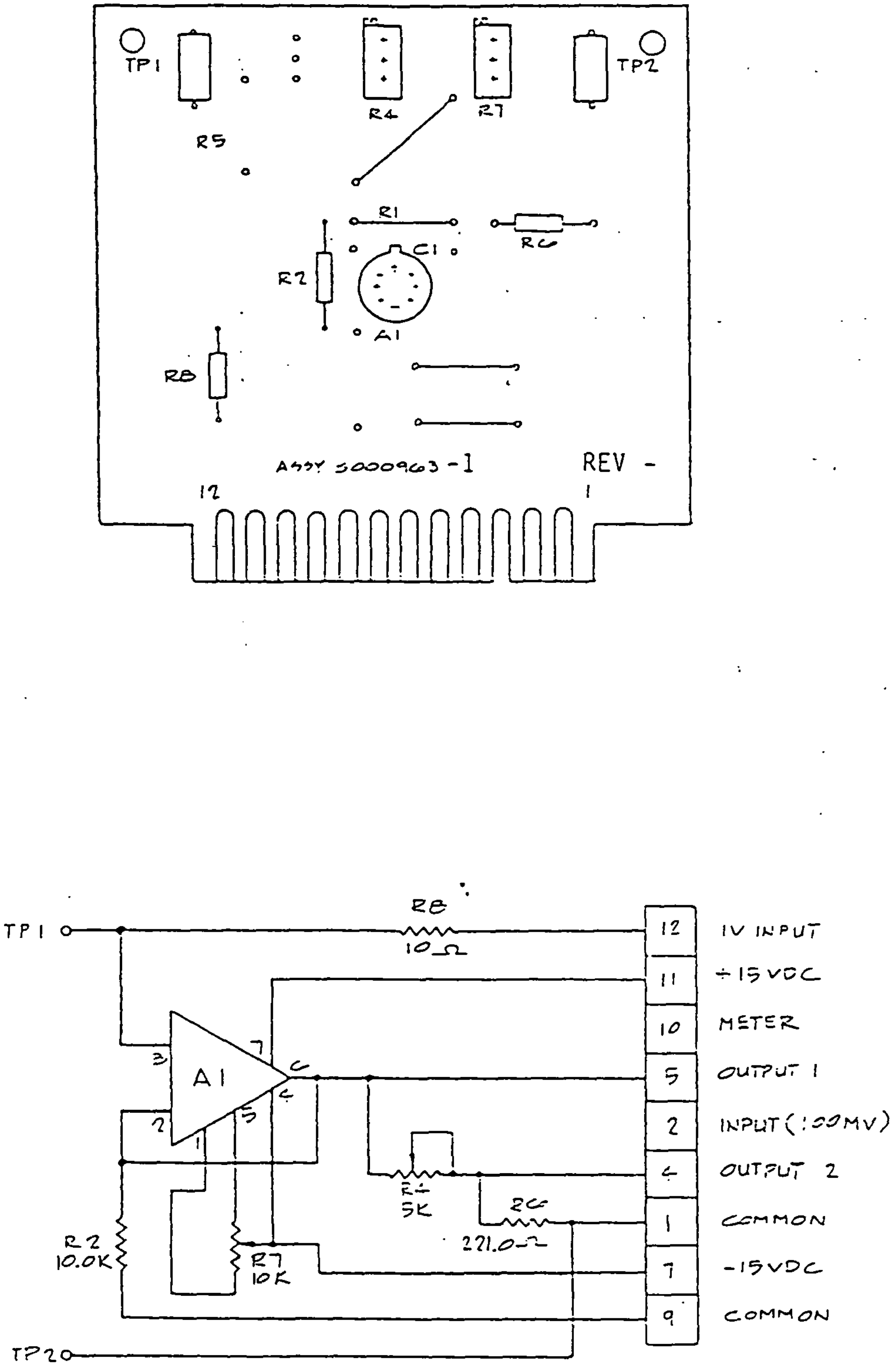
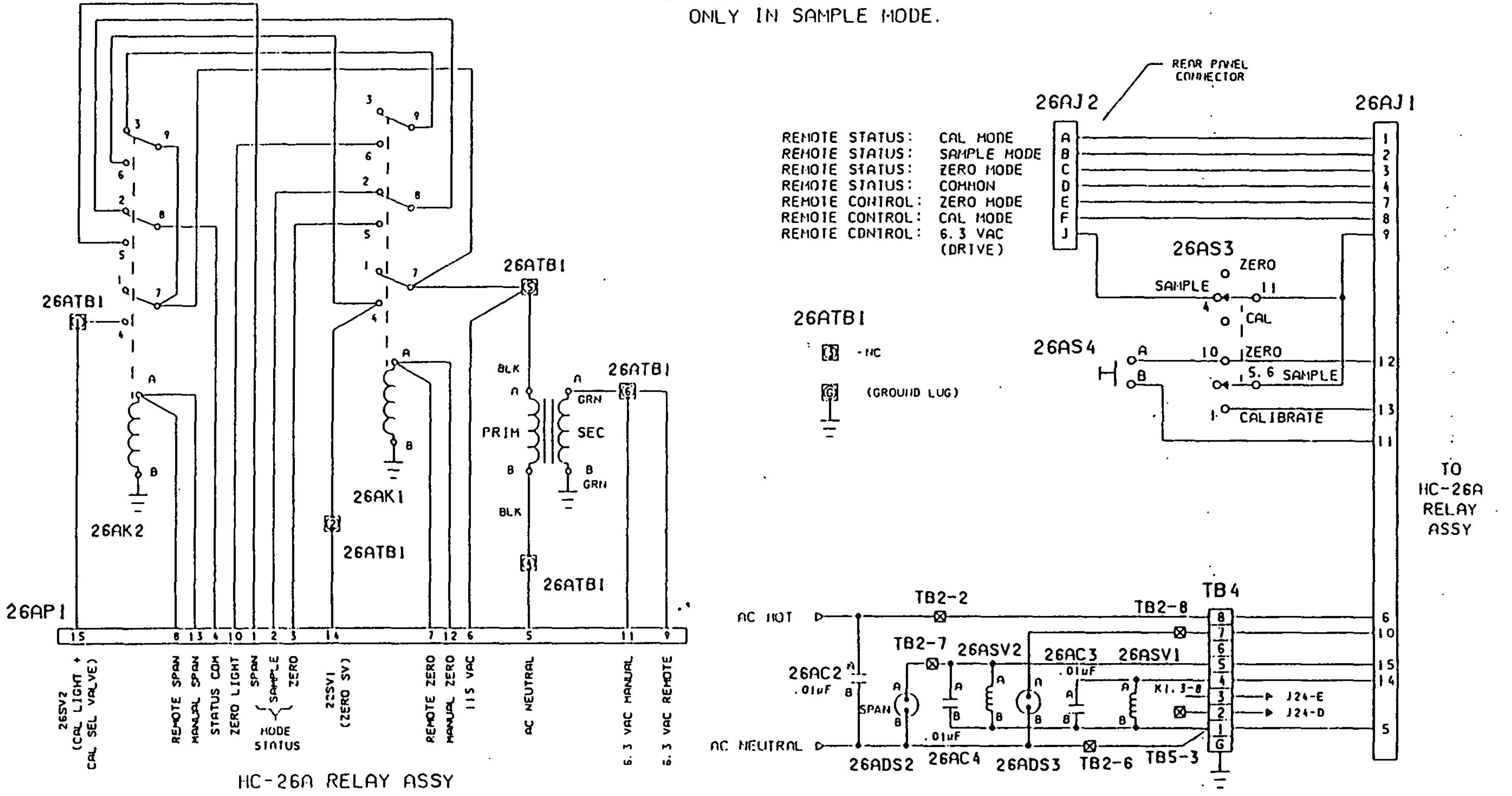


Figure 8.7 Output Amplifier Option HC-15 (J34)

NOTE: REMOTE CONTROL IS AVAILABLE ONLY IN SAMPLE MODE.



VALVE STATE TABLE: 0= OFF; 1= ON; X= DON'T CARE

26ASV1	26ASV2	RESULT
0	X	SAMPLE
1	0	ZERO AIR
1	1	SPAN GAS

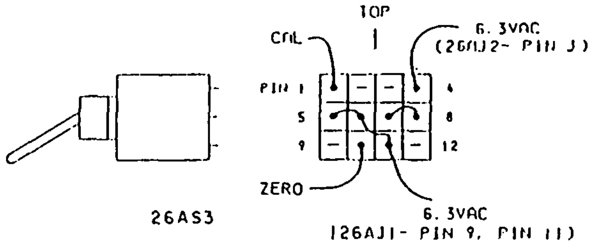


Figure 8.8

UNLESS OTHERWISE SPECIFIED
DO NOT SCALE THIS DWG
ALL DIMENSIONS ARE IN INCHES
REMOVE ALL BURRS & SHARP EDGES
TOLERANCES
3 PLACE DECIMALS ± .005
2 PLACE DECIMALS ± .010
ANGLES ± 1°

MATL

FINISH

SCALE

DATE 12-29-88

RELEASE APPROVAL

CSI COLUMBIA SCIENTIFIC INDUSTRIES
AUSTIN TEXAS

OPTION HC-26A
ELECTRICAL SCHEMATIC,
REMOTE/MANUAL, ZERO/SPAN
& STATUS

SHEET	SIZE		REV
1 of 1	C	972-2000	-

9. PARTS LIST

Part No.	Description	Qty.	Circuit Symbol
S000497-2	Rotameter Assembly	1	
S000349-1	Exhaust Valve/Line Assembly	1	
S900787	Solenoid Valve, 3-way (Options HC-11B and HC-26A)	2	SV1,2
S900120	Solenoid Valve, Hydrogen Shut-Off	1	SV3
S900425	Hydrogen Pressure Regulator	1	
S000743-1	Restrictor Oven Assembly	1	
S000746-1	Burner Block Assembly	1	
R451585-4	Block		
R357710-1	Burner Tip		
R357708-1	Ignitor Glow Plug w/O-ring		
S900163	Block Heater		
S900311	Flame-Out Sensor w/Plate		
R259120-1	Front Plate	1	
250-0100	O-ring, Front Plate	1	
S000857-1	Meter	1	M4
S903132	Ignition Switch	1	S2
S900130	Air Flow Switch (Options HC-11B, HC-26A and HC-11BF)	1	
S902914	Power/Circuit Breaker Switch	1	S1
S900131	Mode Switch (Options HC-11B, HC-26A, HC-11BF)	1	S4
S900137	Indicator Lights (Options HC-11B, HC-26A and HC-11BF)	2	DS1,2
511-0015	Mode Switch (Option HC-26A)	1	26AS3
S900996	Timer, 10 minute, w/Cams and Switches	1	M3

Part No.	Description	Qty.	Circuit Symbol
S902474	Fan 5"	1	M5
S903261	Filter for 5" Fan	1	
S000668-1	Low Voltage Power Supply Board	1	J25
S000213-1	Temperature Control Board	1	J27
S000213-2	Temperature Control Board	1	J26
S000419-1	Flame-Out Indicator Board	1	J29
S000849-1	Amplifier Assembly	1	
450-0072	Relay	2	K1 & K3
C3987-0019	Calibrator Interface Connector	1	P24
S001802-1	Ion Probe Assembly	1	
S000117-1	Battery Box Assembly	1	
S903817	Relay (Option HC-26A)	2	
S900228	Battery	2	
S900749	Transformer, 6.3 volt	1	T1
S902594	Pump, Vacuum 115 V 60 Hz	1	M6
S000324-4	Output Amplifier	1	J34
S000963-1	Output Amplifier (Option HC-15)	1	(J34)
S902595	Pump, Vacuum 115 V 50 Hz (230 Vac version of HC500-2C)	1	M6
S900388	Timer, 24 hour, 60 Hz (Option HC-11B)	1	M1
S900995	Timer, 2 hour, 60 Hz (Option HC-11B)	1	M2
S900487	Timer, 24 hour, 50 Hz (Option HC-11BF)	1	M1
972-8001	Battery Cable 13"	1	P2,6

Part No.	Description	Qty.	Circuit Symbol
972-8002	Battery Cable 21"	1	P3,5
S001804-1	Thermocouple Assembly	2	
999-5009-1	H2 Orifice/Filter (at SV3 out)	1	

10. OPTIONS

CSI has a variety of available options at additional cost which the suer can select to incorporate into the basic analyzer to meet his particular requirements.

10.1 Option HC-11B, Automatic Zero/Span/Sample Control

Analyzers with this optional feature have the same calibrate functions as in paragraph 10.3 (below), but without external remote control capabilities. Instead, they have a timer with a dial on the front panel which automatically programs the calibrate cycle once every 24 hours. The air flow is thus switched from "SAMPLE" to "ZERO" to "CALIBRATE" to "ZERO" and back to "SAMPLE". The "ZERO", "CALIBRATE" and "ZERO" steps are approximately 15 minutes each.

The automatic Span, Zero, and Sample switching option consists of 3 main components:

(1) 24 hour timer

(2) 2 hour solenoid sequence control, and

(3) Solenoid valves.

Refer to Figure 8.1. The twenty-four hour timer, mounted on the front panel, furnished a pulse once every twenty-four hours, (the time of occurrence can be set by the user as desired) to start the sequence control. The timer can be turned manually to set the time of day or to initiate the sequence.

The sequence control consists of 3 sets of cams. One set is the latching group which, after sequence has been initiated, apply power to the cam drive for a period of 2 hours after which time the latching contacts open and the cams cease to be driven. The other two sets of cams control the zero and span control solenoids. These two cams are adjustable to allow application of any time combination of zero and span air to the detector, up to one hour. The factory adjusted sequence is: zero-15 min, span-15 min, zero-15 min and then return to the normal ambient sampling mode.

The zero and span inputs may be manually controlled by a front panel toggle switch at any time outside the automatic sequence span.

The 2 hour control can be reset only after removing the chassis cover and manually moving the cams.

Sample flow rate is adjusted while observing rotameter flow of "zero" air. In this manner the rotameter is protected from contaminants and the flow path for the sample air is maintained as short as possible thereby keeping "on line" response time to a maximum.

10.2 Option HC-11BF, Automatic Zero/Span/Sample Control

Same as Option HC-11B but with 50 Hz timer.

10.3 Option HC-18, Rack Mount Option

Includes front draw handles and slide mounts.

10.4 Option HC-18A, Rack Handles with Ears

Same as HC-18 less slide mounts.

10.5 Option HC-26A, Remote Manual Zero/Span with Status

Analyzers equipped with this option have a three position "MODE" switch on the front panel which controls two solenoid valves that in turn control the air flow path. With the switch in the "CALIBRATE" position, both valves are energized and air flows through the "SPAN GAS" port into the burner block. With the switch in the "ZERO" position, only one valve is energized and the air flows through the "ZERO AIR" port and into the burner block. When the switch is in the "SAMPLE" position, neither valve is energized and the air flow through the "SAMPLE INLET" port into the burner block. Remote actuation through external contact closures can be attained when the "MODE" switch is in the "SAMPLE" position.

Status is indicated on the front panel by indicator lamps and in the "SAMPLE" position at a rear panel connector as contact closures. Figure 4.3 shows the pneumatic network for this option. Wiring diagram for this option is shown in Figure 8.10.

10.6 Option HC-15, Recorder Output 0-10 V

This option allows the normal 0-1 volt output to be expanded up to 10 volts. The output booster (S000963-1) replaces the amplifier at J34. Figure 8.7 shows the PCB layout and wiring diagram.

11. WARRANTY

The Warranty Statement appears on the following two pages.

WARRANTY

1. Except as otherwise indicated, all instruments and stack systems manufactured and sold by Columbia Scientific Industries Corporation (CSI) are guaranteed for a period of one year from date of shipment from the factory against defects in materials and workmanship of those parts manufactured by CSI, and then, only when operated, serviced and maintained in accordance with the instruction manual. Those parts not manufactured by CSI are guaranteed only to the extent that they are covered by a warranty of original manufacturer. Permeation tubes are warranted for six (6) months. Spare parts and accessories, except expendables, are warranted for ninety (90) days. Expendables such as batteries, sample holders, fuses and indicating lamps are not covered by this warranty.

2. The warranty is voided by the following:

a) Injection into CSI stack systems or CSI ambient air monitoring or calibrating equipment, of gas mixtures containing reactive suspended matter or molecules yielding and depositing liquids, tars, solids and other non-gaseous residues.

b) Injection of caustic solutions into the hydrogen lines of CSI hydrocarbon monitors by a malfunctioning hydrogen generator.

c) Damage to CSI Accelerating Rate Calorimeters by samples that detonate, deflagrate or otherwise escape the confines of the sample holder.

d) Damage to stack sampling probes caused by severe corrosion.

e) Damage caused by incorrect installation, by misuse, or by mishandling.

3. Warranty service requests must be received by CSI within the warranty period. Upon notification by the purchaser, CSI will correct defects coming within the scope of this warranty by repairing or replacing the defective unit either at the CSI factory or at the customer's site, at CSI's option. Return shipment of items to CSI must be authorized by a CSI representative and is at customer's expense.

4. Instruments and systems which have been repaired or replaced during their warranty period are themselves guaranteed for only the remaining unexpired portion of their original warranty period. Parts and accessories, including stack probes, umbilicals and permeation tubes, will receive their full warranty period from the date of replacement even if the instrument or system warranty period should expire.

5. Repairs, replacements, adjustments and service performed out-of-warranty shall be charged to the customer at the then current prices for parts, labor, transportation and subsistence.

6. This warranty attaches to the instrument itself and is not limited to the original purchaser.

7. In no event will CSI have any obligation or liability for damages, including but not limited to, consequential damage arising out of, or in connection with, the use or performance of equipment or accessories. No other warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose will apply to equipment or accessories.

8. This warranty constitutes the full understanding of the manufacturer and buyer, and no terms, conditions, understanding or agreement professing to modify or vary the terms hereof shall be binding unless hereafter made in writing and signed by an authorized official of CSI.

All price revisions and design modification privileges reserved.

PUREGAS®

P-07409

CO_2 EXTRACTOR

MODELS 100A301 & 100A303

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

PUREGAS®
General Cable Company
A Unit of The Penn Central Corporation

P.O Box 666, 5600 West 88th Avenue, Westminster, Colorado 80030
(303) 427-3700/Telex 45908

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P100A301 AND P-100A303 CO_2 EXTRACTORS

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DRAWINGS

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CO_2 Extractor	3	11
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I GENERAL

This instruction manual covers the description, installation, operation and maintenance of the P-100A301 and P-100A303 CO_2 extractors. The purpose of the unit is to provide clean dry air with minimal CO_2 for air bearings and for purging the optics of IR and FTIR analyzers.

II DESCRIPTION

The units described in this manual are designated as CO_2 extractor Model P-100A301 and CO_2 extractor Model P-100A303. These two models are basically identical, except for their chamber size and capacities. Model P-100A301 has the larger chambers and capacity. These extractors consist of a dryer and CO_2 adsorber piped in series with inlet and outlet filters attached. The relative locations and functions of the various major components can be best understood by referring to the following drawings:

Flow Diagrams	Figures 1 & 1A	Page 7
Wiring Diagram	Figure 2	Page 8
CO_2 Extractor	Figure 3	Page 11
Dryer and Adsorber (Exploded View)	Figure 4	Page 13

III MAJOR COMPONENTS

1. INLET AIR FILTER - ITEM 15, FIGURE 3. The functiion of the inlet air filter is to collect liquid condensate and particles, larger than 25 microns, contained in the compressed inlet air. The air filter bowl has a manual drain petcock. It is necessary to periodically check the filter and drain the liquid.

   Special Note: This filter is not an "oil removal" filter. While it will intercept some oil in liquid form, it will not remove oil mist or "aerosols" that may be present in the system. Therefore, in any system in which the air source is an oil-lubricated compressor, it is recommended that a "coalescing" type filter be used. Refer to flow diagram, Figure 1A for installation.

III 2. MOISTURE REMOVAL DRYER - ITEM 1, 2, 3 or 4, FIGURE 3. The function of the air dryer is to remove the moisture from the compressed inlet air.

3. CO_2 ADSORBER - ITEM 5, 6, 7 or 8, FIGURE 3. The function of the adsorber is to remove CO_2 from the dry compressed air leaving the dryer and entering the adsorber. The adsorber differs from the dryer. Its chambers are packed with a different adsorbent material and its cycle timer permits repressurizing of the purging chamber prior to dumping the adsorbing chamber's pressure to atmosphere.

Repressurization results in a substantial reduction in the outlet pressure fluctuation during switching, which occurs in dryers not equipped with this feature. Further reduction in the outlet pressure variation can be obtained by installing a suitable two to five gallon air storage tank downstream of the outlet air filter and upstream of a pressure regulator.

The air dryer and adsorber have purge exhaust mufflers installed on the solenoid valves to quiet the exhaust air. Do not plug or restrict the purge discharge. Additional muffling of the purge air may be obtained by enclosing the unit in a well-ventilated, sound-adsorbing box.

4. OUTLET AIR FILTER - ITEM 16, FIGURE 3. The function of the outlet air filter is to trap particles larger than 5 microns, primarily occasional particles of adsorbent material, which may escape from the adsorbent beds.

5. OUTLET FLOW ORIFICE - ITEM 28, FIGURE 3. The function of the orifice is to limit the outflow of air in accordance with operating pressures and conditions as specified on the purchase order. The number P-300-691 is the number of the blank before its final orifice size is established. The numbers range from P-300-691-4 (.005" diameter) to P-300-691-103 (.0995" diameter).

IV SPECIFICATIONS

1. CAPACITY, DEW POINT AND CO_2 REMOVAL.

	MODEL P-100A301	MODEL P-100A303
Inlet Pressure	90 PSIG	90 PSIG
Inlet Temperature	70° F.	70° F.
Inlet Flow		
Outlet Flow *	3.5 SCFM	1.5 SCFM
Atmospheric Dew Point	-100° F.	-100° F.
CO_2 Removal **	90%	90%

* Contact the factory for rated capacity at other operating pressures.

** 90% of the CO_2 from ordinary atmospheric air.

2. Maximum Inlet Pressure: 100 PSIG

3. Maximum Inlet Temperature: 100° F.

4. Air Connections: 1/4" FPT

5. Electrical Requirements:

Model No.	Power		
P-100A301-1/P-100A303-1	120V	50/60Hz	115W
P-100A301-2/P-100A303-2	240V	50/60Hz	115W

V INSTALLATION INSTRUCTIONS

1. Puregas heatless dryers have been thoroughly inspected and tested at the factory and are in proper working condition. Inspect the CO_2 extractor for evidence of any exterior or interior shipping damage and immediately report damage to the carrier.

2. Read description of equipment and specifications before installing CO_2 extractor.

3. OPERATING PRESSURES. The CO_2 extractors are designed to operate at a maximum pressure of 100 PSIG. The sizing of the purge orifices is critical to the correct operation of the air dryer and CO_2 adsorber. Any change in operating pressure, inlet temperature, or outlet flow will require an orifice change to maintain the proper degree of water and CO_2 removal. Orifice glands (Item 4, Figure 4), are identified by numbers stamped on the top of the hex. Both orifices in the dryer or adsorber must be the same size (same number). Orifice numbers are also stamped on the name plate as the last two numbers of the dryer and CO_2 adsorber model number. (Example: P-05411A1<u>34</u>.) Orifice sizes must not be changed unless operating conditions change.

V 3. (continued) Your instrument is sized for a specific flow and operating condition. The outlet flow of the CO_2 extractor can be regulated with a throttle valve and a visual indication of measurement made with a flow meter. After installation, the outlet flow and operating pressure should be checked to be sure they do not exceed the rated capacity of the instrument.

If a lower outlet pressure is required, always install the pressure regulator <u>downstream</u>, as close to the usage point as possible.

4. OPERATING TEMPERATURES The dryer and adsorber can operate at a maximum ambient temperature of 100° F. and a maximum inlet air temperature of 100° F. However, at temperatures above 70° F. the capacity will have to be reduced.

Do not operate the unit at temperatures which could result in damage due to freezing.

5. PIPING AND AIR CONNECTIONS. The CO_2 extractor is designed to be mounted on a bench or shelf with the desiccant chambers up.

The inlet and outlet connections are 1/4" female NPT. When connections are made directly into the unit, a pipe compound should be used to prevent galling of the threads. 3/8" copper tubing with 1/4" pipe connections should be installed at the input and output for maximum flow. Larger lines are recommended to avoid pressure drop where long piping runs are encountered.

After connecting the piping or tubing to the unit, use a soap solution to check the connections for air leaks.

A manual drain, 25-micron inlet filter is supplied with the CO_2 extractor to remove particulate matter and liquid water. Reference flow diagram, Figure 1. If oil in liquid or mist form is present in the air stream, an oil coalescing filter should be used as shown in Figure 1A.

The extractor should not be operated in corrosive atmospheres.

6. ELECTRICAL CONNECTIONS. Before wiring, check the nameplate for electrical requirements. Standard electrical characteristics are 120V, 50-60Hz, 115 W. 240V, 50-60Hz units are also available.

No overload protection is provided in the CO_2 extractor. The attached 8 foot wire power cord should be plugged into a properly protected outlet.

V 7. SOLID STATE TIMERS. The solid state cycle timers are equipped with a one-hour-minimum memory circuit which will restart the timers at the same point in the timing cycle as when the power was lost or interrupted.

During start up and when timer memory has been lost, it will be necessary to stagger the timing cycles so that the dryer and CO_2 adsorber will not switch simultaneously. This can be accomplished by removing the power from the dryer timer for a period of 15 seconds.

Timers P-06521-F1 or F2 are the standard timers used on the air dryer. The timers permit simultaneous switching of the solenoid valves every 30 seconds.

Timers P-06500-F1 or F2 permit the CO_2 adsorber to repressurize the purging chamber before switching chambers. The repressurizing period is 3.75 seconds and the purging period is 26.25 seconds.

Repressurizing helps to minimize dryer outlet pressure fluctuation as the flow switches from one desiccant chamber to the other. Further reduction in outlet pressure swings can be obtained by installing a 2 to 5-gallon air storage tank between the outlet filter and the outlet pressure regulator. Refer to Figure 1A.

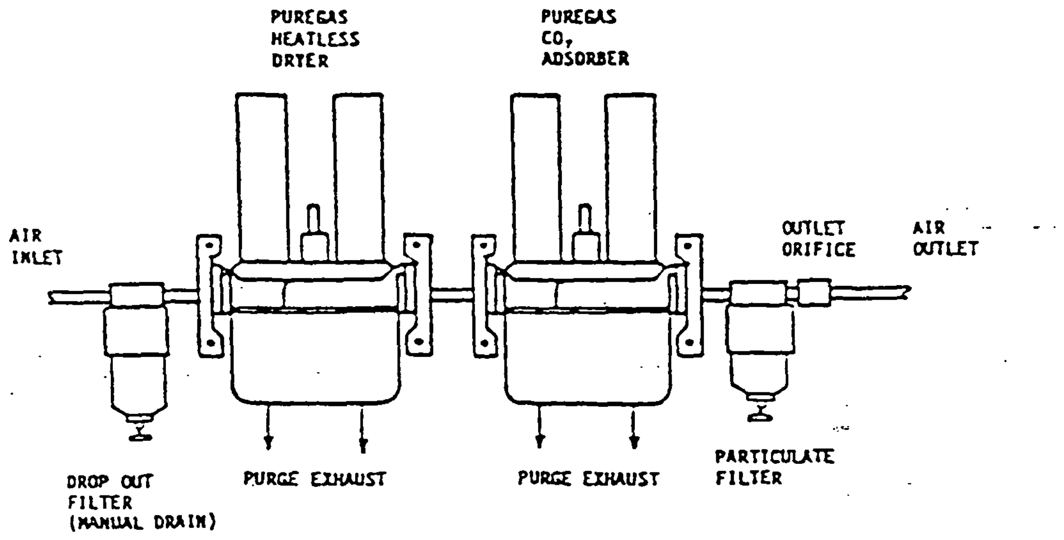
VI OPERATING INSTRUCTIONS

In normal operation, the dryer and CO_2 adsorber will switch every 30 seconds or, when their cycle times are staggered, (Reference Section V, Paragraph 7), approximately every 15 seconds. Each chamber alternately purges with an audible exhaust. This sound is quieted by the use of mufflers installed on the exhaust port of each solenoid valve. Do not plug or restrict the purge exhausts. If operating conditions change, different purge orifices may be required. If orifices are replaced, they should be replaced in matched pairs. The heat of adsorption and the heat from the solenoid coils cause the unit to become warm - this is normal and does not indicate a malfunction of the unit. The temperature rise is more pronounced in a dryer operating at a low flow rate.

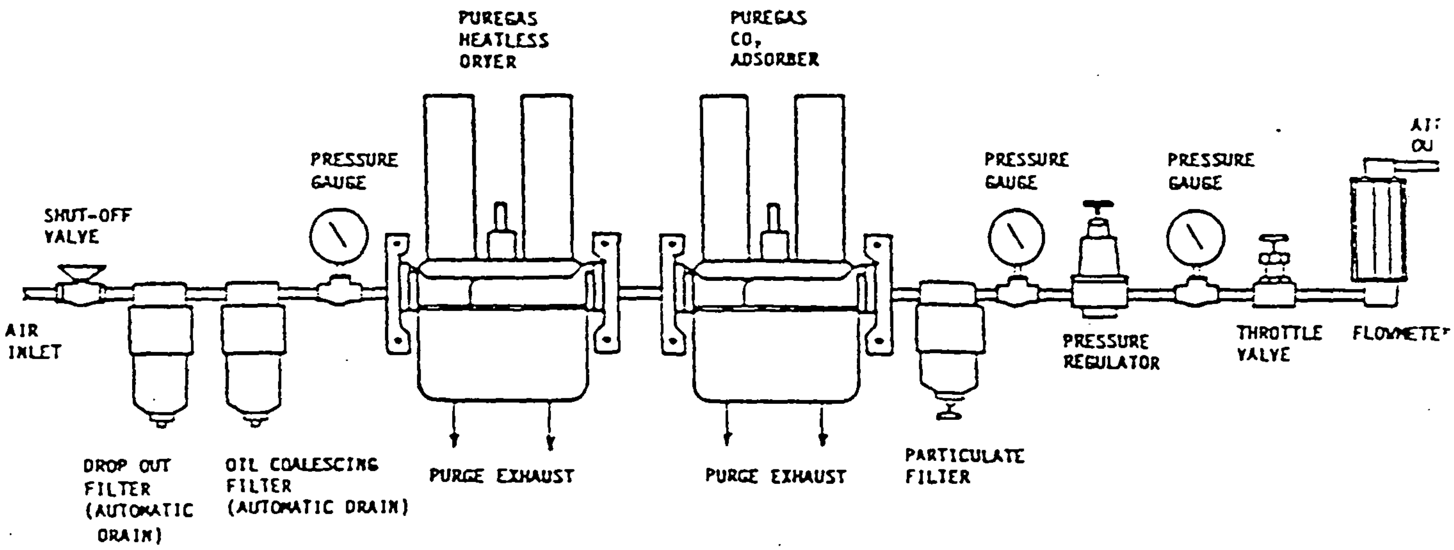
VII MAINTENANCE INSTRUCTIONS

No field adjustments are necessary after a Puregas CO_2 extractor has been installed in accordance with these instructions. No lubrication is required on the instrument.

It is recommended, however, that at six-month intervals the unit be thoroughly inspected. Inspection should include audible inspection for proper solenoid valve operation and purge, and visual inspection for excessive dirt or oil fouling



FLOW DIAGRAM CO_2 EXTRACTOR
FIG. 1



RECOMMENDED INSTALLATION DIAGRAM
FIG. 1A

VII (continued) and for desiccant attrition. This involves removal of the air manifold covers and the desiccant chambers. Annual inspections should be more thorough, and should also include removal of the solenoid valves and the purge orifice glands to inspect for excessive wear or deterioration of valve parts or the check valve balls as well as for possible plugging of the purge orifices.

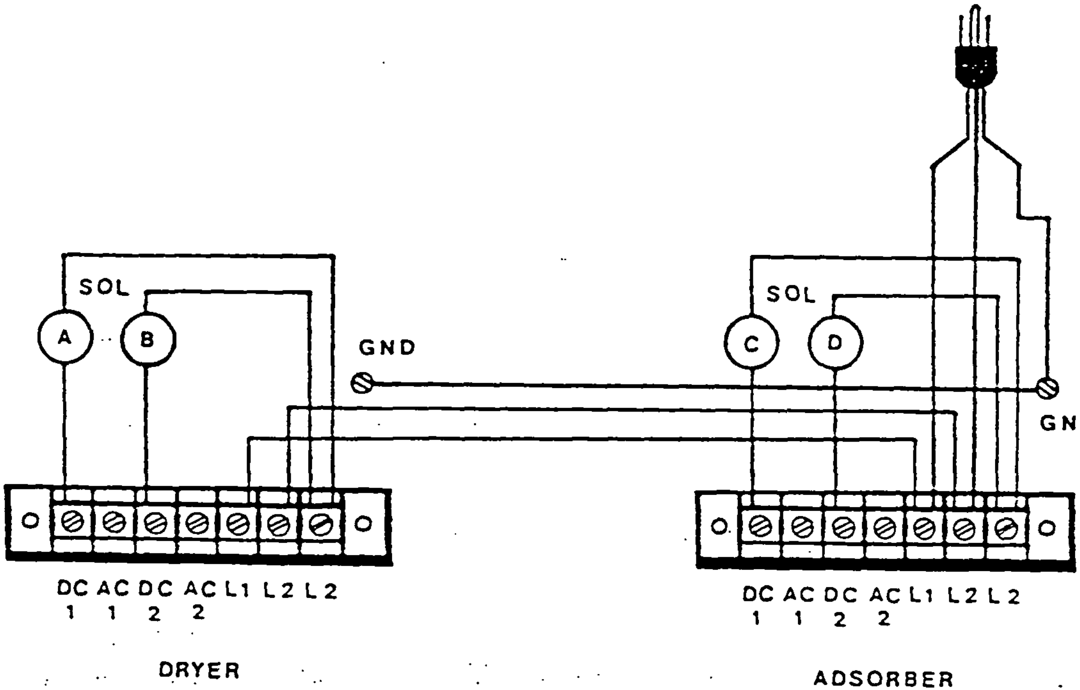
As the orifices are critical parts in determining the performance of a dryer and adsorber, do not increase the orifice size by drilling a larger hole. Instead, orifices of the proper size should be obtained from the factory.

Purge orifice glands are screwed into the manifold beneath the desiccant chambers. To change orifices, unscrew the chambers and remove the orifices with a standard 7/8" socket wrench.

The cycle timer can be replaced in the field.

Improper packing of the desiccant chambers can cause channeling of the gas stream and improper purification. For this reason, **NO ATTEMPT SHOULD BE MADE TO REPACK DESICCANT CHAMBERS IN THE FIELD.** Replacement chambers should be obtained from your local authorized distributor.

In the event of breakdown, the following troubleshooting guide should enable you to determine the problem. Contact your local authorized distributor for replacement parts, dryers or adsorbers.



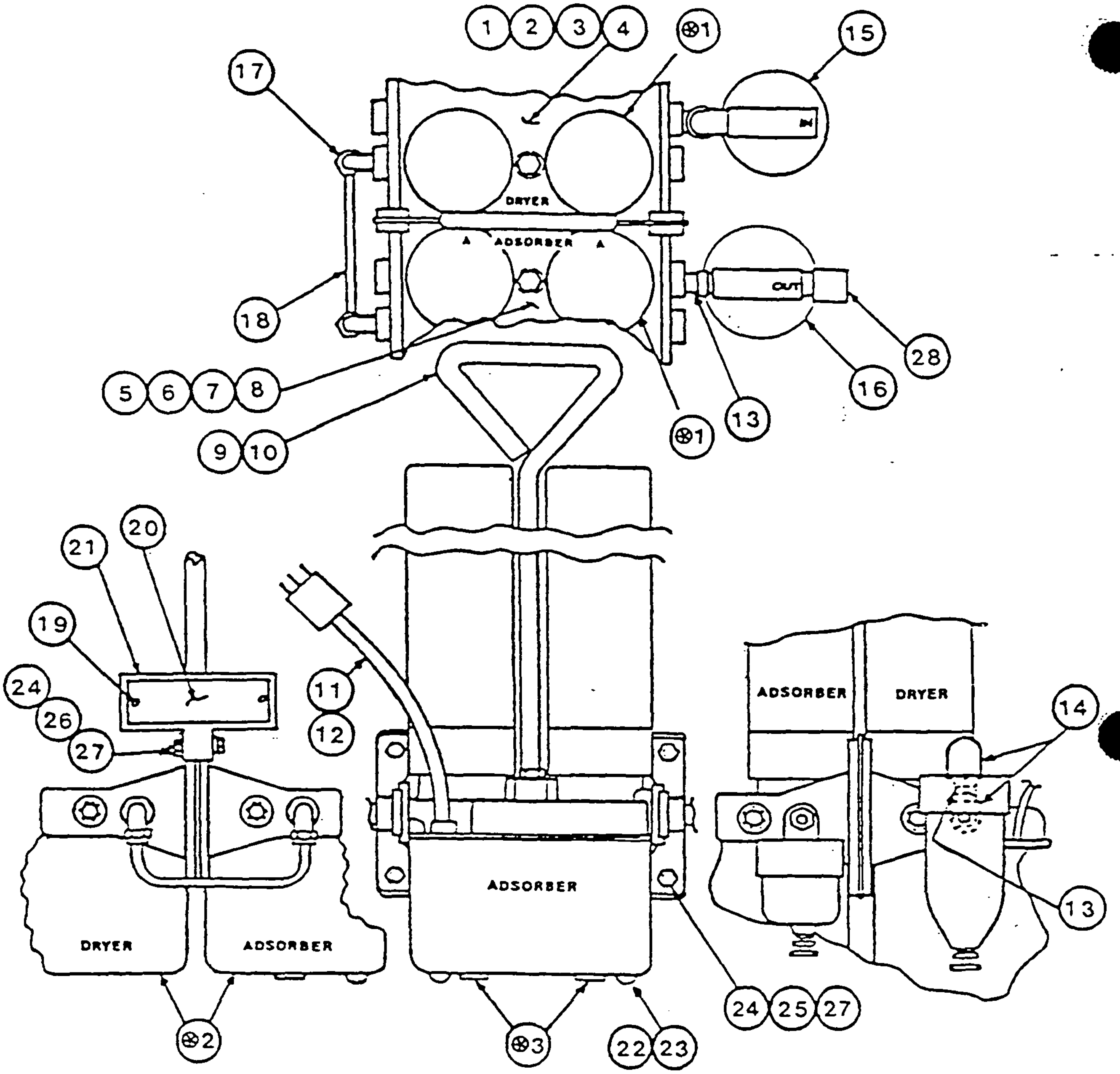
WIRING DIAGRAM
FIG. 2

VIII TROUBLESHOOTING GUIDE

1. UNIT DELIVERS WET AIR

A. Improper operating conditions.	Adjust operating conditions.
B. Solenoid core spring broken.	Remove solenoid valve, inspect core assembly. Spring should be seated on core and not broken. Replace if necessary.
C. Purge orifice plugged.	Remove, inspect, and clean orifice. DO NOT FORCE WIRES THROUGH CRITICALLY-DRILLED HOLES. Use air gun to clean.
D. Solenoid coil burned out.	Remove cover, place iron or steel material (screwdriver or nail) on exposed end of solenoid base to feel the magnetic effect indicating proper operation. NOTE: Each dryer coil should be energized for 30 seconds and each adsorber coil for 33.75 seconds. Check Section 1, Paragraph E immediately below, before replacing coil.
E. Improper operation of cycle timer.	1. Check the power supply. If the correct voltage is not present between L1 and both of the L2 terminals., check the wiring and protective devices supplying power to the dryer. 2. Dryers with DC solenoid valves should alternately have DC voltage between L2 and DC1 and between L2 and DC2. Replace the timer if voltage is present at either DC terminal continuously or not at all. Timer Input 120 VAC/Timer Output 53 VDC Timer Input 240 VAC/Timer Output 106 VDC 3. Refer to Solid State Timers Section V, Paragraph 7, Page 6 for timing cycle information.

1. F. Desiccant contamination or attrition.	1. Check inlet and outlet filters and outlet air line for indication of oil. 2. Remove the desiccant chambers from the air manifold. If the perforated disc at open end of the chambers can be depressed more than 1/4" from the retaining ring, replace chamber, or have it repacked.
2. EXCESSIVE DROP IN OUTLET PRESSURE.	
A. Improper operating conditions.	See Section I, Paragraph A.
B. Solenoid coil burned out.	See Section I, Paragraph D.
C. Improper operation of cycle timer.	See Section I, Paragraph E.
D. Check valve balls seated improperly.	Remove check balls and springs and inspect for excessive wear or damage. Replace if necessary.
E. Plugged air passages.	Check inlet and outlet air passages and piping for blockage
F. Desiccant contamination or attrition.	See Section I, Paragraph F.
3. SOLENOID VALVE CHATTER	
A. Solenoid valve defective.	1. Solenoid valve connected to AC terminal on Solid State Timer. 2. Voltage too low.



CO_2 EXTRACTOR

FIG 3

REFER TO PG. 14

⊗	ITEM NO.
1	1
2	26
3	43

PARTS LIST - CO_2 EXTRACTOR

REFERENCE FIGURE 3.

QUANTITY				PART NO.	DESCRIPTION	ITEM NO.
1	1	1	1	*P-300-691-(--)	ORIFICE-DISCHARGE	28
4	4	4	4	H-NK01-04C-R5	NUT-KEPS 1/4-20 CZ	27
1	1	1	1	H-SH83-04C-12	SCREW HH 1/4-20 X 1 1/4 CZ	26
3	3	3	3	H-SH83-04C-10	SCREW HH 1/4-20 X 1 CZ	25
4	4	4	4	H-WF01-04B-R0	WASHER-FLAT 1/4 CZ REG. B	24
4	4	4	4	H-SP56-00C-02	SCREW-PH 4-40 X 1/4 CZ F	23
4	4	4	4	P-400-451	BUMPER-RUBBER	22
1	1	1	1	P-300-683	HOLDER NAMEPLATE	21
1	1	1	1	P-300-696	NAME PLATE-CO_2 EXTRACTOR	20
2	2	2	2	P-400-322-1	SCREW-DRIVE #4 3/16	19
1	1	1	1	P-300-690	TUBE-INTERCONNECT	18
2	2	2	2	P-400-437-108	ELL-SWAGE-1/4 MPT X 3/8 SWG-BRS	17
1	1	1	1	P-400-452-20	FILTER-5 MICRON-1/4 MPT	16
1	1	1	1	P-400-452-3	FILTER-25 MICRON-1/4 MPT	15
2	2	2	2	P-1291	ELL-STREET-1/4 NPT-BRS	14
2	2	2	2	P-5000-5-12B	NIPPLE-1/4 MPT X 1 3/16-HEX-BRS	13
1	---	1	---	P-200-501	POWER CORD 240 VAC	12
	1	---	1	P-200-411	POWER CORD 120 VAC	11
		1	1	P-300-682-2	PLATE-MTG W/HANDLE/100-301	10
1	1	---	---	P-300-682-1	PLATE-MTG W/HANDLE/100-303	9
		1	---	P-05414A2	CO_2 ADSORBER 240 VAC	8
			1	P-05414A1	CO_2 ADSORBER 120 VAC	7
1	---	---	---	P-05412A2	CO_2 ADSORBER 240 VAC	6
	1	---	---	P-05412A1	CO_2 ADSORBER 120 VAC	5
		1	---	P-05413A2	AIR DRYER 240 VAC	4
			1	P-05413A1	AIR DRYER 120 VAC	3
1	---	---	---	P-05411A2	AIR DRYER 240 VAC	2
	1	---	---	P-05411A1	AIR DRYER 120 VAC	1
X	---	---	---	P-100A303-2	CO_2 EXTRACTOR - 12" 240 VAC	
	X	---	---	P-100A303-1	CO_2 EXTRACTOR - 12" 120 VAC	
		X	---	P-100A301-2	CO_2 EXTRACTOR - 20" 240 VAC	
			X	P-100A301-1	CO_2 EXTRACTOR - 20" 120 VAC	

* Refer to Page 3, Section III, Paragraph 5 for orifice size information.

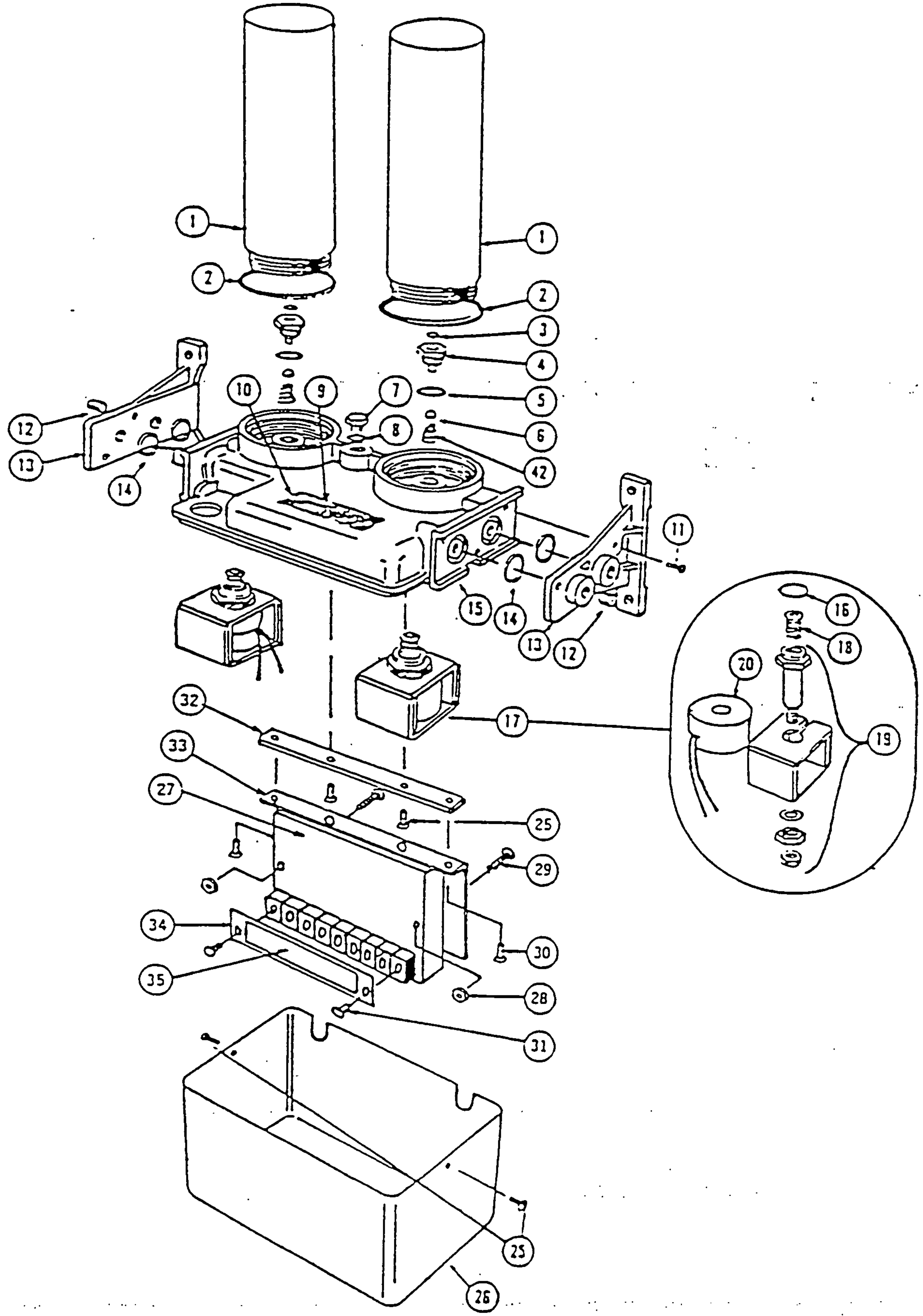

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FIG 4

WARRANTY

These air dryers carry a one year warranty against defective workmanship and material. This period starts at the date of shipment. The Puregas heatless dryers are designed in a manner which permits field repair by the user and replacement parts will be shipped enabling the user to make the necessary field repairs and return the defective parts.

However, the warranty also includes the offering of an immediate replacement with an equivalent air dryer for any unit *for which field repairs are not authorized by Puregas.* Only in unusual cases will it be necessary to ship a replacement unit. On receipt of the replacement air dryer the user will return the defective unit in the same shipping container.

No claims for labor in replacing defective parts or for consequential damages will be allowed. Replacement parts (or if applicable, replacement air dryers) will be invoiced in the regular way with invoices subject to adjustment after the parts (or dryers) claimed defective are examined in our factory. In addition, no material or parts will be accepted at our factory for in-warranty repairs or credit without previous authorization from the Puregas.

Responsibility for damages incurred in transit will be borne by the user and the user in turn should file any damage claim against the carrier.

This warranty shall not apply to any air dryer which shall have been repaired or altered in any way be anyone other than the Puregas, or its authorized repair agent, so as to affect, in our judgment, its proper functioning or reliability, neither will it apply to any air dryer which has been subjected to misuse, negligence or accident.

PUREGAS

PUREGAS®
General Cable Company
P.O. Box 666, 5600 West 88th Avenue, Westminster, Colorado 80030
(303) 427-3700 / Telex 45908
A Unit of The Penn Central Corporation

Code:	A	B	C
Used on:	Dryer & Adsorber	Dryer	Adsorber

ITEM NO.	PART NUMBER	USED ON DRYER	QTY. PER DRYER OR ADSORBER	PART DESCRIPTION
1	P-200-403-12	B	2	Assy-Des Ch-Dryer 12",incl. Item 2
	P-200-403-A12	C	2	Assy-Des Ch.- CO_2 12",incl. Item 2
	P-200-403-20	B	2	Assy-Des Ch-Dryer 20",incl. Item 2
	P-200-403-A20	C	2	Assy-Des Ch.- CO_2 20",incl. Item 2
2	P-400-312-924	A	2	O-Ring - 1.720 I.D. x 0.118 W.
3	P-400-313-110	A	2	O-Ring - 0.362 I.D. x 0.103 W.
4	*P-200-404-(--)	A	2	Purge Orifice Assy. (incl.#3 & #5)
5	P-400-312-908	A	2	O-Ring - 0.644 I.D. x 0.087 W.
6	P-400-375	A	2	Ball, Check Valve
7	P-400-307-4	A	1	Plug, Hex
8	P-400-312-904	A	1	O-Ring - 0.351 I.D. x 0.072 W.
9	P-300-737	A	1	Nameplate
10	P-400-322-1	A	2	Drive Screw #4 x 3/6" Type U rnd. hd., st. st.
11	P-400-361-2	A	6	Screw, #10 - 24 x 5/8", pan.hd.
12	P-400-320-3	A	2	Pipe Plug, 1/4" - 18 socket hd.
13	P-300-497P	A	2	Mounting Bracket
14	P-400-313-116	A	4	O-Ring - 0.731 I.D. x 0.103 W.
15	P-300-495P	A	1	Air Manifold
16	P-400-313-018	A	2	O-Ring - 0.739 I.D. x 0.70 W.
17	P-400-308-DC1	A	2	Solenoid Valve - 53 VDC (for 120 V., 50/60 Hz units)
	P-400-308-DC2	A	2	Solenoid Valve - 106 VDC (for 240 V., 50/60 Hz units)
18	P-400-308-12	A	2	Core Assembly
19	P-400-308-13	A	2	Base Assembly
20	P-400-308-DC11	A	2	Coil, 53 VDC
	P-400-308-DC21	A	2	Coil, 106 VDC
25	P-400-361-1	A	4	Screw #6 - 32x8/8" pan. hd.
26	P-300-685P	A	1	Air Manifold Cover
27	P-06521-F1	B	1	Timer - SS 1 min, cycle 120 VAC
	P-06521-F2	B	1	Timer - SS 1 min, cycle 240 VAC
	P-06500-F1	C	1	Timer - SS 1 min. cycle 120 VAC Repressurizing
	P-06500-F2	C	1	Timer - SS 1 min. cycle 240 VAC Repressurizing
28	H-NK01-OHC-R5	A	2	Nut-Keps 8-32
29	H-SB83-OHC-10	A	2	Screw 8-32 x 1" BH
30	H-SB83-OFC-04	A	2	Screw 6-32 x 1/4" BH
31	H-SB83-OFC-02	A	2	Screw 6-32 x 1/2" BH
32	P-06496	A	1	Plate-Adapter-SS Timer Brkt.
33	P-06497	A	1	Bracket - Mtg. - SS Timer
34	P-06499	A	1	Cover - Terminal
35	P-06498	A	1	Decal - Terminal Cover
42	P-300-507	A	2	Spring - Check Ball
43	P-400-498	A	2	Muffler (not shown)

When ordering parts, always state the dryer and adsorber Model and Serial Nos.
* Orifice number must be specified.

MIGHTY MODULE

INSTRUCTIONS FOR MM4010, MM4050, MM4300 & MM4310 DC TO DC TRANSMITTERS

FUNCTION

The MM4010, MM4050, MM4300 and MM4310 DC to DC Transmitters provide DC output voltages or currents proportional to a DC input signal. They are useful in converting voltages to currents or currents to voltages, in providing signal isolation and in scaling signal levels from one amplitude to another.

DESCRIPTION

A stable amplifier is used to monitor a DC input voltage. For current inputs a shunt resistor is added inside the module to create a voltage level at the amplifier input. A final amplifier produces the desired DC voltage or current output.

MM4300 and MM4310 provide input/output isolation by modulating the pulse width of a VCO with the amplified input. The pulses are optically coupled to a separately-powered demodulator which, in turn, feeds the final amplifier. MM4010 and MM4050 are direct-coupled, input to output.

A wide range input option adds an 8 position DIP switch which provides input voltage and current range selection by connecting any of 6 gain-setting and 2 current-shunt resistors.

MODEL NUMBERS

Transmitters are available with or without input isolation and with standard or narrow spans. The narrow span models use a superior, low drift input amplifier. Model numbers are as follows:

MM4010	Standard spans, nonisolated
MM4050	Narrow spans (below 50mV), nonisolated
MM4300	Standard spans, input-output isolated
MM4310	Narrow spans (below 50mV), input-output isolated

OPTIONS

WR	Wide range input. Allows a choice of input voltage and current range selections by use of an 8 position DIP switch.
U	All circuit boards polyurethane coated for protection against moisture.

WILKERSON INSTRUMENT CO., INC.
3615 CENTURY BLVD. • LAKELAND, FL 33811 • USA
1 (813) 646-3909 • TELEX: 5106011060 WILK INST CO
FAX: 813-644-5318

Linearity	MM4010, MM4050	±0.01% of Span
	MM4300, MM4310	±0.05% of Span
Output Ripple	MM4300, MM4310	less than 0.1% of Span peak-to-peak
Temperature Stability		±0.025% of span per deg C
Common Mode Rejection		120db, DC to 60Hz
Response Time	MM4300, MM4310	75 milliseconds
Isolation:	Power	1500 Vrms
	Input/Output (MM4300, MM4310)	1000 Vrms
Temperature, Operating		0 deg C to 60 deg C 32 deg F to 140 deg F
Power	Standard	115V ±10%, 50 or 60Hz
	Optional	230V, 50 or 60Hz AC 12 or 24V DC; 2.5W max

MOUNTING

The transmitters are designed to plug into a standard 8-pin relay socket. Part number MP008 is a molded plastic socket suitable for mounting on a flat surface or in a piece of PVC track.

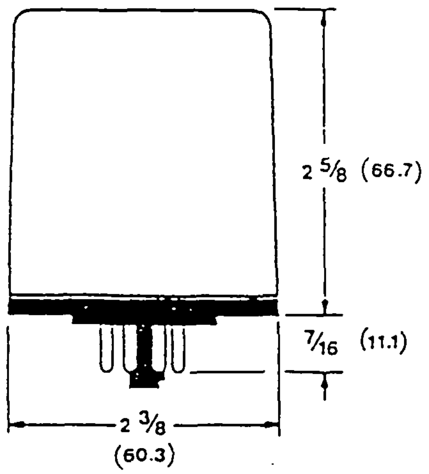
WARRANTY

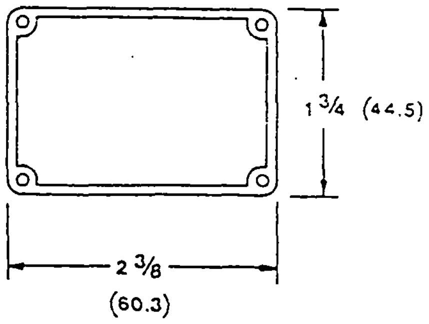
All Wilkerson Instrument Company products carry a 5 year limited warranty against defective material or workmanship. The product will be repaired or replaced, at the company's option, if it fails during this time due to defective material or workmanship. Misapplication or abuse by the user is not covered by this warranty.

In addition, the company will repair any of its products for a period of 5 years after the warranty period for an amount no greater than 10% of the original purchase price.

The owner is responsible for freight costs.

MOUNTING DIMENSIONS INCHES (MM)





POWER 115 or 230 VAC, 12 or 24 VDC.

CONTROLS

The DC to DC transmitters contain two calibration controls, zero and span (gain). The WR option adds an 8 position DIP switch for range selection.

CALIBRATION

The transmitters are precisely calibrated at the factory and do not normally require user calibration. If there is a need to recalibrate, proceed as follows:

If your transmitter includes the WR option, remove its cover and set the 8 DIP switches according to the table below.

ZERO and SPAN adjustments are available on top of the transmitter module. Connect a calibrated signal source to the module input. Monitor the output of the module with an accurate digital meter. Set the input signal to its zero or low value and adjust the ZERO control for the proper output. Increase the input signal to its full scale value and adjust the SPAN control for the proper output. Repeat the procedure once or twice, the controls may interact slightly.

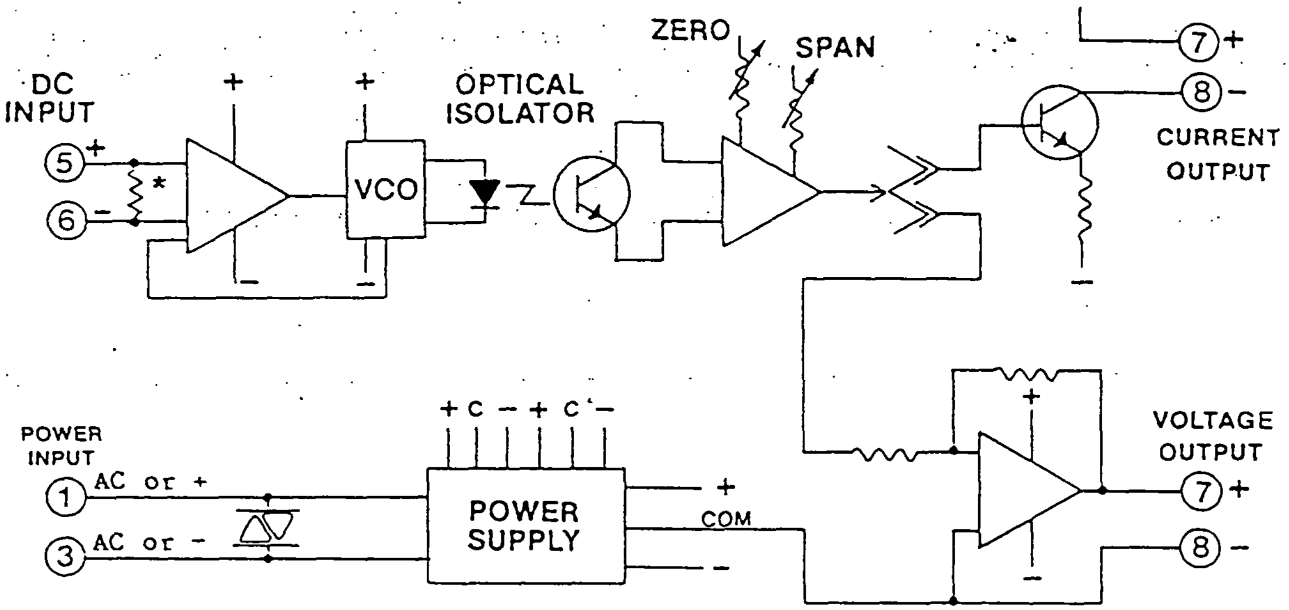
WIDE RANGING INPUT (WR OPTION)			
INPUT	CLOSE SW	INPUT	CLOSE SW
50mV	none	1mA	7
100mV	6	2mA	6,7
200mV	5	4mA	5,7
500mV	4	5mA	7,8
1V	3	10mA	4,7
2V	2	20mA	3,7
5V	1	4/20mA	5,8
10V	1,2,3,4,5,6	25mA	3,5,7
1/5V	2,3,4,5,6	50mA	4,7,8
		10/50mA	4,8

SPECIFICATIONS

Input Impedance	Voltage	200K
	Current	see table on block diagram
Input Limits	MM4010, MM4300	50mV Span min; 200V max
	current:	5 A max, internal shunt
	MM4050, MM4310	10mV Span min; 20V max
Output Limits	Voltage	-10 to +15V, 10mA
	Current	50mA, 24V compliance

MM4300/MM4310

BLOCK DIAGRAM AND PIN CONNECTIONS

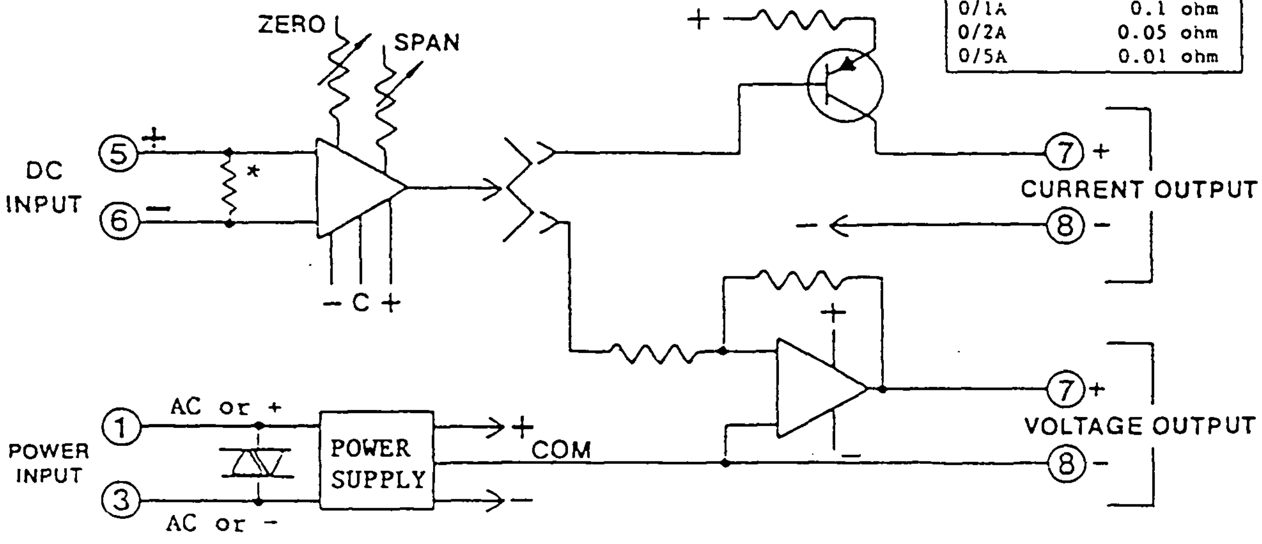


*

CURRENT INPUT	INPUT SHUNT VALUE
0/1mA	100 ohms
0/10mA	10 ohms
0/20mA	5 ohms
4/20mA	61.9 ohms
0/50mA	2 ohms
0/100mA	1 ohm
0/200mA	0.5 ohm
0/500mA	0.1 ohm
0/1A	0.1 ohm
0/2A	0.05 ohm
0/5A	0.01 ohm

MM4010/MM4050

BLOCK DIAGRAM AND PIN CONNECTIONS



IMPULSE SUPPRESSOR INSTALLATION

PLEASE READ DANGER SHEET BEFORE INSTALLING

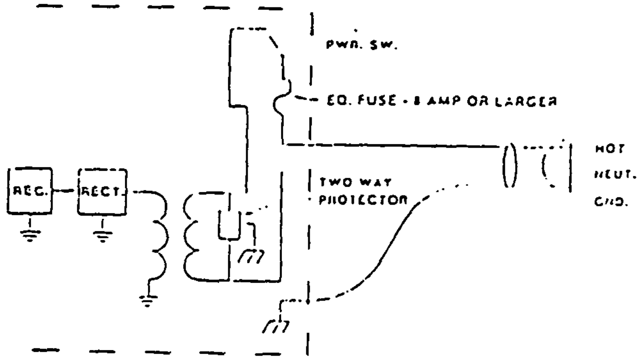
Your "Two Way" IS-PSP-120 (Power Supply Protector) will protect from surges from the power line as well as surge voltages attempting to go to the power line. Your IS-PSP-120 is fast (nanoseconds) and is capable of very high current (35,000 Amps) using IEEE waveform of 8µS ris and 20µS decay to a 50% point. It should have a long life time (which is dependent on the severit of surges that it shunts).

THIS DEVICE IS ONLY FOR 120 VAC (RMS) OR LOWER POWER LINES.

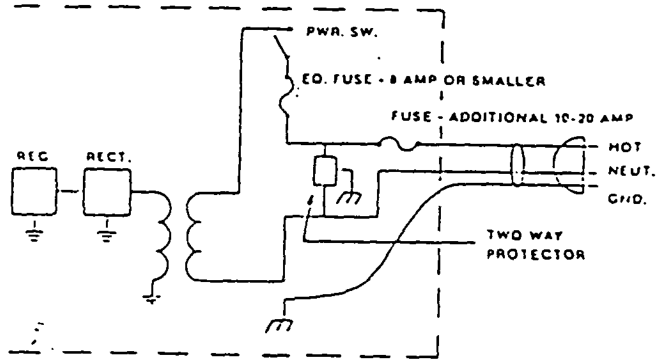
DANGER - DISCONNECT POWER CORD FROM POWER OUTLET BEFORE PROCEEDING WITH INSTALLATION.

To install, it is important that the fuse be electrically located between the power cord and the protector. This is for when the device finally reaches the end of its life, the fuse will continue to be blown, (it dies in a shorted mode). If your equipment has a fuse smaller than 8 Amps, you may wish to add an additional fuse of 10 to 20 Amps. This will prevent surges from frequently blowing the equipment fuse and yet gives safe localized "end of life" protection. Solder in place using the center black wire for chassis ground and the two white wires for each side of the transformer primary as shown in diagram.

For 8 Amp and up Equipment



For less than 8 Amp Equipment add additional fuse



For further information on grounds, ground systems, power line and telephone interconnect protection, order PolyPhaser's book "The 'Grounds' for Lightning & EMP Protection" at a cost of $19.95.

LIMITED WARRANTY

PolyPhaser Corporation warrants this product to meet or exceed the published specifications of the time of manufacturing and to be free of manufacturing defects for a two year period after proven date of purchase. PolyPhaser Corporation makes no claims, nor extends any warranty to include an "IMPLIED WARRANTY OF MERCHANTABILITY OR IMPLIED WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE". PolyPhaser Corporation assumes no responsibility for personal injury, property damage, and any other losses. This warranty is limited to the repair, replacement or refund of purchased price of this product only and it will be PolyPhaser Corporation's decision as to whether this unit is defective and as to which of the above mentioned actions will be taken. PolyPhaser Corporation extends no obligation to up-date or modify any of its existing products, as newly developed products are marketed.

To Keep YOU communicating
U.S. Patent #'s 4,359,764, 4,409,637 & 4,554,608

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OPERATING INSTRUCTIONS & PARTS MANUAL

SHADED-POLE BLOWERS

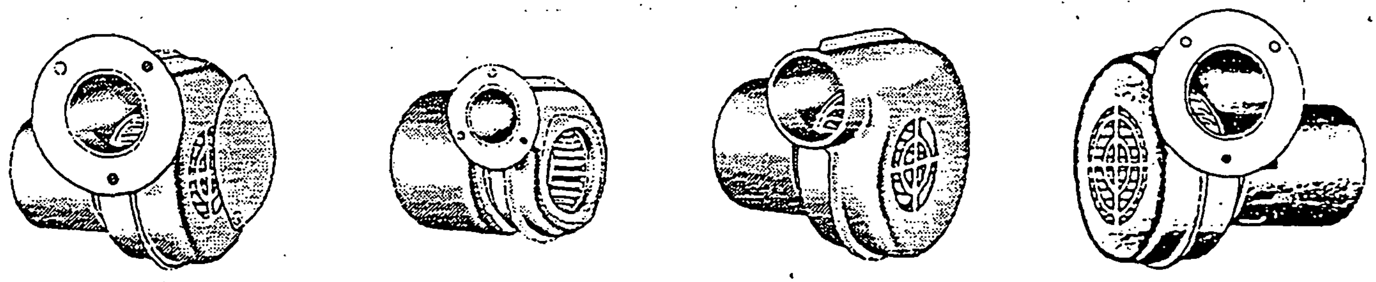
MODELS 2C782, 2C914A, 4C440, 4C441A & 4C443A

FORM
5S254
0404

DAYTON ELECTRIC MANUFACTURING CO. CHICAGO 60648

1186/415/1

READ INSTRUCTIONS CAREFULLY BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE DAYTON SHADED-POLE BLOWERS!
RETAIN INSTRUCTIONS FOR FUTURE REFERENCE.



MODELS 4C440 AND 2C914A

MODEL 2C782

MODEL 4C441A

MODEL 4C443A

Figure 1

Description

The Dayton shaded pole blower, finished in grey enamel, is a single speed unit designed specifically for heating, cooling, exhausting, ventilating and drying. It is field interchangeable with most direct drive blowers and can be mounted in any discharge position. Blower is driven by a shaded-pole motor.

Models 2C914A, 4C440, 4C441A and 4C443A feature automatic-reset thermal protection which automatically shuts off the motor should excessive temperatures develop. Model 2C782 has impedance protection. Maximum ambient temperature is 104°F (40°C).

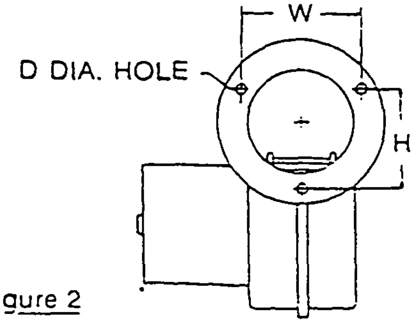


Figure 2

Dimensions

MODEL	"H"	"W"	"D"
2C782	$1\frac{13}{32}$	$1\frac{5}{8}$	$\frac{13}{64}$
2C914A	$2\frac{13}{16}$	$2\frac{3}{8}$	$\frac{9}{32}$
4C440	$2\frac{13}{16}$	$2\frac{3}{8}$	$\frac{9}{32}$
4C441A	—	—	—
4C443A	$2\frac{13}{16}$	$2\frac{3}{8}$	$\frac{9}{32}$

General Safety Information

1. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA).
2. Blower must be securely and adequately grounded. This can be accomplished by wiring with a grounded, metal-clad raceway system, by using a separate ground wire connected to the bare metal of the blower frame, or other suitable means.
3. Always disconnect power source before working on or near a motor or its connected load. If the power disconnect point is out-of-sight, lock it in the open position and tag to prevent unexpected application of power.
4. All moving parts should be guarded.
5. Be careful when touching the exterior of an operating motor — it may be hot enough to be painful or cause injury. With modern motors this condition is normal if operated at rated load and voltage — modern motors are built to operate at higher temperatures.
6. Protect the power cable from coming in contact with sharp objects.
7. Do not kink power cable and never allow the cables to come in contact with oil, grease, hot surfaces, or chemicals.
8. Make certain that the power source conforms to the requirements of your equipment.
9. Wiping or cleaning rags and other flammable waste materials must be placed in a tightly closed metal container and disposed of later in the proper fashion.
10. When cleaning electrical or electronic equipment, always use an approved cleaning agent such as dry cleaning solvent.
11. Do not use these blowers in explosive atmospheres.

Specifications

MODEL	WHEEL SIZE		MOTOR			OUTLET OPENING	OVERALL DIMENSIONS		
	DIA.	W	HP	SPD	PWR. REQD.	DIA.	H	W	D
2C782 •	2	1	$\frac{1}{250}$	1	115V 50/60 HZ	$1\frac{1}{4}$	$3\frac{13}{16}$	$4\frac{3}{16}$	$3\frac{29}{32}$
2C914A Δ	3	$1\frac{7}{8}$	$\frac{1}{125}$	1	230V 50/60 HZ	$2\frac{1}{8}$	$5\frac{13}{16}$	$5\frac{7}{32}$	$6\frac{5}{16}$
4C440 Δ	3	$1\frac{7}{8}$	$\frac{1}{125}$	1	115V 50/60 HZ	$2\frac{1}{8}$	$5\frac{13}{16}$	$5\frac{7}{32}$	$6\frac{5}{16}$
4C441A Δ	3	$1\frac{7}{8}$	$\frac{1}{125}$	1	115V 50/60 HZ	$2\frac{1}{8}$	$5\frac{13}{16}$	$5\frac{7}{32}$	$6\frac{5}{16}$
4C443A Δ	$3\frac{13}{16}$	$1\frac{7}{8}$	$\frac{1}{70}$	1	115V 50/60 HZ	$2\frac{1}{8}$	$5\frac{13}{16}$	$6\frac{7}{16}$	$6\frac{5}{16}$

ΔAutomatic-Reset Thermal Protection. NOTE: All dimensions in inches. • Impedance Protected.

Performance

MODEL	CFM AIR DELIVERY AT SPEED AND STATIC PRESSURE (SP) SHOWN						CUT-OFF SP	FREE AIR		
	FREE AIR	0.1" SP	0.2" SP	0.3" SP	0.4" SP	0.5" SP		SPEED *	WATTS *	AMPS *
2C782	15	13	4				0.22"	3160	16	0.21
2C914A Δ	60	57	54	49	39	23	0.60	3030	36	0.21
4C440 Δ	60	57	54	49	39	23	0.60	3030	36	0.42
4C441A Δ	60	57	54	49	39	23	0.60	3030	36	0.42
4C443A Δ	100	98	95	90	85	80	0.80	2870	61	0.74

ΔAutomatic-Reset Thermal Protection. *At Free Air. NOTE: All data based on 60Hz operation. When operated on 50Hz, a decrease of approximately 20% will occur in flow rate performance.

Installation

1. Mount the unit in the position most desirable to your needs.
2. Connect the two leads to the appropriate power source. Refer to blower name plate.

   NOTE: These blowers are not recommended for use with any type of speed control device.

CAUTION: A ground wire must run from the blower motor housing to a suitable electrical ground such as a properly grounded metallic raceway or ground wire system.

Maintenance

LUBRICATION

The motor bearings should be relubricated every 6 months with 10 or 20 drops of SAE 10W or 20W non-detergent oil (ML-type) or with electric motor oil.

GENERAL

Should further servicing of the unit be necessary, refer to the "exploded" view illustration as an aid in disassembly and assembly procedures.

WARNING: ALWAYS DISCONNECT POWER SUPPLY BEFORE SERVICING THE BLOWER OR WORKING WITH THE UNIT FOR ANY REASON. THIS IS ESPECIALLY IMPORTANT WITH UNITS EQUIPPED WITH AUTOMATIC-RESET THERMAL PROTECTION. UNIT MAY ACTIVATE WITHOUT WARNING!

Troubleshooting Chart

SYMPTOM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
Excessive Noise	1. Blower wheel contacting housing 2. Foreign material inside housing 3. Leak in duct work 4. Loose duct work	1. Realign or replace. 2. Clean. 3. Repair. 4. Secure properly.
Insufficient air flow	1. Leaks in duct work 2. Dampers and/or registers closed 3. Obstruction in system 4. Clogged Filters	1. Repair. 2. Open. 3. Remove. 4. Clean or replace.
Unit fails to operate	1. Blown fuse or open circuit breaker 2. Defective motor 3. Automatic-reset thermal protector "tripped" 4. Motor improperly wired	1. Replace fuse or reset circuit breaker. 2. Replace. 3. Check for high (or low voltage input or ambient temperatures in excess of 40°C (104°F). 4. Re-wire.

LIMITED WARRANTY

DAYTON ONE-YEAR LIMITED WARRANTY. Blowers, Models 2C782, 2C914A, 4C440, 4C441A & 4C443A, are warranted by Dayton Electric Mfg. Co. (Dayton) to the original user against defects in workmanship or materials under normal use for one year after date of purchase. Any part which is determined by Dayton to be defective in material or workmanship and returned to an authorized service location, as Dayton designates, shipping costs prepaid, will be, as the exclusive remedy, repaired or replaced at Dayton's option. For limited warranty claim procedures, see PROMPT DISPOSITION below. This limited warranty gives purchasers specific legal rights which vary from state to state.

LIMITATION OF LIABILITY. To the extent allowable under applicable law, Dayton's liability for consequential and incidental damages is expressly disclaimed. Dayton's liability in all events is limited to, and shall not exceed, the purchase price paid.

WARRANTY DISCLAIMER. Dayton has made a diligent effort to illustrate and describe the products in this literature accurately; however, such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the products are merchantable, or fit for a particular purpose, or that the products will necessarily conform to the illustrations or descriptions.

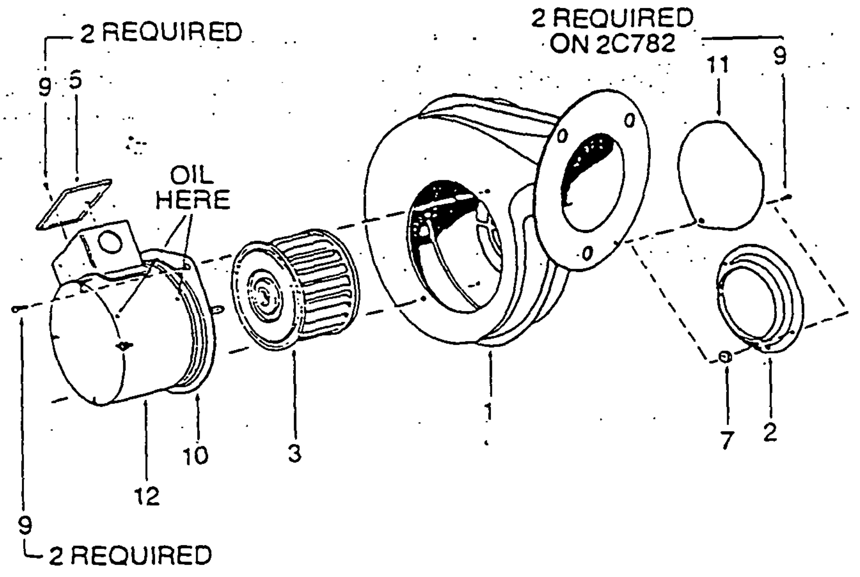
Except as provided below, no warranty or affirmation of fact, expressed or implied, other than as stated in "LIMITED WARRANTY" above is made or authorized by Dayton.

PRODUCT SUITABILITY. Many states and localities have codes and regulations governing sales, construction, installation, and/or use of products for certain purposes, which may vary from those in neighboring areas. While Dayton attempts to assure that its products comply with such codes, it cannot guarantee compliance, and cannot be responsible for how the product is installed or used. Before purchase and use of a product, please review the product application, and national and local codes and regulations, and be sure that the product, installation, and use will comply with them.

Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some states do not allow limitations on how long an implied warranty lasts, consequently the above limitation may not apply to you; and (c) by law, during the period of this Limited Warranty, any implied warranties of merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

PROMPT DISPOSITION. Dayton will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date and number of dealer's invoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file claim with carrier.

Dayton Electric Mfg. Co., 5959 W. Howard St., Chicago, IL 60648



ORDER REPLACEMENT PARTS THROUGH DEALER FROM WHOM PRODUCT WAS PURCHASED

Please provide following information:

- Model Number
- Serial Number (if any)
- Part Description and Number as shown in parts list.

If dealer cannot supply,
order from:
Dayton Electric Mfg. Co.
Parts Department
5959 W. Howard St.
Chicago, Illinois 60648

Figure 3 — Replacement Parts Illustration, Models 2C782, 2C914A, 4C440 & 4C441A

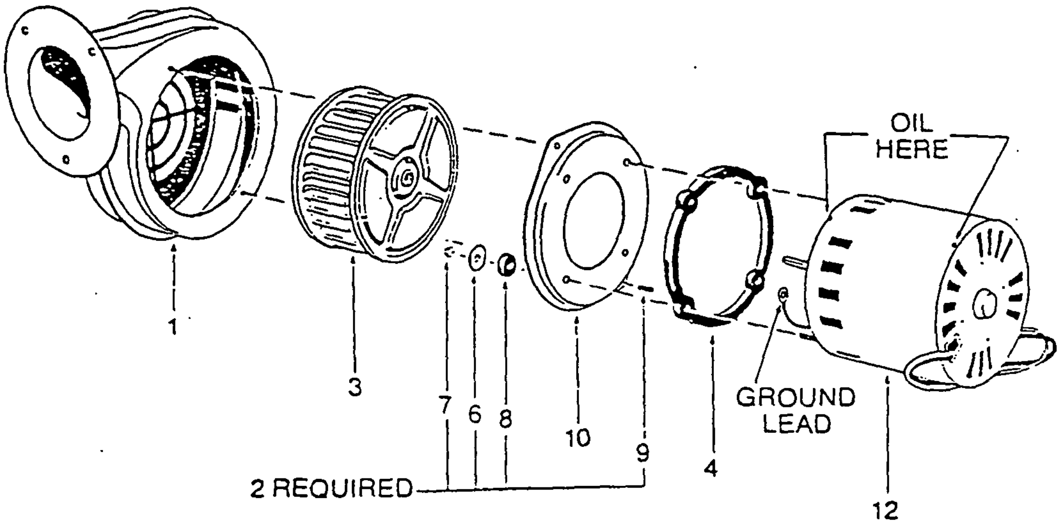


Figure 4 — Replacement Parts Illustration, Model 4C443A
NOTE: Conduit box and cover not shown for Model 4C443A.

Replacement Parts List

REF. NO.	DESCRIPTION	PART NO. FOR MODELS:				
		2C782	2C914A	4C440	4C441A	4C443A
1	Housing	8853-4296	8853-4291	8853-4291	8853-4289	8853-4283
2	Inlet ring	8793-4055	—	—	—	—
3	Blower wheel	0907-0023	0905-0059	0905-0059	0905-0059	0910-0002
4	Gasket	—	—	—	—	0912-0167
5	Conduit box cover	—	8591-6628	8591-6628	8591-6628	8591-6628
6	Washer #8	—	—	—	—	*
7	Nut #8-32	*	—	—	—	*
8	Grommet	—	—	—	—	0912-0168
9	Screw #8-1/4	*	*	*	*	*
10	Mounting cup	8768-4026	—	—	—	8768-4027
11	Damper	—	8631-4006	8631-4006	—	—
12	Motor	7121-1998	7121-3482	7121-3466	7121-4930	7121-4931

*Standard hardware item, available locally.

METHANE REACTOR TROUBLE SHOOTING

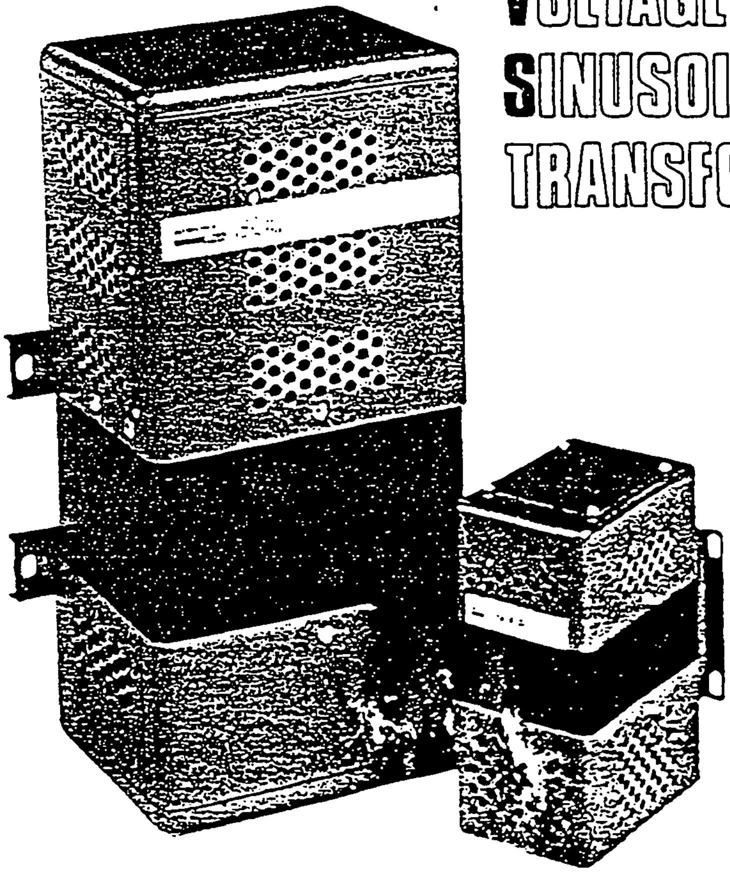
I. Methane reactor is cold to touch.

- (a) Fuse is blown
  - (1) Before replacing fuse, check resistance between black wire and chassis and white wire and chassis. Resistance should be infinite. Replace fuse. Unit should be operational.
  - (2) If resistance is zero, there is a short in the wiring inside the methane reactor. Allow the reactor to cool and inspect all wiring and components for evidence of shorting. Repair wiring or replace defective components.
  - (3) If no shorts visible, lift entire wiring harness from methane reactor block and lay it on non-conducting surface. Measure resistance between black and red leads. It should read zero, indicating continuity through temperature controller switch. If not, replace temperature controller switch.
- (b) Fuse is not blown but power is constant to unit and unit is cold.
  - (1) Measure resistance between red lead and white lead. If unit has 10-LPM or less capacity and operates 120V, the resistance should be about 48-ohms. If operating 230V, resistance should be about 185-ohms. In either case, if resistance is infinite, replace heater.
  - (2) If capacity is 20 or 30-LPM, resistance should be about 22-ohms if both heaters are okay and operating 120V. Resistance should be about 95-ohms if for 230V. If reading is about 48-ohms, 120V, means one heater gone. If reading is about 185-ohms, 230V, means one heater gone. All readings taken between red and white leads.
  - (3) If readings in (b)(2) above are infinite, both heaters gone.

II. Unit is at temperature other than 290°C, replace temperature switch with switch from AADCO. It is imperative that temperature setting be correct. Settings other than prescribed will cause formation NO_x and improper hydrocarbon removal.

III. It is imperative that proper filtering of air prior to methane reactor be done. Removal of particulates, halogens and sulfur compounds is mandatory for longevity and flow specifications to be met.

CONSTANT VOLTAGE SINUSOIDAL TRANSFORMERS



A UNIT OF GENERAL SIGNAL GS

SOLA

INTRODUCTION

This operating and service manual has been prepared to ensure that your SOLA Constant Voltage Transformer can be operated and serviced with minimal effort and involvement. This manual covers SOLA Constant Voltage Sinusoidal (CVS) Transformers.

INSTALLATION - Mechanical

Position

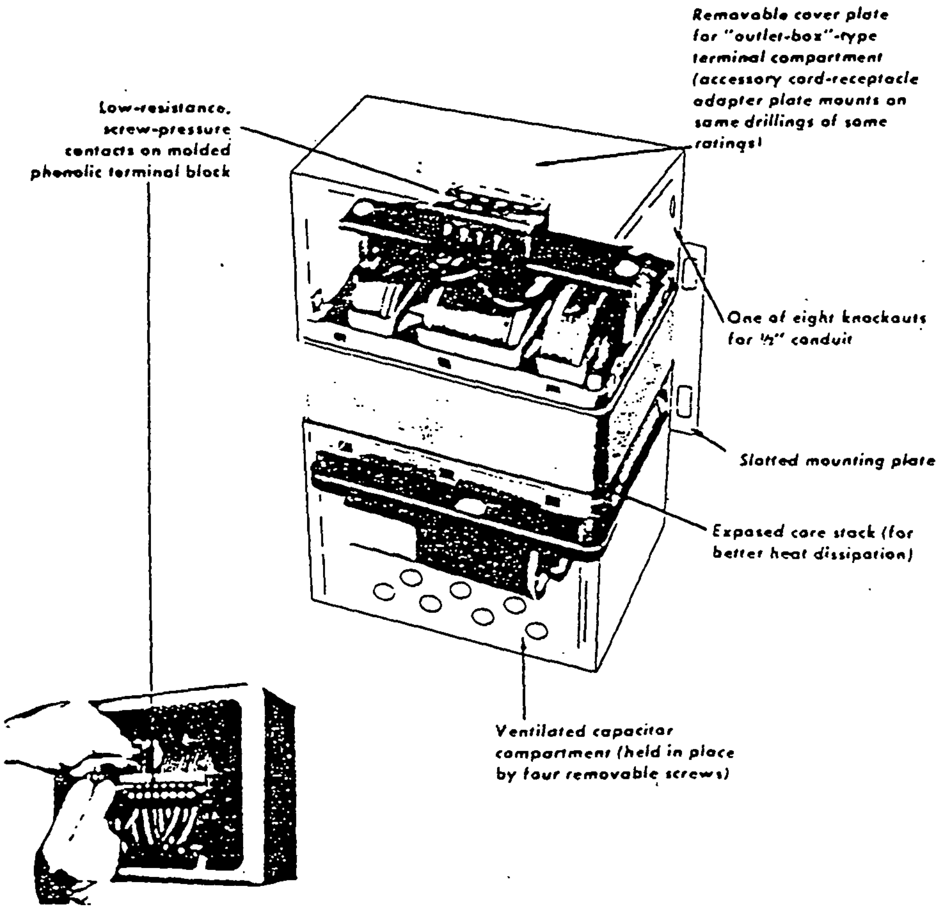
All stock sizes with end housings are intended to be mounted with the silkscreened THIS SIDE UP legend facing upwards. This will place the ventilated capacitor compartment downward, thus providing cooler operation of the capacitor(s). However, all units will give satisfactory performance if mounted in a horizontal position. In either case, the unit should be mounted in an area where it is unlikely that anyone will come into contact with the core surface of the unit. Figure 1 shows a phantom view of a typical unit.

Mounting Considerations

If a unit is to be wall mounted, the mounting hardware should be sized as in Table 1 below. All mounting holes provided must be used.

Table 1. Mounting Screw/Bolt Sizing

RATED VA OF REGULATOR	MIN. DIAMETER OF STEEL MOUNTING BOLTS
30 to 120	#10 Machine Screws
250	1/4" Bolts
500 to 1000	5/16" Bolts
1500 to 10000	3/8" Bolts
15000	1/2" Bolts



Phantom view reveals simplicity of Sola transformer, illustrates convenient terminal block arrangement. Unit contains no moving parts—requires no routine maintenance.

Figure 1. Phantom View

All ratings depend on natural draft air circulation for cooling. They should not be mounted in confined or enclosed spaces unless special provisions have been made for ventilation. Sola's Technical Service department is available for assistance in doubtful situations (see note on Operating Temperature, page 13). Table 2 and Figure 2 show model numbers with their weights and physical dimensions.

Table 2. CVS Weights and Physical Dimensions

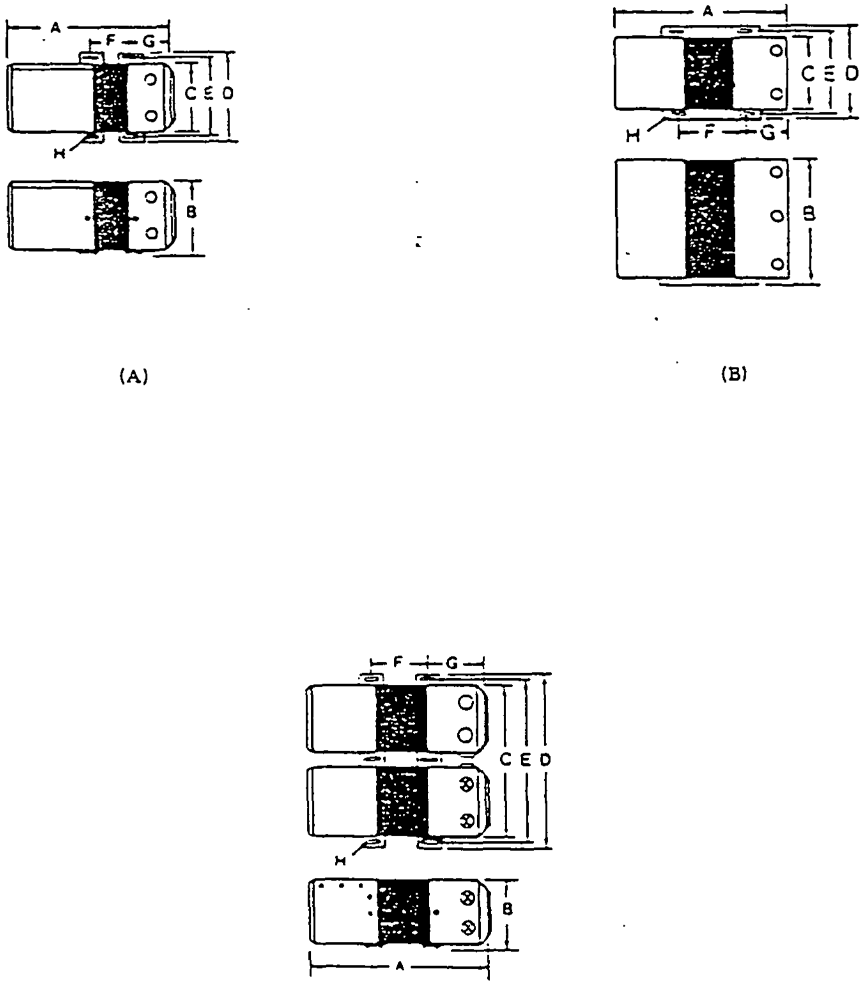
Catalog Number	VA	Outline	A	B	C (in inches)	D	E	F	G	H	Shipping Weight (lbs)
60Hz Single Phase:											
23-13-030-2	30	A	6.12	5.19	3.31	4.00	3.50	3.00	1.75	.22 X .59	7
23-13-060-2	60	A	6.94	5.19	3.31	4.00	3.50	3.00	1.75	.22 X .59	9
23-23-060-2	60	A	6.94	5.19	3.31	4.00	3.50	3.00	1.75	.22 X .59	9
23-22-112-2	120	A	8.12	5.19	3.31	4.00	3.50	3.00	2.44	.22 X .59	13
23-22-125	250	A	9.62	7.44	4.50	5.38	4.75	4.12	2.19	.31 X .69	28
23-23-125-8	250	A	9.88	7.44	4.50	5.38	4.75	4.12	2.19	.31 X .69	28
23-23-125	250	A	9.62	7.44	4.50	5.38	4.75	4.12	2.19	.31 X .69	29
23-22-150	500	A	11.69	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .81	36
23-26-150	500	A	11.69	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .31	36
23-23-150-8	500	A	12.69	6.44	7.78	8.00	8.12	5.62	3.06	.38 X .81	37
23-25-175	750	A	15.38	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .81	52
23-23-175-8	750	A	13.69	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .81	52
23-25-210	1000	A	16.38	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .81	60
23-26-210	1000	A	16.38	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .81	60
23-23-210-8	1000	A	16.75	6.44	7.78	9.00	8.12	5.62	5.25	.38 X .81	63
23-25-215	1500	B	18.44	9.03	10.56	12.75	11.75	3.00	5.19	.44 X .69	94
23-23-215-8	1500	B	16.44	9.03	10.56	12.75	11.75	3.00	5.19	.44 X .69	95
23-25-220	2000	B	19.31	9.03	10.56	12.75	11.75	3.88	5.19	.44 X .69	111
23-23-220-8	2000	B	17.31	9.03	10.56	12.75	11.75	5.25	5.19	.44 X .69	109
23-26-220	2000	B	19.31	9.03	10.56	12.75	11.75	3.38	5.19	.44 X .69	111

Table 2. CVS Weights and Physical Dimensions - (Continued)

Catalog Number	VA	Outline	A	B	C (in inches)	D	E	F	G	H	Shipping Weight (lbs.)
23-25-230-3	3000	B	20.69	9.03	10.56	12.75	11.75	5.25	5.19	.44 X .69	142
23-26-230	3000	B	20.69	9.03	10.56	12.75	11.75	5.25	5.19	.44 X .69	142
23-23-230-8	3000	B	18.69	9.03	10.56	12.75	11.75	5.25	5.19	.44 X .69	142
23-25-250-6	5000	B	30.69	9.03	10.56	12.75	11.75	8.25	8.88	.44 X .69	225
23-26-250-6	5000	B	30.69	9.03	10.56	12.75	11.75	8.25	8.88	.44 X .69	225
23-23-250-8	5000	B	28.19	9.03	10.56	12.75	11.75	8.25	8.88	.44 X .69	222
23-28-275-6	7500	C	29.06	9.03	22.81	25.81	24.81	6.62	8.88	.44 X .69	365
23-28-310-6	10000	C	30.69	9.03	22.81	25.81	24.81	8.25	8.88	.44 X .69	452
23-28-315-6	15000	*	30.69	9.38	35.56	38.25	37.22	8.25	8.88	.56 X .69	715
50Hz Single Phase:											
24-551-2	60	A	7.75	5.19	3.31	4.10	3.50	3.00	2.44	.22 X .59	11
24-552-2	120	A	8.62	7.44	4.50	5.38	4.75	4.12	2.19	.31 X .69	21
24-553-2	250	A	10.31	7.44	4.50	5.38	4.75	4.12	2.19	.31 X .69	37
24-554-9	500	A	12.31	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .81	56
24-554-10	500	A	12.31	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .81	56
24-555-9	1000	B	17.12	6.44	7.78	9.00	8.13	5.62	4.06	.38 X .31	65
24-555-10	1000	B	17.12	6.44	7.78	9.00	8.13	5.62	4.06	.38 X .81	65
24-556-9	2000	B	19.94	9.03	10.56	12.75	11.75	4.50	5.19	.44 X .69	126
24-557-9	3000	B	25.41	9.03	10.56	12.75	11.75	6.66	5.19	.44 X .69	187
24-572-9	5000	C	21.12	9.03	22.81	25.81	24.81	5.69	5.19	.44 X .69	310

* Triplex assembly: Same as Figure 2 (c) except for one more transformer.

Note: 50 and 60Hz CVS transformers are of different designs, and cannot be adjusted or rebuilt for other frequencies.



(A)

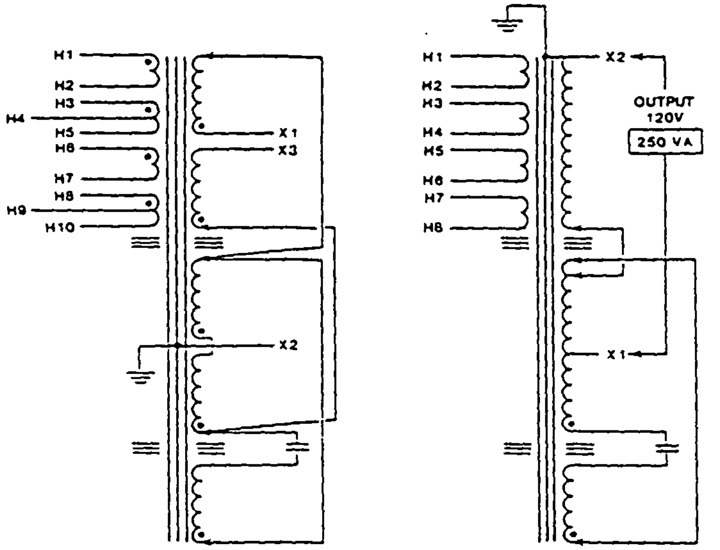
(B)

(C)

Figure 2. Mounting Holes and Dimensions

INSTALLATION - Electrical

On 60VA or smaller units, screw-type lugs in the outlet box are marked "input" and "output", and no connection diagram is necessary. Units rated 120 to 15000 VA are provided with multiple inputs for any one, two, three, or four different line voltages, and some have provision for three-wire output. With all units, a connection diagram is attached to the inside lid of the box cover, or inserted in the outlet box. Figure 3 shows typical connections for -8 models, and Figure 4 shows multiple input connections for all other models. Figure 5 shows the output connections for all models.



INPUT CONNECTIONS - All except 250 VA

Volts	Input	Jumper
95-130	H1-H2	(H1 + H3 + H6 + H8) (H2 + H5 + H7 + H10)
175-235	H1-H4	(H2 + H3) (H7 + H8) (H1 + H6) (H4 + H9)
190-260	H1-H5	(H2 + H3) (H7 + H8) (H1 + H6) (H5 + H10)
380-520	H1-H10	(H2 + H3) (H5 + H6) (H7 + H8)

INPUT CONNECTIONS - 250 VA Only

Volts	Input	Jumper
95-130	H1 - H2	(H1 + H3 + H5 + H7) (H2 + H4 + H6 + H8)
190-260	H1 - H4	(H2 + H3) (H6 + H7) (H1 + H5) (H4 + H8)
380-520	H1 - H8	(H2 + H3) (H4 + H5) (H6 + H7)

Figure 3. Electrical Connection for -8 Models

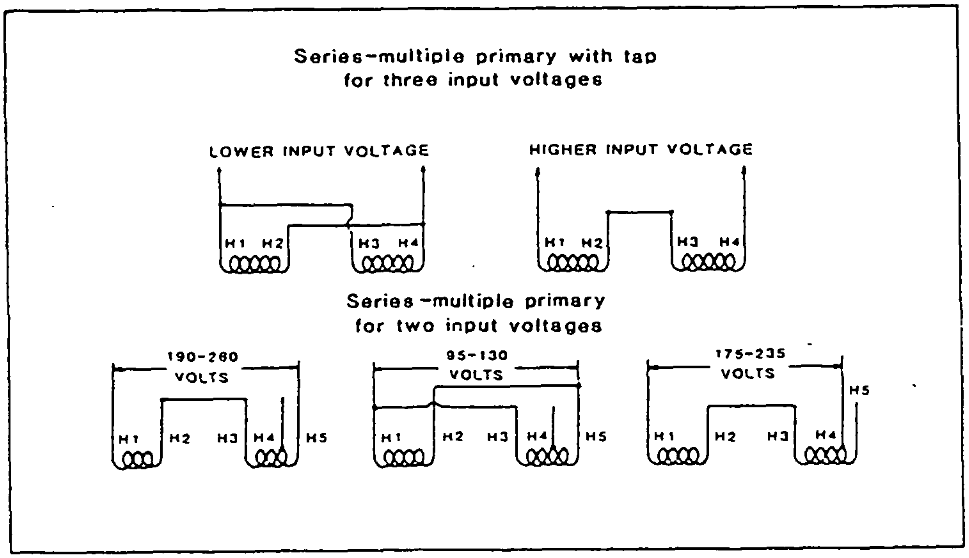


Figure 4. Multiple Input Connections for All Models Not Ending In -8

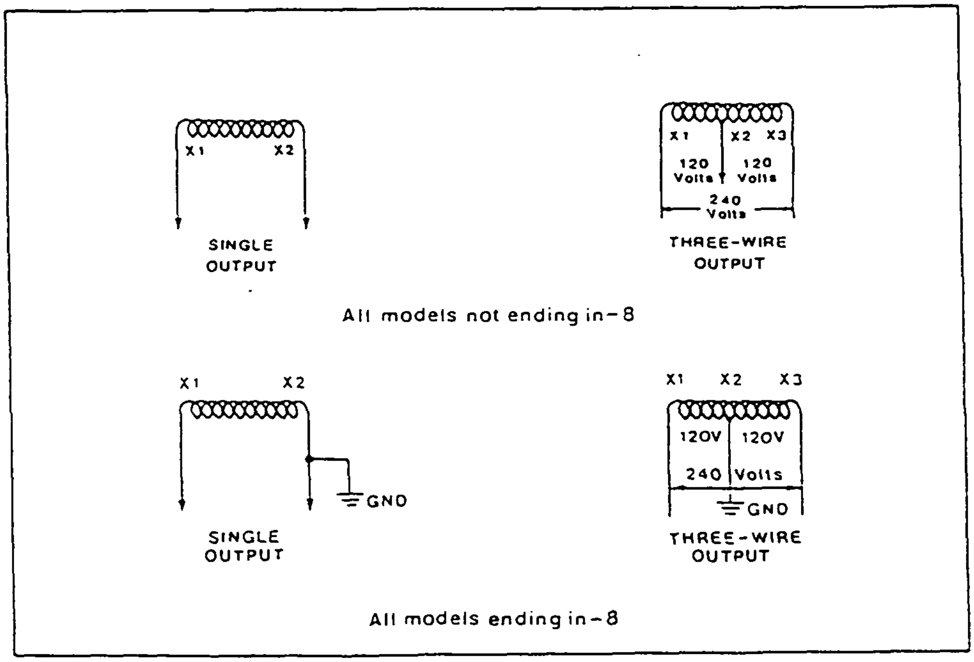


Figure 5. Output Connections

Wire Sizing and Circuit Protection

Table 3 shows suggested circuit protection and wire sizing for the various models of CVS transformers.

Table 3. Circuit Protection/Wire Gauge Sizes

CVS	INPUT			OUTPUT	
VA Rating	Rated Volts	Required Circuit Protection (A)	Minimum Gauge 90°C Wire	Rated Volts	Minimum Gauge 90°C Wire
30	95-130	1	14	120	14
60	95-130	2	14	120	14
120	95-130	3	14	120	14
	175-235	3	14	120	14
	190-260	3	14	120	14
	380-520	1	14	120	14
250	95-130	6	14	120	14
	175-235	3	14	120	14
	190-260	3	14	120	14
	380-520	1	14	120	14
500	95-130	10	14	120	14
	175-235	6	14	208	14
	190-260	6	14	240	14
	380-520	3	14		
750	95-130	15	14	120	14
	175-235	10	14	208	14
	190-260	6	14	240	14
	380-520	3	14		
1000	95-130	15	14	120	14
	175-235	10	14	208	14
	190-260	10	14	240	14
	380-520	6	14		
1500	95-130	25	10	120	12
	175-235	15	14	208	14
	190-260	15	14	240	14
	380-520	10	14		
2000	95-130	30	10	120	10
	175-235	20	12	208	14
	190-260	15	14	240	14
	380-520	10	14		

Table 3. Circuit Protection/Wire Gauge Sizes - (Continued)

CVS	INPUT			OUTPUT	
VA Rating	Rated Volts	Required Circuit Protection (A)	Minimum Gauge 90°C Wire	Rated Volts	Minimum Gauge 90°C Wire
	95-130	45	8	120	8
	175-235	25	10	208	12
3000	190-260	25	10	240	12
	300-520	15	14		
	95-130	80	4	120	8*
	175-235	40	8	208	10
5000	190-260	40	8	240	10
	380-520	20	12		
	175-235	60	6	120	4
7500	190-260	60	6	208	8
	380-520	30	10	240	8
	175-235	80	3	120	3
10000	190-260	80	4	208	6
	380-520	40	8	240	8
	175-235	125	1	120	0
15000	190-260	110	2	208	4
	380-520	60	4	240	4

*Leads in the wiring compartment must be sleeved with 105°C sleeving.

Three-Wire Regulating Action

On those units provided with three-wire output, the standard regulating action of ±1% or better may be obtained from the 240 volt terminals alone, either 120 volt leg alone, combination 240 and 120 volt loads, or unbalanced 120 volt loads.

Other Considerations

For certain smaller ratings, an accessory adapter plate-carrying an input cord and output receptacle, or jacks, is available at a small additional cost. Simple directions for installation are furnished with the adapter kit.

It is desirable to have a switch in the input circuitry for turning off power to the unit when it is not in use. While all CVS transformers are designed for continuous duty, they draw appreciable current regardless of output loading.

The outputs of all Sola standard CVS transformers are isolated from the input lines. Voltage generated by internal leakage currents will occur with respect to ground. This can have undesirable affects in many pieces of electronic equipment. Therefore, it is suggested that the installer tie the input power system neutral to the X2 output terminal. This will not affect regulation or the ability to reject power line noise or transients.

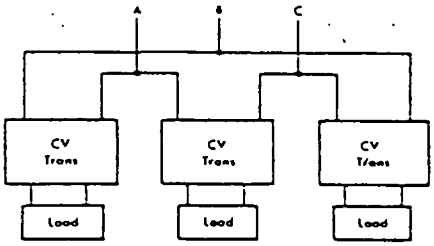
SPECIAL INSTALLATIONS

Use on Three-Phase Power Supply

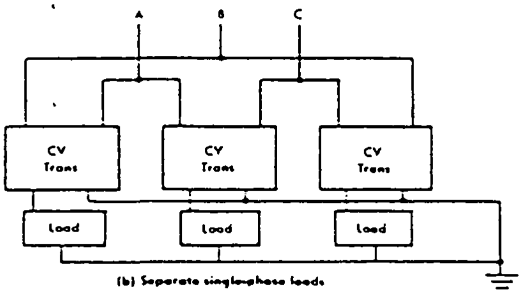
Any three stock units having a tap for 190-260 input connections may be connected in delta to a 240-volt, three-phase power supply; those units equipped with primary tap for 175-235 volts may also be connected in delta to a 208-volt supply. (Terminals to be used are identified on the connection diagram located on the inside face of the outlet box cover.)

All stock production, harmonic-free units now have uniform terminal polarity. This eliminates necessity for "phasing out" either input or output connections.

Output must serve three, independent, single-phase loads of the same total volt-ampere rating. Connections should be made in one of two ways shown in Figure 6.



(a) Isolated single-phase loads.



(b) Separate single-phase loads in grounded wye.

Figure 6. Three–Phase Connections

Use With Switchmode Power Supplies

If a CVS transformer is used as a source for a switchmode power supply, a slight amount of ringing may be noticed on the sine wave output of the CVS at half cycle intervals for a short duration. This ringing occurs at the point when the switchmode power supply current demand drops to zero. The ringing need not be a cause for concern since it is of relatively low magnitude and frequency. The CVS has been tested with a variety of switchmode power supplies and it has been determined that the ringing never affects the DC outputs, nor has it been found to degrade the components of any switchmode power supply.

Multiple Operation

Two CVS transformers of the same rating may be connected with their inputs and outputs in parallel. The regulating action will usually be excellent although the standard ±1% cannot be guaranteed. Series connection of either input or output is not recommended.

Use With Rectifier Loads

The ratio of crest to rms values is approximately 1.3 at rated load, and slightly lower at fractional loads. This factor must be considered when all or a portion of the voltage is rectified. The rectified voltage will now be 10 - 15% lower than if connected directly to a sine wave source.

Operation With Motor Loads

Because of the current limiting effect described later, special attention should be given to motor applications. In general, the CVS must have a load rating nearly equal to the maximum power drawn during the starting cycle. This may run from two to eight times the normal running rating of the motor. In doubtful cases it is advisable to measure the actual starting current.

Cascade Operation

For applications requiring close regulation, two CVS transformers may be operated in "cascade". The output of the combination will show little or no detectable change arising from supply line variations of up to ±15%. However, the combined units will still be frequency sensitive (as discussed under Effect of Frequency, page 15). Since even good power systems may often vary in frequency by 0.1% or more, the output of a Sola cascade combination may vary by up to 0.25% from this cause alone. In actual practice, then, a cascade combination is highly recommended for special applications requiring regulation in the general region of ±0.25%. If the tandem setup is to be operated at near full rating, then the Type CVS "driver" unit should be one standard size larger than the driven unit, in order to overcome the losses in the latter.

PHYSICAL CHARACTERISTICS OF OPERATION

Operating Temperature

Standard units are designed to operate in ambient temperatures of minus 20°C to plus 50°C. In operation, a temperature rise will occur whether or not the transformer is serving load. Normally, this rise may fall anywhere in the range of 45°C to 110°C, depending on the type and rating. In any case, the maximum operating temperature at an ambient of 50°C is always within safe operating limits for the class of insulating material used. (Special units can be designed for lower heat rise or wider ambient temperature range.)

External Magnetic Fields

In almost all applications, this effect may be disregarded. On critical applications, care should be exercized in the orientation of the core with respect to critical circuits, in order to minimize the effect of the field.

In certain rare cases in which the transformer is connected to, or mounted near, high gain audio frequency circuits, special attention may need to be given to adequate physical spacing and/or orientation of the CVS transformer so as to avoid interaction with the audio circuits. Sola's Technical Service Department may be able to offer suggestions for such problems.

ELECTRICAL CHARACTERISTICS OF OPERATION

Checking With Voltmeters

All checks on output voltages should be made with a true RMS voltmeter such as a Fluke model 8020 A. Rectifier-type voltmeters will not give accurate readings due to the small amount of harmonics present in CVS output.

Load Regulation

Changes in output voltage resulting from changes in resistive loads are usually small - running one percent or less in the larger units. Table 4 shows average values for output voltages.

Table 4. Output Voltage Changes - 20% Load to Full Load (100% Power Factor - Nominal Input Voltage)

Transformer VA	Percent Change - Output Voltage
11-30	approximately 4%
31-120	approximately 3%
121-150	approximately 2%
151-over	approximately 1%

Phase Shift

The phase difference which exists between input voltage and output voltage in the range of about 120° to 140° at full load. This phase difference varies with the magnitude of the load and, to a lesser extent, with changes in line voltage.

Output Wave Shape

The CVS transformers all include harmonic-neutralizing circuitry. These units typically have less than 3% total harmonic distortion at full load and less than 4.5% at no load.

Response Time

An important advantage of the Sola principle of static magnetic regulation is its exceedingly fast response time compared with other types of AC regulators. Transient changes in supply voltage are usually corrected by a Sola CVS with 1 1/2 cycles or less, the output voltage will not fluctuate more than a few percent during this interval.

Isolation

Since the input and output are separated not only electrically, but physically, by a magnetic shunt, the Sola CVS has a stronger isolating effect than a conventional transformer. This may often eliminate the need for static shields.

FACTORS AFFECTING OPERATION

Input Charcteristics

As the Sola CVS transformer includes a resonant circuit that is fully energized whether or not a load is present, the input current at no load or light loads may run 50% or more of the full-load primary current. As a result, the temperature of the unit may rise to near full-load levels, even at light or nonexistent loads. Input power factor will average 90-100% at full load, but may drop to approximately 75% at half load and 25% at no load. In any case, it is always leading.

Effect of Load Power Factor

The median value of output voltage will vary from the nameplate rating of the load is a power factor other than that for which the unit was designed. Load regulation will also be relatively greater as the inductive load power factor is decreased (see Figure 7). However, the resulting median values of the output voltage will be regulated against supply line changes at any reasonable load or power factor.

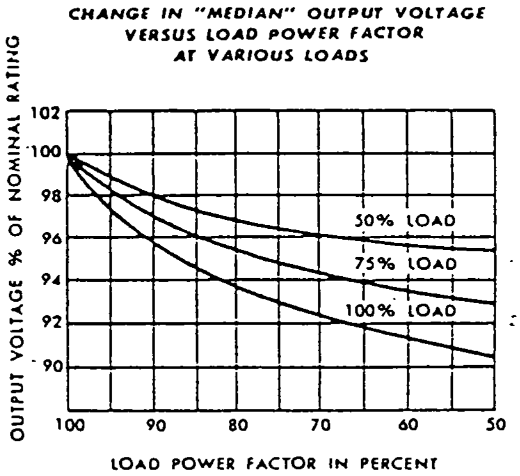


Figure 7. Median Output Voltage Vs. Load Power Factor

Effect of Frequency

Changes in the frequency of the supply voltage will be directly reflected in the output voltage. A change of approximately 1.8% in the output voltage will occur for every 1% change in input frequency in the same direction as the frequency change.

Effect of Temperature

The output voltage will show a small change as the unit warms up to stable operating temperatures at a constant ambient temperature. This change may be about one or two percent, depending on the unit's VA rating. At a stable operating temperature, the output voltage will change slightly with varying ambient temperature. This shift is approximately one percent for each 40°C of temperature change.

Current Limitation

When the load is increased beyond the transformer's rated value, a point is reached where the output voltage suddenly collapses and will not regain its normal value until the load is at least partially released. Under a direct short circuit, the load current is limited to approximately 150-200% of the rated full load value, the input wattage to less than 10% of normal. A CVS will protect both itself and its load against damage from excessive fault currents. Fusing of load circuits is not necessary.

Manufacturing Tolerance

The nominal output voltage of each stock Constant Voltage Transformer is adjusted at the factory to within plus 2%, minus 0% of rated (nameplate) value with rated, nominal voltage at rated frequency applied to the input, and with full rated load at 100% power factor applied to the output. This adjustment is made with the unit at substantially the same temperature as room ambient temperature (25°C).

SERVICING

Routine Maintenance

As the Sola CV Transformer is a simple rugged device without moving parts or manual adjustments, no servicing or maintenance is needed in the ordinary sense. The percentage of possible poor performance or failure is exceedingly low. In any case of apparent poor performance, the user is urged to check the following points immediately:

Checklist on Factors Affecting Performance

A. Nominal Voltage Too High

1. The load may be considerably less than full rating. (See "Load Regulation", page 13.)
2. The load may have a leading power factor.

B. Nominal Voltage Too Low

1. Load power factor may be lagging. (See Load Regulation, page 13.)
2. Unit may be slightly overloaded. (See Current Limitation, page 15.)

C. Does Not Regulate Closely

1. Unit may be slightly overloaded. (See Current Limitation, page 15.)
2. Actual line voltage swings may be outside the rated coverage of unit, particularly on the low side.
3. On varying loads, a certain amount of load regulation may be mixed with the line voltage regulating action. (See Load Regulation, page 13.)

D. Output Voltage Very Low (20-60V)

1. Unsuspected or unplanned overloads of substantial size may occur intermittently (motor-starting currents, solenoid inrush currents, etc.). (See Current Limitation, page 15.)
2. One or more capacitor units in the CVS transformer may be defective. (See Field Replacement of Capacitors, page 18.)

E. No Output Voltage At All

1. Check power source breakers or fuses.
2. Check continuity between input terminals, and also between output terminals.

F. Transformer Operating Temperature

1. These transformers are designed to operate at high flux density, and hence, relatively high temperatures (see Operating Temperature, page 13). After connection to line for a half hour or so, the exposed core structure may be too hot to touch with bare hand, but this is normal and need give no concern. However, if there is any indication of oil or compound leakage, unit should be returned to factory. (See below.)

NOTE

In case the transformer is operating but does not appear to have the correct output, it is very helpful to apply the following test:

1. Disconnect the working load.
2. Connect a dummy load of lamps, heaters, or other resistive load substantially equal to the full load rating of transformer, directly across its output terminals.
3. Measure the output voltage of the CVS using a true RMS type voltmeter directly across its output terminals.

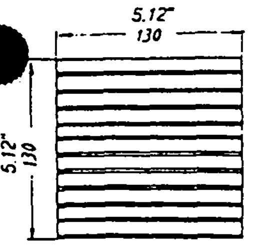
This test will usually establish whether the apparent poor performance is due to a fault in the CVS transformer or to some peculiarity of the working load. Sola's Technical Service department will then be in far better position to give helpful service advice or suggest factory test or service as indicated.

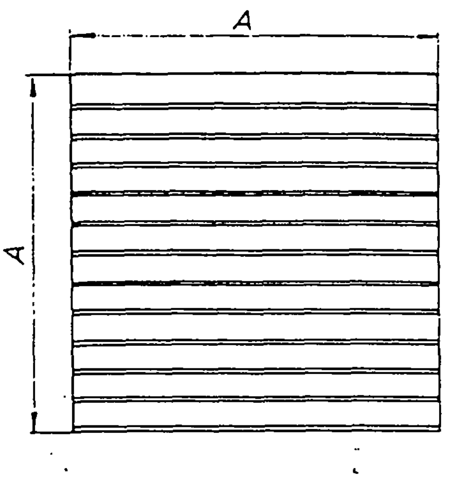
Factory Test and Inspection

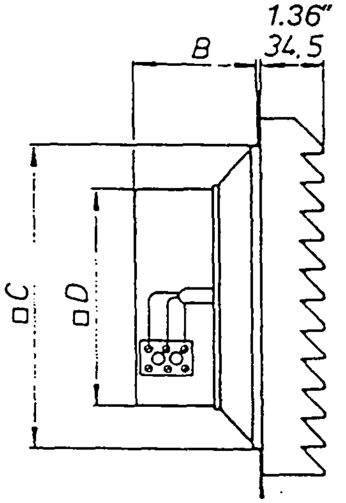
If the field test suggested earlier indicated that the CVS transformer itself may be faulty, a full report of the difficulty should be communicated to the place of purchase, with a request for permission for return. The Authorized Sola Distributor may then suggest further helpful field tests, or authorize return for inspection at once. A Return Authorization Number will be issued. **This number must appear on the outside of the shipping container** otherwise the shipment will not be accepted.

260-0023 FAN SK3168
260-0024 FILTER SK3163

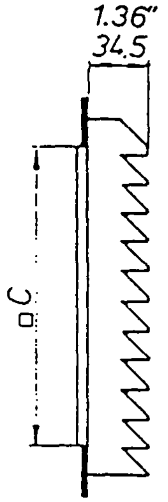
Technical Information at a Glance



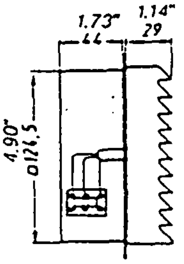




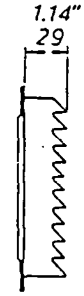
Filter Fan
SK 3151/52/53
SK 3166/67/68



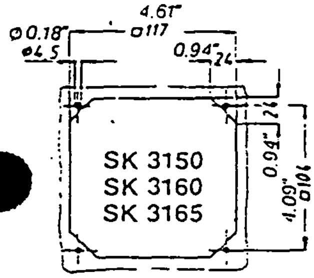
Outlet Filter
SK 3161/62/63



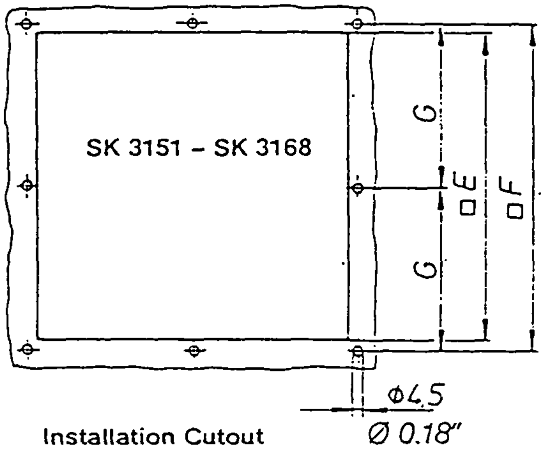
Filter Fan
SK 3150
SK 3165



Outlet
Filter
SK 3160



Installation Cutout



Installation Cutout

Filter Fans	3151/66	3152/67	3153/68
Outlet Filter	3161	3162	3163
A mm/in	204 /8.03"	255 /10.04"	323/12.72"
B mm/in	66 /2.60"	103.5/ 4.07"	140/ 5.51"
C mm/in	175 /6.89"	222 / 8.74"	290/11.42"
D mm/in	124.5/4.90"	160 / 6.30"	206/ 8.11"
E mm/in	176 /6.93"	223 / 8.78"	291/11.46"
F mm/in	185 /7.28"	234 / 9.21"	302/11.89"
G mm/in	–	117 / 4.61"	151/ 5.94"

Model No.	SK 3150	SK 3165	SK 3151	SK 3166	SK 3152	SK 3167	SK 3153	SK 3168
Axial fan with self-starting split pole motor							Axial fan with capacitor motor	
Operating voltage	220/230 V 50/60 Hz	110/115 V 50/60 Hz	220/230 V 50/60 Hz	110/115 V 50/60 Hz	220/230 V 50/60 Hz	110/115 V 50/60 Hz	220 V 50 Hz	115 V 60 Hz
Capacitance value							2 µF	8 µF
Current rating	0.11 A	0.24 A	0.11 A	0.24 A	0.225 A	0.6 A	0.27 A	0.6 A
Power	18 W	20 W	18 W	20 W	35 W	42 W	58 W	75 W
Noise level	48.5/49 dB (A)		47.5/48 dB (A)		49/49.5 dB (A)		64/69 dB (A)	
RPM	2650/3100 min^{-1}		2650/3100 min^{-1}		2850/3350 min^{-1}		2650/3000 min^{-1}	
Temperature range	-10 to +55 °C [+14 to +131 °F]		-10 to +55 °C [+14 to +131 °F]		-10 to +55 °C [+14 to +131 °F]		-10 to +55 °C [+14 to +131 °F]	
Air throughput: unimpeded airflow	48 m^3/h [28.3 ft^3/min]		103 (70) m^3/h [60.62 (41.20) ft^3/min]*		220 (130) m^3/h [129.5 (76.52) ft^3/min]*		500 (340) m^3/h [294.3 (200.1) ft^3/min]*	
With outlet filters	1 SK 3160, 35 m^3/h [20.60 ft^3/min] 2 SK 3160, 42 m^3/h [24.72 ft^3/min] 1 SK 3161, 42 m^3/h [24.72 ft^3/min]		1 SK 3161, 61 (48) m^3/h [35.90 (28.25) ft^3/min]* 2 SK 3160, 59 (47) m^3/h [34.73 (27.66) ft^3/min]* 2 SK 3161, 85 (62) m^3/h [50.03 (36.49) ft^3/min]* 1 SK 3162, 78 (58) m^3/h [45.91 (34.14) ft^3/min]*		1 SK 3162, 150 (105) m^3/h [88.29 (61.80) ft^3/min]* 2 SK 3161, 160 (110) m^3/h [94.17 (64.74) ft^3/min]* 2 SK 3162, 190 (120) m^3/h [111.8 (70.63) ft^3/min]* 1 SK 3163, 180 (118) m^3/h [105.9 (64.45) ft^3/min]*		1 SK 3163, 360 (285) m^3/h [211.9 (167.7) ft^3/min]* 2 SK 3162, 380 (285) m^3/h [223.7 (167.7) ft^3/min]* 2 SK 3163, 440 (320) m^3/h [259.0 (188.3) ft^3/min]*	
Special voltages available in	24 V DC 24 V AC 50/60 Hz 48 V AC 50/60 Hz		24 V DC 24 V AC 50/60 Hz 48 V AC 50/60 Hz		24 V AC 50/60 Hz		110 V AC 50 Hz 230 V AC 60 Hz	

* = Values in brackets ( ) apply when using fine filter

Field Replacement of Capacitors

Capacitors used in all CVS transformers are the highest commercial grade available. Each one is given a rigid acceptance test upon receipt. Nevertheless, as with all capacitors, there is a certain small percentage of failure. Sola's guarantee includes free replacement at the factory of any capacitor unit which fails within one year from date of purchase. Older units can be replaced at moderate charge.

Where competent technical help is available, it may be possible to test and identify defective capacitors in the field, and to make field replacement with new units shipped from the factory. In all such cases, factory advice and cooperation should be requested in advance. Sola cannot be responsible for repairs performed outside factory Authorized Service Centers.

APPENDIX N

RESUMES

Resumes of Key Personnel

Z. Lowell Taylor, Ph.D., P.E.
Chief Operating Officer

Experience

1988-Date

Chief Operating Officer for Williams Environmental Services, Inc. As such, he has been directly responsible for thermal treatment activities of the company. These activities include actual hands-on efforts in design and operation of the thermal treatment units used at two Superfund sites the company has been involved in. He has directly supervised remediation of and operation of two new units used to remediate petroleum-contaminated soils at Columbia, South Carolina, and Fort McClellan, Alabama, in addition to numerous other sites. He has managed the design and construction of a third unit which began operation at another Superfund site, the Letterkenny Munitions Depot in August 1991. Dr. Taylor was on site at the Prentiss, Mississippi, project to perform project and equipment evaluations; he proposed design modifications to be performed before the unit was employed on the Bog Creek Farm site. He was on site at the Bog Creek project approximately 50 percent of the time and directly involved with management of the project. He has been involved with several key field engineering modifications which were instrumental in successful completion of projects. Williams' operating centers include Remediation Services, Thermal Treatment, Groundwater Services, Laboratories, Engineering Services, and Industrial Hygiene Services. He manages approximately 125 employees located in four offices and three laboratories throughout Alabama and Georgia.

JIM WALTER RESOURCES, INC.
Birmingham, Alabama

1980-1987

Vice President. Responsible for operations, environmental affairs, engineering, and research and development for $150 million chemical, coke and fiber manufacturing operation. These facilities included five manufacturing plants, extensive utilities and power plant and waste treat-ment facilities. Major environmental projects included:

- Development and construction of wastewater facilities to treat 1 MGPD of complex coke and chemical waste.
- Design and permitting of waste incinerator for chemical waste.
- Development of RCRA-mandated investigation for five complex landfills and lagoons.
- Development of plans for handling coke facility hazardous waste.
- Development and implementation of environmental and technical feasibility program for incineration of coke oven fuels with cogeneration of steam and power for three 100,000 lb/hr boiler systems.

In this position Dr. Taylor was directly responsible for some 800 employees. The technical groups which conducted the R&D and environmental affairs were comprised of approximately 40 engineers and 30 chemists and industrial hygiene professionals.

FRIT INDUSTRIES, INC.
Ozark, Alabama

1976-1980

Vice President. Responsible for operations, environmental affairs, and engineering for the largest manufacturer of micronutrients in the United States. Operations included five chemical plants located in the Southeast and Midwest. Major environmental projects included:

- Design permitting and construction of facilities to utilize byproduct flue dusts from the metals industry in the manufacture of micronutrient products.
- Lagoon, soil and groundwater studies and corrective action plans for manufacturing site contaminated with heavy metals and nitrates.
- Closure of large chemical fertilizer facility located in the Midwest. The cleanup of nitrates, lead and cadmium was required.

HARMON ENGINEERING ASSOCIATES, INC.
Auburn, Alabama

1975-1976

Senior Vice President. Responsible for the management of all projects including proposal preparation, job costing, project scheduling, and report preparation. Supervised staff of 42 with approximately 17 professionals. Project load included environmental studies, testing and design. Major projects included:

- Development of environmental plan for large foundry operation to include air quality, runoff and wastewater evaluations. Design of total environmental systems was completed.
- Conducted large river basin study of Flint, Chattahoochee, and Apalachicola system. Identified all major industrial and municipal sources of wastewater pollution. Modeled system to show stream and system impacts.
- Developed wastewater treatment systems and designs for 16 industrial facilities ranging from small plating shops to major steel producers.

AUBURN UNIVERSITY
Auburn, Alabama

1970-1975

Professor and Head, Department of Engineering. Responsible for research and academic affairs of an accredited engineering program; consulting practice included the development of wastewater disposal alternatives for DuPont's facility at Holt, Alabama. Treatability studies for ethylene glycol and pesticide containing wastes, and evaluation of fluoride waste control system for aluminum smelting.

U.S. PIPE AND FOUNDRY COMPANY
Birmingham, Alabama

1969-1970

Director of Research. Directed technical effort for the Chemical Division. Responsible for development, technical services, quality control and environmental matters.

AUBURN UNIVERSITY
Auburn, Alabama

1966-1969

Assistant Professor, Department of Chemical Engineering.

U.S. MARINE CORPS
Camp LeJeune, North Carolina

1959-1962

1st Lieutenant.

Education

1959, B.S., Chemical Engineering
1963, M.S., Chemical Engineering
1966, Ph.D., Chemical Engineering

Mark A. Fleri
Project Development Manager

Experience

1988-Date

Project Development Manager. Reports to Vice President, with responsibility for design, installation, startup, and troubleshooting of mobile hazardous waste incinerator. Develops large-scale remediation projects. Activities include conceptual design, estimating, proposal preparation and presentation. Has managed more than forty projects, including incineration, waste stabilization, NPDES/SID permits, PCB remediation, and volume reduction.

1988-1989

Project Manager. Managed Emergency Response Division, with full responsibility for on-scene coordination, establishment of communication with and between federal and state agencies, supervision of site personnel, and monitoring disposal activities.

1987-1988

Project Engineer/Laboratory Manager. Responsible for daily operations of hazardous waste laboratory. Duties included operation of gas chromatograph/mass spectrophotometer unit, gas chromatograph, and other laboratory instruments. Managed and supervised equipment and supply procurement, laboratory analysis, and quality control program. Other duties included variety of wet chemistry methods in *Standard Methods for Water and Wastewater, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846), and *American Society for Testing and Materials* (ASTM) standards.

1986-1987

Part-Time Lab Technician. Responsible for operation of variety of laboratory instruments, including GC/MS system, GC, Atomic Absorption unit, Total Organic Carbon analyzer, pH/ISE meter, and spectrophotometer. Daily activities included preparation of standards, duplicates and spikes; preparation of reports; and guidance of other laboratory personnel.

Project Experience

Technician. PCB sampling of a vacant lot with abandoned capacitors for an international construction firm. Duties included site layout, sampling scheme, analysis of samples, chain-of-custody, quality assurance, quality control, and transportation of samples. Approximately two hundred samples were collected and analyzed by EPA Method 608 (40 CFR 136, Appendix A). The analytical results were used to design a remediation plan for this client.

Technician. Developed method to sample flare gas for a major chemical plant. The methodology involved the use of three impingers filled with varying amounts of methanol. The methanol was used to trap isopropanol, neopentyl glycol, ethylene glycol and epichlorohydrin. The analysis was performed by GC/MS.

Health and Safety Officer. Duties included site safety audits and personnel safety guidance for a U.S. Military Base. The job involved the demolition of a metal plating shop which included such hazards and cyanide, asbestos and heavy metals.

Project Manager. Job duties included the inventorying of 700 lab chemicals, the lab packing of more than 400 chemicals, the identification of 40 unknown chemicals by HazCat procedures, and the detonation of more than 100 pounds of reactive chemicals at a U.S. Military Installation.

Project Manager. A study was performed for a large tire manufacturer to give detailed information on the dissolved oxygen content and sludge depth of an industrial wastewater settling basin.

Project Manager. Job entailed the tracing of the phosphitizing and stripping processes to determine the causes of the high phosphate and pH excursions for a large athletic equipment manufacturer.

Project Manager. A study was conducted for a large wood processing facility to determine the causes of the phenolic excursions at the wastewater treatment facility. The study showed a process change would correct the phenol problem.

Project Manager. The job entailed the development of mercury decontamination procedures and development of a sampling/analytical protocol; the job also involved the application of these procedures and protocol. Asbestos abatement was also involved in the mercury decontamination.

Incinerator Design. Designed an incinerator to meet TSCA/RCRA standards. The design also included an economic feasibility study.

Job Superintendent. Supervised the inground cleaning of a deactivated 15,000-gallon oil tank for a large tire manufacturer.

Technician. Sampled and analyzed several hundred inactive transformers for PCBs at a U.S. Military Installation. Sampling was performed in accordance with ASTM Method D923-86 and the PCB analysis was performed in accordance with 40 CFR 136, Appendix A (Method 608).

Technician. Purged and sampled groundwater monitoring wells for permit compliance for miscellaneous groundwater division work.

Project Manager. A study was conducted for a large clothing service to determine the causes of its pH excursion. The wash process was traced and documented to determine the varying pH values during different wash cycles.

Project Engineer. A chemical spill involving the release of several thousand gallons of nonylphenol polyethylene glycol ether occurred at a major chemical manufacturing plant. The job involved the collection of raw material; the cleaning of the containment system; the collection of 100,000 gallons of contaminated groundwater; and the later release of the water into a municipal sewer system, and the supervising of the support laboratory.

M. Allen Tucker, Jr., P.E.

Manager, Thermal Treatment

Summary of Qualifications

Responsible for design and/or management of engineering projects in the areas of Incineration, Hazardous Waste, Asbestos, Plumbing and HVAC. Many of these projects involved aspects of other disciplines, such as Civil, Structural, Architectural and Electrical. Scope of these projects included collection of field data, design, and engineering inspection of work.

Representative Project Experience

Project Manager for the redesign of a $4 million transportable incineration system used to decontaminate solvent-contaminated soils at a Superfund site. The 32 million Btu/hour system incorporated the country's first application of an oxy-fuel burner system in a transportable incinerator. The unit processed soil at 20 tons per hour and met the 99.99% DRE and stringent 0.015 gr/dscf particulate emission limits.

Project Manager for the design and construction of a 15 ton/hour mobile thermal processing unit used to decontaminate soils at various locations.

Project Manager for the design and construction of a 25 ton/hour mobile thermal processing unit for hazardous and non-hazardous waste processing.

Project Manager for a 400-ton industrial chilled water HVAC system for the paper finishing area of a paper mill. Design included temperature and humidity control for the paper finishing process and architectural alterations to adapt the area for air conditioning.

Project Manager on numerous projects of a three-year open-end contract at Fort Benning, Georgia. Projects included replacement of HVAC systems in buildings, replacement of a commissary refrigeration system, energy conservation measures at Martin Army Hospital, construction of recreational cottages, etc.

Project Manager for additions/renovations of a public high school and elementary school (HVAC and plumbing only).

Project Manager for a cooling water system study for the basic oxygen furnaces at a steel mill. Made recommendations to extend the service life of water cooled panels subjected to direct furnace off-gas.

Project Engineer for the HVAC, plumbing, cost estimating, and fire protection design for a new hazardous waste storage facility for the U.S. Navy. Building included specialized warehouse spaces, office and laboratory spaces.

Project Engineer for the HVAC, plumbing, cost estimating and fire project design for a $1.1 million maintenance facility for the Army Corps of Engineers.

Project Engineer for the mechanical design of an industrial wastewater treatment system for a copper tubing manufacturer involving a new treatment building, pumps, piping, cooling tower, etc.

Education

1982, B.S., Agricultural Engineering
1983, B.S., Mechanical Engineering

Certifications

Registered Professional Engineer, Alabama No. 17611

Industry-Related Training

Supervision of Asbestos Abatement Projects, August 1985, Georgia Institute of Technology

Air Conditioning—Physical Processes and Load Calculations, September 1985, University of Wisconsin

Industrial Ventilation Conference, 1968, University of Alabama

Hazardous Waste Incineration, February 1989, Lamar University

Mark J. Johnson, P.G.
Manager, Groundwater Services

Experience

Mr. Johnson designs, implements and supervises sampling programs for sites which may have been adversely affected by hazardous wastes. He helps conduct groundwater investigations via computer modeling in order to determine hydrogeologic parameters and potential contaminant migration. He has also helped design groundwater remediation programs which are the most cost efficient and effective for specific sites. Specific projects include:

- **Project Geologist** for a preliminary site investigation of 27 potential CERCLA sites at Marshall Space Flight Center (MSFC). Duties included setting up and sampling 27 potential CERCLA sites at MSFC, technical writing, coordinating and overseeing drilling operations.
- **Project Geologist** for an emergency response of 1,1,1-trichloroethane (TCA) spill. Acted as on-site coordinator of drilling and monitoring well installation, setup and operation of pump and treat system (PAT); responsible for technical report writing. Sampled wells and analyzed data using computer-generated graphics.
- **Project Manager** for an assessment of several Chevron USA stations to determine potential hydrocarbon contamination of the soil and groundwater. Duties included job estimates, coordinating drilling operations, overseeing site operations, initial screening of samples with Hnu meter, technical report writing, and data analysis.
- **Project Geologist.** Performed well sampling, supervised drilling and installation of monitoring and test wells. Assisted in the computer analysis of pump test data. Helped design and build pilot scale carbon adsorption system for treatability of groundwater contaminated with phenolic compounds. Determined carbon contact times, isotherms and breakthrough points during operation of pilot scale adsorption system.
- **Project Manager.** Responsible for the estimates, site assessments, data analysis and technical writing for several Maxwell Air Force Base, Montgomery, Alabama sites which may have potential hydrocarbon contamination. These sites ranged from underground storage tanks to aviation refueling areas, and included soil and water sampling. Has also sampled soil and transformers for PCB contamination.
- **Geologist** responsible for Phase I and Phase II assessments to determine horizontal and vertical extent of woodtreating contaminants for a RCRA timber company. Duties included supervision and installation of piezometer and monitoring wells, point-of-compliance wells, well sampling, technical writing, and data analysis. Responsible for designing and implementing sampling and assessment plan. Wrote post-closure permit for RCRA waste impoundments.
- **Geologist.** Assisted in gridding and sampling PCB-contaminated soils for the Marine Corps Logistics Base, Albany, Georgia.
- **Project Geologist.** Responsible for setting up and implementing monitoring plan for lower aquifer for the Pleasure Island Sewer Service, Orange Beach, Alabama, in order to increase pumping rate of treated water to spray fields. Wrote technical paper to permit Pleasure Island Sewer Service to eliminate insignificant analytical parameters which were previously required by wastewater permit.

Education

1982, B.S., Geology
1988, M.S., Geology

Industry-Related Training

1988, 40-Hour Hazardous Materials Handling and Response

1988, Asbestos Worker Training Program, National Asbestos Council

Professional Affiliations

Alabama Academy of Science
Geological Society of America

Nathan D. Heinrich, P.G.

Groundwater Division Manager

Summary of Qualifications —

General job duties include supervision of eight employees and ongoing work at over 60 sites, with annual gross revenues of $11,000,000. Projects include preparation and implementation of work plans for preliminary groundwater assessments, corrective action plans, and site assessments; preparation of post-closure permit applications; interpretation of hydrologic and geologic data; groundwater modeling; and preparation of reports for submittal to state and federal agencies.

Related Project Experience —

- **Project Geologist.** Jointly conducted site investigations of 27 potential CERCLA sites on site in north Alabama. Investigations included over 1,150 locations sampled for potential hazardous waste, including solvents, fuels, heavy metals, PCBs, and cyanide. Supervised and conducted geophysics surveys (conductivity and magnetics) on three sites. Contract required coordination with NASA engineering and security.

  Project Manager. Conducted environmental assessments of closed and open gasoline stations. Responsibilities included subcontracting drilling services and cost estimates. Supervised borings along tank excavation to determine hydrocarbon contamination and installed monitoring wells when contamination extended to groundwater.
- **Project Geologist.** Responsible for the preliminary groundwater assessment. Prepared RFP for installation of wells. Assisted with installation of four wells with two nested piezometers each at a wood treatment facility.
- **Project Manager.** Responsible for preliminary groundwater assessment at former hot-dip galvanizing operation. Supervised soil borings and installation of monitoring wells. Prepared preliminary assessment report for submittal to Alabama Department of Environmental Management (ADEM). Prepared revised assessment plan to define soil and groundwater contamination plumes.
- **Project Manager.** Conducted groundwater assessment outlining contaminant plume at gasoline service station. Implemented free product recovery system which recovered approximately 900 gallons of product. Prepared, submitted, and implmented a corrective action plan and state indirect discharge permit for recovery of dissolved hydrocarbon product.
- **Project Geologist.** Conducted on-site work, including monitoring well installation, at site with volatile organic contaminants. Prepared detailed hydrogeologic study which identified inhomogeneities in the aquifer which affected groundwater flow. Ran computer models to identify locations of recovery wells.
- **Project Manager.** Coordinated and conducted environmental audits for various property transfer sites including: a former cotton mill in Alabama; a commercial/residential area in Florida; a former box plant; a car dealership; a former DOT site; and a former bottling plant in St. Croix, U.S. Virgin Islands. Audits focused on both soil/groundwater contamination and asbestos problems.
- **Project Geologist.** Prepared and submitted post-closure plan for wastewater treatment facility with PCB and cyanide contamination.
- **Project Geologist.** Prepared revision of post-closure permit for wood treating facility with creosote and pentachlorophenol contamination. Also prepared annual groundwater monitoring review for the facility.
- **Project Geologist.** Groundwater assessment for a confidential client. Conducted soil borings to define the extent of contamination in the upper aquifer. Contracted drillers and purchased supplies for installation of three compliance wells in two aquifers and five pump test wells.
- **Project Geologist.** Groundwater corrective action program for a confidential client. Responsible for writing CAP for submittal to ADEM. CAP included groundwater monitoring plan.
- **Project Manager.** PCB sampling at Gunter Air Force Base. Prepared estimates and coordinated sampling of transformers and soil. Responsible for client contact and reporting of analytical results.
- **Materials Coordinator.** Emergency groundwater remediation for a large manufacturing corporation. Responsible for obtaining equipment and materials for remediation system. Contacted local and national vendors for supplies.
- **Project Geologist.** Modification of lagoons and wastewater treatment system for a tubing manufacturer. Supervised installation of three pump wells for use in chromium reduction treatment plant. Conducted well development prior to completion of the treatment system. Prepared groundwater monitoring/effectiveness testing plans for treatment plant.
- **Project Geologist.** Post-closure permit application for NASA. Prepared closure/post-closure permit application for closure in-place of cyanide-contaminated lagoons. Compiled existing data and prepared groundwater monitoring plans.
- **Project Director.** Supervised project managers on over 30 projects conducted under open-end sampling and analysis blank Purchase Agreement for Maxwell Air Force Base, Alabama.
- **Project Director.** Supervised project managers and engineers during preparation of corrective action plans for four UST sites. Plans specified air strippers or diffused air tanks.

Education —

- B.S., Geology, 1981
- M.S., Geology, 1987

Industry-Related Training —

- AHERA Accreditation for Inspectors and Management Planners
- EPA Seminar, "Groundwater Monitoring at Hazardous Waste Sites"
- HES, "Hazardous Materials Handling and Response"
- AEG Short Course, "Geology and Site Characteristics of Hazardous Waste Sites"
- NWWA Short Course "Theory and Application of Vadose Zone Monitoring Techniques"

Professional Affiliations

- Geological Society of America
- NWWA

RÉSUMÉ

Name:	DENNIS R. MOBLEY, P.E.
Title:	PROJECT ENGINEER
Assignment:	CIVIL ENGINEERING
Name of Firm:	BENCHMARK ENGINEERING INC.
Education:	B.S. / 1975 / CIVIL ENGINEERING UNIVERSITY OF ALABAMA M.S. / 1993 / ENGINEERING
Years Experience:	WITH THIS FIRM (1) WITH OTHER FIRMS ( )
Active Registration:	REGISTERED PROFESSIONAL ENGINEER; ALABAMA

Mr. Mobley has a broad base of civil engineering experience and expertise. Prior to joining Benchmark, he worked for a major Southern utility holding company and a major international construction firm. His project assignments have included: Hydro Engineer on dam-related projects; various structural and design-related duties on a variety of projects; and environmental engineering.

Specific Project Experience Includes—

Project Engineer—Manufactured Gas Plant Investigation, Americus, Georgia. Scope of work for this project included review of the previously completed environmental site assessment for adequacy and completeness. These data were then used to develop a work plan and sampling and analysis management plan (SAMP) for a more detailed site investigation to determine more precisely the contaminants present at the site, level of contamination, and horizontal and vertical extent of the contamination. The information was also used evaluate possible remedial alternatives.

Project Engineer—SoGreen Site Remediation, Tifton, Georgia. This PRP-funded cleanup action involves the stabilization of approximately 56,000 cubic yards of electric arc furnace (EAF) dust which is contaminated with lead, nickel, chromium, cadmium, and arsenic. The selected remedial alternative included stabilization of the hazardous waste with Portland cement, subsequent delisting of the material, and disposal in a RCRA Subtitle "D" landfill. Mr. Mobley's efforts on the project included authoring of the Sampling Analysis and Quality Assurance Plan which detailed all of the QA/QC protocols for material stabilization. He also prepared the Mobilization/Demobilization, Utility Installation , and Sampling Handling and Documentation portions of the Remedial plan.

Project Engineer—UST Program Management and Implementation, North Alabama UST site. The scope of work for this project included the completion of Secondary Investigation activities. Mr. Mobley's duties included securing right-of-way for required monitoring wells, surveying of existing wells, supervision of monitor well installation, completion of boring logs, and collection of soil and groundwater samples. Collected samples were properly preserved in the field and prepared for shipment to the laboratory under strict chain of custody. Mr. Mobley reviewed data and prepared a complete report to the Alabama Department of Environmental Management (ADEM).

Structural Engineer—Advanced Solid Rocket Motor Project, Yellow Creek, Mississippi. Mr. Mobley completed the design of concrete rocket support mats for the main rocket test building. The MATS three-dimensional computer-aided drafting program was used to complete the design. Additional duties on this project included design of the main crane girder and crane column for the Auxiliary Building. He reevaluated the existing steel structure for its ability to support additional weight without the benefit of having the original calculations.

Structural Engineer—Gulf States Steel, Demopolis, Alabama. Mr. Mobley was responsible for completion of the structural calculations for construction of a three-story ClO_2 building and a two-story chiller building on this project. Design efforts included concrete and steel design using the STAAD 3 three-dimensional computer-aided drafting program. Mr. Mobley also supervised drafting of the construction drawings for the project.

Structural Engineer—Shell Oil, New Orleans, Louisiana. Mr. Mobley was responsible for completing design of pipe supports for a major renovation project. The renovation incorporated fiberglass pipe with special requirements. Site conditions precluded standardization of design. Shutdown forces, low soil strength, and tank settling were all factors which increased the difficulty of the design.

Hydro Engineer—Rocky Mountain Pumped Storage, Rome, Georgia. Mr. Mobley conceptualized and designed an innovative auxiliary spillway system for the lower reservoir at this facility. The client's initial conceptual design called for two spillways, one 250-foot-long concrete ogee and one 350-foot concrete ogee with a total cost of $6,000,000-$3,000,000. Mr. Mobley's alternative design reduced the overall project cost by approximately $2,000,000.

Project Manager—Alabama Power Hydroelectric Dam's Stability Analysis, State of Alabama. Mr. Mobley was responsible for scope, budget, manpower training, and drafting supervision for reanalysis of nine Alabama Power Dams. The purpose of the project was to incorporate new flood level requirements and replace lost stability analysis for normal and earthquake conditions. Twelve engineers and eight draftspersons were trained to complete the analysis. During the project, all existing drawings were converted to CAD. The project schedule provided for the completion of a separate report for each site with deadlines for reports spaced at one month intervals. All phases of the project were completed on time and within budget.

Senior Hydro Engineer—Hope Hydroelectric Project, Hope, Arkansas. Mr. Mobley completed the layout design and wrote the technical specifications for intake structure tailrace and one-mile-long tailrace canal as part of a Phase I feasibility study. His efforts included calculation of water flow velocity and water volume required to ensure correct hydraulic operation at the turbine. The work product was accepted for Phase II without comment by the U.S. Army Corps of Engineer.

Senior Hydro Engineer—Mitchell Dam Redevelopment. Project involved the addition of three units to an existing dam and hydroelectric generation facility. The additions required additional spillway capacity and modifications to the powerhouse and upstream and downstream retaining walls. Coffer cells were designed for the stage construction project. Mr. Mobley completed the hydraulic design of the D/S tailtrace.

Hydro Engineer—Crist Steam Plant. Mr. Mobley was responsible for design and preparation of the technical specifications for the installation of 2500 feet of 24 inch diameter drainage pipe at a staged dual location (fly and bottom ash) landfill site. Design required separation ditches segregate contaminated water from natural runoff. Inflow and outflow hydrographs for the site were calculated to aid in the design. The design was reviewed by Florida Department of Environmental Regulation (FDER) to ensure environmental compliance.

Hydro Engineer—R.L. Harris Hydroelectric Project. Mr. Mobley was responsible for plant layout and design of the concrete spillway, nonoverflow walls, intake structure, powerhouse, and downstream retaining walls. The project included considerations for the stability of each structure for construction, under normal operating conditions, earthquake conditions, and maximum flood conditions. The total length of the dam was 650 feet with a 150-foot height. Designed 70-foot-diameter upstream and 35-foot-diameter downstream coffer cells required for the two-stage construction at the site. Mr. Mobley supervised the drafting of all stability analyses and conceptual design drawings.

Hydro Engineer—Walter Bouldin Dam Redesign. Mr. Mobley was responsible for design of the intake structure required for an enlarged dam. Overall size of the structure was 260 by 200 feet. The trash rack were redesigned and flownets for sloping multimedia soils were required. Condition analysis included requirements for construction, normal operating, earthquake, and maximum flood.

APPENDIX O

RESPONSES TO USEPA REGION X

WILLIAMS ENVIRONMENTAL SERVICES, INC.

October 15, 1993

Ms. Lynda Priddy
Hazardous Waste Coordinator
U.S. Environmental Protection Agency Region X
1200 Sixth Avenue
Seattle, Washington 98101

Subject: Transmittal of Responses to USEPA Region X
July 20, 1993, Comment Letter on the
Draft Soil Treatment Work Plan
for the Woods Industries Site, Yakima, Washington

Dear Ms. Priddy:

In response to U.S. Environmental Protection Agency (USEPA) Region X's July 20, 1993, comments on the Draft Soil Treatment Work Plan, dated June18, 1993, Burlington Northern Railroad (BNRR), through Williams Environmental (Williams) and Burlington Environmental Inc. (BurlingtonEnvironmental), has prepared this letter and is in the process of revising the Draft Soil Treatment Work Plan.

On August 27, 1993 Cathy Massimino and Bob Kievit of EPA Region X visited the THAN site. A meeting was held on the same day between Mark Fieri, Brett Burgess, Z.L. Taylor (Williams Environmental Services), Bruce Sheppard (Burlington Northern Railroad) and Bob Kievit, Cathy Massimino and John Gilbert (EPA). The following comments and responses are the result of this meeting and later conversation with all parties.

RESPONSES TO USEPA REGION X COMMENTS

Comment No. 1

The work plan needs to include an ambient air monitoring program. Sample locations should include on-site, fence line, and downwind offsite areas predicted to contain maximum concentration of contaminants from the stack. The sampling program should include both time-integrated and real-time monitoring. The sampling program should specify equipment to be used, sampling and analytical procedures, the name(s) of the laboratory(s) conducting the analytical work, action levels,and QA/QC procedures. The plan should be comprehensive to start out and allow for scaling back upon demonstration of acceptable results.

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Response No. 1

A comprehensive air monitoring program prepared by Williams will be included as an appendix to the "Final" Soil Performance Test Work Plan and in the Health and Safety Plan. A "scaled back" monitoring program will be prepared upon demonstration of acceptable results. This "scaled back" version is expected to be implemented after the performance test with the EPA's approval. This will monitor a select number of indicator chemicals based upon previous monitoring results.

The air monitoring program will use sample locations derived from air modeling predicted to contain the maximum concentrations of contaminants resulting from the stack and fugitive dust generated from material handling and will monitor site-related contaminants of concern on a time-integrated and Real-Time basis. Action levels, sampling and analytical procedures, equipment specifications, and QA/QC procedures will also be described.

Identification of the laboratory conducting the analytical procedures will be submitted to the EPA as soon as the appropriate laboratory is selected.

Comment No. 2

A risk assessment needs to be performed based on predicted air emissions and the air modeling currently being conducted. This risk assessment should be updated with the results from the performance test and be included in the performance test report.

Response No. 2

A site specific Air Quality Impact Report is being performed based on predicted air emissions during normal operation and interim operation. This Air Quality Impact Report addresses the compounds listed on page 28 of the draft plan and the risk assessment will be updated if necessary with results from the performance test. Dioxins and furans are not a part of the Air Quality Impact Report, however, as requested by the EPA, dioxins and furans will be tested for in the off gases during the performance test. HCl, Cl and potential organic breakdown or reformation compounds will be addressed in the Air Quality Impact Report.

Comment No. 3

Please note that based on the current schedule the system should expect to operate in conditions beginning in dry 100°F heat and possibly ending in snowy conditions or subzero temperatures.

Response No. 3

Williams anticipates few problems as a result of weather conditions. Williams thermal unit is currently operating at the THAN site with temperatures exceeding 110°F. During cold weather, Williams will take necessary measures to assure that the thermal desorption unit is properly outfitted and winterized.

Comment No. 4

The work plan should discuss any anticipated impact on the surrounding community with respect to noise and odor.

Response No. 4

Regarding odor, Burlington Environmental and Williams do not expect odors above that which existed during soil excavation.

It has been determined through noise level dosimetry that the loudest recorded noise levels were the material handling equipment at the THAN site. The nearest residents located to the THAN property are located approximately one-quarter mile from the site and no complaints have been received about the thermal desorption unit operating twenty-four hours per day. The Woods site is located in an industrial area with the nearest residential area located approximately one-quarter of a mile away from the site.

Comment No. 5

The consent order between EPA and BN is an important document that should be included as an appendix to the final work plan.

Response No. 5

The consent order will be included as an appendix.

Comment No. 6

Section 2.1 The draft plan states that demobilization will proceed after the stockpiled soils have been treated and lab confirmation received that the treated soils meet the cleanup criteria. Please note that the existing stockpiles are situated over areas of contaminated soils that need to be excavated and treated after the piles are removed. Confirmational soil samples will need to be taken in the excavated areas to assure that all soils above cleanup levels are removed. In addition, soil samples will need to be taken in the areas used for treatment, stockpiling of soils, and along soil

hauling routes to assure that clean areas weren't contaminated during the treatment process. The schedule should allow for these activities.

Response No. 6

The soil treatment schedule will allow sufficient time for the necessary soil removal and sampling to occur prior to demobilization. Burlington Environmental will collect the necessary samples in accordance with protocol described in the soil removal work plan. Samples will be collected beneath existing stockpiles and areas where contaminated soils were transported over, stockpiled, or treated.

Comment No. 7

Section 2.2 The responsibilities of BEI should be discussed. The relationship between BEI and Williams needs to be clarified and discussed. The relationship between BEI and the Thermal Treatment Consultant needs to be clarified. This section needs to describe the role and authority of the EPA OSC. Will Williams personnel be responsible for transferring treated soils and oversized cobbles, for excavating contaminated soils from underneath the existing north and south stockpiles, for final site grading. This section should indicate who is responsible for sampling of treated soils, of contaminated soils underneath the existing stockpiles both during and after excavation, of final site sampling just prior to demobilization, and ambient air monitoring. How many shifts will be used? The plan should discuss transition procedures used in changing shifts.

The plan needs to state the name(s) of the laboratory(s) conducting analytical work prior to and during the performance test and during regular operations. The plan should also include detailed information on detection level, lab procedures, and lab QA/QC procedures. Who will subcontract with the labs?

Response No. 7

In reference to Section 2.2, responsibilities will be clarified and incorporated into the "final draft". Responsibilities of Burlington Environmental and Williams will be similar to that of Burlington Environmental and Olympus for soil removal activities. Burlington Environmental will provide oversight and Williams will be the Contractor. Burlington Environmental will have an on-site coordinator. Burlington Environmental will be responsible for weekly reports, reporting to the EPA and the Final Report. Burlington Environmental will also be responsible for emergency reporting. The Thermal Treatment Consultant, independent consultant, will be used for technical guidance and support during the performance test activities and will be subcontracted under Williams. Williams will be responsible for all material handling associated with soil treatment which includes excavating beneath existing stockpiles, backfilling and final site grading. Sampling of treated soils will be the responsibility of Williams and ambient air monitoring will be the responsibility of Burlington Environmental.

Sampling excavations beneath stockpiles and haul roads prior to demobilization will be the responsibility of Burlington Environmental.

Regarding work, Williams will most likely use three shifts. In some instances, shifts are dependent upon weather conditions. Williams will delineate shift transition procedures in the "final draft". Williams will supply its own qualified operators. However, Williams does use local labor from time to time.

Regarding laboratory selection and analytical procedures, Williams will provide this information as soon as it is available.

Comment No .8

Section 3.2 - In general more details are needed regarding soil handling and disposition of cobbles and debris mixed in with soils - i.e. metalbands, pipes, etc. This section says that material over approximately 3 to 4 inches will be considered oversized. What are the factors needed to determine whether it is 3 or 4 inches or something in between. EPA requests that the larger material be treated if the system can physically handle it - i.e. we prefer that 4 inches be the cut off as opposed to 3 inches.

When will oversized cobbles be crushed and analyzed? What procedures will be used to collect, crush and analyzed the cobble samples? How many samples will be taken? Add lead, arsenic, and mercury to the list of analytes for the crushed cobbles. The analytical results from the crushed cobbles should be compared to the treatment goals not the cleanup levels. Assuming that the results will be below the treatment goals, the section should describe how the cobbles will be handled from the screen to final disposition. Will soils from the existing stockpiles be taken directly to the treatment unit or will a secondary stockpile be placed closer to the treatment unit?

Response No. 8

Burlington Environmental is preparing a plan which describes the objectives and methods for characterizing oversized material. Thermal desorption requires a significant amount of material handling. A cutoff size will be established through experience in handling the on-site soils to determine which material will be screened out. Through experience at other sites Williams believes the cutoff size will be 3 inches or less. Through observations made during soil removal activities conducted at the site, BNRR and the USEPA are aware that the soil excavated and placed in the temporary soil storage piles contain approximately 35 to 45 percent "oversized material." This oversized material will not be treated by the thermal desorption process because it cannot be handled via the material handling equipment involved with the thermal desorption process.

As discussed in the Draft Feasibility Study, it is believed that contaminants adhere preferentially to finer particles (silts, clays and humic materials) and contamination of larger materials is related to the adhesion of finer particles to the exterior of larger ones. Observations made during soil removal activities at the site revealed that the exterior of the larger materials are relatively free of finer materials adhering to their surface.

To evaluate the disposition of the oversized material, BNRR proposes collecting and compositing material into a batch which will be screened to form samples of 2.0"+ and 3.0"+ material representing potential "cutoff sizes." These samples of potentially oversized material will be crushed and analyzed for several indicator chemicals.

The results of these analyses will be compared to the treatment goals established for the soils exiting the thermal desorption process which will be used as backfill on site. BNRR understands that oversized material which is below the treatment goals will be suitable to be used as backfill without additional treatment. Additional details will be included in the "final draft" of the work plan.

Debris will be handled similarly as in building demolition and soil removal. Contaminated debris will be disposed of at Chemical Waste Management's Arlington, Oregon, facility. Clean debris will be disposed of at a local sanitary landfill.

Williams anticipates hauling soils directly from the stockpiles to the treatment unit. Necessary precautions will be taken in the event that a "secondary stockpile" is needed.

In the event a secondary stockpile is required (because of increased production rates) control measures such as containment and additional covering of the piles will be added. Engineering controls will be used to prevent fugitive dust emissions where applicable, such as haul roads from stockpiles.

Comment No. 9

Section 3.3 - More details are needed regarding the transfer of baghouse dust to the treated soil pile, the dust control procedures used in the transfer, whether the discharge of baghouse dust is continuous or batch,

and the kind of mixing that occurs between treated soils and baghouse dust. Is the baghouse dust conveyor covered? Discuss dust control during the treated soil stacking. Where will the stacks be located? How long will they be stored?

Discuss backfilling procedures.

Discuss final site grading.

Are there any conditions under which hot gases from the dryer come in contact with the burner?

Response No. 9

The baghouse dust emissions are well controlled prior to mixing with the treated soils. These control measures include negative pressure on the cross over conveyor, transfer auger conveyor and discharge auger conveyor. The baghouse dust is mixed with the treated soils and is moisturized prior to being transferred to the stacking conveyor to prevent fugitive dust. Additional information will be provided in the "final draft". Both Bob Kievit and Cathy Massimino have seen the baghouse transfer auger and control system.

Backfilling procedures and final site grading will be incorporated in the "final draft". Treated soil will be used as backfill on-site. It is expected that final site conditions will be level in most areas and possibly slightly sloped in others. Details will be supplied in the soil treatment work plan.

Williams' unit has been designed to ensure that the burner does not come into contact with hot gases from the rotary dryer.

Comment No. 10

Section 3.4 - This section should discuss locations in the treatment train where hot gases from the dryer can bypass any portions of the air emissions treatment train and the conditions required for such a release. This discussion should include past performance history. How is the acidity of the gases from the dryer monitored?

How is the dissolved solids in the recirculating quench water monitored?

The activated carbon should be periodically sampled to assess the possibility to organic break through. The work plan proposes to re-heat the gas steam to about 150°F to prevent condensation in the carbon beds. According to the Calgon information in the Appendix, 150°F is the

maximum temperature for these systems. Also, it is generally accepted that the carbon efficiency decreases with increasing gas temperatures. Thus, there is a concern the carbon treatment will not be satisfactory for both the pesticides and total hydrocarbons. Lower gas temperatures to the carbon system would relieve this concern. Also see later comment on THC monitoring.

Response No. 10

The VO is designed such that air may only enter from the outside eliminating concerns of hot gases bypassing the air emissions treatment train. For example, the VO is triggered when the baghouse exceeds 510°F and quench gas temperature exceeds 200°F, thus allowing cool air to enter the thermal desorption unit and cool the baghouse and the remainder of the thermal treatment unit. This is done to protect equipment.

Presently the pH of the quench water is monitored manually during the normal operations of the unit. When the water becomes acidic (pH < 4) caustic soda (sodium hydroxide) is added to bring the pH up to approximately 8.

Solids are visually monitored in the quench and air mix chambers. Approximately 1 to 4 gpm of quench water is removed, settled, filtered and processed through activated carbon and then re-used within the thermal desorption unit.

Comment No. 11

Section 3.5 - What is the action level and detection level for effluent sampling from the liquid phase carbon adsorption unit?

The water in the filled collection tanks should be analyzed for metals as well as pesticides. What are the action levels for this water? This section indicates that this water may be used to cool and moisturize treated soils. Is any of this water anticipated to be used for dust control outside the treatment unit or for discharge to the local sewage treatment works? Can a rough mass balance be done on water generated versus water needs? Compare the estimated mass of organics to be collected in the scrubber to the design capacity of the carbon beds. This comparison should assume a worst case scenario of all organics in the air stream being removed in the scrubber system.

Response No. 11

Based upon past history, excess water is not expected from the process. Treated soils will be sampled after the addition of the treated quench water.

Williams does not expect nor intend to analyze metals if the water is to be used for dust suppression or reused as quench water in the thermal desorption unit. If Williams is to discharge treated water to the sanitary sewer system then Williams will analyze for the appropriate constituents and meet the discharge limits prior to discharge to the sewer system. Williams will prepare water mass balance calculations to be included into the "final draft" of the work plan.

Comment No. 12

Table 4-1 - The table indicates the prescreen sized opening is 2 1/2". How does this correlated to the approximately 3 to 4 inches sizing limit mentioned on page 16. The bar and mesh screen sizing are not indicated.

The table appears to indicate that the unit contains a backup I.D. fan. Is this correct?

How will the material be collected in the liquid bag filters be disposed?

Response No. 12

Williams' material handling systems are equipped with several screen sizes. The basis of final selection of screen size is described in response to Comment NO. 8.

There is no backup ID fan.

The liquid bag filters will be cleaned of solid material and re-used throughout the project. The final disposition of the bag filters will be with the used personal protection equipment and contaminated debris at Chemical Waste Management's Arlington, Oregon, facility.

Comment No. 13

Section 5.0 - Prior to running contaminated soils in the treatment unit during startup, uncontaminated soils from the site should first be run through the unit to assure that the unit is operating properly from a particulate control stand point (both stack emissions and fugitive dust).

OSC approval will be needed prior to running contaminated soils through the system.

The work plan should discuss disposition of treated soils generated during the start up period.

OSC approval will be needed to continue operating after completion of the performance test and applying any special conditions for continued operation.

Response No. 13

Williams anticipates to begin startup operations with clean soils. After a thorough shakedown of the unit including its control systems and demonstration of the proposed AWFSOs, the unit will begin production with the contaminated soils including pesticide contaminated soils in the roll-off boxes to ready the unit and crew for the upcoming performance test.

Soil will be treated in the same manner as soil from production operations. Williams recognizes that treating contaminated soils for both the performance test and normal operations will not commence without approval from the EPA's OSC.

Comment No. 14

Section 6.1 - Figure 6 was not included in the draft work plan.

The stated purpose of the vent opening is to allow ambient air to enter the treatment unit. Can hot gases from the dryer exist through this vent? If so, under what conditions and how often are those conditions met based on past performance of this unit?

This section should discuss the procedures used to return the unit to normal operating conditions after triggering the emergency control system. How often do events occur that will trigger VO and AWFSO based on past performance.

Response No. 14

Figure 6 will be included in the "final draft" of the work plan.

The VO was discussed in Response No. 10.

VO occurrences are not recorded due to the fact that they pose no threat of releasing air emissions.

Most AWFSO's do not result in upsets of the thermal process. The AWFSO's normally result in a "no feed" condition, once the AWFSO is terminated the feed is restored with no affect to the process. The operations manual, which will be part of the "final draft" of the work plan, includes startup and shutdown procedures.

Comment No. 15

Table 6-1 - Opacity and real time air monitoring should be added to this list.

The table indicates the operating set point for the mix chamber outlet is 130°F; however, page 18 indicates that this temperature is 140°F. The table indicates the operating set point for the quench camber outlet is 165°F; however, page 26 indicates that the set point is 130°F. This table indicates the typical range of total hydrocarbons in the stack is 20 to 75 ppm with a not to exceed value of 200 ppm. These values are high and are of concem to EPA. We need more information on the composition of these hydrocarbons.

Periodic monitoring of the stack gases should be conducted for pesticides and mercury.

Response No. 15

The discrepancies concerning the mix chamber and quench chamber no longer apply since the unit is configured with a thermal oxidizer.

Williams has provided real time stack gas monitoring with its' CEM system. The present CEM system has the capability of monitoring THC and CO. Opacity can be added to the capabilities of Williams' CEM unit. The type and specifications of the CEM will be included in the "final draft" of the work plan.

Williams' thermal desorption unit is not a BIF, therefore THC is not proposed as a parameter to be measured.

Real time air monitoring can be incorporated into the air monitoring plan as discussed in response to Comment No. 1.

Periodic monitoring of the stack gases is no longer applicable. The performance test will determine the efficiencies achieved by the thermal oxidizer.

Comment No. 16

Table 6.2 - This table indicates that the loss of the draft fan will trigger the vent opening. How does VO compensate for loss of the draft fan?

Response No. 16

A vent opening does not occur when the I.D. fan drops out.

Comment No. 17

Section 6.1.3 - This section mentions auxiliary fuel to the rotary dryer burner. Does the burner have more than one source of fuel?

Response No. 17

The auxiliary fuel mentioned in Section 6.1.3 is the same as primary fuel, which is propane.

Comment No. 18

Section 6.1.6 - This section says that a high THC concentration in the stack is an indication of carbon break through. These measurement should be supplemented by periodic sample and analysis of the carbon. How is the THC concentration in the stack monitored?

Response No. 18

This comment no longer applies.

Comment No. 19

Section 6.1.7 - This section says that interruption of water flow to the quench chamber will trigger certain events including shutting down the ID fan. Where will the hot gases go if the ID fan is shut down.

Response No. 19

The interruption of water flow to the quench chamber will result in a vent opening and an AWFSO and not a shut down of the I.D. fan.

When the I.D. fan shuts down, both burners cease operation and the feed is cut off. The fans wind down at approximately the same rate. From past experience, steam from the primary will escape from the unit until the I.D. fan is restored.

Comment No. 20

How does Section 6.1.7 relate to Section 6.1.8?

Response No. 20

Section 6.1.7 describes the procedures taken when an alarm condition is satisfied. Section 6.1.8 describes procedures taken to prevent the alarm condition described in Section 6.1.7.

Comment No. 21

Section 6.1.9 - What is the established limit for pressure differential across the liquid phase carbon bed? If the liquid carbon system is shutdown for cleaning, what is the effect on the overall treatment system?

Response No. 21

Maximum design differential pressure for the aqueous phase carbon bed is 12 p.s.i. The aqueous treatment unit is designed to include two carbon beds in parallel to prevent the shutdown of the overall treatment system during backflow operations to clean an individual carbon unit.

Comment No. 22

Section 6.1.14 - What effects will occur if the combustion air fan fails? How is operation of the fan monitored?

This section should describe the orderly shut down of the system in the event of a power failure.

Response No. 22

In the event that the combustion fan fails a AWFSO will result.

All motors are monitored through an ammeter.

In the event of a power failure, all processes and operations terminate.

Comment No. 23

Section 7.1 - Air emissions performance standards are not addressed at all by the draft work plan.

Response No. 23

Williams plans to include applicable air emission performance standards in the "final draft" of the work plan.

Comment No. 24

Section 7.2.1 - This section indicates that although all 15 chemicals of concern will be analyzed during the performance test, only hexachlorobenzene and DDT will be analyzed during remaining operations. A decision to reduce the number of analytes should be based on the results of the performance test - i.e. all 15 chemicals should be analyzed until the results of the performance test are available. Analysis of treated soils and stack gases during the performance test should also include the full range of volatile and semi-volatile compounds including dioxins and furans. The detection levels for stackgases should be low enough to evaluate potential impact on human health.

Response No. 24

Treated soils will be analyzed for the 15 chemicals of concern listed in section 7.2.1 of the draft work plan during the performance test and until a decision has been made by BNRR and the EPA to reduce the number of parameters.

Stack gases will be analyzed for the 15 chemicals of concern except for mercury, arsenic, and lead - See Response to John Gilbert's Comment #1. And stack gases will also be analyzed for selected volatile and semi-volatile compounds including dioxins and furans during the performance test. Details will be presented in the "final draft" of the work plan.

Comment No. 25

Section 8.1 - The sampling program is not sufficient for the start of operations. One composite sample should be taken per shift consisting of one grab sample per hour. If these results show consistently good performance, then the sampling program may be scaled back.

This section should include more details concerning sample collection, compositing procedures and QA/QC requirements.

Table 8-1 was not included in the draft work plan.

Response No. 25

A more detailed sampling plan for treated soil will be included in the "final draft" of the work plan which includes sampling during the performance test. The sampling plan during production operations will require sampling of the day piles at a frequency of one (1) grab sample every six hours or eighty tons. The four

(4)grab samples will then be composited at the end of each day. It is anticipated that sampling will later be scaled back based upon good results.

Sampling procedures and QA/QC requirements will be described in the "final draft" of the work plan. Table 8-1 will be included in the "final draft" of the work plan.

Comment No. 26

Section 8.2 - Treated soil samples should be analyzed for all 15 chemicals of concern at least until the results of the performance test are available.

Response No. 26

Please refer to Response No. 24.

Comment No. 27

Section 9.0 - Please clarify the areas to be included in the exclusion zone. Does the exclusion zone contain only the rotary dryer or the entire treatment train? If only the dryer, then why? The untreated stockpile is said to be part of the exclusion zone. Does this include the existing north and south stockpiles or just a working stockpile to be established near the treatment system. Will haul roads be included in the exclusion zone? Where will the treated stockpiles be located? Figure 11-1 does not adequately define the exclusion zone.

Response No. 27

The "final draft" of the work plan shall include the boundaries of the exclusion zone. The exclusion zone will include the waste feed stockpile, the associated haul roads, and the rotary dryer and baghouse.

Comment No. 28

Section 11.1 - The boundaries of the exclusion zone are not clear.

Response No. 28

Please refer to Response No. 27.

Comment No. 29

Section 11.3.4 - The final disposition of the spent carbon needs to be discussed both liquid and gases. As the spent carbon will contain all the contamination removed from the site, EPA needs to be assured that it will be properly treated. Disposition of the carbon needs to comply with EPA's off-site policy.

Response No. 29

Aqueous phase carbon is anticipated to be regenerated by WestStates Carbon in Parker, Arizona.

Comment No. 30

Section 11.4 - The unit should be started up with clean soils. EPA approval will be needed prior to running contaminated soils through the unit.

Response No. 30

Please refer to Response No. 13.

Comment No. 31

Section 11.5 - After all stockpiled soils are treated, soil samples will need to be taken in areas used for treatment, for stockpiling and for hauling to assure that the treatment process did not cause soil contamination above the cleanup standards.

Response No. 31

Please refer to Response No. 6.

Comment No. 32

Appropriate insurance information needs to be submitted to EPA as required by Section 15.1 of the Consent Order.

Response No. 32

Insurance information will be included in the "final draft" of the work plan.

Comment No. 33

Who is responsible for weekly reporting and emergency reporting to EPA and for preparation of the final report?

Response No. 33

Burlington Environmental will be responsible for weekly reporting, emergency reporting to EPA, and will also be responsible for the preparation of the final report.

Comment No. 34

The work plan should include discussion of final site grading.

Response No. 34

Please refer to Response No. 9.

John M. Gilbert's Comments

Comment No. 1

Section 1.1, page 6 - What is the plan for testing metals in the stackgas? The introduction discusses metals in the soil, but nothing about monitoring during the demonstration burn.

Response No. 1

Mercury, arsenic and lead were present in some locations above cleanup levels.

During the RI, mercury was detected at some locations in the lagoon area above cleanup levels. The mercury will be treated by Williams' thermal desorption process. A Tier I analysis has been performed and no exceedance for mercury has been observed, therefore, mercury will not be monitored in the stack gas during the performance test. Lead and arsenic were only detected in a few locations above their respective cleanup levels across the site during the RI, and lead and arsenic impacted soils excavated during soil removal were placed in roll off boxes to be disposed of or treated by a different technology. In addition, a Tier I analysis has been performed for lead and arsenic and no exceedance has been observed. For these reasons, lead and arsenic are not on the parameter list for stack gas testing during the performance test.

Comment No. 2

Section 3.2, page 16 - Any oversized material that is not debris should be crushed and fed into the desorber, not considered as backfill. If this statement only pertains to debris, I have no problem with it.

Response No. 2

Please refer to Response No. 8.

Comment No. 3

Section 3.3, page 17 - The actual soil gas exit temperature will be established as a result of the demonstration burn.

Response No. 3

Williams concurs with the above comment.

Comment No. 4

Section 3.3, page 17 - Fugitive emissions can occur as a result of steam being emitted from the stacking conveyor. Williams will have to control all fugitive emissions.

Response No. 4

The necessary engineering controls (such as negative pressure in the discharge auger and the proper amount of water being added to the soil prior to being discharged) will be practiced to control fugitive dust emissions. The effects of these controls will be documented during the performance test for clean soil.

Comment No. 5

Section 6.1, page 24 - The plan needs to discuss the relation to vent openings (VO) and automatic waste feed shutoff (AWFSO).

Response No. 5

The "final draft" of the work plan will include a description of events triggering a VO and/or AWFSO.

Comment No. 6

Section 6.1, tables 6-1 & 6-2 - No discussion on a AWSFO for CO, feed rate, or quench pH.

Response No. 6

Williams proposes a 100 ppmv limit for CO based on a 60 minute rolling average. The feed rate AWFSO will be determined during the performance test. The quench pH AWFSO will be determined during the performance test.

Comment No. 7

Section 6.1.6, page 26 - The plan indicates a THC concentration greater than 200 ppm, which is too high. The desorber's THC analyzer conditions the sample prior to being analyzed. Method 25 requires an unconditioned sample.

Response No. 7

Williams will use 40 CFR Subpart O guidelines to conduct the performance test. No provisions are made to analyze for THC.

Method 25A results were compared with the conditioned sample results from the CEM during the performance test at THAN. The results were consistent enough that Region IV EPA allowed the use of the cold FID analyzer used in the CEM system for the remainder of the project.

Comment No. 8

Section 6.1.9, page 26 - What is the limit for the pressure differential? How will the pressure differential be equated to changing out the carbon?

Response No. 8

This comment no longer applies.

Comment No. 9

Section 8, page 30 - How often will the AWFSO's be demonstrated during production operations?

Response No. 9

This demonstration is expected to take place prior to the performance test and once per month thereafter.

Comment No. 10

The performance test plan needs to be submitted as soon as possible.

Response No. 10

This comment is true. Williams is currently preparing the equipment specifications for the new thermal treatment unit to be operating at the Woods Industries Site. The heat and mass balances are also being prepared.

Catherine Massimino's Comments

Comment No. 1

I recommend that agency approval of the final work plan, including the Appendices B through E, be required to be issued prior to allowing mobilization of the thermal desorption unit.

Response No. 1

This comment is true.

Comment No. 2

It is not clear whether Appendices C and D will address performing a site specific risk assessment. A site specific risk assessment should be performed addressing the target compounds listed on page 28, dioxins and furans, potential organic breakdown or reformation compounds as a result of the treatment process, HCl, and Cl. This risk assessment should also address the effects of vent stack openings. The detailed procedures/ modeling to be followed to perform the risk assessment on the expected emissions from the incinerator for the performance test and the full production operation need to be provided.

Response No. 2

Please refer to Response No. 2 of Bob Kievit's Comment No. 2.

Comment No. 3

A history of this thermal desorption system (e.g. include desorption unit and air pollution control system) with respect to Automatic Waste Feed Shutoff's (AWFSO's) and vent stack openings needs to be provided. This information should include the following:

Number of AWFSO's and Vent Stack Opening events during all phases of previous operation (i.e. shakedown, performance test, interim operation, and full production).

Events broken down by causes (e.g. - of AWFSO due to power failures, loss of water to quench, etc.).

Corrective actions (e.g. changes to operating procedures or design) taken to eliminate the event.

Long-term corrective actions taken to reduce or eliminate future occurrences of the event.

The work plan should include an evaluation of the potential for incorporation of additional/revised operational procedures and redundancies to the thermal desorption system to minimize the probability of AWFSOs and vent openings (e.g. use of heat exchanger prior to baghouse).

Response No. 3

This comment has been addressed in previous responses. The Williams' unit is being re-configured for thermal oxidation of the off-gases. The unit being proposed for the site is being reconfigured specifically for this project, therefore no history exists for AWFSO and vent openings. The work plan will incorporate an operations manual which will include procedures for corrective actions, and long term corrective actions to reduce or eliminate future occurrences of the unwanted event. The evaluation of the potential for additional procedures and redundancies will also be incorporated into the operations manual.

Comment No. 4

The soil needs additional characterization to enable a more useful heat and energy balance to be performed. This additional characterization needs to include the following: ash content; total chlorine; and heating value.

The mass balance calculations must include a breakdown of the inputs to the system into their elemental components (i.e., C, E, O, N, Cl, inerts, etc.). Streams coming out of the system must also be further broken down to include acid gases and particulates.

- **It needs to be identified whether the soil is likely to present any special feeding problems (e.g. abundant large rocks requiring crushing equipment, substantial fines content resulting in excessive particulate orvery sticky when wet, etc.).**

Response No. 4

The majority of this comment refers to incineration as opposed to thermal desorption (i.e. ash content). Heating value is not of concern with the pesticide concentrations present in the impacted soils.

The mass balance will be provided for the process flow diagram in the revised work plan.

Potential feeding problems are discussed in Response No. 8 of Bob Kievit's comments.

Comment No. 5

The scaled engineering drawings and piping and instrumentation diagrams for the system must be provided. Also, the ID Fan curves should be provided.

Response No. 5

A PI & D diagram and general equipment layouts have been provided in the work plan. A I.D. fan curve will be included in the "final draft" of the work plan.

Comment No. 6

Should include design analysis of the projected efficiency of each individual component of the air pollution control system (APC) and the combined efficiency of all the components of the APC for the constituents of concern (e.g. metals, acid gases, particulate, etc.).

Response No. 6

The maximum efficiencies for metal removals for APC equipment as provided in Table III-8 entitled "Air Pollution Control Devices (APCDs) and Their Conservatively Estimated Efficiencies for Controlling Toxic Metals". The removal efficiency for HCl is estimated at 99% removal.

The particulate loading at the THAN site was determined to be less than <0.05 gr/dscf.

Comment No. 7

A contingency plan needs to be prepared which addresses the elements specified under 40 CFR 264 Subpart G.

In addition the contingency plan must include notifying the Agency of the use of AWFSO's and vent opening events during operations when the soil is in the thermal desorption units or gases from the soils are in the thermal desorption system (including APC), including length of time of event, cause of event, and corrective taken.

The contingency plan must also included a requirement to obtain Agency approval prior to resuming soil feed after use of automatic waste feed cutoffs of greater than once within any operating calendar day and after any vent opening. This requirement would be applicable during all phases of the operation.

Response No. 7

Williams believes that 40 CFR 264 Subpart G - Closure and Post Closure does not apply to Williams' work at the site.

AWFSO's and vent openings should not require reporting to the Agency unless fugitive emissions result. Williams also believes that ceasing operations because of more than one AWFSO or vent opening in one calendar day is burdensome and is not requisite for all AWFSO's and vent openings.

Williams requests a list of EPA contacts and numbers that are available 24 hours a day and a procedure to begin operations when no EPA contact can be reached.

As part of standard operating procedures, Williams records all downtime events and causes on "Round Sheets." The log book in the Control Room documents the corrective actions taken to repair the failure and prevent future occurrences.

It is also Williams' policy to institute AWFSO's or vent openings that prevent fugitive emissions and equipment damage. Therefore when an AWFSO event occurs it does not necessarily represent a permit exceedance.

Comment No. 8

A limitation of operating hours for noisy feed preparation activities (e.g. crushing) should be proposed.

Response No. 8

This comment was addressed in Bob Kievit's Comment No. 4. Crushing is not expected to be necessary.

Comment No. 9

Since the contaminants contained in the soil to be processed in the thermal desorption system are very similar to those found in EPA Waste K, U, and P codes (i.e. 40 CFR Part 261) the performance standards which would be applied to the application here. I recommend the following standards be applied to the stack emissions from the unit: Destruction and Removal Efficiency of 99.99% (the mechanism applied here will be primarily removal); Particulate emission of greater than 0.015 grains per dry standard cubic foot after correction to a stack gas concentration of 7% oxygen; Metal emissions not to exceed the levels specified in 40 CFR Section 266.106; A maximum of 4 lbs/hr HCl emissions or 99% control efficiency which would not exceed the levels specified in 40 CFR Section 266.107.

A free chlorine level which does not exceed the levels specified in 40 CFR Section 266.107; A total hydrocarbon limit (THC) which would not exceed 20 ppmv based on a hourly rolling average basis reported as propane, and continuously corrected to 7 percent oxygen, dry gas basis; A dioxin and furan emission limits of 30 mg/dscm based on the sum of the tetra through octa-dioxin and furan congeners; and site specific risk assessment indicating emission levels areacceptable.

Response No. 9

The technology that is currently being proposed for treating the soils at the site includes a rotary dryer, an afterburner, and an air pollution control system. The applicable performance standards are described in 40 CFR Subpart O. These include:

a. Destruction and removal efficiency of 99.99% for principal organic hazardous constituents (POHCs);

b. Particulate emission of no greater than 0.08 grains per dry standard cubic foot after correction to a stack gas concentration of 7% oxygen;

c. A maximum of 4 lbs/hr HCl emissions or 99% control efficiency;

d. Continuous monitoring for carbon monoxide in the stack gas. Williams proposed that maintaining CO emissions below 100 ppm_v on a one (1) hour rolling average is a relevant and appropriate requirement;

e. Developing acceptable operating limits for the parameters listed in 40 CFR 264.345. Specific parameters and operational limits will be proposed in a performance test plan.

Several of the standards proposed in the EPA comment letter are not applicable, including:

c. Metals emissions not to exceed the levels specified in 40 CFR 266.106.

d. HCl emissions not to exceed the levels specified in 40 CFR Section 266.107. The thermal desorption system is not a boiler or industrial furnace, therefore, this regulation is not applicable.

e. A free chlorine level which does not exceed the levels specified in 40 CFR Section 266.107. The thermal desorption system is not a boiler or industrial furnace, therefore, this regulation is not applicable.

f. A total hydrocarbon limit (THC) which would not exceed 20 ppm_v based on an hourly rolling average reported as propane. The thermal desorption system is not a boiler or industrial furnace, therefore, this regulation is not applicable. The thermal desorption system will demonstrate compliance with a 100 ppm_v CO standard (one (1) hour rolling average, corrected to 7% oxygen). Demonstration of compliance with the THC standard is applicable under the BIF regulations only if compliance with the CO standard is not attained.

g. A dioxins and furan emission limits of 30 mg/dscm (note: probably meant ng/dscm) based on the sum of the tetra through octa-dioxin and furan congeners.

Williams proposes to operate the thermal desorption system under temperature conditions which are not conducive to the formation of dioxins and furans. These conditions include:

- Thermal desorbed soil discharge temperature greater than 750°F.
- Baghouse inlet gas temperature of less than 450°F.
- Afterburner exit gas temperature of greater than 1800°F.
- Rapid quench of baghouse exit gas to the adiabatic saturation temperature (less than 180°F).

h. Site specific risk assessment indicating emission levels are acceptable. This requirement is from the proposed EPA Draft Combustion Strategy which is not currently a regulation.

Comment No. 10

The operation of the thermal desorption unit and the baghouse within the 450 - 750°F temperature range is not desirable as it increases the potential for dioxin and furan formation. An evaluation of the system to eliminate its operation within this range should be performed.

Response No. 10

The temperature of the gas going to the baghouse will be below 450°F. The temperature of the soil discharge from the thermal desorber will be above 750°F.

Comment No. 11

The specifications (e.g. range, accuracy, precision, etc.) for the process monitoring equipment (e.g. Table 6-1 parameters) including the THC monitors needs to be provided. The THC monitors must meet the specifications in Part 266 Appendix IX, Section 2.0, Performance Specifications for Continuous Emission Monitoring Systems. Specific information needs to be also provided on method and equipment to be used to record data (i.e. strip chart speed, including a copy of an example chart, printout frequency for computer logged data, hard disk capacity, etc.). Detailed calibration procedures and frequency must be provided for all the process monitoring equipment.

Response No. 11

Williams' CEM system can meet the specifications of Part 266 Appendix IX for CO and O_2. THC is not included in this 40 CFR citing performance specification. When the appropriate data logger is selected, the specification will be incorporated into the work plan.

Comment No. 12

Amend Table 6-1 to include the following as parameters which are continuously monitored and recorded: quench water minimum pH and maximum total solids parameter for thermal desorption unit solids residence time, thermal desorption unit oxygen level, baghouse inlet temperature high, indicator of vent opening, gas flow rate high, add a THC monitor at stack exit (versus between carbon beds) and soil wastefeed rate. Also the vapor phase carbon differential pressure should be continuously monitored and recorded.

Response No. 12

Williams proposes to continuously monitor and record quench water pH soil feed rate and baghouse inlet temperature. There is no direct method to continuously monitor retention time in the thermal desorber. The best measure of retention time is analytical results of the treated soil.

A vent stack opening is associated with an event (alarm) that triggers the vent to open. When the alarm is logged on the chart paper the vent opening has been triggered. During the performance test process conditions are established for future production operations. If the process conditions are met (i.e. feed rate, thermal oxidizer temperature and minimum O_2 concentration in the thermal oxidizer) then the gas flow rate will be approximately the same. Therefore, Williams does not propose to continuously monitor stack gas flow rate.

Again, it is Williams' position that the thermal oxidizer is not a Boiler/Industrial Furnace and therefore monitoring THC is not an appropriate ARAR.

Vapor phase carbon differential pressure is no longer applicable.

Comment No. 13

Table 6-2, should add the following AWFSO's: soil feed rate high, quench water pH, specific gravity, and nozzle pressure, THC at stack exit at 20 ppm$_v$ or above (see comment 9e, above), thermal desorption unit solids

residence time, baghouse DP, thermal desorption unit at a positive pressure for any length of time, low oxygen level in thermal desorption unit, and vapor phase carbon DP.

For all items on Table 6-2 that result in a VO evaluate the use of time delays to assume that unnecessary openings do not occur. Evaluate the installation of another vent just prior to the carbon unit versus opening the vent after the thermal desorption unit bypassing any particulate or acid gas control when the carbon unit inlet gas high is the cause of the VO.

Also, explicitly state on Table 6-2 that whenever there is a VO the soil feed will be shut off.

The control should be re-configured, if necessary, to clearly indicate in the continuously operating record whether soil is being fed.

Whenever soil feed is interrupted the operator must maintain the units operating parameters within their required ranges.

The pressure within the rotary dryer on this table and page 25 should be corrected to a negative number.

Response No. 13

Williams will provide an AWFSO for soil feed rate high, low quench water pH, baghouse DP flow, dryer pressure and low oxygen level in the thermal oxidizer. These AWFSO will be set during the performance test.

Specific quality of the quench water is not a parameter that is easily measured on-line or very useful for thermal treatment operations, therefore Williams is not proposing an AWFSO for this parameter.

Nozzle pressure for the quench chamber does not require an AWFSO because other parameters are monitored to prevent unbalanced conditions in the quench, such as quench exit gas temperature. Therefore, Williams is not proposing an AWFSO for this parameter.

THC has been addressed in other comments.

Vapor phase carbon DP is no longer applicable.

Williams will incorporate the time delay recommendation as appropriate for the items in Table 6-2. Table 6-2 will also state that when a vent opening occurs, feed is stopped.

Soil feed rate is monitored and recorded continuously.

When soil feed is interrupted it is Williams' standard operating procedure to operate the thermal desorption unit within the required control parameters.

The rotary dryer vacuum is monitored continuously. When the vacuum reaches "0.00" an AWFSO results.

Comment No. 14

Page 30, Section 8.2 the treated soil should also be analyzed for the appropriate TCLP parameters (e.g. mercury, arsenic, etc.).

Response No. 14

TCLP testing is not necessary to characterize the treated or untreated soils because TCLP testing was performed on several contaminated samples as part of the RI to evaluate disposal or treatment options. The results of all TCLP analyses show that the soils are not RCRA characteristic hazardous waste because none of the samples failed the TCLP test. This is described in detail in section 4.5.3 of the Final RI Report.

Comment No. 15

Page 38, increase the time interval for operation at 700°F to at least twice the normal solids residence time in the unit.

Response No. 15

Residence time adjustments, if any, will be dependent upon performance test results.

Comment No. 16

Page 43, provide details of the perimeter air monitoring system (e.g. parameters, equipment, exact locations, data interpretation, sampling and analysis frequency, etc.).

Response No. 16

This comment will be addressed from Bob Kievit's Comment No. 1.

Please let me know if you need assistance interpreting any of these responses.

Sincerely yours,

WILLIAMS ENVIRONMENTAL SERVICES, INC.

Mark A. Fleri
Project Manager

MAF/cd/RESPONSE.

cc Z. Lowell Taylor - Williams Environmental Services
Bruce Sheppard - Burlington Northern Railroad
David Eagleton - Burlington Environmental
Tom Hippe - Burlington Environmental
Bob Kievit - EPA
Tom Backer - Preston Thorgrimson
General File
Job File

APPENDIX P

CONSENT ORDER

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EPA--REGION 10

APR 07 1993

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION 10

EPA - WOO

IN THE MATTER OF:

WOODS INDUSTRIES SITE

Burlington Northern Railroad,

Proceeding Under Sections 106(a) and 122 of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, 42 U.S.C. §§9606(a) and 9622

ADMINISTRATIVE ORDER ON CONSENT FOR REMOVAL RESPONSE ACTIVITIES

U.S. EPA Region 10
CERCLA
Docket No. 1087-03-18-106

I. JURISDICTION AND GENERAL PROVISIONS

1.1 This Order is issued pursuant to the authority vested in the President of the United States by sections 106(a) and 122 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. §§ 9606(a) and 9622, as amended ("CERCLA"), and delegated to the Administrator of the United States Environmental Protection Agency ("EPA") by Executive Order No. 12580, January 23, 1987, 52 Federal Register 2923, and further delegated to the EPA Regional Administrators and the EPA Assistant Administrator for Solid Waste and Emergency Response by EPA Delegation Nos. 14-14-A and 14-14-B. This authority is conferred on the EPA Region 10 Chief, Superfund Response and Investigations

Branch by Regional Redelegation Order signed by the Regional Administrator.

1.2 This Administrative Order on Consent (Order) is entered into voluntarily by the EPA and, Respondent Burlington Northern Railroad Company ("BNR") and its receivers, trustees, successors and assigns. This Order provides for the performance of removal actions by Respondent and the reimbursement of response costs incurred by the United States in connection with the property located at 1 East King Street in Yakima, Washington, and known as the "Woods Industries Site". This Order requires the Respondent to conduct removal actions described herein to abate an imminent and substantial endangerment to the public health, welfare or the environment that may be presented by the actual or threatened release of hazardous substances at or from the Woods Industries Site.

1.3 EPA has notified the State of Washington of this action pursuant to section 106(a) of CERCLA, 42 U.S.C. § 9606(a).

1.4 Respondent's participation in this Order shall not constitute or be construed as an admission of liability or of EPA's findings or determinations contained in this Order except in a proceeding to enforce the terms of this Order. Respondent agrees to comply with and be bound by the terms of this Order. Respondent further agrees that it will not contest the basis or validity of this Order or its terms.

II. PARTIES BOUND

2.1 This Order applies to and is binding upon EPA, and upon Respondent and its directors, officers, employees, agents, receivers, trustees, successors and assigns. Any change in ownership or corporate status of Respondent including, but not limited to, any transfer of assets or real or personal property shall in no way alter Respondent's responsibilities under this Order.

2.2 Respondent shall ensure that its contractors, subcontractors, and representatives receive a copy of this Order and comply with this Order. Respondent shall be responsible for any noncompliance by such persons.

III. FINDINGS OF FACT

3.1 The Woods Industries facility (hereinafter the "Woods site," "site" or "facility"), is a facility as defined in Section 101(9) of CERCLA, 42 U.S.C. § 9109(9), and a former pesticide formulation and distribution operation located in the city of Yakima, Washington. The site is the areal extent of contamination that consists of approximately four (4) acres of land, located at 1 East King Street in Yakima, Washington. The site is located within the city limits of Yakima, Washington, in a commercial and industrial area.

3.2 Burlington Northern Railroad Company is a Delaware corporation authorized to do business in the state of Washington. BNR's principal offices are located in Fort Worth, Texas. The mailing address of BNR for purposes of this order is:

Bruce Sheppard
Manager, Environmental Engineering
Burlington Northern Railroad Company
2200 First Interstate Center
999 Third Avenue
Seattle, WA. 98104-1105

3.3 BNR is the land owner of the site. Several individuals and corporations used the site for pesticide formulation and related operations from at least 1945 until at least 1985 under leases from BNR and its predecessors. Site operators have included, among others, Crop King Co., Richey & Gilbert Co., Akland Irrigation Co., Inc. and their respective officers and directors. Between approximately 1980 and May 1985, Woods Industries, Incorporated (hereinafter "Woods") occupied the site and operated a pesticide business on property leased from BNR.

3.4 In May 1985, the lease between BNR and Woods expired and was not renewed. Woods no longer occupies the site. No current operation is present at the site. BNR now controls the site.

3.5 A wide variety of hazardous substances, including arsenic, aldrin, strychnine, lindane, carbamates, and DDT, were used in the pesticide formulation process on the site. Site inspections and assessments conducted by EPA in October and November of 1985, revealed that a number of drums and chemical containers were present on the site. The inspections and assessments revealed chemical contamination in the soils at the site.

3.6 Pursuant to an Administrative Order on Consent for Immediate Response and Stabilization Activities issued by EPA and dated December 6, 1985 (Order No. 1085-10-02-106), BNR was ordered to perform several actions, including: restricting access to the property, securing pools or solid spills within the buildings of the property, securing drums and bottled chemicals on the property to prevent release of their contents, and securing the entrances and lower windows of buildings on the property.

3.7 In addition to these actions, the order required BNR to: analyze the on-site groundwater well and provide to EPA information on the casing, screening and depth of that well; further investigate the extent of hazardous substance contamination of soils, groundwater, and surface waters at the facility; and investigate pathways for contamination migration.

3.8 The above-mentioned actions were undertaken with the knowledge that more extensive response actions would be required to address the significant and varied environmental hazards at this facility.

3.9 BNR contracted with Morrison-Knudsen Engineers, Incorporated (hereinafter "MKE") to implement the actions required by the December 6, 1985 Consent Order. MKE conducted site characterization studies from July through October 1987 covering air, surface water, soil, and shallow groundwater investigations. The findings and conclusions from those studies are contained in the following documents which have been reviewed and accepted by EPA: 1) a Preliminary Site Characterization Report prepared by MKE and dated March 1987; 2) a letter addressed to Jeff Webb of EPA, dated March 28, 1988; 3) a letter addressed to Jeff Webb, EPA, dated July 6, 1987; and 4) quarterly groundwater monitoring data.

3.10 Pursuant to an Amended Order on Consent dated June 28, 1990, for a Remedial Investigation and Feasibility Study, BNR completed a Remedial Investigation, which was approved by EPA on Sept. 16, 1992.

3.11 The Remedial Investigation found visible evidence of chemical contamination inside the Woods buildings including dry powder above ceiling panels in the basement and stained areas on the floors and walls. Bags containing asbestos material were located in one of the buildings. The buildings were generally in a dilapidated condition.

3.12 Pursuant to an Administrative Order on Consent for Removal Response Activities issued by EPA and dated January 4, 1993 (Order No. 1087-03-18-106), BNR was ordered to demolish and dispose of buildings formerly used for pesticides formulation and to dispose of miscellaneous debris on the site. Building demolition and disposal was completed in February 1993.

3.13 The Remedial Investigation revealed extensive contamination of the surface and subsurface soils at the site. The hazardous substances of greatest concern in the soils are pesticides including DDT and Dieldrin, hexachlorobenzene, lead, mercury, and arsenic. The main sources of this contamination appears to be past waste disposal units including a sump, a washdown area, and a series of lagoons. Most of the contamination on site appears to be located in soils in and around these units. The contamination around these units extends from the surface to the watertable. The maximum concentrations detected in soils within these units are: DDT-30,000 ppm; Dieldrin-200 ppm; hexachlorobenzene- 23,000 ppm; lead- 143,800 ppm; mercury-88.5 ppm; and arsenic-543 ppm. The Remedial Investigation indicates that concentrations of contaminants outside of these areas is much lower and the contamination doesn't extend lower than 2 to 3 feet below the surface.

3.14 The Remedial Investigation found that groundwater under the site is contaminated with many of the same chemicals found in the soils including DDT, Dieldrin, and hexachlorobenzene. The highest concentrations of chemicals found in groundwater on site are: DDT- 77 ppb; Dieldrin- 16 ppb; and hexachlorobenzene- 11 ppb. Highest concentrations of contaminants were found in the upper portion of the aquifer in the area of greatest soil contamination. Concentrations of contaminants in the ground water decreases with depth.

3.15 The Remedial Investigation found that the depth to groundwater under the site varies seasonally by 5 to 8 feet in response to irrigation in the Yakima Valley. The groundwater table is lowest in late winter/early spring and rises rapidly with the onset of irrigation. The groundwater table reaches its maximum elevation in late summer/early fall. In late summer, the Remedial Investigation found high levels of contamination in soils just above the groundwater table, which represent the deepest soil samples taken to date. Soil contamination is suspected to be present below the seasonal high groundwater table. It is likely that groundwater is being contaminated each year as the groundwater table rises into soils containing elevated concentrations of hazardous substances.

3.16 Conditions presently exist at the site that may present an imminent and substantial endangerment to public health or welfare or the environment.

3.17 The conditions at the site meet the criteria for a removal action as stated in the National Contingency Plan, 40 C.F.R. Section 300.415 as follows:

A. High levels of hazardous substances or pollutants or contaminants in soil at or near the surface that may migrate - Surface soils sampled in the lagoon, sump, and washdown areas contain high concentrations of DDT, Dieldrin, Hexachlorobenzene, and other hazardous substances, which may migrate off-site through wind blown dusts and soils. The concentrations of some chemicals exceed the State of Washington cleanup standards for soils in industrial areas. For example the highest concentration of DDT in soil is 1,000 times the state cleanup standard. There are two businesses directly adjacent to the site.

B. Actual or potential exposure to nearby human population, animals, or the food chain from hazardous substances or pollutants or contaminants - Although the property is fenced and site access is restricted, there is a threat of trespassers coming into direct contact with contaminated soils. There is also a threat of contaminated soils migrating offsite through wind blown dust and soils. Many of the pesticides found on-site are known or suspected carcinogens and could pose a cancer risk.

Many of the pesticides found on-site are also known to cause nervous system disorders and liver diseases.

C. Actual or potential contamination of drinking water supplies or sensitive ecosystems - The pollutants overlie a local drinking water aquifer. Concentrations of Endrin in monitoring wells on-site are above the MCL. Concentrations of Hexachlorobenzene are above the proposed non-zero MCLG. Concentrations of pesticides which have no established MCL or MCLG such as DDT and Dieldrin exceeds state promulgated groundwater cleanup standards.

3.18 DDT is a chlorinated organic pesticide, which together with its metabolites DDD and DDE, is very persistant in the environment. DDT, DDD, and DDE are probable human carcinogens. Exposure to DDT can also result in adverse impacts to the central nervous system including excitability, tremors, and seizures.

3.19 Dieldrin is resistant to biodegradation and abiotic degradation and therefore can accumulate in the environment. Dieldrin is a probable human carcinogen. In high doses, Dieldrin is a neurotoxin that affects the central nervous system and can produce tremors, convulsions, coma, and even death. Short-term exposure can result in symptoms such as headaches, dizziness, irritability, loss of appetite, and convulsions.

3.20 Hexachlorobenzene is a probable carcinogen. Long-term exposure can result in hepatic toxicity, kidney effects, immune system abnormalities, and neurological effects.

IV. CONCLUSIONS OF LAW AND DETERMINATIONS

4.1 Based on the Findings of Fact set forth above, and the Administrative Record supporting these removal actions, EPA determines that:

(A) The Woods Industries Site is a "facility" as defined by section 101(9) of CERCLA, 42 U.S.C. § 9601(9).

(B) Each substance identified in the Findings of Fact above is a "hazardous substance" as defined by section 101(14) of CERCLA, 42 U.S.C. § 9601(14).

(C) The Respondent is a "person" as defined by section 101(21) of CERCLA, 42 U.S.C. § 9601(21).

4.2 Respondent is liable under section 107(a) of CERCLA, 42 U.S.C. § 9607(a) as the "owner" of the facility, as defined by section 101(20) of CERCLA, 42 U.S.C. § 9601(20), and within the meaning of section 107(a)(1) of CERCLA, 42 U.S.C. § 9607(a)(1).

4.3 The conditions described in the Findings of Fact above constitute an actual or threatened "release" into the "environment" as defined by sections 101(8) and (22) of CERCLA, 42 U.S.C. §§ 9601(8) and (22).

4.4 The conditions present at the facility constitute a threat to public health, welfare, or the environment based upon the factors set forth in the National Oil and Hazardous substances Pollution Contingency Plan (NCP), 40 C.F.R. § 300.415(b)(2).

4.5 The actual or threatened release of hazardous substances from the Site may present an imminent and substantial endangerment to the public health, welfare, or the environment within the meaning of section 106(a) of CERCLA, 42 U.S.C. §

9606(a).

4.6 The removal actions required by this Order are necessary to protect the public health, welfare, or the environment, and are not inconsistent with the NCP and CERCLA.

V. ORDER

5.1 Based upon the foregoing Findings of Fact, Conclusions of Law, Determinations, and the Administrative Record for this Site, it is hereby ordered and agreed that Respondent shall comply with the following provisions, including but not limited to all attachments, all documents incorporated by reference, and all schedules and deadlines attached to, or incorporated by reference into this Order, and perform the following actions:

5.2 Designation of Contractor, Project Coordinator, and On-Scene Coordinator. Respondent shall perform the work itself or retain a contractor(s) to implement this removal action. Respondent shall notify EPA of Respondent's qualifications or the name(s) and qualification(s) of such contractor(s) within five (5) days of the effective date of this Order. Respondent shall also notify EPA of the name(s) and qualification(s) of any other contractor(s) or subcontractor(s) retained to perform work under this Order at least five (5) days prior to commencement of such work. EPA retains the right to disapprove of any, or all, of the contractors and/or subcontractors retained by the Respondent. If EPA disapproves of a contractor selected by the Respondent, Respondent shall retain a different contractor within five (5) days following EPA's disapproval and shall notify EPA of that contractor's name and qualifications within five (5) days of EPA's disapproval.

5.3 Within five (5) days after the effective date of this Order, the Respondent shall designate a Project Coordinator who shall be responsible for administration of all the Respondent's actions required by the Order. Respondent shall submit the designated coordinator's name, address, telephone number, and qualifications to EPA. To the greatest extent possible, the Project Coordinator shall be present on site or readily available during site work. EPA retains the right to disapprove of any Project Coordinator named by the Respondent. If EPA disapproves of a selected Project Coordinator, Respondent shall retain a different Project Coordinator and shall notify EPA of that person's name and qualifications within five (5) days following EPA's disapproval. Receipt by Respondent's Project Coordinator of any notice or communication from EPA relating to this Order shall constitute receipt by Respondent.

5.4 The EPA has designated Bob Kievit of Region 10 as its On-Scene Coordinator (OSC). Respondent shall direct all submissions required by this Order to the OSC at:

United States Environmental Protection
Agency, Region 10
Washington Operations Office
C/O Washington Department Of Ecology
P.O. Box 47600
Olympia, Washington 98604-7600

EPA and Respondent shall have the right to change their designated OSC or Project Coordinator. EPA shall notify the Respondent, and Respondent shall notify EPA, five (5) days before such a change is made. The initial notification may be orally made but it shall be promptly followed by a written notice. (See Section VI - Authority of the EPA On-scene Coordinator).

5.5 Work to Be Performed. Pursuant to Section 106(a) of CERCLA, 42 U.S.C., Part 9606(a), as amended, Respondent shall conduct all removal activities in accordance with the requirements of this order. The removal action shall include the excavation and treatment of contaminated soils. Because of the immediate need to excavate soils prior to the next seasonal rise of the groundwater table (estimated to begin in early spring) and because of the long lead time needed to develop adequate work plans for soil treatment and to procure an appropriate soil treatment vendor, the removal will proceed in two phases. The first phase will include excavation and temporary storage of all soils on site that contain hazardous substances greater than the cleanup standards established for the site. The first phase shall be conducted in accordance with the Work Plan in Attachment A and in the Schedule of Deliverables in Attachment B, which are attached and incorporated in this Consent Order.

The second phase of the removal will include thermal treatment of all soils excavated in Phase I in accordance with the treatment standards established for the site. The second phase shall be conducted in accordance with the Schedule of Deliverables (Attachment B) and with the Scope of Work and the Work Plan that will be developed under and will be incorporated into this order when approved by EPA.

All such removal activities shall be conducted in accordance with CERCLA, the NCP, and EPA guidance.

5.6 <u>Work Plan and Implementation</u>. The Respondent has submitted to EPA an approved Final Work Plan (Attachment A) for the excavation and temporary storage of contaminated soils. The Work Plan provides a description of, and an expeditious schedule for, the activities required by Phase 1 of this Order. Within thirty (30) days after the effective date of this Order, the Respondent shall submit to EPA for approval a draft Scope of Work for conducting thermal treatment on the soils excavated in Phase 1. The draft Scope of Work shall provide a description, and expeditious schedule for the activities required by Phase 2 of this Order.

5.7 EPA may approve, disapprove, require revisions to, or modify the draft Scope of Work or Work Plan submitted for Phase 2. If EPA requires revisions, respondent shall submit a revised draft Scope of Work or Work Plan which is responsive to EPA comments within thirty (30) days of receipt of EPA's notification of the required revisions. Failure to do so will be considered violation of this order. Respondent shall implement the Scope of Work for Phase 2 and Work Plans for Phase 1 and 2 as finally approved in writing by EPA in accordance with the schedule approved by EPA. The approved Work Plans and Schedule shall be fully enforceable under this Order. Respondent shall notify EPA in writing at least 48 hours prior to performing any on-site work pursuant to an EPA-approved Work Plan. Respondent shall not commence or undertake any removal actions at the Site without prior EPA approval.

5.8 Health and Safety Plan. Ten (10) days before Respondent commences any removal action, or with the approval of the OSC if less then 10 days, the Respondent shall submit for EPA review and comment a plan that ensures the protection of the public health and safety during performance of on-site work under this Order. This plan shall be prepared in accordance with EPA's Standard Operating Safety Guide, dated November 1984, and updated July 1988. The plan shall comply with applicable Occupational Safety and Health Administration (OSHA) regulations found at 29 C.F.R. Part 1910, dated March 6, 1989. In addition, the plan shall also comply with all applicable Washington Industrial Safety and Health Act (WISHA) regulations found at WAC Chapter § 296-62. If EPA determines that it is appropriate, the plan shall also include contingency planning. Respondent shall incorporate all changes to the plan recommended by EPA, and implement the plan during the removal action.

5.9 Quality Assurance and Sampling. All sampling and analyses performed pursuant to this Order shall conform to EPA direction, approval, and guidance regarding sampling, quality assurance/quality control (QA/QC), data validation, and chain of custody procedures. Respondent shall ensure that the laboratory used to perform the analyses participates in a QA/QC program that complies with the appropriate EPA guidance. Respondent shall follow the following documents as appropriate as guidance for QA/QC and sampling: "Quality Assurance/Quality Control Guidance for Removal Activities: Sampling QA/QC Plan and Data Validation Procedures," OSWER Directive Number 9360.4-01; "Environmental

Response Team Standard Operating Procedures," OSWER Directive Numbers 9360.4-02 through 9360.4-08; and the representative Sampling Guidance for soil, air, ecology, waste, and water as this information becomes finalized and available.

5.10 Upon request by EPA, Respondent shall have the laboratory analyze samples submitted by EPA for quality-assurance monitoring. Respondent shall provide to EPA the quality assurance/quality control procedures followed by all sampling teams and laboratories performing data collection and/or analysis.

5.11 Upon request by EPA, Respondent shall allow EPA or its authorized representatives to take split and/or duplicate samples of any samples collected by Respondent while performing work under this Order. Respondent shall notify EPA not less than five (5) days in advance of any sample collection activity, or with the approval of the OSC if less than five (5) days. EPA shall have the right to take any additional samples that it deems necessary.

5.12 Respondent shall submit to EPA the results of all sampling or tests and all other data generated by Respondent or its contractor(s), or on the Respondent's behalf during implementation of this Order. This information shall be submitted to EPA, as it becomes available, in the written progress reports and shall be summarized in the final report submitted pursuant to paragraph 5.16.

5.13 <u>Post-Removal Site Control</u>. To the extent practicable, Respondent shall provide for post-removal site control consistent with the NCP, 40 C.F.R. § 300.415(k) and OSWER Directive 9360.2-02. Respondent shall provide EPA with documentation indicating that these post-removal site control arrangements have been made with the local/state governments.

5.14 Reporting. Respondent shall submit a written progress report to EPA concerning activities undertaken pursuant to this Order every seven (7) days after the date of receipt of EPA's approval of the Work Plan until termination of this Order, unless otherwise directed by the OSC. These reports shall describe all significant developments during the preceding period, including the work performed and any problems encountered, analytical data received during the reporting period, and the developments anticipated during the next reporting period, including a schedule of work to be performed, anticipated problems, and planned resolutions of past or anticipated problems.

5.15 Respondent and any Successor(s) in title shall, at least 30 days prior to the conveyance of any interest in real property at the site, give written notice of this Order to the transferee and written notice to EPA and the State of the proposed conveyance, including the name and address of the transferee. The party conveying such an interest shall require that the transferee comply with Paragraph 5.17 - Access to Property and Information.

5.16 Final Report. Within thirty (30) days after completion of the removal action required under this Order, the Respondent shall submit for EPA review and approval a final report summarizing the actions taken to comply with this Order. The final report shall conform, at a minimum, with the requirements set forth in the NCP, 40 C.F.R. § 300.165 entitled "OSC Reports". The final report shall include a good faith estimate of total costs or statement of actual costs incurred in complying with the Order, a listing of quantities and types of materials removed, a discussion of removal and disposal options considered for those materials, a listing of the ultimate destination of those materials, a presentation of the analytical results of all sampling and analyses performed, and accompanying appendices containing all available relevant documentation generated during the removal action (e.g., manifests, invoices, bills, contracts, and permits). All relevant documentation not available when the final report is submitted shall be submitted to EPA as soon as it becomes available. The final report shall also include the following certification signed by a person who supervised or directed the preparation of that report:

> Under penalty of law, I certify that based on personal knowledge and appropriate inquiries of all relevant persons involved in the preparation of the report, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

5.17 <u>Access to Property and Information</u>. Respondent shall provide and/or obtain access to the Site and appropriate off-site areas, and provide access to all records and documentation related to the conditions at the Site and the activities conducted pursuant to this Order. Such access shall be provided to EPA employees, contractors, agents, consultants, designees, representatives, and State of Washington representatives. These individuals shall be permitted to move freely at the Site and appropriate off-site areas in order to conduct activities which EPA determines to be necessary. Respondent shall submit to EPA the results of all sampling or tests and all other data generated by Respondent or its contractor(s), or on the Respondent's behalf during implementation of this Order.

5.18 Where work under this Order is to be performed in areas owned by or in possession of someone other than Respondent, Respondent shall use its best efforts to obtain all necessary access agreements within thirty (30) days after the effective date of this Order, or as otherwise specified in writing by the OSC. Respondent shall immediately notify EPA if after using its best efforts it is unable to obtain such agreements. Respondent shall describe in writing its efforts to obtain access. EPA may then assist Respondent in gaining access, to the extent necessary to effectuate the response activities described herein, using such means as EPA deems appropriate.

5.19 Record Retention, Documentation, Availability of Information. Respondent shall preserve all documents and information relating to work performed under this Order, or relating to the hazardous substances found on or released from the Site, for at least ten years following completion of the removal actions required by this Order. At the end of this ten year period and 30 days before any document or information is destroyed, Respondent shall notify EPA that such documents and information are available to EPA for inspection, and upon request, shall provide the originals or copies of such documents and information to EPA.

In addition, Respondent shall provide documents and information retained under this section at any time before expiration of the ten year period at the written request of EPA.

5.20 Respondent may assert a business confidentiality claim pursuant to 40 C.F.R. § 2.203(b) with respect to part or all of any information submitted to EPA pursuant to this Order, provided such claim is allowed by section 104(e)(7) of CERCLA, 42 U.S.C. § 9604(e)(7). Analytical and other data specified in section 104(e)(7)(F) of CERCLA shall not be claimed as confidential by the Respondent. EPA shall only disclose information covered by a business confidentiality claim to the extent permitted by, and by means of the procedures set forth at, 40 C.F.R. Part 2, Subpart B. If no such claim accompanies the information when it is received by EPA, EPA may make it available to the public without further notice to Respondent.

5.21 Respondent shall maintain a running log of privileged documents on a document-by-document basis, containing the date, author(s), addressee(s), subject, the privilege or grounds claimed (e.g., attorney work product, attorney-client), and the factual basis for assertion of the privilege. Respondent shall keep the "privilege log" on file and available for inspection. EPA may at any time challenge claims of privilege through negotiations or otherwise as provided by law or the Federal Rules of Civil Procedure.

5.22 Off-Site Shipments. All hazardous substances, pollutants or contaminants removed off-site pursuant to this Order for treatment, storage or disposal shall be treated, stored, or disposed of at a facility in compliance, as determined by EPA, with the EPA Revised "Off-Site Policy," OSWER Directive Number 9834.11, November 13, 1987. (see 42 U.S.C. § 9621(d)(3).)

5.23 Compliance With Other Laws. All actions required pursuant to this Order shall be performed in accordance with all applicable local, state, and federal laws and regulations except as provided in CERCLA section 121(e) and 40 C.F.R. section 300.415(i). In accordance with 40 C.F.R. section 300.415(i), all on-site actions required pursuant to this Order shall, to the extent practicable, as determined by EPA, considering the exigencies of the situation, attain applicable or relevant and appropriate requirements (ARARs) under federal environmental, state environmental, or facility siting laws ("The Superfund Removal Procedure for Consideration of ARARs for Removal Actions," OSWER Directive No. 9360.3-02, August 1991).

5.24 Emergency Response and Notification of Releases. If any incident, or change in site conditions, during the activities conducted pursuant to this Order causes or threatens to cause an additional release of hazardous substances from the Site or an endangerment to the public health, welfare, or the environment, the Respondent shall immediately take all appropriate action to prevent, abate or minimize such release, or endangerment caused or threatened by the release. Respondent shall also immediately notify the OSC at (206) 753-9014 or, in the event of his/her unavailability, shall notify the Regional Duty Officer at (206) 553-1263 of the incident or site conditions.

5.25 In addition, in the event of an actual release of a hazardous substance, Respondent shall immediately notify the National Response Center at telephone number (800) 424-8802. Respondent shall submit a written report to EPA within seven (7) days after each release, setting forth the events that occurred and the measures taken or to be taken to mitigate any release or endangerment caused or threatened by the release and to prevent the reoccurrence of such a release. This reporting requirement is in addition to, not in lieu of, reporting under CERCLA section 103(c) and section 304 of the Emergency Planning and Community Right-To-Know Act of 1986, 42 U.S.C. sections 11001 et seq.

VI. AUTHORITY OF THE EPA ON-SCENE COORDINATOR

6.1 The OSC shall be responsible for overseeing the proper and complete implementation of this Order. The OSC shall have the authority vested in an OSC by the NCP, including the authority to halt, conduct, or direct any work required by this Order, or to direct any other response action undertaken by EPA or Respondent at the Site. Absence of the OSC from the Site shall not be cause for stoppage of work unless specifically directed by the OSC.

EPA and Respondent shall have the right to change their designated OSC or Project Coordinator. EPA shall notify the Respondent, and Respondent shall notify EPA five (5) days before such a change is made. Notification may initially be made orally, but shall be followed promptly by written notice.

VII. REIMBURSEMENT OF COSTS

7.1 Respondent shall reimburse EPA for all past response costs and response costs incurred by the United States in overseeing Respondent's implementation of the requirements of this Order. After the end of each federal fiscal year in which Respondent performs work under the original Administrative Consent Order executed on October 11, 1988, the Amended Administrative Consent Order executed on June 28, 1990, the Administrative Order on Consent for Removal Response Activities executed on January 4, 1993, and under this Order, EPA will submit to Respondent a detailed accounting of all costs, incurred by and/or billed to the United States after the effective date of the original Consent Order in connection with response, oversight, and community relations, costs and activities conducted by the United States government and its contractors and representatives with respect to the implementation of the original Administrative Consent Order, the Amended Administrative Consent Order, and this Order.

7.2 Respondent shall, within (60) days of receipt of the bill, remit a cashier's check, certified check, or corporate check for the amount of those costs made payable to the "Hazardous Substance Superfund" with a copy of such transaction sent to the EPA Project/On-Scene Coordinator. Remittances shall addressed to:

U.S. Environmental Protection Agency Region 10
Superfund Accounting
P.O. Box 360903M
Pittsburgh, Pennsylvania 15251.

Respondent shall simultaneously transmit a copy of the check to EPA.

Regional Hearing Clerk
Office of Regional Counsel
U.S. E.P.A. Region 10, SO-125
1200 Sixth Avenue
Seattle, Washington 98101

Payments shall be designated as Oversight and/or Past Response Costs and shall reference the payor's name and address, the EPA site identification number (*WAD027583525*), and the docket number of this Order.

7.3 Interest at the rate established under section 107(a) of CERCLA, 42 U.S.C. § 9607(a), shall begin to accrue on the unpaid balance from the day after the expiration of the Sixty (60) day period, notwithstanding any dispute or an objection to any portion of the costs.

7.4 Respondent may dispute all or part of a bill submitted under this Order, if Respondent determines that EPA has made an accounting error, or if Respondent alleges that a cost item that is included represents costs that are inconsistent with the NCP.

7.5 If any dispute over costs is resolved before payment is due, the amount due will be adjusted as necessary. If the dispute is not resolved before payment is due, Respondent shall pay the full amount of the uncontested costs into the Hazardous Substances Trust Fund as specified above on or before the due date. Within the same time period, Respondent shall pay the full amount of the contested costs into a market rate interest-bearing escrow account. Respondent shall simultaneously transmit a copy of both checks to the EPA OSC. Respondent shall ensure that the prevailing party or parties in the dispute shall receive the amount upon which they prevailed from the escrow funds plus interest within (30) days after the dispute is resolved.

VIII. DISPUTE RESOLUTION

8.1 The parties to this Order shall attempt to resolve, expeditiously and informally, any disagreements concerning this Order. If the Respondent objects to any EPA action taken pursuant to this Order, the Respondent shall notify EPA in writing of its objection(s) within fourteen (14) days of receipt of such notification or action, unless the objections have been informally resolved. EPA and the Respondent shall have seven (7) days from receipt of the notification of objection to reach agreement. If agreement is reached, it will be reduced to writing and will become a fully enforceable part of this Order. If agreement cannot be reached on any issue within this seven (7) day period, an EPA official will issue a written decision to the Respondent. Respondent's obligations under this Order shall not be tolled by submission of any objection for dispute resolution under this section.

8.2 Following resolution of the dispute, as provided by this section, Respondent shall fulfill the requirement that was the subject of the dispute in accordance with the agreement reached or with EPA's decision, whichever occurs. No EPA decision made pursuant to this section shall constitute a final agency action giving rise to judicial review.

IX. FORCE MAJEURE

9.1 Respondent agrees to perform all requirements under this Order within the time limits established under this Order, unless the performance is delayed by a force majeure. For purposes of this Order, a force majeure is defined as any event arising from causes beyond the control of Respondent or of any entity controlled by Respondent, including but not limited to their contractors and subcontractors, that delays or prevents performance of any obligation under this Order despite Respondent's best efforts to fulfill the obligation. Force majeure does not include financial inability to complete the work or increased cost of performance. Respondent shall notify EPA orally within forty eight (48) hours after the event, and in writing within seven (7) days, after Respondent become(s) or should have become aware of events that constitute a force majeure. Such notice shall: identify the event causing the delay or anticipated delay; estimate the anticipated length of delay, including necessary demobilization and remobilization; state the measures taken or to be taken to minimize the delay; and estimate the timetable for implementation of the measures. Respondent shall take all reasonable measures to avoid and minimize the delay. Failure to comply with the provisions of this section shall waive any claim of force majeure by the Respondent.

9.2 If EPA determines a delay is or was attributable to a force majeure, the time period for performance under this Order shall be extended as deemed necessary by EPA. Such an extension shall not alter Respondent's obligation to perform or complete other tasks required by the Order that are not directly affected by the <u>force</u> <u>majeure</u>.

X. STIPULATED PENALTIES

10.1 Stipulated penalties shall be paid by Respondent, upon notification by EPA to do so, into the Hazardous Substance Response Trust Fund according to the procedures described below. Stipulated penalties shall not apply to any act or omission that is the subject of ongoing dispute resolution under Section VIII of this Order unless EPA determines that the dispute resolution procedures were invoked by Respondent frivolously or in bad faith or for the purpose of delay. Stipulated penalties shall accrue commencing upon Respondent's receipt of an EPA written determination of disapproval, upon the failure of Respondent to meet the schedule specified in Attachment B of this Consent Order, or upon written notice from EPA to Respondent that a violation of this Order has occurred:

A. Failure to submit the following major deliverables and/or perform the following removal actions in compliance with the requirements of this Consent Order, and in accordance with the Schedules incorporated in the Work Plans and Schedule of Deliverables; in the amount up to $500 per day for the first week of violation or delay, up to $1,000 per day for the second week of violation or delay, and up to $3,750 per day for the third week of violation or delay and each day thereafter.

1) Begin Mobilization for Phase 1 project (soil excavation and temporary storage)

2) Complete Phase 1 project

3) Submit draft Work Plan for Phase 2 project

4) Begin Mobilization for Phase 2 project (soil treatment)

5) Complete Phase 2 project

10.2 Subject to paragraph 10.1, EPA may require that Respondent shall pay into the Hazardous Substances Superfund the sums set forth above as stipulated penalties with a copy of such transaction sent to EPA Project/OSC Coordinator. Certified checks or money orders shall be made out to the Hazardous Substances Superfund and specifically reference the identity of the Site and be addressed to:

U.S. Environmental Protection Agency Region 10
Superfund Accounting
P.O. Box 360903M
Pittsburgh, Pennsylvania 15251.

Nothing herein shall prevent the simultaneous accrual of separate penalties for separate violations of this Order. Penalties are assessed per violation per day. Penalties shall accrue regardless of whether EPA has notified Respondent of a violation or act of noncompliance. Respondent must perform the work even if stipulated penalties are assessed.

XI. RESERVATION OF RIGHTS

11.1 Nothing herein shall limit the power and authority of EPA or the United States to take, direct, or order all actions necessary to protect public health, welfare, or the environment or to prevent, abate, or minimize an actual or threatened release of hazardous substances, pollutants or contaminants, or hazardous or solid waste on, at, or from the Site. Further, nothing herein shall prevent EPA from seeking legal or equitable relief to enforce the terms of this Order, from taking other legal or equitable action as it deems appropriate and necessary, or from requiring the Respondent in the future to perform additional activities pursuant to CERCLA or any other applicable law.

XII. OTHER CLAIMS

12.1 By issuance of this Order, the United States and EPA assume no liability for injuries or damages to persons or property resulting from any acts or omissions of Respondent. The United States or EPA shall not be deemed a party to any contract entered into by the Respondent or their directors, officers, employees, agents, successors, representatives, assigns, contractors, or consultants in carrying out activities pursuant to this Order.

12.2 *Except as expressly provided*, nothing in this Order constitutes a satisfaction of or release from any claim or cause of action against the Respondent or any person not a party to this Order, for any liability such person may have under CERCLA, other statutes, or the common law, including but not limited to any claims of the United States for costs, damages and interest under section 106(a) and 107(a) of CERCLA, 42 U.S.C. § 9606(a) and 9607(a).

12.3 This Order does not constitute a preauthorization of funds under section 111(a)(2) of CERCLA, 42 U.S.C. § 9611(a)(2). The Respondent waive(s) any claim to payment under sections 106(b), 111, and 112 of CERCLA, 42 U.S.C. §§ 9606(b), 9611 and 9612, against the United States or the Hazardous Substances Superfund arising out of any activity performed under this Order.

12.4 No action or decision by EPA pursuant to this Order shall give rise to any right to judicial review except as set forth in section 113(h) of CERCLA, 42 U.S.C. § 9613(h).

XIII. CONTRIBUTION

13.1 With regard to claims for contribution against Respondent for matters addressed in this Order, the Parties hereto agree that the Respondent is entitled to such protection from contribution actions or claims to the extent provided by section 113(f)(2) of CERCLA, 42 U.S.C. § 9613(f)(2).

13.2 Nothing in this Order precludes Respondent from asserting any claims, causes of action or demands against any persons not parties to this Order for indemnification, contribution, or cost recovery.

XIV. INDEMNIFICATION

14.1 Respondent agree(s) to indemnify, save and hold harmless the United States, its officials, agents, contractors, and employees from any and all claims or causes of action arising from, or on account of, acts or omissions of Respondent, its officers, directors, officers, employees, agents, contractors, subcontractors, receivers, trustees, successors or assigns, in carrying out activities pursuant to this Order.

XV. INSURANCE

15.1 At least seven (7) days prior to commencing any on-site work under this Order, the Respondent shall secure, and shall maintain for the duration of this Order, comprehensive general liability insurance and automobile insurance with limits of at least one million dollars, combined single limit. Within the same time period, the Respondent shall provide EPA with certificates of such insurance and a copy of each insurance policy. If the Respondent demonstrates by evidence satisfactory to EPA that any contractor or subcontractor maintains insurance equivalent to that described above, or insurance covering the same risks but in a lesser amount, then the Respondent need provide only that portion of the insurance described above which is not maintained by such contractor or subcontractor.

XVI. MODIFICATIONS

16.1 Modifications to any plan or schedule shall be made in writing by the OSC. Minor field modifications to any plan or schedule may be made in writing by the OSC, or at the OSC's oral direction. If the OSC makes an oral modification, it will be memorialized in writing within seven (7) days; provided, however, that the effective date of the modification shall be the date of the OSC's oral direction. Any other requirements of the Order may be modified by mutual agreement of the parties and shall be in writing.

16.2 If Respondent seeks permission to deviate from any approved Work Plan or schedule, Respondent's Project Coordinator shall submit a written request to EPA for approval outlining the proposed Work Plan modification and its basis.

16.3 No informal advice, guidance, suggestion, or comment by EPA regarding reports, plans, specifications, schedules, or any other writing submitted by the Respondent shall relieve the Respondent of obligations to obtain such formal approval as may be required by this Order, and to comply with all requirements of this Order unless it is formally modified.

16.4 If EPA determines that additional response actions not included in an approved plan are necessary to protect public health, welfare, or the environment, EPA will notify Respondent of that determination. Unless otherwise stated by EPA, within thirty days of receipt of notice from EPA that additional response activities are necessary to protect public health, welfare, or the environment, Respondent shall submit for approval by EPA a work plan for the additional response activities. The plan shall conform to the applicable requirements of this Order. Upon EPA approval of the plan, Respondent shall implement the plan for additional response activities in accordance with the provisions and schedule contained therein. This section does not alter or diminish the OSC's authority to make oral modifications to any plan or schedule.

XVII. NOTICE OF COMPLETION

17.1 When EPA determines, after EPA's review of the Final Report, that all work has been fully performed in accordance with this Order, with the exception of any continuing obligations required by this Order, EPA will provide notice to the Respondent. If EPA determines that any removal activities have not been completed in accordance with this Order, EPA will notify the Respondent, provide a list of the deficiencies, and require that Respondent submit to EPA a Work Plan to correct such deficiencies. The Respondent shall implement the new and approved Work Plan and shall submit a modified Final Report in accordance with the EPA notice. Failure by Respondent to implement this approved Work Plan shall be a violation of this Order.

XVIII. SEVERABILITY

18.1 If a court issues an order that invalidates any provision of this Order or finds that Respondent have sufficient cause not to comply with one or more provisions of this Order, Respondent shall remain bound to comply with all provisions of this Order not invalidated or determined to be subject to a sufficient cause defense by the court's order.

XIX. EFFECTIVE DATE

19.1 The effective date of this Consent Order is the date on which it is signed by the EPA Region 10 Chief, Superfund Response and Investigations Branch.

The undersigned representative of Respondent certifies that it is fully authorized to enter into the terms and conditions of this Order and to bind the parties it represents to this document.

Agreed

By Bruce Sheppard

Title Mgr. Environmental Projects

It is so ORDERED and Agreed this 30th day of March, 1993.

BY: Randall F. Smith DATE: 3/30/93

For James M. Everts, Chief
Superfund Response and Investigations Branch
Region 10
U.S. Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

Reply To
Attn Of: HW-113 September 7, 1994

Mr. Bruce A. Sheppard
Manager Environmental Projects
Burlington Northern Railroad
Environmental Engineering
Suite 2000, 999 Third Avenue
Seattle, Washington 98104-1105

Dear Mr. Sheppard:

On July 29, 1994 you submitted to U.S. Environmental Protection Agency (EPA), a proposed revised schedule for completing soil treatment activities at the Woods Site. The schedule you proposed was based on discussions between EPA and Burlington Northern Railroad (BNRR).

According to Section XVI. Modifications of the Administrative Order on Consent for Removal Response Activities at the Woods Site (Docket No. 1087-03-13-106), the Order may be modified by mutual agreement of the parties. EPA has reviewed your proposed schedule and has agreed to modify the existing Order accordingly. EPA has revised Attachment B of the Order to reflect the schedule you proposed in your letter of July 29, 1994. A copy of a revised Attachment B is attached for your records.

Please call me if you have any questions. My number is (206) 553-1987.

Sincerely,

Lynda E. Priddy

Lynda E. Priddy
Environmental Protection
Specialist
Hazardous Waste Division

Attachment

cc: David Eagleton, Burlington Environmental - Columbia
Tom Hippe, BE - Houston
Rick Roeder, Ecology (CRO)
Tom Becker, Preston
Bill Glasser, EPA (HW-113)
Bob Hartman - EPA (SO-155)

ATTACHMENT B

Schedule of Deliverables

	Activity	Deadline
1.	Submit proof of bid award to EPA	August 22, 1994
2.	"EE/CA Addendum" submitted to EPA	August 22, 1994
3.	Submit Draft Soil Treatment Work Plan to EPA	October 7, 1994
4.	BNRR gives contractor notice to proceed with site preparation	December 9, 1994
5.	Startup/Shakedown begins	January 15, 1995
6.	Project Complete/Final Report submitted to EPA	June 30, 1995

ATTACHMENT B

Schedule of Deliverables

	Activity	Deadline
1.	Begin mobilization for Phase 1	March 29, 1993
2.	Complete Phase 1	June 15, 1993
3.	Submit draft completion report for Phase 1	July 15, 1993
4.	Submit draft Scope for Work for Phase 2	Thirty days after effective date of order
5.	Submit draft detailed Work Plan for soil treatment	June 1, 1993
6.	Award contract for soil treatment	30 days after EPA approval of work plan
7.	Begin mobilization for Phase 2	30 days after contract awarded
8.	Complete demonstration test and submit report	45 days after mobilization
9.	Complete Phase 2	1 year from effective data of order
10.	Submit final report	30 days after completing Phase 2

APPENDIX Q

CALCULATIONS

DRE CALCULATIONS

Selected POHC: Hexachlorobenzene

Required DRE: 99.99%

Concentration in Roll-Off Box: 3432.83 mg/kg

Detection Limit: 10 µg /sample

Safety Factor: 10 x Detection Limit ⇒ 100 µg /sample

Sample Volume Required: 106 dscf

Need to have a minimum of 100 µg /sample of HCB in the stack gas in order to show 99.99% DRE.

$$\frac{100\ \mu g}{0.0001} = 1 \times 10^{6}\ \mu g =$$ 1000 mg HCB required in the feed to show 99.99% DRE

The concentration of HCB in the feed for the performance test averages 3432 ppm. Therefore, no spiking of the feed will be necessary.

HCl Analysis

A maximum of 4 lb/hr HCl emissions or 99% control efficiency is required.

Organochloro Compounds	Avg. Conc. in Soil (mg/kg)	Chlorine Percentage (%)	Chlorine Concentration (mg/kg)
Hexachlorobenzene	729.69	74.70	545.08
Heptachlor	0.32	66.48	0.21
Heptachlor Epoxide	0.18	66.48	0.12
Methoxychlor	57.05	30.77	17.55
Chlordane	0.91	69.22	0.63
Aldrin	6.09	58.30	3.55
alpha-BHC	0.73	73.14	0.53
beta-BHC	0.26	73.14	0.19
gamma-BHC	9.78	73.14	7.15
Dieldrin	19.95	55.85	11.14
Endrin	10.83	55.85	6.05
DDD	454.26	50.01	227.18
DDE	51.67	50.01	25.84
DDT	1696.03	50.01	848.18
Toxaphene	109.38	68.00	74.38
		TOTAL	1767.78 mg/kg

Avg. Feed Rate = 20 TPH

Avg. Chlorine Concentration in the Soil = 1767.78 mg/kg

Avg. Emission of HCl (uncontrolled) $= \frac{36.5}{35.5} \times \frac{20 \times 2000 \times 1767.78}{10^6} = 72.70\text{mg/kg}$

The acid gas scrubber utilized by the system will remove in excess of 99% of the HCl.

At 99% DRE, average emission of HCl = (72.70)(.01) = 0.727 lb/hr HCl.

Tier 1 Analysis for Metals

For Tier 1 Analysis of metals, assume the entire concentration of metals in the feed soil bypasses the APCE and is emitted to the atmosphere. If these values are greater than allowable emissions, then stack testing for metals must be performed.

Metal	Average Concentration in Soil (mg/kg)	Metal Emission (lb/hr)(1)
Arsenic	9.75	0.39
Lead	86.67	3.47
Mercury	6.24	0.25
Antimony		
Barium	369.5	14.78
Beryllium		
Cadmium	6.55	0.26
Chromium	25.02	1.00
Selenium	0.75	0.03
Silver	2.00	0.08
Thallium		

(1) Based on average soil feed rate of 20 tons per hour.

APPENDIX R

NOISE EXPOSURE MONITORING

BENCHMARK ENGINEERING

Consulting Engineers and Scientists

Benchmark Engineering Inc.
1550 Pumphrey Avenue
Auburn, Alabama 36830
205/821-9250
Fax 205/821-9765

November 11, 1993

Mr. Mark A. Fleri
WILLIAMS ENVIRONMENTAL SERVICES
2075 West Park Place
Stone Mountain, Georgia 30087

RE: Noise Exposure Monitoring - THAN, Albany, Georgia
Benchmark Project No. 1100-100-110

Dear Mr. Fleri:

Attached are tabulated summaries of the results of noise monitoring efforts for the above-referenced project. Sampling was conducted during the setup and operation of Thermal Processing Unit I (TPU I) at the Albany site; sampling periods ranged from six to nine hours. Both personal and area samples were collected using a Quest M27 Noise Logging Dosimeter. The dosimeters were calibrated daily using a Quest CA-12B calibrator.

Sampling was also conducted to determine the noise level at the site perimeter. For this effort, the ID fan, since it appeared to be the most significant source, was selected as the center point. Monitoring points were then selected around the perimeter of the site as illustrated on the attached figure.

Based on this data, there is no question that a hearing conservation program should be established, and signs posted around some portions, if not all of unit number one. Hearing conservation programs are required by regulation once the 8-hour time-weighted average of employees exceeds 85 dBA. Hearing protection must be provided when the TWA exceeds 90 dBA.

Please review the information and contact me with any questions.

Sincerely,

BENCHMARK ENGINEERING

Roger W. Thompson, CIH, CHMM
Vice President

RWT:ps

Enclosures

Benchmark Engineering Inc.
Riverchase Office Plaza
Bldg. 3, Suite 208
Birmingham, Alabama 35244
205/988-4205
Fax 205/988-5249

Benchmark Engineering Inc.
2075 West Park Place
Stone Mountain, Georgia 30087
404/879-4000
Fax 404/469-0178

Deep South Laboratory
225 Oxmoor Circle, Suite 806
Birmingham, Alabama 35209
205/945-6263
Fax 205/945-0739

WILLIAMS ENVIRONMENTAL SERVICES

PERIMETER NOISE LEVEL ASSESSEMT

THAN SITE, ALBANY, GEORGIA

Benchmark Engineering Project: 1100-100-110

DATE	LOCATION/ GRID POINT	SPL(a)	COMMENTS
10Jul93	N-12s	Void	Monitor not set for community noise.
11Jul93	N-12s	*	Approx. 54 dB Visual readings throughout the day
12Jul93	N-12s	69.3	TPU ran 1st 4 hrs
12Jul93	N-14w	72.9	TPU ran 1st 4 hrs
13Jul93	N-22s	65.4	TPU off/on all day
13Jul93	N-24w	68.7	TPU off/on all day
14Jul93	N-32s	68.9	TPU ran all day
14Jul93	N-0	65.2	TPU ran all day
14Jul93	N-34w	66.8	TPU ran all day
15Jul93	N-44w	61.0	TPU did not run
15Jul93	N-42s	66.1	TPU did not run
16Jul93	N-49.5s	67.3	Towards Hwy.
16Jul93	N-49.5s	65.7	Towards unit
			Total dBA= 69.3
16Jul93	N-0	62.4	TPU ran all day
21Jul93	N-14w	80.2	TPU ran all day
21Jul93	N-12s	68.4	TPU ran all day
04Aug93	N-44w,32s	72.9	TPU down
04Aug93	N-44w,22s	74.6	TPU down
04Aug93	N-44w,12s	66.5	TPU down
12Aug93	N-44w	58.7	TPU up 4:25 comp
12Aug93	N-49.5s,14w	65.4	Facing highway
12Aug93	N-49.5s,14w	65.8	Facing unit
13Aug93	N-34w	70.3	TPU up 1:35 comp
13Aug93	ID fan	91.1	ID fan
13Aug93	Shaker (EZ fence)	91.4	Shaker

WILLIAMS ENVIRONMENTAL SERVICES

PERIMETER NOISE LEVEL ASSESSEMT

THAN SITE, ALBANY, GEORGIA

Benchmark Engineering Project: 1100-100-110

DATE	LOCATION/ GRID POINT	SPL(a)	COMMENTS
13Aug93	N-24w	Void	Dead Battery
13Aug93	N-49.5s,24w	74.5	Facing highway
13Aug93	N-49.5s,24w	74.2	Facing unit
15Aug93	N-14w	103.6	TPU runnning
15Aug93	N-49.5s,34w	Void	Dead Battery
15Aug93	N-49.5s,34w	65.3	Facing unit
16Aug93	N-44s,42w	61.5	Facing RR & Hy
16Aug93	N-44s,42w	65.1	Facing unit
19Aug93	N-44w,42s	66.0	TPU off all day Facing highway
19Aug93	N-44w,42s	63.8	Facing unit
19Aug93	N-44w,12s	44.2	TPU off all day
20Aug93	N-12s	67.1	TPU off all day Facing unit
20Aug93	N-12s	77.8	Facing weld shop
20Aug93	N-44w,32s	61.6	TPU off all day
29Aug93	N-44w,12s	65.2	TPU up all night
29Aug93	N-44w,22s	59.4	TPU up all night
29Aug93	N-44w,32s	64.6	TPU up all night
02Sep93	N-42s	60.7	TPU up all day
02Sep93	N-44w,42s	64.4	Facing unit
02Sep93	N-44w,42s	64.3	Facing hwy./RR

NOTES:
(a) SPL = Sound Pressure Level measured as dBA

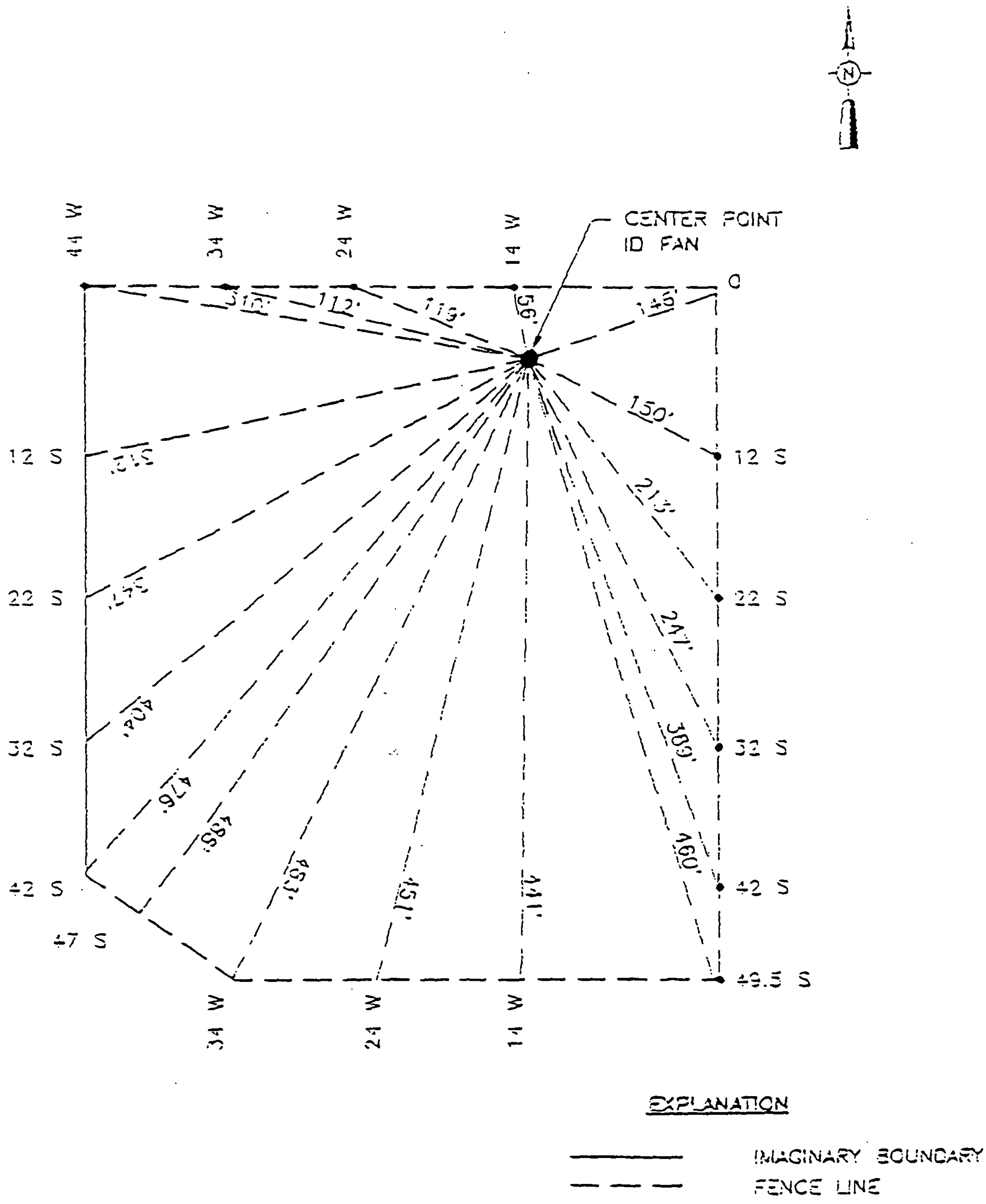


FIGURE NO.
1

DATE:
8-10-93

DESIGNED BY:
TJR

DRAWN BY:
JCM

TH AGRICULTURE & NUTRITION
1401 SCHLEY AVE.
ALBANY, GA.

BENCHMARK ENGINEERING
Consulting Engineers and Scientists
1550 PUMPHREY AVE. AUBURN INDUSTRIAL PARK
AUBURN, ALABAMA 36830-4399 (205) [illegible]

PROJECT NO.:
1100-100-110

SCALE:

WILLIAMS ENVIRONMENRTAL SERVICES

NOISE EXPOSURE ASSESSMENT

THAN SITE, ALBANY, GEORGIA

Benchmark Engineering Project: 1100-100-110

DATE	LOCATION/EMPLOYEE	SPL(a) TWA(dBA)	SPL(b) DOSE(%)	COMMENTS
30Jun93	Jason Weed	74.4	11.57	Mobil/set-up
30Jun93	Bob Kelby	78.5	20.27	Mobil/set-up
01Jul93	Lance Keller	83.6	41.0	Mobil/set-up
01Jul93	Art Terrell	79.4	22.96	Mobil/set-up
02Jul93	Wes Richards	75.4	13.24	Mobil/set-up
02Jul93	Leslie Weed/3 hrs Glenn Weed/6 hrs	82.8	36.9	Mobil/set-up
03Jul93	Ivan Richards	82.4	34.8	Mobil/set-up
03Jul93	Jack McClure	78.9	21.45	Mobil/set-up
06Jul93	Jason Weed	77.7	18.15	106 min act run 81.8% proj dose
06Jul93	Art Terrell	80.9	28.32	8-hr dose 29.92%
06Jul93	Bob Kelby	82.0	33.1	Mobil/setup
07Jul93	Leslie Weed	80.7	27.39	TPU ran from 7:45
07Jul93	Lance Keller	void	void	COMPUTER ERROR
07Jul93	Wes Richards	84.9	49.0	TPU ran from 8:10
08Jul93	Jack McClure	80.7	27.54	Mobil/set-up
08Jul93	Ivan Richards	75.1	12.62	Mobil/set-up
08Jul93	Jason Weed	74.1	10.94	Mobil/set-up
09Jul93	Leslie Weed	82.9	37.3	TPU Running 8-hr dose 37.3%
09Jul93	Art Terrell	93.4	160.6	TPU Running Stack Conveyor
09Jul93	Lance Keller	89.0	87.1	TPU Running Feed Conveyor
10Jul93	Jack McClure	82.1	33.2	TPU ran from 7:00
10Jul93	Wes Richards	86.3	59.9	TPU ran from 7:00 Stack conveyor:
11Jul93	Jason Weed	72.6	9.0	Final Set-up

WILLIAMS ENVIRONMENRTAL SERVICES

NOISE EXPOSURE ASSESSMENT

THAN SITE, ALBANY, GEORGIA

Benchmark Engineering Project: 1100-100-110

DATE	LOCATION/EMPLOYEE	SPL(a) TWA(dBA)	SPL(b) DOSE(%)	COMMENTS
11Jul93	Ivan Richards	86.8	63.8	Was wearing hearing protection.
13Jul93	Area--demister	88.9	85.6	Personnel were wearing hearing protection.
19Jul93	Area-Air Compressor	81.3	29.78	Personnel were wearing hearing protection. 96% of the time dBA was 85 to 95.
19Jul93	Area-Stack Conveyor	81.4	30.2	Personnel were wearing hearing protection. 97.3% of the time dBA was 85 to 95.
18Aug93	Area Fr end loader	79.7	23.86	
18Aug93	Area-Stack conveyor	93.0	150.9	Personnel were wearing hearing protection.
18Aug93	Area-Shaker	89.6	94	Personnel were wearing hearing protection.
18Aug93	Area-Shaker	95.0	198.9	Personnel were wearing hearing protection.
18Aug93	Area Fr end loader	87.3	68.4	Personnel were wearing hearing protection.
18Aug93	Area-Shaker	92.7	145.7	Personnel were wearing hearing protection.
21Aug93	Area-Stack conveyor	Void	Void	Wrong setting
21Aug93	Area-Shaker	"	"	Wrong setting

WILLIAMS ENVIRONMENRTAL SERVICES

NOISE EXPOSURE ASSESSMENT

THAN SITE, ALBANY, GEORGIA

Benchmark Engineering Project: 1100-100-110

DATE	LOCATION/EMPLOYEE	SPL(a) TWA(dBA)	SPL(b) DOSE(%)	COMMENTS
21Aug93	ID fan area	-	-	Wrong setting
29Aug93				
29Aug93	W. Knox/Stc Cavy	Void	Void	Comp Error
29Aug93	J. Whatley/FMU	82.7	36.3	
29Aug93	J. McClure/Cnt Rm	83.2	39.0	

NOTES:
(a) SPL = Sound Pressure Level Recorded in dBA as 8-hour time-weighted average (TWA).
(b) Values represents the percentage of the allowable dose to which the employee would have been expose had hearing protection not been in place.

APPENDIX S

DOBSON COLLAR CUTAWAY VIEW

DOBSON COLLAR

The Dobson Collar is a device developed to allow for the introduction of solid or liquid material into a horizontal rotating drum. The design consists of placing an inner shell within an outer shell known as a Dobson Collar. A chute opening is placed on the Dobson Collar, surrounding the inner shell, allowing gravity to drop the materials into the upper side of the space between the inner shell and Dobson Collar. The inner shell contains a series of openings resembling a waterwheel, that scoop the material from the location between the inner shell and Dobson Collar into the interior of the drum, where it can mix with the existing hot material. As the relatively small flow of material mixes with the hot material that has progressed through the entire drum, it is heated through convection. While this is taking place, the entirety of material is still being heated by the radiant heat given off by the close proximity of the open flame. In this portion of the drum, the material is showered through the air flow; however, the velocity of the air flow is greatly reduced due to the enlargement of the drum diameter, thus minimizing the amount of material carried back through the air pollution control devices.

The purpose of the Dobson Collar on Williams' third operable thermal treatment unit is to allow for the thermal treatment of the baghouse dust. The dusts are re-introduced into the drum near the burner to take advantage of the existing high temperatures. To prevent pulling the fine dusts back into the airstream, the air velocity from the burner flow is reduced by increasing the drum diameter from eight and one half feet to ten feet (see diagram for cutaway view). By increasing the drum diameter, the speed at which the soils move through the drum is reduced, thus increasing the residence time for the baghouse dusts.

Assuming that no further heat is added to the system, the temperature at which the baghouse dust is treated will be approximately 870°F. Of course, the actual temperature will be higher due to the proximity of the burner. This temperature is more than adequate to treat any remaining contamination in the baghouse dust. The following calculation shows how this temperature was determined:

$$M_1\,C_{p,1}\Delta T_1 = M_2\,C_{p,2}\Delta T_2$$
$$C_{p,1} = C_{p,2}$$
$$0.95\Delta T_1 = 0.05\Delta T_2$$
$$19\Delta T_1 = \Delta T_2$$
$$19(900 - \Delta T_2) = (\Delta T_2 - 300)$$
$$\Delta T_2 = 870°F$$

where

M_1 = mass flow rate of soil
M_2 = mass flow rate of baghouse dust
(assumed to be 5% of soil feed)

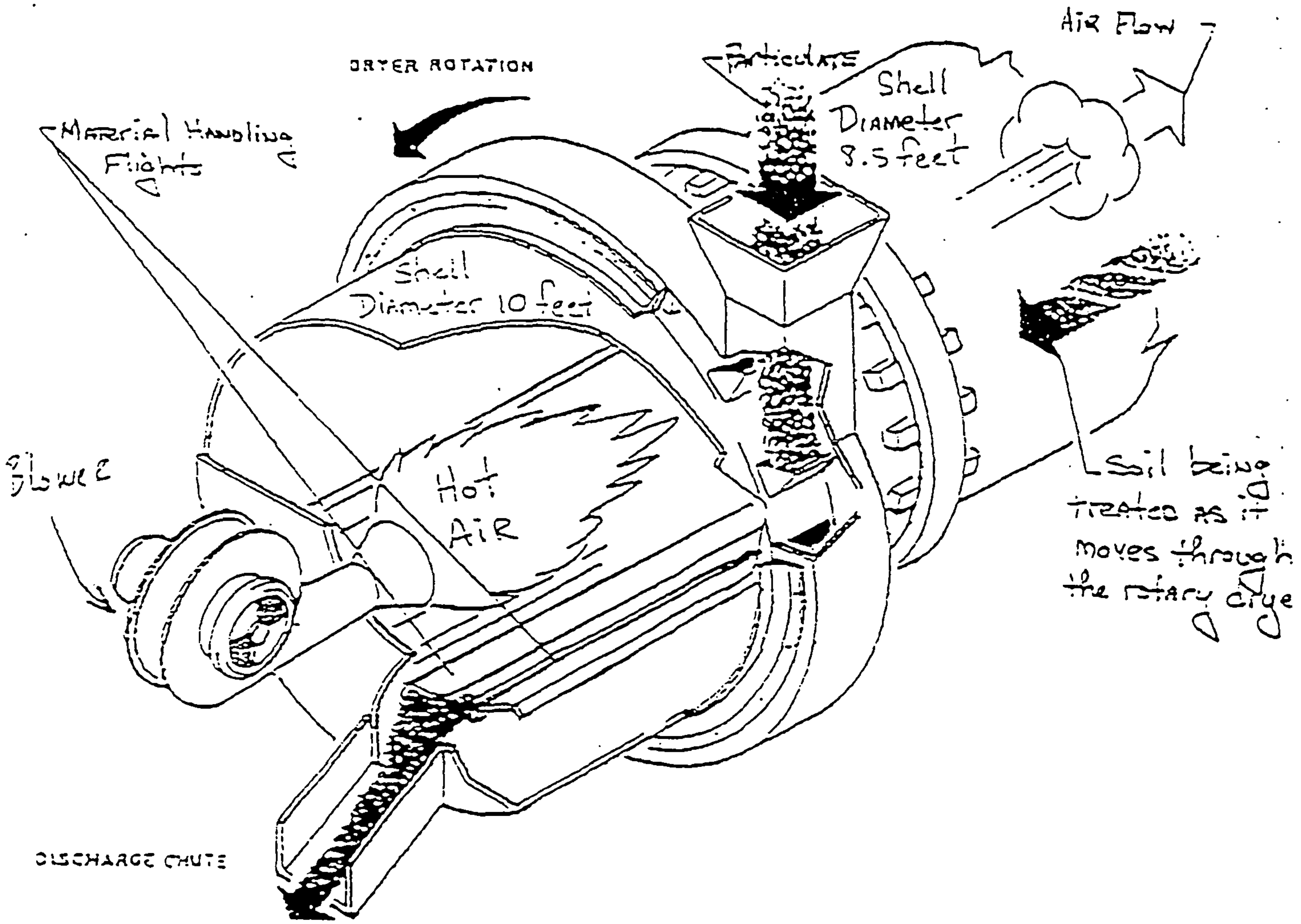
Assumptions:

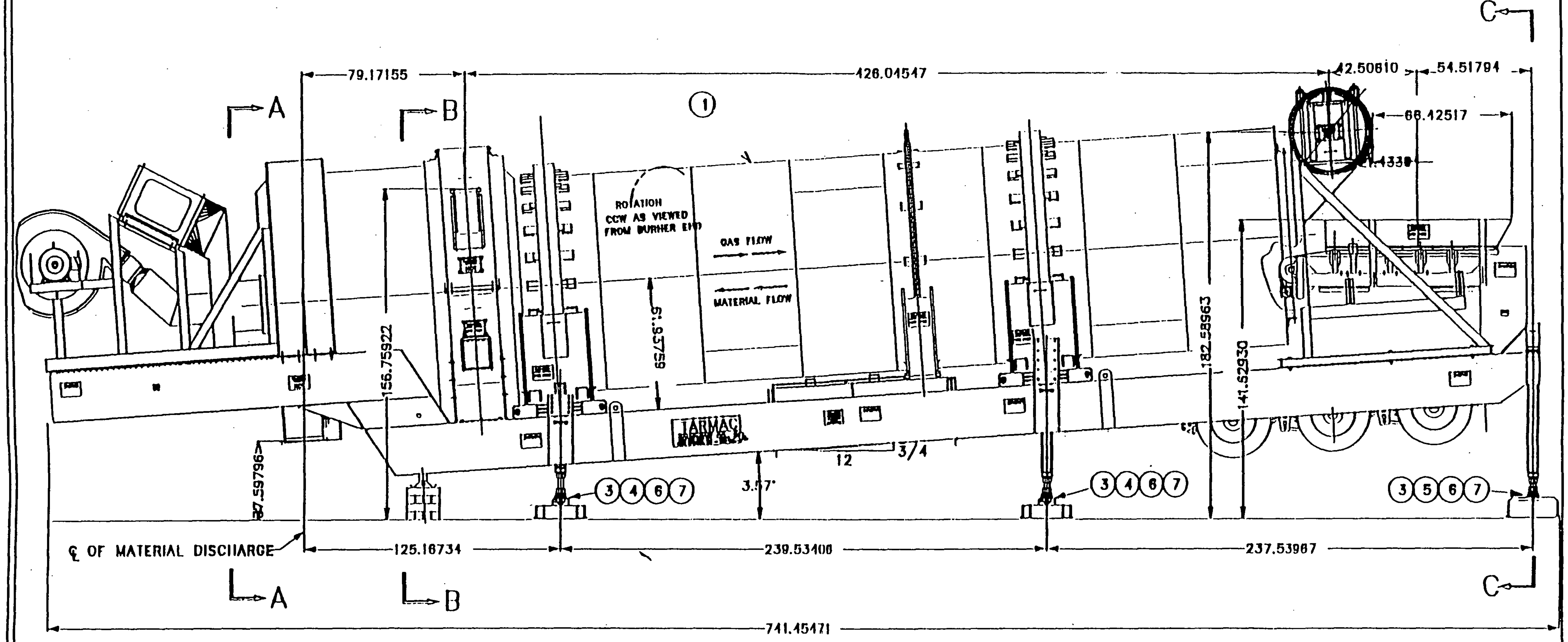
1) Temperature of treated soil = 900°F
2) Temperature of baghouse dust = 300°F

- DRAFT -
- For Discussion Purposes -

Here's a schematic of the "Dobson Collar" design to be implemented on the Woods Project.

- Thermal Desorption with the Dobson Collar -





ITEM	QTY	DESCRIPTION	DWG.	WT.
7	12	HAIR PIN, 1/4" FOR 1-1/2" SHAFT, ISSCO WW CLIP #235		
6	6	RACHET LOAD BINDER, CAMPBELL #620-7805 FOR 1/2" SYSTEM 4 CHAIN		10
5	2	CHAIN, 1/2" SYSTEM 4 WITH CLEVIS GRAB HOOK EACH END, 14' LONG, (CAMPBELL)		39
4	4	CHAIN, 1/2" SYSTEM 4 WITH CLEVIS GRAB HOOK EACH END, 13' LONG, (CAMPBELL)		37
3	6	PIN, STEEL TIMBER CHAIN, 6-1/2" LONG	31-24	3
2	6	PIN, LEG CHAIN, 9-1/4" LONG	31-24	5
1	1	DRYER ASSEMBLY	31-27	9606

TARMAC EQUIPMENT COMPANY

TITLE DRYER ASSEMBLY, 8' 6" x 40' (SHIPPING WT. 96,400#)

BY	© DATE	SCALE	CADD	DWG. NO.		REV
DRA	1/11/94	1/4"=1'-0"	DRYER	31-272	1/3	0

Williams Environmental
2075 West Park Place
Stone Mountain, GA 30087
404/879-4107 (fax) 404/879-4831

TPU

Drawing Title
Sub-title

DATE 3/31/94

FILENAME 3127201.dwg

DWG NO.
3127201

APPENDIX T

APRIL 2, 1994 COMMENTS & RESPONSES

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WILLIAMS ENVIRONMENTAL SERVICES, INC.

May 6, 1994

Ms. Lynda Priddy
Hazardous Waste Coordinator
U. S. Environmental Protection Agency Region X
1200 Sixth Avenue
Seattle, Washington 98101

Subject: Woods Industries Site
Yakima, Washington
Transmittal No.: 0024
Number of Pages: 33

Re: Transmittal of Responses to USEPA Region X
April 14, 1994 Comment Letter on the Work Plan
Williams Project No. 0365-001-110

Dear Ms. Priddy:

In response to U.S. Environmental Protection Agency (USEPA) Region X's April 14, 1994, comments on the Work Plan, dated March 14, 1994, Burlington Northern Railroad (BNRR), through Williams Environmental (Williams) and Burlington Environmental Inc. has prepared this letter and is in the process of revising the Work Plan.

GENERAL COMMENTS ON THE WORK PLAN

Section 3: Process Description

1. Page 17, section 3.2, Feed Processing, last six lines: Prior to "resampling" a failed soil pile, the Work Plan states that the failed soil pile will be " ' recycled' to the waste feed area and placed in piles for further treatment. . . . This 'recycled' feed will not necessarily be stored separately from the 'virgin' feed but . . . feed processed." EPA is not certain what is meant by these statements. Please clarify further. What is the reason for resampling a second time a failed soil pile?

<u>Reply</u>

The last portion of paragraph 3.2 has been re-written to read "If the treated samples pass the clean-up criteria, the soil will not be re-treated. However if the treated soil samples fail to meet the clean-up criteria, the treated soil pile will be re-sampled using a composite of several grab samples. If the composite samples pass the clean-up criteria, the soil will not be re-treated. However, if the second sampling event demonstrates that the treated piles fail to achieve the clean-up criteria, these treated soils will be re-treated. The failed pile will be moved from

the verification holding area to the wastefeed stockpile area. The failed pile will be treated as the production schedule allows. The amount of re-treated material will be deducted monthly based on the production sheets. (One pile represents one day's production.)"

2. Page 18, 1st full paragraph: this is an appropriate location to add some discussion about how the Dobson Collar will work. Additionally, some discussion should be added to page 21, section 3.5.5 and page 24, 4th paragraph. Added information to appropriate sections should address: residence time, feed control, expectations, etc.

Reply

Appendix U has been added to include the correspondence and drawings submitted to date. The text has been revised to reflect the above comment.

3. Page 20, 4th full paragraph: " . . . hauling soils to secondary stockpiles as is shown in Figure 12-1". Figure 12-1 could not be located. Is it Figure S-1? Figure S-1 does not identify a secondary pile. Is it the same thing as the waste feed stockpile or is the secondary stockpile different?

Reply

Figure S-1 is Figure 12-1. The drawings will be revised to show Figure 12-1. The secondary stockpile is the same as the wastefeed stockpile. The document will be revised to reflect wastefeed stockpile.

4. Page 20, 2nd to the last sentence: While the carbon can treat the water, what about the "sludgy" material that settles out from the water in the sumps? This questions also applies to the "sludgy" material that may result from cleaning off the pad during decon. Carbon treatment will probably not work for waste rich in particulate material. Will you have a settling tank?

Reply

The "sludgy" material that settles from the water in the sumps is removed periodically, mixed with the contaminated soil and processed through the thermal desorption unit. The sump pumps are positioned 2" to 6" off the sump bottom to prevent clogging of the pumps with sludge and to prevent large amounts of solids from being carried over to the water treatment system. The sump water and blowdown water are pumped to a frac tank to allow additional time for settling prior to being filtered (200 µm filter maximum) and treated by the carbon units for use as process water. Page 27 of the workplan has a brief summary of the water treatment system.

5. Page 20, 3rd full paragraph: How will contaminated debris be distinguished from clean debris?

Reply

The approach is the same as that used during building demolition and soil removal activities. A paragraph will be inserted on page 20 and will read as follows:

The ultimate fate of the debris found at the Woods Site will be limited by the individual material's character and degree of contamination. Where appropriate, the material will be re-used or recycled. No visibly contaminated material will be recycled or disposed of in a sanitary landfill or municipal landfill. If the material is believed to be contaminated based on visual observation, the material will be cleaned, if practical, or disposed of at a facility permitted to accept the waste as appropriate.

6. Section 3.5 add quench water to the list of residual streams.

Reply

Scrubber water blowdown is the same as quench water and is listed in paragraph 3.5.

7. Westates is presently out of compliance and is not acceptable as a location for accepting the spent carbon until they are in compliance. BNR[R] may want to locate some other alternative disposal facilities that are in compliance.

Reply

Westates has another facility located in Morgantown, West Virginia. According to Westates, the Parker, Arizona facility had another inspection which was conducted by Region 9 of the USEPA and found to be in compliance.

8. Section 3.5.3 Run-off Water: Water from run-off will be collected in modu-tanks, how will that water be transferred to the carbon waste water treatment equipment?

Reply

The text has been revised to read " . . . stored in three frac tanks . . . . This is consistent with Figure 12-1. Water will be transferred via pumps and piping. The process flow for this operation is included in Figure 3-1.

9. Section 3.5.3 Run-off Water: Language should be added to this section that states that carbon-treated run-off water will not be used to control dust from treated soil or condition treated soil AFTER that soil has been sampled and determined to comply with cleanup levels. For soils that have already been confirmed as meeting cleanup levels, only city water may be used for dust control and conditioning of these soils.

Untreated run-off water may not be used for dust control or conditioning associated with ANY treated soils. What will be used for dust control on haul roads?

Reply

Section 3.5.3 has been revised to concur with this comment. City water will be used as a dust control on haul roads.

10. Section 3.5.4 Scrubber Water Blowdown: Similar to the above comment, only city water can be used to condition soil or control dust on treated soils that have already passed confirmatory sampling and been shown to meet cleanup levels. This paragraph should state as such. This requirement is based on the assumption in the work plan that sampling of the treated water is not necessary because "acceptability is determined by the criteria that it does not affect treated soil quality (pg. 21 section 3.5.3).

Reply

Section 3.5.4 has been revised to concur with the above comment.

11. Section 3.5.5 Baghouse Dust: This section does briefly discuss the Dobson Collar, however, somewhere in the work plan a more detailed discussion should be made that explains the length of the residence time and how it was determined, the impact of the decreased air velocity, how the baghouse will be receiving "full, controlled treatment", how the baghouse feed will be controlled back into the dryer, etc. Additionally, a mechanical drawing or engineering diagram of the collar should be included. Additionally, page 24 of the Work Plan, Thermal Desorber section is a place that a detailed discussion of the Dobson Collar should appear.

Reply

Appendix U has been added to include additional information about the Dobson Collar. The text has been revised to reflect the above comment.

12. TPU3, Process Flow Diagram: In this diagram, oversized materials are specified as going to off-site disposal. Disposal depends on sampling results. As agreed, if sample results are below clean-up levels, then the cobbles can be disposed on-site. If data shows that the cobbles will be disposed on-site, please correct this statement.

Reply

The Process Flow Diagram has been revised to reflect the above comment.

13. Page 51, Table 7-2: Add nickel to the list of metals. What about Table 7-3 starting on page 53.

Reply

Nickel has been added to Table 7-2. Nickel was not analyzed for during RI/FS.

Section 4: Equipment Description

1. Page 23: EPA would like more information about the equipment used to separate the cobbles, e.g., how is it designed and will it be on the pad? The Agency is concerned that the undersized cobbles and fines could fall off the separator and on to the ground instead [of] entering the feed mechanism?

Reply

The screening operation will either be done on the wastefeed pad or in the immediate area of the pre-existing stockpiles so as not to contaminate any additional areas. The screening equipment will be selected upon approval of the work plans. This machine will be leased from local vendors in the area.

2. Page 24; 1st eight lines: This paragraph discussed engineering controls to minimize dust emissions. However, specifics regarding the use of engineering controls are not provided. EPA understands that BNR intends to use water to control dust that may be generated from haul roads or the stockpiles. However, what engineering controls will be used to control dust that will be generated from, unloading soils from the front end loader, the screening process to separate cobbles and the feeding of soil into the treatment unit. EPA and BNR have briefly discussed these concerns but at present these concerns are still unresolved. BNR has agreed to find out more about the construction of the screening equipment and feed conveyor, for example, can the conveyor be covered or is it constructed to mitigate effects from wind?

Reply

The text has been edited such that engineering controls have been changed to administrative controls such as speed limits, and covering dump trucks during transport, if necessary. One additional sentence was added to the last line of the paragraph and reads as follows: "Depending on the site conditions, engineering controls such as Williams covering conveyors and screens for the feed handling equipment will be implemented upon agreement between Williams, Burlington Environmental, BNRR and the EPA."

3. Page 26, Quench Tower section: This section states that the blowdown water will be treated by the unit's wastewater treatment unit. The Process Flow Diagram TPU3 does not show quench water entering the wastewater treatment unit.

Reply

The Process Flow Diagram shows the blowdown line leaving the quench tower and scrubber.

Section 5: Project Schedule

1. Page 34 and Figure 5-1: The time frames described in these 2 pages appear to contradict each other.

Reply

Page 34 has been revised to reflect the schedule in Figure 5-1.

2. Page 34, 4th paragraph, last sentence: Add "interim" after "performance test" and before "and normal."

Reply

The text has been revised to reflect this comment.

3. Page 34, 4th paragraph, 1st sentence: add "only the" after "roll-off boxes, including."

Reply

The text has been revised to reflect the above comment.

Section 6: Process Control, Monitoring, and Emergency Procedures

1. page 40. n: Where does the solids from inside the scrubber go?

Reply

Solids from the scrubber will be blown down and/or vacuumed from the unit and processed through the thermal desorber. No addition to text.

Section 7: Performance Criteria

1. Page 49, clean-up goals and Table 1-1 in the Performance Test Plan: Do not round off the numbers. Use the number as specified in the MTCA Method B Tables.

Reply

The table will be modified to agree exactly with MTCA Method B Tables.

2. Page 51, add dioxin and furans to the list of PICs.

Reply

These compounds have been added to Table 7-2.

3. Page 51, footnote 2: provide the data as an addendum to the Work Plan or future revisions.

Reply

TIER I and TIER II levels are shown in Table 7-3 on pages 53 and 54.

Section 8: Performance Test Plan

1. Page 58, 2nd paragraph, last sentence: The Work Plan specifies that the independent oversight [stack testing] contractor's qualifications will be submitted for EPA review and approval. When will this information be provided?

Reply

The stack sampling contractor's qualifications will be submitted after the approval of the work plan and performance test plan so that competitive bidding can be performed for contracting purposes.

2. Pages 60 and 61: These two tables specify that sampling locations are the "discharge screw conveyor or treated soil." Note that samples should not be taken before soil conditioning with treated water has occurred.

Reply

Sample points from either the discharge screw conveyor or treated soil stockpiles occur after soil conditioning has occurred.

Section 12: Mobilization

1. Site Layout Map - The boundaries of the exclusion zone and the support zone are not clear. For example, does the support zone include everything not in the exclusion zone? Does this mean that the proposed verification holding area and the contaminated stockpiles are not in an exclusion zone but rather a support zone? The lines defining the exclusion zone are difficult to differentiate from other lines on the map. We assume the exclusion zone includes all the equipment the waste feed stockpile area and the verification holding area (as opposed to the proposed verification holding area at the south end of the site). If this assumption is correct, workers involved in hauling

contaminated dirt or are in close proximity to the stockpiles should wear appropriate protective equipment. Other people should be prohibited from these areas.

Reply

The exclusion zone includes the following: wastefeed stockpile, the portion of the equipment pad supporting the dryer and baghouse, and the treated soil verification holding area. The support zone includes the area adjacent to the exclusion zone, including the equipment pad for the oxidizer, quench/scrubber and frac tanks. Excavation areas will be considered to be exclusion zones as well. Revisions have been made to Figure 12-1 to more clearly define the exclusion zone.

2. Haul roads, material handling areas and traffic flow patterns should be identified on a similar map. A plan describing the sequence of moving soil from the stockpile areas to the treatment unit should be provided. Are you planning on completing the treatment of the north pile before starting on the south pile or are you considering doing the south pile first?

Reply

Hauling routes are shown on Figure 12-1. All material handling operations will take place on the wastefeed material pad. Williams proposes to begin hauling soil for treatment from the south stockpile. This material will be stored on the wastefeed pad to await processing by the unit. After the soil has been treated and verified to meet clean-up levels, it will be used to begin backfilling the excavation area directly behind the Ackland Building. Williams plans on completing treatment of the north stockpile first to enable additional soil removal activities to begin from under the storage area.

3. Does the proposed verification holding area in the south end of the site have a different purpose than the verification holding area located near the treatment unit? Is there going to be a pad to prevent run-off and an underlining to prevent contamination in the proposed verification holding area? How do you plan to keep holding piles separate, especially piles being held pending sample results from piles that require re-treatment because they failed to meet cleanup levels? Is there adequate space to hold all piles on the holding area near the equipment or is overflow expected to end up in the proposed verification holding area?

Reply

The verification holding areas (north and south) serve the exact same purpose - to hold treated stockpiles pending analytical results. There will be a pad to prevent run-off, but no underlining. Stockpiles will be kept separate by visual observation. Piles will be kept in the verification holding area until analytical results indicate the piles have passed the clean-up criteria.

4. Are you going to be using an oxygen supplement? If so, it should not be stored near the gas supply.

Reply

Williams will not be using an oxygen supplement.

5. Where is figure 12-1? Is it S-1? Figure numbers and references to figures in the text do no always match.

Reply

See comment #3 of Section 3. No addition to the text.

6. Only one fire hydrant is identified on the Site Layout. It is located outside the fence line. Will it be accessible from inside and outside the fence? Are other hydrants located on-site to be used for emergencies? Other hydrants should be identified.

Reply

One fire hydrant is located just north of the main entrance gate outside the fence. Another fire hydrant is located on-site just southwest of the Akland office building, which is accessible from on-site only. Both fire hydrants are accessible for use in case of an emergency.

7. The Site Layout only shows one access point into the site. I believe there is also one on the north end of the site, but it is not shown. Will this access be used and for what purposes? There should be some access on the south end of the site for emergency exits.

Reply

There are three (3) access gates to the site. There is one along the north fence line at the northwest corner of the site. There is one along the south fence line at the southwest corner of the site. The eastern gate is the main gate which will be used for general delivery and parking. This can be seen in Figure 12-1.

8. The location of the personnel decon is in an inconvenient location for leaving the exclusion zone and entering the support area, leaving the site or entering the office area. It should be better located.

Reply

Figure 12-1 will reflect the addition of a decon unit. The decon trailer has been located adjacent to the control trailer. See revised figure 12-1.

9. How will the public be handled? Can they enter the office or the support area? What about deliveries to the site? How is access controlled? A security booth should be located at the east access to the site.

Reply

See Section 10, page 62 of the work plan. No addition to the text.

10. Will haul roads be cleaned automatically or is BNR going to sample first? Will the roads could be scraped with the earth moving equipment and then treated in the thermal unit? If BNR is going to sample first in lieu of scraping, EPA will need to review and approve a sampling plan for the haul roads.

Reply

Two composite samples will be collected of surface soils in the areas used for haul roads. One composite sample will be collected from roadways north of the feed processing area and one composite sample will be collected from roadways south of the feed processing area. Each composite will be formed from three (3) aliquots collected from stations evenly spaced along the roadway. Analytical results will be compared to the clean-up levels for p,p'-DDT, hexachlorobenzene, DDD, DDE, and dieldrin developed for the site and used during soil removal activities. Should analytical results indicate a roadway containing concentrations above the clean-up level for any of these parameters, the roadway will be cleaned and re-sampled for verification purposes.

11. How will run-off from the haul roads and storage areas (south holding area) be handled?

Reply

Provisions for run-off from the haul roads are not being considered because dump trucks will be used to transport the contaminated material to the wastefeed area. Precipitation is generally light, with the rate of evaporation exceeding precipitation. If necessary, the treated stockpiles in the south verification holding area will be covered to prevent water from coming in contact with the piles.

12. On TPU #3 Soil Remediation Unit - General Arrangement the guy wires specify 10 degrees of rotation. What does this mean?

Reply

Two of the guy wires have been rotated 10° off-center so that they would fit the site constraints and unit configuration.

13. How are the pads constructed? Do they overlap with existing concrete pads such that seams may be present or will new concrete be pored over the existing concrete surface? Our concern is that the seams could leak. A detailed plan of the pad is needed e.g., ensure liquid containment, are expansion joints going to be used? Where will the sumps be located? How are you going to be catching drippings from equipment?

Reply

New pads will be poured over the existing concrete pads where appropriate (either concrete or concrete/asphalt). Pad details have been submitted to the USEPA. Drawings of the pad are shown on Figures 12-3 and 12-4.

14. Discuss the precautions that will be taken to protect the public and workers in the area from hazards associated with the construction of the unit on-site.

Reply

Precautions taken during construction of the unit on-site are outlined in Section 6 of the Site Specific HASP. The public will not be at risk during this time.

15. There is some lack of consistency between the language used in the text and that used on diagrams, for example, the text refers to "treated" and "untreated piles" while the diagram specifies "verification areas". Also, is the interim storage area the same as the "verification holding area"?

Reply

Figure 12-1 has been corrected to identify treated soil verification holding areas. Interim storage area is the same as verification holding area. The text has been revised to reflect the above comment.

16. The text refers to the vehicle entrance while the diagram does not identify one.

Reply

The vehicle entrance is identified as the main gate in Figure 12-1. No addition to the text is required.

17. BNR is apparently responsible for sampling underneath the stockpiles and the haul roads. However, who is responsible for cleaning up the pad and haul roads (assuming they are found to exceed cleanup levels?)

<u>Reply</u>

The pad will be cleaned by pressure washing as outlined in Section 12.5, page 69 of the Thermal Desorption Work plan. All water will be collected in the sumps and treated. Haul roads will be cleaned as necessary and as directed by BNRR in agreement with the EPA.

18. What are your plans for vehicle control and parking?

<u>Reply</u>

Only vehicles needed for operations on-site will be allowed within site boundaries. Parking will be available for a limited number of vehicles directly in front of the Ackland Building. No addition to the text is required.

19. What is the design of the decon equipment pad? Is this the best location for it? How will run-on and run-off be controlled?

<u>Reply</u>

Williams' equipment will be decontaminated on the equipment pad to be constructed. The equipment decon pad shown in Figure 12-1 is an existing pad from the previous removal/remedial action. All water collected will be pumped to the frac tanks prior to carbon treatment.

20. Where will the pressure cleaning be done? How will that area be cleaned?

<u>Reply</u>

Pressure cleaning of the equipment will be done on the equipment pad. The pad, as per page 69, paragraph 2, will then be given a final cleaning by high pressure wash. All water will be collected in the sumps and treated.

21. Page 68, section 12.5, Pad and Equipment Decontamination, 2nd paragraph: What happens with the soil residues removed from the unit?

<u>Reply</u>

Soil residues are removed from the unit by heating the soil to approximately 800°F for one hour, as per paragraph 3, Section 12.5, page 68. Residues exiting the unit are handled as treated soils and removed to the interim storage area for subsequent analysis.

22. Page 68-9, section 12.5: The sequencing of the decontamination of the thermal unit and work areas is not clear. This process should be listed in steps. Where will the remaining soil and baghouse residues go? How will the remaining residual material be

treated if the equipment is being cleaned out? What will happen to soil collected during the decontamination and dismantling process? How will it be disposed of?

Reply

Decontamination Sequence:

- Operate unit at 800°F for one hour to treat and remove all remaining soil residue. Any remaining baghouse dust is fed into the Dobson Collar for further treatment prior to discharge. All soils exiting the unit are removed to the interim storage area for subsequent analysis. All soils and sediment collected from the work pad will be processed through the unit.
- Clean interior of scrubber of any residues. Test residues for contamination and process accordingly.
- Pressure clean feed system and stacking conveyor and dismantle.
- Pressure clean screw conveyor and remove.
- Wash and pressure clean exterior of rotary dryer and baghouse. The interior of the baghouse will be free of residues because of its pulse jets of compressed air.
- Clean the exterior surface of the quench.
- Wash and pressure clean exterior surfaces of remaining equipment.
- Disassemble equipment.
- The containment pad will be given a final cleaning by high pressure wash.
- All decon water will be collected and treated on-site by activated carbon adsorption.

23. Page 69, 2nd and 3rd paragraph: A "decontamination (or interface) trailer" is mentioned but does not appear on the site diagram. The text mentions 2 access gates. These do not appear on the site diagram. What are normal operating hours? How will the entrance be controlled? How will people be kept from just wondering on-site?

Reply

A decon trailer is not mentioned on page 69, paragraphs 2 & 3, but will be included on Figure 12-1. Security and site access are detailed in Section 10, page 62. Four (4) access gates will be shown on Figure 12-1. Normal operating hours will be 24-hours per day.

24. Page 69, 1st full paragraph, 2nd sentence: delete "if necessary".

Reply

No

25. Page 69. Has Williams obtained the City of Yakima wastewater discharge permit?

Reply

No. Water would need to be collected and sampled prior to obtaining a city discharge permit.

Section 14: Health and Safety

1. Page 71: Who is the Health and Safety Officer?

Reply

No Health and Safety Officer has been assigned to this project yet. No addition to text.

Section 15: Project Quality Assurance/Quality Control

1. Page 74: What labs are going to be used?

Reply

No lab has been selected yet; however, Williams will submit the selected laboratory Qualifications and Experience and their Quality Assurance plan when a lab has been selected. Selection of the lab will be made after the workplan and performance test plan approvals and the work required goes out for bid. No addition to text.

Section 16: Remedial Action Plan

1. Page 78, number 5: add the EPA OSC name and telephone number and the EPA Technical Advisor. They are as follows: Lynda Priddy (206) 553-1987 and Cathy Massimino (206) 553-4153, respectively.

Reply

Text has been revised to reflect above comments.

Appendix A: Performance Test Plan

1. Table 1-2: I believe Ecology has a new ASILs for DDD [DDE]. That number should be used.

Reply

The ASIL for p'p'-DDE will be added to Table 1-2.

2. QA/QC procedures and plans for additional excavation under the north and south stockpiles should be supplied.

Reply

This additional excavation does not affect the Performance Test Plan.

QA/QC procedures and plans for additional excavation under the north and south stockpiles are the same as those used and approved by the EPA for soil removal activities and are described in the Soil Removal Work Plan, dated March 17, 1993.

3. Figure 3-3: Sampling spot 5 is not described on page 3-13.

Reply

No sampling is planned at this location. Figure 3-3 will be modified and the sampling location removed.

4. Table 3-6: Add to the procedures that samples should be taken after the treated water is added to the soil for conditioning or quenching.

Reply

The procedure will be clarified in Table 3-6.

5. Pages 3-22 and 3-23: Nickel should be listed with the other metals.

Reply

Nickel is listed on both pages. No addition to text.

Attachment 1: Quality Assurance Project Plan

1. Table 5-1: What about samples for metals in treated soil?

Reply:

Specifying samples for analysis for metals in the treated soil on Table 5-1 was inadvertently omitted. The table will be modified.

Cathy Massimino's Comments

General Comments

1. The modifications to the thermal treatment process to address the baghouse dust treatment (e.g., Dobson collar, dust feed rate monitoring mechanism, setting AWFCO for maximum dust feedrate, engineering drawing and equipment descriptions including the Dobson Collar, heat balance, etc.), need to be cohesively added to the workplan. Except for indications on some of the figures (e.g., Figure 3-1, etc.) the document does not describe or reflect the necessary revisions to incorporate this modification. The revisions are expected to be reflected in the narrative, tables, figures and appendices.

Reply

The baghouse dust feed rate is a direct function of the waste feed rate that will be an AWFSO. The performance test will be run using "worse-case" material from the site and soil cleanup criteria will be demonstrated. Return rate of baghouse dust will always be a similar percentage of the waste feed. The volume of baghouse dust is estimated to be less than 5% of the feed volume and will be controlled by the feed rate. Separate measurement is not necessary since sampling of the treated soil will be done on a routine basis during normal operation throughout the site cleanup. However, during shakedown, Williams will incorporate a solids flow meter to measure the flow of baghouse dust to the Dobson Collar. If the device doesn't work as expected, the EPA will relieve Williams of the AWFSO requirement on baghouse dust flow for the remainder of the project. No addition to the text is required.

2. Any additional revisions to this document should be provided in the form of revised pages. It is also recommended that the pages be annotated to reflect the changes.

Reply

The text has been revised to reflect the above comment.

Specific Comments

1. The baghouse was not listed in mass balance, but its particulate removal was accounted for.

Reply

The "kiln off-gas" outlet and "secondary off-gas" are shown on the heat and mass balance to account for the particulate removal from the baghouse. No addition to text.

2. Page 19, revised to reflect that >2" material will be screened out while page 25 [23] still reflects 3".

Reply

The text has been revised to reflect the above comment.

3. Page 35, should reflect that authorization for full production will be based on the final performance test report including the risk assessment addendum.

Reply

The text has been revised to reflect the above comment.

4. Figure 5-1, still does not reflect interim operation.

Reply

Interim operation is reflected in the production schedule.

5. Page 36, §6 should reflect feedrate monitoring and recording on a per minute frequency not per hour.

Reply

Monitoring and recording is on a per minute basis. The units are on a unit per hour basis.

6. PIDs and Table 6.2, only some of the AWFSO parameters are reflected with pre-alarms to alert the operator of a problem so it can be corrected before it goes outside of the acceptable limits. It is strongly recommended that all AWFSO parameters have pre-alarm limits set.

Reply

The PID drawings and Table 6.2 have been checked for accuracy and correlated accordingly. Williams is currently reviewing control philosophy and making

recommendations for engineering pre-alarm limits for various AWFSO parameters.

7. Pages 38-45, should be reviewed for consistency with pages 3-18 and 3-19 of the performance test plan (Appendix A).

Reply

The text has been revised to reflect the above comment.

8. Page 38, item e, should reflect that an instantaneous desorber off-gas temperature of 450°F will result in waste feed shut-off. The concept of totally shutting down the desorber and the thermal oxidizer if maximum temperature are exceeded, is a matter grave concern. The fuel should be cut back as necessary to return to a safe operating mode maintaining the system within required operating temperatures while waste is still within the system. The AWFSO's apply at all times while waste is within the system.

Reply

It is implicit in the operation of the burner management package that if the burner is shut down an AWFSO results. See Table 6.2, page 45. A response for this comment has been inserted into the text and reads as follows:

A thermal oxidizer temperature of approximately 1800°F (permit condition) has been selected. If the temperature rises above 2000°F, the operator will manually begin to decrease the fuel to the burner. If the temperature is still increasing and exceeds 2100°F then the thermal oxidizer burner will be shut-down causing both an AWFSO and primary burner to be shut down, also. The 2100°F limit is to protect all down stream equipment.

9. Page 38, item c, should reflect a feedrate in pounds/minute, and include an instantaneous feedrate AWFSO limit.

Reply

The read out of the present scale is in tons/hour. Williams will add an instantaneous high feed rate AWFSO limit. The AWFSO limit will be determined during the shake down and performance test period.

10. Page 39, item g, should also reflect an instantaneous low soil temperature cut-off.

Reply

No. See response #15(1).

11. Page 39, item h, should also reflect an AWFSO.

Reply

The text has been revised to reflect the above comment. See also Table 6.2, page 49.

12. Page 40, items s. and q, and Table 6.3, a demonstration of whether a back-up emergency generator is necessary needs to be addressed.

Estimated risks associated with power failure causing a shut down of the unit are presented in the revised AAQIR. The conclusion is that a backup generator is not required.

13. Page 41, item v. the AWFSO for these parameters will initially be set during clean soil shakedown. These limits must be accepted by the Agency prior to start-up with contaminated soil. Final limits will be based on the performance test.

Reply

Williams concurs. No addition to the text is required.

14. Table 6.1, pages 42-44, this table incorrectly reflects only exceedences of the CO limit as an AWFSO. Also, needs to be revised to reflect CO corrected to 7% O_2 and revised range of 3000 ppm.

Reply

The text has been revised to reflect the above comment.

15. Table 6.2, need to revised as follows:

1) Include thermal desorber exit soil temperature instantaneous minimum limit and reflection that soil temperature parameter does not apply during first 20 minutes a after start-up.

Reply

During our meeting of February 2, 1994, it was discussed that either gas temperature or soil exit temperature would be used as an AWFSO. Williams has chosen the soil exit temperatures to be used to initiate the AWFSO based on a 20 minutes rolling average. A twenty minute delay has also been agreed to for the first twenty minutes of starting to allow one retention volume of soil to approach the thermocouple. Williams disagrees with an instantaneous AWFSO for low soil temperature. Again, if there is a stoppage of feed for several minutes, that stoppage of feed will be seen as a low temperature one retention time volume

later. If instantaneous feed AWFSO is initiated, the unit would be forced down because no soil was passing over the thermocouple. Therefore, Williams respectfully requests that no instantaneous AWFSO for low soil exit temperature be imposed.

2) See comment 13, above for packed bed scrubber flowrate, APC purge rate, and stack gas flowrate.

Reply

Williams concurs. No addition to text is required.

3) See comment 9, above for the thermal desorber maximum feedrate.

Reply

No.

4) Footnote 4 should also reflect recorded continuously except for ID Fan Failure, Power Failure, Loss of water to Quench.

Reply

The text has been revised to reflect the above comment.

16. Pages 48-49, needs to be amended to include dioxins and furans.

Reply

One sample of the treated soil will be collected for dioxin and furan analysis during each run of the performance test, for a total of three samples. The samples will be composited from 15-minute grab samples collected during the testing. These results will be compared to the levels agreed to between BNRR and the EPA.

17. Page 51, needs to be amended to include nickel and dioxins and furans.

Reply

The text has been revised to reflect the above comment.

18. Table 7-3, needs to be evaluated in conjunction with the risk assessment/air quality document. It is assumed that these documents will address the site specific dispersion modeling for the compounds that failed the Tier II analysis, as well as performance of a total risk evaluation versus per compound. Also, the level of free chlorine should be assumed to be 20% of the HCl level.

Reply

The revised AAQIR addresses site specific dispersion modeling for compounds that failed the TIER II analysis as well as performance of a total risk evaluation versus per compound. The assumption regarding free chlorine has been incorporated into the revised AAQIR. All values are less than TIER III limits.

19. Page 74, indicates data from Kaye data logger will be used to fill out the roundsheet. According to page 3-5 of the performance test plan, Appendix A, certain AWFSO parameters (e.g., baghouse pressure, packed bed pH, stack gas flow indicator) are missing from the data logger. The data logger must be upgraded to continuously record all AWFSO parameters, as well as indicating when a parameter has exceeded its AWFSO limit. Provide an example print-out from the Kaye data logger with the AWFSO parameters for this project.

Reply

The description on page 3-5 of the performance test plan will be changed to reflect the comment. All parameters with AWFSOs will be continuously recorded. An example of the print-out form from the Kaye will be provided when it is programmed specifically for the Woods project.

Appendix A

1. Page 1-2, revised first bullet to address dioxins and furans. Also, replace discussion on what will occur if standards are not met.

Reply

One sample of the treated soil will be collected for dioxin and furan analysis during each run of the performance test, for a total of three samples. These results will be compared to the levels agreed to between BNRR and the EPA. There is no discussion on page 1-2 on what will occur if standards are not met.

2. Page 1-3, discussion on PIC needs to clearly state that meeting acceptable risk limits is one of the performance standards which must be met for the performance test to be deemed successful.

Reply

A general statement has been made as requested.

3. Pages 1-3, 3-12, 3-13, and Table 3-4, should provide the correct EPA method numbers for all the sampling protocols.

Reply

Addition of the appropriate method numbers will be made as follows:

- **Particulates, hydrogen chloride, and chlorine using EPA Method 5 sampling train modified for the collection of acid gases (BIF Method 0050)**
- **OCL Pesticides and Semi-volatile Organic using EPA Modified Method 5 sampling train (SW-846 Method 0010)**
- **Volatile organics by Volatile Organic Sampling Train (VOST SW-846 Method 0030)**
- **Metals by EPA Multiple Metals Train (BIF Methods Manual --NOTE: THEY WANT DRAFT METHOD 29)**
- **PCDDs/PCDFs by EPA Method 23**
- **Continuous Emission Monitor for CO by EPA Method 10(40 CFR 60) and O2 by EPA Method 3A (40 CFR 60).**

4. Page 1-1, revise to include dioxins and furans.

Reply

There is no appropriate place to include dioxins and furans on page 1-1. Change will be made per comment 1 to page 1-2.

5. Table 1-2 needs to be evaluated in conjunction with the risk assessment/air quality document. The evaluation of dioxins and furans needs to be broader, not just 2,3,7,8-TCDD.

Reply

As stated in the text, total equivalent 2,3,7,8-TCDD (TEQ) will be calculated. It is planned to compare this total equivalent to the ASIL for 2,3,7,8-TCDD. Table 1-2 will clarify that the allowable stack gas emission is TEQ. A footnote will be added to the table. No change is planned at this time to incorporate remaining PICs since individual limits are not the concern, rather the total risk comparison.

6. Table 2-1, the operating range for ID fan current and APC recycle water flow rate must be established during the clean soil shakedown. These limits must be accepted by the Agency prior to start-up with contaminated soil. Final limits will be based on the performance test.

Reply

As specified, these limits will be established during clean soil shakedown, approved by the agency and verified during the performance test. This will be clarified by changing Footnote c of Table 2-1.

7. Page 3-6, the thermal desorber exit gas temperature low limit for use during the first 20 minutes of operation after startup will be set based on the performance test.

Reply

Based on past experience, the 250°F unit is an excellent alarm setpoint because it prevents the possibility of water condensation while maintaining a wide operating range during start-up which minimizes both AWFSO and unit shutdowns. It should also be noted that the exit gas temperature does not impact the efficiency of the thermal oxidizer.

8. Page 3-6, the concept of totally shutting down the desorber and the thermal oxidizer, if maximum temperatures are exceeded is a matter of grave concern. The fuel should be cut back as necessary to return to a safe operating mode maintaining the system within required operating temperatures while waste is still within the system. The AWFSO's apply at all times while waste is within the system.

Reply

In the event the high temperature from the thermal oxidizer is exceeded, shutdown of the fuel is required to protect downstream equipment. The control system already would have cut back in an attempt to control the exit temperature. The condition would indicate that a problem existed in the burner control which would need to be corrected. The burner would be restarted as soon as the high temperature condition cleared and the associated burner control problem was corrected.

Also see comment #8 of Cathy Massimino's General Comments.

9. Page 3-7, the operating range for ID fan current must be established during the clean soil shakedown. This limit must be accepted by the Agency prior to start-up with contaminated soil. Final limits will be based on the performance test.

Reply

This is consistent with comment 6 above. A statement will be added to clarify that the limit will initially be established during clean soil start-up and accepted by the agency before start-up on contaminated soil.

10. Page 3-14, §3.6.1, provides procedures for how blending will be performed to assure minimum concentrations provided in the DRE calculation will be achieved.

Reply

The 5 roll-off boxes represent approximately 10% of the total feed planned during the test. Blending will thus be aimed at 1/10 roll-off soil to site soil. Blending should not be critical since the average site concentration of approximately 700 ppm of HCB offers a 1 to 2 order of magnitude safety factor for demonstration of 99.99% DRE. Section 3.6.1 will be modified to state that the soil will be blended approximately 1 part roll-off soil to 9 parts site soil.

11. Page 3-15, §3.6.3, add to bullets the following:

- Compliance with acceptable health based limits for emissions based on the risk assessment/air quality document.

Reply

The text will reflect the above comment.

- **Compliance with acceptable health based limits for emissions based on the risk assessment/air quality document.**

12. Page 3-19, the operating range for ID fan current, APC purge rate and APC recycle water flow rate must be established during the clean soil shakedown. These limits must be accepted by the Agency prior to start-up with contaminated soil. Final limits will be based on the performance test.

Reply

The comment is understood and modification as requested will be made to previous sections of the Plan. This section of the Plan is describing A-1 parameters which will be established as part of the test. At this point in time limits established during shakedown have already been approved. No change is required in this section of the plan.

13. Page 3-20, the thermal desorber exit gas temperature low limit for use during the first 20 minutes of operation after startup will be set based on the performance test data (A-1 parameter).

Reply

See Massimino Comment #7.

14. Page 3-12, the baghouse minimum limit of 1" is based on the baghouse being operated between 1-2" during the performance test. If the baghouse is operated outside of this range during the performance test, the DP will be set based on the performance test data.

Reply

It is recognized that the test will need to be run near the limit as is stated in the plan. No change to the plan language is required.

15. Page 3-23, add risk assessment addendum reflecting results of performance tests.

Reply

A bullet will be added to page 3-23 to indicate the performance test report will contain a risk assessment addendum reflecting the results of the performance tests. The text will reflect the above comment.

16. Table 3-2, amend to include the following:

- instantaneous limits for feedrate and desorber exit soil temperature
- specify soil feed limit in pounds/min
- specify that desorber exit soil temperature not applicable during first 20 minutes of operation
- footnote c and b should refer to clean soil shakedown for setting initial parameter levels
- instrument numbers for failure of ID fan, burner system, and power failure. For the power failure, this is assuming that the data logger has not gone off-line due to the failure.

Reply

All changes will be made except the change to pounds/minute on soil feed rate. This change would require an instrument modification which is not necessary. Instantaneous values of feed rate are recorded each minute and integrated to a 60-minute rolling average value. The units on this recorded value are tons/hr.

17. Tables 3-4 and 3-5, feed soil should be sampled every 15 minutes.

Reply

30 minute intervals were specified since this frequency has been accepted by the EPA at other cleanup sites. Tables 3-4 and 3-5 will be changed to reflect the change to 15 minute frequency. The bracketed amount of (approximately 8 ounces) will be deleted since with the increased frequency one 4-ounce scoop will be sufficient.

18. Tables 3-13 and 3-15, add dioxins and furans.

Reply

One sample of the treated soil will be collected for dioxin and furan analysis during each run of the performance test, for a total of three samples. These results will be compared to the levels agreed to between BNRR and the EPA. This will require modifications to Tables 3-13, 3-14 and the addition of a new table (3-15A Analysis of Dioxins and Furans in Treated Soil).

19. Table 3-25, the operating range for ID fan current, and APC recycle water flow rate must be established during the clean soil shakedown. These limits must be accepted by the Agency prior to start-up with contaminated soil. Final limits will be based on the performance test.

Reply

Footnote b will be changed to say that these operating ranges will be established during clean soil shakedown and approved by the agency.

20. Table 3-26, see comment 12, above on page 3-19, see comment 13, above, on page 3-20, see comment 14, above, on page 3-12, and see comment 16, above on Table 3-2.

Reply

Changes to the table include modification of footnotes c and b to reflect establishment of limit during clean soil shakedown, addition of instantaneous limits on waste feed, minimum thermal desorber soil discharge temperature, footnote that thermal desorber exit soil temperature limits are not in effect during the first 20 minutes after start-up, and addition of a footnote that minimum thermal desorber exit gas temperature will also be established by the test for use during first 20 minutes after startup.

21. Page 4-1, should reflect that authorization for full production will be based on the final performance test report including the risk assessment addendum.

Reply

Page 4-1 will be changed to reflect that authorization for full production will be based on submittal and approval of the final performance test report including the risk assessment addendum.

Attachment 1

1. Page 2-1, see comments 1, 2, and 3, above, under Appendix A.

Attachments 1, 2, and 3 should be provided to the Agency with the performance test notification.

Reply

Section 2 of the QAPP will be made consistent with the changes to the introduction to the PTP.

Donald Matheny's Comments

It appears that the selection of a contract lab(s) is still pending for this project. Once the lab(s) has been selected, a copy of the Laboratory's QA Plan should be forwarded to EPA for review against the requirements found in Tables 1-1 & 1-2 of the Performance Test Plan and Table 10-1 of the QA Plan. These plans should also be incorporated into the site file as relevant supporting documents. Our past comments (11-29-93) regarding the adequacy of past data validation reports for this site are still relevant.

Reply

See Comment 1 of Section 15.

WESTON/Paul Meeter's Comments

General Comments

- Did the emergency release modeling dictate whether a backup ID fan and/or generator were required?

Reply

Estimated risks associated with a power failure causing a shut down of the unit are presented in the revised AAQIR. The conclusion is that a back-up generator is not necessary.

- If treated blowdown water is used during the production burn then it should be used during the performance test and treated soil samples should be taken after treated water application.

Reply

Soil sampling will be occurring throughout operations. Williams does not believe this is necessary. No addition to text.

Work Plan Comments

- Page 32 references an opacity monitor, I thought we agreed to have them perform visible emissions readings. Is opacity an Air Authority requirement?

Reply

Opacity meter will be omitted from text.

- Williams must install an AWFSO for high instantaneous feed rate in addition to the 60 minute rolling average.

Reply

Williams concurs with the above comment.

- What are the detection limits for Cadmium and Mercury in Table 7-3 and how do they compare to the TIER I and TIER II limits.

Reply

The detection limits for Cadmium and Mercury in Table 7-3 are 0.30 mg/kg and 0.10 mg/kg, respectively. Assuming a value for Cadmium and Mercury equal to half the detection limit, as is typical, both metals pass the TIER I and TIER II limits. These results will be reflected in Table 7-3.

- Does Williams have any partitioning and removal efficiencies from other projects instead of using guidance document values in Table 7-3.

Reply

No data is available at this time.

- Table 7-2 must include a full volatile and semi-volatile scan plus the next 10 highest peaks should be identified as TICs.

Reply

Williams concurs with this comment.

- The LTTD roundsheet does not contain all of the required operational parameters that will have AWFCO. How will the additional data be provided.

Reply

The text has been revised to reflect the above comment.

Performance Test Plan Comments:

Page 1-3 - Particulate and HCl are measured by Method 5 and 26 or 0050.

Reply

Method clarification will be made consistent with response to Catherine Massimino comment 3.

Page 1-4 - Volatile organics are measured by EPA Method 0030 not Modified Method 5.

Reply

Change will be made as noted consistent with comment 3 by Catherine Massimino.

Page 1-4 - Multi Metals by Draft Method 29.

Reply

Since Method 29 is a Draft method, we will need to compare to the accepted method from the BIF Manual.

Page 3-6 - Should the auxiliary fuel be shut off or just reduced when the thermal oxidizer or the quench exit gas temperature are exceeded. I don't like the idea of zero combustion while waste is still inside the unit.

Reply

No change is planned per the response to general comment 8 by Catherine Massimino.

Page 3-18 - Why is the soil feed rate limit not activated for the first 20 minutes after startup.

Reply

The soil feed rate is activated during the first 20 minutes after startup as was discussed in detail during the February 2, 1994 meeting in Washington. However, it was agreed that the minimum soil discharge could not be measured during the first 20 minutes of operation. Limits for the first 20 minutes of operation following

start up will be consistent with responses to comments by Catherine Massimino on this subject.

Page 3-22 - What information will be included in the draft performance test report. Will it enable our people to do laboratory data validation.

Reply

The data to be supplied for reduction, validation, and reporting is described in section 9 of the QAPP. No change is planned in response to this comment.

Table 3-5 - Feed soils should be sampled every 15 minutes.

Reply

The change will be made consistent with comment 17 by Catherine Massimino.

Table 3-6 - Treated soils should be sampled every 15 minutes.

Reply

The change will be made consistent with comment 17 by Catherine Massimino.

Table 3-8 - The back half impinger water should be saved and analyzed. The entire train should be rinsed with toluene not just the back half.

Reply

Method 23 clearly states in section 4.2.5 that the impinger water is discarded. The procedure will be modified to direct rinsing of the entire train with toluene as specified.

Table 3-10 - The front half rinse should be 50/50 methanol/methylene chloride.

Reply

The procedure will be corrected as noted to rinse with 50/50 methanol/methylene chloride. Both the front and back half rinses will be changed. Correction will also be made to Table 3-14 and 3-23.

Table 3-14 - Semi-volatiles to include full scan plus 10 highest peaks.

Reply

Tables 3-14 and 3-23 will be modified to include this note.

Table 3-21 - Toluene rinse is analyzed separately.

Reply

Our latest direction from the EPA (Larry Johnson) has been to combine these rinses. No change is required.

Table 3-23 - The semi-volatile samples must be spiked with surrogate standards prior to extraction.

Reply

The procedure will be changed to reflect addition of surrogate standards prior to any manipulation of samples consistent with analysis procedures of EPA Method 0010.

Table 3-24 - VOST tube will be analyzed separately for breakthrough determination.

Reply

A statement will be added to Table 3-24 that VOST tubes will be analyzed separately to check for possible breakthrough. The table will also be changed to note the addition of surrogate standards.

Figure 3-5 - The sample probes at ports A and B represent flow disturbances therefore the traverse point criteria for ports C and D will be different than those shown in Figure 3-5.

Reply

The two levels of sampling ports A, B and C, D are approximately 10 feet apart. The projected area of the sampling probe is insignificant compared to the cross sectional area of the stack. It would be expected that the air flow pattern within the stack would reestablish within a few inches of the probe at the A, B level. Therefore it would not be expected that the A, B probe would represent a flow disturbance at the C,D level several feet away.

Figure 3-7 - Does not indicate the required XAD inlet thermocouple.

Reply

Figure 3-7 will include indication similar to Figure 3-9.

Quality Assurance Project Plan

7. Table 4-1	Under OCL Pesticides for stack gas samples: Precision for the duplicate analysis should be within 20 RP if pesticide concentration is above the lowest calibration standard. Precision for the surrogate should be ± on dibutyl chlorendate (DBC) if DBC not diluted out.

Reply

Table 4-1 is consistent with Table 7-3 Summary of QA/QC Procedures for SVOST, EPA Handbook Quality Assurance/Quality Control Procedures for Hazardous Waste Incineration, for all semi-volatiles (OCL pesticides, hexachlorobenzene and other semi-volatiles) that are to be analyzed.

9. Table 10-1	Under OCL Pesticides: Linearity check frequency should be before sample analysis and once every 72 hours. Single point calibration check frequency should be once every 12 hours. Need to specify an injection blank once every 12 hours, as well. Under Total Chlorine: Assume this refers to chloride. Work plan does not specify either potentiometric titration or specific ion electrode. For ion chromatography: no parameters are listed for QA/QC such as, initial calibration/linearity check, continuing calibration, blanks, matrix spikes, etc.

Reply

The text will be revised to reflect the above comment.

General Comments from Conference Call

Comment - Williams should propose a sampling scheme during shakedown operations.

Reply

Table 9-2 of the Work Plan outlines the soil sampling procedures for pre-performance test operations. This period will include shakedown of the unit.

If you have any additional questions, please feel free to call me at 404/879-4075.

Sincerely yours,

WILLIAMS ENVIRONMENTAL SERVICES, INC.

Mark A. Fleri
Project Manager
MAF:js

cc: Z. Lowell Taylor, Williams Environmental Services
Bruce Sheppard Burlington Northern Railroad
David Eagleton - Burlington Environmental
Tom Hippe - Burlington Environmental
Bob Kievit - EPA
Tom Backer - Preston Thorgrimson
General File
Job File

APPENDIX U

NOVEMBER 1994
COMMENT & RESPONSE LETTERS

WILLIAMS ENVIRONMENTAL SERVICES, INC.

November 18, 1994

Ms. Lynda Priddy
Environmental Protection Specialist
Hazardous Waste Specialist
United States Environmental Protection Agency, Region X
1200 Sixth Avenue
Seattle, Washington 98101

Subject: Woods Industries Site
Yakima, Washington
Transmittal No.: 0047
Number of Pages: 5

Re: Responses to EPA's Comments Received October 24, 1994
Williams Project No. 0365

Dear Ms. Priddy:

Williams Environmental Services, Inc. (Williams) has received the EPA's comments on the April 1994 revised pages to the Thermal Desorption Workplan and has provided the responses outlined below. Where applicable, these responses have been incorporated into the workplan. In addition, the workplan has been finalized to reflect the use of TPU #4 at the Woods site.

Comment 1

The workplan is not internally consistent with respect to the AWFSOs that are required for this project. Appendix A, Table 3-2, accurately reflects the AWFSOs for this project, until revisions are approved by the Agency based on the clean soil shakedown or performance test. It is strongly recommended that other Tables or narrative in the workplan that list these AWFSOs refer to this table.

Response 1

The workplan has been made internally consistent with respect to the AWFSOs shown in Appendix A, Table 3-2. Additionally, reference is made to Table 3-2 in the narrative portion of the workplan.

Comment 2

Page 17,§3.2, if treated soil does not pass the required treatment criteria, and there is not a legitimate reason to question the acceptability of the sampling procedures or the analytical results (i.e., QA/QC requirements are not met, etc.), the treated soil must be retreated and not resampled.

2075 West Park Place Stone Mountain, Georgia 30087 404/879-4107

Response 2

Williams concurs with this comment.

Comment 3

Pages 20 and 25, §3.5 and 4.1, there is still an inconsistency.with the limitation of the size of debris to process in the desorber. We originally agreed that the cobble cut-off size would be 3" unless it was demonstrated the equipment could not handle 3".

Response 3

Sections 3.5 and 4.1 have been revised to show a cutoff size of 3" unless it is demonstrated that the equipment cannot handle debris this size.

Comment 4

Page 21, item 19, provide example print-out of desorber AWFSO data logger with the final work plan.

Response 4

An example printout from the data logger has been provided in Appendix X.

Comment 5

Page 21, §3.5.2, the sump sludgy material, when fed to the desorber with or without the contaminated soil, must comply with the operating and feed restrictions on the desorber, as well as assuring that the performance test adequately addresses this material.

Response 5

Sludgy material collected in the sumps will be fed to the desorber in compliance with all operating and feed restrictions. No change to the text is required.

Comment 6

Page 22, §3.5.3, the issue of the compliance status of the facility that will receive the spent carbon should be revisited prior to sending the material off-site.

Response 6

Westates Carbon's disposal/regeneration facilities have already been shown to be in compliance with applicable rules and regulations. However, their compliance status can be re-verified prior to sending any carbon off site.

Comment 7

Page 28, the issue of whether the baghouse dust feedrate monitoring proves successful does not affect the requirement for shutdown of the feed of the baghouse dust to the desorber during AWFSOs.

Response 7

If an AWFSO occurs, the baghouse dust feed to the desorber will be stopped along with the waste feed to the desorber.

Comment 8

Page 53, Table 7.1, add dioxins and furans to this table.

Response 8

Dioxins and furans have not been added to Table 7.1. As stated in the USEPA's April 20, 1994, comments on the March 14, 1994, workplan, it was agreed that the quenched (previously contaminated) treated soil would be sampled only once for dioxins during the performance test.

Comment 9

TPU Round Sheet, still does not include all AWFSOs.

Response 9

Figure 15.2 has been updated to show the LTTD roundsheet currently being used.

Comment 10

Section 15, a separate daily manually logged form should be maintained for AWFSOs including description of AWFSO (i.e., low thermal oxidizer temperature), instrument number, instrument reading during event, date and time of the event, duration of the event, cause of the event, corrective actions taken to address the event and minimize future occurrences, time waste feed restarted, record of report of event and time of approval for restart from Agency if greater than 7 AWFSOs within a week.

Response 10

Williams concurs with this comment and has developed a separate daily manually logged form to document AWFSOs. A copy of this form is included in Section 15.

Comment 11

Appendix A, pages 1-4, and 3-13, stack sampling protocols for the continuous emission monitoring should specify 40 CFR Part 266 Appendix IX, Section 2.

Response 11

Williams' LTTD is neither a boiler nor an industrial furnace and its CEMs should not be subject to the BIF regulations as outlined in 40 CFR Part 266, Appendix IX, Section 2. Williams does agree to abide by the regulations as stated in 40 CFR Part 60, Appendices B and F.

Comment 12

Appendix A, Table 3-10, last bullet, correct misspelling of methanol.

Response 12

The requested correction has been made.

Comment 13

Page 68-9, §12.5, the minimum number of baghouse pulse cycles planned, and internal inspection planned to assure the baghouse interior and bags are free of residue needs to be addressed.

Response 13

The minimum number of baghouse pulse cycles planned will be determined once operations have begun. The frequency at which the baghouse is pulsed will depend upon the soil characteristics and the amount of dust carryover that is experienced. In order to ensure that the baghouse interior and bags are free of residue, the baghouse will be inspected upon its arrival on site. It will again be inspected two weeks after operations have commenced and monthly thereafter.

Comment 14

Each pile of treated soil must be labeled with information that correlates with sample numbers and dates of sampling or some system as suggested by Burlington. The purpose is to prevent pile mix-up.

Response 14

All treated soil piles are segregated and tracked to prevent any chance for pile mix-ups. Soil piles can also be identified by flag markers if necessary.

Comment 15

If public interest increases at the site a methodology for accounting for unidentified compounds may need to be added to the performance test plan. For the methodology refer to pages 4-7 of EPA's DRAFT EXPOSURE ASSESSMENT GUIDANCE FOR RCRA HAZARDOUS WASTE COMBUSTION FACILITY (EPA-530 R-94-021).

Response 15

This issue will need to be addressed by both Burlington Environmental and Burlington Northern Railroad if public interest increases to a point that such discussions are deemed necessary.

As mentioned previously, these responses have been incorporated into the workplan where applicable. If you have any questions, please call me at (404) 879-4854 or Mark Fleri at (404) 879-4075.

Sincerely,

WILLIAMS ENVIRONMENTAL SERVICES, INC.

Greg Whetstone

Greg Whetstone
Project Engineer
GTW:cl

cc: Mark A. Fleri
George Harbour
David Eagleton (Burlington Environmental)
Bruce Sheppard (Burlington Northern Railroad)
Paul Meeter (Weston)
Rick Roeder (Washington State Dept. of Ecology)
John Gilbert (USEPA)
Job File 0364

WILLIAMS ENVIRONMENTAL SERVICES, INC.

November 18, 1994

Ms. Lynda Priddy
Environmental Protection Specialist
Hazardous Waste Specialist
United States Environmental Protection Agency, Region X
1200 Sixth Avenue
Seattle, Washington 98101

Subject: Woods Industries Site
Yakima, Washington
Transmittal No.: 0048
Number of Pages: 7

Re: Responses to EPA's Comments Received November 1 and 8, 1994
Williams Project No. 0365

Dear Ms. Priddy:

Williams Environmental Services, Inc. (Williams) has reviewed EPA's comments on the revised Thermal Desorption Work Plan dated October 7, 1994, and has provided the responses outlined below. Where applicable, these responses have been incorporated into the plan.

November 1, 1994, Comments

Comment 1

The Performance Test Plan portion of the Work Plan was not included in this submission.

Response 1

A revised Performance Test Plan will be included with the next submission of the work plan.

Comment 2

Page 5, number 2 and page 25, last paragraph: EPA disagrees with the last sentence "(d)epending on the site conditions, engineering controls such as Williams covering conveyors and screens for the feed handling equipment will be implemented upon agreement between Williams, Burlington Environmental (BE), BNRR and EPA." EPA will review monitoring results or based on visual observations EPA may require mitigation practices which could include engineering controls or shutting down operations until the causes/situations have been remedied (e.g., weather conditions change or other controls are implemented and found effective). Yakima is a non-attainment area for PM10. Because of EPA concerns for PM10, EPA has discussed the use of engineering controls with Williams and BE. BE agreed to

2075 West Park Place Stone Mountain, Georgia 30087 404/879-4107

investigate the use of engineering controls and to report back to EPA. To date, BE has not reported back to EPA on the potential use of engineering controls such as conveyor and screen covers.

The document states that the "vibratory screening of oversized material will only be performed as needed" to reduce the potential for dust formation. How will this affect the availability of a reliable steady stream of untreated soil to keep the TDU in consistent operation? Why would the screening operation only produce "significant dust" at certain times?

Response 2

Williams has discussed the use of engineering controls with Burlington Environmental (BE) and has agreed to cover the feed soil and stacking conveyors. Additionally, Williams has modified the work plan text to reflect the comment.

Vibratory and shaker screening will be performed to separate cobbles and other debris from the soil stockpiles. The screening operation will not affect the availability of feed soil to the unit for maintaining consistent operations. Enough feed soil will be stockpiled in the waste feed storage area to maintain thermal operations should screening operations stop. Screening operations have the potential to produce dust depending upon soil conditions and characteristics, but Williams will make every effort to minimize fugitive dust emissions.

Comment 3

Page 21, 5th sentence: The "and then processed" we assume means that the sludge will be "processed" through the TDU and will meet cleanup standards. Is this a correct assumption.

Response 3

The comment as stated is correct.

Comment 4

Page 53, footnote 2: Treated soils must meet the cleanup numbers for metals (arsenic, lead and mercury) or be retreated or deposited of as specified in the consent order.

Response 4

Williams' LTTD does not operate at temperatures high enough to volatilize metals from the soil, with the exception of mercury. Williams does not purport that its units treat metals and will not be responsible for treated piles that fail based on analysis for metals. If cleanup goals for metals are exceeded, the soil will be deposited as specified in the consent order.

Comment 5

Page 8, reply number 2: The reply first states that Williams plans to start hauling from the south pile first and later in the reply it is stated that Williams plans to complete treatment of the north pile first. Please correct or clarify. Sampling (and treatment if treatment goals are exceeded) will be necessary under both the south and north piles.

Response 5

Williams will haul from either stockpile as needed but plans to complete treatment of the north stockpile first. Sampling will be performed by BNRR under both piles and additional soil treated if contaminant levels exceed industrial soil cleanup levels established for the site.

Comment 6

Site Layout Map, Figure 12-1: It is unclear from the site layout plan whether there is a decontamination area that permits easy access from the TDU exclusion zone into the office area/parking lot area. There is apparently a decon trailer south of the TDU exclusion area; however, from the site plan it does not seem apparent that someone leaving the TDU exclusion zone and using this decon trailer can enter the office/parking lot area or main entrance area without crossing back over the TDU exclusion area. Previously EPA and BE discussed having the decon area in close proximity to the office.

According to the plan legend, the exclusion area is the area inside the area defined by -x-x-x-x. However, on the plan such an area is also identified as being a support zone (near the tool trailer). Please clarify whether this area is an exclusion zone or a support zone. EPA and BE need to discuss site arrangements in more detail including:

a. the placement of EPA office space;

b. an adequate barrier zone along the Woods fence line as it borders the Haas parking lot in the vicinity of the TDU;

c. parking. The designated parking area apparently will not be big enough to meet all parking needs; and

d. site security. EPA requires that access to the site be controlled at all times. Williams' plan to have visitors report to the office is not controlled access. Whatever controlled access approach is adopted for the Woods site, the approach must ensure that people inside the site can quickly escape in case of an emergency.

Response 6

Figure 12-1 has been revised to reflect the use of TPU #4. As shown in Figure 12-2, the decontamination trailer has been re-located to provide easy access between the exclusion zone and the office area. Additionally, the figure has been revised to delineate the exclusion and support zones. Exclusion zones will include the soil stockpiles, feed and treated soil storage areas, and the thermal desorber and baghouse. Support zones will include those areas around the thermal oxidizer, quench, scrubber, and control trailer.

Items a-d have been discussed between EPA and Burlington Environmental. Currently, it is Williams' understanding that the EPA office will be north of the Ackland building. Parking may be available along the fence line east of the site or at another offsite location. Finally, Williams, BE, and BNRR are currently working on a revised control access approach for discussion with the EPA.

Comment 7

Page 12 of response letter, reply to number 17: Who is responsible for cleaning the haul roads if sampling shows that cleanup levels are exceeded? Is Williams responsible for cleaning the pad?

Response 7

Williams will be responsibile for cleaning the haul roads if sampling shows that industrial cleanup levels are exceeded, provided that Burlington Environmental supplies Williams with the necessary data to verify the cleanliness of the haul roads prior to Williams mobilizing to the site. Williams is responsible for pressure washing the pad at the completion of the project.

Comment 8

Page 13 of response letter, reply to number 22: What happens to the contaminated material collected from performing the activities described in the last nine bullets?

Response 8

Soils or sludge generated as a result of cleaning the unit will be processed through the unit and verified clean before the unit is disassembled. All decon water collected will be treated by activated carbon adsorption.

Comment 9

Page 10 of response letter, reply to number 10: In general the approach seems OK. Regarding the number of grab and composite samples to be taken to determine whether the haul roads and other similar areas meet cleanup levels will be determined toward the end of operations based on the experience of the OSC/oversight staff.

Response 9

Williams believes this issue needs to be settled prior to the end of operations to avoid any unnecessary delays that may arise as a result of differing opinions. Therefore, Williams proposes to sample the haul roads at a frequency of one composite sample per 100 feet of road.

General Comment 1

Spare parts should be readily available on-site for equipment necessary for on-going operations.

Response

Williams concurs with this comment and will store spare parts and tools in the warehouse portion of the Akland building.

November 8, 1994 Comments

General Comment 2

The proposed alternate monitoring parameter and operating range to be utilized instead of soil temperature for the initial 20 minutes must be provided in the workplan.

Response

During the initial 20 minutes of operation, no soil will be discharging from the thermal desorber. Additionally, prior to each time the unit is shut down, Williams will make an effort to empty the desorber of all soil so that no soil will be discharging during the subsequent 20 minutes of startup. Therefore, no alternate monitoring parameter is required.

Comment 1

Pages 19 and 25 are now consistent with respect to the size limitations for input to the desorber.

Response 1

Williams concurs with this comment.

Comment 2

Page 23, the discharge conveyor has been deleted from trailer 1. Indicate which trailer the conveyor will be located at.

Response 2

The discharge conveyor will no longer be included with Trailer 1 or the other five primary trailers. The discharge conveyor will be shipped separately.

Comment 3

Page 31, the drive for the feed belt has been revised to reflect half the horse power of what was originally proposed, though the feedrate projected and the size of the belt and hopper has not changed. Provide data reflecting Williams experience with failure or breakdown of this feed system with this smaller size drive and the originally proposed size drive at the feedrates proposed for this project. If the failure or breakdown frequency is greater with the smaller drive the larger drive should be substituted.

Response 3

The drive for the feed belt on TPU 4 is actually an 8.9 horsepower variable speed drive. The belt drives are designed for site specific characteristics and conditions. Currently, TPU 4 is in use at a Superfund site in New Jersey and the feed system has not experienced any failures or breakdowns. Additional data reflecting Williams' experience with failure or breakdown of the feed system with the smaller size drive versus the originally proposed size drive is not available, though it is very similar to the one originally proposed and in use on TPU 3. However, by the end of the current project, Williams will have knowledge of its performance.

Comment 4

Page 31, based on the revised dimensions of the desorber is the estimate of 20 minutes solids residence time still expected to be reflective of the system?

Response 4

The internal drum dimensions for TPU #4 are the same as those for TPU #3. Therefore, the estimated solids residence time in the desorber remains unchanged.

Comment 5

Drawing 4ABS, it is not clear that this is a complete PID for the revised quench/scrubber system. For example, as depicted there is only one pump feeding the quench system. Since a number of conditions related to the quench relying on this pump can result in AWFSO's (i.e., loss of water, high quench tower outlet temperature, etc.) additional pumps would be expected as part of this system (previous design had 3 pumps feeding the quench). A similar comment can be made concerning the acid scrubber system which previously had two main headers bringing in water while the system now proposed has only one header.

It should be confirmed that the Drawing 4ABS is complete and the system should be updated to assure adequate redundancy/backup to minimize AWFSO's.

Response 5

There are four pumps feeding the quench/scrubber system of TPU 4. One pump supplies city water to the quench, one pump (P27) supplies water to the scrubber packing, and two pumps (P28 and P32) recycle water to the quench. The scrubber system on TPU 4 has only one main header bringing in water instead of the two headers for TPU 3. The scrubber vessel for TPU 4 consists of a single chamber, while the TPU 3 scrubber consists of two scrubbing chambers.

Williams has incorporated these responses into the work plan where applicable. All revisions have been marked accordingly so that they are easily identifiable.

Sincerely,

WILLIAMS ENVIRONMENTAL SERVICES, INC.

Greg Whetstone

Greg Whetstone
Project Engineer
GTW:pc

cc:
- Z. Lowell Taylor
- Mark A. Fleri
- George Harbour
- David Eagleton (Burlington Environmental)
- Bruce Sheppard (Burlington Northern Railroad)
- Paul Meeter (Weston)
- Rick Roeder (Washington State Dept. of Ecology)
- John Gilbert (USEPA)
- Job File 0365

State of New Jersey
Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, J
Commission

Post-it™ brand fax transmittal memo 7671

To Greg Whetstone	# of pages ▸ 2
Co. Williams Envr	From R. Buskus
Dept.	Co. NJDEP
Fax # 404 879 5748	Phone # 609 530 4041
	Fax #

RECEIVED
NOV 18 1994
WILLIAMS ENVIRONMENTAL

November 18, 1994

Mr. Greg Whetstone
Williams Environmental Services, Inc.
2075 West Park Place
Stone Mountain, GA 30087

RE: LTVS - Lipari Off-Site Remediation
Trial Burn Plan
Log No. 01-94-0845

Dear Mr. Whetstone:

This office is in receipt of your letter dated October 25, 1994. All of the issues in your letter are acceptable with the exception of item five.

Based on the information provided by you, it is agreed that with a stack gas moisture content 56% an additional 2.3 liters of condensation will be additionally accumulated in the sample train. In order to accommodate the excess moisture, an empty 2-3 liter flask shall be placed before the HNO_3/H_2O_2 impingers as an extra condensate trap. This additional moisture knock-out trap will be sufficient to handle the excess moisture problem.

Regarding the analysis of impingers one through three, EPA Method 29 requires that Fraction 2A (as per Section 5.3.4) be reduced to 20 ml. This is a standard procedure in the method. Section 5.3.4.1 then details how fraction 2A shall be digested and diluted to 150 ml or the appropriate volume for the expected metals concentration. This digested fraction then becomes known as the "Concentrated Fraction 2A". It is this dilution volume that my September 27 letter refers to as a volume of 15 ml. The same is true for Section 5.3.3, instead of diluting to 300 ml the volume shall only be diluted to 30 ml.

If the above procedures are implemented, the test consultant for your facility should be able to obtain the necessary minimum detection limits (mdl) for metals.

A written response to this letter is required before the final protocol approval and the stack tests can be conducted. Failure to provide such a response could result in possible enforcement action.

If you have any questions please feel free to contact me at (609) 530-4041.

Sincerely,

Richelle Burkeen

Richelle Burkeen
Sr. Env. Engineer
Bureau of Technical Services

c Gordon McDonald - Sevenson
Edward Choromanski - SRO

APPENDIX V

DATA LOGGER EXAMPLE PRINTOUT

```
08/05/94 14:22:22 LIMIT  102 KILN VAC    0.00P  ROTARY DRYER VACUUM HIGH
08/05/94 14:25:26 RETURN 102 KILN VAC   -0.13P  ROTARY DRYER VACUUM HIGH
    W.E.S. 15 MIN. SHIFT REPORT.     LAPARI SITE.
08/05/94 14:30:00 15 MIN. REPORT (KORA).
     B.H.-DP       KILN VAC      I.D.AMPS      SCRB-DPL      SCRB-DPR      SCALE        OXYGEN        CO INST.
100    0.3P         -0.14P          0.0A          0.3P          0.3P          0.0T         0.00           0.P

     THC INST        CO2         SCC-TEMP      QNCHTEMP      TRIBOFLO      SOILTEMP      BHSTEMP       SCB-TMPF
        0.C           0.C          82.4F         82.9F          0.C          74.6F         80.8F         82.1F

     SCB-TMPR      SCRB B.D      SCB-FL-F      SCB-FL-R      QCH-FL-R      QCH-FL-F      SMP-PH-R      SMP-PH-F
200   81.9F          94.G          0.G           0.G           0.G           0.G          7.43U         8.57U

     PCC-O2                                                                              CMCAL-SW      MAN-TRND
       25.0P                                                                              0.005M        OPEN N

     CO-R-1HR      CO-R-10M      SCLE 24H      TOT-*10       THC-RL-1
300    0.0C          0.0C          0.0T          1.T          0.0C



08/05/94 14:45:00 15 MIN. REPORT (KORA).
     B.H.-DP       KILN VAC      I.D.AMPS      SCRB-DPL      SCRB-DPR      SCALE        OXYGEN        CO INST.
100    0.3P         -0.14P          0.0A          0.3P          0.3P          0.0T         0.00           0.P

     THC INST        CO2         SCC-TEMP      QNCHTEMP      TRIBOFLO      SOILTEMP      BHSTEMP       SCB-TMPF
        0.C           0.C          81.6F         81.9F          0.C          74.2F         79.6F         81.4F

     SCB-TMPR      SCRB B.D      SCB-FL-F      SCB-FL-R      QCH-FL-R      QCH-FL-F      SMP-PH-R      SMP-PH-F
200   81.2F          95.G          0.G           0.G           0.G           0.G          7.43U         8.56U

     PCC-O2                                                                              CMCAL-SW      MAN-TRND
       25.0P                                                                              0.004M        OPEN N

     CO-R-1HR      CO-R-10M      SCLE 24H      TOT-*10       THC-RL-1
300    0.0C          0.0C          0.0T          1.T          0.0C
```

```
08/05/94 15:00:00 15 MIN. REPORT (KORA).
    B.H.-DP         KILN VAC        I.D.AMPS        SCRB-DPL        SCRB-DPR        SCALE           OXYGEN          CO INST.
100    0.3P          -0.14P            0.0A            0.3P            0.3P            0.0T            0.00             0.P

    THC INST          CO2           SCC-TEMP        QNCHTEMP        TRIBOFLO        SOILTEMP        BHSTEMP         SCB-TMPF
        0.C             0.C           80.8F           80.9F             0.C           73.6F           78.5F           80.6F

    SCB-TMPR        SCRB B.P        SCB-FL-F        SCB-FL-R        QCH-FL-R        QCH-FL-F        SMP-PH-R        SMP-PH-F
200   80.4F            91.G             0.G             0.G             0.G             0.G           7.46U           8.54U

    PCC-02                                                                                          CMCAL-SW        MAN-TRND
      25.0P                                                                                          0.004M          OPEN M

    CO-R-1HR        CO-R-10M        SCLE 24H        TOT-*10         THC-RL-1
300    0.0C            0.0C            0.0T             1.T            0.0C


08/05/94 15:15:00 15 MIN. REPORT (KORA).
    B.H.-DP         KILN VAC        I.D.AMPS        SCRB-DPL        SCRB-DPR        SCALE           OXYGEN          CO INST.
100    0.3P          -0.14P            0.0A            0.3P            0.4P            0.0T            0.00             0.P

    THC INST          CO2           SCC-TEMP        QNCHTEMP        TRIBOFLO        SOILTEMP        BHSTEMP         SCB-TMPF
        0.C             0.C           79.5F           79.7F             0.C           72.3F           77.2F           79.5F

    SCB-TMPR        SCRB B.P        SCB-FL-F        SCB-FL-R        QCH-FL-R        QCH-FL-F        SMP-PH-R        SMP-PH-F
200   79.4F            89.G             0.G             0.G             0.G             0.G           7.45U           8.53U

    PCC-02                                                                                          CMCAL-SW        MAN-TRND
      25.0P                                                                                          0.003M          OPEN M

    CO-R-1HR        CO-R-10M        SCLE 24H        TOT-*10         THC-RL-I
300    0.0C            0.0C            0.0T             1.T            0.0C
```

```
08/05/94 15:30:00 15 MIN. REPORT (KORA).
    B.H.-DP          KILN VAC         I.D.AMPS         SCRB-DPL         SCRB-DPR         SCALE            OXYGEN           CO INST.
100    0.3P           -0.14P             0.0A             0.3P             0.4P             0.0T             0.00             0.P

    THC INST           CO2            SCC-TEMP         QHCHTEMP         TRIBOFLO         SOILTEMP         BHSTEMP          SCB-TMPF
        0.C              0.C            78.2F            78.5F              0.C            71.4F            75.9F            78.3F

    SCB-TMPR         SCRB B.D         SCB-FL-F         SCB-FL-R         QCH-FL-R         QCH-FL-F         SMP-PH-R         SMP-PH-F
200   78.3F             89.G              0.G              0.G              0.G              0.G            7.48U            8.52U

    PCC-O2                                                                                                CMCAL-SW         MAN-TRND
      25.0P                                                                                                0.004M           OPEN M

    CO-R-1HR         CO-R-10M         SCLE 24H         TOT-*10          THC-RL-I
300    0.0C             0.0C             0.0T              1.T             0.0C



08/05/94 15:45:00 15 MIN. REPORT (KORA).
    B.H.-DP          KILN VAC         I.D.AMPS         SCRB-DPL         SCRB-DPR         SCALE            OXYGEN           CO INST.
100    0.3P           -0.14P             0.0A             0.3P             0.4P             0.0T             0.00             0.P

    THC INST           CO2            SCC-TEMP         QHCHTEMP         TRIBOFLO         SOILTEMP         BHSTEMP          SCB-TMPF
        0.C              0.C            77.1F            77.5F              0.C            70.6F            74.6F            77.5F

    SCB-TMPR         SCRB B.D         SCB-FL-F         SCB-FL-R         QCH-FL-R         QCH-FL-F         SMP-PH-R         SMP-PH-F
200   77.5F             86.G              0.G              0.G              0.G              0.G            7.46U            8.52U

    PCC-O2                                                                                                CMCAL-SW         MAN-TRND
      25.0P                                                                                                0.003M           OPEN M

    CO-R-1HR         CO-R-10M         SCLE 24H         TOT-*10          THC-RL-I
300    0.0C             0.0C             0.0T              1.T             0.0C
```

```
    W.E.S. 15 MIN. SHIFT REPORT,    LAPARI SITE.
03/05/94 16:00:00 15 MIN. REPORT (KORA).
    B.H.-DP         KILN VAC        I.D.AMPS        SCRB-DPL        SCRB-DPR        SCALE           OXYGEN          CO INST.
100    0.4P          -0.14P            0.0A            0.4P            0.4P            0.0T            0.00             0.P

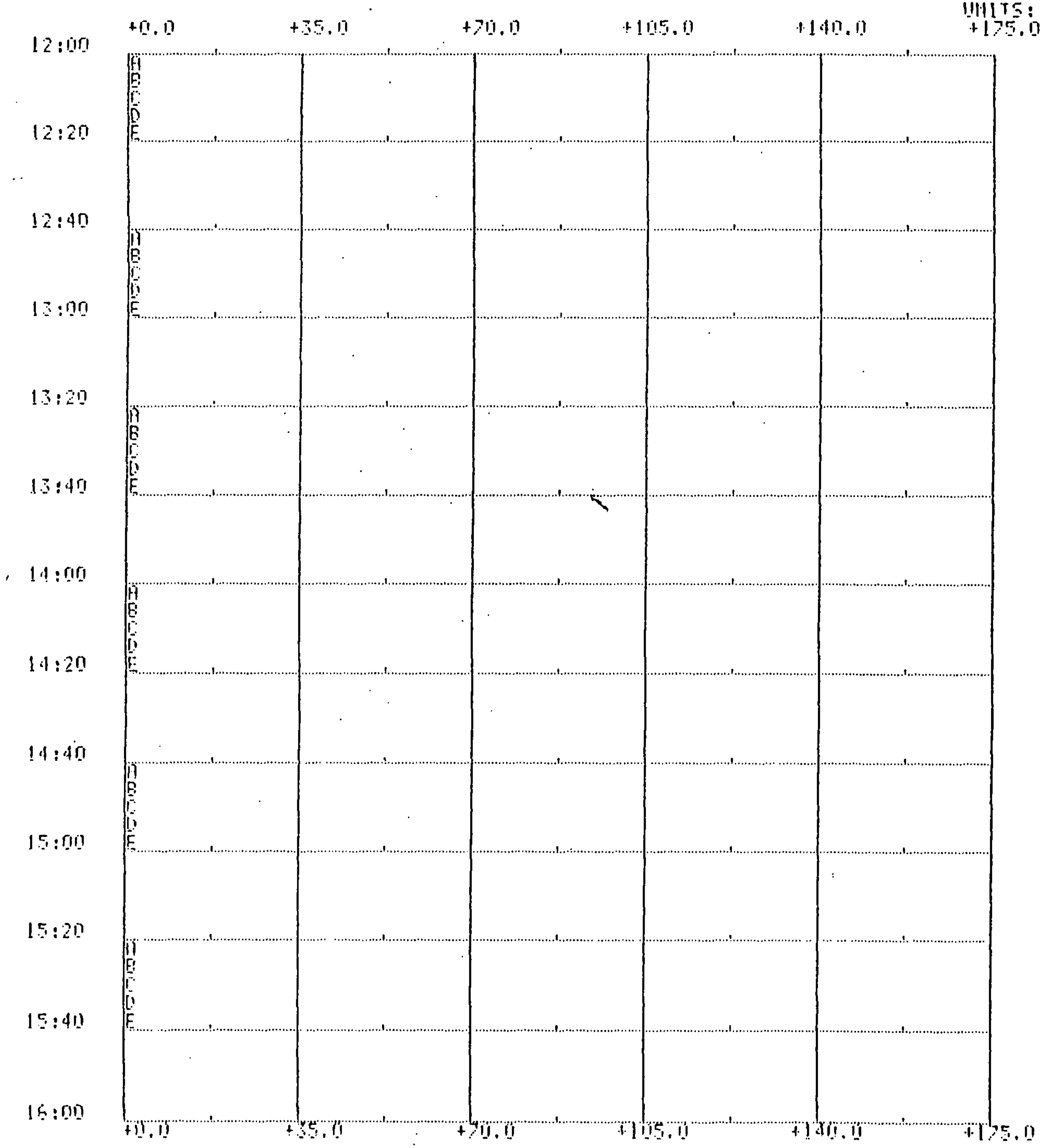
    THC INST          CO2           SCC-TEMP        QNCHTEMP        TRIBOFLO        SOILTEMP        BHSTEMP         SCB-TMPF
        0.C             0.C           76.6F           76.3F             0.C           69.7F           73.4F           76.5F

    SCB-TMPR        SCRB B.D        SCB-FL-F        SCB-FL-R        QCH-FL-R        QCH-FL-F        SMP-PH-R        SMP-PH-F
200   76.7F            88.G             0.G             0.G             0.G             0.G           7.48U           8.50U

    PCC-02                                                                                          CHCAL-SW        MAN-TRND
      25.0P                                                                                          0.004M          OPEN M

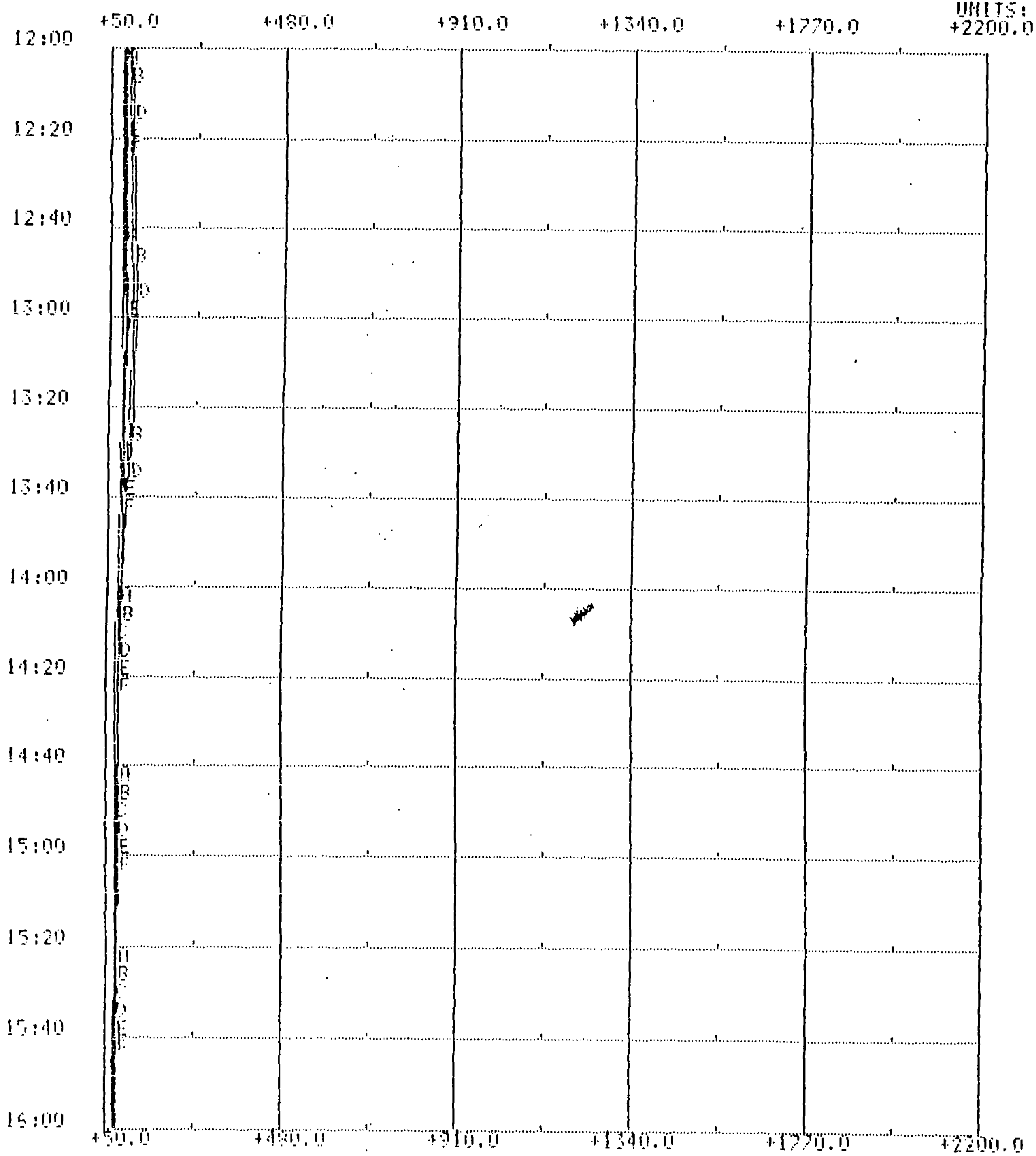
    CO-R-1HR        CO-R-10M        SCLE 24H        TOT-*10         THC-RL-1
300    0.0C            0.0C            0.0T             1.T            0.0C
```

SUMMARY: HIST, HOR1, TRIG48, SLOW, CS02



A	B	C	D	E
I.D.AMPS	SCALE	OXYGEN	CO2	TRIBOFLO
UNITS: A	T	O	C	C
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.
0.0	0.0	0.0	0.	0.

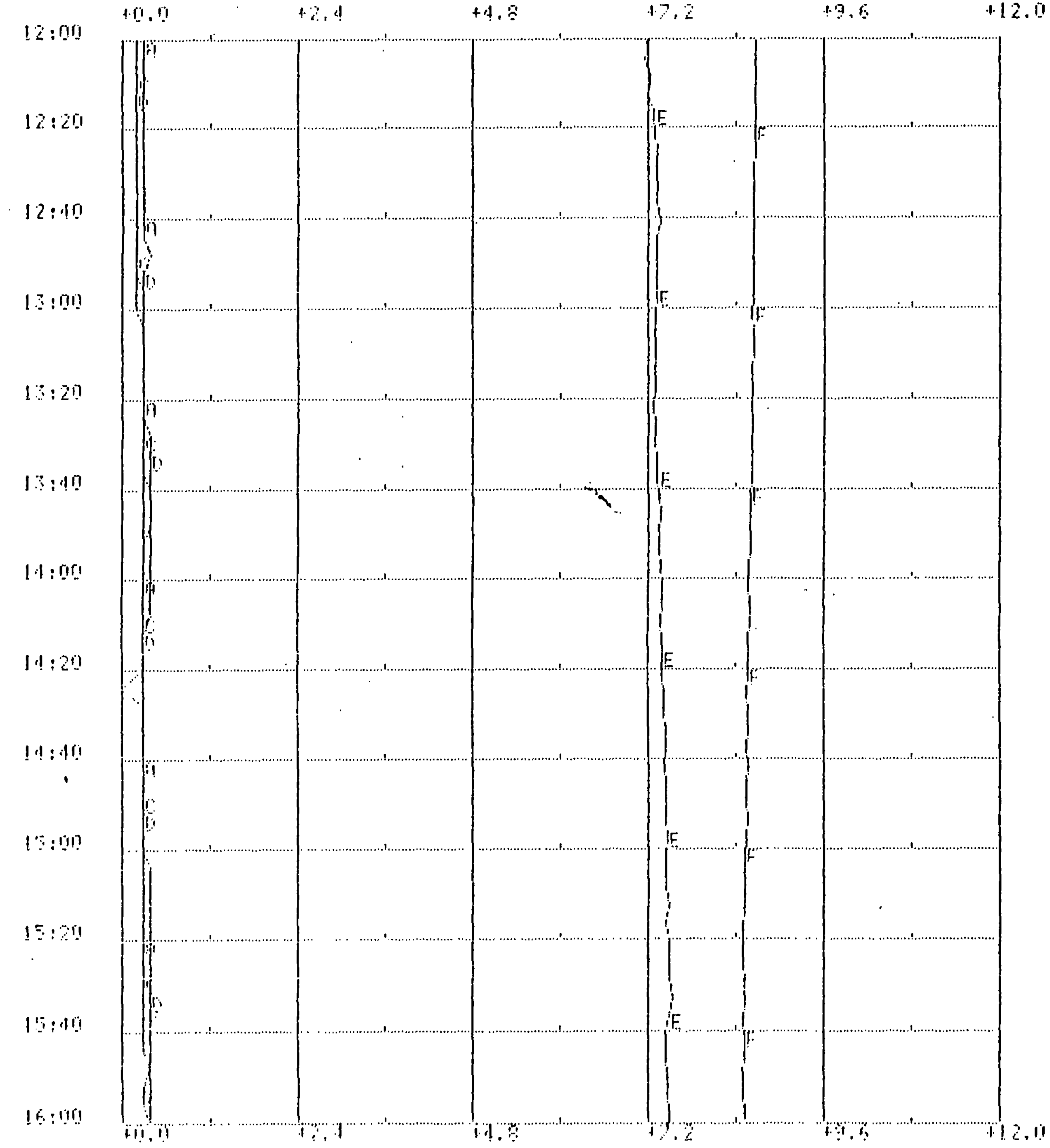
08/05/94



UNITS:

A SCC-TEMP F	B QNCHTEMP F	C SOILTEMP F	D BHSTEMP F	E SCB-TMPF F	F SCB-TMPR F
86.5	99.6	81.9	104.7	90.5	89.8
86.6	100.2	82.1	105.7	90.6	90.1
86.8	100.6	82.2	106.6	90.8	90.4
86.9	101.0	82.4	107.4	91.0	90.5
87.1	101.7	82.5	108.5	91.2	90.8
87.3	102.2	82.6	109.5	91.4	91.0
87.4	102.8	82.8	110.4	91.7	91.2
87.6	103.4	83.0	111.2	91.8	91.5
87.7	103.8	83.1	111.9	92.0	91.8
87.9	104.3	83.2	112.7	92.2	92.0
88.0	105.0	83.3	113.5	92.3	92.2
88.3	105.8	83.6	114.6	92.6	92.4
88.4	106.5	83.7	115.6	92.8	92.6
88.6	106.9	84.0	116.2	93.0	92.6
88.7	107.0	84.1	116.3	93.2	92.8
88.8	106.9	84.2	116.0	93.2	92.8
89.0	106.6	84.3	115.4	93.2	92.9
89.0	106.1	84.4	114.4	93.0	92.7
89.1	105.4	84.4	113.3	92.9	92.5
89.1	104.5	84.5	112.1	92.6	92.2
89.0	103.5	84.6	110.6	92.4	91.9
88.9	101.8	84.5	108.5	92.0	91.5
88.8	99.5	84.3	106.1	91.4	90.9
88.4	97.3	83.5	103.2	90.6	90.2
87.9	95.2	82.0	100.0	89.5	89.4
87.3	93.0	80.6	96.8	88.5	88.4
86.7	91.0	79.5	94.0	87.6	87.6
86.1	89.6	78.6	91.5	86.7	86.7
85.5	88.2	77.7	89.3	85.8	85.8
84.5	87.1	76.8	87.5	85.0	85.0
84.1	86.2	76.2	85.8	84.3	84.5
83.8	85.5	75.8	84.6	83.7	84.0
83.5	85.0	75.4	83.6	83.3	83.5
83.3	84.6	75.1	82.9	83.0	83.2
82.9	84.1	74.9	82.3	82.6	82.7
82.7	83.7	74.8	81.8	82.4	82.4
82.4	83.4	74.7	81.3	82.2	82.1
82.4	83.1	74.6	81.0	82.1	82.0
82.2	82.8	74.6	80.7	82.0	81.8
82.0	82.5	74.4	80.3	81.8	81.6
81.8	82.2	74.3	79.9	81.6	81.4
81.6	81.9	74.2	79.6	81.4	81.2
81.5	81.6	74.1	79.3	81.2	81.1
81.2	81.4	73.9	79.1	81.0	80.8
81.0	81.2	73.8	78.8	80.8	80.7
80.8	80.9	73.6	78.5	80.6	80.4
80.5	80.6	73.4	78.2	80.3	80.3
80.2	80.3	73.0	77.9	80.0	80.0
79.9	80.0	72.7	77.5	79.8	79.7
79.5	79.7	72.3	77.1	79.5	79.3
79.1	79.3	72.0	76.7	79.1	79.0
78.7	79.0	71.7	76.4	78.7	78.7
78.4	78.7	71.5	76.0	78.5	78.4
78.0	78.3	71.2	75.6	78.2	78.1
77.7	78.0	71.0	75.3	77.9	77.9
77.4	77.7	70.8	75.0	77.6	77.6
77.1	77.5	70.6	74.6	77.5	77.5
76.9	77.2	70.5	74.5	77.4	77.3
77.3	77.0	70.2	74.2	77.1	77.2
76.8	76.6	69.9	74.2	76.7	76.9
76.6	76.3	69.7	73.4	76.5	76.7

08/05/94



A	B	C	D	E	F
B.H.-DP	KILN VAC	SCRB-DPL	SCRB-DPR	SMP-PH-R	SMP-PH-F
P	P	P	P	U	U
0.3	-0.14	0.2	0.2	7.19	8.67
0.3	-0.14	0.2	0.2	7.17	8.67
0.3	-0.14	0.2	0.2	7.23	8.67
0.3	-0.14	0.2	0.2	7.22	8.67
0.3	-0.14	0.2	0.2	7.28	8.68
0.3	-0.14	0.2	0.2	7.30	8.68
0.3	-0.14	0.2	0.2	7.32	8.67
0.3	-0.14	0.2	0.2	7.33	8.65
0.3	-0.14	0.2	0.2	7.33	8.65
0.3	-0.14	0.2	0.2	7.33	8.65
0.3	-0.14	0.2	0.2	7.38	8.65
0.3	-0.14	0.2	0.2	7.33	8.64
0.4	-0.14	0.2	0.2	7.33	8.66
0.3	-0.14	0.2	0.2	7.32	8.64
0.3	-0.14	0.2	0.3	7.33	8.64
0.3	-0.14	0.2	0.3	7.31	8.63
0.3	-0.14	0.3	0.3	7.30	8.64
0.3	-0.14	0.3	0.3	7.31	8.64
0.3	-0.14	0.3	0.3	7.30	8.63
0.3	-0.14	0.3	0.3	7.30	8.62
0.3	-0.14	0.3	0.3	7.28	8.63
0.3	-0.14	0.3	0.3	7.30	8.62
0.3	-0.14	0.3	0.4	7.31	8.62
0.3	-0.14	0.3	0.4	7.32	8.62
0.3	-0.14	0.3	0.4	7.33	8.62
0.3	-0.14	0.4	0.4	7.36	8.60
0.3	-0.14	0.4	0.4	7.32	8.61
0.3	-0.14	0.4	0.4	7.35	8.60
0.3	-0.14	0.3	0.4	7.36	8.60
0.3	-0.14	0.3	0.4	7.37	8.59
0.3	-0.14	0.3	0.4	7.40	8.59
0.3	-0.14	0.3	0.4	7.41	8.60
0.3	-0.14	0.3	0.4	7.39	8.61
0.3	-0.14	0.3	0.3	7.40	8.58
0.3	-0.14	0.3	0.3	7.40	8.58
0.3	-0.14	0.3	0.3	7.41	8.58
0.0	0.00	0.3	0.3	7.42	8.56
0.3	-0.14	0.3	0.3	7.43	8.57
0.3	-0.14	0.3	0.3	7.45	8.57
0.3	-0.14	0.3	0.3	7.44	8.56
0.3	-0.14	0.3	0.3	7.43	8.58
0.3	-0.14	0.3	0.3	7.45	8.55
0.3	-0.14	0.3	0.3	7.44	8.55
0.3	-0.14	0.3	0.3	7.46	8.57
0.3	-0.14	0.3	0.3	7.47	8.55
0.3	-0.14	0.3	0.3	7.46	8.54
0.3	-0.14	0.3	0.4	7.45	8.53
0.3	-0.14	0.3	0.4	7.45	8.52
0.4	-0.14	0.3	0.4	7.50	8.52
0.3	-0.14	0.3	0.4	7.46	8.51
0.3	-0.14	0.3	0.4	7.50	8.51
0.3	-0.14	0.3	0.4	7.51	8.51
0.3	-0.14	0.3	0.4	7.50	8.52
0.3	-0.14	0.3	0.4	7.55	8.52
0.5	-0.14	0.3	0.4	7.49	8.51
0.3	-0.14	0.3	0.4	7.46	8.52
0.3	-0.14	0.3	0.4	7.46	8.57
0.4	-0.14	0.4	0.4	7.48	8.51
0.3	-0.14	0.3	0.4	7.48	8.51
0.4	-0.14	0.3	0.4	7.49	8.53
0.4	-0.14	0.4	0.4	7.48	8.50

08/05/94

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      B.H.-DP      KILN VAC      I.D.AMPS      SCRB-DPL      SCRB-DPR      SCALE         OXYGEN        CO INST.
100     0.3P        -0.14P          0.0A          0.3P          0.4P          0.0T          0.00          0.P

      THC INST       CO2         SCC-TEMP      QNCHTEMP      TRIBOFLO      SOILTEMP      BHSTEMP       SCB-TMPF
           0.C          0.C        75.4F         75.3F          0.C         68.7F         72.3F         75.4F

      SCB-TMPR     SCRB B.D      SCB-FL-F      SCB-FL-R      QCH-FL-R      QCH-FL-F      SMP-PH-R      SMP-PH-F
200     75.5F        84.G           0.G           0.G           0.G           0.G         7.49U         8.50U

      PCC-02                                                                             CMCAL-SW      MAN-TRND
        25.0P                                                                             0.002M        OPEN M

      CO-R-1HR     CO-R-10M      SCLE 24H      TOT-*ID       THC-RL-1
300     0.0C         0.0C          0.0T           1.T          0.0C
```

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08/05/94 16:30:00 15 MIN. REPORT (KORA).
     B.H.-DP        KILN VAC       I.D.AMPS       SCRB-DPL       SCRB-DPR       SCALE          OXYGEN         CO INST.
100    0.3P          -0.14P          0.0A           0.3P           0.4P           0.0T           0.00           0.P

     THC INST         CO2          SCC-TEMP       QNCHTEMP       TRIBOFLO       SOILTEMP       BHSTEMP        SCB-IMPF
        0.0           0.0           74.6F          74.6F            0.0          68.2F          71.8F          74.8F

     SCB-IMPR       SCRB B.D       SCB-FL-F       SCB-FL-R       QCH-FL-R       QCH-FL-F       SMP-PH-R       SMP-PH-F
200   75.1F           79.G            0.G            0.G            0.G            0.G          7.54U          8.50U

     PCC-O2                                                                                    CMCAL-SW       MAN-TRND
      25.0P                                                                                    0.003M         OPEN M

     CO-R-1HR       CO-R-10M       SCLE 24H       TOT-*10        THC-FL-I
300    0.00           0.00           0.0T           1.T           0.00




08/05/94 16:43:39 RETURN 107 OXYGEN       9.50  STACK OXYGEN CONTENT LOW
08/05/94 16:43:39 RETURN 107 OXYGEN       9.50  STACK OXYGEN CONTENT LOW LOW
08/05/94 16:43:50 LIMIT  107 OXYGEN       0.00  STACK OXYGEN CONTENT LOW
08/05/94 16:43:50 LIMIT  107 OXYGEN       0.00  STACK OXYGEN CONTENT LOW LOW
08/05/94 16:43:50 RETURN 107 OXYGEN       9.60  STACK OXYGEN CONTENT LOW
08/05/94 16:43:50 RETURN 107 OXYGEN       9.60  STACK OXYGEN CONTENT LOW LOW
08/05/94 16:43:53 LIMIT  107 OXYGEN       1.90  STACK OXYGEN CONTENT LOW
08/05/94 16:43:53 LIMIT  107 OXYGEN       1.90  STACK OXYGEN CONTENT LOW LOW
08/05/94 16:43:54 RETURN 107 OXYGEN       3.40  STACK OXYGEN CONTENT LOW LOW
08/05/94 16:43:56 RETURN 107 OXYGEN       9.10  STACK OXYGEN CONTENT LOW

08/05/94 16:48:10 LIMIT  107 OXYGEN       0.00  STACK OXYGEN CONTENT LOW
08/05/94 16:48:10 LIMIT  107 OXYGEN       0.00  STACK OXYGEN CONTENT LOW LOW
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Soil Treatment Final Report
Woods Industries Site
Yakima, Washington

Volume II —Appendices E and E-1

August 7, 1996

Prepared for:

BURLINGTON NORTHERN RAILROAD
Seattle, Washington

PHILIP ENVIRONMENTAL SERVICES CORPORATION
210 West Sand Bank Road
Post Office Box 230
Columbia, Illinois 62236-0230

Project 12883088

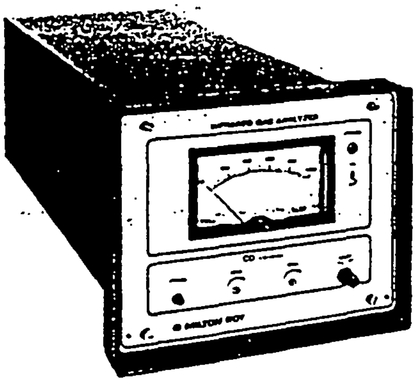
PHILIP
ENVIRONMENTAL

MILTON ROY

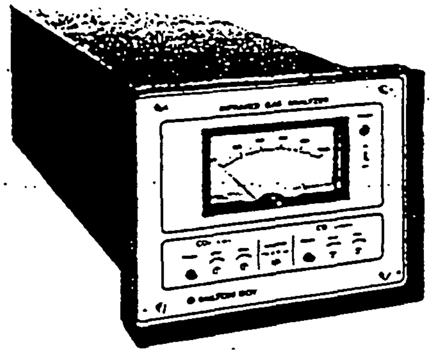
INFRARED GAS ANALYZER

MODELS 3300 & 3400

- *No optical or mechanical adjustments* ■
- *Single beam optics* ■
- *alog or ig. eadout* ■
- *Modular nstruction for maintenance* ■
- *sensitivity to vibration* ■



Model 3300
Single Component Dual Range



Model 3400
Dual Component Single Range

The simplicity of single beam optics design — made possible by the Microflow Detector — results in highly stable, reliable analyzers of unmatched analytical performance, requiring no optical adjustments and only the simplest maintenance.

Principle of Operation

The analyzer uses a technique based on the infrared absorption characteristics of gases to measure gas concentration. Use of an efficient single beam design results in good long-term stability.

A single beam of infrared energy is modulated and passed through a sample cell containing the gas to be measured. The beam emerges attenuated by the amount of energy absorbed by the gas(es) in the sample. Changes in the concentration of the gas(es) result in changes of the intensity of the beam. The remaining energy in the beam is passed serially through two cavities of an infrared detector, a mass-flow sensor filled with gas of the type to be measured.

Changes in the intensity of the beam change the pressure differential between the cavities and consequently the balance of the electrical bridge in the detector circuit.

Electronic processing and linearization of the imbalance signal are used to generate an electrical output signal linearly proportional to the concentration of the gas measured.

Standard Applications

Combustion Efficiency
  Burners & Boilers (CO, CO_2)
  Commercial Ovens (CO, CO_2)

Controlled Atmospheres
  Heat treating (CO, CO_2, CH_4)
  Greenhouses (CO_2)
  Fermentation (CO_2)
  Air Liquification (CO_2)

Process Chemical Gas Analysis

Respiration Studies
  Single Breath Lung Diffusion (CO)

Stack Gases

Total Organic Carbon Analysis (TOC)

MILTON ROY

A subsidiary of Sundstrand Corporation

PROCESS & ENVIRONMENTAL INSTRUMENTS DIVISION

5. Repairs, replacements, adjustments and service performed out-of-warranty shall be charged to the customer at the then current prices for parts, labor, transportation and subsistence.

6. This warranty attaches to the instrument itself and is not limited to the original purchaser.

7. In no event will CSI have any obligation or liability for damages, including but not limited to, consequential damage arising out of, or in connection with, the use or performance of equipment or accessories. No other warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose will apply to equipment or accessories.

8. This warranty constitutes the full understanding of the manufacturer and buyer, and no terms, conditions, understanding or agreement professing to modify or vary the terms hereof shall be binding unless hereafter made in writing and signed by an authorized official of CSI.

All price revisions and design modification privileges reserved.

WARRANTY

1. Except as otherwise indicated, all instruments and stack systems manufactured and sold by Columbia Scientific Industries Corporation (CSI) are guaranteed for a period of one year from date of shipment from the factory against defects in materials and workmanship of those parts manufactured by CSI, and then, only when operated, serviced and maintained in accordance with the instruction manual. Those parts not manufactured by CSI are guaranteed only to the extent that they are covered by a warranty of original manufacturer. Permeation tubes are warranted for six (6) months. Spare parts and accessories, except expendables, are warranted for ninety (90) days. Expendables such as batteries, sample holders, fuses and indicating lamps are not covered by this warranty.

2. The warranty is voided by the following:

a) Injection into CSI stack systems or CSI ambient air monitoring or calibrating equipment, of gas mixtures containing reactive suspended matter or molecules yielding and depositing liquids, tars, solids and other non-gaseous residues.

b) Injection of caustic solutions into the hydrogen lines of CSI hydrocarbon monitors by a malfunctioning hydrogen generator.

c) Damage to CSI Accelerating Rate Calorimeters or Quantitative Reaction Calorimeters caused by samples that detonate, deflagrate or otherwise escape the confines of the sample holder.

d) Damage to stack sampling probes caused by severe corrosion.

e) Damage caused by incorrect installation, by misuse, or by mishandling.

3. Warranty service requests must be received by CSI within the warranty period. Upon notification by the purchaser, CSI will correct defects coming within the scope of this warranty by repairing or replacing the defective unit either at the CSI factory or at the customer's site, at CSI's option. Return shipment of items to CSI must be authorized by a CSI representative and is at customer's expense.

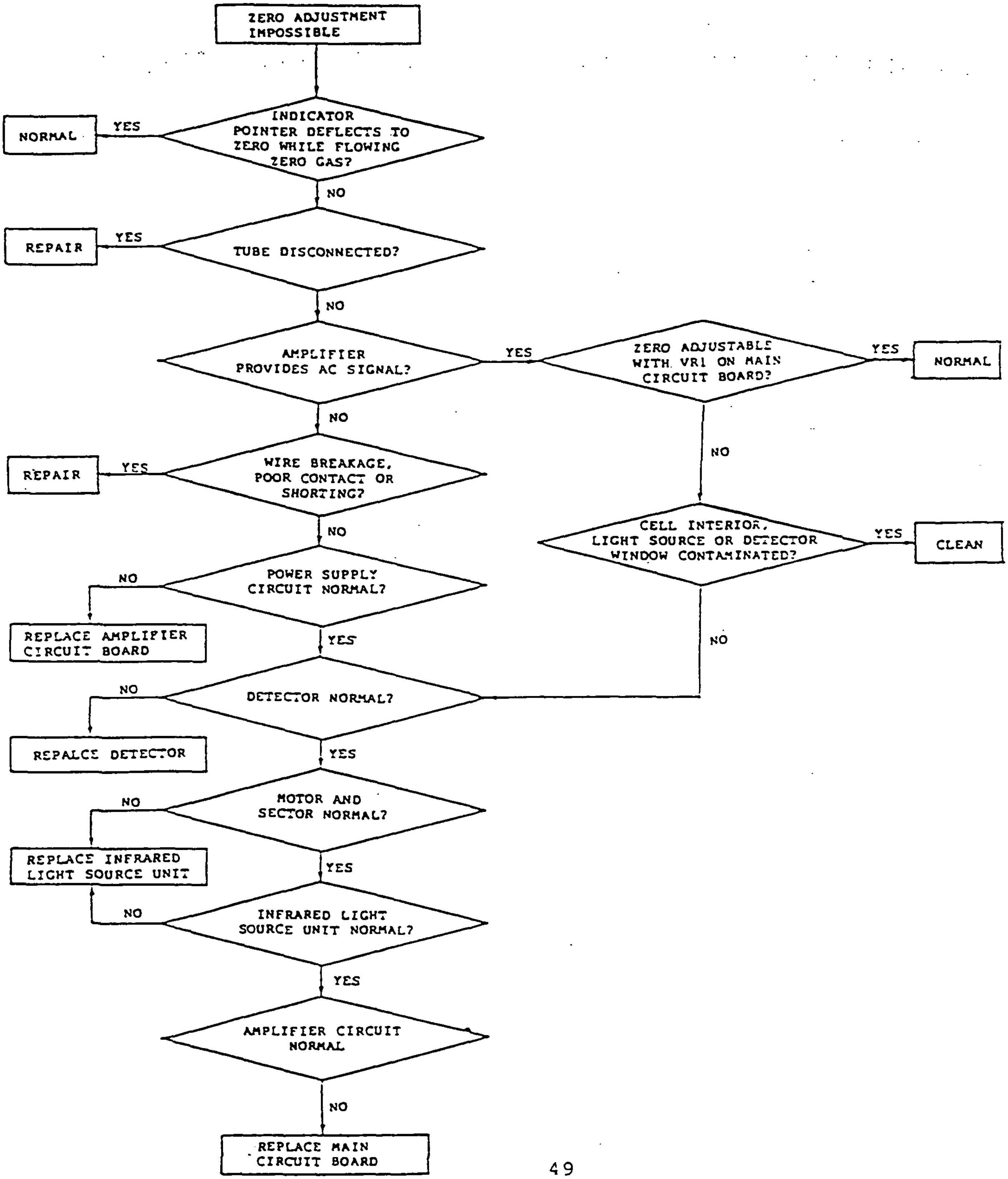
4. Instruments and systems which have been repaired or replaced during their warranty period are themselves guaranteed for only the remaining unexpired portion of their original warranty period. Parts and accessories, including stack probes, umbilicals and permeation tubes, will receive their full warranty period from the date of replacement even if the instrument or system warranty period should expire.

7. WARRANTY

The Warranty Statement appears on the following two pages.

TROUBLESHOOTING CHARTS (Continued)

Chart 2: Unable to Adjust Front Panel Zero



TROUBLESHOOTING GUIDE (Continued)

TROUBLESHOOTING CHARTS (Continued)

Chart 3: Unstable Indicator Readings

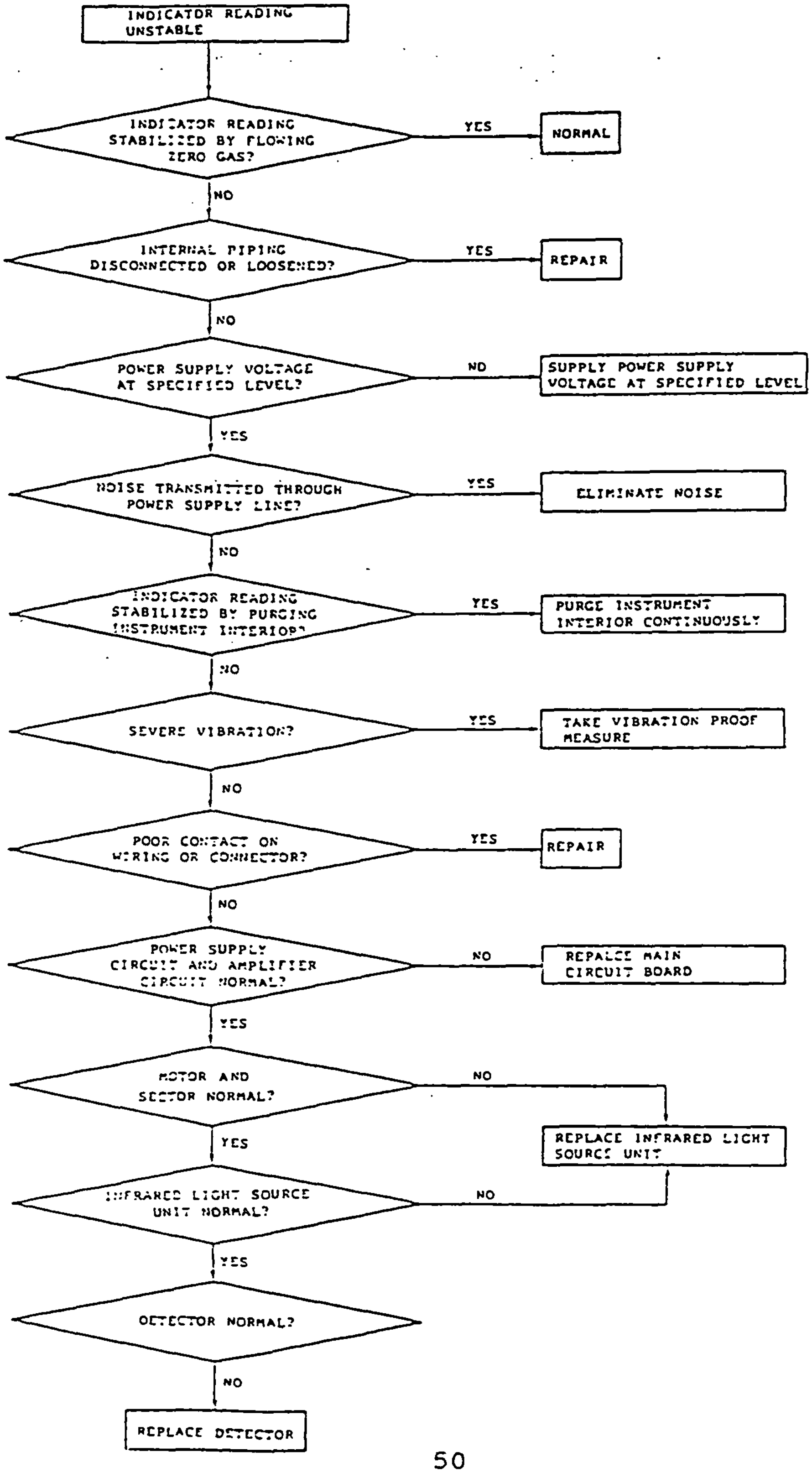


Chart 4: Response Too Slow

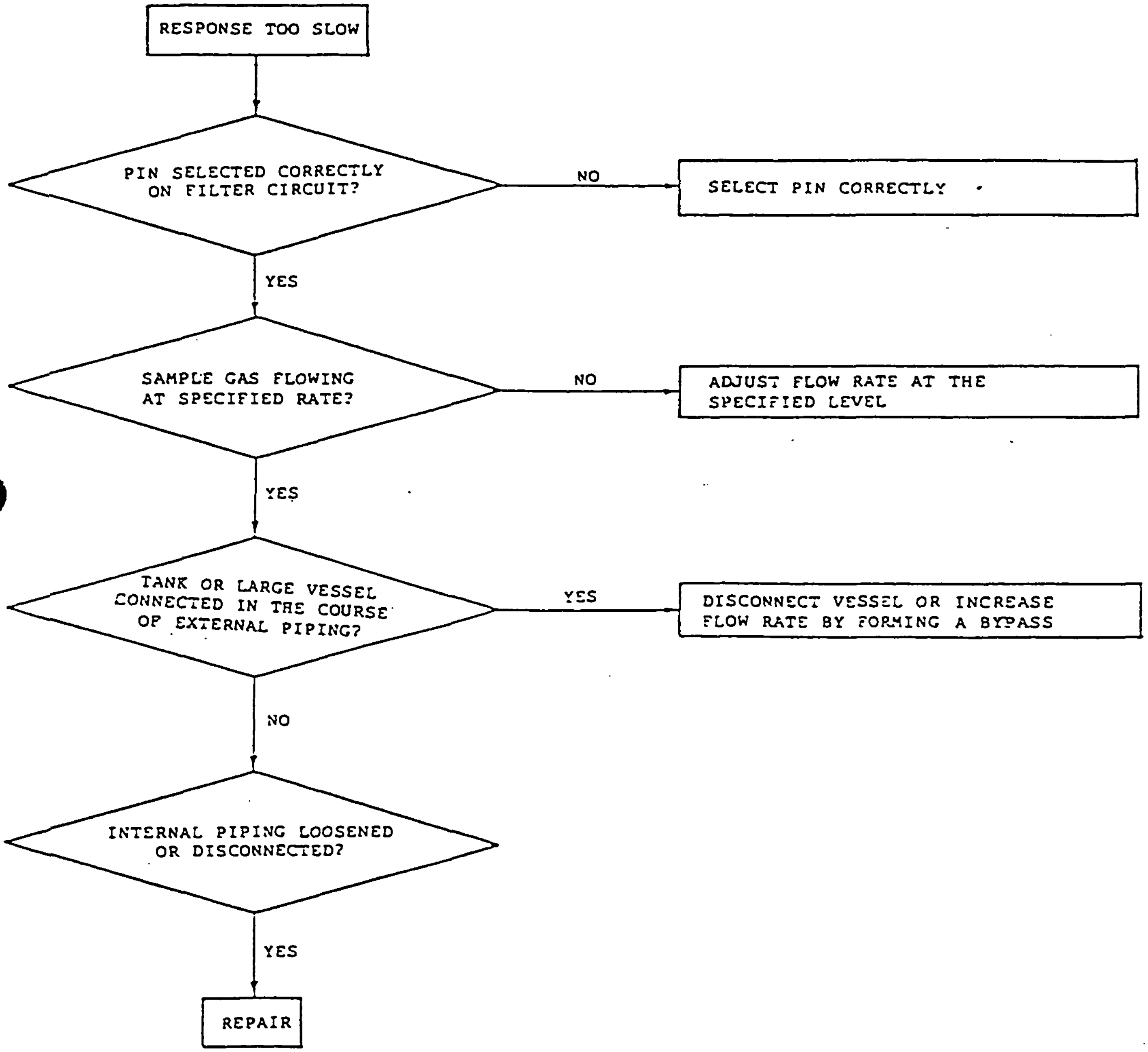
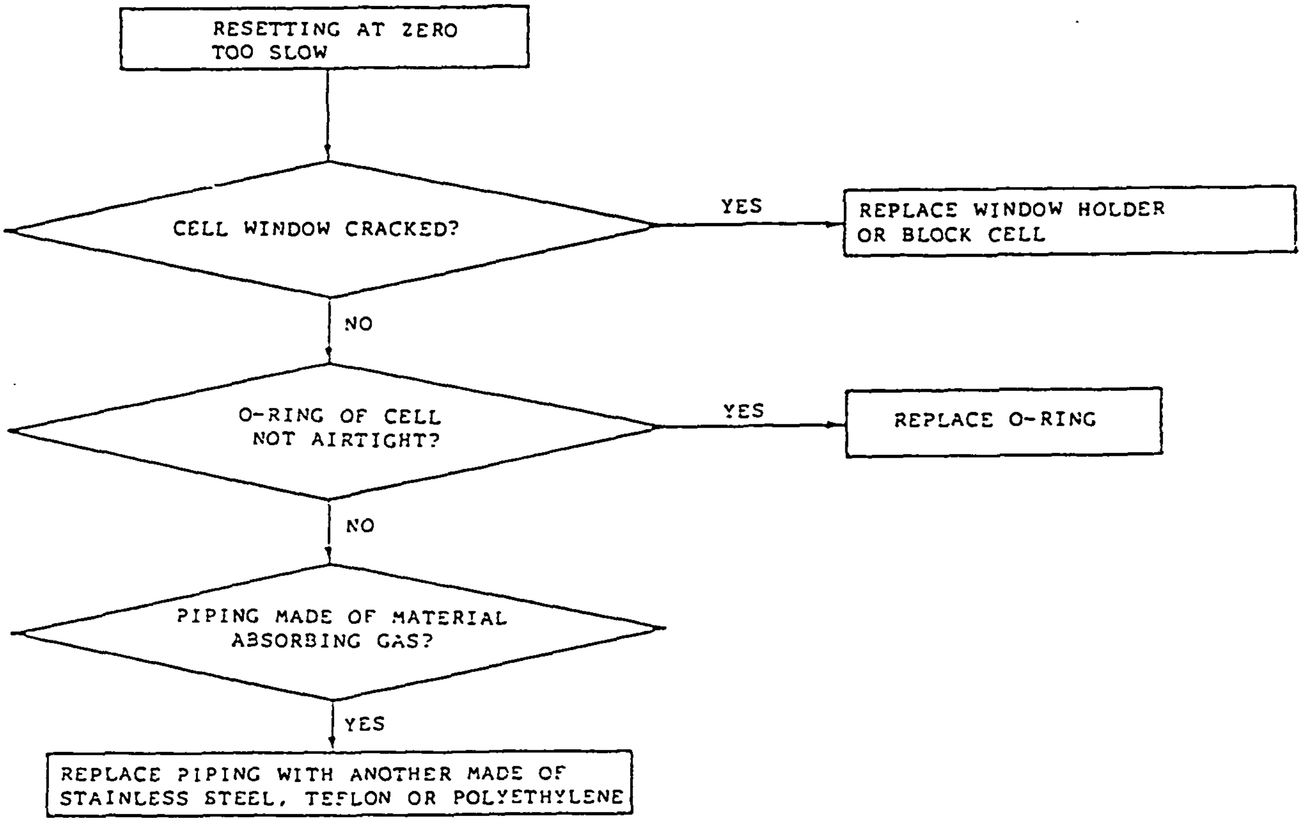
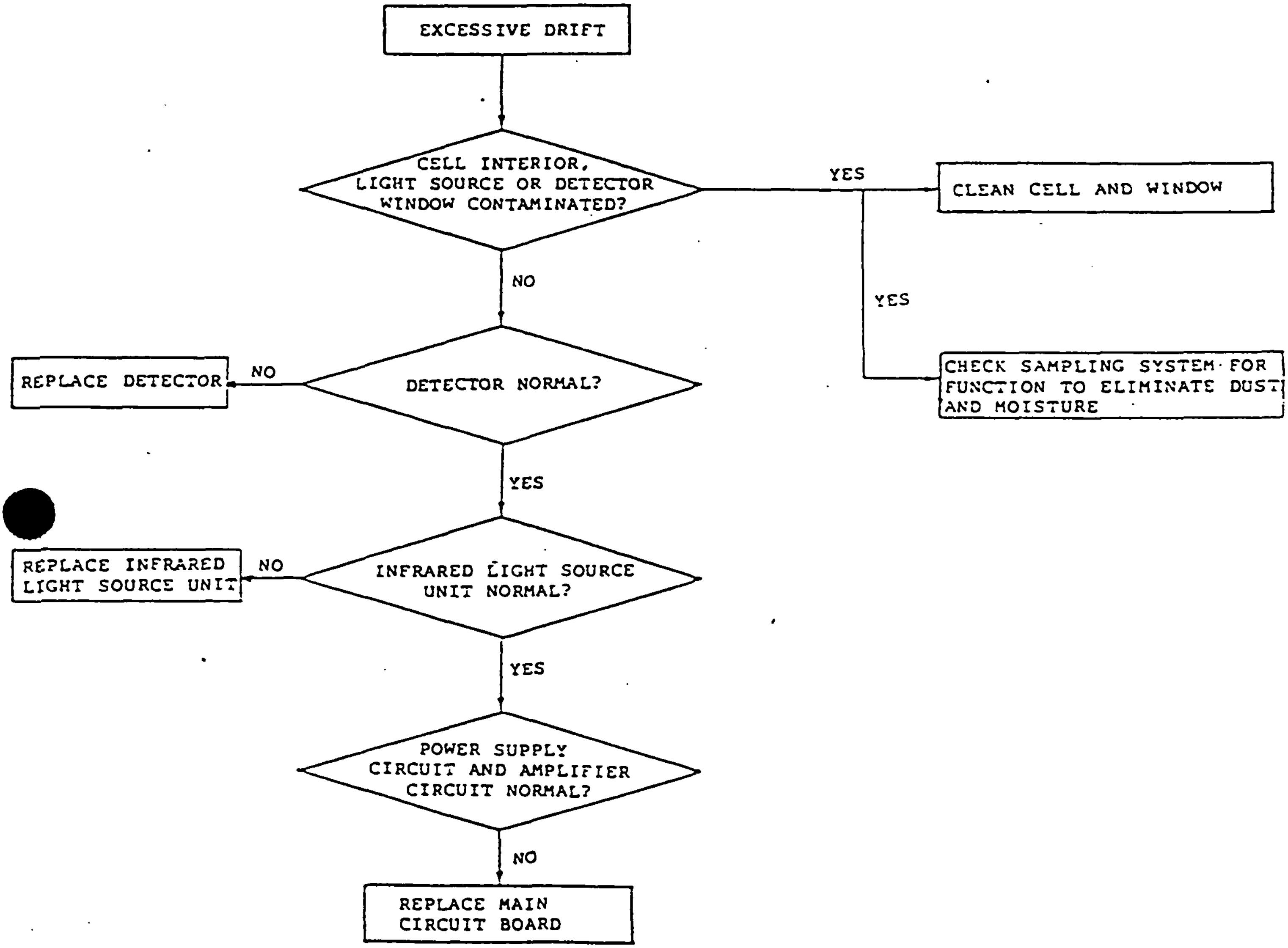


Chart 5: Resetting at Zero Too Slow



TROUBLESHOOTING CHARTS (Continued)

Chart 6: Excessive Drift



CHECK OUT AND REPAIR

1. **Detector**
   (Refer to Item 15 of Figure 12)

   Symptom: Unable to adjust Front Panel Zero

   Trouble: Mass flow sensor damaged, Bridge Resistor defective, or Detector leaking gas.

   Tests:

   a. The mass flow sensor and Bridge Resistor (Item 1 16 in Figure 12) are normal when DC voltages of about 1.5 to 2.0 V appear between Terminals 1 and 3, and 2 and 3, on the bridge circuit board. These two voltage readings should be within 0.1 V of each other.

   b. Connect an oscilloscope between Test Points A1 and M2, on the Main Circuit Board. If readings in "A" above are normal, but an AC waveform (of about 10 Hz is not seen at A1, then the gas is probably leaking from the Detector. Detector should be replaced.

   c. If the voltage readings in "A" above are not normal, turn OFF the Power Switch. Uncouple the Detector connector CN1, and disconnect the bridge resistor.

   Test the resistance value of the mass flow sensor by measuring the resistance between the Terminals 1 and 3, and 2 and 3, on the Bridge Circuit Board. If the reading is between 25 and 50 ohms, the mass flow sensor is normal and the Bridge Resistor is probably defective. If the value approaches infinity, the sensor is defective and should be replaced.

   Replacement:

   a. To replace the Detector Assembly with a new unit refer to Figure 12. With instruments using a Pipe type Sample Cell, the Detector is retained by screws from the bottom. It is necessary to first remove the entire Optical Bench.

   b. After replacing the Detector, adjust the detector voltage to the specified value. Readjust Zero and Span.

CHECKOUT AND REPAIR

2. Infrared Light Source
(Item 5 in Figure 12, and Figure 13)

Symptom: Readings always negative or output unstable.

Trouble: Infrared Light Source defective or leaking gas.

Tests:

a. Turn the Power Switch OFF. Disconnect one lead from the two pin connector providing power to the Infrared Light Source. Measure the resistance across the Light Source. The reading should be about 38 ohms. If the reading approaches infinity, the Light Source is open. (The instrument output drifts in a negative direction as the resistance decreases).

b. The Indicator may also drift due to gases from the atmosphere leaking into the Light Source.

NOTE

Low concentration CO_2 analyzers may drift due to atmospheric CO_2 penetrating the gaps between the components of the Optical Bench. See page 16, "Influence of Atmospheric CO_2 and Purging".

Replacement:

a. Disconnect both leads from the two pin terminal block. Unplug the Chopper Motor connector. Remove the two screws retaining the Light Source Assembly to the base plate. Separate and replace the Light Source.

b. After replacement, readjust the Zero Level and Span Controls.

CHECKOUT AND REPAIR (Continued)

3. **Chopper**

Symptom: Indicator output unstable, or scale out of calibration.

Trouble: Rotation abnormal.

Tests:

a. Turn the Power Switch ON. Listen for rubbing noises as the blade rotates. Remove the Infrared Light Source and protective cover. If necessary, bend the blade slightly to prevent contact with adjacent component. Take care not to damage the blade as it is manufactured from very thin material. No adjustment is normally required.

b. With the Power ON, and the motor shaft does not rotate, disconnect the motor power supply connector and check that 100 VAC is being supplied to the connector. If present, check the motor shaft and rotor for contact with an adjacent part. If the motor rotates freely by hand, but still does not rotate under power, the motor itself is defective.

Replacement:

a. When the Chopper Motor is defective, the Light Source Assembly as a whole must be replaced.

4. **Sample Cell, Detector Window, & Infrared Light Source Window**

Symptom: Zero adjustment impossible.

Trouble: Cell or Window badly contaminated.

Test:

a. Remove the Sample Cell. Check the cell and Windows for contamination. If contamination is seen, carefully wipe off contaminant with a soft cloth soaked with alcohol. Take care not to injure the windows as they are very fragile. (See also Section VI, Disassembly Procedures).

5. Tubing

Symptom: Indicator reading unstable or response too slow.

Trouble: Tubing loosened, disconnected, or clogged.

Tests:

a. Firmly reconnect the disconnected or loosened tubing or connections.

b. With tubing disconnected from Sample Cell, use clean high pressure air to blow out restriction.

6. Main Circuit Board

A. Power Supply Circuits

Tests:

a. Output voltages from the Power Transformer should read approximately 18 VAC and 100 VAC (See Figure 26 or 27).

b. DC voltage on the aluminum electrolytic capacitor of the Power Supply should be approximately 22 V.

c. Positive Power Supply line voltage between Test Points A6 and M1 should be 14V +/- 0.05 VDC (See Figure 23).

d. Negative Power Supply line voltage between Test Points A7 and M1 should be -15 V +/- 1.0 VDC.

e. Detector Power Supply voltage between Test Points A8 and M1 should be the voltage level specified for that specific Detector.

TROUBLESHOOTING GUIDE (Continued)

CHECKOUT AND REPAIR (Continued)

B. **Amplifier Circuits**

(Refer to Figure 23 or 24)

Tests: a. Verify the the power supply circuits are as specified above.

b. AC Amplifier:

1. Connect an Oscilloscope across Test Points A2 and M1 and observe the AC waveform. Flow Zero Gas and adjust VR1 for about 6V peak to peak (see Figure 18).

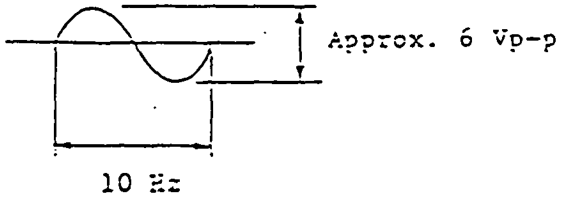


Figure 18: Test Waveform - AC Amplifier

2. If no signal is present at A2, or the signal is not as described in Figure 18, check between Test Points A1 and M1. A 10 Hz AC signal (V1) should be seen. If this is normal, then the AC amplifier Q1 is normal and the AC amplifier Q2 or VR1 is defective.

3. If an AC waveform is not seen across A1 and M1, measure the voltage Vd between Terminals 4 and 5 of the Bridge Circuit Board on the Detector Assembly. Compare with the voltage V1 measured between Test Points A1 and M1. If jumpers J1 to J2 and J4 to J5 are connected, V1 should equal Vd x 22. If J1 to J3 and J4 to J6 are connected, V1 should equal Vd x 100. If Q1 appears normal, check the Detector.

TROUBLESHOOTING GUIDE (Continued)

CHECKOUT AND REPAIR (Continued)

c. Demodulator Circuit

With Zero Gas flowing, the waveform across Test Points A3 and M1 should be as in Figure 19.

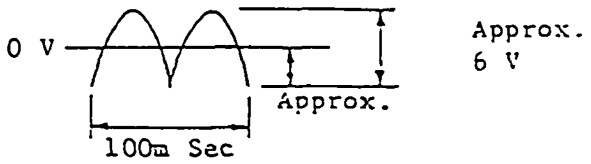


Figure 19: Test Waveform - Demodulator Circuit

d. Dc Amplifier Circuit

Flow Zero Gas and depress the Front Panel Span Check Switch. Voltage across Test Points A4 and M1 should be approximately 0.9 VDC. If the AC amplifiers and demodulator are working normally, and this voltage is not present, DC Amplifier Q4 is probably defective.

e. Buffer Amplifiers

Flow Zero Gas and depress the Front Panel Span Check Switch. Voltage across Test Points A5 and M1, and Output Selection Jumper E4, and Test Point M1 should both be approximately 0.9 V. If either of these voltages is not present, and the previous tests "a" through "d" are normal, the Buffer Amplifier Q5 is probably defective.

SECTION VIII

SCHEMATIC AND ASSEMBLY DIAGRAMS

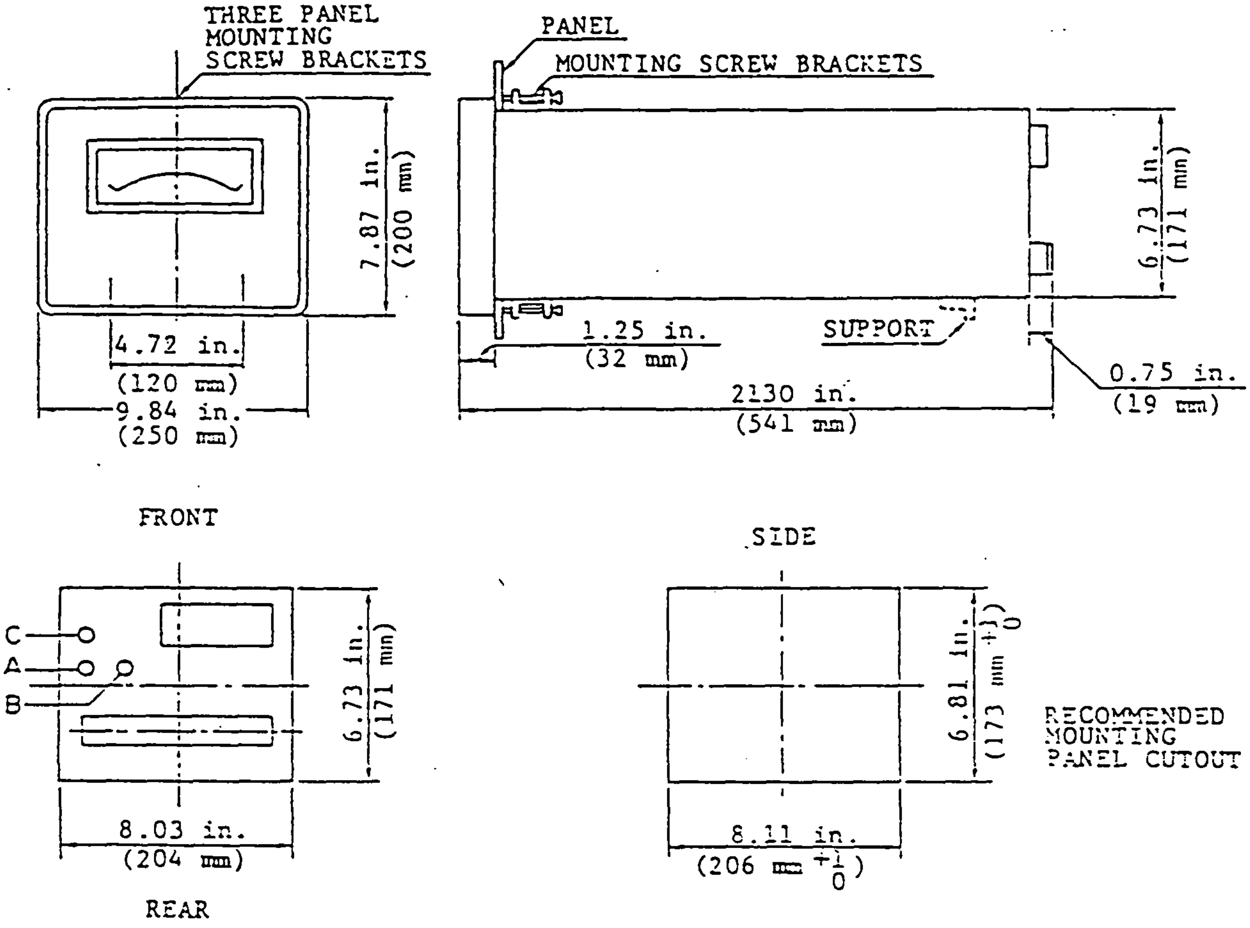


Figure 20: Outline and Mounting Dimensions

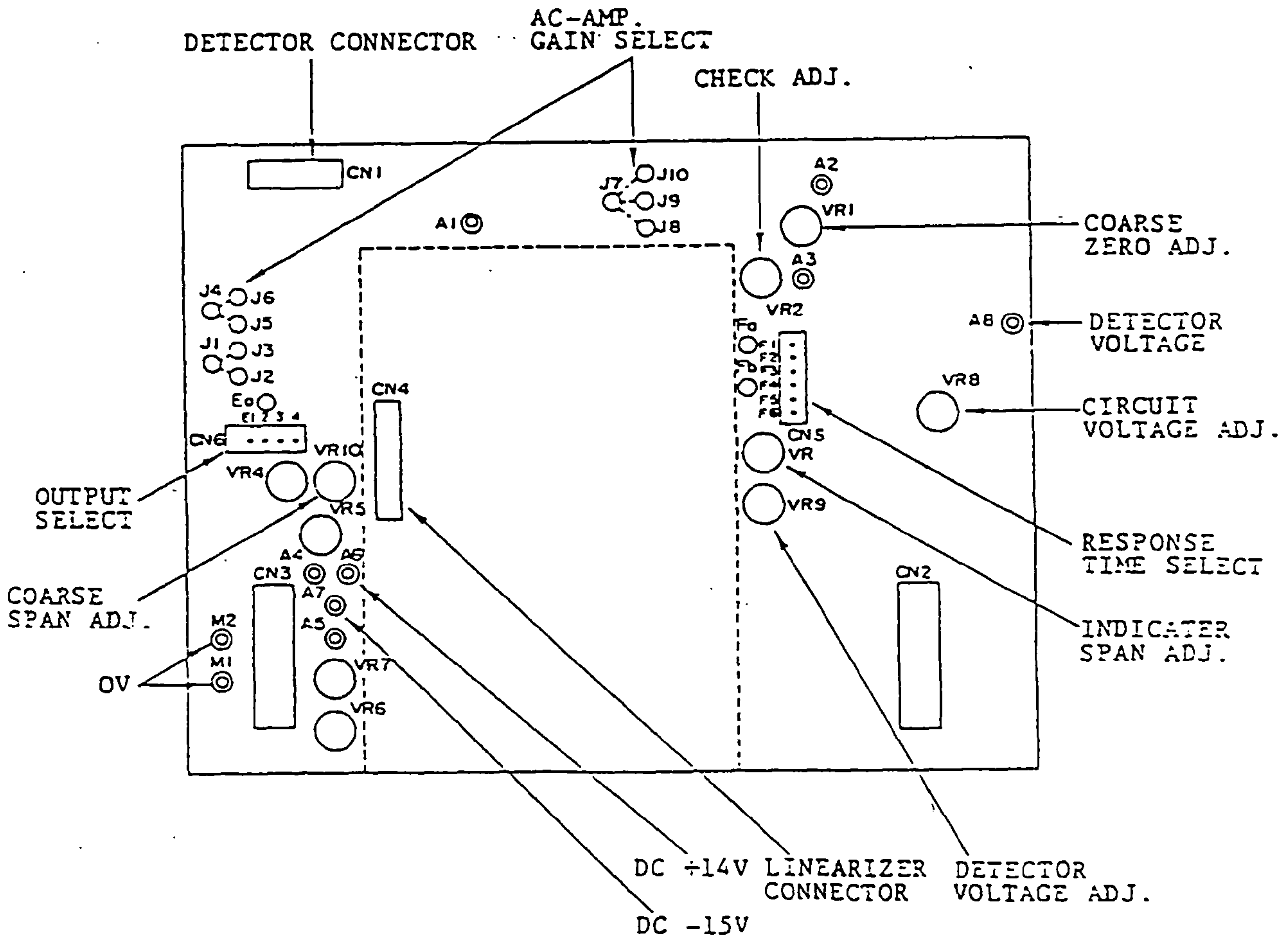


Figure 21: Main Circuit Board Layout (3300 and 3400)

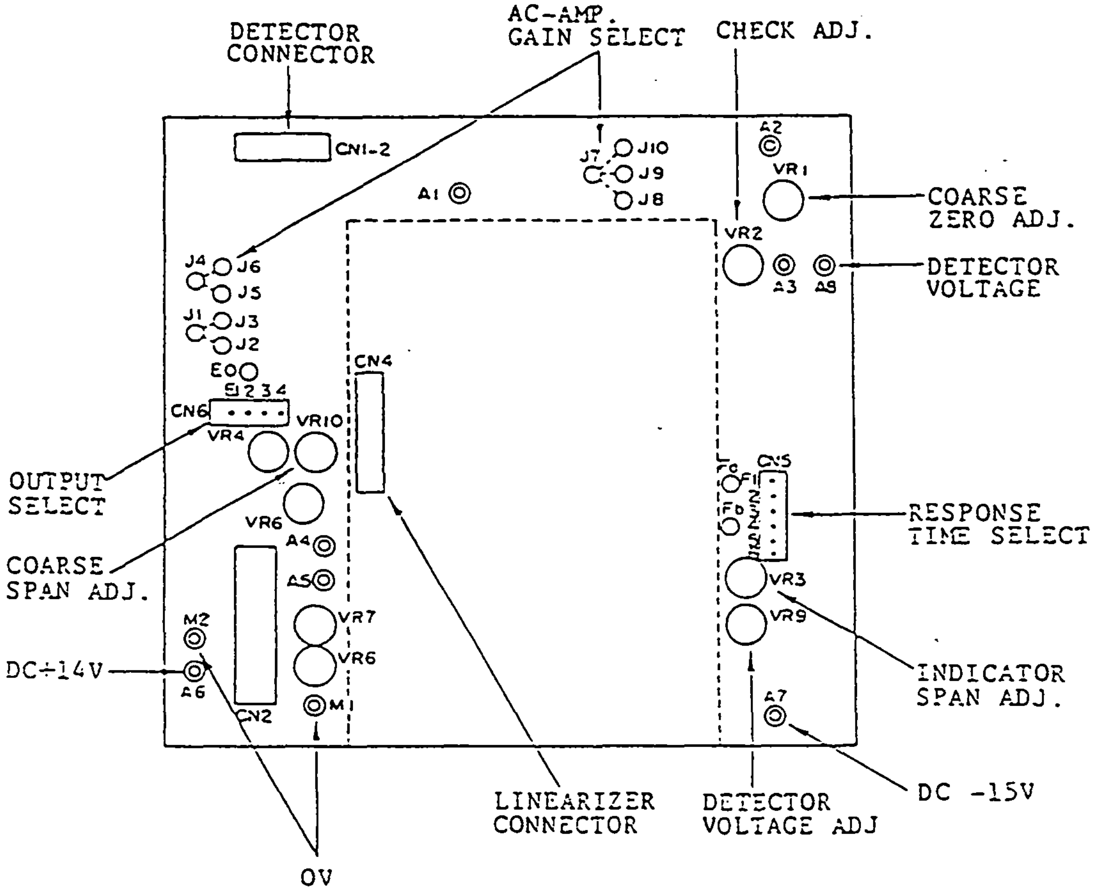


Figure 22: Circuit Board Layout for Second Gas Component (Model 3400 Only)

SCHEMATIC AND ASSEMBLY DIAGRAMS (Continued)

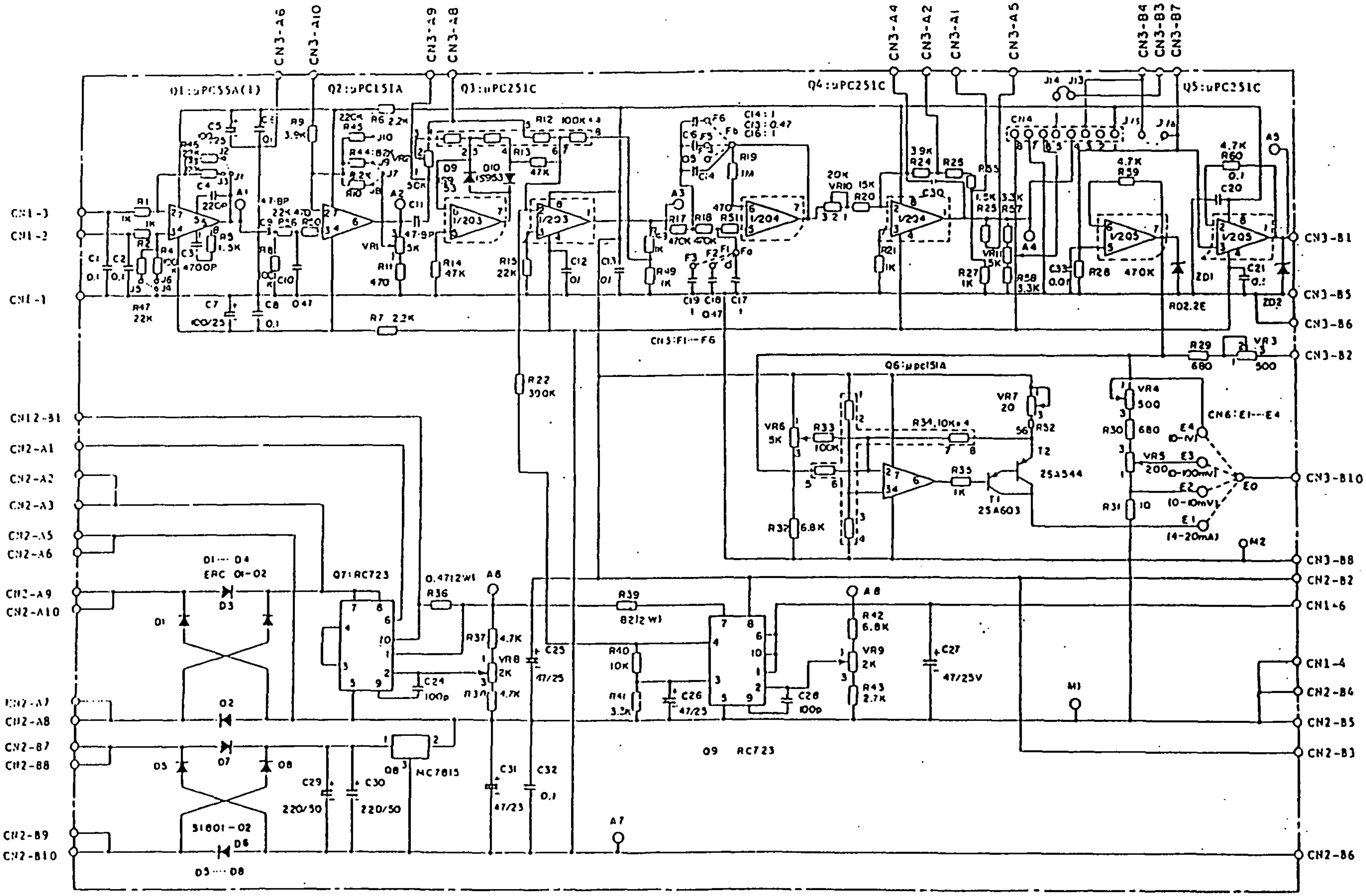


Figure 23: Detailed Schematic Diagram of Main Circuit Board (3300 and 3400)

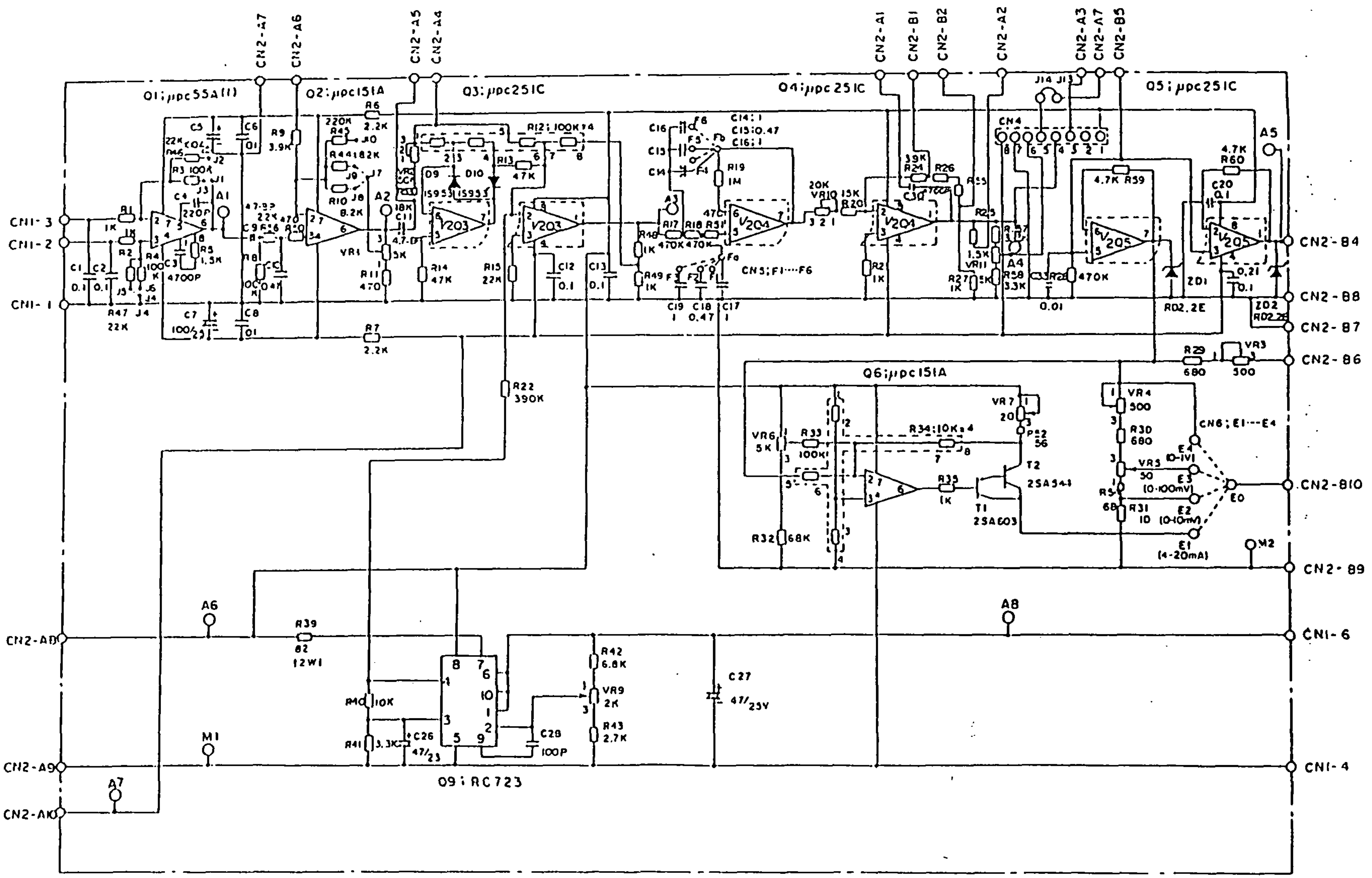


Figure 24: Detailed Schematic of Second Gas Component Circuit Board (Model 3400 only)

SCHEMATIC AND ASSEMBLY DIAGRAMS (Continued)

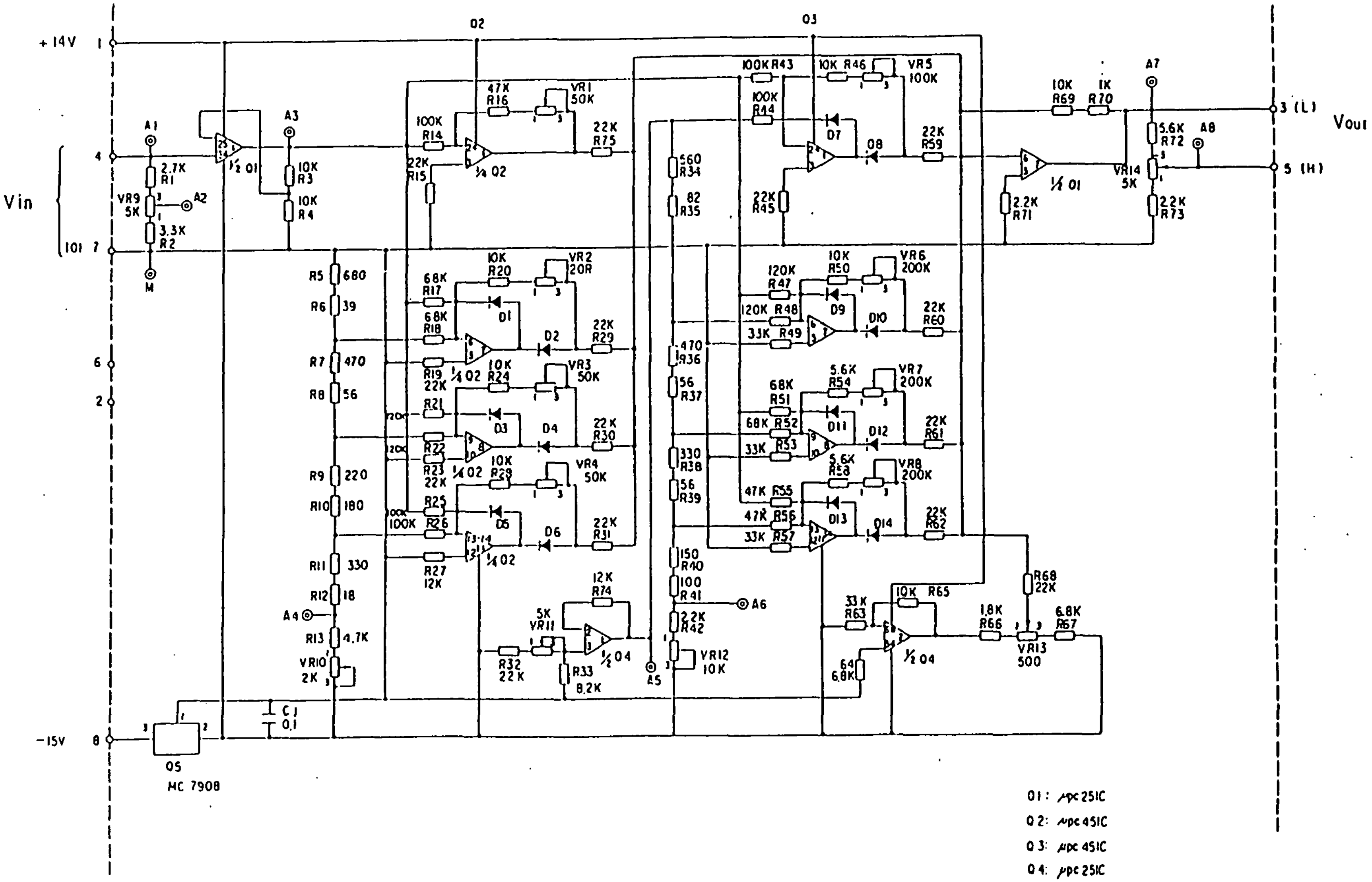


Figure 25: Detailed Schematic Diagram of Linearizer Circuit Board

SCHEMATIC AND ASSEMBLY DIAGRAMS (Continued)

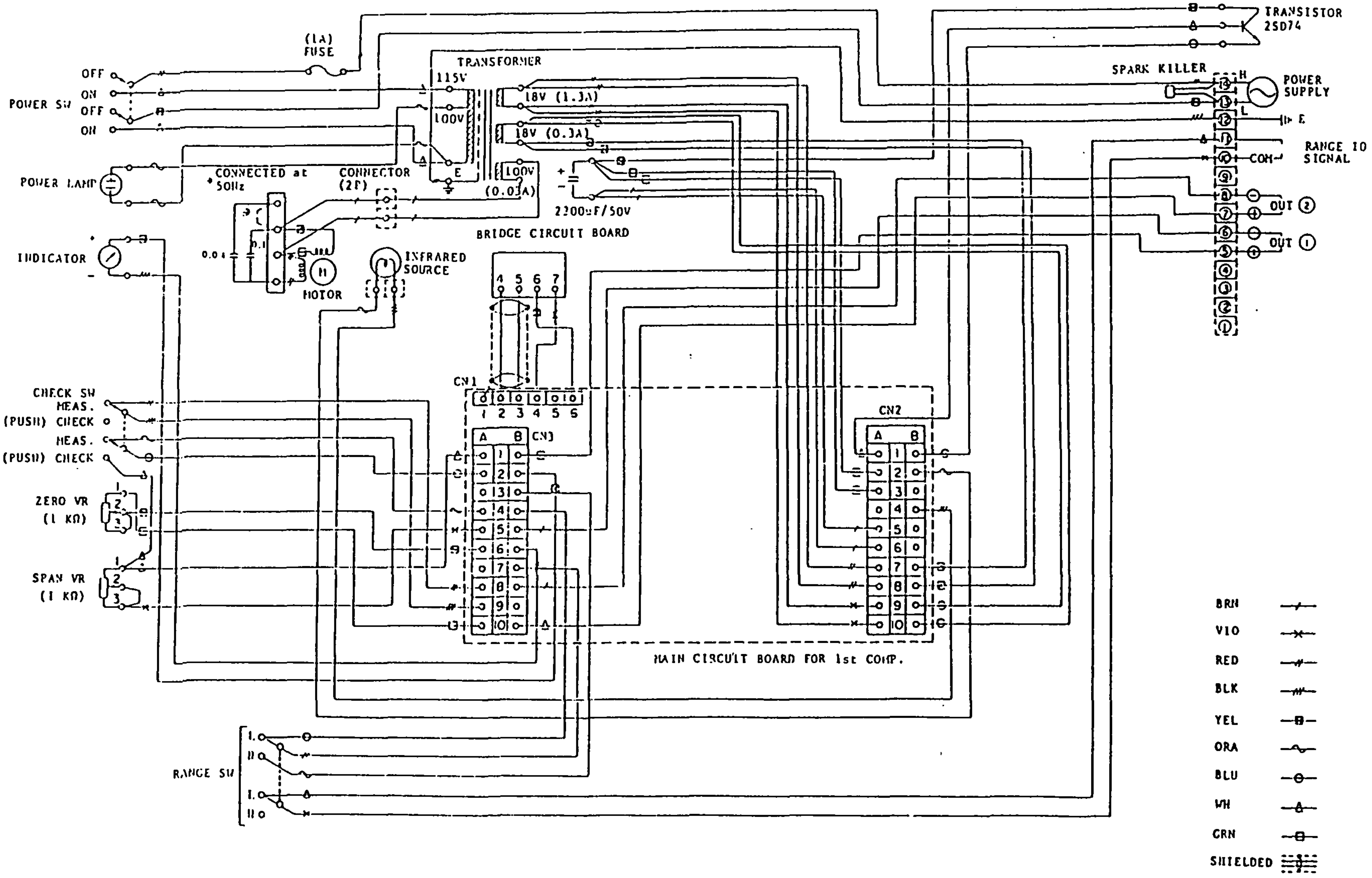


Figure 26: Detailed Schematic Diagram of Chassis Wiring (Model 3300)

SCHEMATIC AND ASSEMBLY DRAWINGS (continued)

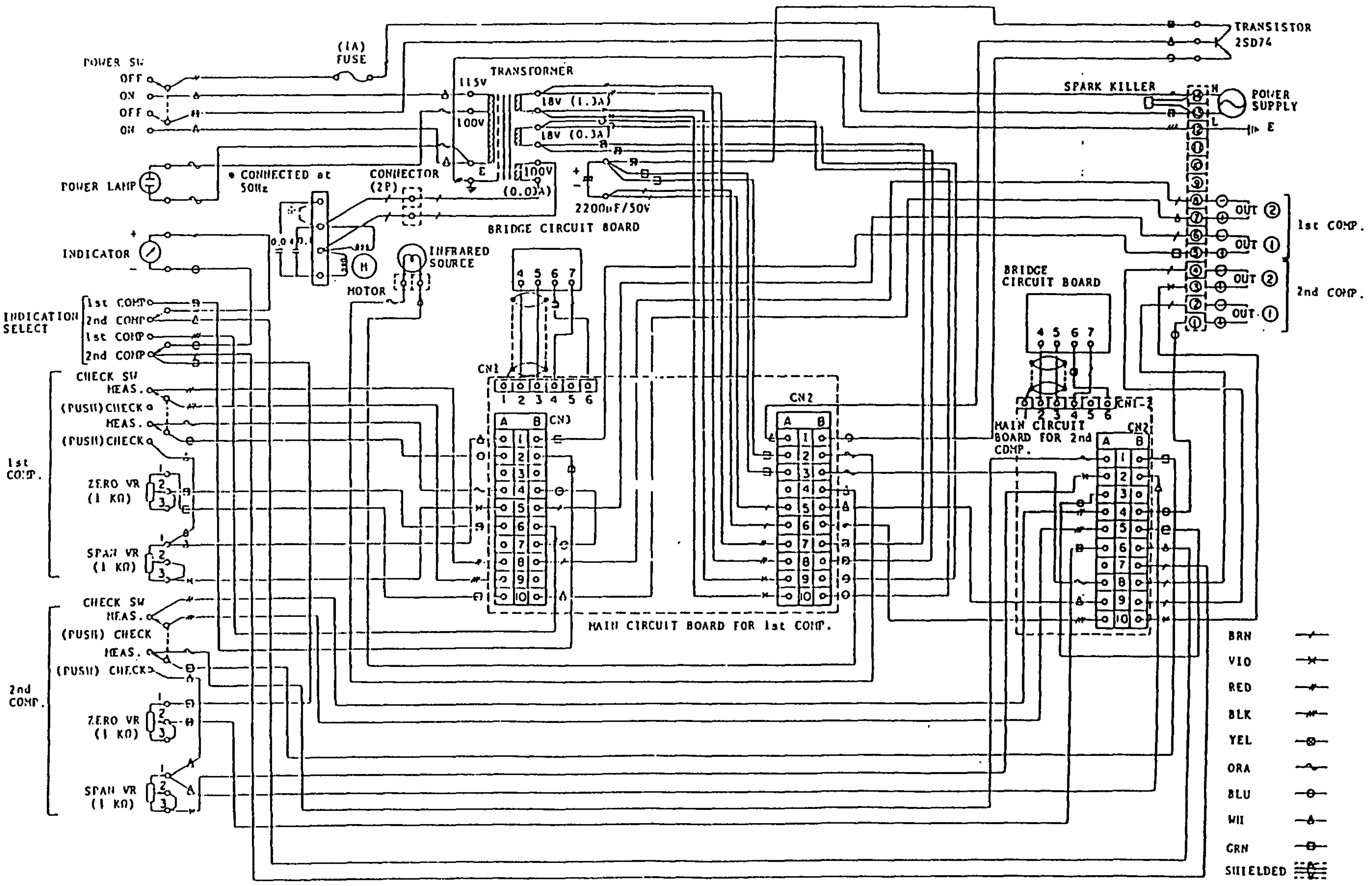
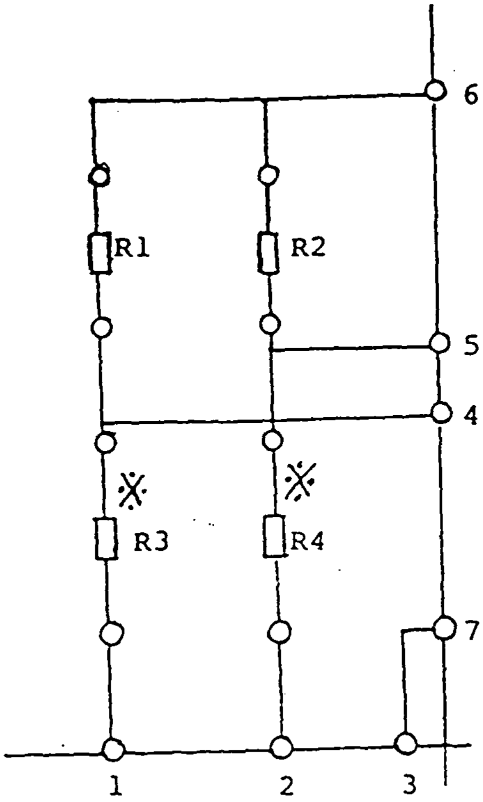


Figure 27: Detailed Schematic Diagram of Chassis Wiring (Model 3400)



※ R3 and R4 are for balance adjustment and shorted if unnecessary.

FIGURE 28

Figure 29

Comp.		Range (%)	Range Ratio	Cell Length (mm)							Detector	Optical Filter
				4	8	16	32	64	125	250		
CO	1	0-0.05/0.1	1:2							0	CO - L	0
	2	0-0.1 /0.2	1:2							0	M	0
	3	0-0.2 /0.5	1:2.5						0		M	0
	4	0-0.5 /1	1:2					0			M	0
	5	0-1 /2	1:2				0				M	0
	6	0-2 /5	1:2.5		0						M	0
	7	0-5 /10	1:2	0							M	0
	8	0-10 /20	1:2			0					H	0
CO_2	1	0-0.05/0.1	1:2							0	CO_2 - L	
	2	0-0.1 /0.2	1:2					0			L	
	3	0-0.2 /0.5	1:2.5				0				L	
	4	0-0.5 /1	1:2			0					L	
	5	0-1 /2	1:2		0						L	
	6	0-2 /5	1:2.5	0							L	
	7	0-5 /10	1:2			0					H	
	8	0-10 /20	1.2		0						H	
CH_4	1	--------	-----	-	-	-	-	-	-	-	--------	------
	2	0-0.1 /0.2	1:2							0	CH_4 - L	0
	3	0-0.2 /0.5	1:2.5							0	M	
	4	0-0.5 /1	1:2						0		M	
	5	0-1 /2	1:2					0			M	
	6	0-2 /5	1:2.5			0					M	
	7	0-5 /10	1:2		0						M	
	8	0-10 /20	1:2	0							M	

Note 1: Cell and detector for each measuring range should be selected according to the above table. If the ranges are not in the same zone enclosed by the wide line, it is necessary to change the detector besides the cell in changing the range.

1420B

Oxygen Analyser
Instruction Manual

Ref No. 01420/001B/0
Order as part No. 01420001B

Servomex

Section 1. DESCRIPTION

1.1 General

The Servomex 1400B series of gas analysers comprises two base units, the 1410B analyser using dual wavelength, single beam infrared technique and the 1420B oxygen analyser using paramagnetic technology. This manual describes the 1420B oxygen analyser.

The 1400B series may be fitted into a twin unit 19" rack mounted case, a bench top case or a single unit case for flush panel mounting.

The 1420B has voltage and current outputs, multiple ranges, oxygen level alarms, flow alarm and remote range indication.

A version of the analyser is available for oxygen purity measurements.

Included with the analyser are the following accessories:

Fuses	- 2531-0526
Filters	- 2377-3608
'D' connectors	
Manual	- 01420001B
IEC Power connector.	

A 31/2 digit green LED indicates the oxygen content to 0.1% resolution.

WARNING

This analyser is not suitable for use in hazardous areas or for measuring flammable sample gases.

1.2 Principles of Operation

The 1420B oxygen analyser measures the paramagnetic susceptibility of the sample gas by means of a magneto-dynamic type measuring cell.

Oxygen is virtually unique in being a paramagnetic gas, this means that it is attracted into a magnetic field. In the Servomex measuring cell the oxygen concentration is detected by means of a dumb-bell mounted on a torque suspension in a strong, non-linear magnetic field. The higher the concentration of oxygen the greater this dumb-bell is deflected from its rest position. This deflection is detected by an optical system and twin photo-cells connected to an amplifier. Around the dumb-bell is a coil of wire. A current is passed through this coil to return the dumb-bell to its original position. The current is measured and is proportional to the oxygen concentration.

1.4 Use With Toxic or Flammable Gases

1.4.1 Toxic Gases

If the analyser is used with sample gases which may be toxic, asphyxiant or otherwise harmful to health then adequate precautions should be taken to ensure safe installation and operation.

These precautions could, for example, include ensuring good quality sample piping to reduce the possibility of leaks, regular leak checking of the analyser and sample piping, minimum sample pressure, adequate ventilation of enclosed spaces and the possibility of monitoring for toxic levels.

The analyser vent should be piped to a well ventilated area.

1.4.2 Flammable Gases

WARNING

This analyser is not suitable for use in hazardous areas or for measuring flammable sample gases.

Consult Servomex for details of analysers which may be more suitable for measuring sample gases which can be toxic or flammable.

1.5 Specification

Performance Specification (typical)

Repeatability:	Better than ±0.1% O_2 under constant conditions (measured at the IV electrical output).
Temperature coefficient:	±0.005% O2 ±0.04% of reading(on display) per degree C change from calibration temperature.
Response Time:	Less than 15 seconds to 90%. At point when flow alarm is triggered the response time will be approximately 50 seconds

Electrical

AC Supply:	88 to 264V, 47 to 440Hz.
Power required:	50VA.

Environmental Limits

Operating ambient temperature:	0 to +45°C (32 to 113°F) 0 to 40°C (32 to 104°F, bench top case)
Storage temperature range:	-20 to +70 C (-4 to 158 F)
Relative humidity:	0-85%, non-condensing.
Sunlight:	Protect from direct sunlight which may cause the interior of the analyser to overheat.
Vibration:	Protect the analyser from excessive vibration.
EMC:	Complies with EN 50022(1987) CLASS A for conducted interference and radiated electric field.

1.6 Product Identification

A label is fitted to the rear panel giving the model and serial numbers. It is of the form 1420B/701/NNNN where NNNN is the serial number

SECTION 2. INSTALLATION

Installation Overview

2.1 Unpack the analyser

2.2 Set-up output ranges and oxygen level alarm functions

2.3 Install analyser

2.4 Make electrical connections

2.5 Make gas connections

2.6 Calibrate

2.1 General

Unpack the instrument and inspect the unit for signs of damage during transit. If any damage is evident, inform Servomex or their agents immediately

Accurate and secure installation will minimise maintenance and instrument breakdown and will provide reliable service.

The location should be vibration free and be subject to minimal fluctuations in ambient temperature.

> WARNING
>
> The installer must be satisfied that the analyser installation conforms to the relevant safety requirements and that the installation is safe for any extremes of conditions which may be experienced in the operating environment of the analyser.

2.2 Setting-up Ranges and Alarm Functions

It is necessary to set links inside the analyser to set the desired ranges of the analogue output and the correct operation of the oxygen alarms.

Note: The analyser display will always indicate 0-100% O_2.

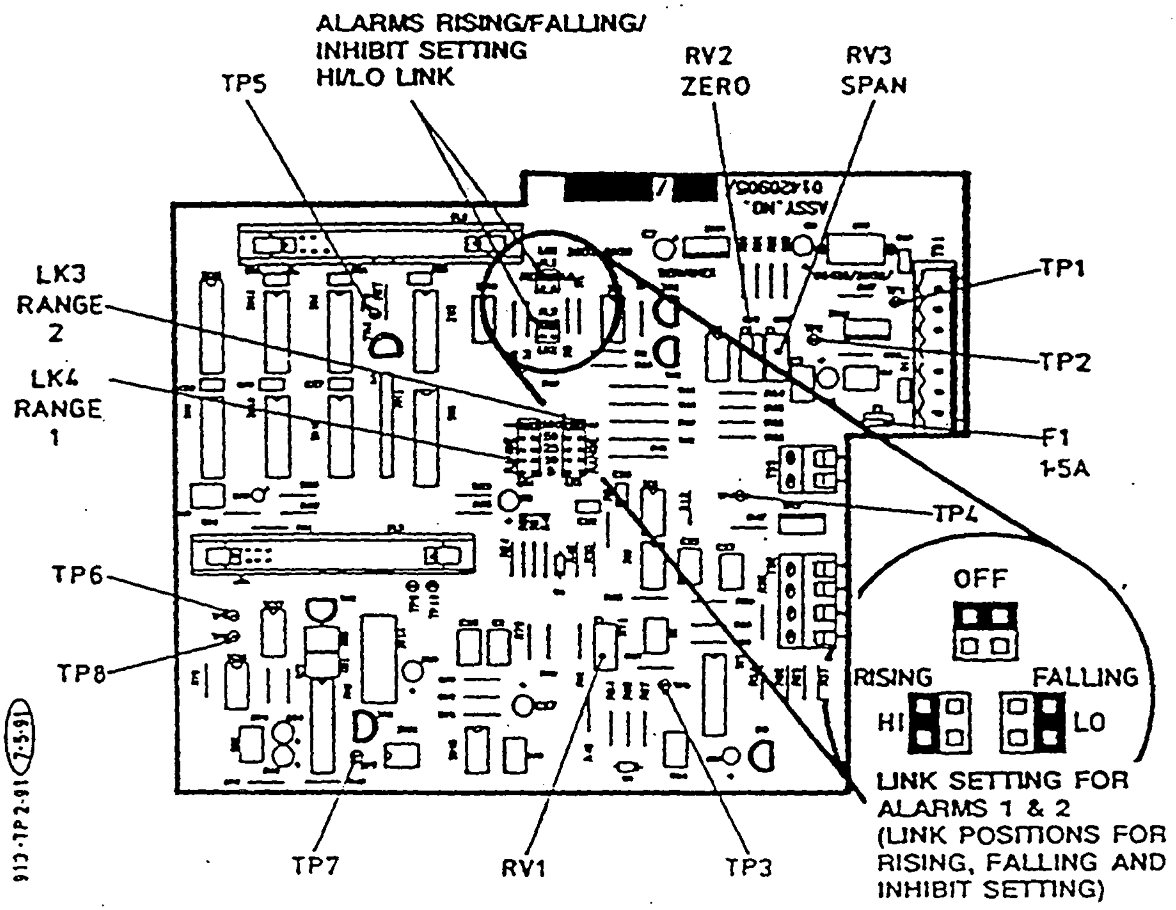


Figure 2.1 Range Changing and Alarm Function Setting

2.3 Installation

The analyser can be installed in a 19in relay rack, flush panel mounted or in a bench top case. See figure 2.2 for dimensions.

The location should be vibration free and be subject to minimal fluctuations in ambient temperature.

There should be access to the rear of the analyser for making gas and electrical connections.

If the analyser is being used to measure sample gases which are toxic then the analyser should be well ventilated to prevent a high concentration of dangerous gas occurring. It may also be advisable to fit appropriate monitoring equipment to warn of sample leaks.

2.4 Electrical Supply Connections

WARNING

Since an isolating switch is not fitted to this instrument it is necessary to ensure that the electricity supply is fitted with a switch to disconnect the instrument. The instrument cases must be connected to earth (ground) at all times.

Electrical supply connection is made to the IEC type connector on the rear of the analyser. The supply voltage can be in the range 88 to 264V, 47 to 440Hz. There is no voltage setting required. If a centre tapped electrical power supply is used (eg 55-0-55V) then both poles must be switched and fused.

On installations where the electrical supply is not referenced to ground an isolating transformer must be fitted and its secondary winding suitably grounded.

When installed in the Servomex 19 inch rack case it is necessary to earth (ground) the case to one or both of the analysers using the earth connections and earth studs on the rear of the instrument.

2.4.2 Alarm Connections

Alarm connections are made to the 'D' plug on the rear of the analyser. See Figure 2.4 for details. Contacts are rated at 1A/110Vac max, non-inductive.

The alarm relay contacts (PL5) must not be connected to a supply exceeding 110V ac rms, and careful wiring within the 'D' connector is required to maintain the insulation and clearances.

Ensure case is earthed (grounded) when relays are connected to a supply exceeding 50V ac or 120V dc.

2.5 Sample Gas Connections

Pipework and fittings used for gas connections should be degreased and suitable for oxygen service.

Connections are made to the pipes on the rear of the analyser. 'Sample In' and 'Sample Out' are labelled.

Gas connection can be made with flexible tubing suitable for the push-on 6.4mm (1/4in) OD connector. Sample gas connections can also be made with 1/4in compression fittings.

Note that response time will be increased by long lengths of sample tubing.

Sample pressures are given in the specification - see Section 1.5. Pressure regulation should be incorporated in the sample line to ensure these values are not exceeded.

If the gas being sampled is excessively dusty or has high humidity it will be necessary to install external filters or dryers.

2.6 Analyser Exhaust

The exhaust from the analyser must not be constricted. If the exhaust is piped away then, to avoid a backpressure in the measuring cell, the diameter of the piping used should be greater than the inlet piping.

If the analyser exhausts into a confined space there may be a danger of a build-up of harmful gases. In such cases the analyser vent should piped to a place with good ventilation.

2.7 Calibration Gases.

WARNING

Nitrogen is an asphyxiant and must not be used in confined spaces without adequate ventilation.

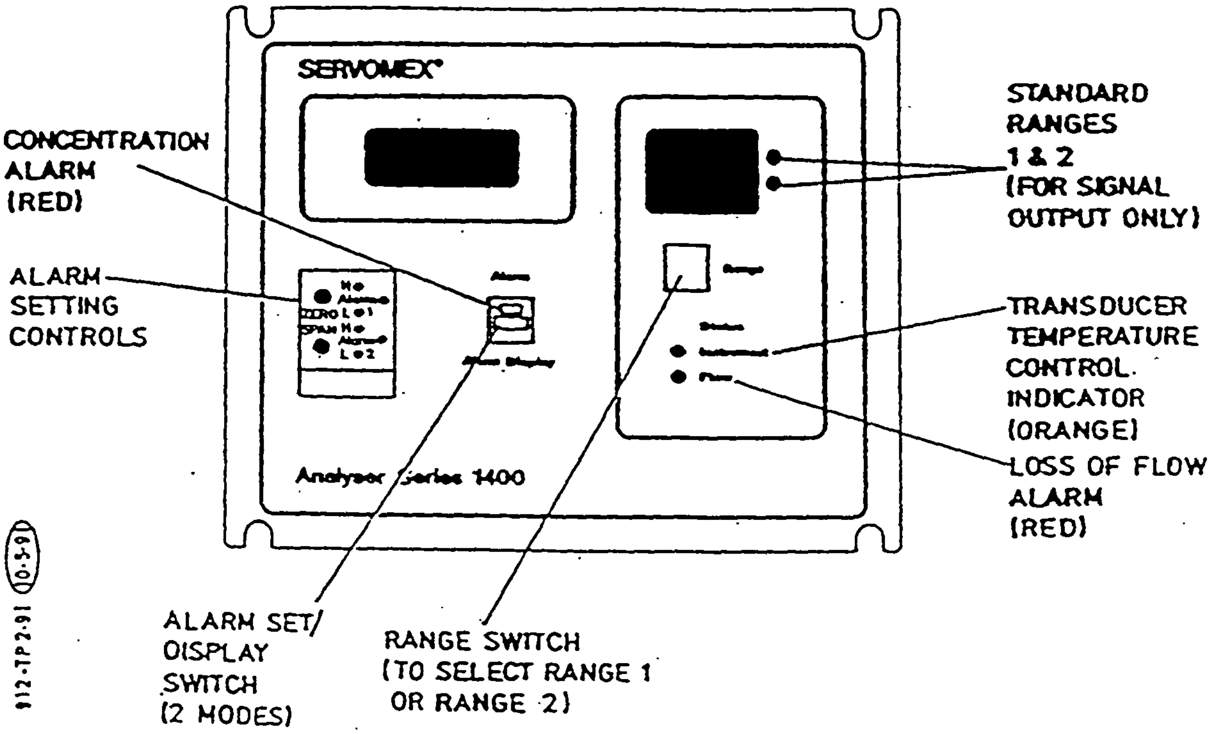
All gas cylinders must be fitted with a regulator to limit the delivery pressure to the values above and an appropriate output pressure gauge. This will prevent serious over pressurising of the analyser and damage to the measuring cell.

All gas cylinders must be fastened securely.

SECTION 3. OPERATION

3.1 Controls

See Fig 3.1 for location of the controls.



912-TP2-91 (10-3-91)

Figure 3.1 Front Panel Controls and Indicators

3.2 Calibration

The analyser should be allowed to warm-up for 3 hours before it is calibrated.

3.2.1 Setting the Zero

Introduce zero gas (normally high purity nitrogen) at a pressure of less than 10 psig to the gas inlet on rear panel of the analyser. Adjust the Zero control, located behind the flip down panel below the display, to give a reading of 0.0 on the display. If the range of adjustment is inadequate then the transducer zero will need resetting (See Section 4.2.4).

3.2.2 Setting the Span

Introduce clean, dry air at a pressure of less than 10 psig to the gas inlet on the rear panel. Adjust the Span control, located behind the flip down panel below the display, to give a reading of 20.9 on the display.

If using a calibration gas other than air then set the span calibration to the value of the calibration gas.

In the alarm condition the red LED incorporated in the alarm switch will flash. The LED beside the relevant alarm control will also flash. The upper LED indicates a high oxygen alarm, the lower LED indicates a low oxygen alarm. The relevant relay will also go to the alarm condition.

Alarms are cleared when the oxygen concentration returns to a non-alarming value.

3.5 Flow Alarm.

The analyser incorporates a pressure switch to detect satisfactory sample flow. If the flow fails or the sample inlet or outlet becomes blocked then the yellow 'Flow' LED will flash and the 'Flow' alarm relay will go to the alarm condition.

This alarm is cleared when flow returns to normal.

3.6 Instrument Status

The measuring cell is heated. The red LED on the front panel illuminates when the heater is on. During warm-up the lamp remains on continuously, but will flash when the temperature has stabilised.

3.7 Vent Pressure

The pressure at the analyser vent connection is the same as that in the measuring cell. The analyser determines the partial pressure of oxygen. Pressure changes occurring since the last calibration cause a proportional change in the oxygen reading unless the back pressure regulator is fitted.

See Section 2.6 for information about safe venting of exhaust gases.

3.8 Routine Maintenance

Frequency Of Calibration

The frequency of calibration required will depend upon the operating requirement for accuracy and upon environmental conditions. The following is a guide which can be modified in the light of operating experience in particular circumstances.

Weekly: Adjust the Span.
Monthly: Adjust the Zero then the Span.

Changing The Filter

Check the filter. The filter element is removed by unscrewing the large filter knob on the rear panel of the analyser. Discard the old element if dirty or wet and fit a new filter element (part no. 2377-3608) then check that sample pre-conditioning is adequate.

FID TOTAL HYDROCARBON ANALYZER
MODEL HC500-2D

Operation, Maintenance, and
Parts Manual

P/N 972-9001

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Austin, Texas 78720

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February 1990
Rev --

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1. INTRODUCTION

The Columbia Scientific Industries Corporation (CSI) Model HC500-2D Total Hydrocarbon Analyzer is a self-contained system for monitoring ambient concentrations of total hydrocarbons.

Sample air is introduced directly into an FID detector to yield a total hydrocarbon reading which is stored in an electrical circuit.

The hydrocarbon detection system utilizes the well established technique of flame ionization. Hydrocarbons passing through the hydrogen rich flame are converted to ions. An electrostatic field in the burner causes these ions to migrate and collect on an electrode. An electric current is produced which is proportional to the concentration of ions collected.

The design of the Model HC500-2D was implemented with the emphasis focused on obtaining stable and reliable performance and ease of service and maintenance. Precise pneumatic and thermal control of critical elements and the utilization of proven solid state circuitry contribute to the performance characteristics of the instrument.

In addition to the basic HC500-2D, CSI provides a variety of options and accessories to meet most user's requirements. Section 10 describes these.

2. PRINCIPLE OF OPERATION

The CSI Flame Ionization Detector (FID) is based on the ionization of hydrocarbon molecules in a hydrogen hyperventilated flame. Hydrocarbons are fragmented by the flame to carbon radicals, e.g. CH . These radicals react with oxygen radicals to form positive carbon ions and electrons. The positive ions can undergo further reactions with water molecules to produce hydronium ions.

The following equations summarize some of the possible reactions:

$$C_xH_y \longrightarrow CH\cdot$$

$$CH\cdot + O\cdot \longrightarrow CHO^+ + e^-$$

$$CHO^+ + H_2O \longrightarrow H_3O^+ + CO$$

An 84 volt battery is used to produce an electrostatic field between the ionization probe inside the burner chamber and the burner block. This causes the electrons to migrate to the positively charged probe, and the positive ions to the burner block. The resulting current is proportional to the ions collected. An electrometer amplifier converts the current to voltage which is fed to the amplifier output recorder jacks.

The FID detector is designed to optimize the sensitivity and stability of these reactions. Sample air is drawn into the detector block by means of a vacuum pump. Hydrogen is supplied under a slight pressure from a cylinder or hydrogen generator. Both these gas streams are controlled and regulated to provide stable flow rates to the burner.

3. SPECIFICATIONS

Performance Specifications

	Hydrocarbon FID Detector
Ranges:	0-10 ppm 0-50 ppm 0-100 ppm 0-500 ppm 0-1000 ppm
Minimum Detectable Sensitivity:	0.1 ppm CH4
Noise:	±0.05 ppm CH4
Lag Time:	Less than 15 seconds
Rise Time to 90%:	Less than 30 seconds
Fall Time to 10%:	Less than 30 seconds
Updating Time (Switching Time):	5 minutes
Total cycle time:	10 minutes
Precision:	±1% FS
Zero Drift:	±2% FS/day ±3% FS/3 days
Span Drift:	±2% FS/day ±3% FS/3 days
Linearity:	±1% FS
Selectable Time Constants:	1 second or 10 seconds

Operational Specifications

Unattended Operation: (No adjustment of flow or electrical systems)	7 days
Sample Flow Rate:	Approx. 200 ml/min
Hydrogen Flow Rate:	Approx. 140 ml/min
Power Requirements:	115 ±10 Vac (50-60 Hz) 250 watts
Recorder Outputs:	0-100 mV 0-1 V 4-20 ma (optional) 0-10 V (optional)

Relative Humidity:	5-95%
Ambient Temperature Range:	10-40 deg C

Configurational Specifications

Weight:	40 lbs. (18 kg)
Case Dimensions:	17"W x 20"L x 12 1/4"H (43cm W x 51cm L x 31.1cm H)
Mounting Available:	Bench Rack (optional)
Sample Pump:	Internal (external w/230 V option)

4. DESCRIPTION

The analyzer is a completely self-contained unit comprised of three basic subsystems: 1) the pneumatic network, 2) FID burner assembly, and 3) the associated electronics. Figure 4.1 is a top view of the analyzer interior illustrating these subsystems and some of the major components. The subsystems described below, together with the front and rear panels.

4.1 Pneumatic Network

Figure 4.2 presents the pneumatic network of the analyzer without any options. Sample air can be introduced into the analyzer by two paths. In one case, the sample enters through the rear panel port marked "METERED INLET" and flows through a calibrated rotameter to a tee. In this mode the rotameter can cause hold-up of some hydrocarbons and produce a longer response time. Therefore it is recommended that this pneumatic path is used only during setting up of the analyzer and to check the air flow rate.

In the normal sampling mode, the sample is introduced through the port marked "SAMPLE INLET" which by-passes the rotameter and goes directly to the tee. (Note: One of these ports must be capped for proper operation.) From the tee the sample air passes through a pneumatic line into the burner block to yield the total hydrocarbon analysis. Hydrogen, from a 60 psig source, enters through the rear panel port marked "HYDROGEN". The hydrogen passes through a flow controlling pressure regulator, capillary combination and then through a calibrated rotameter to the burner block. The burner block exhaust gas passes through a heated and temperature controlled needle valve which controls the exhaust gas flow rate. Air is drawn into the analyzer from a hypodermic needle inserted in the "DILUTION AIR" port. This air mixes with the exhaust gases downstream of the valve to prevent condensation of moisture in the exhaust system and reduce the hydrogen gas concentration. The pump expels the burner and dilution air gas mixture out the "EXHAUST" port.

Figure 4.3 shows the Pneumatic Network with Options. Both SV1 and SV2 are supplied with Option HC26A, Remote Manual Zero/Span with Status,and HC-11B, Automatic Zero/Span/Sample Control. With the Mode switch in the "SAMPLE" position, sample air comes into the sample inlet, passes through the de-energized SV1 then directly to the burner block. Either by placing the mode switch in "ZERO" or pressing the air flow button, SV1 will be energized, closing the sample inlet. This causes air to travel from the "ZERO AIR" inlet through the rotameter, through the de-energized SV2, SV1, and then directly to the burner block. When the Mode switch is in "CALIBRATE" position SV1 and SV2 are energized causing the gas at the "SPAN GAS" port on the rear panel to be drawn into the analyzer and through the burner block.

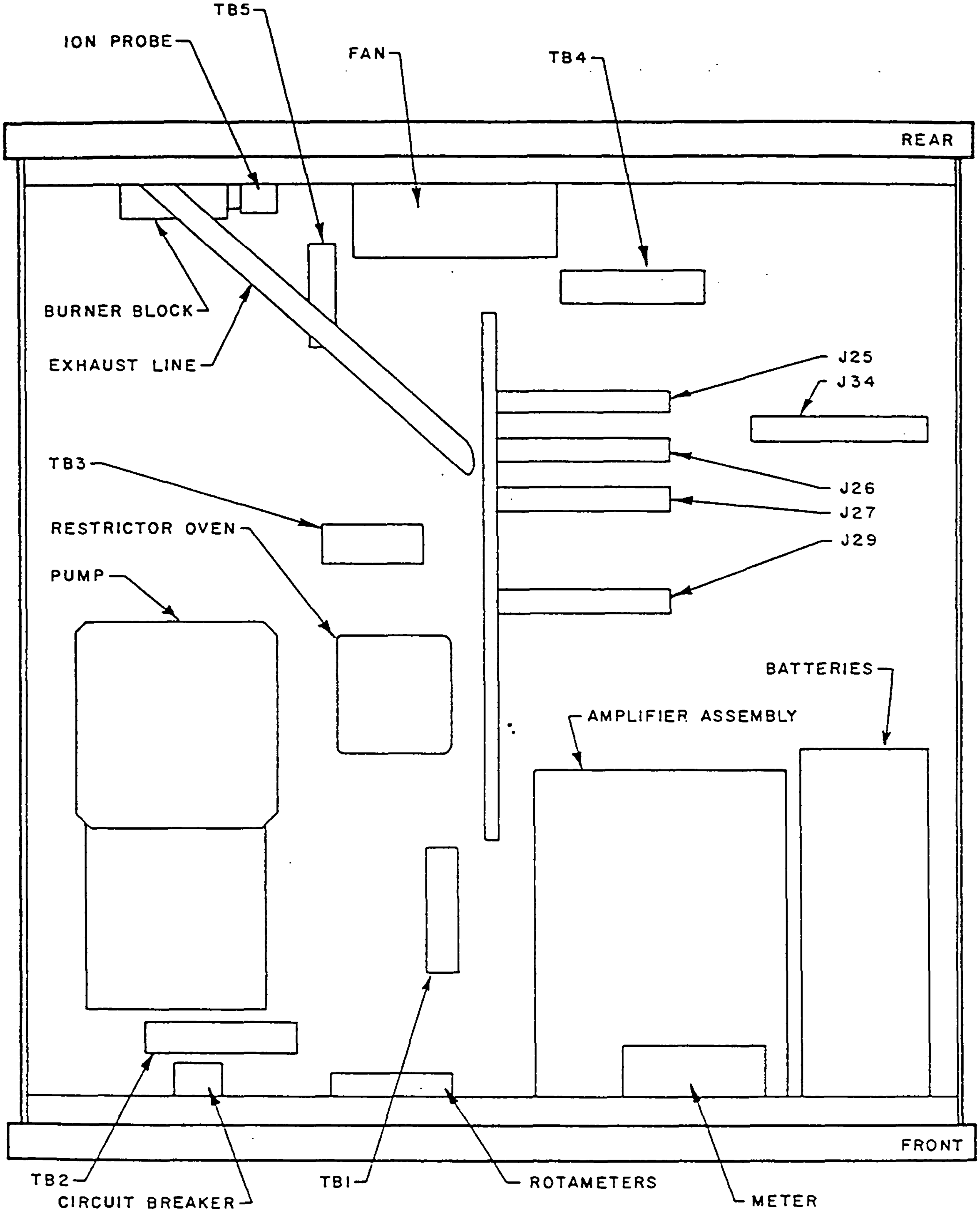


Figure 4.1 Internal Top View of HC500-2D

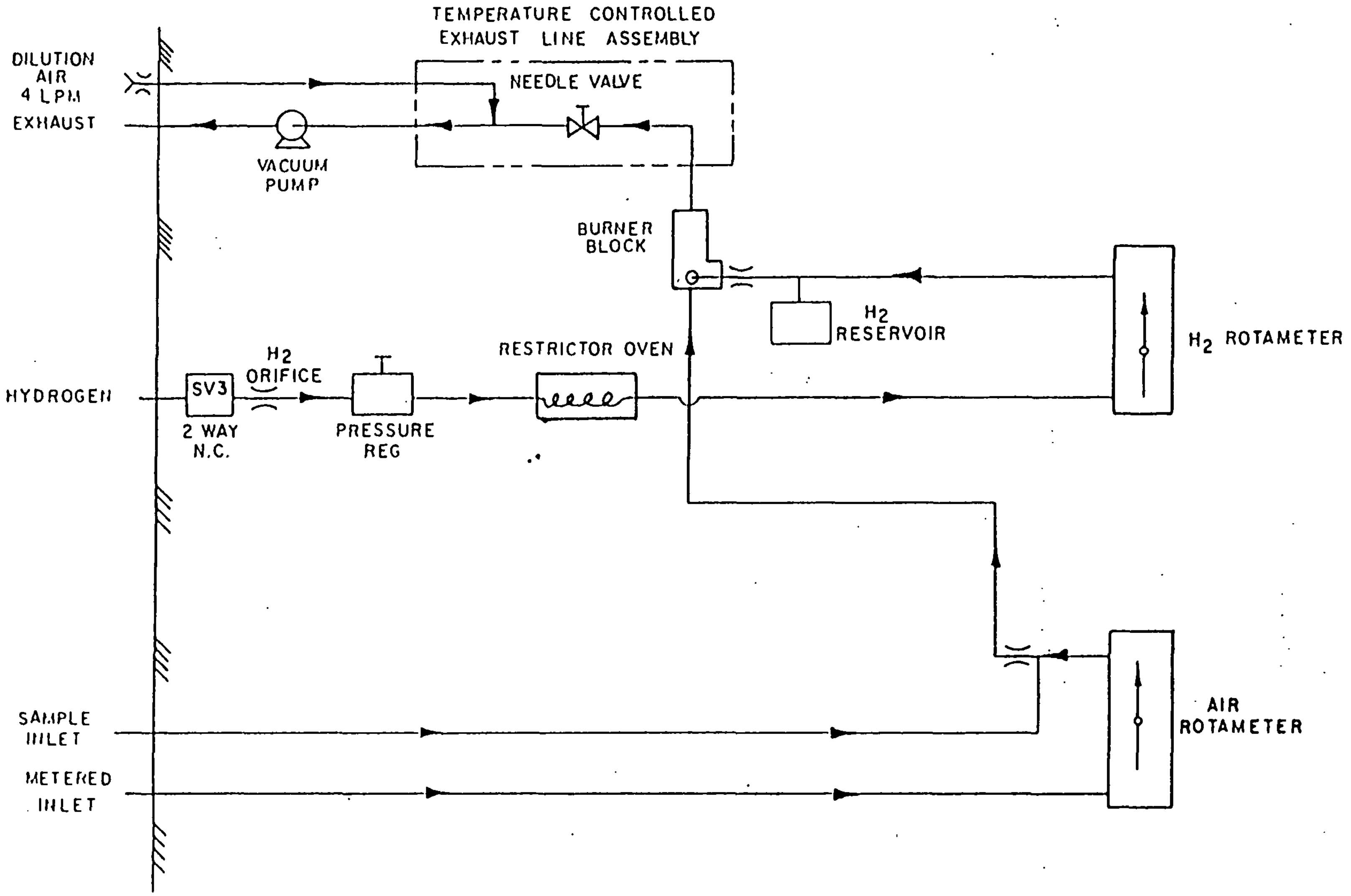


Figure 4.2 Pneumatic System of HC500-2D w/o Options

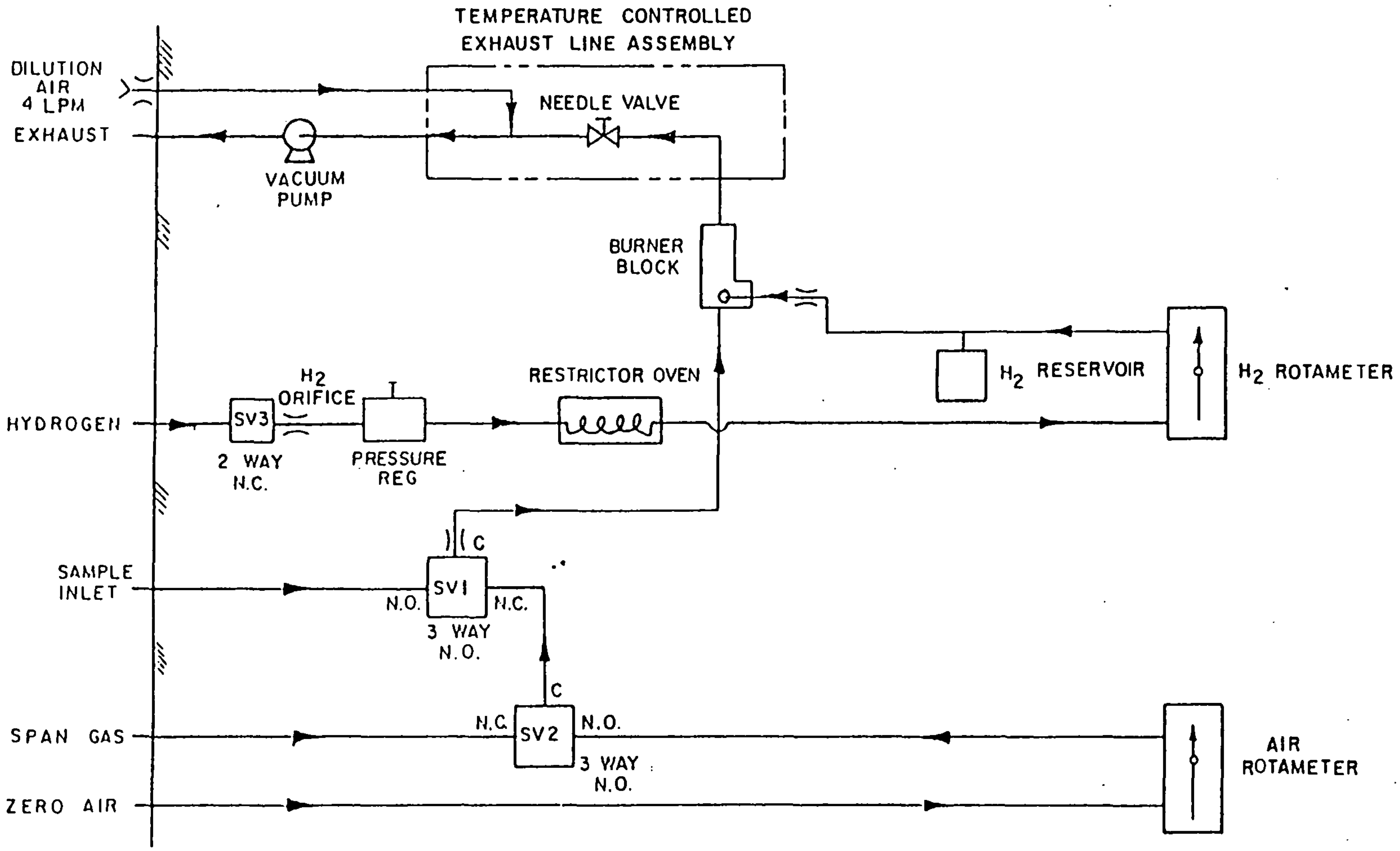


Figure 4.3 Pneumatic System of HC500-2D with Options

(1) Pneumatic Lines

The sample stream lines are 1/8" OD standard wall Teflon* tubing with stainless steel connectors. The hydrogen stream lines are 1/8" OD Teflon and stainless steel lines. Exhaust lines from the burner block are 1/4" OD stainless steel and polyethylene tubing. The stainless steel line from the burner block to the needle valve is heated and temperature controlled to avoid moisture condensation and to provide stable flow conditions.

(2) Rotameters

Flow rate measurement by rotameters is provided for both air and hydrogen streams. The rotameters are calibrated at the factory for the recommended flow setting. The setting value is printed on the rotameter glass cover near the bottom of each rotameter and also on the calibration curve supplied with each analyzer. Figures 4.4 and 4.5 illustrate typical flow rate vs rotameter curves.

(3) Needle Valve

The needle valve is used to set and control the gas flow rate from the burner block to exhaust. The valve functions as a heated and temperature controlled critical orifice to provide stable flows in the burner block. The temperature is approximately 105 deg C to prevent moisture condensation. An iron-constantan thermocouple is provided to monitor this temperature at the rear panel.

(4) Dilution Air System

The dilution air system consists of a 1/4" OD stainless steel line in which the inlet is capped with a rubber septum pierced with a #18 one inch long hypodermic needle. This system supplies approximately 4 lpm of dilution air into the exhaust system, for H2 dilution to a non-combustible mixture.

(5) Hydrogen Pressure Regulator

The HC500-2D uses a hydrogen regulator to set the hydrogen flow rate and also maintain a constant downstream pressure. This regulator is a special model which maintains a constant pressure from ambient temperatures of 10 to 40 deg C. The regulator should not be disassembled nor cleaned by flushing with solvent or air.

---

*DuPont registered trademark

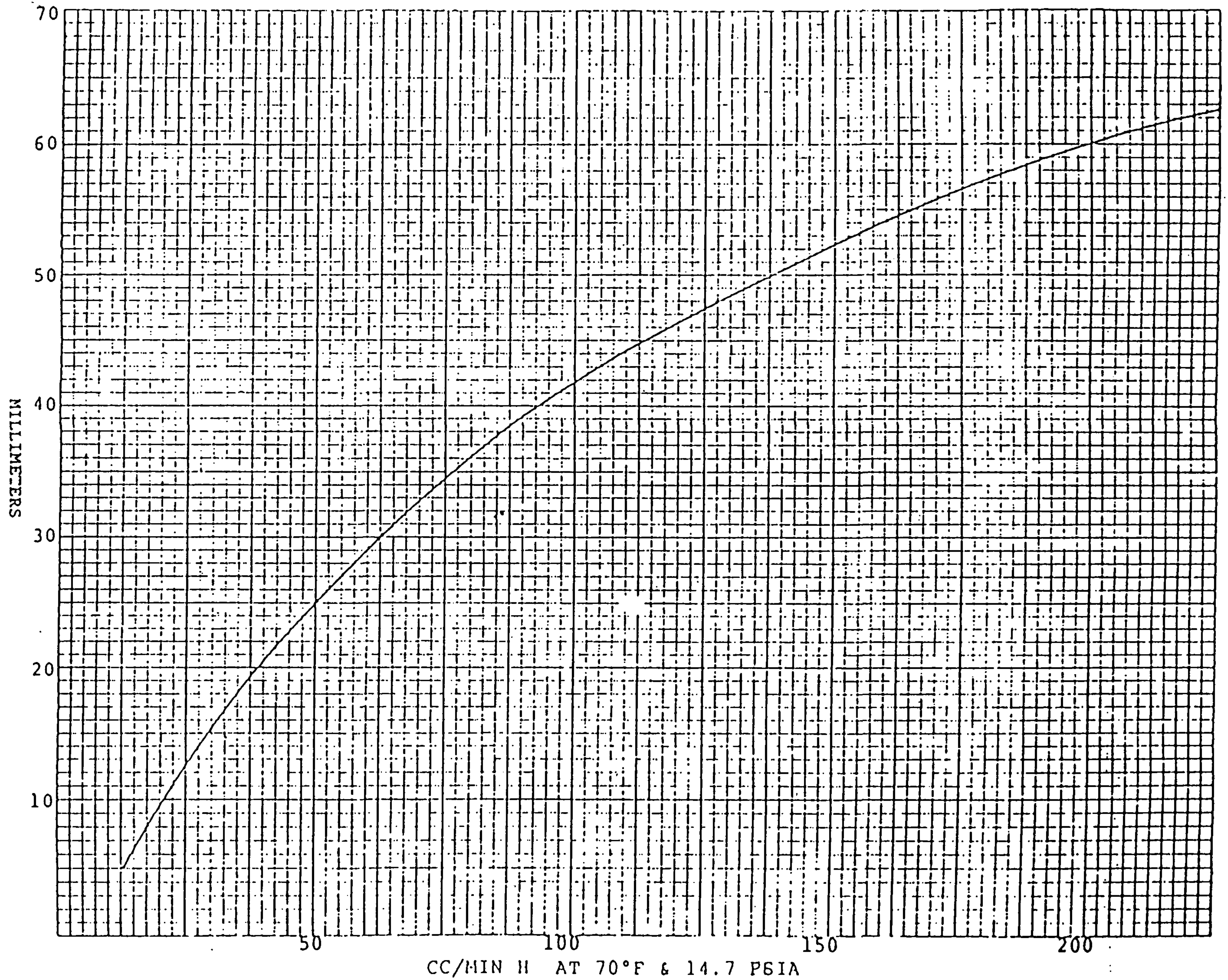


FIGURE 4.4 Hydrogen Calibration Curve (Nominal)

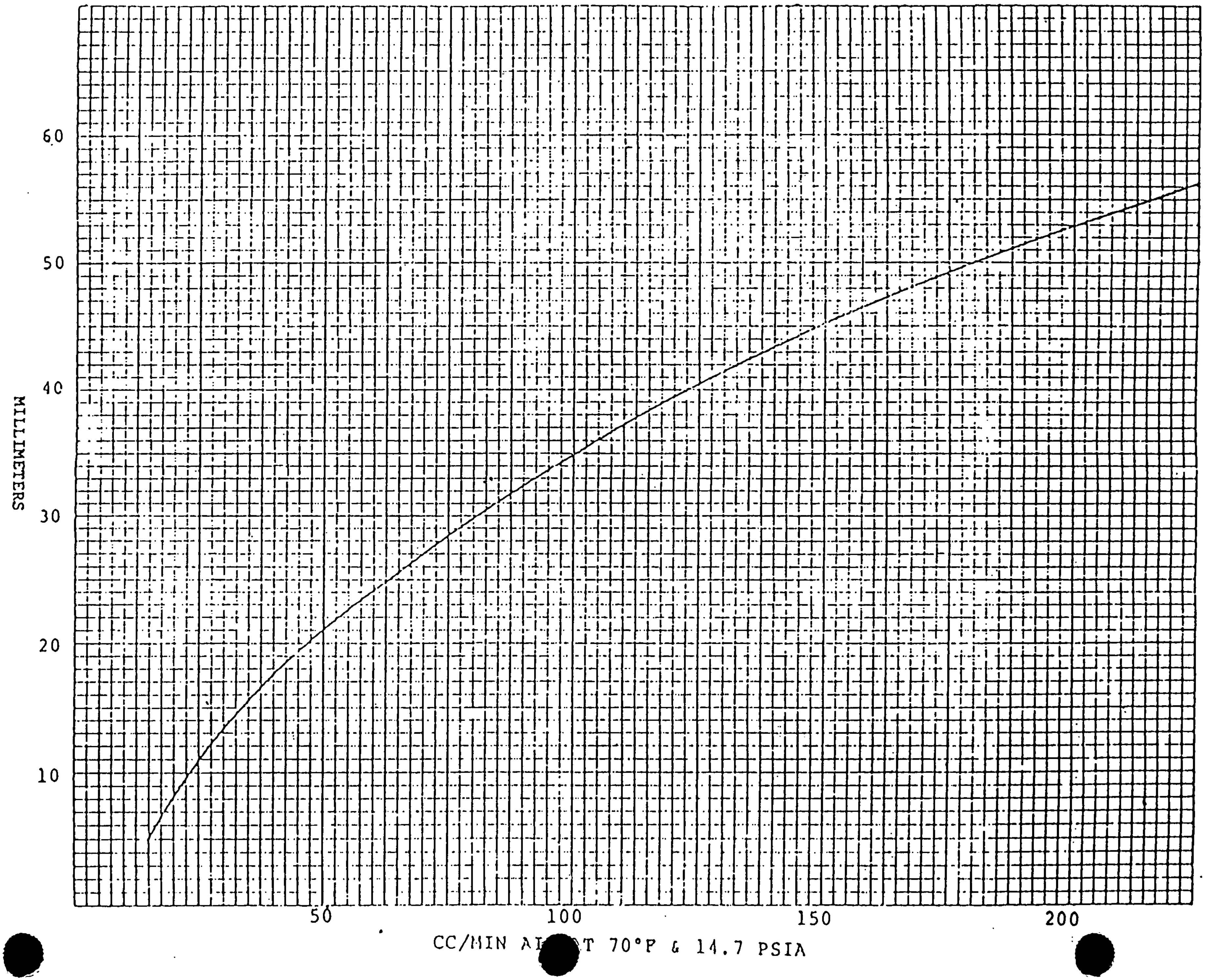


FIGURE 4.5 Air Calibration Curve (Nominal)

(6) Flow Restrictor Capillary

The hydrogen flow is further controlled by a stainless steel restrictor capillary. The capillary is temperature controlled to provide stable flow within the specified ambient temperature range. An iron-constantan thermocouple is provided to monitor this temperature at the rear panel.

(7) Hydrogen Solenoid Valve

A normally closed, 50/60 Hz, 115 Vac solenoid valve (SV3); located on the rear panel is used to provide internal shut-off of the hydrogen flow if the flame is not lit or if there is a power failure. It is energized when the ignitor button is pushed or a flame-on condition is indicated.

(8) Hydrogen Flow Limiter

The elbow connected to the outlet of the hydrogen solenoid contains an orifice to limit the hydrogen flow should a leak develop within the analyzer and a filter to protect the hydrogen flow system from particulate contamination.

4.2 FID Burner Assembly

Figure 4.6 shows an interior view of the FID burner block. Its function is to produce a stable burning condition for the flame to promote the formation of ions from hydrocarbon molecules. Sample air is introduced through the bottom inlet and hydrogen through the side inlet of the burner block. The two gas streams pass through a special burner tip where they mix and provide a stable diffusion flame. The combustion products are exhausted out of the top of the block. An ignition plug is positioned just above the hydrogen inlet port. A cartridge heater is inserted into the block just below the hydrogen inlet and maintains the block at approximately 105 deg C. Its temperature is monitored by a thermocouple attached to the block.

The ionization probe for collection of the ions is inserted into the block on the side opposite ignition plug.

A flame-out sensor, consisting of a thermocouple mounted on a round metal plate, is attached to the backside of the block. The front side of the block is covered by a metal plate.

4.3 Associated Electronics

Figure 8.1 gives the wiring schematic for the analyzer including the options. Figure 4.7 shows the position of the electronic boards with pin locations.

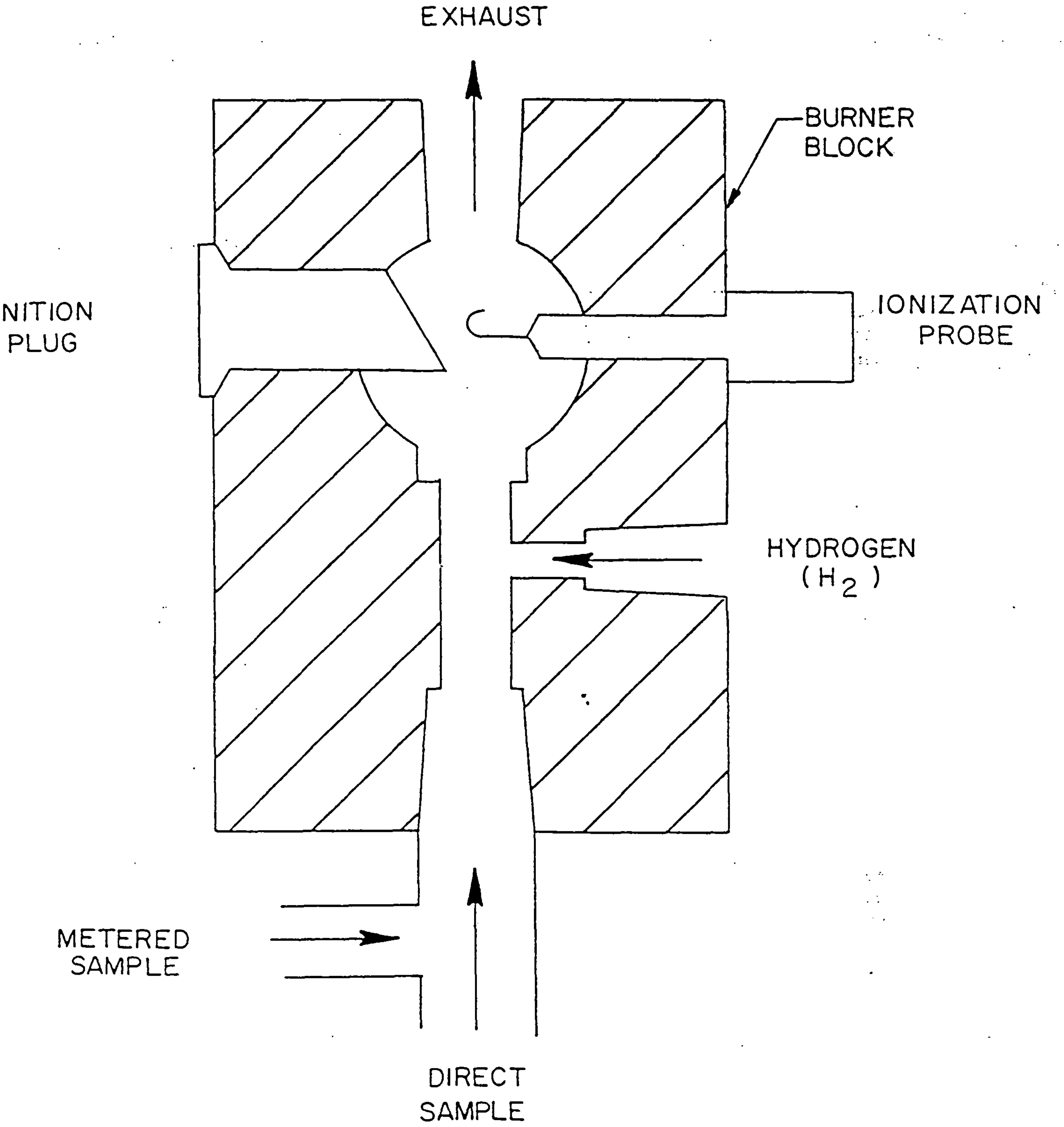


Figure 4.6 Interior View of the Burner Block

The basic tasks of the analyzer electronic system are to process the signal emanating from the FID detector for readout, to temperature-control the air and hydrogen pneumatic systems, to supply power to the subsystems, and to detect flame-out condition.

A functional block diagram of the electronic system is shown in Figure 4.8. A well regulated low voltage power supply provides ±15 Vdc for the electrometer amplifier, flame-out indicator, and output amplifier.

In the FID electrical system mercury batteries are used to apply an 84 volt positive potential to the ionization probe. The current produced at the probe is fed via the battery to an electrometer amplifier (J1) which converts the current to a voltage. The amplifier is adjustable so that the output may represent up to 5 decades of input current. The amplifier output is fed through the output Amplifier circuit for the total hydrocarbon analysis.

(1) Temperature Controllers (J26, 27)

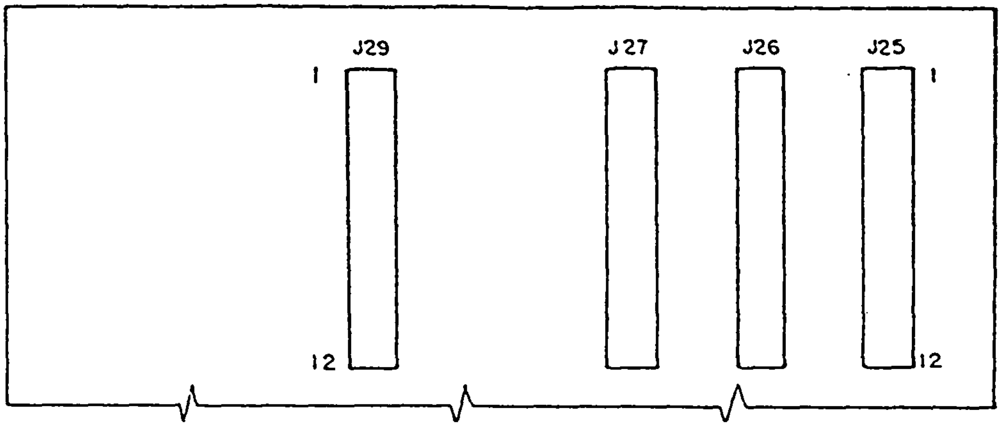
The temperature control boards utilize a local oscillator, controlled by a thermistor sensor to supply a drive signal for an a.c. switching device and thus provide proportional control. Switching of the triac is performed at the zero a.c. level to reduce R.F.I. effects. Each board has an adjustable resistor (R6) to set the temperature control point. The J27 board controls the temperature of the exhaust gas line and provides power to the heaters for both the burner block and exhaust assembly. The J26 board controls the temperature of the hydrogen capillary oven.

(2) Flame-out Detector (J29)

The flame-out detector circuit is a multi-function device. It detects the absence of a flame through the amplification of a thermocouple signal and contains circuitry for a re-light signal.

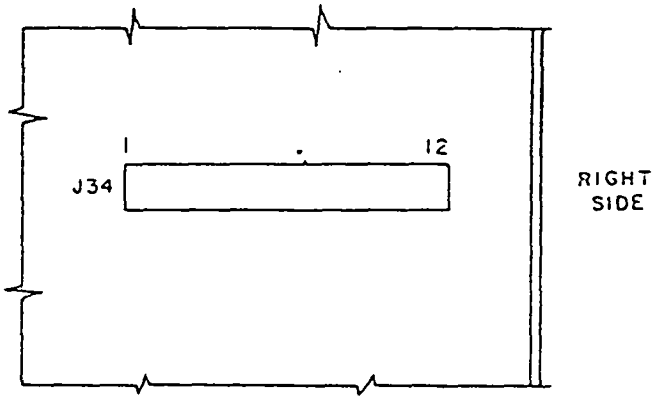
(3) Auto Reignite

A timer and relay in the instrument initiate the automatic ignition sequence after a flame-out has occurred. When flame-out is detected, a signal from the flame-out board (J29) causes K3 to de-energize. This activates the 10 minute timer motor. Cams connected to the motor shaft set the ignition sequence by controlling the closure of switches. The sequence gives switch closure for 30 seconds and switch open for 2.8 minutes. When the flame is on, K1 and K3 are energized. This stops the operation of the motor and ignition sequence. The wiring for this function is shown in Figure 8.1.



J25 — ±15VDC POWER SUPPLY
J26 — RESTRICTOR OVEN TEMP CONTROLLER
J27 — EXHAUST TEMP CONTROLLER
J29 — FLAME OUT INDICATOR

VIEWED FROM RIGHT SIDE OF UNIT



J34 — OUTPUT AMPLIFIER

VIEWED FROM TOP OF UNIT

Figure 4.7 Electronic Boards with Pin Locations

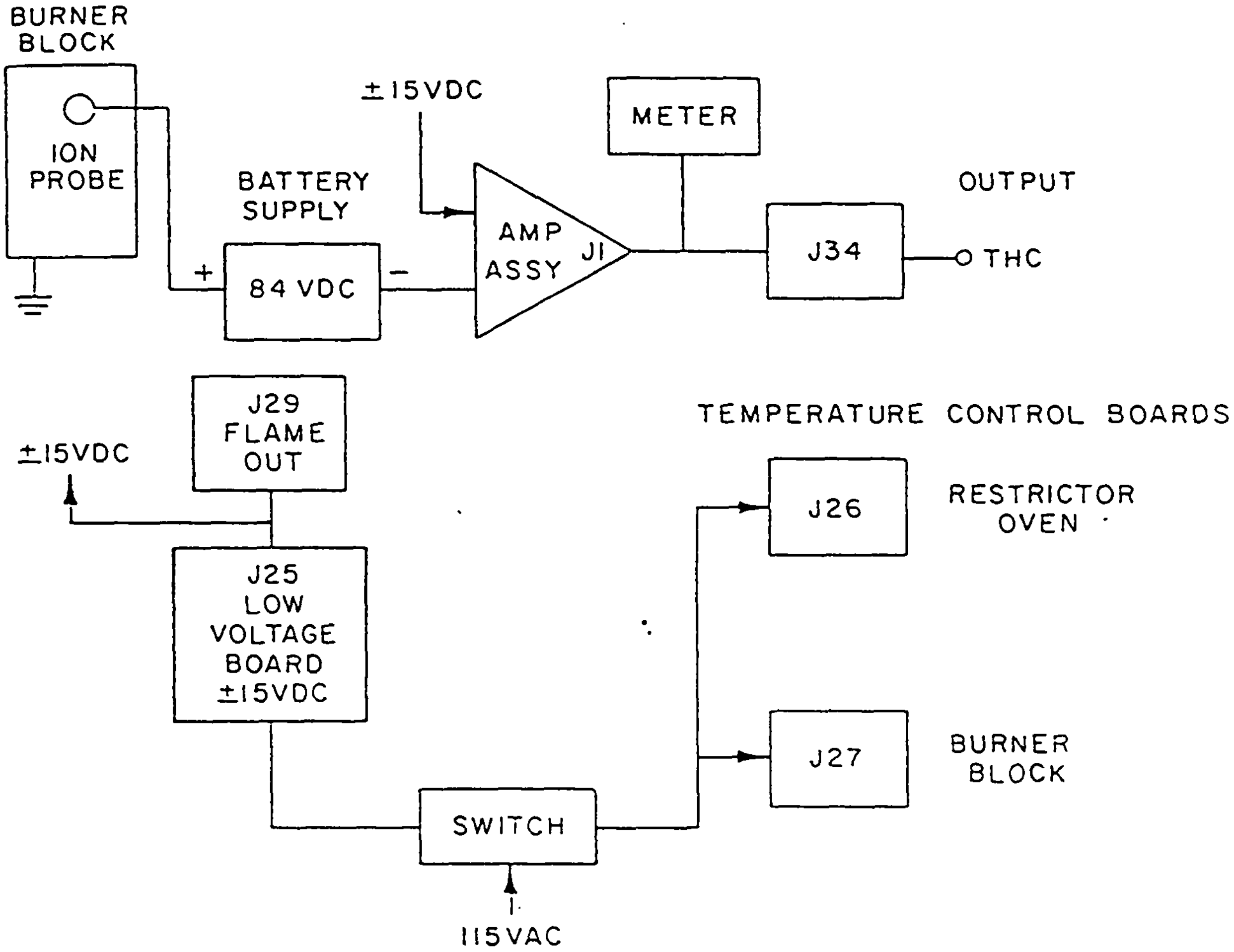


Figure 4.8 Block Diagram of Electronic System

(4) Power Supply (J25)

A low voltage supply (±15 Vdc) comprises the power supply subsystem. The ±15 volt supply provides power to the bulk of the electronic systems.

(5) FID Battery Source

The FID battery source consists of two 42 volt mercury batteries connected in series to provide the 84 Vdc potential in the FID detector circuit.

(6) FID Amplifier (J1)

The FID amplifier is a current to voltage converter which has a high input impedance characteristic. It is capable of providing a 1 volt output for 1×10^{-12} amps of input current with low noise and drift. This amplifier provides a 0-10 volt output level. The input zero adjust (R15) is used to adjust any voltage offset of the input amplifier (A1) to zero.

(7) Output Amplifier (J34)

This board employs a simple voltage divider network which takes a 10 Vdc input on pin 12 and supplies a 100 mV output on pin 4 and a 1.0 Vdc output on pin 5. This board is in the signal path between the Amplifier Assembly and the recorder output on the rear panel of the HC500-2D.

4.4 Front Panel

Figure 4.9 shows the front view of the analyzer with optional features included.

(1) Power Switch/Circuit Breaker

The power switch/circuit breaker is circumscribed by the region labeled "POWER" at the lower left hand corner of the panel. In the "ON" position, the switch is lit and provides 115 Vac to the analyzer. An internal circuit breaker will automatically turn the power off if a short occurs in the analyzer.

(2) Mode Switch (Option HC-26A or HC-11B)

The analyzer operational mode is controlled by the three position switch circumscribed by the region labeled "MODE" directly above the power switch. With the switch in "SAMPLE" position air introduced into the "SAMPLE INLET" port is analyzed. In the "ZERO" position, air is introduced into the analyzer through the "ZERO AIR" port. In the "CALIBRATE" position, air introduced into the "SPAN GAS" port is analyzed. Indicator lights are provided to show the position of the switch.

(3) Flow Controls and Indicators

All controls and indicators for making gas flow adjustments and measurements are circumscribed in the region labeled "FLOW".

a) Hydrogen Flow Adjust

The hydrogen flow is adjusted by the knob labeled "H ". Clockwise turn increases the flow rate.

b) Hydrogen Rotameter

The hydrogen flow rate is indicated by the rotameter labeled "H ". The flow rate is set properly when the center of the ball is at the value marked near the bottom of the rotameter or given on the calibration curve.

c) Air Flow Adjust

The air flow is adjusted by the knob labeled "AIR". Clockwise turn decreases the flow rate.

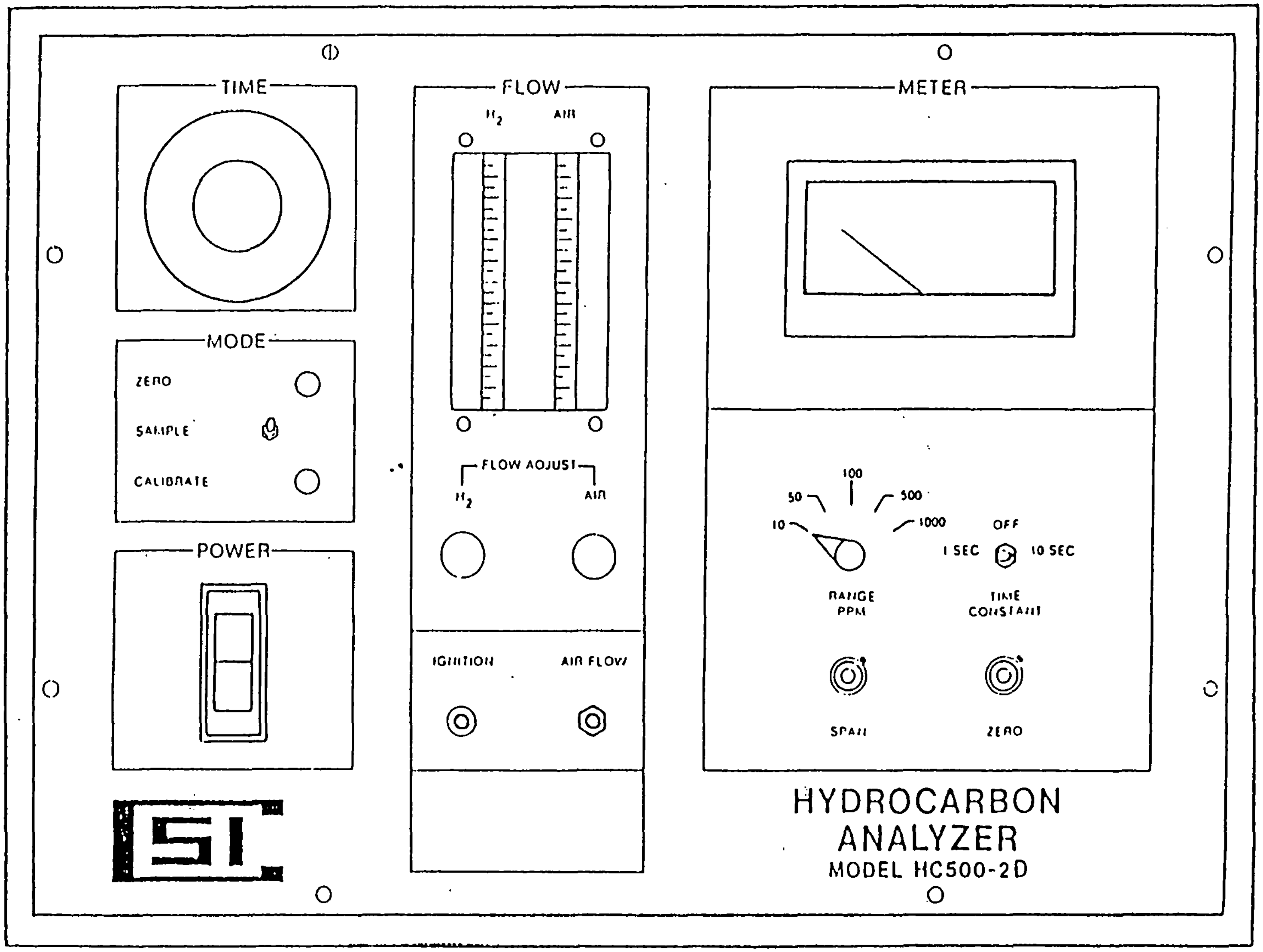


Figure 4.9 Front View of Analyzer

d) Air Rotameter

The air flow rate is indicated by the rotameter labeled "AIR". The flow rate is set properly when the center of the ball is at the value marked near the bottom of the rotameter or given on the calibration curve.

e) Air Flow (Option HC-26A or HC-11B)

This button is used when the air flow rate is to be read. Depressing and holding the button in energizes solenoid valve SV1, and causes air from the "ZERO AIR" port to pass through the "AIR" rotameter to the detector system.

(4) Ignition Button

The button marked "IGNITION", located in the circumscribed "FLOW" region, is used to ignite the flame. Depressing the button supplies power to the ignition plug in the burner block. When the indicator light in the button is lit, there is a "flame-out" condition, that is the flame is not burning. This button should not be pushed until the operation procedure is read.

(5) Electronic Controls and Indicators

Controls and indicators for making electronic adjustments or readings are circumscribed in the region labeled "METER".

a) Meter

The meter is used to indicate the hydrocarbon concentration in ppm of the air being burned in the analyzer. It is a 0-50 ua meter.

b) Range

The "RANGE" selector switch is used to set the output of the FID system. There are five selectable ranges 0-10, 0-50, 0-100, 0-500 and 0-1000 ppm hydrocarbon.

c) Time Constant Switch

A three position toggle switch is located at the right of the "RANGE" switch. It is used to minimize the output noise of the FID system when using the sensitive scales. The center "OFF" position bypasses this function. The "1 SEC" and "10 SEC" positions introduce a time constant into the output circuitry. The "10 SEC" position provides the lowest noise level in the output.

d) Zero

The "ZERO" knob, located to the bottom right of the "RANGE" is used to set the baseline for the FID output. This control is a ten turn potentiometer that provides 2 x 10 amps of buckout or suppression. Turning clockwise will increase the baseline signal. A locking device on the right side of the knob should be released, by pushing the lever counterclockwise, when setting this knob.

e) Span

The "SPAN" knob is used to adjust the output of the analyzer to the value of the span or calibration gas when that gas is being introduced into the analyzer and after the zero has been set. Turning clockwise will increase the gain or span output. A locking device on the right side of the knob should be released, by pushing the lever counterclockwise, when setting this knob.

(6) Timer Control (Option HC-11B)

The indicator dial located in the area labeled "TIME" is used to set the time to initiate the automatic calibration cycle. The dial is marked off in divisions representing 24 hours. When the "0" on the dial is adjacent to the mark under the word "TIME" the cycle will begin.

4.5 Rear Panel

Figure 4.10 shows the rear view of the analyzer.

(1) Electrical Connectors

a) Temperature Output Jacks

The jacks labeled "THERMOCOUPLES" are provided to monitor the temperature of the exhaust line, capillary oven and burner block. The temperature outputs are iron-constantan thermocouples. [Iron (white wire) is positive and constantan (red wire) is negative].

b) Power Cord

The analyzer power cord is located at the lower left hand corner of the rear panel. It can be plugged into a 110 ±10 Vac, 50/60 Hz source.

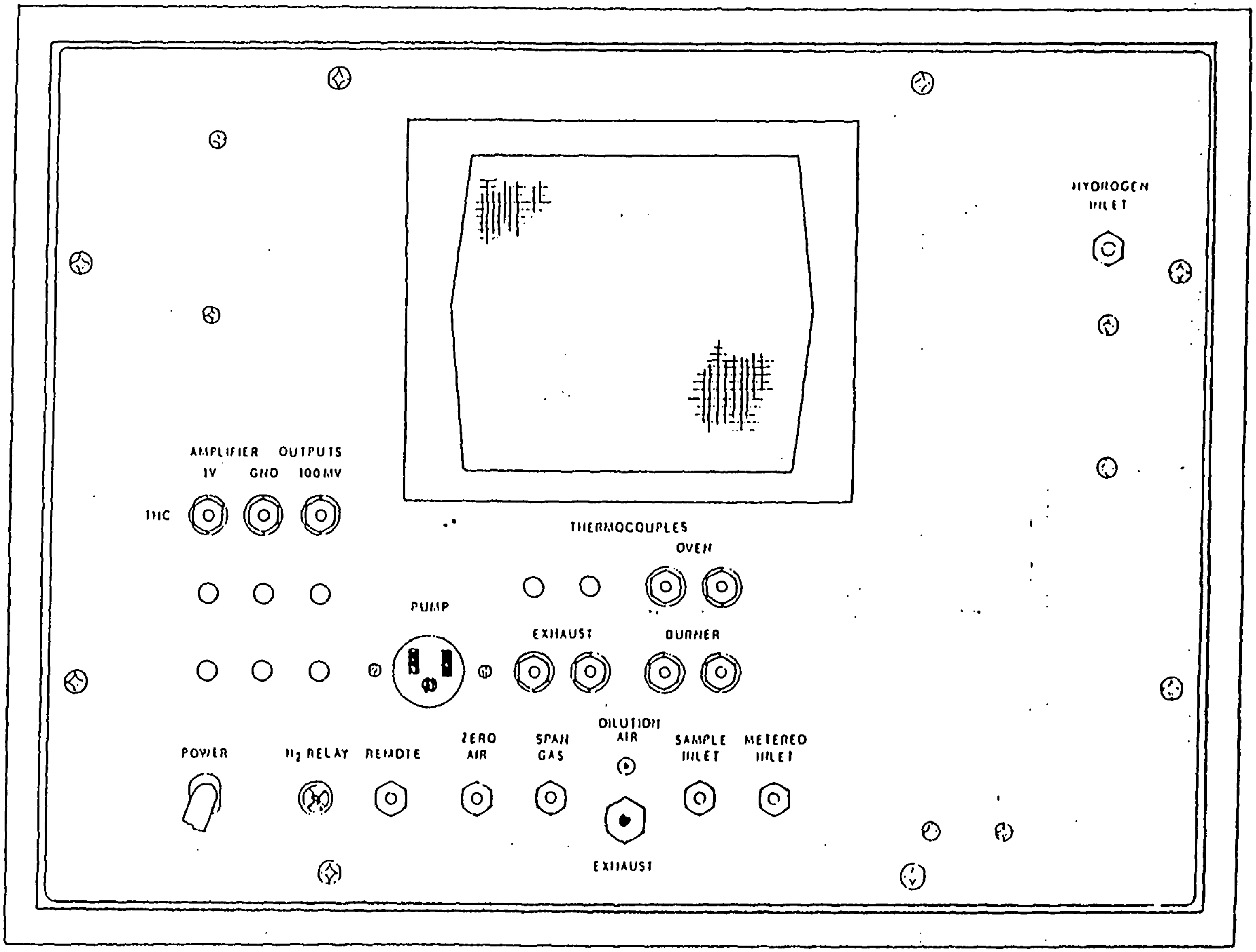


Figure 4.10 Rear View of Analyzer

c) Recorder Outputs

There are three jacks for the total hydrogren channel. The jacks are color coded: The black jack (common or ground) is used with either the red or white jacks for 0-1 volt or 0-100 mV full scale output, respectively.

d) Hydrogen Shut-Off Valve Connector

A 9-pin electrical connector labeled "H Relay" is provided for energizing an external hydrogen shut-off solenoid valve. Wiring of the connector is shown in Figure 8.1.

(2) Gas Line Connectors

a) The hydrogen gas inlet fitting is located near the upper right-hand corner and labeled "HYDROGEN INLET".

b) The sample air inlet is the fitting labeled "SAMPLE INLET".

c) Analyzers without Option HC-26A or HC-11B are provided with the fitting labeled "METERED INLET". This is used to determine the air flow rate.

d) The calibration gas inlet fitting (provided only with Option HC-26A or HC-11B) is labeled "SPAN GAS".

e) The zero air inlet fitting (provided only with Options HC-26A or HC-11B is labeled "ZERO AIR".

f) The analyzer exhaust 1/4" fitting is located at the center bottom edge of the rear panel and labeled "EXHAUST".

g) The dilution air enters through the tube opening at the center bottom edge of the rear panel and labeled "DILUTION AIR". This must be capped with a septum and a hypodermic needle inserted in the septum before operation.

(3) Cooling Fan

The cooling fan with screen is located at the center upper half of the rear panel.

5. OPERATION

Operation of the analyzer is a relatively simple task after initial set up. It requires only readout and operational adjustments for continuous operation.

5.1 Set-Up Procedure

Prior to start-up and operation of the analyzer, it is essential to prepare the system as follows:

1. Place Power Switch in "OFF" position. Remove analog meter shorting clip. Reinstall clip when shipping analyzer.

2. Connect 1/8" OD Teflon sample line to port on rear panel marked "METERED INLET". Analyzers with options HC-26A or HC-11B, connect sample line to port labeled "SAMPLE INLET".

3. If analyzer has Option HC-26A or HC-11B connect 1/8" OD Teflon line from zero and span sources to respective ports on rear panel marked "ZERO" and "SPAN".

> NOTE: These sources ("SAMPLE", "METERED", "SPAN" and "ZERO") must be vented sources or have close to one atmosphere pressure to avoid damage to analyzer.

4. Connect 1/8" OD hydrogen supply line to port on rear panel marked "HYDROGEN INLET". If an external hydrogen shut off valve is to be used, connect wires to electrical plug located on rear panel marked "H2 RELAY". See wiring diagram for pin connections.

CAUTION: HYDROGEN IS A FLAMMABLE GAS. USE METAL TUBING AND CHECK FOR LEAKS AT ALL CONNECTIONS. USE A HYDROGEN CYLINDER REGULATOR WITH A LIMITING ORIFICE. IF THE HYDROGEN CYLINDER IS NOT IN AN OPEN AREA, THE REGULATOR SAFETY RELIEF PORT SHOULD BE VENTED TO THE OUTSIDE.

5. Cap rear panel port marked "DILUTION AIR" with rubber septum cap and insert hypodermic needle supplied with instrument through center of septum.

6. If desired, vent analyzer exhaust to another location. Connect 1/4" OD line to port on rear panel labeled "EXHAUST".

7. Connect recorder or other readout device to corresponding output jacks on rear panel.

8. Connect power cord to 115 Vac, 50/60 Hz power source.

5.2 Start-Up Procedure

After completion of the set-up procedure, the analyzer is ready for start-up as follows:

1. Set front panel functional switches as follows:

a) "RANGE" to 1000 ppm.
b) "TIME CONSTANT" to "OFF" position.
c) "ZERO ADJUST" to 10.0 position (fully clockwise).

2. With hydrogen source shut off, push "POWER" switch to "ON" position. The "POWER" and "IGNITION" switches should light.

3. Adjust air flow so that the "AIR" rotameter ball is set at 6.0.

> NOTE: With Options HC-26A or HC-11B place the calibrate switch in "ZERO" position to read the air flow.
>
> CAUTION: The Air Control is a metering control only and should not be used as a shut-off valve. If the control is used to close off flow, particularly while the unit is warm, the valve may be damaged. The air control should always be left open.

4. Allow the burner chamber assembly to warm up for 15 minutes. The automatic temperature controller is factory set to warm up the assembly and maintain the proper operating temperature level.

5. Adjust the hydrogen supply inlet pressure to 60 psig.

6. Readjust the air flow rate to an "AIR" rotameter setting of 6.0.

7. Depress the "IGNITION" button, after a couple of seconds quickly set the hydrogen flow to read approximately 5.0 on the "HYDROGEN" rotameter and after a couple of seconds release the "IGNITION" button. The "IGNITION" button should not be lit.

> NOTE: The analyzer will automatically light itself, however both the hydrogen and air flows must be set manually as above. The ignition button will not be lit during automatic ignition attempts. It will remain off if lighting is successful and come back on if unsuccessful.
>
> CAUTION: When turning the hydrogen off, close the flow control only to the point that the ball just attains a zero reading. If the flow control valve is closed beyond this point, the valve may be damaged.
>
> NOTE: If the "IGNITION" button is still lit, the flame is not burning. Repeat steps 3 through 7.

CAUTION: Never push the "IGNITION" button with the hydrogen flowing as this may cause an explosion in the burner chamber which could damage the ignitor.

NOTE: If ignition does not occur after several attempts, open the air valve another full turn counterclockwise prior to repeating the start-up procedure.

5.3 Operating Procedure

At the conclusion of the start-up procedure the analyzer is ready for operation.

1. After ignition, set the air and hydrogen flows to the values listed on the calibration curves supplied with the analyzer or printed on the front panel near the bottom of each rotameter.

2. Allow 15 minutes for the internal temperature of the instrument to stabilize and reset the hydrogen and air flows as before.

3. Set the Range and Time Constant switches to the desired positions.

4. Set the zero baseline as follows: with the zero air entering sample inlet (or with Option HC-26A or HC-11B the Mode switch in "ZERO" position and zero air line connected to the "ZERO" inlet) set the meter on the front panel to read zero with the "ZERO" adjust pot on the front panel.

5. Connect the sample air line to "SAMPLE INLET" port and securely cap the "METERED INLET" port (place "MODE" switch in the "SAMPLE" position with analyzers having Option HC-26A or HC-11B).

6. If the analyzer has Option HC-11B set "TIME" dial to desired position (see instructions for setting switch in section 10).

7. The analyzer is now ready for sampling. The "SPAN" has been preset at the factory and should not be adjusted unless the analyzer is to be calibrated. A dynamic calibration of the analyzer may be performed as described in section 5.4.

5.4 Calibration Procedures

Each individual analyzer is calibrated at the factory prior to shipment and calibration curves supplied with it. These curves contain operating conditions specific to the unit. Typical curves are shown in Figures 5.1 and 5.2.

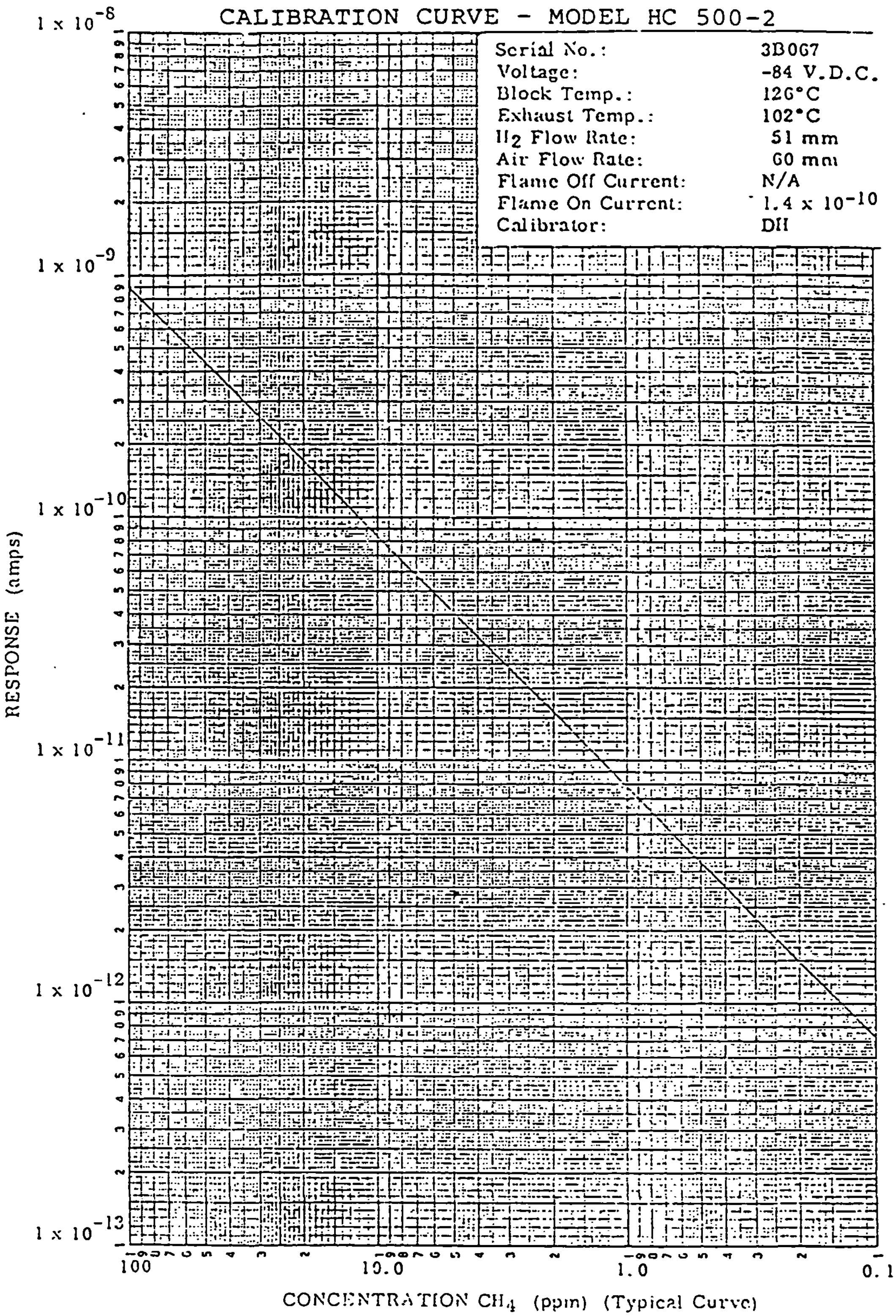
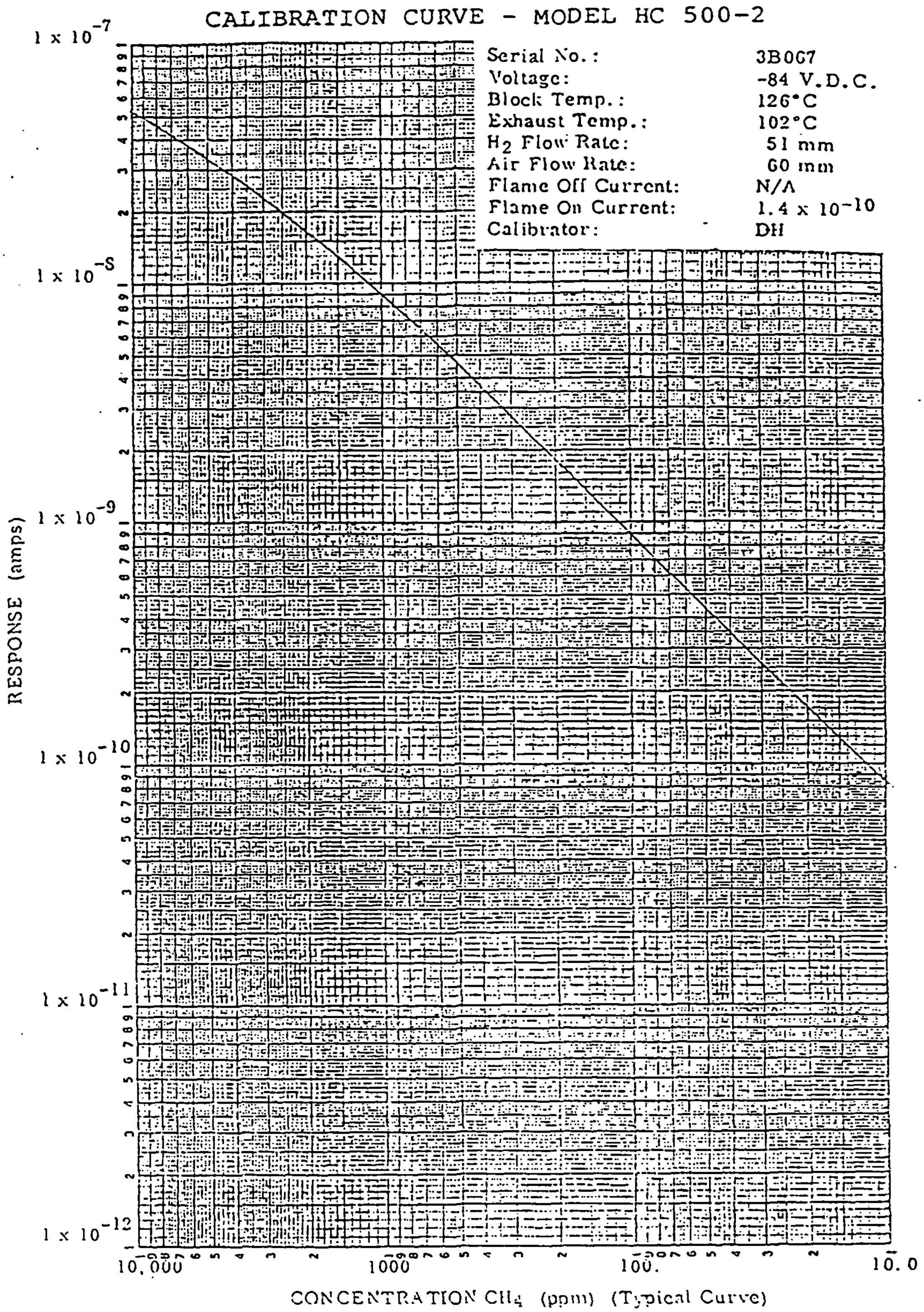


Figure 5.1 Typical FID Calibration Curve
(0.1 to 100 ppm methane)



Serial No.: 3B0G7
Voltage: -84 V.D.C.
Block Temp.: 126°C
Exhaust Temp.: 102°C
H_2 Flow Rate: 51 mm
Air Flow Rate: 60 mm
Flame Off Current: N/A
Flame On Current: 1.4 x 10^{-10}
Calibrator: DH

Figure 5.2 Typical FID Calibration Curve
(10.0 to 10,000 ppm methane)

(1) Calibration Curve

The calibration curve is the ion probe current response to sample hydrocarbon concentration levels referenced to "ZERO AIR", i.e. air scrubbed of hydrocarbon compounds.

NOTE: Air supply lines usually contain hydrocarbons unless filtered. A list and definition of the calibration curve parameters are given below:

a) Serial No. - Number assigned to the specific analyzer. Number also given on rear panel of analyzer.

b) Voltage - The voltage of the ion probe.

c) Oven Temperature and Exhaust Temperature - the temperature of the restrictor oven and exhaust line can be measured. Thermocouples are iron-constantan.

d) H Flow Rate and Air Flow Rate - the recommended rotameter settings for hydrogen and air.

e) Flame-Off Current - the analyzer residual baseline with the flame off.

f) Flame-On Current - the analyzer residual baseline reference established by sampling "ZERO AIR". Flame-on current must be subtracted from signal reading to obtain a high degree of accuracy at low hydrocarbon concentrations. If no buckout or "ZERO" control is used, the flame-on current specified is directly subtracted from the analyzer output to obtain the hydrocarbon concentration level. In setting the "ZERO" control, zero air must be introduced into the analyzer. This is required because room air contains small amounts of hydrocarbon compounds which increase the actual reading. This zero air reading may then be reduced by using the "ZERO" control and establishing a new baseline.

g) Calibrator - initials of person who performed the test.

(2) Dynamic Calibration

The instrument can be calibrated dynamically by using a zero air source and methane span gas source. The procedure is as follows:

a) Set air and hydrogen flows to the settings given on the specification sheets.

b) Introduce zero air to analyzer. (Mode switch in zero position with Option HC-26A or HC-11B).

c) While in the direct mode use "ZERO" adjust pot to set THC output.

d) Set "RANGE" switch to appropriate position for concentration of methane span gas to be used.

e) Introduce methane span gas to analyzer. (Mode switch to calibrate position with Option HC-26A or HC-11B).

f) Adjust span knob so that output reads methane value.

g) Repeat steps b, c, d and e several times until zero and span are repeatable.

5.5 Shut-Down Procedure

To shut down the unit for a short time, turn off the hydrogen flow at the hydrogen tank. Do not switch off sample pump until all hydrogen has been bled from system. The electronics may be left on. For longer periods of time turn off the main power switch. If the unit is to be moved, shipped, or stored, disconnect the gas lines and electrical connections on the rear panel. Protect the ports, both from thread damage and dirt in the lines. Swagelok caps are suggested. Remove the #18 hypodermic needle from the dilution port to keep it from being bent. This can be taped to the unit to prevent loss. The shipping box the unit came in or its equivalent is recommended for optimum protection.

6. MAINTENANCE

The analyzer maintenance requirements are primarily associated with the pneumatic subsystem and the burner assembly. The recommended maintenance schedule is given in Table 6.1. The cleaning and replacement procedures are given below.

6.1 Pneumatic Sampling Network

Under most operating conditions, the sample cleanliness level determines the maintenance frequency. The wearout or replacement times of the elements listed below are rated for continuous operation of the analyzer in a reasonably clean environment.

(1) Teflon Lines

The Teflon lines must be periodically replaced or cleaned. Over long term continuous operating periods the sample line may accumulate deposits which can impede the sample air flow rate and/or interact with the sample gas. The frequency of replacement is dependent upon the average condition of the sample ingested. However, CSI recommends replacement or cleaning every 12 months.

If lines are replaced, remove all lines with their fittings. Cut new lines to the same dimensions as the old lines and use new fittings when installing the new lines. The lines can be cleaned by removing them and pulling a good, fresh degreasing solvent (e.g. Freon) through the lines at a high velocity. Thoroughly dry lines before reassembly.

NOTE: Use only Teflon tubing for replacement that has been purged of impurities.

CAUTION: Be sure all hydrogen gas has been flushed with air before removing the lines and all new lines are properly retightened.

(2) Flow Restrictor Capillary

It is important that the flow restrictor capillary be free of dirt to maintain a stable flow. The capillary should be replaced only when hydrogen flow cannot be maintained and other components are proven to be functioning correctly. Be sure the hydrogen source flow and detector temperature are stable, the hydrogen and exhaust orifices are clean, and there are no leaks, before replacing the capillary.

Table 6.1 Recommended Maintenance Schedule

ITEM	ANNUAL MAINTENANCE	BIENNIAL MAINTENANCE
Pneumatic Sampling System:		
Teflon Lines	Replace*	
Flow Resictor Capillary	Replace	
Rotameters	Clean*	
Hydrogen Regulator		Replace
Dilution Air Orifice	Replace*	
FID Burner Assembly:		
Burner Chamber	Clean*	
Chassis, Fan Assembly:		
Air Filter	Clean*	
FID Detector Batteries	Replace	
Pump		Replace

*NOTE: These items may require maintenance more often, depending on cleanliness of its environment and the exposure rate.

(3) Rotameters

Rotameters should be cleaned every 12 months, or when the ball does not move freely when adjusting the flow. To clean, remove both inlet and outlet lines and flush with Freon or similar degreasing solvent.

(4) Hydrogen Regulator

The hydrogen regulator should be replaced every 24 months. To replace, remove inlet and outlet lines and the front panel securing nut. Remove regulator and replace new one in reverse manner. Replace with only a regulator from CSI as this is a special regulator.

CAUTION: Be sure to flush all hydrogen from lines before removing the lines and that all lines are properly retightened.

(5) Dilution Air Orifice

The orifice is a size #18 hypodermic needle 1 inch long, which controls the 4 liters/min flow of dilution air. The needle and septum should be replaced every 12 months.

6.2 FID Burner Assembly

(1) Burner Chamber

The burner chamber will periodically require cleaning. If loss of sensitivity is noticed it should be suspected that the unit is dirty. Some units have functioned continuously for over 30 months without cleaning being necessary. To clean the detector, follow this procedure:

a) Remove the ac power supply cord from the electrical power source. Unlock the eight screws from the sides of the cover and lift the cover off.

b) Disconnect the hydrogen inlet, air inlet and exhaust air outlet line at the burner block and cap the hydrogen inlet with a Swagelok plug (P/N 200-P).

c) Connect to the burner exhaust port a liquid suction apparatus, such as a water aspirator with a suitable trap, to flush the liquid through the burner chamber.

d) Inject distilled water into the burner block (a length of Teflon line with a 1/8" Swagelok fitting will help in this step).

e) repeat the purging operation using reagent grade acetone.

f) Connect a clean air supply to the air inlet and purge the system for a period of approximately 10 minutes or until no trace of acetone is detectable in the exhaust.

g) Plug in the ac power supply to a power source, place "POWER" switch to the "ON" position, and continue clean air flushing.

CAUTION: Disable Auto Re-ignite function (remove K3). Do not actuate the ignition switch during the cleaning procedure, as this may cause damage to the glow plug.

h) Allow the unit to operate for one (1) hour. This should completely dry out all internal components in the burner chamber and sample and exhaust lines.

i) Following the drying period, reconnect the hydrogen line to the burner chamber. Perform a leak test by removing the exhaust line from the top of the burner block and capping it. Also cap all the air inlet ports. Attach a hydrogen* supply line to the "HYDROGEN INLET" port. Adjust inlet pressure to 5 psig and open the hydrogen flow control valve. Any displacement of the float in the H rotameter indicates a leak in the system. An initial displacement and return of the float to 0 mm is normal when the H valve is opened and does not indicate a leak.

j) After finding and stopping the leaks, if any, reconnect the lines as before. The analyzer is now ready for start-up procedure.

6.3 Chassis, Fan Assembly

(1) Air Filter

The air filter for the chassis ventilating fan should be cleaned every 12 months or as needed. Shut off the power to the analyzer and remove the filter. Wash it in warm detergent solution and recoat with ROTRON filter oil or equivalent.

6.4 Electronics

The electronics of the analyzer are essentially trouble free and, except for the FID batteries, should not require periodic maintenance. However, should the amplifier need replacing it will need recalibration. The recalibration should be attempted only by qualified people with the proper equipment.

*Helium may be substituted for hydrogen for purposes of safety, though no problem has been encountered to date using hydrogen and exercising general safety practices.

(1) Battery Replacement

The two mercury batteries should be replaced every 12 months. Replace batteries by the following procedure:

a) Unplug analyzer from wall socket and remove cover.

b) Remove two screws on top cover of battery holder (located on bottom right side just behind front panel).

c) Remove holder cover and lift out Teflon wrapped batteries. Care must be taken not to break the resistor attached to the snap-on connectors.

d) Remove Teflon protective insulation and disconnect batteries from snap-on connectors.

e) Replace new batteries in reverse order.

(2) Electronic Alignment

All voltages are measured with respect to chassis ground unless otherwise noted.

a) Turn on power and remove the analyzer cover.

b) Set the ZERO control on the front panel fully clockwise and the RANGE control to the 500 ppm position.

c) Connect a current source (KEITHLEY MODEL 261 or equivalent) to the amplifier input jack (J2). Set the current for zero or any current less than 1 x 10 amps.

d) Monitor pin 12 of J34 with a d.c. digital voltmeter (Fluke Model 801 or equivalent) and adjust R15 on the amplifier board (J1) for 0.000 volts.

e) Set the RANGE control on the front panel to 10 ppm and set the current source for a reading of 10 volts on the DVM at J34, pin 12.

f) Adjust R24 of the amplifier board (J1) until the front panel meter reads full scale.

g) Measure voltage at J15 rear panel and adjust R4 on output amp board (J34) for 1.000 Volt, and adjust R3 for 100mV at J17 on rear panel.

This completes the electronic alignment. Disconnect the current source and digital voltmeter, connect the cable from the battery to the amplifier at J2. The instrument is now ready for operation.

7. TROUBLE SHOOTING PROCEDURES

The analyzer is designed to provide trouble-free continuous operation. However, in the event of a problem or malfunction, the trouble shooting procedure listed below presents an orderly sequence of tasks to locate and correct the instrument malfunction.

Symptom	Probable Cause	Corrective Action
1. Power switch "ON" but does not light.	No power to analyzer.	Check power at 115 Vac outlet. Be sure plug is securely in outlet.
	Defective fuse.	Replace fuse.
	Burnt out indicator bulb.	Replace power switch.
	Defective transformer.	Replace isolation transformer.
2. Power switch will not stay in "ON" position.	Short in electrical system.	Find and fix electrical problem.
3. Ignition switch does not light with flame out.	Defective light.	Replace ignition switch.
	Open circuit.	Repair loose or broken wires.
	Defective relay (K1).	Replace relay if it does not make a click sound when "IGNITION" button is pushed
	Loose or defective flame-out board.	Check to see if board is properly set in place. Replace defective board.
	Defective transformer.	If secondary output of T1 transformer is not 6.3 Vac, replace transformer.

	Defective temperature sensor.	Disconnect lines to thermocouple. If higher than 500 ohms, replace thermocouple.
4. Ignition button remains lit after being pushed.	Flame not burning.	See symptom #7, "Analyzer fails to ignite".
5. Air flow absent, incorrect, or unstable.	Defective vacuum pump.	Check vacuum system (should be capable of maintaining 5 l/min flow rate at 370 Torr), if not, replace pump.
	Wrong flow setting.	Set air flow to recommended value.
	Dirt in flow system.	Isolate source by disconnecting, starting at analyzer inlet and working towards pump.
	Leak in flow system.	Retighten fittings and caps. Check lines for small holes.
	Moisture in exhaust line.	If exhaust line is warm (about 90 deg C at thermocouple) allow analyzer to run for 10 min to dry line; if not dry replace exhaust line.
	Defective flow control valve(s).	Replace valve(s)
	Dilution air orifice clogged or septum leaking.	Replace needle and/or septum.

	Loss of temperature control.	See symptom #12 "No or incorrect temperature control".
6.Hydrogen flow absent, incorrect or unstable.	Hydrogen source empty or not producing sufficient hydrogen.	Replace hydrogen source or its regulator. Set regulator on hydrogen source at 30 psig and open all related valves.
	Hydrogen shut-off valve not energized.	Check voltage for 110 Vac to valve when "IGNITION" button pushed.
	Internal hydrogen regulator defective.	Replace regulator.
	Flow system problems.	See discussion above on air flow problems.
7.Analyzer fails to ignite.	Improper hydrogen or air flow.	Set flow as recommended.
	Insufficient purge.	Open flow control valves until rotameters are set at 6.0, and allow gases to purge for 30 seconds.
	Temperature too low.	Check temperature by inserting temp. indicator into thermocouple terminals at rear of instrument. The exhaust temperature should read above 90 deg C, and block temperature

		above 90 deg C. If temperature indicator is not available, remove instrument cover and feel exhaust line which should be warm.
	Ignitor glow plug defective.	Remove flame-out indicator board from J29 connector and measure resistance between pin 11 on J29 connector and chassis (ground). If resistance is not in the order of 20 ohms replace ignition plug and O-ring.
	Loose or defective flame-out board.(J29).	Be sure board is properly in its socket. Measure voltage between test point on board and chassis(ground). If flame is off, voltage should be -1.5 to -2.0 volts. If flame is on, voltage should be 4.0 volts or higher. Adjust R3 for proper voltage or replace board If voltage is not between 5-10 Vdc, when flame is lit replace board.
8.No output at meter but power switch lights.	Flame not burning.	If "IGNITION" button is lit relight flame per instructions

Loose electronic board or connections.	Insure all boards are securely in place. Check for loose wires or connectors.
Defective meter.	If the recorder output and current across terminal leads to meter are good, replace meter.
No power to low voltage power supply board.	Remove low voltage power supply board from J25 connector. Measure across pin 4 and pin 9 for 115 Vac, if missing check for loose wire at connector or electrical leads to connector.
Defective low voltage power supply board.	Check J25 connector (with board in place) for +15 Vdc across pin 11 and chassis (ground) and for -15 Vdc across pin 2 and chassis. If missing either voltage, replace board.
Defective batteries.	Remove "PROBE" (+) and "AMP"(-) connectors from battery holder (located at bottom front right). Measure voltage between the center pins of the two connectors on battery holder. If not 80 ±5 Vdc replace batteries inside holder.

	Defective amplifier assembly.	Connect an external calibrator to the amplifier input to determine if amplifier functions.
9.No output to recorder.	Defective output amplifier.	Replace amp board or look for broken wires
10.Loss of analyzer sensitivity and/or noisy operation.	Flows not set properly.	Set air and hydrogen flows to recommended values.
	Leaks in flow system.	Retighten fittings. Check lines for small holes.
	Dirty burner block.	Clean burner block per instructions.
	Impure hydrogen.	Replace source if noise increases greatly with small increase in hydrogen flow rate.
	Loss of temperature control.	See symptom #12 "No or incorrect temperature control".
11.Unstable or incorrect zero.	Zero or span source spent or incorrect.	Verify or replace source.
	Leak in zero air system.	Locate leak and fix.
	Solenoid valve(s) defective for analyzers with Options HC-26A or HC-11B.	Replace valve(s)
	Contaminated or clogged air lines.	Replace or clean air flow lines.

	Flows set improperly.	Set air and hydrogen flows to recommended values.
	Zero and span controls not set up properly.	Recalibrate instrument per instructions.
	Dirty burner block.	Clean burner block per instructions.
	Defective battery.	See symptom #3 "No Output".
12.Temperature control inoperative or incorrect.	Defective heaters.	A)Burner block heater: Disconnect plug P4 (located on burner assembly) Measure resistance between connector contacts H and F If there is no continuity or resistance is greater than 500 ohms, replace heater. B) Exhaust heater: Remove temp controller from connector J27 and unplug P4. Measure the resistance between pins H and F on the plug. If there is no continuity or resistance is greater than 500 ohms, replace heater. C) Restrictor Oven: Remove low temp controller from connector J26. Measure resistance between TB3-3 and TB3-4. If

	there is no continuity or resistance is greater than 500 ohms, replace heater.
Defective thermistor.	A) Exhaust Thermistor: Remove high temp control board from connector J27. Measure resistance across contacts 1 and 9. If resistance is not approx. 100K ohms at 25 deg C replace thermistor. B) Restrictor Oven: Remove low temp control board from connector J26. Measure resistance between contacts 1 and 9. If resistance is not approx. 4K ohms at 25 deg C replace thermistor.
Defective temperature control board.	The exhaust temp control (J27) and capillary oven (J26) boards may be checked as follows: Measure the input voltage 115 Vac, between contacts 2 and 10 (neutral) for each board connector. If missing, check for broken or loose wires. If present, measure the voltage

between contacts 6 and 10 (neutral) or each connector. The voltage should show variations during one min. of measuring. If not, replace board.

NOTE: Heaters and thermistor should be checked and found good before this step.

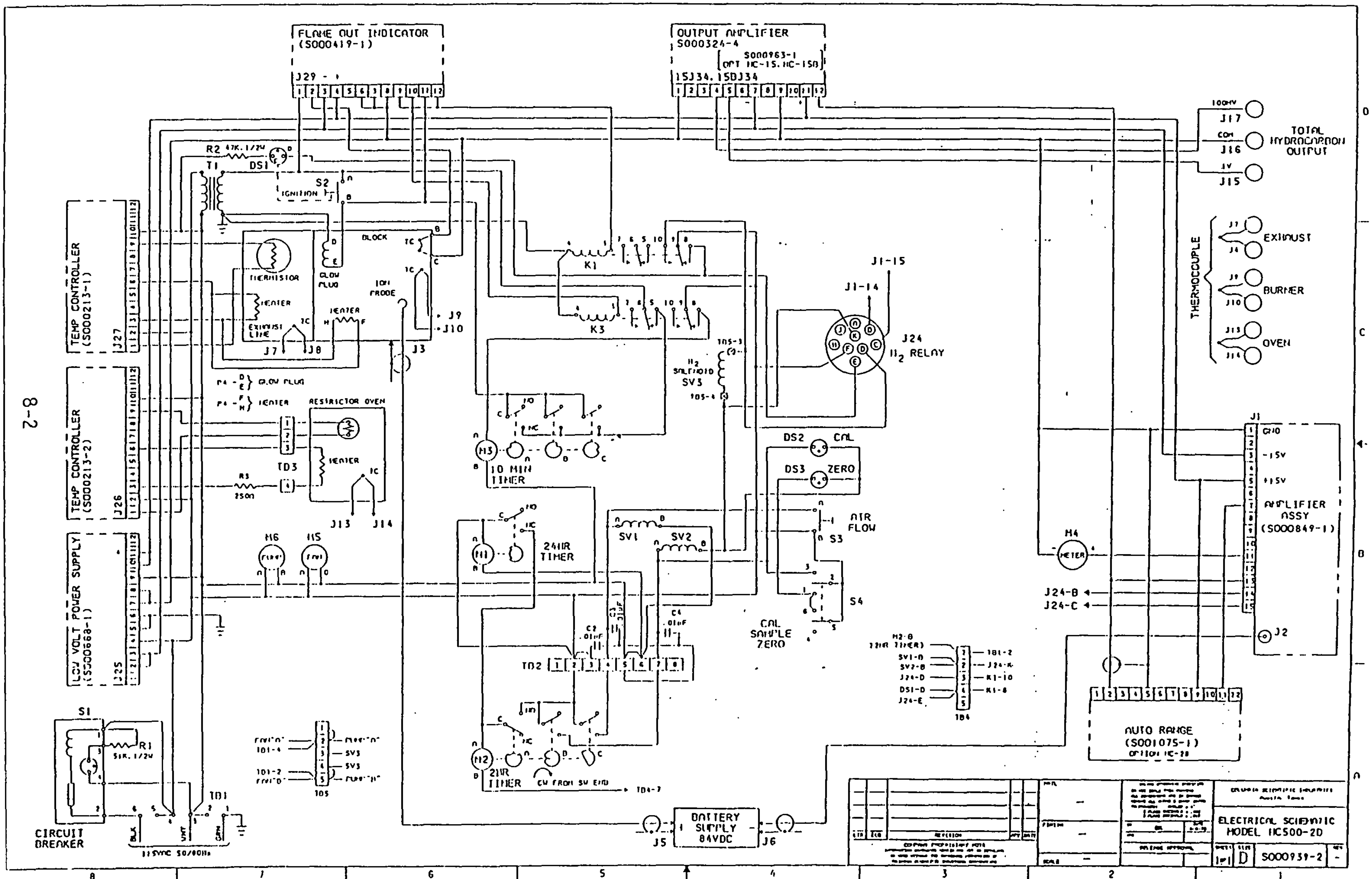
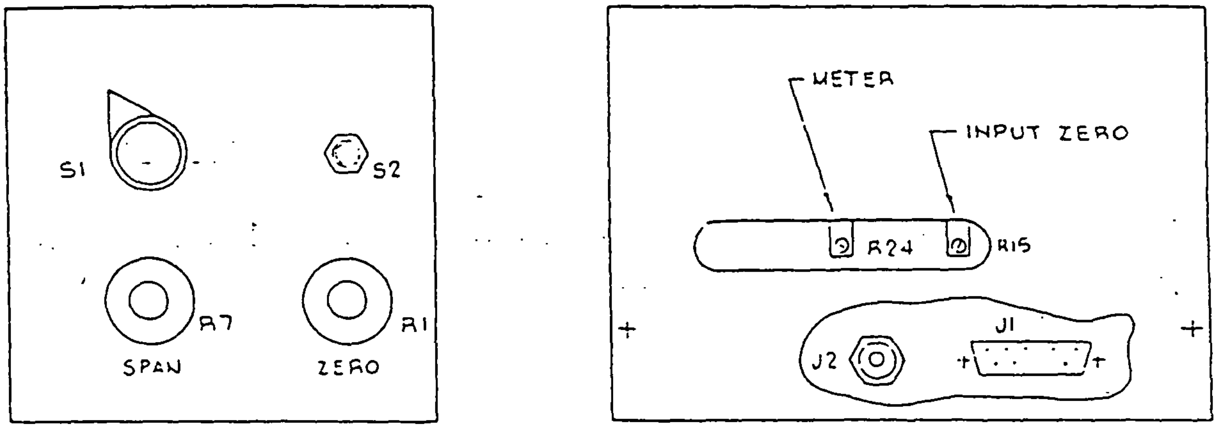


Figure 8.1 Wiring Schematic for HC500-2D



FRONT VIEW

SIDE VIEW

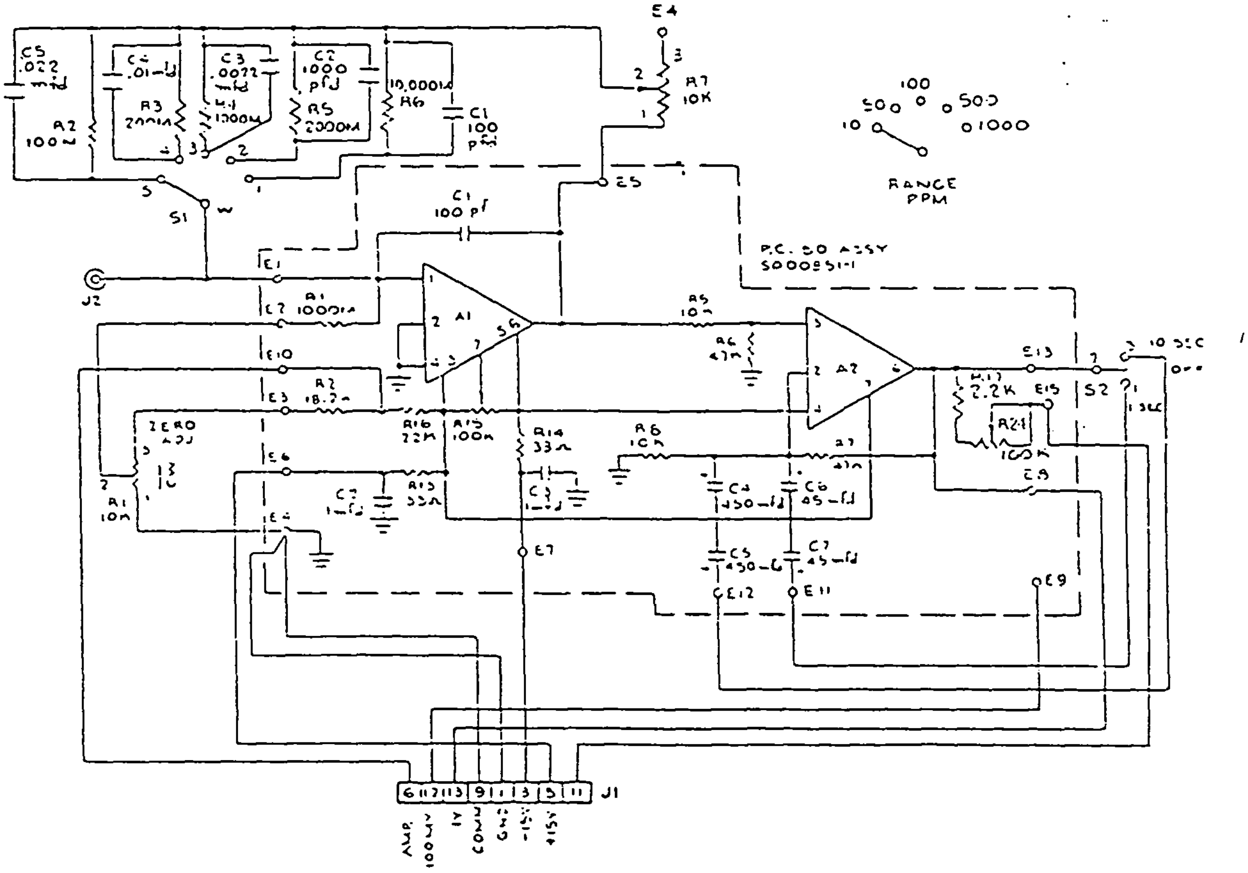
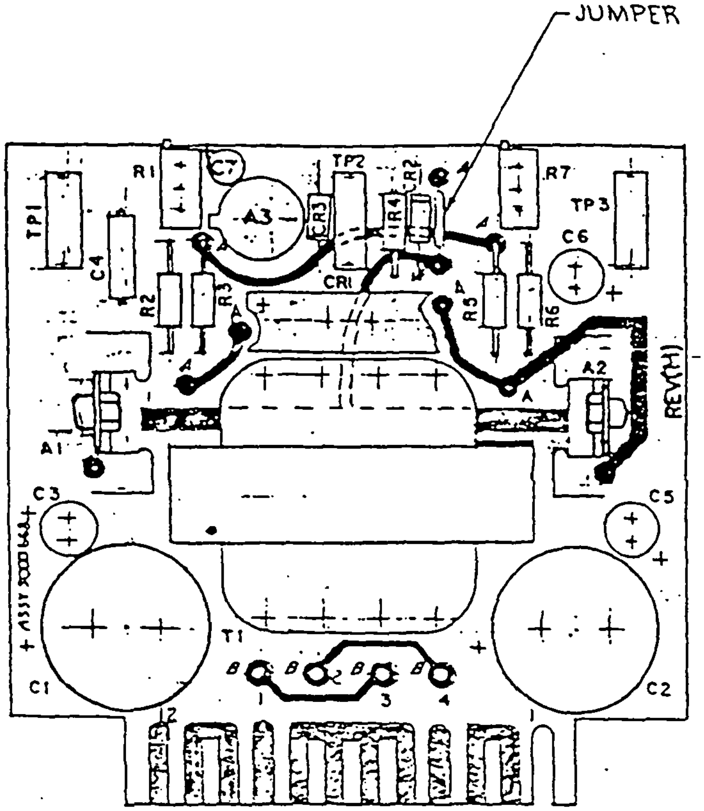
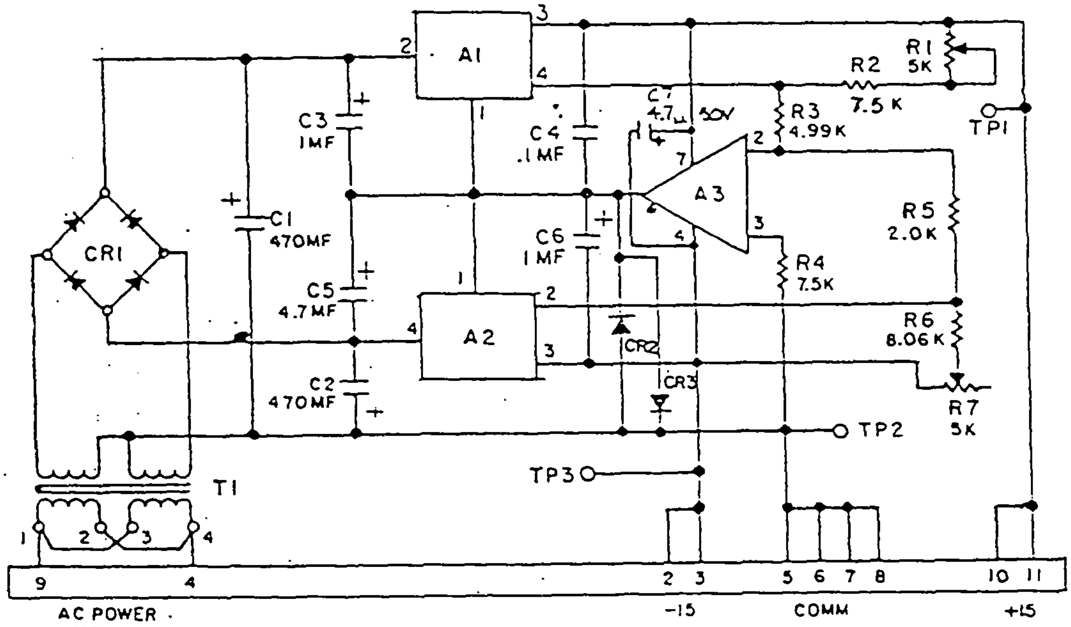


FIGURE 8.2 Amplifier Assembly



COMPONENT SIDE



ELECTRICAL SCHEMATIC
(DASH -1)

FIGURE 8.3 ±15 Vdc Power Supply Board

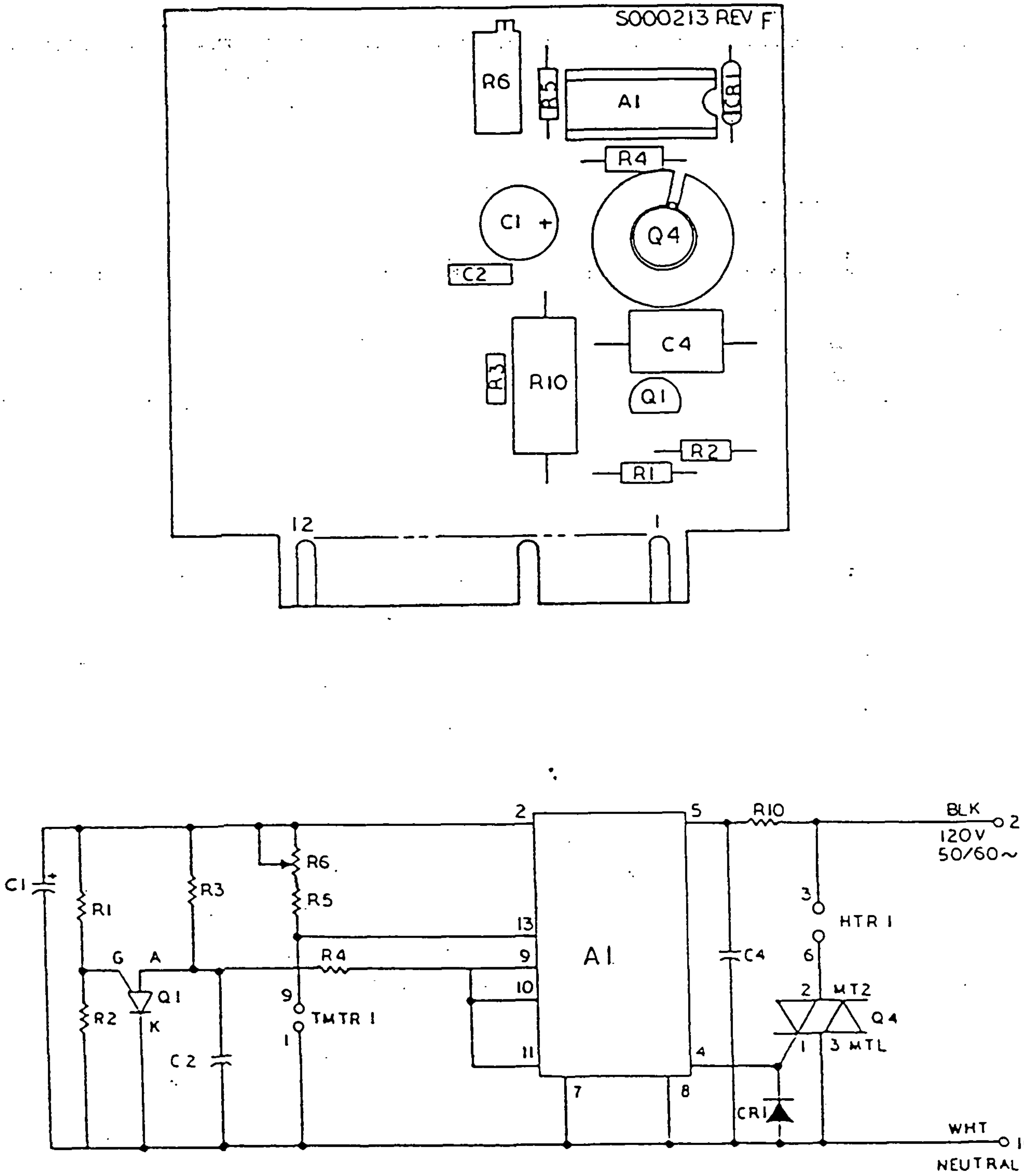


FIGURE 8.4 Temperature Control Module

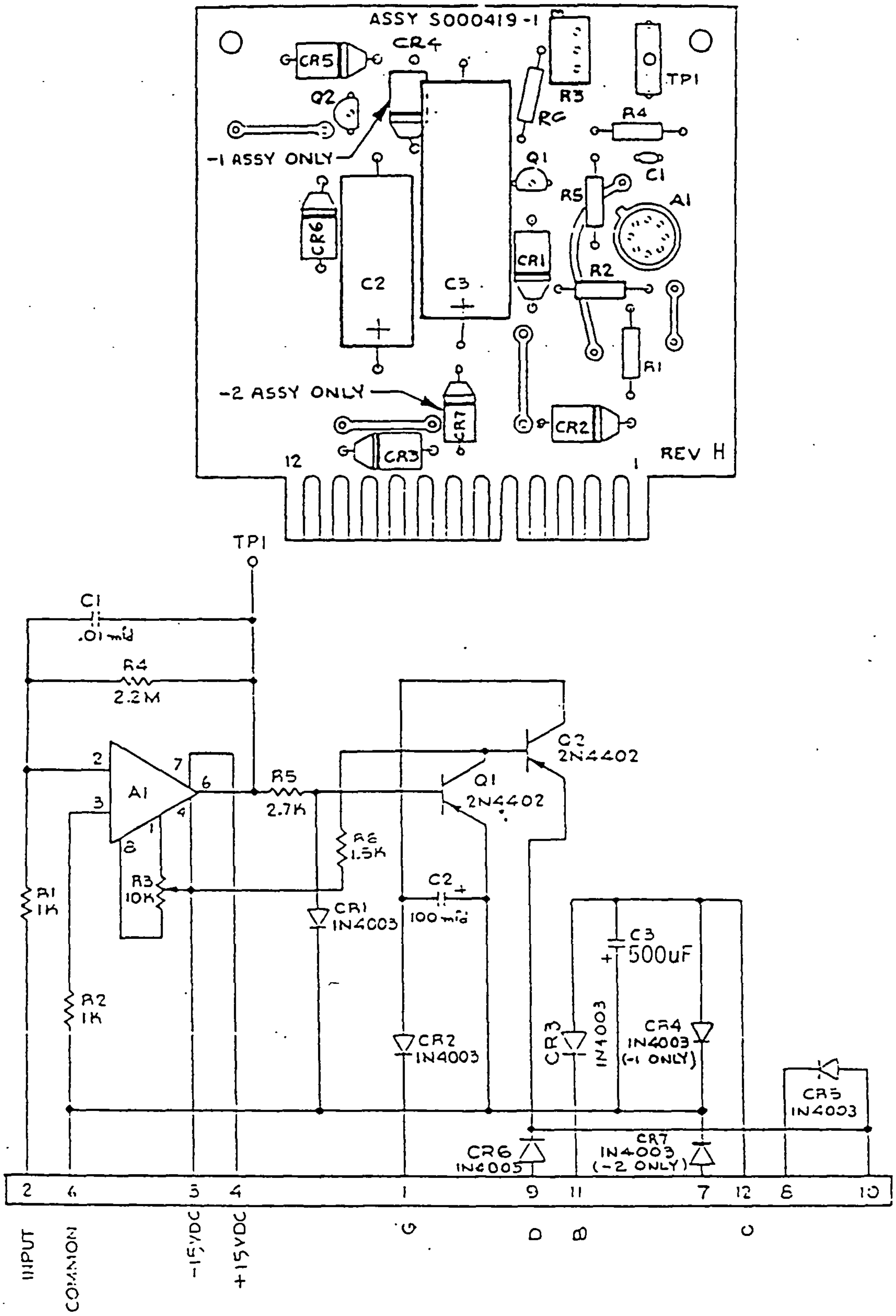
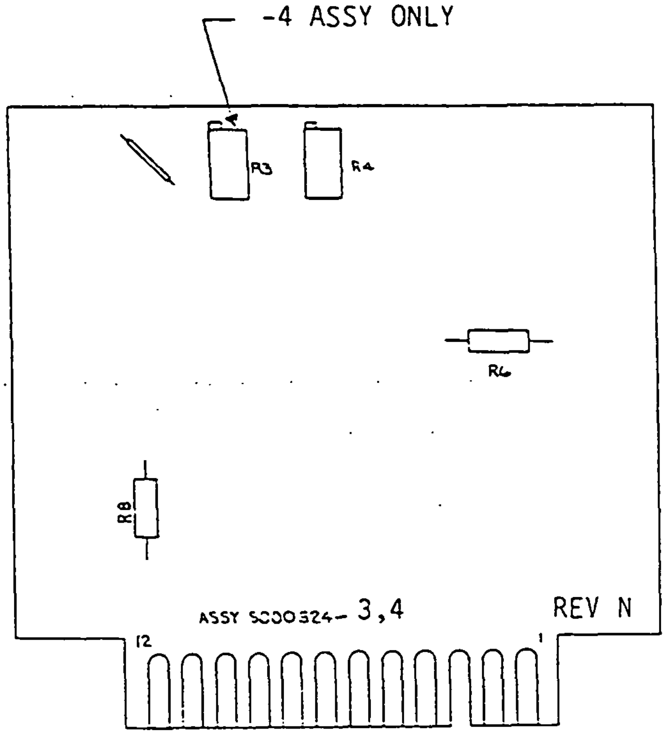
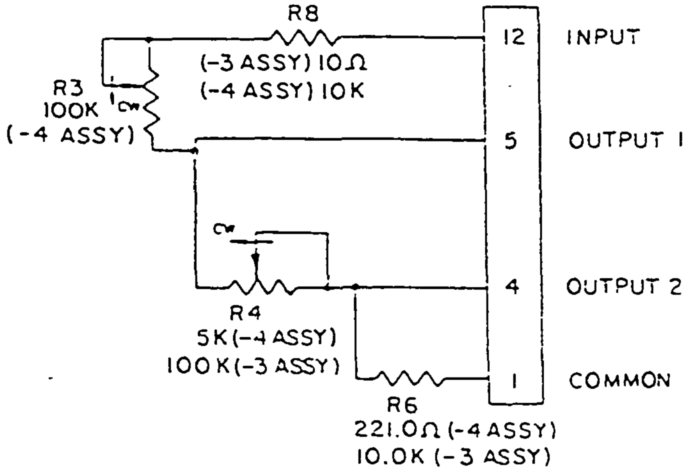


FIGURE 8.5 Flame-Out Module





-3 AND-4 SCHEMATIC

Figure 8.6 Output Amplifier, S000324-4 (J34)

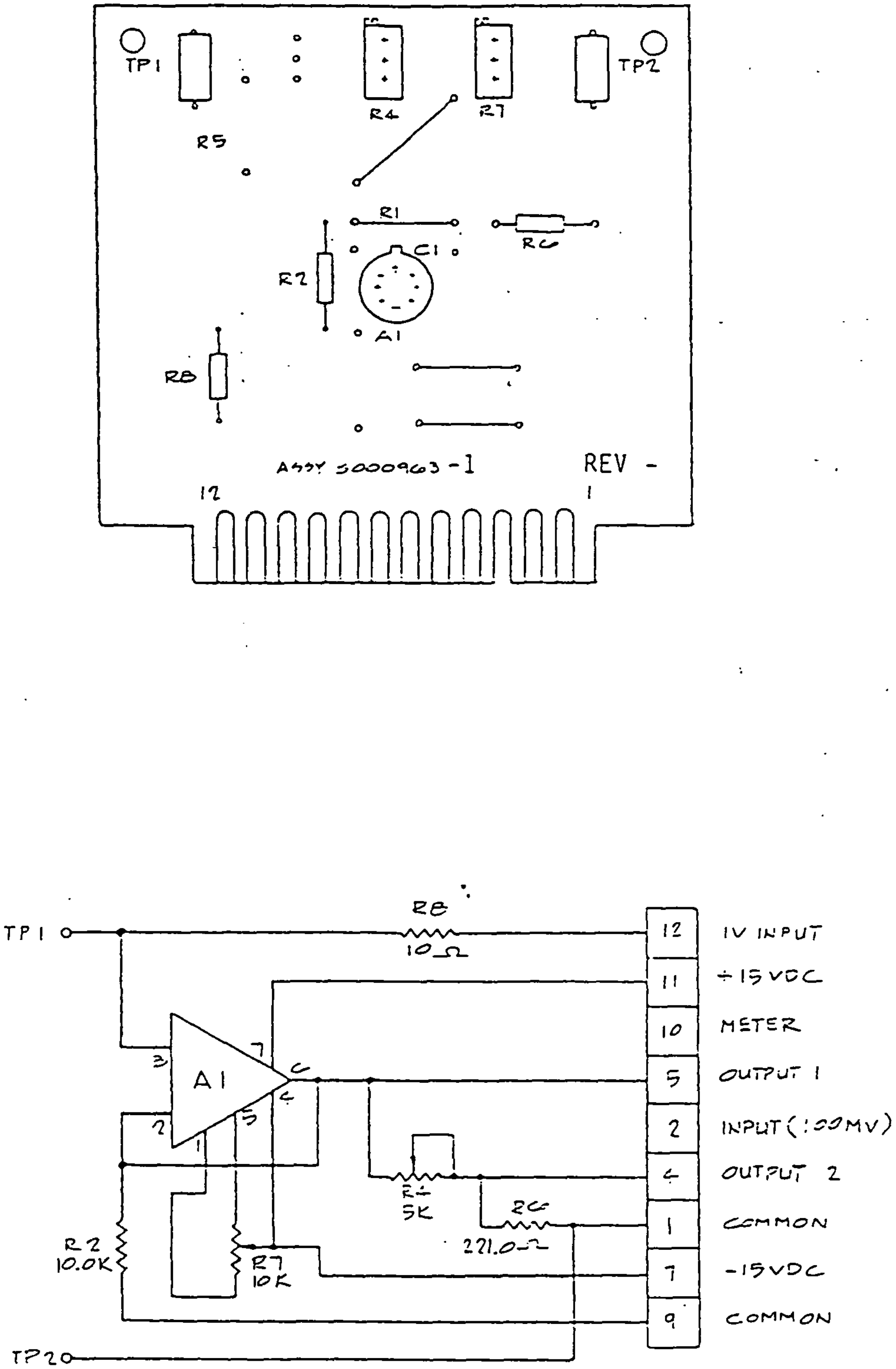
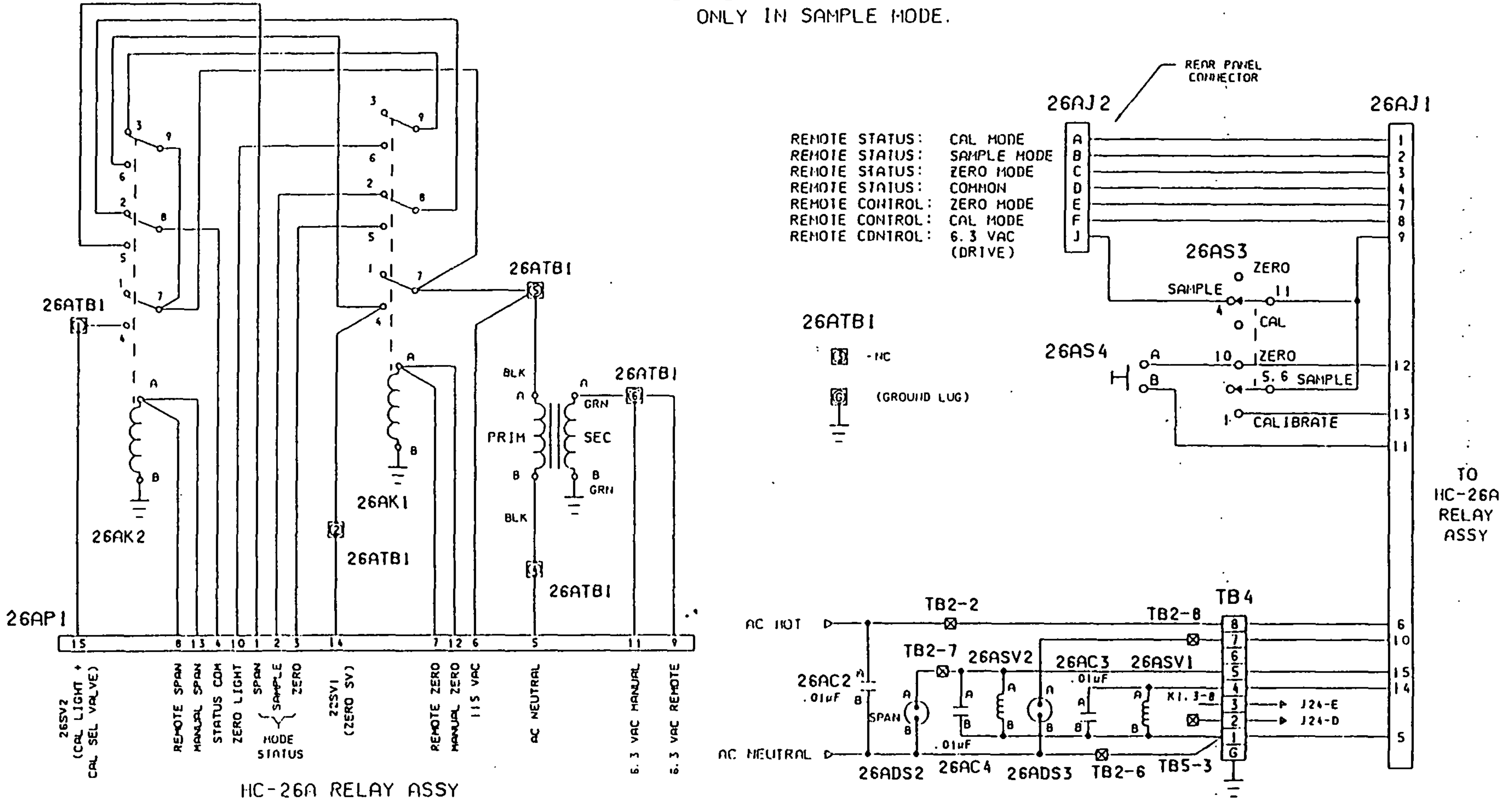


Figure 8.7 Output Amplifier Option HC-15 (J34)

NOTE: REMOTE CONTROL IS AVAILABLE ONLY IN SAMPLE MODE.



VALVE STATE TABLE: 0= OFF; 1= ON; X= DON'T CARE

26ASV1	26ASV2	RESULT
0	X	SAMPLE
1	0	ZERO AIR
1	1	SPAN GAS

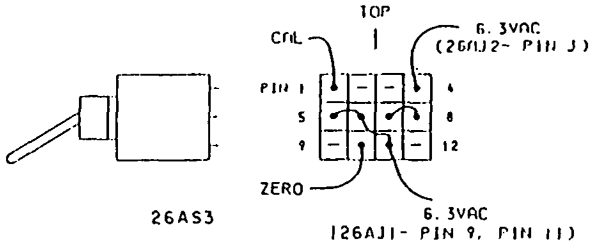


Figure 8.8

CSI COLUMBIA SCIENTIFIC INDUSTRIES
AUSTIN TEXAS

OPTION HC-26A
ELECTRICAL SCHEMATIC,
REMOTE/MANUAL, ZERO/SPAN
& STATUS

UNLESS OTHERWISE SPECIFIED
DO NOT SCALE THIS DWG
ALL DIMENSIONS ARE IN INCHES
REMOVE ALL BURRS & SHARP EDGES
TOLERANCES
2 PLACE DECIMALS ± .005
3 PLACE DECIMALS ± .010
ANGLES ± 1°

MATL
FINISH
SCALE
DATE 12-29-88
RELEASE APPROVAL

SHEET 1 of 1
SIZE C
972-2000
REV -

9. PARTS LIST

Part No.	Description	Qty.	Circuit Symbol
S000497-2	Rotameter Assembly	1	
S000349-1	Exhaust Valve/Line Assembly	1	
S900787	Solenoid Valve, 3-way (Options HC-11B and HC-26A)	2	SV1,2
S900120	Solenoid Valve, Hydrogen Shut-Off	1	SV3
S900425	Hydrogen Pressure Regulator	1	
S000743-1	Restrictor Oven Assembly	1	
S000746-1	Burner Block Assembly	1	
R451585-4	Block		
R357710-1	Burner Tip		
R357708-1	Ignitor Glow Plug w/O-ring		
S900163	Block Heater		
S900311	Flame-Out Sensor w/Plate		
R259120-1	Front Plate	1	
250-0100	O-ring, Front Plate	1	
S000857-1	Meter	1	M4
S903132	Ignition Switch	1	S2
S900130	Air Flow Switch (Options HC-11B, HC-26A and HC-11BF)	1	
S902914	Power/Circuit Breaker Switch	1	S1
S900131	Mode Switch (Options HC-11B, HC-26A, HC-11BF)	1	S4
S900137	Indicator Lights (Options HC-11B, HC-26A and HC-11BF)	2	DS1,2
511-0015	Mode Switch (Option HC-26A)	1	26AS3
S900996	Timer, 10 minute, w/Cams and Switches	1	M3

Part No.	Description	Qty.	Circuit Symbol
S902474	Fan 5"	1	M5
S903261	Filter for 5" Fan	1	
S000668-1	Low Voltage Power Supply Board	1	J25
S000213-1	Temperature Control Board	1	J27
S000213-2	Temperature Control Board	1	J26
S000419-1	Flame-Out Indicator Board	1	J29
S000849-1	Amplifier Assembly	1	
450-0072	Relay	2	K1 & K3
C3987-0019	Calibrator Interface Connector	1	P24
S001802-1	Ion Probe Assembly	1	
S000117-1	Battery Box Assembly	1	
S903817	Relay (Option HC-26A)	2	
S900228	Battery	2	
S900749	Transformer, 6.3 volt	1	T1
S902594	Pump, Vacuum 115 V 60 Hz	1	M6
S000324-4	Output Amplifier	1	J34
S000963-1	Output Amplifier (Option HC-15)	1	(J34)
S902595	Pump, Vacuum 115 V 50 Hz (230 Vac version of HC500-2C)	1	M6
S900388	Timer, 24 hour, 60 Hz (Option HC-11B)	1	M1
S900995	Timer, 2 hour, 60 Hz (Option HC-11B)	1	M2
S900487	Timer, 24 hour, 50 Hz (Option HC-11BF)	1	M1
972-8001	Battery Cable 13"	1	P2,6

Part No.	Description	Qty.	Circuit Symbol
972-8002	Battery Cable 21"	1	P3,5
S001804-1	Thermocouple Assembly	2	
999-5009-1	H2 Orifice/Filter (at SV3 out)	1	

10. OPTIONS

CSI has a variety of available options at additional cost which the suer can select to incorporate into the basic analyzer to meet his particular requirements.

10.1 Option HC-11B, Automatic Zero/Span/Sample Control

Analyzers with this optional feature have the same calibrate functions as in paragraph 10.3 (below), but without external remote control capabilities. Instead, they have a timer with a dial on the front panel which automatically programs the calibrate cycle once every 24 hours. The air flow is thus switched from "SAMPLE" to "ZERO" to "CALIBRATE" to "ZERO" and back to "SAMPLE". The "ZERO", "CALIBRATE" and "ZERO" steps are approximately 15 minutes each.

The automatic Span, Zero, and Sample switching option consists of 3 main components:

(1) 24 hour timer

(2) 2 hour solenoid sequence control, and

(3) Solenoid valves.

Refer to Figure 8.1. The twenty-four hour timer, mounted on the front panel, furnished a pulse once every twenty-four hours, (the time of occurrence can be set by the user as desired) to start the sequence control. The timer can be turned manually to set the time of day or to initiate the sequence.

The sequence control consists of 3 sets of cams. One set is the latching group which, after sequence has been initiated, apply power to the cam drive for a period of 2 hours after which time the latching contacts open and the cams cease to be driven. The other two sets of cams control the zero and span control solenoids. These two cams are adjustable to allow application of any time combination of zero and span air to the detector, up to one hour. The factory adjusted sequence is: zero-15 min, span-15 min, zero-15 min and then return to the normal ambient sampling mode.

The zero and span inputs may be manually controlled by a front panel toggle switch at any time outside the automatic sequence span.

The 2 hour control can be reset only after removing the chassis cover and manually moving the cams.

Sample flow rate is adjusted while observing rotameter flow of "zero" air. In this manner the rotameter is protected from contaminants and the flow path for the sample air is maintained as short as possible thereby keeping "on line" response time to a maximum.

10.2 Option HC-11BF, Automatic Zero/Span/Sample Control

Same as Option HC-11B but with 50 Hz timer.

10.3 Option HC-18, Rack Mount Option

Includes front draw handles and slide mounts.

10.4 Option HC-18A, Rack Handles with Ears

Same as HC-18 less slide mounts.

10.5 Option HC-26A, Remote Manual Zero/Span with Status

Analyzers equipped with this option have a three position "MODE" switch on the front panel which controls two solenoid valves that in turn control the air flow path. With the switch in the "CALIBRATE" position, both valves are energized and air flows through the "SPAN GAS" port into the burner block. With the switch in the "ZERO" position, only one valve is energized and the air flows through the "ZERO AIR" port and into the burner block. When the switch is in the "SAMPLE" position, neither valve is energized and the air flow through the "SAMPLE INLET" port into the burner block. Remote actuation through external contact closures can be attained when the "MODE" switch is in the "SAMPLE" position.

Status is indicated on the front panel by indicator lamps and in the "SAMPLE" position at a rear panel connector as contact closures. Figure 4.3 shows the pneumatic network for this option. Wiring diagram for this option is shown in Figure 8.10.

10.6 Option HC-15, Recorder Output 0-10 V

This option allows the normal 0-1 volt output to be expanded up to 10 volts. The output booster (S000963-1) replaces the amplifier at J34. Figure 8.7 shows the PCB layout and wiring diagram.

11. WARRANTY

The Warranty Statement appears on the following two pages.

WARRANTY

1. Except as otherwise indicated, all instruments and stack systems manufactured and sold by Columbia Scientific Industries Corporation (CSI) are guaranteed for a period of one year from date of shipment from the factory against defects in materials and workmanship of those parts manufactured by CSI, and then, only when operated, serviced and maintained in accordance with the instruction manual. Those parts not manufactured by CSI are guaranteed only to the extent that they are covered by a warranty of original manufacturer. Permeation tubes are warranted for six (6) months. Spare parts and accessories, except expendables, are warranted for ninety (90) days. Expendables such as batteries, sample holders, fuses and indicating lamps are not covered by this warranty.

2. The warranty is voided by the following:

a) Injection into CSI stack systems or CSI ambient air monitoring or calibrating equipment, of gas mixtures containing reactive suspended matter or molecules yielding and depositing liquids, tars, solids and other non-gaseous residues.

b) Injection of caustic solutions into the hydrogen lines of CSI hydrocarbon monitors by a malfunctioning hydrogen generator.

c) Damage to CSI Accelerating Rate Calorimeters by samples that detonate, deflagrate or otherwise escape the confines of the sample holder.

d) Damage to stack sampling probes caused by severe corrosion.

e) Damage caused by incorrect installation, by misuse, or by mishandling.

3. Warranty service requests must be received by CSI within the warranty period. Upon notification by the purchaser, CSI will correct defects coming within the scope of this warranty by repairing or replacing the defective unit either at the CSI factory or at the customer's site, at CSI's option. Return shipment of items to CSI must be authorized by a CSI representative and is at customer's expense.

4. Instruments and systems which have been repaired or replaced during their warranty period are themselves guaranteed for only the remaining unexpired portion of their original warranty period. Parts and accessories, including stack probes, umbilicals and permeation tubes, will receive their full warranty period from the date of replacement even if the instrument or system warranty period should expire.

5. Repairs, replacements, adjustments and service performed out-of-warranty shall be charged to the customer at the then current prices for parts, labor, transportation and subsistence.

6. This warranty attaches to the instrument itself and is not limited to the original purchaser.

7. In no event will CSI have any obligation or liability for damages, including but not limited to, consequential damage arising out of, or in connection with, the use or performance of equipment or accessories. No other warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose will apply to equipment or accessories.

8. This warranty constitutes the full understanding of the manufacturer and buyer, and no terms, conditions, understanding or agreement professing to modify or vary the terms hereof shall be binding unless hereafter made in writing and signed by an authorized official of CSI.

All price revisions and design modification privileges reserved.

PUREGAS®

P-07409

CO_2 EXTRACTOR

MODELS 100A301 & 100A303

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

PUREGAS®
General Cable Company
A Unit of The Penn Central Corporation

P.O Box 666, 5600 West 88th Avenue, Westminster, Colorado 80030
(303) 427-3700/Telex 45908

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P100A301 AND P-100A303 CO_2 EXTRACTORS

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DRAWINGS

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CO_2 Extractor	3	11
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I GENERAL

This instruction manual covers the description, installation, operation and maintenance of the P-100A301 and P-100A303 CO_2 extractors. The purpose of the unit is to provide clean dry air with minimal CO_2 for air bearings and for purging the optics of IR and FTIR analyzers.

II DESCRIPTION

The units described in this manual are designated as CO_2 extractor Model P-100A301 and CO_2 extractor Model P-100A303. These two models are basically identical, except for their chamber size and capacities. Model P-100A301 has the larger chambers and capacity. These extractors consist of a dryer and CO_2 adsorber piped in series with inlet and outlet filters attached. The relative locations and functions of the various major components can be best understood by referring to the following drawings:

Flow Diagrams	Figures 1 & 1A	Page 7
Wiring Diagram	Figure 2	Page 8
CO_2 Extractor	Figure 3	Page 11
Dryer and Adsorber (Exploded View)	Figure 4	Page 13

III MAJOR COMPONENTS

1. INLET AIR FILTER - ITEM 15, FIGURE 3. The functiion of the inlet air filter is to collect liquid condensate and particles, larger than 25 microns, contained in the compressed inlet air. The air filter bowl has a manual drain petcock. It is necessary to periodically check the filter and drain the liquid.

   Special Note: This filter is not an "oil removal" filter. While it will intercept some oil in liquid form, it will not remove oil mist or "aerosols" that may be present in the system. Therefore, in any system in which the air source is an oil-lubricated compressor, it is recommended that a "coalescing" type filter be used. Refer to flow diagram, Figure 1A for installation.

III

2. MOISTURE REMOVAL DRYER - ITEM 1, 2, 3 or 4, FIGURE 3. The function of the air dryer is to remove the moisture from the compressed inlet air.

3. CO_2 ADSORBER - ITEM 5, 6, 7 or 8, FIGURE 3. The function of the adsorber is to remove CO_2 from the dry compressed air leaving the dryer and entering the adsorber. The adsorber differs from the dryer. Its chambers are packed with a different adsorbent material and its cycle timer permits repressurizing of the purging chamber prior to dumping the adsorbing chamber's pressure to atmosphere.

   Repressurization results in a substantial reduction in the outlet pressure fluctuation during switching, which occurs in dryers not equipped with this feature. Further reduction in the outlet pressure variation can be obtained by installing a suitable two to five gallon air storage tank downstream of the outlet air filter and upstream of a pressure regulator.

   The air dryer and adsorber have purge exhaust mufflers installed on the solenoid valves to quiet the exhaust air. Do not plug or restrict the purge discharge. Additional muffling of the purge air may be obtained by enclosing the unit in a well-ventilated, sound-adsorbing box.

4. OUTLET AIR FILTER - ITEM 16, FIGURE 3. The function of the outlet air filter is to trap particles larger than 5 microns, primarily occasional particles of adsorbent material, which may escape from the adsorbent beds.

5. OUTLET FLOW ORIFICE - ITEM 28, FIGURE 3. The function of the orifice is to limit the outflow of air in accordance with operating pressures and conditions as specified on the purchase order. The number P-300-691 is the number of the blank before its final orifice size is established. The numbers range from P-300-691-4 (.005" diameter) to P-300-691-103 (.0995" diameter).

IV SPECIFICATIONS

1. CAPACITY, DEW POINT AND CO_2 REMOVAL.

	MODEL P-100A301	MODEL P-100A303
Inlet Pressure	90 PSIG	90 PSIG
Inlet Temperature	70° F.	70° F.
Inlet Flow		
Outlet Flow *	3.5 SCFM	1.5 SCFM
Atmospheric Dew Point	-100° F.	-100° F.
CO_2 Removal **	90%	90%

* Contact the factory for rated capacity at other operating pressures.

** 90% of the CO_2 from ordinary atmospheric air.

2. Maximum Inlet Pressure: 100 PSIG

3. Maximum Inlet Temperature: 100° F.

4. Air Connections: 1/4" FPT

5. Electrical Requirements:

Model No.	Power		
P-100A301-1/P-100A303-1	120V	50/60Hz	115W
P-100A301-2/P-100A303-2	240V	50/60Hz	115W

V INSTALLATION INSTRUCTIONS

1. Puregas heatless dryers have been thoroughly inspected and tested at the factory and are in proper working condition. Inspect the CO_2 extractor for evidence of any exterior or interior shipping damage and immediately report damage to the carrier.

2. Read description of equipment and specifications before installing CO_2 extractor.

3. OPERATING PRESSURES. The CO_2 extractors are designed to operate at a maximum pressure of 100 PSIG. The sizing of the purge orifices is critical to the correct operation of the air dryer and CO_2 adsorber. Any change in operating pressure, inlet temperature, or outlet flow will require an orifice change to maintain the proper degree of water and CO_2 removal. Orifice glands (Item 4, Figure 4), are identified by numbers stamped on the top of the hex. Both orifices in the dryer or adsorber must be the same size (same number). Orifice numbers are also stamped on the name plate as the last two numbers of the dryer and CO_2 adsorber model number. (Example: P-05411A1<u>34</u>.) Orifice sizes must not be changed unless operating conditions change.

V

3. (continued) Your instrument is sized for a specific flow and operating condition. The outlet flow of the CO_2 extractor can be regulated with a throttle valve and a visual indication of measurement made with a flow meter. After installation, the outlet flow and operating pressure should be checked to be sure they do not exceed the rated capacity of the instrument.

   If a lower outlet pressure is required, always install the pressure regulator <u>downstream</u>, as close to the usage point as possible.

4. OPERATING TEMPERATURES The dryer and adsorber can operate at a maximum ambient temperature of 100° F. and a maximum inlet air temperature of 100° F. However, at temperatures above 70° F. the capacity will have to be reduced.

   Do not operate the unit at temperatures which could result in damage due to freezing.

5. PIPING AND AIR CONNECTIONS. The CO_2 extractor is designed to be mounted on a bench or shelf with the desiccant chambers up.

   The inlet and outlet connections are 1/4" female NPT. When connections are made directly into the unit, a pipe compound should be used to prevent galling of the threads. 3/8" copper tubing with 1/4" pipe connections should be installed at the input and output for maximum flow. Larger lines are recommended to avoid pressure drop where long piping runs are encountered.

   After connecting the piping or tubing to the unit, use a soap solution to check the connections for air leaks.

   A manual drain, 25-micron inlet filter is supplied with the CO_2 extractor to remove particulate matter and liquid water. Reference flow diagram, Figure 1. If oil in liquid or mist form is present in the air stream, an oil coalescing filter should be used as shown in Figure 1A.

   The extractor should not be operated in corrosive atmospheres.

6. ELECTRICAL CONNECTIONS. Before wiring, check the nameplate for electrical requirements. Standard electrical characteristics are 120V, 50-60Hz, 115 W. 240V, 50-60Hz units are also available.

   No overload protection is provided in the CO_2 extractor. The attached 8 foot wire power cord should be plugged into a properly protected outlet.

V 7. SOLID STATE TIMERS. The solid state cycle timers are equipped with a one-hour-minimum memory circuit which will restart the timers at the same point in the timing cycle as when the power was lost or interrupted.

During start up and when timer memory has been lost, it will be necessary to stagger the timing cycles so that the dryer and CO_2 adsorber will not switch simultaneously. This can be accomplished by removing the power from the dryer timer for a period of 15 seconds.

Timers P-06521-F1 or F2 are the standard timers used on the air dryer. The timers permit simultaneous switching of the solenoid valves every 30 seconds.

Timers P-06500-F1 or F2 permit the CO_2 adsorber to repressurize the purging chamber before switching chambers. The repressurizing period is 3.75 seconds and the purging period is 26.25 seconds.

Repressurizing helps to minimize dryer outlet pressure fluctuation as the flow switches from one desiccant chamber to the other. Further reduction in outlet pressure swings can be obtained by installing a 2 to 5-gallon air storage tank between the outlet filter and the outlet pressure regulator. Refer to Figure 1A.

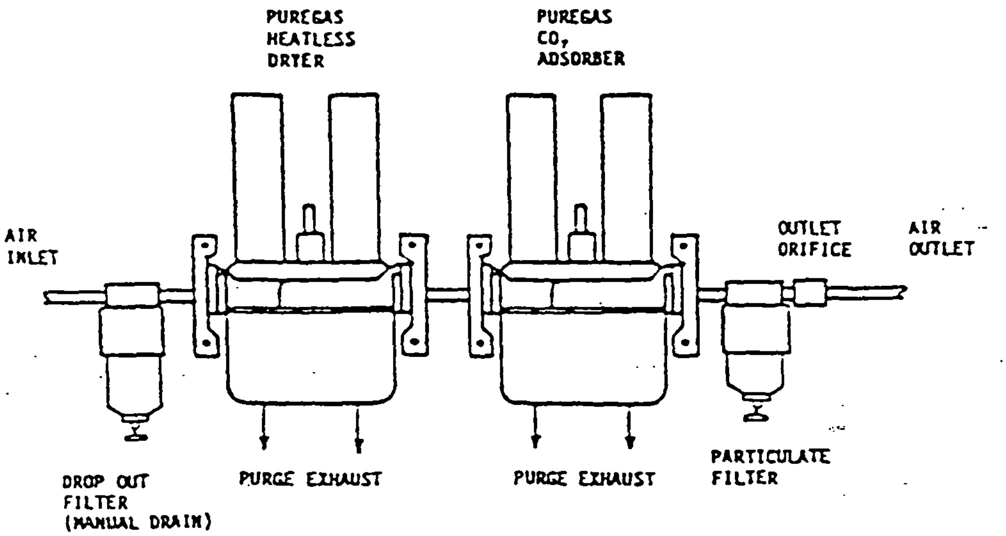
VI OPERATING INSTRUCTIONS

In normal operation, the dryer and CO_2 adsorber will switch every 30 seconds or, when their cycle times are staggered, (Reference Section V, Paragraph 7), approximately every 15 seconds. Each chamber alternately purges with an audible exhaust. This sound is quieted by the use of mufflers installed on the exhaust port of each solenoid valve. Do not plug or restrict the purge exhausts. If operating conditions change, different purge orifices may be required. If orifices are replaced, they should be replaced in matched pairs. The heat of adsorption and the heat from the solenoid coils cause the unit to become warm - this is normal and does not indicate a malfunction of the unit. The temperature rise is more pronounced in a dryer operating at a low flow rate.

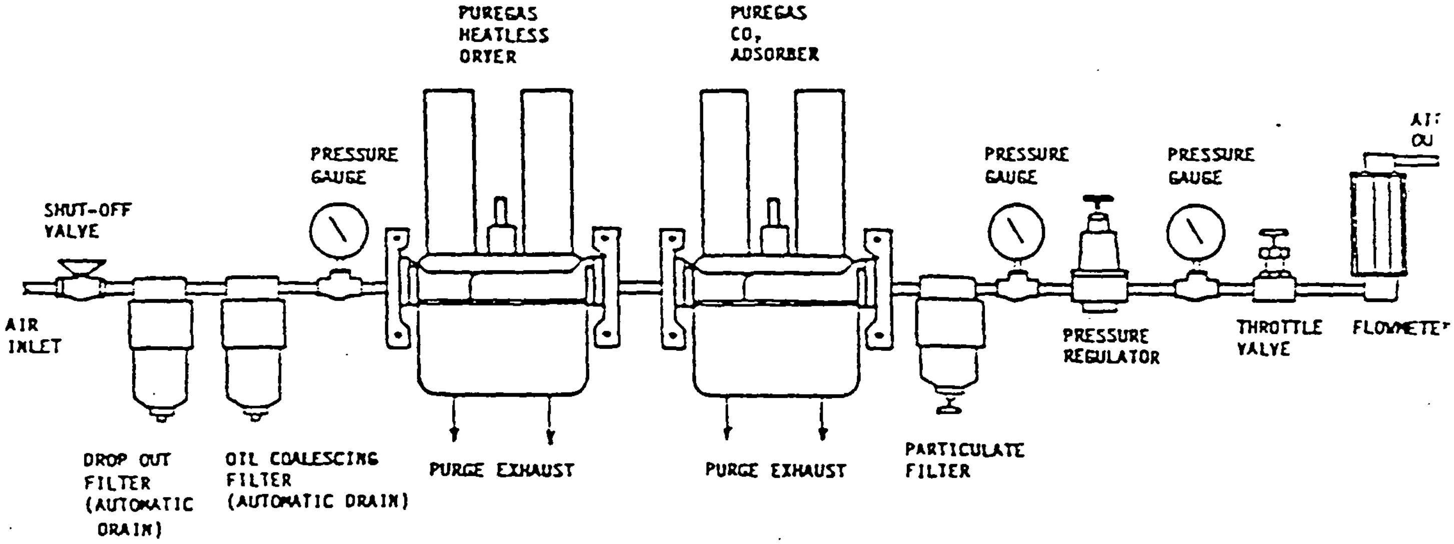
VII MAINTENANCE INSTRUCTIONS

No field adjustments are necessary after a Puregas CO_2 extractor has been installed in accordance with these instructions. No lubrication is required on the instrument.

It is recommended, however, that at six-month intervals the unit be thoroughly inspected. Inspection should include audible inspection for proper solenoid valve operation and purge, and visual inspection for excessive dirt or oil fouling



FLOW DIAGRAM CO_2 EXTRACTOR
FIG. 1



RECOMMENDED INSTALLATION DIAGRAM
FIG. 1A

VII (continued) and for desiccant attrition. This involves removal of the air manifold covers and the desiccant chambers. Annual inspections should be more thorough, and should also include removal of the solenoid valves and the purge orifice glands to inspect for excessive wear or deterioration of valve parts or the check valve balls as well as for possible plugging of the purge orifices.

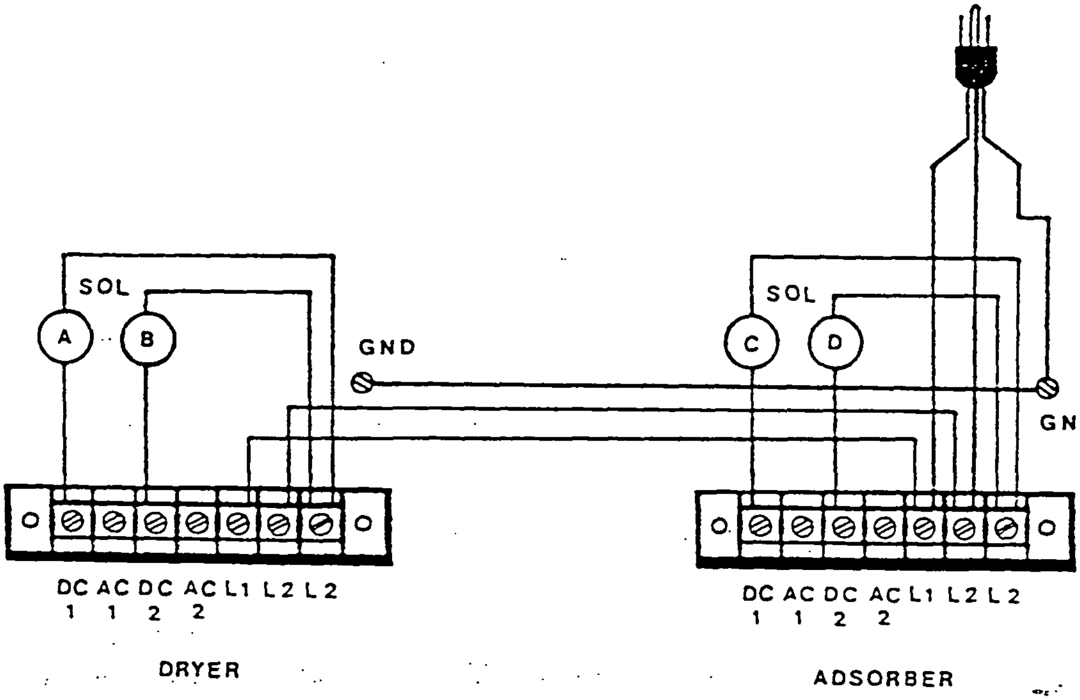
As the orifices are critical parts in determining the performance of a dryer and adsorber, do not increase the orifice size by drilling a larger hole. Instead, orifices of the proper size should be obtained from the factory.

Purge orifice glands are screwed into the manifold beneath the desiccant chambers. To change orifices, unscrew the chambers and remove the orifices with a standard 7/8" socket wrench.

The cycle timer can be replaced in the field.

Improper packing of the desiccant chambers can cause channeling of the gas stream and improper purification. For this reason, **NO ATTEMPT SHOULD BE MADE TO REPACK DESICCANT CHAMBERS IN THE FIELD.** Replacement chambers should be obtained from your local authorized distributor.

In the event of breakdown, the following troubleshooting guide should enable you to determine the problem. Contact your local authorized distributor for replacement parts, dryers or adsorbers.



WIRING DIAGRAM
FIG. 2

VIII TROUBLESHOOTING GUIDE

1. UNIT DELIVERS WET AIR

A. Improper operating conditions.	Adjust operating conditions.
B. Solenoid core spring broken.	Remove solenoid valve, inspect core assembly. Spring should be seated on core and not broken. Replace if necessary.
C. Purge orifice plugged.	Remove, inspect, and clean orifice. DO NOT FORCE WIRES THROUGH CRITICALLY-DRILLED HOLES. Use air gun to clean.
D. Solenoid coil burned out.	Remove cover, place iron or steel material (screwdriver or nail) on exposed end of solenoid base to feel the magnetic effect indicating proper operation. NOTE: Each dryer coil should be energized for 30 seconds and each adsorber coil for 33.75 seconds. Check Section 1, Paragraph E immediately below, before replacing coil.
E. Improper operation of cycle timer.	1. Check the power supply. If the correct voltage is not present between L1 and both of the L2 terminals., check the wiring and protective devices supplying power to the dryer. 2. Dryers with DC solenoid valves should alternately have DC voltage between L2 and DC1 and between L2 and DC2. Replace the timer if voltage is present at either DC terminal continuously or not at all. Timer Input 120 VAC/Timer Output 53 VDC Timer Input 240 VAC/Timer Output 106 VDC 3. Refer to Solid State Timers Section V, Paragraph 7, Page 6 for timing cycle information.

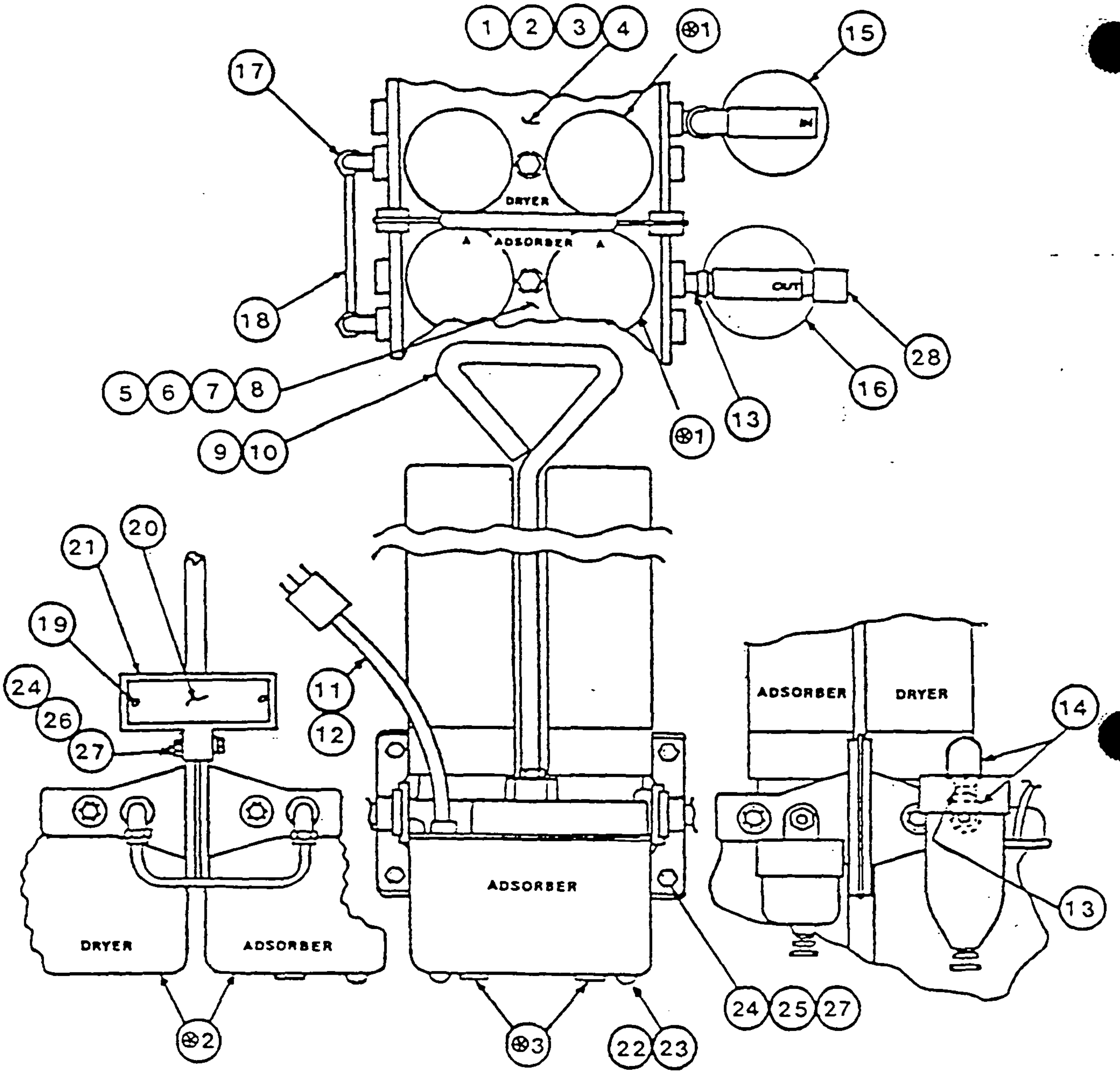
1. F. Desiccant contamination or attrition.	1. Check inlet and outlet filters and outlet air line for indication of oil. 2. Remove the desiccant chambers from the air manifold. If the perforated disc at open end of the chambers can be depressed more than 1/4" from the retaining ring, replace chamber, or have it repacked.

2. EXCESSIVE DROP IN OUTLET PRESSURE.

A. Improper operating conditions.	See Section I, Paragraph A.
B. Solenoid coil burned out.	See Section I, Paragraph D.
C. Improper operation of cycle timer.	See Section I, Paragraph E.
D. Check valve balls seated improperly.	Remove check balls and springs and inspect for excessive wear or damage. Replace if necessary.
E. Plugged air passages.	Check inlet and outlet air passages and piping for blockage
F. Desiccant contamination or attrition.	See Section I, Paragraph F.

3. SOLENOID VALVE CHATTER

A. Solenoid valve defective.	1. Solenoid valve connected to AC terminal on Solid State Timer. 2. Voltage too low.



CO$_2$ EXTRACTOR

FIG 3

REFER TO PG. 14

⊗	ITEM NO.
1	1
2	26
3	43

PARTS LIST - CO_2 EXTRACTOR

REFERENCE FIGURE 3.

QUANTITY				PART NO.	DESCRIPTION	ITEM NO.
1	1	1	1	*P-300-691-(--)	ORIFICE-DISCHARGE	28
4	4	4	4	H-NK01-04C-R5	NUT-KEPS 1/4-20 CZ	27
1	1	1	1	H-SH83-04C-12	SCREW HH 1/4-20 X 1 1/4 CZ	26
3	3	3	3	H-SH83-04C-10	SCREW HH 1/4-20 X 1 CZ	25
4	4	4	4	H-WF01-04B-R0	WASHER-FLAT 1/4 CZ REG. B	24
4	4	4	4	H-SP56-00C-02	SCREW-PH 4-40 X 1/4 CZ F	23
4	4	4	4	P-400-451	BUMPER-RUBBER	22
1	1	1	1	P-300-683	HOLDER NAMEPLATE	21
1	1	1	1	P-300-696	NAME PLATE-CO_2 EXTRACTOR	20
2	2	2	2	P-400-322-1	SCREW-DRIVE #4 3/16	19
1	1	1	1	P-300-690	TUBE-INTERCONNECT	18
2	2	2	2	P-400-437-108	ELL-SWAGE-1/4 MPT X 3/8 SWG-BRS	17
1	1	1	1	P-400-452-20	FILTER-5 MICRON-1/4 MPT	16
1	1	1	1	P-400-452-3	FILTER-25 MICRON-1/4 MPT	15
2	2	2	2	P-1291	ELL-STREET-1/4 NPT-BRS	14
2	2	2	2	P-5000-5-12B	NIPPLE-1/4 MPT X 1 3/16-HEX-BRS	13
1	---	1	---	P-200-501	POWER CORD 240 VAC	12
	1	---	1	P-200-411	POWER CORD 120 VAC	11
		1	1	P-300-682-2	PLATE-MTG W/HANDLE/100-301	10
1	1	---	---	P-300-682-1	PLATE-MTG W/HANDLE/100-303	9
		1	---	P-05414A2	CO_2 ADSORBER 240 VAC	8
			1	P-05414A1	CO_2 ADSORBER 120 VAC	7
1	---	---	---	P-05412A2	CO_2 ADSORBER 240 VAC	6
	1	---	---	P-05412A1	CO_2 ADSORBER 120 VAC	5
		1	---	P-05413A2	AIR DRYER 240 VAC	4
			1	P-05413A1	AIR DRYER 120 VAC	3
1	---	---	---	P-05411A2	AIR DRYER 240 VAC	2
	1	---	---	P-05411A1	AIR DRYER 120 VAC	1
X	---	---	---	P-100A303-2	CO_2 EXTRACTOR - 12" 240 VAC	
	X	---	---	P-100A303-1	CO_2 EXTRACTOR - 12" 120 VAC	
		X	---	P-100A301-2	CO_2 EXTRACTOR - 20" 240 VAC	
			X	P-100A301-1	CO_2 EXTRACTOR - 20" 120 VAC	

* Refer to Page 3, Section III, Paragraph 5 for orifice size information.

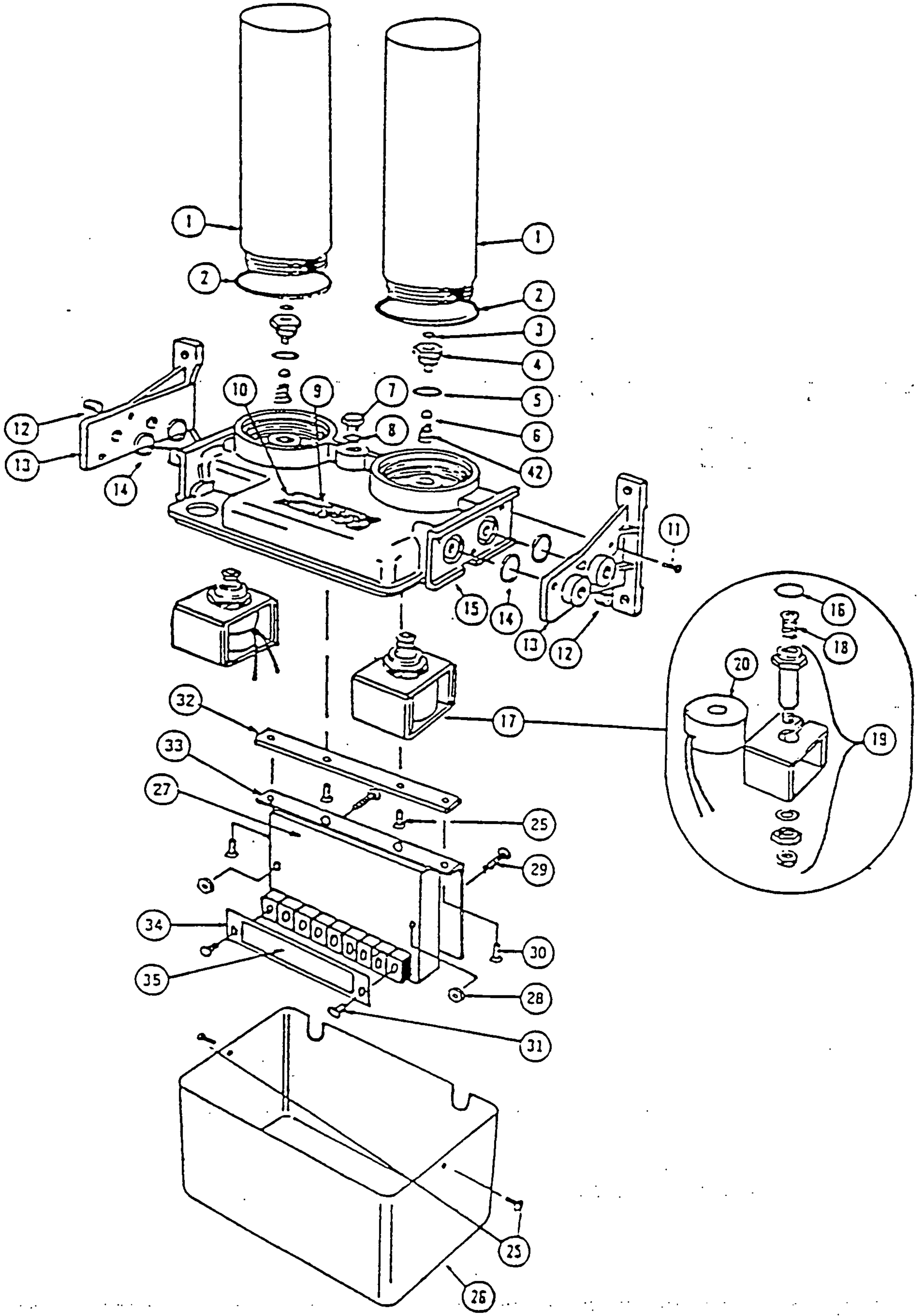

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FIG 4

WARRANTY

These air dryers carry a one year warranty against defective workmanship and material. This period starts at the date of shipment. The Puregas heatless dryers are designed in a manner which permits field repair by the user and replacement parts will be shipped enabling the user to make the necessary field repairs and return the defective parts.

However, the warranty also includes the offering of an immediate replacement with an equivalent air dryer for any unit *for which field repairs are not authorized by Puregas.* Only in unusual cases will it be necessary to ship a replacement unit. On receipt of the replacement air dryer the user will return the defective unit in the same shipping container.

No claims for labor in replacing defective parts or for consequential damages will be allowed. Replacement parts (or if applicable, replacement air dryers) will be invoiced in the regular way with invoices subject to adjustment after the parts (or dryers) claimed defective are examined in our factory. In addition, no material or parts will be accepted at our factory for in-warranty repairs or credit without previous authorization from the Puregas.

Responsibility for damages incurred in transit will be borne by the user and the user in turn should file any damage claim against the carrier.

This warranty shall not apply to any air dryer which shall have been repaired or altered in any way be anyone other than the Puregas, or its authorized repair agent, so as to affect, in our judgment, its proper functioning or reliability, neither will it apply to any air dryer which has been subjected to misuse, negligence or accident.

PUREGAS

PUREGAS®
General Cable Company

P.O. Box 666, 5600 West 88th Avenue, Westminster, Colorado 80030
(303) 427-3700 / Telex 45908

A Unit of The Penn Central Corporation

Code:	A	B	C
Used on:	Dryer & Adsorber	Dryer	Adsorber

ITEM NO.	PART NUMBER	USED ON DRYER	QTY. PER DRYER OR ADSORBER	PART DESCRIPTION
1	P-200-403-12	B	2	Assy-Des Ch-Dryer 12",incl. Item 2
	P-200-403-A12	C	2	Assy-Des Ch.- CO_2 12",incl. Item 2
	P-200-403-20	B	2	Assy-Des Ch-Dryer 20",incl. Item 2
	P-200-403-A20	C	2	Assy-Des Ch.- CO_2 20",incl. Item 2
2	P-400-312-924	A	2	O-Ring - 1.720 I.D. x 0.118 W.
3	P-400-313-110	A	2	O-Ring - 0.362 I.D. x 0.103 W.
4	*P-200-404-(--)	A	2	Purge Orifice Assy. (incl.#3 & #5)
5	P-400-312-908	A	2	O-Ring - 0.644 I.D. x 0.087 W.
6	P-400-375	A	2	Ball, Check Valve
7	P-400-307-4	A	1	Plug, Hex
8	P-400-312-904	A	1	O-Ring - 0.351 I.D. x 0.072 W.
9	P-300-737	A	1	Nameplate
10	P-400-322-1	A	2	Drive Screw #4 x 3/6" Type U rnd. hd., st. st.
11	P-400-361-2	A	6	Screw, #10 - 24 x 5/8", pan.hd.
12	P-400-320-3	A	2	Pipe Plug, 1/4" - 18 socket hd.
13	P-300-497P	A	2	Mounting Bracket
14	P-400-313-116	A	4	O-Ring - 0.731 I.D. x 0.103 W.
15	P-300-495P	A	1	Air Manifold
16	P-400-313-018	A	2	O-Ring - 0.739 I.D. x 0.70 W.
17	P-400-308-DC1	A	2	Solenoid Valve - 53 VDC (for 120 V., 50/60 Hz units)
	P-400-308-DC2	A	2	Solenoid Valve - 106 VDC (for 240 V., 50/60 Hz units)
18	P-400-308-12	A	2	Core Assembly
19	P-400-308-13	A	2	Base Assembly
20	P-400-308-DC11	A	2	Coil, 53 VDC
	P-400-308-DC21	A	2	Coil, 106 VDC
25	P-400-361-1	A	4	Screw #6 - 32x8/8" pan. hd.
26	P-300-685P	A	1	Air Manifold Cover
27	P-06521-F1	B	1	Timer - SS 1 min, cycle 120 VAC
	P-06521-F2	B	1	Timer - SS 1 min, cycle 240 VAC
	P-06500-F1	C	1	Timer - SS 1 min. cycle 120 VAC Repressurizing
	P-06500-F2	C	1	Timer - SS 1 min. cycle 240 VAC Repressurizing
28	H-NK01-OHC-R5	A	2	Nut-Keps 8-32
29	H-SB83-OHC-10	A	2	Screw 8-32 x 1" BH
30	H-SB83-OFC-04	A	2	Screw 6-32 x 1/4" BH
31	H-SB83-OFC-02	A	2	Screw 6-32 x 1/2" BH
32	P-06496	A	1	Plate-Adapter-SS Timer Brkt.
33	P-06497	A	1	Bracket - Mtg. - SS Timer
34	P-06499	A	1	Cover - Terminal
35	P-06498	A	1	Decal - Terminal Cover
42	P-300-507	A	2	Spring - Check Ball
43	P-400-498	A	2	Muffler (not shown)

When ordering parts, always state the dryer and adsorber Model and Serial Nos.
* Orifice number must be specified.

MIGHTY MODULE

INSTRUCTIONS FOR
MM4010, MM4050,
MM4300 & MM4310
DC TO DC TRANSMITTERS

FUNCTION

The MM4010, MM4050, MM4300 and MM4310 DC to DC Transmitters provide DC output voltages or currents proportional to a DC input signal. They are useful in converting voltages to currents or currents to voltages, in providing signal isolation and in scaling signal levels from one amplitude to another.

DESCRIPTION

A stable amplifier is used to monitor a DC input voltage. For current inputs a shunt resistor is added inside the module to create a voltage level at the amplifier input. A final amplifier produces the desired DC voltage or current output.

MM4300 and MM4310 provide input/output isolation by modulating the pulse width of a VCO with the amplified input. The pulses are optically coupled to a separately-powered demodulator which, in turn, feeds the final amplifier. MM4010 and MM4050 are direct-coupled, input to output.

A wide range input option adds an 8 position DIP switch which provides input voltage and current range selection by connecting any of 6 gain-setting and 2 current-shunt resistors.

MODEL NUMBERS

Transmitters are available with or without input isolation and with standard or narrow spans. The narrow span models use a superior, low drift input amplifier. Model numbers are as follows:

MM4010	Standard spans, nonisolated
MM4050	Narrow spans (below 50mV), nonisolated
MM4300	Standard spans, input-output isolated
MM4310	Narrow spans (below 50mV), input-output isolated

OPTIONS

WR	Wide range input. Allows a choice of input voltage and current range selections by use of an 8 position DIP switch.
U	All circuit boards polyurethane coated for protection against moisture.

WILKERSON INSTRUMENT CO., INC.
3615 CENTURY BLVD. • LAKELAND, FL 33811 • USA
1 (813) 646-3909 • TELEX: 5106011060 WILK INST CO
FAX: 813-644-5318

Linearity	MM4010, MM4050	±0.01% of Span
	MM4300, MM4310	±0.05% of Span
Output Ripple	MM4300, MM4310	less than 0.1% of Span peak-to-peak
Temperature Stability		±0.025% of span per deg C
Common Mode Rejection		120db, DC to 60Hz
Response Time	MM4300, MM4310	75 milliseconds
Isolation:	Power	1500 Vrms
	Input/Output (MM4300, MM4310)	1000 Vrms
Temperature, Operating		0 deg C to 60 deg C 32 deg F to 140 deg F
Power	Standard	115V ±10%, 50 or 60Hz
	Optional	230V, 50 or 60Hz AC 12 or 24V DC; 2.5W max

MOUNTING

The transmitters are designed to plug into a standard 8-pin relay socket. Part number MP008 is a molded plastic socket suitable for mounting on a flat surface or in a piece of PVC track.

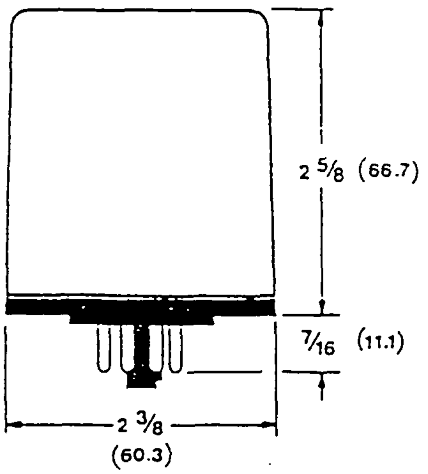
WARRANTY

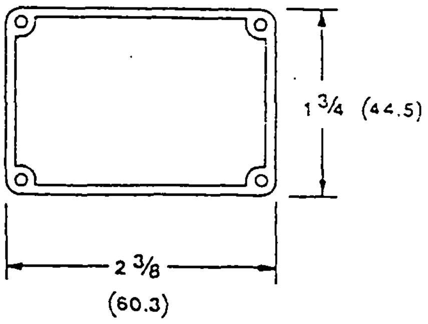
All Wilkerson Instrument Company products carry a 5 year limited warranty against defective material or workmanship. The product will be repaired or replaced, at the company's option, if it fails during this time due to defective material or workmanship. Misapplication or abuse by the user is not covered by this warranty.

In addition, the company will repair any of its products for a period of 5 years after the warranty period for an amount no greater than 10% of the original purchase price.

The owner is responsible for freight costs.

MOUNTING DIMENSIONS INCHES (MM)





POWER 115 or 230 VAC, 12 or 24 VDC.

CONTROLS

The DC to DC transmitters contain two calibration controls, zero and span (gain). The WR option adds an 8 position DIP switch for range selection.

CALIBRATION

The transmitters are precisely calibrated at the factory and do not normally require user calibration. If there is a need to recalibrate, proceed as follows:

If your transmitter includes the WR option, remove its cover and set the 8 DIP switches according to the table below.

ZERO and SPAN adjustments are available on top of the transmitter module. Connect a calibrated signal source to the module input. Monitor the output of the module with an accurate digital meter. Set the input signal to its zero or low value and adjust the ZERO control for the proper output. Increase the input signal to its full scale value and adjust the SPAN control for the proper output. Repeat the procedure once or twice, the controls may interact slightly.

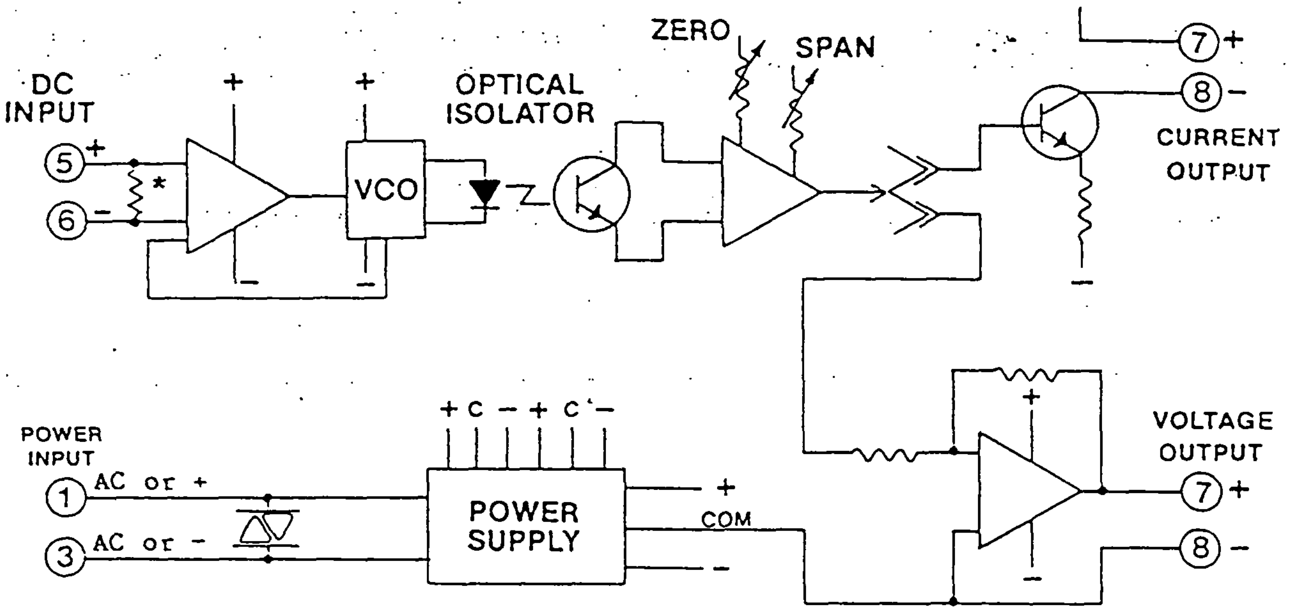
WIDE RANGING INPUT (WR OPTION)

INPUT	CLOSE SW	INPUT	CLOSE SW
50mV	none	1mA	7
100mV	6	2mA	6,7
200mV	5	4mA	5,7
500mV	4	5mA	7,8
1V	3	10mA	4,7
2V	2	20mA	3,7
5V	1	4/20mA	5,8
10V	1,2,3,4,5,6	25mA	3,5,7
1/5V	2,3,4,5,6	50mA	4,7,8
		10/50mA	4,8

SPECIFICATIONS

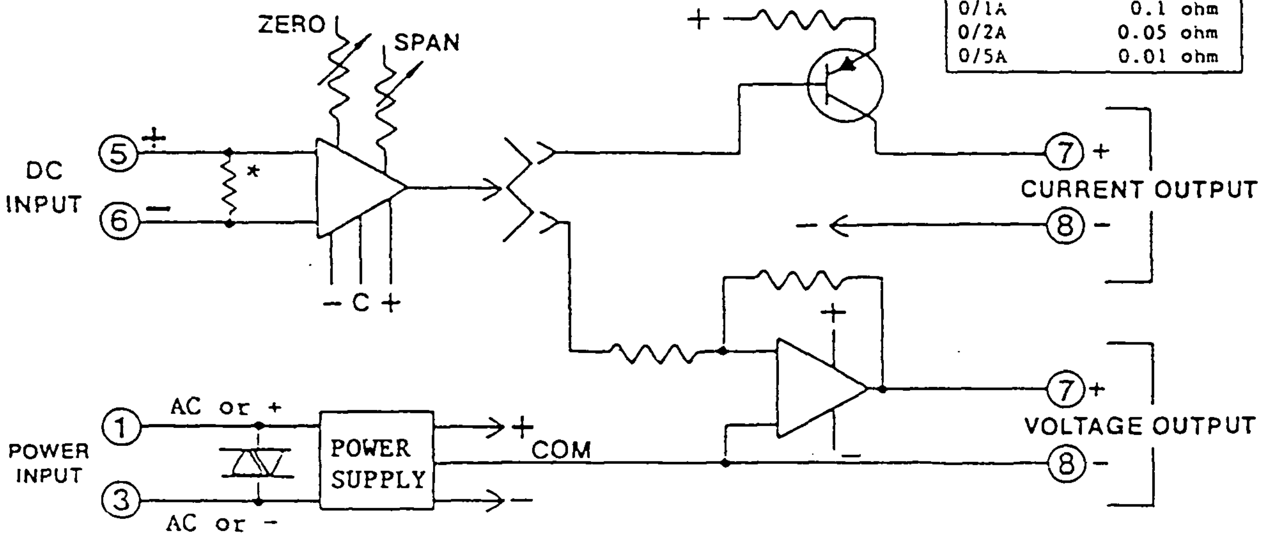
Input Impedance	Voltage	200K
	Current	see table on block diagram
Input Limits	MM4010, MM4300	50mV Span min; 200V max
	current:	5 A max, internal shunt
	MM4050, MM4310	10mV Span min; 20V max
Output Limits	Voltage	-10 to +15V, 10mA
	Current	50mA, 24V compliance

MM4300/MM4310
BLOCK DIAGRAM AND PIN CONNECTIONS



* CURRENT INPUT	INPUT SHUNT VALUE
0/1mA	100 ohms
0/10mA	10 ohms
0/20mA	5 ohms
4/20mA	61.9 ohms
0/50mA	2 ohms
0/100mA	1 ohm
0/200mA	0.5 ohm
0/500mA	0.1 ohm
0/1A	0.1 ohm
0/2A	0.05 ohm
0/5A	0.01 ohm

MM4010/MM4050
BLOCK DIAGRAM AND PIN CONNECTIONS



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IMPULSE SUPPRESSOR INSTALLATION

PLEASE READ DANGER SHEET BEFORE INSTALLING

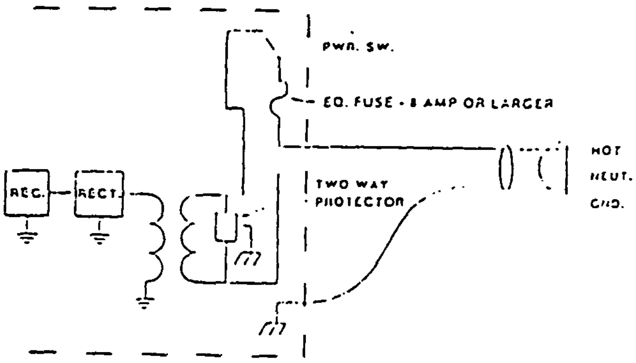
Your "Two Way" IS-PSP-120 (Power Supply Protector) will protect from surges from the power line as well as surge voltages attempting to go to the power line. Your IS-PSP-120 is fast (nanoseconds) and is capable of very high current (35,000 Amps) using IEEE waveform of 8µS ris and 20µS decay to a 50% point. It should have a long life time (which is dependent on the severit of surges that it shunts).

THIS DEVICE IS ONLY FOR 120 VAC (RMS) OR LOWER POWER LINES.

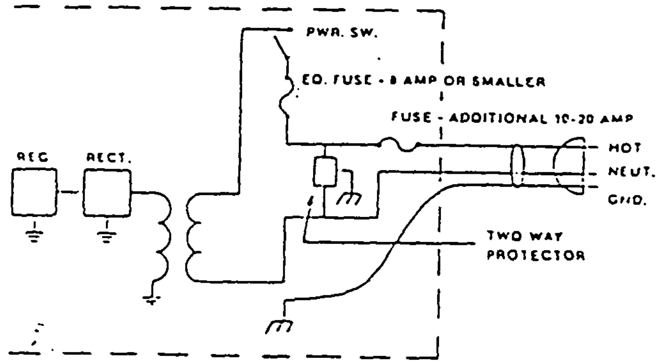
DANGER - DISCONNECT POWER CORD FROM POWER OUTLET BEFORE PROCEEDING WITH INSTALLATION.

To install, it is important that the fuse be electrically located between the power cord and the protector. This is for when the device finally reaches the end of its life, the fuse will continue to be blown, (it dies in a shorted mode). If your equipment has a fuse smaller than 8 Amps, you may wish to add an additional fuse of 10 to 20 Amps. This will prevent surges from frequently blowing the equipment fuse and yet gives safe localized "end of life" protection. Solder in place using the center black wire for chassis ground and the two white wires for each side of the transformer primary as shown in diagram.

For 8 Amp and up Equipment



For less than 8 Amp Equipment add additional fuse



For further information on grounds, ground systems, power line and telephone interconnect protection, order PolyPhaser's book "The 'Grounds' for Lightning & EMP Protection" at a cost of $19.95.

LIMITED WARRANTY

PolyPhaser Corporation warrants this product to meet or exceed the published specifications of the time of manufacturing and to be free of manufacturing defects for a two year period after proven date of purchase. PolyPhaser Corporation makes no claims, nor extends any warranty to include an "IMPLIED WARRANTY OF MERCHANTABILITY OR IMPLIED WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE". PolyPhaser Corporation assumes no responsibility for personal injury, property damage, and any other losses. This warranty is limited to the repair, replacement or refund of purchased price of this product only and it will be PolyPhaser Corporation's decision as to whether this unit is defective and as to which of the above mentioned actions will be taken. PolyPhaser Corporation extends no obligation to up-date or modify any of its existing products, as newly developed products are marketed.

To Keep YOU communicating
U.S. Patent #'s 4,359,764, 4,409,637 & 4,554,608

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CORPORATION

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OPERATING INSTRUCTIONS & PARTS MANUAL

SHADED-POLE BLOWERS

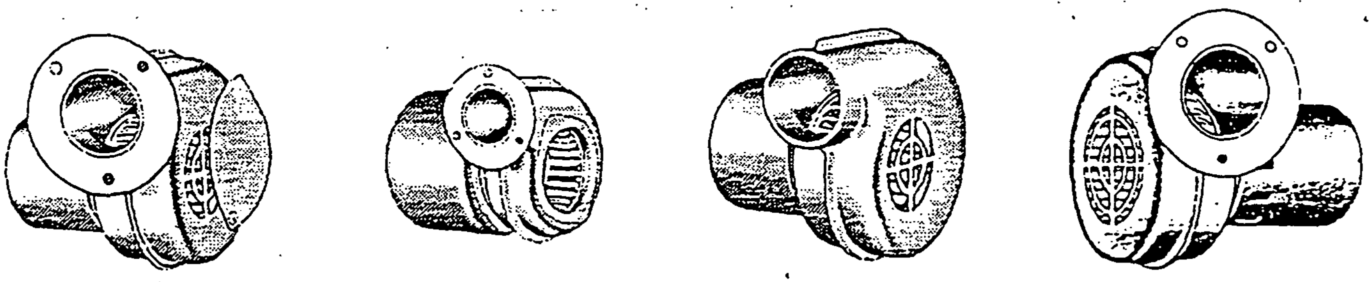
MODELS 2C782, 2C914A, 4C440, 4C441A & 4C443A

FORM
5S254
0404

DAYTON ELECTRIC MANUFACTURING CO. CHICAGO 60648

1186/415/1

READ INSTRUCTIONS CAREFULLY BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE DAYTON SHADED-POLE BLOWERS!
RETAIN INSTRUCTIONS FOR FUTURE REFERENCE.



MODELS
4C440 AND 2C914A

MODEL 2C782

MODEL 4C441A

MODEL 4C443A

Figure 1

Description

The Dayton shaded pole blower, finished in grey enamel, is a single speed unit designed specifically for heating, cooling, exhausting, ventilating and drying. It is field interchangeable with most direct drive blowers and can be mounted in any discharge position. Blower is driven by a shaded-pole motor.

Models 2C914A, 4C440, 4C441A and 4C443A feature automatic-reset thermal protection which automatically shuts off the motor should excessive temperatures develop. Model 2C782 has impedance protection. Maximum ambient temperature is 104°F (40°C).

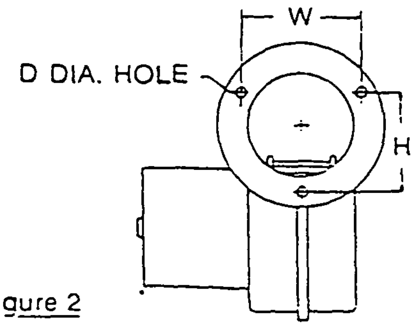


Figure 2

Dimensions

MODEL	"H"	"W"	"D"
2C782	$1\frac{13}{32}$	$1\frac{5}{8}$	$\frac{13}{64}$
2C914A	$2\frac{13}{16}$	$2\frac{3}{8}$	$\frac{9}{32}$
4C440	$2\frac{13}{16}$	$2\frac{3}{8}$	$\frac{9}{32}$
4C441A	—	—	—
4C443A	$2\frac{13}{16}$	$2\frac{3}{8}$	$\frac{9}{32}$

General Safety Information

1. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA).
2. Blower must be securely and adequately grounded. This can be accomplished by wiring with a grounded, metal-clad raceway system, by using a separate ground wire connected to the bare metal of the blower frame, or other suitable means.
3. Always disconnect power source before working on or near a motor or its connected load. If the power disconnect point is out-of-sight, lock it in the open position and tag to prevent unexpected application of power.
4. All moving parts should be guarded.
5. Be careful when touching the exterior of an operating motor — it may be hot enough to be painful or cause injury. With modern motors this condition is normal if operated at rated load and voltage — modern motors are built to operate at higher temperatures.
6. Protect the power cable from coming in contact with sharp objects.
7. Do not kink power cable and never allow the cables to come in contact with oil, grease, hot surfaces, or chemicals.
8. Make certain that the power source conforms to the requirements of your equipment.
9. Wiping or cleaning rags and other flammable waste materials must be placed in a tightly closed metal container and disposed of later in the proper fashion.
10. When cleaning electrical or electronic equipment, always use an approved cleaning agent such as dry cleaning solvent.
11. Do not use these blowers in explosive atmospheres.

Specifications

MODEL	WHEEL SIZE		MOTOR			OUTLET OPENING	OVERALL DIMENSIONS		
	DIA.	W	HP	SPD	PWR. REQD.	DIA.	H	W	D
2C782 •	2	1	1/250	1	115V 50/60 HZ	1 1/4	3 13/16	4 3/16	3 29/32
2C914A Δ	3	1 7/8	1/125	1	230V 50/60 HZ	2 1/8	5 13/16	5 7/32	6 5/16
4C440 Δ	3	1 7/8	1/125	1	115V 50/60 HZ	2 1/8	5 13/16	5 7/32	6 5/16
4C441A Δ	3	1 7/8	1/125	1	115V 50/60 HZ	2 1/8	5 13/16	5 7/32	6 5/16
4C443A Δ	3 13/16	1 7/8	1/70	1	115V 50/60 HZ	2 1/8	5 13/16	6 7/16	6 5/16

ΔAutomatic-Reset Thermal Protection. NOTE: All dimensions in inches. • Impedance Protected.

Performance

MODEL	CFM AIR DELIVERY AT SPEED AND STATIC PRESSURE (SP) SHOWN						CUT-OFF SP	FREE AIR		
	FREE AIR	0.1" SP	0.2" SP	0.3" SP	0.4" SP	0.5" SP		SPEED *	WATTS *	AMPS *
2C782	15	13	4				0.22"	3160	16	0.21
2C914A Δ	60	57	54	49	39	23	0.60	3030	36	0.21
4C440 Δ	60	57	54	49	39	23	0.60	3030	36	0.42
4C441A Δ	60	57	54	49	39	23	0.60	3030	36	0.42
4C443A Δ	100	98	95	90	85	80	0.80	2870	61	0.74

ΔAutomatic-Reset Thermal Protection. *At Free Air. NOTE: All data based on 60Hz operation. When operated on 50Hz, a decrease of approximately 20% will occur in flow rate performance.

Installation

1. Mount the unit in the position most desirable to your needs.
2. Connect the two leads to the appropriate power source. Refer to blower name plate.

NOTE: These blowers are not recommended for use with any type of speed control device.

CAUTION: A ground wire must run from the blower motor housing to a suitable electrical ground such as a properly grounded metallic raceway or ground wire system.

Maintenance

LUBRICATION

The motor bearings should be relubricated every 6 months with 10 or 20 drops of SAE 10W or 20W non-detergent oil (ML-type) or with electric motor oil.

GENERAL

Should further servicing of the unit be necessary, refer to the "exploded" view illustration as an aid in disassembly and assembly procedures.

WARNING: ALWAYS DISCONNECT POWER SUPPLY BEFORE SERVICING THE BLOWER OR WORKING WITH THE UNIT FOR ANY REASON. THIS IS ESPECIALLY IMPORTANT WITH UNITS EQUIPPED WITH AUTOMATIC-RESET THERMAL PROTECTION. UNIT MAY ACTIVATE WITHOUT WARNING!

Troubleshooting Chart

SYMPTOM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
Excessive Noise	1. Blower wheel contacting housing 2. Foreign material inside housing 3. Leak in duct work 4. Loose duct work	1. Realign or replace. 2. Clean. 3. Repair. 4. Secure properly.
Insufficient air flow	1. Leaks in duct work 2. Dampers and/or registers closed 3. Obstruction in system 4. Clogged Filters	1. Repair. 2. Open. 3. Remove. 4. Clean or replace.
Unit fails to operate	1. Blown fuse or open circuit breaker 2. Defective motor 3. Automatic-reset thermal protector "tripped" 4. Motor improperly wired	1. Replace fuse or reset circuit breaker. 2. Replace. 3. Check for high (or low voltage input or ambient temperatures in excess of 40°C (104°F). 4. Re-wire.

LIMITED WARRANTY

DAYTON ONE-YEAR LIMITED WARRANTY. Blowers, Models 2C782, 2C914A, 4C440, 4C441A & 4C443A, are warranted by Dayton Electric Mfg. Co. (Dayton) to the original user against defects in workmanship or materials under normal use for one year after date of purchase. Any part which is determined by Dayton to be defective in material or workmanship and returned to an authorized service location, as Dayton designates, shipping costs prepaid, will be, as the exclusive remedy, repaired or replaced at Dayton's option. For limited warranty claim procedures, see PROMPT DISPOSITION below. This limited warranty gives purchasers specific legal rights which vary from state to state.

LIMITATION OF LIABILITY. To the extent allowable under applicable law, Dayton's liability for consequential and incidental damages is expressly disclaimed. Dayton's liability in all events is limited to, and shall not exceed, the purchase price paid.

WARRANTY DISCLAIMER. Dayton has made a diligent effort to illustrate and describe the products in this literature accurately; however, such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the products are merchantable, or fit for a particular purpose, or that the products will necessarily conform to the illustrations or descriptions.

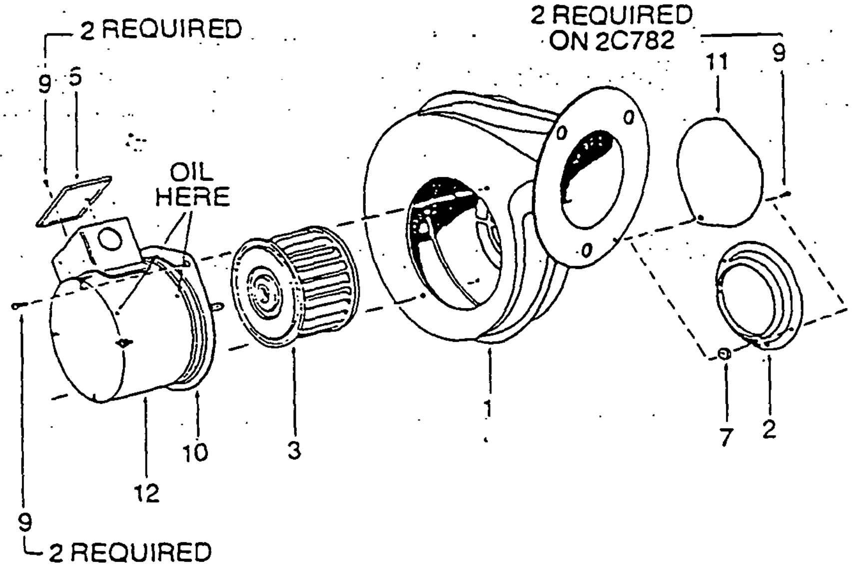
Except as provided below, no warranty or affirmation of fact, expressed or implied, other than as stated in "LIMITED WARRANTY" above is made or authorized by Dayton.

PRODUCT SUITABILITY. Many states and localities have codes and regulations governing sales, construction, installation, and/or use of products for certain purposes, which may vary from those in neighboring areas. While Dayton attempts to assure that its products comply with such codes, it cannot guarantee compliance, and cannot be responsible for how the product is installed or used. Before purchase and use of a product, please review the product application, and national and local codes and regulations, and be sure that the product, installation, and use will comply with them.

Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some states do not allow limitations on how long an implied warranty lasts, consequently the above limitation may not apply to you; and (c) by law, during the period of this Limited Warranty, any implied warranties of merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

PROMPT DISPOSITION. Dayton will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date and number of dealer's invoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file claim with carrier.

Dayton Electric Mfg. Co., 5959 W. Howard St., Chicago, IL 60648



ORDER REPLACEMENT PARTS THROUGH DEALER FROM WHOM PRODUCT WAS PURCHASED

Please provide following information:

- Model Number
- Serial Number (if any)
- Part Description and Number as shown in parts list.

If dealer cannot supply, order from:
Dayton Electric Mfg. Co.
Parts Department
5959 W. Howard St.
Chicago, Illinois 60648

Figure 3 — Replacement Parts Illustration, Models 2C782, 2C914A, 4C440 & 4C441A

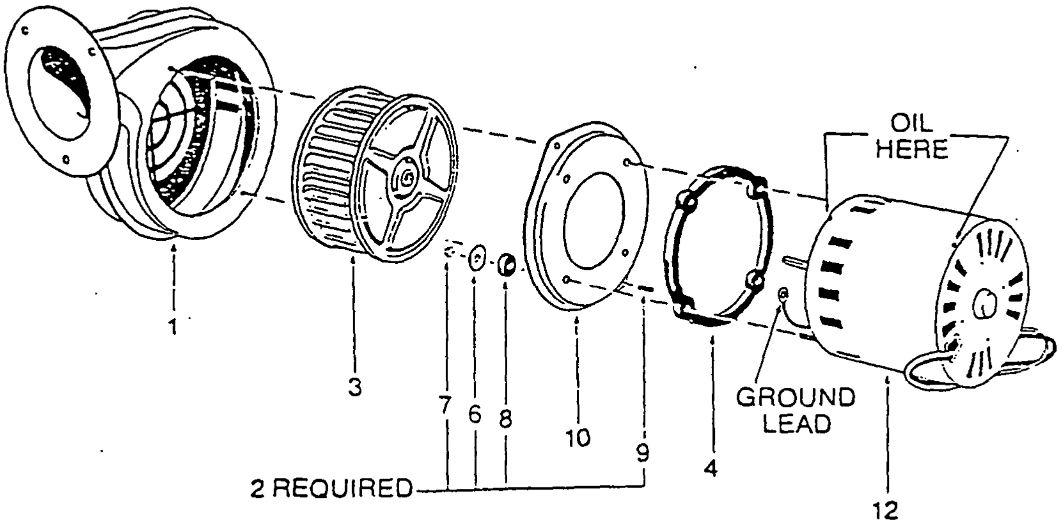


Figure 4 — Replacement Parts Illustration, Model 4C443A
NOTE: Conduit box and cover not shown for Model 4C443A.

Replacement Parts List

REF. NO.	DESCRIPTION	PART NO. FOR MODELS:				
		2C782	2C914A	4C440	4C441A	4C443A
1	Housing	8853-4296	8853-4291	8853-4291	8853-4289	8853-4283
2	Inlet ring	8793-4055	—	—	—	—
3	Blower wheel	0907-0023	0905-0059	0905-0059	0905-0059	0910-0002
4	Gasket	—	—	—	—	0912-0167
5	Conduit box cover	—	8591-6628	8591-6628	8591-6628	8591-6628
6	Washer #8	—	—	—	—	*
7	Nut #8-32	*	—	—	—	*
8	Grommet	—	—	—	—	0912-0168
9	Screw #8-1/4	*	*	*	*	*
10	Mounting cup	8768-4026	—	—	—	8768-4027
11	Damper	—	8631-4006	8631-4006	—	—
12	Motor	7121-1998	7121-3482	7121-3466	7121-4930	7121-4931

*Standard hardware item, available locally.

METHANE REACTOR TROUBLE SHOOTING

I. Methane reactor is cold to touch.

(a) Fuse is blown

(1) Before replacing fuse, check resistance between black wire and chassis and white wire and chassis. Resistance should be infinite. Replace fuse. Unit should be operational.

(2) If resistance is zero, there is a short in the wiring inside the methane reactor. Allow the reactor to cool and inspect all wiring and components for evidence of shorting. Repair wiring or replace defective components.

(3) If no shorts visible, lift entire wiring harness from methane reactor block and lay it on non-conducting surface. Measure resistance between black and red leads. It should read zero, indicating continuity through temperature controller switch. If not, replace temperature controller switch.

(b) Fuse is not blown but power is constant to unit and unit is cold.

(1) Measure resistance between red lead and white lead. If unit has 10-LPM or less capacity and operates 120V, the resistance should be about 48-ohms. If operating 230V, resistance should be about 185-ohms. In either case, if resistance is infinite, replace heater.

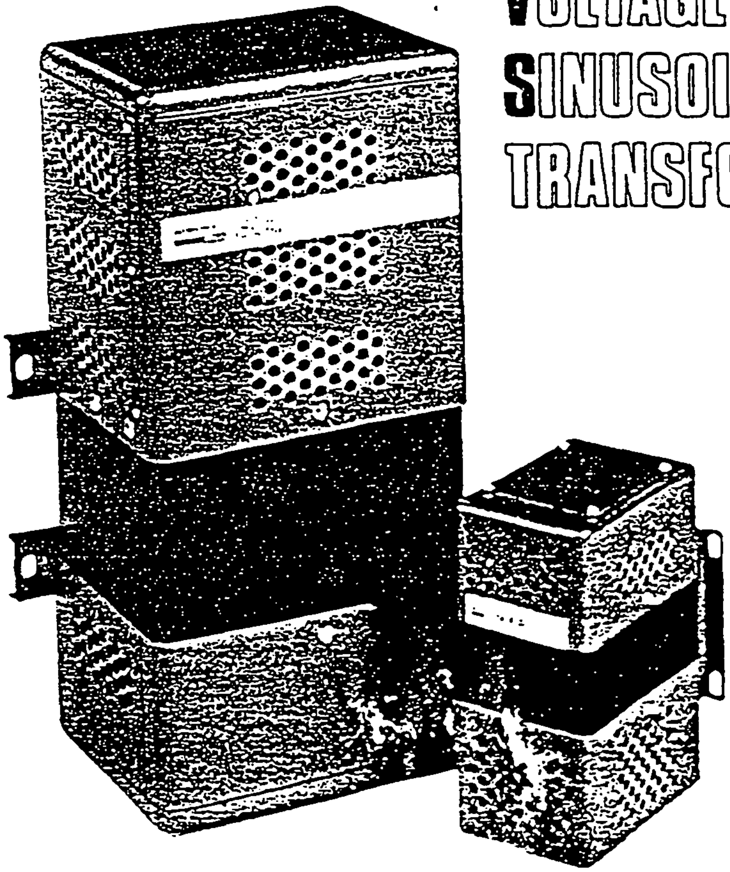
(2) If capacity is 20 or 30-LPM, resistance should be about 22-ohms if both heaters are okay and operating 120V. Resistance should be about 95-ohms if for 230V. If reading is about 48-ohms, 120V, means one heater gone. If reading is about 185-ohms, 230V, means one heater gone. All readings taken between red and white leads.

(3) If readings in (b)(2) above are infinite, both heaters gone.

II. Unit is at temperature other than 290°C, replace temperature switch with switch from AADCO. It is imperative that temperature setting be correct. Settings other than prescribed will cause formation NO_X and improper hydrocarbon removal.

III. It is imperative that proper filtering of air prior to methane reactor be done. Removal of particulates, halogens and sulfur compounds is mandatory for longevity and flow specifications to be met.

CONSTANT
VOLTAGE
SINUSOIDAL
TRANSFORMERS



A UNIT OF GENERAL SIGNAL GS

SOLA

INTRODUCTION

This operating and service manual has been prepared to ensure that your SOLA Constant Voltage Transformer can be operated and serviced with minimal effort and involvement. This manual covers SOLA Constant Voltage Sinusoidal (CVS) Transformers.

INSTALLATION - Mechanical

Position

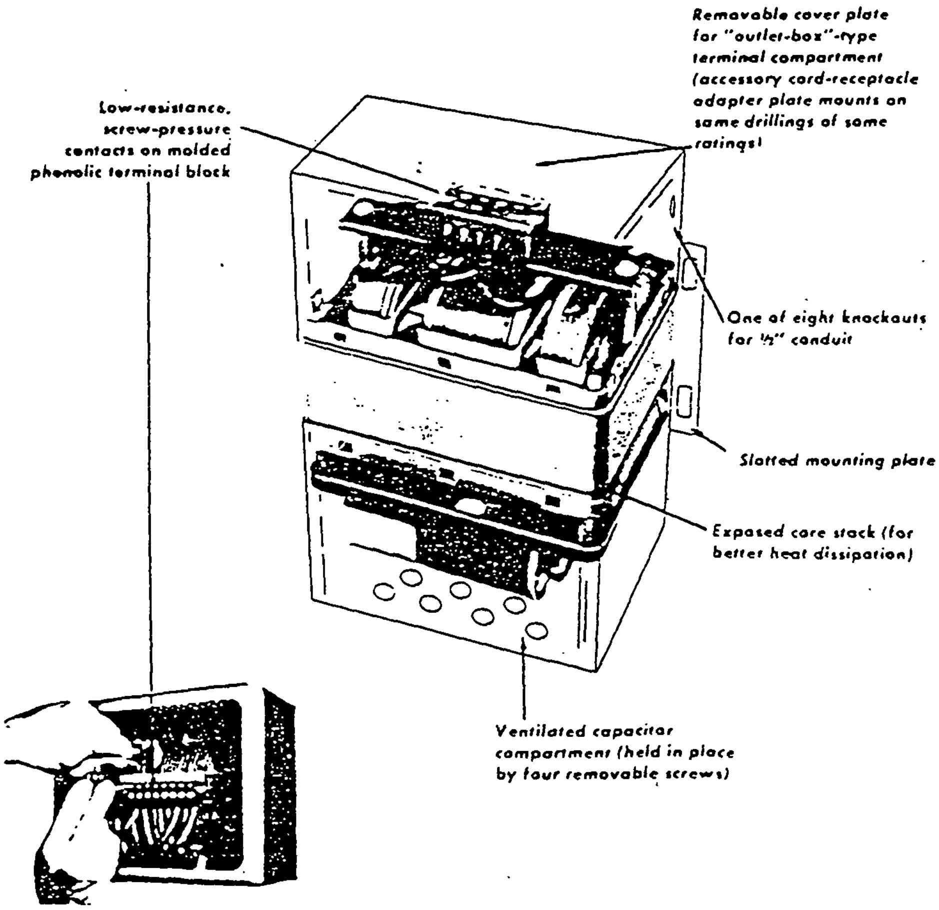
All stock sizes with end housings are intended to be mounted with the silkscreened THIS SIDE UP legend facing upwards. This will place the ventilated capacitor compartment downward, thus providing cooler operation of the capacitor(s). However, all units will give satisfactory performance if mounted in a horizontal position. In either case, the unit should be mounted in an area where it is unlikely that anyone will come into contact with the core surface of the unit. Figure 1 shows a phantom view of a typical unit.

Mounting Considerations

If a unit is to be wall mounted, the mounting hardware should be sized as in Table 1 below. All mounting holes provided must be used.

Table 1. Mounting Screw/Bolt Sizing

RATED VA OF REGULATOR	MIN. DIAMETER OF STEEL MOUNTING BOLTS
30 to 120	#10 Machine Screws
250	1/4" Bolts
500 to 1000	5/16" Bolts
1500 to 10000	3/8" Bolts
15000	1/2" Bolts



Phantom view reveals simplicity of Solo transformer, illustrates convenient terminal block arrangement. Unit contains no moving parts—requires no routine maintenance.

Figure 1. Phantom View

All ratings depend on natural draft air circulation for cooling. They should not be mounted in confined or enclosed spaces unless special provisions have been made for ventilation. Sola's Technical Service department is available for assistance in doubtful situations (see note on Operating Temperature, page 13). Table 2 and Figure 2 show model numbers with their weights and physical dimensions.

Table 2. CVS Weights and Physical Dimensions

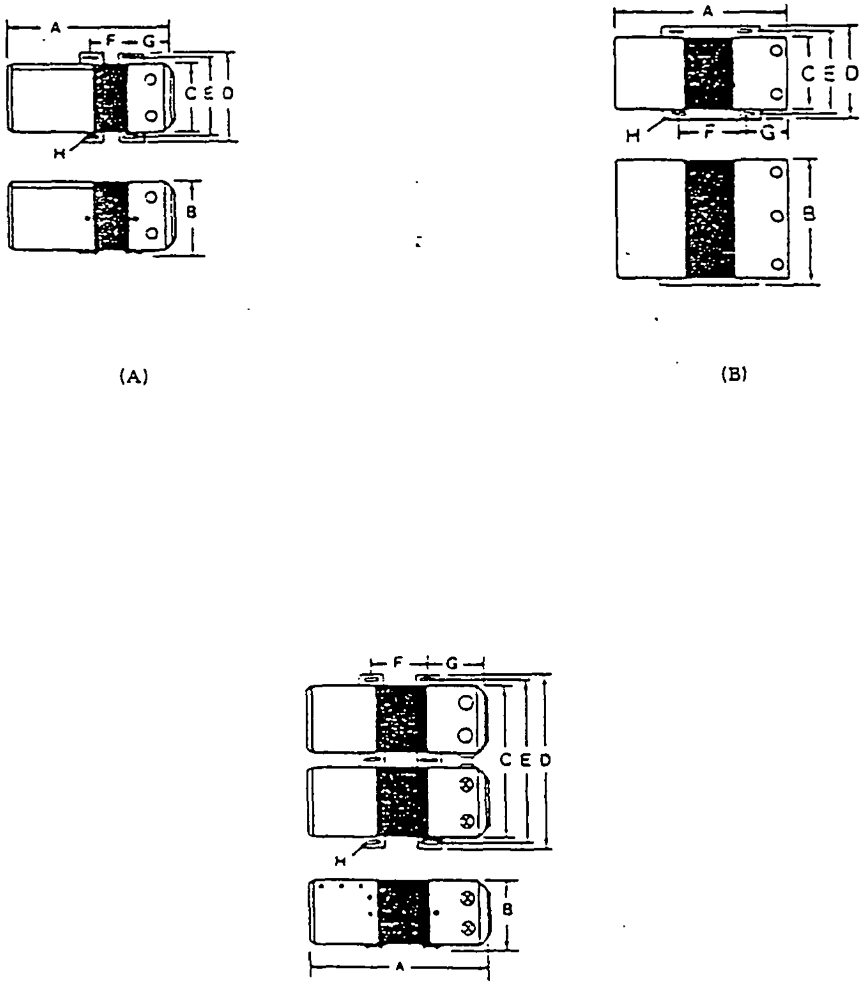
Catalog Number	VA	Outline	A	B	C	D	E	F	G	H	Shipping Weight (lbs)
					(in inches)						
60Hz Single Phase:											
23-13-030-2	30	A	6.12	5.19	3.31	4.00	3.50	3.00	1.75	.22 X .59	7
23-13-060-2	60	A	6.94	5.19	3.31	4.00	3.50	3.00	1.75	.22 X .59	9
23-23-060-2	60	A	6.94	5.19	3.31	4.00	3.50	3.00	1.75	.22 X .59	9
23-22-112-2	120	A	8.12	5.19	3.31	4.00	3.50	3.00	2.44	.22 X .59	13
23-22-125	250	A	9.62	7.44	4.50	5.38	4.75	4.12	2.19	.31 X .69	28
23-23-125-8	250	A	9.88	7.44	4.50	5.38	4.75	4.12	2.19	.31 X .69	28
23-23-125	250	A	9.62	7.44	4.50	5.38	4.75	4.12	2.19	.31 X .69	29
23-22-150	500	A	11.69	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .81	36
23-26-150	500	A	11.69	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .31	36
23-23-150-8	500	A	12.69	6.44	7.78	8.00	8.12	5.62	3.06	.38 X .81	37
23-25-175	750	A	15.38	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .81	52
23-23-175-8	750	A	13.69	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .81	52
23-25-210	1000	A	16.38	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .81	60
23-26-210	1000	A	16.38	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .81	60
23-23-210-8	1000	A	16.75	6.44	7.78	9.00	8.12	5.62	5.25	.38 X .81	63
23-25-215	1500	B	18.44	9.03	10.56	12.75	11.75	3.00	5.19	.44 X .69	94
23-23-215-8	1500	B	16.44	9.03	10.56	12.75	11.75	3.00	5.19	.44 X .69	95
23-25-220	2000	B	19.31	9.03	10.56	12.75	11.75	3.88	5.19	.44 X .69	111
23-23-220-8	2000	B	17.31	9.03	10.56	12.75	11.75	5.25	5.19	.44 X .69	109
23-26-220	2000	B	19.31	9.03	10.56	12.75	11.75	3.38	5.19	.44 X .69	111

Table 2. CVS Weights and Physical Dimensions - (Continued)

Catalog Number	VA	Outline	A	B	C	D	E	F	G	H	Shipping Weight (lbs.)
					(in inches)						
23-25-230-3	3000	B	20.69	9.03	10.56	12.75	11.75	5.25	5.19	.44 X .69	142
23-26-230	3000	B	20.69	9.03	10.56	12.75	11.75	5.25	5.19	.44 X .69	142
23-23-230-8	3000	B	18.69	9.03	10.56	12.75	11.75	5.25	5.19	.44 X .69	142
23-25-250-6	5000	B	30.69	9.03	10.56	12.75	11.75	8.25	8.88	.44 X .69	225
23-26-250-6	5000	B	30.69	9.03	10.56	12.75	11.75	8.25	8.88	.44 X .69	225
23-23-250-8	5000	B	28.19	9.03	10.56	12.75	11.75	8.25	8.88	.44 X .69	222
23-28-275-6	7500	C	29.06	9.03	22.81	25.81	24.81	6.62	8.88	.44 X .69	365
23-28-310-6	10000	C	30.69	9.03	22.81	25.81	24.81	8.25	8.88	.44 X .69	452
23-28-315-6	15000	*	30.69	9.38	35.56	38.25	37.22	8.25	8.88	.56 X .69	715
50Hz Single Phase:											
24-551-2	60	A	7.75	5.19	3.31	4.10	3.50	3.00	2.44	.22 X .59	11
24-552-2	120	A	8.62	7.44	4.50	5.38	4.75	4.12	2.19	.31 X .69	21
24-553-2	250	A	10.31	7.44	4.50	5.38	4.75	4.12	2.19	.31 X .69	37
24-554-9	500	A	12.31	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .81	56
24-554-10	500	A	12.31	6.44	7.78	9.00	8.12	5.62	3.06	.38 X .81	56
24-555-9	1000	B	17.12	6.44	7.78	9.00	8.13	5.62	4.06	.38 X .31	65
24-555-10	1000	B	17.12	6.44	7.78	9.00	8.13	5.62	4.06	.38 X .81	65
24-556-9	2000	B	19.94	9.03	10.56	12.75	11.75	4.50	5.19	.44 X .69	126
24-557-9	3000	B	25.41	9.03	10.56	12.75	11.75	6.66	5.19	.44 X .69	187
24-572-9	5000	C	21.12	9.03	22.81	25.81	24.81	5.69	5.19	.44 X .69	310

* Triplex assembly: Same as Figure 2 (c) except for one more transformer.

Note: 50 and 60Hz CVS transformers are of different designs, and cannot be adjusted or rebuilt for other frequencies.



(A)

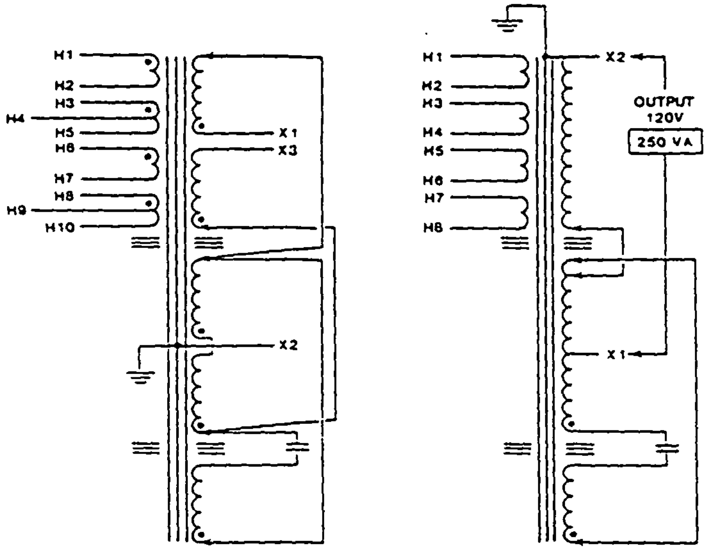
(B)

(C)

Figure 2. Mounting Holes and Dimensions

INSTALLATION - Electrical

On 60VA or smaller units, screw-type lugs in the outlet box are marked "input" and "output", and no connection diagram is necessary. Units rated 120 to 15000 VA are provided with multiple inputs for any one, two, three, or four different line voltages, and some have provision for three-wire output. With all units, a connection diagram is attached to the inside lid of the box cover, or inserted in the outlet box. Figure 3 shows typical connections for -8 models, and Figure 4 shows multiple input connections for all other models. Figure 5 shows the output connections for all models.



INPUT CONNECTIONS - All except 250 VA

Volts	Input	Jumper
95-130	H1-H2	(H1 + H3 + H6 + H8) (H2 + H5 + H7 + H10)
175-235	H1-H4	(H2 + H3) (H7 + H8) (H1 + H6) (H4 + H9)
190-260	H1-H5	(H2 + H3) (H7 + H8) (H1 + H6) (H5 + H10)
380-520	H1-H10	(H2 + H3) (H5 + H6) (H7 + H8)

INPUT CONNECTIONS - 250 VA Only

Volts	Input	Jumper
95-130	H1 - H2	(H1 + H3 + H5 + H7) (H2 + H4 + H6 + H8)
190-260	H1 - H4	(H2 + H3) (H6 + H7) (H1 + H5) (H4 + H8)
380-520	H1 - H8	(H2 + H3) (H4 + H5) (H6 + H7)

Figure 3. Electrical Connection for -8 Models

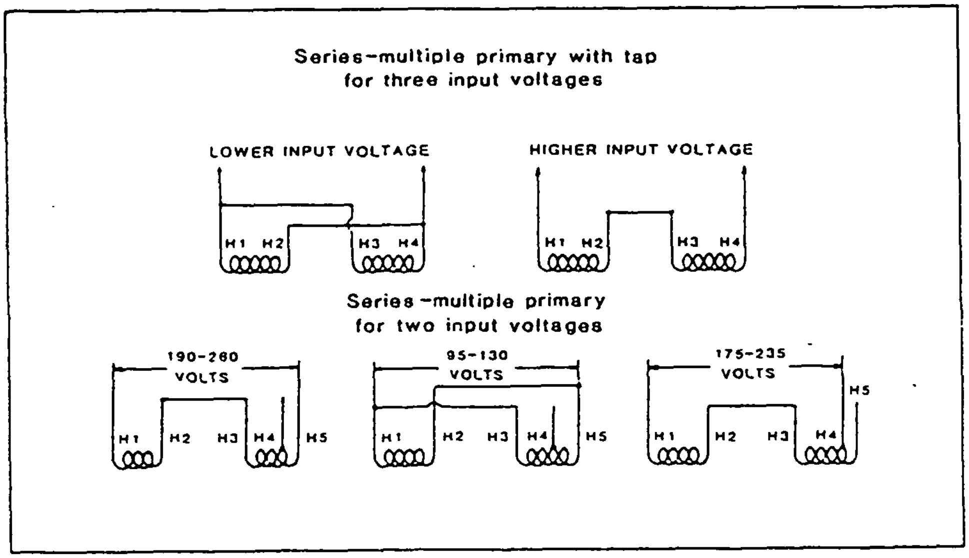


Figure 4. Multiple Input Connections for All Models Not Ending In -8

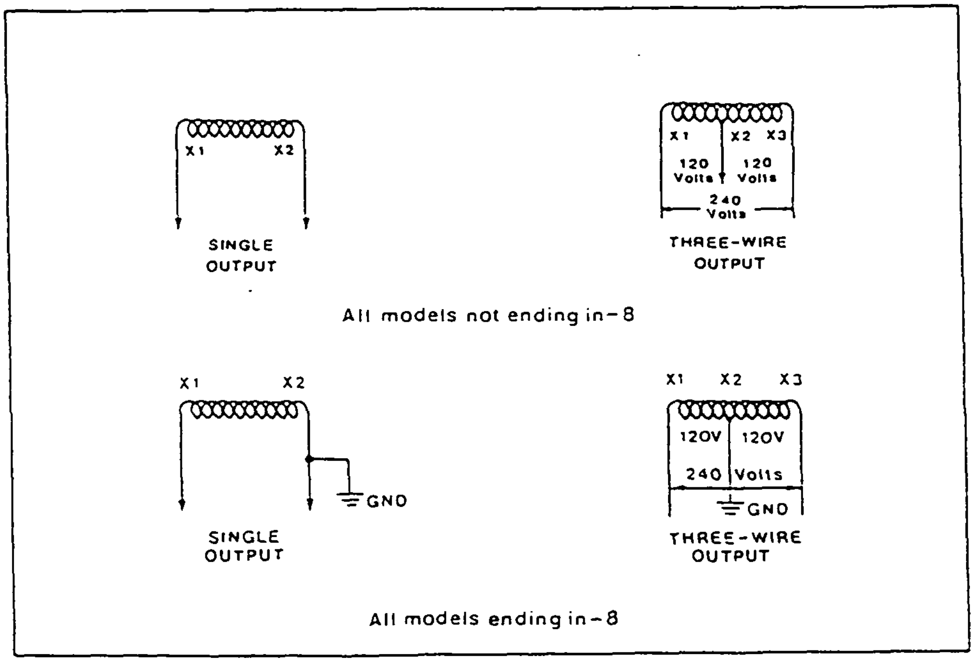


Figure 5. Output Connections

Wire Sizing and Circuit Protection

Table 3 shows suggested circuit protection and wire sizing for the various models of CVS transformers.

Table 3. Circuit Protection/Wire Gauge Sizes

CVS	INPUT			OUTPUT	
VA Rating	Rated Volts	Required Circuit Protection (A)	Minimum Gauge 90°C Wire	Rated Volts	Minimum Gauge 90°C Wire
30	95-130	1	14	120	14
60	95-130	2	14	120	14
120	95-130	3	14	120	14
	175-235	3	14	120	14
	190-260	3	14	120	14
	380-520	1	14	120	14
250	95-130	6	14	120	14
	175-235	3	14	120	14
	190-260	3	14	120	14
	380-520	1	14	120	14
500	95-130	10	14	120	14
	175-235	6	14	208	14
	190-260	6	14	240	14
	380-520	3	14		
750	95-130	15	14	120	14
	175-235	10	14	208	14
	190-260	6	14	240	14
	380-520	3	14		
1000	95-130	15	14	120	14
	175-235	10	14	208	14
	190-260	10	14	240	14
	380-520	6	14		
1500	95-130	25	10	120	12
	175-235	15	14	208	14
	190-260	15	14	240	14
	380-520	10	14		
2000	95-130	30	10	120	10
	175-235	20	12	208	14
	190-260	15	14	240	14
	380-520	10	14		

Table 3. Circuit Protection/Wire Gauge Sizes - (Continued)

CVS		INPUT		OUTPUT	
VA Rating	Rated Volts	Required Circuit Protection (A)	Minimum Gauge 90°C Wire	Rated Volts	Minimum Gauge 90°C Wire
	95-130	45	8	120	8
	175-235	25	10	208	12
3000	190-260	25	10	240	12
	300-520	15	14		
	95-130	80	4	120	8*
	175-235	40	8	208	10
5000	190-260	40	8	240	10
	380-520	20	12		
	175-235	60	6	120	4
7500	190-260	60	6	208	8
	380-520	30	10	240	8
	175-235	80	3	120	3
10000	190-260	80	4	208	6
	380-520	40	8	240	8
	175-235	125	1	120	0
15000	190-260	110	2	208	4
	380-520	60	4	240	4

*Leads in the wiring compartment must be sleeved with 105°C sleeving.

Three-Wire Regulating Action

On those units provided with three-wire output, the standard regulating action of ±1% or better may be obtained from the 240 volt terminals alone, either 120 volt leg alone, combination 240 and 120 volt loads, or unbalanced 120 volt loads.

Other Considerations

For certain smaller ratings, an accessory adapter plate-carrying an input cord and output receptacle, or jacks, is available at a small additional cost. Simple directions for installation are furnished with the adapter kit.

It is desirable to have a switch in the input circuitry for turning off power to the unit when it is not in use. While all CVS transformers are designed for continuous duty, they draw appreciable current regardless of output loading.

The outputs of all Sola standard CVS transformers are isolated from the input lines. Voltage generated by internal leakage currents will occur with respect to ground. This can have undesirable affects in many pieces of electronic equipment. Therefore, it is suggested that the installer tie the input power system neutral to the X2 output terminal. This will not affect regulation or the ability to reject power line noise or transients.

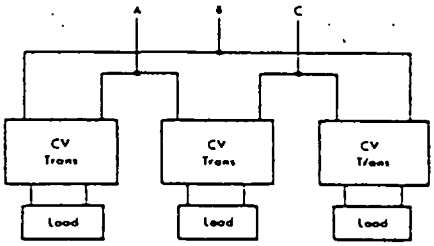
SPECIAL INSTALLATIONS

Use on Three-Phase Power Supply

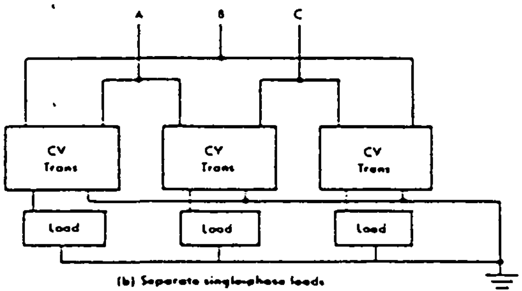
Any three stock units having a tap for 190-260 input connections may be connected in delta to a 240-volt, three-phase power supply; those units equipped with primary tap for 175-235 volts may also be connected in delta to a 208-volt supply. (Terminals to be used are identified on the connection diagram located on the inside face of the outlet box cover.)

All stock production, harmonic-free units now have uniform terminal polarity. This eliminates necessity for "phasing out" either input or output connections.

Output must serve three, independent, single-phase loads of the same total volt-ampere rating. Connections should be made in one of two ways shown in Figure 6.



(a) Isolated single-phase loads.



(b) Separate single-phase loads in grounded wye.

Figure 6. Three-Phase Connections

Use With Switchmode Power Supplies

If a CVS transformer is used as a source for a switchmode power supply, a slight amount of ringing may be noticed on the sine wave output of the CVS at half cycle intervals for a short duration. This ringing occurs at the point when the switchmode power supply current demand drops to zero. The ringing need not be a cause for concern since it is of relatively low magnitude and frequency. The CVS has been tested with a variety of switchmode power supplies and it has been determined that the ringing never affects the DC outputs, nor has it been found to degrade the components of any switchmode power supply.

Multiple Operation

Two CVS transformers of the same rating may be connected with their inputs and outputs in parallel. The regulating action will usually be excellent although the standard ±1% cannot be guaranteed. Series connection of either input or output is not recommended.

Use With Rectifier Loads

The ratio of crest to rms values is approximately 1.3 at rated load, and slightly lower at fractional loads. This factor must be considered when all or a portion of the voltage is rectified. The rectified voltage will now be 10 - 15% lower than if connected directly to a sine wave source.

Operation With Motor Loads

Because of the current limiting effect described later, special attention should be given to motor applications. In general, the CVS must have a load rating nearly equal to the maximum power drawn during the starting cycle. This may run from two to eight times the normal running rating of the motor. In doubtful cases it is advisable to measure the actual starting current.

Cascade Operation

For applications requiring close regulation, two CVS transformers may be operated in "cascade". The output of the combination will show little or no detectable change arising from supply line variations of up to ±15%. However, the combined units will still be frequency sensitive (as discussed under Effect of Frequency, page 15). Since even good power systems may often vary in frequency by 0.1% or more, the output of a Sola cascade combination may vary by up to 0.25% from this cause alone. In actual practice, then, a cascade combination is highly recommended for special applications requiring regulation in the general region of ±0.25%. If the tandem setup is to be operated at near full rating, then the Type CVS "driver" unit should be one standard size larger than the driven unit, in order to overcome the losses in the latter.

PHYSICAL CHARACTERISTICS OF OPERATION

Operating Temperature

Standard units are designed to operate in ambient temperatures of minus 20°C to plus 50°C. In operation, a temperature rise will occur whether or not the transformer is serving load. Normally, this rise may fall anywhere in the range of 45°C to 110°C, depending on the type and rating. In any case, the maximum operating temperature at an ambient of 50°C is always within safe operating limits for the class of insulating material used. (Special units can be designed for lower heat rise or wider ambient temperature range.)

External Magnetic Fields

In almost all applications, this effect may be disregarded. On critical applications, care should be exercized in the orientation of the core with respect to critical circuits, in order to minimize the effect of the field.

In certain rare cases in which the transformer is connected to, or mounted near, high gain audio frequency circuits, special attention may need to be given to adequate physical spacing and/or orientation of the CVS transformer so as to avoid interaction with the audio circuits. Sola's Technical Service Department may be able to offer suggestions for such problems.

ELECTRICAL CHARACTERISTICS OF OPERATION

Checking With Voltmeters

All checks on output voltages should be made with a true RMS voltmeter such as a Fluke model 8020 A. Rectifier-type voltmeters will not give accurate readings due to the small amount of harmonics present in CVS output.

Load Regulation

Changes in output voltage resulting from changes in resistive loads are usually small - running one percent or less in the larger units. Table 4 shows average values for output voltages.

Table 4. Output Voltage Changes - 20% Load to Full Load (100% Power Factor - Nominal Input Voltage)

Transformer VA	Percent Change - Output Voltage
11-30	approximately 4%
31-120	approximately 3%
121-150	approximately 2%
151-over	approximately 1%

Phase Shift

The phase difference which exists between input voltage and output voltage in the range of about 120° to 140° at full load. This phase difference varies with the magnitude of the load and, to a lesser extent, with changes in line voltage.

Output Wave Shape

The CVS transformers all include harmonic-neutralizing circuitry. These units typically have less than 3% total harmonic distortion at full load and less than 4.5% at no load.

Response Time

An important advantage of the Sola principle of static magnetic regulation is its exceedingly fast response time compared with other types of AC regulators. Transient changes in supply voltage are usually corrected by a Sola CVS with 1 1/2 cycles or less, the output voltage will not fluctuate more than a few percent during this interval.

Isolation

Since the input and output are separated not only electrically, but physically, by a magnetic shunt, the Sola CVS has a stronger isolating effect than a conventional transformer. This may often eliminate the need for static shields.

FACTORS AFFECTING OPERATION

Input Charcteristics

As the Sola CVS transformer includes a resonant circuit that is fully energized whether or not a load is present, the input current at no load or light loads may run 50% or more of the full-load primary current. As a result, the temperature of the unit may rise to near full-load levels, even at light or nonexistent loads. Input power factor will average 90-100% at full load, but may drop to approximately 75% at half load and 25% at no load. In any case, it is always leading.

Effect of Load Power Factor

The median value of output voltage will vary from the nameplate rating of the load is a power factor other than that for which the unit was designed. Load regulation will also be relatively greater as the inductive load power factor is decreased (see Figure 7). However, the resulting median values of the output voltage will be regulated against supply line changes at any reasonable load or power factor.

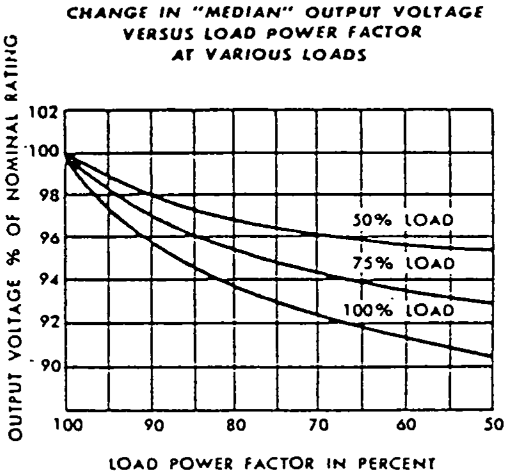


Figure 7. Median Output Voltage Vs. Load Power Factor

Effect of Frequency

Changes in the frequency of the supply voltage will be directly reflected in the output voltage. A change of approximately 1.8% in the output voltage will occur for every 1% change in input frequency in the same direction as the frequency change.

Effect of Temperature

The output voltage will show a small change as the unit warms up to stable operating temperatures at a constant ambient temperature. This change may be about one or two percent, depending on the unit's VA rating. At a stable operating temperature, the output voltage will change slightly with varying ambient temperature. This shift is approximately one percent for each 40°C of temperature change.

Current Limitation

When the load is increased beyond the transformer's rated value, a point is reached where the output voltage suddenly collapses and will not regain its normal value until the load is at least partially released. Under a direct short circuit, the load current is limited to approximately 150-200% of the rated full load value, the input wattage to less than 10% of normal. A CVS will protect both itself and its load against damage from excessive fault currents. Fusing of load circuits is not necessary.

Manufacturing Tolerance

The nominal output voltage of each stock Constant Voltage Transformer is adjusted at the factory to within plus 2%, minus 0% of rated (nameplate) value with rated, nominal voltage at rated frequency applied to the input, and with full rated load at 100% power factor applied to the output. This adjustment is made with the unit at substantially the same temperature as room ambient temperature (25°C).

SERVICING

Routine Maintenance

As the Sola CV Transformer is a simple rugged device without moving parts or manual adjustments, no servicing or maintenance is needed in the ordinary sense. The percentage of possible poor performance or failure is exceedingly low. In any case of apparent poor performance, the user is urged to check the following points immediately:

Checklist on Factors Affecting Performance

A. Nominal Voltage Too High
   1. The load may be considerably less than full rating. (See "Load Regulation", page 13.)
   2. The load may have a leading power factor.

B. Nominal Voltage Too Low
   1. Load power factor may be lagging. (See Load Regulation, page 13.)
   2. Unit may be slightly overloaded. (See Current Limitation, page 15.)

C. Does Not Regulate Closely
   1. Unit may be slightly overloaded. (See Current Limitation, page 15.)
   2. Actual line voltage swings may be outside the rated coverage of unit, particularly on the low side.
   3. On varying loads, a certain amount of load regulation may be mixed with the line voltage regulating action. (See Load Regulation, page 13.)

D. Output Voltage Very Low (20-60V)
   1. Unsuspected or unplanned overloads of substantial size may occur intermittently (motor-starting currents, solenoid inrush currents, etc.). (See Current Limitation, page 15.)
   2. One or more capacitor units in the CVS transformer may be defective. (See Field Replacement of Capacitors, page 18.)

E. No Output Voltage At All
   1. Check power source breakers or fuses.
   2. Check continuity between input terminals, and also between output terminals.

F. Transformer Operating Temperature

1. These transformers are designed to operate at high flux density, and hence, relatively high temperatures (see Operating Temperature, page 13). After connection to line for a half hour or so, the exposed core structure may be too hot to touch with bare hand, but this is normal and need give no concern. However, if there is any indication of oil or compound leakage, unit should be returned to factory. (See below.)

<u>NOTE</u>

In case the transformer is operating but does not appear to have the correct output, it is very helpful to apply the following test:

1. Disconnect the working load.
2. Connect a dummy load of lamps, heaters, or other resistive load substantially equal to the full load rating of transformer, directly across its output terminals.
3. Measure the output voltage of the CVS using a true RMS type voltmeter directly across its output terminals.

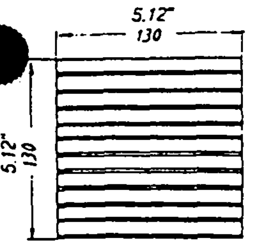
This test will usually establish whether the apparent poor performance is due to a fault in the CVS transformer or to some peculiarity of the working load. Sola's Technical Service department will then be in far better position to give helpful service advice or suggest factory test or service as indicated.

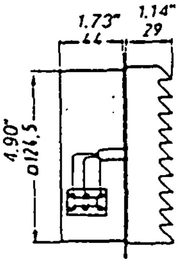
Factory Test and Inspection

If the field test suggested earlier indicated that the CVS transformer itself may be faulty, a full report of the difficulty should be communicated to the place of purchase, with a request for permission for return. The Authorized Sola Distributor may then suggest further helpful field tests, or authorize return for inspection at once. A Return Authorization Number will be issued. **This number must appear on the outside of the shipping container** otherwise the shipment will not be accepted.

260-0023 FAN SK3168
260-0024 FILTER SK3163

Technical Information at a Glance





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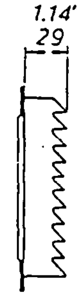
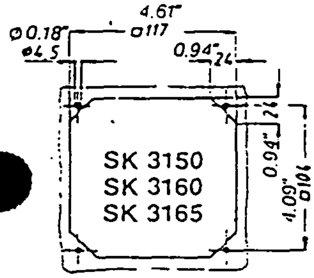
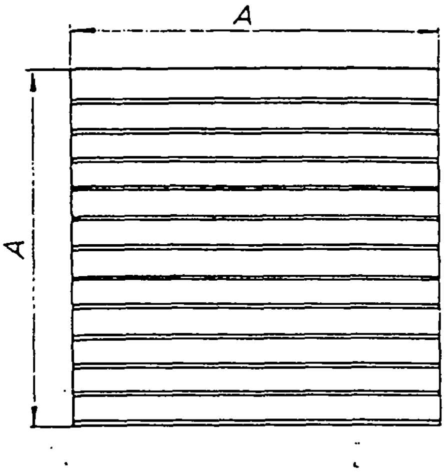
SK 3150
SK 3165

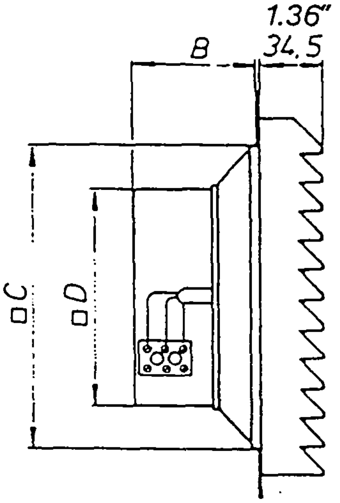


Outlet
Filter
SK 3160

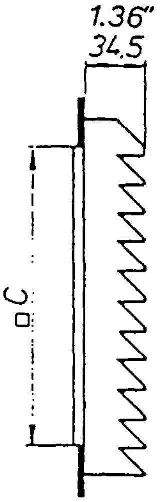


Installation Cutout

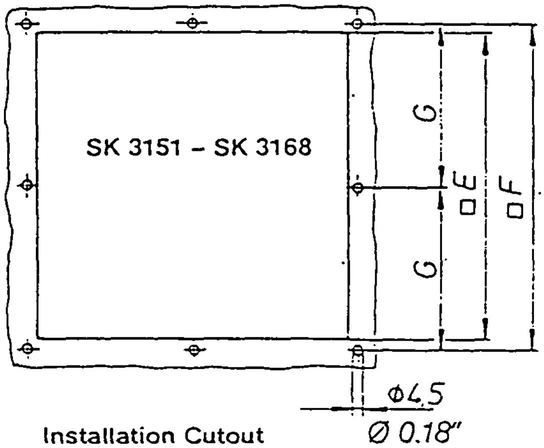




Filter Fan
SK 3151/52/53
SK 3166/67/68



Outlet Filter
SK 3161/62/63



Installation Cutout

Filter Fans	3151/66	3152/67	3153/68
Outlet Filter	3161	3162	3163
A mm/in	204 /8.03"	255 /10.04"	323/12.72"
B mm/in	66 /2.60"	103.5/ 4.07"	140/ 5.51"
C mm/in	175 /6.89"	222 / 8.74"	290/11.42"
D mm/in	124.5/4.90"	160 / 6.30"	206/ 8.11"
E mm/in	176 /6.93"	223 / 8.78"	291/11.46"
F mm/in	185 /7.28"	234 / 9.21"	302/11.89"
G mm/in	–	117 / 4.61"	151/ 5.94"

Model No.	SK 3150	SK 3165	SK 3151	SK 3166	SK 3152	SK 3167	SK 3153	SK 3168
Axial fan with self-starting split pole motor							Axial fan with capacitor motor	
Operating voltage	220/230 V 50/60 Hz	110/115 V 50/60 Hz	220/230 V 50/60 Hz	110/115 V 50/60 Hz	220/230 V 50/60 Hz	110/115 V 50/60 Hz	220 V 50 Hz	115 V 60 Hz
Capacitance value							2 µF	8 µF
Current rating	0.11 A	0.24 A	0.11 A	0.24 A	0.225 A	0.6 A	0.27 A	0.6 A
Power	18 W	20 W	18 W	20 W	35 W	42 W	58 W	75 W
Noise level	48.5/49 dB (A)		47.5/48 dB (A)		49/49.5 dB (A)		64/69 dB (A)	
RPM	2650/3100 min⁻¹		2650/3100 min⁻¹		2850/3350 min⁻¹		2650/3000 min⁻¹	
Temperature range	-10 to +55 °C [+14 to +131 °F]		-10 to +55 °C [+14 to +131 °F]		-10 to +55 °C [+14 to +131 °F]		-10 to +55 °C [+14 to +131 °F]	
Air throughput: unimpeded airflow	48 m³/h [28.3 ft³/min]		103 (70) m³/h [60.62 (41.20) ft³/min]*		220 (130) m³/h [129.5 (76.52) ft³/min]*		500 (340) m³/h [294.3 (200.1) ft³/min]*	
With outlet filters	1 SK 3160, 35 m³/h [20.60 ft³/min] 2 SK 3160, 42 m³/h [24.72 ft³/min] 1 SK 3161, 42 m³/h [24.72 ft³/min]		1 SK 3161, 61 (48) m³/h [35.90 (28.25) ft³/min]* 2 SK 3160, 59 (47) m³/h [34.73 (27.66) ft³/min]* 2 SK 3161, 85 (62) m³/h [50.03 (36.49) ft³/min]* 1 SK 3162, 78 (58) m³/h [45.91 (34.14) ft³/min]*		1 SK 3162, 150 (105) m³/h [88.29 (61.80) ft³/min]* 2 SK 3161, 160 (110) m³/h [94.17 (64.74) ft³/min]* 2 SK 3162, 190 (120) m³/h [111.8 (70.63) ft³/min]* 1 SK 3163, 180 (118) m³/h [105.9 (64.45) ft³/min]*		1 SK 3163, 360 (285) m³/h [211.9 (167.7) ft³/min]* 2 SK 3162, 380 (285) m³/h [223.7 (167.7) ft³/min]* 2 SK 3163, 440 (320) m³/h [259.0 (188.3) ft³/min]*	
Special voltages available in	24 V DC 24 V AC 50/60 Hz 48 V AC 50/60 Hz		24 V DC 24 V AC 50/60 Hz 48 V AC 50/60 Hz		24 V AC 50/60 Hz		110 V AC 50 Hz 230 V AC 60 Hz	

* = Values in brackets ( ) apply when using fine filter

Field Replacement of Capacitors

Capacitors used in all CVS transformers are the highest commercial grade available. Each one is given a rigid acceptance test upon receipt. Nevertheless, as with all capacitors, there is a certain small percentage of failure. Sola's guarantee includes free replacement at the factory of any capacitor unit which fails within one year from date of purchase. Older units can be replaced at moderate charge.

Where competent technical help is available, it may be possible to test and identify defective capacitors in the field, and to make field replacement with new units shipped from the factory. In all such cases, factory advice and cooperation should be requested in advance. Sola cannot be responsible for repairs performed outside factory Authorized Service Centers.

APPENDIX N

RESUMES

Resumes of Key Personnel

Z. Lowell Taylor, Ph.D., P.E.

Chief Operating Officer

Experience

1988-Date

Chief Operating Officer for Williams Environmental Services, Inc. As such, he has been directly responsible for thermal treatment activities of the company. These activities include actual hands-on efforts in design and operation of the thermal treatment units used at two Superfund sites the company has been involved in. He has directly supervised remediation of and operation of two new units used to remediate petroleum-contaminated soils at Columbia, South Carolina, and Fort McClellan, Alabama, in addition to numerous other sites. He has managed the design and construction of a third unit which began operation at another Superfund site, the Letterkenny Munitions Depot in August 1991. Dr. Taylor was on site at the Prentiss, Mississippi, project to perform project and equipment evaluations; he proposed design modifications to be performed before the unit was employed on the Bog Creek Farm site. He was on site at the Bog Creek project approximately 50 percent of the time and directly involved with management of the project. He has been involved with several key field engineering modifications which were instrumental in successful completion of projects. Williams' operating centers include Remediation Services, Thermal Treatment, Groundwater Services, Laboratories, Engineering Services, and Industrial Hygiene Services. He manages approximately 125 employees located in four offices and three laboratories throughout Alabama and Georgia.

JIM WALTER RESOURCES, INC.
Birmingham, Alabama

1980-1987

Vice President. Responsible for operations, environmental affairs, engineering, and research and development for $150 million chemical, coke and fiber manufacturing operation. These facilities included five manufacturing plants, extensive utilities and power plant and waste treat-ment facilities. Major environmental projects included:

- Development and construction of wastewater facilities to treat 1 MGPD of complex coke and chemical waste.
- Design and permitting of waste incinerator for chemical waste.
- Development of RCRA-mandated investigation for five complex landfills and lagoons.
- Development of plans for handling coke facility hazardous waste.
- Development and implementation of environmental and technical feasibility program for incineration of coke oven fuels with cogeneration of steam and power for three 100,000 lb/hr boiler systems.

In this position Dr. Taylor was directly responsible for some 800 employees. The technical groups which conducted the R&D and environmental affairs were comprised of approximately 40 engineers and 30 chemists and industrial hygiene professionals.

FRIT INDUSTRIES, INC.
Ozark, Alabama

1976-1980

Vice President. Responsible for operations, environmental affairs, and engineering for the largest manufacturer of micronutrients in the United States. Operations included five chemical plants located in the Southeast and Midwest. Major environmental projects included:

- Design permitting and construction of facilities to utilize byproduct flue dusts from the metals industry in the manufacture of micronutrient products.
- Lagoon, soil and groundwater studies and corrective action plans for manufacturing site contaminated with heavy metals and nitrates.
- Closure of large chemical fertilizer facility located in the Midwest. The cleanup of nitrates, lead and cadmium was required.

HARMON ENGINEERING ASSOCIATES, INC.
Auburn, Alabama

1975-1976

Senior Vice President. Responsible for the management of all projects including proposal preparation, job costing, project scheduling, and report preparation. Supervised staff of 42 with approximately 17 professionals. Project load included environmental studies, testing and design. Major projects included:

- Development of environmental plan for large foundry operation to include air quality, runoff and wastewater evaluations. Design of total environmental systems was completed.
- Conducted large river basin study of Flint, Chattahoochee, and Apalachicola system. Identified all major industrial and municipal sources of wastewater pollution. Modeled system to show stream and system impacts.
- Developed wastewater treatment systems and designs for 16 industrial facilities ranging from small plating shops to major steel producers.

AUBURN UNIVERSITY
Auburn, Alabama

1970-1975

Professor and Head, Department of Engineering. Responsible for research and academic affairs of an accredited engineering program; consulting practice included the development of wastewater disposal alternatives for DuPont's facility at Holt, Alabama. Treatability studies for ethylene glycol and pesticide containing wastes, and evaluation of fluoride waste control system for aluminum smelting.

U.S. PIPE AND FOUNDRY COMPANY
Birmingham, Alabama

1969-1970

Director of Research. Directed technical effort for the Chemical Division. Responsible for development, technical services, quality control and environmental matters.

AUBURN UNIVERSITY
Auburn, Alabama

1966-1969

Assistant Professor. Department of Chemical Engineering.

U.S. MARINE CORPS
Camp Lejeune, North Carolina

1959-1962

1st Lieutenant.

Education

1959, B.S., Chemical Engineering
1963, M.S., Chemical Engineering
1966, Ph.D., Chemical Engineering

Mark A. Fleri

Project Development Manager

Experience

1988-Date

Project Development Manager. Reports to Vice President, with responsibility for design, installation, startup, and troubleshooting of mobile hazardous waste incinerator. Develops large-scale remediation projects. Activities include conceptual design, estimating, proposal preparation and presentation. Has managed more than forty projects, including incineration, waste stabilization, NPDES/SID permits, PCB remediation, and volume reduction.

1988-1989

Project Manager. Managed Emergency Response Division, with full responsibility for on-scene coordination, establishment of communication with and between federal and state agencies, supervision of site personnel, and monitoring disposal activities.

1987-1988

Project Engineer/Laboratory Manager. Responsible for daily operations of hazardous waste laboratory. Duties included operation of gas chromatograph/mass spectrophotometer unit, gas chromatograph, and other laboratory instruments. Managed and supervised equipment and supply procurement, laboratory analysis, and quality control program. Other duties included variety of wet chemistry methods in *Standard Methods for Water and Wastewater*, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846), and *American Society for Testing and Materials* (ASTM) standards.

1986-1987

Part-Time Lab Technician. Responsible for operation of variety of laboratory instruments, including GC/MS system, GC, Atomic Absorption unit, Total Organic Carbon analyzer, pH/ISE meter, and spectrophotometer. Daily activities included preparation of standards, duplicates and spikes; preparation of reports; and guidance of other laboratory personnel.

Project Experience

Technician. PCB sampling of a vacant lot with abandoned capacitors for an international construction firm. Duties included site layout, sampling scheme, analysis of samples, chain-of-custody, quality assurance, quality control, and transportation of samples. Approximately two hundred samples were collected and analyzed by EPA Method 608 (40 CFR 136, Appendix A). The analytical results were used to design a remediation plan for this client.

Technician. Developed method to sample flare gas for a major chemical plant. The methodology involved the use of three impingers filled with varying amounts of methanol. The methanol was used to trap isopropanol, neopentyl glycol, ethylene glycol and epichlorohydrin. The analysis was performed by GC/MS.

Health and Safety Officer. Duties included site safety audits and personnel safety guidance for a U.S. Military Base. The job involved the demolition of a metal plating shop which included such hazards and cyanide, asbestos and heavy metals.

Project Manager. Job duties included the inventorying of 700 lab chemicals, the lab packing of more than 400 chemicals, the identification of 40 unknown chemicals by HazCat procedures, and the detonation of more than 100 pounds of reactive chemicals at a U.S. Military Installation.

Project Manager. A study was performed for a large tire manufacturer to give detailed information on the dissolved oxygen content and sludge depth of an industrial wastewater settling basin.

Project Manager. Job entailed the tracing of the phosphitizing and stripping processes to determine the causes of the high phosphate and pH excursions for a large athletic equipment manufacturer.

Project Manager. A study was conducted for a large wood processing facility to determine the causes of the phenolic excursions at the wastewater treatment facility. The study showed a process change would correct the phenol problem.

Project Manager. The job entailed the development of mercury decontamination procedures and development of a sampling/analytical protocol; the job also involved the application of these procedures and protocol. Asbestos abatement was also involved in the mercury decontamination.

Incinerator Design. Designed an incinerator to meet TSCA/RCRA standards. The design also included an economic feasibility study.

Job Superintendent. Supervised the in-ground cleaning of a deactivated 15,000-gallon oil tank for a large tire manufacturer.

Technician. Sampled and analyzed several hundred inactive transformers for PCBs at a U.S. Military Installation. Sampling was performed in accordance with ASTM Method D923-86 and the PCB analysis was performed in accordance with 40 CFR 136, Appendix A (Method 608).

Technician. Purged and sampled groundwater monitoring wells for permit compliance for miscellaneous groundwater division work.

Project Manager. A study was conducted for a large clothing service to determine the causes of its pH excursion. The wash process was traced and documented to determine the varying pH values during different wash cycles.

Project Engineer. A chemical spill involving the release of several thousand gallons of nonylphenol polyethylene glycol ether occurred at a major chemical manufacturing plant. The job involved the collection of raw material; the cleaning of the containment system; the collection of 100,000 gallons of contaminated groundwater; and the later release of the water into a municipal sewer system, and the supervising of the support laboratory.

M. Allen Tucker, Jr., P.E.
Manager, Thermal Treatment

Summary of Qualifications

Responsible for design and/or management of engineering projects in the areas of Incineration, Hazardous Waste, Asbestos, Plumbing and HVAC. Many of these projects involved aspects of other disciplines, such as Civil, Structural, Architectural and Electrical. Scope of these projects included collection of field data, design, and engineering inspection of work.

Representative Project Experience

Project Manager for the redesign of a $4 million transportable incineration system used to decontaminate solvent-contaminated soils at a Superfund site. The 82 million Btu/hour system incorporated the country's first application of an oxy-fuel burner system in a transportable incinerator. The unit processed soil at 20 tons per hour and met the 99.99% DRE and stringent 0.015 gr/dscf particulate emission limits.

Project Manager for the design and construction of a 15 ton/hour mobile thermal processing unit used to decontaminate soils at various locations.

Project Manager for the design and construction of a 25 ton/hour mobile thermal processing unit for hazardous and non-hazardous waste processing.

Project Manager for a 400-ton industrial chilled water HVAC system for the paper finishing area of a paper mill. Design included temperature and humidity control for the paper finishing process and architectural alterations to adapt the area for air conditioning.

Project Manager on numerous projects of a three-year open-end contract at Fort Benning, Georgia. Projects included replacement of HVAC systems in buildings, replacement of a commissary refrigeration system, energy conservation measures at Martin Army Hospital, construction of recreational cottages, etc.

Project Manager for additions/renovations of a public high school and elementary school (HVAC and plumbing only).

Project Manager for a cooling water system study for the basic oxygen furnaces at a steel mill. Made recommendations to extend the service life of water cooled panels subjected to direct furnace off-gas.

Project Engineer for the HVAC, plumbing, cost estimating, and fire protection design for a new hazardous waste storage facility for the U.S. Navy. Building included specialized warehouse spaces, office and laboratory spaces.

Project Engineer for the HVAC, plumbing, cost estimating and fire project design for a $1.1 million maintenance facility for the Army Corps of Engineers.

Project Engineer for the mechanical design of an industrial wastewater treatment system for a copper tubing manufacturer involving a new treatment building, pumps, piping, cooling tower, etc.

Education

1982, B.S., Agricultural Engineering
1983, B.S., Mechanical Engineering

Certifications

Registered Professional Engineer, Alabama
No. 17611

Industry-Related Training

Supervision of Asbestos Abatement Projects, August 1985, Georgia Institute of Technology

Air Conditioning—Physical Processes and Load Calculations, September 1985, University of Wisconsin

Industrial Ventilation Conference, 1988, University of Alabama

Hazardous Waste Incineration, February 1989, Lamar University

Mark J. Johnson, P.G.

Manager, Groundwater Services

Experience

Mr. Johnson designs, implements and supervises sampling programs for sites which may have been adversely affected by hazardous wastes. He helps conduct groundwater investigations via computer modeling in order to determine hydrogeologic parameters and potential contaminant migration. He has also helped design groundwater remediation programs which are the most cost efficient and effective for specific sites. Specific projects include:

- **Project Geologist** for a preliminary site investigation of 27 potential CERCLA sites at Marshall Space Flight Center (MSFC). Duties included setting up and sampling 27 potential CERCLA sites at MSFC, technical writing, coordinating and overseeing drilling operations.
- **Project Geologist** for an emergency response of 1,1,1-trichloroethane (TCA) spill. Acted as on-site coordinator of drilling and monitoring well installation, setup and operation of pump and treat system (PAT); responsible for technical report writing. Sampled wells and analyzed data using computer-generated graphics.
- **Project Manager** for an assessment of several Chevron USA stations to determine potential hydrocarbon contamination of the soil and groundwater. Duties included job estimates, coordinating drilling operations, overseeing site operations, initial screening of samples with Hnu meter, technical report writing, and data analysis.
- **Project Geologist.** Performed well sampling, supervised drilling and installation of monitoring and test wells. Assisted in the computer analysis of pump test data. Helped design and build pilot scale carbon adsorption system for treatability of groundwater contaminated with phenolic compounds. Determined carbon contact times, isotherms and breakthrough points during operation of pilot scale adsorption system.
- **Project Manager.** Responsible for the estimates, site assessments, data analysis and technical writing for several Maxwell Air Force Base, Montgomery, Alabama sites which may have potential hydrocarbon contamination. These sites ranged from underground storage tanks to aviation refueling areas, and included soil and water sampling. Has also sampled soil and transformers for PCB contamination.
- **Geologist** responsible for Phase I and Phase II assessments to determine horizontal and vertical extent of woodtreating contaminants for a RCRA timber company. Duties included supervision and installation of piezometer and monitoring wells, point-of-compliance wells, well sampling, technical writing, and data analysis. Responsible for designing and implementing sampling and assessment plan. Wrote post-closure permit for RCRA waste impoundments.
- **Geologist.** Assisted in gridding and sampling PCB-contaminated soils for the Marine Corps Logistics Base, Albany, Georgia.
- **Project Geologist.** Responsible for setting up and implementing monitoring plan for lower aquifer for the Pleasure Island Sewer Service, Orange Beach, Alabama, in order to increase pumping rate of treated water to spray fields. Wrote technical paper to permit Pleasure Island Sewer Service to eliminate insignificant analytical parameters which were previously required by wastewater permit.

Education

1982, B.S., Geology
1988, M.S., Geology

Industry-Related Training

1988, 40-Hour Hazardous Materials Handling and Response

1988, Asbestos Worker Training Program, National Asbestos Council

Professional Affiliations

Alabama Academy of Science
Geological Society of America

Nathan D. Heinrich, P.G.

Groundwater Division Manager

Summary of Qualifications —

General job duties include supervision of eight employees and ongoing work at over 60 sites, with annual gross revenues of $11,000,000. Projects include preparation and implementation of work plans for preliminary groundwater assessments, corrective action plans, and site assessments; preparation of post-closure permit applications; interpretation of hydrologic and geologic data; groundwater modeling; and preparation of reports for submittal to state and federal agencies.

Related Project Experience —

- **Project Geologist.** Jointly conducted site investigations of 27 potential CERCLA sites on site in north Alabama. Investigations included over 1,150 locations sampled for potential hazardous waste, including solvents, fuels, heavy metals, PCBs, and cyanide. Supervised and conducted geophysics surveys (conductivity and magnetics) on three sites. Contract required coordination with NASA engineering and security.

  Project Manager. Conducted environmental assessments of closed and open gasoline stations. Responsibilities included subcontracting drilling services and cost estimates. Supervised borings along tank excavation to determine hydrocarbon contamination and installed monitoring wells when contamination extended to groundwater.
- **Project Geologist.** Responsible for the preliminary groundwater assessment. Prepared RFP for installation of wells. Assisted with installation of four wells with two nested piezometers each at a wood treatment facility.
- **Project Manager.** Responsible for preliminary groundwater assessment at former hot-dip galvanizing operation. Supervised soil borings and installation of monitoring wells. Prepared preliminary assessment report for submittal to Alabama Department of Environmental Management (ADEM). Prepared revised assessment plan to define soil and groundwater contamination plumes.
- **Project Manager.** Conducted groundwater assessment outlining contaminant plume at gasoline service station. Implemented free product recovery system which recovered approximately 900 gallons of product. Prepared, submitted, and implmented a corrective action plan and state indirect discharge permit for recovery of dissolved hydrocarbon product.
- **Project Geologist.** Conducted on-site work, including monitoring well installation, at site with volatile organic contaminants. Prepared detailed hydrogeologic study which identified inhomogeneities in the aquifer which affected groundwater flow. Ran computer models to identify locations of recovery wells.
- **Project Manager.** Coordinated and conducted environmental audits for various property transfer sites including: a former cotton mill in Alabama; a commercial/residential area in Florida; a former box plant; a car dealership; a former DOT site; and a former bottling plant in St. Croix, U.S. Virgin Islands. Audits focused on both soil/groundwater contamination and asbestos problems.
- **Project Geologist.** Prepared and submitted post-closure plan for wastewater treatment facility with PCB and cyanide contamination.
- **Project Geologist.** Prepared revision of post-closure permit for wood treating facility with creosote and pentachlorophenol contamination. Also prepared annual groundwater monitoring review for the facility.
- **Project Geologist.** Groundwater assessment for a confidential client. Conducted soil borings to define the extent of contamination in the upper aquifer. Contracted drillers and purchased supplies for installation of three compliance wells in two aquifers and five pump test wells.
- **Project Geologist.** Groundwater corrective action program for a confidential client. Responsible for writing CAP for submittal to ADEM. CAP included groundwater monitoring plan.
- **Project Manager.** PCB sampling at Gunter Air Force Base. Prepared estimates and coordinated sampling of transformers and soil. Responsible for client contact and reporting of analytical results.
- **Materials Coordinator.** Emergency groundwater remediation for a large manufacturing corporation. Responsible for obtaining equipment and materials for remediation system. Contacted local and national vendors for supplies.
- **Project Geologist.** Modification of lagoons and wastewater treatment system for a tubing manufacturer. Supervised installation of three pump wells for use in chromium reduction treatment plant. Conducted well development prior to completion of the treatment system. Prepared groundwater monitoring/effectiveness testing plans for treatment plant.
- **Project Geologist.** Post-closure permit application for NASA. Prepared closure/post-closure permit application for closure in-place of cyanide-contaminated lagoons. Compiled existing data and prepared groundwater monitoring plans.
- **Project Director.** Supervised project managers on over 30 projects conducted under open-end sampling and analysis blank Purchase Agreement for Maxwell Air Force Base, Alabama.
- **Project Director.** Supervised project managers and engineers during preparation of corrective action plans for four UST sites. Plans specified air strippers or diffused air tanks.

Education —

- B.S., Geology, 1981
- M.S., Geology, 1987

Industry-Related Training —

- AHERA Accreditation for Inspectors and Management Planners
- EPA Seminar, "Groundwater Monitoring at Hazardous Waste Sites"
- HES, "Hazardous Materials Handling and Response"
- AEG Short Course, "Geology and Site Characteristics of Hazardous Waste Sites"
- NWWA Short Course "Theory and Application of Vadose Zone Monitoring Techniques"

Professional Affiliations

- Geological Society of America
- NWWA

RÉSUMÉ

Name:	DENNIS R. MOBLEY, P.E.
Title:	PROJECT ENGINEER
Assignment:	CIVIL ENGINEERING
Name of Firm:	BENCHMARK ENGINEERING INC.
Education:	B.S. / 1975 / CIVIL ENGINEERING UNIVERSITY OF ALABAMA M.S. / 1993 / ENGINEERING
Years Experience:	WITH THIS FIRM (1) WITH OTHER FIRMS ( )
Active Registration:	REGISTERED PROFESSIONAL ENGINEER; ALABAMA

Mr. Mobley has a broad base of civil engineering experience and expertise. Prior to joining Benchmark, he worked for a major Southern utility holding company and a major international construction firm. His project assignments have included: Hydro Engineer on dam-related projects; various structural and design-related duties on a variety of projects; and environmental engineering.

Specific Project Experience Includes—

Project Engineer—Manufactured Gas Plant Investigation, Americus, Georgia. Scope of work for this project included review of the previously completed environmental site assessment for adequacy and completeness. These data were then used to develop a work plan and sampling and analysis management plan (SAMP) for a more detailed site investigation to determine more precisely the contaminants present at the site, level of contamination, and horizontal and vertical extent of the contamination. The information was also used evaluate possible remedial alternatives.

Project Engineer—SoGreen Site Remediation, Tifton, Georgia. This PRP-funded cleanup action involves the stabilization of approximately 56,000 cubic yards of electric arc furnace (EAF) dust which is contaminated with lead, nickel, chromium, cadmium, and arsenic. The selected remedial alternative included stabilization of the hazardous waste with Portland cement, subsequent delisting of the material, and disposal in a RCRA Subtitle "D" landfill. Mr. Mobley's efforts on the project included authoring of the Sampling Analysis and Quality Assurance Plan which detailed all of the QA/QC protocols for material stabilization. He also prepared the Mobilization/Demobilization, Utility Installation , and Sampling Handling and Documentation portions of the Remedial plan.

Project Engineer—UST Program Management and Implementation, North Alabama UST site. The scope of work for this project included the completion of Secondary Investigation activities. Mr. Mobley's duties included securing right-of-way for required monitoring wells, surveying of existing wells, supervision of monitor well installation, completion of boring logs, and collection of soil and groundwater samples. Collected samples were properly preserved in the field and prepared for shipment to the laboratory under strict chain of custody. Mr. Mobley reviewed data and prepared a complete report to the Alabama Department of Environmental Management (ADEM).

Structural Engineer—Advanced Solid Rocket Motor Project, Yellow Creek, Mississippi. Mr. Mobley completed the design of concrete rocket support mats for the main rocket test building. The MATS three-dimensional computer-aided drafting program was used to complete the design. Additional duties on this project included design of the main crane girder and crane column for the Auxiliary Building. He reevaluated the existing steel structure for its ability to support additional weight without the benefit of having the original calculations.

Structural Engineer—Gulf States Steel, Demopolis, Alabama. Mr. Mobley was responsible for completion of the structural calculations for construction of a three-story ClO_2 building and a two-story chiller building on this project. Design efforts included concrete and steel design using the STAAD 3 three-dimensional computer-aided drafting program. Mr. Mobley also supervised drafting of the construction drawings for the project.

Structural Engineer—Shell Oil, New Orleans, Louisiana. Mr. Mobley was responsible for completing design of pipe supports for a major renovation project. The renovation incorporated fiberglass pipe with special requirements. Site conditions precluded standardization of design. Shutdown forces, low soil strength, and tank settling were all factors which increased the difficulty of the design.

Hydro Engineer—Rocky Mountain Pumped Storage, Rome, Georgia. Mr. Mobley conceptualized and designed an innovative auxiliary spillway system for the lower reservoir at this facility. The client's initial conceptual design called for two spillways, one 250-foot-long concrete ogee and one 350-foot concrete ogee with a total cost of $6,000,000-$8,000,000. Mr. Mobley's alternative design reduced the overall project cost by approximately $2,000,000.

Project Manager—Alabama Power Hydroelectric Dam's Stability Analysis, State of Alabama. Mr. Mobley was responsible for scope, budget, manpower training, and drafting supervision for reanalysis of nine Alabama Power Dams. The purpose of the project was to incorporate new flood level requirements and replace lost stability analysis for normal and earthquake conditions. Twelve engineers and eight draftspersons were trained to complete the analysis. During the project, all existing drawings were converted to CAD. The project schedule provided for the completion of a separate report for each site with deadlines for reports spaced at one month intervals. All phases of the project were completed on time and within budget.

Senior Hydro Engineer—Hope Hydroelectric Project, Hope, Arkansas. Mr. Mobley completed the layout design and wrote the technical specifications for intake structure tailrace and one-mile-long tailrace canal as part of a Phase I feasibility study. His efforts included calculation of water flow velocity and water volume required to ensure correct hydraulic operation at the turbine. The work product was accepted for Phase II without comment by the U.S. Army Corps of Engineer.

Senior Hydro Engineer—Mitchell Dam Redevelopment. Project involved the addition of three units to an existing dam and hydroelectric generation facility. The additions required additional spillway capacity and modifications to the powerhouse and upstream and downstream retaining walls. Coffer cells were designed for the stage construction project. Mr. Mobley completed the hydraulic design of the D/S tailtrace.

Hydro Engineer—Crist Steam Plant. Mr. Mobley was responsible for design and preparation of the technical specifications for the installation of 2500 feet of 24 inch diameter drainage pipe at a staged dual location (fly and bottom ash) landfill site. Design required separation ditches segregate contaminated water from natural runoff. Inflow and outflow hydrographs for the site were calculated to aid in the design. The design was reviewed by Florida Department of Environmental Regulation (FDER) to ensure environmental compliance.

Hydro Engineer—R.L. Harris Hydroelectric Project. Mr. Mobley was responsible for plant layout and design of the concrete spillway, nonoverflow walls, intake structure, powerhouse, and downstream retaining walls. The project included considerations for the stability of each structure for construction, under normal operating conditions, earthquake conditions, and maximum flood conditions. The total length of the dam was 650 feet with a 150-foot height. Designed 70-foot-diameter upstream and 35-foot-diameter downstream coffer cells required for the two-stage construction at the site. Mr. Mobley supervised the drafting of all stability analyses and conceptual design drawings.

Hydro Engineer—Walter Bouldin Dam Redesign. Mr. Mobley was responsible for design of the intake structure required for an enlarged dam. Overall size of the structure was 260 by 200 feet. The trash rack were redesigned and flownets for sloping multimedia soils were required. Condition analysis included requirements for construction, normal operating, earthquake, and maximum flood.

APPENDIX O

RESPONSES TO USEPA REGION X

WILLIAMS ENVIRONMENTAL SERVICES, INC.

October 15, 1993

Ms. Lynda Priddy
Hazardous Waste Coordinator
U.S. Environmental Protection Agency Region X
1200 Sixth Avenue
Seattle, Washington 98101

Subject: Transmittal of Responses to USEPA Region X
July 20, 1993, Comment Letter on the
Draft Soil Treatment Work Plan
for the Woods Industries Site, Yakima, Washington

Dear Ms. Priddy:

In response to U.S. Environmental Protection Agency (USEPA) Region X's July 20, 1993, comments on the Draft Soil Treatment Work Plan, dated June18, 1993, Burlington Northern Railroad (BNRR), through Williams Environmental (Williams) and Burlington Environmental Inc. (BurlingtonEnvironmental), has prepared this letter and is in the process of revising the Draft Soil Treatment Work Plan.

On August 27, 1993 Cathy Massimino and Bob Kievit of EPA Region X visited the THAN site. A meeting was held on the same day between Mark Fieri, Brett Burgess, Z.L. Taylor (Williams Environmental Services), Bruce Sheppard (Burlington Northern Railroad) and Bob Kievit, Cathy Massimino and John Gilbert (EPA). The following comments and responses are the result of this meeting and later conversation with all parties.

RESPONSES TO USEPA REGION X COMMENTS

Comment No. 1

The work plan needs to include an ambient air monitoring program. Sample locations should include on-site, fence line, and downwind offsite areas predicted to contain maximum concentration of contaminants from the stack. The sampling program should include both time-integrated and real-time monitoring. The sampling program should specify equipment to be used, sampling and analytical procedures, the name(s) of the laboratory(s) conducting the analytical work, action levels,and QA/QC procedures. The plan should be comprehensive to start out and allow for scaling back upon demonstration of acceptable results.

2075 West Park Place Stone Mountain, Georgia 30087 404/498-2020

Response No. 1

A comprehensive air monitoring program prepared by Williams will be included as an appendix to the "Final" Soil Performance Test Work Plan and in the Health and Safety Plan. A "scaled back" monitoring program will be prepared upon demonstration of acceptable results. This "scaled back" version is expected to be implemented after the performance test with the EPA's approval. This will monitor a select number of indicator chemicals based upon previous monitoring results.

The air monitoring program will use sample locations derived from air modeling predicted to contain the maximum concentrations of contaminants resulting from the stack and fugitive dust generated from material handling and will monitor site-related contaminants of concern on a time-integrated and Real-Time basis. Action levels, sampling and analytical procedures, equipment specifications, and QA/QC procedures will also be described.

Identification of the laboratory conducting the analytical procedures will be submitted to the EPA as soon as the appropriate laboratory is selected.

Comment No. 2

A risk assessment needs to be performed based on predicted air emissions and the air modeling currently being conducted. This risk assessment should be updated with the results from the performance test and be included in the performance test report.

Response No. 2

A site specific Air Quality Impact Report is being performed based on predicted air emissions during normal operation and interim operation. This Air Quality Impact Report addresses the compounds listed on page 28 of the draft plan and the risk assessment will be updated if necessary with results from the performance test. Dioxins and furans are not a part of the Air Quality Impact Report, however, as requested by the EPA, dioxins and furans will be tested for in the off gases during the performance test. HCl, Cl and potential organic breakdown or reformation compounds will be addressed in the Air Quality Impact Report.

Comment No. 3

Please note that based on the current schedule the system should expect to operate in conditions beginning in dry 100°F heat and possibly ending in snowy conditions or subzero temperatures.

Response No. 3

Williams anticipates few problems as a result of weather conditions. Williams thermal unit is currently operating at the THAN site with temperatures exceeding 110°F. During cold weather, Williams will take necessary measures to assure that the thermal desorption unit is properly outfitted and winterized.

Comment No. 4

The work plan should discuss any anticipated impact on the surrounding community with respect to noise and odor.

Response No. 4

Regarding odor, Burlington Environmental and Williams do not expect odors above that which existed during soil excavation.

It has been determined through noise level dosimetry that the loudest recorded noise levels were the material handling equipment at the THAN site. The nearest residents located to the THAN property are located approximately one-quarter mile from the site and no complaints have been received about the thermal desorption unit operating twenty-four hours per day. The Woods site is located in an industrial area with the nearest residential area located approximately one-quarter of a mile away from the site.

Comment No. 5

The consent order between EPA and BN is an important document that should be included as an appendix to the final work plan.

Response No. 5

The consent order will be included as an appendix.

Comment No. 6

Section 2.1 The draft plan states that demobilization will proceed after the stockpiled soils have been treated and lab confirmation received that the treated soils meet the cleanup criteria. Please note that the existing stockpiles are situated over areas of contaminated soils that need to be excavated and treated after the piles are removed. Confirmational soil samples will need to be taken in the excavated areas to assure that all soils above cleanup levels are removed. In addition, soil samples will need to be taken in the areas used for treatment, stockpiling of soils, and along soil

hauling routes to assure that clean areas weren't contaminated during the treatment process. The schedule should allow for these activities.

Response No. 6

The soil treatment schedule will allow sufficient time for the necessary soil removal and sampling to occur prior to demobilization. Burlington Environmental will collect the necessary samples in accordance with protocol described in the soil removal work plan. Samples will be collected beneath existing stockpiles and areas where contaminated soils were transported over, stockpiled, or treated.

Comment No. 7

Section 2.2 The responsibilities of BEI should be discussed. The relationship between BEI and Williams needs to be clarified and discussed. The relationship between BEI and the Thermal Treatment Consultant needs to be clarified. This section needs to describe the role and authority of the EPA OSC. Will Williams personnel be responsible for transferring treated soils and oversized cobbles, for excavating contaminated soils from underneath the existing north and south stockpiles, for final site grading. This section should indicate who is responsible for sampling of treated soils, of contaminated soils underneath the existing stockpiles both during and after excavation, of final site sampling just prior to demobilization, and ambient air monitoring. How many shifts will be used? The plan should discuss transition procedures used in changing shifts.

The plan needs to state the name(s) of the laboratory(s) conducting analytical work prior to and during the performance test and during regular operations. The plan should also include detailed information on detection level, lab procedures, and lab QA/QC procedures. Who will subcontract with the labs?

Response No. 7

In reference to Section 2.2, responsibilities will be clarified and incorporated into the "final draft". Responsibilities of Burlington Environmental and Williams will be similar to that of Burlington Environmental and Olympus for soil removal activities. Burlington Environmental will provide oversight and Williams will be the Contractor. Burlington Environmental will have an on-site coordinator. Burlington Environmental will be responsible for weekly reports, reporting to the EPA and the Final Report. Burlington Environmental will also be responsible for emergency reporting. The Thermal Treatment Consultant, independent consultant, will be used for technical guidance and support during the performance test activities and will be subcontracted under Williams. Williams will be responsible for all material handling associated with soil treatment which includes excavating beneath existing stockpiles, backfilling and final site grading. Sampling of treated soils will be the responsibility of Williams and ambient air monitoring will be the responsibility of Burlington Environmental.

Sampling excavations beneath stockpiles and haul roads prior to demobilization will be the responsibility of Burlington Environmental.

Regarding work, Williams will most likely use three shifts. In some instances, shifts are dependent upon weather conditions. Williams will delineate shift transition procedures in the "final draft". Williams will supply its own qualified operators. However, Williams does use local labor from time to time.

Regarding laboratory selection and analytical procedures, Williams will provide this information as soon as it is available.

Comment No .8

Section 3.2 - In general more details are needed regarding soil handling and disposition of cobbles and debris mixed in with soils - i.e. metalbands, pipes, etc. This section says that material over approximately 3 to 4 inches will be considered oversized. What are the factors needed to determine whether it is 3 or 4 inches or something in between. EPA requests that the larger material be treated if the system can physically handle it - i.e. we prefer that 4 inches be the cut off as opposed to 3 inches.

When will oversized cobbles be crushed and analyzed? What procedures will be used to collect, crush and analyzed the cobble samples? How many samples will be taken? Add lead, arsenic, and mercury to the list of analytes for the crushed cobbles. The analytical results from the crushed cobbles should be compared to the treatment goals not the cleanup levels. Assuming that the results will be below the treatment goals, the section should describe how the cobbles will be handled from the screen to final disposition. Will soils from the existing stockpiles be taken directly to the treatment unit or will a secondary stockpile be placed closer to the treatment unit?

Response No. 8

Burlington Environmental is preparing a plan which describes the objectives and methods for characterizing oversized material. Thermal desorption requires a significant amount of material handling. A cutoff size will be established through experience in handling the on-site soils to determine which material will be screened out. Through experience at other sites Williams believes the cutoff size will be 3 inches or less. Through observations made during soil removal activities conducted at the site, BNRR and the USEPA are aware that the soil excavated and placed in the temporary soil storage piles contain approximately 35 to 45 percent "oversized material." This oversized material will not be treated by the thermal desorption process because it cannot be handled via the material handling equipment involved with the thermal desorption process.

As discussed in the Draft Feasibility Study, it is believed that contaminants adhere preferentially to finer particles (silts, clays and humic materials) and contamination of larger materials is related to the adhesion of finer particles to the exterior of larger ones. Observations made during soil removal activities at the site revealed that the exterior of the larger materials are relatively free of finer materials adhering to their surface.

To evaluate the disposition of the oversized material, BNRR proposes collecting and compositing material into a batch which will be screened to form samples of 2.0"+ and 3.0"+ material representing potential "cutoff sizes." These samples of potentially oversized material will be crushed and analyzed for several indicator chemicals.

The results of these analyses will be compared to the treatment goals established for the soils exiting the thermal desorption process which will be used as backfill on site. BNRR understands that oversized material which is below the treatment goals will be suitable to be used as backfill without additional treatment. Additional details will be included in the "final draft" of the work plan.

Debris will be handled similarly as in building demolition and soil removal. Contaminated debris will be disposed of at Chemical Waste Management's Arlington, Oregon, facility. Clean debris will be disposed of at a local sanitary landfill.

Williams anticipates hauling soils directly from the stockpiles to the treatment unit. Necessary precautions will be taken in the event that a "secondary stockpile" is needed.

In the event a secondary stockpile is required (because of increased production rates) control measures such as containment and additional covering of the piles will be added. Engineering controls will be used to prevent fugitive dust emissions where applicable, such as haul roads from stockpiles.

Comment No. 9

Section 3.3 - More details are needed regarding the transfer of baghouse dust to the treated soil pile, the dust control procedures used in the transfer, whether the discharge of baghouse dust is continuous or batch,

and the kind of mixing that occurs between treated soils and baghouse dust. Is the baghouse dust conveyor covered? Discuss dust control during the treated soil stacking. Where will the stacks be located? How long will they be stored?

Discuss backfilling procedures.

Discuss final site grading.

Are there any conditions under which hot gases from the dryer come in contact with the burner?

Response No. 9

The baghouse dust emissions are well controlled prior to mixing with the treated soils. These control measures include negative pressure on the cross over conveyor, transfer auger conveyor and discharge auger conveyor. The baghouse dust is mixed with the treated soils and is moisturized prior to being transferred to the stacking conveyor to prevent fugitive dust. Additional information will be provided in the "final draft". Both Bob Kievit and Cathy Massimino have seen the baghouse transfer auger and control system.

Backfilling procedures and final site grading will be incorporated in the "final draft". Treated soil will be used as backfill on-site. It is expected that final site conditions will be level in most areas and possibly slightly sloped in others. Details will be supplied in the soil treatment work plan.

Williams' unit has been designed to ensure that the burner does not come into contact with hot gases from the rotary dryer.

Comment No. 10

Section 3.4 - This section should discuss locations in the treatment train where hot gases from the dryer can bypass any portions of the air emissions treatment train and the conditions required for such a release. This discussion should include past performance history. How is the acidity of the gases from the dryer monitored?

How is the dissolved solids in the recirculating quench water monitored?

The activated carbon should be periodically sampled to assess the possibility to organic break through. The work plan proposes to re-heat the gas steam to about 150°F to prevent condensation in the carbon beds. According to the Calgon information in the Appendix, 150°F is the

maximum temperature for these systems. Also, it is generally accepted that the carbon efficiency decreases with increasing gas temperatures. Thus, there is a concem the carbon treatment will not be satisfactory for both the pesticides and total hydrocarbons. Lower gas temperatures to the carbon system would relieve this concem. Also see later comment on THC monitoring.

Response No. 10

The VO is designed such that air may only enter from the outside eliminating concerns of hot gases bypassing the air emissions treatment train. For example, the VO is triggered when the baghouse exceeds 510°F and quench gas temperature exceeds 200°F, thus allowing cool air to enter the thermal desorption unit and cool the baghouse and the remainder of the thermal treatment unit. This is done to protect equipment.

Presently the pH of the quench water is monitored manually during the normal operations of the unit. When the water becomes acidic ($pH < 4$) caustic soda (sodium hydroxide) is added to bring the pH up to approximately 8.

Solids are visually monitored in the quench and air mix chambers. Approximately 1 to 4 gpm of quench water is removed, settled, filtered and processed through activated carbon and then re-used within the thermal desorption unit.

Comment No. 11

Section 3.5 - What is the action level and detection level for effluent sampling from the liquid phase carbon adsorption unit?

The water in the filled collection tanks should be analyzed for metals as well as pesticides. What are the action levels for this water? This section indicates that this water may be used to cool and moisturize treated soils. Is any of this water anticipated to be used for dust control outside the treatment unit or for discharge to the local sewage treatment works? Can a rough mass balance be done on water generated versus water needs? Compare the estimated mass of organics to be collected in the scrubber to the design capacity of the carbon beds. This comparison should assume a worst case scenario of all organics in the air stream being removed in the scrubber system.

Response No. 11

Based upon past history, excess water is not expected from the process. Treated soils will be sampled after the addition of the treated quench water.

Williams does not expect nor intend to analyze metals if the water is to be used for dust suppression or reused as quench water in the thermal desorption unit. If Williams is to discharge treated water to the sanitary sewer system then Williams will analyze for the appropriate constituents and meet the discharge limits prior to discharge to the sewer system. Williams will prepare water mass balance calculations to be included into the "final draft" of the work plan.

Comment No. 12

Table 4-1 - The table indicates the prescreen sized opening is 2 1/2". How does this correlated to the approximately 3 to 4 inches sizing limit mentioned on page 16. The bar and mesh screen sizing are not indicated.

The table appears to indicate that the unit contains a backup I.D. fan. Is this correct?

How will the material be collected in the liquid bag filters be disposed?

Response No. 12

Williams' material handling systems are equipped with several screen sizes. The basis of final selection of screen size is described in response to Comment NO. 8.

There is no backup ID fan.

The liquid bag filters will be cleaned of solid material and re-used throughout the project. The final disposition of the bag filters will be with the used personal protection equipment and contaminated debris at Chemical Waste Management's Arlington, Oregon, facility.

Comment No. 13

Section 5.0 - Prior to running contaminated soils in the treatment unit during startup, uncontaminated soils from the site should first be run through the unit to assure that the unit is operating properly from a particulate control stand point (both stack emissions and fugitive dust).

OSC approval will be needed prior to running contaminated soils through the system.

The work plan should discuss disposition of treated soils generated during the start up period.

OSC approval will be needed to continue operating after completion of the performance test and applying any special conditions for continued operation.

Response No. 13

Williams anticipates to begin startup operations with clean soils. After a thorough shakedown of the unit including its control systems and demonstration of the proposed AWFSOs, the unit will begin production with the contaminated soils including pesticide contaminated soils in the roll-off boxes to ready the unit and crew for the upcoming performance test.

Soil will be treated in the same manner as soil from production operations. Williams recognizes that treating contaminated soils for both the performance test and normal operations will not commence without approval from the EPA's OSC.

Comment No. 14

Section 6.1 - Figure 6 was not included in the draft work plan.

The stated purpose of the vent opening is to allow ambient air to enter the treatment unit. Can hot gases from the dryer exist through this vent? If so, under what conditions and how often are those conditions met based on past performance of this unit?

This section should discuss the procedures used to return the unit to normal operating conditions after triggering the emergency control system. How often do events occur that will trigger VO and AWFSO based on past performance.

Response No. 14

Figure 6 will be included in the "final draft" of the work plan.

The VO was discussed in Response No. 10.

VO occurrences are not recorded due to the fact that they pose no threat of releasing air emissions.

Most AWFSO's do not result in upsets of the thermal process. The AWFSO's normally result in a "no feed" condition, once the AWFSO is terminated the feed is restored with no affect to the process. The operations manual, which will be part of the "final draft" of the work plan, includes startup and shutdown procedures.

Comment No. 15

Table 6-1 - Opacity and real time air monitoring should be added to this list.

The table indicates the operating set point for the mix chamber outlet is 130°F; however, page 18 indicates that this temperature is 140°F. The table indicates the operating set point for the quench camber outlet is 165°F; however, page 26 indicates that the set point is 130°F. This table indicates the typical range of total hydrocarbons in the stack is 20 to 75 ppm with a not to exceed value of 200 ppm. These values are high and are of concern to EPA. We need more information on the composition of these hydrocarbons.

Periodic monitoring of the stack gases should be conducted for pesticides and mercury.

Response No. 15

The discrepancies concerning the mix chamber and quench chamber no longer apply since the unit is configured with a thermal oxidizer.

Williams has provided real time stack gas monitoring with its' CEM system. The present CEM system has the capability of monitoring THC and CO. Opacity can be added to the capabilities of Williams' CEM unit. The type and specifications of the CEM will be included in the "final draft" of the work plan.

Williams' thermal desorption unit is not a BIF, therefore THC is not proposed as a parameter to be measured.

Real time air monitoring can be incorporated into the air monitoring plan as discussed in response to Comment No. 1.

Periodic monitoring of the stack gases is no longer applicable. The performance test will determine the efficiencies achieved by the thermal oxidizer.

Comment No. 16

Table 6.2 - This table indicates that the loss of the draft fan will trigger the vent opening. How does VO compensate for loss of the draft fan?

Response No. 16

A vent opening does not occur when the I.D. fan drops out.

Comment No. 17

Section 6.1.3 - This section mentions auxiliary fuel to the rotary dryer burner. Does the burner have more than one source of fuel?

Response No. 17

The auxiliary fuel mentioned in Section 6.1.3 is the same as primary fuel, which is propane.

Comment No. 18

Section 6.1.6 - This section says that a high THC concentration in the stack is an indication of carbon break through. These measurement should be supplemented by periodic sample and analysis of the carbon. How is the THC concentration in the stack monitored?

Response No. 18

This comment no longer applies.

Comment No. 19

Section 6.1.7 - This section says that interruption of water flow to the quench chamber will trigger certain events including shutting down the ID fan. Where will the hot gases go if the ID fan is shut down.

Response No. 19

The interruption of water flow to the quench chamber will result in a vent opening and an AWFSO and not a shut down of the I.D. fan.

When the I.D. fan shuts down, both burners cease operation and the feed is cut off. The fans wind down at approximately the same rate. From past experience, steam from the primary will escape from the unit until the I.D. fan is restored.

Comment No. 20

How does Section 6.1.7 relate to Section 6.1.8?

Response No. 20

Section 6.1.7 describes the procedures taken when an alarm condition is satisfied. Section 6.1.8 describes procedures taken to prevent the alarm condition described in Section 6.1.7.

Comment No. 21

Section 6.1.9 - What is the established limit for pressure differential across the liquid phase carbon bed? If the liquid carbon system is shutdown for cleaning, what is the effect on the overall treatment system?

Response No. 21

Maximum design differential pressure for the aqueous phase carbon bed is 12 p.s.i. The aqueous treatment unit is designed to include two carbon beds in parallel to prevent the shutdown of the overall treatment system during backflow operations to clean an individual carbon unit.

Comment No. 22

Section 6.1.14 - What effects will occur if the combustion air fan fails? How is operation of the fan monitored?

This section should describe the orderly shut down of the system in the event of a power failure.

Response No. 22

In the event that the combustion fan fails a AWFSO will result.

All motors are monitored through an ammeter.

In the event of a power failure, all processes and operations terminate.

Comment No. 23

Section 7.1 - Air emissions performance standards are not addressed at all by the draft work plan.

Response No. 23

Williams plans to include applicable air emission performance standards in the "final draft" of the work plan.

Comment No. 24

Section 7.2.1 - This section indicates that although all 15 chemicals of concern will be analyzed during the performance test, only hexachlorobenzene and DDT will be analyzed during remaining operations. A decision to reduce the number of analytes should be based on the results of the performance test - i.e. all 15 chemicals should be analyzed until the results of the performance test are available. Analysis of treated soils and stack gases during the performance test should also include the full range of volatile and semi-volatile compounds including dioxins and furans. The detection levels for stackgases should be low enough to evaluate potential impact on human health.

Response No. 24

Treated soils will be analyzed for the 15 chemicals of concern listed in section 7.2.1 of the draft work plan during the performance test and until a decision has been made by BNRR and the EPA to reduce the number of parameters.

Stack gases will be analyzed for the 15 chemicals of concern except for mercury, arsenic, and lead - See Response to John Gilbert's Comment #1. And stack gases will also be analyzed for selected volatile and semi-volatile compounds including dioxins and furans during the performance test. Details will be presented in the "final draft" of the work plan.

Comment No. 25

Section 8.1 - The sampling program is not sufficient for the start of operations. One composite sample should be taken per shift consisting of one grab sample per hour. If these results show consistently good performance, then the sampling program may be scaled back.

This section should include more details concerning sample collection, compositing procedures and QA/QC requirements.

Table 8-1 was not included in the draft work plan.

Response No. 25

A more detailed sampling plan for treated soil will be included in the "final draft" of the work plan which includes sampling during the performance test. The sampling plan during production operations will require sampling of the day piles at a frequency of one (1) grab sample every six hours or eighty tons. The four

(4)grab samples will then be composited at the end of each day. It is anticipated that sampling will later be scaled back based upon good results.

Sampling procedures and QA/QC requirements will be described in the "final draft" of the work plan. Table 8-1 will be included in the "final draft" of the work plan.

Comment No. 26

Section 8.2 - Treated soil samples should be analyzed for all 15 chemicals of concern at least until the results of the performance test are available.

Response No. 26

Please refer to Response No. 24.

Comment No. 27

Section 9.0 - Please clarify the areas to be included in the exclusion zone. Does the exclusion zone contain only the rotary dryer or the entire treatment train? If only the dryer, then why? The untreated stockpile is said to be part of the exclusion zone. Does this include the existing north and south stockpiles or just a working stockpile to be established near the treatment system. Will haul roads be included in the exclusion zone? Where will the treated stockpiles be located? Figure 11-1 does not adequately define the exclusion zone.

Response No. 27

The "final draft" of the work plan shall include the boundaries of the exclusion zone. The exclusion zone will include the waste feed stockpile, the associated haul roads, and the rotary dryer and baghouse.

Comment No. 28

Section 11.1 - The boundaries of the exclusion zone are not clear.

Response No. 28

Please refer to Response No. 27.

Comment No. 29

Section 11.3.4 - The final disposition of the spent carbon needs to be discussed both liquid and gases. As the spent carbon will contain all the contamination removed from the site, EPA needs to be assured that it will be properly treated. Disposition of the carbon needs to comply with EPA's off-site policy.

Response No. 29

Aqueous phase carbon is anticipated to be regenerated by WestStates Carbon in Parker, Arizona.

Comment No. 30

Section 11.4 - The unit should be started up with clean soils. EPA approval will be needed prior to running contaminated soils through the unit.

Response No. 30

Please refer to Response No. 13.

Comment No. 31

Section 11.5 - After all stockpiled soils are treated, soil samples will need to be taken in areas used for treatment, for stockpiling and for hauling to assure that the treatment process did not cause soil contamination above the cleanup standards.

Response No. 31

Please refer to Response No. 6.

Comment No. 32

Appropriate insurance information needs to be submitted to EPA as required by Section 15.1 of the Consent Order.

Response No. 32

Insurance information will be included in the "final draft" of the work plan.

Comment No. 33

Who is responsible for weekly reporting and emergency reporting to EPA and for preparation of the final report?

Response No. 33

Burlington Environmental will be responsible for weekly reporting, emergency reporting to EPA, and will also be responsible for the preparation of the final report.

Comment No. 34

The work plan should include discussion of final site grading.

Response No. 34

Please refer to Response No. 9.

John M. Gilbert's Comments

Comment No. 1

Section 1.1, page 6 - What is the plan for testing metals in the stackgas? The introduction discusses metals in the soil, but nothing about monitoring during the demonstration burn.

Response No. 1

Mercury, arsenic and lead were present in some locations above cleanup levels.

During the RI, mercury was detected at some locations in the lagoon area above cleanup levels. The mercury will be treated by Williams' thermal desorption process. A Tier I analysis has been performed and no exceedance for mercury has been observed, therefore, mercury will not be monitored in the stack gas during the performance test. Lead and arsenic were only detected in a few locations above their respective cleanup levels across the site during the RI, and lead and arsenic impacted soils excavated during soil removal were placed in roll off boxes to be disposed of or treated by a different technology. In addition, a Tier I analysis has been performed for lead and arsenic and no exceedance has been observed. For these reasons, lead and arsenic are not on the parameter list for stack gas testing during the performance test.

Comment No. 2

Section 3.2, page 16 - Any oversized material that is not debris should be crushed and fed into the desorber, not considered as backfill. If this statement only pertains to debris, I have no problem with it.

Response No. 2

Please refer to Response No. 8.

Comment No. 3

Section 3.3, page 17 - The actual soil gas exit temperature will be established as a result of the demonstration burn.

Response No. 3

Williams concurs with the above comment.

Comment No. 4

Section 3.3, page 17 - Fugitive emissions can occur as a result of steam being emitted from the stacking conveyor. Williams will have to control all fugitive emissions.

Response No. 4

The necessary engineering controls (such as negative pressure in the discharge auger and the proper amount of water being added to the soil prior to being discharged) will be practiced to control fugitive dust emissions. The effects of these controls will be documented during the performance test for clean soil.

Comment No. 5

Section 6.1, page 24 - The plan needs to discuss the relation to vent openings (VO) and automatic waste feed shutoff (AWFSO).

Response No. 5

The "final draft" of the work plan will include a description of events triggering a VO and/or AWFSO.

Comment No. 6

Section 6.1, tables 6-1 & 6-2 - No discussion on a AWSFO for CO, feed rate, or quench pH.

Response No. 6

Williams proposes a 100 ppmv limit for CO based on a 60 minute rolling average. The feed rate AWFSO will be determined during the performance test. The quench pH AWFSO will be determined during the performance test.

Comment No. 7

Section 6.1.6, page 26 - The plan indicates a THC concentration greater than 200 ppm, which is too high. The desorber's THC analyzer conditions the sample prior to being analyzed. Method 25 requires an unconditioned sample.

Response No. 7

Williams will use 40 CFR Subpart O guidelines to conduct the performance test. No provisions are made to analyze for THC.

Method 25A results were compared with the conditioned sample results from the CEM during the performance test at THAN. The results were consistent enough that Region IV EPA allowed the use of the cold FID analyzer used in the CEM system for the remainder of the project.

Comment No. 8

Section 6.1.9, page 26 - What is the limit for the pressure differential? How will the pressure differential be equated to changing out the carbon?

Response No. 8

This comment no longer applies.

Comment No. 9

Section 8, page 30 - How often will the AWFSO's be demonstrated during production operations?

Response No. 9

This demonstration is expected to take place prior to the performance test and once per month thereafter.

Comment No. 10

The performance test plan needs to be submitted as soon as possible.

Response No. 10

This comment is true. Williams is currently preparing the equipment specifications for the new thermal treatment unit to be operating at the Woods Industries Site. The heat and mass balances are also being prepared.

Catherine Massimino's Comments

Comment No. 1

I recommend that agency approval of the final work plan, including the Appendices B through E, be required to be issued prior to allowing mobilization of the thermal desorption unit.

Response No. 1

This comment is true.

Comment No. 2

It is not clear whether Appendices C and D will address performing a site specific risk assessment. A site specific risk assessment should be performed addressing the target compounds listed on page 28, dioxins and furans, potential organic breakdown or reformation compounds as a result of the treatment process, HCl, and Cl. This risk assessment should also address the effects of vent stack openings. The detailed procedures/ modeling to be followed to perform the risk assessment on the expected emissions from the incinerator for the performance test and the full production operation need to be provided.

Response No. 2

Please refer to Response No. 2 of Bob Kievit's Comment No. 2.

Comment No. 3

A history of this thermal desorption system (e.g. include desorption unit and air pollution control system) with respect to Automatic Waste Feed Shutoff's (AWFSO's) and vent stack openings needs to be provided. This information should include the following:

Number of AWFSO's and Vent Stack Opening events during all phases of previous operation (i.e. shakedown, performance test, interim operation, and full production).

Events broken down by causes (e.g. - of AWFSO due to power failures, loss of water to quench, etc.).

Corrective actions (e.g. changes to operating procedures or design) taken to eliminate the event.

Long-term corrective actions taken to reduce or eliminate future occurrences of the event.

The work plan should include an evaluation of the potential for incorporation of additional/revised operational procedures and redundancies to the thermal desorption system to minimize the probability of AWFSOs and vent openings (e.g. use of heat exchanger prior to baghouse).

Response No. 3

This comment has been addressed in previous responses. The Williams' unit is being re-configured for thermal oxidation of the off-gases. The unit being proposed for the site is being reconfigured specifically for this project, therefore no history exists for AWFSO and vent openings. The work plan will incorporate an operations manual which will include procedures for corrective actions, and long term corrective actions to reduce or eliminate future occurrences of the unwanted event. The evaluation of the potential for additional procedures and redundancies will also be incorporated into the operations manual.

Comment No. 4

The soil needs additional characterization to enable a more useful heat and energy balance to be performed. This additional characterization needs to include the following: ash content; total chlorine; and heating value.

The mass balance calculations must include a breakdown of the inputs to the system into their elemental components (i.e., C, E, O, N, Cl, inerts, etc.). Streams coming out of the system must also be further broken down to include acid gases and particulates.

- **It needs to be identified whether the soil is likely to present any special feeding problems (e.g. abundant large rocks requiring crushing equipment, substantial fines content resulting in excessive particulate orvery sticky when wet, etc.).**

Response No. 4

The majority of this comment refers to incineration as opposed to thermal desorption (i.e. ash content). Heating value is not of concern with the pesticide concentrations present in the impacted soils.

The mass balance will be provided for the process flow diagram in the revised work plan.

Potential feeding problems are discussed in Response No. 8 of Bob Kievit's comments.

Comment No. 5

The scaled engineering drawings and piping and instrumentation diagrams for the system must be provided. Also, the ID Fan curves should be provided.

Response No. 5

A PI & D diagram and general equipment layouts have been provided in the work plan. A I.D. fan curve will be included in the "final draft" of the work plan.

Comment No. 6

Should include design analysis of the projected efficiency of each individual component of the air pollution control system (APC) and the combined efficiency of all the components of the APC for the constituents of concern (e.g. metals, acid gases, particulate, etc.).

Response No. 6

The maximum efficiencies for metal removals for APC equipment as provided in Table III-8 entitled "Air Pollution Control Devices (APCDs) and Their Conservatively Estimated Efficiencies for Controlling Toxic Metals". The removal efficiency for HCl is estimated at 99% removal.

The particulate loading at the THAN site was determined to be less than <0.05 gr/dscf.

Comment No. 7

A contingency plan needs to be prepared which addresses the elements specified under 40 CFR 264 Subpart G.

In addition the contingency plan must include notifying the Agency of the use of AWFSO's and vent opening events during operations when the soil is in the thermal desorption units or gases from the soils are in the thermal desorption system (including APC), including length of time of event, cause of event, and corrective taken.

The contingency plan must also included a requirement to obtain Agency approval prior to resuming soil feed after use of automatic waste feed cutoffs of greater than once within any operating calendar day and after any vent opening. This requirement would be applicable during all phases of the operation.

Response No. 7

Williams believes that 40 CFR 264 Subpart G - Closure and Post Closure does not apply to Williams' work at the site.

AWFSO's and vent openings should not require reporting to the Agency unless fugitive emissions result. Williams also believes that ceasing operations because of more than one AWFSO or vent opening in one calendar day is burdensome and is not requisite for all AWFSO's and vent openings.

Williams requests a list of EPA contacts and numbers that are available 24 hours a day and a procedure to begin operations when no EPA contact can be reached.

As part of standard operating procedures, Williams records all downtime events and causes on "Round Sheets." The log book in the Control Room documents the corrective actions taken to repair the failure and prevent future occurrences.

It is also Williams' policy to institute AWFSO's or vent openings that prevent fugitive emissions and equipment damage. Therefore when an AWFSO event occurs it does not necessarily represent a permit exceedance.

Comment No. 8

A limitation of operating hours for noisy feed preparation activities (e.g. crushing) should be proposed.

Response No. 8

This comment was addressed in Bob Kievit's Comment No. 4. Crushing is not expected to be necessary.

Comment No. 9

Since the contaminants contained in the soil to be processed in the thermal desorption system are very similar to those found in EPA Waste K, U, and P codes (i.e. 40 CFR Part 261) the performance standards which would be applied to the application here. I recommend the following standards be applied to the stack emissions from the unit: Destruction and Removal Efficiency of 99.99% (the mechanism applied here will be primarily removal); Particulate emission of greater than 0.015 grains per dry standard cubic foot after correction to a stack gas concentration of 7% oxygen; Metal emissions not to exceed the levels specified in 40 CFR Section 266.106; A maximum of 4 lbs/hr HCl emissions or 99% control efficiency which would not exceed the levels specified in 40 CFR Section 266.107.

A free chlorine level which does not exceed the levels specified in 40 CFR Section 266.107; A total hydrocarbon limit (THC) which would not exceed 20 ppmv based on a hourly rolling average basis reported as propane, and continuously corrected to 7 percent oxygen, dry gas basis; A dioxin and furan emission limits of 30 mg/dscm based on the sum of the tetra through octa-dioxin and furan congeners; and site specific risk assessment indicating emission levels areacceptable.

Response No. 9

The technology that is currently being proposed for treating the soils at the site includes a rotary dryer, an afterburner, and an air pollution control system. The applicable performance standards are described in 40 CFR Subpart O. These include:

a. Destruction and removal efficiency of 99.99% for principal organic hazardous constituents (POHCs);

b. Particulate emission of no greater than 0.08 grains per dry standard cubic foot after correction to a stack gas concentration of 7% oxygen;

c. A maximum of 4 lbs/hr HCl emissions or 99% control efficiency;

d. Continuous monitoring for carbon monoxide in the stack gas. Williams proposed that maintaining CO emissions below 100 ppm_v on a one (1) hour rolling average is a relevant and appropriate requirement;

e. Developing acceptable operating limits for the parameters listed in 40 CFR 264.345. Specific parameters and operational limits will be proposed in a performance test plan.

Several of the standards proposed in the EPA comment letter are not applicable, including:

c. Metals emissions not to exceed the levels specified in 40 CFR 266.106.

d. HCl emissions not to exceed the levels specified in 40 CFR Section 266.107. The thermal desorption system is not a boiler or industrial furnace, therefore, this regulation is not applicable.

e. A free chlorine level which does not exceed the levels specified in 40 CFR Section 266.107. The thermal desorption system is not a boiler or industrial furnace, therefore, this regulation is not applicable.

f. A total hydrocarbon limit (THC) which would not exceed 20 ppm_v based on an hourly rolling average reported as propane. The thermal desorption system is not a boiler or industrial furnace, therefore, this regulation is not applicable. The thermal desorption system will demonstrate compliance with a 100 ppm_v CO standard (one (1) hour rolling average, corrected to 7% oxygen). Demonstration of compliance with the THC standard is applicable under the BIF regulations only if compliance with the CO standard is not attained.

g. A dioxins and furan emission limits of 30 mg/dscm (note: probably meant ng/dscm) based on the sum of the tetra through octa-dioxin and furan congeners.

Williams proposes to operate the thermal desorption system under temperature conditions which are not conducive to the formation of dioxins and furans. These conditions include:

- Thermal desorbed soil discharge temperature greater than 750°F.
- Baghouse inlet gas temperature of less than 450°F.
- Afterburner exit gas temperature of greater than 1800°F.
- Rapid quench of baghouse exit gas to the adiabatic saturation temperature (less than 180°F).

h. Site specific risk assessment indicating emission levels are acceptable. This requirement is from the proposed EPA Draft Combustion Strategy which is not currently a regulation.

Comment No. 10

The operation of the thermal desorption unit and the baghouse within the 450 - 750°F temperature range is not desirable as it increases the potential for dioxin and furan formation. An evaluation of the system to eliminate its operation within this range should be performed.

Response No. 10

The temperature of the gas going to the baghouse will be below 450°F. The temperature of the soil discharge from the thermal desorber will be above 750°F.

Comment No. 11

The specifications (e.g. range, accuracy, precision, etc.) for the process monitoring equipment (e.g. Table 6-1 parameters) including the THC monitors needs to be provided. The THC monitors must meet the specifications in Part 266 Appendix IX, Section 2.0, Performance Specifications for Continuous Emission Monitoring Systems. Specific information needs to be also provided on method and equipment to be used to record data (i.e. strip chart speed, including a copy of an example chart, printout frequency for computer logged data, hard disk capacity, etc.). Detailed calibration procedures and frequency must be provided for all the process monitoring equipment.

Response No. 11

Williams' CEM system can meet the specifications of Part 266 Appendix IX for CO and O_2. THC is not included in this 40 CFR citing performance specification. When the appropriate data logger is selected, the specification will be incorporated into the work plan.

Comment No. 12

Amend Table 6-1 to include the following as parameters which are continuously monitored and recorded: quench water minimum pH and maximum total solids parameter for thermal desorption unit solids residence time, thermal desorption unit oxygen level, baghouse inlet temperature high, indicator of vent opening, gas flow rate high, add a THC monitor at stack exit (versus between carbon beds) and soil wastefeed rate. Also the vapor phase carbon differential pressure should be continuously monitored and recorded.

Response No. 12

Williams proposes to continuously monitor and record quench water pH soil feed rate and baghouse inlet temperature. There is no direct method to continuously monitor retention time in the thermal desorber. The best measure of retention time is analytical results of the treated soil.

A vent stack opening is associated with an event (alarm) that triggers the vent to open. When the alarm is logged on the chart paper the vent opening has been triggered. During the performance test process conditions are established for future production operations. If the process conditions are met (i.e. feed rate, thermal oxidizer temperature and minimum O_2 concentration in the thermal oxidizer) then the gas flow rate will be approximately the same. Therefore, Williams does not propose to continuously monitor stack gas flow rate.

Again, it is Williams' position that the thermal oxidizer is not a Boiler/Industrial Furnace and therefore monitoring THC is not an appropriate ARAR.

Vapor phase carbon differential pressure is no longer applicable.

Comment No. 13

Table 6-2, should add the following AWFSO's: soil feed rate high, quench water pH, specific gravity, and nozzle pressure, THC at stack exit at 20 ppm$_v$ or above (see comment 9e, above), thermal desorption unit solids

residence time, baghouse DP, thermal desorption unit at a positive pressure for any length of time, low oxygen level in thermal desorption unit, and vapor phase carbon DP.

For all items on Table 6-2 that result in a VO evaluate the use of time delays to assume that unnecessary openings do not occur. Evaluate the installation of another vent just prior to the carbon unit versus opening the vent after the thermal desorption unit bypassing any particulate or acid gas control when the carbon unit inlet gas high is the cause of the VO.

Also, explicitly state on Table 6-2 that whenever there is a VO the soil feed will be shut off.

The control should be re-configured, if necessary, to clearly indicate in the continuously operating record whether soil is being fed.

Whenever soil feed is interrupted the operator must maintain the units operating parameters within their required ranges.

The pressure within the rotary dryer on this table and page 25 should be corrected to a negative number.

Response No. 13

Williams will provide an AWFSO for soil feed rate high, low quench water pH, baghouse DP flow, dryer pressure and low oxygen level in the thermal oxidizer. These AWFSO will be set during the performance test.

Specific quality of the quench water is not a parameter that is easily measured on-line or very useful for thermal treatment operations, therefore Williams is not proposing an AWFSO for this parameter.

Nozzle pressure for the quench chamber does not require an AWFSO because other parameters are monitored to prevent unbalanced conditions in the quench, such as quench exit gas temperature. Therefore, Williams is not proposing an AWFSO for this parameter.

THC has been addressed in other comments.

Vapor phase carbon DP is no longer applicable.

Williams will incorporate the time delay recommendation as appropriate for the items in Table 6-2. Table 6-2 will also state that when a vent opening occurs, feed is stopped.

Soil feed rate is monitored and recorded continuously.

When soil feed is interrupted it is Williams' standard operating procedure to operate the thermal desorption unit within the required control parameters.

The rotary dryer vacuum is monitored continuously. When the vacuum reaches "0.00" an AWFSO results.

Comment No. 14

Page 30, Section 8.2 the treated soil should also be analyzed for the appropriate TCLP parameters (e.g. mercury, arsenic, etc.).

Response No. 14

TCLP testing is not necessary to characterize the treated or untreated soils because TCLP testing was performed on several contaminated samples as part of the RI to evaluate disposal or treatment options. The results of all TCLP analyses show that the soils are not RCRA characteristic hazardous waste because none of the samples failed the TCLP test. This is described in detail in section 4.5.3 of the Final RI Report.

Comment No. 15

Page 38, increase the time interval for operation at 700°F to at least twice the normal solids residence time in the unit.

Response No. 15

Residence time adjustments, if any, will be dependent upon performance test results.

Comment No. 16

Page 43, provide details of the perimeter air monitoring system (e.g. parameters, equipment, exact locations, data interpretation, sampling and analysis frequency, etc.).

Response No. 16

This comment will be addressed from Bob Kievit's Comment No. 1.

Please let me know if you need assistance interpreting any of these responses.

Sincerely yours,

WILLIAMS ENVIRONMENTAL SERVICES, INC.

Mark A. Fleri
Project Manager

MAF/cd/RESPONSE.

cc Z. Lowell Taylor - Williams Environmental Services
Bruce Sheppard - Burlington Northern Railroad
David Eagleton - Burlington Environmental
Tom Hippe - Burlington Environmental
Bob Kievit - EPA
Tom Backer - Preston Thorgrimson
General File
Job File

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APPENDIX P

CONSENT ORDER

APR 07 1993

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HEARINGS CLERK
EPA --REGION 10

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION 10

EPA - WOO

IN THE MATTER OF: WOODS INDUSTRIES SITE Burlington Northern Railroad, Proceeding Under Sections 106(a) and 122 of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, 42 U.S.C. §§9606(a) and 9622	ADMINISTRATIVE ORDER ON CONSENT FOR REMOVAL RESPONSE ACTIVITIES U.S. EPA Region 10 CERCLA Docket No. 1087-03-18-106

I. JURISDICTION AND GENERAL PROVISIONS

1.1 This Order is issued pursuant to the authority vested in the President of the United States by sections 106(a) and 122 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. §§ 9606(a) and 9622, as amended ("CERCLA"), and delegated to the Administrator of the United States Environmental Protection Agency ("EPA") by Executive Order No. 12580, January 23, 1987, 52 Federal Register 2923, and further delegated to the EPA Regional Administrators and the EPA Assistant Administrator for Solid Waste and Emergency Response by EPA Delegation Nos. 14-14-A and 14-14-B. This authority is conferred on the EPA Region 10 Chief, Superfund Response and Investigations

Branch by Regional Redelegation Order signed by the Regional Administrator.

1.2 This Administrative Order on Consent (Order) is entered into voluntarily by the EPA and, Respondent Burlington Northern Railroad Company ("BNR") and its receivers, trustees, successors and assigns. This Order provides for the performance of removal actions by Respondent and the reimbursement of response costs incurred by the United States in connection with the property located at 1 East King Street in Yakima, Washington, and known as the "Woods Industries Site". This Order requires the Respondent to conduct removal actions described herein to abate an imminent and substantial endangerment to the public health, welfare or the environment that may be presented by the actual or threatened release of hazardous substances at or from the Woods Industries Site.

1.3 EPA has notified the State of Washington of this action pursuant to section 106(a) of CERCLA, 42 U.S.C. § 9606(a).

1.4 Respondent's participation in this Order shall not constitute or be construed as an admission of liability or of EPA's findings or determinations contained in this Order except in a proceeding to enforce the terms of this Order. Respondent agrees to comply with and be bound by the terms of this Order. Respondent further agrees that it will not contest the basis or validity of this Order or its terms.

II. PARTIES BOUND

2.1 This Order applies to and is binding upon EPA, and upon Respondent and its directors, officers, employees, agents, receivers, trustees, successors and assigns. Any change in ownership or corporate status of Respondent including, but not limited to, any transfer of assets or real or personal property shall in no way alter Respondent's responsibilities under this Order.

2.2 Respondent shall ensure that its contractors, subcontractors, and representatives receive a copy of this Order and comply with this Order. Respondent shall be responsible for any noncompliance by such persons.

III. FINDINGS OF FACT

3.1 The Woods Industries facility (hereinafter the "Woods site," "site" or "facility"), is a facility as defined in Section 101(9) of CERCLA, 42 U.S.C. § 9109(9), and a former pesticide formulation and distribution operation located in the city of Yakima, Washington. The site is the areal extent of contamination that consists of approximately four (4) acres of land, located at 1 East King Street in Yakima, Washington. The site is located within the city limits of Yakima, Washington, in a commercial and industrial area.

3.2 Burlington Northern Railroad Company is a Delaware corporation authorized to do business in the state of Washington. BNR's principal offices are located in Fort Worth, Texas. The mailing address of BNR for purposes of this order is:

Bruce Sheppard
Manager, Environmental Engineering
Burlington Northern Railroad Company
2200 First Interstate Center
999 Third Avenue
Seattle, WA. 98104-1105

3.3 BNR is the land owner of the site. Several individuals and corporations used the site for pesticide formulation and related operations from at least 1945 until at least 1985 under leases from BNR and its predecessors. Site operators have included, among others, Crop King Co., Richey & Gilbert Co., Akland Irrigation Co., Inc. and their respective officers and directors. Between approximately 1980 and May 1985, Woods Industries, Incorporated (hereinafter "Woods") occupied the site and operated a pesticide business on property leased from BNR.

3.4 In May 1985, the lease between BNR and Woods expired and was not renewed. Woods no longer occupies the site. No current operation is present at the site. BNR now controls the site.

3.5 A wide variety of hazardous substances, including arsenic, aldrin, strychnine, lindane, carbamates, and DDT, were used in the pesticide formulation process on the site. Site inspections and assessments conducted by EPA in October and November of 1985, revealed that a number of drums and chemical containers were present on the site. The inspections and assessments revealed chemical contamination in the soils at the site.

3.6 Pursuant to an Administrative Order on Consent for Immediate Response and Stabilization Activities issued by EPA and dated December 6, 1985 (Order No. 1085-10-02-106), BNR was ordered to perform several actions, including: restricting access to the property, securing pools or solid spills within the buildings of the property, securing drums and bottled chemicals on the property to prevent release of their contents, and securing the entrances and lower windows of buildings on the property.

3.7 In addition to these actions, the order required BNR to: analyze the on-site groundwater well and provide to EPA information on the casing, screening and depth of that well; further investigate the extent of hazardous substance contamination of soils, groundwater, and surface waters at the facility; and investigate pathways for contamination migration.

3.8 The above-mentioned actions were undertaken with the knowledge that more extensive response actions would be required to address the significant and varied environmental hazards at this facility.

3.9 BNR contracted with Morrison-Knudsen Engineers, Incorporated (hereinafter "MKE") to implement the actions required by the December 6, 1985 Consent Order. MKE conducted site characterization studies from July through October 1987 covering air, surface water, soil, and shallow groundwater investigations. The findings and conclusions from those studies are contained in the following documents which have been reviewed and accepted by EPA: 1) a Preliminary Site Characterization Report prepared by MKE and dated March 1987; 2) a letter addressed to Jeff Webb of EPA, dated March 28, 1988; 3) a letter addressed to Jeff Webb, EPA, dated July 6, 1987; and 4) quarterly groundwater monitoring data.

3.10 Pursuant to an Amended Order on Consent dated June 28, 1990, for a Remedial Investigation and Feasibility Study, BNR completed a Remedial Investigation, which was approved by EPA on Sept. 16, 1992.

3.11 The Remedial Investigation found visible evidence of chemical contamination inside the Woods buildings including dry powder above ceiling panels in the basement and stained areas on the floors and walls. Bags containing asbestos material were located in one of the buildings. The buildings were generally in a dilapidated condition.

3.12 Pursuant to an Administrative Order on Consent for Removal Response Activities issued by EPA and dated January 4, 1993 (Order No. 1087-03-18-106), BNR was ordered to demolish and dispose of buildings formerly used for pesticides formulation and to dispose of miscellaneous debris on the site. Building demolition and disposal was completed in February 1993.

3.13 The Remedial Investigation revealed extensive contamination of the surface and subsurface soils at the site. The hazardous substances of greatest concern in the soils are pesticides including DDT and Dieldrin, hexachlorobenzene, lead, mercury, and arsenic. The main sources of this contamination appears to be past waste disposal units including a sump, a washdown area, and a series of lagoons. Most of the contamination on site appears to be located in soils in and around these units. The contamination around these units extends from the surface to the watertable. The maximum concentrations detected in soils within these units are: DDT-30,000 ppm; Dieldrin-200 ppm; hexachlorobenzene- 23,000 ppm; lead- 143,800 ppm; mercury-88.5 ppm; and arsenic-543 ppm. The Remedial Investigation indicates that concentrations of contaminants outside of these areas is much lower and the contamination doesn't extend lower than 2 to 3 feet below the surface.

3.14 The Remedial Investigation found that groundwater under the site is contaminated with many of the same chemicals found in the soils including DDT, Dieldrin, and hexachlorobenzene. The highest concentrations of chemicals found in groundwater on site are: DDT- 77 ppb; Dieldrin- 16 ppb; and hexachlorobenzene- 11 ppb. Highest concentrations of contaminants were found in the upper portion of the aquifer in the area of greatest soil contamination. Concentrations of contaminants in the ground water decreases with depth.

3.15 The Remedial Investigation found that the depth to groundwater under the site varies seasonally by 5 to 8 feet in response to irrigation in the Yakima Valley. The groundwater table is lowest in late winter/early spring and rises rapidly with the onset of irrigation. The groundwater table reaches its maximum elevation in late summer/early fall. In late summer, the Remedial Investigation found high levels of contamination in soils just above the groundwater table, which represent the deepest soil samples taken to date. Soil contamination is suspected to be present below the seasonal high groundwater table. It is likely that groundwater is being contaminated each year as the groundwater table rises into soils containing elevated concentrations of hazardous substances.

3.16 Conditions presently exist at the site that may present an imminent and substantial endangerment to public health or welfare or the environment.

3.17 The conditions at the site meet the criteria for a removal action as stated in the National Contingency Plan, 40 C.F.R. Section 300.415 as follows:

A. High levels of hazardous substances or pollutants or contaminants in soil at or near the surface that may migrate - Surface soils sampled in the lagoon, sump, and washdown areas contain high concentrations of DDT, Dieldrin, Hexachlorobenzene, and other hazardous substances, which may migrate off-site through wind blown dusts and soils. The concentrations of some chemicals exceed the State of Washington cleanup standards for soils in industrial areas. For example the highest concentration of DDT in soil is 1,000 times the state cleanup standard. There are two businesses directly adjacent to the site.

B. Actual or potential exposure to nearby human population, animals, or the food chain from hazardous substances or pollutants or contaminants - Although the property is fenced and site access is restricted, there is a threat of trespassers coming into direct contact with contaminated soils. There is also a threat of contaminated soils migrating offsite through wind blown dust and soils. Many of the pesticides found on-site are known or suspected carcinogens and could pose a cancer risk.

Many of the pesticides found on-site are also known to cause nervous system disorders and liver diseases.

C. <u>Actual or potential contamination of drinking water supplies or sensitive ecosystems</u> - The pollutants overlie a local drinking water aquifer. Concentrations of Endrin in monitoring wells on-site are above the MCL. Concentrations of Hexachlorobenzene are above the proposed non-zero MCLG. Concentrations of pesticides which have no established MCL or MCLG such as DDT and Dieldrin exceeds state promulgated groundwater cleanup standards.

3.18 DDT is a chlorinated organic pesticide, which together with its metabolites DDD and DDE, is very persistant in the environment. DDT, DDD, and DDE are probable human carcinogens. Exposure to DDT can also result in adverse impacts to the central nervous system including excitability, tremors, and seizures.

3.19 Dieldrin is resistant to biodegradation and abiotic degradation and therefore can accumulate in the environment. Dieldrin is a probable human carcinogen. In high doses, Dieldrin is a neurotoxin that affects the central nervous system and can produce tremors, convulsions, coma, and even death. Short-term exposure can result in symptoms such as headaches, dizziness, irritability, loss of appetite, and convulsions.

3.20 Hexachlorobenzene is a probable carcinogen. Long-term exposure can result in hepatic toxicity, kidney effects, immune system abnormalities, and neurological effects.

IV. CONCLUSIONS OF LAW AND DETERMINATIONS

4.1 Based on the Findings of Fact set forth above, and the Administrative Record supporting these removal actions, EPA determines that:

(A) The Woods Industries Site is a "facility" as defined by section 101(9) of CERCLA, 42 U.S.C. § 9601(9).

(B) Each substance identified in the Findings of Fact above is a "hazardous substance" as defined by section 101(14) of CERCLA, 42 U.S.C. § 9601(14).

(C) The Respondent is a "person" as defined by section 101(21) of CERCLA, 42 U.S.C. § 9601(21).

4.2 Respondent is liable under section 107(a) of CERCLA, 42 U.S.C. § 9607(a) as the "owner" of the facility, as defined by section 101(20) of CERCLA, 42 U.S.C. § 9601(20), and within the meaning of section 107(a)(1) of CERCLA, 42 U.S.C. § 9607(a)(1).

4.3 The conditions described in the Findings of Fact above constitute an actual or threatened "release" into the "environment" as defined by sections 101(8) and (22) of CERCLA, 42 U.S.C. §§ 9601(8) and (22).

4.4 The conditions present at the facility constitute a threat to public health, welfare, or the environment based upon the factors set forth in the National Oil and Hazardous substances Pollution Contingency Plan (NCP), 40 C.F.R. § 300.415(b)(2).

4.5 The actual or threatened release of hazardous substances from the Site may present an imminent and substantial endangerment to the public health, welfare, or the environment within the meaning of section 106(a) of CERCLA, 42 U.S.C. §

9606(a).

4.6 The removal actions required by this Order are necessary to protect the public health, welfare, or the environment, and are not inconsistent with the NCP and CERCLA.

V. ORDER

5.1 Based upon the foregoing Findings of Fact, Conclusions of Law, Determinations, and the Administrative Record for this Site, it is hereby ordered and agreed that Respondent shall comply with the following provisions, including but not limited to all attachments, all documents incorporated by reference, and all schedules and deadlines attached to, or incorporated by reference into this Order, and perform the following actions:

5.2 <u>Designation of Contractor, Project Coordinator, and On-Scene Coordinator</u>. Respondent shall perform the work itself or retain a contractor(s) to implement this removal action. Respondent shall notify EPA of Respondent's qualifications or the name(s) and qualification(s) of such contractor(s) within five (5) days of the effective date of this Order. Respondent shall also notify EPA of the name(s) and qualification(s) of any other contractor(s) or subcontractor(s) retained to perform work under this Order at least five (5) days prior to commencement of such work. EPA retains the right to disapprove of any, or all, of the contractors and/or subcontractors retained by the Respondent. If EPA disapproves of a contractor selected by the Respondent, Respondent shall retain a different contractor within five (5) days following EPA's disapproval and shall notify EPA of that contractor's name and qualifications within five (5) days of EPA's disapproval.

5.3 Within five (5) days after the effective date of this Order, the Respondent shall designate a Project Coordinator who shall be responsible for administration of all the Respondent's actions required by the Order. Respondent shall submit the designated coordinator's name, address, telephone number, and qualifications to EPA. To the greatest extent possible, the Project Coordinator shall be present on site or readily available during site work. EPA retains the right to disapprove of any Project Coordinator named by the Respondent. If EPA disapproves of a selected Project Coordinator, Respondent shall retain a different Project Coordinator and shall notify EPA of that person's name and qualifications within five (5) days following EPA's disapproval. Receipt by Respondent's Project Coordinator of any notice or communication from EPA relating to this Order shall constitute receipt by Respondent.

5.4 The EPA has designated Bob Kievit of Region 10 as its On-Scene Coordinator (OSC). Respondent shall direct all submissions required by this Order to the OSC at:

United States Environmental Protection
Agency, Region 10
Washington Operations Office
C/O Washington Department Of Ecology
P.O. Box 47600
Olympia, Washington 98604-7600

EPA and Respondent shall have the right to change their designated OSC or Project Coordinator. EPA shall notify the Respondent, and Respondent shall notify EPA, five (5) days before such a change is made. The initial notification may be orally made but it shall be promptly followed by a written notice. (See Section VI - Authority of the EPA On-scene Coordinator).

5.5 Work to Be Performed. Pursuant to Section 106(a) of CERCLA, 42 U.S.C., Part 9606(a), as amended, Respondent shall conduct all removal activities in accordance with the requirements of this order. The removal action shall include the excavation and treatment of contaminated soils. Because of the immediate need to excavate soils prior to the next seasonal rise of the groundwater table (estimated to begin in early spring) and because of the long lead time needed to develop adequate work plans for soil treatment and to procure an appropriate soil treatment vendor, the removal will proceed in two phases. The first phase will include excavation and temporary storage of all soils on site that contain hazardous substances greater than the cleanup standards established for the site. The first phase shall be conducted in accordance with the Work Plan in Attachment A and in the Schedule of Deliverables in Attachment B, which are attached and incorporated in this Consent Order.

The second phase of the removal will include thermal treatment of all soils excavated in Phase I in accordance with the treatment standards established for the site. The second phase shall be conducted in accordance with the Schedule of Deliverables (Attachment B) and with the Scope of Work and the Work Plan that will be developed under and will be incorporated into this order when approved by EPA.

All such removal activities shall be conducted in accordance with CERCLA, the NCP, and EPA guidance.

5.6 Work Plan and Implementation. The Respondent has submitted to EPA an approved Final Work Plan (Attachment A) for the excavation and temporary storage of contaminated soils. The Work Plan provides a description of, and an expeditious schedule for, the activities required by Phase 1 of this Order. Within thirty (30) days after the effective date of this Order, the Respondent shall submit to EPA for approval a draft Scope of Work for conducting thermal treatment on the soils excavated in Phase 1. The draft Scope of Work shall provide a description, and expeditious schedule for the activities required by Phase 2 of this Order.

5.7 EPA may approve, disapprove, require revisions to, or modify the draft Scope of Work or Work Plan submitted for Phase 2. If EPA requires revisions, respondent shall submit a revised draft Scope of Work or Work Plan which is responsive to EPA comments within thirty (30) days of receipt of EPA's notification of the required revisions. Failure to do so will be considered violation of this order. Respondent shall implement the Scope of Work for Phase 2 and Work Plans for Phase 1 and 2 as finally approved in writing by EPA in accordance with the schedule approved by EPA. The approved Work Plans and Schedule shall be fully enforceable under this Order. Respondent shall notify EPA in writing at least 48 hours prior to performing any on-site work pursuant to an EPA-approved Work Plan. Respondent shall not commence or undertake any removal actions at the Site without prior EPA approval.

5.8 Health and Safety Plan. Ten (10) days before Respondent commences any removal action, or with the approval of the OSC if less then 10 days, the Respondent shall submit for EPA review and comment a plan that ensures the protection of the public health and safety during performance of on-site work under this Order. This plan shall be prepared in accordance with EPA's Standard Operating Safety Guide, dated November 1984, and updated July 1988. The plan shall comply with applicable Occupational Safety and Health Administration (OSHA) regulations found at 29 C.F.R. Part 1910, dated March 6, 1989. In addition, the plan shall also comply with all applicable Washington Industrial Safety and Health Act (WISHA) regulations found at WAC Chapter § 296-62. If EPA determines that it is appropriate, the plan shall also include contingency planning. Respondent shall incorporate all changes to the plan recommended by EPA, and implement the plan during the removal action.

5.9 Quality Assurance and Sampling. All sampling and analyses performed pursuant to this Order shall conform to EPA direction, approval, and guidance regarding sampling, quality assurance/quality control (QA/QC), data validation, and chain of custody procedures. Respondent shall ensure that the laboratory used to perform the analyses participates in a QA/QC program that complies with the appropriate EPA guidance. Respondent shall follow the following documents as appropriate as guidance for QA/QC and sampling: "Quality Assurance/Quality Control Guidance for Removal Activities: Sampling QA/QC Plan and Data Validation Procedures," OSWER Directive Number 9360.4-01; "Environmental

Response Team Standard Operating Procedures," OSWER Directive Numbers 9360.4-02 through 9360.4-08; and the representative Sampling Guidance for soil, air, ecology, waste, and water as this information becomes finalized and available.

5.10 Upon request by EPA, Respondent shall have the laboratory analyze samples submitted by EPA for quality-assurance monitoring. Respondent shall provide to EPA the quality assurance/quality control procedures followed by all sampling teams and laboratories performing data collection and/or analysis.

5.11 Upon request by EPA, Respondent shall allow EPA or its authorized representatives to take split and/or duplicate samples of any samples collected by Respondent while performing work under this Order. Respondent shall notify EPA not less than five (5) days in advance of any sample collection activity, or with the approval of the OSC if less than five (5) days. EPA shall have the right to take any additional samples that it deems necessary.

5.12 Respondent shall submit to EPA the results of all sampling or tests and all other data generated by Respondent or its contractor(s), or on the Respondent's behalf during implementation of this Order. This information shall be submitted to EPA, as it becomes available, in the written progress reports and shall be summarized in the final report submitted pursuant to paragraph 5.16.

5.13 Post-Removal Site Control. To the extent practicable, Respondent shall provide for post-removal site control consistent with the NCP, 40 C.F.R. § 300.415(k) and OSWER Directive 9360.2-02. Respondent shall provide EPA with documentation indicating that these post-removal site control arrangements have been made with the local/state governments.

5.14 Reporting. Respondent shall submit a written progress report to EPA concerning activities undertaken pursuant to this Order every seven (7) days after the date of receipt of EPA's approval of the Work Plan until termination of this Order, unless otherwise directed by the OSC. These reports shall describe all significant developments during the preceding period, including the work performed and any problems encountered, analytical data received during the reporting period, and the developments anticipated during the next reporting period, including a schedule of work to be performed, anticipated problems, and planned resolutions of past or anticipated problems.

5.15 Respondent and any Successor(s) in title shall, at least 30 days prior to the conveyance of any interest in real property at the site, give written notice of this Order to the transferee and written notice to EPA and the State of the proposed conveyance, including the name and address of the transferee. The party conveying such an interest shall require that the transferee comply with Paragraph 5.17 - Access to Property and Information.

5.16 Final Report. Within thirty (30) days after completion of the removal action required under this Order, the Respondent shall submit for EPA review and approval a final report summarizing the actions taken to comply with this Order. The final report shall conform, at a minimum, with the requirements set forth in the NCP, 40 C.F.R. § 300.165 entitled "OSC Reports". The final report shall include a good faith estimate of total costs or statement of actual costs incurred in complying with the Order, a listing of quantities and types of materials removed, a discussion of removal and disposal options considered for those materials, a listing of the ultimate destination of those materials, a presentation of the analytical results of all sampling and analyses performed, and accompanying appendices containing all available relevant documentation generated during the removal action (e.g., manifests, invoices, bills, contracts, and permits). All relevant documentation not available when the final report is submitted shall be submitted to EPA as soon as it becomes available. The final report shall also include the following certification signed by a person who supervised or directed the preparation of that report:

> Under penalty of law, I certify that based on personal knowledge and appropriate inquiries of all relevant persons involved in the preparation of the report, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

5.17 Access to Property and Information. Respondent shall provide and/or obtain access to the Site and appropriate off-site areas, and provide access to all records and documentation related to the conditions at the Site and the activities conducted pursuant to this Order. Such access shall be provided to EPA employees, contractors, agents, consultants, designees, representatives, and State of Washington representatives. These individuals shall be permitted to move freely at the Site and appropriate off-site areas in order to conduct activities which EPA determines to be necessary. Respondent shall submit to EPA the results of all sampling or tests and all other data generated by Respondent or its contractor(s), or on the Respondent's behalf during implementation of this Order.

5.18 Where work under this Order is to be performed in areas owned by or in possession of someone other than Respondent, Respondent shall use its best efforts to obtain all necessary access agreements within thirty (30) days after the effective date of this Order, or as otherwise specified in writing by the OSC. Respondent shall immediately notify EPA if after using its best efforts it is unable to obtain such agreements. Respondent shall describe in writing its efforts to obtain access. EPA may then assist Respondent in gaining access, to the extent necessary to effectuate the response activities described herein, using such means as EPA deems appropriate.

5.19 Record Retention, Documentation, Availability of Information. Respondent shall preserve all documents and information relating to work performed under this Order, or relating to the hazardous substances found on or released from the Site, for at least ten years following completion of the removal actions required by this Order. At the end of this ten year period and 30 days before any document or information is destroyed, Respondent shall notify EPA that such documents and information are available to EPA for inspection, and upon request, shall provide the originals or copies of such documents and information to EPA.

In addition, Respondent shall provide documents and information retained under this section at any time before expiration of the ten year period at the written request of EPA.

5.20 Respondent may assert a business confidentiality claim pursuant to 40 C.F.R. § 2.203(b) with respect to part or all of any information submitted to EPA pursuant to this Order, provided such claim is allowed by section 104(e)(7) of CERCLA, 42 U.S.C. § 9604(e)(7). Analytical and other data specified in section 104(e)(7)(F) of CERCLA shall not be claimed as confidential by the Respondent. EPA shall only disclose information covered by a business confidentiality claim to the extent permitted by, and by means of the procedures set forth at, 40 C.F.R. Part 2, Subpart B. If no such claim accompanies the information when it is received by EPA, EPA may make it available to the public without further notice to Respondent.

5.21 Respondent shall maintain a running log of privileged documents on a document-by-document basis, containing the date, author(s), addressee(s), subject, the privilege or grounds claimed (e.g., attorney work product, attorney-client), and the factual basis for assertion of the privilege. Respondent shall keep the "privilege log" on file and available for inspection. EPA may at any time challenge claims of privilege through negotiations or otherwise as provided by law or the Federal Rules of Civil Procedure.

5.22 Off-Site Shipments. All hazardous substances, pollutants or contaminants removed off-site pursuant to this Order for treatment, storage or disposal shall be treated, stored, or disposed of at a facility in compliance, as determined by EPA, with the EPA Revised "Off-Site Policy," OSWER Directive Number 9834.11, November 13, 1987. (see 42 U.S.C. § 9621(d)(3).)

5.23 Compliance With Other Laws. All actions required pursuant to this Order shall be performed in accordance with all applicable local, state, and federal laws and regulations except as provided in CERCLA section 121(e) and 40 C.F.R. section 300.415(i). In accordance with 40 C.F.R. section 300.415(i), all on-site actions required pursuant to this Order shall, to the extent practicable, as determined by EPA, considering the exigencies of the situation, attain applicable or relevant and appropriate requirements (ARARs) under federal environmental, state environmental, or facility siting laws ("The Superfund Removal Procedure for Consideration of ARARs for Removal Actions," OSWER Directive No. 9360.3-02, August 1991).

5.24 Emergency Response and Notification of Releases. If any incident, or change in site conditions, during the activities conducted pursuant to this Order causes or threatens to cause an additional release of hazardous substances from the Site or an endangerment to the public health, welfare, or the environment, the Respondent shall immediately take all appropriate action to prevent, abate or minimize such release, or endangerment caused or threatened by the release. Respondent shall also immediately notify the OSC at (206) 753-9014 or, in the event of his/her unavailability, shall notify the Regional Duty Officer at (206) 553-1263 of the incident or site conditions.

5.25 In addition, in the event of an actual release of a hazardous substance, Respondent shall immediately notify the National Response Center at telephone number (800) 424-8802. Respondent shall submit a written report to EPA within seven (7) days after each release, setting forth the events that occurred and the measures taken or to be taken to mitigate any release or endangerment caused or threatened by the release and to prevent the reoccurrence of such a release. This reporting requirement is in addition to, not in lieu of, reporting under CERCLA section 103(c) and section 304 of the Emergency Planning and Community Right-To-Know Act of 1986, 42 U.S.C. sections 11001 et seq.

VI. AUTHORITY OF THE EPA ON-SCENE COORDINATOR

6.1 The OSC shall be responsible for overseeing the proper and complete implementation of this Order. The OSC shall have the authority vested in an OSC by the NCP, including the authority to halt, conduct, or direct any work required by this Order, or to direct any other response action undertaken by EPA or Respondent at the Site. Absence of the OSC from the Site shall not be cause for stoppage of work unless specifically directed by the OSC.

EPA and Respondent shall have the right to change their designated OSC or Project Coordinator. EPA shall notify the Respondent, and Respondent shall notify EPA five (5) days before such a change is made. Notification may initially be made orally, but shall be followed promptly by written notice.

VII. REIMBURSEMENT OF COSTS

7.1 Respondent shall reimburse EPA for all past response costs and response costs incurred by the United States in overseeing Respondent's implementation of the requirements of this Order. After the end of each federal fiscal year in which Respondent performs work under the original Administrative Consent Order executed on October 11, 1988, the Amended Administrative Consent Order executed on June 28, 1990, the Administrative Order on Consent for Removal Response Activities executed on January 4, 1993, and under this Order, EPA will submit to Respondent a detailed accounting of all costs, incurred by and/or billed to the United States after the effective date of the original Consent Order in connection with response, oversight, and community relations, costs and activities conducted by the United States government and its contractors and representatives with respect to the implementation of the original Administrative Consent Order, the Amended Administrative Consent Order, and this Order.

7.2 Respondent shall, within (60) days of receipt of the bill, remit a cashier's check, certified check, or corporate check for the amount of those costs made payable to the "Hazardous Substance Superfund" with a copy of such transaction sent to the EPA Project/On-Scene Coordinator. Remittances shall addressed to:

U.S. Environmental Protection Agency Region 10
Superfund Accounting
P.O. Box 360903M
Pittsburgh, Pennsylvania 15251.

Respondent shall simultaneously transmit a copy of the check to EPA.

Regional Hearing Clerk
Office of Regional Counsel
U.S. E.P.A. Region 10, SO-125
1200 Sixth Avenue
Seattle, Washington 98101

Payments shall be designated as Oversight and/or Past Response Costs and shall reference the payor's name and address, the EPA site identification number (*WAD027583525*), and the docket number of this Order.

7.3 Interest at the rate established under section 107(a) of CERCLA, 42 U.S.C. § 9607(a), shall begin to accrue on the unpaid balance from the day after the expiration of the Sixty (60) day period, notwithstanding any dispute or an objection to any portion of the costs.

7.4 Respondent may dispute all or part of a bill submitted under this Order, if Respondent determines that EPA has made an accounting error, or if Respondent alleges that a cost item that is included represents costs that are inconsistent with the NCP.

7.5 If any dispute over costs is resolved before payment is due, the amount due will be adjusted as necessary. If the dispute is not resolved before payment is due, Respondent shall pay the full amount of the uncontested costs into the Hazardous Substances Trust Fund as specified above on or before the due date. Within the same time period, Respondent shall pay the full amount of the contested costs into a market rate interest-bearing escrow account. Respondent shall simultaneously transmit a copy of both checks to the EPA OSC. Respondent shall ensure that the prevailing party or parties in the dispute shall receive the amount upon which they prevailed from the escrow funds plus interest within (30) days after the dispute is resolved.

VIII. DISPUTE RESOLUTION

8.1 The parties to this Order shall attempt to resolve, expeditiously and informally, any disagreements concerning this Order. If the Respondent objects to any EPA action taken pursuant to this Order, the Respondent shall notify EPA in writing of its objection(s) within fourteen (14) days of receipt of such notification or action, unless the objections have been informally resolved. EPA and the Respondent shall have seven (7) days from receipt of the notification of objection to reach agreement. If agreement is reached, it will be reduced to writing and will become a fully enforceable part of this Order. If agreement cannot be reached on any issue within this seven (7) day period, an EPA official will issue a written decision to the Respondent. Respondent's obligations under this Order shall not be tolled by submission of any objection for dispute resolution under this section.

8.2 Following resolution of the dispute, as provided by this section, Respondent shall fulfill the requirement that was the subject of the dispute in accordance with the agreement reached or with EPA's decision, whichever occurs. No EPA decision made pursuant to this section shall constitute a final agency action giving rise to judicial review.

IX. FORCE MAJEURE

9.1 Respondent agrees to perform all requirements under this Order within the time limits established under this Order, unless the performance is delayed by a force majeure. For purposes of this Order, a force majeure is defined as any event arising from causes beyond the control of Respondent or of any entity controlled by Respondent, including but not limited to their contractors and subcontractors, that delays or prevents performance of any obligation under this Order despite Respondent's best efforts to fulfill the obligation. Force majeure does not include financial inability to complete the work or increased cost of performance. Respondent shall notify EPA orally within forty eight (48) hours after the event, and in writing within seven (7) days, after Respondent become(s) or should have become aware of events that constitute a force majeure. Such notice shall: identify the event causing the delay or anticipated delay; estimate the anticipated length of delay, including necessary demobilization and re-mobilization; state the measures taken or to be taken to minimize the delay; and estimate the timetable for implementation of the measures. Respondent shall take all reasonable measures to avoid and minimize the delay. Failure to comply with the provisions of this section shall waive any claim of force majeure by the Respondent.

9.2 If EPA determines a delay is or was attributable to a force majeure, the time period for performance under this Order shall be extended as deemed necessary by EPA. Such an extension shall not alter Respondent's obligation to perform or complete other tasks required by the Order that are not directly affected by the force majeure.

X. STIPULATED PENALTIES

10.1 Stipulated penalties shall be paid by Respondent, upon notification by EPA to do so, into the Hazardous Substance Response Trust Fund according to the procedures described below. Stipulated penalties shall not apply to any act or omission that is the subject of ongoing dispute resolution under Section VIII of this Order unless EPA determines that the dispute resolution procedures were invoked by Respondent frivolously or in bad faith or for the purpose of delay. Stipulated penalties shall accrue commencing upon Respondent's receipt of an EPA written determination of disapproval, upon the failure of Respondent to meet the schedule specified in Attachment B of this Consent Order, or upon written notice from EPA to Respondent that a violation of this Order has occurred:

A. Failure to submit the following major deliverables and/or perform the following removal actions in compliance with the requirements of this Consent Order, and in accordance with the Schedules incorporated in the Work Plans and Schedule of Deliverables; in the amount up to $500 per day for the first week of violation or delay, up to $1,000 per day for the second week of violation or delay, and up to $3,750 per day for the third week of violation or delay and each day thereafter.

1) Begin Mobilization for Phase 1 project (soil excavation and temporary storage)

2) Complete Phase 1 project

3) Submit draft Work Plan for Phase 2 project

4) Begin Mobilization for Phase 2 project (soil treatment)

5) Complete Phase 2 project

10.2 Subject to paragraph 10.1, EPA may require that Respondent shall pay into the Hazardous Substances Superfund the sums set forth above as stipulated penalties with a copy of such transaction sent to EPA Project/OSC Coordinator. Certified checks or money orders shall be made out to the Hazardous Substances Superfund and specifically reference the identity of the Site and be addressed to:

U.S. Environmental Protection Agency Region 10
Superfund Accounting
P.O. Box 360903M
Pittsburgh, Pennsylvania 15251.

Nothing herein shall prevent the simultaneous accrual of separate penalties for separate violations of this Order. Penalties are assessed per violation per day. Penalties shall accrue regardless of whether EPA has notified Respondent of a violation or act of noncompliance. Respondent must perform the work even if stipulated penalties are assessed.

XI. RESERVATION OF RIGHTS

11.1 Nothing herein shall limit the power and authority of EPA or the United States to take, direct, or order all actions necessary to protect public health, welfare, or the environment or to prevent, abate, or minimize an actual or threatened release of hazardous substances, pollutants or contaminants, or hazardous or solid waste on, at, or from the Site. Further, nothing herein shall prevent EPA from seeking legal or equitable relief to enforce the terms of this Order, from taking other legal or equitable action as it deems appropriate and necessary, or from requiring the Respondent in the future to perform additional activities pursuant to CERCLA or any other applicable law.

XII. OTHER CLAIMS

12.1 By issuance of this Order, the United States and EPA assume no liability for injuries or damages to persons or property resulting from any acts or omissions of Respondent. The United States or EPA shall not be deemed a party to any contract entered into by the Respondent or their directors, officers, employees, agents, successors, representatives, assigns, contractors, or consultants in carrying out activities pursuant to this Order.

12.2 *Except as expressly provided*, nothing in this Order constitutes a satisfaction of or release from any claim or cause of action against the Respondent or any person not a party to this Order, for any liability such person may have under CERCLA, other statutes, or the common law, including but not limited to any claims of the United States for costs, damages and interest under section 106(a) and 107(a) of CERCLA, 42 U.S.C. § 9606(a) and 9607(a).

12.3 This Order does not constitute a preauthorization of funds under section 111(a)(2) of CERCLA, 42 U.S.C. § 9611(a)(2). The Respondent waive(s) any claim to payment under sections 106(b), 111, and 112 of CERCLA, 42 U.S.C. §§ 9606(b), 9611 and 9612, against the United States or the Hazardous Substances Superfund arising out of any activity performed under this Order.

12.4 No action or decision by EPA pursuant to this Order shall give rise to any right to judicial review except as set forth in section 113(h) of CERCLA, 42 U.S.C. § 9613(h).

XIII. CONTRIBUTION

13.1 With regard to claims for contribution against Respondent for matters addressed in this Order, the Parties hereto agree that the Respondent is entitled to such protection from contribution actions or claims to the extent provided by section 113(f)(2) of CERCLA, 42 U.S.C. § 9613(f)(2).

13.2 Nothing in this Order precludes Respondent from asserting any claims, causes of action or demands against any persons not parties to this Order for indemnification, contribution, or cost recovery.

XIV. INDEMNIFICATION

14.1 Respondent agree(s) to indemnify, save and hold harmless the United States, its officials, agents, contractors, and employees from any and all claims or causes of action arising from, or on account of, acts or omissions of Respondent, its officers, directors, officers, employees, agents, contractors, subcontractors, receivers, trustees, successors or assigns, in carrying out activities pursuant to this Order.

XV. INSURANCE

15.1 At least seven (7) days prior to commencing any on-site work under this Order, the Respondent shall secure, and shall maintain for the duration of this Order, comprehensive general liability insurance and automobile insurance with limits of at least one million dollars, combined single limit. Within the same time period, the Respondent shall provide EPA with certificates of such insurance and a copy of each insurance policy. If the Respondent demonstrates by evidence satisfactory to EPA that any contractor or subcontractor maintains insurance equivalent to that described above, or insurance covering the same risks but in a lesser amount, then the Respondent need provide only that portion of the insurance described above which is not maintained by such contractor or subcontractor.

XVI. MODIFICATIONS

16.1 Modifications to any plan or schedule shall be made in writing by the OSC. Minor field modifications to any plan or schedule may be made in writing by the OSC, or at the OSC's oral direction. If the OSC makes an oral modification, it will be memorialized in writing within seven (7) days; provided, however, that the effective date of the modification shall be the date of the OSC's oral direction. Any other requirements of the Order may be modified by mutual agreement of the parties and shall be in writing.

16.2 If Respondent seeks permission to deviate from any approved Work Plan or schedule, Respondent's Project Coordinator shall submit a written request to EPA for approval outlining the proposed Work Plan modification and its basis.

16.3 No informal advice, guidance, suggestion, or comment by EPA regarding reports, plans, specifications, schedules, or any other writing submitted by the Respondent shall relieve the Respondent of obligations to obtain such formal approval as may be required by this Order, and to comply with all requirements of this Order unless it is formally modified.

16.4 If EPA determines that additional response actions not included in an approved plan are necessary to protect public health, welfare, or the environment, EPA will notify Respondent of that determination. Unless otherwise stated by EPA, within thirty days of receipt of notice from EPA that additional response activities are necessary to protect public health, welfare, or the environment, Respondent shall submit for approval by EPA a work plan for the additional response activities. The plan shall conform to the applicable requirements of this Order. Upon EPA approval of the plan, Respondent shall implement the plan for additional response activities in accordance with the provisions and schedule contained therein. This section does not alter or diminish the OSC's authority to make oral modifications to any plan or schedule.

XVII. NOTICE OF COMPLETION

17.1 When EPA determines, after EPA's review of the Final Report, that all work has been fully performed in accordance with this Order, with the exception of any continuing obligations required by this Order, EPA will provide notice to the Respondent. If EPA determines that any removal activities have not been completed in accordance with this Order, EPA will notify the Respondent, provide a list of the deficiencies, and require that Respondent submit to EPA a Work Plan to correct such deficiencies. The Respondent shall implement the new and approved Work Plan and shall submit a modified Final Report in accordance with the EPA notice. Failure by Respondent to implement this approved Work Plan shall be a violation of this Order.

XVIII. SEVERABILITY

18.1 If a court issues an order that invalidates any provision of this Order or finds that Respondent have sufficient cause not to comply with one or more provisions of this Order, Respondent shall remain bound to comply with all provisions of this Order not invalidated or determined to be subject to a sufficient cause defense by the court's order.

XIX. EFFECTIVE DATE

19.1 The effective date of this Consent Order is the date on which it is signed by the EPA Region 10 Chief, Superfund Response and Investigations Branch.

The undersigned representative of Respondent certifies that it is fully authorized to enter into the terms and conditions of this Order and to bind the parties it represents to this document.

Agreed

By Bruce Sheppard

Title Mgr. Environmental Projects

It is so ORDERED and Agreed this 30th day of March, 1993.

BY: Randall F. Smith DATE: 3/30/93

For James M. Everts, Chief
Superfund Response and Investigations Branch
Region 10
U.S. Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

Reply To
Attn Of: HW-113 September 7, 1994

Mr. Bruce A. Sheppard
Manager Environmental Projects
Burlington Northern Railroad
Environmental Engineering
Suite 2000, 999 Third Avenue
Seattle, Washington 98104-1105

Dear Mr. Sheppard:

On July 29, 1994 you submitted to U.S. Environmental Protection Agency (EPA), a proposed revised schedule for completing soil treatment activities at the Woods Site. The schedule you proposed was based on discussions between EPA and Burlington Northern Railroad (BNRR).

According to Section XVI. Modifications of the Administrative Order on Consent for Removal Response Activities at the Woods Site (Docket No. 1087-03-13-106), the Order may be modified by mutual agreement of the parties. EPA has reviewed your proposed schedule and has agreed to modify the existing Order accordingly. EPA has revised Attachment B of the Order to reflect the schedule you proposed in your letter of July 29, 1994. A copy of a revised Attachment B is attached for your records.

Please call me if you have any questions. My number is (206) 553-1987.

Sincerely,

Lynda E. Priddy

Lynda E. Priddy
Environmental Protection
Specialist
Hazardous Waste Division

Attachment

cc: David Eagleton, Burlington Environmental - Columbia
Tom Hippe, BE - Houston
Rick Roeder, Ecology (CRO)
Tom Becker, Preston
Bill Glasser, EPA (HW-113)
Bob Hartman - EPA (SO-155)

ATTACHMENT B

Schedule of Deliverables

	Activity	Deadline
1.	Submit proof of bid award to EPA	August 22, 1994
2.	"EE/CA Addendum" submitted to EPA	August 22, 1994
3.	Submit Draft Soil Treatment Work Plan to EPA	October 7, 1994
4.	BNRR gives contractor notice to proceed with site preparation	December 9, 1994
5.	Startup/Shakedown begins	January 15, 1995
6.	Project Complete/Final Report submitted to EPA	June 30, 1995

ATTACHMENT B

Schedule of Deliverables

	Activity	Deadline
1.	Begin mobilization for Phase 1	March 29, 1993
2.	Complete Phase 1	June 15, 1993
3.	Submit draft completion report for Phase 1	July 15, 1993
4.	Submit draft Scope for Work for Phase 2	Thirty days after effective date of order
5.	Submit draft detailed Work Plan for soil treatment	June 1, 1993
6.	Award contract for soil treatment	30 days after EPA approval of work plan
7.	Begin mobilization for Phase 2	30 days after contract awarded
8.	Complete demonstration test and submit report	45 days after mobilization
9.	Complete Phase 2	1 year from effective data of order
10.	Submit final report	30 days after completing Phase 2

APPENDIX Q

CALCULATIONS

DRE CALCULATIONS

Selected POHC: Hexachlorobenzene

Required DRE: 99.99%

Concentration in Roll-Off Box: 3432.83 mg/kg

Detection Limit: 10 μg /sample

Safety Factor: 10 x Detection Limit ⇒ 100 μg /sample

Sample Volume Required: 106 dscf

Need to have a minimum of 100 μg /sample of HCB in the stack gas in order to show 99.99% DRE.

$$\frac{100\ \mu g}{0.0001} = 1 \times 10^{6}\ \mu g =$$ 1000 mg HCB required in the feed to show 99.99% DRE

The concentration of HCB in the feed for the performance test averages 3432 ppm. Therefore, no spiking of the feed will be necessary.

HCl Analysis

A maximum of 4 lb/hr HCl emissions or 99% control efficiency is required.

Organochloro Compounds	Avg. Conc. in Soil (mg/kg)	Chlorine Percentage (%)	Chlorine Concentration (mg/kg)
Hexachlorobenzene	729.69	74.70	545.08
Heptachlor	0.32	66.48	0.21
Heptachlor Epoxide	0.18	66.48	0.12
Methoxychlor	57.05	30.77	17.55
Chlordane	0.91	69.22	0.63
Aldrin	6.09	58.30	3.55
alpha-BHC	0.73	73.14	0.53
beta-BHC	0.26	73.14	0.19
gamma-BHC	9.78	73.14	7.15
Dieldrin	19.95	55.85	11.14
Endrin	10.83	55.85	6.05
DDD	454.26	50.01	227.18
DDE	51.67	50.01	25.84
DDT	1696.03	50.01	848.18
Toxaphene	109.38	68.00	74.38
		TOTAL	1767.78 mg/kg

Avg. Feed Rate = 20 TPH

Avg. Chlorine Concentration in the Soil = 1767.78 mg/kg

Avg. Emission of HCl (uncontrolled) $= \frac{36.5}{35.5} \times \frac{20 \times 2000 \times 1767.78}{10^6} = 72.70\text{mg/kg}$

The acid gas scrubber utilized by the system will remove in excess of 99% of the HCl.

At 99% DRE, average emission of HCl = (72.70)(.01) = 0.727 lb/hr HCl.

Tier 1 Analysis for Metals

For Tier 1 Analysis of metals, assume the entire concentration of metals in the feed soil bypasses the APCE and is emitted to the atmosphere. If these values are greater than allowable emissions, then stack testing for metals must be performed.

Metal	Average Concentration in Soil (mg/kg)	Metal Emission (lb/hr)(1)
Arsenic	9.75	0.39
Lead	86.67	3.47
Mercury	6.24	0.25
Antimony		
Barium	369.5	14.78
Beryllium		
Cadmium	6.55	0.26
Chromium	25.02	1.00
Selenium	0.75	0.03
Silver	2.00	0.08
Thallium		

(1) Based on average soil feed rate of 20 tons per hour.

APPENDIX R

NOISE EXPOSURE MONITORING

BENCHMARK ENGINEERING

Consulting Engineers
and Scientists

Benchmark Engineering Inc.
1550 Pumphrey Avenue
Auburn, Alabama 36830
205/821-9250
Fax 205/821-9765

November 11, 1993

Mr. Mark A. Fleri
WILLIAMS ENVIRONMENTAL SERVICES
2075 West Park Place
Stone Mountain, Georgia 30087

RE: Noise Exposure Monitoring - THAN, Albany, Georgia
Benchmark Project No. 1100-100-110

Dear Mr. Fleri:

Attached are tabulated summaries of the results of noise monitoring efforts for the above-referenced project. Sampling was conducted during the setup and operation of Thermal Processing Unit I (TPU I) at the Albany site; sampling periods ranged from six to nine hours. Both personal and area samples were collected using a Quest M27 Noise Logging Dosimeter. The dosimeters were calibrated daily using a Quest CA-12B calibrator.

Sampling was also conducted to determine the noise level at the site perimeter. For this effort, the ID fan, since it appeared to be the most significant source, was selected as the center point. Monitoring points were then selected around the perimeter of the site as illustrated on the attached figure.

Based on this data, there is no question that a hearing conservation program should be established, and signs posted around some portions, if not all of unit number one. Hearing conservation programs are required by regulation once the 8-hour time-weighted average of employees exceeds 85 dBA. Hearing protection must be provided when the TWA exceeds 90 dBA.

Please review the information and contact me with any questions.

Sincerely,

BENCHMARK ENGINEERING

Roger W. Thompson, CIH, CHMM
Vice President

RWT:ps

Enclosures

Benchmark Engineering Inc.
Riverchase Office Plaza
Bldg. 3, Suite 208
Birmingham, Alabama 35244
205/988-4305
Fax 205/988-5249

Benchmark Engineering Inc.
2075 West Park Place
Stone Mountain, Georgia 30087
404/879-4000
Fax 404/469-0178

Deep South Laboratory
225 Oxmoor Circle, Suite 806
Birmingham, Alabama 35209
205/945-6260
Fax 205/945-0739

WILLIAMS ENVIRONMENTAL SERVICES

PERIMETER NOISE LEVEL ASSESSEMT

THAN SITE, ALBANY, GEORGIA

Benchmark Engineering Project: 1100-100-110

DATE	LOCATION/ GRID POINT	SPL(a)	COMMENTS
10Jul93	N-12s	Void	Monitor not set for community noise.
11Jul93	N-12s	*	Approx. 54 dB Visual readings throughout the day
12Jul93	N-12s	69.3	TPU ran 1st 4 hrs
12Jul93	N-14w	72.9	TPU ran 1st 4 hrs
13Jul93	N-22s	65.4	TPU off/on all day
13Jul93	N-24w	68.7	TPU off/on all day
14Jul93	N-32s	68.9	TPU ran all day
14Jul93	N-0	65.2	TPU ran all day
14Jul93	N-34w	66.8	TPU ran all day
15Jul93	N-44w	61.0	TPU did not run
15Jul93	N-42s	66.1	TPU did not run
16Jul93	N-49.5s	67.3	Towards Hwy.
16Jul93	N-49.5s	65.7	Towards unit Total dBA= 69.3
16Jul93	N-0	62.4	TPU ran all day
21Jul93	N-14w	80.2	TPU ran all day
21Jul93	N-12s	68.4	TPU ran all day
04Aug93	N-44w,32s	72.9	TPU down
04Aug93	N-44w,22s	74.6	TPU down
04Aug93	N-44w,12s	66.5	TPU down
12Aug93	N-44w	58.7	TPU up 4:25 comp
12Aug93	N-49.5s,14w	65.4	Facing highway
12Aug93	N-49.5s,14w	65.8	Facing unit
13Aug93	N-34w	70.3	TPU up 1:35 comp
13Aug93	ID fan	91.1	ID fan
13Aug93	Shaker (EZ fence)	91.4	Shaker

WILLIAMS ENVIRONMENTAL SERVICES

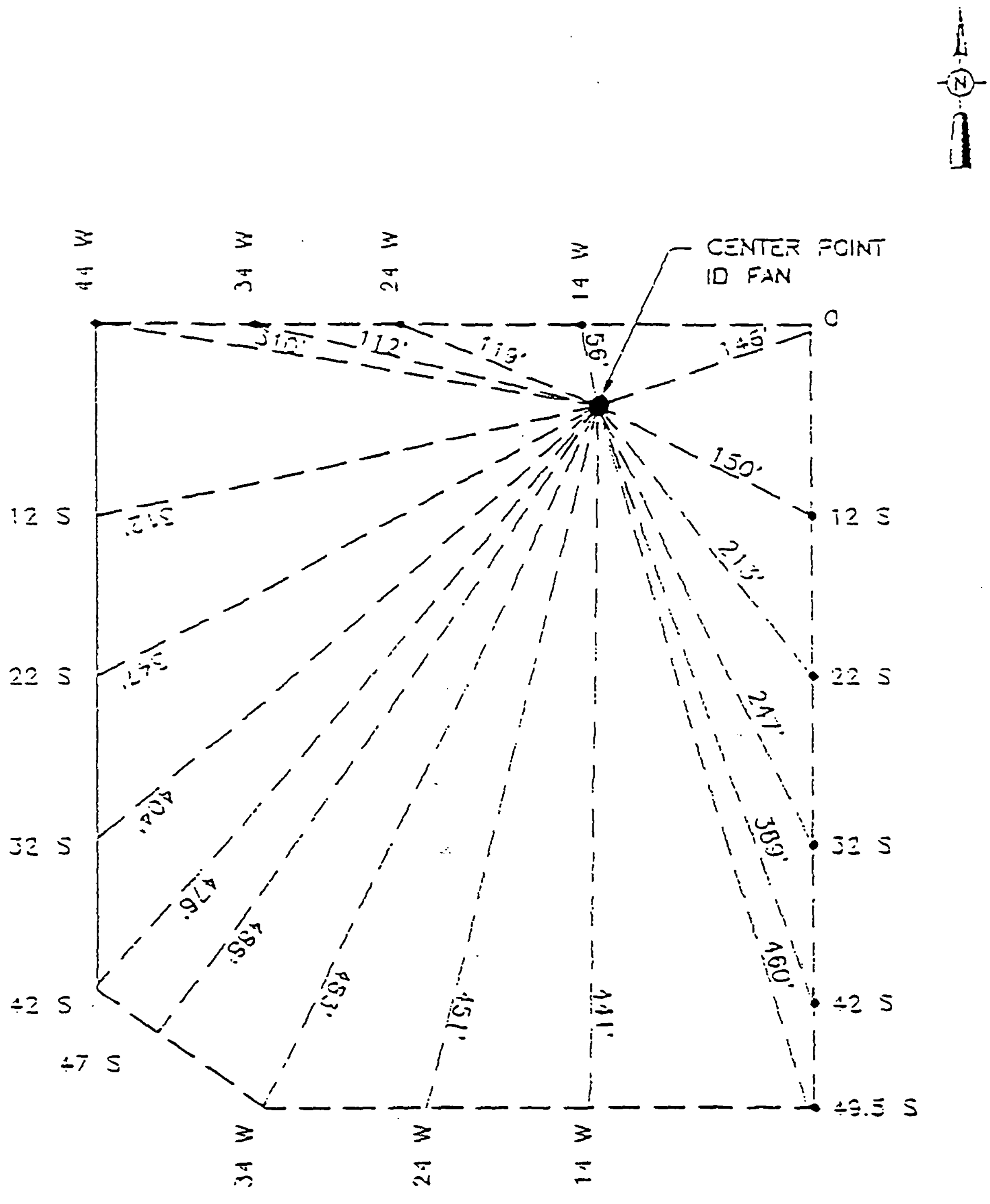
PERIMETER NOISE LEVEL ASSESSEMT

THAN SITE, ALBANY, GEORGIA

Benchmark Engineering Project: 1100-100-110

DATE	LOCATION/ GRID POINT	SPL(a)		COMMENTS
13Aug93	N-24w	Void		Dead Battery
13Aug93	N-49.5s,24w	74.5		Facing highway
13Aug93	N-49.5s,24w	74.2		Facing unit
15Aug93	N-14w	103.6		TPU runnning
15Aug93	N-49.5s,34w	Void		Dead Battery
15Aug93	N-49.5s,34w	65.3		Facing unit
16Aug93	N-44s,42w	61.5		Facing RR & Hy
16Aug93	N-44s,42w	65.1		Facing unit
19Aug93	N-44w,42s	66.0		TPU off all day Facing highway
19Aug93	N-44w,42s	63.8		Facing unit
19Aug93	N-44w,12s	44.2		TPU off all day
				TPU off all day
20Aug93	N-12s	67.1		Facing unit
20Aug93	N-12s	77.8		Facing weld shop
20Aug93	N-44w,32s	61.6		TPU off all day
29Aug93	N-44w,12s	65.2		TPU up all night
29Aug93	N-44w,22s	59.4		TPU up all night
29Aug93	N-44w,32s	64.6		TPU up all night
02Sep93	N-42s	60.7		TPU up all day
02Sep93	N-44w,42s	64.4		Facing unit
02Sep93	N-44w,42s	64.3		Facing hwy./RR

NOTES:
(a) SPL = Sound Pressure Level measured as dBA



EXPLANATION

——— IMAGINARY BOUNDARY
— — — FENCE LINE

FIGURE NO. 1

DATE: 8-10-93

DESIGNED BY: TJR

DRAWN BY: JCM

TH AGRICULTURE & NUTRITION
1401 SCHLEY AVE.
ALBANY, GA.

BENCHMARK ENGINEERING
Consulting Engineers and Scientists
1550 HUMPHREY AVE. AUBURN INDUSTRIAL PARK
AUBURN, ALABAMA 36830-4359 (205)

PROJECT NO.: 1100-100-110

SCALE:

WILLIAMS ENVIRONMENRTAL SERVICES

NOISE EXPOSURE ASSESSMENT

THAN SITE, ALBANY, GEORGIA

Benchmark Engineering Project: 1100-100-110

DATE	LOCATION/EMPLOYEE	SPL(a) TWA(dBA)	SPL(b) DOSE(%)	COMMENTS
30Jun93	Jason Weed	74.4	11.57	Mobil/set-up
30Jun93	Bob Kelby	78.5	20.27	Mobil/set-up
01Jul93	Lance Keller	83.6	41.0	Mobil/set-up
01Jul93	Art Terrell	79.4	22.96	Mobil/set-up
02Jul93	Wes Richards	75.4	13.24	Mobil/set-up
02Jul93	Leslie Weed/3 hrs			
	Glenn Weed/6 hrs	82.8	36.9	Mobil/set-up
03Jul93	Ivan Richards	82.4	34.8	Mobil/set-up
03Jul93	Jack McClure	78.9	21.45	Mobil/set-up
06Jul93	Jason Weed	77.7	18.15	106 min act run 81.8% proj dose
06Jul93	Art Terrell	80.9	28.32	8-hr dose 29.92%
06Jul93	Bob Kelby	82.0	33.1	Mobil/setup
07Jul93	Leslie Weed	80.7	27.39	TPU ran from 7:45
07Jul93	Lance Keller	void	void	COMPUTER ERROR
07Jul93	Wes Richards	84.9	49.0	TPU ran from 8:10
08Jul93	Jack McClure	80.7	27.54	Mobil/set-up
08Jul93	Ivan Richards	75.1	12.62	Mobil/set-up
08Jul93	Jason Weed	74.1	10.94	Mobil/set-up
09Jul93	Leslie Weed	82.9	37.3	TPU Running 8-hr dose 37.3%
09Jul93	Art Terrell	93.4	160.6	TPU Running Stack Conveyor
09Jul93	Lance Keller	89.0	87.1	TPU Running Feed Conveyor
10Jul93	Jack McClure	82.1	33.2	TPU ran from 7:00
10Jul93	Wes Richards	86.3	59.9	TPU ran from 7:00 Stack conveyor:
11Jul93	Jason Weed	72.6	9.0	Final Set-up

WILLIAMS ENVIRONMENRTAL SERVICES

NOISE EXPOSURE ASSESSMENT

THAN SITE, ALBANY, GEORGIA

Benchmark Engineering Project: 1100-100-110

DATE	LOCATION/EMPLOYEE	SPL(a) TWA(dBA)	SPL(b) DOSE(%)	COMMENTS
11Jul93	Ivan Richards	86.8	63.8	Was wearing hearing protection.
13Jul93	Area--demister	88.9	85.6	Personnel were wearing hearing protection.
19Jul93	Area-Air Compressor	81.3	29.78	Personnel were wearing hearing protection. 96% of the time dBA was 85 to 95.
19Jul93	Area-Stack Conveyor	81.4	30.2	Personnel were wearing hearing protection. 97.3% of the time dBA was 85 to 95.
18Aug93	Area Fr end loader	79.7	23.86	
18Aug93	Area-Stack conveyor	93.0	150.9	Personnel were wearing hearing protection.
18Aug93	Area-Shaker	89.6	94	Personnel were wearing hearing protection.
18Aug93	Area-Shaker	95.0	198.9	Personnel were wearing hearing protection.
18Aug93	Area Fr end loader	87.3	68.4	Personnel were wearing hearing protection.
18Aug93	Area-Shaker	92.7	145.7	Personnel were wearing hearing protection.
21Aug93	Area-Stack conveyor	Void	Void	Wrong setting
21Aug93	Area-Shaker	•	•	Wrong setting

WILLIAMS ENVIRONMENRTAL SERVICES

NOISE EXPOSURE ASSESSMENT

THAN SITE, ALBANY, GEORGIA

Benchmark Engineering Project: 1100-100-110

DATE	LOCATION/EMPLOYEE	SPL(a) TWA(dBA)	SPL(b) DOSE(%)	COMMENTS
21Aug93	ID fan area	-	-	Wrong setting
29Aug93				
29Aug93	W. Knox/Stc Cavy	Void	Void	Comp Error
29Aug93	J. Whatley/FMU	82.7	36.3	
29Aug93	J. McClure/Cnt Rm	83.2	39.0	

NOTES:
(a) SPL = Sound Pressure Level Recorded in dBA as 8-hour time-weighted average (TWA).
(b) Values represents the percentage of the allowable dose to which the employee would have been expose had hearing protection not been in place.

APPENDIX S

DOBSON COLLAR CUTAWAY VIEW

DOBSON COLLAR

The Dobson Collar is a device developed to allow for the introduction of solid or liquid material into a horizontal rotating drum. The design consists of placing an inner shell within an outer shell known as a Dobson Collar. A chute opening is placed on the Dobson Collar, surrounding the inner shell, allowing gravity to drop the materials into the upper side of the space between the inner shell and Dobson Collar. The inner shell contains a series of openings resembling a waterwheel, that scoop the material from the location between the inner shell and Dobson Collar into the interior of the drum, where it can mix with the existing hot material. As the relatively small flow of material mixes with the hot material that has progressed through the entire drum, it is heated through convection. While this is taking place, the entirety of material is still being heated by the radiant heat given off by the close proximity of the open flame. In this portion of the drum, the material is showered through the air flow; however, the velocity of the air flow is greatly reduced due to the enlargement of the drum diameter, thus minimizing the amount of material carried back through the air pollution control devices.

The purpose of the Dobson Collar on Williams' third operable thermal treatment unit is to allow for the thermal treatment of the baghouse dust. The dusts are re-introduced into the drum near the burner to take advantage of the existing high temperatures. To prevent pulling the fine dusts back into the airstream, the air velocity from the burner flow is reduced by increasing the drum diameter from eight and one half feet to ten feet (see diagram for cutaway view). By increasing the drum diameter, the speed at which the soils move through the drum is reduced, thus increasing the residence time for the baghouse dusts.

Assuming that no further heat is added to the system, the temperature at which the baghouse dust is treated will be approximately 870°F. Of course, the actual temperature will be higher due to the proximity of the burner. This temperature is more than adequate to treat any remaining contamination in the baghouse dust. The following calculation shows how this temperature was determined:

$$M_1\, C_{p,1}\Delta T_1 = M_2\, C_{p,2}\Delta T_2$$
$$C_{p,1} = C_{p,2}$$
$$0.95\Delta T_1 = 0.05\Delta T_2$$
$$19\Delta T_1 = \Delta T_2$$
$$19(900 - \Delta T_2) = (\Delta T_2 - 300)$$
$$\Delta T_2 = 870°F$$

where

M_1 = mass flow rate of soil
M_2 = mass flow rate of baghouse dust
(assumed to be 5% of soil feed)

Assumptions:

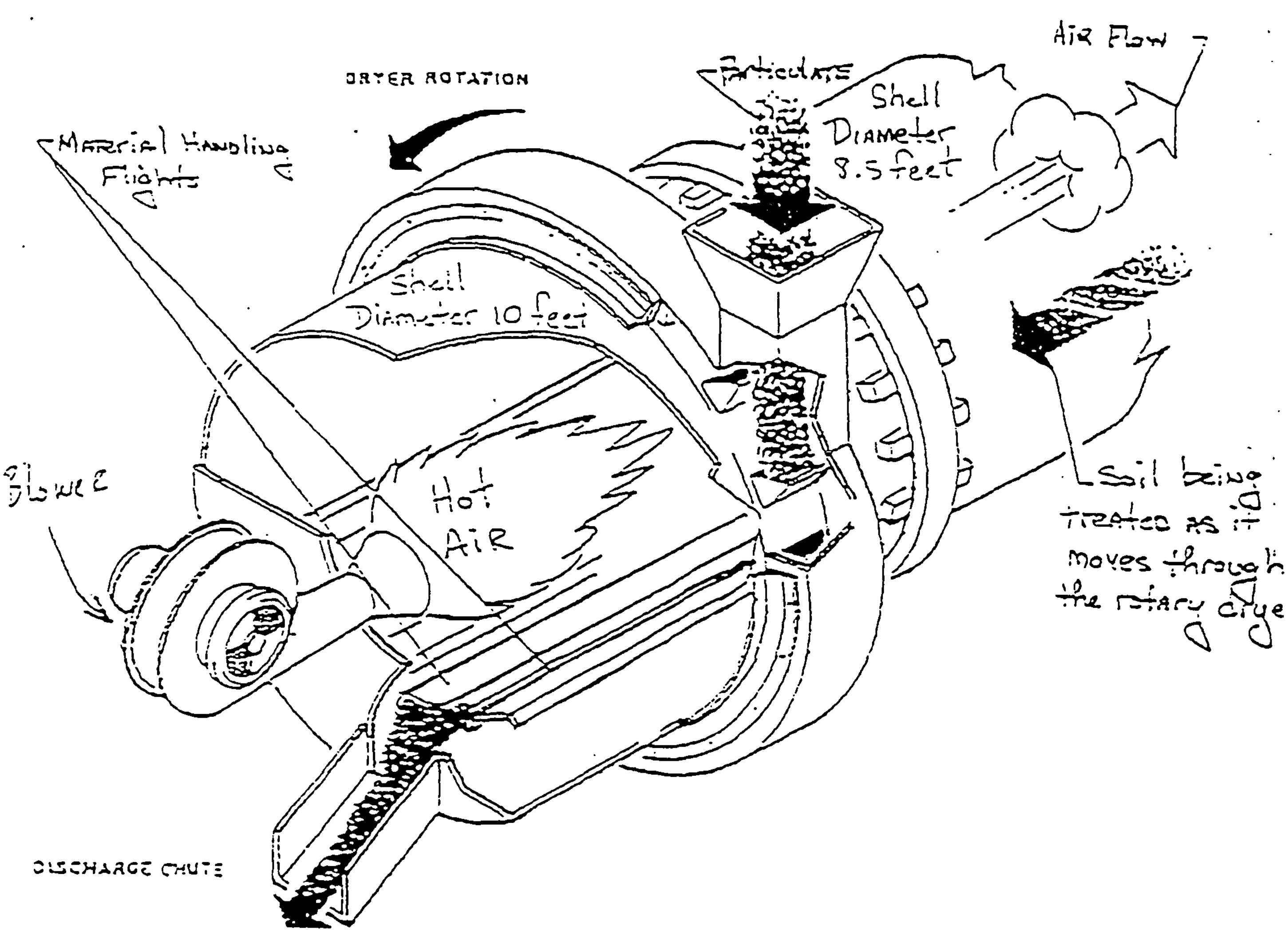
1) Temperature of treated soil = 900°F
2) Temperature of baghouse dust = 300°F

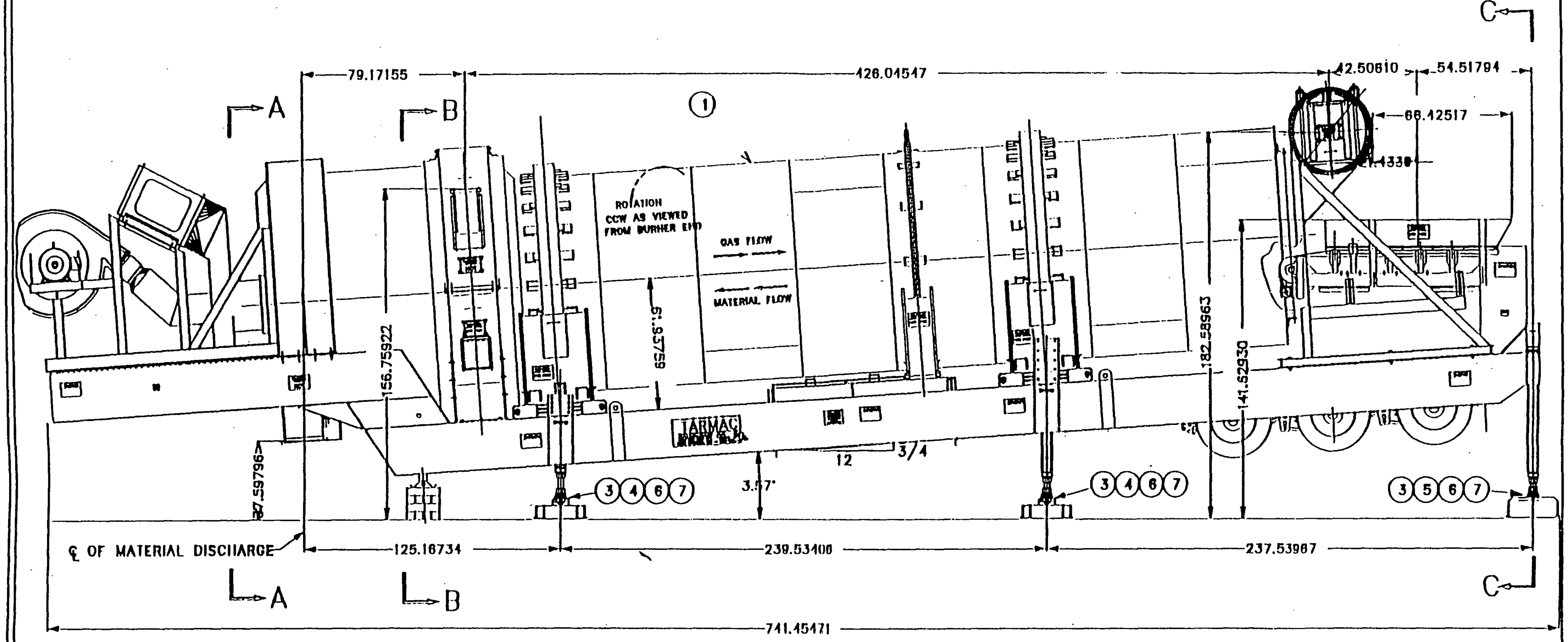
– DRAFT –

– For Discussion Purposes –

Here's a schematic of the "Dobson Collar" design to be implemented on the Woods Project.

– Thermal Desorption with the Dobson Collar –





ITEM	QTY	DESCRIPTION	DWG.	WT.
7	12	HAIR PIN, 1/4" FOR 1-1/2" SHAFT, ISSCO WW CLIP #235		
6	6	RACHET LOAD BINDER, CAMPBELL #620-7805 FOR 1/2" SYSTEM 4 CHAIN		10
5	2	CHAIN, 1/2" SYSTEM 4 WITH CLEVIS GRAB HOOK EACH END, 14' LONG, (CAMPBELL)		39
4	4	CHAIN, 1/2" SYSTEM 4 WITH CLEVIS GRAB HOOK EACH END, 13' LONG, (CAMPBELL)		37
3	6	PIN, STEEL TIMBER CHAIN, 6-1/2" LONG	31-24	3
2	6	PIN, LEG CHAIN, 9-1/4" LONG	31-24	5
1	1	DRYER ASSEMBLY	31-27	96067

TARMAC EQUIPMENT COMPANY

TITLE DRYER ASSEMBLY, 8' 6" x 40' (SHIPPING WT. 96,400#)

BY	© DATE	SCALE	CADD	DWG. NO.		REV
DRA	1/11/94	1/4"=1'-0"	DRYER	31-272	1/3	0

Williams Environmental
2075 West Park Place
Stone Mountain, GA 30087
404/879-4107 (fax) 404/879-4831

TPU

Drawing Title
Sub-title

DATE 3/31/94
DIRECTORY
FILENAME 3127201.dwg
DWG NO.
3127201

APPENDIX T

APRIL 2, 1994 COMMENTS & RESPONSES

WILLIAMS ENVIRONMENTAL SERVICES, INC.

May 6, 1994

Ms. Lynda Priddy
Hazardous Waste Coordinator
U. S. Environmental Protection Agency Region X
1200 Sixth Avenue
Seattle, Washington 98101

Subject: Woods Industries Site
Yakima, Washington
Transmittal No.: 0024
Number of Pages: 33

Re: Transmittal of Responses to USEPA Region X
April 14, 1994 Comment Letter on the Work Plan
Williams Project No. 0365-001-110

Dear Ms. Priddy:

In response to U.S. Environmental Protection Agency (USEPA) Region X's April 14, 1994, comments on the Work Plan, dated March 14, 1994, Burlington Northern Railroad (BNRR), through Williams Environmental (Williams) and Burlington Environmental Inc. has prepared this letter and is in the process of revising the Work Plan.

GENERAL COMMENTS ON THE WORK PLAN

Section 3: Process Description

1. Page 17, section 3.2, Feed Processing, last six lines: Prior to "resampling" a failed soil pile, the Work Plan states that the failed soil pile will be " ' recycled' to the waste feed area and placed in piles for further treatment. . . . This 'recycled' feed will not necessarily be stored separately from the 'virgin' feed but . . . feed processed." EPA is not certain what is meant by these statements. Please clarify further. What is the reason for resampling a second time a failed soil pile?

<u>Reply</u>

The last portion of paragraph 3.2 has been re-written to read "If the treated samples pass the clean-up criteria, the soil will not be re-treated. However if the treated soil samples fail to meet the clean-up criteria, the treated soil pile will be re-sampled using a composite of several grab samples. If the composite samples pass the clean-up criteria, the soil will not be re-treated. However, if the second sampling event demonstrates that the treated piles fail to achieve the clean-up criteria, these treated soils will be re-treated. The failed pile will be moved from

the verification holding area to the wastefeed stockpile area. The failed pile will be treated as the production schedule allows. The amount of re-treated material will be deducted monthly based on the production sheets. (One pile represents one day's production.)"

2. Page 18, 1st full paragraph: this is an appropriate location to add some discussion about how the Dobson Collar will work. Additionally, some discussion should be added to page 21, section 3.5.5 and page 24, 4th paragraph. Added information to appropriate sections should address: residence time, feed control, expectations, etc.

Reply

Appendix U has been added to include the correspondence and drawings submitted to date. The text has been revised to reflect the above comment.

3. Page 20, 4th full paragraph: " . . . hauling soils to secondary stockpiles as is shown in Figure 12-1". Figure 12-1 could not be located. Is it Figure S-1? Figure S-1 does not identify a secondary pile. Is it the same thing as the waste feed stockpile or is the secondary stockpile different?

Reply

Figure S-1 is Figure 12-1. The drawings will be revised to show Figure 12-1. The secondary stockpile is the same as the wastefeed stockpile. The document will be revised to reflect wastefeed stockpile.

4. Page 20, 2nd to the last sentence: While the carbon can treat the water, what about the "sludgy" material that settles out from the water in the sumps? This questions also applies to the "sludgy" material that may result from cleaning off the pad during decon. Carbon treatment will probably not work for waste rich in particulate material. Will you have a settling tank?

Reply

The "sludgy" material that settles from the water in the sumps is removed periodically, mixed with the contaminated soil and processed through the thermal desorption unit. The sump pumps are positioned 2" to 6" off the sump bottom to prevent clogging of the pumps with sludge and to prevent large amounts of solids from being carried over to the water treatment system. The sump water and blowdown water are pumped to a frac tank to allow additional time for settling prior to being filtered (200 μm filter maximum) and treated by the carbon units for use as process water. Page 27 of the workplan has a brief summary of the water treatment system.

5. Page 20, 3rd full paragraph: How will contaminated debris be distinguished from clean debris?

Reply

The approach is the same as that used during building demolition and soil removal activities. A paragraph will be inserted on page 20 and will read as follows:

The ultimate fate of the debris found at the Woods Site will be limited by the individual material's character and degree of contamination. Where appropriate, the material will be re-used or recycled. No visibly contaminated material will be recycled or disposed of in a sanitary landfill or municipal landfill. If the material is believed to be contaminated based on visual observation, the material will be cleaned, if practical, or disposed of at a facility permitted to accept the waste as appropriate.

6. Section 3.5 add quench water to the list of residual streams.

Reply

Scrubber water blowdown is the same as quench water and is listed in paragraph 3.5.

7. Westates is presently out of compliance and is not acceptable as a location for accepting the spent carbon until they are in compliance. BNR[R] may want to locate some other alternative disposal facilities that are in compliance.

Reply

Westates has another facility located in Morgantown, West Virginia. According to Westates, the Parker, Arizona facility had another inspection which was conducted by Region 9 of the USEPA and found to be in compliance.

8. Section 3.5.3 Run-off Water: Water from run-off will be collected in modu-tanks, how will that water be transferred to the carbon waste water treatment equipment?

Reply

The text has been revised to read " . . . stored in three frac tanks . . . . This is consistent with Figure 12-1. Water will be transferred via pumps and piping. The process flow for this operation is included in Figure 3-1.

9. Section 3.5.3 Run-off Water: Language should be added to this section that states that carbon-treated run-off water will not be used to control dust from treated soil or condition treated soil AFTER that soil has been sampled and determined to comply with cleanup levels. For soils that have already been confirmed as meeting cleanup levels, only city water may be used for dust control and conditioning of these soils.

Untreated run-off water may not be used for dust control or conditioning associated with ANY treated soils. What will be used for dust control on haul roads?

Reply

Section 3.5.3 has been revised to concur with this comment. City water will be used as a dust control on haul roads.

10. Section 3.5.4 Scrubber Water Blowdown: Similar to the above comment, only city water can be used to condition soil or control dust on treated soils that have already passed confirmatory sampling and been shown to meet cleanup levels. This paragraph should state as such. This requirement is based on the assumption in the work plan that sampling of the treated water is not necessary because "acceptability is determined by the criteria that it does not affect treated soil quality (pg. 21 section 3.5.3).

Reply

Section 3.5.4 has been revised to concur with the above comment.

11. Section 3.5.5 Baghouse Dust: This section does briefly discuss the Dobson Collar, however, somewhere in the work plan a more detailed discussion should be made that explains the length of the residence time and how it was determined, the impact of the decreased air velocity, how the baghouse will be receiving "full, controlled treatment", how the baghouse feed will be controlled back into the dryer, etc. Additionally, a mechanical drawing or engineering diagram of the collar should be included. Additionally, page 24 of the Work Plan, Thermal Desorber section is a place that a detailed discussion of the Dobson Collar should appear.

Reply

Appendix U has been added to include additional information about the Dobson Collar. The text has been revised to reflect the above comment.

12. TPU3, Process Flow Diagram: In this diagram, oversized materials are specified as going to off-site disposal. Disposal depends on sampling results. As agreed, if sample results are below clean-up levels, then the cobbles can be disposed on-site. If data shows that the cobbles will be disposed on-site, please correct this statement.

Reply

The Process Flow Diagram has been revised to reflect the above comment.

13. Page 51, Table 7-2: Add nickel to the list of metals. What about Table 7-3 starting on page 53.

Reply

Nickel has been added to Table 7-2. Nickel was not analyzed for during RI/FS.

Section 4: Equipment Description

1. Page 23: EPA would like more information about the equipment used to separate the cobbles, e.g., how is it designed and will it be on the pad? The Agency is concerned that the undersized cobbles and fines could fall off the separator and on to the ground instead [of] entering the feed mechanism?

Reply

The screening operation will either be done on the wastefeed pad or in the immediate area of the pre-existing stockpiles so as not to contaminate any additional areas. The screening equipment will be selected upon approval of the work plans. This machine will be leased from local vendors in the area.

2. Page 24; 1st eight lines: This paragraph discussed engineering controls to minimize dust emissions. However, specifics regarding the use of engineering controls are not provided. EPA understands that BNR intends to use water to control dust that may be generated from haul roads or the stockpiles. However, what engineering controls will be used to control dust that will be generated from, unloading soils from the front end loader, the screening process to separate cobbles and the feeding of soil into the treatment unit. EPA and BNR have briefly discussed these concerns but at present these concerns are still unresolved. BNR has agreed to find out more about the construction of the screening equipment and feed conveyor, for example, can the conveyor be covered or is it constructed to mitigate effects from wind?

Reply

The text has been edited such that engineering controls have been changed to administrative controls such as speed limits, and covering dump trucks during transport, if necessary. One additional sentence was added to the last line of the paragraph and reads as follows: "Depending on the site conditions, engineering controls such as Williams covering conveyors and screens for the feed handling equipment will be implemented upon agreement between Williams, Burlington Environmental, BNRR and the EPA."

3. Page 26, Quench Tower section: This section states that the blowdown water will be treated by the unit's wastewater treatment unit. The Process Flow Diagram TPU3 does not show quench water entering the wastewater treatment unit.

Reply

The Process Flow Diagram shows the blowdown line leaving the quench tower and scrubber.

Section 5: Project Schedule

1. Page 34 and Figure 5-1: The time frames described in these 2 pages appear to contradict each other.

Reply

Page 34 has been revised to reflect the schedule in Figure 5-1.

2. Page 34, 4th paragraph, last sentence: Add "interim" after "performance test" and before "and normal."

Reply

The text has been revised to reflect this comment.

3. Page 34, 4th paragraph, 1st sentence: add "only the" after "roll-off boxes, including."

Reply

The text has been revised to reflect the above comment.

Section 6: Process Control, Monitoring, and Emergency Procedures

1. page 40. n: Where does the solids from inside the scrubber go?

Reply

Solids from the scrubber will be blown down and/or vacuumed from the unit and processed through the thermal desorber. No addition to text.

Section 7: Performance Criteria

1. Page 49, clean-up goals and Table 1-1 in the Performance Test Plan: Do not round off the numbers. Use the number as specified in the MTCA Method B Tables.

Reply

The table will be modified to agree exactly with MTCA Method B Tables.

2. Page 51, add dioxin and furans to the list of PICs.

Reply

These compounds have been added to Table 7-2.

3. Page 51, footnote 2: provide the data as an addendum to the Work Plan or future revisions.

Reply

TIER I and TIER II levels are shown in Table 7-3 on pages 53 and 54.

Section 8: Performance Test Plan

1. Page 58, 2nd paragraph, last sentence: The Work Plan specifies that the independent oversight [stack testing] contractor's qualifications will be submitted for EPA review and approval. When will this information be provided?

Reply

The stack sampling contractor's qualifications will be submitted after the approval of the work plan and performance test plan so that competitive bidding can be performed for contracting purposes.

2. Pages 60 and 61: These two tables specify that sampling locations are the "discharge screw conveyor or treated soil." Note that samples should not be taken before soil conditioning with treated water has occurred.

Reply

Sample points from either the discharge screw conveyor or treated soil stockpiles occur after soil conditioning has occurred.

Section 12: Mobilization

1. Site Layout Map - The boundaries of the exclusion zone and the support zone are not clear. For example, does the support zone include everything not in the exclusion zone? Does this mean that the proposed verification holding area and the contaminated stockpiles are not in an exclusion zone but rather a support zone? The lines defining the exclusion zone are difficult to differentiate from other lines on the map. We assume the exclusion zone includes all the equipment the waste feed stockpile area and the verification holding area (as opposed to the proposed verification holding area at the south end of the site). If this assumption is correct, workers involved in hauling

contaminated dirt or are in close proximity to the stockpiles should wear appropriate protective equipment. Other people should be prohibited from these areas.

Reply

The exclusion zone includes the following: wastefeed stockpile, the portion of the equipment pad supporting the dryer and baghouse, and the treated soil verification holding area. The support zone includes the area adjacent to the exclusion zone, including the equipment pad for the oxidizer, quench/scrubber and frac tanks. Excavation areas will be considered to be exclusion zones as well. Revisions have been made to Figure 12-1 to more clearly define the exclusion zone.

2. Haul roads, material handling areas and traffic flow patterns should be identified on a similar map. A plan describing the sequence of moving soil from the stockpile areas to the treatment unit should be provided. Are you planning on completing the treatment of the north pile before starting on the south pile or are you considering doing the south pile first?

Reply

Hauling routes are shown on Figure 12-1. All material handling operations will take place on the wastefeed material pad. Williams proposes to begin hauling soil for treatment from the south stockpile. This material will be stored on the wastefeed pad to await processing by the unit. After the soil has been treated and verified to meet clean-up levels, it will be used to begin backfilling the excavation area directly behind the Ackland Building. Williams plans on completing treatment of the north stockpile first to enable additional soil removal activities to begin from under the storage area.

3. Does the proposed verification holding area in the south end of the site have a different purpose than the verification holding area located near the treatment unit? Is there going to be a pad to prevent run-off and an underlining to prevent contamination in the proposed verification holding area? How do you plan to keep holding piles separate, especially piles being held pending sample results from piles that require re-treatment because they failed to meet cleanup levels? Is there adequate space to hold all piles on the holding area near the equipment or is overflow expected to end up in the proposed verification holding area?

Reply

The verification holding areas (north and south) serve the exact same purpose - to hold treated stockpiles pending analytical results. There will be a pad to prevent run-off, but no underlining. Stockpiles will be kept separate by visual observation. Piles will be kept in the verification holding area until analytical results indicate the piles have passed the clean-up criteria.

4. Are you going to be using an oxygen supplement? If so, it should not be stored near the gas supply.

Reply

Williams will not be using an oxygen supplement.

5. Where is figure 12-1? Is it S-1? Figure numbers and references to figures in the text do no always match.

Reply

See comment #3 of Section 3. No addition to the text.

6. Only one fire hydrant is identified on the Site Layout. It is located outside the fence line. Will it be accessible from inside and outside the fence? Are other hydrants located on-site to be used for emergencies? Other hydrants should be identified.

Reply

One fire hydrant is located just north of the main entrance gate outside the fence. Another fire hydrant is located on-site just southwest of the Akland office building, which is accessible from on-site only. Both fire hydrants are accessible for use in case of an emergency.

7. The Site Layout only shows one access point into the site. I believe there is also one on the north end of the site, but it is not shown. Will this access be used and for what purposes? There should be some access on the south end of the site for emergency exits.

Reply

There are three (3) access gates to the site. There is one along the north fence line at the northwest corner of the site. There is one along the south fence line at the southwest corner of the site. The eastern gate is the main gate which will be used for general delivery and parking. This can be seen in Figure 12-1.

8. The location of the personnel decon is in an inconvenient location for leaving the exclusion zone and entering the support area, leaving the site or entering the office area. It should be better located.

Reply

Figure 12-1 will reflect the addition of a decon unit. The decon trailer has been located adjacent to the control trailer. See revised figure 12-1.

9. How will the public be handled? Can they enter the office or the support area? What about deliveries to the site? How is access controlled? A security booth should be located at the east access to the site.

Reply

See Section 10, page 62 of the work plan. No addition to the text.

10. Will haul roads be cleaned automatically or is BNR going to sample first? Will the roads could be scraped with the earth moving equipment and then treated in the thermal unit? If BNR is going to sample first in lieu of scraping, EPA will need to review and approve a sampling plan for the haul roads.

Reply

Two composite samples will be collected of surface soils in the areas used for haul roads. One composite sample will be collected from roadways north of the feed processing area and one composite sample will be collected from roadways south of the feed processing area. Each composite will be formed from three (3) aliquots collected from stations evenly spaced along the roadway. Analytical results will be compared to the clean-up levels for p,p'-DDT, hexachlorobenzene, DDD, DDE, and dieldrin developed for the site and used during soil removal activities. Should analytical results indicate a roadway containing concentrations above the clean-up level for any of these parameters, the roadway will be cleaned and re-sampled for verification purposes.

11. How will run-off from the haul roads and storage areas (south holding area) be handled?

Reply

Provisions for run-off from the haul roads are not being considered because dump trucks will be used to transport the contaminated material to the wastefeed area. Precipitation is generally light, with the rate of evaporation exceeding precipitation. If necessary, the treated stockpiles in the south verification holding area will be covered to prevent water from coming in contact with the piles.

12. On TPU #3 Soil Remediation Unit - General Arrangement the guy wires specify 10 degrees of rotation. What does this mean?

Reply

Two of the guy wires have been rotated 10° off-center so that they would fit the site constraints and unit configuration.

13. How are the pads constructed? Do they overlap with existing concrete pads such that seams may be present or will new concrete be pored over the existing concrete surface? Our concern is that the seams could leak. A detailed plan of the pad is needed e.g., ensure liquid containment, are expansion joints going to be used? Where will the sumps be located? How are you going to be catching drippings from equipment?

Reply

New pads will be poured over the existing concrete pads where appropriate (either concrete or concrete/asphalt). Pad details have been submitted to the USEPA. Drawings of the pad are shown on Figures 12-3 and 12-4.

14. Discuss the precautions that will be taken to protect the public and workers in the area from hazards associated with the construction of the unit on-site.

Reply

Precautions taken during construction of the unit on-site are outlined in Section 6 of the Site Specific HASP. The public will not be at risk during this time.

15. There is some lack of consistency between the language used in the text and that used on diagrams, for example, the text refers to "treated" and "untreated piles" while the diagram specifies "verification areas". Also, is the interim storage area the same as the "verification holding area"?

Reply

Figure 12-1 has been corrected to identify treated soil verification holding areas. Interim storage area is the same as verification holding area. The text has been revised to reflect the above comment.

16. The text refers to the vehicle entrance while the diagram does not identify one.

Reply

The vehicle entrance is identified as the main gate in Figure 12-1. No addition to the text is required.

17. BNR is apparently responsible for sampling underneath the stockpiles and the haul roads. However, who is responsible for cleaning up the pad and haul roads (assuming they are found to exceed cleanup levels?)

Reply

The pad will be cleaned by pressure washing as outlined in Section 12.5, page 69 of the Thermal Desorption Work plan. All water will be collected in the sumps and treated. Haul roads will be cleaned as necessary and as directed by BNRR in agreement with the EPA.

18. What are your plans for vehicle control and parking?

Reply

Only vehicles needed for operations on-site will be allowed within site boundaries. Parking will be available for a limited number of vehicles directly in front of the Ackland Building. No addition to the text is required.

19. What is the design of the decon equipment pad? Is this the best location for it? How will run-on and run-off be controlled?

Reply

Williams' equipment will be decontaminated on the equipment pad to be constructed. The equipment decon pad shown in Figure 12-1 is an existing pad from the previous removal/remedial action. All water collected will be pumped to the frac tanks prior to carbon treatment.

20. Where will the pressure cleaning be done? How will that area be cleaned?

Reply

Pressure cleaning of the equipment will be done on the equipment pad. The pad, as per page 69, paragraph 2, will then be given a final cleaning by high pressure wash. All water will be collected in the sumps and treated.

21. Page 68, section 12.5, Pad and Equipment Decontamination, 2nd paragraph: What happens with the soil residues removed from the unit?

Reply

Soil residues are removed from the unit by heating the soil to approximately 800°F for one hour, as per paragraph 3, Section 12.5, page 68. Residues exiting the unit are handled as treated soils and removed to the interim storage area for subsequent analysis.

22. Page 68-9, section 12.5: The sequencing of the decontamination of the thermal unit and work areas is not clear. This process should be listed in steps. Where will the remaining soil and baghouse residues go? How will the remaining residual material be

treated if the equipment is being cleaned out? What will happen to soil collected during the decontamination and dismantling process? How will it be disposed of?

Reply

Decontamination Sequence:

- Operate unit at 800°F for one hour to treat and remove all remaining soil residue. Any remaining baghouse dust is fed into the Dobson Collar for further treatment prior to discharge. All soils exiting the unit are removed to the interim storage area for subsequent analysis. All soils and sediment collected from the work pad will be processed through the unit.
- Clean interior of scrubber of any residues. Test residues for contamination and process accordingly.
- Pressure clean feed system and stacking conveyor and dismantle.
- Pressure clean screw conveyor and remove.
- Wash and pressure clean exterior of rotary dryer and baghouse. The interior of the baghouse will be free of residues because of its pulse jets of compressed air.
- Clean the exterior surface of the quench.
- Wash and pressure clean exterior surfaces of remaining equipment.
- Disassemble equipment.
- The containment pad will be given a final cleaning by high pressure wash.
- All decon water will be collected and treated on-site by activated carbon adsorption.

23. Page 69, 2nd and 3rd paragraph: A "decontamination (or interface) trailer" is mentioned but does not appear on the site diagram. The text mentions 2 access gates. These do not appear on the site diagram. What are normal operating hours? How will the entrance be controlled? How will people be kept from just wondering on-site?

Reply

A decon trailer is not mentioned on page 69, paragraphs 2 & 3, but will be included on Figure 12-1. Security and site access are detailed in Section 10, page 62. Four (4) access gates will be shown on Figure 12-1. Normal operating hours will be 24-hours per day.

24. Page 69, 1st full paragraph, 2nd sentence: delete "if necessary".

Reply

No

25. Page 69. Has Williams obtained the City of Yakima wastewater discharge permit?

Reply

No. Water would need to be collected and sampled prior to obtaining a city discharge permit.

Section 14: Health and Safety

1. Page 71: Who is the Health and Safety Officer?

Reply

No Health and Safety Officer has been assigned to this project yet. No addition to text.

Section 15: Project Quality Assurance/Quality Control

1. Page 74: What labs are going to be used?

Reply

No lab has been selected yet; however, Williams will submit the selected laboratory Qualifications and Experience and their Quality Assurance plan when a lab has been selected. Selection of the lab will be made after the workplan and performance test plan approvals and the work required goes out for bid. No addition to text.

Section 16: Remedial Action Plan

1. Page 78, number 5: add the EPA OSC name and telephone number and the EPA Technical Advisor. They are as follows: Lynda Priddy (206) 553-1987 and Cathy Massimino (206) 553-4153, respectively.

Reply

Text has been revised to reflect above comments.

Appendix A: Performance Test Plan

1. Table 1-2: I believe Ecology has a new ASILs for DDD [DDE]. That number should be used.

Reply

The ASIL for p'p'-DDE will be added to Table 1-2.

2. QA/QC procedures and plans for additional excavation under the north and south stockpiles should be supplied.

Reply

This additional excavation does not affect the Performance Test Plan.

QA/QC procedures and plans for additional excavation under the north and south stockpiles are the same as those used and approved by the EPA for soil removal activities and are described in the Soil Removal Work Plan, dated March 17, 1993.

3. Figure 3-3: Sampling spot 5 is not described on page 3-13.

Reply

No sampling is planned at this location. Figure 3-3 will be modified and the sampling location removed.

4. Table 3-6: Add to the procedures that samples should be taken after the treated water is added to the soil for conditioning or quenching.

Reply

The procedure will be clarified in Table 3-6.

5. Pages 3-22 and 3-23: Nickel should be listed with the other metals.

Reply

Nickel is listed on both pages. No addition to text.

Attachment 1: Quality Assurance Project Plan

1. Table 5-1: What about samples for metals in treated soil?

Reply:

Specifying samples for analysis for metals in the treated soil on Table 5-1 was inadvertently omitted. The table will be modified.

Cathy Massimino's Comments

General Comments

1. The modifications to the thermal treatment process to address the baghouse dust treatment (e.g., Dobson collar, dust feed rate monitoring mechanism, setting AWFCO for maximum dust feedrate, engineering drawing and equipment descriptions including the Dobson Collar, heat balance, etc.), need to be cohesively added to the workplan. Except for indications on some of the figures (e.g., Figure 3-1, etc.) the document does not describe or reflect the necessary revisions to incorporate this modification. The revisions are expected to be reflected in the narrative, tables, figures and appendices.

Reply

The baghouse dust feed rate is a direct function of the waste feed rate that will be an AWFSO. The performance test will be run using "worse-case" material from the site and soil cleanup criteria will be demonstrated. Return rate of baghouse dust will always be a similar percentage of the waste feed. The volume of baghouse dust is estimated to be less than 5% of the feed volume and will be controlled by the feed rate. Separate measurement is not necessary since sampling of the treated soil will be done on a routine basis during normal operation throughout the site cleanup. However, during shakedown, Williams will incorporate a solids flow meter to measure the flow of baghouse dust to the Dobson Collar. If the device doesn't work as expected, the EPA will relieve Williams of the AWFSO requirement on baghouse dust flow for the remainder of the project. No addition to the text is required.

2. Any additional revisions to this document should be provided in the form of revised pages. It is also recommended that the pages be annotated to reflect the changes.

Reply

The text has been revised to reflect the above comment.

Specific Comments

1. The baghouse was not listed in mass balance, but its particulate removal was accounted for.

Reply

The "kiln off-gas" outlet and "secondary off-gas" are shown on the heat and mass balance to account for the particulate removal from the baghouse. No addition to text.

2. Page 19, revised to reflect that >2" material will be screened out while page 25 [23] still reflects 3".

Reply

The text has been revised to reflect the above comment.

3. Page 35, should reflect that authorization for full production will be based on the final performance test report including the risk assessment addendum.

Reply

The text has been revised to reflect the above comment.

4. Figure 5-1, still does not reflect interim operation.

Reply

Interim operation is reflected in the production schedule.

5. Page 36, §6 should reflect feedrate monitoring and recording on a per minute frequency not per hour.

Reply

Monitoring and recording is on a per minute basis. The units are on a unit per hour basis.

6. PIDs and Table 6.2, only some of the AWFSO parameters are reflected with pre-alarms to alert the operator of a problem so it can be corrected before it goes outside of the acceptable limits. It is strongly recommended that all AWFSO parameters have pre-alarm limits set.

Reply

The PID drawings and Table 6.2 have been checked for accuracy and correlated accordingly. Williams is currently reviewing control philosophy and making

recommendations for engineering pre-alarm limits for various AWFSO parameters.

7. Pages 38-45, should be reviewed for consistency with pages 3-18 and 3-19 of the performance test plan (Appendix A).

Reply

The text has been revised to reflect the above comment.

8. Page 38, item e, should reflect that an instantaneous desorber off-gas temperature of 450°F will result in waste feed shut-off. The concept of totally shutting down the desorber and the thermal oxidizer if maximum temperature are exceeded, is a matter grave concern. The fuel should be cut back as necessary to return to a safe operating mode maintaining the system within required operating temperatures while waste is still within the system. The AWFSO's apply at all times while waste is within the system.

Reply

It is implicit in the operation of the burner management package that if the burner is shut down an AWFSO results. See Table 6.2, page 45. A response for this comment has been inserted into the text and reads as follows:

A thermal oxidizer temperature of approximately 1800°F (permit condition) has been selected. If the temperature rises above 2000°F, the operator will manually begin to decrease the fuel to the burner. If the temperature is still increasing and exceeds 2100°F then the thermal oxidizer burner will be shut-down causing both an AWFSO and primary burner to be shut down, also. The 2100°F limit is to protect all down stream equipment.

9. Page 38, item c, should reflect a feedrate in pounds/minute, and include an instantaneous feedrate AWFSO limit.

Reply

The read out of the present scale is in tons/hour. Williams will add an instantaneous high feed rate AWFSO limit. The AWFSO limit will be determined during the shake down and performance test period.

10. Page 39, item g, should also reflect an instantaneous low soil temperature cut-off.

Reply

No. See response #15(1).

11. Page 39, item h, should also reflect an AWFSO.

Reply

The text has been revised to reflect the above comment. See also Table 6.2, page 49.

12. Page 40, items s. and q, and Table 6.3, a demonstration of whether a back-up emergency generator is necessary needs to be addressed.

Estimated risks associated with power failure causing a shut down of the unit are presented in the revised AAQIR. The conclusion is that a backup generator is not required.

13. Page 41, item v. the AWFSO for these parameters will initially be set during clean soil shakedown. These limits must be accepted by the Agency prior to start-up with contaminated soil. Final limits will be based on the performance test.

Reply

Williams concurs. No addition to the text is required.

14. Table 6.1, pages 42-44, this table incorrectly reflects only exceedences of the CO limit as an AWFSO. Also, needs to be revised to reflect CO corrected to 7% O_2 and revised range of 3000 ppm.

Reply

The text has been revised to reflect the above comment.

15. Table 6.2, need to revised as follows:

1) Include thermal desorber exit soil temperature instantaneous minimum limit and reflection that soil temperature parameter does not apply during first 20 minutes a after start-up.

Reply

During our meeting of February 2, 1994, it was discussed that either gas temperature or soil exit temperature would be used as an AWFSO. Williams has chosen the soil exit temperatures to be used to initiate the AWFSO based on a 20 minutes rolling average. A twenty minute delay has also been agreed to for the first twenty minutes of starting to allow one retention volume of soil to approach the thermocouple. Williams disagrees with an instantaneous AWFSO for low soil temperature. Again, if there is a stoppage of feed for several minutes, that stoppage of feed will be seen as a low temperature one retention time volume

later. If instantaneous feed AWFSO is initiated, the unit would be forced down because no soil was passing over the thermocouple. Therefore, Williams respectfully requests that no instantaneous AWFSO for low soil exit temperature be imposed.

2) See comment 13, above for packed bed scrubber flowrate, APC purge rate, and stack gas flowrate.

<u>Reply</u>

Williams concurs. No addition to text is required.

3) See comment 9, above for the thermal desorber maximum feedrate.

<u>Reply</u>

No.

4) Footnote 4 should also reflect recorded continuously except for ID Fan Failure, Power Failure, Loss of water to Quench.

<u>Reply</u>

The text has been revised to reflect the above comment.

16. Pages 48-49, needs to be amended to include dioxins and furans.

<u>Reply</u>

One sample of the treated soil will be collected for dioxin and furan analysis during each run of the performance test, for a total of three samples. The samples will be composited from 15-minute grab samples collected during the testing. These results will be compared to the levels agreed to between BNRR and the EPA.

17. Page 51, needs to be amended to include nickel and dioxins and furans.

<u>Reply</u>

The text has been revised to reflect the above comment.

18. Table 7-3, needs to be evaluated in conjunction with the risk assessment/air quality document. It is assumed that these documents will address the site specific dispersion modeling for the compounds that failed the Tier II analysis, as well as performance of a total risk evaluation versus per compound. Also, the level of free chlorine should be assumed to be 20% of the HCl level.

Reply

The revised AAQIR addresses site specific dispersion modeling for compounds that failed the TIER II analysis as well as performance of a total risk evaluation versus per compound. The assumption regarding free chlorine has been incorporated into the revised AAQIR. All values are less than TIER III limits.

19. Page 74, indicates data from Kaye data logger will be used to fill out the roundsheet. According to page 3-5 of the performance test plan, Appendix A, certain AWFSO parameters (e.g., baghouse pressure, packed bed pH, stack gas flow indicator) are missing from the data logger. The data logger must be upgraded to continuously record all AWFSO parameters, as well as indicating when a parameter has exceeded its AWFSO limit. Provide an example print-out from the Kaye data logger with the AWFSO parameters for this project.

Reply

The description on page 3-5 of the performance test plan will be changed to reflect the comment. All parameters with AWFSOs will be continuously recorded. An example of the print-out form from the Kaye will be provided when it is programmed specifically for the Woods project.

Appendix A

1. Page 1-2, revised first bullet to address dioxins and furans. Also, replace discussion on what will occur if standards are not met.

Reply

One sample of the treated soil will be collected for dioxin and furan analysis during each run of the performance test, for a total of three samples. These results will be compared to the levels agreed to between BNRR and the EPA. There is no discussion on page 1-2 on what will occur if standards are not met.

2. Page 1-3, discussion on PIC needs to clearly state that meeting acceptable risk limits is one of the performance standards which must be met for the performance test to be deemed successful.

Reply

A general statement has been made as requested.

3. Pages 1-3, 3-12, 3-13, and Table 3-4, should provide the correct EPA method numbers for all the sampling protocols.

Reply

Addition of the appropriate method numbers will be made as follows:

- **Particulates, hydrogen chloride, and chlorine using EPA Method 5 sampling train modified for the collection of acid gases (BIF Method 0050)**
- **OCL Pesticides and Semi-volatile Organic using EPA Modified Method 5 sampling train (SW-846 Method 0010)**
- **Volatile organics by Volatile Organic Sampling Train (VOST SW-846 Method 0030)**
- **Metals by EPA Multiple Metals Train (BIF Methods Manual –NOTE: THEY WANT DRAFT METHOD 29)**
- **PCDDs/PCDFs by EPA Method 23**
- **Continuous Emission Monitor for CO by EPA Method 10(40 CFR 60) and O2 by EPA Method 3A (40 CFR 60).**

4. Page 1-1, revise to include dioxins and furans.

Reply

There is no appropriate place to include dioxins and furans on page 1-1. Change will be made per comment 1 to page 1-2.

5. Table 1-2 needs to be evaluated in conjunction with the risk assessment/air quality document. The evaluation of dioxins and furans needs to be broader, not just 2,3,7,8-TCDD.

Reply

As stated in the text, total equivalent 2,3,7,8-TCDD (TEQ) will be calculated. It is planned to compare this total equivalent to the ASIL for 2,3,7,8-TCDD. Table 1-2 will clarify that the allowable stack gas emission is TEQ. A footnote will be added to the table. No change is planned at this time to incorporate remaining PICs since individual limits are not the concern, rather the total risk comparison.

6. Table 2-1, the operating range for ID fan current and APC recycle water flow rate must be established during the clean soil shakedown. These limits must be accepted by the Agency prior to start-up with contaminated soil. Final limits will be based on the performance test.

Reply

As specified, these limits will be established during clean soil shakedown, approved by the agency and verified during the performance test. This will be clarified by changing Footnote c of Table 2-1.

7. Page 3-6, the thermal desorber exit gas temperature low limit for use during the first 20 minutes of operation after startup will be set based on the performance test.

Reply

Based on past experience, the 250°F unit is an excellent alarm setpoint because it prevents the possibility of water condensation while maintaining a wide operating range during start-up which minimizes both AWFSO and unit shutdowns. It should also be noted that the exit gas temperature does not impact the efficiency of the thermal oxidizer.

8. Page 3-6, the concept of totally shutting down the desorber and the thermal oxidizer, if maximum temperatures are exceeded is a matter of grave concern. The fuel should be cut back as necessary to return to a safe operating mode maintaining the system within required operating temperatures while waste is still within the system. The AWFSO's apply at all times while waste is within the system.

Reply

In the event the high temperature from the thermal oxidizer is exceeded, shutdown of the fuel is required to protect downstream equipment. The control system already would have cut back in an attempt to control the exit temperature. The condition would indicate that a problem existed in the burner control which would need to be corrected. The burner would be restarted as soon as the high temperature condition cleared and the associated burner control problem was corrected.

Also see comment #8 of Cathy Massimino's General Comments.

9. Page 3-7, the operating range for ID fan current must be established during the clean soil shakedown. This limit must be accepted by the Agency prior to start-up with contaminated soil. Final limits will be based on the performance test.

Reply

This is consistent with comment 6 above. A statement will be added to clarify that the limit will initially be established during clean soil start-up and accepted by the agency before start-up on contaminated soil.

10. Page 3-14, §3.6.1, provides procedures for how blending will be performed to assure minimum concentrations provided in the DRE calculation will be achieved.

Reply

The 5 roll-off boxes represent approximately 10% of the total feed planned during the test. Blending will thus be aimed at 1/10 roll-off soil to site soil. Blending should not be critical since the average site concentration of approximately 700 ppm of HCB offers a 1 to 2 order of magnitude safety factor for demonstration of 99.99% DRE. Section 3.6.1 will be modified to state that the soil will be blended approximately 1 part roll-off soil to 9 parts site soil.

11. Page 3-15, §3.6.3, add to bullets the following:

- Compliance with acceptable health based limits for emissions based on the risk assessment/air quality document.

Reply

The text will reflect the above comment.

- **Compliance with acceptable health based limits for emissions based on the risk assessment/air quality document.**

12. Page 3-19, the operating range for ID fan current, APC purge rate and APC recycle water flow rate must be established during the clean soil shakedown. These limits must be accepted by the Agency prior to start-up with contaminated soil. Final limits will be based on the performance test.

Reply

The comment is understood and modification as requested will be made to previous sections of the Plan. This section of the Plan is describing A-1 parameters which will be established as part of the test. At this point in time limits established during shakedown have already been approved. No change is required in this section of the plan.

13. Page 3-20, the thermal desorber exit gas temperature low limit for use during the first 20 minutes of operation after startup will be set based on the performance test data (A-1 parameter).

Reply

See Massimino Comment #7.

14. Page 3-12, the baghouse minimum limit of 1" is based on the baghouse being operated between 1-2" during the performance test. If the baghouse is operated outside of this range during the performance test, the DP will be set based on the performance test data.

Reply

It is recognized that the test will need to be run near the limit as is stated in the plan. No change to the plan language is required.

15. Page 3-23, add risk assessment addendum reflecting results of performance tests.

Reply

A bullet will be added to page 3-23 to indicate the performance test report will contain a risk assessment addendum reflecting the results of the performance tests. The text will reflect the above comment.

16. Table 3-2, amend to include the following:

- instantaneous limits for feedrate and desorber exit soil temperature
- specify soil feed limit in pounds/min
- specify that desorber exit soil temperature not applicable during first 20 minutes of operation
- footnote c and b should refer to clean soil shakedown for setting initial parameter levels
- instrument numbers for failure of ID fan, burner system, and power failure. For the power failure, this is assuming that the data logger has not gone off-line due to the failure.

Reply

All changes will be made except the change to pounds/minute on soil feed rate. This change would require an instrument modification which is not necessary. Instantaneous values of feed rate are recorded each minute and integrated to a 60-minute rolling average value. The units on this recorded value are tons/hr.

17. Tables 3-4 and 3-5, feed soil should be sampled every 15 minutes.

Reply

30 minute intervals were specified since this frequency has been accepted by the EPA at other cleanup sites. Tables 3-4 and 3-5 will be changed to reflect the change to 15 minute frequency. The bracketed amount of (approximately 8 ounces) will be deleted since with the increased frequency one 4-ounce scoop will be sufficient.

18. Tables 3-13 and 3-15, add dioxins and furans.

Reply

One sample of the treated soil will be collected for dioxin and furan analysis during each run of the performance test, for a total of three samples. These results will be compared to the levels agreed to between BNRR and the EPA. This will require modifications to Tables 3-13, 3-14 and the addition of a new table (3-15A Analysis of Dioxins and Furans in Treated Soil).

19. Table 3-25, the operating range for ID fan current, and APC recycle water flow rate must be established during the clean soil shakedown. These limits must be accepted by the Agency prior to start-up with contaminated soil. Final limits will be based on the performance test.

Reply

Footnote b will be changed to say that these operating ranges will be established during clean soil shakedown and approved by the agency.

20. Table 3-26, see comment 12, above on page 3-19, see comment 13, above, on page 3-20, see comment 14, above, on page 3-12, and see comment 16, above on Table 3-2.

Reply

Changes to the table include modification of footnotes c and b to reflect establishment of limit during clean soil shakedown, addition of instantaneous limits on waste feed, minimum thermal desorber soil discharge temperature, footnote that thermal desorber exit soil temperature limits are not in effect during the first 20 minutes after start-up, and addition of a footnote that minimum thermal desorber exit gas temperature will also be established by the test for use during first 20 minutes after startup.

21. Page 4-1, should reflect that authorization for full production will be based on the final performance test report including the risk assessment addendum.

Reply

Page 4-1 will be changed to reflect that authorization for full production will be based on submittal and approval of the final performance test report including the risk assessment addendum.

Attachment 1

1. Page 2-1, see comments 1, 2, and 3, above, under Appendix A.

Attachments 1, 2, and 3 should be provided to the Agency with the performance test notification.

Reply

Section 2 of the QAPP will be made consistent with the changes to the introduction to the PTP.

Donald Matheny's Comments

It appears that the selection of a contract lab(s) is still pending for this project. Once the lab(s) has been selected, a copy of the Laboratory's QA Plan should be forwarded to EPA for review against the requirements found in Tables 1-1 & 1-2 of the Performance Test Plan and Table 10-1 of the QA Plan. These plans should also be incorporated into the site file as relevant supporting documents. Our past comments (11-29-93) regarding the adequacy of past data validation reports for this site are still relevant.

Reply

See Comment 1 of Section 15.

WESTON/Paul Meeter's Comments

General Comments

- Did the emergency release modeling dictate whether a backup ID fan and/or generator were required?

Reply

Estimated risks associated with a power failure causing a shut down of the unit are presented in the revised AAQIR. The conclusion is that a back-up generator is not necessary.

- If treated blowdown water is used during the production burn then it should be used during the performance test and treated soil samples should be taken after treated water application.

Reply

Soil sampling will be occurring throughout operations. Williams does not believe this is necessary. No addition to text.

Work Plan Comments

- Page 32 references an opacity monitor, I thought we agreed to have them perform visible emissions readings. Is opacity an Air Authority requirement?

Reply

Opacity meter will be omitted from text.

- Williams must install an AWFSO for high instantaneous feed rate in addition to the 60 minute rolling average.

Reply

Williams concurs with the above comment.

- What are the detection limits for Cadmium and Mercury in Table 7-3 and how do they compare to the TIER I and TIER II limits.

Reply

The detection limits for Cadmium and Mercury in Table 7-3 are 0.30 mg/kg and 0.10 mg/kg, respectively. Assuming a value for Cadmium and Mercury equal to half the detection limit, as is typical, both metals pass the TIER I and TIER II limits. These results will be reflected in Table 7-3.

- Does Williams have any partitioning and removal efficiencies from other projects instead of using guidance document values in Table 7-3.

Reply

No data is available at this time.

- Table 7-2 must include a full volatile and semi-volatile scan plus the next 10 highest peaks should be identified as TICs.

Reply

Williams concurs with this comment.

- The LTTD roundsheet does not contain all of the required operational parameters that will have AWFCO. How will the additional data be provided.

Reply

The text has been revised to reflect the above comment.

Performance Test Plan Comments:

Page 1-3 - Particulate and HCl are measured by Method 5 and 26 or 0050.

Reply

Method clarification will be made consistent with response to Catherine Massimino comment 3.

Page 1-4 - Volatile organics are measured by EPA Method 0030 not Modified Method 5.

Reply

Change will be made as noted consistent with comment 3 by Catherine Massimino.

Page 1-4 - Multi Metals by Draft Method 29.

Reply

Since Method 29 is a Draft method, we will need to compare to the accepted method from the BIF Manual.

Page 3-6 - Should the auxiliary fuel be shut off or just reduced when the thermal oxidizer or the quench exit gas temperature are exceeded. I don't like the idea of zero combustion while waste is still inside the unit.

Reply

No change is planned per the response to general comment 8 by Catherine Massimino.

Page 3-18 - Why is the soil feed rate limit not activated for the first 20 minutes after startup.

Reply

The soil feed rate is activated during the first 20 minutes after startup as was discussed in detail during the February 2, 1994 meeting in Washington. However, it was agreed that the minimum soil discharge could not be measured during the first 20 minutes of operation. Limits for the first 20 minutes of operation following

start up will be consistent with responses to comments by Catherine Massimino on this subject.

Page 3-22 - What information will be included in the draft performance test report. Will it enable our people to do laboratory data validation.

Reply

The data to be supplied for reduction, validation, and reporting is described in section 9 of the QAPP. No change is planned in response to this comment.

Table 3-5 - Feed soils should be sampled every 15 minutes.

Reply

The change will be made consistent with comment 17 by Catherine Massimino.

Table 3-6 - Treated soils should be sampled every 15 minutes.

Reply

The change will be made consistent with comment 17 by Catherine Massimino.

Table 3-8 - The back half impinger water should be saved and analyzed. The entire train should be rinsed with toluene not just the back half.

Reply

Method 23 clearly states in section 4.2.5 that the impinger water is discarded. The procedure will be modified to direct rinsing of the entire train with toluene as specified.

Table 3-10 - The front half rinse should be 50/50 methanol/methylene chloride.

Reply

The procedure will be corrected as noted to rinse with 50/50 methanol/methylene chloride. Both the front and back half rinses will be changed. Correction will also be made to Table 3-14 and 3-23.

Table 3-14 - Semi-volatiles to include full scan plus 10 highest peaks.

Reply

Tables 3-14 and 3-23 will be modified to include this note.

Table 3-21 - Toluene rinse is analyzed separately.

Reply

Our latest direction from the EPA (Larry Johnson) has been to combine these rinses. No change is required.

Table 3-23 - The semi-volatile samples must be spiked with surrogate standards prior to extraction.

Reply

The procedure will be changed to reflect addition of surrogate standards prior to any manipulation of samples consistent with analysis procedures of EPA Method 0010.

Table 3-24 - VOST tube will be analyzed separately for breakthrough determination.

Reply

A statement will be added to Table 3-24 that VOST tubes will be analyzed separately to check for possible breakthrough. The table will also be changed to note the addition of surrogate standards.

Figure 3-5 - The sample probes at ports A and B represent flow disturbances therefore the traverse point criteria for ports C and D will be different than those shown in Figure 3-5.

Reply

The two levels of sampling ports A, B and C, D are approximately 10 feet apart. The projected area of the sampling probe is insignificant compared to the cross sectional area of the stack. It would be expected that the air flow pattern within the stack would reestablish within a few inches of the probe at the A, B level. Therefore it would not be expected that the A, B probe would represent a flow disturbance at the C,D level several feet away.

Figure 3-7 - Does not indicate the required XAD inlet thermocouple.

Reply

Figure 3-7 will include indication similar to Figure 3-9.

Quality Assurance Project Plan

7. Table 4-1	Under OCL Pesticides for stack gas samples: Precision for the duplicate analysis should be within 20 RP if pesticide concentration is above the lowest calibration standard. Precision for the surrogate should be ± on dibutyl chlorendate (DBC) if DBC not diluted out.

Reply

Table 4-1 is consistent with Table 7-3 Summary of QA/QC Procedures for SVOST, EPA Handbook Quality Assurance/Quality Control Procedures for Hazardous Waste Incineration, for all semi-volatiles (OCL pesticides, hexachlorobenzene and other semi-volatiles) that are to be analyzed.

9. Table 10-1	Under OCL Pesticides: Linearity check frequency should be before sample analysis and once every 72 hours. Single point calibration check frequency should be once every 12 hours. Need to specify an injection blank once every 12 hours, as well. Under Total Chlorine: Assume this refers to chloride. Work plan does not specify either potentiometric titration or specific ion electrode. For ion chromatography: no parameters are listed for QA/QC such as, initial calibration/linearity check, continuing calibration, blanks, matrix spikes, etc.

Reply

The text will be revised to reflect the above comment.

General Comments from Conference Call

Comment - Williams should propose a sampling scheme during shakedown operations.

Reply

Table 9-2 of the Work Plan outlines the soil sampling procedures for pre-performance test operations. This period will include shakedown of the unit.

If you have any additional questions, please feel free to call me at 404/879-4075.

Sincerely yours,

WILLIAMS ENVIRONMENTAL SERVICES, INC.

Mark A. Fleri
Project Manager
MAF:js

cc: Z. Lowell Taylor, Williams Environmental Services
Bruce Sheppard Burlington Northern Railroad
David Eagleton - Burlington Environmental
Tom Hippe - Burlington Environmental
Bob Kievit - EPA
Tom Backer - Preston Thorgrimson
General File
Job File

APPENDIX U

NOVEMBER 1994
COMMENT & RESPONSE LETTERS

WILLIAMS ENVIRONMENTAL SERVICES, INC.

November 18, 1994

Ms. Lynda Priddy
Environmental Protection Specialist
Hazardous Waste Specialist
United States Environmental Protection Agency, Region X
1200 Sixth Avenue
Seattle, Washington 98101

Subject: Woods Industries Site
Yakima, Washington
Transmittal No.: 0047
Number of Pages: 5

Re: Responses to EPA's Comments Received October 24, 1994
Williams Project No. 0365

Dear Ms. Priddy:

Williams Environmental Services, Inc. (Williams) has received the EPA's comments on the April 1994 revised pages to the Thermal Desorption Workplan and has provided the responses outlined below. Where applicable, these responses have been incorporated into the workplan. In addition, the workplan has been finalized to reflect the use of TPU #4 at the Woods site.

Comment 1

The workplan is not intemally consistent with respect to the AWFSOs that are required for this project. Appendix A, Table 3-2, accurately reflects the AWFSOs for this project, until revisions are approved by the Agency based on the clean soil shakedown or performance test. It is strongly recommended that other Tables or narrative in the workplan that list these AWFSOs refer to this table.

Response 1

The workplan has been made internally consistent with respect to the AWFSOs shown in Appendix A, Table 3-2. Additionally, reference is made to Table 3-2 in the narrative portion of the workplan.

Comment 2

Page 17,§3.2, if treated soil does not pass the required treatment criteria, and there is not a legitimate reason to question the acceptability of the sampling procedures or the analytical results (i.e., QA/QC requirements are not met, etc.), the treated soil must be retreated and not resampled.

Response 2

Williams concurs with this comment.

Comment 3

Pages 20 and 25, §3.5 and 4.1, there is still an inconsistency.with the limitation of the size of debris to process in the desorber. We originally agreed that the cobble cut-off size would be 3" unless it was demonstrated the equipment could not handle 3".

Response 3

Sections 3.5 and 4.1 have been revised to show a cutoff size of 3" unless it is demonstrated that the equipment cannot handle debris this size.

Comment 4

Page 21, item 19, provide example print-out of desorber AWFSO data logger with the final work plan.

Response 4

An example printout from the data logger has been provided in Appendix X.

Comment 5

Page 21, §3.5.2, the sump sludgy material, when fed to the desorber with or without the contaminated soil, must comply with the operating and feed restrictions on the desorber, as well as assuring that the performance test adequately addresses this material.

Response 5

Sludgy material collected in the sumps will be fed to the desorber in compliance with all operating and feed restrictions. No change to the text is required.

Comment 6

Page 22, §3.5.3, the issue of the compliance status of the facility that will receive the spent carbon should be revisited prior to sending the material off-site.

Response 6

Westates Carbon's disposal/regeneration facilities have already been shown to be in compliance with applicable rules and regulations. However, their compliance status can be re-verified prior to sending any carbon off site.

Comment 7

Page 28, the issue of whether the baghouse dust feedrate monitoring proves successful does not affect the requirement for shutdown of the feed of the baghouse dust to the desorber during AWFSOs.

Response 7

If an AWFSO occurs, the baghouse dust feed to the desorber will be stopped along with the waste feed to the desorber.

Comment 8

Page 53, Table 7.1, add dioxins and furans to this table.

Response 8

Dioxins and furans have not been added to Table 7.1. As stated in the USEPA's April 20, 1994, comments on the March 14, 1994, workplan, it was agreed that the quenched (previously contaminated) treated soil would be sampled only once for dioxins during the performance test.

Comment 9

TPU Round Sheet, still does not include all AWFSOs.

Response 9

Figure 15.2 has been updated to show the LTTD roundsheet currently being used.

Comment 10

Section 15, a separate daily manually logged form should be maintained for AWFSOs including description of AWFSO (i.e., low thermal oxidizer temperature), instrument number, instrument reading during event, date and time of the event, duration of the event, cause of the event, corrective actions taken to address the event and minimize future occurrences, time waste feed restarted, record of report of event and time of approval for restart from Agency if greater than 7 AWFSOs within a week.

Response 10

Williams concurs with this comment and has developed a separate daily manually logged form to document AWFSOs. A copy of this form is included in Section 15.

Comment 11

Appendix A, pages 1-4, and 3-13, stack sampling protocols for the continuous emission monitoring should specify 40 CFR Part 266 Appendix IX, Section 2.

Response 11

Williams' LTTD is neither a boiler nor an industrial furnace and its CEMs should not be subject to the BIF regulations as outlined in 40 CFR Part 266, Appendix IX, Section 2. Williams does agree to abide by the regulations as stated in 40 CFR Part 60, Appendices B and F.

Comment 12

Appendix A, Table 3-10, last bullet, correct misspelling of methanol.

Response 12

The requested correction has been made.

Comment 13

Page 68-9, §12.5, the minimum number of baghouse pulse cycles planned, and internal inspection planned to assure the baghouse interior and bags are free of residue needs to be addressed.

Response 13

The minimum number of baghouse pulse cycles planned will be determined once operations have begun. The frequency at which the baghouse is pulsed will depend upon the soil characteristics and the amount of dust carryover that is experienced. In order to ensure that the baghouse interior and bags are free of residue, the baghouse will be inspected upon its arrival on site. It will again be inspected two weeks after operations have commenced and monthly thereafter.

Comment 14

Each pile of treated soil must be labeled with information that correlates with sample numbers and dates of sampling or some system as suggested by Burlington. The purpose is to prevent pile mix-up.

Response 14

All treated soil piles are segregated and tracked to prevent any chance for pile mix-ups. Soil piles can also be identified by flag markers if necessary.

Comment 15

If public interest increases at the site a methodology for accounting for unidentified compounds may need to be added to the performance test plan. For the methodology refer to pages 4-7 of EPA's DRAFT EXPOSURE ASSESSMENT GUIDANCE FOR RCRA HAZARDOUS WASTE COMBUSTION FACILITY (EPA-530 R-94-021).

Response 15

This issue will need to be addressed by both Burlington Environmental and Burlington Northern Railroad if public interest increases to a point that such discussions are deemed necessary.

As mentioned previously, these responses have been incorporated into the workplan where applicable. If you have any questions, please call me at (404) 879-4854 or Mark Fleri at (404) 879-4075.

Sincerely,

WILLIAMS ENVIRONMENTAL SERVICES, INC.

Greg Whetstone

Greg Whetstone
Project Engineer
GTW:cl

cc: Mark A. Fleri
George Harbour
David Eagleton (Burlington Environmental)
Bruce Sheppard (Burlington Northern Railroad)
Paul Meeter (Weston)
Rick Roeder (Washington State Dept. of Ecology)
John Gilbert (USEPA)
Job File 0364

WILLIAMS ENVIRONMENTAL SERVICES, INC.

November 18, 1994

Ms. Lynda Priddy
Environmental Protection Specialist
Hazardous Waste Specialist
United States Environmental Protection Agency, Region X
1200 Sixth Avenue
Seattle, Washington 98101

Subject: Woods Industries Site
Yakima, Washington
Transmittal No.: 0048
Number of Pages: 7

Re: Responses to EPA's Comments Received November 1 and 8, 1994
Williams Project No. 0365

Dear Ms. Priddy:

Williams Environmental Services, Inc. (Williams) has reviewed EPA's comments on the revised Thermal Desorption Work Plan dated October 7, 1994, and has provided the responses outlined below. Where applicable, these responses have been incorporated into the plan.

November 1, 1994, Comments

Comment 1

The Performance Test Plan portion of the Work Plan was not included in this submission.

Response 1

A revised Performance Test Plan will be included with the next submission of the work plan.

Comment 2

Page 5, number 2 and page 25, last paragraph: EPA disagrees with the last sentence "(d)epending on the site conditions, engineering controls such as Williams covering conveyors and screens for the feed handling equipment will be implemented upon agreement between Williams, Burlington Environmental (BE), BNRR and EPA." EPA will review monitoring results or based on visual observations EPA may require mitigation practices which could include engineering controls or shutting down operations until the causes/situations have been remedied (e.g., weather conditions change or other controls are implemented and found effective). Yakima is a non-attainment area for PM10. Because of EPA concerns for PM10, EPA has discussed the use of engineering controls with Williams and BE. BE agreed to investigate the use of engineering controls and to report back to EPA. To date, BE has not reported back to EPA on the potential use of engineering controls such as conveyor and screen covers.

The document states that the "vibratory screening of oversized material will only be performed as needed" to reduce the potential for dust formation. How will this affect the availability of a reliable steady stream of untreated soil to keep the TDU in consistent operation? Why would the screening operation only produce "significant dust" at certain times?

Response 2

Williams has discussed the use of engineering controls with Burlington Environmental (BE) and has agreed to cover the feed soil and stacking conveyors. Additionally, Williams has modified the work plan text to reflect the comment.

Vibratory and shaker screening will be performed to separate cobbles and other debris from the soil stockpiles. The screening operation will not affect the availability of feed soil to the unit for maintaining consistent operations. Enough feed soil will be stockpiled in the waste feed storage area to maintain thermal operations should screening operations stop. Screening operations have the potential to produce dust depending upon soil conditions and characteristics, but Williams will make every effort to minimize fugitive dust emissions.

Comment 3

Page 21, 5th sentence: The "and then processed" we assume means that the sludge will be "processed" through the TDU and will meet cleanup standards. Is this a correct assumption.

Response 3

The comment as stated is correct.

Comment 4

Page 53, footnote 2: Treated soils must meet the cleanup numbers for metals (arsenic, lead and mercury) or be retreated or deposited of as specified in the consent order.

Response 4

Williams' LTTD does not operate at temperatures high enough to volatilize metals from the soil, with the exception of mercury. Williams does not purport that its units treat metals and will not be responsible for treated piles that fail based on analysis for metals. If cleanup goals for metals are exceeded, the soil will be deposited as specified in the consent order.

Comment 5

Page 8, reply number 2: The reply first states that Williams plans to start hauling from the south pile first and later in the reply it is stated that Williams plans to complete treatment of the north pile first. Please correct or clarify. Sampling (and treatment if treatment goals are exceeded) will be necessary under both the south and north piles.

Response 5

Williams will haul from either stockpile as needed but plans to complete treatment of the north stockpile first. Sampling will be performed by BNRR under both piles and additional soil treated if contaminant levels exceed industrial soil cleanup levels established for the site.

Comment 6

Site Layout Map, Figure 12-1: It is unclear from the site layout plan whether there is a decontamination area that permits easy access from the TDU exclusion zone into the office area/parking lot area. There is apparently a decon trailer south of the TDU exclusion area; however, from the site plan it does not seem apparent that someone leaving the TDU exclusion zone and using this decon trailer can enter the office/parking lot area or main entrance area without crossing back over the TDU exclusion area. Previously EPA and BE discussed having the decon area in close proximity to the office.

According to the plan legend, the exclusion area is the area inside the area defined by -x-x-x-x. However, on the plan such an area is also identified as being a support zone (near the tool trailer). Please clarify whether this area is an exclusion zone or a support zone. EPA and BE need to discuss site arrangements in more detail including:

a. the placement of EPA office space;

b. an adequate barrier zone along the Woods fence line as it borders the Haas parking lot in the vicinity of the TDU;

c. parking. The designated parking area apparently will not be big enough to meet all parking needs; and

d. site security. EPA requires that access to the site be controlled at all times. Williams' plan to have visitors report to the office is not controlled access. Whatever controlled access approach is adopted for the Woods site, the approach must ensure that people inside the site can quickly escape in case of an emergency.

Response 6

Figure 12-1 has been revised to reflect the use of TPU #4. As shown in Figure 12-2, the decontamination trailer has been re-located to provide easy access between the exclusion zone and the office area. Additionally, the figure has been revised to delineate the exclusion and support zones. Exclusion zones will include the soil stockpiles, feed and treated soil storage areas, and the thermal desorber and baghouse. Support zones will include those areas around the thermal oxidizer, quench, scrubber, and control trailer.

Items a-d have been discussed between EPA and Burlington Environmental. Currently, it is Williams' understanding that the EPA office will be north of the Ackland building. Parking may be available along the fence line east of the site or at another offsite location. Finally, Williams, BE, and BNRR are currently working on a revised control access approach for discussion with the EPA.

Comment 7

Page 12 of response letter, reply to number 17: Who is responsible for cleaning the haul roads if sampling shows that cleanup levels are exceeded? Is Williams responsible for cleaning the pad?

Response 7

Williams will be responsibile for cleaning the haul roads if sampling shows that industrial cleanup levels are exceeded, provided that Burlington Environmental supplies Williams with the necessary data to verify the cleanliness of the haul roads prior to Williams mobilizing to the site. Williams is responsible for pressure washing the pad at the completion of the project.

Comment 8

Page 13 of response letter, reply to number 22: What happens to the contaminated material collected from performing the activities described in the last nine bullets?

Response 8

Soils or sludge generated as a result of cleaning the unit will be processed through the unit and verified clean before the unit is disassembled. All decon water collected will be treated by activated carbon adsorption.

<u>Comment 9</u>

Page 10 of response letter, reply to number 10: In general the approach seems OK. Regarding the number of grab and composite samples to be taken to determine whether the haul roads and other similar areas meet cleanup levels will be determined toward the end of operations based on the experience of the OSC/oversight staff.

<u>Response 9</u>

Williams believes this issue needs to be settled prior to the end of operations to avoid any unnecessary delays that may arise as a result of differing opinions. Therefore, Williams proposes to sample the haul roads at a frequency of one composite sample per 100 feet of road.

<u>General Comment 1</u>

Spare parts should be readily available on-site for equipment necessary for on-going operations.

<u>Response</u>

Williams concurs with this comment and will store spare parts and tools in the warehouse portion of the Akland building.

November 8, 1994 Comments

<u>General Comment 2</u>

The proposed alternate monitoring parameter and operating range to be utilized instead of soil temperature for the initial 20 minutes must be provided in the workplan.

<u>Response</u>

During the initial 20 minutes of operation, no soil will be discharging from the thermal desorber. Additionally, prior to each time the unit is shut down, Williams will make an effort to empty the desorber of all soil so that no soil will be discharging during the subsequent 20 minutes of startup. Therefore, no alternate monitoring parameter is required.

<u>Comment 1</u>

Pages 19 and 25 are now consistent with respect to the size limitations for input to the desorber.

Response 1

Williams concurs with this comment.

Comment 2

Page 23, the discharge conveyor has been deleted from trailer 1. Indicate which trailer the conveyor will be located at.

Response 2

The discharge conveyor will no longer be included with Trailer 1 or the other five primary trailers. The discharge conveyor will be shipped separately.

Comment 3

Page 31, the drive for the feed belt has been revised to reflect half the horse power of what was originally proposed, though the feedrate projected and the size of the belt and hopper has not changed. Provide data reflecting Williams experience with failure or breakdown of this feed system with this smaller size drive and the originally proposed size drive at the feedrates proposed for this project. If the failure or breakdown frequency is greater with the smaller drive the larger drive should be substituted.

Response 3

The drive for the feed belt on TPU 4 is actually an 8.9 horsepower variable speed drive. The belt drives are designed for site specific characteristics and conditions. Currently, TPU 4 is in use at a Superfund site in New Jersey and the feed system has not experienced any failures or breakdowns. Additional data reflecting Williams' experience with failure or breakdown of the feed system with the smaller size drive versus the originally proposed size drive is not available, though it is very similar to the one originally proposed and in use on TPU 3. However, by the end of the current project, Williams will have knowledge of its performance.

Comment 4

Page 31, based on the revised dimensions of the desorber is the estimate of 20 minutes solids residence time still expected to be reflective of the system?

Response 4

The internal drum dimensions for TPU #4 are the same as those for TPU #3. Therefore, the estimated solids residence time in the desorber remains unchanged.

<u>Comment 5</u>

Drawing 4ABS, it is not clear that this is a complete PID for the revised quench/scrubber system. For example, as depicted there is only one pump feeding the quench system. Since a number of conditions related to the quench relying on this pump can result in AWFSO's (i.e., loss of water, high quench tower outlet temperature, etc.) additional pumps would be expected as part of this system (previous design had 3 pumps feeding the quench). A similar comment can be made concerning the acid scrubber system which previously had two main headers bringing in water while the system now proposed has only one header.

It should be confirmed that the Drawing 4ABS is complete and the system should be updated to assure adequate redundancy/backup to minimize AWFSO's.

<u>Response 5</u>

There are four pumps feeding the quench/scrubber system of TPU 4. One pump supplies city water to the quench, one pump (P27) supplies water to the scrubber packing, and two pumps (P28 and P32) recycle water to the quench. The scrubber system on TPU 4 has only one main header bringing in water instead of the two headers for TPU 3. The scrubber vessel for TPU 4 consists of a single chamber, while the TPU 3 scrubber consists of two scrubbing chambers.

Williams has incorporated these responses into the work plan where applicable. All revisions have been marked accordingly so that they are easily identifiable.

Sincerely,

WILLIAMS ENVIRONMENTAL SERVICES, INC.

Greg Whetstone

Greg Whetstone
Project Engineer
GTW:pc

cc: Z. Lowell Taylor
Mark A. Fleri
George Harbour
David Eagleton (Burlington Environmental)
Bruce Sheppard (Burlington Northern Railroad)
Paul Meeter (Weston)
Rick Roeder (Washington State Dept. of Ecology)
John Gilbert (USEPA)
Job File 0365

State of New Jersey
Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, J
Commission

Post-it™ brand fax transmittal memo 7671 | # of pages ▸ 2
To Greg Whetstone
Co. Williams Envr
Dept.
Fax # 404 879 5748
From R Buskiew
Co. NJDEP
Phone # 609 530 4441
Fax #

RECEIVED
NOV 18 1994
WILLIAMS ENVIRONMENTAL

November 18, 1994

Mr. Greg Whetstone
Williams Environmental Services, Inc.
2075 West Park Place
Stone Mountain, GA 30087

RE: LTVS - Lipari Off-Site Remediation
Trial Burn Plan
Log No. 01-94-0845

Dear Mr. Whetstone:

This office is in receipt of your letter dated October 25, 1994. All of the issues in your letter are acceptable with the exception of item five.

Based on the information provided by you, it is agreed that with a stack gas moisture content 56% an additional 2.3 liters of condensation will be additionally accumulated in the sample train. In order to accommodate the excess moisture, an empty 2-3 liter flask shall be placed before the HNO_3/H_2O_2 impingers as an extra condensate trap. This additional moisture knock-out trap will be sufficient to handle the excess moisture problem.

Regarding the analysis of impingers one through three, EPA Method 29 requires that Fraction 2A (as per Section 5.3.4) be reduced to 20 ml. This is a standard procedure in the method. Section 5.3.4.1 then details how fraction 2A shall be digested and diluted to 150 ml or the appropriate volume for the expected metals concentration. This digested fraction then becomes known as the "Concentrated Fraction 2A". It is this dilution volume that my September 27 letter refers to as a volume of 15 ml. The same is true for Section 5.3.3, instead of diluting to 300 ml the volume shall only be diluted to 30 ml.

If the above procedures are implemented, the test consultant for your facility should be able to obtain the necessary minimum detection limits (mdl) for metals.

A written response to this letter is required before the final protocol approval and the stack tests can be conducted. Failure to provide such a response could result in possible enforcement action.

If you have any questions please feel free to contact me at (609) 530-4041.

Sincerely,

Richelle Burkeen

Richelle Burkeen
Sr. Env. Engineer
Bureau of Technical Services

c Gordon McDonald - Sevenson
Edward Choromanski - SRO

APPENDIX V

DATA LOGGER EXAMPLE PRINTOUT

```
08/05/94.14:22:22 LIMIT  102 KILN VAC   0.00P  ROTARY DRYER VACUUM HIGH
08/05/94.14:25:26 RETURN 102 KILN VAC  -0.13P  ROTARY DRYER VACUUM HIGH
   W.E.S. 15 MIN. SHIFT REPORT.    LAPARI SITE.
08/05/94 14:30:00 15 MIN. REPORT (KORA).
    B.H.-DP        KILN VAC      I.D.AMPS      SCRB-DPL      SCRB-DPR      SCALE         OXYGEN        CO INST.
100   0.3P          -0.14P         0.0A          0.3P          0.3P          0.0T          0.00          0.P

    THC INST        CO2          SCC-TEMP      QMCHTEMP      TRIBOFLO      SOILTEMP      BHSTEMP       SCB-TMPF
       0.C           0.C          82.4F         82.9F          0.C          74.6F         80.8F         82.1F

    SCB-TMPR       SCRB B.D      SCB-FL-F      SCB-FL-R      QCH-FL-R      QCH-FL-F      SMP-PH-R      SMP-PH-F
200  81.9F          94.G           0.G           0.G           0.G           0.G          7.43U         8.57U

    PCC-02                                                                              CMCAL-SW      MAN-TRND
     25.0P                                                                              0.005M        OPEN M

    CO-R-1HR       CO-R-10M      SCLE 24H      TOT-*10       THC-RL-I
300   0.0C           0.0C          0.0T          1.T           0.0C



08/05/94 14:45:00 15 MIN. REPORT (KORA).
    B.H.-DP        KILN VAC      I.D.AMPS      SCRB-DPL      SCRB-DPR      SCALE         OXYGEN        CO INST.
100   0.3P          -0.14P         0.0A          0.3P          0.3P          0.0T          0.00          0.P

    THC INST        CO2          SCC-TEMP      QMCHTEMP      TRIBOFLO      SOILTEMP      BHSTEMP       SCB-TMPF
       0.C           0.C          81.6F         81.9F          0.C          74.2F         79.6F         81.4F

    SCB-TMPR       SCRB B.D      SCB-FL-F      SCB-FL-R      QCH-FL-R      QCH-FL-F      SMP-PH-R      SMP-PH-F
200  81.2F          95.G           0.G           0.G           0.G           0.G          7.43U         8.56U

    PCC-02                                                                              CMCAL-SW      MAN-TRND
     25.0P                                                                              0.004M        OPEN M

    CO-R-1HR       CO-R-10M      SCLE 24H      TOT-*10       THC-RL-I
300   0.0C           0.0C          0.0T          1.T           0.0C
```

```
08/05/94 15:00:00 15 MIN. REPORT (KORA).
    B.H.-DP         KILN VAC        I.D.AMPS        SCRB-DPL        SCRB-DPR        SCALE           OXYGEN          CO INST.
100     0.3P          -0.14P            0.0A            0.3P            0.3P            0.0T            0.00             0.P

    THC INST          CO2           SCC-TEMP        QNCHTEMP        TRIBOFLO        SOILTEMP        BHSTEMP         SCB-INPF
         0.C             0.C           80.8F           80.9F             0.C           73.6F           78.5F           80.6F

    SCB-INPR        SCRB B.D        SCB-FL-F        SCB-FL-R        QCH-FL-R        QCH-FL-F        SMP-PH-R        SMP-PH-F
200    80.4F            91.G             0.G             0.G             0.G             0.G           7.46U           8.54U

    PCC-O2                                                                                          CMCAL-SW        MAN-TRND
       25.0P                                                                                          0.004M          OPEN M

    CO-R-1HR        CO-R-10M        SCLE 24H        TOT-*10         THC-RL-1
300     0.0C            0.0C            0.0T             1.T            0.0C



08/05/94 15:15:00 15 MIN. REPORT (KORA).
    B.H.-DP         KILN VAC        I.D.AMPS        SCRB-DPL        SCRB-DPR        SCALE           OXYGEN          CO INST.
100     0.3P          -0.14P            0.0A            0.3P            0.4P            0.0T            0.00             0.P

    THC INST          CO2           SCC-TEMP        QNCHTEMP        TRIBOFLO        SOILTEMP        BHSTEMP         SCB-INPF
         0.C             0.C           79.5F           79.7F             0.C           72.3F           77.2F           79.5F

    SCB-INPR        SCRB B.D        SCB-FL-F        SCB-FL-R        QCH-FL-R        QCH-FL-F        SMP-PH-R        SMP-PH-F
200    79.4F            89.G             0.G             0.G             0.G             0.G           7.45U           8.53U

    PCC-O2                                                                                          CMCAL-SW        MAN-TRND
       25.0P                                                                                          0.003M          OPEN M

    CO-R-1HR        CO-R-10M        SCLE 24H        TOT-*10         THC-RL-1
300     0.0C            0.0C            0.0T             1.T            0.0C
```

```
08/05/94 15:30:00 15 MIN. REPORT (KORA).
    B.H.-DP         KILN VAC        I.D.AMPS        SCRB-DPL        SCRB-DPR        SCALE           OXYGEN          CO INST.
100    0.3P          -0.14P            0.0A            0.3P            0.4P            0.0T            0.00            0.P

    THC INST          CO2           SCC-TEMP        QNCHTEMP        TRIBOFLO        SOILTEMP        BHSTEMP         SCB-TMPF
        0.C             0.C           78.2F           78.5F             0.C           71.4F           75.9F           78.3F

    SCB-TMPR        SCRB B.D        SCB-FL-F        SCB-FL-R        QCH-FL-R        QCH-FL-F        SMP-PH-R        SMP-PH-F
200   78.3F            89.G            0.G             0.G             0.G             0.G           7.48U           8.52U

    PCC-02                                                                                          CMCAL-SW        MAN-TRND
      25.0P                                                                                          0.004M          OPEN N

    CO-R-1HR        CO-R-10M        SCLE 24H        TOT-*10         THC-RL-1
300    0.0C            0.0C            0.0T            1.T             0.0C


08/05/94 15:45:00 15 MIN. REPORT (KORA).
    B.H.-DP         KILN VAC        I.D.AMPS        SCRB-DPL        SCRB-DPR        SCALE           OXYGEN          CO INST.
100    0.3P          -0.14P            0.0A            0.3P            0.4P            0.0T            0.00            0.P

    THC INST          CO2           SCC-TEMP        QNCHTEMP        TRIBOFLO        SOILTEMP        BHSTEMP         SCB-TMPF
        0.C             0.C           77.1F           77.5F             0.C           70.6F           74.6F           77.5F

    SCB-TMPR        SCRB B.D        SCB-FL-F        SCB-FL-R        QCH-FL-R        QCH-FL-F        SMP-PH-R        SMP-PH-F
200   77.5F            86.G            0.G             0.G             0.G             0.G           7.46U           8.52U

  / PCC-02                                                                                          CMCAL-SW        MAN-TRND
      25.0P                                                                                          0.003M          OPEN N

    CO-R-1HR        CO-R-10M        SCLE 24H        TOT-*10         THC-RL-1
300    0.0C            0.0C            0.0T            1.T             0.0C
```

```
    W.E.S. 15 MIN. SHIFT REPORT,    LAPARI SITE.
03/05/94 16:00:00 15 MIN. REPORT (KORA).
    B.H.-DP         KILN VAC        I.D.AMPS        SCRB-DPL        SCRB-DPR        SCALE           OXYGEN          CO INST.
100    0.4P          -0.14P            0.0A            0.4P            0.4P            0.0T            0.00             0.P

    THC INST          CO2           SCC-TEMP        QNCHTEMP        TRIBOFLO        SOILTEMP        BHSTEMP         SCB-TMPF
        0.C             0.C           76.6F           76.3F             0.C           69.7F           73.4F           76.5F

    SCB-TMPR        SCRB B.D        SCB-FL-F        SCB-FL-R        QCH-FL-R        QCH-FL-F        SMP-PH-R        SMP-PH-F
200  76.7F             88.G             0.G             0.G             0.G             0.G           7.48U           8.50U

    PCC-02                                                                                          CMCAL-SW        MAN-TRND
      25.0P                                                                                          0.004M          OPEN M

    CO-R-1HR        CO-R-10M        SCLE 24H        TOT-*10         THC-RL-1
300    0.0C            0.0C            0.0T             1.T            0.0C
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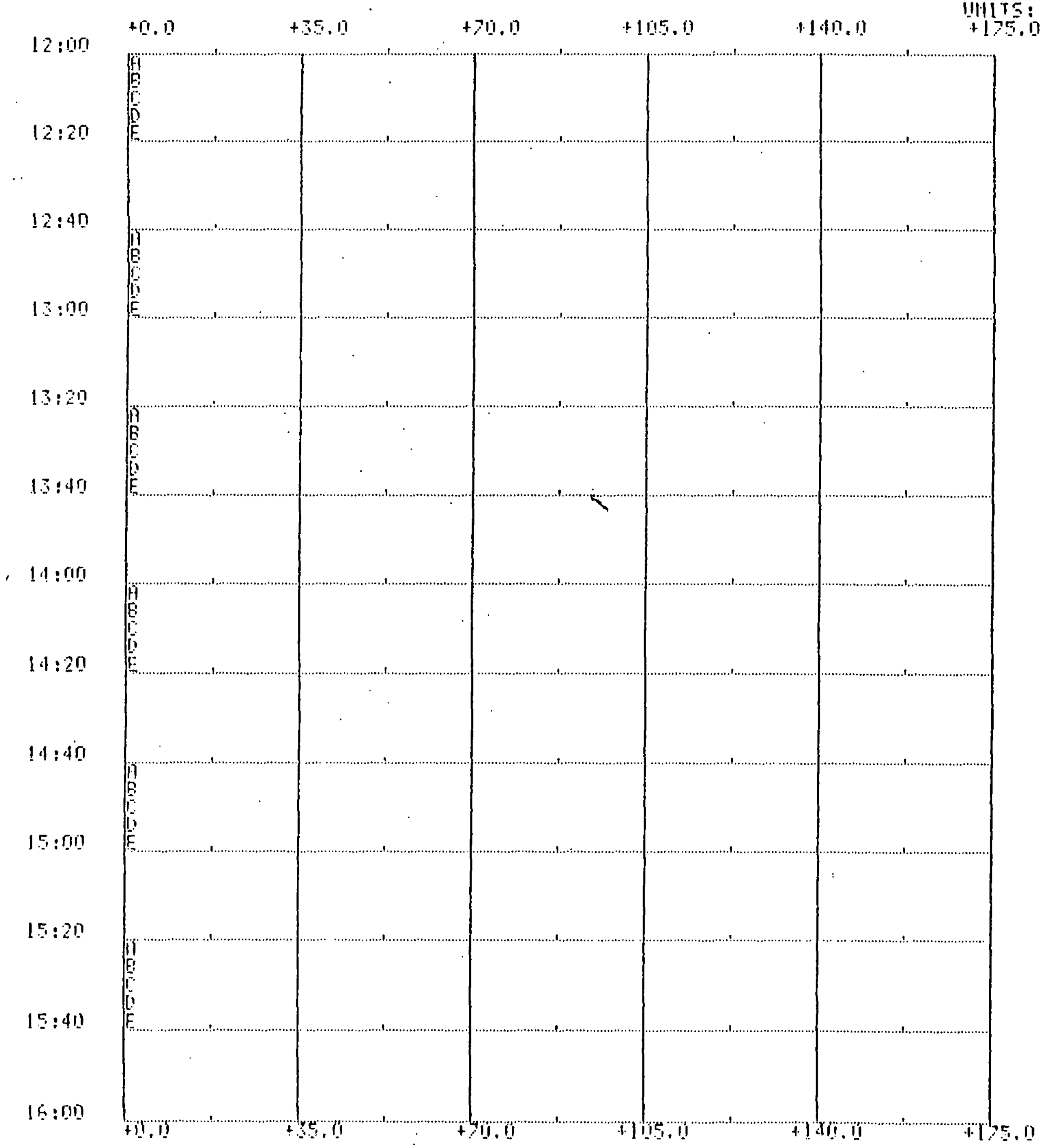

	A I.D.AMPS	B SCALE	C OXYGEN	D CO2	E TRIBOFLO
UNITS:	A	T	O	C	C
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	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
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	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
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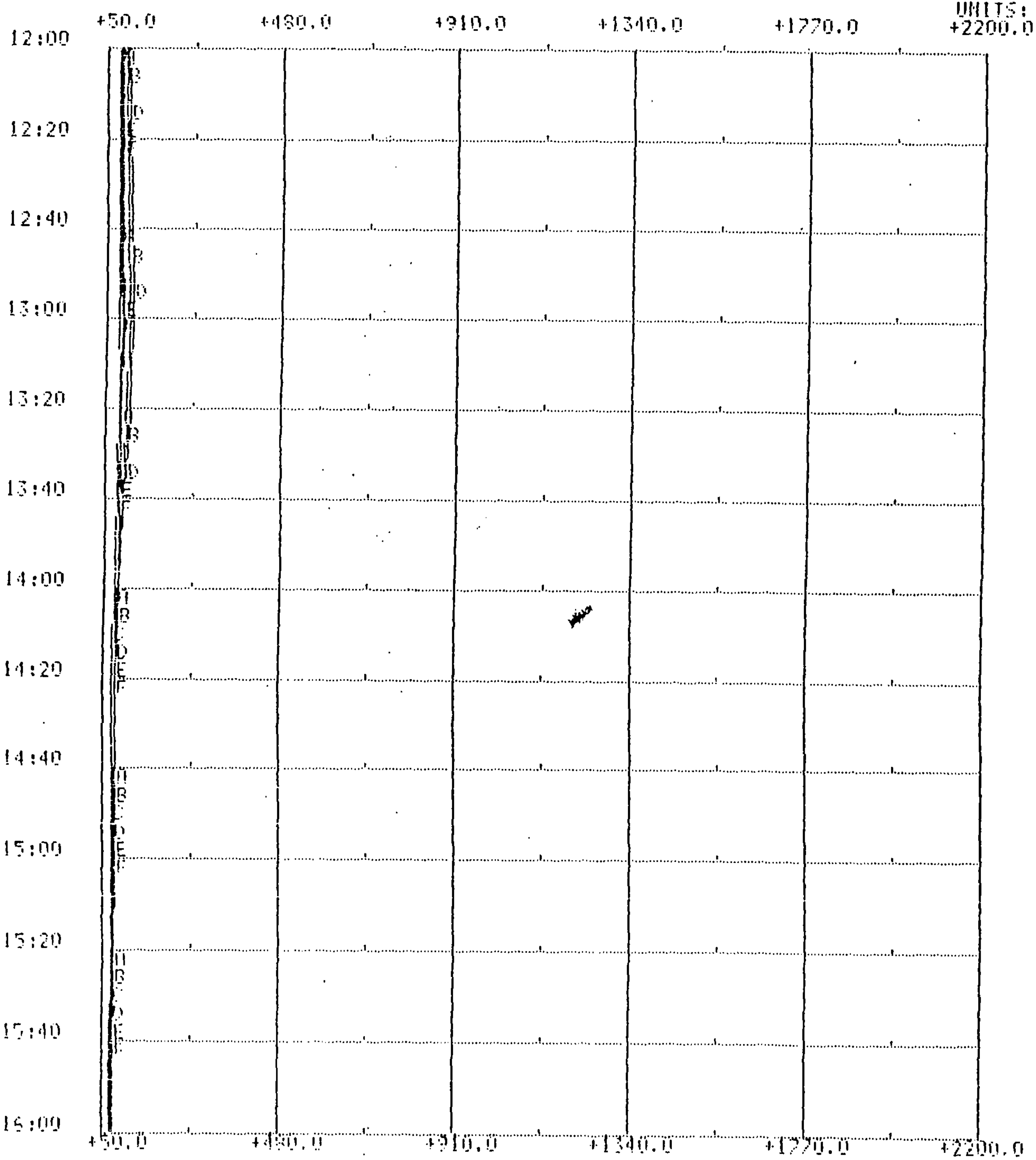
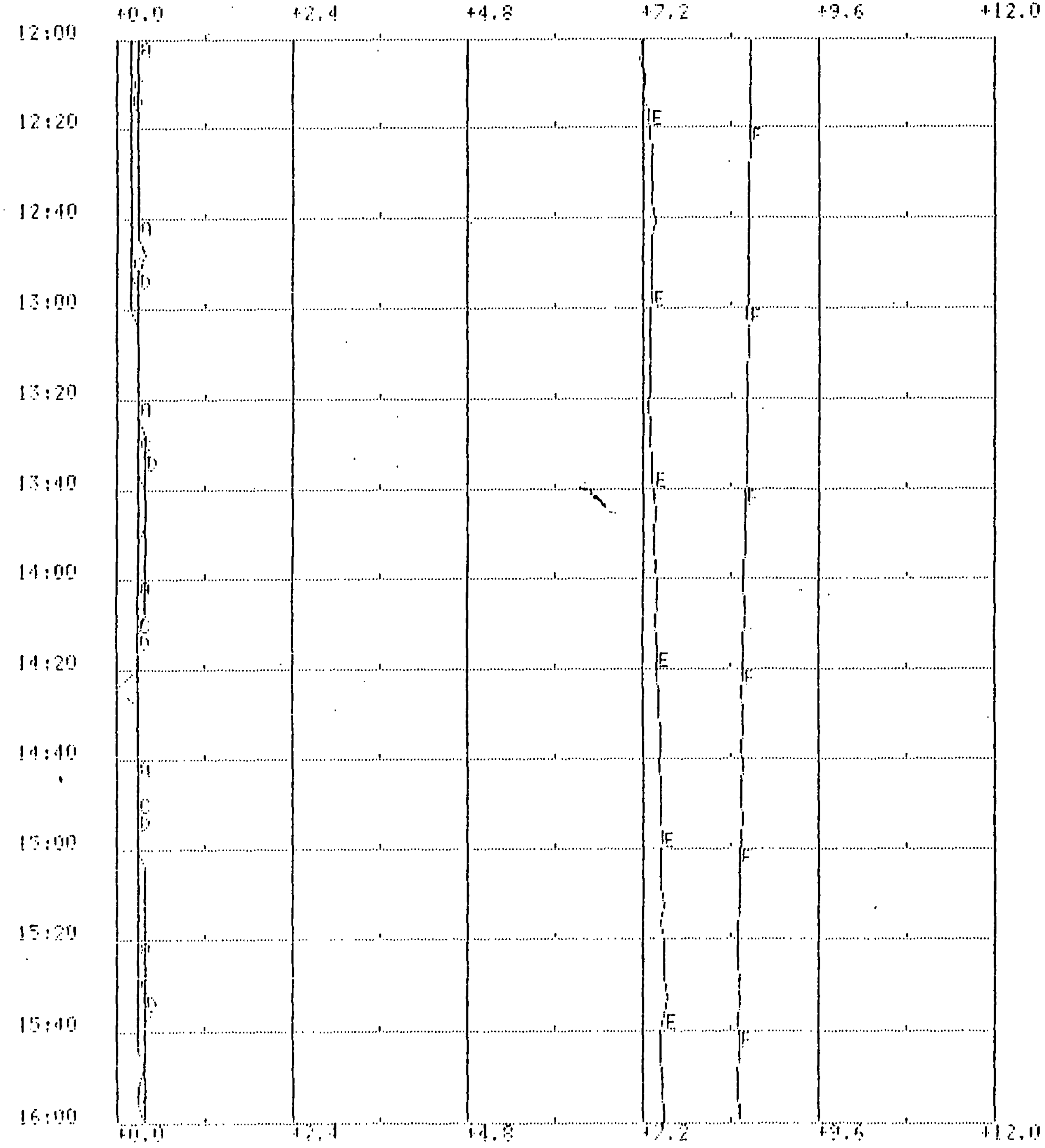
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.
	0.0	0.0	0.0	0.	0.



UNITS:	A SCC-TEMP	B QNCHTEMP	C SOILTEMP	D BHSTEMP	E SCB-TMPF	F SCB-TMPR
	F	F	F	F	F	F
	86.5	99.6	81.9	104.7	90.5	89.8
	86.6	100.2	82.1	105.7	90.6	90.1
	86.8	100.6	82.2	106.6	90.8	90.4
	86.9	101.0	82.4	107.4	91.0	90.5
	87.1	101.7	82.5	108.5	91.2	90.8
	87.3	102.2	82.6	109.5	91.4	91.0
	87.4	102.8	82.8	110.4	91.7	91.2
	87.6	103.4	83.0	111.2	91.8	91.5
	87.7	103.8	83.1	111.9	92.0	91.8
	87.9	104.3	83.2	112.7	92.2	92.0
	88.0	105.0	83.3	113.5	92.3	92.2
	88.3	105.8	83.6	114.6	92.6	92.4
	88.4	106.5	83.7	115.6	92.8	92.6
	88.6	106.9	84.0	116.2	93.0	92.6
	88.7	107.0	84.1	116.3	93.2	92.8
	88.8	106.9	84.2	116.0	93.2	92.8
	89.0	106.6	84.3	115.4	93.2	92.9
	89.0	106.1	84.4	114.4	93.0	92.7
	89.1	105.4	84.4	113.3	92.9	92.5
	89.1	104.5	84.5	112.1	92.6	92.2
	89.0	103.5	84.6	110.6	92.4	91.9
	88.9	101.8	84.5	108.5	92.0	91.5
	88.8	99.5	84.3	106.1	91.4	90.9
	88.4	97.3	83.5	103.2	90.6	90.2
	87.9	95.2	82.0	100.0	89.5	89.4
	87.3	93.0	80.6	96.8	88.5	88.4
	86.7	91.0	79.5	94.0	87.6	87.6
	86.1	89.6	78.6	91.5	86.7	86.7
	85.5	88.2	77.7	89.3	85.8	85.8
	84.5	87.1	76.8	87.5	85.0	85.0
	84.1	86.2	76.2	85.8	84.3	84.5
	83.8	85.5	75.8	84.6	83.7	84.0
	83.5	85.0	75.4	83.6	83.3	83.5
	83.3	84.6	75.1	82.9	83.0	83.2
	82.9	84.1	74.9	82.3	82.6	82.7
	82.7	83.7	74.8	81.8	82.4	82.4
	82.4	83.4	74.7	81.3	82.2	82.1
	82.4	83.1	74.6	81.0	82.1	82.0
	82.2	82.8	74.6	80.7	82.0	81.8
	82.0	82.5	74.4	80.3	81.8	81.6
	81.8	82.2	74.3	79.9	81.6	81.4
	81.6	81.9	74.2	79.6	81.4	81.2
	81.5	81.6	74.1	79.3	81.2	81.1
	81.2	81.4	73.9	79.1	81.0	80.8
	81.0	81.2	73.8	78.8	80.8	80.7
	80.8	80.9	73.6	78.5	80.6	80.4
	80.5	80.6	73.4	78.2	80.3	80.3
	80.2	80.3	73.0	77.9	80.0	80.0
	79.9	80.0	72.7	77.5	79.8	79.7
	79.5	79.7	72.3	77.1	79.5	79.3
	79.1	79.3	72.0	76.7	79.1	79.0
	78.7	79.0	71.7	76.4	78.7	78.7
	78.4	78.7	71.5	76.0	78.5	78.4
	78.0	78.3	71.2	75.6	78.2	78.1
	77.7	78.0	71.0	75.3	77.9	77.9
	77.4	77.7	70.8	75.0	77.6	77.6
	77.1	77.5	70.6	74.6	77.5	77.5
	76.9	77.2	70.5	74.5	77.4	77.3
	77.3	77.0	70.2	74.2	77.1	77.2
	76.8	76.6	69.9	74.2	76.7	76.9
	76.6	76.3	69.7	73.4	76.5	76.7

08/05/94



	A	B	C	D	E	F
	B.H.-DP	KILN VAC	SCRB-DPL	SCRB-DPR	SMP-PH-R	SMP-PH-F
UNITS:	P	P	P	P	U	U
	0.3	-0.14	0.2	0.2	7.19	8.67
	0.3	-0.14	0.2	0.2	7.17	8.67
	0.3	-0.14	0.2	0.2	7.23	8.67
	0.3	-0.14	0.2	0.2	7.22	8.67
	0.3	-0.14	0.2	0.2	7.28	8.68
	0.3	-0.14	0.2	0.2	7.30	8.68
	0.3	-0.14	0.2	0.2	7.32	8.67
	0.3	-0.14	0.2	0.2	7.33	8.65
	0.3	-0.14	0.2	0.2	7.33	8.65
	0.3	-0.14	0.2	0.2	7.33	8.65
	0.3	-0.14	0.2	0.2	7.38	8.65
	0.3	-0.14	0.2	0.2	7.33	8.64
	0.4	-0.14	0.2	0.2	7.33	8.66
	0.3	-0.14	0.2	0.2	7.32	8.64
	0.3	-0.14	0.2	0.3	7.33	8.64
	0.3	-0.14	0.2	0.3	7.31	8.63
	0.3	-0.14	0.3	0.3	7.30	8.64
	0.3	-0.14	0.3	0.3	7.31	8.64
	0.3	-0.14	0.3	0.3	7.30	8.63
	0.3	-0.14	0.3	0.3	7.30	8.62
	0.3	-0.14	0.3	0.3	7.28	8.63
	0.3	-0.14	0.3	0.3	7.30	8.62
	0.3	-0.14	0.3	0.4	7.31	8.62
	0.3	-0.14	0.3	0.4	7.32	8.62
	0.3	-0.14	0.3	0.4	7.33	8.62
	0.3	-0.14	0.4	0.4	7.36	8.60
	0.3	-0.14	0.4	0.4	7.32	8.61
	0.3	-0.14	0.4	0.4	7.35	8.60
	0.3	-0.14	0.3	0.4	7.36	8.60
	0.3	-0.14	0.3	0.4	7.37	8.59
	0.3	-0.14	0.3	0.4	7.40	8.59
	0.3	-0.14	0.3	0.4	7.41	8.60
	0.3	-0.14	0.3	0.4	7.39	8.61
	0.3	-0.14	0.3	0.3	7.40	8.58
	0.3	-0.14	0.3	0.3	7.40	8.58
	0.3	-0.14	0.3	0.3	7.41	8.58
	0.0	0.00	0.3	0.3	7.42	8.56
	0.3	-0.14	0.3	0.3	7.43	8.57
	0.3	-0.14	0.3	0.3	7.45	8.57
	0.3	-0.14	0.3	0.3	7.44	8.56
	0.3	-0.14	0.3	0.3	7.43	8.58
	0.3	-0.14	0.3	0.3	7.45	8.55
	0.3	-0.14	0.3	0.3	7.44	8.55
	0.3	-0.14	0.3	0.3	7.46	8.57
	0.3	-0.14	0.3	0.3	7.47	8.55
	0.3	-0.14	0.3	0.3	7.46	8.54
	0.3	-0.14	0.3	0.4	7.45	8.53
	0.3	-0.14	0.3	0.4	7.45	8.52
	0.4	-0.14	0.3	0.4	7.50	8.52
	0.3	-0.14	0.3	0.4	7.46	8.51
	0.3	-0.14	0.3	0.4	7.50	8.51
	0.3	-0.14	0.3	0.4	7.51	8.51
	0.3	-0.14	0.3	0.4	7.50	8.52
	0.3	-0.14	0.3	0.4	7.55	8.52
	0.5	-0.14	0.3	0.4	7.49	8.51
	0.3	-0.14	0.3	0.4	7.46	8.52
	0.3	-0.14	0.3	0.4	7.46	8.57
	0.4	-0.14	0.4	0.4	7.48	8.51
	0.3	-0.14	0.3	0.4	7.48	8.51
	0.4	-0.14	0.3	0.4	7.49	8.53
	0.4	-0.14	0.4	0.4	7.48	8.50

08/05/94

```
     B.H.-DP         KILN VAC        I.D.AMPS        SCRB-DPL        SCRB-DPR        SCALE           OXYGEN          CO INST.
100     0.3P          -0.14P            0.0A            0.3P            0.4P            0.0T            0.00            0.P

     THC INST          CO2           SCC-TEMP        QNCHTEMP        TRIBOFLO        SOILTEMP        BHSTEMP         SCB-TMPF
         0.C            0.C            75.4F           75.3F             0.C           68.7F           72.3F           75.4F

     SCB-TMPR        SCRB B.D        SCB-FL-F        SCB-FL-R        QCH-FL-R        QCH-FL-F        SMP-PH-R        SMP-PH-F
200    75.5F            84.G             0.G             0.G             0.G             0.G           7.49U           8.50U

     PCC-O2                                                                                          CMCAL-SW        MAN-TRND
       25.0P                                                                                          0.002M          OPEN M

     CO-R-1HR        CO-R-10M        SCLE 24H        TOT-*ID         THC-RL-1
300     0.0C            0.0C            0.0T             1.T            0.0C
```

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08/05/94 16:30:00 15 MIN. REPORT (KORA).
    B.H.-DP         KILN VAC        I.D.AMPS        SCRB-DPL        SCRB-DPR        SCALE           OXYGEN          CO INST.
100    0.3P          -0.14P            0.00            0.3P            0.4P            0.0T            0.00             0.P

    THC INST        CO2             SCC-TEMP        QNCHTEMP        TRIBOFLO        SOILTEMP        BHSTEMP         SCB-IMPF
       0.0             0.0            74.6F           74.6F             0.0           68.2F           71.8F           74.8F

    SCB-IMPR        SCRB B.D        SCB-FL-F        SCB-FL-R        QCH-FL-R        QCH-FL-F        SMP-PH-R        SMP-PH-F
200   75.1F            79.G             0.G             0.G             0.G             0.G           7.54U           8.50U

    PCC-O2                                                                                          CMCAL-SW        MAN-TRND
      25.0P                                                                                          0.003M          OPEN M

    CO-R-1HR        CO-R-10M        SCLE 24H        TOT-*10         THC-FL-I
300    0.00            0.00            0.0T             1.T            0.00




08/05/94 16:43:39 RETURN 107 OXYGEN      9.50  STACK OXYGEN CONTENT LOW
08/05/94 16:43:39 RETURN 107 OXYGEN      9.50  STACK OXYGEN CONTENT LOW LOW
08/05/94 16:43:50 LIMIT  107 OXYGEN      0.00  STACK OXYGEN CONTENT LOW
08/05/94 16:43:50 LIMIT  107 OXYGEN      0.00  STACK OXYGEN CONTENT LOW LOW
08/05/94 16:43:50 RETURN 107 OXYGEN      9.60  STACK OXYGEN CONTENT LOW
08/05/94 16:43:50 RETURN 107 OXYGEN      9.60  STACK OXYGEN CONTENT LOW LOW
08/05/94 16:43:53 LIMIT  107 OXYGEN      1.90  STACK OXYGEN CONTENT LOW
08/05/94 16:43:53 LIMIT  107 OXYGEN      1.90  STACK OXYGEN CONTENT LOW LOW
08/05/94 16:43:54 RETURN 107 OXYGEN      3.40  STACK OXYGEN CONTENT LOW LOW
08/05/94 16:43:56 RETURN 107 OXYGEN      9.10  STACK OXYGEN CONTENT LOW

08/05/94 16:48:10 LIMIT  107 OXYGEN      0.00  STACK OXYGEN CONTENT LOW
08/05/94 16:48:10 LIMIT  107 OXYGEN      0.00  STACK OXYGEN CONTENT LOW LOW
```

Soil Treatment Final Report
Woods Industries Site
Yakima, Washington

Volume III —Appendices E-2 and E-3

August 7, 1996

Prepared for:

BURLINGTON NORTHERN RAILROAD
Seattle, Washington

PHILIP ENVIRONMENTAL SERVICES CORPORATION
210 West Sand Bank Road
Post Office Box 230
Columbia, Illinois 62236-0230

Project 12883088

PHILIP
ENVIRONMENTAL

APPENDIX E-2

AAQIR

FINAL AMBIENT AIR QUALITY IMPACT REPORT FOR A TEMPORARY LOW-TEMPERATURE THERMAL DESORPTION UNIT

WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

July 27, 1995

Prepared for:

BURLINGTON NORTHERN RAILROAD
Seattle, Washington

Project 12883088

PHILIP ENVIRONMENTAL SERVICES CORPORATION
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(412) 244-9000

EXECUTIVE SUMMARY

As part of the ongoing effort to remediate the Woods Industries Site (Woods Site) in Yakima, Washington, Burlington Northern Railroad (BNRR) is using a low-temperature thermal desorption (LTTD) unit to remove pesticide contamination from soil on site. The site is being remediated in accordance with the Administrative Order on Consent (Number 1087-03-18-106) for this site. Soil treatment is expected to be completed by September, 1995. Approximately 19,000 tons of pesticide-contaminated soil will be treated. This report describes the impact that treatment of this soil may have on ambient air quality around Yakima. This Final Ambient Air Quality Impact Report is being submitted to the U.S. Environmental Protection Agency (USEPA) by Philip Environmental Services Corporation (Philip) on behalf of BNRR.

The air quality impacts described in this report are based on emissions measured during the preoperation performance test and ambient air monitoring data collected through May 26, 1995. Two types of emissions are associated with operation of the LTTD unit, fugitive and exhaust (stack) emissions.

Based on the amount of soil treated, the type of operations to be performed, and the location of the facility, and measured emission rates for various pollutants, ground level concentrations were estimated based on USEPA air quality models and existing ambient air monitoring data. Air dispersion modeling was performed to estimate the ambient ground level concentrations of pollutants from thermal treatment of soil at the site. This modeling was performed as required by Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Washington Toxic Air Pollutant Rules (WAC 173-460-080(2)(c)).

Potential chemical-specific applicable or relevant and appropriate requirements (ARARs) and possible risks to human health associated with emissions from the site during these soil treatment activities were evaluated in the preparation of this report.

Based on measured emission rates and modeled ground level concentrations expected to occur during operation of the LTTD unit to treat soil at the Woods Site, impacts to ambient air quality and to human health and the environment are within USEPA and Washington Department of Ecology guidelines.

Prior to full operation of the LTTD unit, actual emissions were measured during a pre-operation performance test at the site. The pre-operation performance test was conducted to determine operating conditions under which the LTTD system meets all soil treatment and air emissions criteria. These conditions were used to set process operating parameter limits to ensure that all applicable soil treatment and stack emission standards are met during production operations. Williams Environmental Services, Inc.

continuously monitors system operation to maximize destruction of contaminants in the soil and to maximize removal of particulates, metals, hydrochloric acid (HCl), chloride (Cl), products of incomplete combustion (PICs), and principal organic hazardous constituents (POHCs) from the system gasses prior to being released from the stack. In addition, dust control measures are employed during material handling operations to minimize fugitive emissions.

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List of Abbreviations and Acronyms

AAMP	Ambient Air Monitoring Plan
AICs	acute inhalation criteria
APCE	air pollution control equipment
ARARs	applicable or relevant and appropriate requirements
ASIL	acceptable source impact level
AWFSO	automatic waste feed shutoff
BACT	best available control technology
BHC	hexachlorocyclohexane (BHC)
BIF	Boiler and Industrial Furnace
BNRR	Burlington Northern Railroad
BPIP	Building Profile Input Program
CEM	continuous emission monitoring
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Cl_2	chlorine
CO	carbon monoxide
CRL	cancer risk levels
DDD	p,p'-DDD
DDE	p,p'-DDE
DDT	p,p'-DDT
DRE	destruction and removal efficiency
DW	dry weight
ECAO	Environmental Criteria and Assessment Office Superfund Health Risk Technical Support Center
ECAO-TSC	USEPA's Environmental Criteria and Assessment Office, Technical Support Center
°F	degrees Fahrenheit
GEP	Good Engineering Practice
g/day	grams per day
g/dscf	grams per dry standard cubic feet
g/m^2	grams per cubic meter

List of Abbreviations and Acronyms, Continued

g/sec	grams per second
g/s	grams per second
FAAQIR	Final Ambient Air Quality Impact Report
HI	hazard index
HCl	hydrochloric acid
HEAST	Health Effects Assessment Summary Tables
HQ	hazard quotient
HxCB	hexachlorobenzene
I.D. fan	induced-draft fan
IRIS	Integrated Risk Information System
k	kilometers
kg/hr	kilograms per hour
kg	kilogram
L/2	one-half the detection limit
LOAEL	lowest-observed-adverse-effect-level
LTTD	low-temperature thermal desorption
m	meter
m^3	cubic meters
mg/g	milligrams per gram
mg/kg	milligrams per kilogram
mg/kg/day	milligrams per kilogram of body weight per day
mg/m^3	milligrams per cubic meter
MKE	Morrison-Knudson Engineers, Inc.
mph	miles per hour
NAAQS	National Ambient Air Quality Standards
NCP	National Oil and Hazardous Substances Contingency Plan
NESHAP	National Emissions Standards for Hazardous Air Pollutants
ng/dscm	nanograms per dry standard cubic meter
ng/m^3	nanograms per cubic meter
NO$_2$	nitrogen dioxide

List of Abbreviations and Acronyms, Continued

NOAA	National Oceanic and Atmospheric Administration
NAAQS	National Ambient Air Quality Standards
NOAEL	No Observed Adverse Effect Level
NPC	National Oil and Hazardous Substances Pollution Contingency Plan
NSPS	New Source Performance Standards
NWS	National Weather Service
O_3	ozone
P-84 Fabric	polyamide bag material
PCDD	polychlorinated dibenzo-p-dioxin
Philip	Philip Environmental Services Corporation
PICs	products of incomplete combustion
PM_{-10}	particulate matter
POHCs	principal organic hazardous constituents
ppm_v	parts per million by volume
PPT	pre-operation performance test
PSD	Prevention of Significant Deterioration
RA	risk assessment
RAC	reference ambient air concentration
RACT	Reasonably Available Control Technology
RfC	reference concentrations
RfD	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
RSD	risk-specific dose
SO_2	sulfur dioxide
TAPs	Toxic Air Pollutants
TCL	Target Compound List
TICs	tentatively identified compounds
TLV	Threshold Limit Value
TPH	tons per hour

List of Abbreviations and Acronyms, Continued

TSC	Technical Support Center
TSDFs	treatment, storage, and disposal facilities
TWA	time-weighted average
mg/m^3	micrograms per cubic meter
UCl	upper confidence limit
USGS	U.S. Geological Survey
USEPA	U.S. Environmental Protection Agency
UTM	Universal Transverse Mercator
VOCs	volatile organic compounds
VO	vent opening
WDOE	Washington Department of Ecology
Williams	Williams Environmental Services, Inc.
Woods Site	Woods Industries Site
STAP	Washington Toxic Air Pollutant Rules
YCCAA	Yakima County Clean Air Authority

FINAL AMBIENT AIR QUALITY IMPACT REPORT FOR A TEMPORARY LOW-TEMPERATURE THERMAL DESORPTION UNIT

WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

1 INTRODUCTION

As part of the ongoing effort to remediate the Woods Industries Site (Woods Site) in Yakima, Washington, Burlington Northern Railroad (BNRR) is using a low-temperature thermal desorption (LTTD) unit to remove pesticide contamination from soil on site. The site is being remediated in accordance with the Administrative Order on Consent (Number 1087-03-18-106) for this site. The LTTD unit is expected to require approximately five months from the commencement of the pre-operation performance test (PPT) to treat approximately 19,000 tons of pesticide-contaminated soil at the site. This report describes the impact that treatment of this soil may have on ambient air quality around Yakima. This Final Ambient Air Quality Impact Report (FAAQIR) is being submitted to the U.S. Environmental Protection Agency (USEPA).

Philip Environmental Services Corporation (Philip) (formerly Burlington Environmental Inc.) is serving as BNRR's engineering representative for the remediation of this site. Philip provides oversight, and Williams Environmental Services, Inc., (Williams) owns and operates the LTTD unit. Relationships and responsibilities are described in the Soil Treatment Work Plan.

The air quality impacts described in this report are based on emission rates for various pollutants measured during the preoperation performance test (PPT). During the PPT, the operating conditions of the LTTD unit were optimized and the actual emissions were measured.

Following these PPT, the LTTD unit was operated at 75 percent of capacity (interim status). On June 30, 1995, the USEPA approved operation of the LTTD at 100 percent capacity; however, Williams will continue operations at 75 percent through completion of soil treatment. Following treatment of these on-site soils, the LTTD unit will be removed from the site. The treated soil will be within USEPA and Washington Department of Ecology (WDOE) guidelines and will be returned to the ground at the site. After the soil is returned to the ground, remaining activity will include groundwater monitoring.

1.1 Site Location

The site is located on King Street just west of North First Street along the railroad tracks within the city limits of Yakima, Washington, and is in an industrial area within the Northwest Quarter of the Northeast Quarter of Section 31, Township 13 North, Range 19 East, West Meridian (Figure 1-1, Site Location Map). The site consists of two areas formerly leased from BNRR to Woods Industries, which sublet a portion of the site to Akland Irrigation. The entire area that was leased from BNRR covers approximately four acres. Land use in the immediate vicinity of the site is primarily industrial. A fruit packing facility operates on the property east of the site.

1.2 Site History

For approximately 50 years, BNRR and its predecessors leased the site to industrial lessees. The area leased by Woods Industries was used for the contract formulation of market-grade pesticides from technical-grade material from approximately 1938 until May 1985, when the lease was terminated by BNRR because of environmental concerns.

Wastes from the formulation process and laboratory were discharged to a French drain/sump area on the site. The French drain/sump area was an excavated area with rows of vertically set, perforated drums sitting on and covered by timbers beneath approximately two feet of construction rubble and soil backfill leveled at grade.

The Akland Irrigation area of the site was used primarily for the sale, storage, and maintenance of irrigation equipment. The middle portion of the Akland Irrigation area contained two discharge lagoons. These lagoons were used to collect and discharge liquids carried by pipeline from the Woods Industries area. The lagoons were filled in with surrounding soil and debris including metal scraps, between approximately 1973 and 1977, based on interpretation of aerial photographs. The lagoon area was then used for storage of irrigation equipment.

After Woods Industries' lease was terminated in May 1985, Woods Industries removed some personal property from the site, and BNRR assumed control of the property.

1.3 Site Cleanup Activities

In December 1985, the USEPA issued a Removal Action Order, which, among other things, required that a detailed plan for site characterization be developed and executed. A site characterization plan was prepared and executed in 1986 by Morrison-Knudson Engineers, Inc., (MKE), BNRR's contractor at the time.

Based on the results of the preliminary site characterization, elevated concentrations of p,p'-DDD (DDD), p,p'-DDT (DDT), p,p'-DDE (DDE), copper, lead, zinc, hexachlorobenzene, bis(2-ethylhexyl)phthalate, acetone, and methylene chloride were found in soil samples collected from the site. This preliminary study concluded that DDT was the most widely spread of the pesticides in soil.

Pesticides, volatile organic compounds (VOCs), and metals were detected in groundwater samples collected from five wells installed during this preliminary investigation.

In 1990 and 1991, BNRR conducted a remedial investigation (RI) of the site in accordance with the requirements of Consent Order Number 1087-03-18-106 as amended June 28, 1990, and the Remedial Investigation/Feasibility Study Work Plans approved by the USEPA. The investigations were performed in two phases. Phase I was performed in 1990 and Phase II was performed in 1991. Some additional tasks, such as disposal of drummed drill cuttings and well development water, were performed in 1992. The primary soil contaminants were DDT, hexachlorobenzene, and dieldrin. Other organochlorine pesticides and some metals (mercury, arsenic, and lead) were also detected above cleanup levels at some locations.

In January and February of 1993, buildings on the site were demolished to grade. The buildings were demolished to remove a physical hazard, a toxic health hazard, and a fire hazard from the site and to expedite site remediation. Building demolition was performed in accordance with the Building Demolition Work Plan, the Administrative Order on Consent for Building Demolition, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). In summary, the existing buildings were demolished and debris was removed and disposed of properly.

In March 1993, a separate Administrative Order on Consent was entered into by BNRR for the removal, temporary storage, and treatment of contaminated soil from the site. This removal action was necessary to reduce a threat to groundwater and public health at the site. The LTTD unit is being used to treat soil from these temporary storage areas and some contaminated soil from the ground under the north and south stockpiles. This removal action will reduce contaminant concentrations to acceptable levels under an industrial future-use scenario as defined under the State of Washington's Model Toxics Control Act.

1.4 Organization of the Report

Physical characteristics of the study area are described in Chapter 2. The soil treatment project and the LTTD unit are described in Chapter 3. Existing air quality in the Yakima area is described in Chapter 4. A list of pollutants evaluated in this analysis and the measured emission rates are presented in Chapter 5. The air dispersion modeling methodology and input data are discussed in Chapter 6. The calculated ambient air concentrations are compared with appropriate ambient standards and risk levels in Chapter 7. The risk evaluation is presented in Chapter 8. Conclusions are presented in Chapter 9.

Appendices supporting the discussions in this report contain criteria pollutant emission rates in Appendix A. Summary statistics for stockpiled soil are included in Appendix B. Appendix C contains summary statistics for stockpiled soil. Appendix D includes a diskette that contains all the air modeling conducted to develop this FAAQIR (The diskette is included only in Bill Ryan's and Paul Meeter's copies.) and plots from the ISCST2 modeling. Appendix E presents detailed calculations for direct pathways. Appendix F contains summary calculations for indirect pathways of exposure.

2 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

The physical characteristics of the study area are described in this chapter based on the results of previous investigations conducted by MKE (1987) and the U.S. Geological Survey (USGS) and Phases I and II of the RI conducted by Philip.

2.1 Surface Features

The surface features during soil processing at the site include one building (the Akland building), two temporary soil storage areas, the LTTD unit and associated equipment.

The site is flat except for the two temporary soil storage areas and the partially backfilled excavations, and consists of sandy, gravelly soils, which combine to create physical conditions that allow rapid infiltration of precipitation.

2.2 Meteorology

The climate of the Yakima Valley is relatively mild and dry. It has characteristics of both maritime and continental climates, modified by the Cascade Mountain Range. Summers are hot and dry; winters are cool with only light snowfall.

Existing data reveal that over one-half of the winter seasons do not have even one day below 0 Fahrenheit (°F). Temperatures below freezing are infrequent during the period from mid-May through September. Temperatures below 40°F during July and August have occurred in about half of the years for which climatological data are available.

Precipitation follows the pattern of a West Coast marine climate with the typical late fall and early winter precipitation. However, since Yakima lies in the rain shadow of the Cascades, total amounts of rainfall are small. Average annual precipitation for the area is seven inches. Three months (November, December, and January) account for nearly half of the annual precipitation accumulation. Late June, July, and August are very dry. Snowfall in the Yakima area is light, averaging 20 to 25 inches annually.

Winds are mostly light, averaging about seven miles per hour (mph) for the year. The winds are somewhat stronger in late spring and weaker in winter. Speeds of 30 to 35 mph are reached at least once in about half the months, and speeds exceeding 40 mph occur in about one out of every five months. The general wind direction is from the west.

Climatological information was collected from the National Oceanic and Atmospheric Administration's (NOAA's) *Local Climatological Data: Annual Summary with Comparative Data* (NOAA, 1987).

2.3 Demography and Land Use

According to the 1990 U.S. Census as reported by the Office of City Planning, the population of the city of Yakima was 54,435 persons (Arlington, 1991). According to Larry Laehman of the Yakima Office of City Planning, no significant alterations in zoning are anticipated for the near future (Laehman, 1992). Zoning and land use are shown in Figure 2-1.

The area surrounding the Woods Site and the site itself are zoned light industrial. Between the site and Maryland Avenue (to the east) is the Hansen Fruit & Cold Storage property. Property to the east of Maryland Avenue is zoned commercial/business district support. Due east of this area is a light industrial park located on South 12th Street and South 13th Street.

The nearest area zoned for residential use is north of East Mead Avenue and East of 10th Street. Throughout the city of Yakima, the railroad corridor is zoned either light or heavy industrial or commercial/business district support. Based on current land use and adjacent land use, as well as the proximity to the railroad tracks, the expected future use of the site is for industrial purposes.

3 PROCESS DESCRIPTION

A complete description of the LTTD unit is included in the revised Soil Treatment Work Plan that was submitted to the USEPA by Williams (1994b). The four main components of the LTTD unit are the feed unit, the rotary dryer, the air pollution control equipment (APCE), and the quench water treatment equipment. Figure 3-1 is a schematic diagram of the LTTD unit. This chapter is a brief description of the LTTD unit.

3.1 Material Flow

Contaminated soil is continuously fed into the unit. Thermal desorption to separate pesticide contamination from the soil occurs in the rotary dryer, where heated air from an external burner is used to heat the soil. A baghouse removes particulate matter from the gas stream exiting the rotary dryer. Contaminants remaining in the gas stream are oxidized in a thermal oxidizer. Propane or natural gas are also used to heat the thermal oxidizer. The gases are then quenched in the quench tower to reduce their temperature. Quench water is treated by carbon to remove organic compounds. Spent carbon from the quench water treatment system will be regenerated at a Westates in Parker, Arizona. The gas stream finally passes through a wet scrubber to remove acid gases and particulate matter prior to exiting the stack into the atmosphere.

3.2 Feed Unit

The feed soil for this project consists of previously excavated soil stockpiled on site and some contaminated soil in the ground under the stockpiles. The soil is removed from the stockpiles with a front-end loader and delivered to the feed unit where it will be screened into a feed hopper. An apron feeder transports the soil from the hopper to a belt conveyor, which elevates the soil to the feed belt of the rotary dryer. Fugitive dust control is applied as needed and is discussed in detail in the Soil Treatment Work Plan.

3.3 Rotary Dryer

A countercurrent rotary dryer (desorber) is used to remove moisture and organic constituents from the soil. The rotary dryer has internal flights to ensure intimate contact between the soil and rotary dryer gases. The soil enters at the same end where the exhaust gases leave. The exit gas temperature is approximately 350 to 400 °F. As the soil passes through the rotary dryer, the soil temperature initially rises to 212°F as water is removed. After the moisture has been removed, the soil moving toward the discharge end of the rotary dryer will increase in temperature to approximately 800°F.

The treated soil exits from the rotary dryer and is then quenched to suppress potential dust.

3.4 Air Pollution Control Equipment

The gas stream leaving the desorber contains particulate matter, moisture, and volatilized organics. This gas stream must be treated to remove the particulate and organic matter to achieve air emission standards prior to discharge into the atmosphere. A baghouse and a thermal oxidizer are used to achieve these standards.

The baghouse utilizes a pulse-jet-type cleaning system. A maximum air-to-cloth ratio of 5:1 is provided. The polyamide bag material (P-84 Fabric) provides excellent removal efficiency and has a maximum continuous operating temperature of 500°F. The air from the desorber enters the baghouse below 450°.

The baghouse dust is removed from the baghouse hoppers by a screw conveyor. The first conveyor discharges into a second totally enclosed screw conveyor that discharges into the Dobson Collar located at the hot end of the desorber where it undergoes additional treatment in the rotary dryer.

After removal of particulate matter, the gas stream enters the thermal oxidizer where destruction of the pesticides and VOCs occurs. The destruction efficiency depends on the temperature of the thermal oxidizer, the turbulence of the gases, and the residence time of the gases inside the thermal oxidizer chamber. The chamber is sized to provide sufficient retention time (greater than two seconds) at 1,800°F and has a high-intensity "vortometric" (mixing) burner to provide the temperature and turbulence required to oxidize the organics. From the thermal oxidizer, gases flow to the quench tower. In the quench tower, the gases are quenched to reduce their temperature, then are passed through the wet scrubber to remove acid gases and further particulate matter, and finally through the stack to the atmosphere. The clean stack gases are monitored using a continuous emission monitoring (CEM) system. The CEM system was installed and certified prior to operation of the LTTD unit to provide real-time stack gas monitoring. The system, at a minimum, monitors oxygen and carbon monoxide (CO).

Bypass of the APCE by the off-gas is not possible due to the positioning of the vent. The vent is located prior to the induced-draft (I.D.) fan, which maintains an induced draft on the system. If a vent opening should occur, air is drawn into the system and passes through the fan to the APCE, as does the off-gas from the desorber. All the off-gas continues to be treated in the same manner as under normal operation.

3.5 Quench Water Treatment System

A liquid-phase activated carbon adsorption system is used to continuously treat the quench chamber blowdown water to remove organic compounds. Spent carbon will be regenerated at a Westates in Parker, Arizona (a USEPA-approved facility).

4 EXISTING AIR QUALITY

During operation of the LTTD unit, ambient air quality around Yakima is also influenced by the climate and existing ambient air quality. These existing conditions are described in this chapter.

4.1 Meteorology and Climatology

The climate at the Woods Site and in the surrounding Yakima region is characteristic of a semiarid steppe. Winters are relatively cool with only slight snowfall while summers are dry and hot.

The surface meteorological data from the National Weather Service (NWS) meteorological station located at the Yakima Airport and the on-site meteorological station operated by Philip are considered representative of site and regional climatic conditions. The following climatological and meteorological information is primarily based on data collected from these two stations. The on-site information consists of data collected from February 14, 1995, to May 26, 1995. The on-site data is consistent with the data measured at the Yakima Airport.

4.1.1 Wind

Prevailing wind directions in Yakima are from the west, with a secondary maximum frequency from the southwest. The annual average wind speed is 7.1 mph. Monthly average wind speeds range from 5.2 mph in December to 8.7 mph in June.

The on-site data gave an average wind speed of 6.1 mph. Daily average wind speeds ranged from 2.9 mph (March 8) to 10.8 mph (April 7). The maximum wind speed recorded on site is 27.6 mph (May 25).

4.1.2 Temperature and Humidity

The annual average temperature at Yakima is 49.7°F; monthly average temperatures vary from 28.2°F in January to 70.4°F in July. The annual average relative humidity at Yakima is 60 percent.

The on-site data has an average temperature of 51°F. The minimum temperature recorded on site was 25°F (February 14) and the maximum was 69°F (May 24 and 25).

The average on-site relative humidity was 55.8 percent. The minimum relative humidity recorded was 32 percent (May 21) and the maximum relative humidity recorded was 92 percent (April 29).

4.1.3 Precipitation

The average annual precipitation (water equivalent) at Yakima is 7.9 inches. The average annual snowfall is 24.8 inches. Precipitation was not part of the on-site meteorological station sampling protocol.

The surface meteorological data from the Yakima Airport and upper air (mixing height) data from Spokane, Washington, are considered representative of regional climatic conditions. The following climatological and meteorological information is primarily based on data obtained from the National Climatic Data Center.

4.2 Ambient Air Quality

The Woods Site is located in Yakima County, which is within the South Central Washington Intrastate Air Quality Control Region. The state air pollution control agency is the WDOE. However, in Washington many local air pollution control agencies exist. Yakima County is under the jurisdiction of the Yakima County Clean Air Authority (YCCAA), which has adopted the state's air pollution control regulations.

National Ambient Air Quality Standards (NAAQS) for six criteria pollutants have been established by the USEPA: PM_{10}, sulfur dioxide (SO_2), CO, nitrogen dioxide (NO_2), ozone (O_3), and lead.

Air quality status is determined by comparing ambient air quality levels to the NAAQS. An area is in attainment for a particular pollutant if it does not exceed the NAAQS for that pollutant. Likewise, areas exceeding NAAQS are designated as nonattainment for the specific pollutant. Yakima County is in nonattainment for particulate matter measured as less than 10 microns in diameter or respirable particles (PM_{10}) and CO. Yakima County had some exceedances for CO in 1988 and 1989. The YCCAA has since implemented measures to reduce CO emissions and the county should be in attainment for CO in the near future.

Three Prevention of Significant Deterioration (PSD) Class I areas are located along the western boundary of Yakima County. Goat Rocks Wilderness area is located approximately 60 miles (97 kilometers) west of the site. Mount Ranier National Park and the Mount Adams Wilderness Area are located approximately 70 miles (113 kilometers) northwest and southwest of the site, respectively. The Yakima Indian Reservation is located approximately 10 miles (16 kilometers) south of the site.

4.3 Ambient Air Quality Monitoring

The YCCAA is under contract with the WDOE to monitor PM_{10} and CO emissions at various stations throughout Yakima County. Table 4-1 presents a summary of ambient CO concentrations measured from July 1993 to July 1994 at WDOE monitoring site number 7A-3996002A. Table 4-2 presents a summary of ambient PM-10 for 1993 and January 1994 to July 1994 at WDOE monitoring site number 3996008F.

In addition to this regional criteria pollutant monitoring by YCCAA, ambient air monitoring was performed on the Woods Site on behalf of BNRR during the RI and subsequent cleanup activities. During the RI, samples were taken to characterize background levels of organochlorine pesticides and hexachlorobenzene. Samples were collected near the French drain area because that area was believed to produce the highest ambient air levels. Organochlorine pesticide concentrations ranged from 0.2 to 41 nanograms per cubic meter (ng/m^3). Hexachlorobenzene concentrations ranged from 20 to 88 ng/m^3. Less than two percent of the soil at the site was found to be smaller than the upper limit of suspendible soil particle size (100 microns in diameter).

Throughout the soil excavation work, dust control measures were employed to minimize fugitive emissions. Background air samples were taken prior to the start of the excavation activities. In addition, air samples were collected during the following site activities: sheet piling installation, soil excavation in the north area and south lagoons, and removal of buried drums and lead arsenate. Perimeter air monitoring occurred throughout the excavation activities. Substances that were monitored were total dust, arsenic, lead, mercury, DDT, dieldrin, heptachlor, toxaphene, and 2,4-D. The results showed that the ambient concentrations of dust, metals, and pesticides were not detectable.

An ambient air quality monitoring program was developed specifically for soil treatment operations (Burlington, 1995b). The objectives of this air monitoring program are to:

- provide near-real-time feedback on air impacts related to site activities;
- measure wind speed and wind direction to identify the most likely airborne contaminant migration directions;
- document ambient concentrations of hazardous constituents during LTTD operation;
- document that applicable National Ambient Air Quality Standards (NAAQS) have not been exceeded as a consequence of LTTD operation;

- collect data by utilizing time-integrated ambient air sampling methods to implement mitigation procedures, as necessary, to reduce the potential for off-site migration of contaminants; and

- provide a means of checking model-predicted concentrations used to estimate risks.

Ambient air is monitored in three phases of activities:

- **Baseline Air Monitoring** - five days of monitoring before LTTD unit operation to establish background conditions;

- **Remedial Action Air Monitoring** - daily for PM_{10} from the start of LTTD unit operations and daily for other parameters beginning when contaminated soil is first processed through the LTTD unit until the end of the performance test and with USEPA approval, daily at location A11/AG1 and a reduced frequency (every third day) at all other locations, thereafter during ongoing operation to measure actual ambient air impacts from site emissions (fugitive and source); and

- **Post-Remedial Action Air Monitoring** - five days of monitoring after LTTD unit operation (if necessary based on observed concentrations) to establish that baseline concentrations have been restored in the vicinity of the site.

A portable real-time particulate monitor will be used as necessary to help direct dust control measures. A stationary real-time particulate monitor will be operated continuously at the east perimeter near the LTTD unit. The stationary monitor is used to measure 1-hour average concentrations.

PM_{10}, DDT, dieldrin, hexachlorobenzene, and mercury were monitored at the site perimeter and at two off-site monitoring locations. Samples will be collected for 24-hour periods.

4.4 Local Emission Sources

Only one facility in Yakima meets the USEPA definition of a major source: the Boise-Cascade mill. This lumber and plywood veneer mill operates boilers in addition to the production machinery. Pollutants emitted from this facility are PM_{-10}, CO, SO_2, and VOCs.

The Cameron-Yakima, Inc., facility, located at Nob Hill and First streets, emits benzene, toluene, ethylbenzene, xylene, and halogenated organic compounds from reactivation of spent carbon canisters.

In addition, several minor sources typical of a small urban area, such as asphalt plants, are operated around Yakima.

5 EMISSIONS MODELING

During operation of the LTTD unit, two types of emissions are generated at the site: fugitive and exhaust (stack) emissions. Based on the amount of soil to be treated, the type of operations to be performed, and the location of the facility, the emission rates for various pollutants were estimated based on the USEPA-recommended procedures in AP-42 (USEPA, 1985) and existing data.

5.1 Fugitive Emissions

Potential fugitive emissions sources were inventoried and emission rates from each source were inventoried as part of the pre-operation performance test AAQIR. Appropriate dust control measures were identified in the Ambient Air Monitoring Plan (AAMP). These measures included covering the feed conveyor on the soil treatment unit, placing barriers around the screen, the waste feed stockpile, the batch drop onto the waste feed stockpile, the batch drop into the feed metering unit, the drop from the apron feeder to the feed material conveyor, and the drop from the belt conveyor to the transition hopper. Barriers were also placed around the following treated soil emission sources: the stacking conveyor, the treated soil stockpile, and during backfilling operations in the north and south excavations. During shakedown and the pre-operation performance test additional dust control measures were implemented including installation of a sprinkler system to wet down the treated soil piles.

Fugitive dust modeling performed for the pre-operation performance test AAQIR did not reflect these dust control measures. Ongoing fugitive dust monitoring conducted during soil treatment has indicated that the treated soil pile is the predominate source of fugitive emissions.

Ambient air monitoring results indicate sampler A11, and the co-located sampler A61, consistently detect the highest concentrations of PM_{10}. A11 principally monitors emissions from the stack conveyor, baghouse dust meter/auger system (which returns the dust into the Dobson collar), the treated soil discharge area, and the treated soil handling and storage area. The geometric mean 24-hour concentration (from March 18 to May 26, 1995) at location A11 is 49 micrograms per cubic meter (ug/m^3) and the maximum observed 214.7 ug/m^3. An additional excursion above the 150 ug/m^3 standard (167.3 ug/m^3) occurred on March 23, 1995. (On three other occasions, A61 the co-located sampler, indicated a 24-hour concentration above 150 ug/m^3, but A11 did not.) These excursions have been attributed to dust clouds formed when the capacity of the pug mill was exceeded, so negative pressure was not maintained. In accordance with the AAMP, Philip informed USEPA and USEPA's on-site contractor, URS, of each exceedance. On each occasion, corrective actions were taken. These actions included adding water to soil on the discharge auger, redesigning the discharge auger system, and watering down the piles. No excursions have been observed since April 20, 1995. On April 25, 1995, an oscillating sprinkler system was installed along the eastern fenceline to wet down the treated soil piles.

5.2 Exhaust Emissions

Three types of emissions from the LTTD unit operation are of potential concern:

- soil contaminants that may not be 100 percent removed in the LTTD unit or the APCE;
- organic compounds that are synthesized during the combustion process, usually called products of incomplete combustion (PICs), based on past experience with similar technologies, literature review, and structural analysis; and
- criteria pollutants for which NAAQS exist.

5.2.1 Pollutant Sources

Organic contaminants in the soil being treated include hexachlorobenzene, aldrin, alpha-BHC, beta-BHC, gamma-BHC (lindane), chlordane, dieldrin, endrin, heptachlor, heptachlor epoxide, methoxychlor, DDD, DDE, DDT, and toxaphene. Metals in this soil include arsenic, lead, and mercury. Each of these can be emitted from the LTTD unit. The fuel used to heat the LTTD unit and the thermal oxidizer do not significantly contribute to the emissions. The system is capable of producing PICs.

Preliminary PICS

Possible PICs were identified from three references: data from the FMC site (a Superfund site where the remedy included incineration of pesticide-contaminated soil) as provided by USEPA, a summary article on LTTD treatment of pesticide-contaminated soil (Troxler and others, 1993), and structural evaluation of indicator chemicals. The PICs evaluated in the pre-operation AAQIR (Burlington, 1995) are listed in Table 5-1.

According to the FMC report, pollutants detected in stack gases during the performance test at the FMC site include chromium, CO, SO_2, NO_2, PM_{10}, and hydrochloric acid (HCl). According to the text of that report, pesticides, VOCs, semivolatile organic compounds (SVOCs), metals (other than chromium), and chlorine (Cl_2) were not detected during the performance test. However, data summaries in the appendices of the report indicate several VOCs, SVOCs, and tentatively identified compounds (TICs) were detected.

Target Compound List (TCL) VOCs and SVOCs detected in the stack gases include acetone, benzene, benzoic acid, bis(2-ethyl)hexylphthalate, bromomethane, 2-butanone, butylbenzylphthalate, carbon tetrachloride, chloroform, di-n-butylphthalate, diethylphthalate, di-n-octylphthalate, ethylbenzene, 2-hexanone, methylene chloride, naphthalene, 2-nitrophenol, 4-nitrophenol, phenol, toluene, 1,1,1-trichloroethane, trichlorofluoromethane, and xylene. TICs include: aliphatic alcohol, benzaldehyde, benzonitrile, dimethoxymethane, 1-(1,4-dimethyl-3-cyclohexene-1)ethanone, 4-ethylbenzaldhyde, hexane, N-methoxymethanamine, N-methyoxymethamine, octamethyl-cyclononasilane, silane, tetracosamethylcyclodedecasiloxane, and 2,2,4-trimethylpentane.

Other than acetone, benzaldehyde, benzene, chloroform, ethylbenzene, toluene, and xylene, no PICs were consistently identified. These seven frequently detected PICs were therefore evaluated in the pre-operation AAQIR (Burlington, 1995).

The summary article by Troxler and others (1993) on LTTD treatment of organochlorine-pesticide-contaminated soil discussed observed PICs for three different sites. At the Old Marsh Aviation site, pollutants detected in the stack gases were: acetone, acetonitrile, acrylonitrile, benzene, benzoic acid, benzyl alcohol, benzaldehyde, chloromethane, DDE, dihydrofuranone, methylphenol, phenol, and toluene. Dioxins were not detected in the stack gas, the treated soil, the liquid condensate, and the granular activated carbon systems during the demonstration. At the T H Agriculture and Nutrition site (the THAN site), detected pollutants were chloromethane, chloroethane, methylene chloride, and benzene. Additional sampling at selected points in the process detected m-ethyltoluene, styrene, trichlorofluoromethane, chloroform, bis(2-ethylhexyl)phthalate, and vinyl chloride (Williams, 1993). The S&S Flying/Malone site LTTD unit included an afterburner (1,850°F and a residence time of 0.6 seconds). Unfortunately, stack gas sampling was either not performed or the results were not presented in the test report (Ecotechniek, 1991).

The chemical structures of all organic chemicals present in the feed material at the Woods Site in concentrations greater than 100 milligrams per kilogram (mg/kg) were evaluated for potential PICs. Based on this analysis, possible PICs include: chlorobenzene, 1,1,1-trichloroethane, and DDE from DDT; trichlorobenzenes, dichlorobenzenes, chlorobenzene, and benzene from hexachlorobenzene; camphene from toxaphene; hexachloropentadiene from aldrin and dieldrin; methylphenylether and 1,1,1-trichloroethane from methoxychlor; and ethanol and nitrobenzene from parathion.

Emissions of polychlorinated dibenzo-p-dioxin (PCDDs) and polychlorinated dibenzofurans (PCDFs) was also considered. The low temperature catalytic formation of dioxin, either through catalytic chlorination, or catalytic condensation of ring species, may be the most likely pathway of PCDD/PCDF formation (Helble, 1993).

Criteria Pollutants

Criteria pollutants emitted from the thermal desorber include CO, SO_2, NO_2, PM_{10}, and HCl. HCl must be considered because of the organochlorine pesticides present in the waste feed. Emissions of chlorine (Cl_2) are assumed to be 20 percent of HCl emissions.

5.2.2 Estimated Emission Rates

To estimate emission rates, it was assumed that the LTTD unit operates at full capacity, which is a feed rate of 30 tons per hour (27,216 kilograms per hour [kg/hr]). The actual full capacity feed rate was determined during the performance test to be 26.7 tons/hour. Total operations are expected to last approximately 19.3 weeks.

Once soil treatment operations began, USEPA observed that the gas exit temperature could not be correlated to the soil exit temperature, and that the temperature in the primary chamber did not reach a 600 °F rolling average until approximately 54 to 60 minutes after the soil feed was initiated during unit start up. Therefore, USEPA required a modification to the performance test to reflect the actual operating conditions of the unit (USEPA, 1995a). One of the three performance test runs was modified to reflect a "cold start" during startup. A "cold start" performance test run is where the performance test and soil feed into the unit start simultaneously. Normally (and as was the case with the other two test runs), the performance test starts once the unit has attained all operating parameters, including a 600 °F rolling average. Stack emission rates were measured for all three performance test runs.

Temporary increases in emissions that may occur as a result of startup and shutdown in operations, malfunctions or perturbations in the combustion process, or change in the removal efficiency of the air pollution control equipment were evaluated. Consistent with USEPA guidance (USEPA, 1993), the procedures developed by the State of California Air Resources Board (CARB, 1990) were used to evaluate upset conditions. To represent stack emissions during operating conditions that are worse than normal, CARB recommends, as a default, multiplying the average emissions (found from the source test database) by ten. This factor is incorporated into the annual emission rate of organic and metal emissions. CARB further recommends using default values for the fraction of the time a facility operates under poor conditions (upset time) on an annual basis (20 percent for organics and 5 percent for inorganics). For this project, the actual proportion of upset time out of total operating hours was calculated. The existing database is not sufficient to distinguish conditions that would affect organics or metals emissions. The average proportion of upset conditions out of total operating time is 4 percent. TPU IV operating conditions, data, and calculations are provided in Appendix C.

A comparison of previously estimated (from the pre-operation AAQIR) and measured emission rates is summarized in Table 5-2. Emission rates were calculated for each emittant using the following approach (Philip, 1995):

- for detected indicator chemicals, use 95 percent upper confidence level (UCL) (assume one-half the detection limit [L/2] for non-detects in calculations) or maximum, whichever is less (consistent with USEPA, 1989) (as agreed with USEPA in August 26, 1994, response letter);
- if indicator chemical is not detected in any samples, assume L/2;
- if present in on-site soil (but not an indicator chemical), treat like an indicator chemical;
- for potential PICs that were detected, treat as above;
- for unanticipated PICs (by definition these chemicals will have been detected in at least one PPT sample), treat as above (as agreed in August 26 response letter) to calculate concentrations;
- for potential PICs that were not detected in any samples, if detection limit was sufficiently low for risk assessment purposes, then the chemical is assumed to be not present (as agreed in August 26 response letter); and
- for criteria pollutants and hydrogen chloride, the average and 95 percent UCL will be calculated using the L/2 method for values reported as not detected.

Since only two normal operating conditions runs were monitored, the maximum concentration detected in either Runs 1 or 3 was always less than the 95 percent UCL. So, in practice, the maximum measured concentration was used to calculate time-weighted average (TWA) emission rates.

Estimated emission rates for TWA normal and cold start operating conditions, including upset time, are summarized in Table 5-3.

Consistent with the CARB approach suggested by USEPA (USEPA, 1993), emissions during upsets were assumed to be 10 times higher than emissions during normal operating conditions. Estimated emissions during upset time are shown in

Table 5-4 under the heading "Upset Conditions E rate (g/sec)". TWA emission rates for normal operating conditions were calculated as:

Normal & Upset TWA E rate = (0.96 * Max of Runs 1 & 3) +
(0.04 * Upset Conditions E rate)

TWA emission rates for cold start operating conditions were calculated as:

Cold Run & Upset TWA E rate = (0.96 * Cold Run E rate (RUN 2)) +
(0.04 * Upset Conditions E rate)

5.2.2.1 Organic Compounds

In the pre-operation AAQIR, organic compounds emission rates were estimated using the 95 UCL concentration of the constituent in untreated soil and the expected destruction/removal efficiency (DRE) achieved by the LTTD unit and the APCE.

Measured emissions of pesticides were either less than previously estimated or were not detectable. In general, however, measured emissions of detected volatile organic compounds were slightly higher than anticipated.

Several organic compounds detected in untreated soil were not detected in the stack gas sampling. These were aldrin, alpha-BHC, alpha-chlordane, beta-BHC, ethylbenzene, heptachlor, heptachlor epoxide, methoxychlor, toxaphene, 1,2,4-trichlorobenzene, and xylene. Because these constituents are present in untreated soils, one-half the reported detection limit was used to calculate the estimated emission rate.

Emissions varied, as expected, between sample runs. In Run 2 (the cold start run), emissions of DDD and DDE were higher, while emissions of dieldrin and endrin were lower than in Runs 1 and 3. Emissions of VOCs, other pesticides, and phthalates were reasonably comparable in all three runs.

5.2.2.2 Metals

For the pre-operation AAQIR, metals emission rates were based on:

- the partitioning of metals in the rotary dryer (specifically, the amount that remains in the treated soil and the amount that becomes part of the gas stream); and

- the removal efficiency of the APCE for metals.

Measured metal emission rates were reasonably consistent in Runs 1, 2, and 3. Antimony, beryllium and thallium were not detected. Measured emission rates were comparable to previously estimated emission rates used in the pre-operation AAQIR. Arsenic and barium were not detected in Runs 1 and 3 but were detected in Run 2. Cadmium, chromium, lead, mercury, nickel, selenium and silver were detected.

5.2.2.3 Products of Incomplete Combustion

Anticipated PICs detected in stack emissions included chloromethane, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, styrene, and extremely low levels of dioxins and furans.

Several anticipated PICs were not detected in the stack gas sampling. These included acetonitrile, acrylonitrile, benzaldehyde, benzyl alcohol, camphene, chlorobenzene, chloroethane, dihydrofuranone, ethanol, hexachlorocyclopentadiene, 2-methylphenol, 3-methylphenol, 4-methylphenol, methylphenylether, m-ethyltoluene, nitrobenzene, 1,1,1-trichloroethane, trichlorofluoromethane, and vinyl chloride. Unanticipated PICs detected in stack emissions included 2-nitrophenol, naphthalene, phthalates (diethylphthalate, di-n-butylphthalate, di-n-octylphthalate), benzoyl chloride, undecane, 2-fluoro-4-nitrophenol, octadecanoic acid, and hexadecanoic acid. Another isomer of DDE (specifically o,p'-DDE) was reported as a tentatively identified compound.

Seven additional compounds were identified in USEPA audit tubes (York, 1995). These are 1,1,2,2-tetrachloroethane (6.72 ppb and 26.48 ppb in Audit tubes 1A and 2A, respectively) and styrene (0.97 ppb and 3.12 ppb in Audit tubes 1A and 2A, respectively). Five other compounds were reported but were not calibrated. These are: 1-bromo-2-chloroethane, hexanal, hexane, dimethoxymethane, and methyl acetate (York, 1995).

5.2.2.4 Criteria Pollutants and HCl

Estimated maximum stack gas emission rates for SO_2, NO_2, CO, PM_{-10}, and HCl are listed in Table 5-2.

Measured emission rates for HCl and Cl_2 were somewhat greater than the previously estimated emission rates. Emissions were higher during the cold start run than the normal runs. Emissions of Cl_2 were not detectable for Runs 1 and 3. Emission rates for PM_{10} were reasonably constant for all three performance test runs.

5.2.3 Emissions During Upset Conditions

Certain specific process upsets can create situations where timely actions are required to ensure safety, protect equipment, or prevent the unauthorized emission of soils, gases, or liquids from the system. Two automatic control actions are provided to address the most probable upsets, failures, or emergencies:

- vent opening (VO); and
- automatic waste feed shutoff (AWFSO).

The VO action allows ambient air to be introduced into the process gas stream just prior to the baghouse. The VO action is designed such that air may enter only from the outside, eliminating concerns that hot gases will bypass the APCE. This is accomplished by opening a damper to the main crossover duct before it enters the baghouse plenum chamber. The major purpose of the VO action is to protect the APCE components from high temperature excursions. Since the VO action is located prior to the induced draft fan, outside air is pulled into the system and passes through the APCE. A negative draft is maintained throughout the process to prevent fugitive emissions.

The AWFSO action shuts down the feed belt conveyor to the rotary kiln. This is accomplished by interlocks in the control system. The major purpose of the AWFSO action is to halt the soil processing if conditions are outside acceptable limits for adequate treatment of the soil or gas streams.

Events triggering a VO or AWFSO action are described in the Soil Treatment Work Plan.

Although unlikely, one possible situation has been identified that would allow untreated off-gases to escape prior to treatment: failure of the I.D. fan. Failure of the I.D. fan would trigger an AWFSO, resulting in a rapid drop in temperature in the rotary dryer. Several minutes would be required for the fan to completely wind down. Any vaporized contaminant in the dryer would be drawn out of the stack by both the residual draft produced by the fan and the temperature gradient. Because of the very low vapor pressures of DDT and hexachlorobenzene, most of the escaping contaminant would be entrained dust.

The exposure point concentrations were estimated by assuming that emissions occur at the uncontrolled emission rate (no APCE) and disperse into spherical "bubbles" at each end of the rotary dryer. Workers are present 8 to 12 feet from the dryer at both the feed port and at the end of the soil discharge auger.

Approach

1. Calculate volume of "bubble".

The diameter of the rotary dryer is approximately 8 feet. The height of the dryer is approximately 13.5 feet. Therefore, if the radius of the bubble is from the mid-point of the dryer to the ground, r=9.5 feet. The length of the dryer is 60 feet 4 inches.

Volume of sphere = $(4\ p\ r^3)/3 = (4 \times 3.14 \times 2.90^3)/3 = 102\ m^3$
Total volume of bubble = $2 \times 102 = 204\ m^3$

2. Calculate time for emissions to "fill" bubble.

Windspeed is 7.1 mph = 3.17 m/s

So, using average wind speed, time required to travel the distance r, or 9.5 feet (2.90 m), is 0.91 seconds. After bubble is "full", flux out of bubble is conservatively assumed to equal emission rate. Actually the bubble is constantly expanding at an exponential rate (proportionate to r^2) and the emission rate is decreasing approximately linearly with temperature. Based on Williams' past experience, upsets are infrequent and generally less than five minutes in duration because I.D. fan failure triggers an AWFSO.

3. Calculate concentration in bubble.

Concentration (mg/m^3) = emission rate (g/s) x conversion factor (1,000 mg/g) x time (0.91 seconds) / volume ($204\ m^3$)

Contaminant	Concentration (mg/m^3)	Uncontrolled Emission Rate (g/s)
hexachlorobenzene	13.3	59
DDT	21.9	98
mercury	0.0809	0.36

6 AIR DISPERSION MODELING

Air dispersion modeling was performed to estimate air quality impacts from operations associated with thermal treatment of soil at the site. This modeling was performed as required by Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121 and the Washington Toxic Air Pollutant (WTAP) Rules (WAC 173-460-080(2)(c)). The modeling was performed based on the emission rates presented in Chapter 5. This chapter describes the methodology and results of this modeling. Appendix D contains plots from the ISCST2 and fugitive dust modeling.

6.1 Air Quality Modeling Considerations

The selection of appropriate input data is an integral part of an air dispersion modeling analysis. This section describes the general inputs that were selected for use in the various models employed in the analysis.

6.1.1 Topography and Land Use

The site is located in an east-west valley in the northwestern part of the Yakima Valley, within the city limits of Yakima. The U.S. Geological Survey Yakima East 15-minute quadrangle map (Figure 6-1) and the site location map (Figure 1-1) show that the area surrounding the site is relatively flat. However, the terrain is complex approximately 3.5 to 4 kilometers (k) to the south and west of the site. Approximate Universal Transverse Mercator (UTM) coordinates for the stack are 692,049 Easting, 5,160,805 Northing.

The "Guideline on Air Quality Models (Revised)" (USEPA, 1986, 1987, 1990, and 1993) describes two techniques (land use or population density) that should be used to determine whether urban or rural dispersion coefficients should be used in an air dispersion modeling application. The land use procedure proposed by Auer (1978) was used because it is considered to more definitive than population density.

The Auer land use procedure involves classifying the land use types within an area circumscribed by a 3,000-meter (approximately 1.86 mile) radius. If land use is determined to be less than 50 percent urban, then the area within a 3-km (approximately 1.86 mile) radius of the site is classified as rural. The land use analysis showed that the area surrounding the Woods Site is rural. Therefore, rural dispersion coefficients should be used in air dispersion modeling applications.

6.1.2 Receptor Grids

Cartesian receptor grids and discrete receptors used in the modeling analysis were based on UTM coordinates. The SCREEN2 model was used to calculate impacts out to 5 km using a specified array of receptors. Since the maximum impacts occurred off site within approximately 1 km of the site, 100-meter grids were used in the modeling.

For ISCST2 modeling, a 34 x 34 receptor grid with 100-meter spacing that was centered on the source was used.

The COMPDEP model limits the number of receptors to 500. Due to this limitation, a truncated ISCST2 receptor grid (20 x 20 with 100-meter spacing) was used for the COMPDEP modeling. In addition, a series of discrete receptors located 25 meters off the property line and spaced approximately every 50 meters were used in the COMPDEP modeling.

Since maximum impacts from the fugitive dust sources occur close to the sources, a truncated ISCST2 receptor grid (9 x 6 with 100-meter spacing) was used for the FDM modeling as well as the discrete receptors described above. In addition, a series of discrete receptors were located on the property line and spaced approximately every 25 meters.

6.1.3 Source Input

Stack parameters for normal LTTD unit and APCE operating conditions are listed in Table 6-1. The stack height and stack inside diameter parameters were supplied by Williams, who operates the LTTD unit at the site. The stack gas exit temperature and stack gas exit velocity represent averages of Performance Test Runs 1 and 3 supplied by Focus Environmental.

6.1.4 Modeled Emission Rates

In the modeling of emissions from the LTTD stack, a unit emission rate of one gram per second was used. Pollutant-specific concentrations were calculated by multiplying the maximum unit ground level concentrations calculated by the model times the actual emission rate of the pollutant.

6.1.5 Building Downwash Analysis

A building downwash analysis was performed to evaluate whether nearby structures would affect dispersion of the LTTD unit stack emissions. The USEPA's Building

Profile Input Program (BPIP) was used to perform the analysis. The following structures were used in the analysis:

- adjacent off-property buildings;
- Akland building (on site); and
- structures associated with the LTTD unit and APCE.

The structure heights and direction-specific building widths were used in this air dispersion modeling analysis. The BPIP results indicate that the tallest structure surrounding the LTTD stack is 4.2 meters. Since the LTTD stack is 16.46 meters, the stack is in compliance with Good Engineering Practice (GEP) and no downwash dimensions are required for the ISCST2 or COMPDEP dispersion modeling. The results of the BPIP analysis are presented on disk in Appendix D.

6.1.6 Meteorological Data

The air dispersion models used in this analysis require meteorological data consisting of hourly surface observations and morning and afternoon mixing heights. Five years (1984 to 1988) of National Weather Service meteorological data were obtained from the USEPA Office of Air Quality Planning and Standards Technology Transfer Network. The surface data was collected at the Yakima Airport (Station 24243). The mixing height data had been collected at Spokane, Washington (Station 24157). The WDOE Modeling Section considers this meteorological data to be representative of the area where the source is located. A surface level (10-meter) wind rose for Yakima is shown in Figure 6-2. While on-site surface meteorological data has been collected since the performance test began, the revised modeling used the same meteorological data set that was used in the pre-operation AAQIR.

COMPDEP requires additional meteorological data in order to calculate wet deposition. PREPROC, the precipitation data file preprocessor for COMPDEP, was obtained from the USEPA Office of Air Quality Planning and Standards Technology Transfer Network. The CD-144 and TD-3240 files required by PREPROC were obtained from the National Climatic Data Center.

Philip believes that the five years of Yakima/Spokane meteorological data is preferable to the on-site meteorological data for the following reasons:

- on-site meteorological data is not available for modeling the long-term impact of the project's duration; and

- appropriate precipitation data for input into the COMPDEP model was not part of the on-site meteorological monitoring program.

6.2 Air Quality Models

The air quality modeling analysis was performed in accordance with the USEPA's "Guideline on Air Quality Models (Revised)" (1986, 1987, 1990, and 1993) and other procedures recommended by USEPA Region X.

6.2.1 ISCST2 Modeling

The USEPA's Industrial Source Complex Short-Term (ISCST2 Version 93109) air dispersion model was used to estimate pollutant concentrations from the LTTD unit stack. ISCST2 is appropriate for this project because it can be used for the following applications:

- refined modeling;
- rolling or flat terrain;
- multiple (point, area, and volume) sources;
- urban or rural areas;
- one-hour to annual averaging times; and
- direction-specific downwash.

As recommended by the USEPA, the regulatory default operation was used. With this option selected, the model will implement the following:

- stack-tip downwash;
- no gradual plume rise;
- calms suppressing routine;
- buoyancy-induced dispersion;
- default wind profile exponents; and
- default vertical potential temperature gradients.

For this analysis, 1-hour, 3-hour, 8-hour, 24-hour, and 12-week long-term average concentrations were calculated. The 19.3-week period runs from April 2 to August 15 and corresponds to the anticipated LTTD unit operation schedule. April 2 marks the beginning of contaminated soil treatment by the LTTD unit and August 15 is the anticipated completion date of contaminated soil treatment by the LTTD unit. Cartesian receptor grids based on UTM coordinates were used.

6.2.2 COMPDEP Modeling

The USEPA's COMPDEP model (Version 94262) was used to estimate total annual wet and dry deposition fluxes of the LTTD unit stack emissions.

COMPDEP is a combination of ISCST, COMPLEX I, and MPTER-DS and thus contains features found in these models such as terrain adjustments, default wind profile exponents, buoyancy-induced dispersion, calms processing, terrain adjustments, and building downwash. The options that were selected for ISCST2 were also used in the COMPDEP modeling. A 19.3-week long-term concentration could not be calculated because COMPDEP calculates an annual concentration.

The approach outlined in the *Addendum to the Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions* (EPA/600/AP-93/003) and *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes* (EPA/530/R-94/021) was utilized for application of the model and for development of the particle size distribution and proportion of available surface area exiting the stack.

The actual size distribution and proportion of available surface area for stack emissions from the LTTD unit is unknown for the Woods Site. The distribution of particulate matter is greatly dependent upon many variables, including the size distribution of the feed soils and the air pollution control equipment on the treatment unit. Williams has not derived such information for the selected treatment unit or any similar unit. According to USEPA guidance, *Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions*, the exact particle size distribution cannot be calculated even if these variables are known; therefore, it is necessary to resort to a "generalized" assumption of the distribution for purposes of deposition analysis.

The COMPDEP modeling included running the model for all five years of meteorological data using the updated stack parameters presented in Table 6-2. The COMPDEP modeling analysis used the particle size distribution based on the Fraction of Total Surface Area column from Table 6-2.

6.2.3 Fugitive Dusts

Measured PM_{10} concentrations were used to evaluate risks associated with exposure to fugitive dusts. Data from location A11/A61 were used to calculate fenceline fugitive dust concentrations. The 95 percent UCL of the arithmetic mean was calculated consistent with USEPA guidance (USEPA, 1992). The calculated 95 percent UCL for PM_{10} at this location is 81.71 ug/m^3. This PM_{10} concentration was used to calculate the fenceline air concentration of chemicals detected in untreated soil. Because location A11/A61 primarily monitors treated soil, this method would likely overestimate the concentration of chemicals in air. The maximum measured PM_{10} concentration of 214.7 ug/m^3 was used to estimated exposure-point concentrations for short-term exposures (8-hour).

6.3 Air Quality Modeling Results

This section summarizes the air dispersion modeling results. A discussion of pollutant-specific concentrations for comparison with applicable ambient air standards and total deposition impacts for use in the risk assessment is presented in Chapter 7.

6.3.1 Ambient Air Concentrations

Table 6-3 is a summary of the maximum ground level concentrations predicted by ISCST2 for 1-, 3-, 8-, 24-hour, and annual averaging periods for normal operating conditions. ISCST2 was used to estimate impacts for normal and cold start operating conditions. For a conservative approach, Table 6-3 uses wet and dry deposition values for VOC emittants using COMPDEP assuming VOCs are particulate-bound, which may or may not be true. Pollutant-specific results are discussed in Chapters 7 and 8.

Summarized in Table 6-4 are 24-hour and annual average maximum ground level concentrations based on TWA concentrations for cold start operating conditions.

All maximum concentrations occurred off site within approximately one kilometer of the source. With the exception of the 3-hour maximum, which was located northeast of the source, all maximum impacts occurred to the east or south-southwest of the source.

6.3.2 Total Deposition

Maximum deposition impacts were modeled and a presentation and detailed discussion of how the deposition impacts were utilized in the risk assessment is presented in Chapter 8. The values used are the maximum values calculated by the models for all five years of meteorological data analyzed.

6.4 Air Quality Modeling Uncertainties

The air dispersion models used in this analysis (and the worst-case scenarios modeled) are inherently conservative and overestimate the impacts. Actual impacts will be lower than the impacts presented in this report.

For ISCST2 modeling, the regulatory default option was selected which will overestimate the impacts. The COMPDEP model employs many of the options included in the ISCST2 regulatory default option and these were used in the modeling analysis.

7 COMPARISON TO STANDARDS

Approximately 19,000 tons of pesticide-contaminated soil will be treated on site. Operation of the system is anticipated to require 19.3 weeks to treat these soils. Potential chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) and possible risks to human health associated with emissions from the LTTD unit during this period are evaluated in this chapter.

7.1 Clean Air Act

"In general, emissions from CERCLA activities are not expected to qualify as 'major'" (USEPA, 1989a) and, therefore, a PSD permit is not required. A major source is one that emits over 250 tons per year of any regulated pollutant. If the source is an incinerator, then it is a major source if it emits over 100 tons per year (mostly as NO_2, CO, and PM_{10}). Because total emissions of regulated pollutants will be less than 8 tons in one year, the LTTD unit is not a "major" source.

7.1.1 National Ambient Air Quality Standards

USEPA has promulgated NAAQS for the following six pollutants (called "criteria pollutants"): PM_{10}, SO_2, CO, ozone, NO_2, and lead. Primary standards are set at levels to protect public health. Secondary standards are set at levels to protect public welfare, which includes wildlife, climate, recreation, transportation, and economic values. NAAQS do not apply directly to source-specific emissions limitations; rather, they are national limitations on ambient concentrations intended to protect health and welfare.

States have primary responsibility for assuring that NAAQS are attained and maintained. A new stationary source of air emissions must undergo a pre-construction review to determine if the source will interfere with attainment or maintenance of NAAQS or will fail to meet other new source review requirements (such as, New Source Performance Standards). If the new source is a significant contributor to the non-attainment status of an area or would delay attainment, then best available control technology (BACT) is required for criteria pollutants. Otherwise, Reasonably Available Control Technology (RACT) is required for criteria pollutants. Washington state standards for sources of toxic pollutants include use of T-BACT. Specifically, "major" new sources must meet PSD requirements and obtain PSD permits before beginning construction. Pursuant to Section 121(e), a CERCLA response action taking place entirely on site is exempt from the requirement to obtain a permit. However, the action must comply with all substantive requirements of a PSD review if it is a "major" new source. Because treatment of impacted soils does not constitute a "major" source of air emissions, requirements in the permitting process related to attainment of NAAQS do not apply.

The maximum modeled ground level concentrations of (annual average and 24-hour average) PM_{10} and (quarterly average) lead emitted from the stack are well below their respective NAAQS.

A geometric mean was calculated for long-term average PM_{10} concentration. The Wilk-Shapiro test (USEPA, 1992) was used to characterize the frequency distribution of PM_{10} results. The statistical test indicated that PM_{10} concentrations were consistent with a log-normal distribution. The statistical testing rejected the hypothesis of normality. The arithmetic average PM_{10} concentration for the period March 18 to May 26, 1995 at location A11 is 62.1 ug/m^3. Average PM_{10} concentrations at the other five locations for the same time period were 22.6 to 31.3 ug/m^3. PM_{10} measurements obtained prior to soil treatment (February 14 to March 10, 1995) average 28.7 to 41 ug/m^3 at the various monitoring points. The time-weighted annual average concentration would be 44 ug/m^3 assuming a project duration of 19.3 weeks, and average background fugitive dust emissions (32.7 ug/m^3) for the balance of the year.

7.1.2 National Emission Standards for Hazardous Air Pollutants

National Emissions Standards for Hazardous Air Pollutants (NESHAP) apply to specific source categories of air emissions. The LTTD unit does not meet the definition of any regulated source.

7.1.3 New Source Performance Standards

New Source Performance Standards (NSPS) are source-specific requirements. The systems with the LTTD unit are not included in the NSPS.

7.2 Washington State Standards

Washington state has developed standards for both toxic and criteria pollutants. These standards are discussed in the following sections.

7.2.1 Washington Toxic Air Pollutants Rules

The WTAP Rules may be applicable and are relevant and appropriate to remedial actions performed at the site because the Model Toxics Control Act is an ARAR. Substantive requirements of the WTAP Rules include new source review requirements, requirement to quantify emissions of Toxic Air Pollutants (TAPs), and ambient impact requirements. New source review requirements include notification of the authority and use of BACT for toxics. Ambient impact requirements include demonstration that the emissions from the source are sufficiently low to protect human health and safety from potential carcinogenic and other toxic effects, and acceptable source impact level (ASIL) analysis for Class A and Class B TAPs. Comparison to ASILs is discussed below. Quantitative evaluation of potential risks to human health associated with emissions is discussed in Chapter 8.

As required by the WTAP Rules, an acceptable source impact level analysis must be performed for all new toxic air pollutant sources. There are three types of ASILs: risk-based, threshold-based, and special ASILs. ASILs for Class A TAPs (known, probable, or potential human carcinogens) are based on a 1×10^{-6} risk level assuming lifetime residential exposure. For Class A TAPs, the annual average concentrations are compared to the ASILs. Class B TAPs are based on a threshold, either a USEPA inhalation reference dose (RfD), or when an RfD is unavailable, the Threshold Limit Value TWA (TLV-TWA) divided by 300 to calculate a 24-hour TWA. For Class B TAPs, a 24-hour averaging time is used.

TWA emission rates for normal operations, incorporating upset conditions, were combined with dispersion coefficients from the ISCST2 modeling to estimate maximum ground level concentrations of each detected emittant. The long-term average (19.3 weeks) or 24-hour dispersion coefficients were used to estimate maximum ground level concentrations for Class A and Class B Toxic Air Pollutants, respectively. The resulting estimates and ASILs are shown in Table 7-1. On the basis of this analysis, maximum incremental emissions associated with stack emissions do not exceed ASILs.

7.2.2 Washington Air Pollution Control Regulations

Combustion units must meet a particulate standard of 0.1 grams per dry standard cubic foot (gr/dscf) per WAC 173-400-050(1). All measured particulate emissions from TPU-4 were below this standard. WDOE has stated the unit meets the definition of a temporary source (Newman, 1994).

7.2.3 Washington Air Pollution Control Regulations

General standards include limits on opacity, fallout, fugitive emissions, odors, detrimental emissions, sulfur dioxide, concealment and masking, and minimization of fugitive dust emissions. The LTTD unit does not meet the definition of a "major" source because none of the regulated potential emitted pollutants exceeds 100 tons per year. In fact, estimated total emissions of criteria pollutants are well below this level.

Combustion units must meet the above requirements plus a particulate standard of 0.1 gr/dscf (WAC 173-400-050(1)), 100 parts per million (ppm) of total carbonyls (WAC 173-400-050(2)), and measured concentrations for combustion sources shall be adjusted for volumes and corrected to seven percent oxygen (WAC 173-340-050(3)).

7.3 Air Emissions Under Resource Conservation and Recovery Act (RCRA)

Existing RCRA regulations covering hazardous waste air emissions are limited to controls on incinerators, boilers, and industrial furnaces and some other types of treatment, storage, and disposal facilities (TSDFs), and controls on fugitive particulate matter from landfills, waste piles, and land treatment facilities. Regulations pertinent to the Woods Site are discussed below.

7.3.1 Hazardous Waste Burned in Boilers and Industrial Furnaces

The Boiler and Industrial Furnace (BIF) Regulations (40 CFR 266 Subpart H) are not applicable because the contaminated soil is not a hazardous waste.

TCLP tests during the RI indicated the soil and other materials were below the regulatory limits. Prior to the RI, USEPA stated some of the material handled on-site may have been similar to toxic waste codes U061 (DDT), U127 (Hexachlorobenzene), or U129 (Lindane). Existing information (from depositions, site investigations, and previous remedial actions) is not generally sufficient to distinguish areas impacted by pure or technical grade product from areas impacted by materials, such as manufacturing process wastes, that contain these substances. Where possible, lead- and arsenic-contaminated soil was segregated during soil removal. This material is not going to be treated by the LTTD unit. It will be properly treated and disposed of off-site at a RCRA-permitted facility.

The CERCLA *Compliance with Other Laws/Manual* (USEPAc, 1988) (pages 2-6 and 2-7) states "Simply the presence of a hazardous constituent in a waste is not sufficient to automatically consider a waste to be hazardous under RCRA. For example, . . .low concentrations of a hazardous constituent, dispersed in soil over a wide area, would generally not trigger Subtitle C as relevant and appropriate."

Certain aspects of the BIF Regulations may be relevant and appropriate. For example, organic emissions must be less than their respective risk-specific dose (RSD) concentration or reference ambient air concentration (RAC). Similarly, metals emissions from BIFs must meet either the Tier II screening levels or the Tier III site-specific risk assessment levels. As shown in Table 7-2, the estimated organics and metals emissions are well below their respective RSD concentration or RAC. The cumulative ratio of each carcinogenic metal to its RAC is also well below 1.0.

7.3.2 Draft Combustion Strategy

Three aspects of the draft combustion strategy were considered for the Woods project. These are performance of a site-specific risk assessment, upgraded particulate standard, and dioxin and furan emissions. A site-specific risk assessment was submitted to USEPA on January 19, 1995. The emission rate for the sum of tetra through octa dioxin and furan congeners for Runs 1 and 3 were 0.984 and 0.671 nanogram per dry standard cubic meter (ng/dscm), respectively. For the cold start run, Run 2, the measured emission rate was 1.06 ng/dscm. Each of these is well below the emission standard for total dioxins and furan emissions, 30 ng/dscm (based on the sum of the tetra through octa dioxin and furan congeners).

The draft combustion strategy also incorporates an upgraded particulate standard of 0.015 gr/dscf (or 34 mg/dscm, corrected to 7 percent O_2). This project's standard was set at 0.03 gr/dscf corrected to 7 percent O_2. The measured particulate emissions were in excess of the requirement for all runs except Run 4. PM_{10} emissions for Runs 1 and 3, were 0.035 gr/dscf and 0.03906 gr/dscf (corrected to 7 percent O_2), respectively. For Run 2 (the cold start run), PM_{10} emissions were 0.04671 gr/dscf (corrected to 7 percent O_2). After some equipment modifications on TPU IV, the 0.03 gr/dscf standard was achieved. For Run 4 (also a cold start run), emissions were 0.01273 gr/dscf corrected to 7 percent O_2. The higher than anticipated particulate emissions have been attributed to stack demister problems experienced during the performance test. It is believed that some scrubber water passed through the demisters and the dissolved solids in the scrubber water are contributing to the particulate in the sample. Williams has discussed this issue with USEPA and has agreed to continue to attempt to correct the problem (Focus Environmental, 1995).

According to the draft combustion strategy, "(t)his technology-based standard operates to provide a major control on metals emissions from combustion units. The upgraded PM standard will be used for BIFs unless another protective standard is applicable under state or federal law." The ASILs are both applicable and protective. As shown in Table 7-2, all detected emissions are below ASILs.

8 RISK EVALUATION

The four major steps of the risk assessment (RA) process are addressed in the following sections and earlier chapters of this report. The first step, data evaluation and identification of chemicals of potential concern, are discussed in Chapter 5. The exposure setting is discussed in Chapter 2. Models used to estimate exposure-point concentrations are described in Chapter 6.

In this chapter, specific exposure scenarios, and parameters used to describe the duration and frequency of exposure are presented in Section 8.2. The toxicity values used to estimate potential risk from each indicator chemical are discussed in Section 8.3. The final component of the risk assessment process is risk characterization, which combines exposure information and toxicological data to estimate the potential increased risk of cancer and the potential for other adverse health effects. The risk characterization is presented in Section 8.4. A qualitative uncertainty analysis is presented in Section 8.5. A brief summary of the chemicals of potential concern, exposure assessment, toxicity assessment, and risk characterization is provided below.

8.1 Summary

Based on the results of the RI, indicator chemicals for soil at the Woods Site are: aldrin, alpha-BHC, beta-BHC, gamma-BHC, chlordane, DDD, DDE, DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, methoxychlor, toxaphene, arsenic, lead, and mercury.

Soil handling may result in fugitive dust emissions of untreated soil. Backfilling of the site with treated soil may also result in fugitive dust emissions of treated soil. Fugitive dust emissions could impact the immediate site environs. Emissions of indicator chemicals, plus possible PICs, other metals, and criteria pollutants from the stack of the LTTD unit may result in direct and indirect exposures to the community.

Direct pathways include inhalation of emitted pollutants in air and are limited to the duration of soil treatment (approximately 19 weeks). Indirect exposures are associated with deposition of the emitted pollutants on soil and are long-term. Indirect exposures may include incidental ingestion of soil, consumption of home-grown produce grown in soil, or consumption of animal products from livestock grazing in the area. In the immediate vicinity of the site, fugitive dusts from soil handling could be inhaled by workers or deposited on nearby properties. Although unlikely, failure of the I.D. fan could result in a sudden, brief release of particulate-laden steam. Equipment operators could be exposed to chemicals in the steam cloud.

All of the organochlorine pesticide indicator chemicals are either possible or probable human carcinogens except for endrin and methoxychlor. The target organ for all possible or probable carcinogenic indicator chemicals is the liver. Non-cancer health effects associated with subchronic or chronic exposure to the pesticide indicator chemicals are primarily associated with liver toxicity. Arsenic is a known carcinogen, and lead is a probable carcinogen.

Risks for complete or potentially complete pathways were evaluated qualitatively or quantitatively. The calculated cancer risk levels and hazard indices (HIs) were well below 1×10^{-6} and 1, respectively, for all pathways evaluated quantitatively. Risks for pathways not quantified are believed to be below these CERCLA benchmark levels also.

8.2 Exposure Assessment

The fundamental concept of a RA is that, for a potential risk to exist, there must be a complete exposure pathway. A complete exposure pathway is comprised of the following four elements:

- a source and mechanism of chemical release to the environment, such as stockpiled soil exposed to wind erosion;
- an environmental transport medium, such as windborne transport;
- a point of potential contact with the impacted medium, such as being in close proximity to the site; and
- a route of exposure, such as inhalation.

The available data were evaluated in context with the exposure setting to identify exposure pathways that are currently complete or may become complete at some time in the future.

Exposure pathways considered in this risk evaluation are summarized in Table 8-1. Land-use and demographics are discussed in Chapter 2. Anticipated future use of the site is for industrial purposes. The site borders a major railway corridor. No significant change in surrounding land use is anticipated.

Direct pathways (such as inhalation of particulate-bound contaminants as fugitive dusts, or inhalation of emitted pollutants from the stack) were considered quantitatively. Indirect pathways associated with deposition of contaminants, such as ingestion of locally-raised animal products, consumption of homegrown vegetables, or incidental ingestion of soil, were evaluated quantitatively using USEPA's guidance for performing screening level risk analysis (USEPA, 1994).

Emissions from the stack occur during startup, the performance test, and treatment of the stockpiled soils and the soil beneath the stockpiles. The expected duration of treatment is 19.3 weeks. Based on the new ISCST2 modeling results, the highest concentrations of stack emissions occur to the east or south-southwest of the site. The modeled maximum 1-hour concentration occurs within 700 m of the southeastern edge of the property in a commercial area. The modeled maximum 24-hour concentrations occur approximately 400 m southeast of the site in an industrial area, which is currently used for produce storage and packing. Therefore, industrial exposure assumptions were used to evaluate possible health risk associated with short-term exposure under normal and cold-start run operating conditions. Reduced performance (*i.e.*, upsets) are incorporated into estimated emission rates for both sets of operating conditions.

The modeled annual maximum concentrations occur approximately 500 m east of the site. Approximately 550 m east of the site and extending east to Route 97 (approximately 1,750 m east of the site) are residential areas. Therefore, direct pathway risks associated with estimated annual concentrations at the maximum exposure point were evaluated using residential exposure assumptions. Modeled maximum deposition of stack emittants occurs at the eastern fenceline (see Figure 8-1). Although this area is used for fruit packing and storage, indirect pathway risks were evaluated for this location using the subsistence farmer scenario because this scenario was previously used to evaluate indirect pathway risks. Because of the higher rate of exposure, risks for subsistence farmers will typically be higher than those for adult or child residents in the same area. Therefore, the subsistence farmer scenario was selected for quantification.

In the subsistence farmer scenario, an adult farmer is exposed via consumption of homegrown beef and milk, consumption of homegrown vegetables, incidental soil ingestion and direct inhalation of vapors and particles. The subsistence farmer is assumed to raise cattle for both beef and milk consumption and grow crops for home consumption.

To calculate estimated chemical intakes, it was necessary to estimate both the exposure-point concentrations and to develop specific parameters to describe the frequency and duration of exposure and are discussed below.

8.2.1 Calculation of Exposure Point Concentrations

Methods and models used to estimate the concentrations of chemicals in different environmental media are described below.

8.2.1.1 Fugitive Dusts

Measured PM_{10} concentrations were used to evaluate risks associated with exposure to fugitive dusts. Data from location A11/A61 (Figure 8-1) were used to calculate fenceline fugitive dust concentrations. The 95 percent upper confidence limit (UCL) of the arithmetic mean was calculated consistent with USEPA guidance (USEPA, 1992). The calculated 95 percent UCL for PM_{10} at this location is 81.71 ug/m^3. This PM_{10} concentration was used to calculate the fenceline air concentration of chemicals detected in untreated soil. Because location A11/A61 primarily monitors treated soil, this method would likely overestimate the concentration of chemicals in air. The maximum measured PM_{10} concentration of 214.7 ug/m^3 was used to estimate exposure-point concentrations for short-term exposures (8-hour). Calculated concentrations (shown in Table 8-2) are higher than the highest concentrations measured during the ambient air monitoring program. "Calculated concentrations" refers to concentrations calculated from the measured PM_{10} levels and the 95 percent UCL of the average concentration for each contaminant in the untreated soils. As indicated in Section 8.2.1, the highest measured levels of PM_{10} were near the treated soil piles; therefore, this approach is likely to overestimate the concentration of individual contaminants in air.

Treated soil will be used to backfill the excavated portions of the site to restore grade. After soil treatment is complete, the site will either be revegetated or paved, which will minimize subsequent dust generation.

8.2.1.2 Stack Emitted Pollutants in Ambient Air

Measured emission rates for normal (Runs 1 and 3) and cold start (Run 2) operating conditions were used to calculate TWA emission rates, each incorporating a 10-fold increase in emissions during upset conditions. According to data collected during the performance test, emissions during upsets occur approximately 7 percent of total operating time. Ground level concentrations were calculated using the ISCST2 results and TWA normal and cold start emission rates. These calculated ground level concentrations are shown in Tables 6-3 and 6-4.

8.2.1.3 Wet and Dry Deposition on Soil

Emitted pollutant concentrations in soil were derived from the deposition rates estimated using the COMPDEP results described in Section 6.3.2. The total maximum annual wet deposition rate is 3.716 grams per square meter (g/m^2) on the western fenceline and dry deposition is 0.04256 g/m^2 approximately 250 m southeast of the southeastern corner of the site. Table 6-3 includes estimated deposition rates (wet and dry) for each detected emittant. This method considers deposition of particulate-bound contaminants, but does not consider vapor-phase depositions or diffusions. All detected emittants (including volatiles) are assumed to be particulate-bound. The method does not consider losses due to volatilization, leaching, erosion, runoff, or degradation (including photo-degradation). The screening model USEPA uses to evaluate indirect exposure pathways focuses on a limited number of constituents. These constituents were selected based on an analysis of their potential to pose increased risk by means of one or more of the indirect exposure pathways (USEPA, 1994a). Any detected emittants that were included in USEPA's screening list (specifically, arsenic, lead, mercury, 2,3,7,8-TCDD equivalents, bis(2-ethylhexyl)phthalate, and hexachlorobenzene) were evaluated. Chemical-specific information for DDT and dieldrin was provided by USEPA specifically for this project (USEPA, 1994f). Chemical-specific information for DDD and DDE were developed by Philip.

Maximum wet and dry deposition rates and average annual ground level air concentrations were used in the indirect pathway analysis. Because these points are not co-located, and because they also occur in areas that are not agricultural, this will result in an over-estimate of risk. Indirect pathway risks were recalculated for all detected emittants previously evaluated.

8.2.1.4 Upset Conditions

I.D. fan failure was identified as a possible, if unlikely, upset condition. If the I.D. fan failed, some emissions could bypass the APCE. As discussed in Section 5.2.3, the estimated concentrations of DDT, hexachlorobenzene, and mercury during a five-minute upset were 98 mg/m^3, 59 mg/m^3, and 0.36 mg/m^3, respectively. On July 9 during an AWFSO, there was a momentary loss of the I.D. fan. Measured 24-hour concentrations at location A11 were 157 ug/m^3 for PM_{10}, 0.143 ug/m^3 for hexachlorobenzene, ND<0.023 ug/m^3 for both DDT and dieldrin.

8.2.2 Estimation of Intakes

Exposure factors used to calculate human intakes of chemicals were obtained primarily from USEPA Region X guidance (USEPA, 1991a). This guidance incorporates the standard default exposure factors for the reasonable maximum exposure (RME) case developed by USEPA headquarters (USEPA, 1991b). The potential exposure of any individual to chemicals of potential concern depends on such factors as individual activity patterns, location-specific contaminant concentrations, and other site-specific factors. The exposure pathways quantified in this risk assessment are:

- Direct pathways
  - Inhalation of particulates and VOCs

- Indirect pathways
    - Incidental soil ingestion
    - Consumption of home grown produce
    - Consumption of animal products (beef and milk)

The exposure factors, the rationale for each exposure factor, and the sources for the assumptions are presented below by exposure pathway.

The 1-hour, 3-hour, 8-hour, and 24-hour maximum concentrations all occur within industrial/commercial areas. USEPA Standard Default Exposure Factors for industrial exposure are: 20 cubic meter (m^3) of air inhaled per day, 70-kg body weight, 250-days-per-year exposure frequency, and 25-year exposure duration. Because soil treatment will take only 19.3 weeks, an exposure duration of 19.3 weeks was assumed for direct pathways. Because the estimated 1-, 3-, 8- and 24-hour maximums during normal operations are greater than those during interim operations, only the estimated emission rates during normal operations were used to estimate potential health effects associated with acute exposure. The 95 percent UCL concentration in soil prior to treatment was used to estimate peak short-term emission rates.

The annual average maximum concentrations occur within residential areas east of the site. Therefore, Standard Default Exposure Factors for residential exposure were used. These factors are: 20 m^3 of air inhaled per day, 70-kg body weight, 350-days-per-year exposure frequency, and 30-year duration. As discussed above, because soil treatment will be completed within a 19.3-week time period, an exposure duration of 19.3 weeks was assumed for direct pathways. The formula used to calculated intake is shown in Table 8-3.

Emitted pollutants deposited on soil will persist far beyond the duration of soil treatment. Default exposure factors for the subsistence farmer scenario are: 44 percent of an average daily intake of 100 g/day of beef is contaminated, 40 percent of an average daily intake of 300 g/day of milk is contaminated, 95 percent of an average intake of 24 g (dry weight [DW])/day) of above-ground vegetables are contaminated, 95 percent of an average intake of 6.3 g (DW)/day of root vegetables are contaminated, and 100 percent of the average daily intake of 100 mg/day of soil and 20 m^3/day of air are contaminated (USEPA, 1994a,b). For all indirect pathways the assumed duration of exposure is 30 years based on the assumption that farmers are less mobile than the general population. For direct pathways (inhalation of vapor and particulate in air), the assumed duration of exposure corresponds to the duration of soil treatment, or 19.3 weeks.

8.3 Toxicity Assessment

The science of toxicology is concerned with the evaluation of the intrinsic properties of chemicals and how various concentrations of a chemical can affect the human body. In general, exposure to greater concentrations of a chemical increases the likelihood or probability that an adverse health effect will occur, may increase the severity of the effect, or may even result in additional adverse health effects. The USEPA has developed an approach to quantify the dose-response relationship between the concentration to which a person is exposed and the increased risk of that person developing cancer which is summarized by the "cancer slope factor (CSF)." These CSFs are expressed as the increased risk of cancer per average daily exposure to the chemical over a lifetime, expressed as inverse milligrams per kilogram of body weight per day $(mg/kg/day)^{-1}$. The quantity and quality of the available scientific information indicating that the chemical is a human carcinogen is summarized by the "weight-of-evidence" rating. The USEPA weight-of-evidence rating categories are summarized in Table 8-4.

For health effects other than cancer, USEPA has developed RfDs and reference concentrations (RfCs) that are often derived from laboratory studies on animals. Typically, the lowest concentration of a chemical that resulted in an adverse health effect (known as a LOAEL) or the highest concentration that did not result in an adverse health effect (referred to as a NOAEL) is reduced by a factor of 10 or 10,000 to develop the RfD or RfC. RfDs are expressed as the average daily exposure in milligrams of the chemical per kilogram of body weight per day (mg/kg/day). RfCs are expressed in milligrams of the chemical per cubic meter of air (mg/m^3). RfCs are based on an assumed inhalation rate of 20 m^3/day and 70 kg body weight.

Some of the chemicals detected at the site are considered potential carcinogens, such as DDT and hexachlorobenzene. Some, although not considered carcinogens, may cause other adverse health effects. Included in Appendix X of the RI Report for the Woods Site is a brief description of the intrinsic toxicological properties and typical sources and uses of these chemicals. Also included in the toxicological summaries is an evaluation of the potential for acute toxicity.

Consistent with USEPA guidance, the Integrated Risk Information System (IRIS) database (1995) and the Health Effects Assessment Summary Tables (HEAST) (USEPA, 1994b) were consulted for toxicity information for non-carcinogenic effects of detected emittants. In the absence of established values in IRIS or HEAST, provisional toxicity values were used according to the following hierarchy:

- values that have been derived by USEPA in other documents (e.g., Health Effects Assessment Documents, Drinking Water Criteria Documents);

- toxicity values obtained from the USEPA Environmental Criteria and Assessment Office (ECAO) for this project (USEPA, 1994c and 1994d);

- toxicity values that have been withdrawn from IRIS or HEAST without being replaced;

- for non-carcinogens, RfCs were calculated from oral RfDs using route-to-route extrapolation (correction factor of 1.0), an inhalation rate of 20 m^3, a body weight of 70 kg, and a background level factor of 0.25 to account for indirect exposure from the source in question or other sources (USEPA, 1989). Calculated RfCs and the equation are provided on Table 8-5;

- for potential carcinogens (specifically, DDD and DDE), the oral slope factor was used in lieu of the inhalation slope factor, assuming route-to-route extrapolation; and

- toxicity criteria specific to o,p'-DDE could not be located in the literature reviewed. Therefore, toxicity values for p,p'-DDE were utilized for o,p'-DDE.

Subchronic RfCs are appropriate for evaluation of exposures of two weeks to seven years in duration (USEPA, 1989c). A number of subchronic RfCs were obtained from USEPA's Environmental Criteria and Assessment Office, Technical Support Center (ECAO-TSC). Inhalation toxicity values are summarized in Table 8-6.

To assess risk from exposure to the short-term indicator chemical concentrations (1- and 8-hour averages), a toxicity criterion corresponding to a similar exposure duration was used. Where available, USEPA Acute Inhalation Criteria (AIC) were used. The AIC provides a threshold level above which acute inhalation exposure could result in toxicity to the most sensitive target organ. The only available AIC Risk Assessment Issue Paper is for lead. According to that document, it is not appropriate to derive an AIC for lead (Dollarhide, 1993). If AICs were unavailable, the TLV-TWA were used. TLV-TWA values are listed in Table 8-7.

To assess risk from exposure to emissions for the five-month duration of the project, the inhalation unit risks were converted to inhalation cancer slope factors.

All values were available either in the 1994 HEAST (USEPA, 1994e) or were obtained from the USEPA ECAO-TSC (TSC, 1994).

Long-term risks associated with ingestion of emitted pollutants deposited on soil were evaluated using oral CSFs and oral RfDs obtained from the 1994 HEAST (USEPA, 1994e) or IRIS.

8.4 Risk Characterization

The final component of the RA process is the risk characterization, in which potential non-carcinogenic health effects and carcinogenic risks are estimated. In this section, calculated risks and HIs for the exposure pathways presented in Section 8.2 are compared to pertinent risk criteria. Total cancer risk levels (CRLs) and HIs are summarized in Table 8-8. Detailed calculations for direct exposures are presented in Appendix E and detailed calculations for indirect exposures are presented in Appendix F.

8.4.1 Methodology

The increase to the baseline risk of developing cancer is estimated as a statistical probability and is therefore bounded by 0 and 1. The baseline incidence of cancer is approximately 1 in 3. This RA estimates the incremental increase in this baseline risk. The NCP defines the range of "acceptable risk" to be between 1 x 10^{-6} (one in one million) and 1 x 10^{-4} (one in ten thousand). Risks below this level (that is, below one in one million) are generally considered to be *de minimus* risks. Because estimated cancer risks or CRLs are considered to be independent statistical probabilities, risks are assumed to be additive across routes of exposure and multiple chemicals. The potential for other adverse health effects (that is, other than cancer) is presented as a hazard quotient (HQ), which is the ratio of the estimated intake to the RfD. The possible cumulative effect of subthreshold exposures is evaluated by the HI, which is the sum of individual HQs. An HQ greater than 1 indicates that the estimated intake exceeds the RfD and that adverse health effects may occur. An HI greater than 1 indicates that the cumulative effect of exposure to multiple contaminants may result in adverse health effects.

8.4.2 Discussion of Risk Estimates

8.4.2.1 Acute Exposures

Acute exposures could occur if the I.D. fan failed, allowing the escape of untreated material as a steam cloud. The estimated concentrations of DDT, hexachlorobenzene, and mercury in the steam cloud are 98 mg/m^3, 59 mg/m^3, and

0.36 mg/m^3, respectively. The estimated concentration of DDT exceeds the TLV of 1 mg/m3. There is no TLV for hexachlorobenzene. The acute inhalation toxicity of hexachlorobenzene is relatively low, as reflected in ECAO's decision not to develop a subchronic RfC for this compound. The estimated concentration of mercury exceeds the PEL of 0.05 mg/m^3. Dose response data for inhalation exposure to DDT is extremely limited. Reported health effects include moderate irritation of the nose, throat, and eyes (ATSDR, 1992).

8.4.2.2 Subchronic Exposures (Two Weeks to Less Than Seven Years)

Longer-duration exposures were evaluated by comparing the project long-term average emissions for both normal and cold start operating conditions (both of which were time-weighted to account for emissions during upset conditions) to subchronic RfCs. Subchronic RfCs are useful for evaluating exposures of two weeks to seven years in duration. Estimated maximum ground level concentrations are well below chemical-specific subchronic RfCs. The chronic RfC was used as a conservative estimate of the subchronic RfC if a subchronic value was not available. Cumulative effects were evaluated using an HI approach. Using this approach, HIs for normal and cold start operating conditions were 0.03 and 0.05, respectively. Both values are well below one.

The estimated upper-bound excess individual lifetime cancer risk to the community from direct exposures for the anticipated duration of soil treatment (19.3 weeks) is 3×10^{-9}, for both normal and cold start operating conditions. This value is well below the NCP bench mark level of 1×10^{-6}, the WTAP level of 1×10^{-5}, and the BIF Tier III level of 1×10^{-5}.

8.4.2.3 Long-Term

Possible long-term risks associated with deposition of emittants in soil and the uptake into the food chain were also evaluated for a subset of emittants. The total excess cancer risk associated with subsistence farming at the point of maximum deposition of stack emittants is 2.2×10^{-7} and the HI is 0.18. Risks to residents ingesting emitted pollutants in soil at the point of maximum deposition of stack emittants are 5×10^{-11} and the HI of 0.00004.

8.5 Uncertainties

The procedures used to assess potential human health risks are subject to a number of uncertainties. There are five identified sources of uncertainty in this RA:

- selection of emitted pollutants;
- other potential sources of exposure that are not quantifiable;
- estimation of exposure-point concentrations;
- exposure parameters used to characterize frequency, duration, and mode of exposure; and
- toxicological data.

8.5.1 Selection of Emitted Pollutants

The identification of possible PICs is necessarily speculative at this point in time. As discussed in Section 5.2.2.3, a reasonably comprehensive approach was employed. Actual PICs will be determined during the performance test and this report will be updated accordingly.

8.5.2 Additional Exposure Pathways

As described below, there may be additional sources of exposure; therefore, additional sources of risk that could not be explicitly evaluated in this RA could exist. Dermal contact with contaminated soil represents a potentially significant indirect route of exposure. Studies of dermal absorption of DDT indicate that 1 to 3 percent of the applied dose may be absorbed (Webster and others, 1991, as cited in USEPA, 1992). But the upper bound may be as high as nearly 40 percent (USEPA, 1992). Due to the wide range of absorption fractions predicted by the data, USEPA has not recommended a range of values for the percutaneous absorption of DDT (USEPA, 1992). Absorption data for the other indicator chemicals are unavailable at this time.

8.5.3 Exposure-Point Concentrations

The greatest uncertainties are in the modeling of contaminant concentrations from the site to the receptor location. The model simulations consider the concentration of a single contaminant during each modeling scenario. Therefore, possible chemical reactions between contaminants have not been considered. Whenever appropriate, assumptions used in the air modeling were conservative, so that the modeling would tend to overestimate the concentration of each indicator compound at the receptor.

Several factors used to evaluate indirect exposure pathways are likely to result in an over-estimate of risk. Selection of the subsistence farmer scenario is likely an overestimate of risk as subsistence farming has not been observed within the general vicinity of the site. Because subsistence farmers consume more contaminated beef and milk and vegetables than the general population, their intake is greater, and consequently risks are higher than risks to the general population. The total mass of metal emissions was assumed to be available for both inhalation and for wet and dry deposition on soil. By conservation of mass, this results in an overestimate of exposure. Consistent with USEPA guidance (USEPA, 1994b,c), no degradation of organics was assumed for any of the compounds evaluated through soil ingestion, vegetable uptake, or beef and dairy accumulation.

8.5.4 Exposure Parameters

There are inherent uncertainties in determining the exposure parameters that are combined with toxicological information used to assess risks. Parameters used to evaluate the RME scenarios are based on USEPA-suggested default exposure guidance (USEPA, 1991b).

8.5.5 Toxicity Evaluation

Toxicological data are another source of uncertainty in this RA. Subchronic and chronic RfCs were not available for many indicator chemicals and potential PICs. Therefore, the total HIs may be underestimated.

Inhalation CSFs for gamma-BHC, DDD, DDE, 1,4-dichlorobenzene, and lead were not available. Therefore, the direct pathway (inhalation) risks may be underestimated.

Nearly all of the potential carcinogens evaluated in this RA are classified as B2, or probable human carcinogens. The potential for either synergistic or antagonistic effects has not been evaluated in this RA. The predominant principal tumor site is the liver; therefore, the assumption of the simple similar action may be appropriate. This should not result in a systematic bias in risk estimates.

In general, RfDs, RfCs, and CSFs are derived by USEPA in a conservative fashion. RfDs and RfCs are based on the NOAEL or LOAEL reduced by generally consistent application of order-of-magnitude uncertainty factors. The RfD and RfC are estimates of a daily exposure by human population, including sensitive subgroups, that is likely to be without appreciable risk of deleterious effects. Most CSFs are 95 percent upper-bound statistical estimates of carcinogenic potency. For these reasons, actual risk of adverse health effects for the pathways evaluated are not likely to be greater than the RA estimates indicate, but could be considerably smaller.

In this report, route-to-route extrapolation was used to calculate RfCs from oral RfDs for several detected emittants when a USEPA developed RfC was not available. This approach is more conservative than using no toxicity value, but is inconsistent with current guidance for the derivation of RfCs. Current guidance (USEPA, 1994) emphasizes the need to consider issues of lung physiology to identify the animal model that is most relevant to humans, dosimetric adjustment, determination of the critical effect, and other issues that limit the usefulness of route-to-route extrapolation.

Route-to-route extrapolation was also used to calculate slope factors for DDD and DDE using their respective oral slope factors. Because USEPA's inhalation slope factor for DDT is based on the oral slope factor for DDT using a conversion factor of 1.0, a conversion factor of 1.0 was also used for DDD and DDE.

9 CONCLUSIONS

Based on the pollutant concentrations and emission rates modeled to occur during operation of the LTTD unit to treat soil at the Woods Site, impacts to ambient air quality and to human health and the environment are within USEPA and WDOE guidelines. The preoperation performance test was conducted to determine operating conditions under which the LTTD system meets all soil treatment and air emissions criteria. These conditions were used to set process operating parameter limits to ensure that all applicable soil treatment and stack emission standards are met during production operations. Williams continuously monitors system operation to maximize destruction of contaminants in the soil. In addition, dust control measures are employed during material handling operations to minimize fugitive emissions.

Ambient air quality is routinely evaluated in accordance with the Ambient Air Monitoring Plan. That plan has been prepared as an integral part of the Soil Treatment Work Plan. The objective of the air monitoring program is to document actual impact of the soil treatment and associated activities and to verify the conclusions presented in this FAAQIR.

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Table 4-1

MAXIMUM 1-HOUR CO CONCENTRATIONS
WDOE SITE NUMBER 7A-3996002A

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

MONTH	1993	1994	93-94
July	10		
August	12		
September	19		
October	25		
November	28		
December	26		
January		35	
February		22	
March		17	
April		14	
May		14	
June		13	
July		13	
Mean	20	18.9	19.14

Concentrations in ppm.

Table 4-2

Maximum 24-Hour PM-10 Concentrations
WDOE Site Number 399600F

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

MONTH	1993	1994	93-94
January	37	50	43.5
February	58	32	45.00
March	43	34	38.50
April	22	15	18.50
May	30	20	25.00
June	15	15	15.00
July	16	24	20.00
August	26		
September	40		
October	56		
November	73		
December	40		
ANNUAL MEAN	38	27.14	32.57
JAN-MAR MEAN	46	38.67	42.33

Concentrations in ug/m3

Table 5-1

CHEMICALS EVALUATED IN THE PRE-OPERATION AAQIR

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

Organics[1]	Products of Incomplete Metals[2]	Criteria Combustion[3]	Pollutants
Aldrin	Antimony	Acetone	CO
alpha-BHC	Arsenic	Acetonitrile	PM_{10}
beta-BHC	Barium	Acrylonitrile	HCl
gamma-BHC	Beryllium	Benzaldehyde	Cl_2
Chlordane	Cadmium	Benzene	SO_2
p,p'-DDD	Chromium	Benzoic acid	NO_2
p,p'-DDE	Lead	Benzyl alcohol	
p,p'-DDT	Mercury	bis(2-ethylhexyl)phthalate	
Dieldrin	Selenium	Camphene	
Endrin	Silver	Chlorobenzene	
Heptachlor	Thallium	Chloroethane	
Heptachlor epoxide	Nickel	Chloroform	
Hexachlorobenzene		Chloromethane	
Methoxychlor		p,p'-DDE	
Toxaphene		Dichlorobenzene	
		Dihydrofuranone	
		Ethanol	
		Ethylbenzene	
		m-Ethyltoluene	
		Hexachloropentadiene	
		Methylene chloride	
		Methylphenol	
		Methylphenylether	
		Nitrobenzene	
		Phenol	
		Styrene	
		Toluene	
		Trichlorobenzene	
		Trichlorofluoromethane	
		1,1,1-Trichloroethane	
		Vinyl chloride	
		Xylene	
		PCDD/PCDF	

(1) Listed are all organic indicator chemicals from the Baseline Risk Assessment (Burlington Environmental, 1992).

(2) Arsenic, lead, and mercury are indicator chemicals.

(3) PICs are based on past experience with similar technologies, literature review, and a structural analysis.

Table 5-2

Observed versus Expected Emission Rates

Ambient Air Quality Impact Report
Woods Industries Site
Yakima, Washington

	Estimated APCE E rate (g/sec)	Run 1 APCE E rate (g/sec)	Run 3 APCE E rate (g/sec)	Run 2 APCE E rate (g/sec)	Run 4 APCE E rate (g/sec)	Maximum Observed vs Expected
Expected PICs						
Acetone	2.12E-07	6.90E-05	< 2.19E-05	6.29E-05		OVER
Acetonitrile	6.21E-02	< 3.90E-06	< 3.90E-06	< 3.90E-06		ND
Acrylonitrile	2.65E-02					NR
Aldrin	8.20E-06	< 9.79E-07	< 1.56E-06	< 1.46E-06		ND
alpha-BHC	5.52E-07	< 9.79E-07	< 1.56E-06	< 1.46E-06		ND
alpha-Chlordane	6.88E-07	< 9.79E-07	< 1.56E-06	< 1.46E-06		ND
Benzaldehyde						NR
Benzene	3.78E-09	3.33E-05	9.17E-06	1.79E-05		OVER
Benzoic acid	4.84E-07	6.61E-04	3.11E-04	4.88E-04		OVER
Benzyl alcohol	6.80E-06					NR
beta-BHC	1.97E-07	< 9.79E-07	< 1.56E-06	< 1.46E-06		ND
bis(2-ethylhexyl)phthalate	4.01E-06	2.13E-04	1.40E-05	2.41E-04		OVER
Camphene	1.52E-05					NR
Chlorobenzene	3.40E-04	< 3.90E-06	< 4.78E-06	< 3.90E-06		ND
Chloroethane		< 3.90E-06	< 3.90E-06	< 4.00E-06		ND
Chloroform	3.48E-09	3.14E-04	1.37E-04	4.43E-05		OVER
Chloromethane	6.62E-03	< 7.51E-06	< 3.90E-06	6.83E-06		under
p,p'-DDD	5.66E-04	< 9.79E-07	1.37E-05	< 1.46E-06		under
p,p'-DDE	2.75E-04	< 9.79E-07	8.55E-05	< 1.46E-06		under
p,p'-DDT	2.19E-03	2.69E-05	3.11E-05	4.63E-05		under
1,2-Dichlorobenzene	3.40E-04	1.25E-05	2.34E-05	5.95E-06		under
1,3-Dichlorobenzene	3.40E-04	1.10E-05	< 1.80E-05	< 4.29E-06		under
1,4-Dichlorobenzene	2.27E-04	1.33E-05	< 2.07E-05	7.02E-06		under
Dieldrin	2.43E-05	5.14E-05	< 1.56E-06	9.02E-05		OVER
Dihydrofuranone						NR
Endrin	1.51E-05	3.18E-06	< 1.56E-06	9.27E-06		under
Ethanol	3.70E-04	< 3.90E-06	< 3.90E-06	< 3.90E-06		ND
Ethylbenzene	1.89E-07	< 3.90E-06	< 5.36E-06	< 3.90E-06		ND
gamma-BHC	1.20E-05	9.54E-06	< 1.56E-06	9.54E-06		under
Heptachlor	2.42E-07	< 9.79E-07	< 1.56E-06	< 1.46E-06		ND
Heptachlor epoxide	1.36E-07	< 9.79E-07	< 1.56E-06	< 1.46E-06		ND
Hexachlorobenzene	1.33E-03	5.87E-05	3.89E-05	5.36E-05		under
Hexachlorocyclopentadiene	3.25E-06	< 4.89E-06	< 5.18E-06	< 9.75E-06		ND
Methoxychlor	7.83E-05	< 9.79E-07	< 1.56E-06	< 1.46E-06		ND
Methylene chloride	7.56E-09	2.75E-05	1.43E-05	1.62E-05		OVER
2-Methylphenol	7.28E-06	< 4.89E-06	< 5.18E-06	< 9.75E-06		ND
3-Methylphenol		< 4.89E-06	< 5.18E-06	< 9.75E-06		ND
4-Methylphenol	1.60E-05	< 4.89E-06	< 5.18E-06	< 9.75E-06		ND
Methylphenylether	7.83E-06					NR
m-Ethyltoluene						NR
Nitrobenzene	3.70E-04	< 4.89E-06	< 5.18E-06	< 9.75E-06		ND
Phenol	2.79E-06	< 4.89E-06	1.04E-05	< 9.75E-06		OVER
Styrene	0.00E+00	1.46E-05	7.69E-05	7.80E-06		OVER
2,3,7,8-TCDD	1.65E-11	6.72E-11	2.93E-11	8.27E-11		OVER

Table 5-2

Observed versus Expected Emission Rates

Ambient Air Quality Impact Report
Woods Industries Site
Yakima, Washington

	Estimated APCE E rate (g/sec)	**Run 1 APCE E rate (g/sec)**	**Run 3 APCE E rate (g/sec)**	**Run 2 APCE E rate (g/sec)**	**Run 4 APCE E rate (g/sec)**	**Maximum Observed vs Expected**
Expected PICs						
Toluene	4.54E-07	5.95E-06	< 5.07E-06	4.39E-06		OVER
Toxaphene	1.52E-04	< 9.79E-07	< 1.56E-06	< 1.46E-06		ND
1,2,4-Trichlorobenzene	1.34E-04	< 4.89E-06	< 5.18E-06	< 9.75E-06		ND
1,1,1-Trichloroethane	2.26E-04	< 3.90E-06	< 8.48E-06	< 3.90E-06		ND
Trichlorofluoromethane		< 4.88E-06	< 3.90E-06	< 3.90E-06		ND
Vinyl chloride		< 4.88E-06	< 3.90E-06	< 3.90E-06		ND
Xylene	3.33E-06	< 4.29E-06	< 6.24E-06	< 3.90E-06		ND
Antimony	3.20E-05	< 2.65E-05	< 2.75E-05	< 2.30E-06		ND
Arsenic	7.43E-06	< 1.33E-05	< 1.37E-05	7.37E-06		OVER
Barium	1.11E-04	< 7.95E-05	< 8.24E-05	5.44E-05		under
Beryllium	7.78E-08	< 2.65E-06	< 2.75E-06	< 2.30E-06		ND
Cadmium	5.03E-06	3.40E-06	7.32E-06	1.15E-05		OVER
Chromium III	1.15E-05	4.06E-05	4.53E-05	6.36E-05		OVER
Chromium VI	0.00E+00	4.06E-05	4.53E-05	6.36E-05		OVER
Lead	7.24E-05	1.17E-04	1.09E-04	1.51E-04		OVER
Mercury	4.04E-02	4.97E-03	7.32E-03	1.47E-02		under
Nickel	1.16E-05	4.37E-05	5.58E-05	1.00E-04		OVER
Selenium		2.78E-05	2.98E-05	1.07E-04		OVER
Silver	1.32E-06	1.33E-05	< 5.49E-06	2.30E-06		OVER
Thallium		< 2.65E-05	< 2.75E-05	< 2.30E-06		ND
PM-10	5.99E-01	0.63945	0.62597304	0.6697971	0.18843678	OVER
SO_2	1.60E-03					NR
NO_2	1.47E+00					NR
HCl	1.70E-02	0.015246	0.02205	0.045108	0	OVER
Cl_2	3.40E-03	< 0.0002	< 0.0003	0.004914	0	OVER
CO	8.47E-01					under
UNANTICIPATED PICs						
2-Nitrophenol		1.71E-05		< 9.75E-06		
Naphthalene		1.86E-05		< 9.75E-06		
Diethylphthalate		8.56E-06	1.35E-05	< 9.75E-06		
Di-n-butylphthalate		2.94E-05	1.53E-05	< 9.75E-06		
Di-n-octylphthalate		1.22E-05				
Benzoyl Chloride		1.08E-04				
Undecane		1.57E-04				
2-Fluoro-4-nitrophenol		1.13E-04				
Octadecanoic acid		1.79E-04				
o,p'-DDE		1.08E-04	1.17E-04			
Hexadecanoic acid			1.19E-04			

Table 5-3

Time-Weighted Average Emission Rates
Normal and Cold Start Operating Conditions

Ambient Air Quality Impact Report
Woods Industries Site
Yakima, Washington

	Minimum of 95UCL or Maximum Runs 1&3 (g/sec)	Upset Conditions E rate (g/sec)	Normal & Upset TWA E rate (g/sec)	Cold Run E rate (g/sec)	Cold Run & Upset TWA E rate (g/sec)
Acetone	6.90E-05	6.90E-04	9.38E-05	6.29E-05	8.80E-05
Acetonitrile					
Acrylonitrile					
Aldrin	7.80E-07	7.80E-06	1.06E-06	7.30E-07	1.01E-06
alpha-BHC	7.80E-07	7.80E-06	1.06E-06	7.30E-07	1.01E-06
alpha-Chlordane	7.80E-07	7.80E-06	1.06E-06	7.30E-07	1.01E-06
Benzaldehyde					
Benzene	3.33E-05	3.33E-04	4.53E-05	1.79E-05	3.05E-05
Benzoic acid	6.61E-04	6.61E-03	8.99E-04	4.88E-04	7.33E-04
Benzyl alcohol					
beta-BHC	7.80E-07	7.80E-06	1.06E-06	7.30E-07	1.01E-06
bis(2-ethylhexyl)phthalate	2.13E-04	2.13E-03	2.90E-04	2.41E-04	3.17E-04
Camphene					
Chlorobenzene					
Chloroethane					
Chloroform	3.14E-04	3.14E-03	4.27E-04	4.43E-05	1.68E-04
Chloromethane	3.76E-06	3.76E-05	5.11E-06	6.83E-06	8.06E-06
p,p'-DDD	1.37E-05	1.37E-04	1.86E-05	7.30E-07	6.18E-06
p,p'-DDE	8.55E-05	8.55E-04	1.16E-04	7.30E-07	3.49E-05
p,p'-DDT	3.11E-05	3.11E-04	4.23E-05	4.63E-05	5.69E-05
1,2-Dichlorobenzene	2.34E-05	2.34E-04	3.18E-05	5.95E-06	1.51E-05
1,3-Dichlorobenzene	1.10E-05	1.10E-04	1.50E-05	2.15E-06	6.46E-06
1,4-Dichlorobenzene	1.33E-05	1.33E-04	1.81E-05	7.02E-06	1.21E-05
Dieldrin	5.14E-05	5.14E-04	6.99E-05	9.02E-05	1.07E-04
Dihydrofuranone					
Endrin	3.18E-06	3.18E-05	4.32E-06	9.27E-06	1.02E-05
Ethanol					
Ethylbenzene	2.68E-06	2.68E-05	3.64E-06	1.95E-06	2.94E-06
gamma-BHC	9.54E-06	9.54E-05	1.30E-05	9.54E-06	1.30E-05
Heptachlor	7.80E-07	7.80E-06	1.06E-06	7.30E-07	1.01E-06
Heptachlor epoxide	7.80E-07	7.80E-06	1.06E-06	7.30E-07	1.01E-06
Hexachlorobenzene	5.87E-05	5.87E-04	7.98E-05	5.36E-05	7.49E-05
Hexachlorocyclopentadiene					
Methoxychlor	7.80E-07	7.80E-06	1.06E-06	7.30E-07	1.01E-06
Methylene chloride	2.75E-05	2.75E-04	3.74E-05	1.62E-05	2.66E-05
2-Methylphenol					
3-Methylphenol					
4-Methylphenol					
Methylphenylether					
m-Ethyltoluene					
Nitrobenzene					
Phenol	1.04E-05	1.04E-04	1.41E-05	4.88E-06	8.84E-06
Styrene	7.69E-05	7.69E-04	1.05E-04	7.80E-06	3.82E-05
2,3,7,8-TCDD	7.29E-11	7.29E-10	9.91E-11	8.27E-11	1.09E-10
Toluene	5.95E-06	5.95E-05	8.09E-06	4.39E-06	6.59E-06

Table 5-3

Time-Weighted Average Emission Rates
Normal and Cold Start Operating Conditions

Ambient Air Quality Impact Report
Woods Industries Site
Yakima, Washington

	Minimum of 95UCL or Maximum Runs 1&3 (g/sec)	Upset Conditions E rate (g/sec)	Normal & Upset TWA E rate (g/sec)	Cold Run E rate (g/sec)	Cold Run & Upset TWA E rate (g/sec)
Toxaphene	7.80E-07	7.80E-06	1.06E-06	7.30E-07	1.01E-06
1,2,4-Trichlorobenzene	2.59E-06	2.59E-05	3.52E-06	4.88E-06	5.72E-06
1,1,1-Trichloroethane					
Trichlorofluoromethane					
Vinyl chloride					
Xylene	3.12E-06	3.12E-05	4.24E-06	1.95E-06	3.12E-06
Antimony	1.38E-05	1.38E-04	1.87E-05	1.15E-06	6.60E-06
Arsenic	6.85E-06	6.85E-05	9.32E-06	7.37E-06	9.82E-06
Barium	4.12E-05	4.12E-04	5.60E-05	5.44E-05	6.87E-05
Beryllium	1.38E-06	1.38E-05	1.87E-06	1.15E-06	1.65E-06
Cadmium	7.32E-06	7.32E-05	9.96E-06	1.15E-05	1.40E-05
Chromium III					
Chromium VI	4.53E-05	4.53E-04	6.16E-05	6.36E-05	7.92E-05
Lead	1.17E-04	1.17E-03	1.59E-04	1.51E-04	1.92E-04
Mercury	7.32E-03	7.32E-02	9.96E-03	1.47E-02	1.70E-02
Nickel	5.58E-05	5.58E-04	7.59E-05	1.00E-04	1.18E-04
Selenium	2.98E-05	2.98E-04	4.05E-05	1.07E-04	1.15E-04
Silver	1.33E-05	1.33E-04	1.81E-05	2.30E-06	7.53E-06
Thallium					
PM-10	6.39E-01	6.39E+00	8.70E-01	6.70E-01	8.99E-01
SO_2					
NO_2					
HCl	2.21E-02	2.21E-01	3.00E-02	4.51E-02	5.21E-02
Cl_2				4.91E-03	4.72E-03
CO					
UNANTICIPATED PICs					
2-Nitrophenol	1.71E-05	1.71E-04	2.33E-05	4.88E-06	1.15E-05
Naphthalene	1.86E-05	1.86E-04	2.53E-05	4.88E-06	1.21E-05
Diethylphthalate	1.35E-05	1.35E-04	1.84E-05	4.88E-06	1.01E-05
Di-n-butylphthalate	2.94E-05	2.94E-04	4.00E-05	4.88E-06	1.64E-05
Di-n-octylphthalate	1.22E-05	1.22E-04	1.66E-05		4.88E-06
Benzoyl Chloride	1.08E-04	1.08E-03	1.47E-04		4.32E-05
Undecane	1.57E-04	1.57E-03	2.14E-04		6.28E-05
2-Fluoro-4-nitrophenol	1.13E-04	1.13E-03	1.54E-04		4.52E-05
Octadecanoic acid	1.79E-04	1.79E-03	2.43E-04		7.16E-05
o,p'-DDE	1.17E-04	1.17E-03	1.59E-04		4.68E-05
Hexadecanoic acid	1.19E-04	1.19E-03	1.62E-04		4.76E-05

Table 6-1

STACK DESIGN PARAMETERS

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

Source Parameters	Units
Stack Height	21.336 meters
Stack Inside Diameter	1.372 meters
Stack Gas Exit Temperature	357.2 Kelvin
Stack Gas Exit Velocity	14.35 meters per second

Table 6-2
PARTICLE SIZE DISTRIBUTION

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

Particle Diameter (um)	Particle Radius (um)	Surface Area/Volume	Fraction of Total Weight	Proportion Available Surface Area	Fraction of Total Surface Area
>15.0	7.50	0.400	0.128	0.0512	0.0149
12.5	6.25	0.480	0.105	0.0504	0.0146
8.1	4.05	0.741	0.104	0.0771	0.0224
5.5	2.75	1.091	0.073	0.0796	0.0231
3.6	1.80	1.667	0.103	0.1717	0.0499
2.0	1.00	3.000	0.105	0.3150	0.0915
1.1	0.55	5.455	0.082	0.4473	0.1290
0.7	0.40	7.500	0.076	0.5700	0.1656
<0.7	0.40	7.500	0.224	1.6800	0.4800

Generalized particle size distribution (um), and proportion of available surface area, to be used as a default in deposition modeling if site-specific data is unavailable.

Source: *Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions*

Table 6-3

ESTIMATED GROUND LEVEL CONCENTRATIONS - ISCST2 MODEL - Normal Operating Conditons

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

Parameter	**Emission Rate (g/sec)**	**ISCST2 1-hour (ug/m3)**	**ISCST2 3-hour (ug/m3)**	**ISCST2 8-hour (ug/m3)**	**ISCST2 24-hour (ug/m3)**	**ISCST2 Long term (ug/m3)**	**Wet Deposition (g/m2/yr)**	**Dry Deposition (g/m2/yr)**	**Soil Conc (mg/kg)**
Dispersion coefficient	1 g/sec	20.71384	11.75135	8.39332	3.98562	0.463	3.716	0.04256	
Acetone	9.38E-05	1.94E-03	1.10E-03	7.88E-04	3.74E-04	4.34E-05	3.49E-04	3.99E-06	8.70E-03
Acetonitrile									
Acrylonitrile									
Aldrin	1.06E-06	2.20E-05	1.25E-05	8.90E-06	4.23E-06	4.91E-07	3.94E-06	4.51E-08	9.83E-05
alpha-BHC	1.06E-06	2.20E-05	1.25E-05	8.90E-06	4.23E-06	4.91E-07	3.94E-06	4.51E-08	9.83E-05
alpha-Chlordane	1.06E-06	2.20E-05	1.25E-05	8.90E-06	4.23E-06	4.91E-07	3.94E-06	4.51E-08	9.83E-05
Benzaldehyde									
Benzene	4.53E-05	9.38E-04	5.32E-04	3.80E-04	1.81E-04	2.10E-05	1.68E-04	1.93E-06	4.20E-03
Benzoic acid	8.99E-04	1.86E-02	1.06E-02	7.55E-03	3.58E-03	4.16E-04	3.34E-03	3.83E-05	8.33E-02
Benzyl alcohol									
beta-BHC	1.06E-06	2.20E-05	1.25E-05	8.90E-06	4.23E-06	4.91E-07	3.94E-06	4.51E-08	9.83E-05
bis(2-ethylhexyl)phthalate	2.90E-04	6.00E-03	3.40E-03	2.43E-03	1.15E-03	1.34E-04	1.08E-03	1.23E-05	2.69E-02
Camphene									
Chlorobenzene									
Chloroethane									
Chloroform	4.27E-04	8.85E-03	5.02E-03	3.58E-03	1.70E-03	1.98E-04	1.59E-03	1.82E-05	3.96E-02
Chloromethane	5.11E-06	1.06E-04	6.00E-05	4.29E-05	2.04E-05	2.36E-06	1.90E-05	2.17E-07	4.73E-04
p,p'-DDD	1.86E-05	3.86E-04	2.19E-04	1.56E-04	7.43E-05	8.63E-06	6.92E-05	7.93E-07	1.73E-03
p,p'-DDE	1.16E-04	2.41E-03	1.37E-03	9.76E-04	4.63E-04	5.38E-05	4.32E-04	4.95E-06	1.08E-02
p,p'-DDT	4.23E-05	8.76E-04	4.97E-04	3.55E-04	1.69E-04	1.96E-05	1.57E-04	1.80E-06	3.92E-03
1,2-Dichlorobenzene	3.18E-05	6.59E-04	3.74E-04	2.67E-04	1.27E-04	1.47E-05	1.18E-04	1.35E-06	2.95E-03
1,3-Dichlorobenzene	1.50E-05	3.10E-04	1.76E-04	1.26E-04	5.96E-05	6.93E-06	5.56E-05	6.37E-07	1.39E-03
1,4-Dichlorobenzene	1.81E-05	3.75E-04	2.13E-04	1.52E-04	7.21E-05	8.37E-06	6.72E-05	7.70E-07	1.68E-03
Dieldrin	6.99E-05	1.45E-03	8.21E-04	5.87E-04	2.79E-04	3.24E-05	2.60E-04	2.98E-06	6.48E-03
Dihydrofuranone									
Endrin	4.32E-06	8.96E-05	5.08E-05	3.63E-05	1.72E-05	2.00E-06	1.61E-05	1.84E-07	4.01E-04
Ethanol									
Ethylbenzene	3.64E-06	7.55E-05	4.28E-05	3.06E-05	1.45E-05	1.69E-06	1.35E-05	1.55E-07	3.38E-04
gamma-BHC	1.30E-05	2.69E-04	1.52E-04	1.09E-04	5.17E-05	6.01E-06	4.82E-05	5.52E-07	1.20E-03
Heptachlor	1.06E-06	2.20E-05	1.25E-05	8.90E-06	4.23E-06	4.91E-07	3.94E-06	4.51E-08	9.83E-05
Heptachlor epoxide	1.06E-06	2.20E-05	1.25E-05	8.90E-06	4.23E-06	4.91E-07	3.94E-06	4.51E-08	9.83E-05
Hexachlorobenzene	7.98E-05	1.65E-03	9.38E-04	6.70E-04	3.18E-04	3.70E-05	2.97E-04	3.40E-06	7.40E-03
Hexachlorocyclopentadiene									
Methoxychlor	1.06E-06	2.20E-05	1.25E-05	8.90E-06	4.23E-06	4.91E-07	3.94E-06	4.51E-08	9.83E-05
Methylene chloride	3.74E-05	7.75E-04	4.40E-04	3.14E-04	1.49E-04	1.73E-05	1.39E-04	1.59E-06	3.47E-03
2-Methylphenol									
3-Methylphenol									
4-Methylphenol									
Methylphenylether									
m-Ethyltoluene									
Nitrobenzene									
Phenol	1.41E-05	2.93E-04	1.66E-04	1.19E-04	5.64E-05	6.55E-06	5.26E-05	6.02E-07	1.31E-03
Styrene	1.05E-04	2.17E-03	1.23E-03	8.78E-04	4.17E-04	4.84E-05	3.89E-04	4.45E-06	9.70E-03
2,3,7,8-TCDD	9.91E-11	2.05E-09	1.17E-09	8.32E-10	3.95E-10	4.59E-11	3.68E-10	4.22E-12	9.19E-09
Toluene	8.09E-06	1.68E-04	9.51E-05	6.79E-05	3.23E-05	3.75E-06	3.01E-05	3.44E-07	7.50E-04
Toxaphene	1.06E-06	2.20E-05	1.25E-05	8.90E-06	4.23E-06	4.91E-07	3.94E-06	4.51E-08	9.83E-05
1,2,4-Trichlorobenzene	3.52E-06	7.30E-05	4.14E-05	2.96E-05	1.40E-05	1.63E-06	1.31E-05	1.50E-07	3.27E-04
1,1,1-Trichloroethane									
Trichlorofluoromethane									
Vinyl chloride									
Xylene	4.24E-06	8.79E-05	4.99E-05	3.56E-05	1.69E-05	1.96E-06	1.58E-05	1.81E-07	3.93E-04
Antimony	1.87E-05	3.87E-04	2.20E-04	1.57E-04	7.45E-05	8.66E-06	6.95E-05	7.96E-07	1.73E-03
Arsenic	9.32E-06	1.93E-04	1.09E-04	7.82E-05	3.71E-05	4.31E-06	3.46E-05	3.96E-07	8.64E-04
Barium	5.60E-05	1.16E-03	6.58E-04	4.70E-04	2.23E-04	2.59E-05	2.08E-04	2.38E-06	5.19E-03
Beryllium	1.87E-06	3.87E-05	2.20E-05	1.57E-05	7.45E-06	8.66E-07	6.95E-06	7.96E-08	1.73E-04
Cadmium	9.96E-06	2.06E-04	1.17E-04	8.36E-05	3.97E-05	4.61E-06	3.70E-05	4.24E-07	9.23E-04

Table 6-3

ESTIMATED GROUND LEVEL CONCENTRATIONS - ISCST2 MODEL - Normal Operating Conditons

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

Parameter	Emission Rate (g/sec)	ISCST2 1-hour (ug/m3)	ISCST2 3-hour (ug/m3)	ISCST2 8-hour (ug/m3)	ISCST2 24-hour (ug/m3)	ISCST2 Long term (ug/m3)	Wet Deposition (g/m2/yr)	Dry Deposition (g/m2/yr)	Soil Conc (mg/kg)
Chromium III									
Chromium VI	6.16E-05	1.28E-03	7.24E-04	5.17E-04	2.46E-04	2.85E-05	2.29E-04	2.62E-06	5.71E-03
Lead	1.59E-04	3.30E-03	1.87E-03	1.34E-03	6.34E-04	7.37E-05	5.91E-04	6.77E-06	1.48E-02
Mercury	9.96E-03	2.06E-01	1.17E-01	8.36E-02	3.97E-02	4.61E-03	3.70E-02	4.24E-04	9.23E-01
Nickel	7.59E-05	1.57E-03	8.92E-04	6.37E-04	3.02E-04	3.51E-05	2.82E-04	3.23E-06	7.04E-03
Selenium	4.05E-05	8.39E-04	4.76E-04	3.40E-04	1.62E-04	1.88E-05	1.51E-04	1.72E-06	3.76E-03
Silver	1.81E-05	3.75E-04	2.13E-04	1.52E-04	7.21E-05	8.37E-06	6.72E-05	7.70E-07	1.68E-03
Thallium									
PM-10	8.70E-01	1.80E+01	1.02E+01	7.30E+00	3.47E+00	4.03E-01	3.23E+00	3.70E-02	8.06E+01
SO_2									
NO_2									
HCl	3.00E-02	6.21E-01	3.52E-01	2.52E-01	1.20E-01	1.39E-02	1.11E-01	1.28E-03	2.78E+00
Cl_2									
CO									
UNANTICIPATED PICs									
2-Nitrophenol	2.33E-05	4.82E-04	2.73E-04	1.95E-04	9.27E-05	1.08E-05	8.64E-05	9.90E-07	2.16E-03
Naphthalene	2.53E-05	5.24E-04	2.97E-04	2.12E-04	1.01E-04	1.17E-05	9.40E-05	1.08E-06	2.35E-03
Diethylphthalate	1.84E-05	3.80E-04	2.16E-04	1.54E-04	7.32E-05	8.50E-06	6.82E-05	7.81E-07	1.70E-03
Di-n-butylphthalate	4.00E-05	8.28E-04	4.70E-04	3.36E-04	1.59E-04	1.85E-05	1.49E-04	1.70E-06	3.71E-03
Di-n-octylphthalate	1.66E-05	3.44E-04	1.95E-04	1.39E-04	6.61E-05	7.68E-06	6.17E-05	7.06E-07	1.54E-03
Benzoyl Chloride	1.47E-04	3.04E-03	1.73E-03	1.23E-03	5.85E-04	6.80E-05	5.46E-04	6.25E-06	1.36E-02
Undecane	2.14E-04	4.42E-03	2.51E-03	1.79E-03	8.51E-04	9.89E-05	7.93E-04	9.09E-06	1.98E-02
2-Fluoro-4-nitrophenol	1.54E-04	3.18E-03	1.81E-03	1.29E-03	6.13E-04	7.12E-05	5.71E-04	6.54E-06	1.42E-02
Octadecanoic acid	2.43E-04	5.04E-03	2.86E-03	2.04E-03	9.70E-04	1.13E-04	9.05E-04	1.04E-05	2.26E-02
o,p'-DDE	1.59E-04	3.30E-03	1.87E-03	1.34E-03	6.34E-04	7.37E-05	5.91E-04	6.77E-06	1.48E-02
Hexadecanoic acid	1.62E-04	3.35E-03	1.90E-03	1.36E-03	6.45E-04	7.49E-05	6.01E-04	6.89E-06	1.50E-02

Table 6-4

ESTIMATED GROUND LEVEL CONCENTRATIONS - ISCST2 MODEL - Cold Start Operating Conditions

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

Parameter	Emission Rate (g/sec)	ISCST2 24-hour (ug/m3)	ISCST2 Annual Ave (ug/m3)
Acetone	8.80E-05	3.51E-04	4.07E-05
Acetonitrile			
Acrylonitrile			
Aldrin	1.01E-06	4.04E-06	4.69E-07
alpha-BHC	1.01E-06	4.04E-06	4.69E-07
alpha-Chlordane	1.01E-06	4.04E-06	4.69E-07
Benzaldehyde			
Benzene	3.05E-05	1.22E-04	1.41E-05
Benzoic acid	7.33E-04	2.92E-03	3.39E-04
Benzyl alcohol			
beta-BHC	1.01E-06	4.04E-06	4.69E-07
bis(2-ethylhexyl)phthalate	3.17E-04	1.26E-03	1.47E-04
Camphene			
Chlorobenzene			
Chloroethane			
Chloroform	1.68E-04	6.70E-04	7.78E-05
Chloromethane	8.06E-06	3.21E-05	3.73E-06
p,p'-DDD	6.18E-06	2.46E-05	2.86E-06
p,p'-DDE	3.49E-05	1.39E-04	1.62E-05
p,p'-DDT	5.69E-05	2.27E-04	2.63E-05
1,2-Dichlorobenzene	1.51E-05	6.01E-05	6.98E-06
1,3-Dichlorobenzene	6.46E-06	2.57E-05	2.99E-06
1,4-Dichlorobenzene	1.21E-05	4.81E-05	5.58E-06
Dieldrin	1.07E-04	4.27E-04	4.96E-05
Dihydrofuranone			
Endrin	1.02E-05	4.05E-05	4.71E-06
Ethanol			
Ethylbenzene	2.94E-06	1.17E-05	1.36E-06
gamma-BHC	1.30E-05	5.17E-05	6.01E-06
Heptachlor	1.01E-06	4.04E-06	4.69E-07
Heptachlor epoxide	1.01E-06	4.04E-06	4.69E-07
Hexachlorobenzene	7.49E-05	2.99E-04	3.47E-05
Hexachlorocyclopentadiene			
Methoxychlor	1.01E-06	4.04E-06	4.69E-07
Methylene chloride	2.66E-05	1.06E-04	1.23E-05
2-Methylphenol			
3-Methylphenol			
4-Methylphenol			
Methylphenylether			
m-Ethyltoluene			
Nitrobenzene			
Phenol	8.84E-06	3.52E-05	4.09E-06
Styrene	3.82E-05	1.52E-04	1.77E-05
2,3,7,8-TCDD	1.09E-10	4.33E-10	5.03E-11
Toluene	6.59E-06	2.63E-05	3.05E-06

Table 6-4

ESTIMATED GROUND LEVEL CONCENTRATIONS - ISCST2 MODEL - Cold Start Operating Conditions

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

Parameter	Emission Rate (g/sec)	ISCST2 24-hour (ug/m3)	ISCST2 Annual Ave (ug/m3)
Toxaphene	1.01E-06	4.04E-06	4.69E-07
1,2,4-Trichlorobenzene	5.72E-06	2.28E-05	2.65E-06
1,1,1-Trichloroethane			
Trichlorofluoromethane			
Vinyl chloride			
Xylene	3.12E-06	1.24E-05	1.44E-06
Antimony	6.60E-06	2.63E-05	3.06E-06
Arsenic	9.82E-06	3.91E-05	4.54E-06
Barium	6.87E-05	2.74E-04	3.18E-05
Beryllium	1.65E-06	6.59E-06	7.66E-07
Cadmium	1.40E-05	5.57E-05	6.47E-06
Chromium III			
Chromium VI	7.92E-05	3.16E-04	3.67E-05
Lead	1.92E-04	7.64E-04	8.88E-05
Mercury	1.70E-02	6.79E-02	7.89E-03
Nickel	1.18E-04	4.72E-04	5.48E-05
Selenium	1.15E-04	4.57E-04	5.31E-05
Silver	7.53E-06	3.00E-05	3.49E-06
Thallium			
PM-10	8.99E-01	3.58E+00	4.16E-01
SO_2			
NO_2			
HCl	5.21E-02	2.08E-01	2.41E-02
Cl_2	4.72E-03	1.88E-02	2.18E-03
CO			
UNANTICIPATED PICs			
2-Nitrophenol	1.15E-05	4.59E-05	5.33E-06
Naphthalene	1.21E-05	4.83E-05	5.61E-06
Diethylphthalate	1.01E-05	4.02E-05	4.67E-06
Di-n-butylphthalate	1.64E-05	6.55E-05	7.61E-06
Di-n-octylphthalate	4.88E-06	1.94E-05	2.26E-06
Benzoyl Chloride	4.32E-05	1.72E-04	2.00E-05
Undecane	6.28E-05	2.50E-04	2.91E-05
2-Fluoro-4-nitrophenol	4.52E-05	1.80E-04	2.09E-05
Octadecanoic acid	7.16E-05	2.85E-04	3.32E-05
o,p'-DDE	4.68E-05	1.87E-04	2.17E-05
Hexadecanoic acid	4.76E-05	1.90E-04	2.20E-05

Table 7-1

Estimated Ground-Level Concentrations and ASILs - ISCST2 Model

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

	ISCST2 24-hour (ug/m3)	ISCST2 Long term (ug/m3)	Class A ASIL (ug/m3)	Class A Special (ug/m3)	Class B ASILs (ug/m3)
CLASS A TOXIC POLLUTANTS					
1,4-Dichlorobenzene		8.37E-06	1.5		
2,3,7,8-TCDD		3.68E-10	0.00000003		
Aldrin		4.91E-07	0.0002		
alpha-Chlordane		4.91E-07	0.0027		
Arsenic		4.31E-06	0.00023		
Benzene		2.10E-05	0.12		
Beryllium		8.66E-07	0.00042		
bis(2-ethylhexyl)phthalate		1.34E-04	2.5		
Cadmium		4.61E-06	0.00056		
Chloroform		1.98E-04	0.043		
Chromium VI		2.85E-05	0.000083		
Dieldrin		3.24E-05	0.0002		
gamma-BHC		6.01E-06	0.0026		
Heptachlor		4.91E-07	0.00077		
Hexachlorobenzene		4.91E-07	0.002		
Methylene chloride		1.73E-05	0.56		
Nickel		3.51E-05	0.0021		
p,p'-DDE		5.38E-05	0.1		
p,p'-DDT		1.96E-05	0.01		
Toxaphene		4.91E-07	0.0031		
CLASS A TOXIC POLLUTANTS WITH 24-HOUR AVERAGING TIMES					
alpha-BHC	4.23E-06			1.7	
beta-BHC	4.23E-06			1.7	
Lead	6.34E-04			0.5	
CLASS B TOXIC POLLUTANTS WITH 24-HOUR AVERAGING TIMES					
1,2,4-Trichlorobenzene	1.40E-05				120
1,2-Dichlorobenzene	1.27E-04				1000
Acetone	3.74E-04				5900
Antimony	7.45E-05				1.7
Barium	2.23E-04				1.7
Di-n-butylphthalate	1.59E-04				17
Diethylphthalate	7.32E-05				17
Endrin	1.72E-05				0.33
Ethylbenzene	1.45E-05				1000
Mercury	3.97E-02				0.2
Methoxychlor	4.23E-06				33
Naphthalene	1.01E-04				170
Phenol	5.64E-05				63
Selenium	1.62E-04				0.67
Silver	7.21E-05				0.33

Table 7-1

Estimated Ground-Level Concentrations and ASILs - ISCST2 Model

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

	ISCST2 24-hour (ug/m3)	**ISCST2 Long term (ug/m3)**	**Class A ASIL (ug/m3)**	**Class A Special (ug/m3)**	**Class B ASILs (ug/m3)**
CLASS A TOXIC POLLUTANTS					
Styrene	4.17E-04				1000
Toluene	3.23E-05				400
Xylene	1.69E-05				1500
DETECTED TOXIC POLLUTANTS WITHOUT ASILS					
1,3-Dichlorobenzene	5.96E-05	6.93E-06			
2-Fluoro-4-nitrophenol	6.13E-04	7.12E-05			
2-Nitrophenol	9.27E-05	1.08E-05			
Benzoic acid	3.58E-03	4.16E-04			
Benzoyl Chloride	5.85E-04	6.80E-05			
Chloromethane	2.04E-05	2.36E-06			
Di-n-octylphthalate	6.61E-05	7.68E-06			
Heptachlor epoxide	4.23E-06	4.91E-07			
Hexadecanoic acid	6.45E-04	7.49E-05			
o,p'-DDE	6.34E-04	7.37E-05			
Octadecanoic acid	9.70E-04	1.13E-04			
p,p'-DDD	7.43E-05	8.63E-06			
Undecane	8.51E-04	9.89E-05			

NOTES:
Class A ASILs WAC 173-460-150
Class B ASILs WAC 173-460-160

Table 7-2

ESTIMATED GROUND LEVEL CONCENTRATIONS AND TIER III LIMITS

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

	Annual Average (ug/m^3)	Tier III Limits (ug/m^3)	RSD / RAC	Average : Tier III Limit
Acetone	4.34E-05			
Acetonitrile		1.00E+01	RAC	under
Acrylonitrile		1.50E-01	RSD	under
Aldrin	4.91E-07	2.00E-03	RSD	under
alpha-BHC	4.91E-07	5.60E-03	RSD	under
alpha-Chlordane	4.91E-07	2.70E-02	RSD	under
Benzaldehyde				
Benzene	2.10E-05	1.25E+00	RSD	under
Benzoic acid	4.16E-04			
Benzyl alcohol				
beta-BHC	4.91E-07	1.90E-02	RSD	under
bis(2-ethylhexyl)phthalate	1.34E-04	4.20E+01	RSD	under
Camphene				
Chlorobenzene				
Chloroethane				
Chloroform	1.98E-04	4.30E-01	RSD	under
Chloromethane	2.36E-06	2.80E+00	RSD	under
p,p'-DDD	8.63E-06			
p,p'-DDE	5.38E-05			
p,p'-DDT	1.96E-05	1.00E-01	RSD	under
1,2-Dichlorobenzene	1.47E-05	1.00E+01	RAC	under
1,3-Dichlorobenzene	6.93E-06			
1,4-Dichlorobenzene	8.37E-06	1.00E+01	RAC	under
Dieldrin	3.24E-05	2.20E-03	RSD	under
Dihydrofuranone				
Endrin	2.00E-06	3.00E-01	RAC	under
Ethanol				
Ethylbenzene	1.69E-06			
gamma-BHC	6.01E-06	2.60E-02	RSD	under
Heptachlor	4.91E-07	7.70E-03	RSD	under
Heptachlor epoxide	4.91E-07	3.80E-03	RSD	under
Hexachlorobenzene	3.70E-05	2.00E-02	RSD	under
Hexachlorocyclopentadiene		5.00E+00	RAC	under
Methoxychlor	4.91E-07	5.00E+01	RAC	under
Methylene chloride	1.73E-05	2.40E+00	RSD	under
2-Methylphenol		5.00E+01	RAC	under
3-Methylphenol		5.00E+01	RAC	under
4-Methylphenol		5.00E+01	RAC	under
Methylphenylether				
m-Ethyltoluene				
Nitrobenzene		8.00E-01	RAC	under
Phenol	6.55E-06	3.00E+01	RAC	under
Styrene	4.84E-05			
2,3,7,8-TCDD	4.59E-11	2.20E-07	RSD	under
Toluene	3.75E-06	3.00E+02	RAC	under

Table 7-2

ESTIMATED GROUND LEVEL CONCENTRATIONS AND TIER III LIMITS

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

	Annual Average (ug/m^3)	Tier III Limits (ug/m^3)	RSD / RAC	Average : Tier III Limit
Toxaphene	4.91E-07	3.10E-02	RSD	under
1,2,4-Trichlorobenzene	1.63E-06	2.00E+01	RAC	under
1,1,1-Trichloroethane				
Trichlorofluoromethane		3.00E+02	RAC	under
Vinyl chloride		1.40E+00	RSD	under
Xylene	1.96E-06	8.00E+01	RAC	under
Antimony	8.66E-06	3.00E-01	RAC	under
Arsenic	4.31E-06	2.30E-03	RSD	under
Barium	2.59E-05	5.00E+01	RAC	under
Beryllium	8.66E-07	4.20E-03	RSD	under
Cadmium	4.61E-06	5.60E-03	RSD	under
Chromium III		1.00E+03	RAC	under
Chromium VI	2.85E-05	8.30E-04	RSD	under
Lead	7.37E-05	9.00E-02	RAC	under
Mercury	4.61E-03	3.00E-01	RAC	under
Nickel	3.51E-05	4.20E-02	RSD	under
Selenium	1.88E-05	4.00E+00	RAC	under
Silver	8.37E-06	3.00E+00	RAC	under
Thallium		5.00E-01	RAC	under
PM-10	4.03E-01			
SO2				
NO2				
HCl	1.39E-02			
Cl2				
CO				
UNANTICIPATED PICs				
2-Nitrophenol	1.08E-05			
Naphthalene	1.17E-05			
Diethylphthalate	8.50E-06	8.00E+02	RAC	under
Di-n-butylphthalate	1.85E-05	1.00E+02	RAC	under
Di-n-octylphthalate	7.68E-06			
Benzoyl Chloride	6.80E-05			
Undecane	9.89E-05			
2-Fluoro-4-nitrophenol	7.12E-05			
Octadecanoic acid	1.13E-04			
o,p'-DDE	7.37E-05			
Hexadecanoic acid	7.49E-05			

Total ratio of carcinogenic metals to RSDs: 3.81E-02

RAC = Reference ambient concentration.
RSD = Risk specific dose.
ug/m^3 = micrograms per cubic meter.

Table 8-1

SUMMARY OF COMPLETE EXPOSURE PATHWAYS

AMBIENT AIR QUALITY IMPACT REPORT
WOOD INDUSTRIES SITE
YAKIMA, WASHINGTON

Potentially Exposed Population	Exposure Route, Medium and Exposure Point	Pathway Selected for Quantitative Evaluation	Reason for Selection or Exclusion
Workers at Property Boundary	Inhalation of dust bound chemicals from soil prior to treatment.	Yes	Pathway may be complete during soil handling prior to treatment.
	Inhalation of chemicals in dusts deposited on produce.	Yes	Pathway may be complete under current conditions (Semiquantitative evaluation).
Residents Downwind	Inhalation of stack emitted pollutants	Yes	Pathway may be complete during startup, performance test, and treatment.
	Ingestion of emitted pollutants deposited on soil.	Yes	Pathway may be complete during and after soil treatment.
Subsistence Farmer	Ingestion of emitted pollutants deposited on soil.	Yes	Pathway may be complete during and after soil treatment.
	Consumption of home grown produce.	Yes	Pathway may be complete during and after soil treatment.
	Consumption of homegrown beef and milk.	Yes	Pathway may be complete during and after soil treatment.

Table 8-2

FENCELINE FUGITIVE DUST CONCENTRATIONS

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

Parameter	**95% UCL (or max) (mg/kg)**	**Fenceline Fugitive Dust (mg/m3) (untreated sources)**	**8-hour Fencelin Dust (mg/m3)**	**8-hour Fenceline Stack (mg/m3)**
Acetone	0.28	2.29E-08	6.01E-08	9.4E-10
Acetonitrile				
Acrylonitrile				
Aldrin	10.84	8.86E-07	2.33E-06	
alpha-BHC	0.73	5.96E-08	1.57E-07	
alpha-Chlordane	0.91	7.44E-08	1.95E-07	
Benzaldehyde				
Benzene	0.005	4.09E-10	1.07E-09	
Benzoic acid	0.64	5.23E-08	1.37E-07	
Benzyl alcohol				
beta-BHC	0.26	2.12E-08	5.58E-08	
bis(2-ethylhexyl)phthal	5.3	4.33E-07	1.14E-06	
Camphene				
Chlorobenzene				
Chloroethane				
Chloroform	0.0046	3.76E-10	9.88E-10	
Chloromethane				
p,p'-DDD	748.29	6.11E-05	1.61E-04	
p,p'-DDE	75.28	6.15E-06	1.62E-05	
p,p'-DDT	2890.36	2.36E-04	6.21E-04	
1,2-Dichlorobenzene				
1,3-Dichlorobenzene				
1,4-Dichlorobenzene				
Dieldrin	32.17	2.63E-06	6.91E-06	
Dihydrofuranone				
Endrin	19.99	1.63E-06	4.29E-06	
Ethanol				
Ethylbenzene	0.25	2.04E-08	5.37E-08	
gamma-BHC	15.91	1.30E-06	3.42E-06	
Heptachlor	0.32	2.61E-08	6.87E-08	
Heptachlor epoxide	0.18	1.47E-08	3.86E-08	
Hexachlorobenzene	1753.73	1.43E-04	3.77E-04	
Hexachlorocyclopenta				
Methoxychlor	103.61	8.47E-06	2.22E-05	
Methylene chloride	0.01	8.17E-10	2.15E-09	
2-Methylphenol				
3-Methylphenol				
4-Methylphenol				
Methylphenylether				
m-Ethyltoluene				
Nitrobenzene				
Phenol	3.69	3.02E-07	7.92E-07	
Styrene				
2,3,7,8-TCDD				
Toluene	0.6	4.90E-08	1.29E-07	
Toxaphene	200.57	1.64E-05	4.31E-05	
1,2,4-Trichlorobenzen	2.08	1.70E-07	4.47E-07	
1,1,1-Trichloroethane				
Trichlorofluoromethan				
Vinyl chloride				
Xylene	4.4	3.60E-07	9.45E-07	
Antimony	53.4	4.36E-06	1.15E-05	
Arsenic	12.42	1.01E-06	2.67E-06	
Barium	184.667	1.51E-05	3.96E-05	
Beryllium	0.13	1.06E-08	2.79E-08	
Cadmium	8.41	6.87E-07	1.81E-06	
Chromium III	19.28	1.58E-06	4.14E-06	
Chromium VI				
Lead	121.02	9.89E-06	2.60E-05	
Mercury	10.7	8.74E-07	2.30E-06	
Nickel	19.37	1.58E-06	4.16E-06	
Selenium				
Silver	2.2	1.80E-07	4.72E-07	
Thallium				
PM_10 (all sources)		8.17E-02	2.15E-01	

mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram

Table 8-3

INDUSTRIAL AND RESIDENTIAL EXPOSURE: INTAKE FROM INHALATION OF CHEMICALS IN AIR

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

$$I_{inh} = \frac{C_{air} \times IR \times FI \times ED}{BW \times AT}$$

where:

I_{inh} = estimated daily intake of inhaled emitted pollutants(mg/kg-day)
C_{air} = chemical concentration in air (mg/m^3)
IR = inhalation rate (m^3/day)
FI = fraction inhaled from contaminated source (unitless)
ED = exposure duration (days)
BW = body weight (kg)
AT = averaging time (days)
- carcinogenic effects: 70-year lifetime x 365 days/year
- noncarcinogenic effects: exposure duration (ED)

Exposure Assumptions

Parameter	RME Values[b]
C_{air}	Chemical-specific exposure concentration
IR	20 (adult and worker)
FI	1.0
ED	84[c]
BW	70 (adult)

Sample Calculation:

I_{inh} (for carcinogenic effects, childhood exposure, if C_{air} = 1 mg/m^3)

$$= \frac{1\ mg/m^3 \times 10\ m^3/day \times 1.0 \times 19.3\ weeks}{15\ kg \times 25{,}550\ days} = 2.19 \times 10^{-3}\ mg/kg\text{-}day$$

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[a] All exposure assumptions from USEPA (1991a) unless otherwise noted.
[b] Exposure values reflect RME assumptions (see text).
[c] Exposure duration reflects duration of soil treatment (19.3 weeks).

Table 8-4

USEPA WEIGHT-OF-EVIDENCE CATEGORIES

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

USEPA Category	Description of Category	Description of Evidence
A	Human Carcinogen	Sufficient evidence exists from epidemiologic studies to support a casual association between exposure and cancer.
B1	Probable Human Carcinogen	Limited evidence of carcinogenicity from epidemiologic studies.
B2	Probable Human Carcinogen	Sufficient evidence of carcinogenicity in animals, and inadequate evidence of carcinogenicity in humans.
C	Possible Human Carcinogen	Limited evidence of carcinogenicity in animals.
D	Not Classified	Inadequate evidence of carcinogenicity in animals.
E	No Evidence of Carcinogenicity in Humans	No evidence for carcinogenicity in at least two adequate animal tests or in both epidemiologic and animal studies.
U	No Rating Given	

Source: USEPA, 1989b.

Table 8-5

CALCULATED REFERENCE CONCENTRATION

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

	Oral RfD (mg/kg/d)	Calculated RAC (mg/m^3)
Acetone	1.00E-01	8.75E-02
Acetonitrile	6.00E-03	5.25E-03
Acrylonitrile	1.00E-03	8.75E-04
Aldrin	3.00E-05	2.63E-05
alpha-BHC		
alpha-Chlordane	6.00E-05	5.25E-05
Benzaldehyde	1.00E-01	8.75E-02
Benzene		
Benzoic acid	4.00E+00	3.50E+00
Benzyl alcohol	3.00E-01	2.63E-01
beta-BHC		
bis(2-ethylhexyl)phthalate	2.00E-02	1.75E-02
Camphene		
Chlorobenzene	2.00E-02	1.75E-02
Chloroethane	4.00E-01	3.50E-01
Chloroform	1.00E-02	8.75E-03
Chloromethane		
p,p'-DDD		
p,p'-DDE		
p,p'-DDT	5.00E-04	4.38E-04
1,2-Dichlorobenzene	9.00E-02	7.88E-02
1,3-Dichlorobenzene	8.90E-02 Ot	7.79E-02
1,4-Dichlorobenzene		
Dieldrin	5.00E-05	4.38E-05
Dihydrofuranone		
Endrin	3.00E-04 i	2.63E-04
Ethanol		
Ethylbenzene	1.00E-01 i	8.75E-02
gamma-BHC	3.00E-04	2.63E-04
Heptachlor	5.00E-04	4.38E-04
Heptachlor epoxide	1.30E-05	1.14E-05
Hexachlorobenzene	8.00E-04	7.00E-04
Hexachlorocyclopentadiene	7.00E-03	6.13E-03
Methoxychlor	5.00E-03 i	4.38E-03
Methylene chloride	6.00E-02 i	5.25E-02
2-Methylphenol	5.00E-02 i	4.38E-02
3-Methylphenol	5.00E-02 i	4.38E-02
4-Methylphenol	5.00E-03 h	4.38E-03
Methylphenylether		
m-Ethyltoluene		
Nitrobenzene	5.00E-04 i	4.38E-04
Phenol	6.00E-01 i	5.25E-01
Styrene	2.00E-01 i	1.75E-01
2,3,7,8-TCDD		
Toluene	2.00E-01 i	1.75E-01
Toxaphene		
1,2,4-Trichlorobenzene	1.00E-02 i	8.75E-03
1,1,1-Trichloroethane	9.00E-02 i	7.88E-02
Trichlorofluoromethane		
Vinyl chloride		
Xylene		
Antimony	4.00E-04 i	3.50E-04
Arsenic	3.00E-04 i	2.63E-04
Barium	7.00E-02	6.13E-02
Beryllium	5.00E-03	4.38E-03
Cadmium	5.00E-04 i	4.38E-04
Chromium III	1.00E+00 i	8.75E-01
Chromium VI	5.00E-03 i	4.38E-03
Lead		
Mercury	3.00E-04 h	2.63E-04
Nickel	2.00E-02 i	1.75E-02
Selenium	5.00E-03 i	4.38E-03
Silver	5.00E-03 i	4.38E-03
Thallium		
PM-10		
SO_2		
NO_2		
HCl		
Cl_2		
CO		

Table 8-5

CALCULATED REFERENCE CONCENTRATION

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

	Oral RfD (mg/kg/d)	Calculated RAC (mg/m^3)
UNANTICIPATED PICs		
2-Nitrophenol		
Naphthalene	4.00E-02 w	3.50E-02
Diethylphthalate	8.00E-01 i	7.00E-01
Di-n-butylphthalate	1.00E-01 i	8.75E-02
Di-n-octylphthalate	2.00E-02 h	1.75E-02
Benzoyl Chloride		
Undecane		
2-Fluoro-4-nitrophenol		
Octadecanoic acid		
o,p'-DDE		
Hexadecanoic acid		

i = IRIS
h = HEAST, 1994
o = Other USEPA documents
w = withdrawn from IRIS or HEAST

Equation (USEPA, 1989):

$$\text{RAC (mg/m}^3\text{)} = \frac{\text{RfDo (mg/kg-bw/day) x body weight (kg) x correction factor (1.0) x background level factor (0.25)}}{\text{m}^3\text{ air breathed / day}}$$

Tab

INHALATION TOXICITY VALUES

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

	Inhalation Unit risk (ug/m3)	Inhalation Slope Factor (mg/kg-day)	Weight of Evidence	Tumor Site	Source	Subchronic RfC (mg/m3)	Subchronic UF	Source	Chronic RfC (mg/m3)	Chronic UF	Source
Acetone	—	—	D		I,1994; H,1993	No data	No data	H,1993	8.75E-02	No data	I,1995;USEPA, 1989
Acetonitrile	—	—	D		I,1994; H,1993	0.5	300	H,1993	0.05	3000	H,1993
Acrylonitrile	0.000068	0.24	B1	Lung tumors	I,1994; H,1993	No data	No data	H,1993	0.002	1000	I,1994
Aldrin	0.0049	17	B2	Liver carcinoma	I,1994; H,1993	No data	No data	H,1993	2.63E-06	No data	I,1995;USEPA, 1989
alpha-BHC	0.0018	6.3	B2	Liver tumors	I,1994; H,1993	No data	No data	H,1993	No data	No data	I,1994; H,1993
alpha-Chlordane	0.00037	1.3	B2	Liver carcinoma	I,1994; H,1993	Not available		E,1994	5.25E-05	No data	I,1995;USEPA, 1989
Benzaldehyde	—	—	D		I,1994; H,1993	No data	No data	H,1993	0.0875	No data	I,1995;USEPA, 1989
Benzene	0.0000083	0.029	A	Blood (Leukemia)	I,1994; H,1993	0.06	300	E,1994	No data	No data	I,1994; H,1993
Benzoic acid	—	—	D		I,1994; H,1993	No data	No data	H,1993	3.5	No data	I,1995;USEPA, 1989
Benzyl alcohol	—	—	NA		I,1994; H,1993	No data	No data	H,1993	0.263	No data	I,1995;USEPA, 1989
beta-BHC	0.00053	1.8	C	Liver tumors	I,1994; H,1993	No data	No data	H,1993	No data	No data	I,1994; H,1993
bis(2-ethylhexyl)phthalate	—	0.014	B2	Liver tumors	I,1995; H,1994	No data	No data		0.0175	No data	I,1995;USEPA, 1989
Camphene	—	—	NA		Not in IRIS or HEAST	No data	No data	H,1993	No data	No data	I,1994; H,1993
Chlorobenzene	—	—	D		I,1994; H,1993	Not available	No data	E, 1994	0.02	10000	H,1993
Chloroethane	—	—	D		I,1994; H,1993	10	300	H,1993	10	300	I,1994
Chloroform	0.000023	0.081	B2	Liver carcinoma	I,1994; H,1993	0.04	300	E,1994	0.00875	No data	I,1995;USEPA, 1989
Chloromethane	—	6.30E-03	D		H,1994	9	30	E,1994	No data	No data	I,1994; H,1993
p,p'-DDD	NA	0.24	B2	Liver tumors	Route-to-route	No data	No data	H,1993	No data	No data	I,1994; H,1993
p,p'-DDE	NA	0.34	B2	Liver tumors	Route-to-route	No data	No data	H,1993	No data	No data	I,1994; H,1993
p,p'-DDT	9.70E-05	0.34	B2	Liver tumors	I,1994; H,1993	No data	No data	H,1993	0.000438	No data	I,1995;USEPA, 1989
1,2-Dichlorobenzene	—	—	D		I,1994; H,1993	No data	No data	H,1993	0.2	1000	H,1993
1,3-Dichlorobenzene	—	—	D		I,1994; H,1993	No data	No data	H,1993	0.0779	No data	Other;USEPA, 1989
1,4-Dichlorobenzene	NA	0.024	B2 (oral)	Liver tumors	Route-to-route	0.8	100	H,1993	0.8	100	I,1994; H,1993
Dieldrin	0.0046	16	B2	Liver carcinoma	I,1994; H,1993	No data	No data	H,1993	0.0000438	No data	I,1995;USEPA, 1989
Dihydrofuranone	—	—	NA		Not in IRIS or HEAST	No data	No data	H,1993	No data	No data	I,1994; H,1993
Endrin	—	—	D		I,1994; H,1993	No data	No data	H,1993	0.000263	No data	I,1995;USEPA, 1989
Ethanol	—	—	NA		Not in IRIS or HEAST	No data	No data	H,1993	No data	No data	I,1994; H,1993
Ethylbenzene	—	—	D		I,1994; H,1993	Pending	No data	E,1994	1	300	I,1994; H,1993
gamma-BHC	NA	1.3	B2/C	Liver tumors	Route-to-route	No data	No data	H,1993	0.000263	No data	I,1995;USEPA, 1989
Heptachlor	0.0013	4.5	B2	Liver carcinoma	I,1994; H,1993	No data	No data	H,1993	0.000438	No data	I,1995;USEPA, 1989
Heptachlor epoxide	0.0026	9.1	B2	Liver carcinoma	I,1994; H,1993	No data	No data	H,1993	0.0000114	No data	I,1995;USEPA, 1989
Hexachlorobenzene	0.00046	1.6	B2	Liver tumors	I,1994; H,1993	Not recommended		E,1993	0.0007	No data	I,1995;USEPA, 1989
Hexachlorocyclopentadiene	—	—	D		I,1994; H,1993	0.0007	100	H,1993	0.00007	1000	H,1993
Methoxychlor	—	—	D		I,1994; H,1993	No data	No data	H,1993	0.00438	No data	I,1995;USEPA, 1989
Methylene chloride	0.00000047	1.64E-03	B2	Lung; liver	I,1994; H,1993	3	100	H,1993	3	100	I,1994; H,1993
2-Methylphenol	—	—	D		I,1994	No data	No data	H,1993	0.0438	No data	I,1995;USEPA, 1989
3-Methylphenol	—	—	D		I,1994	No data	No data	H,1993	0.0438	No data	I,1995;USEPA, 1989
4-Methylphenol	—	—	D		I,1994	No data	No data	H,1993	0.00438	No data	H,1994;USEPA, 1989
Methylphenylether	—	—	NA		Not in IRIS or HEAST	No data	No data	H,1993	No data	No data	I,1994; H,1993
m-Ethyltoluene	—	—	D		I,1994; H,1993	No data	No data	H,1993	Data Inadequate		H,1993
Nitrobenzene	—	—	D		I,1994; H,1993	0.02	1000	H,1993	0.002	10000	H,1993
Phenol	—	—	D		I,1994; H,1993	No data	No data	H,1993	0.525	No data	I,1995;USEPA, 1989
Styrene	—	—	D	IARC - Possible	E,1994	3	10	H,1993	1	No data	I,1995
2,3,7,8-TCDD	0.000033	1.50E+05	B2		H; 1994	No data	No data	H,1993	No data	No data	I,1994; H,1993
Toluene	—	—	D		I,1994; H,1993	1	No data	E,1994	0.4	300	I,1994
Toxaphene	0.00032	1.1	B2		I,1994; H,1993	No data	No data	H,1993	No data	No data	I,1994; H,1993
1,2,4-Trichlorobenzene	—	—	D		I,1994; H,1993	0.09	100	H,1993	0.009	100	I,1994; H,1993

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INHALATION TOXICITY VALUES

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

	Inhalation Unit risk (ug/m3)	Inhalation Slope Factor (mg/kg-day)	Weight of Evidence	Tumor Site	Source	Subchronic RfC (mg/m3)	Subchronic UF	Source	Chronic RfC (mg/m3)	Chronic UF	Source
1,1,1-Trichloroethane	—	—	D		I,1994; H,1993	1	1000	E,1994	0.0788	No data	I,1995;USEPA, 1989
Trichlorofluoromethane	—	—	D		I,1994; H,1993	7	1000	H,1993	0.7	10000	H,1993
Vinyl chloride	0.000084	0.3	A	Liver tumors	H,1993	Inadequate data	No data	E,1994	No data	No data	I,1994; H,1993
Xylene	—	—	D		I,1994; H,1993	Pending	No data	E,1994	No data	No data	I,1994; H,1993
Antimony	—	—	D		I,1994	No data	No data	H,1993	0.0003	No data	USEPA, 1992
Arsenic	0.0043	15	A	Respiratory tract	I,1994; H,1993	No data	No data	H,1993	0.000263	No data	I,1995;USEPA, 1989
Barium	—	—	D		I,1994	0.005	100	H,1993	0.0005	1000	H,1993
Beryllium	0.0024	8.4	B2	Lung tumors	I,1994; H,1993	No data	No data	H,1993	0.00438	No data	I,1995;USEPA, 1989
Cadmium	0.0018	6.3	B1	Respiratory tract	I,1994	No data	No data	H,1993	0.000438	No data	I,1995;USEPA, 1989
Chromium III	—	—	D		I,1994	No data	No data	H,1993	0.875	No data	I,1995;USEPA, 1989
Chromium VI	0.012	41	A	Lung tumors	I,1994; H,1993	0.000004	100	E,1994	0.00438	No data	I,1995;USEPA, 1989
Lead	NA	NA	B2	IRIS says no data	I,1994; H,1993	Not recommended		E,1993	0.0015	No data	I,1994; H,1993
Mercury	—	—	D		I,1994; H,1993	0.0003	30	H,1993	0.0003	30	H,1993
Nickel	—	—	D		I,1994; H,1993	No data	No data	H,1993	0.02	No data	USEPA, 1992
Selenium	—	—	D			No data	No data	H,1993	0.004	No data	USEPA, 1992
Silver	—	—	D		I,1994	No data	No data	H,1993	0.003	No data	USEPA, 1992
Thallium	—	—	NA		Not in IRIS	No data	No data	H,1993	0.0003	No data	USEPA, 1992
PM-10	—	—	NA			0.05		NAAQS			
SO_2	—	—	NA			No data	No data		No data	No data	
NO_2	—	—	NA			No data	No data		No data	No data	
HCl	—	—	NA			No data	No data		0.007	No data	USEPA, 1992
Cl_2	—	—	NA			No data	No data		0.0004	No data	USEPA, 1992
CO	—	—	NA			No data	No data		No data	No data	
UNANTICIPATED PICs	—	—				–	–		–		
2-Nitrophenol	—	—	D			No data	No data	H,1994	No data	No data	I,1994; H,1994
Naphthalene	—	—	D			No data	No data	H,1994	3.50E-02	No data	W;USEPA, 1989
Diethylphthalate	—	—	D			No data	No data	H,1994	0.7	No data	I,1995; USEPA, 1989
Di-n-butylphthalate	—	—	D			No data	No data	H,1994	0.0875	No data	I,1995; USEPA, 1989
Di-n-octylphthalate	—	—	D			No data	No data	H,1994	0.0175	No data	I,1995; USEPA, 1989
Benzoyl Chloride	—	—	NA			No data	No data	H,1994	No data	No data	I,1994; H,1994
Undecane	—	—	NA			No data	No data	H,1994	No data	No data	I,1994; H,1994
2-Fluoro-4-nitrophenol	—	—	NA			No data	No data	H,1994	No data	No data	I,1994; H,1994
Octadecanoic acid	—	—	NA			No data	No data	H,1994	No data	No data	I,1994; H,1994
o,p'-DDE	—	0.34	NA	p,p'-DDE; Route-to-route		No data	No data	H,1994	No data	No data	I,1994; H,1994
Hexadecanoic acid	—	—	NA			No data	No data	H,1994	No data	No data	I,1994; H,1994

Table 8-7

8-HOUR PEAK FENCELINE CONCENTRATIONS VERSUS TLVS AND PELS

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

	Fenceline Dust Concentration (mg/m3)	Stack Emittant Concentration (mg/m3)	Total Fenceline (mg/m3)	TLV-TWA (mg/m3)	Comment	Result
Acetone	6.01E-08	9.38E-10	6.11E-08	1800		
Acetonitrile				70		
Acrylonitrile				4.406	PEL	
Aldrin	2.33E-06	1.06E-11	2.33E-06	0.25		
alpha-BHC	1.57E-07	1.06E-11	1.57E-07			
alpha-Chlordane	1.95E-07	1.06E-11	1.95E-07	0.5		
Benzaldehyde						
Benzene	1.07E-09	4.53E-10	1.53E-09	3.26	PEL	
Benzoic acid	1.37E-07	8.99E-09	1.46E-07			
Benzyl alcohol						
beta-BHC	5.58E-08	1.06E-11	5.58E-08			
bis(2-ethylhexyl)phthalate	1.14E-06	2.90E-09	1.14E-06			
Camphene						
Chlorobenzene				350		
Chloroethane						
Chloroform	9.88E-10	4.27E-09	5.26E-09			
Chloromethane		5.11E-11	5.11E-11	9.78		
p,p'-DDD	1.61E-04	1.86E-10	1.61E-04			
p,p'-DDE	1.62E-05	1.16E-09	1.62E-05			
p,p'-DDT	6.21E-04	4.23E-10	6.21E-04	1		
1,2-Dichlorobenzene		3.18E-10	3.18E-10	300	PEL	
1,3-Dichlorobenzene		1.50E-10	1.50E-10			
1,4-Dichlorobenzene		1.81E-10	1.81E-10	450		
Dieldrin	6.91E-06	6.99E-10	6.91E-06	0.025		
Dihydrofuranone						
Endrin	4.29E-06	4.32E-11	4.29E-06	0.1		
Ethanol						
Ethylbenzene	5.37E-08	3.64E-11	5.37E-08			
gamma-BHC	3.42E-06	1.30E-10	3.42E-06	0.5		
Heptachlor	6.87E-08	1.06E-11	6.87E-08	0.5		
Heptachlor epoxide	3.86E-08	1.06E-11	3.87E-08			
Hexachlorobenzene	3.77E-04	7.98E-10	3.77E-04			
Hexachlorocyclopentadiene				0.1		
Methoxychlor	2.22E-05	1.06E-11	2.22E-05	10	Dust	
Methylene chloride	2.15E-09	3.74E-10	2.52E-09	1765		
2-Methylphenol				22		
3-Methylphenol				22		
4-Methylphenol				22		
Methylphenylether						
m-Ethyltoluene						
Nitrobenzene				5		
Phenol	7.92E-07	1.41E-10	7.92E-07	19		
Styrene		1.05E-09	1.05E-09	215		
2,3,7,8-TCDD		9.91E-16	9.91E-16			
Toluene	1.29E-07	8.09E-11	1.29E-07	375		
Toxaphene	4.31E-05	1.06E-11	4.31E-05	0.5	Chlorinated camphene	
1,2,4-Trichlorobenzene	4.47E-07	3.52E-11	4.47E-07	40	Ceiling	
1,1,1-Trichloroethane				1900		
Trichlorofluoromethane						
Vinyl chloride				2.6	PEL	
Xylene	9.45E-07	4.24E-11	9.45E-07	435		
Antimony	1.15E-05	1.87E-10	1.15E-05	0.5		
Arsenic	2.67E-06	9.32E-11	2.67E-06	0.01	PEL	
Barium	3.96E-05	5.60E-10	3.96E-05	0.5	Soluable compounds	
Beryllium	2.79E-08	1.87E-11	2.79E-08	0.002		
Cadmium	1.81E-06	9.96E-11	1.81E-06	0.1/0.2	Fume/Dust	
Chromium III	4.14E-06		4.14E-06	1	Metal	
Chromium VI		6.16E-10	6.16E-10			
Lead	2.60E-05	1.59E-09	2.60E-05	0.05	PEL	
Mercury	2.30E-06	9.96E-08	2.40E-06	0.05		
Nickel	4.16E-06	7.59E-10	4.16E-06	1	Metal	
Selenium		4.05E-10	4.05E-10	0.2		
Silver	4.72E-07	1.81E-10	4.73E-07	0.01		
Thallium				0.1	Soluable compounds	
PM-10	2.16E-01	8.70E-06	2.16E-01	5/15	PM-10/Total Dust	Exceed PM-10, below total dust
SO2						
NO2						
HCl		3.00E-07	3.00E-07			
Cl2						
CO						

Table 8-7

8-HOUR PEAK FENCELINE CONCENTRATIONS VERSUS TLVS AND PELS

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

	Fenceline Dust Concentration (mg/m3)	Stack Emittant Concentration (mg/m3)	Total Fenceline (mg/m3)	TLV-TWA (mg/m3)	Comment	Result
UNANTICIPATED PICs						
2-Nitrophenol		2.33E-10	2.33E-10			
Naphthalene		2.53E-10	2.53E-10	52		
Diethylphthalate		1.84E-10	1.84E-10	5		
Di-n-butylphthalate		4.00E-10	4.00E-10	5		
Di-n-octylphthalate		1.66E-10	1.66E-10	5		
Benzoyl Chloride		1.47E-09	1.47E-09			
Undecane		2.14E-09	2.14E-09			
2-Fluoro-4-nitrophenol		1.54E-09	1.54E-09			
Octadecanoic acid		2.43E-09	2.43E-09			
o,p'-DDE		1.59E-09	1.59E-09			
Hexadecanoic acid		1.62E-09	1.62E-09			

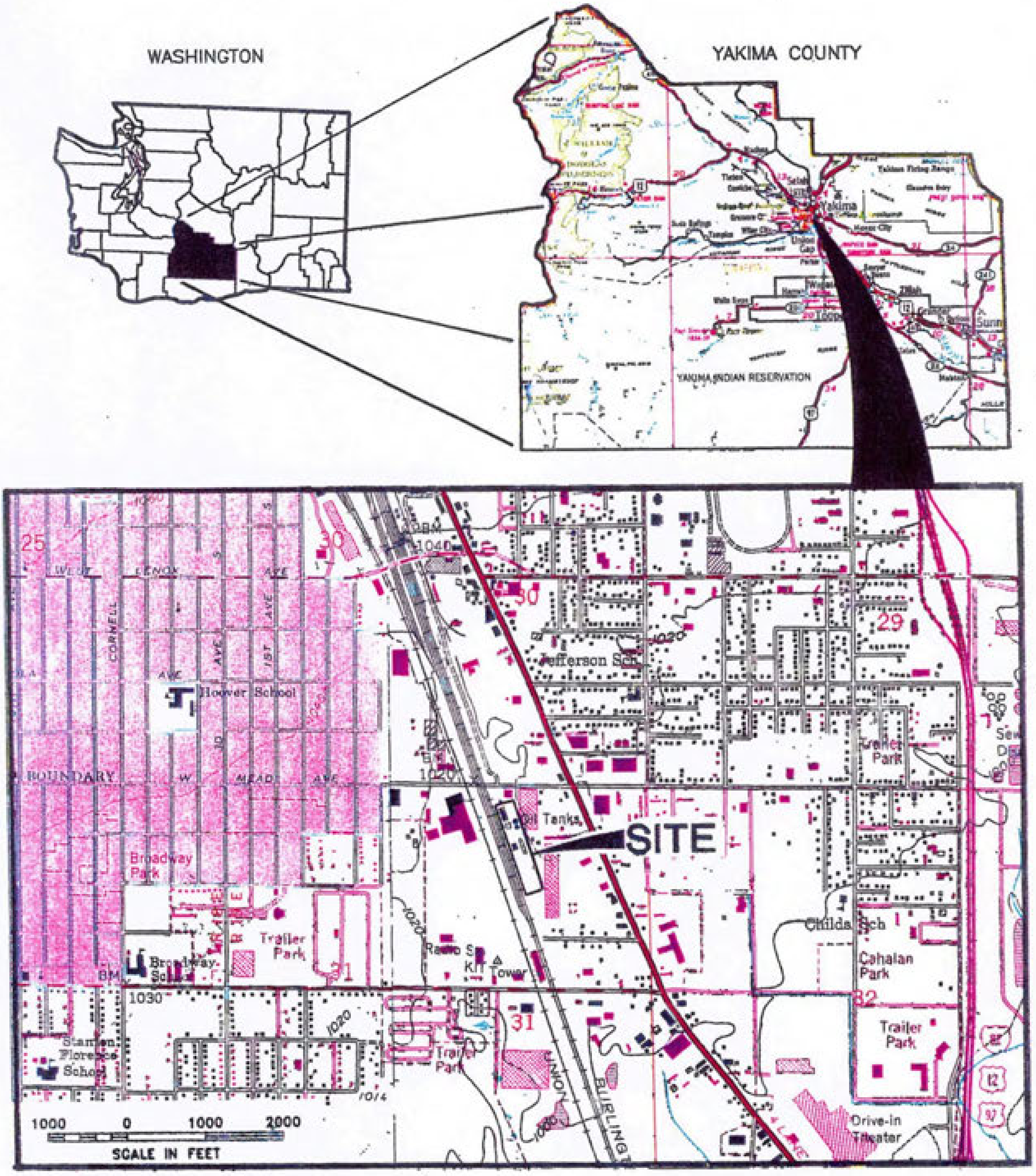
Table 8-8

CALCULATED CANCER RISK LEVELS AND HAZARD INDICES

AMBIENT AIR QUALITY IMPACT REPORT
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

Receptor	Pathway	Cancer Risk Level	Hazard Index
Workers at property boundary	Inhalation of fugitive dusts	4×10^{-7}	0.89*
	Inhalation of stack emittants	8.4×10^{-11}	0.000007
Residents downwind	Inhalation of stack emittants (normal)	3.4×10^{-9}	0.034
	(cold)	3.3×10^{-9}	0.052
	Ingestion of emitted pollutants on soil	4.9×10^{-11}	0.00004
Subsistence farmer	Inhalation of stack emittants (normal)	3.4×10^{-9}	0.034
	(cold)	3.3×10^{-9}	0.052
	Ingestion of emitted pollutants in soil; consumption of produce, beef, and milk	2.2×10^{-7}	0.18

* Does not include PM_{10}.



SCALE IS VARIABLE

N

PHILIP ENVIRONMENTAL	SITE LOCATION MAP	SCALE VARIES	DATE	PROJECT NO: 12883088 WOODS INDUSTRIES YAKIMA, WASHINGTON
		DWN:		
		DES:		
		CHKD:		FIGURE 1–1
		APPD:		REV: A

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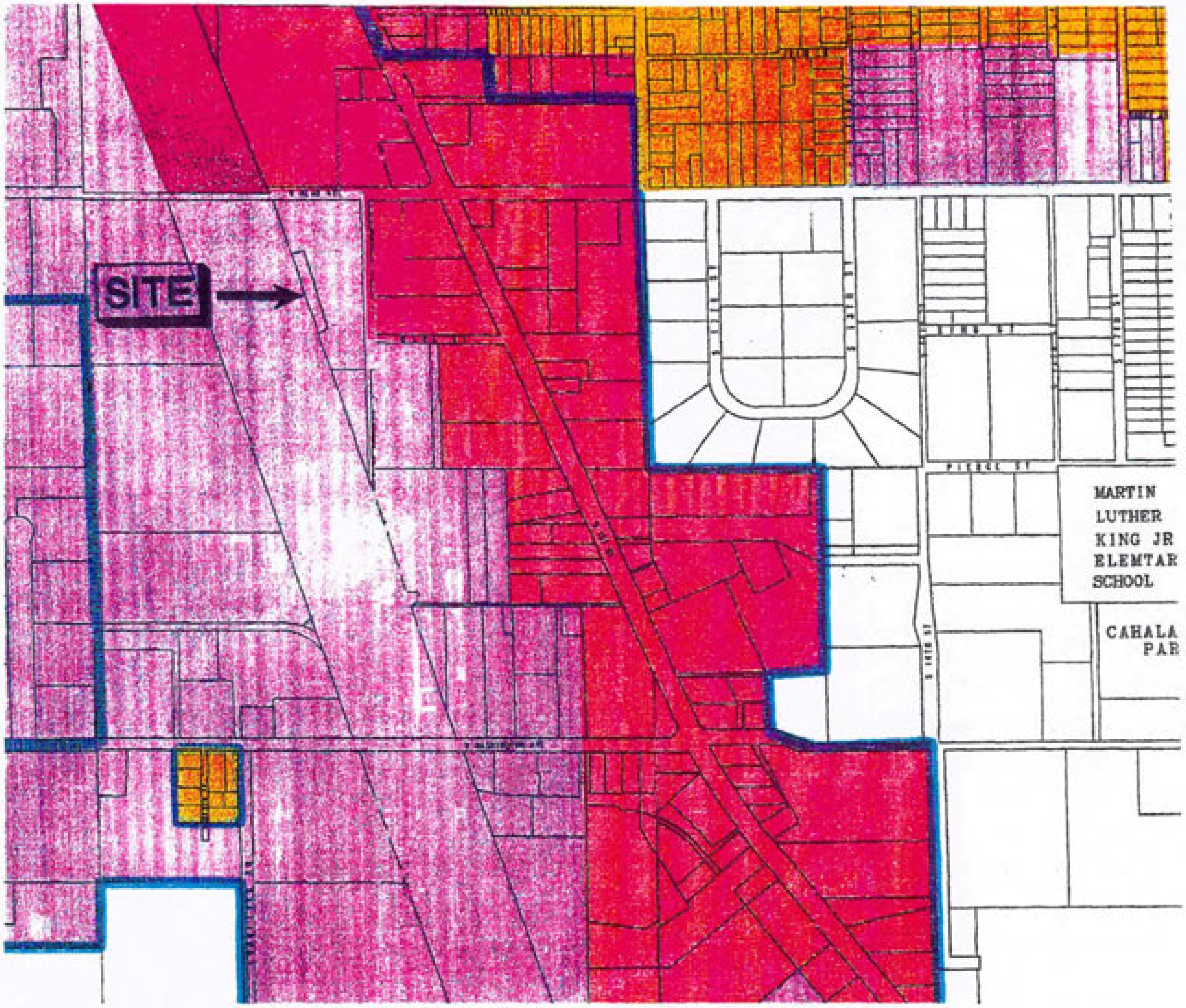

LEGEND:

☐ UNION GAP, NOT ZONED

🟧 TWO-FAMILY RESIDENTIAL

🟥 CENTRAL BUSINESS DISTRICT SUPPORT (COMMERCIAL)

🟪 LIGHT INDUSTRIAL

■ HEAVY INDUSTRIAL

0 800 1600
FEET

PHILIP ENVIRONMENTAL	SURROUNDING LAND USE AND ZONING	SCALE 1" = 800'	DATE	PROJECT NO: 12883088 WOODS INDUSTRIES YAKIMA, WASHINGTON	
		DWN: CAM	4/25/94		
		DES:		FIGURE 2-1	REV: A
		CHKD:			
		APPD:			

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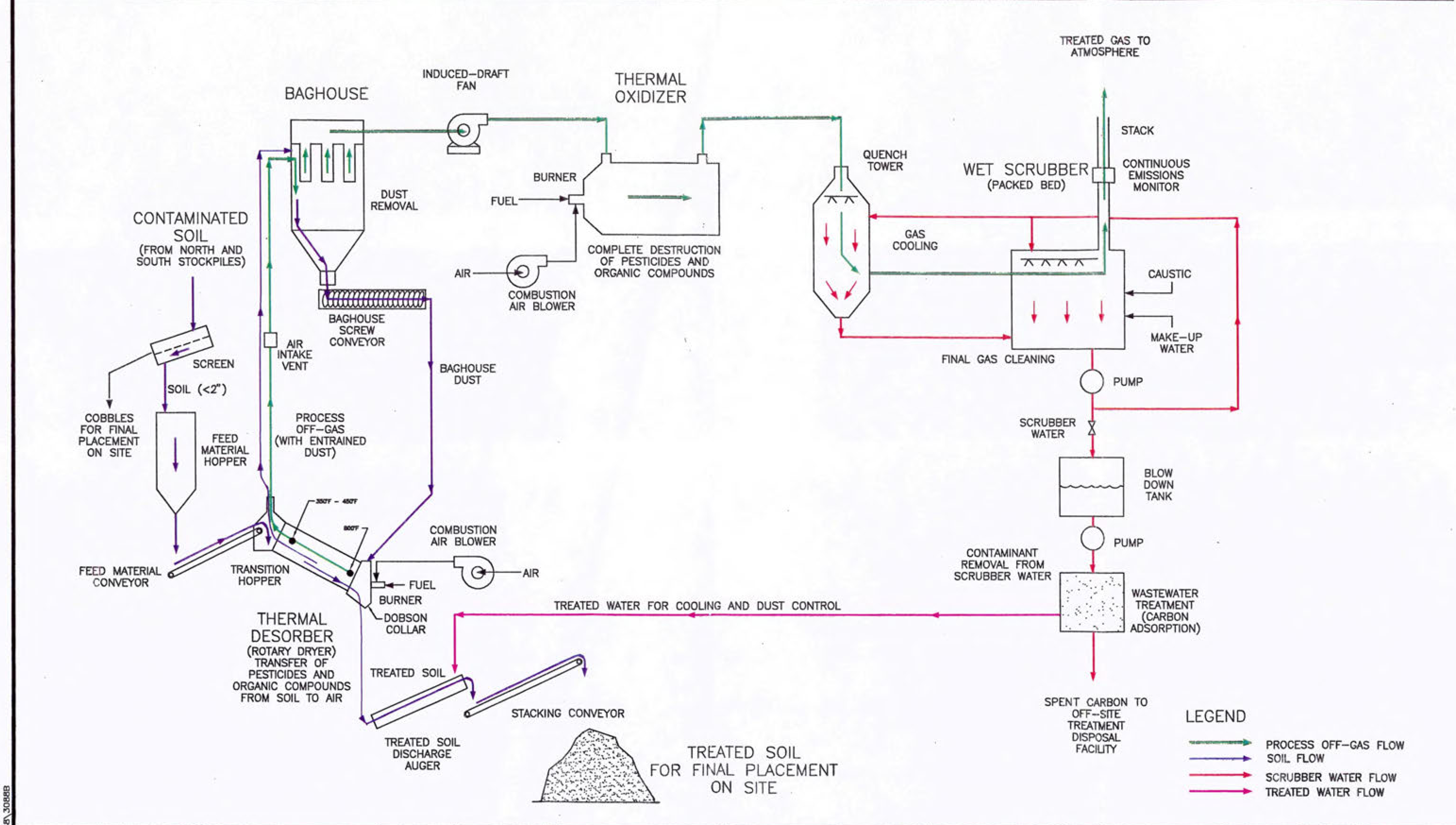

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PHILIP
ENVIRONMENTAL

TITLE:
LTTD PROCESS FLOW DIAGRAM

NO.	REVISION	BY	APPR.	DATE
△				

SCALE SCHEMATIC
DWN: JEN
DATE: 11/16/94
DES:
CHKD:
APPD:
DATE: 7/27/95
7/27/95

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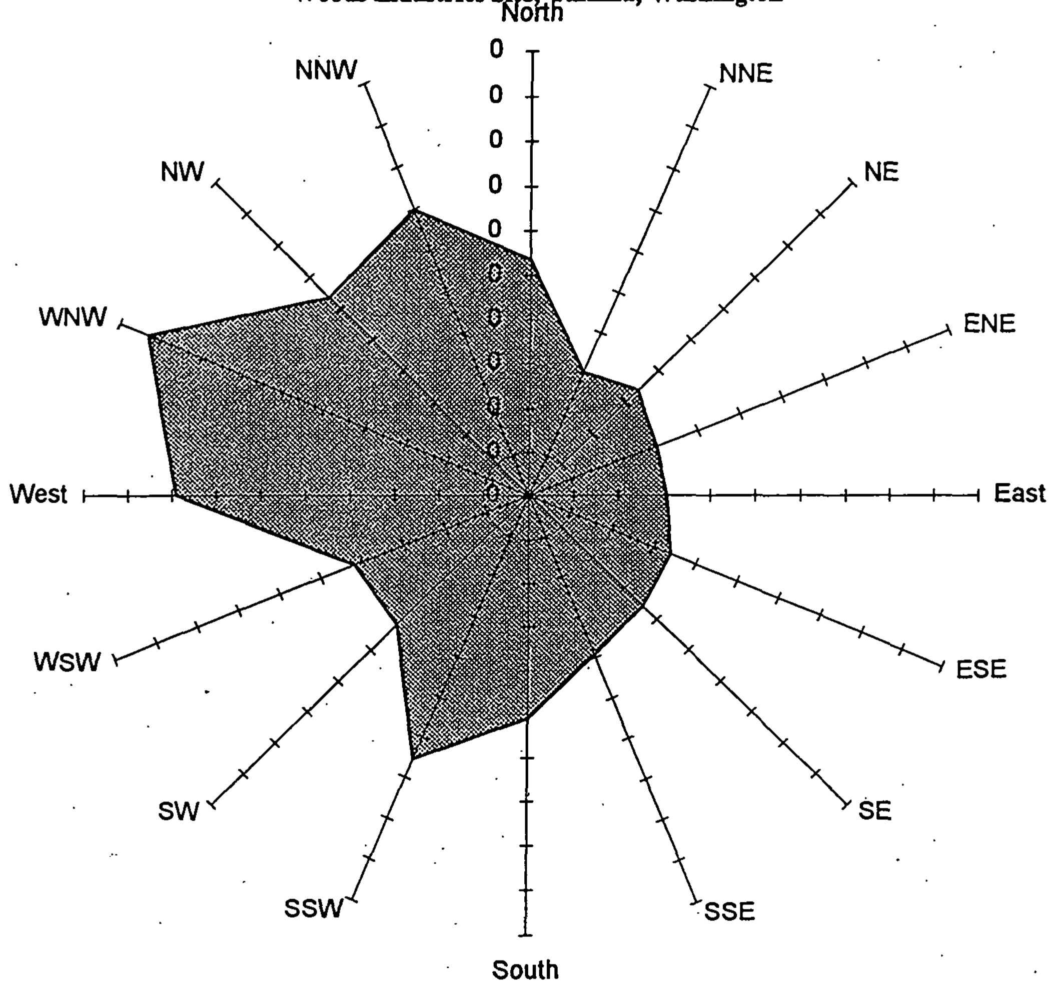
PROJECT NO: 1288308

WOODS INDUSTRIES
YAKIMA, WASHINGTON

FIGURE 3-1
REV A

(Percentage of Time from Each Direction)
Based on Hourly Averages from On-site Meteorological Station
February 14, 1995 to May 26, 1995
Woods Industries Site, Yakima, Washington



PHILIP
ENVIRONMENTAL

WIND DIRECTION

SCALE NONE	DATE	PROJECT NO: 12883088 WOODS INDUSTRIES YAKIMA, WASHINGTON
DWN:		
DES:		FIGURE 4-2
CHKD:		REV: A
APPD:		

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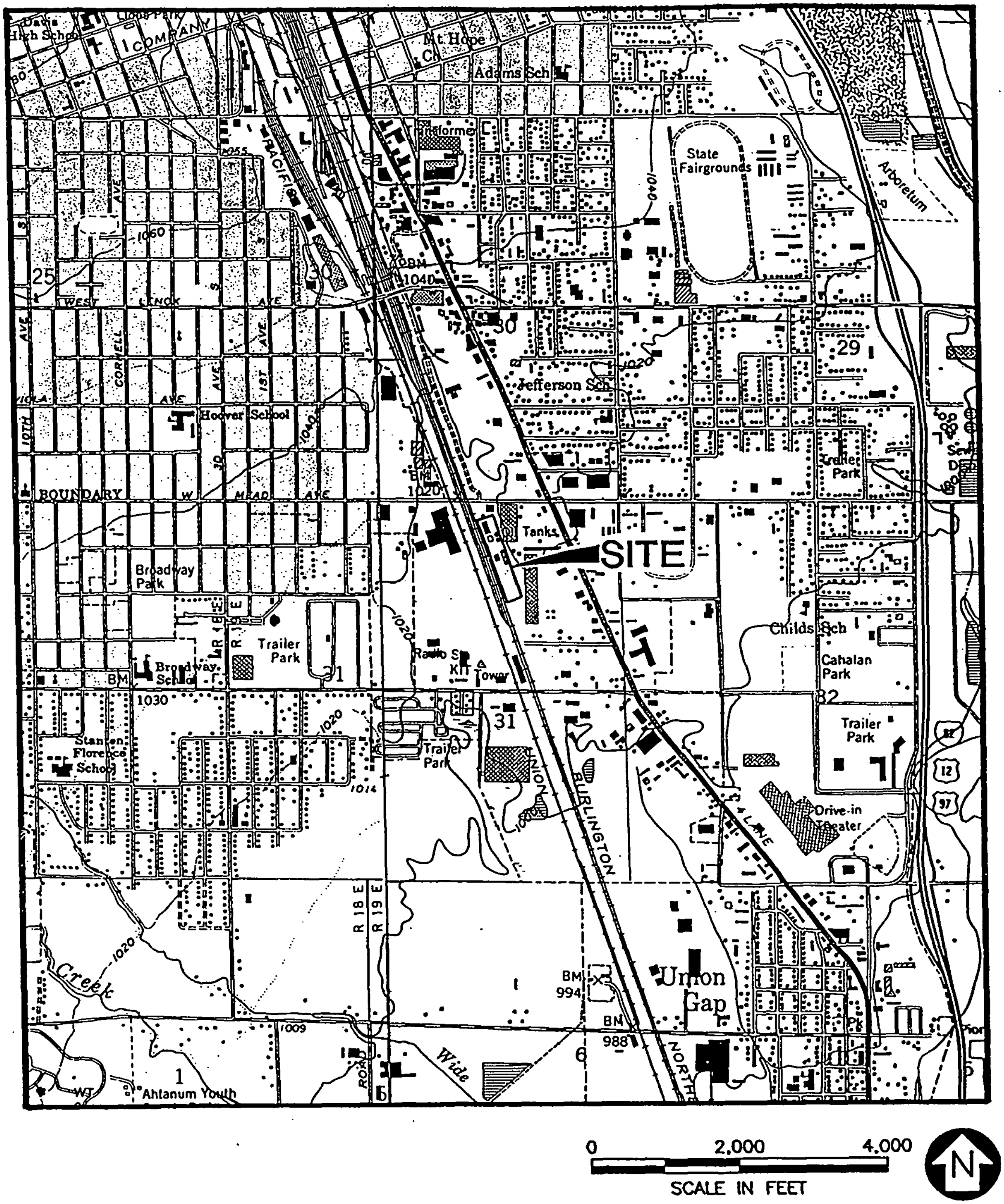

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PHILIP
ENVIRONMENTAL

TOPOGRAPHIC MAP

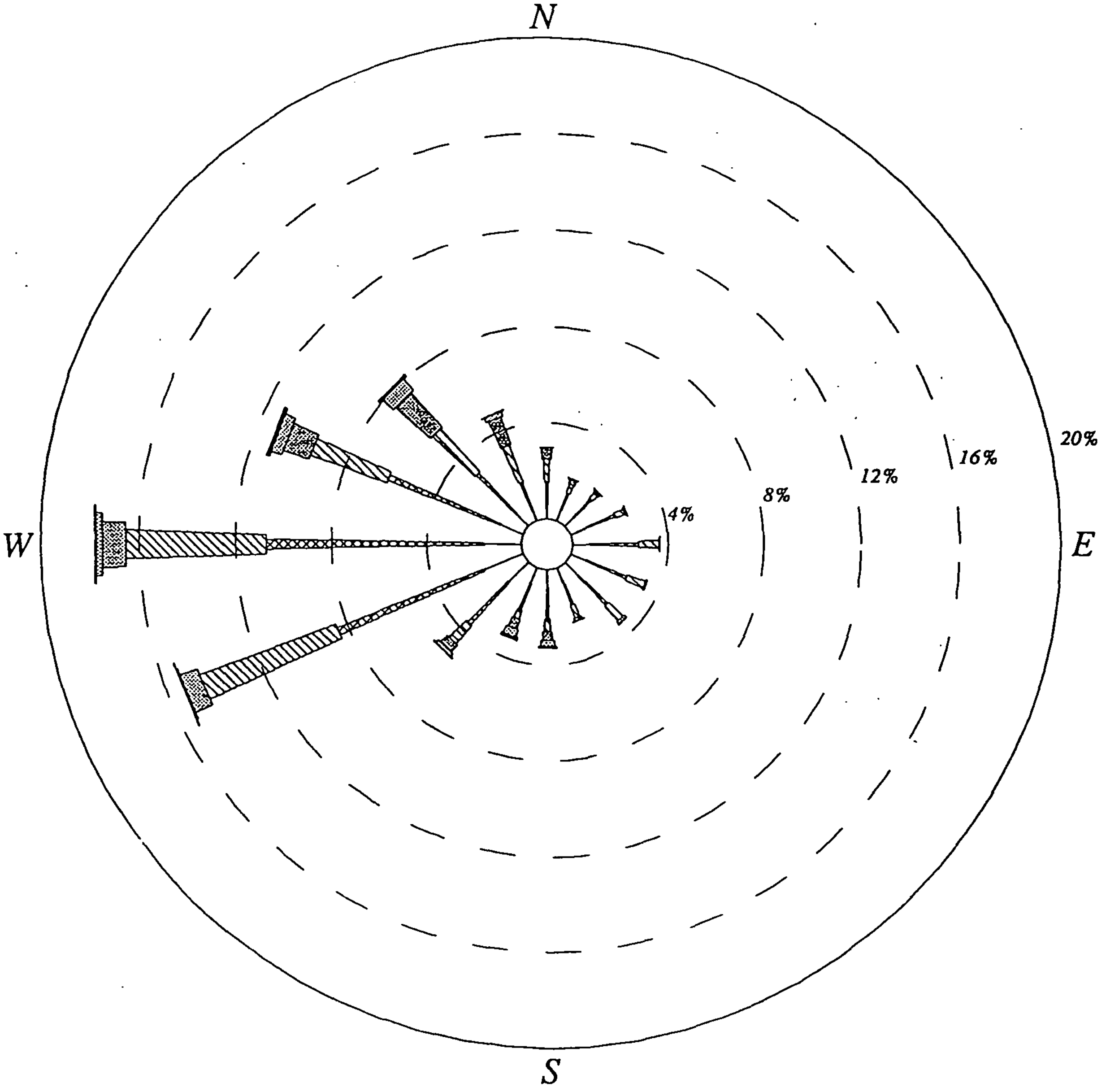
SCALE 1" = 2000'
DATE
DWN: 11/11/93
DES:
CHKD:
APPD:

PROJECT NO: 12883088
WOODS INDUSTRIES
YAKIMA, WASHINGTON

FIGURE 6-1
REV: A

YAKIMA 1984-88

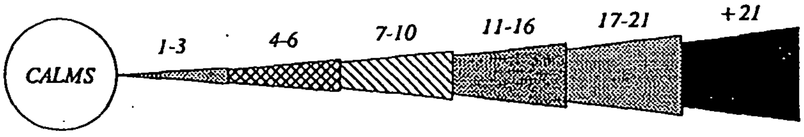
January 1-December 31; Midnight-11 PM



CALM WINDS 8.56%

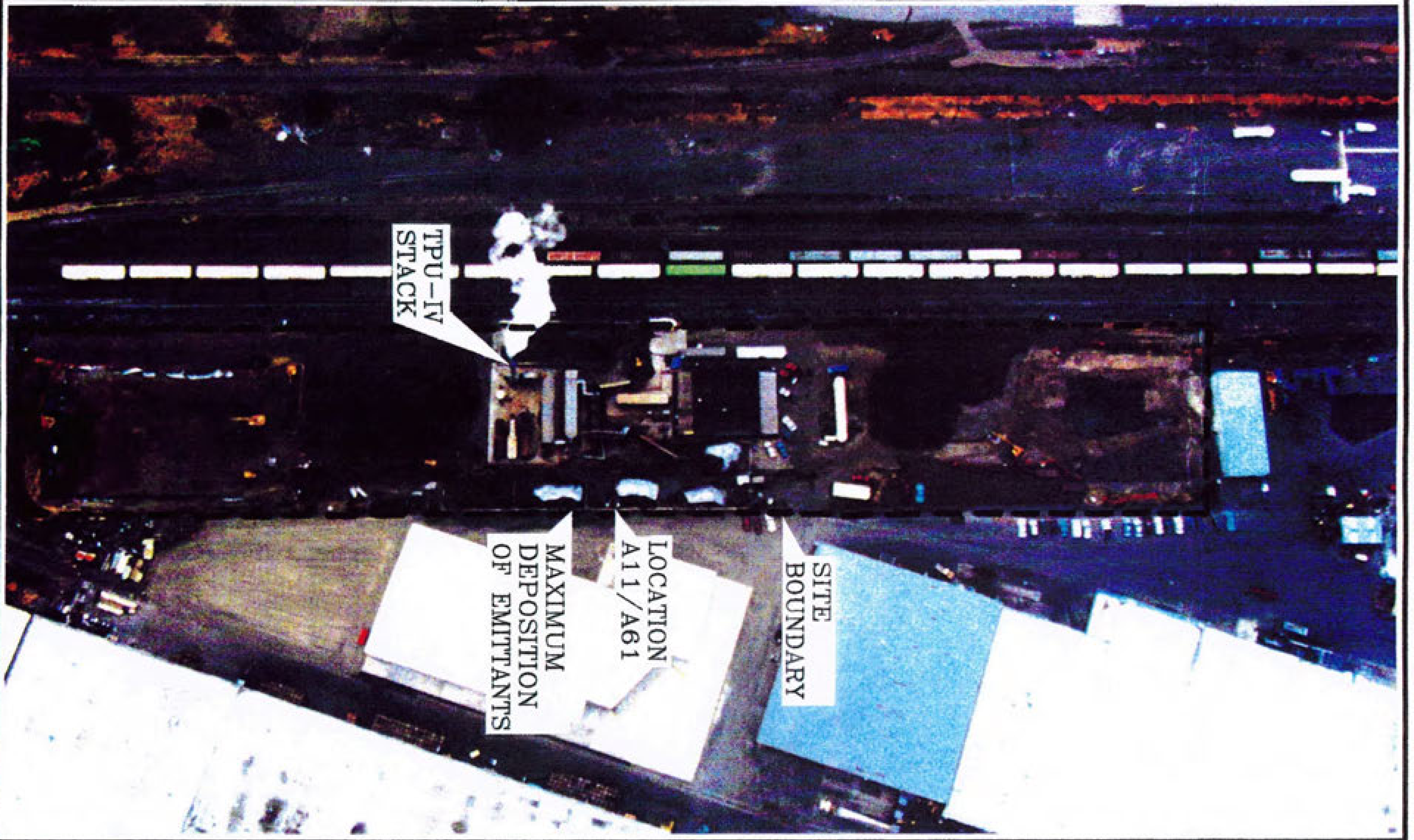
WIND SPEED (KNOTS)

NOTE: Frequencies indicate direction from which the wind is blowing.



PHILIP ENVIRONMENTAL	WIND ROSE WOODS INDUSTRIES SITE YAKIMA, WASHINGTON	SCALE AS SHOWN	DATE	PROJECT NO: 12883088 WOODS INDUSTRIES YAKIMA, WASHINGTON
		DWN:	11/12/93	
		DES:		
		CHKD:		FIGURE 6-2
		APPD:		REV: A

COL. K:\CAD\ 088\3088G



PHILIP
ENVIRONMENTAL

SITE FEATURES

WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

SCALE	NONE	DATE
DWN:	RA	7/22/95
DES:	EBU	7/27/95
CHKD:	AAB	7/28/95
APPD:	AAB	7/28/95

PROJECT NO: 12883088
WOODS INDUSTRIES
YAKIMA, WASHINGTON

FIGURE 8-1

REV: A

COL K:\CAD\12883088\3088H

APPENDIX A

Estimated Criteria Pollutant Emission Rates

Estimated Criteria Pollutant Emissions

Basis: 100 ppm_v CO Stack Gas Concentration

91,621 lb/hr Stack Gas Flow Rate (Dry Basis)

0.09S lb SO_2/1,000 gal. C_3H_8 SO_2 Emission Factor, where S = 0.16 gr/100 cu ft

3,984 lb C_3H_8/hr Fuel Usage Rate, @ 30 tons/hr Feed Rate

12.4 lb NO_2/1,000 gal. C_3H_8 NO_2 Emission Factor

CO Emissions

100 ppm = 6.72 lb/hr as CO

SO_2 Emissions

$$\text{Volumetric Fuel Usage Rate} = \frac{1 \text{ gal. } C_3H_8}{4.23 \text{ lb } C_3H_8} \times \frac{3{,}984 \text{ lb } C_3H_8}{hr} = 941.84 \text{ gal/hr as } C_3H_8$$

$$SO_2 \text{ Emission Factor} = 0.09S = 0.09\ (0.16) = 0.014 \text{ lb } SO_2/1{,}000 \text{ gal. } C_3H_8$$

$$SO_2 \text{ Emission Rate} = \frac{0.014 \text{ lb } SO_2}{1{,}000 \text{ gal. } C_3H_8} \times \frac{941.84 \text{ gal. } C_3H_8}{hr} = 0.013 \text{ lb/hr as } SO_2$$

NO_2 Emissions

$$NO_2 \text{ Emission Rate} = \frac{12.4 \text{ lb } NO_2}{1{,}000 \text{ gal. } C_3H_8} \times \frac{941.84 \text{ gal. } C_3H_8}{hr} = 11.68 \text{ lb/hr as } NO_2$$

APPENDIX B

Summary Statistics for Stockpiled Soil

SUMMARY STATISTICS

TABLE 1

SUMMARY STATISTICS FOR DETECTED ANALYTES IN ON-SITE SOIL SAMPLES AREA INSIDE OF CONTOURS USING REMEDIATION CRITERIA OF DDT GE 30 OR HEXACHLOROBENZENE GE 40

WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

Parameter	Frequency of Detection	Range of Sample Quantitation Limits	Range of Detected Concentrations	Arithmetic Mean	95% UCL for Mean
Sample Type=Soil Sample Units=mg/kg					
Benzoic acid	1/31	1.7-110	0.64-0.64	6.322258	11.19
Phenol	3/38	0.33-3.7	1.3-39.2479	1.624945	3.69
2,4-Dimethylphenol	1/31	0.33-21	0.22-0.22	1.19	2.12
Acenaphthylene	1/31	0.33-21	0.042-0.042	1.209258	2.14
1,2,4-Trichlorobenzene	4/31	0.33-21	0.052-0.29	1.148161	2.08
Hexachlorobenzene	44/46	0.0017-2100	0.0099-23000	729.6866	1753.73
Benzo(a)anthracene	1/31	0.33-21	0.13-0.13	1.212419	2.14
Benzo(a)pyrene	1/31	0.33-21	0.16-0.16	1.213387	2.14
Benzo(b)fluoranthene	4/31	0.33-21	0.082-0.33	1.216355	2.14
Benzo(k)fluoranthene	4/31	0.33-21	0.082-0.33	1.216355	2.14
Chrysene	2/31	0.33-21	0.052-0.15	1.209419	2.14
Dibenzofuran	6/31	0.33-21	0.029-0.22	1.176516	2.11
2,4-Dinitrotoluene	1/31	0.33-21	0.052-0.052	1.209581	2.14
Fluoranthene	3/31	0.33-21	0.07-0.21	1.209129	2.14
2-Methylnaphthalene	11/31	0.33-21	0.035-1.3	1.193645	2.13
Naphthalene	9/31	0.33-21	0.03-0.62	1.191806	2.12
Phenanthrene	9/31	0.33-21	0.033-0.31	1.176581	2.11
Butyl benzyl phthalate	3/31	0.33-21	0.21-2.6	1.251452	2.19
Bis(2-ethylhexyl)phthalate	9/14	0.33-21	0.22-13	2.956429	5.30
Diethyl phthalate	1/31	0.33-21	0.077-0.077	1.193452	2.12
Di-n-butyl phthalate	2/30	0.33-21	0.079-0.66	0.9118	1.62
Pyrene	6/31	0.33-21	0.035-0.18	1.193097	2.12
Acetone	18/27	0.01-0.01	0.014-2.1	0.125148	0.28
Ethylbenzene	5/36	0.005-0.005	0.038-2.7	0.095431	0.25
Carbon disulfide	1/36	0.005-0.005	0.007-0.007	0.002625	0.00

Notes: Arithmetic mean calculated using the L/2 method for non-detects.
Includes duplicate samples. Does not include results flagged as B or R.
Does not include Z2-223-03 which if now in the roll-off boxes

SUMMARY STATISTICS

TABLE 1

SUMMARY STATISTICS FOR DETECTED ANALYTES IN ON-SITE SOIL SAMPLES AREA INSIDE OF CONTOURS USING REMEDIATION CRITERIA OF DDT GE 30 OR HEXACHLOROBENZENE GE 40

WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

Parameter	Frequency of Detection	Range of Sample Quantitation Limits	Range of Detected Concentrations	Arithmetic Mean	95% UCL for Mean
ample Type=Soil Sample Units=mg/kg					
Chloroform	1/32	0.0005-0.0005	0.0046-0.0046	0.000386	0.00
Tetrachloroethene	14/35	0.0003-0.0003	0.0004-0.3	0.010484	0.03
Methylene chloride; Dichloromethane	22/32	0.005-0.005	0.002-0.018	0.006531	0.01
Toluene	15/36	0.005-0.005	0.006-6.2	0.244986	0.60
1,2,3-Trichloropropane	3/36	0.005-0.005	0.05-1.142	0.046458	0.11
Xylenes (Total)	5/36	0.005-0.005	0.22-51	1.522986	4.40
Aldrin	9/57	0.008-180	0.028-37	6.094675	10.84
alpha-BHC	2/57	0.008-180	0.25-0.73	4.930086	9.53
beta-BHC	2/57	0.008-180	0.039-0.26	4.918132	9.52
delta-BHC	1/38	0.008-83	0.77-0.77	1.961313	4.19
gamma-BHC; (Lindane)	13/57	0.008-180	0.073-83	9.782886	15.91
alpha-Chlordane	2/57	0.08-1800	0.6-0.91	49.15535	95.20
2,4-Dichlorophenoxyacetic acid	10/36	0.005-0.005	0.025-0.52	0.038778	0.07
Dieldrin	22/57	0.016-360	0.081-200	19.94968	32.17
Endosulfan sulfate	1/38	0.016-170	0.82-0.82	3.969474	8.54
Endrin	6/57	0.016-360	0.14-37	10.83337	19.99
Heptachlor	2/57	0.008-180	0.027-0.32	4.916946	9.52
Heptachlor epoxide	1/57	0.008-180	0.18-0.18	4.916121	9.52
Malathion	5/35	0.3-0.3	0.07-4	0.260143	0.48
Methoxychlor	8/57	0.08-1800	1.6-270	57.04647	103.61
Parathion	15/35	0.3-8.2	0.05-280	15.91743	36.97
p,p'-DDD	50/57	0.016-170	0.0056-6600	454.2585	748.29
p,p'-DDE	53/57	0.016-170	0.0072-560	51.66651	75.28
p,p'-DDT	57/57	0.016-1700	0.033-30000	1696.032	2890.36

Notes: Arithmetic mean calculated using the L/2 method for non-detects.
Includes duplicate samples. Does not include results flagged as B or R.
Does not include Z2-223-03 which if now in the roll-off boxes

SUMMARY STATISTICS

TABLE 1

SUMMARY STATISTICS FOR DETECTED ANALYTES IN ON-SITE SOIL SAMPLES AREA INSIDE OF CONTOURS USING REMEDIATION CRITERIA OF DDT GE 30 OR HEXACHLOROBENZENE GE 40

WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

Parameter	Frequency of Detection	Range of Sample Quantitation Limits	Range of Detected Concentrations	Arithmetic Mean	95% UCL for Mean
Sample Type=Soil Sample Units=mg/kg					
Toxaphene	12/57	0.16-3600	1.4-290	109.3775	200.57
Arsenic	58/58	0.2-0.5	2.8-55.3	9.747728	12.42
Cadmium	39/39	0.5-0.5	2.8-14.4	7.716921	8.41
Chromium	39/39	2.5-2.5	12.7-28.3	18.26553	19.28
Copper	39/39	2-2	17.5-13700	444.0707	1152.23
Lead	58/58	0.1-10	2.7-812	86.67259	121.02
Mercury	43/58	0.08-0.1	0.11-88.5	6.23649	10.70
Nickel	39/39	1.1-1.2	8.2-38.2	17.06032	19.37
Zinc	39/39	2-2	78.5-5590	902.1181	1287.68
Cyanide	3/40	1-1	2.2-5.3	0.73	1.02

Notes: Arithmetic mean calculated using the L/2 method for non-detects. Includes duplicate samples. Does not include results flagged as B or R. Does not include Z2-223-03 which if now in the roll-off boxes

APPENDIX C

Upset and Emission Rate Calculation

Upset Conditions Duration
Woods Industries(William's TPU-IV)

Date	Total Downtime From AWFSO Log[1]	Time Attributed to Startup[2]	Downtime > 24 min.[3]	Total Upset Duration(min.)[4]	Total Upset Duration(hrs)	Total Downtime (Hours)[5]	Total Operating (Hours)	% Upset
4/2/95	15	6	0	9	0.15	10.17	13.83	1%
4/3/95	2	2	0	0	0.00	18.55	5.45	0%
4/4/95	94	4	16	74	1.23	9.84	14.16	9%
4/5/95	331	2	303	26	0.43	12	12	4%
4/6/95	11	6	0	5	0.08	8.28	15.72	1%
4/7/95	163	2	88	73	1.22	2.83	21.17	6%
4/8/95	41	0	0	41	0.68	7.3	16.7	4%
4/9/95	6	0	0	6	0.10	23.86	0.14	71%
4/10/95	96	0	70	26	0.43	21	3	14%
4/11/95	745	0	720	25	0.42	20	4	10%
4/12/95	10	0	0	10	0.17	21.94	2.06	8%
4/13/95	6	0	0	6	0.10	17.65	6.35	2%
4/14/95	19	0	0	19	0.32	18.91	5.09	6%
4/15/95	5	0	0	5	0.08	17.12	6.88	1%
4/16/95	0	0	0	0	0.00	21.5	2.5	0%
4/17/95	11	0	0	11	0.18	2.43	21.57	1%
4/18/95	1	0	0	1	0.02	22.03	1.97	1%
4/19/95	83	2	41	40	0.67	17.34	6.66	10%
4/20/95	37	15	0	22	0.37	15.63	8.37	4%
4/21/95	139	1	88	50	0.83	6.12	17.88	5%
4/22/95	18	0	0	18	0.30	15.43	8.57	4%
4/23/95	34	3	0	31	0.52	19.8	4.2	12%
4/24/95	144	3	107	34	0.57	14.56	9.44	6%
4/25/95	18	3	0	15	0.25	3.55	20.45	1%
4/26/95	10	3	0	7	0.12	14.7	9.3	1%
4/27/95	1	1	0	0	0.00	8.36	15.64	0%
4/28/95	207	12	157	38	0.63	15.09	8.91	7%
4/29/95	117	2	72	43	0.72	3.8	20.2	4%
4/30/95	1	0	0	1	0.02	10.74	13.26	0%
5/1/95	39	2	0	37	0.62	8.53	15.47	4%
5/2/95	1	0	0	1	0.02	18.68	5.32	0%
5/3/95	0	0	0	0	0.00	20.21	3.79	0%
5/4/95	0	0	0	0	0.00	24	0	na
5/5/95	154	0	92	62	1.03	20.85	3.15	33%
5/6/95	119	0	71	48	0.80	16.57	7.43	11%
5/7/95	24	0	0	24	0.40	20.55	3.45	12%
5/8/95	41	0	0	41	0.68	0.68	23.32	3%
5/9/95	45	0	13	32	0.53	9.42	14.58	4%

Upset Conditions Duration
Woods Industries(William's TPU-IV)

Date	Total Downtime From AWFSO Log[1]	Time Attributed to Startup[2]	Downtime > 24 min.[3]	Total Upset Duration(min.)[4]	Total Upset Duration(hrs)	Total Downtime (Hours)[5]	Total Operating (Hours)		% Upset
5/10/95	0	0	0	0	0.00	12	12		0%
5/11/95	1	0	0	1	0.02	19	5		0%
5/12/95	33	0	0	33	0.55	15.5	8.5		6%
5/13/95	0	0	0	0	0.00	24	0		na
5/14/95	0	0	0	0	0.00	24	0		na
5/15/95	0	0	0	0	0.00	24	0		na
5/16/95	0	0	0	0	0.00	24	0		na
5/17/95	0	0	0	0	0.00	24	0		na
5/18/95	0	0	0	0	0.00	24	0		na
5/19/95	0	0	0	0	0.00	24	0		na
5/20/95	130	0	62	68	1.13	16.35	7.65		15%
5/21/95	24	0	1	23	0.38	22	2		19%
5/22/95	18	0	0	18	0.30	19.5	4.5		7%
5/23/95	53	0	0	53	0.88	12.5	11.5		8%
5/24/95	25	0	0	25	0.42	0	24		2%
5/25/95	61	0	0	61	1.02	0	24		4%
5/26/95	83	0	35	48	0.80	0	24		3%
			Total =	1211		Total	495.13	average=	4%
			Average/operating day =	28.83					

[1] Total Minutes from AWFSO excursion log per instructions received from C. Massimino, USEPA

[2] Minutes from AWFSO log attributed to cold start-up.

[3] Downtime listed on AWFSO excursion log that included time greater than 24 minutes.

[4] Total upset time = Total logged time - cold startup - time> 24 minutes

[5] Total Downtime for day supplied by Williams Env.

Isomer No.	PCDD/PCDF		Analytical Result (pg/sample)	Stack Concentration (ng/dscm)	2,3,7,8-TCDD TEF	Stack Concentration as 2,3,7,8-TCDD equivalents (ng/dscm)	Emission Rate as 2,3,7,8-TCDD (g/sec)
1	2,3,7,8-TCDD	<	1.9	3.17E-04	1	3.17E-04	2.35E-12
	Other TCDD		22.1	7.37E-03			
	Total TCDD		2	6.67E-04			
2	1,2,3,7,8-PeCDD	<	5.5	9.17E-04	0.5	4.58E-04	3.41E-12
	Other PeCDD		1.5	5.00E-04			
	Total PeCDD		18	6.00E-03			
3	1,2,3,4,7,8-HxCDD		7.4	2.47E-03	0.1	2.47E-04	1.83E-12
4	1,2,3,7,8,9-HxCDD		16	5.33E-03	0.1	5.33E-04	3.96E-12
5	1,2,3,7,8,9-HxCDD		11	3.67E-03	0.1	3.67E-04	2.72E-12
	Other HxCDD		105.6	3.52E-02			
	Total HxCDD		140	4.67E-02			
6	1,2,3,4,6,7,8-HpCDD		91	3.03E-02	0.01	3.03E-04	2.25E-12
	Other HpCDD		79	2.63E-02			
	Total HpCDD		170	5.67E-02			
7	OCDD		379	1.26E-01	0.001	1.26E-04	9.39E-13
Total PCDDs(d)			731	2.44E-01			
8	2,3,7,8-TCDF		16	5.33E-03	0.1	5.33E-04	3.96E-12
	Other TCDF		1584	5.28E-01			
	Total TCDF		1600	5.33E-01			
9	1,2,3,7,8-PeCDF		12	4.00E-03	0.05	2.00E-04	1.49E-12
10	2,3,4,7,8-PeCDF		22	7.33E-03	0.5	3.67E-03	2.72E-11
	Other PeCDF		196	6.53E-02			
	Total PeCDF		230	7.67E-02			
11	1,2,3,4,7,8-HxCDF		19	6.33E-03	0.1	6.33E-04	4.71E-12
12	1,2,3,6,7,8-HxCDF		15	5.00E-03	0.1	5.00E-04	3.72E-12
13	2,3,4,6,7,8-HxCDF		18	6.00E-03	0.1	6.00E-04	4.46E-12
14	1,2,3,7,8,9-HxCDF		8.6	2.87E-03	0.1	2.87E-04	2.13E-12
	Other HxCDF		79.4	2.65E-02			
	Total HxCDF		140	4.67E-02			
15	1,2,3,4,6,7,8-HpCDF		55	1.83E-02	0.01	1.83E-04	1.36E-12
16	1,2,3,4,7,8,9-HpCDF		10	3.33E-03	0.01	3.33E-05	2.48E-13
	Other HpCDF		15	5.00E-03			
	Total HpCDF		80	2.67E-02			
17	OCDF		170	5.67E-02	0.001	5.67E-05	4.21E-13
Total PCDDs(d)			2220	7.40E-01			
Total PCDD/PCDF			2951	9.84E-01			**6.72E-11**

NOTE: All concentrations are at actual stack conditions.

(a) Stack gas sample volume:

105.91 dry standard cubic feet

3.0 dry standard cubic meters

(b) Stack gas flow rate:

15.739 dry standard cubic feet per minute

7.43 dry standard cubic meters per second

(c) For non-detects, stack concentrations and emissions are calculated using one-half the detection limit. If the sum of the detection limits of the individual isomers for a given dioxin or furan exceeded the detection of the total it was assumed that these individual isomers, when added, constituted the entire total so that any contribution to the total by "other" isomers would be zero.

(d) Total PCDDs = Total TCDD + Total PeCDD + Total HxCDD + Total HpCDD + OCDD.

(e) Total PCDFs = Total TCDF + Total PeCDF + Total HxCDF + Total HpCDF + OCDF.

(f) Toxicity Equivalence Factors from 40 CFR 266 Appendix IX, Section 4.0.

Isomer No.	PCDD/PCDF		Analytical Result (pg/sample)	Stack Concentration (ng/dscm)	2,3,7,8-TCDD TEF	Stack Concentration as 2,3,7,8-TCDD equivalents (ng/dscm)	Emission Rate as 2,3,7,8-TCDD (g/sec)
1	2,3,7,8-TCDD	<	3.6	6.36E-04	1	6.36E-04	4.40E-12
	Other TCDD		42.4	1.50E-02			
	Total TCDD		46	1.63E-02			
2	1,2,3,7,8-PeCDD	<	9.6	1.70E-03	0.5	8.48E-04	5.87E-12
	Other PeCDD		27.4	9.68E-03			
	Total PeCDD		37	1.31E-02			
3	1,2,3,4,7,8-HxCDD		8.3	2.93E-03	0.1	2.93E-04	2.03E-12
4	1,2,3,7,8,9-HxCDD		16	5.65E-03	0.1	5.65E-04	3.91E-12
5	1,2,3,7,8,9-HxCDD		13	4.59E-03	0.1	4.59E-04	3.18E-12
	Other HxCDD		132.7	4.69E-02			
	Total HxCDD		170	6.01E-02			
6	1,2,3,4,6,7,8-HpCDD		110	3.89E-02	0.01	3.89E-04	2.69E-12
	Other HpCDD		100	3.53E-02			
	Total HpCDD		210	7.42E-02			
7	OCDD		490	1.73E-01	0.001	1.73E-04	1.20E-12
Total PCDDs(d)			953	3.37E-01			
8	2,3,7,8-TCDF		23	8.13E-03	0.1	8.13E-04	5.62E-12
	Other TCDF		1177	4.16E-01			
	Total TCDF		1200	4.24E-01			
9	1,2,3,7,8-PeCDF		16	5.65E-03	0.05	2.83E-04	1.96E-12
10	2,3,4,7,8-PeCDF		25	8.83E-03	0.5	4.42E-03	3.06E-11
	Other PeCDF		269	9.51E-02			
	Total PeCDF		310	1.10E-01			
11	1,2,3,4,7,8-HxCDF		25	8.83E-03	0.1	8.83E-04	6.11E-12
12	1,2,3,6,7,8-HxCDF		21	7.42E-03	0.1	7.42E-04	5.13E-12
13	2,3,4,6,7,8-HxCDF		20	7.07E-03	0.1	7.07E-04	4.89E-12
14	1,2,3,7,8,9-HxCDF		10	3.53E-03	0.1	3.53E-04	2.45E-12
	Other HxCDF		114	4.03E-02			
	Total HxCDF		190	6.71E-02			
15	1,2,3,4,6,7,8-HpCDF		70	2.47E-02	0.01	2.47E-04	1.71E-12
16	1,2,3,4,7,8,9-HpCDF		16	5.65E-03	0.01	5.65E-05	3.91E-13
	Other HpCDF		24	8.48E-03			
	Total HpCDF		110	3.89E-02			
17	OCDF		240	8.48E-02	0.001	8.48E-05	5.87E-13
Total PCDDs(d)			2050	7.24E-01			
Total PCDD/PCDF			3003	1.06E+00			**8.27E-11**

NOTE: All concentrations are at actual stack conditions.

(a) Stack gas sample volume:

99.88 dry standard cubic feet

2.83 dry standard cubic meters

(b) Stack gas flow rate:

14,670 dry standard cubic feet per minute

6.92 dry standard cubic meters per second

(c) For non-detects, stack concentrations and emissions are calculated using one-half the detection limit. If the sum of the detection limits of the individual isomers for a given dioxin or furan exceeded the detection of the total it was assumed that these individual isomers, when added, constituted the entire total so that any contribution to the total by "other" isomers would be zero.

(d) Total PCDDs = Total TCDD + Total PeCDD + Total HxCDD + Total HpCDD + OCDD.

(e) Total PCDFs = Total TCDF + Total PeCDF + Total HxCDF + Total HpCDF + OCDF.

(f) Toxicity Equivalence Factors from 40 CFR 266 Appendix IX, Section 4.0.

Isomer No.	PCDD/PCDF		Analytical Result (pg/sample)	Stack Concentration (ng/dscm)	2,3,7,8-TCDD TEF	Stack Concentration as 2,3,7,8-TCDD equivalents (ng/dscm)	Emission Rate as 2,3,7,8-TCDD (g/sec)
1	2,3,7,8-TCDD	<	1.6	2.79E-04	1	2.79E-04	2.00E-12
	Other TCDD		26.4	9.20E-03			
	Total TCDD		28	9.76E-03			
2	1,2,3,7,8-PeCDD	<	5	8.71E-04	0.5	4.36E-04	3.12E-12
	Other PeCDD		4.9	1.71E-03			
	Total PeCDD		9.9	3.45E-03			
3	1,2,3,4,7,8-HxCDD	<	4	6.97E-04	0.1	6.97E-05	5.00E-13
4	1,2,3,7,8,9-HxCDD		36	1.25E-02	0.1	1.25E-03	8.99E-12
5	1,2,3,7,8,9-HxCDD		18	6.27E-03	0.1	6.27E-04	4.50E-12
	Other HxCDD		172	5.99E-02			
	Total HxCDD		230	8.01E-02			
6	1,2,3,4,6,7,8-HpCDD		74	2.58E-02	0.01	2.58E-04	1.85E-12
	Other HpCDD		66	2.30E-02			
	Total HpCDD		140	4.88E-02			
7	OCDD		128.9	4.49E-02	0.001	4.49E-05	3.22E-13
Total PCDDs(d)			536.8	1.87E-01			
8	2,3,7,8-TCDF		11	3.83E-03	0.1	3.83E-04	2.75E-12
	Other TCDF		189	6.59E-02			
	Total TCDF		1300	4.53E-01			
9	1,2,3,7,8-PeCDF	<	4.4	7.67E-04	0.05	3.83E-05	2.75E-13
10	2,3,4,7,8-PeCDF	<	4.4	7.67E-04	0.5	3.83E-04	2.75E-12
	Other PeCDF						
	Total PeCDF	<	8.4	1.46E-03			
11	1,2,3,4,7,8-HxCDF	<	2	3.48E-04	0.1	3.48E-05	2.50E-13
12	1,2,3,6,7,8-HxCDF	<	3.5	6.10E-04	0.1	6.10E-05	4.37E-13
13	2,3,4,6,7,8-HxCDF	<	1.8	3.14E-04	0.1	3.14E-05	2.25E-13
14	1,2,3,7,8,9-HxCDF	<	2.2	3.83E-04	0.1	3.83E-05	2.75E-13
	Other HxCDF		5.5	1.92E-03			
	Total HxCDF		15	5.23E-03			
15	1,2,3,4,6,7,8-HpCDF		40	1.39E-02	0.01	1.39E-04	9.99E-13
16	1,2,3,4,7,8,9-HpCDF	<	1.4	2.44E-04	0.01	2.44E-06	1.75E-14
	Other HpCDF		1.6	5.57E-04			
	Total HpCDF		43	1.50E-02			
17	OCDF		24	8.36E-03	0.001	8.36E-06	6.00E-14
Total PCDDs(d)			1390	4.84E-01			
Total PCDD/PCDF			1927	6.71E-01			**2.93E-11**

NOTE: All concentrations are at actual stack conditions.

(a) Stack gas sample volume:
101.50 dry standard cubic feet
2.8 dry standard cubic meters

(b) Stack gas flow rate:
15,185 dry standard cubic feet per minute
7.17 dry standard cubic meters per second

(c) For non-detects, stack concentrations and emissions are calculated using one-half the detection limit. If the sum of the detection limits of the individual isomers for a given dioxin or furan exceeded the detection of the total it was assumed that these individual isomers, when added, constituted the entire total so that any contribution to the total by "other" isomers would be zero.

(d) Total PCDDs = Total TCDD + Total PeCDD + Total HxCDD + Total HpCDD + OCDD.

(e) Total PCDFs = Total TCDF + Total PeCDF + Total HxCDF + Total HpCDF + OCDF.

(f) Toxicity Equivalence Factors from 40 CFR 266 Appendix IX, Section 4.0.

Attachment A-2

Calculation of 95% UCL and Maximum - Runs 1 and 3

Addendum - Ambient Air Quality Impact Report
Woods Industries Site
Yakima, Washington

		Run 1 APCE E rate (g/sec)		Run 3 APCE E rate (g/sec)	Average (g/sec)	Standard Deviation	95%UCL for Runs 1&3 (g/sec)	Maximum for Runs 1&3 (g/sec)	Minimum of 95UCL or Maximum Runs 1&3		
Expected PICs											
Acetone		6.90E-05	<	1.10E-05	4.00E-05	4.10E-05	2.23E-04	6.90E-05	6.90E-05	Run 1	
Acetonitrile	<	1.95E-06	<	1.95E-06	1.95E-06	0.00E+00	1.95E-06	1.95E-06		Run 3	ND
Acrylonitrile											ND
Aldrin	<	4.90E-07	<	7.80E-07	6.35E-07	2.05E-07	1.55E-06	7.80E-07	7.80E-07	Run 3	
alpha-BHC	<	4.90E-07	<	7.80E-07	6.35E-07	2.05E-07	1.55E-06	7.80E-07	7.80E-07	Run 3	
alpha-Chlordane	<	4.90E-07	<	7.80E-07	6.35E-07	2.05E-07	1.55E-06	7.80E-07	7.80E-07	Run 3	
Benzaldehyde											ND
Benzene		3.33E-05		9.17E-06	2.12E-05	1.71E-05	9.74E-05	3.33E-05	3.33E-05	Run 1	
Benzoic acid		6.61E-04		3.11E-04	4.86E-04	2.47E-04	1.59E-03	6.61E-04	6.61E-04	Run 1	
Benzyl alcohol											ND
beta-BHC	<	4.90E-07	<	7.80E-07	6.35E-07	2.05E-07	1.55E-06	7.80E-07	7.80E-07	Run 3	
bis(2-ethylhexyl)phthalate		2.13E-04		1.40E-05	1.14E-04	1.41E-04	7.42E-04	2.13E-04	2.13E-04	Run 1	
Camphene											NR
Chlorobenzene	<	1.95E-06	<	2.39E-06	2.17E-06	3.11E-07	3.56E-06	2.39E-06		Run 3	ND
Chloroethane	<	1.95E-06	<	1.95E-06	1.95E-06	0.00E+00	1.95E-06	1.95E-06		Run 3	ND
Chloroform		3.14E-04		1.37E-04	2.26E-04	1.25E-04	7.84E-04	3.14E-04	3.14E-04	Run 1	
Chloromethane	<	3.76E-06	<	1.95E-06	2.85E-06	1.28E-06	8.55E-06	3.76E-06	3.76E-06	Run 1	
p,p'-DDD	<	4.90E-07		1.37E-05	7.09E-06	9.34E-06	4.88E-05	1.37E-05	1.37E-05	Run 3	
p,p'-DDE	<	4.90E-07		8.55E-05	4.30E-05	6.01E-05	3.11E-04	8.55E-05	8.55E-05	Run 3	
p,p'-DDT		2.69E-05		3.11E-05	2.90E-05	2.97E-06	4.23E-05	3.11E-05	3.11E-05	Run 3	
1,2-Dichlorobenzene		1.25E-05		2.34E-05	1.80E-05	7.71E-06	5.24E-05	2.34E-05	2.34E-05	Run 3	
1,3-Dichlorobenzene		1.10E-05	<	9.00E-06	1.00E-05	1.41E-06	1.63E-05	1.10E-05	1.10E-05	Run 1	
1,4-Dichlorobenzene		1.33E-05	<	1.04E-05	1.18E-05	2.09E-06	2.11E-05	1.33E-05	1.33E-05	Run 1	
Dieldrin		5.14E-05	<	7.80E-07	2.61E-05	3.58E-05	1.86E-04	5.14E-05	5.14E-05	Run 1	
Dihydrofuranone											NR
Endrin		3.18E-06	<	7.80E-07	1.98E-06	1.70E-06	9.56E-06	3.18E-06	3.18E-06	Run 1	
Ethanol	<	1.95E-06	<	1.95E-06	1.95E-06	0.00E+00	1.95E-06	1.95E-06		Run 3	ND
Ethylbenzene	<	1.95E-06	<	2.68E-06	2.32E-06	5.16E-07	4.62E-06	2.68E-06	2.68E-06	Run 3	
gamma-BHC		9.54E-06	<	7.80E-07	5.16E-06	6.19E-06	3.28E-05	9.54E-06	9.54E-06	Run 1	
Heptachlor	<	4.90E-07	<	7.80E-07	6.35E-07	2.05E-07	1.55E-06	7.80E-07	7.80E-07	Run 3	
Heptachlor epoxide	<	4.90E-07	<	7.80E-07	6.35E-07	2.05E-07	1.55E-06	7.80E-07	7.80E-07	Run 3	
Hexachlorobenzene		5.87E-05		3.89E-05	4.88E-05	1.40E-05	1.11E-04	5.87E-05	5.87E-05	Run 1	
Hexachlorocyclopentadiene	<	2.45E-06	<	2.59E-06	2.52E-06	1.03E-07	2.98E-06	2.59E-06		Run 3	ND
Methoxychlor	<	4.90E-07	<	7.80E-07	6.35E-07	2.05E-07	1.55E-06	7.80E-07	7.80E-07	Run 3	
Methylene chloride		2.75E-05		1.43E-05	2.09E-05	9.33E-06	6.26E-05	2.75E-05	2.75E-05	Run 1	
2-Methylphenol	<	2.45E-06	<	2.59E-06	2.52E-06	1.03E-07	2.98E-06	2.59E-06		Run 3	ND
3-Methylphenol	<	2.45E-06	<	2.59E-06	2.52E-06	1.03E-07	2.98E-06	2.59E-06		Run 3	ND
4-Methylphenol	<	2.45E-06	<	2.59E-06	2.52E-06	1.03E-07	2.98E-06	2.59E-06		Run 3	ND
Methylphenylether											NR
m-Ethyltoluene											NR
Nitrobenzene	<	2.45E-06	<	2.59E-06	2.52E-06	1.03E-07	2.98E-06	2.59E-06		Run 3	ND
Phenol	<	2.45E-06		1.04E-05	6.42E-06	5.63E-06	3.15E-05	1.04E-05	1.04E-05	Run 3	
Styrene		1.46E-05		7.69E-05	4.58E-05	4.41E-05	2.42E-04	7.69E-05	7.69E-05	Run 3	
2,3,7,8-TCDD		6.72E-11		2.93E-11	4.83E-11	2.68E-11	1.68E-10	6.72E-11	6.72E-11	Run 1	
Toluene		5.95E-06	<	2.54E-06	4.24E-06	2.41E-06	1.50E-05	5.95E-06	5.95E-06	Run 1	
Toxaphene	<	4.90E-07	<	7.80E-07	6.35E-07	2.05E-07	1.55E-06	7.80E-07	7.80E-07	Run 3	
1,2,4-Trichlorobenzene	<	2.45E-06	<	2.59E-06	2.52E-06	1.03E-07	2.98E-06	2.59E-06	2.59E-06	Run 3	

6/21/95 2:22 PM

Attachment A-2

Calculation of 95% UCL and Maximum - Runs 1 and 3

Addendum - Ambient Air Quality Impact Report
Woods Industries Site
Yakima, Washington

	Run 1 APCE E rate (g/sec)	Run 3 APCE E rate (g/sec)	Average (g/sec)	Standard Deviation	95%UCL for Runs 1&3 (g/sec)	Maximum for Runs 1&3 (g/sec)	Minimum of 95UCL or Maximum Runs 1&3		
Expected PICs									
1,1,1-Trichloroethane	< 1.95E-06	< 4.24E-06	3.10E-06	1.62E-06	1.03E-05	4.24E-06		Run 3	ND
Trichlorofluoromethane	< 2.44E-06	< 1.95E-06	2.20E-06	3.46E-07	3.74E-06	2.44E-06		Run 1	ND
Vinyl chloride	< 2.44E-06	< 1.95E-06	2.20E-06	3.46E-07	3.74E-06	2.44E-06		Run 1	ND
Xylene	< 2.15E-06	< 3.12E-06	2.63E-06	6.89E-07	5.71E-06	3.12E-06	3.12E-06	Run 3	
Antimony	< 1.33E-05	< 1.38E-05	1.35E-05	3.54E-07	1.51E-05	1.38E-05	1.38E-05	Run 3	
Arsenic	< 6.65E-06	< 6.85E-06	6.75E-06	1.41E-07	7.38E-06	6.85E-06	6.85E-06	Run 3	
Barium	< 3.98E-05	< 4.12E-05	4.05E-05	1.03E-06	4.51E-05	4.12E-05	4.12E-05	Run 3	
Beryllium	< 1.33E-06	< 1.38E-06	1.35E-06	3.54E-08	1.51E-06	1.38E-06	1.38E-06	Run 3	
Cadmium	3.40E-06	7.32E-06	5.36E-06	2.77E-06	1.77E-05	7.32E-06	7.32E-06	Run 3	
Chromium III	<	<							
Chromium VI	4.06E-05	4.53E-05	4.30E-05	3.32E-06	5.78E-05	4.53E-05	4.53E-05	Run 3	
Lead	1.17E-04	1.09E-04	1.13E-04	5.66E-06	1.38E-04	1.17E-04	1.17E-04	Run 1	
Mercury	4.97E-03	7.32E-03	6.15E-03	1.66E-03	1.36E-02	7.32E-03	7.32E-03	Run 3	
Nickel	4.37E-05	5.58E-05	4.98E-05	8.56E-06	8.79E-05	5.58E-05	5.58E-05	Run 3	
Selenium	2.78E-05	2.98E-05	2.88E-05	1.41E-06	3.51E-05	2.98E-05	2.98E-05	Run 3	
Silver	1.33E-05	< 2.75E-06	8.02E-06	7.46E-06	4.13E-05	1.33E-05	1.33E-05	Run 1	
Thallium	< 1.33E-05	< 1.38E-05	1.35E-05	3.54E-07	1.51E-05	1.38E-05		Run 3	ND
[illegible]M-10	0.63945	0.625973	6.33E-01	9.53E-03	6.75E-01	6.39E-01	6.39E-01	Run 1	
SO_2									
NO_2									
HCl	0.015246	0.02205	1.86E-02	4.81E-03	4.01E-02	2.21E-02	2.21E-02	Run 3	
Cl_2	< 0	< 0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	Run 3	
CO									
UNANTICIPATED PICs									
2-Nitrophenol	1.71E-05		1.71E-05			1.71E-05	1.71E-05	Run 1	
Naphthalene	1.86E-05		1.86E-05			1.86E-05	1.86E-05	Run 1	
Diethylphthalate	8.56E-06	1.35E-05	1.10E-05	3.49E-06	2.66E-05	1.35E-05	1.35E-05	Run 3	
Di-n-butylphthalate	2.94E-05	1.53E-05	2.24E-05	9.97E-06	6.69E-05	2.94E-05	2.94E-05	Run 1	
Di-n-octylphthalate	1.22E-05		1.22E-05			1.22E-05	1.22E-05	Run 1	
Benzoyl Chloride	1.08E-04		1.08E-04			1.08E-04	1.08E-04	Run 1	
Undecane	1.57E-04		1.57E-04			1.57E-04	1.57E-04	Run 1	
2-Fluoro-4-nitrophenol	1.13E-04		1.13E-04			1.13E-04	1.13E-04	Run 1	
Octadecanoic acid	1.79E-04		1.79E-04			1.79E-04	1.79E-04	Run 1	
o,p'-DDE	1.08E-04	1.17E-04	1.13E-04	6.36E-06	1.41E-04	1.17E-04	1.17E-04	Run 3	
Hexadecanoic acid		1.19E-04	1.19E-04			1.19E-04	1.19E-04	Run 3	

APPENDIX D

Air Dispersion Modeling

Table 1 COMPDEP Results
Unit Emission Rate (1 gram per second)

Year	COMPDEP Maximum Annual Dry Depostion (g/m^2)	COMPDEP Maximum Annual Wet Deposition (g/m^2)	COMPDEP Maximum Annual Combined Deposition (g/m^2)	COMPDEP Maximum Annual Average Concentrations (ug/m^3)
1984 Receptor	0.03844 #157	2.351 #231	2.351 #231	0.3194 #311
1985 Receptor	0.03926 #136	3.309 #231	3.309 #231	0.3778 #292
1986 Receptor	0.03976 #136	3.716 #231	3.716 #231	0.3997 #292
1987 Receptor	0.03814 #263	2.417 #231	2.417 #231	0.3903 #292
1988 Receptor	0.04256 #157	2.505 #231	2.505 #231	0.381 #291

Receptor #136	UTMeast	692417
	UTMnorth	5160296
Receptor #157	UTMeast	692517
	UTMnorth	5160396
Receptor #231	UTMeast	692017
	UTMnorth	5160796
Receptor #263	UTMeast	692717
	UTMnorth	5160896
Receptor #264	UTMeast	692817
	UTMnorth	5160896
Receptor #292	UTMeast	693017
	UTMnorth	5160996
Receptor #311	UTMeast	692917
	UTMnorth	5161096

Table 2 COMPDEP Results
Summary of Maxima from Table 1
Unit Emission Rate (1 gram per second)

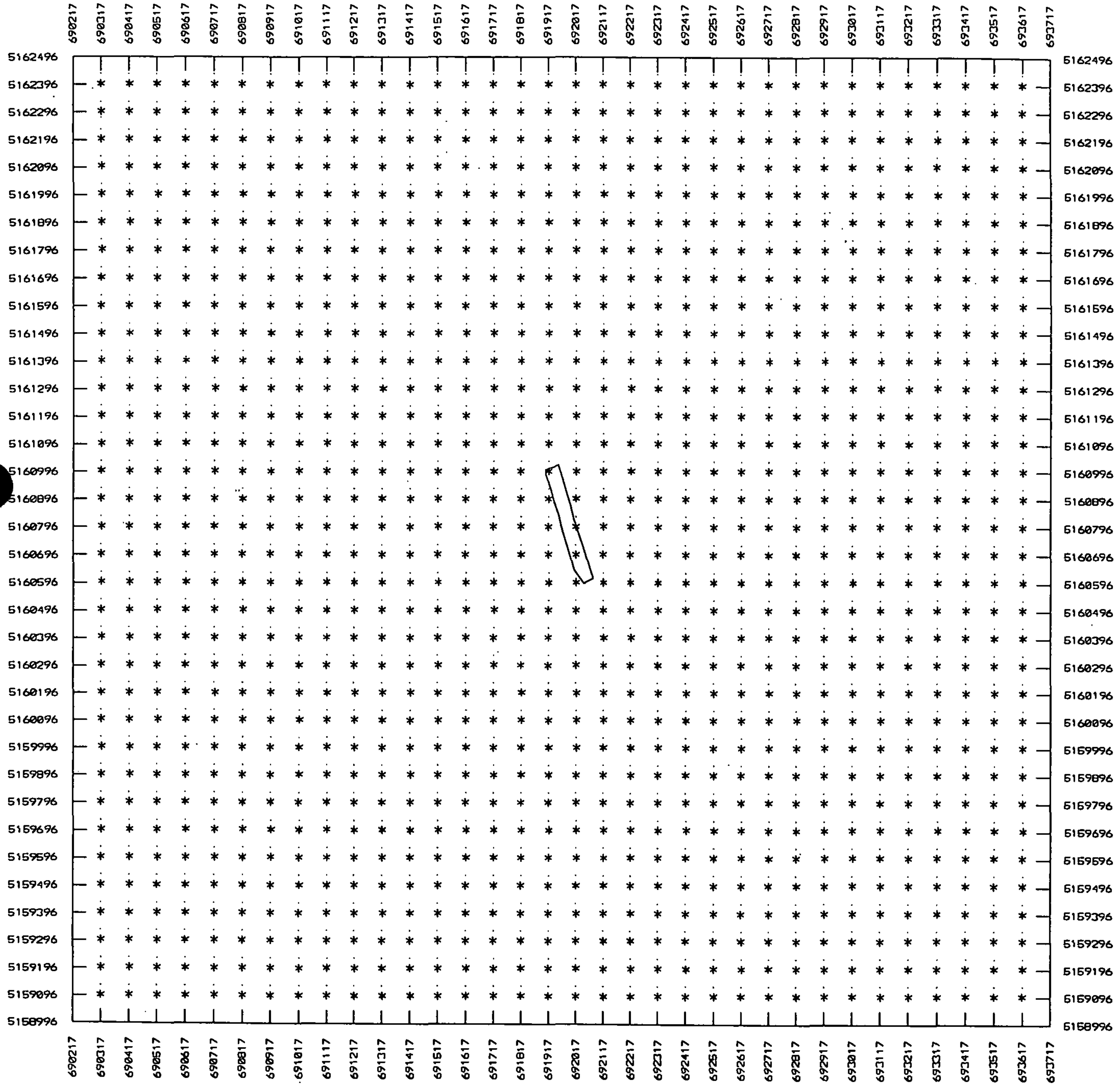
Location	COMPDEP Maximum Annual Dry Depostion (g/m^2)	COMPDEP Maximum Annual Wet Deposition (g/m^2)	COMPDEP Maximum Annual Combined Deposition (g/m^2)	COMPDEP Maximum Annual Average Concentrations (ug/m^3)
	0.04256	3.716	3.716	0.3997
UTMeast(in meters)	692517	692017	692017	693017
UTMnorth(in meters)	5160396	5160796	5160796	5160996

Table 3 ISCST2 Results
Unit Emission Rate (1 gram per second)

Averaging Period	1-hour (ug/m^3)	3-hour (ug/m^3)	8-hour (ug/m^3)	24-hour (ug/m^3)	Annual (ug/m^3)
Concentration	20.71384	11.75135	8.39332	3.98562	0.463
Location (UTM)*	692517E 5160796N	691617E 5160996N	692017E 5160396N	692517E 5160896N	692717E 5160896N

* Universal Trans Mercator Coordinates

Woods Industries Site
Coordinates in UTM meters



Woods Industries Site
ISCST2 Long-term Impacts
Concentrations in ug/m^3
Coordinates in UTM meters

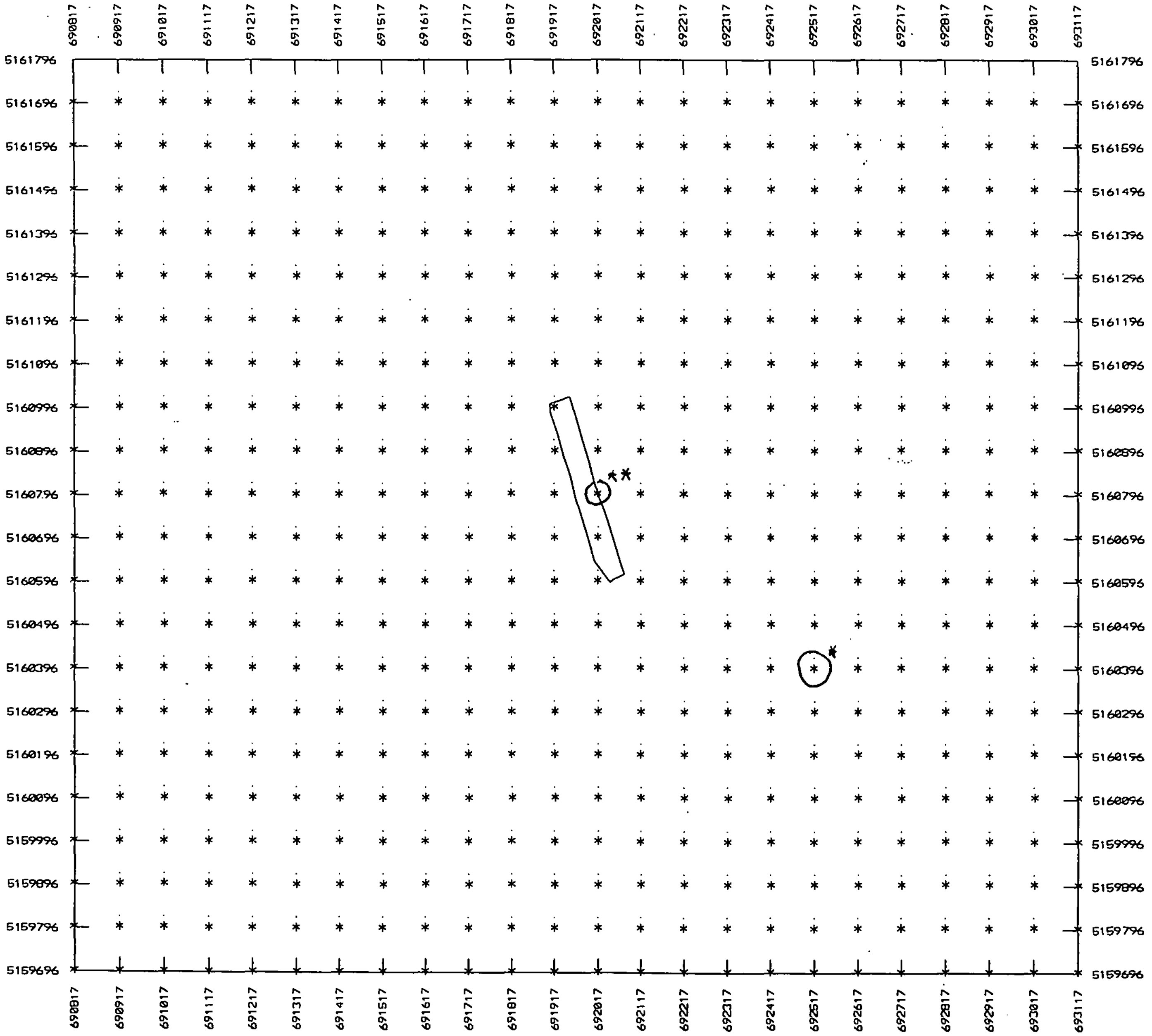
	690217	690317	690417	690517	690617	690717	690817	690917	691017	691117	691217	691317	691417	691517	691617	691717	691817	691917	692017	692117	692217	692317	692417	692517	692617	692717	692817	692917	693017	693117	693217	693317	693417	693517	693617	693717
5162496																																				
5162396		0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.07	0.07	0.08	0.09	0.09	0.09	0.08	0.08	0.09	0.08	0.08	0.08	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.08	0.08	
5162296		0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.09	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.07	0.07	0.06	0.06	0.06	0.06	0.07	0.07	0.08	0.08	0.09	0.09	
5162196		0.06	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.07	0.07	0.08	0.09	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.09	0.08	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.09	0.10	0.10	0.10	
5162096		0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.09	0.08	0.08	0.09	0.10	0.11	0.12	0.11	0.11	0.11	0.11	0.10	0.10	0.09	0.08	0.08	0.07	0.07	0.08	0.08	0.09	0.10	0.10	0.11	0.10	0.10	
5161996		0.07	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.12	0.13	0.13	0.12	0.12	0.12	0.11	0.11	0.09	0.08	0.08	0.08	0.08	0.09	0.10	0.11	0.11	0.12	0.11	0.11	0.11	
5161896		0.08	0.08	0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.11	0.10	0.10	0.11	0.13	0.14	0.14	0.13	0.13	0.13	0.12	0.11	0.10	0.09	0.09	0.09	0.10	0.11	0.12	0.12	0.12	0.12	0.11	0.12	0.13	
5161796		0.08	0.09	0.09	0.10	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.13	0.15	0.16	0.15	0.14	0.14	0.13	0.12	0.10	0.10	0.10	0.11	0.12	0.13	0.14	0.14	0.13	0.13	0.13	0.15	0.15	
5161696		0.09	0.09	0.10	0.11	0.11	0.11	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.14	0.17	0.17	0.17	0.16	0.15	0.14	0.12	0.11	0.11	0.12	0.13	0.14	0.15	0.15	0.14	0.14	0.15	0.16	0.17	0.18	
5161596		0.08	0.09	0.10	0.11	0.12	0.13	0.13	0.13	0.14	0.16	0.15	0.15	0.15	0.15	0.18	0.19	0.18	0.17	0.16	0.15	0.13	0.12	0.13	0.14	0.16	0.17	0.16	0.16	0.16	0.17	0.18	0.19	0.21	0.22	
5161496		0.08	0.09	0.10	0.11	0.13	0.14	0.15	0.15	0.16	0.17	0.17	0.17	0.17	0.17	0.18	0.21	0.20	0.19	0.18	0.15	0.14	0.14	0.15	0.18	0.19	0.18	0.18	0.19	0.20	0.21	0.22	0.24	0.25	0.26	
5161396		0.07	0.08	0.09	0.11	0.13	0.14	0.16	0.17	0.18	0.19	0.20	0.20	0.20	0.19	0.19	0.22	0.22	0.20	0.18	0.15	0.15	0.16	0.19	0.21	0.20	0.21	0.22	0.23	0.25	0.26	0.28	0.29	0.29	0.29	
5161296		0.07	0.07	0.08	0.10	0.11	0.14	0.16	0.18	0.20	0.22	0.23	0.23	0.23	0.22	0.20	0.22	0.23	0.21	0.18	0.16	0.16	0.20	0.23	0.23	0.24	0.26	0.27	0.29	0.31	0.32	0.32	0.32	0.31	0.31	
5161196		0.07	0.08	0.08	0.09	0.11	0.12	0.15	0.17	0.21	0.24	0.26	0.27	0.27	0.26	0.22	0.20	0.21	0.19	0.16	0.16	0.19	0.23	0.25	0.28	0.30	0.33	0.36	0.36	0.36	0.36	0.35	0.34	0.34	0.33	
5161096		0.07	0.08	0.09	0.10	0.11	0.12	0.14	0.16	0.19	0.23	0.27	0.31	0.33	0.30	0.24	0.17	0.15	0.13	0.12	0.15	0.21	0.27	0.31	0.36	0.38	0.40	0.41	0.40	0.40	0.39	0.37	0.36	0.35	0.33	
5160996		0.08	0.08	0.09	0.10	0.11	0.13	0.15	0.17	0.19	0.23	0.26	0.31	0.36	0.36	0.27	0.13	0.06	0.04	0.06	0.14	0.24	0.32	0.38	0.42	0.44	0.45	0.44	0.43	0.41	0.39	0.37	0.36	0.34	0.33	
5160896		0.08	0.09	0.10	0.11	0.12	0.13	0.15	0.17	0.20	0.23	0.27	0.31	0.36	0.36	0.20	0.09	0.00	0.00	0.02	0.13	0.27	0.38	0.44	0.46	0.46	0.45	0.44	0.42	0.40	0.38	0.37	0.36	0.34	0.32	
5160796		0.08	0.09	0.10	0.11	0.12	0.14	0.15	0.17	0.20	0.22	0.26	0.29	0.31	0.30	0.22	0.04	0.00	0.00	0.01	0.13	0.28	0.37	0.42	0.43	0.43	0.42	0.41	0.39	0.37	0.36	0.34	0.33	0.32	0.31	
5160696		0.08	0.09	0.09	0.10	0.11	0.12	0.14	0.16	0.17	0.19	0.21	0.22	0.22	0.18	0.11	0.02	0.00	0.00	0.02	0.12	0.22	0.31	0.37	0.39	0.40	0.40	0.39	0.37	0.36	0.34	0.33	0.31	0.30	0.29	
5160596		0.07	0.08	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.15	0.14	0.11	0.08	0.04	0.02	0.04	0.09	0.20	0.27	0.32	0.32	0.32	0.33	0.34	0.34	0.34	0.33	0.33	0.32	0.31	0.30	0.29	
5160496		0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.10	0.10	0.08	0.06	0.05	0.08	0.13	0.18	0.28	0.36	0.39	0.37	0.36	0.32	0.30	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.27	
5160396		0.06	0.06	0.06	0.06	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.06	0.08	0.12	0.19	0.25	0.31	0.41	0.43	0.44	0.39	0.36	0.32	0.29	0.26	0.24	0.23	0.23	0.22	0.22	0.23	
5160296		0.05	0.05	0.05	0.05	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.07	0.10	0.14	0.21	0.28	0.33	0.40	0.45	0.43	0.43	0.39	0.34	0.31	0.28	0.26	0.23	0.22	0.20	0.20	0.19	
5160196		0.04	0.04	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.06	0.08	0.11	0.14	0.21	0.28	0.33	0.36	0.43	0.44	0.41	0.40	0.38	0.33	0.29	0.27	0.25	0.23	0.21	0.19	0.18	
5160096		0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.06	0.05	0.04	0.04	0.04	0.05	0.06	0.09	0.11	0.14	0.19	0.26	0.31	0.34	0.38	0.42	0.41	0.38	0.36	0.35	0.31	0.28	0.25	0.23	0.22	0.20	0.19	
5159996		0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.06	0.09	0.10	0.13	0.18	0.24	0.29	0.32	0.33	0.37	0.39	0.38	0.34	0.33	0.32	0.30	0.26	0.24	0.22	0.21	0.20	
5159896		0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.09	0.09	0.12	0.16	0.21	0.26	0.29	0.30	0.32	0.36	0.36	0.34	0.31	0.30	0.29	0.28	0.25	0.23	0.21	0.20	
5159796		0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.05	0.07	0.08	0.09	0.11	0.14	0.19	0.23	0.26	0.28	0.28	0.31	0.33	0.33	0.31	0.29	0.27	0.27	0.26	0.24	0.22	0.20	
5159696		0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.05	0.07	0.08	0.08	0.10	0.13	0.17	0.21	0.24	0.25	0.26	0.27	0.30	0.31	0.31	0.29	0.27	0.25	0.25	0.24	0.23	0.21	
5159596		0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.05	0.07	0.07	0.07	0.09	0.12	0.15	0.18	0.22	0.23	0.24	0.24	0.26	0.28	0.29	0.28	0.27	0.25	0.23	0.23	0.23	0.22	
5159496		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.05	0.07	0.06	0.07	0.09	0.11	0.14	0.17	0.19	0.22	0.22	0.22	0.23	0.25	0.26	0.27	0.26	0.25	0.23	0.22	0.22	0.21	
5159396		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.05	0.06	0.06	0.06	0.08	0.10	0.12	0.15	0.18	0.20	0.20	0.20	0.21	0.23	0.24	0.25	0.25	0.24	0.23	0.22	0.20	0.20	
5159296		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.05	0.06	0.05	0.06	0.08	0.09	0.11	0.14	0.16	0.18	0.19	0.19	0.19	0.20	0.22	0.23	0.23	0.23	0.23	0.22	0.20	0.19	
5159196		0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.05	0.05	0.05	0.06	0.07	0.08	0.10	0.12	0.14	0.17	0.18	0.18	0.18	0.18	0.20	0.21	0.22	0.22	0.22	0.21	0.20	0.19	
5159096		0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.05	0.05	0.05	0.05	0.07	0.08	0.09	0.11	0.13	0.15	0.17	0.17	0.17	0.17	0.18	0.19	0.20	0.21	0.21	0.21	0.20	0.19	
5158996																																				

Woods Industries Site
ISCST2 Long-term Impacts

Concentrations in ug/m^3
Coordinates in UTM meters

	690817	690917	691017	691117	691217	691317	691417	691517	691617	691717	691817	691917	692017	692117	692217	692317	692417	692517	692617	692717	692817	692917	693017	693117
5161796																								
5161696	0.11	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.14	0.17	0.17	0.17	0.16	0.15	0.14	0.12	0.11	0.11	0.12	0.13	0.14	0.15	0.15	0.14
5161596	0.13	0.13	0.13	0.14	0.15	0.15	0.15	0.15	0.15	0.18	0.19	0.18	0.17	0.16	0.15	0.13	0.12	0.13	0.14	0.16	0.17	0.16	0.16	0.16
5161496	0.14	0.15	0.15	0.16	0.17	0.17	0.17	0.17	0.17	0.18	0.21	0.20	0.19	0.18	0.15	0.14	0.14	0.15	0.18	0.19	0.18	0.18	0.19	0.20
5161396	0.14	0.16	0.17	0.18	0.19	0.20	0.20	0.20	0.19	0.19	0.22	0.22	0.20	0.18	0.15	0.15	0.16	0.19	0.21	0.20	0.21	0.22	0.23	0.25
5161296	0.14	0.16	0.18	0.20	0.22	0.23	0.23	0.23	0.22	0.20	0.22	0.23	0.21	0.18	0.16	0.16	0.20	0.23	0.23	0.24	0.26	0.27	0.29	0.31
5161196	0.12	0.15	0.17	0.21	0.24	0.26	0.27	0.27	0.26	0.22	0.20	0.21	0.19	0.16	0.16	0.19	0.23	0.25	0.28	0.30	0.33	0.35	0.36	0.36
5161096	0.12	0.14	0.16	0.19	0.23	0.27	0.31	0.33	0.30	0.24	0.17	0.15	0.13	0.12	0.15	0.21	0.27	0.31	0.35	0.38	0.40	0.41	0.40	0.40
5160996	0.13	0.15	0.17	0.19	0.23	0.26	0.31	0.36	0.36	0.27	0.13	0.06	0.04	0.06	0.14	0.24	0.32	0.38	0.42	0.44	0.45	0.44	0.43	0.41
5160896	0.13	0.15	0.17	0.20	0.23	0.27	0.31	0.35	0.35	0.28	0.09	0.00	0.00	0.02	0.13	0.27	0.38	0.44	0.46	0.46	0.45	0.44	0.42	0.40
5160796	0.14	0.15	0.17	0.20	0.22	0.26	0.29	0.31	0.30	0.22	0.04	0.00	0.00	0.01	0.13	0.28	0.37	0.42	0.43	0.43	0.42	0.41	0.39	0.37
5160696	0.12	0.14	0.15	0.17	0.19	0.21	0.22	0.22	0.18	0.11	0.02	0.00	0.00	0.02	0.12	0.22	0.31	0.37	0.39	0.40	0.40	0.39	0.37	0.36
5160596	0.11	0.12	0.13	0.14	0.15	0.15	0.15	0.14	0.11	0.08	0.04	0.02	0.04	0.09	0.20	0.27	0.32	0.32	0.32	0.33	0.34	0.34	0.34	0.33
5160496	0.09	0.09	0.10	0.10	0.11	0.11	0.10	0.10	0.08	0.06	0.05	0.08	0.13	0.18	0.28	0.36	0.39	0.37	0.35	0.32	0.30	0.28	0.27	0.27
5160396	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.06	0.08	0.12	0.19	0.25	0.31	0.41	0.43	0.44	0.39	0.35	0.32	0.29	0.26	0.24
5160296	0.06	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.07	0.10	0.14	0.21	0.28	0.33	0.40	0.45	0.43	0.43	0.39	0.34	0.31	0.28	0.26
5160196	0.05	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.06	0.08	0.11	0.14	0.21	0.28	0.33	0.36	0.43	0.44	0.41	0.40	0.38	0.33	0.29	0.27
5160096	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.05	0.06	0.09	0.11	0.14	0.19	0.26	0.31	0.34	0.38	0.42	0.41	0.38	0.36	0.35	0.31	0.28
5159996	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.06	0.09	0.10	0.13	0.18	0.24	0.29	0.32	0.33	0.37	0.39	0.38	0.34	0.33	0.32	0.30
5159896	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.09	0.09	0.12	0.16	0.21	0.26	0.29	0.30	0.32	0.35	0.36	0.34	0.31	0.30	0.29
5159796	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.05	0.07	0.08	0.09	0.11	0.14	0.19	0.23	0.26	0.28	0.28	0.31	0.33	0.33	0.31	0.29	0.27
5159696	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.05	0.07	0.08	0.08	0.10	0.13	0.17	0.21	0.24	0.26	0.25	0.27	0.30	0.31	0.31	0.29	0.27

Woods Industries Site
Coordinates in UTM meters



* COMPDEP
MAXIMUM
ANNUAL DRY
DEPOSITION IN grams/meter^2
UTME 692517 UTMN 5160396
0.04256 g/m^2

** COMPDEP
MAXIMUM
ANNUAL WET
DEPOSITION IN grams/meter^2
UTME 692017 UTMN 5160796
3.716 g/m^2

MODELING DISKETTE OUTLINE

Modeling Input and Output Files

All updated modeling input and output files are included on the attached diskette. The files are in an archived or zipped format. The PKUNZIP.EXE will expand the files for viewing. The files include inputs and outputs for the following model runs:

- ISCST2 (WDISC695.ZIP)
- COMPDEP (WDCD695.ZIP)

ISCST2 Results

The format for the filenames is 61495XX(A).Z
where:

XX = year of meteorological data
(A) = annual model runs; if no AN is attached, the model run was for the other averaging periods (1-hr, 3-hr, 8-hr, and 24-hr)
Z = input or output

COMPDEP Results

The format for the filename is 615XXCD.Z
where:

XX = year of meteorological data
Z = input or output

APPENDIX E

Direct Risks and Hazard Indices Calculations

Cancer Risk Level for Ground Level - Inhalation of Emittants - Normal Operating Conditions

	Weighted Annual Average (ug/m3)	Intake (mg/kg/d)	Slope Factor (mg/kg/d)^-1	Risk Level
Acetone	4.34E-05	6.29E-11	---	
Acetonitrile			---	
Acrylonitrile			0.24	
Aldrin	4.91E-07	7.11E-13	17	1.2E-11
alpha-BHC	4.91E-07	7.11E-13	6.3	4.5E-12
alpha-Chlordane	4.91E-07	7.11E-13	1.3	9.2E-13
Benzaldehyde			---	
Benzene	2.10E-05	3.04E-11	0.029	8.8E-13
Benzoic acid	4.16E-04	6.03E-10	---	
Benzyl alcohol			---	
beta-BHC	4.91E-07	7.11E-13	1.8	1.3E-12
bis(2-ethylhexyl)phthalate	1.34E-04	1.94E-10	0.014	2.7E-12
Camphene			---	
Chlorobenzene			---	
Chloroethane			---	
Chloroform	1.98E-04	2.86E-10	0.081	2.3E-11
Chloromethane	2.36E-06	3.42E-12	0.0063	2.2E-14
p,p'-DDD	8.63E-06	1.25E-11	0.24	3.0E-12
p,p'-DDE	5.38E-05	7.80E-11	0.34	2.7E-11
p,p'-DDT	1.96E-05	2.84E-11	0.34	9.6E-12
1,2-Dichlorobenzene	1.47E-05	2.13E-11	---	
1,3-Dichlorobenzene	6.93E-06	1.00E-11	---	
1,4-Dichlorobenzene	8.37E-06	1.21E-11	0.024	2.9E-13
Dieldrin	3.24E-05	4.69E-11	16	7.5E-10
Dihydrofuranone			---	
Endrin	2.00E-06	2.90E-12	---	
Ethanol			---	
Ethylbenzene	1.69E-06	2.44E-12	---	
gamma-BHC	6.01E-06	8.70E-12	1.3	1.1E-11
Heptachlor	4.91E-07	7.11E-13	4.5	3.2E-12
Heptachlor epoxide	4.91E-07	7.11E-13	9.1	6.5E-12
Hexachlorobenzene	3.70E-05	5.35E-11	1.6	8.6E-11
Hexachlorocyclopentadiene			---	
Methoxychlor	4.91E-07	7.11E-13	---	
Methylene chloride	1.73E-05	2.51E-11	0.00164	4.1E-14
2-Methylphenol			---	
3-Methylphenol			---	
4-Methylphenol			---	
Methylphenylether			---	
m-Ethyltoluene			---	
Nitrobenzene			---	
Phenol	6.55E-06	9.48E-12	---	
Styrene	4.84E-05	7.01E-11	---	
2,3,7,8-TCDD	4.59E-11	6.65E-17	150000	1.0E-11
Toluene	3.75E-06	5.43E-12	---	
Toxaphene	4.91E-07	7.11E-13	1.1	7.8E-13
1,2,4-Trichlorobenzene	1.63E-06	2.36E-12	---	
1,1,1-Trichloroethane			---	
Trichlorofluoromethane			---	
Vinyl chloride			0.3	
Xylene	1.96E-06	2.85E-12	---	

Cancer Risk Level for Ground Level - Inhalation of Emittants - Normal Operating Conditions

	Weighted Annual Average (ug/m3)	Intake (mg/kg/d)	Slope Factor (mg/kg/d)^-1	Risk Level
Antimony	8.66E-06	1.25E-11	---	
Arsenic	4.31E-06	6.25E-12	15	9.4E-11
Barium	2.59E-05	3.76E-11	---	
Beryllium	8.66E-07	1.25E-12	8.4	1.1E-11
Cadmium	4.61E-06	6.67E-12	6.3	4.2E-11
Chromium III			---	
Chromium VI	2.85E-05	4.13E-11	41	1.7E-09
Lead	7.37E-05	1.07E-10	NA	
Mercury	4.61E-03	6.67E-09	---	
Nickel	3.51E-05	5.09E-11	---	
Selenium	1.88E-05	2.72E-11	---	
Silver	8.37E-06	1.21E-11	---	
Thallium			---	
PM-10	4.03E-01	5.83E-07	---	
SO_2			---	
NO_2			---	
HCl	1.39E-02	2.01E-08	---	
Cl_2			---	
CO			---	
UNANTICIPATED PICs			---	
2-Nitrophenol	1.08E-05	1.56E-11	---	
Naphthalene	1.17E-05	1.70E-11	---	
Diethylphthalate	8.50E-06	1.23E-11	---	
Di-n-butylphthalate	1.85E-05	2.68E-11	---	
Di-n-octylphthalate	7.68E-06	1.11E-11	---	
Benzoyl Chloride	6.80E-05	9.85E-11	---	
Undecane	9.89E-05	1.43E-10	---	
2-Fluoro-4-nitrophenol	7.12E-05	1.03E-10	---	
Octadecanoic acid	1.13E-04	1.63E-10	---	
o,p'-DDE	7.37E-05	1.07E-10	0.34	3.6E-11
Hexadecanoic acid	7.49E-05	1.09E-10	---	
			TOTAL	**2.83E-09**

Carcinogenic Risk Characterization			
Inhalation Rate	(m3/day)	20	SDEF for Residential (USEPA, 1991)
Exposure Frequency	(days/yr)	350	SDEF for Residential (USEPA, 1991)
Exposure Duration	(yr)	0.37	Duration of soil treatment (19.3 weeks)
Body Weight	(kg)	70	SDEF for Residential (USEPA, 1991)
Averaging Time	(days)	25550	SDEF for Residential (USEPA, 1991)

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Hazard Index for Inhalation of Ground Level of Stack Emittants - Normal Operating Conditions

	Weighted Annual (mg/m3)	Subchronic RfC (mg/m3)	Chronic RfC (mg/m3)	Ratio to Subchronic RfC
Acetone	4.34E-08	No data	0.0875	4.97E-07
Acetonitrile		0.5	0.05	
Acrylonitrile		No data	0.002	
Aldrin	4.91E-10	No data	0.0000263	1.87E-05
alpha-BHC	4.91E-10	No data	No data	
alpha-Chlordane	4.91E-10	Not available	0.0000525	9.36E-06
Benzaldehyde		No data	0.0875	
Benzene	2.10E-08	0.06	No data	3.49E-07
Benzoic acid	4.16E-07	No data	3.5	1.19E-07
Benzyl alcohol		No data	0.263	
beta-BHC	4.91E-10	No data	No data	
bis(2-ethylhexyl)phthalate	1.34E-07	No data	0.0175	7.66E-06
Camphene		No data	No data	
Chlorobenzene		Not available	0.02	
Chloroethane		10	10	
Chloroform	1.98E-07	0.04	0.00875	4.94E-06
Chloromethane	2.36E-09	9	No data	2.63E-10
p,p'-DDD	8.63E-09	No data	No data	
p,p'-DDE	5.38E-08	No data	No data	
p,p'-DDT	1.96E-08	No data	0.000438	4.47E-05
1,2-Dichlorobenzene	1.47E-08	No data	0.2	7.37E-08
1,3-Dichlorobenzene	6.93E-09	No data	0.0779	8.89E-08
1,4-Dichlorobenzene	8.37E-09	0.8	0.8	1.05E-08
Dieldrin	3.24E-08	No data	0.0000438	7.39E-04
Dihydrofuranone		No data	No data	
Endrin	2.00E-09	No data	0.000263	7.61E-06
Ethanol		No data	No data	
Ethylbenzene	1.69E-09	Pending	1	1.69E-09
gamma-BHC	6.01E-09	No data	0.000263	2.28E-05
Heptachlor	4.91E-10	No data	0.000438	1.12E-06
Heptachlor epoxide	4.91E-10	No data	0.0000114	4.31E-05
Hexachlorobenzene	3.70E-08	Not recommended	0.0007	5.28E-05
Hexachlorocyclopentadiene		0.0007	0.00007	
Methoxychlor	4.91E-10	No data	0.00438	1.12E-07
Methylene chloride	1.73E-08	3	3	5.77E-09
2-Methylphenol		No data	0.0438	
3-Methylphenol		No data	0.0438	
4-Methylphenol		No data	0.00438	
Methylphenylether		No data	No data	
m-Ethyltoluene		No data	Data inadequate	
Nitrobenzene		0.02	0.002	
Phenol	6.55E-09	No data	0.525	1.25E-08
Styrene	4.84E-08	3	1	1.61E-08
2,3,7,8-TCDD	4.59E-14	No data	No data	
Toluene	3.75E-09	1	0.4	3.75E-09
Toxaphene	4.91E-10	No data	No data	
1,2,4-Trichlorobenzene	1.63E-09	0.09	0.009	1.81E-08
1,1,1-Trichloroethane		1	0.0788	
Trichlorofluoromethane		7	0.7	
Vinyl chloride		Inadequate data	No data	
Xylene	1.96E-09	Pending	No data	

Chronic RfC used when subchronic RfC was unavailable
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Hazard Index for Inhalation of Ground Level of Stack Emittants - Normal Operating Conditions

	Weighted Annual (mg/m3)	**Subchronic RfC (mg/m3)**	**Chronic RfC (mg/m3)**	**Ratio to Subchronic RfC**
Antimony	8.66E-09	No data	0.0003	2.89E-05
Arsenic	4.31E-09	No data	0.000263	1.64E-05
Barium	2.59E-08	0.005	0.0005	5.19E-06
Beryllium	8.66E-10	No data	0.00438	1.98E-07
Cadmium	4.61E-09	No data	0.000438	1.05E-05
Chromium III		No data	0.875	
Chromium VI	2.85E-08	0.000004	0.00438	7.13E-03
Lead	7.37E-08	Not recommended	0.0015	4.91E-05
Mercury	4.61E-06	0.0003	0.0003	1.54E-02
Nickel	3.51E-08	No data	0.02	1.76E-06
Selenium	1.88E-08	No data	0.004	4.69E-06
Silver	8.37E-09	No data	0.003	2.79E-06
Thallium		No data	0.0003	
PM-10	4.03E-04	0.05		8.05E-03
SO_2		No data	No data	
NO_2		No data	No data	
HCl	1.39E-05	No data	0.007	1.98E-03
Cl_2		No data	0.0004	
CO		No data	No data	
UNANTICIPATED PICs		--	--	
2-Nitrophenol	1.08E-08	No data	No data	
Naphthalene	1.17E-08	No data	0.035	3.35E-07
Diethylphthalate	8.50E-09	No data	0.7	1.21E-08
Di-n-butylphthalate	1.85E-08	No data	0.0875	2.12E-07
Di-n-octylphthalate	7.68E-09	No data	0.0175	4.39E-07
Benzoyl Chloride	6.80E-08	No data	No data	
Undecane	9.89E-08	No data	No data	
2-Fluoro-4-nitrophenol	7.12E-08	No data	No data	
Octadecanoic acid	1.13E-07	No data	No data	
o,p'-DDE	7.37E-08	No data	No data	
Hexadecanoic acid	7.49E-08	No data	No data	
			TOTAL	**3.36E-02**

Chronic RfC used when subchronic RfC was unavailable
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Cancer Risk Level for Ground Level - Inhalation of Emittants - Cold Start Operating Conditions

	Weighted Annual Average (ug/m3)	Intake (mg/kg/d)	Slope Factor (mg/kg/d)^-1	Risk Level
Acetone	3.74E-05	5.42E-11	—	
Acetonitrile			—	
Acrylonitrile			0.24	
Aldrin	4.30E-07	6.23E-13	17	1.1E-11
alpha-BHC	4.30E-07	6.23E-13	6.3	3.9E-12
alpha-Chlordane	4.30E-07	6.23E-13	1.3	8.1E-13
Benzaldehyde			—	
Benzene	1.34E-05	1.93E-11	0.029	5.6E-13
Benzoic acid	3.15E-04	4.56E-10	—	
Benzyl alcohol			—	
beta-BHC	4.30E-07	6.23E-13	1.8	1.1E-12
bis(2-ethylhexyl)phthalate	1.33E-04	1.93E-10	0.014	2.7E-12
Camphene			—	
Chlorobenzene			—	
Chloroethane			—	
Chloroform	7.90E-05	1.14E-10	0.081	9.3E-12
Chloromethane	3.32E-06	4.81E-12	0.0063	3.0E-14
p,p'-DDD	2.99E-06	4.34E-12	0.24	1.0E-12
p,p'-DDE	1.72E-05	2.50E-11	0.34	8.5E-12
p,p'-DDT	2.36E-05	3.42E-11	0.34	1.2E-11
1,2-Dichlorobenzene	6.89E-06	9.97E-12	—	
1,3-Dichlorobenzene	2.99E-06	4.33E-12	—	
1,4-Dichlorobenzene	5.29E-06	7.66E-12	0.024	1.8E-13
Dieldrin	4.42E-05	6.40E-11	16	1.0E-09
Dihydrofuranone			—	
Endrin	4.13E-06	5.98E-12	—	
Ethanol			—	
Ethylbenzene	1.27E-06	1.84E-12	—	
gamma-BHC	5.49E-06	7.95E-12	1.3	1.0E-11
Heptachlor	4.30E-07	6.23E-13	4.5	2.8E-12
Heptachlor epoxide	4.30E-07	6.23E-13	9.1	5.7E-12
Hexachlorobenzene	3.19E-05	4.61E-11	1.6	7.4E-11
Hexachlorocyclopentadiene			—	
Methoxychlor	4.30E-07	6.23E-13	—	
Methylene chloride	1.16E-05	1.68E-11	0.00164	2.7E-14
2-Methylphenol			—	
3-Methylphenol			—	
4-Methylphenol			—	
Methylphenylether			—	
m-Ethyltoluene			—	
Nitrobenzene			—	
Phenol	3.90E-06	5.65E-12	—	
Styrene	1.82E-05	2.64E-11	—	
2,3,7,8-TCDD	4.57E-11	6.61E-17	150000	9.9E-12
Toluene	2.84E-06	4.11E-12	—	
Toxaphene	4.30E-07	6.23E-13	1.1	6.9E-13
1,2,4-Trichlorobenzene	2.35E-06	3.41E-12	—	
1,1,1-Trichloroethane			—	
Trichlorofluoromethane			—	
Vinyl chloride			0.3	
Xylene	1.35E-06	1.96E-12	—	

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Cancer Risk Level for Ground Level - Inhalation of Emittants - Cold Start Operating Conditions

	Weighted Annual Average (ug/m3)	Intake (mg/kg/d)	Slope Factor (mg/kg/d)^-1	Risk Level
Antimony	3.16E-06	4.58E-12	---	
Arsenic	4.14E-06	5.99E-12	15	9.0E-11
Barium	2.87E-05	4.15E-11	---	
Beryllium	7.07E-07	1.02E-12	8.4	8.6E-12
Cadmium	5.79E-06	8.38E-12	6.3	5.3E-11
Chromium III			---	
Chromium VI	3.30E-05	4.78E-11	41	2.0E-09
Lead	8.02E-05	1.16E-10	NA	
Mercury	7.00E-03	1.01E-08	---	
Nickel	4.88E-05	7.06E-11	---	
Selenium	4.63E-05	6.70E-11	---	
Silver	3.51E-06	5.08E-12	---	
Thallium			---	
PM-10	3.79E-01	5.50E-07	---	
SO_2			---	
NO_2			---	
HCl	2.14E-02	3.10E-08	---	
Cl_2	1.85E-03	2.68E-09	---	
CO			---	
UNANTICIPATED PICs			---	
2-Nitrophenol	5.23E-06	7.58E-12	---	
Naphthalene	5.53E-06	8.01E-12	---	
Diethylphthalate	4.52E-06	6.54E-12	---	
Di-n-butylphthalate	7.67E-06	1.11E-11	---	
Di-n-octylphthalate	2.42E-06	3.51E-12	---	
Benzoyl Chloride	2.14E-05	3.10E-11	---	
Undecane	3.12E-05	4.51E-11	---	
2-Fluoro-4-nitrophenol	2.24E-05	3.25E-11	---	
Octadecanoic acid	3.55E-05	5.14E-11	---	
o,p'-DDE	2.32E-05	3.36E-11	0.34	1.1E-11
Hexadecanoic acid	3.31E-05	4.79E-11	---	
			TOTAL	**3.30E-09**

Carcinogenic Risk Characterization

Inhalation Rate	(m3/day)	20	SDEF for Residential (USEPA, 1991)
Exposure Frequency	(days/yr)	350	SDEF for Residential (USEPA, 1991)
Exposure Duration	(yr)	0.37	Duration of soil treatment (19.3 weeks)
Body Weight	(kg)	70	SDEF for Residential (USEPA, 1991)
Averaging Time	(days)	25550	SDEF for Residential (USEPA, 1991)

Hazard Index for Inhalation of Ground Level of Stack Emittants - Cold Start Operating Conditions

	Weighted Annual (mg/m3)	Subchronic RfC (mg/m3)	Chronic RfC (mg/m3)	Ratio to Subchronic RfC
Acetone	4.07E-08	No data	0.0875	4.66E-07
Acetonitrile		0.5	0.05	
Acrylonitrile		No data	0.002	
Aldrin	4.69E-10	No data	0.0000263	1.78E-05
alpha-BHC	4.69E-10	No data	No data	
alpha-Chlordane	4.69E-10	Not available	0.0000525	8.93E-06
Benzaldehyde		No data	0.0875	
Benzene	1.41E-08	0.06	No data	2.35E-07
Benzoic acid	3.39E-07	No data	3.5	9.69E-08
Benzyl alcohol		No data	0.263	
beta-BHC	4.69E-10	No data	No data	
bis(2-ethylhexyl)phthalate	1.47E-07	No data	0.0175	8.38E-06
Camphene		No data	No data	
Chlorobenzene		Not available	0.02	
Chloroethane		10	10	
Chloroform	7.78E-08	0.04	0.00875	1.95E-06
Chloromethane	3.73E-09	9	No data	4.15E-10
p,p'-DDD	2.86E-09	No data	No data	
p,p'-DDE	1.62E-08	No data	No data	
p,p'-DDT	2.63E-08	No data	0.000438	6.01E-05
1,2-Dichlorobenzene	6.98E-09	No data	0.2	3.49E-08
1,3-Dichlorobenzene	2.99E-09	No data	0.0779	3.84E-08
1,4-Dichlorobenzene	5.58E-09	0.8	0.8	6.98E-09
Dieldrin	4.96E-08	No data	0.0000438	1.13E-03
Dihydrofuranone		No data	No data	
Endrin	4.71E-09	No data	0.000263	1.79E-05
Ethanol		No data	No data	
Ethylbenzene	1.36E-09	Pending	1	1.36E-09
gamma-BHC	6.01E-09	No data	0.000263	2.28E-05
Heptachlor	4.69E-10	No data	0.000438	1.07E-06
Heptachlor epoxide	4.69E-10	No data	0.0000114	4.11E-05
Hexachlorobenzene	3.47E-08	Not recommended	0.0007	4.96E-05
Hexachlorocyclopentadiene		0.0007	0.00007	
Methoxychlor	4.69E-10	No data	0.00438	1.07E-07
Methylene chloride	1.23E-08	3	3	4.10E-09
2-Methylphenol		No data	0.0438	
3-Methylphenol		No data	0.0438	
4-Methylphenol		No data	0.00438	
Methylphenylether		No data	No data	
m-Ethyltoluene		No data	Data inadequate	
Nitrobenzene		0.02	0.002	
Phenol	4.09E-09	No data	0.525	7.80E-09
Styrene	1.77E-08	3	1	5.90E-09
2,3,7,8-TCDD	5.03E-14	No data	No data	
Toluene	3.05E-09	1	0.4	3.05E-09
Toxaphene	4.69E-10	No data	No data	
1,2,4-Trichlorobenzene	2.65E-09	0.09	0.009	2.94E-08
1,1,1-Trichloroethane		1	0.0788	
Trichlorofluoromethane		7	0.7	
Vinyl chloride		Inadequate data	No data	
Xylene	1.44E-09	Pending	No data	

Chronic RfC used when subchronic RfC was unavailable
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Hazard Index for Inhalation of Ground Level of Stack Emittants - Cold Start Operating Conditions

	Weighted Annual (mg/m3)	Subchronic RfC (mg/m3)	Chronic RfC (mg/m3)	Ratio to Subchronic RfC
Antimony	3.06E-09	No data	0.0003	1.02E-05
Arsenic	4.54E-09	No data	0.000263	1.73E-05
Barium	3.18E-08	0.005	0.0005	6.36E-06
Beryllium	7.66E-10	No data	0.00438	1.75E-07
Cadmium	6.47E-09	No data	0.000438	1.48E-05
Chromium III		No data	0.875	
Chromium VI	3.67E-08	0.000004	0.00438	9.16E-03
Lead	8.88E-08	Not recommended	0.0015	5.92E-05
Mercury	7.89E-06	0.0003	0.0003	2.63E-02
Nickel	5.48E-08	No data	0.02	2.74E-06
Selenium	5.31E-08	No data	0.004	1.33E-05
Silver	3.49E-09	No data	0.003	1.16E-06
Thallium		No data	0.0003	
PM-10	4.16E-04	0.05		8.32E-03
SO_2		No data	No data	
NO_2		No data	No data	
HCl	2.41E-05	No data	0.007	3.45E-03
Cl_2	2.18E-06	No data	0.0004	5.46E-03
CO		No data	No data	
UNANTICIPATED PICs		--	--	
2-Nitrophenol	5.33E-09	No data	No data	
Naphthalene	5.61E-09	No data	0.035	1.60E-07
Diethylphthalate	4.67E-09	No data	0.7	6.67E-09
Di-n-butylphthalate	7.61E-09	No data	0.0875	8.70E-08
Di-n-octylphthalate	2.26E-09	No data	0.0175	1.29E-07
Benzoyl Chloride	2.00E-08	No data	No data	
Undecane	2.91E-08	No data	No data	
2-Fluoro-4-nitrophenol	2.09E-08	No data	No data	
Octadecanoic acid	3.32E-08	No data	No data	
o,p'-DDE	2.17E-08	No data	No data	
Hexadecanoic acid	2.20E-08	No data	No data	
			TOTAL	**5.42E-02**

Chronic RfC used when subchronic RfC was unavailable
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Cancer Risk Level Calculations for Fenceline Fugitive Dusts

	Fenceline (untreated) Dust and Emittants (mg/m3)	Intake (mg/kg/d)	Slope Factor (mg/kg/d)^-1	Risk Level
Acetone	2.38E-08	2.46E-11	—	
Acetonitrile			—	
Acrylonitrile			0.24	
Aldrin	8.86E-07	9.16E-10	17	1.6E-08
alpha-BHC	5.97E-08	6.17E-11	6.3	3.9E-10
alpha-Chlordane	7.44E-08	7.69E-11	1.3	1.0E-10
Benzaldehyde			—	
Benzene	8.61E-10	8.91E-13	0.029	2.6E-14
Benzoic acid	6.13E-08	6.34E-11	—	
Benzyl alcohol			—	
beta-BHC	2.13E-08	2.20E-11	1.8	4.0E-11
bis(2-ethylhexyl)phthalate	4.36E-07	4.51E-10	0.014	6.3E-12
Camphene			—	
Chlorobenzene			—	
Chloroethane			—	
Chloroform	4.65E-09	4.81E-12	0.081	3.9E-13
Chloromethane	5.11E-11	5.28E-14	0.0063	3.3E-16
p,p'-DDD	6.11E-05	6.32E-08	0.24	1.5E-08
p,p'-DDE	6.15E-06	6.36E-09	0.34	2.2E-09
p,p'-DDT	2.36E-04	2.44E-07	0.34	8.3E-08
1,2-Dichlorobenzene	3.18E-10	3.29E-13	—	
1,3-Dichlorobenzene	1.50E-10	1.55E-13	—	
1,4-Dichlorobenzene	1.81E-10	1.87E-13	0.024	4.5E-15
Dieldrin	2.63E-06	2.72E-09	16	4.4E-08
Dihydrofuranone			—	
Endrin	1.63E-06	1.69E-09	—	
Ethanol			—	
Ethylbenzene	2.05E-08	2.12E-11	—	
gamma-BHC	1.30E-06	1.34E-09	1.3	1.7E-09
Heptachlor	2.62E-08	2.71E-11	4.5	1.2E-10
Heptachlor epoxide	1.47E-08	1.52E-11	9.1	1.4E-10
Hexachlorobenzene	1.43E-04	1.48E-07	1.6	2.4E-07
Hexachlorocyclopentadiene			—	
Methoxychlor	8.47E-06	8.76E-09	—	
Methylene chloride	1.19E-09	1.23E-12	0.00164	2.0E-15
2-Methylphenol			—	
3-Methylphenol			—	
4-Methylphenol			—	
Methylphenylether			—	
m-Ethyltoluene			—	
Nitrobenzene			—	
Phenol	3.02E-07	3.12E-10	—	
Styrene	1.05E-09	1.08E-12	—	

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Cancer Risk Level Calculations for Fenceline Fugitive Dusts

2,3,7,8-TCDD	9.91E-16	1.03E-18	150000	1.5E-13
Toluene	4.91E-08	5.08E-11	---	
Toxaphene	1.64E-05	1.70E-08	1.1	1.9E-08
1,2,4-Trichlorobenzene	1.70E-07	1.76E-10	---	
1,1,1-Trichloroethane			---	
Trichlorofluoromethane			---	
Vinyl chloride			0.3	
Xylene	3.60E-07	3.72E-10	---	
Antimony	4.36E-06	4.51E-09	---	
Arsenic	1.01E-06	1.05E-09	15	1.6E-08
Barium	1.51E-05	1.56E-08	---	
Beryllium	1.06E-08	1.10E-11	8.4	9.2E-11
Cadmium	6.87E-07	7.11E-10	6.3	4.5E-09
Chromium III	1.58E-06	1.63E-09	---	
Chromium VI	6.16E-10	6.37E-13	41	2.6E-11
Lead	9.89E-06	1.02E-08	NA	
Mercury	9.74E-07	1.01E-09	---	
Nickel	1.58E-06	1.64E-09	---	
Selenium	4.05E-10	4.19E-13	---	
Silver	1.80E-07	1.86E-10	---	
Thallium			---	
PM-10	8.17E-02	8.45E-05	---	
SO2			---	
NO2			---	
HCl	3.00E-07	3.10E-10	---	
Cl2			---	
CO			---	
UNANTICIPATED PICs			---	
2-Nitrophenol	2.33E-10	2.41E-13	---	
Naphthalene	2.53E-10	2.62E-13	---	
Diethylphthalate	1.84E-10	1.90E-13	---	
Di-n-butylphthalate	4.00E-10	4.14E-13	---	
Di-n-octylphthalate	1.66E-10	1.72E-13	---	
Benzoyl Chloride	1.47E-09	1.52E-12	---	
Undecane	2.14E-09	2.21E-12	---	
2-Fluoro-4-nitrophenol	1.54E-09	1.59E-12	---	
Octadecanoic acid	2.43E-09	2.52E-12	---	
o,p'-DDE	1.59E-09	1.65E-12	0.34	5.6E-13
Hexadecanoic acid	1.62E-09	1.67E-12	---	
			TOTAL	**4.38E-07**

Carcinogenic Risk Characterization

Inhalation Rate	(m3/day)	20	SDEF for Industrial (USEPA, 1991)
Exposure Frequency	(days/yr)	250	SDEF for Industrial (USEPA, 1991)
Exposure Duration	(yr)	0.37	Duration of soil treatment (19.3 weeks)
Body Weight	(kg)	70	SDEF for Industrial (USEPA, 1991)
Averaging time	(days)	25550	SDEF (USEPA, 1991)

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Hazard Index for Inhalation of Fugitive Dusts at Fenceline

	Fenceline (untreated) Dust and Emittants (mg/m3)	**Subchronic RfC (mg/m3)**	**Chronic RfC (mg/m3)**	**Ratio to Subchronic RfC**
Acetone	2.38E-08	No data	0.0875	2.72E-07
Acetonitrile		0.5	0.05	
Acrylonitrile		No data	0.002	
Aldrin	8.86E-07	No data	0.0000263	3.37E-02
alpha-BHC	5.97E-08	No data	No data	
alpha-Chlordane	7.44E-08	Not available	0.0000525	1.42E-03
Benzaldehyde		No data	0.0875	
Benzene	8.61E-10	0.06	No data	1.44E-08
Benzoic acid	6.13E-08	No data	3.5	1.75E-08
Benzyl alcohol		No data	0.263	
beta-BHC	2.13E-08	No data	No data	
bis(2-ethylhexyl)phthalate	4.36E-07	No data	0.0175	2.49E-05
Camphene		No data	No data	
Chlorobenzene		Not available	0.02	
Chloroethane		10	10	
Chloroform	4.65E-09	0.04	0.00875	1.16E-07
Chloromethane	5.11E-11	9	No data	5.67E-12
p,p'-DDD	6.11E-05	No data	No data	
p,p'-DDE	6.15E-06	No data	No data	
p,p'-DDT	2.36E-04	No data	0.000438	5.39E-01
1,2-Dichlorobenzene	3.18E-10	No data	0.2	1.59E-09
1,3-Dichlorobenzene	1.50E-10	No data	0.0779	1.92E-09
1,4-Dichlorobenzene	1.81E-10	0.8	0.8	2.26E-10
Dieldrin	2.63E-06	No data	0.0000438	6.00E-02
Dihydrofuranone		No data	No data	
Endrin	1.63E-06	No data	0.000263	6.21E-03
Ethanol		No data	No data	
Ethylbenzene	2.05E-08	Pending	1	2.05E-08
gamma-BHC	1.30E-06	No data	0.000263	4.94E-03
Heptachlor	2.62E-08	No data	0.000438	5.97E-05
Heptachlor epoxide	1.47E-08	No data	0.0000114	1.29E-03
Hexachlorobenzene	1.43E-04	Not recommended	0.0007	2.05E-01
Hexachlorocyclopentadiene		0.0007	0.00007	
Methoxychlor	8.47E-06	No data	0.00438	1.93E-03
Methylene chloride	1.19E-09	3	3	3.97E-10
2-Methylphenol		No data	0.0438	
3-Methylphenol		No data	0.0438	
4-Methylphenol		No data	0.00438	
Methylphenylether		No data	No data	
m-Ethyltoluene		No data	Data inadequate	
Nitrobenzene		0.02	0.002	
Phenol	3.02E-07	No data	0.525	5.75E-07
Styrene	1.05E-09	3	1	3.49E-10
2,3,7,8-TCDD	9.91E-16	No data	No data	
Toluene	4.91E-08	1	0.4	4.91E-08

Chronic RfC used when subchronic RfC was unavailable
7/27/95

Hazard Index for Inhalation of Fugitive Dusts at Fenceline

Toxaphene	1.64E-05	No data	No data	
1,2,4-Trichlorobenzene	1.70E-07	0.09	0.009	1.89E-06
1,1,1-Trichloroethane		1	0.0788	
Trichlorofluoromethane		7	0.7	
Vinyl chloride		Inadequate data	No data	
Xylene	3.60E-07	Pending	No data	
Antimony	4.36E-06	No data	0.0003	1.45E-02
Arsenic	1.01E-06	No data	0.000263	3.86E-03
Barium	1.51E-05	0.005	0.0005	3.02E-03
Beryllium	1.06E-08	No data	0.00438	2.43E-06
Cadmium	6.87E-07	No data	0.000438	1.57E-03
Chromium III	1.58E-06	No data	0.875	1.80E-06
Chromium VI	6.16E-10	0.000004	0.00438	1.54E-04
Lead	9.89E-06	Not recommended	0.0015	6.59E-03
Mercury	9.74E-07	0.0003	0.0003	3.25E-03
Nickel	1.58E-06	No data	0.02	7.92E-05
Selenium	4.05E-10	No data	0.004	1.01E-07
Silver	1.80E-07	No data	0.003	6.00E-05
Thallium		No data	0.0003	
PM-10	8.17E-02	0.05		1.63E+00
SO2		No data	No data	
NO2		No data	No data	
HCl	3.00E-07	No data	0.007	4.28E-05
Cl2		No data	0.0004	
CO		No data	No data	
UNANTICIPATED PICs		--	--	
2-Nitrophenol	2.33E-10	No data	No data	
Naphthalene	2.53E-10	No data	0.035	7.23E-09
Diethylphthalate	1.84E-10	No data	0.7	2.62E-10
Di-n-butylphthalate	4.00E-10	No data	0.0875	4.57E-09
Di-n-octylphthalate	1.66E-10	No data	0.0175	9.48E-09
Benzoyl Chloride	1.47E-09	No data	No data	
Undecane	2.14E-09	No data	No data	
2-Fluoro-4-nitrophenol	1.54E-09	No data	No data	
Octadecanoic acid	2.43E-09	No data	No data	
o,p'-DDE	1.59E-09	No data	No data	
Hexadecanoic acid	1.62E-09	No data	No data	
			TOTAL	**2.52E+00**

Chronic RfC used when subchronic RfC was unavailable
7/27/95

APPENDIX F

Indirect Risks and Hazard Indices Calculations

Insert chemical specific information				
PARAMETER	**SYMBOL**	**UNITS**	**VALUE**	**DEFAULT/COMMENT**
Chemical Name			Arsenic	
Soil loss constant due to degradation	ksg	1/yr	0	USEPA, 1994b
Fraction of pollutant in vapor phase	Fv	dimensionless	0	chemical-specific; Arsenic (USEPA, 1994a,b)
Soil-water partition coefficient	Kd_s	mL/g	29	USEPA, 1994b
Air-to-plant biotransfer factor	Bv	[ug/pollutant/g plant tissue DW]/[ug pollutant/g air]	NA	USEPA, 1994b
Ratio of concentration in the roots to concentration in soil pore water	RCF	[ug/pollutant/g plant tissue FW]/[ug pollutant/mL pore water]	0.008	USEPA, 1994b
Biotransfer factor for beef	Ba_beef	day/kg	0.002	chemical-specific; Arsenic (USEPA, 1994a,b)
Biotransfer factor for milk	Ba_milk	day/kg	0.006	chemical-specific; Arsenic (USEPA, 1994a,b)
Fraction of wet deposition that adheres to plant surfaces	Fw	dimensionless	0.2	chemical-specific; Arsenic (USEPA, 1994a,b)
Cancer Slope Factor	CSF	(mg/kg/day)^-1	1.75E+00	USEPA, 1994b, IRIS
Reference Dose	RfD	(mg/kg/day)	3.00E-04	USEPA, 1994b, IRIS
MODEL OUTPUTS				
Modeled dry deposition - stack		g/m^2	3.96E-07	COMDEP
Modeled dust deposition - fugitives		g/m^2	0.00E+00	
Modeled wet deposition		g/m^2	3.46E-05	COMDEP
Modeled annual air concentration		ug/m^3	4.31E-06	ISCST2
Total time period over which deposition occurs	Tc	yrs	0.37	site-specific
Average annual dry deposition	Dyd	g/m^2/yr	3.66E-09	Modeled; Dry deposition from stack
Average annual wet deposition	Dyw	g/m^2/yr	3.20E-07	Modeled; Arsenic
Average annual air concentration	Cy	ug/m^3	3.99E-08	Modeled; Arsenic

CANCER RISK AND HAZARD QUOTIENT FOR INDIVIDUAL CHEMICALS FOR SUBSISTENCE FARMER SCENARIO

PARAMETER	SYMBOL	UNITS	VALUE	COMMENT/DEFAULT
Individual lifetime cancer risk	CRL	unitless	1.84E-09	=(I*ED*EF*CSF)/(BW*AT*365)
Total daily intake of contaminant	I	mg/day	1.35E-07	calculated
Exposure duration	ED	yr	40	High end; assumes farmers live longer at one location than the general population (USEPA, 1994a,b)
Exposure frequency	EF	day/yr	350	350
Body weight	BW	kg	70	70
Averaging time	AT	yr	70	70
Conversion factor	CF	day/yr	365	365
Oral cancer slope factor	CSF	(mg/kg-day)^-1	1.75E+00	chemical-specific
Hazard Quotient	HQ	unitless	6.41E-06	=I/(BW*RfD)
Total daily intake of contaminant	I	mg/day	1.35E-07	calculated
Reference dose	RfD	mg/kg/day	3.00E-04	chemical-specific
Arsenic				

Insert chemical specific information				
PARAMETER	**SYMBOL**	**UNITS**	**VALUE**	**DEFAULT/COMMENT**
Chemical Name			DDD	
Soil loss constant due to degradation	ksg	1/yr	0	USEPA, 1994b
Fraction of pollutant in vapor phase	Fv	dimensionless	1	calculated (USEPA, 1982; ATSDR, 1993)
Soil-water partition coefficient	Kd_s	mL/g	3869.77	USEPA, 1994e
Air-to-plant biotransfer factor	Bv	[ug/pollutant/g plant tissue DW]/[ug pollutant/g air]	33,957	USEPA, 1994e
Ratio of concentration in the roots to concentration in soil pore water	RCF	[ug/pollutant/g plant tissue FW]/[ug pollutant/mL pore water]	1646.3	USEPA, 1994e
Biotransfer factor for beef	Ba_beef	day/kg	0.0389	chemical-specific; DDD (USEPA, 1994e)
Biotransfer factor for milk	Ba_milk	day/kg	0.0123	chemical-specific; DDD (USEPA, 1994e)
Fraction of wet deposition that adheres to plant surfaces	Fw	dimensionless	0.6	chemical-specific; DDD (USEPA, 1994e)
Cancer Slope Factor	CSF	(mg/kg/day)^-1	3.40E-01	USEPA, 1994b, IRIS
Reference Dose	RfD	(mg/kg/day)	NA	USEPA, 1994b, IRIS
MODEL OUTPUTS				
Modeled dry deposition - stack		g/m^2	7.93E-07	COMDEP
Modeled dust deposition - fugitives		g/m^2	0.00E+00	
Modeled wet deposition		g/m^2	6.92E-05	COMDEP
Modeled annual air concentration		ug/m^3	8.63E-06	ISCST2
Total time period over which deposition occurs	Tc	yrs	0.37	site-specific
Average annual dry deposition	Dyd	g/m^2/yr	7.34E-09	Modeled; Dry deposition from stack
Average annual wet deposition	Dyw	g/m^2/yr	6.40E-07	Modeled; DDD
Average annual air concentration	Cy	ug/m^3	7.98E-08	Modeled; DDD

CANCER RISK AND HAZARD QUOTIENT FOR INDIVIDUAL CHEMICALS FOR SUBSISTENCE FARMER SCENARIO				
PARAMETER	**SYMBOL**	**UNITS**	**VALUE**	**COMMENT/DEFAULT**
Individual lifetime cancer risk	CRL	unitless	6.69E-09	=(I*ED*EF*CSF)/(BW*AT*365)
Total daily intake of contaminant	I	mg/day	2.51E-06	calculated
Exposure duration	ED	yr	40	High end; assumes farmers live longer at one location than the general population (USEPA, 1994a,b)
Exposure frequency	EF	day/yr	350	350
Body weight	BW	kg	70	70
Averaging time	AT	yr	70	70
Conversion factor	CF	day/yr	365	365
Oral cancer slope factor	CSF	(mg/kg-day)^-1	3.40E-01	chemical-specific
Hazard Quotient	HQ	unitless	NA	=I/(BW*RfD)
Total daily intake of contaminant	I	mg/day	2.51E-06	calculated
Reference dose	RfD	mg/kg/day	NA	chemical-specific
DDD				

Insert chemical specific information				
PARAMETER	**SYMBOL**	**UNITS**	**VALUE**	**DEFAULT/COMMENT**
Chemical Name			o,p'-DDE+p,p'-DDE	
Soil loss constant due to degradation	ksg	1/yr	0	USEPA, 1994b
Fraction of pollutant in vapor phase	Fv	dimensionless	0.9	calculated (USEPA, 1982; ATSDR, 1993)
Soil-water partition coefficient	Kd_s	mL/g	3869.77	USEPA, 1994e
Air-to-plant biotransfer factor	Bv	[ug/pollutant/g plant tissue DW]/[ug pollutant/g air]	33,957	USEPA, 1994e
Ratio of concentration in the roots to concentration in soil pore water	RCF	[ug/pollutant/g plant tissue FW]/[ug pollutant/mL pore water]	1646.3	USEPA, 1994e
Biotransfer factor for beef	Ba_beef	day/kg	0.0389	chemical-specific; DDE (USEPA, 1994e)
Biotransfer factor for milk	Ba_milk	day/kg	0.0123	chemical-specific; DDE (USEPA, 1994e)
Fraction of wet deposition that adheres to plant surfaces	Fw	dimensionless	0.6	chemical-specific; DDE (USEPA, 1994e)
Cancer Slope Factor	CSF	(mg/kg/day)^-1	3.40E-01	USEPA, 1994b, IRIS
Reference Dose	RfD	(mg/kg/day)	NA	USEPA, 1994b, IRIS
MODEL OUTPUTS				
Modeled dry deposition - stack		g/m^2	1.17E-05	COMDEP
Modeled dust deposition - fugitives		g/m^2	0.00E+00	
Modeled wet deposition		g/m^2	1.02E-03	COMDEP
Modeled annual air concentration		ug/m^3	1.28E-04	ISCST2
Total time period over which deposition occurs	Tc	yrs	0.37	site-specific
Average annual dry deposition	Dyd	g/m^2/yr	1.08E-07	Modeled; Dry deposition from stack
Average annual wet deposition	Dyw	g/m^2/yr	9.46E-06	Modeled; DDE
Average annual air concentration	Cy	ug/m^3	1.18E-06	Modeled; DDE

CANCER RISK AND HAZARD QUOTIENT FOR INDIVIDUAL CHEMICALS FOR SUBSISTENCE FARMER SCENARIO				
PARAMETER	**SYMBOL**	**UNITS**	**VALUE**	**COMMENT/DEFAULT**
Individual lifetime cancer risk	CRL	unitless	9.91E-08	=(I*ED*EF*CSF)/(BW*AT*365)
Total daily intake of contaminant	I	mg/day	3.72E-05	calculated
Exposure duration	ED	yr	40	High end; assumes farmers live longer at one location than the general population (USEPA, 1994a,b)
Exposure frequency	EF	day/yr	350	350
Body weight	BW	kg	70	70
Averaging time	AT	yr	70	70
Conversion factor	CF	day/yr	365	365
Oral cancer slope factor	CSF	(mg/kg-day)^-1	3.40E-01	chemical-specific
Hazard Quotient	HQ	unitless	NA	=I/(BW*RfD)
Total daily intake of contaminant	I	mg/day	3.72E-05	calculated
Reference dose	RfD	mg/kg/day	NA	chemical-specific
o,p'-DDE+p,p'-DDE				

Insert chemical specific information				
PARAMETER	**SYMBOL**	**UNITS**	**VALUE**	**DEFAULT/COMMENT**
Chemical Name			DDT	
Soil loss constant due to degradation	ksg	1/yr	0	USEPA, 1994b
Fraction of pollutant in vapor phase	Fv	dimensionless	0.8	calculated (USEPA, 1982; ATSDR, 1993)
Soil-water partition coefficient	Kd_s	mL/g	3869.77	USEPA, 1994e
Air-to-plant biotransfer factor	Bv	[ug/pollutant/g plant tissue DW]/[ug pollutant/g air]	33,957	USEPA, 1994e
Ratio of concentration in the roots to concentration in soil pore water	RCF	[ug/pollutant/g plant tissue FW]/[ug pollutant/mL pore water]	1646.3	USEPA, 1994e
Biotransfer factor for beef	Ba_beef	day/kg	0.0389	chemical-specific; DDT (USEPA, 1994e)
Biotransfer factor for milk	Ba_milk	day/kg	0.0123	chemical-specific; DDT (USEPA, 1994e)
Fraction of wet deposition that adheres to plant surfaces	Fw	dimensionless	0.6	chemical-specific; DDT (USEPA, 1994e)
Cancer Slope Factor	CSF	(mg/kg/day)^-1	3.40E-01	USEPA, 1994b, IRIS
Reference Dose	RfD	(mg/kg/day)	5.00E-04	USEPA, 1994b, IRIS
MODEL OUTPUTS				
Modeled dry deposition - stack		g/m^2	1.80E-06	COMDEP
Modeled dust deposition - fugitives		g/m^2	0.00E+00	
Modeled wet deposition		g/m^2	1.57E-04	COMDEP
Modeled annual air concentration		ug/m^3	1.96E-05	ISCST2
Total time period over which deposition occurs	Tc	yrs	0.37	site-specific
Average annual dry deposition	Dyd	g/m^2/yr	1.67E-08	Modeled; Dry deposition from stack
Average annual wet deposition	Dyw	g/m^2/yr	1.45E-06	Modeled; DDT
Average annual air concentration	Cy	ug/m^3	1.81E-07	Modeled; DDT

CANCER RISK AND HAZARD QUOTIENT FOR INDIVIDUAL CHEMICALS FOR SUBSISTENCE FARMER SCENARIO

PARAMETER	SYMBOL	UNITS	VALUE	COMMENT/DEFAULT
Individual lifetime cancer risk	CRL	unitless	1.52E-08	=(I*ED*EF*CSF)/(BW*AT*365)
Total daily intake of contaminant	I	mg/day	5.73E-06	calculated
Exposure duration	ED	yr	40	High end; assumes farmers live longer at one location than the general population (USEPA, 1994a,b)
Exposure frequency	EF	day/yr	350	350
Body weight	BW	kg	70	70
Averaging time	AT	yr	70	70
Conversion factor	CF	day/yr	365	365
Oral cancer slope factor	CSF	(mg/kg-day)^-1	3.40E-01	chemical-specific
Hazard Quotient	HQ	unitless	0.000164	=I/(BW*RfD)
Total daily intake of contaminant	I	mg/day	5.73E-06	calculated
Reference dose	RfD	mg/kg/day	5.00E-04	chemical-specific
DDT				

Insert chemical specific information				
PARAMETER	SYMBOL	UNITS	VALUE	DEFAULT/COMMENT
Chemical Name			DEHP	
Soil loss constant due to degradation	ksg	1/yr	0	USEPA, 1994b
Fraction of pollutant in vapor phase	Fv	dimensionless	0.8	chemical-specific; DEHP (USEPA, 1994a,b)
Soil-water partition coefficient	Kd_s	mL/g	1400	USEPA, 1994b
Air-to-plant biotransfer factor	Bv	[ug/pollutant/g plant tissue DW]/[ug pollutant/g air]	640,000	USEPA, 1994b
Ratio of concentration in the roots to concentration in soil pore water	RCF	[ug/pollutant/g plant tissue FW]/[ug pollutant/mL pore water]	4500	USEPA, 1994b
Biotransfer factor for beef	Ba_beef	day/kg	0	chemical-specific; DEHP (USEPA, 1994a,b)
Biotransfer factor for milk	Ba_milk	day/kg	0	chemical-specific; DEHP (USEPA, 1994a,b)
Fraction of wet deposition that adheres to plant surfaces	Fw	dimensionless	0.6	chemical-specific; DEHP (USEPA, 1994a,b)
Cancer Slope Factor	CSF	(mg/kg/day)^-1	1.40E-02	USEPA, 1994b, IRIS
Reference Dose	RfD	(mg/kg/day)	2.00E-02	USEPA, 1994b, IRIS
MODEL OUTPUTS				
Modeled dry deposition - stack		g/m^2	3.40E-06	COMDEP
Modeled dust deposition - fugitives		g/m^2	0.00E+00	
Modeled wet deposition		g/m^2	2.97E-04	COMDEP
Modeled annual air concentration		ug/m^3	3.70E-05	ISCST2
Total time period over which deposition occurs	Tc	yrs	0.37	site-specific
Average annual dry deposition	Dyd	g/m^2/yr	3.15E-08	Modeled; Dry deposition from stack
Average annual wet deposition	Dyw	g/m^2/yr	2.75E-06	Modeled; DEHP
Average annual air concentration	Cy	ug/m^3	3.42E-07	Modeled; DEHP

CANCER RISK AND HAZARD QUOTIENT FOR INDIVIDUAL CHEMICALS FOR SUBSISTENCE FARMER SCENARIO				
PARAMETER	**SYMBOL**	**UNITS**	**VALUE**	**COMMENT/DEFAULT**
Individual lifetime cancer risk	CRL	unitless	9.56E-12	=(I*ED*EF*CSF)/(BW*AT*365)
Total daily intake of contaminant	I	mg/day	8.72E-08	calculated
Exposure duration	ED	yr	40	High end; assumes farmers live longer at one location than the general population (USEPA, 1994a,b)
Exposure frequency	EF	day/yr	350	350
Body weight	BW	kg	70	70
Averaging time	AT	yr	70	70
Conversion factor	CF	day/yr	365	365
Oral cancer slope factor	CSF	(mg/kg-day)^-1	1.40E-02	chemical-specific
Hazard Quotient	HQ	unitless	6.23E-08	=I/(BW*RfD)
Total daily intake of contaminant	I	mg/day	8.72E-08	calculated
Reference dose	RfD	mg/kg/day	2.00E-02	chemical-specific
DEHP				

Insert chemical specific information				
PARAMETER	**SYMBOL**	**UNITS**	**VALUE**	**DEFAULT/COMMENT**
Chemical Name			Dieldrin	
Soil loss constant due to degradation	ksg	1/yr	NA	USEPA, 1994b
Fraction of pollutant in vapor phase	Fv	dimensionless	1	calculated (USEPA, 1982; ATSDR, 1993)
Soil-water partition coefficient	Kd_s	mL/g	17	USEPA, 1994e
Air-to-plant biotransfer factor	Bv	[ug/pollutant/g plant tissue DW]/[ug pollutant/g air]	168	USEPA, 1994e
Ratio of concentration in the roots to concentration in soil pore water	RCF	[ug/pollutant/g plant tissue FW]/[ug pollutant/mL pore water]	502	USEPA, 1994e
Biotransfer factor for beef	Ba_beef	day/kg	5.20E-04	chemical-specific; Dieldrin (USEPA, 1994e)
Biotransfer factor for milk	Ba_milk	day/kg	1.70E-04	chemical-specific; Dieldrin (USEPA, 1994e)
Fraction of wet deposition that adheres to plant surfaces	Fw	dimensionless	0.6	chemical-specific; Dieldrin (USEPA, 1994e)
Cancer Slope Factor	CSF	(mg/kg/day)^-1	1.60E+01	USEPA, 1994b, IRIS
Reference Dose	RfD	(mg/kg/day)	5.00E-05	USEPA, 1994b, IRIS
MODEL OUTPUTS				
Modeled dry deposition - stack		g/m^2	2.98E-06	COMDEP
Modeled dust deposition - fugitives		g/m^2	0.00E+00	
Modeled wet deposition		g/m^2	2.60E-04	COMDEP
Modeled annual air concentration		ug/m^3	3.24E-05	ISCST2
Total time period over which deposition occurs	Tc	yrs	0.37	site-specific
Average annual dry deposition	Dyd	g/m^2/yr	2.76E-08	Modeled; Dry deposition from stack
Average annual wet deposition	Dyw	g/m^2/yr	2.41E-06	Modeled; Dieldrin
Average annual air concentration	Cy	ug/m^3	3.00E-07	Modeled; Dieldrin

CANCER RISK AND HAZARD QUOTIENT FOR INDIVIDUAL CHEMICALS FOR SUBSISTENCE FARMER SCENARIO

PARAMETER	SYMBOL	UNITS	VALUE	COMMENT/DEFAULT
Individual lifetime cancer risk	CRL	unitless	2.22E-08	=(I*ED*EF*CSF)/(BW*AT*365)
Total daily intake of contaminant	I	mg/day	1.77E-07	calculated
Exposure duration	ED	yr	40	High end; assumes farmers live longer at one location than the general population (USEPA, 1994a,b)
Exposure frequency	EF	day/yr	350	350
Body weight	BW	kg	70	70
Averaging time	AT	yr	70	70
Conversion factor	CF	day/yr	365	365
Oral cancer slope factor	CSF	(mg/kg-day)^-1	1.60E+01	chemical-specific
Hazard Quotient	HQ	unitless	5.07E-05	=I/(BW*RfD)
Total daily intake of contaminant	I	mg/day	1.77E-07	calculated
Reference dose	RfD	mg/kg/day	5.00E-05	chemical-specific
Dieldrin				

Insert chemical specific information				
PARAMETER	**SYMBOL**	**UNITS**	**VALUE**	**DEFAULT/COMMENT**
Chemical Name			DEHP	
Soil loss constant due to degradation	ksg	1/yr	0	USEPA, 1994b
Fraction of pollutant in vapor phase	Fv	dimensionless	0.8	chemical-specific; DEHP (USEPA, 1994a,b)
Soil-water partition coefficient	Kd_s	mL/g	1400	USEPA, 1994b
Air-to-plant biotransfer factor	Bv	[ug/pollutant/g plant tissue DW]/[ug pollutant/g air]	640,000	USEPA, 1994b
Ratio of concentration in the roots to concentration in soil pore water	RCF	[ug/pollutant/g plant tissue FW]/[ug pollutant/mL pore water]	4500	USEPA, 1994b
Biotransfer factor for beef	Ba_beef	day/kg	0	chemical-specific; DEHP (USEPA, 1994a,b)
Biotransfer factor for milk	Ba_milk	day/kg	0	chemical-specific; DEHP (USEPA, 1994a,b)
Fraction of wet deposition that adheres to plant surfaces	Fw	dimensionless	0.6	chemical-specific; DEHP (USEPA, 1994a,b)
Cancer Slope Factor	CSF	(mg/kg/day)^-1	1.40E-02	USEPA, 1994b, IRIS
Reference Dose	RfD	(mg/kg/day)	2.00E-02	USEPA, 1994b, IRIS
MODEL OUTPUTS				
Modeled dry deposition - stack		g/m^2	3.40E-06	COMDEP
Modeled dust deposition - fugitives		g/m^2	0.00E+00	
Modeled wet deposition		g/m^2	2.97E-04	COMDEP
Modeled annual air concentration		ug/m^3	3.70E-05	ISCST2
Total time period over which deposition occurs	Tc	yrs	0.37	site-specific
Average annual dry deposition	Dyd	g/m^2/yr	3.15E-08	Modeled; Dry deposition from stack
Average annual wet deposition	Dyw	g/m^2/yr	2.75E-06	Modeled; DEHP
Average annual air concentration	Cy	ug/m^3	3.42E-07	Modeled; DEHP

CANCER RISK AND HAZARD QUOTIENT FOR INDIVIDUAL CHEMICALS FOR SUBSISTENCE FARMER SCENARIO

PARAMETER	SYMBOL	UNITS	VALUE	COMMENT/DEFAULT
Individual lifetime cancer risk	CRL	unitless	9.56E-12	=(I*ED*EF*CSF)/(BW*AT*365)
Total daily intake of contaminant	I	mg/day	8.72E-08	calculated
Exposure duration	ED	yr	40	High end; assumes farmers live longer at one location than the general population (USEPA, 1994a,b)
Exposure frequency	EF	day/yr	350	350
Body weight	BW	kg	70	70
Averaging time	AT	yr	70	70
Conversion factor	CF	day/yr	365	365
Oral cancer slope factor	CSF	(mg/kg-day)^-1	1.40E-02	chemical-specific
Hazard Quotient	HQ	unitless	6.23E-08	=I/(BW*RfD)
Total daily intake of contaminant	I	mg/day	8.72E-08	calculated
Reference dose	RfD	mg/kg/day	2.00E-02	chemical-specific
DEHP				

Insert chemical specific information				
PARAMETER	**SYMBOL**	**UNITS**	**VALUE**	**DEFAULT/COMMENT**
Chemical Name			Hexachlorobenzene	
Soil loss constant due to degradation	ksg	1/yr	0	USEPA, 1994b
Fraction of pollutant in vapor phase	Fv	dimensionless	1	chemical-specific; Hexachlorobenzene (USEPA, 1994a,b)
Soil-water partition coefficient	Kd_s	mL/g	2800	USEPA, 1994b
Air-to-plant biotransfer factor	Bv	[ug/pollutant/g plant tissue DW]/[ug pollutant/g air]	290	USEPA, 1994b
Ratio of concentration in the roots to concentration in soil pore water	RCF	[ug/pollutant/g plant tissue FW]/[ug pollutant/mL pore water]	520	USEPA, 1994b
Biotransfer factor for beef	Ba_beef	day/kg	0.008	chemical-specific; Hexachlorobenzene (USEPA, 1994a,b)
Biotransfer factor for milk	Ba_milk	day/kg	0.0025	chemical-specific; Hexachlorobenzene (USEPA, 1994a,b)
Fraction of wet deposition that adheres to plant surfaces	Fw	dimensionless	0.6	chemical-specific; Hexachlorobenzene (USEPA, 1994a,b)
Cancer Slope Factor	CSF	(mg/kg/day)^-1	1.60E+00	USEPA, 1994b, IRIS
Reference Dose	RfD	(mg/kg/day)	8.00E-04	USEPA, 1994b, IRIS
MODEL OUTPUTS				
Modeled dry deposition - stack		g/m^2	3.40E-06	COMDEP
Modeled dust deposition - fugitives		g/m^2	0.00E+00	
Modeled wet deposition		g/m^2	2.97E-04	COMDEP
Modeled annual air concentration		ug/m^3	3.70E-05	ISCST2
Total time period over which deposition occurs	Tc	yrs	0.37	site-specific
Average annual dry deposition	Dyd	g/m^2/yr	3.15E-08	Modeled; Dry deposition from stack
Average annual wet deposition	Dyw	g/m^2/yr	2.75E-06	Modeled; Hexachlorobenzene
Average annual air concentration	Cy	ug/m^3	3.42E-07	Modeled; Hexachlorobenzene

CANCER RISK AND HAZARD QUOTIENT FOR INDIVIDUAL CHEMICALS FOR SUBSISTENCE FARMER SCENARIO				
PARAMETER	**SYMBOL**	**UNITS**	**VALUE**	**COMMENT/DEFAULT**
Individual lifetime cancer risk	CRL	unitless	2.81E-08	=(I*ED*EF*CSF)/(BW*AT*365)
Total daily intake of contaminant	I	mg/day	2.25E-06	calculated
Exposure duration	ED	yr	40	High end; assumes farmers live longer at one location than the general population (USEPA, 1994a,b)
Exposure frequency	EF	day/yr	350	350
Body weight	BW	kg	70	70
Averaging time	AT	yr	70	70
Conversion factor	CF	day/yr	365	365
Oral cancer slope factor	CSF	(mg/kg-day)^-1	1.60E+00	chemical-specific
Hazard Quotient	HQ	unitless	4.01E-05	=I/(BW*RfD)
Total daily intake of contaminant	I	mg/day	2.25E-06	calculated
Reference dose	RfD	mg/kg/day	8.00E-04	chemical-specific
Hexachlorobenzene				

Insert chemical specific information				
PARAMETER	**SYMBOL**	**UNITS**	**VALUE**	**DEFAULT/COMMENT**
Chemical Name			Lead	
Soil loss constant due to degradation	ksg	1/yr	0	USEPA, 1994b
Fraction of pollutant in vapor phase	Fv	dimensionless	0	chemical-specific; Lead (USEPA, 1994a,b)
Soil-water partition coefficient	Kd_s	mL/g	600	USEPA, 1994b
Air-to-plant biotransfer factor	Bv	[ug/pollutant/g plant tissue DW]/[ug pollutant/g air]	NA	USEPA, 1994b
Ratio of concentration in the roots to concentration in soil pore water	RCF	[ug/pollutant/g plant tissue FW]/[ug pollutant/mL pore water]	NA	USEPA, 1994b
Biotransfer factor for beef	Ba_beef	day/kg	NA	chemical-specific; Lead (USEPA, 1994a,b)
Biotransfer factor for milk	Ba_milk	day/kg	NA	chemical-specific; Lead (USEPA, 1994a,b)
Fraction of wet deposition that adheres to plant surfaces	Fw	dimensionless	0.6	chemical-specific; Lead (USEPA, 1994a,b)
Cancer Slope Factor	CSF	(mg/kg/day)^-1	NA	USEPA, 1994b, IRIS
Reference Dose	RfD	(mg/kg/day)	NA	USEPA, 1994b, IRIS
MODEL OUTPUTS				
Modeled dry deposition - stack		g/m^2	6.77E-06	COMDEP
Modeled dust deposition - fugitives		g/m^2	0.00E+00	
Modeled wet deposition		g/m^2	5.91E-04	COMDEP
Modeled annual air concentration		ug/m^3	7.37E-05	ISCST2
Total time period over which deposition occurs	Tc	yrs	0.37	site-specific
Average annual dry deposition	Dyd	g/m^2/yr	6.26E-08	Modeled; Dry deposition from stack
Average annual wet deposition	Dyw	g/m^2/yr	5.47E-06	Modeled; Lead
Average annual air concentration	Cy	ug/m^3	6.82E-07	Modeled; Lead

CANCER RISK AND HAZARD QUOTIENT FOR INDIVIDUAL CHEMICALS FOR SUBSISTENCE FARMER SCENARIO

PARAMETER	SYMBOL	UNITS	VALUE	COMMENT/DEFAULT
Individual lifetime cancer risk	CRL	unitless	NA	=(I*ED*EF*CSF)/(BW*AT*365)
Total daily intake of contaminant	I	mg/day	#VALUE!	calculated
Exposure duration	ED	yr	40	High end; assumes farmers live longer at one location than the general population (USEPA, 1994a,b)
Exposure frequency	EF	day/yr	350	350
Body weight	BW	kg	70	70
Averaging time	AT	yr	70	70
Conversion factor	CF	day/yr	365	365
Oral cancer slope factor	CSF	(mg/kg-day)^-1	NA	chemical-specific
Hazard Quotient	HQ	unitless	NA	=I/(BW*RfD)
Total daily intake of contaminant	I	mg/day	#VALUE!	calculated
Reference dose	RfD	mg/kg/day	NA	chemical-specific
Lead				

Insert chemical specific information				
PARAMETER	**SYMBOL**	**UNITS**	**VALUE**	**DEFAULT/COMMENT**
Chemical Name			Mercury	
Soil loss constant due to degradation	ksg	1/yr	0	USEPA, 1994b
Fraction of pollutant in vapor phase	Fv	dimensionless	1	chemical-specific; Mercury (USEPA, 1994a,b)
Soil-water partition coefficient	Kd_s	mL/g	150	USEPA, 1994b
Air-to-plant biotransfer factor	Bv	[ug/pollutant/g plant tissue DW]/[ug pollutant/g air]	1,000	USEPA, 1994b
Ratio of concentration in the roots to concentration in soil pore water	RCF	[ug/pollutant/g plant tissue FW]/[ug pollutant/mL pore water]	0.007	USEPA, 1994b
Biotransfer factor for beef	Ba_beef	day/kg	0.25	chemical-specific; Mercury (USEPA, 1994a,b)
Biotransfer factor for milk	Ba_milk	day/kg	0.00045	chemical-specific; Mercury (USEPA, 1994a,b)
Fraction of wet deposition that adheres to plant surfaces	Fw	dimensionless	0.6	chemical-specific; Mercury (USEPA, 1994a,b)
Cancer Slope Factor	CSF	(mg/kg/day)^-1		USEPA, 1994b, IRIS
Reference Dose	RfD	(mg/kg/day)	3.00E-04	USEPA, 1994b, IRIS
MODEL OUTPUTS				
Modeled dry deposition - stack		g/m^2	4.24E-04	COMDEP
Modeled dust deposition - fugitives		g/m^2	0.00E+00	
Modeled wet deposition		g/m^2	3.70E-02	COMDEP
Modeled annual air concentration		ug/m^3	4.61E-03	ISCST2
Total time period over which deposition occurs	Tc	yrs	0.37	site-specific
Average annual dry deposition	Dyd	g/m^2/yr	3.92E-06	Modeled; Dry deposition from stack
Average annual wet deposition	Dyw	g/m^2/yr	3.42E-04	Modeled; Mercury
Average annual air concentration	Cy	ug/m^3	4.26E-05	Modeled; Mercury

CANCER RISK AND HAZARD QUOTIENT FOR INDIVIDUAL CHEMICALS FOR SUBSISTENCE FARMER SCENARIO

PARAMETER	SYMBOL	UNITS	VALUE	COMMENT/DEFAULT
Individual lifetime cancer risk	CRL	unitless	0	=(I*ED*EF*CSF)/(BW*AT*365)
Total daily intake of contaminant	I	mg/day	0.003791	calculated
Exposure duration	ED	yr	40	High end; assumes farmers live longer at one location than the general population (USEPA, 1994a,b)
Exposure frequency	EF	day/yr	350	350
Body weight	BW	kg	70	70
Averaging time	AT	yr	70	70
Conversion factor	CF	day/yr	365	365
Oral cancer slope factor	CSF	(mg/kg-day)^-1	0.00E+00	chemical-specific
Hazard Quotient	HQ	unitless	0.180521	=I/(BW*RfD)
Total daily intake of contaminant	I	mg/day	0.003791	calculated
Reference dose	RfD	mg/kg/day	3.00E-04	chemical-specific
Mercury				

Insert chemical specific information				
PARAMETER	**SYMBOL**	**UNITS**	**VALUE**	**DEFAULT/COMMENT**
Chemical Name			2,3,7,8-TCDD equivalents	
Soil loss constant due to degradation	ksg	1/yr	0.07	USEPA, 1994b
Fraction of pollutant in vapor phase	Fv	dimensionless	0.6	chemical-specific; 2,3,7,8-TCDD (USEPA, 1994a,b)
Soil-water partition coefficient	Kd_s	mL/g	25000	USEPA, 1994b
Air-to-plant biotransfer factor	Bv	[ug/pollutant/g plant tissue DW]/[ug pollutant/g air]	270,000	USEPA, 1994b
Ratio of concentration in the roots to concentration in soil pore water	RCF	[ug/pollutant/g plant tissue FW]/[ug pollutant/mL pore water]	3900	USEPA, 1994b
Biotransfer factor for beef	Ba_beef	day/kg	0.11	chemical-specific; 2,3,7,8-TCDD (USEPA, 1994a,b)
Biotransfer factor for milk	Ba_milk	day/kg	0.035	chemical-specific; 2,3,7,8-TCDD (USEPA, 1994a,b)
Fraction of wet deposition that adheres to plant surfaces	Fw	dimensionless	0.6	chemical-specific; 2,3,7,8-TCDD (USEPA, 1994a,b)
Cancer Slope Factor	CSF	(mg/kg/day)^-1	1.56E+05	USEPA, 1994b, IRIS
Reference Dose	RfD	(mg/kg/day)	NA	USEPA, 1994b, IRIS
MODEL OUTPUTS				
Modeled dry deposition - stack		g/m^2	4.22E-12	COMDEP
Modeled dust deposition - fugitives		g/m^2	0.00E+00	
Modeled wet deposition		g/m^2	3.68E-10	COMDEP
Modeled annual air concentration		ug/m^3	4.59E-11	ISCST2
Total time period over which deposition occurs	Tc	yrs	0.37	site-specific
Average annual dry deposition	Dyd	g/m^2/yr	3.90E-14	Modeled; Dry deposition from stack
Average annual wet deposition	Dyw	g/m^2/yr	3.40E-12	Modeled; 2,3,7,8-TCDD eq
Average annual air concentration	Cy	ug/m^3	4.25E-13	Modeled; 2,3,7,8-TCDD eq

CANCER RISK AND HAZARD QUOTIENT FOR INDIVIDUAL CHEMICALS FOR SUBSISTENCE FARMER SCENARIO

PARAMETER	SYMBOL	UNITS	VALUE	COMMENT/DEFAULT
Individual lifetime cancer risk	CRL	unitless	4.66E-08	=(I*ED*EF*CSF)/(BW*AT*365)
Total daily intake of contaminant	I	mg/day	3.82E-11	calculated
Exposure duration	ED	yr	40	High end; assumes farmers live longer at one location than the general population (USEPA, 1994a,b)
Exposure frequency	EF	day/yr	350	350
Body weight	BW	kg	70	70
Averaging time	AT	yr	70	70
Conversion factor	CF	day/yr	365	365
Oral cancer slope factor	CSF	(mg/kg-day)^-1	1.56E+05	chemical-specific
Hazard Quotient	HQ	unitless	NA	=I/(BW*RfD)
Total daily intake of contaminant	I	mg/day	3.82E-11	calculated
Reference dose	RfD	mg/kg/day	NA	chemical-specific
2,3,7,8-TCDD equivalents				

Soil Treatment Final Report
Woods Industries Site
Yakima, Washington

Volume III —Appendices E-2 and E-3

August 7, 1996

Prepared for:

BURLINGTON NORTHERN RAILROAD
Seattle, Washington

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Project 12883088

PHILIP
ENVIRONMENTAL

APPENDIX E-3

Ambient Air Monitoring Plan

Ambient Air Monitoring Plan for On-Site Soil Treatment Activities at the Woods Industries Site, Yakima, Washington

February 7, 1995 Revision

Prepared for:

BURLINGTON NORTHERN RAILROAD INC.
Seattle, Washington

BURLINGTON
ENVIRONMENTAL
A Philip Environmental Company

Columbia, Illinois

Ambient Air Monitoring Plan for On-Site Soil Treatment Activities at the Woods Industries Site, Yakima, Washington

February 7, 1995 Revision

Prepared for:

BURLINGTON NORTHERN RAILROAD INC.
Seattle, Washington

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Project 12883088

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Executive Summary

On behalf of Burlington Northern Railroad, this ambient air monitoring plan will be implemented during operation of a low-temperature thermal desorption unit at the Woods Industries Site. This unit is expected to operate for approximately three months to treat pesticide-contaminated soil on site. This ambient air monitoring plan is an integral part of the Soil Treatment Work Plan Package.

The objectives of this air monitoring program will be to:

- provide near-real-time feedback on air impacts related to site activities;
- measure wind speed and wind direction to identify the most likely airborne contaminant migration directions;
- document ambient concentrations of hazardous constituents during LTTD operation;
- document that applicable National Ambient Air Quality Standards (NAAQS) have not been exceeded as a consequence of LTTD operation;
- collect data by utilizing time-integrated ambient air sampling methods to implement mitigation procedures, as necessary, to reduce the potential for off-site migration of contaminants; and
- provide a means of checking model-predicted concentrations used to estimate risks.

This plan is intended to be a prescriptive presentation of the monitoring program, documenting the rationale for undertaking the monitoring effort and the methods to be employed to achieve the desired goals. It is designed to provide sufficient detail and specificity to ensure that those tasked to perform the various components of the project will be able to successfully achieve the desired goals. The plan is also intended to provide sufficient detail for one to reconstruct, from some point in the future, if necessary, the work performed.

Ambient air will be monitored in three phases of activities:

- **Baseline Air Monitoring** — five days of monitoring before LTTD unit operation to establish background conditions;

- **Remedial Action Air Monitoring** — daily for PM_{10} from the start of LTTD unit operations and daily for other parameters beginning when contaminated soil is first processed through the LTTD unit until the end of the performance test and, with USEPA approval, a reduced frequency, such as every third or sixth day, thereafter during ongoing operation to measure actual ambient air impacts from site emissions (fugitive and source); and

- **Post-Remedial Action Air Monitoring** — five days of monitoring after LTTD unit operation (if necessary based on observed concentrations) to establish that baseline concentrations have been restored in the vicinity of the site.

A portable real-time particulate monitor will be used as necessary to help direct dust control measures. A stationary real-time particulate monitor will be operated continuously at the east perimeter near the LTTD unit. The stationary monitor will be used to measure 1-hour average concentrations.

PM_{10}, DDT, dieldrin, hexachlorobenzene, and mercury will be monitored at the site perimeter and at two off-site monitoring locations. Samples will be collected for 24-hour periods.

Quality assurance and quality control checks will be made during operation of the system to demonstrate that the ambient air monitoring is achieving the desired data quality objectives.

1 INTRODUCTION

This ambient air monitoring plan will be implemented during operation of a low-temperature thermal desorption (LTTD) unit to treat pesticide-contaminated soil at the Woods Industries Site in Yakima, Washington. This plan was developed on behalf of Burlington Northern Railroad (BNRR), the site owner. This plan is an integral part of the Soil Treatment Work Plan Package.

BNRR is performing this cleanup in accordance with the Administrative Order on Consent (Number 1087-03-187-1096) for this site. U.S. Environmental Protection Agency Region X (USEPA) is providing oversight for the cleanup of this site.

Soil treatment at the site will take approximately three months and will be complete no later than June 30, 1995. The site location is shown in Figure 1-1 Site Location Map.

Figure 1-1 Site Location Map

PROJECT MANAGER

DOCUMENT MANAGER

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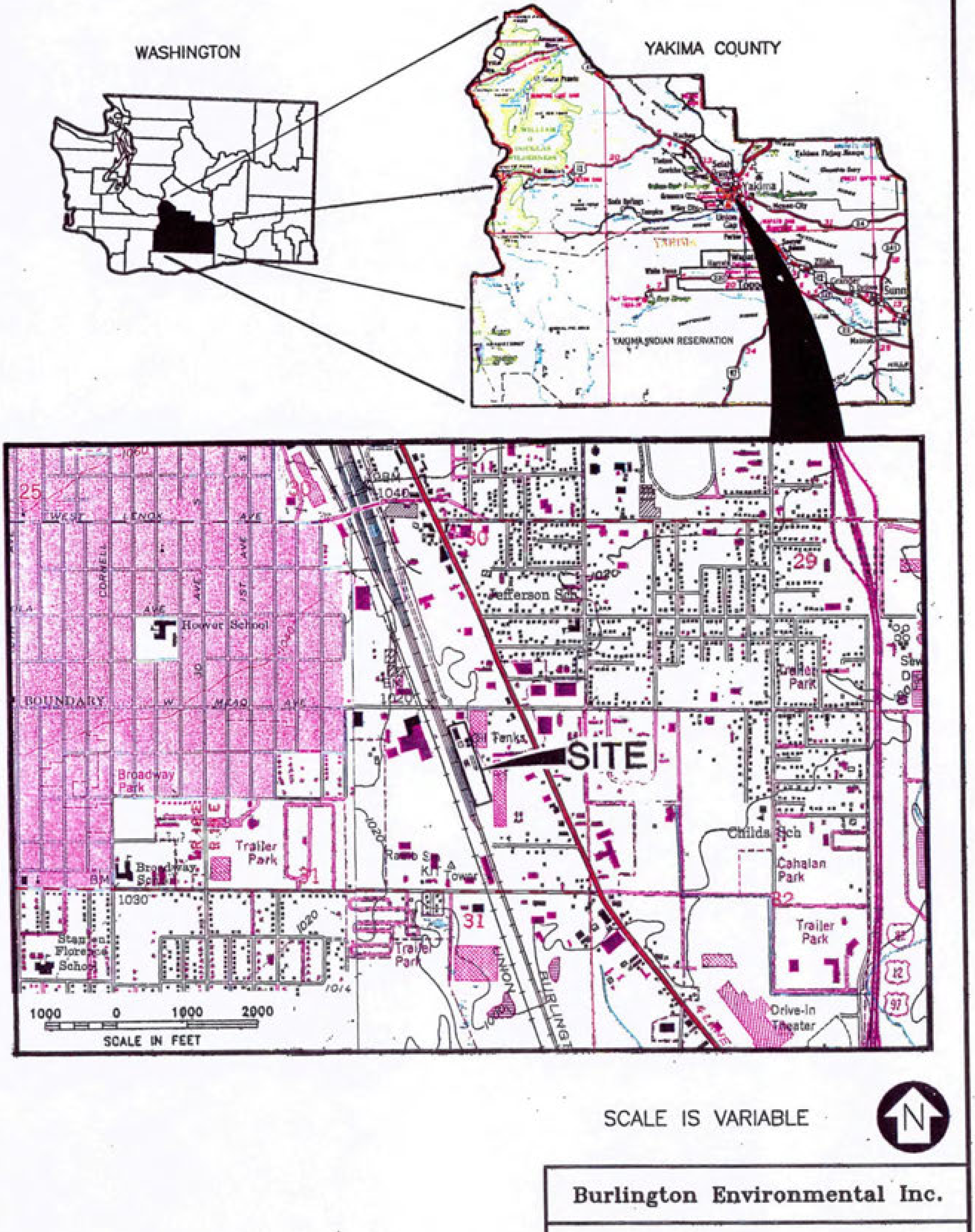


Burlington Environmental Inc.

SITE LOCATION MAP

WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON
12883088

FIGURE 1-1

Modified from U.S. Geological Survey, Yakima East, Washington, quadrangle, Photorevised 1985.

1.1 General

The worst-case effects from operation of the LTTD unit are evaluated in the *Ambient Air Quality Impact Report for Soil Treatment, Woods Industries Site, Yakima, Washington* (AAQIR) for this remedial action (Burlington Environmental, 1994). As described in the AAQIR, the ambient air impacts from operation of the LTTD unit will be within USEPA and Washington Department of Ecology guidelines. The air monitoring program described in this plan is intended to document that air quality is not adversely affected by operation of the LTTD unit and to provide real-time monitoring results so corrective actions can be made quickly if information indicates that standards are exceeded.

This plan was developed in accordance with the USEPA's May 1993 *Air/Superfund National Technical Guidance Study Series: Volume IV - Guidance for Ambient Air Monitoring at Superfund Sites (Revised)* and additional guidance documents cited herein.

1.2 Background

As part of an agreement between BNRR and USEPA Region X, pesticide-contaminated soil at the Woods Industries Site will be processed through the LTTD unit in early 1995 to remove and destroy the pesticide contamination from the soil.

Soil at the site was contaminated by material handling and disposal practices of Woods Industries (Crop King), which operated a pesticide-formulation business from approximately 1938 to May 1985 on property leased from BNRR. Due to its concern about Woods Industries' environmental practices, BNRR ended the lease in 1985. Since then, BNRR and USEPA have investigated the site, selected a remedial alternative, removed contaminated soil from the ground, and placed the contaminated soil in stockpiles where it awaits treatment. Processing of the soil through the LTTD unit is part of the selected remedial alternative.

1.3 Project Description

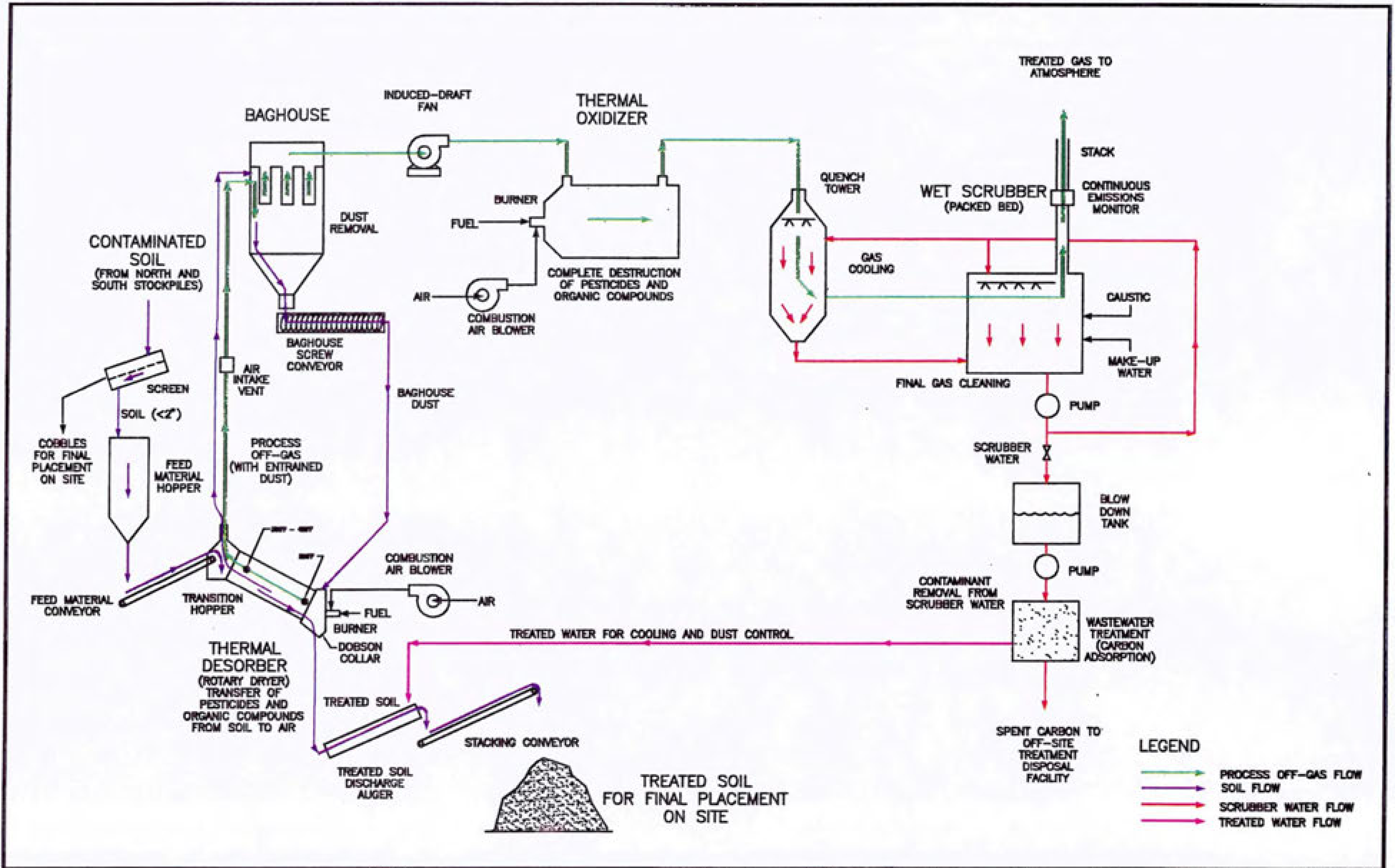
Williams Environmental Inc. will operate, on behalf of BNRR, one of its LTTD units (TPU-4) on site for approximately three months. Approximately 19,000 tons of pesticide-contaminated soil is to be processed. Figure 1-2 is a schematic drawing of the treatment system. The planned equipment layout is shown in Figure 1-3.

Soil from the storage piles will first be fed through a screening process to remove oversize materials (cobbles larger than a specific diameter). Once the cobbles are removed, the soil will be fed through the LTTD unit, tested to evaluate the effectiveness of the treatment, held for evaluation of the test results, and returned to the ground as backfill. Treated soil will be reprocessed as necessary to meet the treatment criteria established by USEPA. Cobbles will be returned to the ground as backfill without further processing. These soil handling and treatment activities can potentially generate emissions, which will be controlled through a rigorous program of fugitive and source emission controls.

The LTTD unit includes a sealed, rotary dryer in which the soil will be heated to cause the pesticides to become airborne for transport to the thermal oxidizer. The treated soil will exit the rotary dryer via an auger, where the soil will be wetted to reduce the potential for fugitive dust emissions, before being placed in a treated soil storage pile. Air drawn from the rotary dryer is expected to contain some airborne soil particles. These will be extracted from the gas flow in a heated baghouse, where particles will be captured for additional treatment. Pesticides and other organic vapors will remain airborne and flow into a thermal oxidizer to be destroyed. From the thermal oxidizer, the air will flow through pollution control devices (a quencher and a scrubber) to capture particulate matter and acid gases before being released to the atmosphere. Actual emissions from the stack will be measured during an on-site performance test prior to full-capacity operation of the LTTD unit. The performance test work plan is a separate document that will be approved by the USEPA prior to the start of performance testing.

All work is being performed with oversight from USEPA Region X. Burlington Environmental is serving as BNRR's consultant site manager on this project. Burlington Environmental or its subcontractor will perform the ambient air monitoring activities described in this plan.

Figure 1-2 LTTD Process Flow Diagram



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TITLE:
LTTD Process Flow Diagram

DWN: TMM	DES.:
CHKD.:	APPD:
DATE: 11/18/94	REV.:

PROJECT NO.: 12883088
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

FIGURE 1–2

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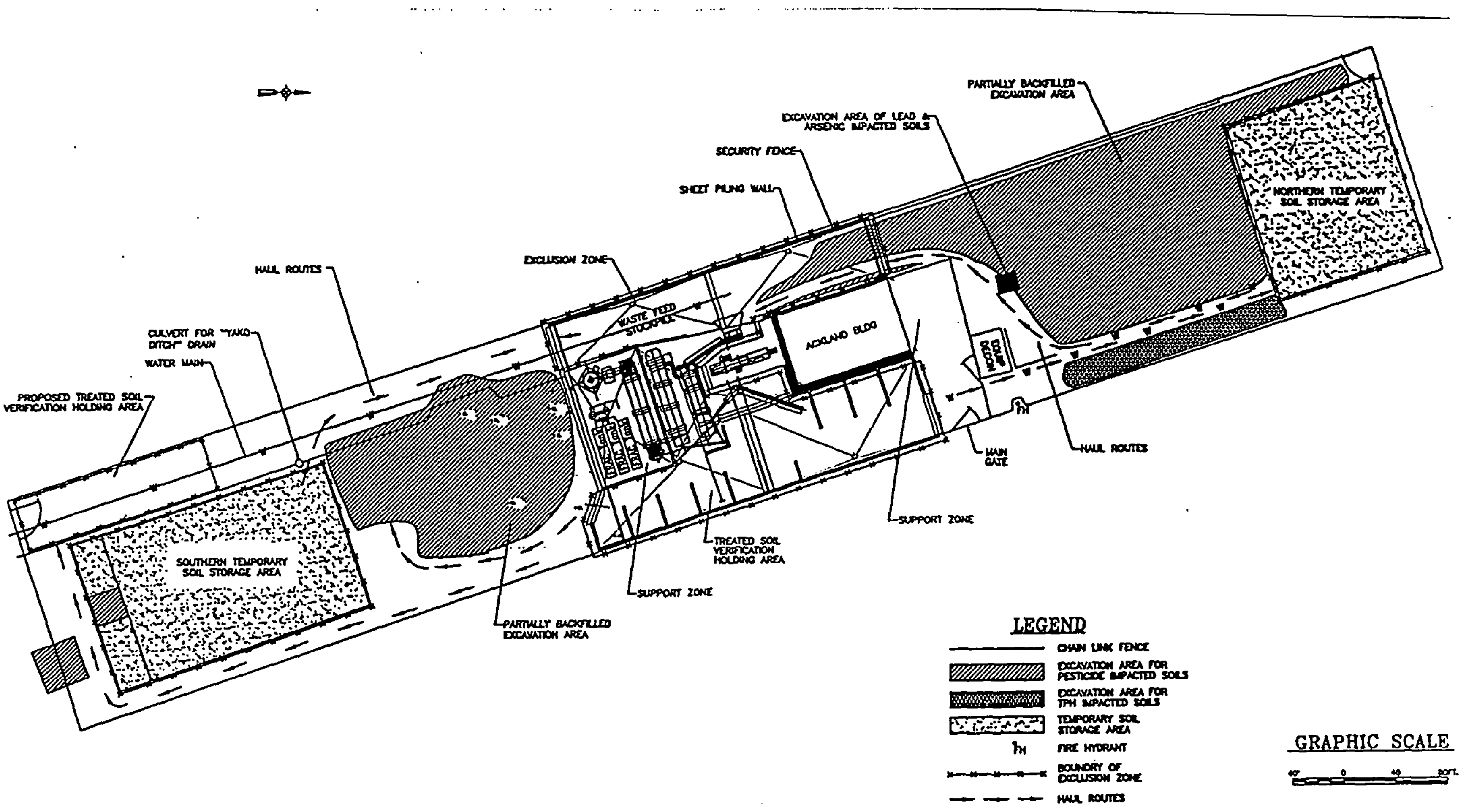
Figure 1-3 Site Layout



BURLINGTON ENVIRONMENTAL
– A Philip Environmental Company –

TITLE:
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DWN: TMM
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CHKD:
APPD:
DATE: 11/18/94
REV.:

PROJECT NO.: 12883088
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

FIGURE 1–3

Ambient air will be monitored in three phases of activities:

- **Baseline Air Monitoring** — before LTTD unit operation to establish background conditions;
- **Remedial Action Air Monitoring** — during LTTD unit operation to measure actual ambient air impacts from site emissions (fugitive and source); and
- **Post-Remedial Action Air Monitoring** — after LTTD unit operation (if necessary based on observed concentrations) to establish that baseline concentrations have been restored in the vicinity of the site.

The procedures described in this plan will be used to perform this monitoring.

Soil will be removed from one stockpile at a time. The north stockpile will be treated first. Ambient air monitoring activities will be focused on the center of the site near the LTTD unit and the end of the site near the active soil stockpile.

1.4 Purpose of the Ambient Air Monitoring Plan

The purposes of this air monitoring program will be to:

- provide near-real-time feedback on air impacts related to site activities;
- measure wind speed and wind direction to identify the most likely airborne contaminant migration directions;
- document ambient concentrations of hazardous constituents during LTTD operation;
- document that applicable National Ambient Air Quality Standards (NAAQS) have not been exceeded as a consequence of LTTD operation;
- collect data by utilizing time-integrated ambient air sampling methods to implement mitigation procedures, as necessary, to reduce the potential for off-site migration of contaminants; and
- provide a means of checking model-predicted concentrations used to estimate risks.

This plan is intended to be a prescriptive presentation of the monitoring program, documenting the rationale for undertaking the monitoring effort and the methods to be employed to achieve the desired goals. It is designed to provide sufficient detail and specificity to ensure that those tasked to perform the various components of the project will be able to successfully achieve the desired goals. The plan is also intended to provide sufficient detail for one to reconstruct, from some point in the future, if necessary, the work performed.

1.5 Organization of this Plan

An overview of the ambient air monitoring program is presented in Chapter 2.

Meteorological monitoring is described in Chapter 3. Appendix A contains descriptions and calibration procedures for the meteorological monitoring equipment.

Ambient air monitoring is described in Chapter 4. Test methods for ambient air monitoring are in Appendix B.

Quality control and reporting procedures for these activities are described in both Chapters 3 and 4.

Actions that will be taken if site-related impacts exceed certain limits are described in Section 4.6.

2 OVERVIEW OF THE AMBIENT AIR MONITORING PROGRAM

Ambient air will be monitored at the Woods Industries Site to accomplish the following objectives:

- provide near–real–time feedback on air impacts related to site activities;
- measure wind speed and wind direction to identify the most likely airborne contaminant migration directions;
- document ambient concentrations of hazardous constituents during LTTD operation;
- document that applicable National Ambient Air Quality Standards (NAAQS) have not been exceeded as a consequence of LTTD operation;
- collect data by utilizing time-integrated ambient air sampling methods to implement mitigation procedures, as necessary, to reduce the potential for off-site migration of contaminants; and
- provide a means of checking model-predicted concentrations used to estimate risks.

To accomplish these objectives, meteorological monitoring and ambient air monitoring will be performed. These are described in detail in Chapters 3 and 4, respectively, and briefly described in the following sections.

2.1 Meteorological Monitoring

Meteorological monitoring will consist of measuring wind speed, wind direction, temperature, barometric pressure, and relative humidity.

Quality assurance will be performed in accordance with the *On-Site Meteorological Program Guidance for Regulatory Modeling Applications* (USEPA, 1987) and *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV - Meteorological Measurements* (USEPA, 1989).

The meteorological monitoring data will be used daily to identify, if possible, which ambient air monitoring stations are upwind and downwind of the soil treatment activities. This information will be needed to identify the site-related impacts to ambient air quality.

2.2 Ambient Air Monitoring

To document conditions before and during soil treatment, ambient air monitoring will be performed in three phases:

- baseline air monitoring;
- remedial action air monitoring; and
- if necessary, post-remedial action air monitoring.

Monitoring will be performed at the site perimeter to measure the fugitive emissions from soil handling and processing activities. Off-site monitoring will be performed to measure the effects of LTTD unit stack emissions.

During each event, ambient air will be monitored at six stations on or around the site. Four will be at the site perimeter (two west and two east of the site) and two will be off site. Perimeter monitoring will be performed at one of the two sets of established locations depending upon which soil stockpile is being used. The off-site monitoring stations will be at, or as close as possible to, the locations that are predicted by the modeling presented in the AAQIR to be the 24-hour maximum exposed individual and an approximately equal distance on the opposite side of the site. These off-site locations are approximately one-half mile east and one-third mile west-northwest of the stack.

Samples will be analyzed, for all parameters except real-time particulate data and mercury vapor, by an off-site laboratory. Mercury vapor samples will be analyzed on site.

Ambient air will be monitored for DDT, dieldrin, hexachlorobenzene, PM_{10} (particulate matter smaller than 10 microns) and mercury. These parameters were selected based on the risk assessment performed during development of the *Ambient Air Quality Impact Report* (Burlington Environmental, 1994). Particulate matter concentrations will also be measured using a real-time instrument to help direct dust control activities.

3 METEOROLOGICAL MONITORING

Weather conditions will be monitored to document the direction potential airborne contaminants travel onto or from the site. Meteorological monitoring will be performed by Burlington Environmental or a subcontractor as described in this chapter.

The National Oceanic and Atmospheric Administration (1987) description of the climate in Yakima is presented below.

Yakima is located in a small east–west valley in the upper (northwestern) part of the Yakima Valley. Local topography is complex with a number of minor valleys and ridges giving a local relief of as much as 1,000 feet. This complex topography results in marked variations in air drainage, winds, and low temperatures within short distances.

The climate of the Yakima Valley is relatively mild and dry. It has characteristics of both maritime and continental climates, modified by the Cascade and the Rocky Mountains, respectively. Summers are dry and rather hot, and winters cool with only light snowfall. **The maritime influence is strongest in winter when the prevailing westerlies are the strongest and most steady.** The Selkirk and Rocky Mountains in British Columbia and Idaho shield the area from most of the very cold air masses that sweep down from Canada into the Great Plains and eastern United States. Sometimes a strong polar high pressure area over western Canada will occur at the same time that a low pressure area covers the southwestern United States. On these occasions, the cold arctic air will pour through the passes and down the river valleys of British Columbia, bringing very cold temperatures to Yakima. However, over one-half of the winters remain above zero.

The modifying influence of the Pacific Ocean is much less in summer. Afternoons are hot, but the dry air results in a rapid temperature fall after sunset, and nights are pleasantly cool with summertime low temperatures, usually in the 60s. Spells of 4 to 11 days of 100 degrees or more have occurred.

The length of the growing season varies depending on the immediate topography and the crop grown. Temperatures below 32 degrees are infrequent during the period from mid-May through September. Temperatures below 40 degrees during July and August have occurred in about half the years.

Precipitation follows the pattern of a West Coast Marine climate with the typical late fall and early winter high. However, since Yakima lies in the rain shadow of the Cascades, total amounts are small. The three months, November to January, total nearly half of the annual fall. Late June, July, and August are very dry.

Irrigation is necessary for nearly all crops. Ample water supplies are available from the snowmelt in the Cascade Mountains, which is collected in storage reservoirs for summer use.

Snowfall in the Yakima area is light, averaging 20 to 25 inches.

Summers are sunny, with about 85 percent of the possible sunshine. Winters are generally cloudy, with only a third of the possible sunshine.

Winds are mostly light, averaging about 7 mph for the year, being somewhat stronger in late spring and weaker in winter. Speeds of 30 to 35 mph are reached at least once in about half the months and speeds over 40 mph occur in about 1 out of 9 months. **The most common wind direction in downtown Yakima is northwest, while at the airport the wind is from the west in winter and the west-northwest in summer.**

3.1 Meteorological Monitoring Parameters

A 10-meter tower will be equipped with sensors and instruments to measure the following parameters:

- horizontal wind speed;
- horizontal wind direction;
- temperature; and
- relative humidity.

In addition, barometric pressure will be measured at ground level.

All sensors will be connected to an electronic data logger.

3.2 Description of the Monitoring Site

A 10-meter tower will be installed near the Woods Industries Site approximately 200 feet west of the Akland Building as shown in Figure 3-1. This location was chosen based on the following factors:

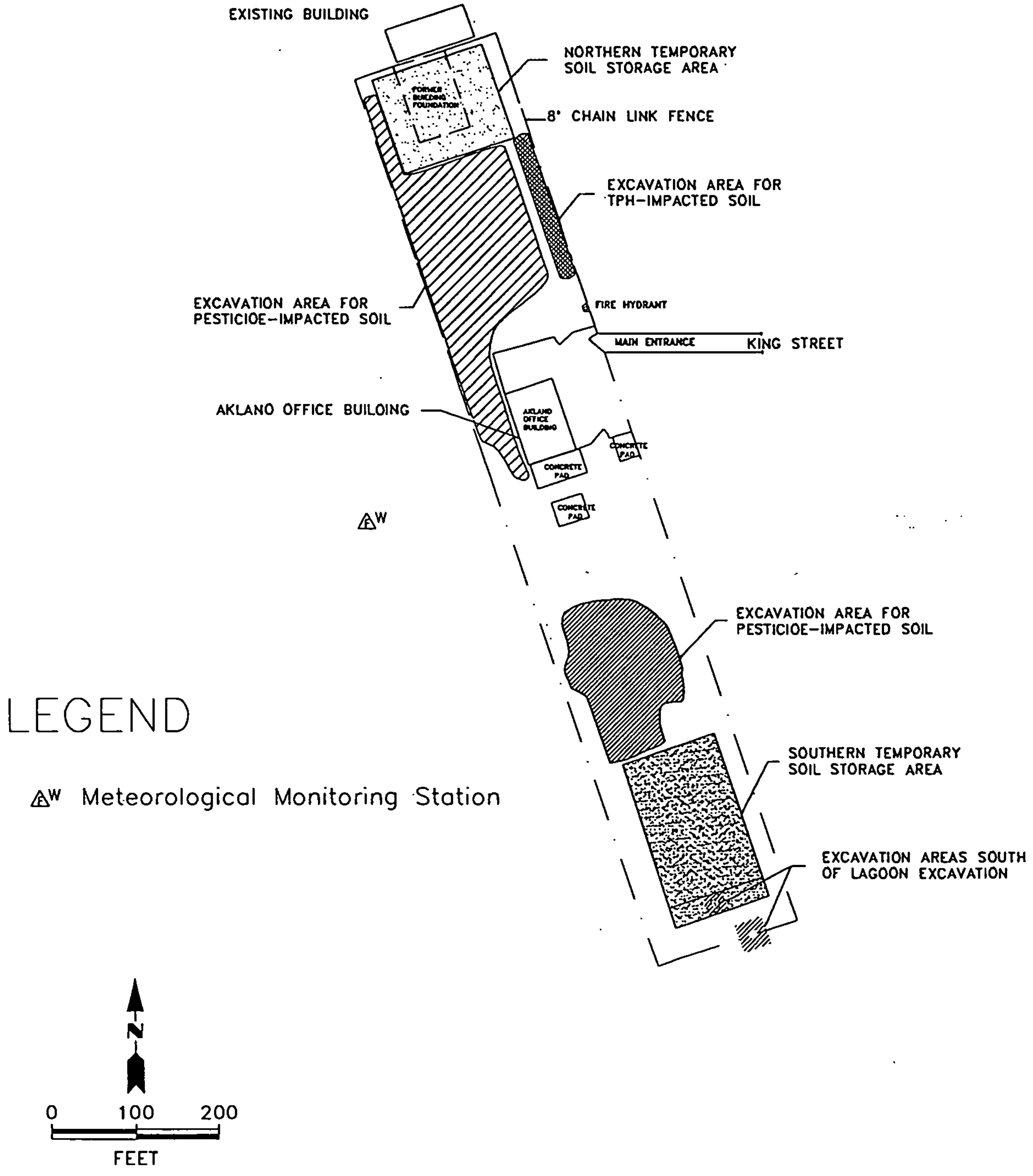
- avoidance of interference with on-site activities;
- representative of local, on-site wind conditions;
- exposure and generally flat topography;
- accessibility; and
- availability of power service.

Building-induced influences on wind (from the Akland Building, the stockpiles, nearby off-site buildings, railcars on the adjacent six rail lines at the west perimeter, and crates stacked up to 30 feet high on the east perimeter) will occur on the entire site. Soil treatment activities will occupy or disturb, at one time or another, almost every part of the Woods site. This location was selected because it will be undisturbed throughout this remedial action and will be representative of on-site conditions. This meteorological data is intended to be used to measure impacts in the immediate vicinity of the site from LTTD unit operations. Meteorological data from higher than 10 meters would not accurately represent the effects of wind on emissions from fugitive sources near the ground surface. Considering the presence of buildings of similar height to the Akland Building on the northwest, north, and east sides of the site, the presence of six railroad tracks where box cars can be parked at any time immediately west of the site, and large stacks of crates on the east perimeter, this is a suitable location for meteorological monitoring for the intended purpose of the data.

As shown in Figure 3-1, on-site soil storage piles 20–25 feet high are present at the north and south ends of the site. The LTTD unit will occupy the center of the site. The Universal Transverse Mercator (UTM) Zone 10 coordinates of this location are approximately 692,000 meters Easting and 5,160,800 meters Northing. The base elevation is approximately 1,020 feet above mean sea level.

Yakima is in a relatively flat valley that slopes downward toward the east between nearby mountains. Ahtanum Ridge and Rattlesnake Hills,

Figure 3-1 Weather Station Location



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BURLINGTON ENVIRONMENTAL
– A Philip Environmental Company –

TITLE: Weather Station Location	DWN: KDM	DES.: KDM	PROJECT NO.: 12883088	Woods Industries Site Yakima, WA
	CHKD:	APPD:		
	DATE: 11/18/94	REV.: 0	Figure 3-1	

which are 2,000 to 2,200 feet high, are approximately three miles south of the site. The Yakima Ridge, which is more than 2,200 feet high, is approximately four miles north of the site. The town of Union Gap is approximately one mile south of the site. The site is in an industrial area located in the southeast part of Yakima, two miles east of the airport and one mile west of Interstate 82. Single-story industrial buildings are present in the vicinity of the site. Fruit-packing companies commonly stack shipping crates as much as 30 feet high during some parts of the year along the east fenceline of the site.

3.3 Description of the Meteorological Monitoring Equipment

An electronic weather station will be used to gather meteorological data. The system will be equipped with lightning and electrical surge protection. The system will meet USEPA equipment specifications for PSD (Prevention of Significant Deterioration) monitoring. The sensors will meet the accuracy and resolution specifications described in the following subsections.

Vendor information for this equipment is presented in Appendix A.

3.3.1 Sensors

Barometric pressure and relative humidity will be measured approximately 1.5 meters above ground at the office area. Horizontal wind speed, horizontal wind direction, and temperature sensors will be installed on the 10-meter tower. A naturally aspirated shield will be installed to protect the temperature sensor from solar radiation. These sensors will meet the following specifications.

Table 3-1 Meteorological Sensor Specifications

Sensor	Instrument	Specification	
Wind Speed	Met One 010C	Accuracy	0.15 mph or ± 1.0% of true wind speed (whichever is greater)
		Threshold	0.5 mph
		Range	0 to 125 mph
Wind Direction	Met One 020C	Accuracy	±3°
		Threshold	0.5 mph
		Range	0 to 360°
Temperature	Met One 083C-1-35	Accuracy	±0.27°F
		Range	–22° to 122°F
Barometric Pressure	Met One 090D	Accuracy	±0.04 in. Hg
Relative Humidity	Met One 083C-1-35	Accuracy	±3%
		Range	0 to 100%

3.3.2 Data Recording System

Data will be recorded electronically using a data logger. The system will meet the PSD level of precision and accuracy.

3.3.3 Spare Parts

Sufficient spare parts and equipment will be maintained on site to replace or repair failed or damaged equipment within three working days of failure or damage. This will include, at a minimum, a spare wind speed sensor and a spare wind direction sensor.

3.4 Meteorological Monitoring Quality Assurance/Quality Control

Quality assurance (QA) will be applied to location and equipment selection, equipment acquisition and installation, routine site operation, data processing, and reporting. Quality control (QC) procedures will be applied at each step to provide checks for acceptable conditions with corrective procedures specified when necessary.

This meteorological monitoring program is based on guidance documents such as Volume IV of the USEPA *Quality Assurance Handbook for Air Pollution Measurement Systems* (USEPA, 1989) and *On-Site Meteorological Program Guidance for Regulatory Applications* (USEPA, 1987). System and performance audits will be performed by qualified Burlington Environmental or subcontractor personnel not actively engaged in site operations or system installation. The following subsections describe the QC, calibration, and auditing procedures to be used during this ambient air monitoring program.

The purpose of QC procedures is to routinely assess and document data quality and to define remedial corrective actions when operating conditions exceed pre-established limits. Routine QC procedures are designed to focus on the areas most likely to have problems, based on experience and guidance documents. The audits, calibrations, and routine QC measures to be performed at regular intervals during operation of this system are shown in the following table.

Table 3-2 Meteorological System QA/QC Schedule

Frequency	QC Activity
Start of Program	Tower Installation, System Calibration
Daily	Routine Checks of Recorded Data
Monthly	Electronic Checks, Data Processing and Editing Checks

3.4.1 Quality Control: Sensors

The meteorological sensors will meet PSD ambient monitoring sensitivity guidelines. They will be installed and calibrated by qualified technicians from the equipment vendor.

The wind direction sensor will be oriented via compass siting scope and topographic maps for true north declination to ensure proper orientation. A digital voltmeter will be used to confirm that instrument output reflects the actual sensor direction.

QC of meteorological data will also include comparing recorded data to ambient conditions observed by field personnel performing routine site activities. As part of this step, a checklist will be completed by the field personnel assigned to the ambient air monitoring program. Verification of suspected equipment problems will be performed by these field personnel.

3.4.2 Quality Control: Data Recording System

QC tasks will be performed to assure both the accuracy of the data records and the consistency of the sensor measurements.

Meteorological data will be screened using the criteria listed in the following table.

Table 3-3 Meteorological Data Screening

Parameter	Flag data that:
Wind Speed	• is less than zero or greater than 25 m/s (56 mph) • does not vary by more than 0.1 m/s (0.2 mph) for 3 consecutive hours • does not vary by more than 0.5 m/s (1 mph) for 12 consecutive hours
Wind Direction	• is less than zero or greater than 360 degrees • does not vary by more than 1 degree for more than 3 consecutive hours • does not vary by more than 10 degrees for 18 consecutive hours
Ambient Temperature	• is greater than the local record high • is less than the local record low • is greater than a 5°C (9°F) change from the previous hour • does not vary by more than 0.5°C (1°F) for 12 consecutive hours
Relative Humidity	• is less than zero or greater than 100 percent

3.5 Calibration

The meteorological station will be calibrated using material and equipment traceable to NIST primary standards. Calibration results will be documented in field logbooks or calibration forms.

Formal calibration of the meteorological equipment will be performed at least once every six months by the manufacturer. The manufacturer uses NIST-traceable devices for all calibrations. The manufacturer will perform the initial on-site calibration.

3.6 Performance and System Audits

A QC audit for the meteorological measurement system will be performed at startup (prior to the performance test) and immediately prior to system dismantling (expected to be within 4 months of startup). The audits will be performed using procedures in *Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV, Meteorological Measurements* (USEPA, 1989).

Audits will include all components of the meteorological monitoring system: sensors, data recording, and data reporting. The performance and systems audits will be performed by qualified personnel not actively engaged in site operations or system installation. These audits will be performed by Burlington Environmental or subcontractor personnel experienced in meteorological monitoring system audits.

3.6.1 Horizontal Wind Direction

A siting scope fixed on a known east or west point will be used to measure the accuracy of the crossarm orientation. A linearity test fixture will be used to align the vane in known directions so the output voltages can be compared with known voltages. The starting threshold will be checked with a torque wheel.

Alternatively, a collocated meteorology station will be installed adjacent to the site meteorology station to evaluate the performance of the wind direction sensor.

3.6.2 Horizontal Wind Speed

A synchronous motor, which produces a known speed, will be used to audit the wind speed sensor system. The starting threshold will be checked with a torque wheel.

Alternatively, a collocated meteorology station will be installed adjacent to the site meteorology station to evaluate the performance of the wind speed sensor.

3.6.3 Ambient Temperature

A NIST-traceable thermometer will be used to audit the ambient temperature sensor. Two points will be checked. A distilled ice water slurry will be used to check for 32.0°F. A water bath from 69°F to 95°F will be used as the second point. Both readings will be made using distilled water in an insulated Thermos container. Readings will be recorded after a stable response is obtained.

Alternatively, a collocated meteorology station will be installed adjacent to the site meteorology station to evaluate the performance of the thermometer.

3.6.4 Barometric Pressure

A barometric pressure reading from the on-site monitoring station will be compared to the reading for the same time from the Yakima airport, which is less than two miles away. Both readings will be corrected to the same elevation.

Alternatively, a collocated meteorology station will be installed adjacent to the site meteorology station to evaluate the performance of the barometric pressure sensor.

3.6.5 Relative Humidity

A collocated transfer standard will be used to calibrate the relative humidity sensor.

Alternatively, a collocated meteorology station will be installed adjacent to the site meteorology station to evaluate the performance of the relative humidity sensor.

3.6.6 Results of the Performance Test

A percent difference between the known and observed values will be calculated based on the results of the audited sensors.

3.7 Data Reporting

Each day, a summary of wind direction, wind speed, ambient temperature, and relative humidity during the ambient air sampling period will be submitted to the Burlington Environmental Manager on site. Monthly and final data reports will be submitted to this manager. These reports will include the hourly data summarized by month, monthly data recovery percentages, and explanations of missing data. Audit reports will be prepared following each audit.

3.8 Monitoring Startup and Duration

The meteorological monitoring system will begin operation, simultaneous with the ambient air monitoring network, approximately 14 days prior to the expected startup of the soil treatment system. The system is designed to operate 24 hours per day, 7 days per week until the end of the ambient air monitoring program.

4 AMBIENT AIR MONITORING

Ambient air monitoring will be performed as described in this chapter. Three phases of monitoring will be performed: baseline, remedial action, and, if necessary, post-remedial action.

Simultaneous with this ambient air monitoring program, personnel and work area time-integrated and real-time sampling will be performed to protect the health of on-site personnel. Collection of these industrial hygiene samples is described in the Health and Safety Plan submitted separately.

4.1 Ambient Air Sampling Parameters

Ambient air will be sampled to monitor the concentrations of the following parameters:

- real-time particulate matter;
- PM_{10};
- DDT;
- dieldrin;
- hexachlorobenzene; and
- mercury (on particulate matter and as vapor).

These parameters were selected based on the risk assessment performed during development of the *Ambient Air Quality Impact Report* (Burlington Environmental, 1994).

Real-time particulate monitoring will be performed to provide an indication of the need for dust control measures during LTTD unit operation. PM_{10} (particulate matter smaller than 10 microns) was selected because Yakima is a non-attainment area for PM_{10} and soil treatment operations can generate fugitive dust emissions. In addition, PM_{10} results may be directly correlated with potential health effects of respirable particles. Mercury, a volatile metal, was selected because it contributes a significant portion of the potential risk attributable to the soil treatment activities. Hexachlorobenzene and dieldrin (both chlorinated semivolatile organic compounds) and DDT (a chlorinated nonvolatile organic compound) were selected because of their prevalence in the soil to be treated and their contribution to the potential risk attributable to the soil treatment activities.

The following table is a summary of the monitoring locations, sampling durations, and the sampling frequency for each monitoring program phase.

Mercury vapor will be monitored at two sampling locations (A11 and A21) for the first week of monitoring during the performance tests. Mercury monitoring may be discontinued after this week as described in Table 4-1 Ambient Air Sampling LocationsTable 4-1.

Table 4-1 Ambient Air Sampling Locations

Monitoring Program Phase	Sampling Frequency†	Sampling Duration per Event	Monitoring Phase Duration	Monitoring Locations	Parameters *(See Note)*
Baseline	5 days of sampling	24 hours	Within 14 days before soil treatment begins	4 Perimeter* and 2 Off Site	PM_{10} Mercury (PM_{10}) DDT Dieldrin Hexachlorobenzene
Remedial Action	• Daily until performance tests are complete • A reduced frequency thereafter‡	24 hours	Throughout soil treatment	4 Perimeter* and 2 Off Site	PM_{10} Mercury (PM_{10})§ DDT Dieldrin Hexachlorobenzene
Post-Remedial Action	5 days of sampling	24 hours	Within 14 days after soil treatment ceases	4 Perimeter* and 2 Off Site	PM_{10} Mercury (PM_{10}) DDT Dieldrin Hexachlorobenzene

NOTE: At one east perimeter location (A11), particulate matter will be monitored continuously on a real-time basis throughout all three phases of the ambient air monitoring program.

* The perimeter locations only on the end of the site nearest the active stockpile and near the middle of the site will be monitored at one time.

‡ Contingent upon observed concentration data, reductions in sampling frequency may be requested. Sampling pattern for "Every Third Day" program: Monday, Thursday, Sunday, Wednesday, Saturday, Tuesday, Friday, Monday, and so forth. Sampling pattern for "Every Sixth Day" program: Monday, Sunday, Saturday, Friday, and so forth.

† Sampling may be performed on additional days at the discretion of USEPA Region X, contingent upon 3-day notice to allow sample media, personnel, and laboratory services to be arranged.

§ Mercury vapor will be monitored using gold-coil dosimeters at locations A11 and A21 during the first week of monitoring to assess whether airborne mercury is present as vapor. Following USEPA review of the concentrations of mercury detected, if any, in the vapor and particulate phases, either the particulate or vapor monitoring for mercury may be eliminated from this monitoring program. If mercury vapor is retained, sampling for mercury will be performed at each of the six active monitoring locations.

4.2 Ambient Air Sampling Locations

Two types of locations will be monitored: perimeter and off-site.

Sampling locations were selected based on the prevailing wind direction for the seasons when the sampling is being performed and the area of the site where the majority of activity that may cause fugitive emissions is occurring. Figure 4-1 contains seasonal wind roses for Yakima. As shown in these wind roses, the prevailing wind during each season is from the west.

Wind directions in Yakima are significantly restricted by the east-west mountain ranges and the downward slope of the valley toward the east. Thus the sampling locations on the west perimeter will be predominantly upwind.

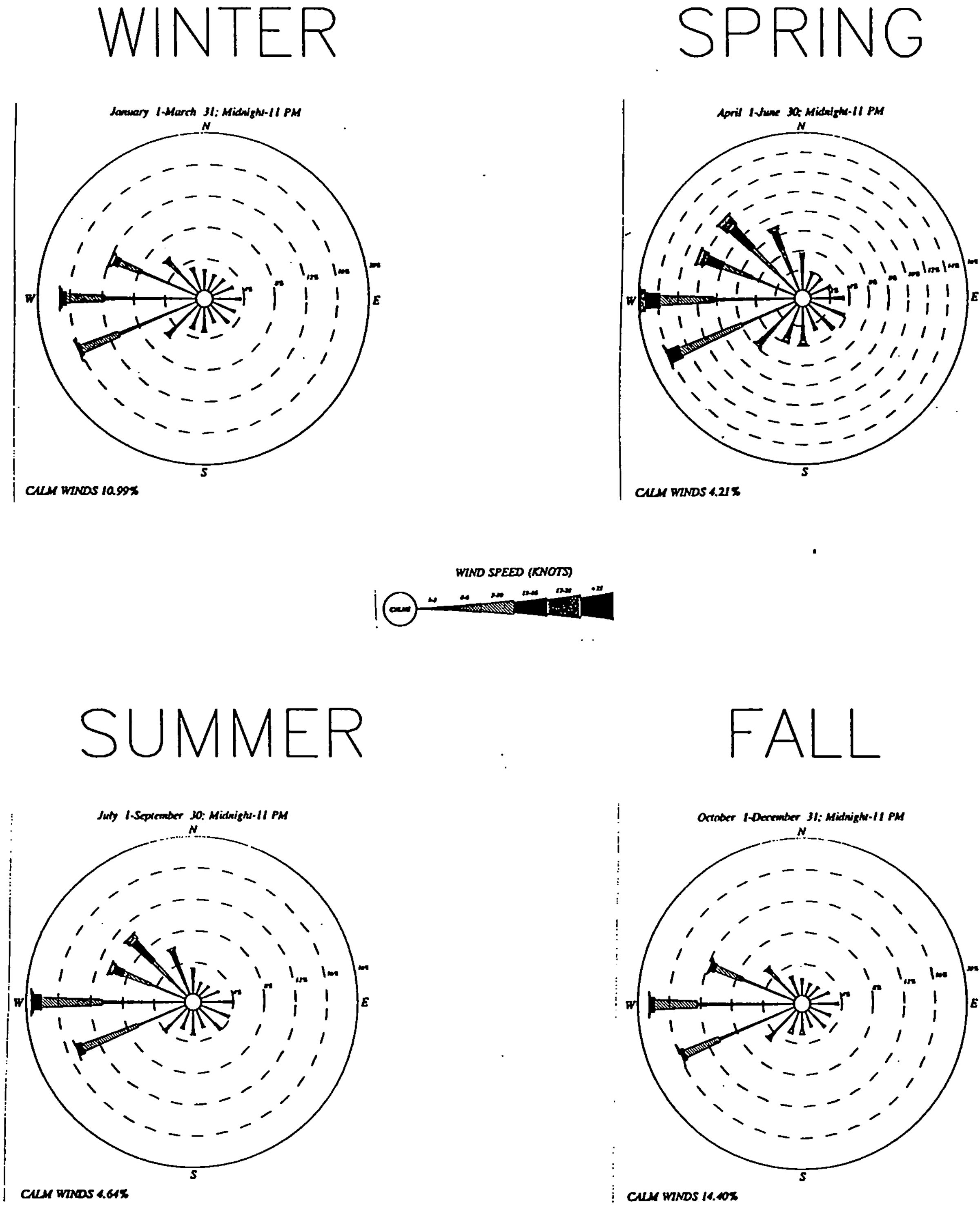
4.2.1 Perimeter

Perimeter monitoring will be focused on the east perimeter due to the prevailing westerly winds in Yakima and the close proximity of nearby businesses on the east side of the site. Due to the predictability of the wind direction (westerly); the long, narrow shape of the site (length six times width); and the extent of the on-site area to be disturbed during the remedial action (70 to 80 percent), crosswind sampling locations are not part of this monitoring program.

As shown in Figure 4-2, one of the west perimeter locations (A12) will be approximately 200 feet west of the center of the west fenceline. This location is on an adjacent property. The other perimeter sampling locations will be at the fenceline on the site boundary as shown in Figure 4-2.

This monitoring is intended to detect fugitive emissions from soil handling and treatment activities. These activities include removal of soil from the north and south soil stockpiles, screening of soil for size at the stockpiles, processing of soil through the LTTD unit, storage of the treated soil, and placement of the treated soil in the ground as backfill. Each of these activities can potentially generate ground-level, non-buoyant emissions. The fenceline monitoring is intended to measure these fugitive emissions.

Figure 4-1 Seasonal Wind Roses for Yakima, Washington



NOTE: Frequencies indicate direction from which the wind is blowing.

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TITLE:
Seasonal Wind Roses
for
Yakima, Washington

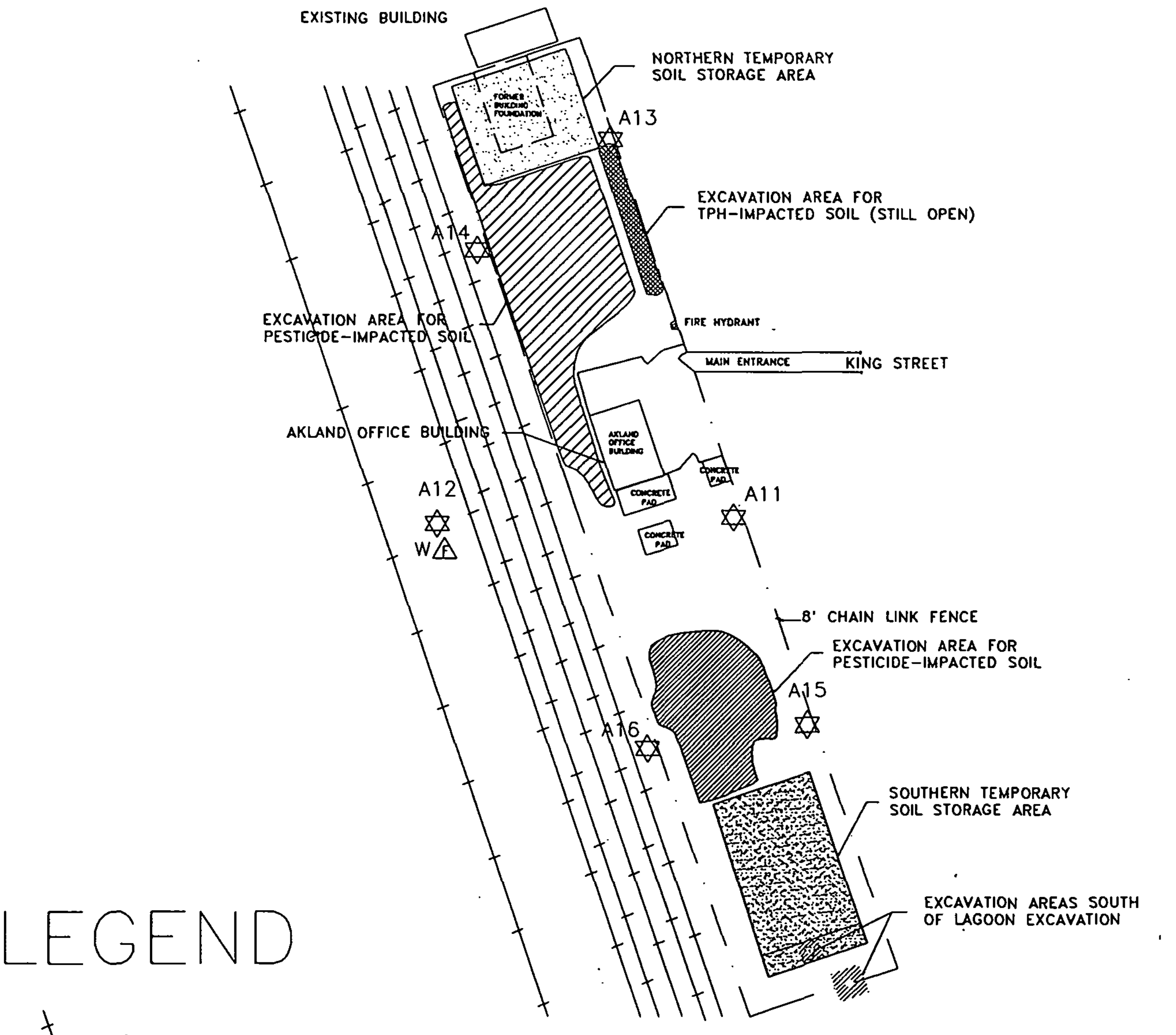
DWN: TMM	DES.: KDM
CHKD:	APPD:
DATE: 11/18/94	REV.:

PROJECT NO.: 12883088
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

FIGURE 4-1

COL 128308AF-003

Figure 4-2 Perimeter Air Monitoring Locations with Site Features after Soil Excavation, before Treatment

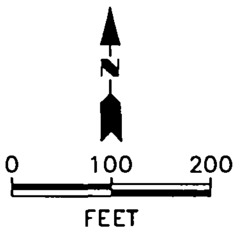


LEGEND

Railroad Line (Approximate Location)

A12 ✡ Perimeter Air Monitoring Location

W△ Meteorological Monitoring Station



Location	Samplers
A11	PM_{10}/Hg; TO-10, DATARAM, Hg Vapor
A12	PM_{10}/Hg; TO-10
A13	PM_{10}/Hg; TO-10
A14	PM_{10}/Hg; TO-10
A15	PM_{10}/Hg; TO-10
A16	PM_{10}/Hg; TO-10
A21	PM_{10}/Hg; TO-10; Hg Vapor
A22	PM_{10}/Hg; TO-10
A61	Collocated PM Sampler (Location A11)

BURLINGTON ENVIRONMENTAL
- A Philip Environmental Company -

TITLE:
Perimeter Air Monitoring Locations
With Site Features after
Soil Excavation, before Treatment

DWN: KDM
DES.: KDM
CHKD:
APPD:
DATE: 2/1/95
REV.: 4

PROJECT NO.: 12883088
Woods Industries Site
Yakima, WA

Figure 4-2

COL#1 C:\WOO O\MAPS\AIR42_4

One location (A11) on the east fenceline will be as close as possible to directly east of the center of the site. (The LTTD unit will be located at the center of the site.) Depending on which soil stockpile is being used, either A13 and A14 **or** A15 and A16 will be used. One stockpile will be used at one time. A11 and A12 will be used for all events.

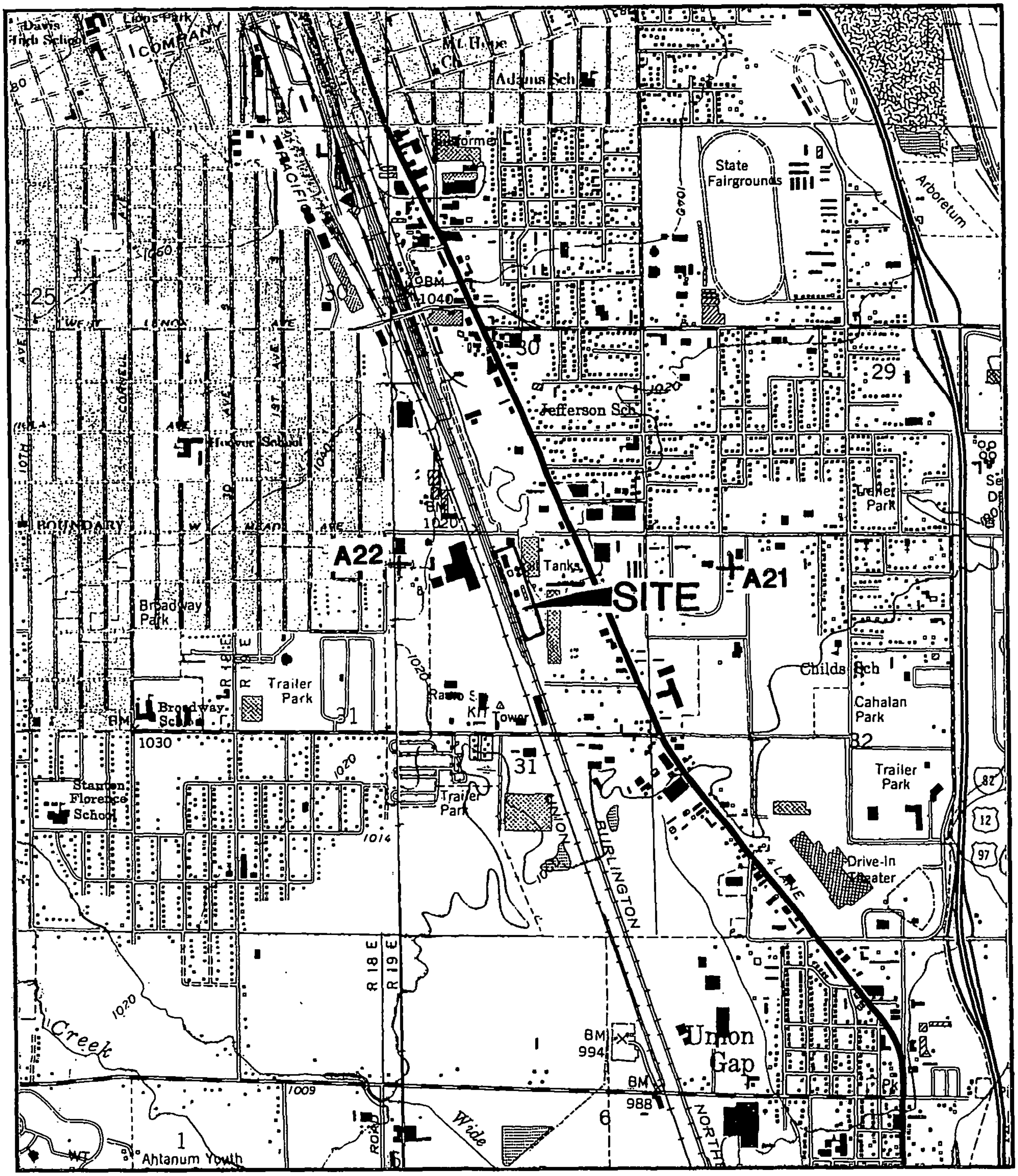
Soil beneath the foundation that is currently below the north stockpile may be excavated concurrently with use of soil from the south stockpile. If this occurs, all perimeter monitoring locations will be used while soil is being both removed from the south stockpile and excavated from beneath the foundation at the north end of the site.

4.2.2 Off-Site

The LTTD unit will emit a buoyant plume from the stack. Dispersion of this plume was modeled as part of the AAQIR. The desired off-site monitoring location was identified based on this modeling and the risk assessment performed during development of the AAQIR (Burlington Environmental, 1994).This modeling indicates that ambient concentrations of site-related parameters from this stack will be well below both the chronic and acute risk levels at the maximum exposed individual (MEI) locations (1-hour, 3-hour, 8-hour, 24-hour, and annual). The 1-hour and 24-hour MEI locations were modeled to be within a few hundred feet of one another. The estimated concentrations of the organic parameters at these locations are also below the detection limits for USEPA-developed ambient air monitoring procedures.

Off-site monitoring will be performed near the 24-hour MEI location and a location an approximately equal distance away on the opposite side of the site (A21 and A22, respectively). These off-site monitoring locations are, respectively, approximately one-half mile east and one-third mile west-northwest of the site, as shown in Figure 4-3. Permission to collect ambient air samples at these locations will be requested from the property owners. If permission to monitor at those locations cannot be obtained, owners of nearby properties will be contacted to identify suitable alternatives.

Figure 4-3 Off-Site Ambient Air Monitoring Locations



LEGEND

A21 OFF-SITE MONITORING LOCATION

0 2,000
FEET

N

Modified from U.S. Geological Survey, Yakima East, Washington, quadrangel, Photorevised 1985.

BURLINGTON ENVIRONMENTAL
– A Philip Environmental Company –

TITLE: Off–Site Ambient Air Monitoring Locations

DWN: TMM
DES.:
CHKD:
APPD:
DATE: 2/1/95
REV.:

PROJECT NO.: 12883088
WOODS INDUSTRIES SITE
YAKIMA, WASHINGTON

FIGURE 4–3

COL 128308

4.3 Ambient Air Methods

Ambient air monitoring and analysis will be performed in accordance with the following methods. Use of these methods is intended to achieve detection limits low enough to correspond to chronic or acute risk levels for these parameters.

Table 4-2 Sampling and Analysis Methods

Parameter	**Method**
Real-Time Particulate	MIE's (Instrument Manufacturer's) Procedure
PM_{10}	40 CFR 50, Appendix J
Mercury	X-Ray Fluorescence — Guidelines for PM-10 Sampling and Analysis Applicable to Receptor ModelingManufacturer's Procedure **(and for two temporary locations,** Arizona Instruments Inc. Gold Coil Dosimeter and Mercury Vapor (Jerome) Analyzer)
Hexachlorobenzene, DDT, Dieldrin	Method TO-10 — *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* EPA/600/4-84-041, April 1984 with supplements (Air Sampling for Pesticides);

Copies of the sampling methods are in Appendix B.

4.4 Ambient Air Sampling Equipment

The following equipment will be used to collect these samples. All equipment will be operated by commercial electric power.

4.4.1 Real-Time Particulate

Stationary real-time air monitoring of particulate matter concentrations at the east perimeter (Location A11) will be performed using a MIE DataRAM Real-Time Aerosol Monitor equipped with an Omnidirectional Sampling Inlet (DR-OSI), a PM_{10} Inlet Head (DR-PM10/2.5) set to collect particles smaller than 10 microns, and a temperature conditioning heater (DR-TCH). The monitor will be hardwired to a data logger in the site office and an alarm system in the control room. The alarm will set to sound if the one-hour average PM_{10} concentration exceeds 150 micrograms per cubic meter ($\mu g/m^3$).

In addition, a MIE Model PDM-3 Miniram Aerosol Monitor with cyclone for respirable dust and data logger will be used as a portable instrument to help direct the dust control measures. This instrument will be used adjacent to operations suspected of generating fugitive dust emissions that may cause the PM_{10} action level to be exceeded at the site perimeter. Readings from this instrument will be recorded in a logbook, along with date, time, location, nearby activities, and other pertinent information.

4.4.2 PM_{10}/Mercury Sampler

Ambient air samples for PM_{10} and particulate mercury will be collected using PM_{10} samplers. The sample media will be a pre-weighed 8- by 10-inch quartz fiber filter. Because the samples will be analyzed for mercury, unpowdered latex gloves will be worn when handling the filters.

The sample will be collected by drawing ambient air at a rate of approximately 40 acfm into a separator that allows only the particles smaller than 10 μm in diameter to be deposited onto the pre-weighed filter. The flow rate is controlled by a fixed geometric orifice that maintains the flow rate through sample collection even as filter loading increases.

At the end of the sample collection period, the filter will be recovered and sent to the off-site laboratory for weighing and analysis.

4.4.3 Mercury Vapor

As recommended in the USEPA's May 1993 *Air/Superfund National Technical Guidance Study Series: Volume IV - Guidance for Ambient Air Monitoring at Superfund Sites (Revised)*, gold-coil dosimeters will be used in conjunction with a Jerome Mercury Analyzer Model 431-X to monitor mercury vapor concentrations.

The dosimeters will be purged on-site immediately prior to use for sample collection. A known volume of air between 1 and 25 liters will be drawn through the dosimeters. The dosimeters will then be analyzed on site using the procedures specified by the manufacturer (Arizona Instruments Corporation). The volume of air to be collected will be established based upon the concentrations of mercury observed during baseline monitoring.

4.4.4 TO-10 Sampler (DDT, Dieldrin, and Hexachlorobenzene)

Ambient air sampling for particulate and vapor collection of DDT, dieldrin, and hexachlorobenzene will be performed using the samplers described in Method TO-10. The sample media to be used will be a polyurethane foam (PUF) plug.

The sample will be collected by drawing ambient air at a rate of one to five liters per minute (L/min) through the PUF plug. The sample flow rate will be calculated based on sample duration and the calibrated flow at the beginning and end of the sampling period.

At the end of the sample collection period, the PUF plug will be recovered and sent to the off-site laboratory for analysis.

4.4.5 Spare Parts

Sufficient spare parts and equipment will be maintained on site to replace or repair failed or damaged equipment. By providing spare parts and back-up equipment, the loss of data will be limited to one sampling period.

4.5 Ambient Air Sampling Duration and Frequency

Ambient air sampling will be performed in three phases as described in the following sections. Sampling events will be approximately 24 hours long in all phases of this ambient air monitoring program. Samplers will be serviced during periods of minimal or steady-state operations on site. Downtime for sample media collection and during should be 0.5 hour to 1 hour during periods of daily monitoring. When sampling is performed at a frequency less than daily, sampling will be performed. from midnight to midnight using automatic timers on the samplers.

Mercury vapor monitoring may require a shorter duration (such as 8 hours) depending upon the concentrations detected.

Real-time particulate monitoring will be performed continuously at Location A12 throughout the operating period of the LTTD unit, with the exception of downtime for normal calibration of the monitor. This real-time air monitor will operate during each sampling event in the baseline and post-remedial phases of ambient air monitoring.

The portable real-time particulate monitor will be used to monitor for variable lengths of time, usually one-hour periods. The one-hour averages will be used to evaluate the need for additional dust control measures.

4.5.1 Baseline Phase

During the baseline phase, ambient air samples will be collected at six sampling locations (A11, A12, A13, A14, A21, and A22) for a minimum of five days. Sampling will start within 14 days before the LTTD unit begins operation.

The intent of this sampling period is to define the effects of the undisturbed site and off-site sources on ambient air quality in the vicinity of the site.

The real-time particulate monitor at Location A11 will be operated during each monitoring event.

4.5.2 Remedial Phase

The real-time particulate monitor will be operated continuously during LTTD unit operations, except during instrument calibration and maintenance periods. DataRAM calibration and downloading is expected to require less than 30 minutes per day and will be performed, if possible, during periods of either minimal or steady-state site activity.

During the remedial phase, ambient air samples will be collected at six sampling locations (A11, A12, A13 or A15, A14 or A16, A21, and A22). As described in Section 4.2.1, all six perimeter monitoring locations will be used during monitoring events that occur when soil is being simultaneously removed from the south stockpile and excavated from below the foundation that is now beneath the north stockpile.

Sampling for PM_{10} will be performed daily from the start of LTTD unit operations until the end of the performance test. Sampling for DDT, dieldrin, hexachlorobenzene, and mercury will be performed daily during LTTD unit operation from the start of LTTD unit operation with contaminated soil until the performance tests are complete. Because the LTTD unit will operate at full load throughout the performance test period, fugitive and stack emissions during that period should be representative of potential emissions during later full-scale operation of the unit.

Data from the first 10 to 14 monitoring events will be submitted to USEPA for review at the end of the performance test. At that time, BNRR expects to request that the sampling frequency be reduced. The sampling frequency for all parameters will then, immediately following the performance test, be reduced to the frequency agreed upon by the USEPA and the project manager. This reduced frequency will be selected based on ambient concentrations, meteorological data, site activities, and the observed relationships between the monitored parameters. If the sampling frequency is reduced to less than daily, operations records for the LTTD unit will be used to document that soil treatment and handling activities remain consistent during sampling and non-sampling days.

4.5.3 Post-Remedial Phase

If ambient air is demonstrated to be impacted during the remedial phase, post-remedial monitoring will be performed. The intent of this monitoring phase will be to establish that baseline conditions are restored in the vicinity of the site.

During the post-remedial phase, ambient air samples will be collected at six sampling locations (A11, A12, A15, A16, A21, and A22). The south perimeter monitoring locations (A15 and A16) will be those closest to the most recently disturbed area of the site, rather than the locations used during baseline monitoring.

The stationary real-time particulate monitor will be operated during each monitoring event.

4.6 Ambient Air Action Levels

Action levels for site-related airborne concentrations of the parameters being monitored are shown in the following table. Meteorological data for each monitoring day will be used to identify, if possible, the upwind and downwind sampling locations. The background (upwind) concentration will be subtracted from the downwind concentration, if observed wind directions are stable during the sampling period, to calculate the site-related concentrations of the monitored parameters. Either the measured or site-related downwind concentrations will be compared to the action levels in the following table to evaluate the need for action each day. Site-related downwind concentrations will be used only following consultation with the USEPA representative.

Table 4-3 Action Levels

Site-Related Concentration ($\mu g/m^3$)					
DDT	Dieldrin	Hexachloro-benzene	PM_{10}	Mercury	Action
1-Hour Average At Real-Time Stationary Monitor					
--	--	--	150**	--	Implement Additional Dust Control Measures
Portable Miniram Particulate Monitor					
Based on measurements made at the site, a correlation will be developed between the total dust value reported by the Miniram and the PM_{10} data. Additional dust control measures will be implemented when the 10-minute (or longer) average Miniram total dust concentration exceeds the value equivalent to a PM_{10} concentration of 150 $\mu g/m^3$. Because of positive biases in high humidity, high Miniram readings will not be cause to implement additional dust control measures when the relative humidity exceeds 65 percent.					
24-Hour Measurement At Site Perimeter					
3.25*	0.0691*	0.726*	150**	0.3*	First Occurrence: Implement Additional Dust Control Measures or Modify Soil Handling Operations
					Second Occurrence in Consecutive Monitoring Events: Halt Operation of LTTD Unit until Corrective Measures are Implemented or Weather Conditions Change
24-Hour Measurement At Off-Site Downwind Location					
3.25*	0.0691*	0.726*	150**	0.3*	Halt Operation of LTTD Unit until Corrective Measures are Implemented or Weather Conditions Change

* 10^{-6} Cancer Risk Level.
** NAAQS 24-Hour Limit.

The correlation between the measured real-time particulate data from the stationary monitor and the 24-hour PM_{10} concentration from the collocated PM_{10} monitor will be calculated. Based on this correlation, control actions will be implemented when real-time particulate data indicate the control level has been exceeded for a one-hour period. The following equations will be used to develop and use these correlation factors.

Calculate Correlation Factor:

$$\frac{\text{24-Hour PM}_{10}\text{ Concentration A}}{\text{24-Hour Real-Time Particulate Concentration}} = \text{Correlation Factor A}$$

Calculate Probable Concentration:

$$\text{1-Hour Average Real-Time Particulate Reading} \times \text{Correlation Factor A} = \text{Probable PM}_{10}\text{ Concentration}$$

4.7 Quality Assurance/Quality Control (QA/QC)

The QC procedures for the ambient air monitoring activities include planned calibrations, audits, preventive maintenance, collocated sampling, and field/trip blanks. These QC procedures are described in the following sections.

4.7.1 Calibrations and Audits

Calibrations will be performed in accordance with USEPA and manufacturer instructions. All audits will be performed by Burlington Environmental or subcontractor personnel experienced in air monitoring, but not involved with calibration, installation, and operation of the samplers.

4.7.1.1 Real-Time Particulate Monitor

The real-time particulate monitor will be initially calibrated by the factory or vendor.

Field calibrations will be performed daily using the internal calibration zero and span checks. If the calibration is not within the manufacturer's specifications, the calibration will be adjusted in accordance with the manufacturer's instructions.

4.7.1.2 PM_{10}/Mercury Sampler

PM_{10} samplers have flow controllers to maintain a constant flow rate during the sampling period. Because of this, a single-point calibration is sufficient. An adapter plate, NIST-traceable orifice calibration unit, and a manometer will be used to measure the pressure drop (ΔH) in inches of water across the orifice calibration unit. This calibration will be performed upon installation of the sampler at the site and at least once per quarter until the end of the ambient air monitoring program.

The PM_{10} sampler calibration will be audited at the beginning of the ambient air monitoring program and at least quarterly thereafter. A different orifice from that used to perform the calibrations will be used to perform the audits. If the flow measured during the audit deviates by more than 7% from the expected flow, the sampler will be recalibrated.

4.7.1.3 TO-10 Sampler (DDT, Dieldrin, and Hexachlorobenzene)

A single-point calibration will be performed on the flow measurement system of the TO-10 samplers. These calibration results will be used to calculate the flow rate of the TO-10 sampler. This calibration will be performed immediately prior to and following use of the samplers. An electronic bubble burette calibrator will be used to calibrate the sampling pumps.

The calibrator used to calibrate the TO-10 sampling pumps will be calibrated using NIST-traceable procedures prior to and after the ambient air monitoring program at the Woods Site.

4.7.1.4 Mercury Vapor

The same sampler calibration procedures described in Section 4.7.1.3 will be used to calibrate the mercury vapor samplers.

The mercury gold-coil dosimeters will be purged immediately prior to use. When not in use, the dosimeters will be sealed with clean tubing.

The Jerome Mercury Analyzer will be regenerated 30–60 minutes prior to dosimeter analysis. The zero on the analyzer will be adjusted 20–30 minutes after regeneration, prior to analysis of samples.

A functional test of the Jerome Mercury Analyzer will be performed weekly. If the reading is not within manufacturer's specification, the instrument will be returned to the manufacturer for recalibration.

4.7.2 Preventive Maintenance

The maintenance procedures specified by the manufacturers will be performed to keep the instruments from failing and to return failed instruments to service.

Table 4-4 Preventive Maintenance Schedule

Sampler	Quarterly Maintenance	Daily Maintenance
Real-Time Particulate Monitor	N/A	Clean Sample Inlet
PM_{10} and Mercury	Replace motor brushes, Inspect and clean controller	Clean Sample Inlet
TO-10 and Mercury Vapor	N/A	Clean Sample Inlet

4.7.3 Precision and Accuracy

To assess the precision of the monitoring data, a collocated sampler of each type will be used to collect samples once each week (or every seventh event if sampling is not daily) simultaneous with the monitoring events. The collocated samplers used to assess precision will be at location A11. These samples will be submitted to the laboratory for analysis with the samples from that monitoring event.

Accuracy will be checked by auditing the sampler flow rates at the beginning and end of the ambient air monitoring program.

4.7.4 Field Blanks

Two types of field blanks (field and trip) samples will be collected to measure the possible contamination introduced by field sampling procedures, sample media, equipment, or shipment of samples.

Field blanks will be handled in the same manner as actual samples, including preparation, installation in a sampler, and cleanup procedures. The only difference between a field blank and an actual sample is that no air will be drawing through the field blank.

Trip blanks will be kept in the shipping container during transportation of the samples to, on, and from the site. Trip blanks will not be installed in a sampler.

One field blank will be collected weekly (regardless of whether sampling is performed less than daily) for the PM_{10}, TO-10, and mercury vapor samplers. Each field blank will be shipped to the site, installed in a sampler, recovered from the sampler without drawing air through the sample media, and returned to the laboratory for analysis.

One set of trip blank samples for these same parameters will be submitted and analyzed with each shipment of samples. Field blank samples will include:

- one PUF plug for DDT, dieldrin, and hexachlorobenzene analysis; and
- one filter and one gold-Coil dosimeter for (on-site) mercury analysis.

The gold-Coil dosimeter blanks will be analyzed on site along with the samples.

4.8 Analysis

The samples will be analyzed as described in this section.

4.8.1 Methods

The following methods will be used to analyze the ambient air samples.

Table 4-5 Analysis Methods

Parameter	Method
PM_{10}	40 CFR 50, Appendix J
Mercury	X-Ray Fluorescence Analysis of PM_{10} Filters and Arizona Instruments Method (See Appendix B-3)
DDT	TO-10
Dieldrin	TO-10
Hexachlorobenzene	TO-10

4.8.2 Laboratory

Ross Analytical Services, Inc. (Ross) of Strongsville, Ohio, will analyze the ambient air samples. Samples for all parameters, except real-time particulate matter and mercury vapor, will be submitted to the off-site laboratory for analysis. Samples will be retained for the duration of the soil treatment activities. Chain-of-custody forms will accompany all samples during shipment.

Samples for mercury vapor will be analyzed on site by the air monitoring technician.

The laboratory contact at Ross for this project is Jon Sunderman.

Phone: (800) 325-7737
Fax : (216) 572-7620.

Woods Site Address:

Burlington Environmental Inc.
Woods Industries Site
2 East King Street
Yakima, Washington 98901

4.8.3 Detection Limits

The detection limit for the ambient air sampling and analytical methods will be requested to be 80% of the action levels presented in Section 4.6. These detection limits are intended to be low enough to correspond to chronic or acute risk levels. Detection limits are a function of the sampling duration, sample volume, the sampling method, and the analysis procedures used. Sample volumes (and duration for mercury vapor) may be altered based on observed conditions to achieve desired detection limits.

For each potentially carcinogenic indicator compound, Burlington Environmental calculated the 1×10^{-6} risk level assuming a 20 m^3 inhalation rate, 70 kg body weight, and an exposure duration of 12 weeks. For non-carcinogens, the subchronic (where available) or chronic reference concentration was used. These concentrations are shown in Table 4-6, along with the achievable detection limits and the associated sampling/analysis methods. For lead and PM_{10}, the National Ambient Air Quality Standards were used instead of a site-specific concentration.

Table 4-6

Indicator Chemical Risk Levels and Detection Limits

Compound	Concentration of Risk Concern (µg/m^3)	Detection Limit (µg/m^3)	Method
Aldrin	0.0662	0.01	**
Arsenic	0.07	0.009	**
alpha-BHC	0.176	0.01	**
beta-BHC	0.646	--	**
gamma-BHC	--	0.01	**
Chlordane	0.86	0.01	**
p,p'-DDD	--	--	**
p,p'-DDE	--	0.001	**
p,p'-DDT	3.2	0.001	**
Dieldrin	0.0691	0.01	**
Endrin	--	0.01	**
Heptachlor	0.252	0.01	**
Heptachlor epoxide	0.125	0.01	**
Hexachlorobenzene	0.726	0.01	**
Lead	1.5	--	--
Mercury	0.3	0.020	XRF of PM_{10} Filter
Methoxychlor	--	0.01	**
PM_{10} *	--	--	PM10 Procedures
Toxaphene	1.010	--	**

* Not an indicator compound.

** USEPA Compendium of Methods for Determination of Toxic Organic Compounds in Ambient Air

4.9 Data Reporting

The laboratory will report data to the site within four business days after receipt of the samples at the laboratory. Samples will be shipped via overnight delivery service to the laboratory on the first work day after the end of the sampling period.

Preliminary ambient air monitoring results will be reported to the Burlington Environmental Manager on site and the USEPA site representative upon receipt of sample results from the laboratory. The preliminary data reports will include:

- ambient air concentrations for each parameter at each sampling location, including the off-site locations;
- site-related concentrations for each parameter at each sampling location (downwind minus upwind concentrations when an upwind and downwind can be reasonably designated); and
- designation of results that exceed action levels for each parameter at each location.

Once the final analytical results have been reviewed by the Project Laboratory Quality Assurance Officer, a final daily summary will be prepared. This daily summary will take into account the results from field blanks, trip blanks, and collocated samplers in designation of whether the action levels were exceeded.

Once 10 days on final monitoring data are obtained during operation of the LTTD unit, the results from the baseline and remedial phases to date will be compiled into a report for delivery to the USEPA. This report will be used to evaluate whether the sampling can be performed less frequently.

At the end of the sampling program, a final summary report will be compiled. This report will include copies of field data sheets, laboratory reports, and tables of daily results for each parameter. Meteorological data tables will be included in this report.

List of Abbreviations and Acronyms

acfm	actual cubic feet per minute
BNRR	Burlington Northern Railroad
°C	degrees Celsius
°F	degrees Fahrenheit
in. Hg	inches of mercury
L/min	liters per minute
LTTD	Low-temperature thermal desorption
MEI	Maximum exposed individual
mg/m^3	milligrams per cubic meter
mph	miles per hour
m/s	meters per second
NAAQS	National Ambient Air Quality Standards
PM_{10}	particulate matter smaller than 10 microns
PSD	Prevention of Significant Deterioration
PUF	polyurethane foam
QA	Quality assurance
QC	Quality control
TO-10	(USEPA) Toxic Organic Method 10
TSP	total suspended particulate
USEPA	U.S. Environmental Protection Agency
UTM	Universal Transverse Mercator
µm	micron (micrometer)

References

Burlington Environmental Inc. 1994. *Ambient Air Quality Impact Report, Woods Industries Site, Yakima, Washington.* November 18.

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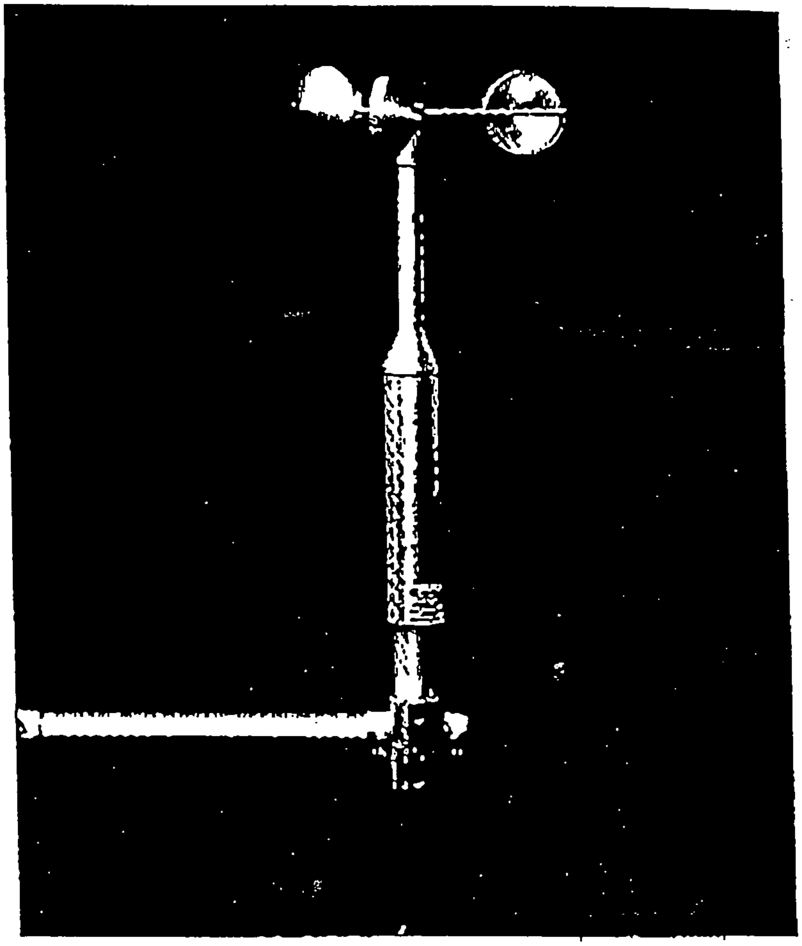
APPENDIX A

Meteorological Monitoring System

Wind Speed Sensor

010C

The Model 010C Wind Speed Sensor provides accurate and detailed information on horizontal wind velocity. It is used in virtually all applications where fast response and low starting threshold are of paramount importance. The sensor has a NIST traceable accuracy of ±1% over its entire calibrated range, with a starting threshold of 0.5 mph. The 010C Wind Speed Sensor is presently employed in continuous service in environments ranging from Antarctic cold to arid desert regions.



Accurate, rugged, fast response and low starting threshold – from the Antarctic to desert regions.

Features

- Low starting threshold
- Solid state light source and electronics
- Low profile to minimize "Sensor Turbulence"
- Calibrated to NIST secondary standard
- Quick-disconnect connector
- Internal heater for long bearing life

Operation

The lightweight three cup anemometer is directly coupled to a slotted disc chopper wheel. The chopper rotates and interrupts the light path of an optical link. The signal is amplified and produces pulsed frequency output proportional to wind speed. Typically, the pulsed output signal is applied to Met One's Wind Speed Translator Module for conversion to analog voltage/current output signals. The pulsed output signal from the 010C may alternately be used directly with various digital counters, totalizers and other signal processors. Met One has taken steps to make the 010C functionally more reliable than any other sensor of its kind:

- Built-in electrical field surge protection, which greatly reduces problems associated with static fields, near-miss lightning hits and poor grounding systems.

- Inclusion of Met One's internal heater (AC use only) which provides positive clean aspiration through the bearings, thereby greatly increasing sensor life.

- An optional, external de-icing heater sleeve may be supplied for those applications where freezing rain, ice and low wind speeds may be encountered.

Met One Instruments

Factory Sales & Service: 1600 Washington Blvd., Grants Pass, OR 97526, Phone (503) 471-7111, Fax (503) 471-7116
Regional Sales & Service: 3206 Main Street, Suite 106, Rowlett, TX 75088, Phone (214) 412-4747, Fax (214) 412-4716

Specifications

010C Performance Characteristics

Maximum Operating Range	0-125 mph or 0-60 meters/second
Starting Speed	0.5 mph or .22 meters/second
Calibrated Range	0-100 mph or 0-50 meters/second
Accuracy	±1% or 0.15 mph
Temperature Range	-50° C to +65° C
Response	Distant constant less than 5* feet of flow *The distance travelled by the air after a sharp edged gust has occurred for the anemometer rate to reach 63% of the new speed.

Electrical Characteristics

Power Requirements	12 VDC at 10 mA
Output Signal	11-volt pulse
Output Impedance	100 Ohms maximum

Physical Characteristics

Weight	1.5 lbs.
Finish	Anodized Aluminum
Mounting Fixtures	Use with 191 Crossarm Assembly

Accessories

1953 Cable Assembly, vinyl jacketed shielded cable. Specify length in -xx feet.
Aluminum Cup Assembly, distance constant = 15 feet

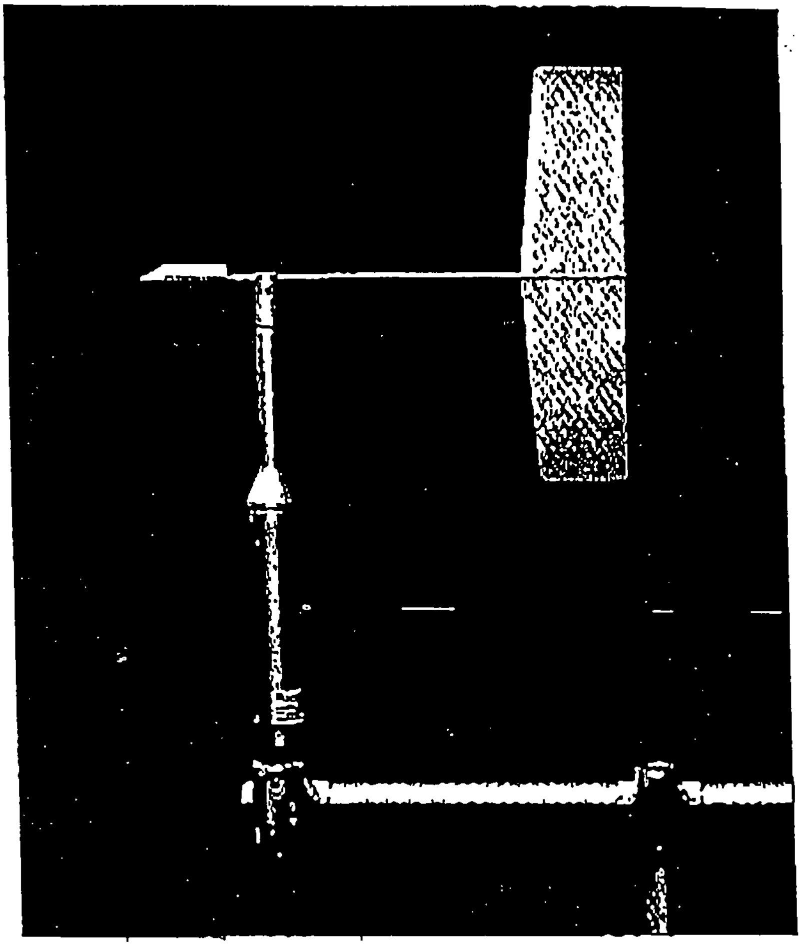
Subject to change without notice.

Wind Direction Sensor

020C

The Model 020C Wind Direction Sensor provides azimuth data for use in micrometeorological measurements related to operational studies and research. This sensor is especially useful when a low starting threshold, a high damping ratio or a short delay distance is required. (For example, in making Pasquill determinations or for use with sigma computers, both a high damping ratio and a short delay distance are mandatory performance criteria.)

The 020C Wind Direction Sensor is presently employed in continuous service in environments ranging from Antarctic cold to arid desert regions.



The Model 020C is useful when a low starting threshold, a high damping ratio or short delay distance is required.

Features

- Low starting threshold
- Single potentiometer for either 360° or 540° applications
- Low profile to minimize "Sensor Turbulence"
- High damping ratio
- Short delay distance
- Orientation lock
- Quick-disconnect connector
- Internal heater for long bearing life

Operation

The lightweight, airfoil vane is directly coupled to a single precision potentiometer. The built-in electronics module provides a voltage source for the potentiometer and amplifies the output signal for transmission over long cable lengths. Typically, the voltage output is applied to Met One Instruments' 540° Wind Direction Translator Module for conversion to analog voltage/current output signals. An optional 360° translator module is also available. The voltage output signal from the 020C may be used directly with other types of signal processors. Met One Instruments has taken steps to make the 020C functionally more reliable than any other sensor of its kind:

- Inclusion of Met One's internal heater (AC use only) which provides positive clean aspiration through the bearings, thereby greatly increasing bearing life.
- Built-in electrical field surge protection, which greatly reduces problems associated with static fields, near-miss lightning hits and poor grounding systems.
- An optional external de-icing heater sleeve may be supplied.

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Specifications

020C Construction

The airfoil shaped polyurethane vane assembly is easily installed or replaced without requiring recalibration. All sensor components are made of selected stainless steel and heavily anodized aluminum components.

All major electronic components are field-replaceable without requiring recalibration.

Performance Characteristics

Azimuth	Electrical 0-357° Mechanical 0-360° 0-540° with appropriate translator
Threshold	0.5 MPH
Linearity	±1/2% of full scale
Accuracy	±3°
Damping Ratio	0.4-0.6
Delay Distance	Less than 3 feet
Temperature Range	-50° C to +65° C

Electrical Characteristics

Power Requirements	12VDC at 10mA
Output Signal Selectable	a. 0-5 Volts for 0-360° (or 540°) b. 0-2.5 Volts for 0-360° (or 540°)
Output Impedance	100 Ohms maximum

Physical Characteristics

Weight	1.5 lbs.
Finish	Clear anodized aluminum
Mounting	Model 191 Cross Arm (Contains orientation lock)

Ordering Information

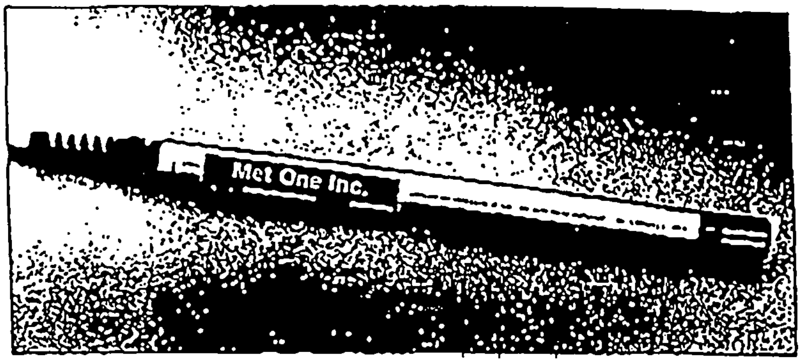
Cable	#1957 - xx (xx = length in feet)

Subject to change without notice.

Relative Humidity Sensor

083C

The Model 083C sensor probe represents sensitivity, accuracy, linearity and stability not encountered with conventional relative humidity sensors. It is extremely well suited for meteorological, industrial, laboratory and other demanding applications.



The Model 083C Relative Humidity Sensor is extremely well suited for meteorological, industrial, laboratory and other demanding applications.

Features

- All solid state construction
- Fast response of less than five seconds
- Low power consumption of 4 ma at 12 VDC
- Easily cleaned using distilled water
- 0-1V output for 0-100% RH
- Will operate from a 12 VDC battery

The model 083C RH sensor can also be supplied with a Model 060 Temperature Sensor mounted in it and used with various radiation shields for reliable, accurate measurements.

Operation

The model 083C Relative Humidity Sensor is based upon the capacitance change of a polymer thin film capacitor. A one-micron thick dielectric polymer layer absorbs water molecules through a thin metal electrode and causes capacitance change proportional to relative humidity. The thin polymer layer reacts very fast, and therefore, the response time is very short—less than five seconds to 90% of the final value of relative humidity. The sensor responds to the full range from 0-100% relative humidity. Its response is essentially linear, with small hysteresis, and negligible temperature dependence.

Construction

The sensor is mounted in a small probe which contains all the electronics necessary to provide an output for indicating or recording humidity. Since the capacitance change of the sensor is sensitive only to the ambient humidity, temperature compensation is not required for most applications. The probe body is water tight and made from corrosion resistant aluminum. Immersion in water does not affect the calibration of the sensor.

The polymer material is resistant to most chemicals. The calibration of the sensor is not affected by liquid.

Specifications

Sensing Element:	Thin film capacitor	
Range:	0-100% Relative Humidity	
Temperature Range:	-20°C to +60°C	
Response Time:	Less than 15 seconds at 68°F of Final (with filter)	
Accuracy:	0-10%	±3%
	10-90%	±2%
	90-100%	±3%
Temperature Coefficient:	0.04% RH/°C	
Output:	0-1.00 VDC - Standard	
Input Power:	4 MA at 12 VDC Battery	
Dimensions:	Diameter 0.75"	Length 7.5"
Weight:	2.5 oz.	

Subject to change without notice.

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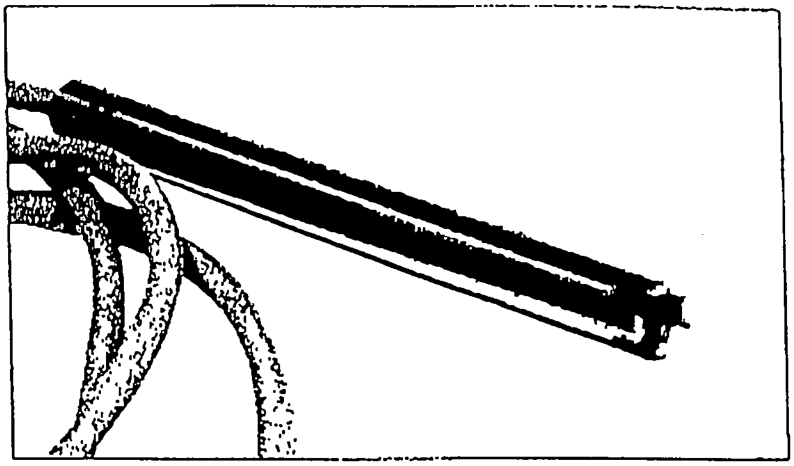
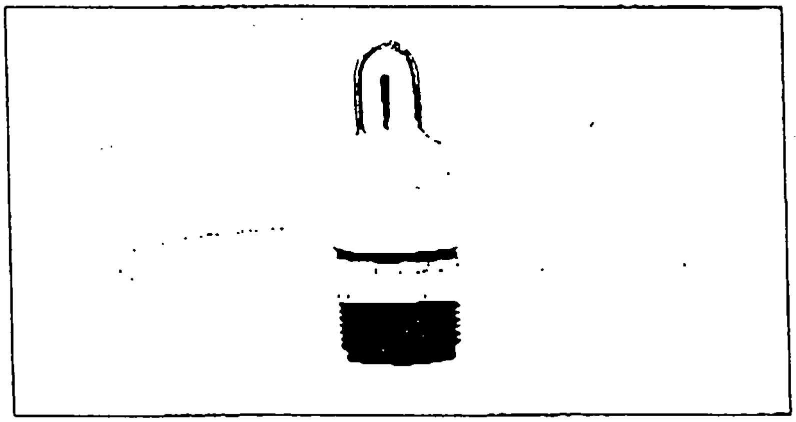
ir Temperature Sensors

060
062
064

Met One Temperature Sensors are precision, extended range thermistor devices that are used for the accurate measurement of ambient air temperature. They are particularly well suited for field applications, as they exhibit a very high resistance sensitivity. Problems associated with line lead length, noisy environments, and poor connections are virtually eliminated. Sensors may be interchanged without requiring system recalibration. Difference among these sensors are associated with packaging and accuracy, allowing for the precise solution to sensor selection.



Model 060A, Model 062



Model 064

Features

- ☐ Rapid response time
- ☐ Calibration traceable to NIST
- ☐ Interchangeable without recalibration
- ☐ High resistance values to minimize signal line resistance
- ☐ 'Free air' suspension of thermistor bead
- ☐ Several ranges available

Operation

The solid state multi-element thermistor produces a relatively large resistance change per degree of temperature change, allowing the use of normal signal voltages without self-heating of the sensor. When used with signal conditioning modules, the resultant output is a precise analog voltage.

Construction

The thermistor has a speed of response of 10 seconds in still air. In order to insure this response time, the thermistor bead is supported in free air and protected by the sensor body. In addition to providing minimum response time, this mounting configuration prohibits the sensor from measuring the strain that may be caused by potting compounds.

Met One Instruments

[illegible]mmon Specifications

Sensing element	Multi-stage solid state thermistor, highly linearized
Time Constant	Less than 10 seconds in still air
Self Heating	None

Model 060A

The Model 060A-2 is designed for general purpose measurements of ambient air temperature.

Housing	3/8-inch O.D. x 6"
Range	-50° to +50° C Other ranges available to meet special requirements.
Accuracy	±0.1° C throughout range, PSD compliant
Cable	1 Foot pigtails (for use with 076, 071, or 077 Radiation Shield). Additional length may be supplied; specify length.

Model 062

The Model 062 is a highly accurate version of the 060A-2. It is used in pairs for the measurement of differential temperature (ΔT), or singly for highly critical ambient temperature measurement.

Housing	3/8-inch O.D. x 6"
Range	-50° to +50° C
Accuracy	±0.05° C, PSD compliant

Linearity Deviation

For a system range of:	Maximum error per degree of differential temperature:	Maximum error over range:
- 5° F to + 5° F	.02° F	.05° F
- 5° C to + 5° C	.02° C	.05° C
- 5° F to +10° F	.02° F	.1° F
- 5° C to +10° C	.02° C	.1° C
-10° F to +20° F	.02° F	.2° F

Cable	1 Foot pigtails (for use with 076 or 077 Radiation Shield). Additional length may be supplied; specify length.

Model 064

The Model 064 utilizes the same sensing network as the 060, but is configured to mount directly to the 073B or 075B Radiation Shield. The sensor is supplied with a screw-type connector which allows the direct connection of the signal cable. Thermistor bead is protected by a stainless steel bumper.

Range	064-1 -30° to +50° C 064-2 -50° to +50° C Other ranges available to meet special requirements
Accuracy	064-1 ±0.15° C 064-2 ±0.1° C, PSD compliant
Housing	Mounting plate, white epoxy finished aluminum, 4" diameter, with screw connector for sensor cable. Thermistor bead is protected by a stainless steel bumper.
Cable	1958-xx (xx= length in feet)

Radiation Shield

073B

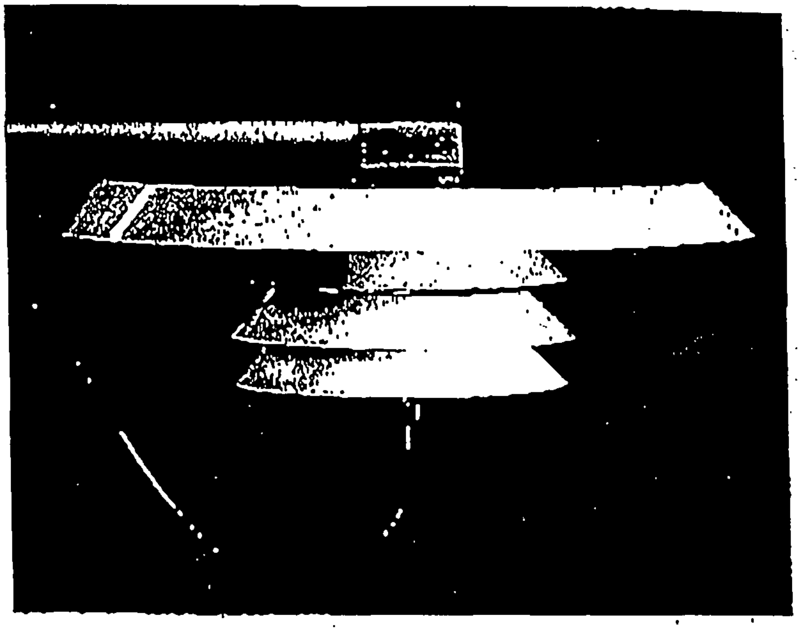
The model 073B Radiation Shield is designed to greatly reduce errors in temperature measurement due to direct solar radiation. The temperature sensor is shielded by concentric aluminum plates, which are turned down at the outer edges and painted white to reflect solar energy.

Features

- Accommodates RH & Temperature sensors
- Requires no power
- Easily mounted
- Reduces errors in temperature measurement

Operation

The model 073B Radiation Shield is normally used with 064 Temperature Sensors or 083C or 083V Temperature/ Relative Humidity Sensors. These sensors are supplied with a quick disconnect connector. Mating cables are supplied with several types of termination. Refer to cable drawings in the sensor manuals for particular wiring.



The 073B Naturally Aspirated Radiation Shield is used in remote areas, where power is not available.

Specifications

Sensors:	064A, 083C, 083V
Transducer Sensing Zone:	1 inch maximum
Maximum Transducer Diameter:	3/4 inch
Mounting:	1 inch tubing or 3/4 inch IPS pipe
Plate Material:	Spun Aluminum
Finish:	White epoxy paint
Weight:	2.6 pounds
Size (less sensor):	14.25 in. diameter x 6 in. high

Subject to change without notice.

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Barometric Pressure Sensors

090D
091

Barometric Pressure Sensors convert absolute atmospheric pressure into a linear, proportional voltage, which may be used in any meteorological program.

Features

- Compact size
- Weatherproof enclosure
- Remote output
- Permanent calibration
- Robust construction

These sensors are inherently stable devices that do not require periodic service or routine recalibration.

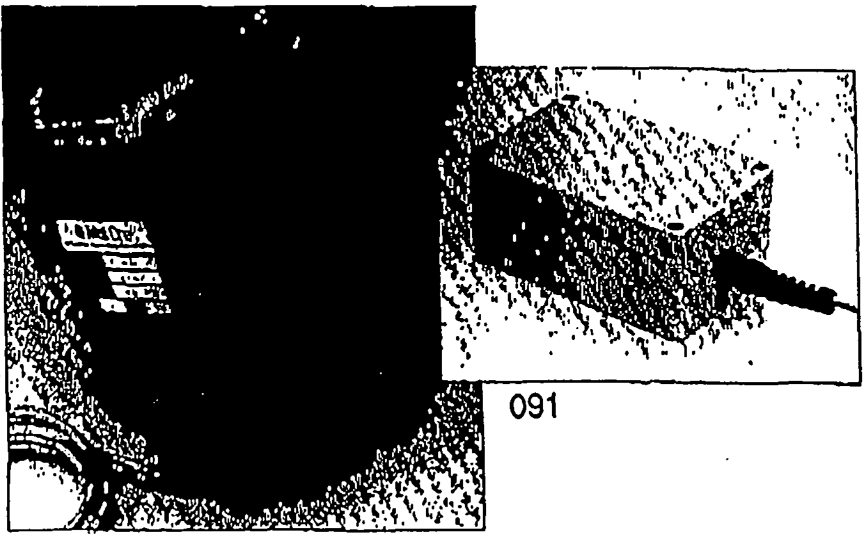
Operation

The enclosure houses a solid-state pressure transducer, with linearization and amplification electronics.

The Model 090D is housed in a heavy duty fiberglass enclosure, suitable for harsh and severe environments. A hose barb is provided to enable the connection of a 1/4" sampling tube to the outside environment.

The Model 091 is contained within a small polycarbonate enclosure, and may be mounted outside or inside a building or other enclosure. Small inlet holes allow the atmospheric pressure access to the sensing element.

The standard range of the 090/091 is 26-32 in. Hg, suitable for elevations sealevel to 1500 feet. Other ranges are available.


091

090D

Performance	**090D/091**
Resolution	Infinite
Temp Operating Range	-40°C to 65°C
Temp Compensated Range	-18°C to 65°C
Accuracy	±0.04 in Hg (±1.35 mb) or ±0.125% FS

Electrical Characteristics	**090D/091**
Power requirement	11 mA @ 12 VDC, Typical
Sensor Output	0-1 VDC Standard 0-5 VDC Optional 4-20 mA Optional

Physical Characteristics	**090D**
Weight	2 lbs, 5 oz (1.05 Kg)
Dimensions	5.5" x 5" x 7.5" (14x12x19 cm)
Weight	8.8 oz (250 g)
Dimensions	2.13" x 3.2" x 5" (5.4x8.3x13 cm)

Ordering Information	**090D/091**
	Specify elevation Specify output voltage
Cable	#1169-xx (xx = length in feet) Specify length in feet

Specifications subject to change without notice.

Met One Instruments

[illegible]tegrated Data Acquisition Units

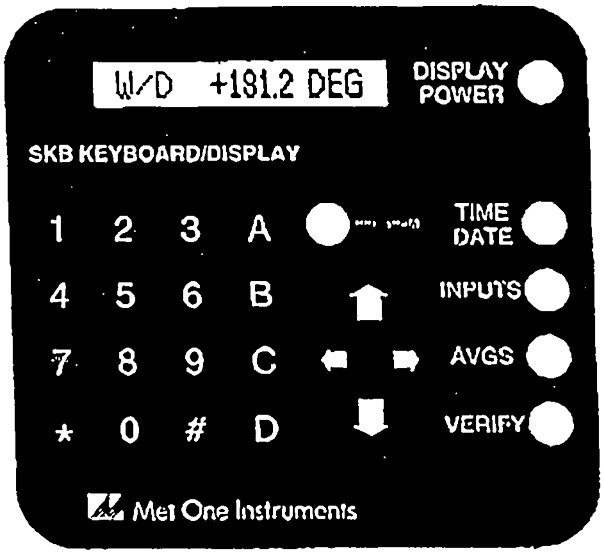
455
456
457

The central "brain" of the modern weather station is the data acquisition unit, or DAU. It is here that the data collected by the sensors are recorded, manipulated, and stored for future use and analysis. The DAUs offered by Met One Northwest offer the highest degree of integration and ease of use available today. They are designed to provide the environmental engineer with:

- a simplified design and procurement procedure
- a system of guaranteed matched components
- the benefits of Met One's field expertise
- assurance of compliance.

A built-in datalogger, scaled directly to the recorded measurements, provides an easy to read, permanent record of the measured meteorological variables.

The system includes the datalogger, the interface board, and panel-mounted Smart KeyBoard/Display. Provision is made for the addition of an optional Storage Module for extended memory capability. An RS232 dataport is available for direct communications with a computer or terminal. A modem may be added to facilitate remote access of the datalogger for programming or data retrieval. Password protection and automatic shutoff of the display provide additional data security. Up to 12 analog and 2 pulsed signals may be connected. The motherboard includes lightning protection diodes, and provides a charging function for a back-up battery (optional with the Model 457).



SKB Keyboard/Display

The Smart Keyboard/Display contains "Smart Keys" which offer shortcut communications with the datalogger.

Display Power turns on the keyboard display and prepares the unit for further operator interaction.

Time/Date will return the datalogger time. Press again to display datalogger date.

Scan Inputs key will display the data going into the system in channel #1. By using the Arrow keys, other data channels can be viewed.

Scan Avgs key will return the data most recently written to datalogger memory. The Arrow keys allow viewing all the elements of the array.

Verify Program key will display the program signature, a number unique to the specific program. This feature alerts the operator if a change has been made to the datalogger program.

Program key, which is password protected, allows access to the datalogger's native programming functions and/or the SKB functions.

Standard equipment includes datalogger, computer interface, lightning protection and back-up battery (optional with the Model 457), direct sensor hook-up, graphic user interface, and enclosure. Differences between model numbers relate to features and packaging. They are functionally equivalent.

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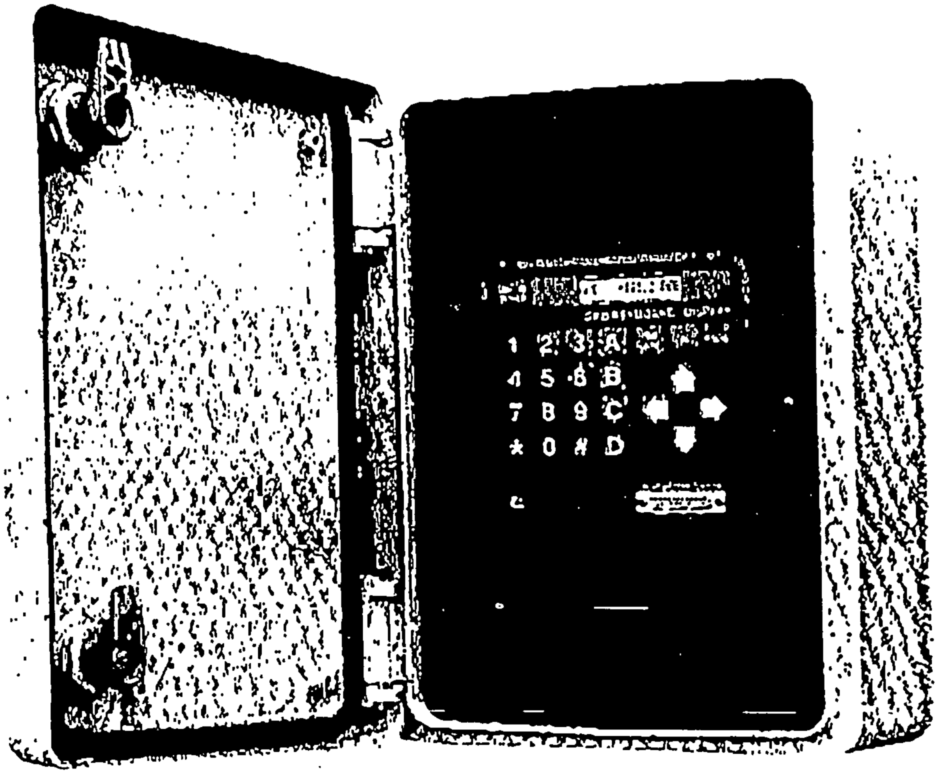
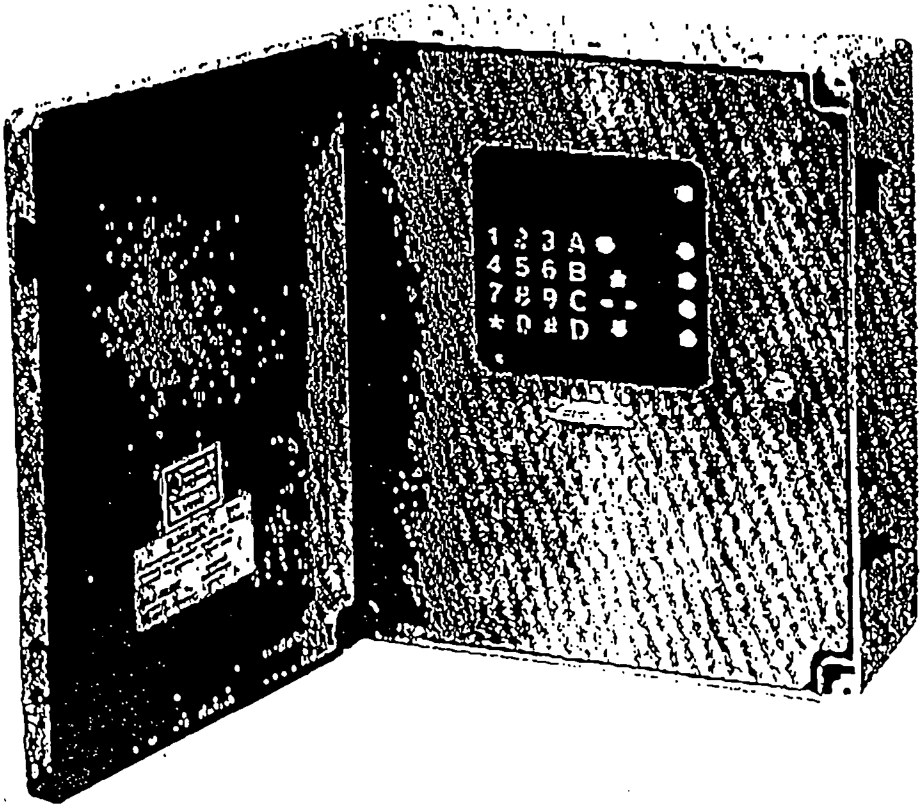
Model 455

This full-featured device provides virtually everything needed for a complete and total weather data system. All hardware is mounted within a high quality compression molded fiberglass enclosure. The enclosure is designed specifically for harsh manufacturing conditions and hostile environments, and will outlast steel or stainless steel in a corrosive or marine environment. The enclosure meets and exceeds most NEMA grade specifications. Door hinges are molded, with stainless steel hinge pins. Cable entry is through a port in the enclosure bottom, fitted with a sealing [illegible]mp. The enclosure contains [illegible]tch with integral tumbler lock for security.



Model 457

The Model 457 is competitively priced to allow any sized operation to take advantage of the functionality and ease of use of the Met One Instruments system. All hardware is mounted within an economical, attractive grey fiberglass enclosure. The enclosure features a continuous stainless steel hinge and latches with padlock hasps, and meets NEMA type 4 classification. Cable entry is through a port in the enclosure bottom, fitted with [illegible] sealing clamp. The backup [illegible]attery and lightning protection are optional with this model. Latches are stainless steel, and include padlock hasps.



Specifications	Model 455	Model 456	Model 457
Enclosure			
Construction	comp'n molded fiberglass	19-inch rack panel	molded fiberglass
Color/finish	beige/textured	beige textured enamel	grey/smooth
Chassis enclosure	N/A	Ass'y #5787	N/A
Security	Locking latch w/ key	N/A	padlockable latch
Supplied Hardware			
	Tower mount kit	Rack mount hardware	Tower mount kit
Dimensions			
H x W x D, inches (cm)	16x12x11 (40x30x28)	7x19x13 (18x48x33)	15x13x7 (39x34x18)
Weight, lbs (Kg)	11 (5)	8 (3.6)	12 (5.5)
Ship wt. lbs (Kg)	15 (6.8)	12 (5.5)	16 (7.3)
Inputs			
Analog	12	12	12
Pulsed	(2) 8-bit or (1) 16-bit	(2) 8-bit or (1) 16-bit	(2) 8-bit or (1) 16-bit
Computations	28	28	28
Viewable elements	20	20	20
Lightning Protection			
	Standard	Standard	Ass'y #2671
Software			
Sensor Basic Software	P/N 550300	P/N 550300	P/N 550300

Options

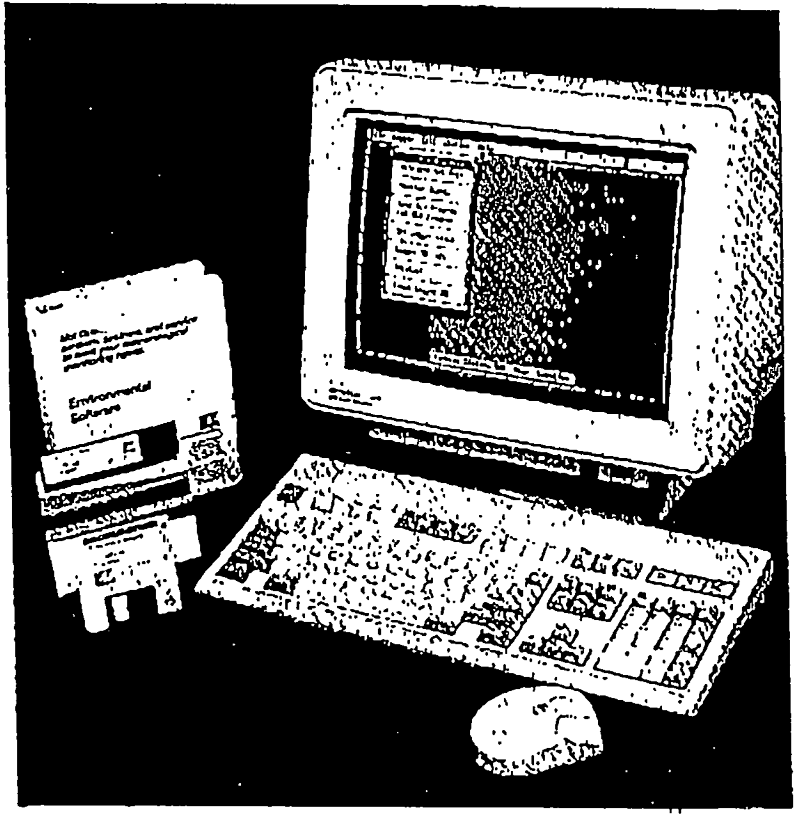
Power			
Standard	115 vac	115 vac	115 vac
Optional	230 vac, 12 VDC	230 vac, 12 VDC	230 vac, 12 VDC
Backup battery	STD	STD	Assy. #2477
Solar Power System	Model 270-X	Model 270-X	Model 270-X
Connections			
Water-tite glands	Optional	N/A	Not available
Bottom port with clamp	Standard	N/A	Standard
Terminal strips	Standard	Standard	Standard
Bulkhead Connectors	Optional	N/A	Not available
Display			
LCD, 1 line x 16 char.	Standard	Standard	Standard
Backlit, (AC only)	Ass'y #2456	Ass'y #2456	Not available
	Original order only – cannot retrofit backlit display		

Accessories

Expanded Memory			
96K datapoints	P/N 550088	P/N 550088	Ass'y #2605 (includes 550088)
Communications			
Conventional Modem	Ass'y #2587	Ass'y #2587	Ass'y #2587
Sensors			
	accepts all standard meteorological sensors	accepts all standard meteorological sensors	accepts all standard meteorological sensors

MicroMet® Software

Environmental software that provides all the data, and in the format required.



Micromet software manual, 3 1/2 and 5 1/4" discs, and computer screen showing Logger Menu.

MicroMet Software is a complete package of communications, data collection, and data reporting tools with a windows like operating environment. MicroMet Software provides complete environmental reporting in compliance with EPA and other requirements.

Features

- User Friendly
- Real time Data Monitoring and Display
- Concurrent logger monitor
- Data filter for exporting
- Time and date setting
- Dial-out modem support
- Pre-written library of routines

Using MicroMet Report, the operator can retrieve data from one of the MicroMet Loggers with only three key strokes. Real time data can be monitored with only a few easy keystrokes. Data files can be viewed, printed, or created for export to another data base. Similarly, the logger's internal setup program can be loaded or retrieved, time and date can be set, or real-time data can be monitored.

Available in two versions to suit all applications from single site compliance monitoring to network size auto polling systems.

For the Single Site

MicroMet Report is designed for use by the non-programmer. It provides the operator a simple and easy method of data logger setup and operation, with local or remote data retrieval. MicroMet Report is used with any of the MicroMet Data loggers. Passwords protect data from alteration while allowing easy access for viewing and reporting. Data sets collected from the data logger are archived in individual monthly files stored in binary format to reduce disk space requirements.

For the Network

All the features as MicroMet Report plus auto polling and the ability to maintain up to 99 station locations. MicroMet Network can communicate to remote stations via combination of leased line, telephone, radio, or direct RS-232. Communication modes may be easily changed and/or new remote units added by the

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[illegible]rator using simple selec[illegible]n menus. Communication alarms and automatic retry are included features.

Operation

MicroMet Report is provided with a simple "Install" program to facilitate getting started. Once in operation, the user is presented with an integrated software environment providing the user with:

- Windows-like screens with pull down menus
- Dialog Boxes
- Mouse support
- Interactive help
- Report generation menus

Data Files

Monthly data files are automatically created, using a compressed binary format to [illegible]ovide maximum storage in [illegible]minimum amount of mem[illegible]. Monthly data files are [illegible]sed for summary reports and for data export.

Reports

Summary reports are generated by MicroMet Report using monthly data files. The operator selects the period to be printed with beginning and ending prompts. Report footers provide the summary scalar averages, vector averages, totals, and percentage of data collection.

Exporting Data

Simple export routine speeds task of transferring data in comma separated standard ASCII format to other data base managers or spread sheet programs.

Real time Monitoring and Display

Real time monitoring of all data logger outputs may be initiated at any time using the built-in continuous screen display monitor. Real time monitoring requires either a direct connection or modem connection maintained to the data logger.

Software Environment

The **File Menu** contains the menu list for printing and viewing data, and includes the selections to determine the type of export data desired by the operator from the MicroMet Logger.

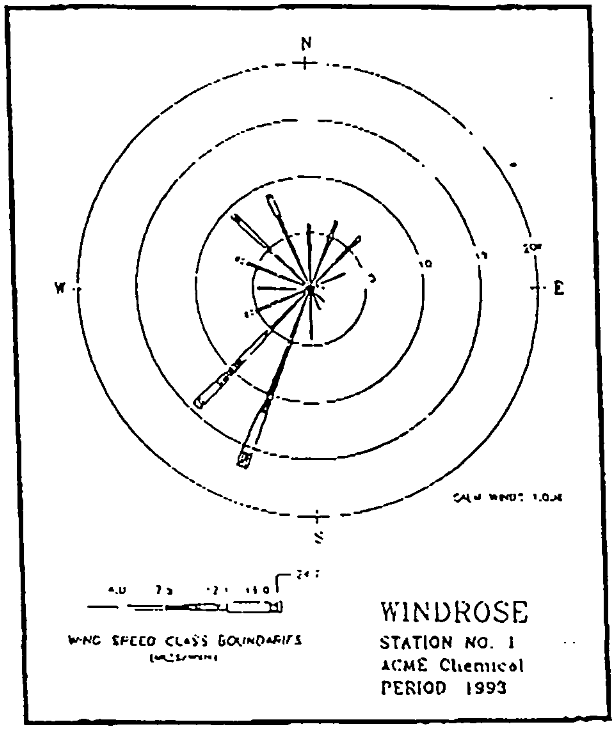
The **Logger Menu** contains menu selections for setting and establishing connections to the logger via the serial port or modem. Provided in the menu are selections for setting date and time, viewing of current information, sending and retrieving of programs, and verification of remote stations operating conditions.

The **Edit Menu** provides the tools for editing the MicroMet program defaults, Logger monitor headings, file directories, and the various output report fields and headings.

The **Help Menu** provides access to the current station and MicroMet setup reports, including MicroMet version information. General help is also provided using the simple selection menu.

Computer Requirements

Platform:	IBM-PC Compatible (286 or better recommended)
Environment:	DOS 3.3 or higher
Memory:	640K
Display:	Mono Text, Hercules, EGA, VGA, or better
Port:	One serial port or modem
Disk Space:	2MB (program)-(Disk space required for data collection varies with sampling rate, array size, resolution of data points, etc.)
Mouse:	Optional, but recommended
Disc size:	Supplied on both 31/2 and 51/4" discs



MicroMet Graphics is a companion utility for either MicroMet Report or MicroMet Network programs that will compute wind rose and frequency histograms and plot them on a variety of plotters and conventional printers.

mple Automet Report:

/22/93 Data Julian Day 356 - >Automet 10< - Station ID 63

me	Ch 1 BV BtV	Ch 2 BP HG	Ch 3 AT C	Ch 4 RH RH	Ch 5 WS MPH	Ch 6 WD DEG	Ch 7 no V	Ch 8 no V	PI RA in
:00	12.34	29.18	-05.25	083.3	000.4	351.6	0.000	0.000	00.07
:00	12.34	29.19	-05.25	083.3	000.6	351.6	0.000	0.000	00.00
:00	12.36	29.19	-05.19	083.3	001.5	338.9	0.000	0.000	00.00
:00	12.37	29.19	-05.25	083.3	001.4	345.7	0.000	0.000	00.00
:00	12.37	29.19	-05.25	083.2	001.1	342.4	0.000	0.000	00.00
5	12.36	29.19	-05.25	083.2	000.9	343.5	0.000	0.000	00.00
[illegible]	12.37	29.19	-05.25	083.2	001.2	329.9	0.000	0.000	00.00
7	12.38	29.19	-05.31	083.2	001.1	336.9	0.000	0.000	00.00
9:00	12.42	29.21	-04.82	083.5	000.4	321.8	0.000	0.000	00.00
0:00	12.45	29.22	-04.33	083.6	000.2	290.3	0.000	0.000	00.00
1:00	12.55	29.22	-03.85	083.8	000.5	307.9	0.000	0.000	00.00
2:00	12.72	29.20	-03.24	084.2	000.2	096.3	0.000	0.000	00.00
3:00	12.92	29.19	-01.47	084.6	000.6	222.4	0.000	0.000	00.00
4:00	12.89	29.18	-01.28	084.8	000.4	260.4	0.000	0.000	00.00
5:00	13.75	29.17	-01.22	085.0	000.2	300.4	0.000	0.000	00.05
6:00	12.38	29.19	-05.31	083.2	001.4	327.7	0.000	0.000	00.00
7:00	12.38	29.19	-05.25	083.2	001.2	334.7	0.000	0.000	00.00
8:00	12.38	29.19	-05.25	083.3	000.8	343.1	0.000	0.000	00.00
9:00	12.38	29.19	-05.25	083.3	001.3	342.0	0.000	0.000	00.00
0:00	12.38	29.19	-05.25	083.3	001.0	340.9	0.000	0.000	00.00
1:00	12.38	29.19	-05.25	083.3	001.3	340.7	0.000	0.000	00.00
2:00	12.38	29.19	-05.19	083.3	001.2	336.0	0.000	0.000	00.00
3:00	12.38	29.19	-05.19	083.3	001.3	330.5	0.000	0.000	00.00
Totals	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	00.12
Savg	12.64	29.20	-03.16	084.1	000.6	253.9	0.000	0.000	n/a
Vavg	00.00	00.00	00.00	000.0	000.0	280.4	0.000	0.000	n/a

Data Recovery 100.0 %

Towers and Tripods

All meteorological systems need a means of raising the sensors to the required elevation above ground level. The standard reference point is ten meters, or approximately 33 feet; however, measurements are frequently required at any elevation from a few feet to several hundred feet. Met One Instruments meets this need with a full line of towers, tripods, and instrument lift systems.

Standard Stacked Towers

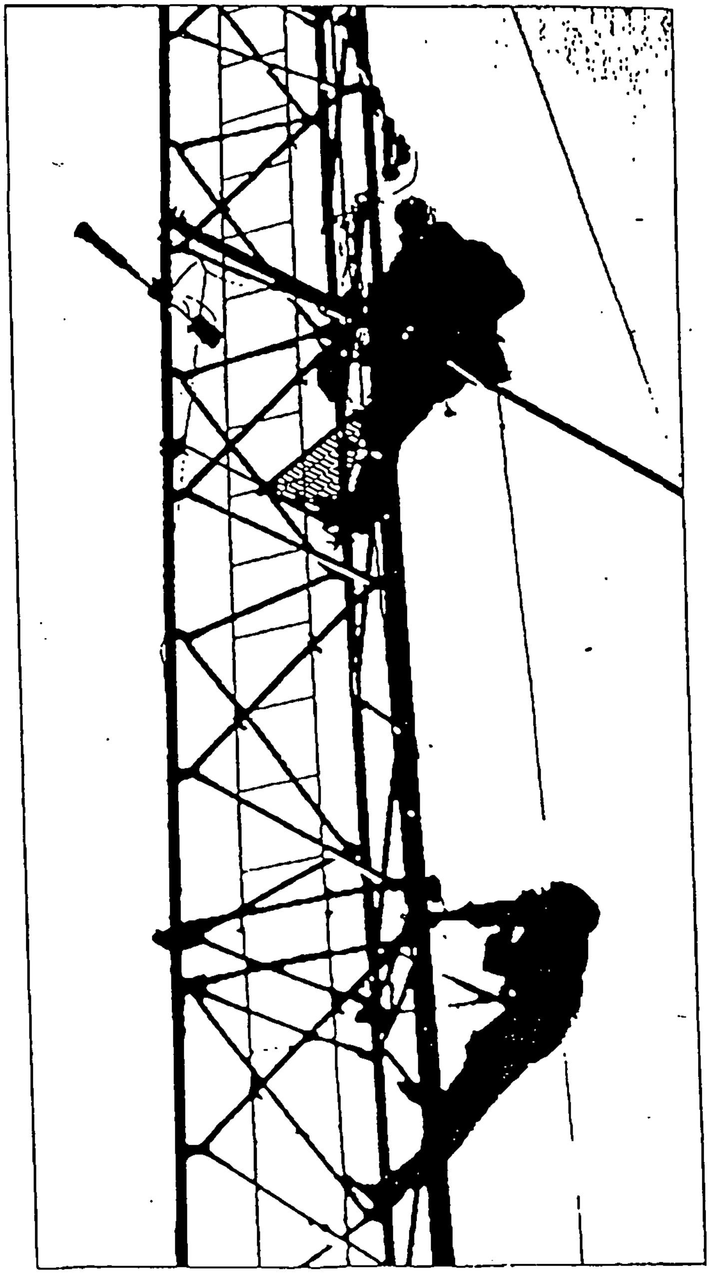
Standard stacked towers are built on a 12" equilateral triangle of 1" steel tubing with electrically welded, continuous steel "zig-zag" cross bracing. This design results in a structure that is at least one-third stronger than competing towers. All sections are hot-dipped galvanized after fabrication for corrosion protection. Individual 10-foot sections are light weight (31 pounds), and are easily connected to each other using double-bolted leg joints. Most installations use guying cables to anchors located at a distance of 80% of the tower height. However, the structure is strong enough to be self-supporting using a house bracket. Several base configurations are available, incorporating a concrete foundation.

Model 970664 40' guyed tower

Three standard 10 foot sections, and one tapered top section of tower are provided. A pier pin is provided which must be located within the foundation. The base of the tower fits over the projecting pin to locate the tower and prevent the base from moving off the foundation. Complete guying materials are provided, including a bracket assembly for the tower, guy cables, turnbuckles, clamps, thimbles, etc. Three anchor rods for guy points are provided, each of which requires a poured concrete foundation. Grounding rods are provided for the tower and each guy point.

Model 970668 40' guyed tower

This tower is identical to Model 970664, except that screw-in anchors are provided for the guy points in place of the poured foundation style.



Model 970666 30' guyed foldover tower

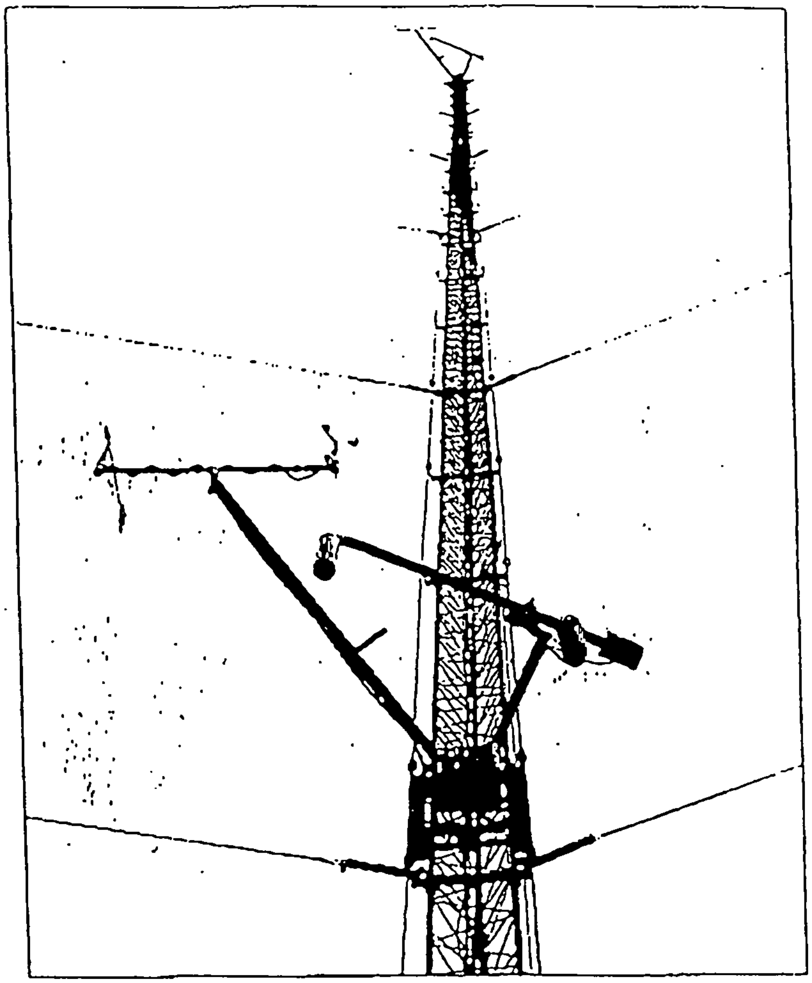
This tower hinges at approximately 10 feet above ground level, allowing the instrumentation mounted on the tower to be serviced from ground level. One special foldover section, one standard 10 foot section, and a tapered top section are provided. A winch mechanism and cabling are included to activate the tilt mechanism. A base section is provided to be imbedded in the foundation, requiring an excavation approximately 3' deep. Four screw anchors to provide guy points to the hinge level are included. Complete guying materials, including guy cables, turnbuckles, clamps, thimbles, etc. are provided. Grounding rods are provided for the tower and each guy point.

Model 970667 40' guyed tower

Three standard 10 foot sections, and one tapered top section of tower are provided. A base section is provided to be imbedded in the foundation, requiring an excavation approximately 3' deep. Three screw anchors to provide guy points are included. Complete guying materials, including guy cables, turnbuckles, clamps, thimbles, etc. are provided. Grounding rods are provided for the tower and each guy point.

Model 970665 40' bracketed tower

Three standard 10 foot sections, and one tapered top section of tower are provided. A base section is provided to be imbedded in the foundation, requiring an excavation approximately 3' deep. Brackets are provided to support the tower to an adjacent building, eliminating the need for guy cables and anchors. Grounding rod is provided for the tower.



Typical Tall Tower and Instrumentation

Aluminum Towers

Aluminum alloy towers have the advantage of lightness of weight which makes relocation from site to site easier. They are also often used in mobile operations, such as on van or trailer mounted monitoring stations.

Model 970894 33 Foot aluminum tower, guys suggested but not required

Tapered top section with 11" leg width, straight center section, 11" width, Lower section with 14" leg width (reducing to 11"). Height to make 10 meters is provided by mast extension. Steel base suitable for imbedding included. Guy kit will be provided to suit requirements.

Model 305831 35 foot telescoping aluminum tower

A light weight tower composed of 3 nested aluminum sections. An integrated winch is used to raise and lower the sections. Guy wires, turnbuckles, cable clamps, etc. are furnished to guy each section, and duckbill ground anchors are provided. The tower is crated for shipment. An optional power winch is available in either 110 VAC or 12 vdc.

Tower Options

#5284 Tower grounding system

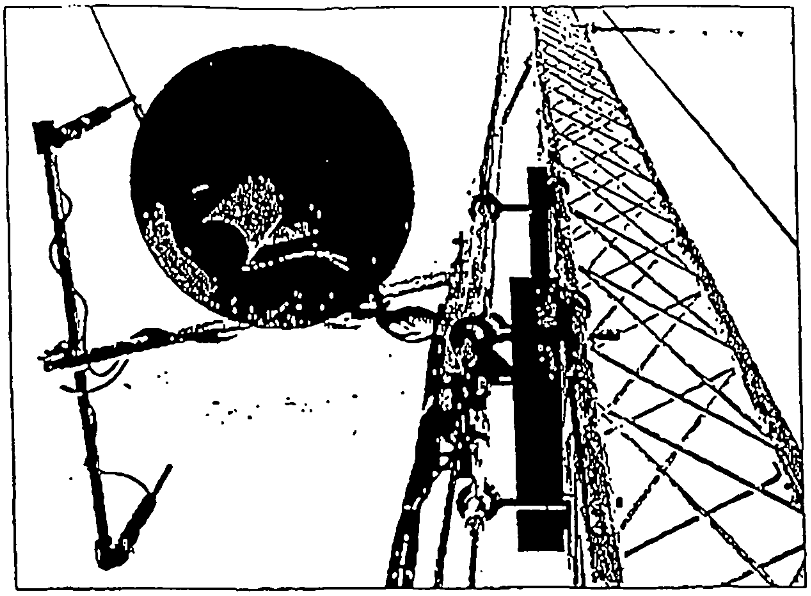
The Model 5284 includes all materials required to provide ightning protection to the tower. An air terminal with 5' extension rod, braided 2-0 copper cable, ground rod, and all clamps are provided.

#2420 Instrument boom

The Model 2420 includes two special cross fittings and a five-foot long, 3/4" IPS aluminum boom. The Model 2420 allows the boom to mount to the side of any tower having a leg diameter of 1.25 inches (standard stacked towers). Aluminum construction for corrosion resistance.

[illegible] 191 Crossarm [illegible]mbly

The primary mounting device for meteorological sensors. Includes cross fitting to mount to vertical or horizontal 3/4" IPS pipe, such as the #2420 Instrument boom.



Instrument Lift Carriage

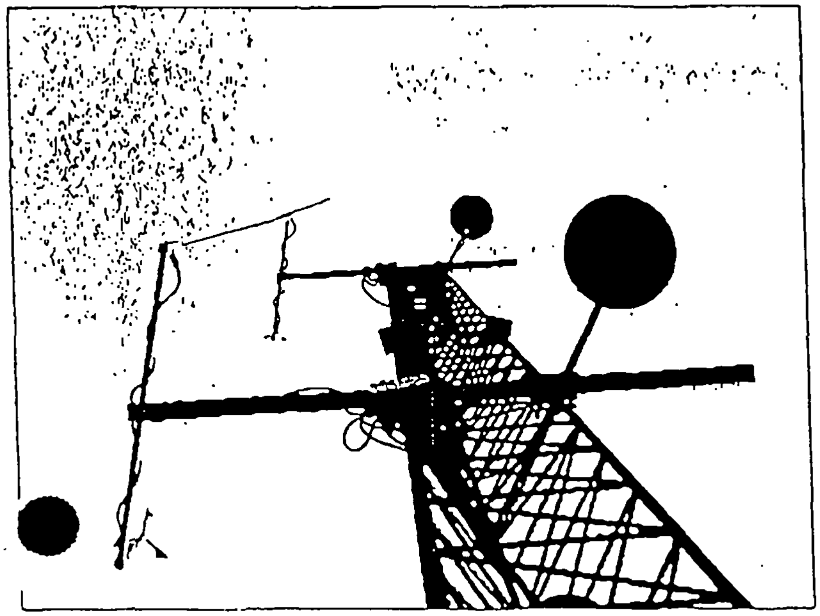
Model 173/175 Instrument Lifts

To avoid the difficulty and danger of tower climbing, the instrument lift is used to return sensors to ground level. Service to the system is easily accomplished without the expense and delay of contracting a professional climber.

Major structural members are hot-dipped galvanized steel. A three-foot instrument boom is standard with all instrument lift systems.

The Model 173 provides a continuous loop drive cable to positively raise and lower an instrument carriage to a maximum height of 100 feet (30 meters). A powered drive winch is an available option.

The Model 175 is a light duty system utilizing a hand-crank winch. The maximum recommended height for this system is 50 feet (15 meters).



Boom and Crossarm Assemblies

Tripod Towers

Tripod towers provide an economical, quick, and easy solution for sensor mounting. We offer a variety of tripods to meet virtually any meteorological system requirement.

Model 2150/2151 Tripods

Lightweight and sturdy, these tripods are constructed of galvanized steel tubing, and come fully assembled. Installation is accomplished by simply opening the legs and installing the mast. Each leg is furnished with a swiveling foot, enabling the tripod to be installed either on a flat surface or a pitched roof. A complete guying kit, including ground stakes, is included. The1-1/4" OD aluminum mast includes a reducer to allow use of an optional Model 191 Crossarm assembly.

Specifications

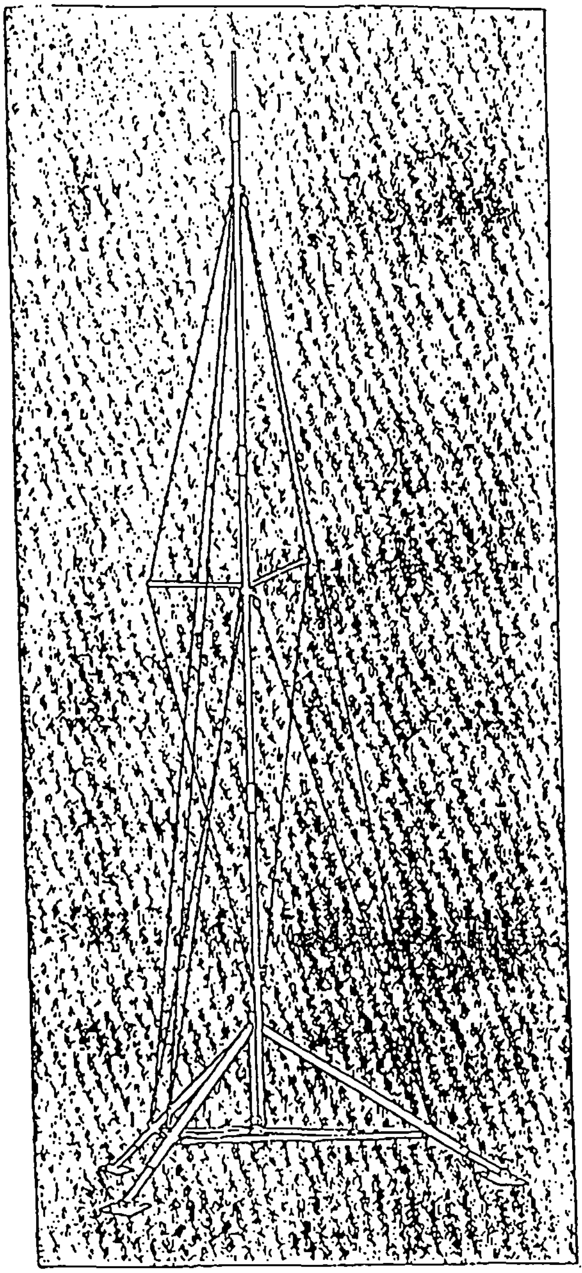
Model	Height to top of mast	Weight (approx.)
2150	11 Ft.	13 lbs.
2151	14 Ft.	18 lbs.

Model 6168/6230 Tripods

"Heavy-duty, self-supporting and extremely robust" describe these tripod towers. The unique design features self-contained guying and a wide footprint to provide strength and stability even in winds as high as 100 mph. Constructed of heavy aluminum tubing, the design features a fold-over mast to ease installation and facilitate servicing of the installed equipment. Heavy galvanized steel "feet and ankles" contribute to stability and are adjustable to conform to terrain variations. The feet can be staked to the ground for added stability. The strength, stability, and economy of these tripods make them a viable alternative to traditional instrument towers.

Specifications

Model	Height to top of mast	Weight (approx.)
6168	20 Ft. (6 M)	170#
6230	33 Ft. (10 M)	205#



Model 6230

Tower Erection and Turnkey Systems

Frequently the customer will find it expeditious and economical for a single contractor to have complete site and system responsibility. Unfortunately it is not easy to find a company that knows both sensors *and* pouring concrete. Met One Instruments has this knowledge—and the experience—gained from supplying numerous turnkey systems throughout the country and overseas. Met One Instruments' project engineers are conversant in all phases of construction associated with meteorological sites. Consult our sales department for budgetary estimates or firm quotations.

GENERAL CALIBRATION PROCEDURES

Met One Instruments

1600 Washington Blvd.
Grants Pass, Oregon 97526
Telephone 503-471-7111
Facsimile 503-471-7116

Regional Sales & Service
3206 Main St., Suite 106
Rowlett, Texas 75088
Telephone 214-412-4747
Facsimile 214-412-4716

1.0 GENERAL CALIBRATION PROCEDURES

1.1 Scope of Calibration

In general, the calibration of the meteorological instrumentation will be in conformance with the pertinent specifications of the PSD Guidelines, and the recommendations of the manufacturer.

1.2 Initial Inspection

The meteorological system will be inspected for apparent operating condition. Emphasis will be placed upon obvious damage due to natural forces (i.e., lightning, wind, hail, etc.) and failures due to operator error.

1.3 Baseline Calibration

The meteorological instruments will be tested using acceptable field techniques and manufacturers' instructions. Test data will provide a historical reference line to enable correction of existing data.

1.4 Calibration Report

The calibration report will summarize the results of the calibration and provide recommendations as required.

1.5 Basic Instrument Maintenance

Using the manufacturer's operation manual, the instrumentation will be cleaned, adjusted and generally maintained. Basic maintenance does not include replacement parts or maintenance procedures that require special jigs or fixtures.

1.6 Instrumentation Re-Calibration

Instrumentation will be calibrated according to manufacturer's measurement equations. Some measurements, such as temperature, incorporate a sensing element which can only be tested for conformity, there is no calibration adjustment.

2.0 WIND SPEED MEASUREMENT

2.1 Scope of Calibration

Calibration of the Wind Speed system will be in conformance with the standards of Section 1.0. Absolute calibration of the Wind Speed sensor requires the use of a wind tunnel facility. Calibration in the field requires procedures which will best approximate laboratory procedures in a field environment. The sensor will be mechanically tested with an input that will produce the same small torque that is experienced with a very low wind speed.

2.2 Calibration Tests

2.2.1 Sensor Threshold (one of the following methods)

a. Starting threshold of the wind sensor will be tested using a manufacturer's procedure, if available, or standard "go-no go" test. The "go-no go" test is based on the sensor's inertial properties. This type of test provides a very positive check of bearing condition and is well suited for field use.

b. Using a NIST traceable torque watch the starting threshold will be tested by measuring the force required to begin the rotation of the sensor shaft and compare this measurement to manufacturors specification for acceptance.

c. Testing of winds speed sensor will be preformed in NIST traceable wind tunnel. To eliminate down time an exchange wind sensor will be provided while main sensor is recalibrated upon completion of testing sensor will be shipped to customer for exchange.

2.2.2 Sensor's Cup Assembly

The relationship of the sensor's cup assembly to the measurement equation is;

$$\text{WIND SPEED}=\text{THRESHOLD}+\frac{\text{OUTPUT FREQUENCY}}{\text{ROTATION CONSTANT}}$$

The Rotation Constant has been determined by the manufacturer using performance data from NIST tests.

The cup assembly will be inspected for mechanical integrity. The cup assembly was set by the manufacturer in a precision jig or built in a wind tunnel and tested against a NIST secondary standard. The characteristics of this cup assembly will not change unless it becomes mechanically altered - broken cup assembly, bent cup arm, loose joint.

2.2.3 Electronics Module

The conformity of the electronics module to the measurement equation will be tested. Using measurement equation the electronics will be driven by simulated signals corresponding to various wind velocities and the output measured and recorded. The "built-in' test functions will be checked for corresponding values. Adjustments to the electronic module will be made as required.

2.2.4 Data Logger

Simulated signals corresponding to various wind velocities will be fed to the data logger. The data logger readings will be measured, recorded and checked for accuracy.

2.2.5 Recorder

Electronic signals will be fed to the recorder to test for accuracy at zero and full scale. Chart Recorder will also be inspected for proper mechanical zero settings.

4.0 WIND DIRECTION MEASUREMENT

4.1 Scope of Calibration

Calibration of the Wind Direction system will be in conformance with the standards of Section 2.0. The sensor will be tested for sensitivity (threshold), and accuracy. The orientation of the sensor will be checked and corrected if necessary. The electronics and recorders will be tested and adjustments will be made as required.

4.2 Calibration Tests

4.2.1 Sensor Threshold

Starting threshold of the wind sensor will be tested using manufacturer's procedure, if available, or standard "go-no go" test. The "go-no go" test is based on the sensor's inertial properties. This type of test provides a very positive check of bearing condition and is well suited for field use.

4.2.2 Sensor Orientation

The orientation of the sensor will be checked for true North-South alignment. If possible, the check will be made using a previously established reference point. If a reference point is not available, then a new point will be established using a compass and a sighting scope.

4.2.3 Sensor's Output Signal

The sensor output signal will be checked at a minimum of four azimuth points. The output signal at the sensor will be recorded and the recorder output will also be verified.

If the system includes a 540° range expander, dynamic tests will be conducted to verify proper operation.

If the sensor is a "bivane" type then the vertical output signal will also be tested and recorded.

4.2.4 Electronics Module

The accuracy and linearity of the electronics module will be tested using simulated sensor inputs and measuring the output signal. The 'built-in' test functions will be checked for corresponding values. Adjustments to the electronic module will be made as required.

4.2.5 Recorder

Electronic signals will be fed to the recorder to test for accuracy at zero and full scale. The Chart Recorder will also be inspected for proper mechanical zero settings.

5.0 TEMPERATURE MEASUREMENT

5.1 Scope of Calibration

Calibration of the Temperature system will be in conformance with the standards of Section 2.0. The Radiation shield will be checked for proper operation. The temperature sensor will be compared to a Standard Sensor to verify accuracy. The electronics and recorders will be tested and adjustments will be made as required.

5.2 Calibration Tests

5.2.1 Radiation Shield

The Radiation Shield will be carefully inspected for adequate flow rate, any obstructions will be removed. If the unit has an air flow monitor, the operation will be tested.

5.2.2 Temperature Sensor (one of the following methods)

a. The sensor will be tested in-situ against a precision NIST traceable standard temperature sensor. The accuracy of this procedure depends on placing the standard sensor within the protective influence of the radiation shield.

b. All sensors being tested will be immersed in an ice-bath and sensor output will be tested against a precision standard. Using the manufacturer's Resistance vs. Temperature Tables, the output resistance will be measured using a Digital-Volt Meter with a "bridge" input.

5.2.4 Electronics Module

The accuracy and linearity of the electronics module will be tested using simulated sensor inputs and measuring the output signal. Fixed resistance values will be applied to the input to test the conformity of the electronics module to Resistance/Temperature Tables. The 'built-in' test functions will be checked for corresponding values. Adjustments to the electronic module will be made as required.

5.2.5 Recorder

Electronic signals will be fed to the recorder to test for accuracy at zero and full scale. Chart Recorder will also be inspected for proper mechanical zero settings.

6.0 RELATIVE HUMIDITY MEASUREMENT

6.1 Scope of Calibration

Calibration of the Relative Humidity system will be in conformance with the standards of Section 2.0. The Radiation shield will be checked for proper operation. The Relative Humidity sensor will be compared to a Standard Sensor to verify accuracy. The electronics and recorders will be tested and adjustments will be made as required.

6.2 Calibration Tests

6.2.1 Radiation Shield

The Radiation Shield will be carefully inspected for adequate flow rate, any obstructions will be removed.

6.2.2 Relative Humidity Sensor (one of the following methods)

a. The sensor will be tested in-situ against a precision standard Relative Humidity sensor. The accuracy of this procedure depends on placing the standard sensor within the protective influence of the radiation shield.

b. The sensor being tested and the precision reference standard will be placed in a closed salt bath container and the outputs will be compared.

c. The sensor output will be compared against a precision wet bulb/dry bulb psychrometer.

6.2.4 Electronics Module

The accuracy and linearity of the electronics module will be tested using simulated sensor inputs and measuring the output signal. Fixed voltages will be applied to the input to test the linearity of the electronics modules. The 'built-in' test functions will be checked for corresponding values. Adjustments to the electronic module will be made as required.

6.2.5 Recorder

Electronic signals will be fed to the recorder to test for accuracy at zero and full scale. Chart Recorder will also be inspected for proper mechanical zero settings.

7.0 BAROMETRIC PRESSURE MEASUREMENT

7.1 Scope of Calibration

Calibration of the BAROMETRIC PRESSURE system will be in conformance with the standards of Section 2.0. The sensor will be tested against NIST traceable secondary standard. The electronics and recorders will be tested and adjustments will be made as required.

7.2 Calibration Tests

The sensor output signal will be compared at a single point against a NIST traceable secondary standard. The output signal at the sensor will be recorded and the recorder output will also be verified.

7.3 Obstruction Check

Sensor inlet will be checked to verify that sensor is measuring outside ambient barometric pressure.

7.4 Electronics Module

The accuracy and linearity of the electronics module will be tested using simulated sensor inputs and measuring the output signal. The 'built-in' test functions will be checked for corresponding values. Adjustments to the electronic module will be made as required.

7.5 Recorder

Electronic signals will be fed to the recorder to test for accuracy at zero and full scale. The Chart Recorder will also be inspected for proper mechanical zero settings.

8.0 SOLAR RADIATION MEASUREMENT

8.1 Scope of Calibration

Calibration of the Solar Radiation system will be in conformance with the standards of Section 2.0. The sensor will be tested against NIST traceable secondary standard. The electronics and recorders will be tested and adjustments will be made as required.

8.2 Calibration Tests

The sensor output signal will be compared at a single point against a secondary standard. The output signal at the sensor will be recorded and the recorder output will also be verified.

8.2.1 Response Test

The sensor will be covered and uncovered to determine sensor response.

8.2.2 Sensor Level

The sensor will be checked for level and will be adjusted as necessary.

8.4 Electronics Module

The accuracy and linearity of the electronics module will be tested using simulated sensor inputs and measuring the output signal. The 'built-in' test functions will be checked for corresponding values. Adjustments to the electronic module will be made as required.

8.5 Recorder

Electronic signals will be fed to the recorder to test for accuracy at zero and full scale. The Chart Recorder will also be inspected for proper mechanical zero settings.

9.0 PRECIPITATION MEASUREMENT

9.1 Scope of Calibration

Calibration of the Precipitation system will be in conformance with the standards of Section 2.0. The sensor will be tested using a measured amount of water to simulate rainfall, additional tests for obstruction, levelness and proper mounting will also be performed.

9.2 Calibration Tests

The sensor output signal will be counted when the sensor is subjected to a simulated rainfall. Using a graduated cylinder, a measured quantity of water will be added at a rate of less than 3" per hour.

9.2.1 Sensor Level

The sensor will be checked for level and will be adjusted as necessary.

9.3 Electronics Module

The accuracy and linearity of the electronics module will be tested using simulated sensor inputs and measuring the output signal. The 'built-in' test functions will be checked for corresponding values. Adjustments to the electronic module will be made as required.

9.5 Recorder

Electronic signals will be fed to the recorder to test for accuracy at zero and full scale. The Chart Recorder will also be inspected for proper mechanical zero settings.

APPENDIX B

Ambient Air Sampling and Analysis Methods

Burlington Environmental Inc. Standard Operating Procedure	SOP:	Woods-AAMP1
	Date:	02/03/95
AMBIENT AIR MONITORING PROGRAM	Approved by:	Kom 2/4/95
WOODS INDUSTRIES SITE, YAKIMA, WASHINGTON	Page:	1 of 18

Purpose

To describe daily operation of the ambient air monitoring program at the Woods Industries Site during soil treatment activities.

Contents

References
Equipment
Forms
Responsibilities
Discussion
Procedure
- Initial Installation
- Each Day of Site Operations
- Each Monitoring Event
- Weekly (or once each 7 sampling events if sampling is not daily)
- To Identify Cause of Excessive Fugitive Emissions

Exceptions

References

Burlington Environmental Inc. 1995. *Ambient Air Monitoring Plan for On-Site Soil Treatment Activities at the Woods Industries Site, Yakima, Washington.* Prepared for Burlington Northern Railroad. Revised February 3. (And references cited therein.)

Operation manuals for the equipment listed below.

Equipment

Samplers	
PM_{10} Samplers (also used for Mercury Sampling)	7
TO-10 Samplers	7
Gold-Coil Mercury Dosimeter with Gilian 513A Pumps	3
Stationary Real-Time Particulate Monitor	
DataRAM with Omnidirectional Sampler Inlet and PM_{10} Inlet Head	1
Remote Alarm System for DataRAM	1
Remote Data Download System for DataRAM	1
Portable Real-Time Particulate Sensor	
Miniram Model PDM-3 with PDL-10 Data Logger and Printer	1
Analyzers	
Jerome Mercury Vapor Analyzer with gold-coil dosimeter analysis equipment	1
Meteorology Station	
Tower, 10-meter with: Wind Speed, Wind Direction, Temperature, Relative Humidity, and Barometric Pressure Sensors	1
Spare Wind Speed Sensor	1
Spare Wind Direction Sensor	1

Spare Wind Direction Sensor	1
Data Logger with Spread-Spectrum Radiotelemetry System	1
Sample Media	
PM_{10}/Mercury Filters	(as needed)
TO-10 PUFs	(as needed)
Calibrators	
High Volume Orifice Calibrator	1
Gilibrator	1
Computer	
Computer with Printer, Meteorology Data Download and Analysis Software, Particulate Monitor Data Logger Download and Analysis Software, and Ambient Air Monitoring Data Record Files	1

Forms

1. Ambient Air Monitoring Event Record
2. Chain of Custody Record
3. Ambient Air Monitoring Event Summary
4. Ambient Air Monitoring Equipment Record
5. Ambient Air Monitoring Database
6. PM_{10} Calibration Record
7. Sample Control Log

Responsibilities

Air Sampling Technician: Calibrate, operate, and maintain ambient air monitoring equipment and meteorology station. Document sampling activities and activities of others that may impact ambient air quality in the site vicinity. Coordinate shipment of sample media to the site. Ship samples to laboratory. Compile results. Inform Burlington Environmental On-Site Manager of air monitoring results. Assist in identifying sources of fugitive emissions and the effectiveness of controls.

Burlington Environmental On-Site Manager: Provide support for air sampling technician. Inform on-site USEPA and Williams Environmental Services representatives of air monitoring results. Inform Williams when significant changes are necessary to meet ambient air action levels.

Williams Environmental Services Inc.: Implement fugitive and stack emission controls necessary to maintain ambient air quality within action levels established in the Ambient Air Monitoring Plan.

Discussion

This SOP describes the actions to be taken by personnel implementing this ambient air monitoring program. As described in the Ambient Air Monitoring Plan, this program is designed to document that ambient air quality is not being negatively impacted by operation of the soil treatment unit at the Woods Industries Site and to allow corrective actions to be taken quickly if action levels are being exceeded.

Procedure

INITIAL INSTALLATION:

1. Create an on-site filing system for equipment manuals, calibration data, sample media shipment records, sampling event records, meteorology records, chain-of-custody records, laboratory data reports, preliminary results, final results, audit records, and air monitoring program corrective actions.

2. Set up a clean work area for storing and handling sample media. Stock the area with the spare PM_{10} filter holders, disposable latex gloves, and spare parts for the sampling equipment. Store filters and other sample media in a locking metal cabinet. **Recovered samples and dirty equipment are not to be placed in this cabinet.**

3. **NOTE: Do not use local tap water to rinse sampling equipment and surfaces where sample media will be handled.**

4. Install a portable HEPA air-filtration unit in the sample handling work area to minimize airborne dust in the area.

5. Assist the meteorology equipment installation company (Met One Instruments) to install the tower and sensors at the location shown in Figure 3-1 and install the communication software on the Burlington Environmental computer in the site office. Ensure the equipment is functioning and that the data logging and data analysis software are operating. Obtain a copy of the installer's installation and calibration records. **Be sure the barometric pressure is not corrected for altitude.**

6. Install platforms at the ambient air monitoring locations to elevate the sampling equipment inlets to the required height above grade. Inlets of the off-site samplers (A21 and A22) are to be 10 feet above grade. Inlets of the perimeter samplers are to be 6 feet above grade. At location A11, sampler inlets will be 6 feet above the temporary ecology block (concrete) wall on the east side of the treated soil storage area. The platform at location A11 is to be large enough to allow the collocated PM_{10} samplers to be 6 feet apart.

7. Provide 110 VAC electrical service to each sampling locations.

8. Install chain-link security fencing with gates and barbed wire around sampling locations not within the site perimeter fencing.

9. Install insulated, vented shelters to protect the TO-10 and mercury vapor samplers (Gilian Air-Con 2 and 513A pumps, respectively) and the DataRAM from the elements. If necessary, place small heat sources in these shelters to maintain the samplers at the required operating temperature range.

10. Install the TO-10, PM_{10}/Mercury, and mercury vapor samplers at the first six locations to be monitored and the collocated sampling location (seven samplers, except only two for mercury vapor).

    Note: The sampler from the collocated sampling location may be moved to serve as an emergency backup if another sampler malfunctions. The malfunctioning sampler is to be repaired or replaced immediately.

11. Calibrate the PM_{10} samplers according to the manufacturer's instructions using a top-loading adapter and a variable orifice calibrator in accordance with the manufacturer's instructions.

12. Calibrate the TO-10 samplers to draw 2 liters per minute through the TO-10 PUF sample media according to the manufacturer's instructions using a Gilian Gilibrator Primary Standard Airflow Calibrator equipped with a Standard Flow Cell Assembly.

13. Calibrate the mercury vapor sampling pumps to draw a known volume of air through the gold-film dosimeters. Evaluate sampling flow rates and sampling durations to identify a combination that will allow 24-hour sampling to be performed at the site without breakthrough. For the first set of samples, install the dosimeters in series to evaluate breakthrough of the sample media. Perform a functional check of the Jerome analyzer.

14. Install the DataRAM in a weatherproof cabinet at the location shown in Figure 4-3. Install the Omnidirectional Sampling Inlet 6 feet above the ecology block wall and 6 feet from the PM_{10} samplers. Connect the DR-PM10/2.5 impactor (set to collect particles smaller than 10 microns) between the Omnidirectional Sampling Inlet and the DR-TCH Temperature Conditioning Heater. Make sure the filter is installed in the impactor. Install flexible tubing between the DR-TCH and the DataRAM sample inlet. Minimize bends and horizontal runs in the flexible tubing.

15. Connect the DataRAM RS-232 output to the computer in the Burlington Environmental site office to allow the data to be downloaded.

16. Connect the DataRAM alarm output to the Alarm/Relay Module in the Williams Environmental Services control room to allow prompt response to ambient air concentrations greater than the action levels set in the Ambient Air Monitoring Plan.

17. Calibrate the DataRAM and set the instrument to collect one-hour average concentration data. Set for automatic zeroing each hour. Set the flow rate for 2.0 liters per minute. Set the alarm to sound if the one-hour average concentration exceeds 150 micrograms per cubic meter ($\mu g/m^3$).

    NOTE: The alarm set point may be revised after the correlation between the PM_{10} samplers and the DataRAM is established.

18. Have sample media for PM_{10}/Hg and TO-10 sampling shipped from the laboratory.

19. Check the MINIRAM for proper operation. Calibrate the instrument. Test the printer connection.

Each Day of Site Operations:

1. Manually zero and check span of the DataRAM. If DataRAM "Calib Diff" exceeds 10%, consult the manufacturer. Check that all DataRAM settings are correct and that flow rate is 2.0 liters per minute.
2. Download data from the DataRAM to the site computer. Print the data summary. Save the data to the DATARAM subdirectory by date. (Do not clear data from the DataRAM instrument until the downloaded data has been saved in a computer file and printed.)
3. Download data from the meteorology station to the site computer. Print the data summary. Save the data to the meteorology data directory by date.
4. Log in any sample results received from the laboratory. Calculate airborne concentrations. Compile preliminary and final summary reports as appropriate for data received. Password protect the summary report files as they are made final.
5. Each Thursday, replace the filter in the PM10/2.5 impactor on the DataRAM. Wipe the interior of the impactor with a cloth dampened with deionized water to remove dust.

Each Monitoring Event:

1. Start a Sampling Event Record sheet.
2. While wearing disposable, unpowdered latex gloves, load pre-weighed filters in the required number of PM_{10}/mercury sample holders.
3. Place the required number of loaded PM_{10}/mercury filter holders and PUF cartridges into the sample media transport case to keep them clean during transport.
4. Purge the required number of Gold Coil Dosimeters for mercury vapor sampling. Seal the ends of the dosimeters with tubing for transport.
5. Observe meteorology station for signs of damage.
6. **If previous samples have already been recovered:** Calibrate the TO-10 samplers using the Gilibrator at the sampling location immediately prior to the sampling event. Record pertinent data.

   If previous sample is still in sampler: First, record the final flow rate (if applicable), ending time, and final counter reading on Sampling Event Record for previous event. Remove previous sample media and package appropriately. Leave filters in filter holders until returned to clean work area. Put recovered sample media in appropriate containers to prevent cross-contamination. Wipe the sample inlet and impactor plate with a cloth dampened with deionized water to remove dust. **Second**, calibrate the TO-10 samplers at the sampling location immediately prior to the sampling event. Record pertinent data.

   For PM_{10} samplers, set flow measurement chart. to proper time.

7. **If sampling is being performed daily:** Immediately start the sampler.

   If sampling is being performed less than daily: Set the automatic timer to start the sampler at midnight and to end at midnight the following day.

   Sampling periods will be approximately 23.5 hours long when samples are being collected daily. Sampling periods will be midnight to midnight when sampling frequency is less than daily.

Form Woods-AAMP-2
Chain-of-Custody Record

BURLINGTON ENVIRONMENTAL
A Philip Environmental Company

Chain-of Custody Record – Nonchemical Samples

210 West Sand Bank Road
P.O. Box 230
Columbia, IL 62236-0230

(618) 281-7173 Phone
(618) 281-5120 FAX

COC Serial No. G 001965

Project Name

Project Number Phase . Task

Samplers

Lab Name

Location

Sample Number	Date	Time	Matrix	Analysis Type					Comments

Relinquished by: **Received By:**

Signature	Date	Time	Signature	Date	Time

Carrier: Airbill No.

Shipping and Lab Notes:

BE-211 (6/94)

Form Woods-AAMP-3
Ambient Air Monitoring Event Summary

Ambient Air Monitoring Event Summary

Woods Industries Site, Yakima, Washington
A Burlington Environmental Inc. Project for Burlington Northern Railroad
Burlington Environmental Inc. is a Philip Environmental Company
Project Manager: David Eagleton

(NOTE: This summary is Preliminary unless Final is checked.)

☐ Preliminary
☐ Final

Monitoring Event Number __________
Date Summary Prepared __________
Summarized by __________

Event	Date	Time
Start		
End		

Site Activities

LTTD Unit Operating
☐ Yes (Capacity) ______ %
☐ No

Stockpile being Used
☐ North
☐ South

Soil being Screened
☐ Yes
☐ No

Soil being Backfilled
☐ Yes
☐ No

Soil beneath North Pile being excavated
☐ Yes
☐ No

Other: __________

Meteorology

Wind Direction		Percent of Time
North	360°	
NNE	22.5°	
Northeast	45°	
ENE	67.5°	
East	90°	
ESE	112.5°	
Southeast	135°	
SSE	157.5°	
South	180°	
SSW	202.5°	
Southwest	225°	
WSW	247.5°	
West	270°	
WNW	292.5°	
Northwest	315°	
NNW	337.5°	

Parameter	Mean	Maximum	Minimum
English Units			
Wind Speed (mph)			
Temperature (°F)			
Barometric Pressure (in. Hg)			
Relative Humidity (%RH)			
Metric Units			
Wind Speed (m/sec)			
Temperature (°C)			
Barometric Pressure (mb)			
Relative Humidity (%RH)			

Lab

	Initials	Date
Lab Data Received		
Lab Data QA/QC Review		

24-Hour Samplers

Concentration (µg/m³)
(Circle or Shade Results that Exceed Action Levels)

	Location Number	Side of Site	End of Site	PM_{10}	Mercury	DDT	Dieldrin	Hexachloro-benzene
Perimeter	A11	East	Center					
	A12	West	Center					
	A13	East	North					
	A14	West	North					
	A15	East	South					
	A16	West	South					
Off-Site	A21	East	–					
	A22	West	–					
QA	A61	East	Center					
Relative Percent Difference between A61 and A11								
Action Level				150	0.3	3250	69.1	726

Stationary Real-Time Particulate Monitor

Location:
A11
(Center of East Perimeter)

Time	Conc. (µg/m³)
01:00	
02:00	
03:00	
04:00	
05:00	
06:00	
07:00	
08:00	
09:00	
10:00	
11:00	
12:00	
13:00	
14:00	
15:00	
16:00	
17:00	
18:00	
19:00	
20:00	
21:00	
22:00	
23:00	
24-hour Avg.	

2/4/95/AIRDATA.XLS/Event Summary

Form Woods-AAMP-4
Ambient Air Monitoring Equipment Record

Ambient Air Monitoring Equipment Records

Woods Industries Site, Yakima, Washington
A Burlington Environmental Inc. Project for Burlington Northern Railroad
Burlington Environmental Inc. is a Philip Environmental Company
Project Manager: David Eagleton

Date ____________

Air Monitoring Technician ____________

Complete one of these forms whenever equipment is moved to a new location at the site.
Record only the moved equipment or new locations, not all sampling locations.

Sample Location Numbering System:
Add Prefix 'A' (without hyphen) to represent ambient air monitoring locations.

10 to 19	Site Perimeter
20 to 29	Off-Site
60 to 70	Collocated QA Samples (Add 50 to site number)

Odd numbers are east of site.
Next higher even number is west of site, at same general distance and longitude.

Sampler Location	Sampler Manufacturer	Sampler Type	Model	Serial Number	Date Installed	Date Removed

2/4/95/AIRDATA.XLS/Equipment

8. Install sample media in PM_{10}/mercury and PUF samplers. Record the sample media serial number, counter reading (if any), and time on the event record. Start the samplers. Record the flow rate.

Sampler	Desired Flow Rate
PM10	40 cubic feet per minute
TO-10	2.0 liters per minute
Mercury Vapor	(To be established based on site conditions)

9. During the day, record observed activities that occur on or near the site that may impact ambient air quality.

10. **At the end of the monitoring period**, record the final flow rate (if applicable), ending time, and final counter reading on Sampling Event Record for previous event. Remove previous sample media. Leave filters in filter holders until returned to clean work area. Seal mercury vapor dosimeters. Put recovered sample media in appropriate containers to prevent cross-contamination.

11. For PM_{10} samplers, remove the flow measurement chart and identify with date, time, and location of sample collection. Install a new chart.

12. In clean area, while wearing disposable, unpowdered latex gloves, recover filters from filter holders. Immediately place in appropriate containers for shipment to lab.

13. Analyze mercury vapor dosimeters on site.

14. Calculate sample volumes for each sample using sampling time, pressures, flow rates, and appropriate calibration data.

15. Complete chain-of-custody record.

16. Package samples, including appropriate blank samples, for shipment to the laboratory.

17. Ship samples via overnight delivery service to laboratory. For samples collected on a weekend or a holiday, retain samples in a sealed container on site until next business day.

18. Download meteorology data for the monitoring event period. Calculate predominant wind direction, average wind speed, temperature, relative humidity, and barometric pressure. Save data to file. Print summary of meteorology data.

19. Calculate 24-hour average for DataRAM results for sampling period. Print results. Save data to file.

20. **Upon receipt of preliminary data from laboratory**, calculate ambient air concentration (if not reported as concentration in air by laboratory).

21. Complete a preliminary air monitoring data summary and provide to the Burlington Environmental and USEPA on-site representatives.

22. When ambient concentrations of monitored parameters exceed action levels specified in Table 4-2 of the Ambient Air Monitoring Plan, alert the Burlington Environmental representative to notify the Williams Environmental Services representative that corrective measures are required.

23. **Upon receipt of final lab data from reviewer**, complete a final air monitoring data summary and provide to the Burlington Environmental and USEPA on-site representatives.

Weekly (Or once each 7 sampling events if sampling is not daily)

1. Operate collocated PM_{10}/mercury and TO-10 samplers simultaneous with other samplers.
2. Submit field blank samples for analysis with other samples.
3. Record collocated sample results as QA data.
4. Calculate a percent relative difference between the QA sample and the primary sample.

To Identify Cause of Excessive Fugitive Emissions

1. Operate properly calibrated Miniram to assist Williams Environmental identify source of emissions. Use instrument to obtain average concentration over at least a 10-minute period. Record monitoring location, date, time, duration, and reading in Miniram logbook.
2. Operate Miniram to assist Williams Environmental to assess the effectiveness of corrective actions implemented.

Exceptions None.

End of Procedure No.: WOODS-AAMP1

Form Woods-AAMP-1
Ambient Air Monitoring Event Record

Ambient Air Monitoring Event Record

Woods Industries Site, Yakima, Washington

A Burlington Environmental Inc. Project for Burlington Northern Railroad
Burlington Environmental Inc. is a Philip Environmental Company

Project Manager: David Eagleton

Monitoring Event Number ______
Date Start ______ Date End ______
Sampling Technician at Start (Print) ______ Signature ______
Sampling Technician at End (Print) ______ Signature ______

Meteorology Tower

Start
Status.................... ☐ OK ☐ Not OK

End
Status.................... ☐ OK ☐ Not OK
Data Logger Downloaded.................... ☐ Yes ☐ No
Data Averaged and Printed.................... ☐ Yes ☐ No

Comments ______

Real-Time Particulate Matter Location A11

Start
Status.................... ☐ OK ☐ Not OK
Calibration Time ______
Calibrated By: ______

End
Status.................... ☐ OK ☐ Not OK
Data Logger Downloaded.................... ☐ Yes ☐ No
Data Averaged and Printed.................... ☐ Yes ☐ No

Comments ______

Samplers

	Time		PM$_{10}$/Mercury Sampler					TO-10 Sampler					
			Filter Number	Flow			Sample Volume (m^3)	Cartridge Number	Flow (L/min)			Sample Volume (m^3)	
Location	Start	End		Start	End	Average			Start	End	Average		Comments
A11													
A12													
A13													
A14													
A15													
A16													
A21													
A22													
A61													

Activities on Site

LTTD Unit Operating Load (% of Capacity).................... ______
Hours of LTTD Unit Operation.................... ______
Soil Beneath North Stockpile being Excavated.............. ☐ Yes ☐ No
Stockpile being Used.................... ☐ North ☐ South
Soil being Screened.................... ☐ Yes ☐ No
Treated Soil being Backfilled.................... ☐ Yes ☐ No
Other (describe): ______

Nearby Off-Site Activities that may Impact Air Quality ______

2/4/95/AIRDATA.XLS/Event Record

Form Woods-AAMP-5
Ambient Air Monitoring Database

Woods Industries Site
Ambient Air Monitoring Program

DDT

1/17/95 12:20
Page 8 of 9

Woods Industries Site
Ambient Air Monitoring Program

Dieldrin

1/17/95 12:20
Page 7 of 9

Woods Industries Site
Ambient Air Monitoring Program

Mercury

1/17/95 12:20
Page 6 of 9

Woods Industries Site
Ambient Air Monitoring Program

PM10

1/17/95 12:20
Page 5 of 8

Monitoring Phase	Event Number	Sampling Start Date	PM$_{10}$ Concentration (µg/m^3) A11	A61	A12	A13	A14	A15	A16	A21	A22
Baseline	1	1/0/00									

Woods Industries Site
Ambient Air Monitoring Program

Hourly Real-Time PM

1/17/95 12:20
Page 4 of 4

Monitoring Phase	Event Number	Sampling Start Date	Monitoring Location	Real-Time Particulate Matter Concentration (µg/m^3) 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	Comments
Baseline	1	1/0/00	A11																									
	2	1/0/00	A11																									

Woods Industries Site
Ambient Air Monitoring Program

Avorage Real-Time PM

1/17/95 12:20
Page 3 of 9

Monitoring Phase	Event Number	Sampling Start Date	Monitoring Location	Average Real-Time Particulate Matter Concentration (µg/m^3)	Comments
Baseline	1	1/0/00	A11	#DIV/0!	
	2	1/0/00	A11	#DIV/0!	

Woods Industries Site
Ambient Air Monitoring Program

Meteorology

1/17/95 12:20
Page 2 of 9

Monitoring Phase	Event Number	Sampling Start Date	Predominant Wind Direction	Wind Speed (mph)	Temp. (F)	Relative Humidity (%)	Baro. Pressure (in. Hg)	Wind Speed (m/s)	Temp. (C)	Relative Humidity (%)	Baro. Pressure (mb)
Baseline	1										
	2										

Woods Industries Site
Ambient Air Monitoring Program

Event Descriptions

1/17/95 12:20
Page 1 of 9

Monitoring Phase	Event No.	Sampling Period Start Date	Start Time	End Date	End Time	Locations Monitored A11	A12	A13	A14	A15	A16	A21	A22	A61	Sampling Technician Start	End	Comments
Baseline	B1					Y	Y	Y	Y	N	N	Y	Y	Y			
	B2																
	B3																
	B4																
	B5																
Remedial	R1																
	R2																
	R3																
	R4																
	R5																
	R6																
	R7																
	R8																
	R9																
	x																
Post-Rem.	P1																
	P2																
	P3																
	P4																
	P5																

Notes:

Form Woods AAMP-6
PM_{10} Calibration Record

HVPM10 SAMPLER CALIBRATION DATA SHEET
MASS FLOW CONTROLLED UNIT

Sampler Location: Date:

Conditions: Ta(K): Pa(mmHg):
Ts(K): Ps(mmHg):

Sampler Model: Sampler S/N: Motor No:.

Orifice S/N: Orifice Cal. Date: Orifice Model:

Orifice Qa Cal. Relationship: m=________ b=________ r=________

Calibration Conducted by:______________

Cal. Point	Plate No.	Total ΔH20	Qa(orifice) flow rate m3/min	Sampler Response I	Corrected Response IC
1					
2					
3					
4					
5					

Qa(orifice): $= 1/m\,[\sqrt{\Delta H20(Ta/Pa)}] - b]$
$IC = I\,[\sqrt{(Ta/Pa)}]$
Sampler's Qa Calibration Relationship:
Qa(orifice), x-axis. IC, y-axis
m=________ b=________ r=________
Set Point Flow Rate:________
SFR = 1.13(Ps/Pa)(Ta/Ts)

Sampler Seasonally Adjusted Calibration Relationship
ms = ________ bs=________
$ms = m / [\sqrt{(Ts/Ps)}]$
$bs = b / [\sqrt{(Ts/Ps)}]$
Sampler Set Point:________

Form Woods AAMP-7
Sample Control Log

Sample Control Log

BURLINGTON ENVIRONMENTAL

Serial No. SCL-____________

Page _____ of ______

Project Name ______________________________

Project No. ______________

Project Manager ______________________________

Phase.Task No. __________.______

Client Company ______________________________

Site Name ______________________________

Date Sampled	Time Sampled	Burlington Sample Number	COC Number	Laboratory	Bill of Lading Number	Date Shipped

Form A0201 Rev. 02/24/94

Burlington Environmental Inc. Standard Operating Procedure

AUDITING OF AMBIENT AIR MONITORING PROGRAM
WOODS INDUSTRIES SITE, YAKIMA, WASHINGTON

SOP: Woods-AAMP2
Date: 02/03/95
Approved by: 2/4/95
Page: 1 of 3

Purpose

To describe the audit program that will be used to assess the ambient air monitoring program at the Woods Industries Site during soil treatment activities.

References

Burlington Environmental Inc. 1995. *Ambient Air Monitoring Plan for On-Site Soil Treatment Activities at the Woods Industries Site, Yakima, Washington*. Prepared for Burlington Northern Railroad. Revised February 3. (And references cited therein.

Reference manuals for equipment listed below and in above plan.

Equipment

Calibrators (Separate from those used in normal operations)

- PM_{10}/Hg: High Volume Orifice Calibrator
- TO-10 and Mercury Vapor: Gilibrator
- Meteorology Station: Calibrators for Wind Speed, Wind Direction, Temperature, Relative Humidity, and Barometric Pressure Sensors (Alternatively, a collocated meteorology station may be used to evaluate the met station.)

Responsibilities

Auditor: Audit operation of the ambient air monitoring program. This person cannot be involved in installation, routine operation, or calibration of equipment used in this program.

Air Sampling Technician: Correct deficiencies noted in audit.

Burlington Environmental On-Site Manager: Provide support for auditor. Inform on-site USEPA representative of audit results.

Discussion

This SOP describes the actions to be taken by personnel auditing the ambient air monitoring program. As described in the Ambient Air Monitoring Plan, these audits are designed to document that the ambient air monitoring program is being operated as designed and is obtaining the desired data.

Procedure

METEOROLOGY STATION:

1. Perform the audit procedures described in Section 3.6 of the Ambient Air Monitoring Plan.
2. Check the calibration of the meteorology station sensors using a set of calibration devices separate from those used by the installer.
3. Calculate a percent difference for each type of data.
4. Check the procedures used to download data and calculate average values.
5. Prepare an audit report.

GILIBRATOR:

(See Section 4.7.1.3 of the Plan)

1. Have Gilibrator calibrated by the manufacturer at the beginning of the ambient air monitoring program using NIST-traceable procedures.
2. Have Gilibrator calibrated by the manufacturer at the end of the ambient air monitoring program using NIST-traceable procedures.

PM$_{10}$/MERCURY SAMPLER SPECIAL AUDITS:

1. Have the high volume orifice calibrator calibrated by the manufacturer at the beginning of the ambient air monitoring program using NIST-traceable procedures.
2. Have the high volume orifice calibrator calibrated by the manufacturer at the end of the ambient air monitoring program using NIST-traceable procedures.

3. If requested by USEPA, use a separate calibrator provided by USEPA to audit the calibration of the PM_{10} samplers during the ambient air monitoring program.

ONGOING AMBIENT AIR MONITORING:

1. Check the calibration of each sampler using a separate calibration device from the one used during routine operation of the site.
2. Review the on-site filing system for completeness.
3. Observe the installation and retrieval of samples by the air monitoring technician.
4. Observe instrument calibration as it is performed by the air monitoring technician.
5. Review a randomly selected group of the calculations performed by the air monitoring technician.
6. Observe handling of field blank samples.
7. Check that sampling is being performed at the required frequency.
8. Prepare an audit report.

Exceptions None

End of Procedure No. WOODS-AAMP2

APPENDIX B-1

DDT, Dieldrin, and Hexachlorobenzene Sampling
by
Method TO-10

Revision 1.0
June, 1987

METHOD TO10

METHOD FOR THE DETERMINATION OF ORGANOCHLORINE PESTICIDES IN AMBIENT AIR USING LOW VOLUME POLYURETHANE FOAM (PUF) SAMPLING WITH GAS CHROMATOGRAPHY/ELECTRON CAPTURE DETECTOR (GC/ECD)

1. Scope

1.1 This document describes a method for sampling and analysis of a variety of organochlorine pesticides in ambient air. The procedure is based on the adsorption of chemicals from ambient air on polyurethane foam (PUF) using a low volume sampler.

1.2 The low volume PUF sampling procedure is applicable to multicomponent atmospheres containing organochlorine pesticide concentrations from 0.01 to 50 ug/m^3 over 4- to 24-hour sampling periods. The detection limit will depend on the nature of the analyte and the length of the sampling period.

1.3 Specific compounds for which the method has been employed are listed in Table 1. The analysis methodology described in this document is currently employed by laboratories using EPA Method 608. The sampling methodology has been formulated to meet the needs of pesticide sampling in ambient air.

2. Applicable Documents

2.1 ASTM Standards

D1356 - Definitions of Terms Related to Atmospheric Sampling and Analysis.

D1605-60 - Standard Recommended Practices for Sampling Atmospheres for Analysis of Gases and Vapors.

E260 - Recommended Practice for General Gas Chromatography Procedures.

E355 - Practice for Gas Chromatography Terms and Relationships.

2.2 EPA Documents

2.2.1 Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA-600/4-84-041, U.S. Environmental Protection Agency, Research Triangle Park, NC, April 1984.

2.2.2 Manual of Analytical Methods for Determination of Pesticides in Humans and Environmental Standards, EPA-600/8-80-038, U.S. Environmental Protection Agency, Research Triangle Park, NC, July 1982.

2.2.3 "Test Method 608, Organochlorine Pesticides and PCBs," in EPA-600/4-82-057, U.S. Environmental Protection Agency, Cincinnati, Ohio, July 1982.

2.2.4 R. G. Lewis, ASTM draft report on standard practice for sampling and analysis pesticides and polychlorinated biphenyls in indoor atmospheres, U.S. Environmental Protection Agency, Research Triangle Park, NC, June 1987.

3. Summary of Method

3.1 A low volume (1 to 5 L/minute) sampler is used to collect vapors on a sorbent cartridge containing PUF. Airborne particles may also be collected, but the sampling efficiency is not known.

3.2 Pesticides are extracted from the sorbent cartridge with 5% diethyl ether in hexane and determined by gas-liquid chromatography coupled with an electron capture detector (ECD). For some organochlorine pesticides, high performance liquid chromatography (HPLC) coupled with an ultraviolet (UV) detector or electrochemical detector may be preferable. This method describes the use of an electron capture detector.

3.3 Interferences resulting from analytes having similar retention times during gas-liquid chromatography are resolved by improving the resolution or separation, such as by changing the chromatographic column or operating parameters, or by fractionating the sample by column chromatography.

3.4 Sampling procedure is also applicable to other pesticides which may be determined by gas-liquid chromatography coupled with a nitrogen-phosphorus detector (NPD), flame photometric detector (FPD), Hall electrolytic conductivity detector (HECD), or a mass spectrometer (MS).

4. Significance

4.1 Pesticide usage and environmental distribution are common to rural and urban areas of the United States. The application of pesticides can cause adverse health effects to humans by contaminating soil, water, air, plants, and animal life.

4.2 Many pesticides exhibit bioaccumulative, chronic health effects; therefore, monitoring the presence of these compounds in ambient air is of great importance.

4.3 Use of a portable, low volume PUF sampling system allows the user flexibility in locating the apparatus. The user can place the apparatus in a stationary or mobile location. The portable sampling apparatus may be positioned in a vertical or horizontal stationary location (if necessary, accompanied with supporting structure). Mobile positioning of the system can be accomplished by attaching the apparatus to a person to test air in the individual's breathing zone. Moreover, the PUF cartridge used in this method provides for successful collection of most pesticides.

5. Definitions

Definitions used in this document and in any user-prepared Standard Operating Procedures (SOPs) should be consistent with ASTM D1356, D1605-60, E260,and E355. All abbreviations and symbols are defined within this document at point of use.

5.1 Sampling efficiency (SE) - ability of the sampling medium to trap vapors of interest. %SE is the percentage of the analyte of interest collected and retained by the sampling medium when it is introduced as a vapor in air or nitrogen into the air sampler and the sampler is operated under normal conditions for a period of time equal to or greater than that required for the intended use.

5.2 Retention efficiency (RE) - ability of sampling medium to retain a compound added (spiked) to it in liquid solution.

5.2.1 Static retention efficiency - ability of the sampling medium to retain the solution spike when the sampling cartridge is stored under clean, quiescent conditions for the duration of the test period.

5.2.2 Dynamic retention efficiency - ability of the sampling medium to retain the solution spike when air or nitrogen is drawn through the sampling cartridge under normal operating conditions for the duration of the test period. The dynamic RE is normally equal to or less than the SE.

5.3 Retention time (RT) - time to elute a specific chemical from a chromatographic column. For a specific carrier gas flow rate, RT is measured from the time the chemical is injected into the gas stream until it appears at the detector.

5.4 Relative retention time (RRT) - a ratio of RTs for two chemicals for the same chromatographic column and carrier gas flow rate, where the denominator represents a reference chemical.

6. Interferences

6.1 Any gas or liquid chromatographic separation of complex mixtures of organic chemicals is subject to serious interference problems due to coelution of two or more compounds. The use of capillary or narrowbore columns with superior resolution and/or two or more columns of different polarity will frequently eliminate these problems.

6.2 The electron capture detector responds to a wide variety of organic compounds. It is likely that such compounds will be encountered as interferences during GC/ECD analysis. The NPD, FPD, and HECD detectors are element specific, but are still subject to interferences. UV detectors for HPLC are nearly universal, and the electrochemical detector may also respond to a variety of chemicals. Mass spectrometric analyses will generally provide positive identification of specific compounds.

6.3 Certain organochlorine pesticides (e.g., chlordane) are complex mixtures of individual compounds that can make difficult accurate quantification of a particular formulation in a multiple component mixture. Polychlorinated biphenyls (PCBs) may interfere with the determination of pesticides.

6.4 Contamination of glassware and sampling apparatus with traces of pesticides can be a major source of error, particularly at lower analyte concentrations. Careful attention to cleaning and handling procedures is required during all steps of sampling and analysis to minimize this source of error.

6.5 The general approaches listed below should be followed to minimize interferences.

6.5.1 Polar compounds, including certain pesticides (e.g., organophosphorus and carbamate classes), can be removed by column chromatography on alumina. This sample clean-up will permit analysis of most organochlorine pesticides.

6.5.2 PCBs may be separated from other organochlorine pesticides by column chromatography on silicic acid.

6.5.3 Many pesticides can be fractionated into groups by column chromatography on Florisil (Floridin Corp.).

7. Apparatus

7.1 Continuous-flow sampling pump (Figure 1) - (DuPont Alpha-1 Air Sampler, E.I. DuPont de Nemours & Co., Inc., Wilmington, DE, 19898, or equivalent).

7.2 Sampling cartridge (Figure 2) - constructed from a 20 mm (i.d.) x 10 cm borosilicate glass tube drawn down to a 7 mm (o.d.) open connection for attachment to the pump via Tygon tubing (Norton Co., P.O. Box 350, Akron, OH, 44309, or equivalent). The cartridge can be fabricated inexpensively from glass by Kontes (P.O. Box 729, Vineland, NJ, 08360), or equivalent.

7.3 Sorbent, polyurethane foam (PUF) - cut into a cylinder, 22 mm in diameter and 7.6 cm long, fitted under slight compression inside the cartridge. The PUF should be of the polyether type, (density No. 3014 or 0.0225 g/cm^3) used for furniture upholstery, pillows, and mattresses; it may be obtained from Olympic Products Co. (Greensboro, NC), or equivalent source. The PUF cylinders (plugs) should be slightly larger in diameter than the internal diameter of the cartridge. They may be cut by one of the following means:

- With a high-speed cutting tool, such as a motorized cork borer. Distilled water should be used to lubricate the cutting tool.

- With a hot wire cutter. Care should be exercised to prevent thermal degradation of the foam.
- With scissors, while plugs are compressed between the 22 mm circular templates.

Alternatively, pre-extracted PUF plugs and glass cartridges may be obtained commercially (Supelco, Inc., Supelco Park, Bellefonte, PA, 16823, No. 2-0557, or equivalent).

7.4 Gas chromatograph (GC) with an electron capture detector (ECD) and either an isothermally controlled or temperature-programmed heating oven. The analytical system should be complete with all required accessories including syringes, analytical columns, gases, detector, and strip chart recorder. A data system is recommended for measuring peak heights. Consult EPA Method 608 for additional specifications.

7.5 Gas chromatograph column, such as 4- or 2-mm (i.d.) x 183 cm borosilicate glass packed with 1.5% SP-2250 (Supelco, Inc.)/1.95% SP-2401 (Supelco, Inc.) on 100/120 mesh Supelcoport (Supelco, Inc.), 4% SE-30 (General Electric, 50 Fordham Rd., Wilmington, MA, 01887, or equivalent)/6% OV-210 (Ohio Valley Specialty Chemical, 115 Industry Rd., Marietta, OH, 45750, or equivalent) on 100/200 mesh Gas Chrom Q (Alltec Assoc., Applied Science Labs, 2051 Waukegan Rd, Deerfield, IL 60015, or equivalent), 3% OV-101 (Ohio Valley Specialty Chemical) on UltraBond (Ultra Scientific, 1 Main St., Hope, RI, 02831, or equivalent) and 3% OV-1 (Ohio Valley Specialty Chemical) on 80/100 mesh Chromosorb WHP (Manville, Filtration, and Materials, P.O. Box 5108, Denver CO, 80271, or equivalent). Capillary GC column, such as 0.32 mm (i.d.) x 30 m DB-5 (J&W Scientific, 3871 Security Park Dr., Rancho Cordova, CA 95670, or equivalent) with 0.25 um film thickness. HPLC column, such as 4.6 mm x 25 cm Zorbax SIL (DuPont Co., Concord Plaza, Wilmington, DE, 19898, or equivalent) or u-Bondapak C-18 (Millipore Corp., 80 Ashby Rd., Bedfore, MA, 01730, or equivalent).

7.6 Microsyringes - 5 uL volume or other appropriate sizes.

8. Reagents and Materials

[Note: For a detailed listing of various other items required for extract preparation, cleanup, and analysis, consult U.s. Method 608 which is provided in Appendix A of Method TO-4 in the Compendium.]

8.1 Round bottom flasks, 500 mL, ₸ 24/40 joints.

8.2 Soxhlet extractors, 300 mL, with reflux condensers.

8.3 Kuderna-Danish concentrator apparatus, 500 mL, with Snyder columns.

8.4 Graduated concentrator tubes, 10mL, with ₮ 19/22 stoppers (Kontes, P.O. Box 729, Vineland, NJ, 08360, Cat. No. K-570050, size 1025, or equivalent).

8.5 Graduated concentrator tubes, 1 mL, with ₮ 14/20 stoppers (Kontes, Vineland, NJ, 08360, Cat. No. K-570050, size 0124, or equivalent).

8.6 TFE fluorocarbon tape, 1/2 in.

8.7 Filter tubes, size 40 mm (i.d.) x 80 mm, (Corning Glass Works, Science Products, Houghton Park, AB-1, Corning, NY, 14831, Cat. No. 9480, or equivalent).

8.8 Serum vials, 1 mL and 5 mL, fitted with caps lined with TFE fluorocarbon.

8.9 Pasteur pipettes, 9 in.

8.10 Glass wool fired at 500°C.

8.11 Boiling chips fired at 500°C.

8.12 Forceps, stainless steel, 12 in.

8.13 Gloves, latex or precleaned (5% ether/hexane Soxhlet extracted) cotton.

8.14 Steam bath.

8.15 Heating mantles, 500 mL.

8.16 Analytical evaporator, nitrogen blow-down (N-Evap®, Organomation Assoc. P.O. Box 159, South Berlin, MA, 01549, or equivalent).

8.17 Acetone, pesticide quality.

8.18 n-Hexane, pesticide quality.

8.19 Diethyl ether preserved with 2% ethanol (Mallinckrodt, Inc., Science Products Division, P.O. Box 5840, St. Louis, MO, 63134, Cat. No. 0850, or equivalent).

8.20 Sodium sulfate, anhydrous analytical grade.

8.21 Alumina, activity grade IV, 100/200 mesh.

8.22 Glass chromatographic column (2 mm i.d. x 15 cm long).

8.23 Soxhlet extraction system, including Soxhlet extractors (500 and 300 mL), variable voltage transformers, and cooling water source.

8.24 Vacuum oven connected to water aspirator.

8.25 Die.

8.26 Ice chest.

8.27 Silicic acid, pesticide quality.

8.28 Octachloronaphthalene (OCN), research grade, (Ultra Scientific, Inc., 1 Main St., Hope, RI, 02831, or equivalent).

8.29 Florisil (Floridin Corp.)

9. Assembly and Calibration of Sampling System

9.1 Description of Sampling Apparatus

9.1.1 The entire sampling system is diagrammed in Figure 1. This apparatus was developed to operate at a rate of 1-5 L/minute and is used by U.S. EPA for low volume sampling of ambient air. The method writeup presents the use of this device.

9.1.2 The sampling module (figure 2) consists of a glass sampling cartridge in which the PUF plug is retained.

9.2 Calibration of Sampling System

9.2.1 Air flow through the sampling system is calibrated by the assembly shown in Figure 3. The air sampler must be calibrated in the laboratory before and after each sample collection period, using the procedure described below.

9.2.2 For accurate calibration, attach the sampling cartridge in-line during calibration. Vinyl bubble tubing (Fisher Scientific, 711 Forbes Ave., Pittsburgh, PA, 15219, Cat. No. 14-170-132, or equivalent) or other means (e.g., rubber stopper or glass joint) may be used to connect the large end of the cartridge to the calibration system. Refer to ASTM Standard Practice D3686, Annex A2 or Standard Practice D4185, Annex A1 for procedures to calibrate small volume air pumps.

10 Preparation of Sampling (PUF) Cartridges

10.1 The PUF adsorbent is white and yellows upon exposure to light.

10.2 For initial cleanup and quality assurance purposes, the PUF plug is placed in a Soxhlet extractor and extracted with acetone for 14 to 24 hours at 4 to 6 cycles per hour (If commercially pre-extracted PUF plugs are used, extraction with acetone is not required.). This procedure is followed by a 16-hour Soxhlet extraction with 5% diethyl ether in n-hexane. When cartridges are reused, 5% ether in n-hexane can be used as the cleanup solvent.

10.3 The extracted PUF is placed in a vacuum oven connected to a water aspirator and dried at room temperature for 2 to 4 hours (until no solvent odor is detected). The clean PUF is placed in labeled glass sampling cartridges using gloves and forceps. The cartridges are wrapped with hexane-rinsed aluminum foil and placed in glass jars fitted with TFE fluorocarbon-lined caps. The foil wrapping may also be marked for identification using a blunt probe.

10.4 At least one assembled cartridge from each batch should be analyzed as a laboratory blank before any samples are analyzed. A blank level of <10 ng/plug for single component compounds is considered to be acceptable. For multiple component mixtures, the blank level should be <100 ng/plug.

11. Sampling

11.1 After the sampling system has been assembled and calibrated as per Section 9, it can be used to collect air samples as described below.

11.2 The prepared sample cartridges should be used within 30 days of loading and should be handled only with latex or precleaned cotton gloves.

11.3 The clean sample cartridge is carefully removed from the aluminum foil wrapping (the foil is returned to jars for later use) and attached to the pump with flexible tubing. The sampling assembly is positioned with the intake downward or horizontally. The sampler is located in an unobstructed area at least 30 cm from any obstacle to air flow. The PUF cartridge intake is positioned 1 to 2 m above ground level. Cartridge height above ground is recorded on the Sampling Data Form shown in Figure 4.

11.4 After the PUF cartridge is correctly inserted and positioned, the power switch is turned on and the sampling begins. The elapsed time meter is activated and the start time is recorded. The pumps are checked during the sampling process and any abnormal conditions discovered are recorded on the data sheet. Ambient temperatures and barometric pressures are measured and recorded periodically during the sampling procedure.

11.5 At the end of the desired sampling period, the power is turned off and the PUF cartridges are wrapped with the original aluminum foil and placed in sealed, labeled containers for transport back to the laboratory. At least one field blank is returned to the laboratory with each group of samples. A field blank is treated exactly like a sample except that no air is drawn through the cartridge. Samples are stored at -10°C or below until analyzed.

12. Sample Preparation, Cleanup, and Analysis

[Note: Sample preparation should be performed under a properly ventilated hood.]

12.1 Sample Preparation

12.1.1 All samples should be extracted within 1 week after collection.

12.1.2 All glassware is washed with a suitable detergent; rinsed with deionized water, acetone, and hexane; rinsed again with deionized water; and fired in an oven (450°C).

12.1.3 Sample extraction efficiency is determined by spiking the samples with a known solution. Octachloronaphthalene (OCN) is an appropriate standard to use for pesticide analysis using GC/ECD techniques.

The spiking solution is prepared by dissolving 10 mg of OCN in 10 mL of 10% acetone in n-hexane, followed by serial dilution with n-hexane to achieve a final concentration of 1 ug/mL.

12.1.4 The extracting solution (5% ether/hexane) is prepared by mixing 1900 mL of freshly opened hexane and 100 mL of freshly opened ethyl ether (preserved with ethanol) to a flask.

12.1.5 All clean glassware, forceps, and other equipment to be used are placed on rinsed (5% ether/hexane) aluminum foil until use. The forceps are also rinsed with 5% ether/hexane. The condensing towers are rinsed with 5% ether/hexane and 300 mL are added to a 500 mL round bottom boiling flask.

12.1.6 Using precleaned (e.g., 5% ether/hexane Soxhlet extracted) cotton gloves, the PUF cartridges are removed from the sealed container and the PUF is placed into a 300 mL Soxhlet extractor using prerinsed forceps.

12.1.7 Before extraction begins, 100 uL of the OCN solution are added directly to the top of the PUF plug. Addition of the standard demonstrates extraction efficiency of the Soxhlet procedure. [Note: Incorporating a known concentration of the solution onto the sample provides a quality assurance check to determine recovery efficiency of the extraction and analytical processes.]

12.1.8 The Soxhlet extractor is then connected to the 500 mL boiling flask and condenser. The glass joints of the assembly are wet with 5% ether/hexane to ensure a tight seal between the fittings. If necessary, the PUF plug can be adjusted using forceps to wedge it midway along the length of the siphon. The above procedure should be followed for all samples, with the inclusion of a blank control sample.

12.1.9 The water flow to the condenser towers of the Soxhlet extraction assembly is checked and the heating unit is turned on. As the samples boil, the Soxhlet extractors are inspected to ensure that they are filling and siphoning properly (4 to 6 cycles/hour). Samples should cycle for a minimum of 16 hours.

12.1.10 At the end of the extracting process, the heating units are turned off and the samples are cooled to room temperature.

12.1.11 The extracts are concentrated to a 5 mL solution using a Kuderna-Danish (K-D) apparatus. The K-D is set up and assembled with concentrator tubes. This assembly is rinsed. The lower end of the filter tube is packed with glass wool and filled with sodium sulfate to a depth of 40 mm. The filter tube is placed in the neck of the K-D. The Soxhlet extractors and boiling flasks are carefully removed from the condenser towers and the remaining solvent is drained into each boiling flask. Sample extract is carefully poured through the filter tube into the K-D. Each boiling flask is rinsed three times by swirling hexane along the sides. Once the sample has drained, the filter tube is rinsed down with hexane. Each Synder column is attached to the K-D and rinsed to wet the joint for a tight seal. The complete K-D apparatus is placed on a steam bath and the sample is evaporated to approximately 5 mL. The sample is removed from the steam bath and allowed to cool. Each Synder column is rinsed with a minimum of hexane. Sample volume is adjusted to 10 mL in a concentrator tube, which is then closed with a glass stopper and sealed with TFE fluorocarbon tape. Alternatively, the sample may be quantitatively transferred (with concentrator tube rinsing) to prescored vials and brought up to final volume. Concentrated extracts are stored at -10°C until analyzed. Analysis should occur no later than two weeks after sample extraction.

12.2 Sample Cleanup

12.2.1 If only organochlorine pesticides are sought, an alumina cleanup procedure is appropriate. Before cleanup, the sample extract is carefully reduced to 1 mL using a gentle stream of clean nitrogen.

12.2.2 A glass chromatographic column (2 mm i.d. x 15 cm long) is packed with alumina, activity grade IV, and rinsed with approximately 20 mL of n-hexane. The concentrated sample extract is placed on the column and eluted with 10 mL of n-hexane at a rate of 0.5 mL/minute. The eluate volume is adjusted to exactly 10 mL and analyzed as per 12.3.

12.2.3 If other pesticides are sought, alternate cleanup procedures may be required (e.g., Florisil). EPA Method 608 identifies appropriate cleanup procedures.

12.3 Sample Analysis

12.3.1 Organochlorine pesticides and many nonchlorinated pesticides are responsive to electron capture detection (Table 1). Most of these compounds can be determined at concentrations of 1 to 50 ng/mL by GC/ECD.

12.3.2 An appropriate GC column is selected for analysis of the extract. (For example, 4 mm i.d. x 183 cm glass, packed with 1.5% SP-2250/1.95% SP-2401 on 100/120 mesh Supeloport, 200°C isothermal, with 5% methane/95% argon carrier gas at 65 to 85 mL/min). A chromatogram showing a mixture containing single component pesticides determined by GC/ECD using a packed column is shown in Figure 5. A table of corresponding chromatographic characteristics follows in Figure 6.

12.3.3 A standard solution is prepared from reference materials of known purity. Standards of organochlorine pesticides may be obtained from the National Bureau of Standards and from the U.S. EPA.

12.3.4 Stock standard solutions (1.00 ug/uL) are prepared by dissolving approximately 10 milligrams of pure material in isooctane and diluting to volume in a 10 mL volumetric flask. Larger volumes can be used at the convenience of the analyst. If compound purity is certified at 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. Commercially prepared stock standards may be used at any concentration if they are certified by the manufacturer or an independent source.

12.3.5 The prepared stock standard solutions are transferred to Teflon-sealed screw-capped bottles and stored at -10°C for no longer than six months. The standard solution should be inspected frequently for signs of degradation or evaporation (especially before preparing calibration standards from them). [Note: Quality control check standards are used to determine accuracy of the calibration standards are available from the U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268.]

12.3.6 The standard solutions of the various compounds of interest are used to determine relative retention times (RRTs) to an internal standard such as p,p'-DDE, aldrin, or OCN.

12.3.7 Before analysis, the GC column is made sensitive to the pesticide samples by injecting a standard pesticide solution ten (10) times more concentrated than the stock standard solution. Detector linearity is then determined by injecting standard solutions of three different concentrations that bracket the required range of analyses.

12.3.8 The GC system is calibrated daily with a minimum of three injections of calibrated standards. Consult EPA Method 608, Section 7 for a detailed procedure to calibrate the gas chromatograph.

12.3.9 If refrigerated, the sample extract is removed from the cooling unit and allowed to warm to room temperature. The sample extract is injected into the GC for analysis in an aliquot of approximately 2-6 uL using the solvent-flush technique (Ref. D3687, 8.1.4.3-8.1.4.5). The actual volume injected is recorded to the nearest 0.05 uL. After GC injection, the sample's response from the strip chart is analyzed by measuring peak heights or determining peak areas. Ideally, the peak heights should be 20 to 80% of full scale deflection. Using injections of 2 to 6 uL of each calibration standard, the peak height or area responses are tabulated against the mass injected (injections of 2, 4, and 6 uL are recommended). If the response (peak height or area) exceeds the linear range of detection, the extract is diluted and reanalyzed.

12.3.10 Pesticide mixtures are quantified by comparison of the total heights or areas of GC peaks with the corresponding peaks in the best-matching standard. If both PCBs and organochlorine pesticides are present in the same sample, column chromatographic separation on silicic acid is used before GC analysis, according to ASTM Standards, Vol. 14.01. If polar compounds that interfere with GC/ECD analysis are present, column chromatographic cleanup on alumina (activity grade IV) is used as per Section 12.2.2.

12.3.11 For confirmation, a second GC column is used such as 4% SE-30/6% OV-210 on 100/200 mesh Gas Chrom Q or 3% OV-1 on 80/100 mesh Chromosorb WHP. For improved resolution, a capillary column is used such as 0.32 mm (i.d.) x 30 m DB-5 with 0.25 um film thickness.

12.3.12 A chromatogram of a mixture containing single component pesticides determined by GC/ECD using a capillary column is shown in Figure 7. A table of the corresponding chromatographic characteristics follows in Figure 8.

12.3.13 Class separation and improved specificity can be achieved by column chromatographic separation on Florisil as per EPA Method 608. For improved specificity, a Hall electrolytic conductivity detector operated in the reductive mode may be substituted for the electron capture detector. Limits of the detection will be reduced by at least an order of magnitude, however.

13. GC Calibration

Appropriate calibration procedures are identified in EPA Method 608, Section 7.

14. Calculations

14.1 The concentration of the analyte in the extract solution is taken from a standard curve where peak height or area is plotted linearly against concentration in nanograms per milliliter (ng/mL). If the detector response is known to be linear, a single point is used as a calculation constant.

14.2 From the standard curve, determine the ng of analyte standard equivalent to the peak height or area for a particular compound.

14.3 Determine if the field blank is contaminated. Blank levels should not exceed 10 ng/sample for organochlorine pesticides or 100 ng/sample for other pesticides. If the blank has been contaminated, the sampling series must be held suspect.

14.4 Quantity of the compound in the sample (A) is calculated using the following equation:

$$A = 1000 \left(\frac{A_s \text{ x } V_e}{V_i} \right)$$

where:

A = total amount of analyte in the sample (ng).

A_s = calculated amount of material (ng) injected onto the chromatograph based on calibration curve for injected standards.

V_e = final volume of extract (mL).

V_i = volume of extract injected (uL).

1000 = factor for converting microliters to milliliters.

14.5 The extraction efficiency (EE) is determined from the recovery of octachloronaphthalene (OCN) spike as follows:

$$EE(\%) = \frac{S}{S_a} \times 100$$

where:

S = amount of spike (ng) recovered.

S_a = amount of spike (ng) added to plug.

14.6 The total amount of nanograms found in the sample is corrected for extraction efficiency and laboratory blank as follows:

$$A_c = \frac{A - A_o}{EE\ (\%)}$$

where:

A_c = corrected amount of analyte in sample (ng).

A_o = amount of analyte in blank (ng).

14.7 The total volume of air sampled under ambient conditions is determined using the following equation:

$$V_a = \frac{\sum_{i=1}^{n} (T_i \times F_i)}{1000\ \text{L/m}_3}$$

where:

V_a = total volume of air sampled (m^3).

T_i = length of sampling segment (min) between flow checks.

F_i = average flow (L/min) during sampling segment.

14.8 The air volume is corrected to 25° and 760 mm Hg (STP) as follows:

$$V_s = V_a \left(\frac{P_b - P_w}{760\ mm\ Hg} \right) \left(\frac{298K}{t_A} \right)$$

where:

V_s = volume of air (m^3) at standard conditions.

V_a = total volume of air sampled (m^3).

P_b = average ambient barometric pressure (mm Hg).

P_w = vapor pressure of water (mm Hg) at calibration temperature.

t_A = average ambient temperature (K).

14.9 If the proper criteria for a sample have been met, concentration of the compound in a cubic meter of air is calculated as follows:

$$ng/m^3 = \frac{A_c}{V_s} x \frac{100}{SE(\%)}$$

where:

SE = sampling efficiency as determined by the procedure outlined in Section 15.

If it is desired to convert the air concentration value to parts per trillion (wt/wt) in dry air at STP, the following conversion is used:

$$ppt = 1.205\ ng/m^3$$

The air concentration is converted to parts per trillion (v/v) in air at STP as follows:

$$pptv = 24.45\left(\frac{ng/m^3}{MW}\right)$$

where:

MW = molecular weight of the compound of interest.

15. Sampling and Retention Efficiencies

15.1 Before using this procedure, the user should determine the sampling efficiency for the compound of interest. The sampling efficiencies shown in Tables 2 and 3 were determined for approximately 1 m^3 of air at about 25°C, sampled at 3.8 L/min. Sampling efficiencies for the pesticides shown in Table 4 are for 24 hours at 3.8 L/min and 25°C. For compounds not listed, longer sampling times, different flow rates, or other air temperatures, the following procedure may be used to determine sampling efficiencies.

15.2 SE is determined by a modified impinger assembly attached to the sampler pump (Figure 9). Clean PUF is placed in the pre-filter location and the inlet is attached to a nitrogen line. [Note: Nitrogen should be used instead of air to prevent oxidation of the compounds under test. The oxidation would not necessarily reflect what may be encountered during actual sampling and may give misleading sampling efficiencies.] PUF plugs (22 mm x 7.6 cm) are placed in the primary and secondary traps and are attached to the pump.

15.3 A standard solution of the compound of interest is prepared in a volatile solvent (e.g., hexane, pentane, or benzene). A small, accurately measured volume (e.g., 1 mL) of the standard solution is placed into the modified midget impinger. The sampler pump is set at the rate to be used in field application and then activated. Nitrogen is drawn through the assembly for a period of time equal to or exceeding that intended for field application. After the desired sampling test period, the PUF plugs are removed and analyzed separately as per Section 12.3.

15.4 The impinger is rinsed with hexane or another suitable solvent and quantitatively transferred to a volumetric flask or concentrator tube for analysis.

15.5 The sampling efficiency (SE) is determined using the following equation:

$$\% \, SE = \frac{W_1}{W_0 - W_r} \times 100$$

where:

W_1 = amount of compound extracted from the primary trap (ng).

W_o = original amount of compound added to the impinger (ng).

W_r = residue left in the impinger at the end of the test (ng).

15.6 If material is found in the secondary trap, it is an indication that breakthrough has occurred. The addition of the amount found in the secondary trap, W_2, to W_1, will provide an indication for the overall sampling efficiency of a tandem-trap sampling system. The sum of W_1, W_2 (if any), and W_r must equal (approximately ±10%) W_o or the test is invalid.

15.7 If the compound of interest is not sufficiently volatile to vaporize at room temperature, the impinger may be heated in a water bath or other suitable heater to a maximum of 50°C to aid volatilization. If the compound of interest cannot be vaporized at 50°C or without thermal degradation, dynamic retention efficiency (RE_d) may be used to estimate sampling efficiency. Dynamic retention efficiency is determined in the manner described in 15.8. Table 5 lists those organochlorine pesticides which dynamic retention efficiencies have been determined.

15.8 A pair of PUF plugs is spiked by slow, dropwise addition of the standard solution to one end of each plug. No more than 0.5 to 1 mL of solution should be used. Amounts added to each plug should be as nearly the same as possible. The plugs are allowed to dry for 2 hours in a clean, protected place (e.g., desiccator). One spiked plug is placed in the primary trap so that the spiked end is at the intake and one clean unspiked plug is placed in the secondary trap. The other spiked plug is wrapped in hexane-rinsed aluminum foil and stored in a clean place for the duration of the test (this is the static control plug, Section 15.9). Prefiltered nitrogen or ambient air is drawn through the assembly as per Section 15.3. [Note: Impinger may be discarded.] Each PUF plug (spiked and static control) is analyzed separately as per Section 12.3.

15.9 % RE_d is calculated as follows:

$$\% \, RE_d = \frac{W_1}{W_o} \times 100$$

where:

W_1 = amount of compound (ng) recovered from primary plug.

W_o = amount of compound (ng) added to primary plug.

If a residue, W_2, is found on the secondary plug, breakthrough has occurred. The sum of $W_1 + W_2$ must equal W_o, within 25% or the test is invalid. For most compounds tested by this procedure, % RE_d values are generally less than % SE values determined per Section 15.1. The purpose of the static RE_d determination is to establish any loss or gain of analyte unrelated to the flow of nitrogen or air through the PUF plug.

16. Performance Criteria and Quality Assurance

This section summarizes required quality assurance (QA) measures and provides guidance concerning performance criteria that should be achieved within each laboratory.

16.1 Standard Operating Procedures (SOPs)

16.1.1 Users should generate SOPs describing the following activities accomplished in their laboratory: (1) assembly, calibration, and operation of the sampling system, with make and model of equipment used; (2) preparation, purification, storage, and handling of sampling cartridges, (3) assembly, calibration, and operation of the GC/ECD system, with make and model of equipment used; and (4) all aspects of data recording and processing, including lists of computer hardware and software used.

16.1.2 SOPs should provide specific stepwise instructions and should be readily available to, and understood by, the laboratory personnel conducting the work.

16.2 Process, Field, and Solvent Blanks

16.2.1 One PUF cartridge from each batch of approximately twenty should be analyzed, without shipment to the field, for the compounds of interest to serve as a process blank.

16.2.2 During each sampling episode, at least one PUF cartridge should be shipped to the field and returned, without drawing air through the sampler, to serve as a field blank.

16.2.3 Before each sampling episode, one PUF plug from each batch of approximately twenty should be spiked with a known amount of the standard solution. The spiked plug will remain in a sealed container and will not be used during the sampling period. The spiked plug is extracted and analyzed with the other samples. This field spike acts as a quality assurance check to determine matrix spike recoveries and to indicate sample degradation.

16.2.4 During the analysis of each batch of samples, at least one solvent process blank (all steps conducted but no PUF cartridge included) should be carried through the procedure and analyzed.

16.2.5 Blank levels should not exceed 10 ng/sample for single components or 100 ng/sample for multiple component mixtures (e.g., for organochlorine pesticides).

16.3 Sampling Efficiency and Spike Recovery

16.3.1 Before using the method for sample analysis, each laboratory must determine its sampling efficiency for the component of interest as per Section 15.

16.3.2 The PUF in the sampler is replaced with a hexane-extracted PUF. The PUF is spiked with a microgram level of compounds of interest by dropwise addition of hexane solutions of the compounds. The solvent is allowed to evaporate.

16.3.3 The sampling system is activated and set at the desired sampling flow rate. The sample flow is monitored for 24 hours.

16.3.4 The PUF cartridge is then removed and analyzed as per Section 12.3.

16.3.5 A second sampler, unspiked, is collected over the same time period to account for any background levels of components in the ambient air matrix.

16.3.6 In general, analytical recoveries and collection efficiencies of 75% are considered to be acceptable method performance.

16.3.7 Replicate (at least triplicate) determinations of collection efficiency should be made. Relative standard deviations for these replicate determinations of ±15% or less are considered acceptable performance.

16.3.8 Blind spiked samples should be included with sample sets periodically as a check on analytical performance.

16.4 Method Precision and Accuracy

16.4.1 Several different parameters involved in both the sampling and analysis steps of this method collectively determine the accuracy with which each compound is detected. As the volume of air sampled is increased, the sensitivity of detection increases proportionately within limits set by (a) the retention efficiency for each specific component trapped on the polyurethane foam plug, and (b) the background interference associated with the analysis of each specific component at a given site sampled. The accuracy of detection of samples recovered by extraction depends on (a) the inherent response of the particular GC detector used in the determinative step, and (b) the extent to which the sample is concentrated for analysis. It is the responsibility of the analyst(s) performing the sampling and analysis steps to adjust parameters so that the required detection limits can be obtained.

16.4.2 The reproducibility of this method has been determined to range from ±5 to ±30% (measured as the relative standard deviation) when replicate sampling cartridges are used (N>5). Sample recoveries for individual compounds generally fall within the range of 90 to 110%, but recoveries ranging from 75 to 115% are considered acceptable. PUF alone may give lower recoveries for more volatile compounds (e.g., those with saturation vapor pressures $>10^{-3}$ mm Hg). In those cases, another sorbent or a combination of PUF and Tenax GC should be employed.

16.5 Method Safety

This procedure may involve hazardous materials, operations, and equipment. This method does not purport to address all of the safety problems associated with its use. It is the users responsibility to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to the implementation of this procedure. This should be part of the users SOP manual.

TABLE 1. PESTICIDES DETERMINED BY
GAS CHROMATOGRAPHY/ELECTRON CAPTURE DETECTOR (GC/ECD)

Aldrin
BHC (α - and β-Hexachlorocyclohexanes)
Captan
Chlordane, technical
Chlorothalonil
Chlorpyrifos
2,4-D esters
p,*p*-DDT
p,*p*-DDE
Dieldrin
Dichlorvos (DDVP)
Dicofol
Endrin
Endrin aldehyde
Folpet
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Lindane (γ-BHC)
Methoxychlor
Mexacarbate
Mirex
trans-Nonachlor
Oxychlordane
Pentachlorobenzene
Pentachlorophenol
Ronnel
2,4,5-Trichlorophenol

TABLE 2. SAMPLING EFFICIENCIES FOR SOME ORGANOCHLORINE PESTICIDES

Compound	Quantity Introduced, ug	Air Volume, m^3	Sampling Efficiency, % mean	RSD	n
α-Hexachlorocyclohexane (α-BHC)	0.005	0.9	115	8	6
γ-Hexachlorocyclohexane (Lindane)	0.05-1.0	0.9	91.5	8	5
Hexachlorobenzene†	0.5, 1.0	0.9	94.5	8	5
Chlordane, technical	0.2	0.9	84.0	11	8
p,p'-DDT	0.6, 1.2	0.9	97.5	21	12
p,p'-DDE	0.2, 0.4	0.9	102	11	12
Mirex	0.6, 1.2	0.9	85.9	22	7
Pentachlorobenzene †	1.0	0.9	94	12	5
Pentachlorophenol	1.0	0.9	107	16	5
2,4,5-Trichlorophenol †	1.0	0.9	108	3	5
2,4-D Esters:					
isopropyl	0.5	3.6	92.0	5	12
butyl	0.5	3.6	82.0	10	11
isobutyl	0.5	3.6	79.0	20	12
isooctyl	0.5	3.6	>80*	--	--

* Not vaporized. Value base on %RE = 81.0 (RSD = 10%, n = 6)

† Semivolatile organochlorine pesticides.

TABLE 3. SAMPLING EFFICIENCIES FOR ORGANOPHOSPHORUS PESTICIDES

Compound	Quantity Introduced,[b] ug	Sampling Efficiency, % mean	RSD	n
Dichlorvos (DDVP)	0.2	72.0	13	2
Ronnel	0.2	106	8	12
Chlorpyrifos	0.2	108	9	12
Diazinon[a]	1.0	84.0	18	18
Methyl parathion[a]	0.6	80.0	19	18
Ethyl parathion[a]	0.3	75.9	15	18
Malathion[a]	0.3	100[c]	--	--

[a] Analyzed by gas chromatography with nitrogen phosphorus detector or flame photometric detector.

[b] Air volume = 0.9 m^3.

[c] Decomposed in generator; value based on %RE = 101 (RDS = 7, n = 4).

TABLE 4. EXTRACTION AND 24-HOUR SAMPLING EFFICIENCIES FOR VARIOUS PESTICIDES AND RELATED COMPOUNDS

	Extraction Efficiency, *%		Sampling Efficiency, † %, at					
			10 ng/m^3		100 ng/m^3		1000 ng/m^3	
Compound	mean	RSD	mean	RSD	mean	RSD	mean	RSD
Chlorpyrifos	83.3	11.5	83.7	18.0	92.7	15.1	83.7	18.0
Pentachlorophenol	84.0	22.6	66.7	42.2	52.3	36.2	66.7	42.2
Chlordane	95.0	7.1	96.0	1.4	74.0	8.5	96.0	1.4
Lindane	96.0	6.9	91.7	11.6	93.0	2.6	91.7	11.6
DDVP	88.3	20.2	51.0	53.7	106.0	1.4	51.0	53.7
2,4-D methyl ester	--	--	75.3	6.8	58.0	23.6	75.3	6.8
Heptachlor	99.0	1.7	97.3	13.6	103.0	17.3	97.3	13.6
Aldrin	97.7	4.0	90.7	5.5	94.0	2.6	90.7	5.5
Dieldrin	95.0	7.0	82.7	7.6	85.0	11.5	82.7	7.6
Ronnel	80.3	19.5	74.7	12.1	60.7	15.5	74.7	12.2
Diazinon	72.0	21.8	63.7	18.9	41.3	26.6	63.7	19.9
trans-Nonachlor	97.7	4.0	96.7	4.2	101.7	15.3	96.7	4.2
Oxychlordane	100.0	0.0	95.3	9.5	94.3	1.2	95.3	9.5
α-BHC	98.0	3.5	86.7	13.7	97.0	18.2	86.7	13.7
Chlorothalonil	90.3	8.4	76.7	6.1	70.3	6.5	76.7	6.1
Heptachlor epoxide	100.0	0.0	95.3	5.5	97.7	14.2	95.3	5.5

* Mean values for one spike at 550 ng/plug and two spikes at 5500 ng/plug.
† Mean values for three determinations.

TABLE 5. EXTRACTION AND 24-HOUR SAMPLING EFFICIENCIES FOR VARIOUS PESTICIDES AND RELATED COMPOUNDS

Compound	Extraction Efficiency, *%		Retention		Efficiency,		† %, at	
			10 ng/m^3		100 ng/m^3		1000 ng/m^3	
	Mean	RSD	mean	RSD	mean	RSD	mean	RSD
Dicofol	57.0	8.5	38.0	25.9	65.0	8.7	69.0	--
Captan	73.0	12.7	56.0	--	45.5	64.3	84.3	16.3
Methoxychlor	65.5	4.9	--	--	--	--	78.5	2.1
Folpet	86.7	11.7	--	--	78.0	--	93.0	--

* Mean values for one spike at 550 ng/plug and two spikes at 5500 ng/plug.

† Mean values for generally three determinations.

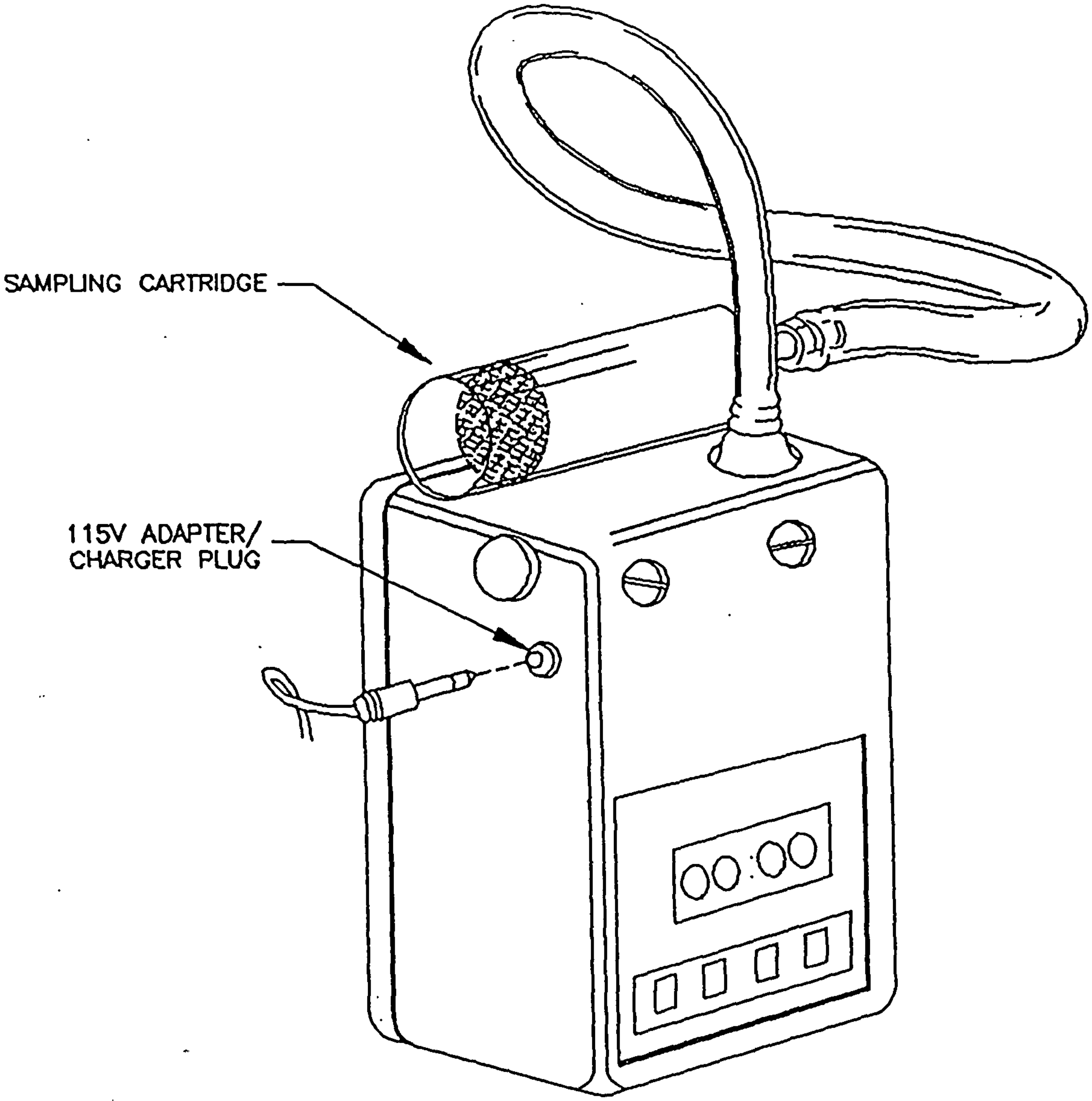


FIGURE 1. LOW VOLUME AIR SAMPLER

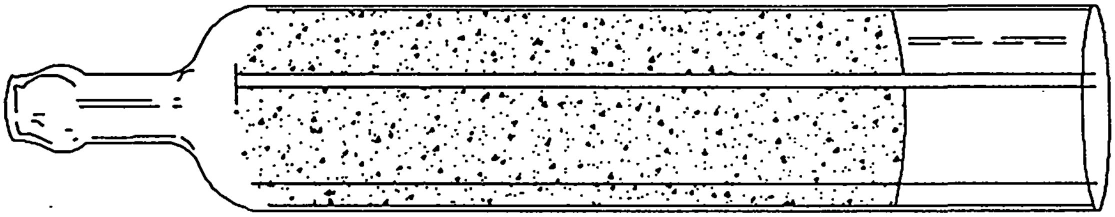


FIGURE 2. POLYURETHANE FOAM (PUF) SAMPLING CARTRIDGE

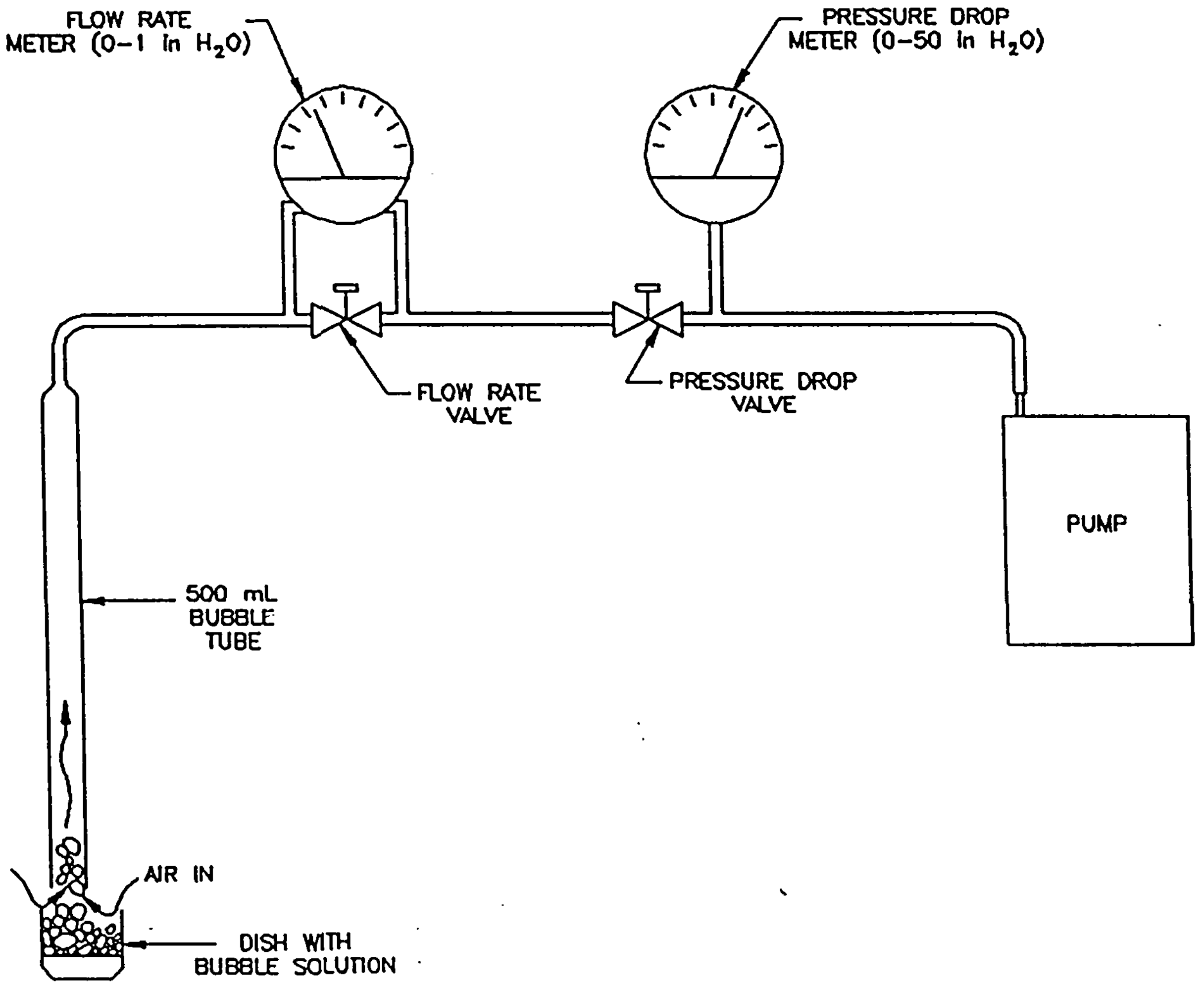


FIGURE 3. CALIBRATION ASSEMBLY FOR AIR SAMPLER PUMP

Site Date Performed by

Sampler S/N	Sampling Location I.D.	Height above Ground	PUF Cart. No.	Sampling Period		Sampling Time min.		Pump timer hr. min.	Low flow Indication		Comments
				Start	Stop				Yes	No	

Checked by ____________________

Date ____________________

FIGURE 4. LOW VOLUME PESTICIDE SAMPLING DATA FORM

TO10-30

OPERATING CONDITIONS

Column Type:	1.5% SP 2250/1.95% SP 2401. 1/4" glass.
Temperature:	200°C Isothermal.
Detector:	Electron Capture.
Carrier Gas:	5% Methane/95% Argon.
Flow Rate:	65 to 85 mL/min.

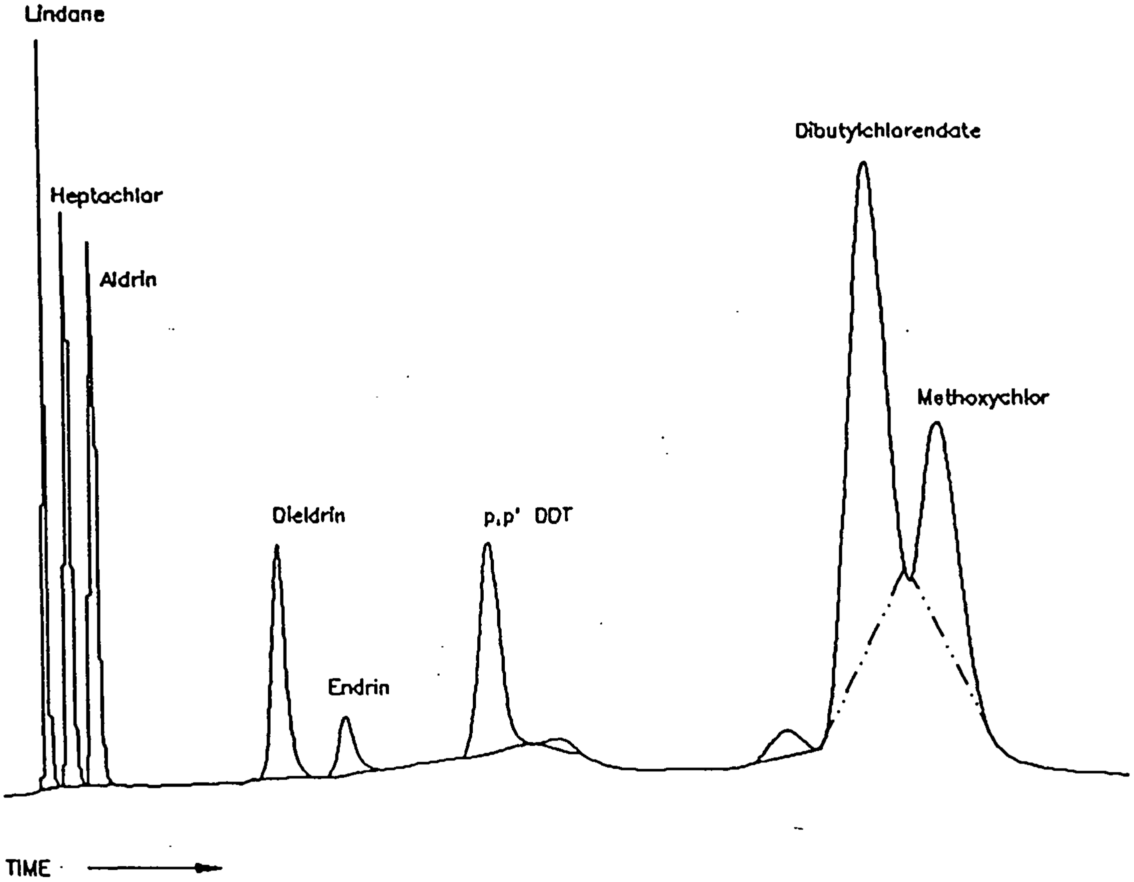


FIGURE 5. CHROMATOGRAM SHOWING A MIXTURE OF SINGLE COMPONENT PESTICIDES DETERMINED BY GC/ECD USING A PACKED COLUMN

EXTERNAL STANDARD TABLE
SINGLE COMPONENT PESTICIDE MIXTURE (5uL) ON A PACKED COLUMN

RETENTION TIME	COMPOUND NAME	CONCENTRATION IN PG ON COLUMN	AREA/ HEIGHT
2.77	gamma-BHC (Lindane)	500	8.2
3.37	Heptachlor	500	10.4
4.03	Aldrin	500	12.0
8.90	Dieldrin	500	24.7
10.72	Endrin	500	30.2
14.63	p,p'-DDT	500	39.0
24.87	Dibutylchlorendate*	2500	61.4
26.82	Methoxychlor	2500	57.5

* Internal standard used for earlier pesticide detection.

FIGURE 6. CHROMATOGRAPHIC CHARACTERISTICS OF THE SINGLE COMPONENT PESTICIDE MIXTURE DETERMINED BY GC/ECD USING A PACKED COLUMN

OPERATING CONDITIONS

Column Type: DB-5 0.32 capillary, 0.25 um film thickness

Column Temperature Program: 90°C(4min)/16°C per min to 154°C/4°C per min to 270°C.

Detector: Electron Capture

Carrier Gas: Helium at 1 mL/min.

Make Up Gas: 5% Methane/95% Argon at 60 mL/min.

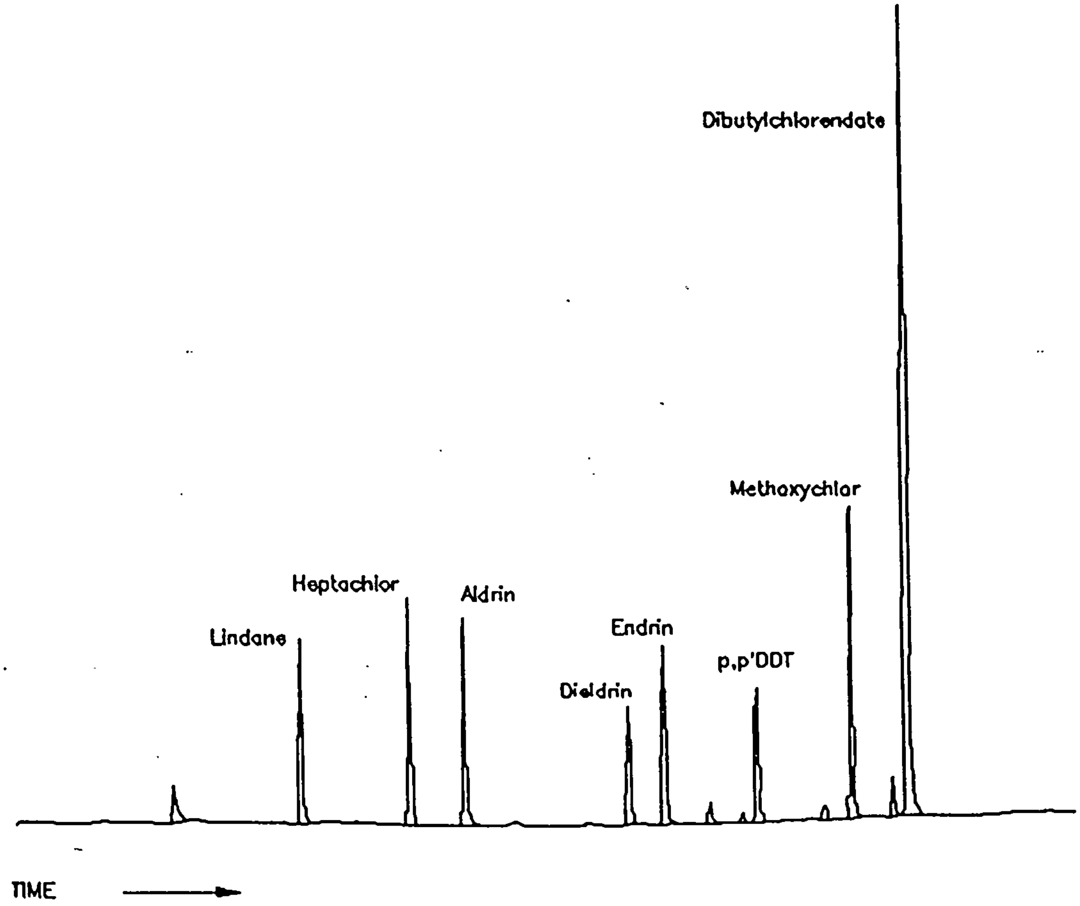


FIGURE 7. CHROMATOGRAM SHOWING A MIXTURE OF SINGLE COMPONENT PESTICIDES DETERMINED BY GC/ECD USING A CAPILLARY COLUMN

EXTERNAL STANDARD TABLE
SINGLE COMPONENT PESTICIDE MIXTURE (2uL)
ON A CAPILLARY COLUMN

RETENTION TIME	COMPOUND NAME	CONCENTRATION IN PG ON COLUMN	AREA/ HEIGHT
14.28	gamma-BHC (Lindane)	200	5.2
17.41	Heptachlor	200	5.3
18.96	Aldrin	200	5.4
23.63	Dieldrin	200	5.8
24.63	Endrin	200	6.3
27.24	p,p-DDT	200	5.6
29.92	Methoxychlor	1000	5.5
31.49	Dibutylchlorendate*	1000	5.4

* Internal standard used for earlier pesticide detection.

FIGURE 8. CHROMATOGRAPHIC CHARACTERISTICS OF THE SINGLE COMPONENT PESTICIDE MIXTURE DETERMINED BY GC/ECD USING A CAPILLARY COLUMN

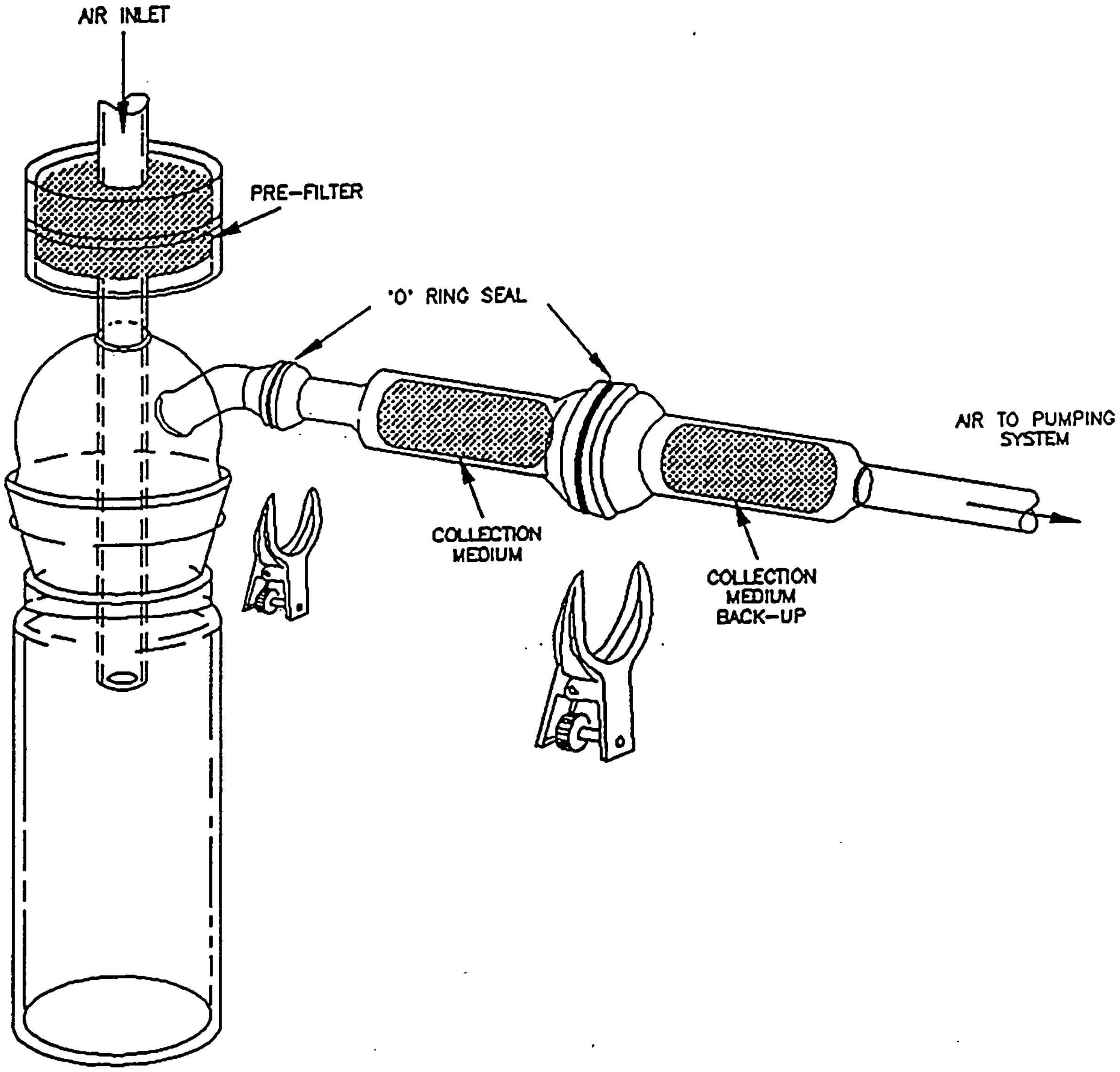


FIGURE 9. APPARATUS FOR DETERMINING SAMPLING EFFICIENCIES

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COPY

Ross Analytical Services, Inc.
STANDARD OPERATING PROCEDURE

SOP No.: OP-026-00
Initial Date: 9/29/92
Page 1 of 4
Date Revised:

Title: PUF Sample Extraction			
Prepared by:	**Approved by:**	**Date:** 12/14/92	**QC Approval:**

1.0 PURPOSE

The purpose of this SOP is to describe the extraction procedure used to prepare PUF modules for pesticide and PCB analysis.

2.0 APPLICATION AND SCOPE

This method applies to all PUF module for the extraction and preparation of pesticides and PCB's.

3.0 REFERENCES

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Method TO4.

4.0 ASSOCIATED SOP's

SOP OP-006, Florisil Cartridge for CLP and non-CLP Pesticides and PCB's.

5.0 PROCEDURE

5.1 Reagents

5.1.1 Ether/Hexane 5:95, Add 212 mL of ether to 4000 mL of hexane in a solvent bottle and mix by inverting. Both solvents of pesticide grade or equivalent.

5.1.2 Sodium sulfate, Conditioned at 450 °C for 4 hours.

5.1.3 Methylene chloride, pesticide grade or equivalent.

5.1.4 Glass wool.

5.1.5 Acetone, pesticide grade or equivalent.

5.1.6 Pasteur pipets.

5.1.7 Florisil.

5.1.8 Polyurethane foam, about 3 x 3 x 3 inch to be used as packing material for shipping.

5.1.9 Glass jar, 32 oz. wide mouth with a Teflon lined lid.

5.1.10 Aluminum foil.

5.2 Equipment

5.2.1 Soxhlet extractor, 500 mL.

5.2.2 Boiling flask, 1000 mL.

5.2.3 Condenser, to fit Soxhlet.

5.2.4 Boiling chips.

5.2.5 Long stem funnel.

5.2.6 Test tube, 12 mL.

5.2.7 Auto sampler vial.

5.2.8 Syringe, 1.0 mL.

5.2.9 Screen cage, to hold PUF's.

5.2.10 Continuous liquid/liquid extractor.

5.2.11 Glass PUF cartridge, solvent rinsed and air dried for 6 to 8 hours.

5.2.12 Kuderna-Danish concentrator.

5.2.13 Snyder column, 2 ball.

5.2.14 Buchner funnel.

5.2.15 Soxhlet extractor, 5 inch diameter.

5.2.16 Side arm flask, 1000 mL.

5.2.17 Hot water bath.

5.2.18 Nitrogen blow down equipment.

5.3 Procedure

Rinse all glassware with the extraction solvent prior to any extraction.

5.3.1 Preparing PUF modules to be used for air sampling.

5.3.1.1 All new PUF material must be extracted with acetone. Place the PUF in a Soxhlet extractor and extract for 24 hours.

5.3.1.2 If a lot of PUF's must be cleaned up, put 6 two inch PUF's or 12 one inch PUF's in a clean-up cage and place the cage in a continuous extractor. Extract with acetone for 48 to 72 hours.

5.3.1.3 If used PUF's are to be cleaned up, the extraction is the same as above using ether/hexane 5:95 in place of acetone.

5.3.1.4 The extracted PUF's are dried in a clean unused hood on aluminum foil for 6 to 8 hours.

5.3.1.5 The dry PUF's are placed in the glass air sampling cartridge and wrapped in aluminum foil. The foil wrapped modules are placed in a 32 oz. jar centered on a polyurethane foam square. A second polyurethane square is placed on top of the module and a Teflon lined lid is screwed on holding the module securely in place.

5.3.1.6 Date the module on the lid of the jar. Always make 1 additional module for every batch or every 20 modules whichever is more frequent for QC.

5.3.2 Preparing filters for PUF's.

5.3.2.1 The quartz or glass filter will be solvent cleaned by one of two methods. Soxhlet extract up to 100 filters with methylene chloride. Place 100 filters in a Soxhlet extractor and extract for 16 hours. Air dry the filters on aluminum foil for 1 hour and oven dry the filters for an additional hour. Immediately wrap the filters in aluminum foil.

5.3.2.2 If a filter is involved with the sampling procedure, prepare an additional filter for each batch or every 20 filters, whichever is more frequent.

5.3.2.3 Include one filter in the Soxhlet with the PUF module to be blank checked (see 6.1).

5.3.3 Extraction of PUF samples for analysis.

5.3.3.1 Place a boiling flask containing boiling chip on a Soxhlet extractor.

5.3.3.2 Remove the PUF cartridge and filter from the sample jar. Wearing gloves, remove the foil and gently place the filter and module into the extractor.

5.3.3.3 Change gloves between samples to eliminate cross contamination.

5.3.3.4 Add 1 mL of low level surrogate solution to the PUF in the extractor. Use care not to touch the syringe on the PUF. Often these samples have high levels of contaminants.

5.3.3.5 Add enough ether/hexane 5:95 to fill the Soxhlet twice.

5.3.3.6 Extract the PUF for 14 to 24 hours.

5.3.3.7 Extract 2 solvent blanks and one check sample with each batch or every 20 samples extracted whichever is more frequent.

5.3.4 Concentration and clean up of extract.

5.3.4.1 Pour the extract through methylene chloride rinsed sodium sulfate into a K-D concentrator. Due to the large volume of extract involved (about 1 liter) only half the extract will fit into a 500 mL K-D. Put the funnel containing the sodium sulfate in the boiling flask and cover with aluminum foil. Concentrate the extract to about 8 mL on a hot water bath using a two ball Snyder column. Allow the K-D to cool.

5.3.4.2 Using the same funnel and sodium sulfate add the balance of the extract to the K-D. Rinse the boiling flask with methylene chloride and pour through the sodium sulfate. Rinse the sodium sulfate with methylene chloride into the K-D. Concentrate again on a hot water bath using a two ball to about 8 mL.

5.3.4.3 Cool and rinse the K-D into the receiver with hexane.

5.3.4.4 Concentrate the extract in the receiver to about 4 mL by nitrogen blow down. Transfer the extract to a test tube calibrated to 5 mL with three rinses of hexane. Take to the 5 mL mark with hexane. Cap the extract and shake well.

5.3.4.5 If the extract is to be analyzed for pesticides, proceed to SOP OP-006 for the Florisil clean up. If the extract is to be analyzed for PCB's only, proceed to 5.3.3.6.

5.3.4.6 Fill a glass wool plugged Pasteur pipet with 0.5 g of Florisil. Using a Pasture pipet, transfer the 5 mL extract to the Florisil column and collect the clean extract in a new test tube. Transfer about 1 mL to an auto sampler vial for analysis.

6.0 QUALITY CONTROL

6.1 The PUF clean up procedure requires a blank check prior to sending the modules into the field. The frequency is one blank check for each batch or every 20 modules prepared whichever is more frequent. The modules will be extracted and concentrated as described in 5.3.2 and 5.3.3. Prepare a solvent blank to run along with the media blank.

6.2 Prepare two solvent blanks for each batch or every 20 samples whichever is more frequent.

6.3 Prepare one check sample for each batch or every 20 samples whichever is more frequent.

Ross Analytical Services, Inc.

STANDARD OPERATING PROCEDURE

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SOP No.: GP-004-01
Initial Date: 02/01/91
Page 1 of 22
Date Revised: 09/20/94

Title: Analysis of Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs) - Method 8081.

Prepared by: aEN Approved by: Date: 10/14/94 QA Approval:

1.0 PURPOSE

The purpose of this procedure is to describe the analysis of Organochlorine Pesticides and PCBs by Gas Chromatography (GC) using an Electron Capture Detector (ECD).

2.0 APPLICATION

This procedure applies to soils, waters, and waste matrices. This procedure utilizes information from EPA SW-846, Method 8080 for Organochlorine Pesticides and PCBs on packed column and Method 8081 for capillary columns. Table 1 lists the targets and their EQL/RLs. A discussion of interferences is found in Section 9.0. Figure I gives the analytical conditions for the analysis of Pesticides/PCBs on instrument L/M (column RTx-1701, column RTx-5). Figure II gives the analytical conditions for the PCB only analysis on instrument Y/Z (column RTx-1701, column RTx-5). Figure III shows chromatograms of Toxaphene and Technical Chlordane on a RTx-5 column. Figure IV shows the Aroclors 1016 and 1260 on a RTx-5. Figure V gives an example of the individual Mix A and Mix B pesticides an the RTx-5.

3.0 REFERENCES

EPA SW-846, Method 3500A -	Organic Extraction and Sample Preparation.
EPA SW-846, Method 3600A -	Cleanup.
EPA SW-846, Method 3660A -	Sulfur Cleanup.
EPA SW-846, Method 8000 -	Gas Chromatography.
EPA SW-846, Method 8080 -	Organochlorine Pesticides and PCBs on packed column.
EPA SW-846, Method 8081 -	Organochlorine Pesticides, Halowaxes, and PCBs as Aroclors by Gas Chromatography: Capillary Column Technique.

Varian Manual - Publication Number 03-914087-00, for Electron Capture Detectors, 1988.

4.0 ASSOCIATED SOPs

OP-002 - Pesticide and PCB Water Extraction.
OP-004 - GPC Operating Procedure.
OP-007 - Extraction of Soils and Wastes for Pesticides and PCBs for Non-CLP.
OP-010 - PCB Oil and Liquid Waste Extraction
OP-022 - Large Florisil Column Clean-up for Non-CLP Pesticides and PCBs.
OP-024 - PCB Solid Waste Extraction.
OP-026 - PUF Sample Extraction.
OP-032 - Extraction of PCBs from Wipes or Swabs.

5.0 EQUIPMENT

5.1 Gas Chromatograph - Varian 3400 suitable for direct injections with an Electron Capture Detector

5.2 Autosampler - Leap Technologies autosampler capable of being programmed to inject a sequence of samples using a 10 uL syringe.

5.3 Gas Chromatographic Columns - RTx-5, fused silica, 30m x 0.32mm 1.0um film thickness.
RTx-1701, fused silica, 30m x 0.32mm 1.0um film thickness.

5.4 Data System - currently using "Chromperfect," capable of collecting data points to measure peak areas and calculate results. Also includes Perkin-Elmer data boxes which collect data during the run and then transfer that information to the system upon completion of a run.

5.5 Syringes of various volumes.

5.6 Autosampler vials - 2mL.

5.7 Autosampler Syringe Rinse Bottles for rinsing syringes after an injection.

5.8 Volumetric Flasks of various sizes.

6.0 STANDARDS AND SOLUTIONS

6.1 Stock Standards

Stock standards are purchased from a commercial vendor and diluted down in hexane to make the calibration standards. A Certificate of Analysis accompanies the ampule certifying that the material meets or exceeds the QA/QC criteria established by the U.S. E.P.A. for commercially purchased analytical standards. These certificates must be kept on file in the office of the Manager of Quality Assurance. These stock solutions should be refrigerated at 4°C and protected from light in Teflon-sealed containers.

6.2 Calibration Standards

Five levels of the single component pesticides are prepared in hexane to make the working calibration curve. These are contained in two separate mixes, A and B, so that each peak is adequately resolved since there are a few peaks that are very close in retention time. The lowest concentration corresponds to the EQL and is near, but above the MDL. The mid-point concentration is four times the low point; and the high point, which is sixteen times the low point, corresponds to the expected upper range of the samples. The Mix A, Mix B calibration standards must be prepared every six months or sooner if comparison to a verification standard indicates a problem. Note that standards preparation and verification must be documented in the standards logbook. The concentration of the mixes in ng/mL are as follows:

LEVELS (ng/mL)

Pesticide Mix A	A	B	C	D	E
alpha-BHC	5	10	20	40	80
Heptachlor	5	10	20	40	80
gamma-BHC	5	10	20	40	80
Endosulfan I	5	10	20	40	80
Dieldrin	10	20	40	80	160
Endrin	10	20	40	80	160
4,4-DDD	10	20	40	80	160
4,4-DDT	10	20	40	80	160
Methoxychlor	10	20	40	80	160
TCMX (surrogate)	5	10	20	40	80
DCB (surrogate)	10	20	40	80	160

Pesticide Mix B	A	B	C	D	E
beta-BHC	5	10	20	40	80
delta-BHC	5	10	20	40	80
Aldrin	5	10	20	40	80
Heptachlor Epoxide	5	10	20	40	80
alpha-Chlordane	5	10	20	40	80
gamma-Chlordane	5	10	20	40	80
4,4-DDE	10	20	40	80	160
Endosulfan Sulfate	10	20	40	80	160
Endrin Aldehyde	10	20	40	80	160
Endrin Ketone	10	20	40	80	160
Endosulfan II	10	20	40	80	160
TCMX (surrogate)	5	10	20	40	80
DCB (surrogate)	10	20	40	80	160

Multi-component standards - Toxaphene, Technical Chlordane, and the Aroclors are prepared individually except Aroclor 1016 and 1260 which are combined onto one standard. These standards are prepared in hexane and must be replaced every six months or sooner if routine QC indicates a problem. The concentrations in ng/mL for the multi-component standards are as follows:

TARGET	LEVELS (ng/mL) A	B	C	D	E	F
Toxaphene	250	500	750	1000	1250	
TCMX (surrogate)	20					
DCB (surrogate)	20					
Tech Chlordane	250	500	750	1000	1250	
TCMX (surrogate)	20					
DCB (surrogate)	20					
Aroclor 1016	100	250	500	750	1000	
Aroclor 1260	100	250	500	750	1000	2500
TCMX (surrogate)	20	50	100	150	200	
DCB (surrogate)	20	50	100	150	200	
Aroclor 1221	200	500	1000	1500	2000	
TCMX (surrogate)	20					
DCB (surrogate)	20					
Aroclor 1232	100	250	500	750	1000	
TCMX (surrogate)	20					
DCB (surrogate)	20					
Aroclor 1242	100	250	500	750	1000	2000
TCMX (surrogate)	20					
DCB (surrogate)	20					
Aroclor 1248	100	250	500	750	1000	2500
TCMX (surrogate)	20					
DCB (surrogate)	20					
Aroclor 1254	100	250	500	750	1000	2500
TCMX (surrogate)	20					
DCB (surrogate)	20					

For each multi-component target the lowest level is near but above the MDL, and the highest level corresponds to the expected range of the concentrations in the samples.

6.3 Performance Evaluation Mixture (PEM)

This mixture is prepared in hexane at the concentration levels below. The PEM must be prepared weekly, or more often if the solution has degraded or concentrated.

PEM Components	Concentration (ng/mL)
gamma-BHC	10.0
alpha-BHC	10.0
4,4'-DDT	100.0
beta-BHC	10.0
Endrin	50.0
Methoxychlor	250.0
TCMX (surrogate)	20.0
DCB (surrogate)	20.0

6.4 Surrogates

There are two surrogates used to monitor the performance for the sample extraction, sample clean-up, instrumentation, and the effectiveness of the method in dealing with each sample matrix. The working surrogate is prepared in the GC lab from a commercially - purchased stock solution at a concentration of 200ug/mL in methanol. The stock is then diluted down in a solvent such as acetone or hexane to make the desired concentration. The concentrations will vary to accommodate the different matrices and different clients. Usually the surrogate is made so that a volume of 1.0mL can be added to each sample, blank, LCS, MS, and MSD to achieve the desired end concentration. For exact amounts that must be added, consult the appropriate organic preparatory SOP.

The Mix A and Mix B calibration standards also include the surrogates which are tetrachloro-m-xylene (TCMX) and decachlorobiphenyl (DCB). TCMX elutes prior to the pesticide targets and the PCBs while DCB elutes after the last target. This allow the analyst to monitor the entire run for recoveries. It may be that lower recoveries will be seen either at the beginning or the end of the run. Having surrogates that bracket the targets gives a good estimate of the status of the instrumental system throughout the run and the matrix of the sample. The PCB mix of 1016/1260 also includes the two surrogates in the first five levels of the calibration so that surrogate curves can be determined for samples that are for PCBs only. See Table 2 for a list of the current surrogate standards in use by the organic preparatory lab for the spiking of various types of samples.

Surrogate recovery limits which are specific to each matrix are generated on a quarterly basis by the Quality Assurance (QA) department. These limits define the acceptance range for surrogate recoveries in all samples, blanks, LCSs, MSs, and MSDs. The analyst must be certain that samples fall within the given ranges or proceed with corrective action if they do not (see Section 8.0 on Quality Control for corrective actions).

6.5 Laboratory Control Spikes (LCSs), Matrix Spikes (MSs), and Matrix Spike Duplicates (MSDs)

Commercially purchased stock standards are diluted down to make spikes at appropriate concentrations for the different matrices. Spikes for the pesticides, PCBs (1260), Toxaphene, and Technical Chlordane are all used for different analyses. Table 3 lists the different spikes, their concentrations, the amounts used, and the solvent in which they are made.

To make an LCS, the organic preparatory lab spikes the appropriate spike mix onto a blank (with surrogate) at the appropriate amount for the analysis. An LCS is extracted with each batch of samples or every twenty samples, which ever is more frequent.

For MS, MSDs, the organic preparatory lab spikes the appropriate spike mix (plus surrogate) onto two duplicates of the desired sample. MS/MSDs are extracted with every 20 samples of each matrix and/or when specifically requested by the client. See Section 8.0 on Quality Control for more information regarding LCSs, MSs, and MSDs.

7.0 PROCEDURE

7.1 GC Operating Conditions

Samples are analyzed using a Varian 3400 GC under varying conditions. Pesticide/PCBs are run under slightly different conditions than the PCB only samples. Since some samples do not need Pesticide analysis, the PCBs are analyzed by a slightly different arrangement where the time for analysis has been compressed. This can be done because there are no co-elution problems or any criteria for resolution. PCBs consist of individual congeners in different concentrations. For example, the Aroclors 1016 through

1242 look relatively similar, having more early eluting congeners whereas 1248, 1254, and 1260 have more of the late eluting congeners . There are some common operating parameters. All Pesticide and PCB analyses utilize the Electron Capture Detector at a range of 12. The system utilized is a dual column setup where there are two injection ports, two columns, and two detectors in parallel. Method 8081 uses the term dual column where the setup includes only one injection port and a "Y" connector delivers sample to two different detectors. In the 8081 system, the injection time is identical for the two columns. In our setup, the autosampler actually injects the sample two separate times to deliver sample to the two columns. This was done because research with the "Y" connector showed that the "Y" system did not deliver equal volumes of sample to the two columns, and did not provide an adequate or reliable seal. The two columns utilized are a RTx-5 and RTx-1701, each is a 30 meter column with a narrow-bore, 0.32 mm ID. For the specific operating parameters for each instrument and analysis, consult the Analytical Conditions Logbook for that particular instrument. Figures I and II. show the analytical conditions for the instruments L/M (pesticides/PCBs) and Y/Z (PCBs only). Figure III exhibits chromatograms for Toxaphene and Technical Chlordane on an RTx-5, instrument L/M. Figure IV shows the Aroclor mix containing 1016 and 1260 on an RTx-5, instrument L/M. Elution orders for the individual pesticides on the two columns are given below:

ELUTION ORDERS FOR INSTRUMENT L/M

RTx-5	RTx-1701
1. TCMX	1. TCMX
2. alpha-BHC	2. alpha-BHC
3. beta-BHC	3. gamma-BHC
4. gamma-BHC	4. Heptachlor
5. delta-BHC	5. Aldrin
6. Heptachlor	6. beta-BHC
7. Aldrin	7. delta-BHC
8. Heptachlor Epoxide	8. Heptachlor Epoxide
9. gamma-Chlordane	9. Endosulfan I
10.Endosulfan I	10.gamma-Chlordane
11.alpha-Chlordane	11.alpha-Chlordane
12.4,4'-DDE	12.4,4'-DDE
13.Dieldrin	13.Dieldrin
14.Endrin	14.Endrin
15.Endosulfan II	15.Endosulfan II
16.4,4'-DDD	16.4,4'-DDD
17.Endrin Aldehyde	17.4,4'-DDT
18.4,4'-DDT	18.Endrin Aldehyde
19.Endosulfan Sulfate	19.Endosulfan Sulfate
20.Endrin Ketone	20.Methoxychlor
21.Methoxychlor	21.Endrin Ketone
22.DCB	22.DCB

7.2 Calibration Procedure

7.2.1 Summary

7.2.1.1 Analysis begins with an initial demonstration of instrument performance and the calibration for all the pesticides and for select PCBs. The chlorinated pesticides and PCBs are determined by a two-column GC/ECD technique. In order to be compliant with the method, analysis on both columns is required for all samples, blanks, matrix spikes, and matrix spike duplicates except when the client requests PCBs only.

7.2.1.2 Quantitative analysis of pesticides and Aroclors are determined by the external standard method. A five point calibration curve is required for the single component pesticides including surrogates and the multi-component analytes in order to comply with the 8081 method.

7.2.1.3 Quantitation can occur only if the ECD responses from the sample are within the range of the five-point calibration curves. The extracts must be diluted and reanalyzed if their areas are greater then the areas for the highest standard.

7.2.1.4 Whenever PCB only analyses are being performed, apply only the specific information below which is pertinent.

7.2.2 Initial Calibration

7.2.2.1 For both pesticide/PCB and PCB only analyses, if maintenance has just been done on the instrument, then a high level standard pesticide or PCB should be run to prime the system and deactivate any sites on the inserts or columns that might adsorb pesticides and PCBs. The analyst may also find it necessary to run midpoint standards a number of times before the system is working optimally. A compliant instrument blank must follow the deactivation analyses.

7.2.2.2 For pesticide/PCB analyses, DDT and Endrin are easily degraded in the injection port when it is contaminated with high boiling residue from sample injections. The degradation of these two targets should be monitored before samples are run on the instrument. This is done by running a Performance Evaluation Mixture (PEM) and calculating the percentage of breakdown as follows:

$$\begin{array}{l}\%\text{Breakdown} \\ \text{for 4,4'-DDT}\end{array} = \frac{\text{Total DDT degradation peak area (DDE+DDD)}}{\text{peak areas (DDT, DDE, + DDD)}} \times 100$$

$$\%\text{Breakdown} = \frac{\text{Total Endrin degradation peak area (EA + EK)}}{\text{peak areas (Endrin + aldehyde + ketone)}} \times 100$$

If degradation of either DDT or Endrin exceeds 15% (Method 8081 for capillary columns - Section 8.3), the analyst must take corrective action before proceeding with the calibration. Please see Section 10.0 of this SOP on troubleshooting for corrective action.

7.2.2.3 For pesticide/PCB analyses, after it has been determined that the breakdown is less than 15%, the analyst should make sure that all the peaks in the PEM are 100% resolved on both columns. Then the five calibration standards for Mix A and Mix B pesticides are run followed by the five calibration standards for 1016/1260 (see Section 7.4.1.1 - Method 8081). The resolution between any two adjacent peaks in the mid Mix A and B in the initial calibration must be 90% or better. Mid points of all other Aroclors should be run after this unless it is known that a particular Aroclor may be found in the samples for a particular client: in this case, all the calibration standards for those Aroclors should also be run at this time. Midpoints of Toxaphene and Technical Chlordane should follow the Aroclor midpoints as well as Isodrin and Kepone if they are targets.

7.2.2.4 For PCB only analyses, run five or six level calibration standards of 1016/1260 mix. The 6th level contains 1260 only. This should be followed by mid points of all other

Aroclors unless it is known that a particular Aroclor may be found in the samples for a particular client; in this case, all calibration standards for those Aroclors should also be run at this time.

7.2.2.5 An injection of 1 to 2 uL is used for both pesticides/PCB and PCB only analyses. After the calibration standards are all run, the curves are created using the software. Peak areas are tabulated against concentrations on column to give response factors (RFs) for each target. If the % relative standard deviation (%RSD) of a response factor is less than 20% over the working range, then linearity through the origin can be assumed. In this case, the response factor can be used in place of a calibration curve. This would only be needed if results were to be calculated by hand. If the analyst is using the computer generated curve, then the 20% RSD rule does not apply. There is no acceptance criteria for the computer curves. For multi-response targets like PCBs five to eight peaks are chosen from each Aroclor and response factors generated for each individual peak. The average of the five to eight peak concentrations generated will then be used as the final reportable concentration.

7.2.3 Working Calibration Curve Verification

According to Method 8081, calibration verifications are based on twelve hour shifts. Continuing calibration checks for all target analytes required in the project plan must be injected at the beginning of each twelve hour sequence. A calibration standard (continuing check) must also be injected after every twenty samples, maximum, or after every ten samples, recommended, to minimize the number of reruns due to failure of a check standard. Our present policy in the GC lab is to run a continuing check every ten runs on the instrument and also at the end of the sequence. The percent difference (%D) for each target response factor is calculated and must not exceed + or - 15% when compared to the initial calibration curve. When this criteria is exceeded, inspect the GC system to determine the cause and perform whatever maintenance is necessary before verifying the calibration and proceeding with the sample analyses. If maintenance does not fix the problem, then a new initial calibration must be performed. Throughout the run, if a CCV fails the +/- 15%D, then the samples following the last compliant continuing check must be reanalyzed provided the initial analysis indicated the presence of the specific target analytes which exceeds the +/- 15%D criteria. If the CCV does not fall in the daily retention time windows, then a new curve must be analyzed followed by Re-analysis of the samples up to the previous good CCV.

For pesticide/PCB analysis, breakdown should also be measured before the analytical sequence begins and again at the beginning of every twelve hour shift (Method 8081 - Section 8.3.2). As with the initial calibration, breakdown must not exceed 15%.

Analysts are urged to use different calibration verification standards throughout the sequence and to use different levels of the standards to ensure that detector response remains stable for all analytes over the calibration range. In other words, it is not necessary to always use the midpoint for continuing calibrations or to always run Mix A and Mix B standards.

7.2.4 Retention Time Windows

Retention time windows must be determined whenever a new column is installed or other major maintenance which has the potential to change retention times is performed. To establish retention time windows, make three injections of all single component and multi-component standards over the course of 72 hours. Injections over less than a 72 hour period result in retention time windows that are too tight. Calculate the standard deviation of the three retention times for each single component standard. For multi-response standards, do the same for each of the peaks (5 to 8) that have been chosen to represent the Aroclors (Note: for multi-response standards, the analyst should use the retention time window, but also rely on pattern recognition as the primary identification independent of exact retention time matches). Plus or minus three times the standard deviation of the retention times will be used to define the window.

To establish updated retention time windows for the 12 hour standard checks, use the absolute retention time of the standards as the midpoint of the window. This will be accomplished by updating the retention times in the method at the beginning of a 12 hour sequence.

7.3 Analysis

For pesticide/PCB analyses, an analytical sequence must begin with the following standards:

1. Performance Evaluation Mixture (PEM)
2. Midpoint Mix A
3. Midpoint Mix B
4. Aroclor midpoint 1016/1260
5. Toxaphene midpoint
6. Technical Chlordane midpoint

For PCB only analyses, an analytical sequence must begin with an Aroclor midpoint of 1016/1260. Proceed to step 7.3.3.

7.3.1 Performance Evaluation Mixture (PEM) - Acceptance criteria for the PEM is 100% resolved peaks and less than 15% breakdown for Endrin and DDT.

7.3.2 Mix A and Mix B - These should show less than or equal to + or - 15% D from the initial calibration curve. The response factors for each analyte are compared to the mean response factors generated from the initial curve. This is accomplished by comparing the concentrations generated to the theoretical concentrations of the standards. This will tell the analyst that the continuing calibration still matches the initial calibration and the sequence may continue. The analyst should update the retention times of the mixes in the method before running the rest of the sequence. If the criteria falls outside the 15% limit, the GC must be inspected to determine the cause and maintenance must be performed. Once this is done, the Mix A and Mix B calibration standards are rerun. If they are still out of range, then a new calibration curve must be run. Note: It may be to the analyst's advantage to go ahead and run the samples if only some of the targets are greater than + or - 15%D. These targets may not be found in the samples. and therefore the %D will not matter.

7.3.3 Multiple-Response Standards - For the multi-response standards the %D for these targets should also be less than or equal to + or - 15%D from the initial calibration. Retention times for each individual peak should be updated in the methods before the samples are run.

7.3.4 After this initial run of standards, blanks, LCSs, samples, MS, and MSDs can be run. MS, MSDs should follow the samples for which they are duplicates. Samples should be run full strength first unless it is known that they contain targets at high levels. Continuing checks must be run at least every 12 hours, and after that every ten runs on the instrument. The analyst should vary the standards used and the level of concentrations to give a better indication of all the target responses across the concentration ranges. A continuing check must also end the analytical sequence. If a sample exceeds the upper limit of the calibration curve, dilute and reanalyze.

7.4 Data Interpretation and Calculations

7.4.1 The analyst should follow the checklist below for analyzing and interpreting data:

7.4.1.1 Inspect the chromatograms for any obvious multi-response patterns such as PCBs, Toxaphene, or chlordane. These samples will need to be reprocessed under the appropriate method for the hit. Retention times should be determined, but the analyst should remember that pattern recognition is the primary tool for identification of multi-response pesticides and PCBs. These multi-response hits must not be calculated for single-component pesticides in the same retention time ranges. The analyst may request that a portion of the extract be put through acid-cleanup to eliminate the presence of some pesticides. Then the two runs may be compared and it may be decided which peaks may be pesticides and which are PCBs.

7.4.1.2 Calculate the surrogate and LCS, MS, and MSD recoveries and make sure they are within the QC acceptance limits for that matrix. If they are not, confirm that there are no calculation errors and check instrument performance. Examine the chromatograms for interferences and/or integration errors. Recalculate and reanalyze the extract if any of the above reveals a problem. Re-extract and reanalyze if none of the above can resolve the discrepancy.

7.4.1.3 Look for any single component pesticide hits and look at the other column to confirm them. If they are not confirmed, they are not reportable. If a hit is confirmed on the second column, then report the lower of the two concentrations. This is because of the likelihood that interfering compounds will co-elute with the target compounds and falsely increase the concentrations. The analyst should consult Section 7.6 in Method 8081 for quantitation of multiple-component analytes. The analyst should also check to make sure the area counts for any hits do not exceed the area counts of the highest standard. If they do, dilute the sample and reanalyze. No peaks should be calculated or verified if they are off the scale of the chromatogram.

7.4.1.4 Target compounds are considered to be hits if their retention times fall within the computer retention time windows for a given analyte. These have been defined as in Section 7.2.3 of this SOP.

7.4.1.5 If interferences are present in the sample, then additional cleanup procedures must be enlisted such as a sulfur cleanup or GPC if allowed for the given targets. Note: the recovery of Endrin Aldehyde is drastically reduced after sulfur cleanup therefore this target must be determined prior to this cleanup procedure (Method 8081 - Section 3.5).

7.4.2 The following formula would be used to hand calculate target concentrations:

$$\underset{(\text{ug/L or ug/Kg})}{\text{concentration}} = \frac{As \times FV \times DF}{RF \times Vi \times Vo}$$

where:

As = Area of the analyte to be measured.
FV = Final volume of the extract.
DF = Dilution factor (if no dilution, DF = 1.0).
RF = Mean response factor for the analyte to be measured in ngOC.
Vi = Volume injected in uL.
Vo = Volume (L) or weight (Kg) of sample extracted.

In the above equation the RF is calculated by dividing the area for an analyte by the concentration and the mean RF is the average of the five calibration levels.

Most results will be calculated by the computer and not hand calculated. The above parameters such as the final extract volume, weight or volume extracted, dilution factors, and amount injected would be put into the analytical sequence which would then allow the result to be automatically calculated. Note: If GPC (Gel Permeation Chromatography) cleanup is done on an extract, then a factor of two must be added to the numerator since the cleanup diminishes the volume of the extract by half. Also, samples may need to be reported on a dry-weight basis for soils. In this case, the % moisture should be obtained from the laboratory performing the % moisture (OP lab) and a copy should be made of the sheet of calculations and included with the package. The dry weight should be calculated by multiplying the wet weight by the percentage of moisture and subtracting that amount from the wet weight. Example: A wet weight of 30.03g was extracted with 12% moisture found in the sample. 30.03g X .12 = 3.60g. Then 30.03g - 3.60 = 26.43g. This weight is now to replace the weight of the sample extracted and will affect the calculation of the targets and the EQLs.

8.0 QUALITY CONTROL

8.1 Holding Times

Sample extracts from the organic preparatory lab have a holding time of forty days after extraction and must be run within that time period. Water samples have a holding time of 7 or 14 days (if preserved) and soils of 14 days from collection to extract. It is therefore necessary for the analyst to perform the analysis within the 7 or 14 day time period in the event that something should need to be re-extracted. This would assure that it could be redone within the holding times.

8.2 Method Blanks

A method blank must be prepared with every analytical batch up to twenty samples.

The following criteria must be met in order for the method blanks to pass. First , the surrogate recoveries must fall within the limits generated by the QA department for the given matrix. These limits are generated on a quarterly basis. Method 8081 - Section 8.2.2 states that if surrogate recoveries are outside the required limits, then the following actions are required: 1.) confirm that there are no errors on calculation and surrogate solutions. Check instrument performance. 2.) Examine chromatograms for interfering peaks and for integrated areas. 3.) Recalculate the data and/or reanalyze the extract if any of the above checks reveal a problem. 4.) Re-extract and reanalyze the sample if none of the above are a problem. Secondly, the blanks must be free of interferences and target hits. The blanks are necessary to prove that the glassware, reagents, and the system are free of interferences. Also, client-requested targets may not be found over the EQLs for the given matrix and theoretically, they should not be present at all. If targets are found in significant amounts, the analyst should make sure that the samples, LCSs, and blanks have not been mislabeled. If there is no immediate explanation for the contamination and possibly even if there is , then the samples must be re-extracted with another set of QC samples.

8.3 Laboratory Control Spikes

LCSs are also performed once per analytical batch or every twenty samples, whichever is more frequent. Method 8081 states that LCSs need only be performed when MS, MSDs are done. Then if the MS/MSD pair does not pass its criteria, the analyst must look at the LCS. If the LCS passes the acceptance criteria, then the batch passes. If it does not, then the method states that a new set of calibration standards should be prepared and analyzed. Our laboratory generates LCSs with every batch of samples up to twenty, regardless of whether an MS/MSD pair is done. This assures that targets other than surrogates are able to be recovered for the extraction method. The LCSs must automatically be reported with the data package.

The following criteria have been established for LCSs. First, like the method blanks, the surrogates must fall within the QA quarterly-generated limits. The spiked target recoveries must fall within the QA annually-generated limits. If an LCS does not pass these criteria, then the analyst should try to determine the cause of the failure. According to the method, it is not necessary for the LCS to pass criteria unless MS/MSDs are analyzed and they do not pass their criteria. However, the analyst should view the LCS as if it were like another method blank. The failure of the LCS could indicate a problem with the reagents, glassware, or the analytical system. For these reasons, our QA department has determined that the LCS is considered to be essential QC and must pass its spiked recovery limits. If it does not, then the samples will need to be re-extracted. Before re-extraction takes place, however, the situation should be discussed with the GC supervisor and the Manager of Quality Assurance.

8.4 Matrix Spikes and Matrix Spike Duplicates

MS/MSDs are performed for every twenty samples and when the client specifically requests that they be done. They must pass the following criteria. First, they must pass the surrogate recovery criteria generated for the matrix. If they do not, then take the steps suggested in Section 8.2 for method blanks. Secondly, they must pass the QA generated limits for MS/MSDs. These limits are matrix specific and like the LCS limits are generated annually. If no errors in calculations were made, the sample should be examined for interferences and reanalyzed. If the second analysis generates similar results, then the analyst should look at the relative percent difference (RPD) between the MS and the MSD. The RPD is calculated using the following formula:

$$RPD = \frac{X1-X2}{(X1+X2)/2}$$

where: X1 = MS % recovery
X2 = MSD % recovery

If the RPD is a relatively low number such as less than 10 or 15, then this precision data of the MS and MSD should be reviewed along with the surrogate recoveries of the sample. If all are similar, the surrogate recoveries for the blank and LCS are good, the spike recoveries of the LCS are good, then this compilation of data indicates that matrix effects are present with these samples. Note that it is possible for a given sample to yield low matrix spike and surrogate recoveries and have it not be out of compliance if the matrix is such that it holds onto the spiked targets even upon extraction. Low matrix spike RPDs would support this phenomenon.

9.0 INTERFERENCES

The analyst should refer to Method 8081 - Section 3.0 for an in-depth discussion of common interferences. Basically there are three categories of sources of interferences: 1. contaminated solvents, reagents, or sample processing hardware (glassware); 2. contaminated gases, parts, columns, or detectors; 3. co-eluting compounds in the samples which can also be detected by the ECD.

9.1 Solvents, Reagents, and Hardware

Interferences by phthalate esters, a component in plastics, introduced during sample preparation can pose a major problem in pesticide analysis. This contamination can be removed, however, by Gel Permeation Chromatography and by avoiding the use of plastics in the laboratory. Glassware must be cleaned as specified in the SOP for glassware cleaning. Sulfur is another contaminant seen in Pesticide and PCB analysis. Sulfur's broad peaks can elute early in a run with many of the pesticides and PCBs such as the Aroclors 1016, 1221, 1232, and 1242. A sulfur cleanup is performed by the analyst after the first analysis of the sample reveals suspect sulfur peaks. Solvent lot checks are analyzed for each new lot of solvent received by the organic extraction laboratory. A portion of the solvent is concentrated and exchanged to hexane.

9.2 Gases, Parts, Columns, and Detectors

The analyst should periodically run hexane blanks through the GC to be sure that contamination from the above components are not interfering with the analysis. Columns may sometimes need to be baked out at an elevated temperature when they have become contaminated from samples. The analyst may also run hexane or methanol rinses through the system while at the elevated temperature to facilitate the removal of the contaminants.

9.3 Co-eluting Compounds in the Samples

When samples are extracted, some cleanup procedures are automatically taken. Then if further interferences are revealed upon analysis, the samples may be put through additional cleanup procedures. Samples being analyzed for PCBs only are automatically acid-cleaned and taken through a Florisil cleanup procedure. After analysis it may be determined that a sulfur cleanup should be done. Sulfur cleanups as well as other cleanup procedures should be performed on the method blanks, LCSs, MSs, and MSDs as well as the samples. For sulfur cleanups, the standards of interest must also be taken through the procedure to validate elution patterns and the absence of reagent interferences. Note: Sulfur cleanup can reduce the recovery of Endrin Aldehyde. If this compound is a target, it should be quantified prior to sulfur cleanup (Method 8081 - Section 3.5). It may be difficult to quantitate Aroclor patterns and single component pesticides together. Acid cleanup can be used on an additional fraction of the sample to eliminate many of the pesticides. Through comparison of the two runs, determination of pesticides can be made.

10.0 TROUBLESHOOTING

It is highly recommended that the analyst read the Varian manual describing the Electron Capture detector. It gives valuable information about the operation and care of the detector that could be used for troubleshooting. Below are some of the common problems associated with the Pesticide/PCB analysis and some suggestions for their correction. Analysts should add to this list on a regular basis to develop a more complete troubleshooting guide. These additions can be hand written and placed behind this SOP in the GC lab SOP book

PROBLEM : CORRECTIVE ACTION

1. Breakdown of DDT and/or Endrin is greater then 15%: Injection ports are usually the problem. Injectors that are chemically active, contaminated from samples, or too hot can cause the degradation of analytes. Injection port liners should be replaced or cleaned and deactivated with Sylon-CT or equivalent, a deactivating agent. Ten centimeters or so should be clipped from the injector side of the column and then the injection liner should be reinstalled. The current temperatures of the injection ports have been carefully researched to reduce breakdown, therefore, the analyst probably will not need to lower the temperature. All maintenance must be recorded in the Preventive Maintenance Logbook for that instrument.

2. Decline in the response of the standards: Leak detect above the injection port to see if there is a septum leak. If a leak is found, the septa should be changed and the standards rerun. If the problem is not eliminated, leak detect around the column joints inside the oven. Tighten the connections if leaks are found. If responses remain low, do as is recommended in #1 above and change the inserts. Active sites may be affecting the responses.

3. Tailing of peaks: Check the column installation; read the Restek installation guide for help in determining the exact problem.

4. Retention time shifts seen in samples for multi-response targets such as PCBs: In some cases, the samples will show an Aroclor pattern, but the retention times will be shifted. Often there is no real explanation for this phenomenon other than that there is something in the samples themselves that is causing the shift. However, the analyst should be sure that it is not the analytical system by running a hexane rinse and then a standard. If the system is still in compliance, then simply update the retention times in the computer method so that the peaks will be identified correctly. For more information read Method 8081 - Section 7.6.4 on PCBs.

TABLE 1. Organochlorine Pesticide and PCB targets and EQL/RLs.

Waters are based on 1 Liter of sample and a 5mL Final Volume.
Soils/Solids are based on 30.00 grams of sample and a 5mL Final Volume (Samples on a dry-weight basis will have higher EQLs).
Wastes/Oils are based on 0.50grams of sample and a 5mL Final Volume.

COMPOUND	Waters EQL/RL (ug/L)	Soils/Solids EQL/RL (ug/Kg)	Wastes/Oils EQL/RL (mg/Kg)
PESTICIDES			
TCMX	0.025	0.83	0.05
alpha-BHC	0.025	0.83	0.05
beta-BHC	0.025	0.83	0.05
gamma-BHC	0.025	0.83	0.05
delta-BHC	0.025	0.83	0.05
Heptachlor	0.025	0.83	0.05
Aldrin	0.025	0.83	0.05
Heptachlor Epoxide	0.025	0.83	0.05
gamma-Chlordane	0.025	0.83	0.05
Endosulfan I	0.025	0.83	0.05
alpha-Chlordane	0.025	0.83	0.05
4,4'DDE	0.050	1.66	0.10
Dieldrin	0.050	1.66	0.10
Endrin	0.050	1.66	0.10
Endosulfan II	0.050	1.66	0.10
4,4'-DDD	0.050	1.66	0.10
Endrin Aldehyde	0.050	1.66	0.10
4,4'-DDT	0.050	1.66	0.10
Endosulfan Sulfate	0.050	1.66	0.10
Endrin Ketone	0.050	1.66	0.10
Methoxychlor	0.250	8.33	0.50
DCB	0.050	1.66	0.10
Toxaphene	1.25	41.67	2.5
Tech. Chlordane	1.25	41.67	2.5
PCBS			
Aroclor 1016	0.50	16.67	1.0
Aroclor 1221	1.00	33.33	2.0
Aroclor 1232	0.50	16.67	1.0
Aroclor 1242	0.50	16.67	1.0
Aroclor 1248	0.50	16.67	1.0
Aroclor 1254	0.50	16.67	1.0
Aroclor 1260	0.50	16.67	1.0

TABLE 2. Concentrations of the Pesticide and PCB surrogate spikes used in the extraction process.

ANALYSIS	Sample Weight or Volume	Final Volume	Concentration of surrogate	Amount added
PEST/PCB (8081)				
WATERS	1L	5mLs	0.20ug/mL	1.0mL
SOILS	30.00g	5mLs	0.20ug/mL	2.0mLs
PCBs only (8081) WASTES/OILS	5.00g	50mLs	1.96ug/mL	1.0mLs
PCBS only (8081) WASTES/OILS	0.50g	5mLs	0.20ug/mL	1.0mL

TABLE 3. Concentration of the Pesticide and PCB spiking solutions used in the extraction of LCSs and Matrix spikes. All spikes made up in acetone.

ANALYSIS	Sample Weight or Volume	Final Volume	Concentration of spike	Amount added
PEST/PCB (8081)				
WATERS	1L	5mLs		
SOILS/SOLIDS	30.00g	5mLs		
TARGETS				
Lindane (g-BHC)	MIX		0.50ug/mL	1.0mL
Heptachlor			0.50ug/mL	
Aldrin			0.50ug/mL	
Dieldrin			1.00ug/mL	
Endrin			1.00ug/mL	
4,4'-DDT			1.00ug/mL	
TCLP PEST	0.200L	5mLs		
TARGETS				
Lindane (g-BHC)	MIX		0.20ug/mL	1.0mL
Heptachlor			0.20ug/mL	
Heptachlor Epoxide			0.20ug/mL	
Endrin			0.20ug/mL	
Methoxychlor			2.00ug/mL	
Toxaphene	0.200L	5mLs	5.0ug/mL	1.0mL
Tech. Chlordane	0.200L	5mLs	5.0ug/mL	1.0mL
PCBs (8081)				
WATERS				
1260	1L	5mLs	2.00ug/mL	1.0mL
SOILS/SOLIDS				
1260	30.00g	5mLs	2.00ug/mL	1.0mL
WASTES/OILS				
1260	0.50g	5mLs	20.9ug/mL	0.100mL
1260	5.00g	5mLs	20.9ug/mL	1.00mL

FIGURE I. Analytical conditions for the instrument L/M used for Pesticides and PCB analyses by dual column confirmation (2 injection ports and 2 ECD detectors). Front column is a RTx-1701 (L), the back column a RTx-5.

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ANALYTICAL CONDITIONS

CLIENT: VARIOUS
DATE: 9/20/94
WORK ORDER: —
ANALYST:
METHOD: 8080/8081 Pest/PCB
608
STANDARD REP:

RTx-1701
(L)

COMPOUND	R.T.	COMPOUND	R.T.
TCMX	7.182	Endosulfan Sulfate	22.679
alpha-BHC	9.907	Methoxychlor	22.956
gamma-BHC	11.223	~~DCB~~ Endrin Ketone	23.914
Heptachlor	11.815	DCB	27.043
Aldrin	12.650		
beta-BHC	14.151		
delta-BHC	14.787		
Heptachlor Epoxide	15.167		
Endosulfan I	16.049		
gamma-Chlordane	16.384		
Alpha-Chlordane	16.618		
4,4'-DDE	17.088		
Dieldrin	17.366		
Endrin	18.078		
Endosulfan II	19.938		
4,4'-DDD	20.003		
4,4'-DDT	20.578		
Endrin Aldehyde	21.481		

DETECTOR ECD RANGE 12 DETECTOR TEMP 300 INJ. TEMP 210

SOLVENT HEXANE COLUMN

INITIAL TEMP 80°C HOLD 0.5 RAMP1 20°/min. TEMP1 150 HOLD 0.0
TEMP1 150°C RAMP2 5.0°C/ TEMP2 260° HOLD 0.0
TEMP2 260°C RAMP3 20°/min TEMP3 270° HOLD 12.0
TEMP3 RAMP4 TEMP4 HOLD
TOTAL RUN TIME

OBSERVATIONS

FIGURE II. Analytical conditions for the instrument Y/Z used for PCB analysis only. Analysis done on the basis of pattern recognition, no column confirmation done.

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ANALYTICAL CONDITIONS

CLIENT: VARIOUS
WORK ORDER: —
METHOD: 8080 / 8081
DATE: 8/20/94
ANALYST:
STANDARD REF: G-618

(Y) RTx-1701 COMPOUND	R.T.	(Z) RTx-5 COMPOUND	R.T.
Aroclor 1016 Peak 1	3.34	Aroclor 1016 peak 1	3.38
2	3.83	2	3.71
3	3.95	3	3.89
4	4.14	4	4.14
5	4.29	5	4.25
6	4.45	6	4.74
7	4.80	7	4.89
8	4.96		
Aroclor 1260 Peak 1	5.42	Aroclor 1260 Peak 1	5.56
2	5.72	2	6.43
3	6.72	3	6.78
4	7.11	4	6.98
5	7.30	5	7.21
6	7.40	6	8.28
7	8.80	7	8.76
8	10.47	8	9.79
TCMX Surrogate	2.35	TCMX Surrogate	3.14
DCB Surrogate	11.25	DCB Surrogate	10.91

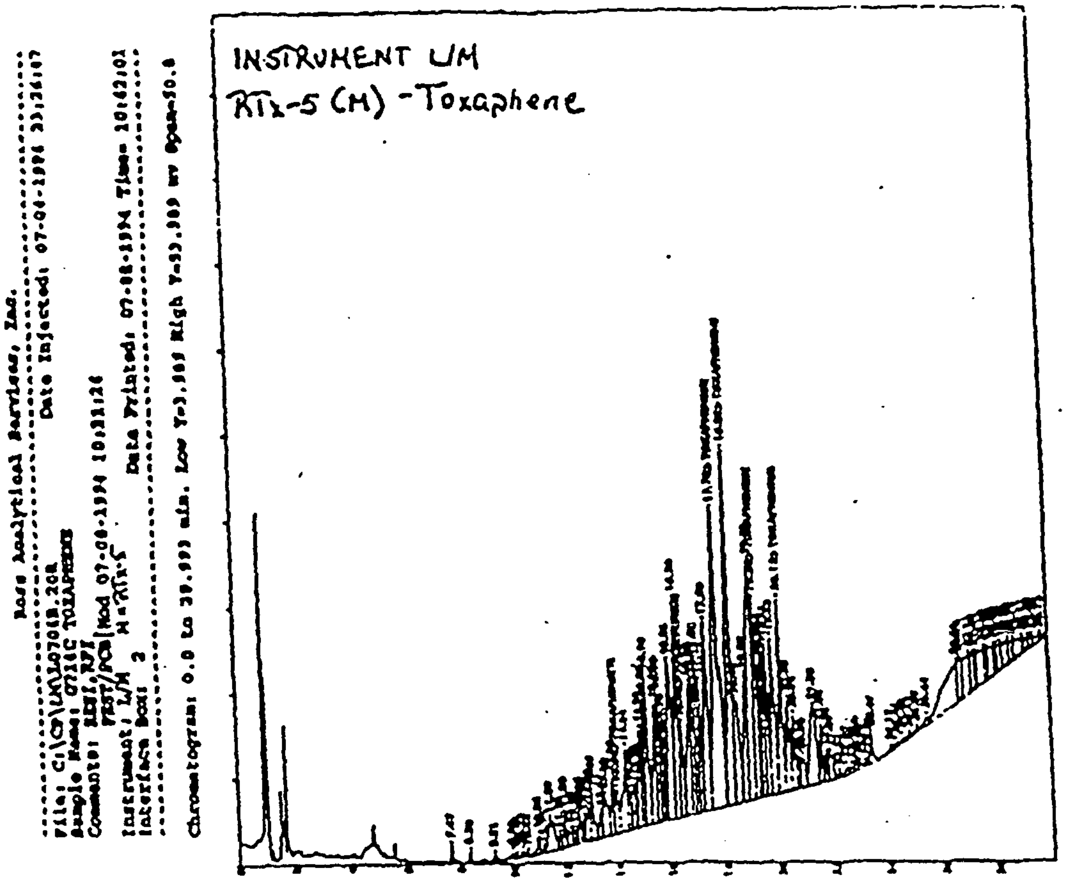
DETECTOR ECD RANGE 12 DETECTOR TEMP 300°C INJ. TEMP 280°C

SOLVENT Hexane COLUMN RTx-1701 (Y) RTx-5 (Z)

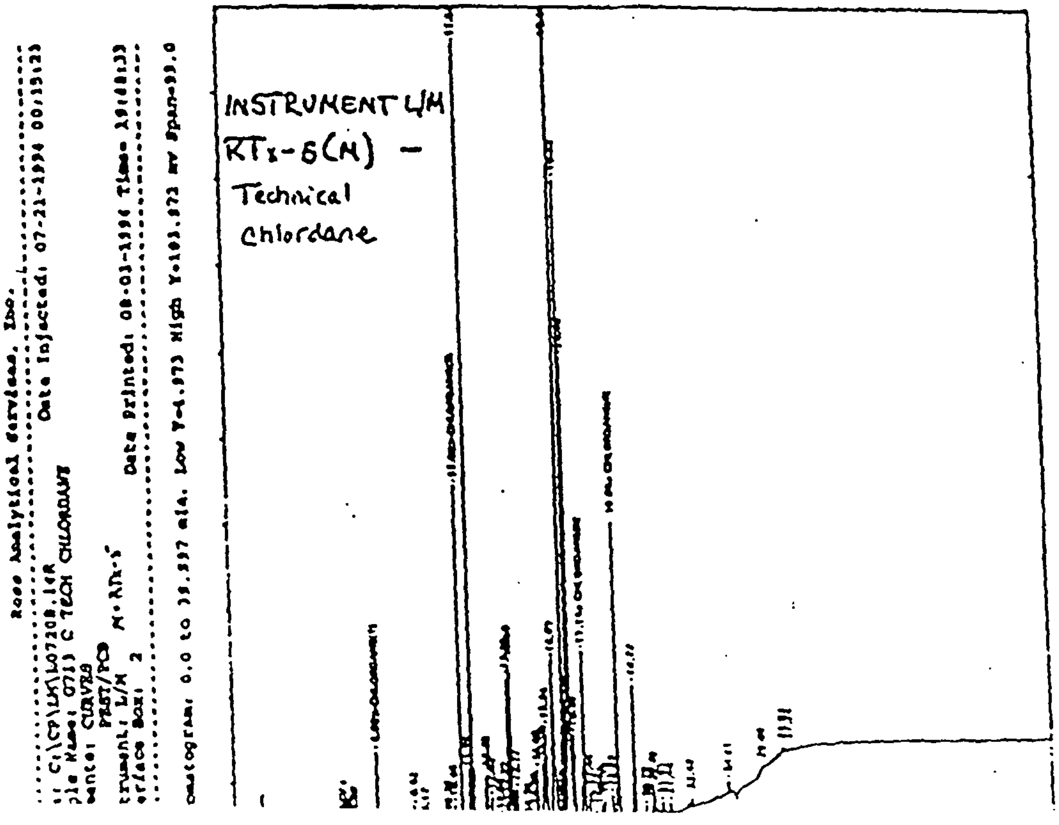
INITIAL TEMP 175°C HOLD 0.0 RAMP1 10°/min. TEMP1 280°C HOLD 1.5
TEMP1 ____ RAMP2 ____ TEMP2 ____ HOLD ____
TEMP2 ____ RAMP3 ____ TEMP3 ____ HOLD ____
TEMP3 ____ RAMP4 ____ TEMP4 ____ HOLD ____
TOTAL RUN TIME ____

OBSERVATIONS SPI (programmable) injector

FIGURE III. Sample chromatograms of the pesticides Toxaphene and Technical Chlordane on a RTx-5 column (back column) instrument L/M.



Ross Analytical Services, Inc.
File: C:\CP\LM\L0701B.20R Date Injected: 07-04-1994 23:26:07
Sample Name: 0716C TOXAPHENE
Comments: RERI,RPT
PEST/PCB|Mod 07-08-1994 10:33:26
Instrument: L/M M=RTx-5 Date Printed: 07-08-1994 Time= 10:42:01
Interface Box: 2
Chromatogram: 0.0 to 39.993 min. Low Y=3.985 High Y=53.989 mv Span=50.0



Ross Analytical Services, Inc.
: C:\CP\LM\L0720B.14R Date Injected: 07-21-1994 00:15:23
ple Name: 0713 C TECH CHLORDANE
ents: CURVE9
PEST/PCB
trument: L/M M=RTx-5 Date Printed: 08-01-1994 Time= 19:48:33
erface Box: 2
omatogram: 0.0 to 39.997 min. Low Y=4.973 High Y=103.973 mv Span=99.0

FIGURE IV. Sample chromatogram of the Aroclor mix 1016 and 1260 on the instrument L/M on the front column RTx-1701.

INSTRUMENT L/M
RTx-1701 (M) - 1016/1260

Ross Analytical Services, Inc.

File: C:\CP\LM\L0818.05R Date Injected: 08-18-1994 20:12:42
Sample Name: AR1660AC
Comments:

Instrument: L/M L = RTx-1701
Interface Box: 2 Date Printed: 08-22-1994 Time= 12:58:28

Chromatogram: 0.0 to 39.997 min. Low Y=5.085 High Y=80.085 mv Span=75.0

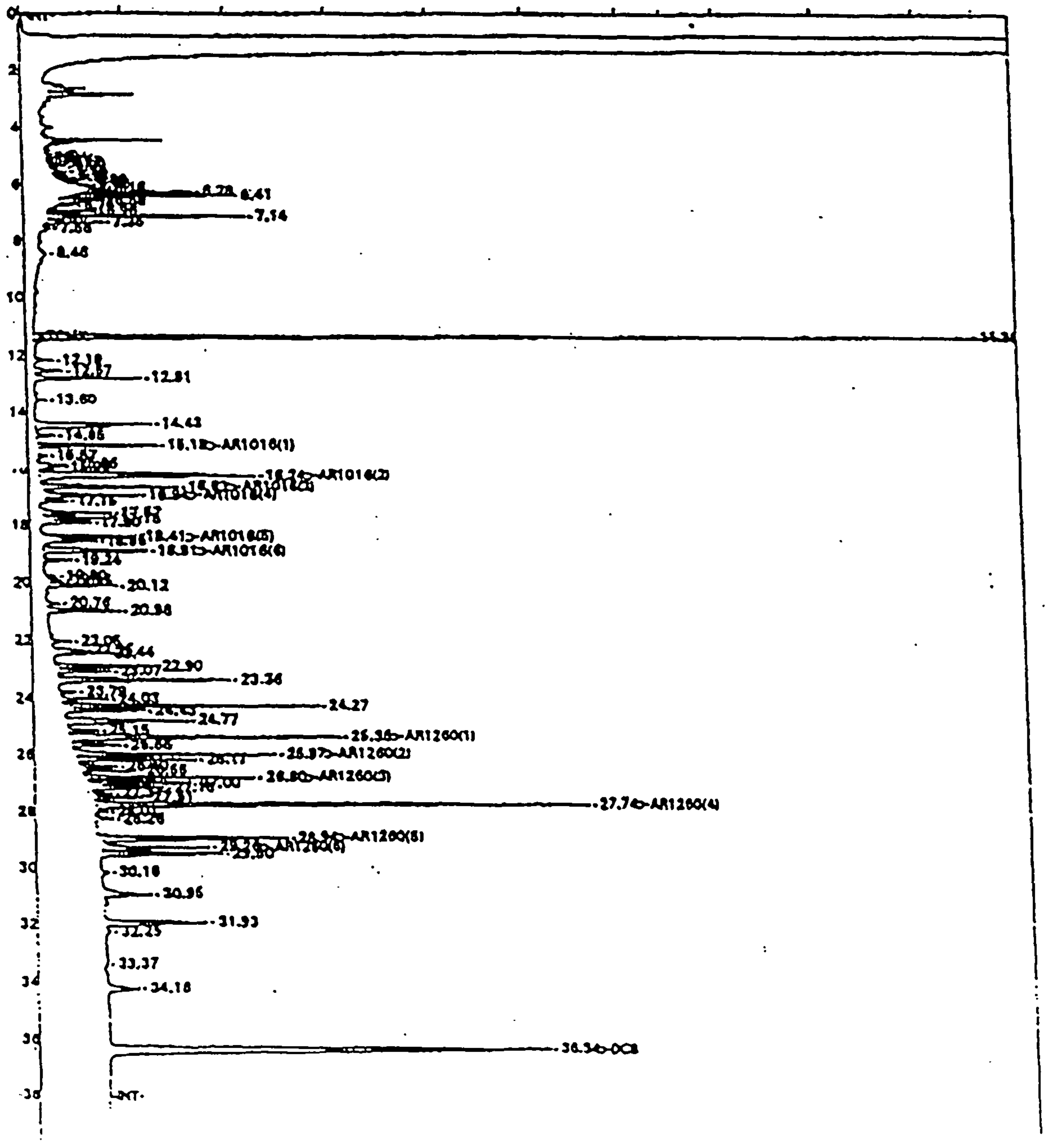
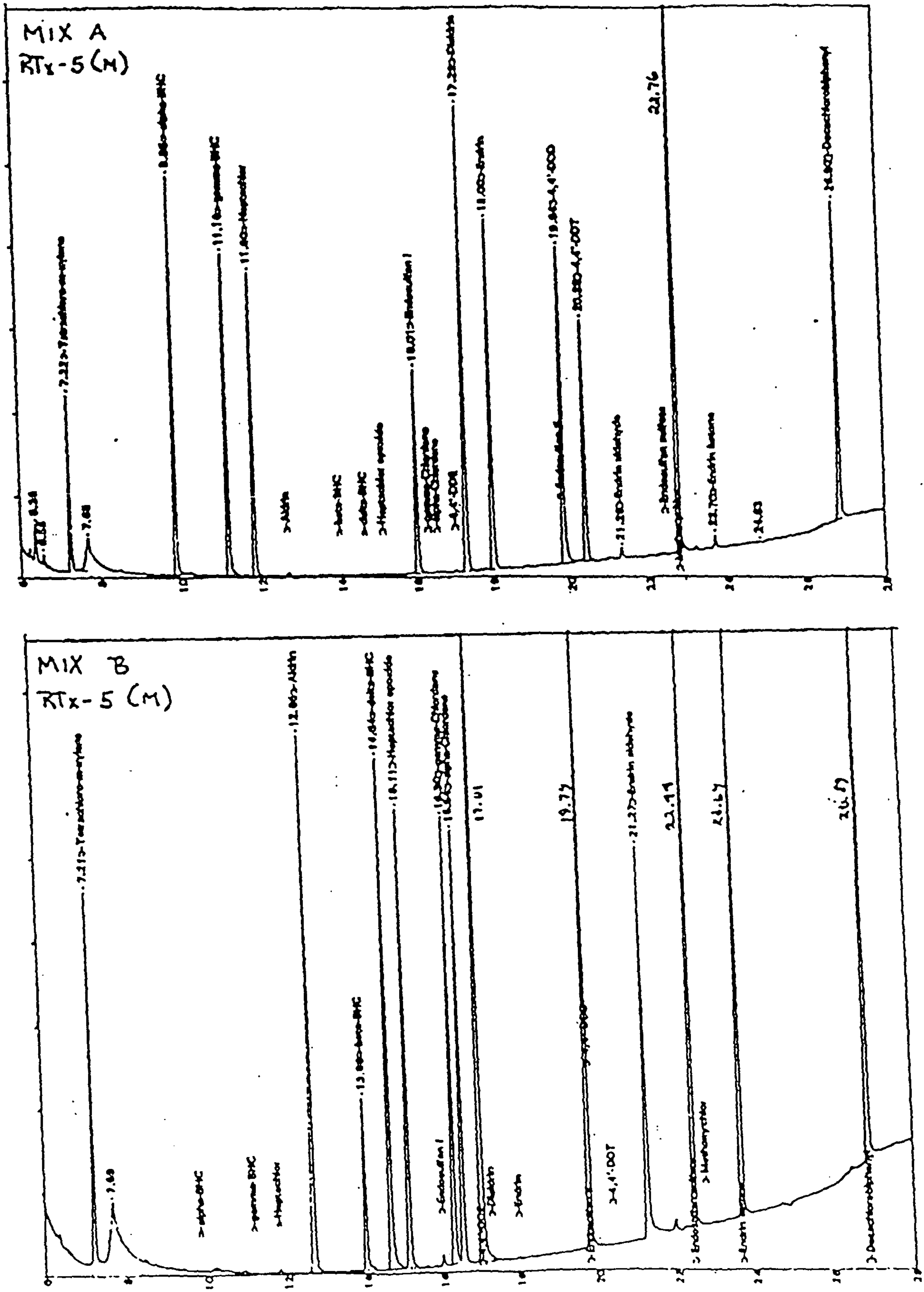


FIGURE V. Sample chromatograms of the Pesticides Mix A and Mix B on the back column (RTx-5) of instrument L/M.



APPENDIX B-2

PM_{10} Sampling by by the Method in 40 CFR 50, Appendix J

APPENDIX J TO PART 50—REFERENCE METHOD FOR THE DETERMINATION OF PARTICULATE MATTER AS PM_{10} IN THE ATMOSPHERE

1.0 *Applicability.*

1.1 This method provides for the measurement of the mass concentration of particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}) in ambient air over a 24-hour period for purposes of determining attainment and maintenance of the primary and secondary national ambient air quality standards for particulate matter specified in § 50.6 of this chapter. The measurement process is nondestructive, and the PM_{10} sample can be subjected to subsequent physical or chemical analyses. Quality assurance procedures and guidance are provided in part 58, appendices A and B, of this chapter and in References 1 and 2.

2.0 *Principle.*

2.1 An air sampler draws ambient air at a constant flow rate into a specially shaped inlet where the suspended particulate matter is inertially separated into one or more size fractions within the PM_{10} size range. Each size fraction in the PM_{10} size range is then collected on a separate filter over the specified sampling period. The particle size discrimination characteristics (sampling effectiveness and 50 percent cutpoint) of the sampler inlet are prescribed as performance specifications in part 53 of this chapter.

2.2 Each filter is weighed (after moisture equilibration) before and after use to determine the net weight (mass) gain due to collected PM_{10}. The total volume of air sampled, corrected to EPA reference conditions (25° C, 101.3 kPa), is determined from the measured flow rate and the sampling time. The mass concentration of PM_{10} in the ambient air is computed as the total mass of collected particles in the PM_{10} size range divided by the volume of air sampled, and is expressed in micrograms per standard cubic meter (μg/std m^3). For PM_{10} samples collected at temperatures and pressures significantly different from EPA reference conditions, these corrected concentrations sometimes differ substantially from actual concentrations (in micrograms per actual cubic meter), particularly at high elevations. Although not required, the actual PM_{10} concentration can be calculated from the corrected concentration, using the average ambient temperature and barometric pressure during the sampling period.

2.3 A method based on this principle will be considered a reference method only if (a) the associated sampler meets the requirements specified in this appendix and the requirements in part 53 of this chapter, and (b) the method has been designated as a reference method in accordance with part 53 of this chapter.

3.0 *Range.*

3.1 The lower limit of the mass concentration range is determined by the repeatability of filter tare weights, assuming the nominal air sample volume for the sampler. For samplers having an automatic filter-changing mechanism, there may be no upper limit. For samplers that do not have an automatic filter-changing mechanism, the upper limit is determined by the filter mass loading beyond which the sampler no longer maintains the operating flow rate within specified limits due to increased pressure drop across the loaded filter. This upper limit cannot be specified precisely because it is a complex function of the ambient particle size distribution and type, humidity, filter type, and perhaps other factors. Nevertheless, all samplers should be capable of measuring 24-hour PM_{10} mass concentrations of at least 300 μg/std m^3 while maintaining the operating flow rate within the specified limits.

4.0 *Precision.*

4.1 The precision of PM_{10} samplers must be 5 μg/m^3 for PM_{10} concentrations below 80 μg/m^3 and 7 percent for PM_{10} concentrations above 80 μg/m^3, as required by part 53 of this chapter, which prescribes a test procedure that determines the variation in the PM_{10} concentration measurements of identical samplers under typical sampling conditions. Continual assessment of precision via collocated samplers is required by part 58 of this chapter for PM_{10} samplers used in certain monitoring networks.

5.0 *Accuracy.*

5.1 Because the size of the particles making up ambient particulate matter varies over a wide range and the concentration of particles varies with particle size, it is difficult to define the absolute accuracy of PM_{10} samplers. Part 53 of this chapter provides a specification for the sampling effectiveness of PM_{10} samplers. This specification requires that the expected mass concentration calculated for a candidate PM_{10} sampler, when sampling a specified particle size distribution, be within ±10 percent of that calculated for an ideal sampler whose sampling effectiveness is explicitly specified. Also, the particle size for 50 percent sampling effectivenss is required to be 10±0.5 micrometers. Other specifications related to accuracy apply to flow measurement and calibration, filter media, analytical (weighing) procedures, and artifact. The flow rate accuracy of PM_{10} samplers used in certain monitoring networks is required by Part 58 of this chapter to be assessed periodically via flow rate audits.

6.0 *Potential Sources of Error.*

6.1 *Volatile Particles.* Volatile particles collected on filters are often lost during shipment and/or storage of the filters prior to the post-sampling weighing[3]. Although shipment or storage of loaded filters is sometimes unavoidable, filters should be reweighed as soon as practical to minimize these losses.

6.2 *Artifacts*. Positive errors in PM_{10} concentration measurements may result from retention of gaseous species on filters[4,5]. Such errors include the retention of sulfur dioxide and nitric acid. Retention of sulfur dioxide on filters, followed by oxidation to sulfate, is referred to as artifact sulfate formation, a phenomenon which increases with increasing filter alkalinity[6]. Little or no artifact sulfate formation should occur using filters that meet the alkalinity specification in section 7.2.4. Artifact nitrate formation, resulting primarily from retention of nitric acid, occurs to varying degrees on many filter types, including glass fiber, cellulose ester, and many quartz fiber filters[5,7,8,9,10]. Loss of true atmospheric particulate nitrate during or following sampling may also occur due to dissociation or chemical reaction. This phenomenon has been observed on Teflon® filters[8] and inferred for quartz fiber filters[11,12]. The magnitude of nitrate artifact errors in PM_{10} mass concentration measurements will vary with location and ambient temperature; however, for most sampling locations, these errors are expected to be small.

6.3 *Humidity*. The effects of ambient humidity on the sample are unavoidable. The filter equilibration procedure in section 9.0 is designed to minimize the effects of moisture on the filter medium.

6.4 *Filter Handling*. Careful handling of filters between presampling and postsampling weighings is necessary to avoid errors due to damaged filters or loss of collected particles from the filters. Use of a filter cartridge or cassette may reduce the magnitude of these errors. Filters must also meet the integrity specification in section 7.2.3.

6.5 *Flow Rate Variation*. Variations in the sampler's operating flow rate may alter the particle size discrimination characteristics of the sampler inlet. The magnitude of this error will depend on the sensitivity of the inlet to variations in flow rate and on the particle distribution in the atmosphere during the sampling period. The use of a flow control device (section 7.1.3) is required to minimize this error.

6.6 *Air Volume Determination*. Errors in the air volume determination may result from errors in the flow rate and/or sampling time measurements. The flow control device serves to minimize errors in the flow rate determination, and an elapsed time meter (section 7.1.5) is required to minimize the error in the sampling time measurement.

7.0 *Apparatus*.

7.1 *PM_{10} Sampler*.

7.1.1 The sampler shall be designed to:

a. Draw the air sample into the sampler inlet and through the particle collection filter at a uniform face velocity.

b. Hold and seal the filter in a horizontal position so that sample air is drawn downward through the filter.

c. Allow the filter to be installed and removed conveniently.

d. Protect the filter and sampler from precipitation and prevent insects and other debris from being sampled.

e. Minimize air leaks that would cause error in the measurement of the air volume passing through the filter.

f. Discharge exhaust air at a sufficient distance from the sampler inlet to minimize the sampling of exhaust air.

g. Minimize the collection of dust from the supporting surface.

7.1.2 The sampler shall have a sample air inlet system that, when operated within a specified flow rate range, provides particle size discrimination characteristics meeting all of the applicable performance specifications prescribed in part 53 of this chapter. The sampler inlet shall show no significant wind direction dependence. The latter requirement can generally be satisfied by an inlet shape that is circularly symmetrical about a vertical axis.

7.1.3 The sampler shall have a flow control device capable of maintaining the sampler's operating flow rate within the flow rate limits specified for the sampler inlet over normal variations in line voltage and filter pressure drop.

7.1.4 The sampler shall provide a means to measure the total flow rate during the sampling period. A continuous flow recorder is recommended but not required. The flow measurement device shall be accurate to ±2 percent.

7.1.5 A timing/control device capable of starting and stopping the sampler shall be used to obtain a sample collection period of 24 ±1 hr (1,440 ±60 min). An elapsed time meter, accurate to within ±15 minutes, shall be used to measure sampling time. This meter is optional for samplers with continuous flow recorders if the sampling time measurement obtained by means of the recorder meets the ±15 minute accuracy specification.

7.1.6 The sampler shall have an associated operation or instruction manual as required by part 53 of this chapter which includes detailed instructions on the calibration, operation, and maintenance of the sampler.

7.2 *Filters*.

7.2.1 *Filter Medium*. No commercially available filter medium is ideal in all respects for all samplers. The user's goals in sampling determine the relative importance of various filter characteristics (e.g., cost, ease of handling, physical and chemical characteristics, etc.) and, consequently, determine the choice among acceptable filters.

Furthermore, certain types of filters may not be suitable for use with some samplers, particularly under heavy loading conditions (high mass concentrations), because of high or rapid increase in the filter flow resistance that would exceed the capability of the sampler's flow control device. However, samplers equipped with automatic filter-changing mechanisms may allow use of these types of filters. The specifications given below are minimum requirements to ensure acceptability of the filter medium for measurement of PM_{10} mass concentrations. Other filter evaluation criteria should be considered to meet individual sampling and analysis objectives.

7.2.2 *Collection Efficiency.* ≥99 percent, as measured by the DOP test (ASTM-2986) with 0.3 μm particles at the sampler's operating face velocity.

7.2.3 *Integrity.* ±5 μg/m³ (assuming sampler's nominal 24-hour air sample volume). Integrity is measured as the PM_{10} concentration equivalent corresponding to the average difference between the initial and the final weights of a random sample of test filters that are weighed and handled under actual or simulated sampling conditions, but have no air sample passed through them (i.e., filter blanks). As a minimum, the test procedure must include initial equilibration and weighing, installation on an inoperative sampler, removal from the sampler, and final equilibration and weighing.

7.2.4 *Alkalinity.* <25 microequivalents/gram of filter, as measured by the procedure given in Reference 13 following at least two months storage in a clean environment (free from contamination by acidic gases) at room temperature and humidity.

7.3 *Flow Rate Transfer Standard.* The flow rate transfer standard must be suitable for the sampler's operating flow rate and must be calibrated against a primary flow or volume standard that is traceable to the National Bureau of Standards (NBS). The flow rate transfer standard must be capable of measuring the sampler's operating flow rate with an accuracy of ±2 percent.

7.4 *Filter Conditioning Environment.*

7.4.1 Temperature range: 15° to 30° C.

7.4.2 Temperature control: ±3° C.

7.4.3 Humidity range: 20% to 45% RH.

7.4.4 Humidity control: ±5% RH.

7.5 *Analytical Balance.* The analytical balance must be suitable for weighing the type and size of filters required by the sampler. The range and sensitivity required will depend on the filter tare weights and mass loadings. Typically, an analytical balance with a sensitivity of 0.1 mg is required for high volume samplers (flow rates >0.5 m³/min). Lower volume samplers (flow rates <0.5 m³/min) will require a more sensitive balance.

8.0 *Calibration.*

8.1 *General Requirements.*

8.1.1 Calibration of the sampler's flow measurement device is required to establish traceability of subsequent flow measurements to a primary standard. A flow rate transfer standard calibrated against a primary flow or volume standard shall be used to calibrate or verify the accuracy of the sampler's flow measurement device.

8.1.2 Particle size discrimination by inertial separation requires that specific air velocities be maintained in the sampler's air inlet system. Therefore, the flow rate through the sampler's inlet must be maintained throughout the sampling period within the design flow rate range specified by the manufacturer. Design flow rates are specified as actual volumetric flow rates, measured at existing conditions of temperature and pressure (Q_a). In contrast, mass concentrations of PM_{10} are computed using flow rates corrected to EPA reference conditions of temperature and pressure (Q_{std}).

8.2 *Flow Rate Calibration Procedure.*

8.2.1 PM_{10} samplers employ various types of flow control and flow measurement devices. The specific procedure used for flow rate calibration or verification will vary depending on the type of flow controller and flow indicator employed. Calibration in terms of actual volumetric flow rates (Q_a) is generally recommended, but other measures of flow rate (e.g., Q_{std}) may be used provided the requirements of section 8.1 are met. The general procedure given here is based on actual volumetric flow units (Q_a) and serves to illustrate the steps involved in the calibration of a PM_{10} sampler. Consult the sampler manufacturer's instruction manual and Reference 2 for specific guidance on calibration. Reference 14 provides additional information on the use of the commonly used measures of flow rate and their interrelationships.

8.2.2 Calibrate the flow rate transfer standard against a primary flow or volume standard traceable to NBS. Establish a calibration relationship (e.g., an equation or family of curves) such that traceability to the primary standard is accurate to within 2 percent over the expected range of ambient conditions (i.e., temperatures and pressures) under which the transfer standard will be used. Recalibrate the transfer standard periodically.

8.2.3 Following the sampler manufacturer's instruction manual, remove the sampler inlet and connect the flow rate transfer standard to the sampler such that the transfer standard accurately measures the sampler's flow rate. Make sure there are no leaks between the transfer standard and the sampler.

8.2.4 Choose a minimum of three flow rates (actual m³/min), spaced over the acceptable flow rate range specified for the inlet (see 7.1.2) that can be obtained by suitable adjustment of the sampler flow rate. In accordance with the sampler manufacturer's instruction manual, obtain or verify the calibration relationship between the flow rate (actual m³/min) as indicated by the transfer standard and the sampler's flow indicator response. Record the ambient temperature and barometric pressure. Temperature and pressure corrections to subsequent flow indicator readings may be required for certain types of flow measurement devices. When such corrections are necessary, correction on an individual or daily basis is preferable. However, seasonal average temperature and average barometric pressure for the sampling site may be incorporated into the sampler calibration to avoid daily corrections. Consult the sampler manufacturer's instruction manual and Reference 2 for additional guidance.

8.2.5 Following calibration, verify that the sampler is operating at its design flow rate (actual m³/min) with a clean filter in place.

8.2.6 Replace the sampler inlet.

9.0 *Procedure.*

9.1 The sampler shall be operated in accordance with the specific guidance provided in the sampler manufacturer's instruction manual and in Reference 2. The general procedure given here assumes that the sampler's flow rate calibration is based on flow rates at ambient conditions (Q_a) and serves to illustrate the steps involved in the operation of a PM_{10} sampler.

9.2 Inspect each filter for pinholes, particles, and other imperfections. Establish a filter information record and assign an identification number to each filter.

9.3 Equilibrate each filter in the conditioning environment (see 7.4) for at least 24 hours.

9.4 Following equilibration, weigh each filter and record the presampling weight with the filter identification number.

9.5 Install a preweighed filter in the sampler following the instructions provided in the sampler manufacturer's instruction manual.

9.6 Turn on the sampler and allow it to establish run-temperature conditions. Record the flow indicator reading and, if needed, the ambient temperature and barometric pressure. Determine the sampler flow rate (actual m³/min) in accordance with the instructions provided in the sampler manufacturer's instruction manual. NOTE.—No onsite temperature or pressure measurements are necessary if the sampler's flow indicator does not require temperature or pressure corrections or if seasonal average temperature and average barometric pressure for the sampling site are incorporated into the sampler calibration (see step 8.2.4). If individual or daily temperature and pressure corrections are required, ambient temperature and barometric pressure can be obtained by on-site measurements or from a nearby weather station. Barometric pressure readings obtained from airports must be station pressure, not corrected to sea level, and may need to be corrected for differences in elevation between the sampling site and the airport.

9.7 If the flow rate is outside the acceptable range specified by the manufacturer, check for leaks, and if necessary, adjust the flow rate to the specified setpoint. Stop the sampler.

9.8 Set the timer to start and stop the sampler at appropriate times. Set the elapsed time meter to zero or record the initial meter reading.

9.9 Record the sample information (site location or identification number, sample date, filter identification number, and sampler model and serial number).

9.10 Sample for 24±1 hours.

9.11 Determine and record the average flow rate ($\bar{Q}_a$) in actual m³/min for the sampling period in accordance with the instructions provided in the sampler manufacturer's instruction manual. Record the elapsed time meter final reading and, if needed, the average ambient temperature and barometric pressure for the sampling period (see note following step 9.6).

9.12 Carefully remove the filter from the sampler, following the sampler manufacturer's instruction manual. Touch only the outer edges of the filter.

9.13 Place the filter in a protective holder or container (e.g., petri dish, glassine envelope, or manila folder).

9.14 Record any factors such as meteorological conditions, construction activity, fires or dust storms, etc., that might be pertinent to the measurement on the filter information record.

9.15 Transport the exposed sample filter to the filter conditioning environment as soon as possible for equilibration and subsequent weighing.

9.16 Equilibrate the exposed filter in the conditioning environment for at least 24 hours under the same temperature and humidity conditions used for presampling filter equilibration (see 9.3).

9.17 Immediately after equilibration, reweigh the filter and record the postsampling weight with the filter identification number.

10.0 *Sampler Maintenance.*

10.1 The PM_{10} sampler shall be maintained in strict accordance with the maintenance procedures specified in the sampler manufacturer's instruction manual.

11.0 *Calculations.*

11.1 Calculate the average flow rate over the sampling period corrected to EPA reference conditions as $\bar{Q}_{std}$. When the sampler's flow indicator is calibrated in actual volumetric units (Q_a), $\bar{Q}_{std}$ is calculated as:

$$\bar{Q}_{std}=\bar{Q}_a\times(P_{av}/T_{av})(T_{std}/P_{std})$$

where

$\bar{Q}_{std}$=average flow rate at EPA reference conditions, std m³/min;

$\bar{Q}_a$=average flow rate at ambient conditions, m^3/min;
P_{av}=average barometric pressure during the sampling period or average barometric pressure for the sampling site, kPa (or mm Hg);
T_{av}=average ambient temperature during the sampling period or seasonal average ambient temperature for the sampling site, K;
T_{std}=standard temperature, defined as 298 K;
P_{std}=standard pressure, defined as 101.3 kPa (or 760 mm Hg).

11.2 Calculate the total volume of air sampled as:

$$V_{std}=\bar{Q}_{std}\times t$$

where

V_{std}=total air sampled in standard volume units, std m^3;
t=sampling time, min.

11.3 Calculate the PM_{10} concentration as:

$$PM_{10}=(W_f-W_i)\times 10^6/V_{std}$$

where

PM_{10}=mass concentration of PM_{10}, μg/std m^3;
W_f, W_i=final and initial weights of filter collecting PM_{10} particles, g;
10^6=conversion of g to μg.

NOTE: If more than one size fraction in the PM_{10} size range is collected by the sampler, the sum of the net weight gain by each collection filter [$\Sigma(W_f-W_i)$] is used to calculate the PM_{10} mass concentration.

12.0 *References.*

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[52 FR 24664, July 1, 1987; 52 FR 29467, Aug. 7, 1987]

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Ross Analytical Services, Inc.

Standard Operating Procedure

SOP NO: CW-021-00
Initial Date 2/26/92
Page 1 of 3
Date Revised:

Title:
Preparation and Analysis of High Volume Air Sampling Filters

Prepared by:	Approved by:	Date:	QC Approval:
CCaldwell	CCaldwell	3/16/92	

1.0 PURPOSE

This SOP defines the procedures for preparation and analysis of filters used for high volume air sampling.

2.0 APPLICATION

This SOP applies to 8" by 10" glass or quartz fiber filters used for high volume ambient air sampling for total suspended particulate (TSP) alone or with metals or other analytes.

3.0 REFERENCES

40 CFR 50.6, Appendix B, "Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method)"

40 CFR 50.6, Appendix J, "Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere"

4.0 ASSOCIATED SOP's

None.

5.0 PROCEDURE

5.1 Materials and Special Equipment

5.1.1 Filters, 8" by 10" glass fiber. Whatman EPM 2000, General Metals Works G810, or equivalent.

5.1.2 Analytical balance with filter weighing chamber attached.

5.1.3 Light table.

5.1.4 Number stamping machine.

5.2 Preparation

5.2.1 Always wear gloves (cotton or non-powdered surgical) when handling the filters. Using the light table, inspect filters for tears, pinholes, and other defects. Reject all which have them. Using a small brush, remove loose material from the filter.

5.2.2 Set the number stamper to duplicate mode and turn the numbers to just below the desired starting number. Set each filter face up in landscape orientation. Stamp its upper right corner within ½" of the edge, turn over on its long axis, and stamp the same number on the upper right corner of the back.

5.2.3 Place the filters in record racks so the numbers are visible. Put the racks in a controlled environment (<50% humidity, approximately 70 F) for about 24 hours.

5.2.4 Tare weigh the filters in the filter chamber of the balance. Zero the balance before each weighing. Before starting, after every 15th filter, and after the last filter weigh a 5 g Class S weight. If the value obtained is outside the range 5 ± 0.001 g, correct the problem and reweigh all filters weighed since the last in-control check weight. After tare weighing, replace the racks in the controlled environment.

5.2.5 Allow filters to sit overnight. Randomly reweigh 10% of the filters. If the second weight does not agree within ± 0.0028 g of the first weight, reweigh all filters between the previous good pair and the next good pair. If a large percentage of the set does not match, equilibrate for another overnight and reweigh all filters.

5.2.6 After acceptable weights are obtained, pack the filters for shipment by interleaving them with onionskin typing paper in a box.

5.3 Analysis

5.3.1 The filters should be returned from the field folded along their long axis with the exposed face inside, in manila envelopes. Open each filter gently and record any odd occurrence, such as loose particulate or more than 10 insects. If any were folded so exposed area extends past the opposite half, refold correctly. Put in record racks so the backside numbers are visible and put the racks in the controlled environment under the same conditions in which they were first equilibrated.

5.4.1 After 24 hours, gross weigh the filters. Weigh the 5 g check weight at the same frequency and with the same acceptance criterion as in Section 5.2.4. Replace them in the controlled environment overnight.

5.4.2 Randomly reweigh 10% of the filters. If the second weight does not agree within ± 0.0050 g of the first weight, reweigh all filters between the previous good pair and the next good pair. If a large percentage of the set does not match, equilibrate for another overnight and reweigh all filters.

5.4.3 After acceptable weights are obtained, replace them in the envelopes for storage.

5.4.4 Calculation: Use the Lotus spreadsheet P:HIGHVOL. Enter the site number (if known), client ID, lab number, tare weight, gross weight, and air volume in m^3 (provided by client). The result in $\mu g/m^3$ is returned.

6.0 QUALITY CONTROL

6.1 Check weights at the beginning and end of sequences and after every 15th filter within the sequence must read 5 ± 0.001 g.

6.2 The two weighings of 10% of the set must agree within ± 0.0028 g for tare weights and ± 0.0050 g for gross weights.

United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards
Research Triangle Park, NC 27711

EPA-452/R-94-009
March 1994

Air

EPA

GUIDELINES FOR PM-10 SAMPLING AND ANALYSIS APPLICABLE TO RECEPTOR MODELING

Balances used to weigh 20.32 cm × 25.40 cm filters from high volume PM_{10} samples must have a sensitivity of at least 100 μg. Balances used for medium volume PM_{10} samples should have a sensitivity of at least 10 μg, and those used for low-volume PM_{10} samples should have a sensitivity of at least 1 μg. Modifications to the balance chamber are sometimes needed to accommodate filters of different sizes. All filters, even those from high-volume PM_{10} samplers, should be handled with gloved hands when subsequent chemical analyses are a possibility.

Balance calibrations should be established before and after each weighing session using Class M and Class S standards, and they should be verified with a standard mass every ten filters. Approximately one out of ten filters should be re-weighed by a different person at a later time. These re-weights should be used to calculate the precision of the measurement as outlined by Watson *et al.* (1989b).

Feeney *et al.* (1984) examined the gravimetric measurement of lightly loaded membrane filters and obtained excellent precision and accuracy. The sensitivity of the electrobalance is about ±0.001 mg, though tolerances on re-weights of Teflon-membrane filters are typically ±0.010 mg. The main interference in gravimetric analysis of filters results from electrostatic effects. Engelbrecht *et al.* (1980) found that residual charge on a filter could produce an electrostatic interaction between the filter on the pan and the metal casing of the electrobalance. This charge can be removed by exposing the filter to a radioactive polonium source before and during sample weighing.

Beta attenuation methods have been applied in the laboratory as well as in the field, and the results are comparable to those of gravimetric measurements. The precision of beta-gauge measurements has been shown to be ±5 $\mu g/m^3$ or better for counting intervals of one minute per sample, which translates into ±32 μg/filter for 37 mm diameter substrates. This is substantially higher than the ±6 μg/filter precision determined by gravimetric analysis using an electrobalance (Feeney *et al.*, 1984). Jaklevic *et al.* (1981) found equivalent accuracy and precision for both techniques as they were used in that study. Courtney *et al.* (1982) found beta attenuation and gravimetric mass measurements to differ by less than ±5%. Patashnick and Rupprecht (1991) examine results from TEOM samplers operated alongside filter-based PM_{10} samplers and Barnes *et al.* (1988) and Shimp (1988) report comparisons with beta attenuation field monitors; these comparisons all show good agreement for mass measurements.

3.2 Elemental Analysis Methods

The most common interest in elemental composition derives from concerns about health effects and the utility of these elements to trace the sources of suspended particles. Instrumental neutron activation analysis (INAA), atomic absorption spectrophotometry (AAS), inductively coupled plasma with atomic emission spectroscopy (ICP/AES), photon-induced x-ray fluorescence (XRF), and proton induced x-ray emission (PIXE) have all been applied to elemental measurements of aerosol samples. AAS and ICP/AES are also appropriate for ionic measurements when the particles are extracted in deionized distilled water (DDW). Since air filters contain very small particle deposits (20 to 100 $\mu g/cm^2$), preference is given to methods which can accommodate small sample sizes. XRF and PIXE leave the sample intact after analysis so that it can be submitted to additional examinations by other methods.

In INAA (Dams *et al.*, 1970; Zoller and Gordon, 1970; Olmez, 1989), a sample is irradiated in the core of a nuclear reactor for periods ranging from a few minutes to several hours. The neutron bombardment chemically transform many elements into radioactive isotopes. The energies of the gamma rays emitted by these isotopes identify them, and therefore their parent elements. The intensity of these gamma rays is proportional to the amount of the parent element present in the sample. Different irradiation times and cooling periods are used before counting with a germanium detector. INAA does not quantify some of the abundant species in ambient particulate matter such as silicon, nickel, tin, and lead. While INAA is technically nondestructive, sample preparation involves folding the sample tightly and sealing it in plastic, and the irradiation process makes the filter membrane brittle and radioactive. These factors limit the use of the sample for subsequent analyses.

In AAS (Ranweiler and Moyers, 1974; Fernandez, 1989), the sample is first extracted in a strong solvent to dissolve the solid material; the filter or a portion of it is also dissolved during this process. A few milliliters of this extract are introduced into a flame where the elements are vaporized. Most elements absorb light at certain wavelengths in the visible spectrum, and a light beam with wavelengths specific to the elements being measured is directed through the flame to be detected by a monochromater. The light absorbed by the flame containing the extract is compared with the absorption from known standards to quantify the elemental concentrations. AAS requires an individual analysis for each element, and a large filter or several filters are needed to obtain concentrations for all of the elements specified in Table 3-1. AAS is a useful complement to other methods, such as XRF and PIXE, for species such as beryllium, sodium, and magnesium which are not well-quantified by these methods. A typical double-beam AAS system is schematically illustrated in Figure 3-1. Airborne particles are chemically complex and do not dissolve easily into complete solution, regardless of the strength of the solvent. There is always a possibility that insoluble residues are left behind and soluble species may co-precipitate on them or on container walls.

In ICP/AES (Fassel and Kniseley, 1974; McQuaker *et al.*, 1979; Lynch *et al.*, 1980; Harman, 1989), the dissolved sample is introduced into an atmosphere of argon gas seeded with free electrons induced by high voltage from a surrounding Tesla coil. The high temperatures in the induced plasma raise valence electrons above their normally stable states. When these electrons return to their stable states, a photon of light is emitted which is unique to the element which was excited. This light is detected at specified wavelengths to identify the elements in the sample. ICP/AES acquires a large number of elemental concentrations using small sample volumes with acceptable detection limits for atmospheric samples. As with AAS, this method requires complete extraction and destruction of the sample.

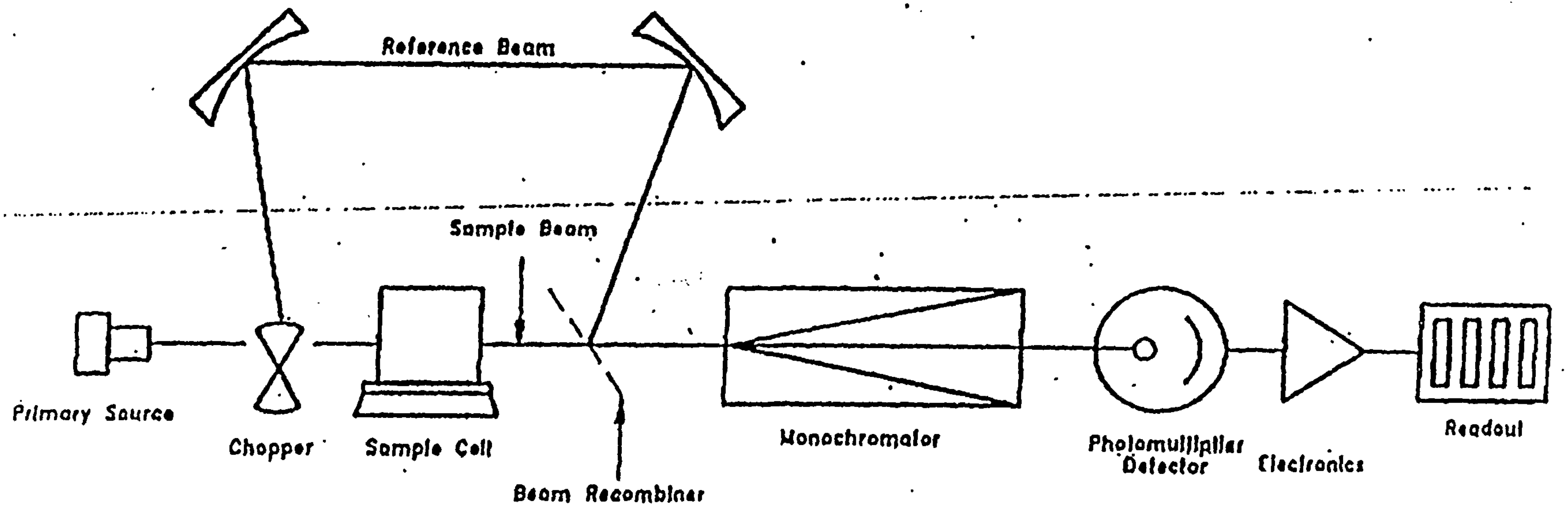


Figure 3-1. Schematic of a typical double-beam AAS system.

In XRF (Dzubay and Stevens, 1975; Jaklevic *et al.*, 1977) and PIXE (Cahill *et al.*, 1990; Eldred, 1993), the filter deposit is irradiated by high energy x-rays (XRF) or protons (PIXE) which eject inner shell electrons from the atoms of each element in the sample. When a higher energy electron drops into the vacant lower energy orbital, a fluorescent x-ray photon is released. The energy of this photon is unique to each element, and the number of photons is proportional to the concentration of the element. Concentrations are quantified by comparing photon counts for a sample with those obtained from thin-film standards of known concentration.

Emitted x-rays with energies less than ~4 kev (affecting the elements sodium, magnesium, aluminum, silicon, phosphorus, sulfur, chlorine, and potassium) can be absorbed in the filter, in a thick particle deposit, or even by large particles in which these elements are contained. Very thick filters also scatter much of the excitation radiation or protons, thereby lowering the signal-to-noise ratio for XRF and PIXE. For this reason, thin membrane filters with deposits in the range of 10 to 50 $\mu g/cm^2$ provide the best accuracy and precision for XRF and PIXE analysis.

XRF methods can be broadly divided into two categories: wavelength dispersive (WDXRF), which utilizes crystal diffraction for observation of fluorescent x-rays, and energy dispersive (EDXRF), which uses a silicon semiconductor detector. The WDXRF method is characterized by high spectral resolution, which minimizes peak overlaps. WDXRF requires high power excitation to overcome low sensitivity which results in excessive sample heating and potential degradation. Conversely, EDXRF features high sensitivity but less spectral resolution, requiring complex spectral deconvolution procedures.

XRF methods can be further categorized as direct/filtered excitation, where the x-ray beam from the tube is optionally filtered and then focused directly on the sample, or secondary target excitation, where the beam is focused on a target of material selected to produce x-rays of the desired energy. The secondary fluorescent radiation is then used to excite the samples. The direct/filtered approach has the advantage of delivering higher incident radiation flux to the sample for a given x-ray tube power, since about 99% of the incident energy is lost in a secondary fluorescer. The secondary fluorescer approach, however, produces a more nearly monochromatic excitation which reduces unwanted scatter from the filter, yielding better detection limits.

XRF and PIXE are usually performed on Teflon-membrane filters for sodium, magnesium, aluminum, silicon, phosphorus, sulfur, chlorine, potassium, calcium, titanium, vanadium, chromium, manganese, iron, cobalt, nickel, copper, zinc, gallium, arsenic, selenium, bromine, rubidium, strontium, yttrium, zirconium, molybdenum, palladium, silver, cadmium, indium, tin, antimony, barium, lanthanum, gold, mercury, thallium, lead, and uranium.

A typical XRF system is schematically illustrated in Figure 3-2. The x-ray output stability should be within ±0.25% for any 8-hour period within a 24-hour duration. Analyses are typically controlled, spectra are acquired, and elemental concentrations are calculated by software on a computer which is interfaced to the analyzer.

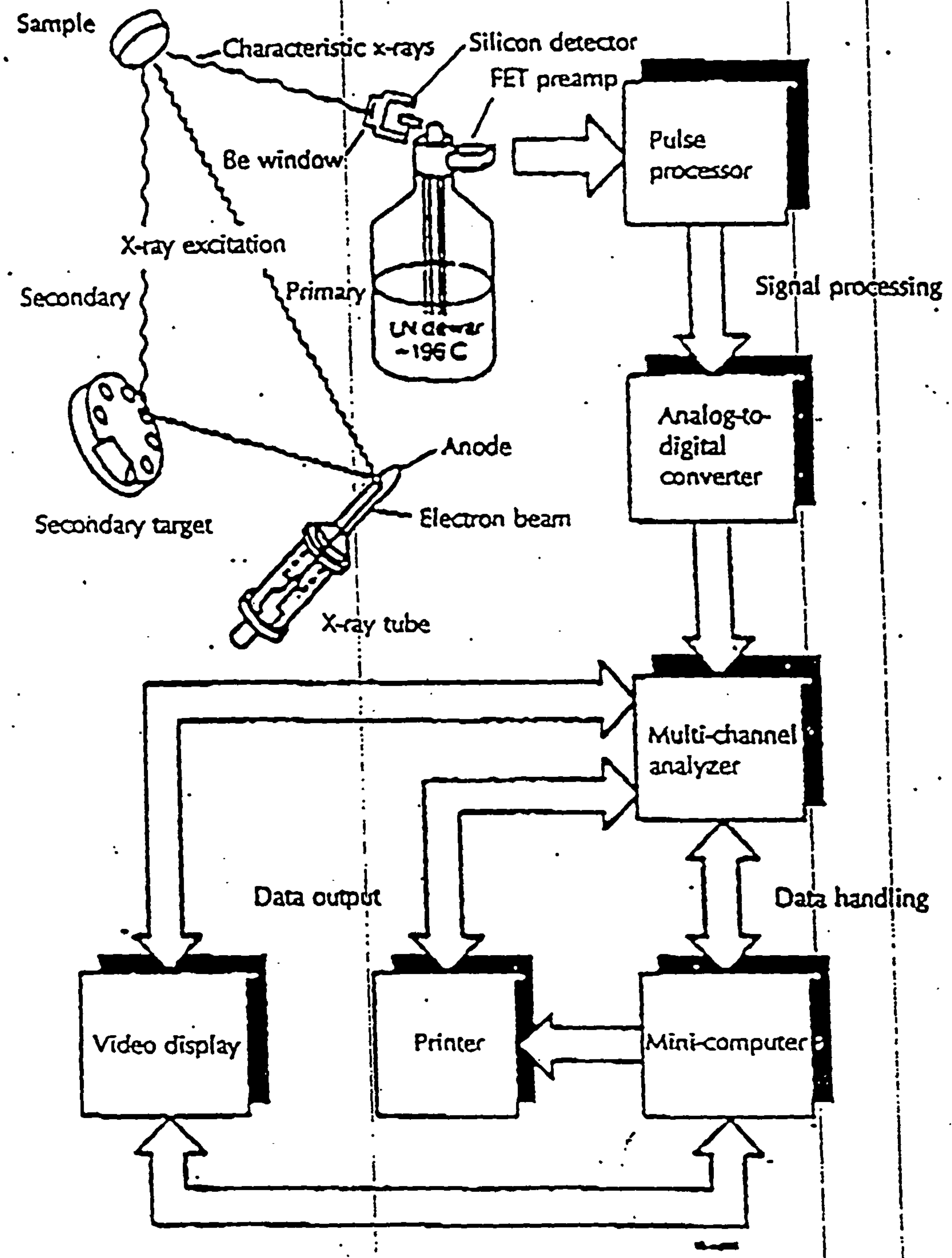


Figure 3-2. Schematic of a typical x-ray fluorescence (XRF) system (Kevex, 1985).

Separate XRF analyses are conducted on each sample to optimize detection limits for the specified elements. A comparison of the minimum detectable limits of Teflon-membrane and quartz-fiber filters is listed in Table 3-2. Figure 3-3 shows an example of an XRF spectrum.

Three types of XRF standards are used for calibration, performance testing, and auditing: 1) vacuum-deposited thin-film elements and compounds (Micromatter); 2) polymer films (Dzubay *et al.*, 1981); and 3) the National Institute of Science and Technology (NIST; formerly NBS) thin-glass films. The vacuum deposits cover the largest number of elements and are used to establish calibration curves. The polymer film and NIST standards are used as quality control measures. NIST produces the definitive standard reference material, but these are only available for the species aluminum, calcium, cobalt, copper, manganese, and silicon (SRM 1832), and iron, lead, potassium, silicon, titanium, and zinc (SRM 1833). A separate Micromatter thin-film standard is used to calibrate the system for each element.

Sensitivity factors (number of x-ray counts per $\mu g/cm^2$ of the element) are determined for each excitation condition. These factors are then adjusted for absorption of the incident and emitted radiation in the thin film. These sensitivity factors are plotted as a function of atomic number and a smooth curve is fitted to the experimental values. The calibration sensitivities are then read from these curves for the atomic numbers of each element in each excitation condition. Polymer film and NIST standards should be analyzed on a periodic basis using these sensitivity factors to verify both the standards and the stability of the instrument response. When deviations from specified values are greater than ±5%, the system should be re-calibrated.

The sensitivity factors are multiplied by the net peak intensities yielded by ambient samples to obtain the $\mu g/cm^2$ deposit for each element. The net peak intensity is obtained by: 1) subtracting background radiation; 2) subtracting spectral interferences; and 3) adjusting for x-ray absorption.

The elemental x-ray peaks reside on a background of radiation scattered from the sampling substrate. A model background is formed by averaging spectra obtained from several blank filters of the same type used in ambient sampling. It is important to retain blank filters for this purpose when XRF or PIXE analyses are anticipated. This model background has the same shape and features of the sample spectra (minus the elemental peaks) if the deposit mass is small relative to the substrate mass (Russ, 1977). This model background is normalized to an excitation radiation scatter peak in each sample spectrum to account for the difference in scatter intensity due to different masses.

The number and spacing of the characteristic x-ray lines relative to detector resolution are such that the peaks from one element can interfere with a peak from another element (Dzubay, 1986). A variety of methods has been used to subtract these peak overlaps (Arinc *et al.*, 1977; Parkes *et al.*, 1979; Drane *et al.*, 1983), including least squares fitting to library spectra, Gaussian and other mathematical functions, and the use of peak overlap coefficients.

Table 3-2
X-ray fluorescence air filter analysis interference-free minimum detectable limits[a] using DRI standard analysis protocols

		Quartz-Fiber Filter[b]	Teflon-Membrane Filter[c]			
Element	Condition Number[d]	Protocol QA-A ng/cm²[e]	Protocol A ng/cm²[e]	Protocol B ng/cm²	Protocol C ng/cm²	Protocol D ng/cm²
Al	5	NA[f]	10	7.2	3.6	2.5
Si	5	NA	6.3	4.4	2.2	1.4
P	5	NA	5.6	4.0	2.0	1.4
S	5	40[g]	5.0	3.5	1.8	1.2
Cl	4	30	10	7.4	3.7	2.6
K	4	40	6.1	4.3	2.2	1.5
Ca	4	100	4.5	3.2	1.6	1.1
Ti	3	50	2.9	2.1	1.0	0.73
V	3	20	2.5	1.7	0.87	0.62
Cr	3	8	1.9	1.4	0.67	0.48
Mn	3	7	1.6	1.1	0.56	0.40
Fe	3	15	1.5	1.1	0.54	0.38
Co	3	5	0.88	0.62	0.31	0.22
Ni	3	4	0.89	0.63	0.31	0.22
Cu	3	4	1.1	0.76	0.38	0.27
Zn	3	6	1.1	0.76	0.38	0.27
Ga	2	8	1.9	1.4	0.68	0.48
As	2	9	1.6	1.1	0.56	0.39
Se	2	5	1.2	0.86	0.43	0.31
Br	2	5	1.0	0.72	0.36	0.25
Rb	2	5	1.0	0.68	0.34	0.24
Sr	2	8	1.1	0.78	0.39	0.28
Y	2	8	1.3	0.92	0.46	0.33
Zr	2	10	1.7	1.2	0.59	0.42
Mo	4	20	2.7	1.9	0.95	0.67
Pd	1	20	11	7.6	3.8	2.7
Ag	1	20	12	8.6	4.3	3.0
Cd	1	25	12	8.6	4.3	3.0
In	1	30	13	9.5	4.8	3.4
Sn	1	40	17	12	6.2	4.4
Sb	1	50	18	13	6.4	4.5
Ba	1	170	52	37	18	13
La	1	190	62	44	22	16
Au	2	NA	3.1	2.2	1.1	0.77
Hg	2	20	2.6	1.8	0.91	0.65

Table 3-2 (continued)
X-ray fluorescence air filter analysis interference-free minimum detectable limits[a] using DRI standard analysis protocols

		Quartz-Fiber Filter[b]	Teflon-Membrane Filter[c]			
Element	Condition Number[d]	Protocol QA-A ng/cm²[e]	Protocol A ng/cm²[g]	Protocol B ng/cm²	Protocol C ng/cm²	Protocol D ng/cm²
Ti	2	NA	2.5	1.8	0.88	0.62
Pb	2	14	3.0	2.2	1.1	0.76
U	2	NA	2.3	1.7	0.83	0.59

[a] MDL defined as three times the standard deviation of the blank for a filter of 1 mg/cm² areal density.

[b] Analysis times are 100 sec. for Conditions 1 and 4, and 400 sec. for Conditions 2 and 3. Actual MDL's for quartz filters vary from batch to batch due to elemental contamination variability.

[c] Analysis times are 100 sec. for Conditions 1, 4 and 5, and 400 sec. for Conditions 2 and 3 for Protocol A; 200 sec. for Conditions 1, 4 and 5 and 800 sec. for Conditions 2 and 3 for Protocol B; 800 sec. for Conditions 1,4 and 5 and 3200 sec. for Conditions 2 and 3 for Protocol C; and 1600 sec. for Conditions 1, 4 and 5 and 6400 sec. for Conditions 2 and 3 for Protocol D.

[d] Condition 1 is direct mode excitation with a primary excitation filter of 0.15 mm thick Mo. Tube voltage is 50 KV and tube current is 0.6 mA. Condition 2 is direct mode excitation with a primary excitation filter of 0.13 mm thick Rh. Tube voltage is 35 KV and tube voltage is 2.0 mA. Condition 3 uses Ge secondary target excitation with the secondary excitation filtered by a Whatman 41 filter. Tube voltage is 30 KV and tube current is 3.3 mA. Condition 4 uses Ti secondary target excitation with the secondary excitation filtered by 3.8 μm thick mylar film. Tube voltage is 30 KV and tube current is 3.3 mA. Condition 5 uses direct mode excitation with a primary excitation filter consisting of 3 layers of Whatman 41 filters. Tube voltage is 8 KV and tube current os 0.6 mA. Multi-channel analyzer energy range is 0 - 40 KeV for condition 1, 0 - 20 KeV for condition 2, and 0 - 10 KeV for conditions 3, 4, and 5.

[e] Typical exposed area is 406 cm² for standard high-volume filters; 6.4 cm² for 37 mm ringed Teflon-membrane filters; and 13.8 cm² for 47 mm ringed Teflon-membrane filters.

[f] Information not available.

[g] For condition 4.

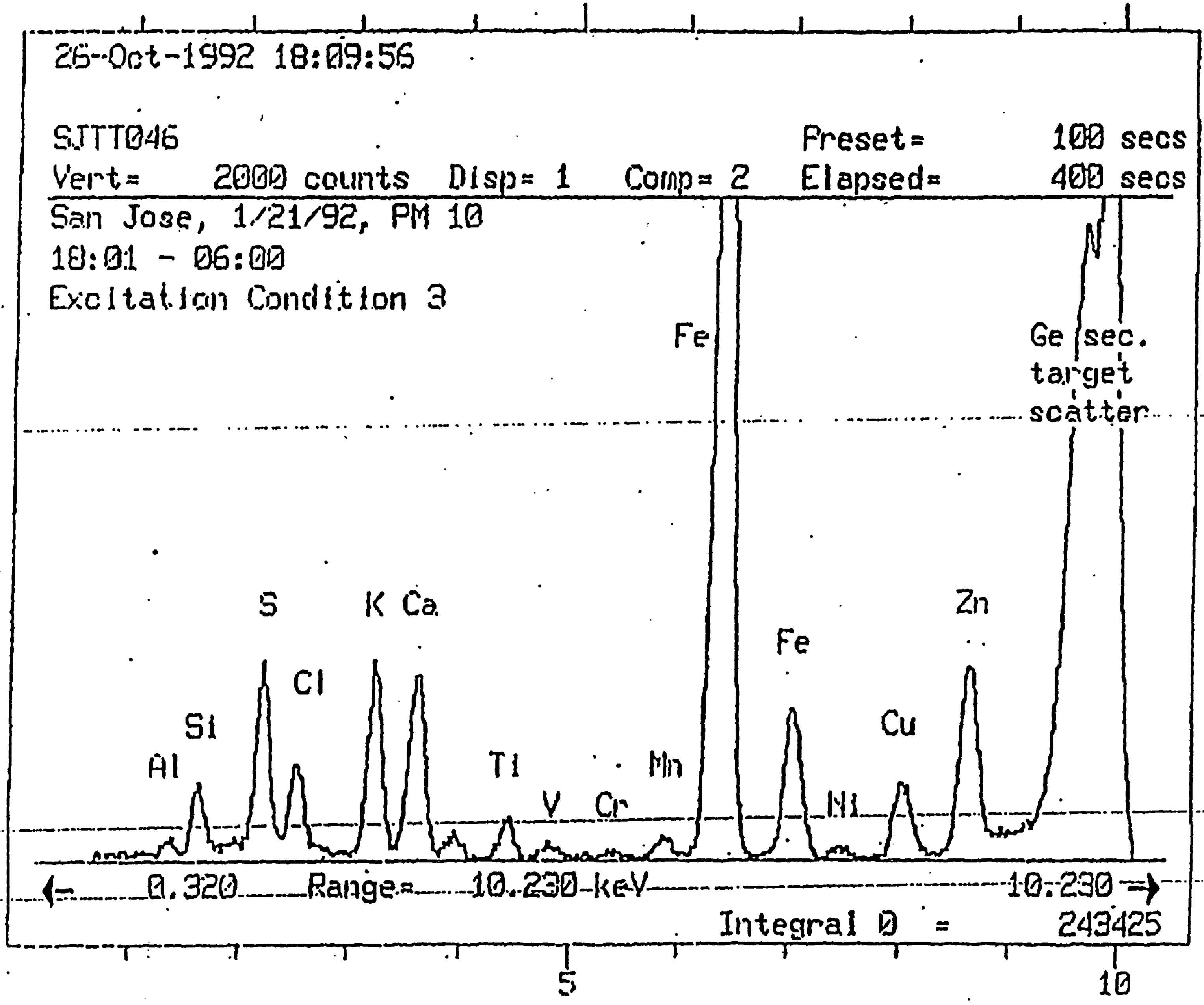


Figure 1-3 Example of an x-ray fluorescence (XRF) spectrum (Chow *et al.*, 1990d).

Peak overlap coefficients are applied to aerosol deposits. The most important of these overlaps are the K-beta to K-alpha overlaps of elements which increase in atomic number from potassium to zirconium, the lead L-alpha to arsenic K-alpha interference, and the lead M line to sulfur K line interference. The ratios of overlap peaks to the primary peak are determined from the thin film standards for each element for the spectral regions of the remaining elements. These ratios are multiplied by the net peak intensity of the primary peak and subtracted from the spectral regions of other elements.

The ability of an x-ray to penetrate matter depends on the energy of the x-ray and the composition and thickness of the material. In general, lower energy x-rays, characteristic of light elements, are absorbed in matter to a much greater degree than higher energy x-rays. XRF analysis of air particulate samples has had widest application to samples collected on membrane-type filters such as Teflon- or polycarbonate-membrane filter substrates. These membrane filters collect the deposit on their surfaces, which eliminates biases due to absorption of x-rays by the filter material. These filters also have a low areal density which minimizes the scatter of incident x-rays, and their inherent trace element content is very low.

Quartz-fiber filters used for high-volume aerosol sampling do not exhibit these features. As noted earlier, blank elemental concentrations in quartz-fiber filters which have not undergone acceptance testing can be several orders of magnitude higher than the concentrations in the particulate deposits. They vary substantially among the different types of quartz-fiber filters available, and even within the same filter type and manufacturing lot. Blank impurity concentrations and their variabilities decrease the precision of background subtraction from the XRF spectral data, resulting in higher detection limits. Impurities observed in various types of glass- and quartz-fiber filters include aluminum, silicon, sulfur, chlorine, potassium, calcium, iron, nickel, copper, zinc, rubidium, strontium, molybdenum, barium, and lead. Concentrations for aluminum, silicon, and phosphorus cannot be determined for quartz-fiber filters because of the large silicon content of the filters.

Quartz-fiber filters also trap particles within the filter matrix, rather than on its surface. This causes absorption of x-rays within the filter fibers yielding lower concentrations than would otherwise be measured. The magnitude of this absorption increases exponentially as the atomic number of the analyte element decreases and varies from sample to sample. Absorption factors generally are 1.2 or less for iron and heavier elements, but can be from two to five for sulfur.

Quartz-fiber filters are much thicker than membrane filters resulting in the scattering of more x-rays with a consequent increase in background and degradation of detection limits. The increased x-ray scatter also overloads the x-ray detector which requires samples to be analyzed at a lowered x-ray intensity. These effects alone can result in degradation of detection limits by up to a factor of ten with respect to Teflon-membrane substrates.

Larger particles collected during aerosol sampling have sufficient size to cause absorption of x-rays within the particles. Attenuation factors for $PM_{2.5}$ are generally negligible (Criss. 1976), even for the lightest elements, but these attenuations can be significant for coarse fraction particles (particles with aerodynamic diameters from 2.5 to 10 μm). Correction factors have been derived using the theory of Dzubay and Nelson (1975) and should be applied to the coarse particle measurements for SFS PM_{10} samples.

During XRF or PIXE analysis, filters are removed from their Petri slides and placed with their deposit sides down into filter cassettes. These cassettes are loaded into a mechanism which exposes the filter deposits to protons for PIXE and x-rays for XRF. The sample chamber is evacuated and a computer program controls the positioning of the samples and the excitation conditions. The vacuum in the x-ray chamber and the heat induced by the absorption of x-rays can cause certain materials to volatilize. For this reason, labile species such as nitrate and organic carbon are better measured on a quartz-fiber filter which samples simultaneously with the Teflon-membrane filter.

Quality control standards and replicates from previous batches should be analyzed for every 10 to 20 samples. When quality control results differ from specifications by more than ±5%, or if the replicate concentrations differ from the original values (assuming they are at least 10 times detection limits) by more than ±10%, the samples should be re-analyzed.

XRF and PIXE are the most commonly used elemental analysis methods owing to their multi-element capabilities, relatively low cost, high detection limits, and preservation of the filter for other analyses. XRF sometimes needs to be supplemented with INAA when extremely low detection limits are needed, but the high cost of INAA prevents this method from being applied to large numbers of samples. Atomic absorption spectroscopy is a good alternative for water-soluble species, but it requires large dilution factors to measure many different elements. ICP is a viable alternative, but it is less desirable because of the expense required to extract the sample and the destruction of the filter sample.

3.3 Water-Soluble Ion Measurement Methods

Aerosol ions refer to chemical compounds which are soluble in water. The water-soluble portion of suspended particles associates itself with liquid water in the atmosphere when relative humidity increases, thereby changing the light scattering properties of these particles. Different emissions sources may also be distinguished by their soluble and non-soluble fractions. Gaseous precursors can also be converted to their ionic counterparts when they interact with chemicals impregnated on the filter material. Samples are generally extracted in DDW which is filtered to remove suspended particulate matter prior to analysis. Several simple ions, such as sodium, magnesium, potassium, and calcium can be quantified by AAS as described above. In practice, AAS has been very useful for measuring water-soluble potassium and sodium, which are important in apportioning sources of vegetative burning and sea salt, respectively. Polyatomic ions such as sulfate, nitrate, ammonium, and phosphate must be quantified by other methods such as ion chromatography (IC) and automated colorimetry (AC). Simple ions, such as chloride, and fluoride may also be measured by these methods along with the polyatomic ions.

APPENDIX B-3

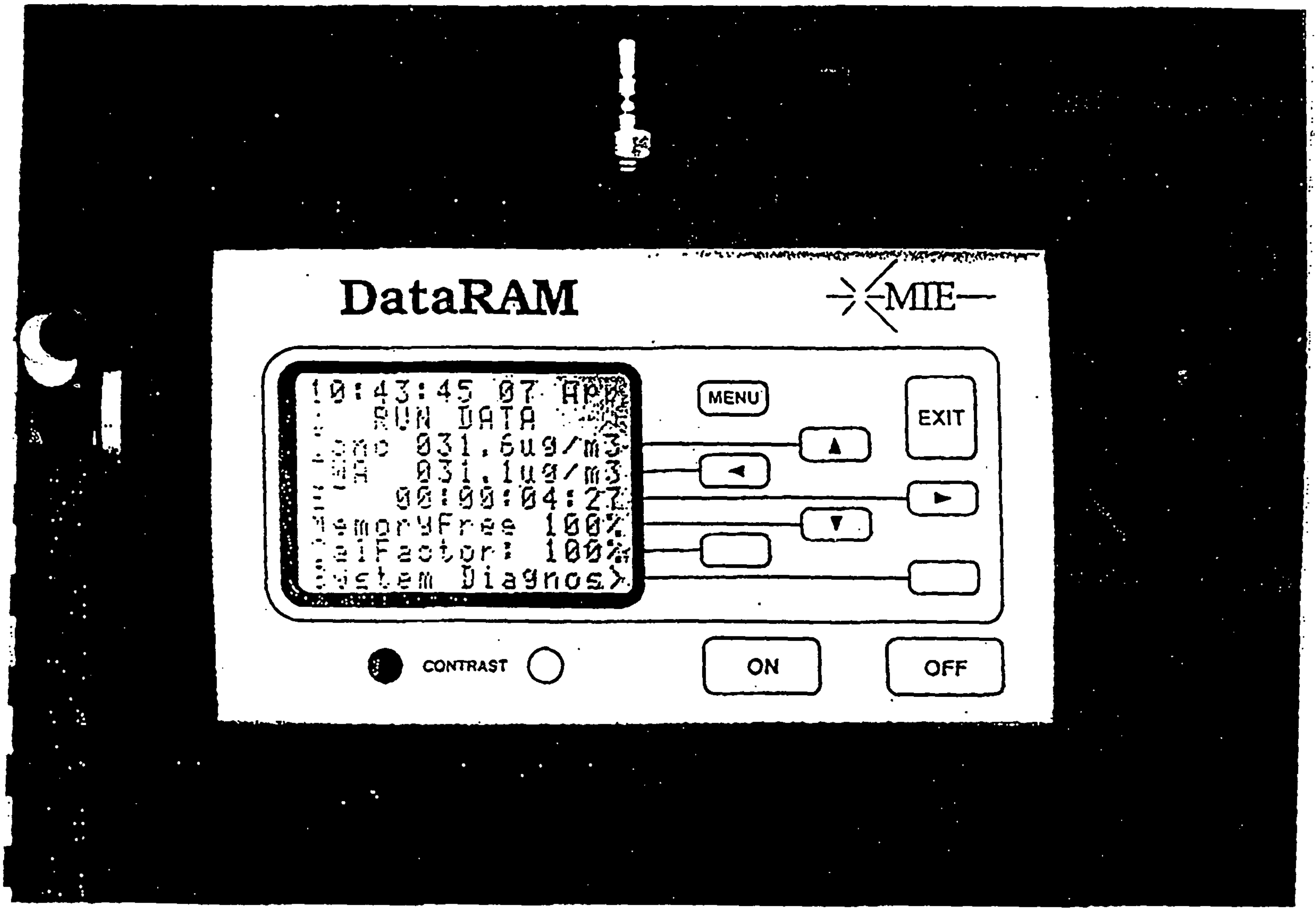
Mercury Sampling and Analysis

APPENDIX B-3-A

Mercury Analysis by X-Ray Fluoresence

DataRAM™ Portable Real-Time Aerosol Monitor

R.A[illegible]
253 W. [illegible]
Chicago [illegible]
(MILW) [illegible]

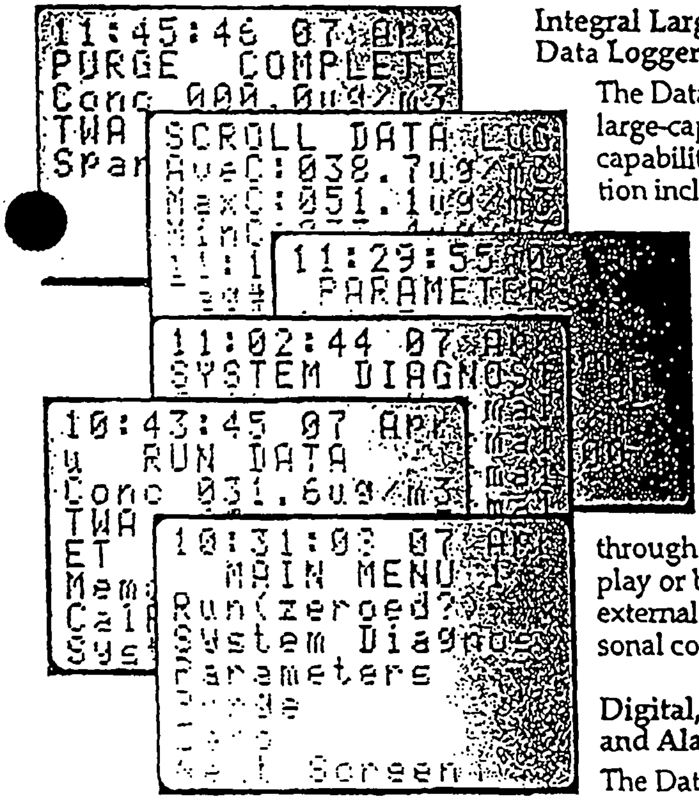


MIE

tile Real-Time Aerosol Monitor

Maintenance-Free Operation

After passing through the optical sensing stage, all particles are retained on a HEPA filter. Part of the filtered air stream is then continuously diverted through and over all optically-sensitive areas (lenses, light traps, etc.) to form a continuous air curtain which protects against particle deposition. This design, in conjunction with a highly reliable diaphragm pump, ensures long-term maintenance-free operation.



Menu-Driven Information Displays

In addition to the auto-ranging real-time concentration readout, the DataRAM provides users with a variety of informational displays on its 8-line LCD screen. Real-time and date, time-weighted average concentrations, elapsed run times, and other information are easily viewed by selecting the appropriate screen using a scroll-through menu. Operating parameters and diagnostic information displays can also be easily accessed through the menu using only 6 keys on the front of the instrument.

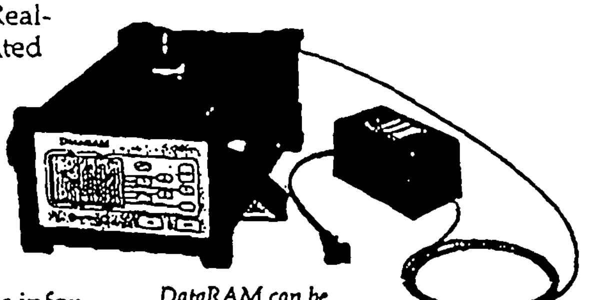
Integral Large-Capacity Data Logger

The DataRAM has built-in large-capacity data logging capabilities. Stored information includes time and date, average concentrations, maximum and minimum values over selected periods, STEL concentration, and tagging codes.

Logged information can be retrieved either by scrolling through the DataRAM's display or by down-loading to an external device such as a personal computer or printer.

Digital, Analog, and Alarm Outputs

The DataRAM provides continuous digital output (by means of an RS232C data port) as well as analog output, and a switched output for selectable high-level alarm with a built-in audible signal.

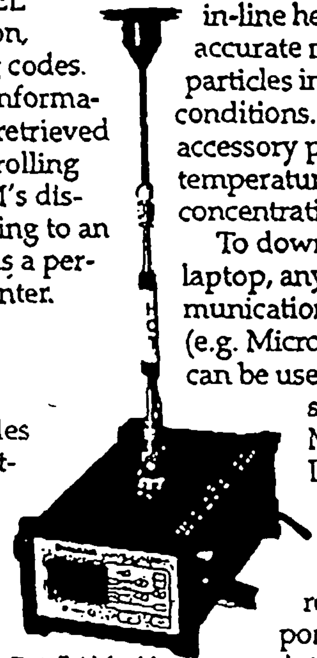


DataRAM can be powered by a rechargeable internal battery or an external power source

Accessories Expand Versatility and Enhance Accuracy

Several optional accessories are available for use with the DataRAM for a wide range of sampling applications. A cyclone precollector allows respirable particle measurements. An omnidirectional air sampling inlet (with or without a PM-10 head) is available for ambient monitoring. Isokinetic inlet nozzles are available for duct sampling. An in-line heater module allows accurate monitoring of solid particles in high humidity/fog conditions. A sample dilution accessory permits elevated temperature and/or very high concentration monitoring.

To down-load data to a PC or laptop, any standard serial communications software package (e.g. Microsoft Windows™ 3.1) can be used. Standard spreadsheet packages (such as Microsoft Excel™, Lotus™, and others) can easily access and analyze data log files transmitted to a PC for review and archiving. A portable battery-powered printer and cabling accessories are also available.

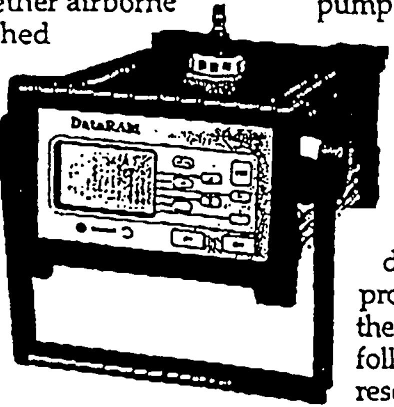


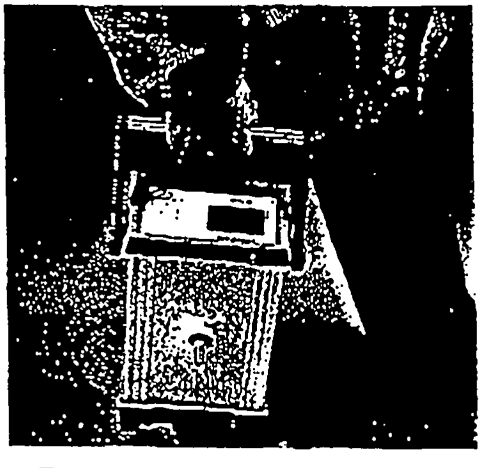
DataRAM with In-Line Heater for monitoring in high humidity or fog

The World's Most Precise and Ve

Real-Time Measurement of Airborne Particulate Concentrations

With the DataRAM™, you'll never again have to wait for laboratory results to assess whether airborne pollutants have reached dangerous levels. The DataRAM Real-Time Aerosol Monitor measures mass concentrations of airborne dust, smoke, mists, haze, and fumes and provides continuous real-time readouts. Large-capacity onboard data logging capability lets you save concentration data for future analysis. With optional accessories, the DataRAM [illegible] also provide respirable or PM-10 related measurements.





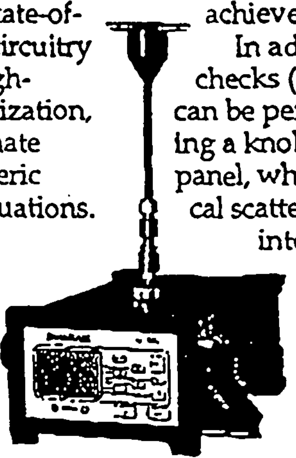
For exposure sampling or continuous unattended indoor air, ambient, duct, or process monitoring, no other aerosol monitor is as fast, accurate, and easy to use as the DataRAM.

Designed for High Sensitivity

A high-sensitivity nephelometric monitor, the DataRAM samples the air at a constant, regulated flow rate by means of a built-in diaphragm pump. The DataRAM's light scattering configuration is optimized for the measurement of airborne particle concentrations, maximizing the unit's sensitivity. The detected signal is processed by state-of-the-art lock-in circuitry followed by high-resolution digitization, achieving ultimate detectability of atmospheric Rayleigh scattering fluctuations.

The Widest Measurement Range of Any Real-Time Particulate Monitor

In addition to its high sensitivity, the DataRAM has the widest measurement range of any real-time aerosol monitor – from 0.0001 mg/m^3 (0.1µg/m^3) to 400 mg/m^3. With a total span of almost 7 decades, the DataRAM is capable of effectively measuring mass concentrations of airborne particles in industrial and ambient environments ranging from exceptionally pristine to extremely polluted. The instrument can also be used for atmospheric visibility measurements over a wide range of scattering coefficients (0.00015 to 600 km^{-1}). The DataRAM's auto-ranging digital display provides both real-time and time-averaged concentrations.



DataRAM with Omnidirectional Sampling Inlet for ambient monitoring

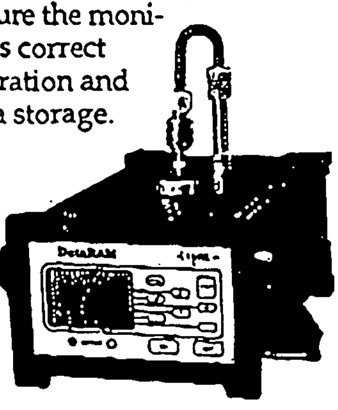
Exceptional Long-Term Stability

The DataRAM incorporates several technological advances which guarantee exceptional long-term stability. Near infrared source output feedback control provides drift-free operation and excellent temperature stability.

For either manual or preprogrammed/automatic zeroing of the monitor, an electronically controlled latching solenoid valve diverts the entire filtered air stream through the optical sensing stage in order to achieve a "zero" air reference.

In addition, instrument span checks (secondary calibration) can be performed simply by turning a knob on the DataRAM's back panel, which inserts a built-in optical scattering/diffusing element into the filtered air stream.

On-screen diagnostic indicators and automatic shut-off for low battery conditions also help ensure the monitor's correct operation and data storage.



DataRAM with Cyclone Precollector for respirable particle measurements

Specifications

Concentration measurement ranges (auto-ranging)[1]:
0.1 to 999.9 μg/m^3 (resolution: 0.1 μg/m^3)
1.00 to 39.99 mg/m^3 (resolution: 0.01 mg/m^3)
40.0 to 399.9 mg/m^3 (resolution: 0.1 mg/m^3)

Scattering coefficient range: 1.5×10^{-6} to 5×10^{-1} m^{-1} (approximate) at $\lambda = 880$ nm

Concentration display averaging/updating interval[2]:
1 or 10 seconds

Precision/repeatability over 1 hour (2-sigma)[3]:
± 0.3 μg/m^3 for 10 second averaging
± 1.0 μg/m^3 for 1 second averaging

Accuracy[1]: ± 5% of reading or ± 5 μg/m^3, whichever is greater

Particle size range of maximum response: 0.1 to 10 μm

Sampling flow rate[2]: 1.7 to 2.3 liters/minute

Sampling flow rate stability (long term)[4]: ± 5% (up to maximum pump loading)

[illegible]/clean air filter replacement time (typical):
[illegible]ars (@ constant 1 mg/m^3)

Alarm level adjustment range[2]: 0.1 μg/m^3 to 399.9 mg/m^3

Alarm averaging time[2]: real-time (1 or 10 seconds), or STEL (15 minutes)

Data logging averaging periods[2]: 1 second to 4 hours

Total number of data points in memory: 4500
(each point: average, minimum, and maximum concentrations)

Logged data:

- For each data point: average, minimum, and maximum concentrations; time/date; and data point number
- Run summary: tag number of logged points; start time/date; total elapsed run time; averaging time; data logging averaging period; calibration factor; STEL concentration; STEL occurrence time after start; overall average concentration; overall maximum and minimum concentrations with data point number

Number of data tags: 10

Real time and date data: seconds; minutes; hours; day of month; month and year (with leap year compensation)

Clock accuracy: ± 1 minute/month, or better

[illegible]psed time range: 1 second to 99 days

[illegible]e keeping and data storage duration: >10 years

Readout display: LCD 120 x 64 dots, 15 characters x 8 lines, 57.6 x 38.4 mm active area

Internal battery: rechargeable sealed lead-acid; 6.5 Ahr; 6 V nominal

Operating time with new battery and initial full battery charge[4]: >20 hours

Operating time with DataRAM charger: continuous and unlimited

Charging input power: 115/230 VAC, 50/60 Hz, 50 VA

External DC power (optional): 6 V @ 3 A

Analog output (auto-ranging)[5]:
0 to 5 V, for 0 to 4 mg/m^3
0.5 to 5 V, for 4 to 40 mg/m^3
0.5 to 5 V, for 40 to 400 mg/m^3

Digital output: RS232C, 9600 baud; 8 data bits, 1 stop bit; parity: none

Alarm output: switched, 1 A @ 10 V maximum, resistance <0.1 Ω

Alarm sound intensity: 90 dB @ 1 m

Fuse: 1 A, fast

Operating environment: 0° to 40°C (32° to 104°F), 0 to 95% RH, noncondensing

Storage environment: -20° to 60°C (-4° to 140°F)

Dimensions: 134 mm (5.28 in) H x 184 mm (7.25 in) W x 346 mm (13.63 in) D

Weight: 5.3 kg (11.7 lbs)

---

[1] Referred to gravimetric calibration with AC Fine test dust (mmd = 2 to 3 μm, σg = 2.5)
[2] User selectable
[3] At constant temperature
[4] At 25°C
[5] Range identified on LCD screen

MIE

Monitoring Instruments for the Environment, Inc.
1 Federal Street, #2
Billerica, MA 01821-3500 USA
TEL: (508) 663-7900
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D/RAM 4/94 10M

Printed in USA

MIE

DataRAM Accessories

A complete line of accessories designed to extend and complement the capabilities and applications of the MIE DataRAM™, the most advanced and powerful real-time particulate monitor available. These modular accessories permit ambient air monitoring over a wide range of wind, temperature and humidity conditions, dilution sampling of high temperature/high concentration streams, respirable particle monitoring, data printout in the field, PC interfacing, etc.

NAME (Model Number)	DESCRIPTION	APPLICATIONS
Omnidirectional Sampling Inlet (DR-OSI)*	Annular type sampling inlet designed, for a flowrate of 2 lpm, to provide a smooth transition between horizontal wind borne particle motion and vertical flow into DataRAM monitor.	Ambient monitoring under a variety of wind speeds and directions to ensure representative sampling especially for particles smaller than 10µm.
Temperature Conditioning Heater (DR-TCH)*	An in-line tubular heater without flow obstructions, designed to raise the temperature and reduce the relative humidity of the sampled air stream.	Ambient monitoring at high humidity conditions (typically above 70% RH) in order to evaporate liquid water from airborne particles and/or eliminate fog droplets. Normally used in combination with DR-OSI and DR-PM10.
PM-10/PM-2.5 Inlet Head (DR-PM10/2.5)*	A modular impactor for 10µm or 2.5µm cutpoint (at 2 lpm) with easily interchangeable nozzles. The DR-PM10/2.5 is designed to be used in combination with the DR-OSI and/or the DR-TCH.	Specifically intended for PM-10 or PM-2.5 ambient particulate monitoring. Typically used in line with the Omnidirectional Sampling Inlet (DR-OSI) which plugs into the DR-PM10/2.5.
Isokinetic Sampling Nozzle Set (RAM-ISN)	Made of stainless steel, it consists of a two-section sampling probe, four (4) interchangeable nozzles covering the range of 750 and 5000 ft/min., tubing, fittings, and carrying case.	To be used to sample isokinetically within ducts and stacks with the DataRAM monitor. Can be used in combination with the DR-TCH to remove water aerosols.

NAME (Model Number)	DESCRIPTION	APPLICATIONS
Respirable Cyclone* Precollector (DR-RCP10)	Consists of a Dorr-Oliver 10-mm nylon cyclone and fittings for quick connect to DataRAM inlet.	For respirable particle monitoring. Flowrate on DataRAM can be adjusted to provide either "old" 3.5μm or "new" 4.0μm particle cut points.
Sampling Dilution Unit (DR-SDU)	Consists of fittings, needle valve and rotameter flowmeter to provide a precisely controlled sample dilution ratio of 4 to 20.	Can be used either to sample from elevated temperature air streams (up to 260° or 500°F), or to monitor particulate concentrations exceeding 400 mg/m³ (i.e. up to 8 g/m³).
Portable Digital Printer (DR-PPR)	High quality portable inkjet digital color printer with rechargeable battery and charger unit, with 60-page sheet feeder, and carrying case. Serial-to-Parallel Converter Kit (DR-S/P) is included.	Provides printout of real-time and stored data directly from DataRAM, or graphic time history (averages, minima and maxima) using a lap-top or other PC.
Serial-to-Parallel Converter Kit (DR-S/P)*	Consists of a small converter unit with cables and connectors to interface DataRAM digital output with parallel input devices.	Used to interconnect DataRAM with Portable Digital Printer (DR-PPS) or other parallel interface printers.

*Included in Ambient Sampling Inlet Set (model DR-AMB), as shown below (attached to DataRAM).

RAECO
253 W. Joe Orr Road
Chicago Heights, IL. 60411
(708) 754-4900

(MILW) (IA) (IN) (GRN BAY)
(800) 252-6795

For more information call or write to MIE, Inc. at this address:

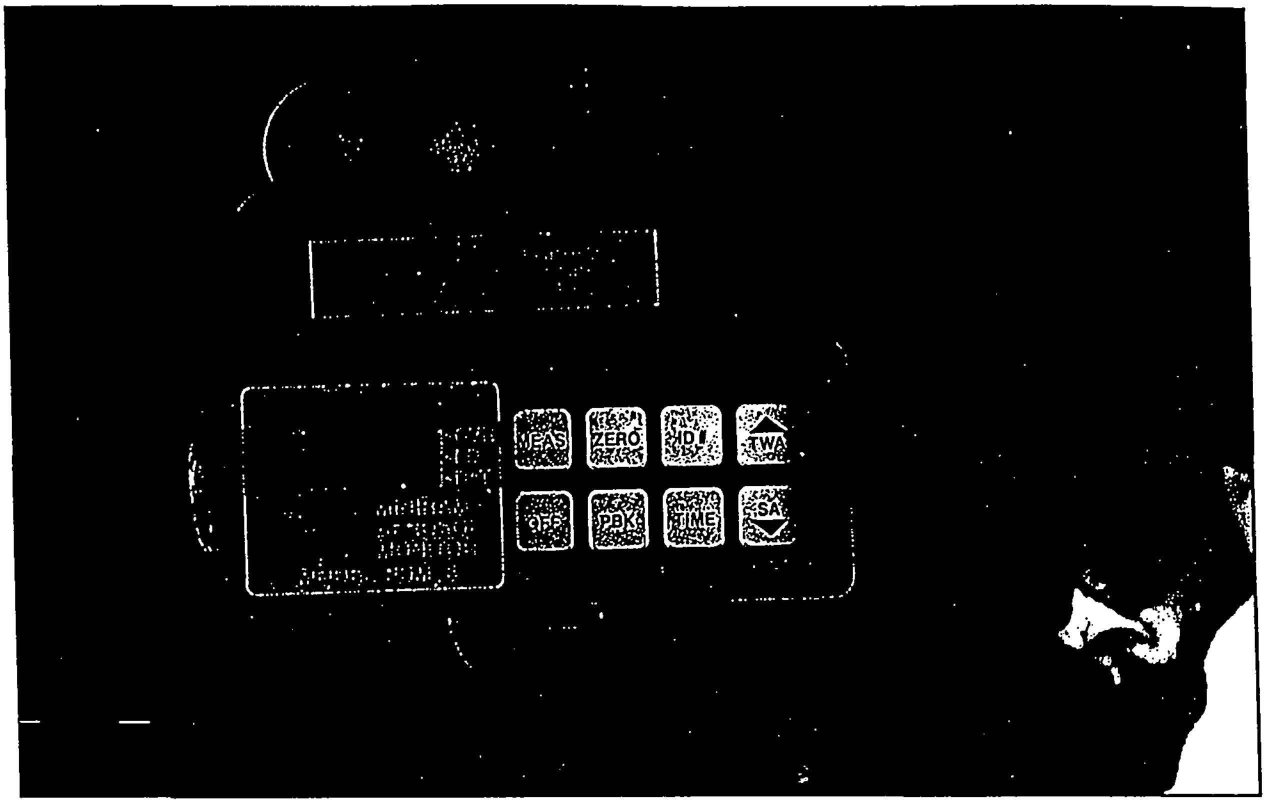
MIE

1 Federal Street, #2
Billerica, MA 01821-3500
U.S.A.
Telephone: 508-663-7900
Fax: 508-663-4890

Monitoring Instruments *for the* Environment, Inc.

MIE PDM-3 Miniram

Dust, Aerosols, Fumes and Mist Monitor



The MIE PDM-3 Miniram is the world's smallest, fastest, smartest direct reading monitor for Dust, Aerosols, Fumes and Mists. The PDM-3 is a real-time monitoring instrument capable of sensing and measuring aerosol concentrations over the range of 0.01 to 100 mg/m³.

This unit is ideal for personal exposure monitoring, off-site dust migration, walk-through surveys and clean room monitoring. Used with the optional cyclone, the Miniram will monitor respirable particulates.

Order No.	Description	Daily	Weekly
R-PDM3	MIE PDM-3 Miniram	$85.00	$195.00
R-PDM2FS	Cyclone for Respirable Dust	15.00	20.00
R-PDL	Data Logger	25.00	45.00
R-PRINT	Okidata Microline 192 Printer	25.00	35.00
R-ARM1	Alarm	10.00	25.00

Specifications

Measurement Range:	0.01 to 100 mg/m³
Display:	LCD direct reading with data updated every 10 seconds
Battery Life:	12 hours per charge
Power Source:	Rechargeable ni-cad batteries
Intrinsic Safety:	MSHA Approval 2G-3532-0
Dimensions:	4 x 4 x 2 inches
Weight:	1 pound

APPENDIX B-3-B

Mercury Sampling and Analysis by Gold-Film Dosimeter

EXTREMELY LOW LEVEL ANALYSIS OF MERCURY VAPOR WITH THE JEROME GOLD COIL DOSIMETER AND THE JEROME 431-X

Some applications require the analysis of mercury at very low levels, for example 100 nanograms/cubic meter (ng/m3 or .0001 mg/m3 level. For this testing, a variation on the standard flow rate of 2 cc/min may be more practical in order to shorten the sample collection time.

NOTE: ARIZONA INSTRUMENT RECOMMENDS A FLOW RATE OF 2 CC/MINUTE FOR MOST INDUSTRIAL HYGIENE APPLICATIONS. SPECIFICATIONS ARE WRITTEN BASED ON SUCH A FLOW RATE. THE FOLLOWING IS A SUGGESTED ALTERNATIVE AND SHOULD BE VERIFIED BY USING YOUR OWN INTERNAL QUALITY CONTROL STANDARDS. DIRECT INJECTIONS OF MERCURY VAPOR, USING THE JEROME MERCURY FUNCTIONAL TEST KIT SHOULD BE USED IN THE Q.C. PROGRAM.

Testing by customers has shown that a flow rate of 60 cc/minute will provide almost a 100% collection efficiency. Typically a flow rate of 750 cc/min will provide about an 80% collection efficiency.

Assuming this, and using the following equation with the Jerome 431-X:

$$\frac{MR \times 87.5 \times CE}{V} = [C]$$

where:

MR = meter response in mg Hg/m3; optimum is 10 ng, (meter response of .110); should not exceed 60 ng (meter response of .660) in order to avoid over ranging the instrument when performing final analysis

87.5 = a conversion factor in ng/mg/m3; a constant used to convert the meter reading to nanograms (note: use 125 with the Jerome 411)

CE = collection efficiency factor (.8 at 750 cc/minute)

V = Total volume of air through dosimeters during collection; (FR x T), where:

  FR = Flow rate of sampling pump in cc/ minute, and

  T = Time sampled

[C] = Concentration of environment sampled

For example, to measure an atmosphere with an expected concentration of .0001 mg/m3 at 750 cc/min, to get a meter response of .110, it is necessary to sample for approximately 1.7 hours. Solving for time, in this case:

$$\frac{.110 \times 87.5 \times .8}{750 \times T} = .0001 \text{ mg Hg/ m3 (100 ng/m3)}$$

$$T = 102.7 \text{ minutes} = 1.7 \text{ hours}$$

For this type of work, two or even three dosimeters should be used in tandem to improve collection efficiency. (Rev: 10/91)

Jerome Dosimeters:

Why Use a Flow Rate of 2 cc/min?

We currently recommend a flow rate of 2 cc/min for the Jerome gold coil dosimeters. Earlier manuals recommenced 20 and 50 cc/min.

There are two main reasons for this: collection efficiency and dosimeter capacity. The lower the flow, the greater the collection efficiency. At flow rates below 20 cc/min, the differencies in efficiencies are insignificant. At levels above 50 cc/min it can be a factor.

The most significant reason for going to the 2 cc/min flow from 20 cc/min is that the mass of mercury collected on the gold film is reduced by a factor of 10. This can, in some cases, reduce the need for the "10:1 dilution module" (also called the "flow splitter"). The dilution module will scrub 90% of the sample stream, allowing the mass that goes into the instrument to be within range of the instrument. The dilution module will add an additional +/- 15% to the sampling error. To avoid adding this extra uncertainty, collect the sample at a flow rate that will allow analysis without the dilution module.

For example, assume:

- capacity of the gold coil dosimeter: 1,000 nanograms
- capacity of the gold film sensor: 450 nanograms
- sampling time: 8 hours
- environment sampled: .05mg Hg/m^3 + .050 ng Hg/m^3

CASE #1:

Flow rate of 20 cc/min
.050 ng/cc x (8 hrs x 60 min/hr x 20 cc/min) = 480 nanograms

Therefore, the mass of Hg collected on the dosimeter exceeds the capacity of the sensor and a dilution module should be used.

CASE #2

Flow rate of 2 cc/min
.050 ng/cc x (8 hrs x 60 min/hr x 2 cc/min) = 48 nanograms

This analysis can be done without the use of the dilution module.

Arizona Instrument Corp.
P.O. Box 1930
Tempe, AZ 85280
(602) 731-3400
(800) 528-7411
FAX (602) 731-3434
Telex 910-950-0134

APPENDIX B

GOLD COIL
PERSONAL MERCURY DOSIMETER

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Dosimeter Analysis B4

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  Dilution Module Ratio Check B8
  Dilution Module Ratio Calculation B10
  Analysis with a Dilution Module B11

INTRODUCTION

The Gold Coil Personal Mercury Dosimeter is a unique collection device for mercury vapor. The Jerome 431 Gold Film Mercury Vapor Analyzer and the Personal Mercury Dosimeter determine personal exposure levels and ambient air concentrations, as well as mercury in natural and stack gas.

For sample collection, the dosimeter is worn as close to the wearer's breathing zone as possible and is connected by tubing to a pump usually worn on a belt. The dosimeter can also be used for multiple point area monitoring by placing a dosimeter, with pump attached, in various strategic locations.

We recommend a pump flow rate of **2 cc/minute** for the most accurate results. If you are considering using any other flow rate, read page B7, Non-standard Flow Rates.

After sampling is completed, the dosimeter is inserted in the Jerome 431's intake, which volatilizes the accumulated mercury onto the Gold Film Sensor. The Jerome 431 determines the **mass** of mercury collected by the dosimeter in a 17 second analysis. The dosimeter is ready for immediate re-use after a mercury measurement has been performed.

DOSIMETER TECHNICAL SPECIFICATIONS*

Sensitivity ————— < 0.5 x 10^{-9}g Hg

Precision ————— 15% RSD @ 0.107 mg/m3 Hg

Accuracy ————— +/- 15% @ 0.107 mg/m3 Hg

Recommended
Flow Rate ———— 2 cc/min
0.002 liters/min = 2 cc/min

Construction ———— Nylon/Glass

Weight ——————— 1.5 ounces

Dimensions ———— 0.5" Dia. X 4.5" L

Capacity ————— 1000 x 10^{-9}g Hg

Analysis Time ———— < 2 min

*Based on 2 cc/min flow rate

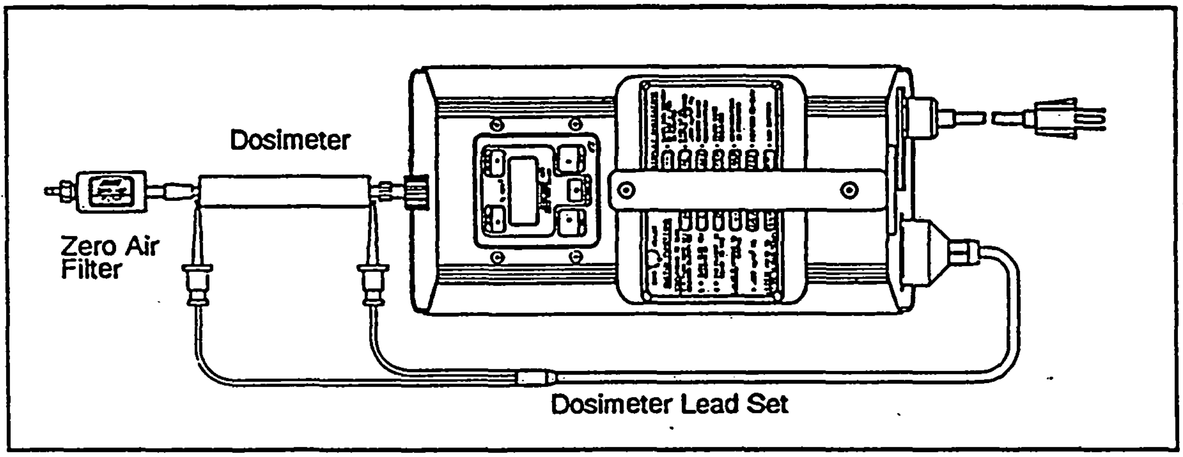
BEFORE SAMPLING WITH THE DOSIMETER

The Personal Mercury Dosimeter absorbs atmospheric mercury over a period of time. Therefore, before each day's use it is necessary to ensure the dosimeter is mercury free. Perform the following steps to remove any accumulated mercury:

PROCEDURE:

1. Connect the system as shown in the figure below.

   Insert the dosimeter's large end in the 431's intake and gently tighten the intake tube nut to ensure an airtight seal.



2. Attach the power cord to the 431 and plug it into AC power.

   AC power is required to heat the dosimeter.

3. Press the Jerome 431's power ON.

4. Press the Jerome 431's SAMPLE.

   The digital meter reading will appear in 17 seconds.

5. Wait 30 seconds and press SAMPLE again.

   The Jerome 431's digital meter should display less than 0.005, verifying all mercury has been removed from the dosimeter coil.

6. The dosimeter is ready for sample collection.

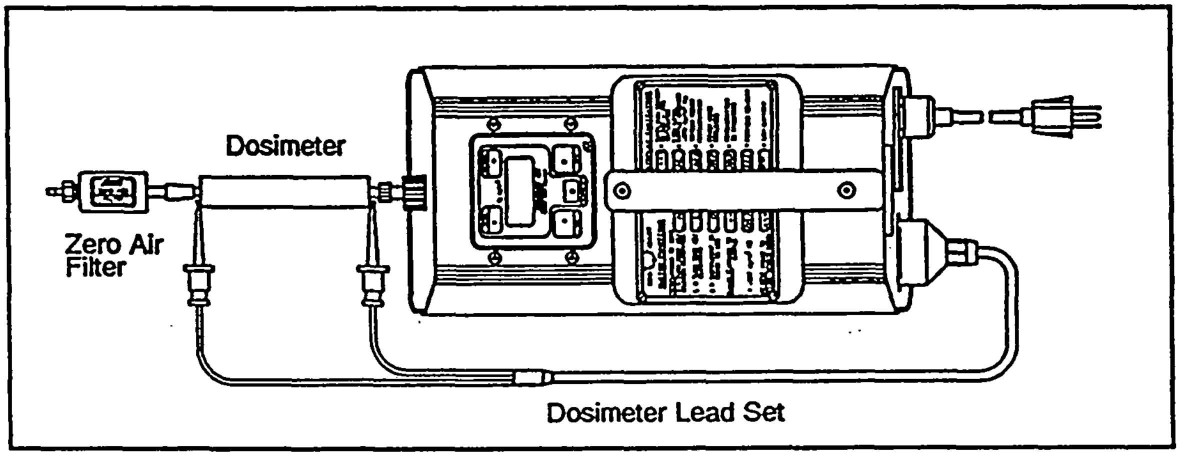
NOTE: For best results, dosimeter analysis should be performed as soon after collection as possible. If analyzing cannot take place immediately after sampling is completed, cap the ends of the dosimeter with Tygon tubing. For accurate results, perform dosimeter analysis no later than five days after sampling.

DOSIMETER ANALYSIS

PROCEDURE:

NOTE: Wait a minimum of 30 minutes after a sensor regeneration before starting this procedure.

1. Connect the system as shown in the figure below.



2. Attach the power cord to the 431 and plug it into AC power.

   AC power is required to heat the dosimeter.

3. Press the Jerome 431's power ON and then press SAMPLE.

   The digital meter reading appears in 17 seconds.

4. Record the digital meter reading (include the decimal point). Wait 30 seconds, then press SAMPLE again and record this digital meter reading.

   Repeating the heating process ensures complete release of mercury from the dosimeter coil.

5. Add the two digital meter readings together.

   The sum of the two digital meter readings is the figure you will use in your calculations and is referred to as the Meter Response.

6. You can perform the following calculation to obtain the mercury concentration in mg/m^3 based on a time weighted average; or alternately, DIP switch #2 can be set to OFF and the digital meter will display nanograms Hg directly.

Working Formula and Units Of Measure

(MR x 87.5) / SV= Sample Concentration .

MR (meter response) = total of the two digital meter readings in mg/m^3
87.5 ng/mg/m^3 (conversion factor, a constant which changes the Meter Response to nanograms of Hg)
SV (sample volume) in cc = pump flow rate (in cc/min) multiplied by sample time (in minutes)
Sample Concentration in ng/cc = mg/m^3

EXAMPLE: (to calculate a time weighted average during an 8 hour period)

Meter Response ______ 0.600 mg/m^3
Conversion Factor _____ 87.5 ng/mg/m^3 (constant)

Pump Flow Rate ______ 2 cc/min
Sampling Time _______ 8 hours (480/min)
Sample Volume _______ 2 cc/min x 480/min = 960cc

(0.600 mg/m^3 x 87.5 ng/mg/m^3) / 960 cc = ng/cc

A. Convert the Meter Response (the total of the two digital meter readings) to nanograms of mercury.

The Meter Response multiplied by 87.5 (conversion factor) equals nanograms of mercury.

0.600 x 87.5 = 52.5 nanograms of Hg

B. Determine the total volume of air sampled.

The pump flow rate times 60 min/hr times 8 hours.

2 cc/min x 60 min/hr x 8 hr = 960 cc

C. Determine the Hg concentration (time weighted average) of the dosimeter.

The mass of Hg collected by the dosimeter divided by the total volume of air sampled.

52.5 nanograms/960 cc = 0.055 ng/cc of Hg = 0.055 mg/m^3 of Hg

(MR x 87.5) /SV = Sample Concentration (in mg/m^3)

7. Check the sensor status after each dosimeter analysis.

   IMPORTANT: Perform a Sensor Regeneration as soon as the meter display shows ---- (four bars) to prevent the loss of a sample.

8. Seal the dosimeter with tubing after analysis to prevent excessive mercury contamination during storage.

   NOTE: If your average dosimeter analysis produces nanogram levels of 75 or more, you risk overranging your instrument and losing your collection data. Call our Customer Service toll free number: (800) 528-7411 for alternative collection methods.

Non-Standard Flow Rates

You may use a pump with a flow rate up to 50 cc/min, but be aware that there are certain limitations.

> If your pump flow rate exceeds 2 cc/min and your average dosimeter analysis produces nanogram levels of 75 or more, you risk overranging your instrument and losing your collection data. Higher flow rates may also impair the capture efficiency of the dosimeter.

We recommend that you drop your flow rate or use a Dilution Module*. Lowering the flow rate to decrease the sample volume provides the greatest accuracy. Using a Dilution Module introduces an additional 15% inaccuracy to your analysis.

Dilution Module Specifications

Accuracy ———————	+/-15% of 10:1 Ratio
Input Concentration Range	
Low ————————	0.7 mg/m^3 Hg
High ———————	5.0 mg/m^3 Hg
Housing ———————	Nylon
Dimensions —————	1" W x 2.7" L x 3" H
Weight ———————	3.3 oz

The Dilution Module is factory set to a X10 ratio. The mass of mercury entering the Dilution Module is reduced by 90%, leaving a 10% (X10 dilution) concentration to be introduced into the Jerome 431. Since this ratio can change slightly with use, it is important to occasionally determine the current Dilution Module ratio to ensure accurate results. For normal applications a X8 to X12 ratio is recommended. The 431 Functional Test Kit contains all accessories necessary to determine the current Dilution Module ratio.

Call our Customer Service toll free number: (800) 528-7411 if you have questions about flow rates or applications.

***The Dilution Module contains Resisorb, Mercury Vapor Absorbent. For safety information, see the Resisorb Material Safety Data Sheet included in this manual.**

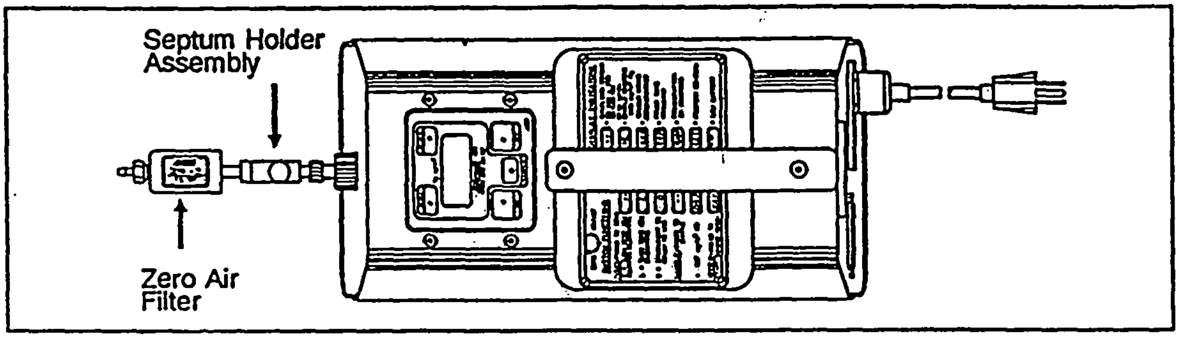
Dilution Module Ratio Check

PROCEDURE:

NOTE: Wait a minimum of 30 minutes after a sensor regeneration before starting this procedure.

Direct 431 Readings:

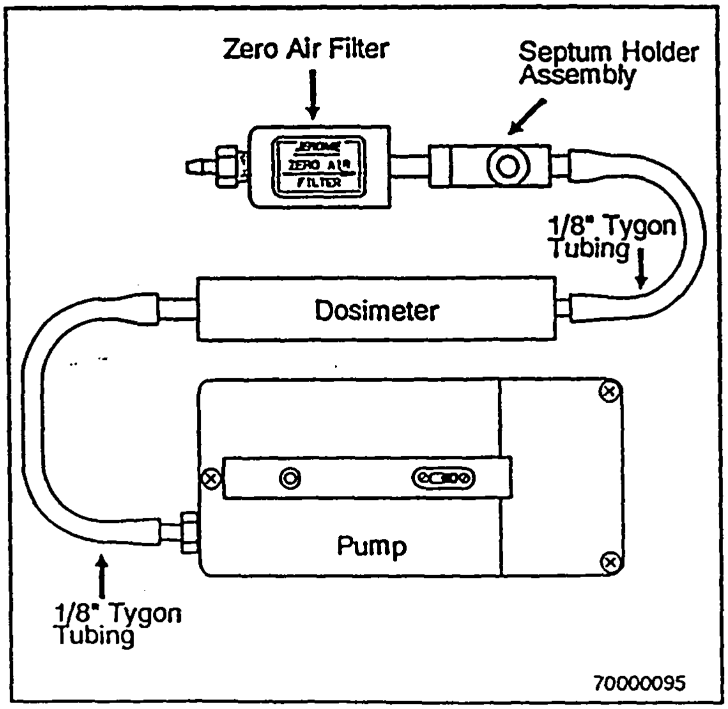
1. Connect the instrument, septum holder assembly and zero air filter as shown in the figure below.



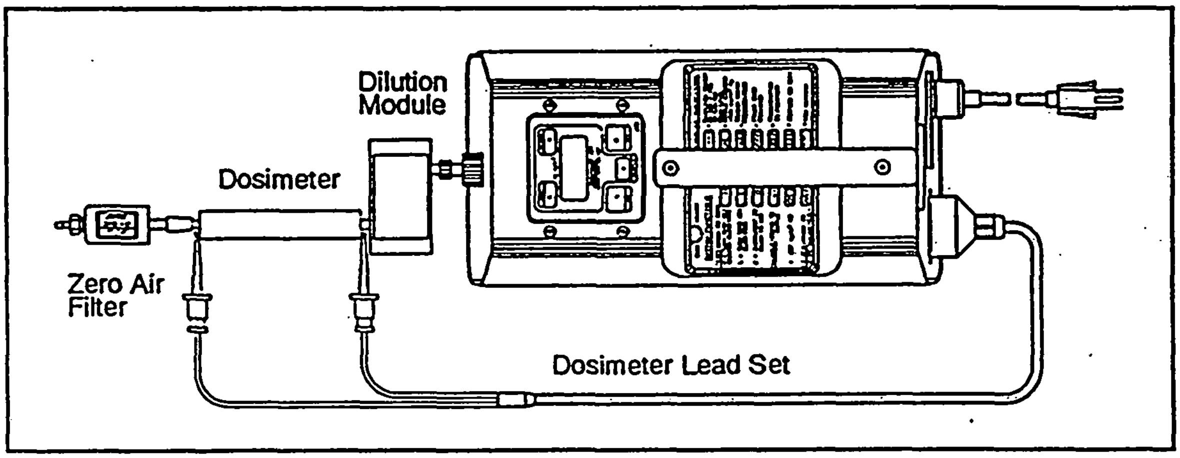
2. Press the Jerome 431's power ON.
3. Inject 1 cc of mercury saturated vapor into the septum, according to the Syringe Technique described on page A5, (431 Functional Test, Appendix A).
4. Make 3 additional 1 cc injections and record the digital meter readings (include the decimal points).
5. Average the results of the last 3 injections.
6. Remove the septum assembly and zero air filter from the instrument.

Loading the Dosimeter:

1. Connect your pump, dosimeter, septum holder assembly and zero air filter (using 1/8" Tygon tubing) according to the figure at the right.



2. Turn on the pump.
3. Inject 10 cc of mercury vapor (1 cc at a time) into the septum.
4. Wait 30 seconds after the last injection, then turn off the pump.
5. Remove the dosimeter, septum assembly and zero air filter from the pump.
6. Connect the instrument, Dilution Module, dosimeter, zero air filter and dosimeter lead set as shown in the figure below.



7. Attach the power cord to the 431 and plug it into AC power.

   AC power is required to heat the dosimeter.

8. Press the Jerome 431's power ON and then press SAMPLE.

   The digital meter reading appears in 17 seconds.

9. Record the digital meter reading (include decimal point). Wait 30 seconds, then press SAMPLE again and record this reading.

   Repeating the heating process ensures complete release of mercury from the dosimeter coil.

10. Add the two digital meter readings together.

    The sum of the two digital meter readings is the figure you will use in your calculations and is referred to as the Meter Response.

11. Repeat steps 1 through 10 two more times.
12. Average the 3 Meter Responses you obtained in this section.

Dilution Module Ratio Calculation

1. Multiply the the average obtained in the **Direct 431 Readings** procedure by 10 (*this is the number of 1 cc injections*).
2. Divide the result obtained in step 1 (above) by the average obtained in the **Loading the Dosimeter** procedure.
3. Use the result as the Dilution Module Ratio in your dosimeter analysis.

NOTE: For normal applications a X8 to X12 ratio is recommended. If your ratio is not within this range, call our Customer Service toll free number: (800) 528-7411 for assistance.

EXAMPLE:

A. Direct 431 Readings

$0.102\ ^{mg}/_{m^3}$
$0.103\ ^{mg}/_{m^3}$
$0.104\ ^{mg}/_{m^3}$
$0.103\ ^{mg}/_{m^3}$ average

B. Loading the Dosimeter

$0.120\ ^{mg}/_{m^3}$
$0.113\ ^{mg}/_{m^3}$
$0.100\ ^{mg}/_{m^3}$
$0.111\ ^{mg}/_{m^3}$ average

C. Step 1 (above)

$$0.103\ ^{mg}/_{m^3} \times 10 = 1.030\ ^{mg}/_{m^3}$$

D. Step 2 (above)

$$\frac{1.030\ ^{mg}/_{m^3}}{0.111\ ^{mg}/_{m^3}} = 9.4$$

E. Dilution Module Ratio

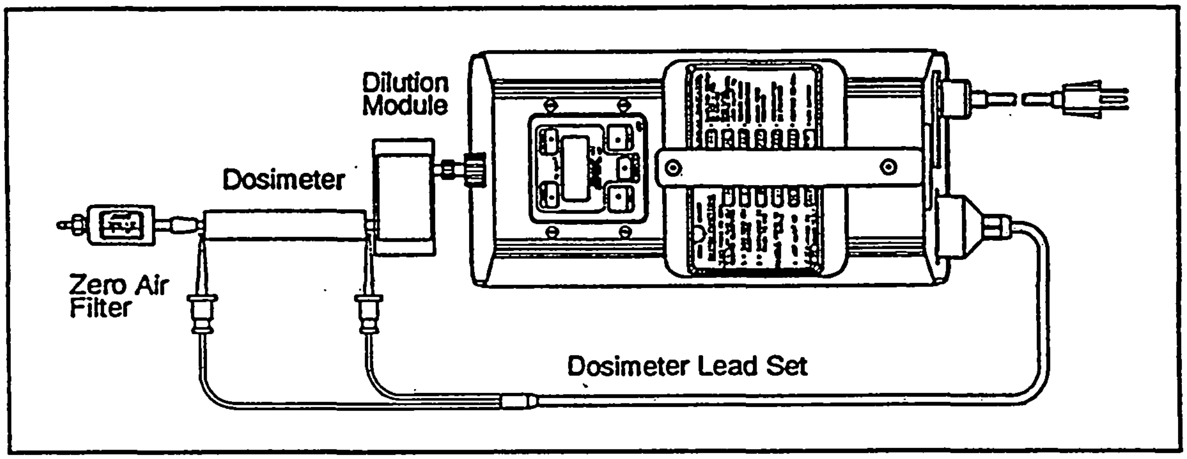
9.4:1

Analysis with a Dilution Module

PROCEDURE:

NOTE: Wait a minimum of 30 minutes after a sensor regeneration before starting this procedure.

1. Connect the system as shown in the figure below.



2. Attach the power cord to the 431 and plug it into AC power.

   AC power is required to heat the dosimeter.

3. Press the Jerome 431's power ON and then press SAMPLE.

   The digital meter reading appears in 17 seconds.

4. Record the digital meter reading (include the decimal point). Wait 30 seconds, then press SAMPLE again and record this reading.

   Repeating the heating process ensures complete release of mercury from the dosimeter coil.

5. Add the two digital meter readings together.

   The sum of the two digital meter readings is the figure you will use in your calculations and is referred to as the Meter Response.

6. You can perform the following calculation to obtain the mercury concentration in mg/m^3 based on a time weighted average; or alternately, DIP switch #2 can be set to OFF and the digital meter will display nanograms Hg directly.

Working Formula and Units Of Measure

[MR x 87.5] x DM / SV= Sample Concentration

MR (meter response) = the total of the two digital meter readings in mg/m^3

87.5 ng/mg/m^3 (conversion factor, a constant which changes the Meter Resonse to nanograms of Hg)

DM Dilution Module ratio (the ratio determined on page B10)

SV (sample volume) in cc = pump flow rate (in cc/min) multiplied by the sample time (in minutes)

Sample Concentration in ng/cc = mg/m^3

EXAMPLE: (to calculate a time weighted average during 8 hour period)

Meter Response ______ 0.600 $^{mg}/_{m^3}$
Conversion Factor ______ 87.5 $^{ng/mg}/_{m^3}$ (constant)
Dilution Module Ratio ____ 9.4

Pump Flow Rate _______ 2 $^{cc}/_{min}$
Sampling Time ________ 8 hours (480/min)
Sample Volume ________ 2 cc/min x 480/min = 960 cc

$$\frac{0.600\ ^{mg}/_{m^3} \times 87.5\ ^{ng/mg}/_{m^3}}{960\ ^{cc}/_{min}} = {}^{ng}/_{cc}$$

A. Convert the Meter Response (the total of the two digital meter readings) to nanograms of mercury.

The Meter Response multiplied by 87.5 (conversion factor) equals nanograms of mercury.

0.600 x 87.5 = 52.5 nanograms of Hg

B. Determine the actual mass of Hg collected by the dosimeter.

Nanograms of mercury times the Dilution Module ratio.
52.5 nanograms x 9.4 = 493.5 nanograms

C. Determine the total volume of air sampled.

The pump flow rate times 60 min/hr times 8 hours.

2cc/min X 60 min/hr X 8 hr = 960 cc

D. Determine the Hg concentration (time weighted average) of the dosimeter.

The mass of Hg collected by the dosimeter divided by the total volume of air sampled.

493.5 nanograms/960 cc = 0.514 ng/cc of Hg = 0.514 mg/m^3 of Hg

[(MR x 87.5) x DM] /SV = Sample Concentration (in mg /m^3)

7. Check the sensor status after each dosimeter analysis.

   IMPORTANT: Perform a Sensor Regeneration as soon as the meter display shows ---- (four bars) to prevent the loss of a sample.

8. Seal the dosimeter with tubing after analysis to prevent excessive mercury contamination during storage.

INSTRUMENT OPERATION

DIGITAL METER DISPLAY CODES

METER DISPLAY	**EXPLANATION**
000	Ready to Sample
.000	Lack of Mercury reading
.8.8.8	Perform Sensor Regeneration (Refer to page 5.)
.H.H.H	Sensor Regeneration in Progress (.H.H.H flashes)
.L.L.L	Perform Re-Zero (Refer to page 5, step 4.)
.P.P.P	Power Cord Required or low line power, <100 VAC (or 200 VAC) (also Refer to page 14, Changing the Fuse, if .P.P.P remains on after the cord is connected.)
.H.L.P	High Line Power, greater than 130 VAC (or 260 VAC)
LO BAT .	Recharge Batteries (Refer to page 10.)
.E.E.E	Same as LO BAT, Automatically Shuts off
. HL	High Level, Sample Exceeded Maximum Sample Limit
During Sampling	
. -	0 - 25% Sensor Saturation
. --	25 - 50% Sensor Saturation
.---	50 - 75% Sensor Saturation
-.---	75 - 100% Sensor Saturation
During Sampling	**(Using the Survey Mode)**
-	Survey Sampling (minus sign flashes)
When Zero Is Depressed	**(this applies only after a Sensor Regen.)**
. 0	Zero, Ready to Sample
. H	High, Turn Zero Pot Counterclockwise
. L	Low, Turn Zero Pot Clockwise

OPERATIONAL TEST

Before each day's use of the Jerome 431-X, perform the following 4 steps to verify proper instrument operation:

PROCEDURE:

1. Press power ON.

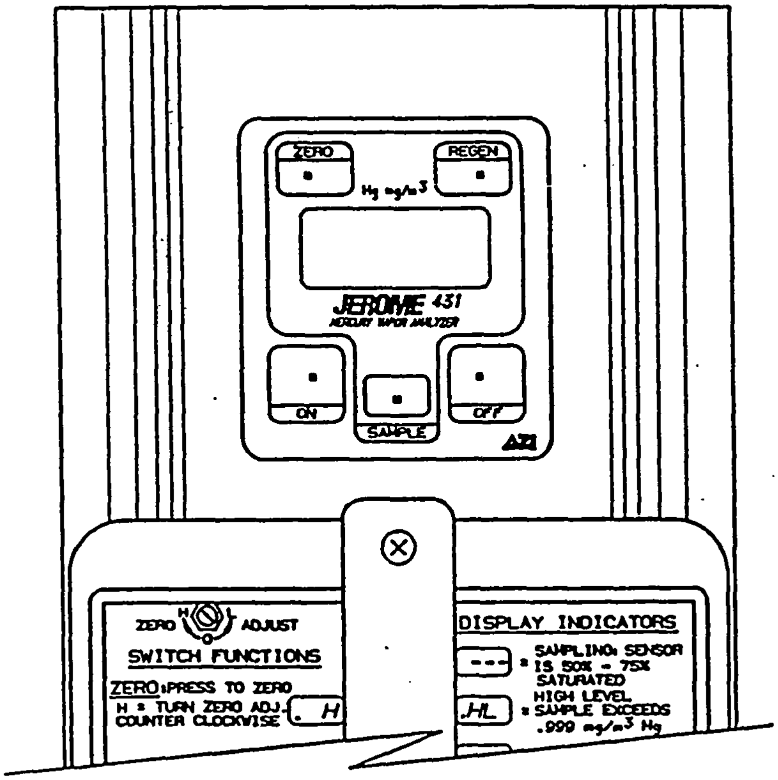
   The digital meter displays 000. (Disregard the digital meter's initial momentary readings.) Recharge or replace the battery pack if the LO BAT indicator REMAINS ON. Refer to page 10 for the procedure.

   To ensure the instrument's electronics have stabilized, allow a 1 minute warm up before beginning the next step.

2. Perform a Sensor Regeneration and re-zero the instrument.

   Refer to page 5 for the procedure.

   Note: A 20 minute wait after the sensor regeneration is completed ensures maximum sample accuracy.



3. Press SAMPLE.

   During the sample cycle, the digital meter displays a bar (-) which indicates the amount of sensor saturation.

4. At the end of the 12 second cycle, read the digital meter.

   The number shown on the digital meter is the mercury concentration in mg/m^3. This value remains displayed until the next sample is taken. The digital meter automatically zeroes at the start of each sample.

SENSOR REGENERATION PROCEDURE

AC power must be between 100-130 VAC and 60 cycles, or 200-260 VAC and 50 cycles, for the sensor to clean properly. If your AC power is not between these limits, an "error code" may appear in the display (see pg. 3). REFER to pg. 14 for voltage and frequency settings.

CAUTION: Once a Sensor Regeneration is Initiated, DO NOT interrupt the cycle.

PROCEDURE:

1. Attach the power cord to the 431-X and plug it into AC power.

   AC power is required to thermally regenerate the sensor.

2. Press power ON.

3. Press REGEN.

   The digital meter flashes .H.H.H for the duration of the 10 minute cycle and displays 000 when the cycle is completed.

   DO NOT INTERRUPT THIS CYCLE. Wait until the cycle is completed before continuing with the next step.

   Note: A 20 minute wait after the sensor regeneration cycle is completed ensures maximum sample accuracy.

4. While pressing ZERO, turn the ZERO ADJUST using the trimmer tool until the digital meter reads . 0.

   See the page 4 illustration for the location of the ZERO ADJUST.

   - *If the meter reads . H, turn the ZERO ADJUST counter-clockwise;*
   - *if the meter reads . L, turn the ZERO ADJUST clockwise.*

   IMPORTANT: Turn the ZERO ADJUST only after a Sensor Regeneration cycle.

5. Press power OFF and disconnect the power cord.

6. The Jerome 431-X is ready for sampling.

   NOTE: The digital meter will read .P.P.P after REGEN is activated if the power cord is not plugged in or if the instrument's fuse needs replacing. Plug in the power cord, or if necessary, replace the fuse according to the procedure on page 14.

MAINTENANCE

PREVENTIVE MAINTENANCE CALENDAR

To keep the Jerome 431-X operating at peak performance, follow this maintenance schedule:

Charge Batteries	After 1 month storage, at end of day's use, or when lo bat appears	page 10
Replace Battery	Annually	
Change Intake Filter Disc	Weekly or as needed	page 12
Change Internal Filters*	After 6 months of use or as needed	page 13
Factory Calibration	Annually	
Replace Zero Air Filter*	Annually	

NOTE: Plug the Zero Air Filter in the instrument's intake during storage.

*C/M filters contain copper sulfate and mallcosorb; scrubber filters and zero air filters contain resisorb. For safety information, see the Material Safety Data Sheets included in this manual.

FLOW SYSTEM

The Jerome 431-X's flow system is the crucial link between the sensor and the sample. For the instrument to perform correctly, the flow system must be properly maintained. The user maintainable components of this system are the intake assembly, a C/M filter and two scrubber filters.

Check the Preventive Maintenance Calendar, page 9, for information on when to change filter disc and filters. The Tygon tubing in the system must be free of crimps for proper flow.

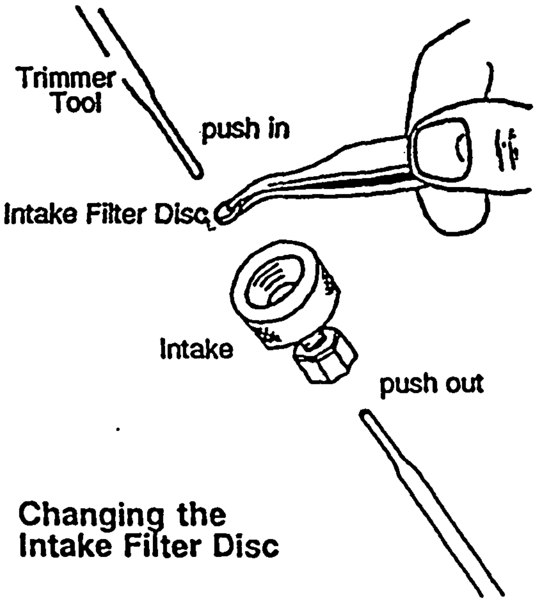
INTAKE FILTER DISC

Replace the intake filter disc once a week. In dusty environments the filter disc may need replacement as often as once a day. Replacement .25 dia. intake filter discs are available from AZI, Jerome Division (see Accessories & Maintenance Parts, page 18).

PROCEDURE:

1. Unscrew the intake from the Jerome 431-X.
2. Push the old filter disc out using your trimmer tool.
3. Use tweezers to insert the new filter disc.

   Avoid touching the new filter disc with your fingers.
4. Using your trimmer tool, seat the filter disc firmly against the inner ledge of the intake.
5. Screw the intake back on the Jerome 431-X.



Changing the Intake Filter Disc

INTERNAL FILTERS

Replace the internal filters (one C/M filter* and two scrubber filters*) after 6 months of use, or as needed.

PROCEDURE:

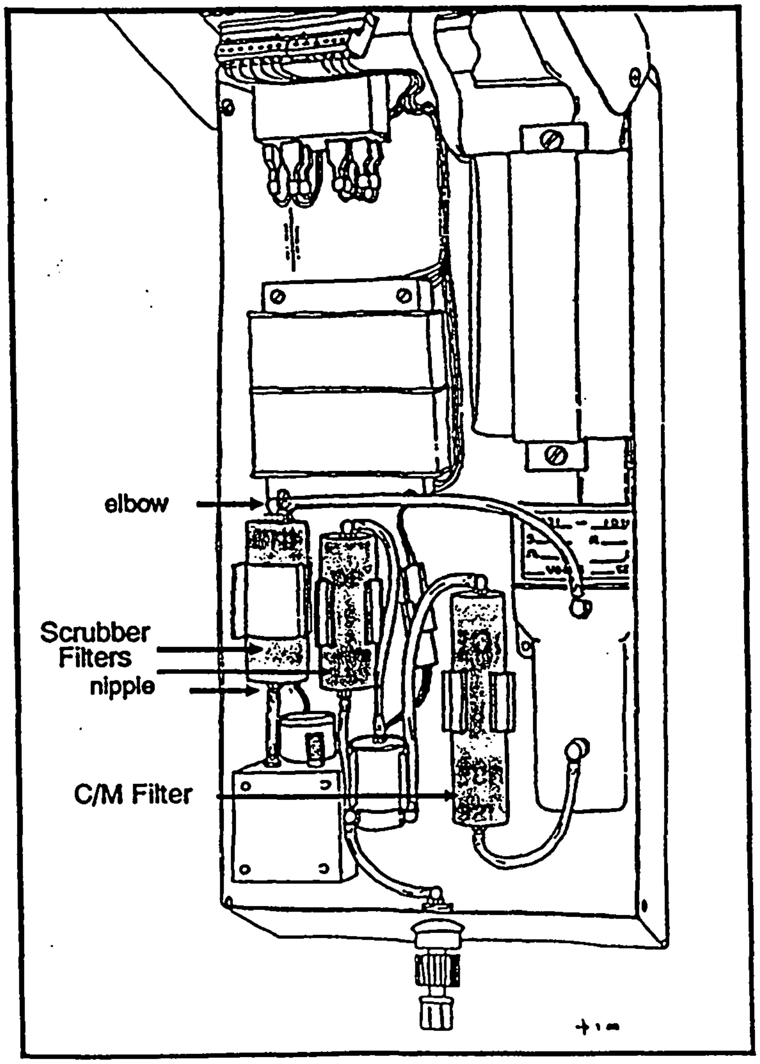
1. Unplug the power cord and press power OFF.
2. Remove the 2 side screws from the intake end of the instrument and open the case.
3. Carefully disconnect the Tygon tubing from both ends of the filters and discard the old filters.

   CAUTION: Old filters contain mercury. Use proper disposal methods (see the Mercury Material Safety Data Sheet included in this manual).

4. Connect the new filters to the Tygon tubing, ensuring all filter nipples point toward the intake and elbows point according to the illustration.

   Push the Tygon up as far as it will go on the filter fittings.

5. Push the filters into the mounting clips.
6. Remove any crimps in the tubing and ensure that tubing connections are secure.
7. Close the case and replace the screws.



*C/M filters contain copper sulfate and mallcosorb; scrubber filters contain resisorb. For safety information see the Material Safety Data Sheets included in this manual.

CALIBRATION

The Jerome 431-X's Gold Film Sensor is inherently stable and does not require frequent calibration. The interval between calibrations depends on the application and frequency of use; however, the recommended minimum interval is every 12 months.

The Jerome 431-X has been factory calibrated using NIST traceable permeation tubes. These permeation tubes have a rated accuracy of +/-2%.

In order to calibrate the Jerome 431-X you must be equipped with a sophisticated calibration system that ensures stability of the calibration gas source, eliminates any pressure in the calibration gas stream and controls the temperature of the calibration environment. If your facility is not equipped with such a system, we strongly recommend you take advantage of our calibration and maintenance service at AZI, Jerome Division.

APPENDIX A

431 FUNCTIONAL TEST

INDEX

Introduction A1
Functional Test Kit A1
Thermos Set Up A2
Replacing Mercury A2
Functional Test Procedure A3
Syringe Technique A5
Temperature Conversion Chart A6
Functional Test Trouble Shooting A7
Mercury Material Safety Data Sheet A8

FUNCTIONAL TEST

If your application requires frequent verification of instrument functionality, this test will benefit you. If the test results fall within the expected range, you may assume the instrument is functioning properly. This test does not calibrate the instrument.

NOTE: Perform the functional test ONLY after a Sensor Regeneration.

431 FUNCTIONAL TEST KIT

The 431 Functional Test Kit contains all accessories necessary to perform this test:

- thermos (1)
- stopper/thermometer assembly (1)
- vial of Hg* (1)
- syringe assembly (1)
- syringe needles (5)
- septum holder assembly (1)
- septa (20)

CAUTION: The vial and thermometer contain liquid mercury and are possible sources of mercury contamination. Follow the instructions carefully.

*For safety information see the Mercury Material Safety Data Sheet, page A8.

THERMOS SET UP

PROCEDURE:

1. Unwrap the thermometer assembly carefully.
2. Remove the cap from the thermos.
3. Remove the cap from the vial containing mercury (labeled CAUTION: MERCURY) and carefully pour the liquid mercury into the thermos.

   Pour over a lipped container to trap any spilled mercury.

4. Install the thermometer assembly securely in the mouth of the thermos.
5. Place the thermos in a location with a stable ambient temperature.

   The temperature range for the test is 18-22°C. Avoid temperature fluctuations.

   CAUTION: Do not use the thermos as a portable container. If the thermos is upset or greatly agitated, mercury droplets will cling to the thermometer stem, the rubber stopper, the mouth of the thermos and the needle guide.

REPLACING MERCURY

An oxide coating will form on the drop of mercury and will cause lower readings in your testing. Replace your mercury on a yearly basis or when a filmy coating is evident on the surface of your mercury drop.

PROCEDURE:

1. Carefully remove the stopper assembly from the thermos.

   BE SURE NEEDLE GUIDE IS FREE OF LIQUID MERCURY.

2. Replace the oxidized mercury with approximately 1/2cc fresh mercury.

   Do NOT use the syringe for measuring liquid mercury. Dispose of oxidized mercury properly.

3. Reinstall the stopper assembly.

FUNCTIONAL TEST PROCEDURE:

NOTE: Perform the functional test ONLY after a Sensor Regeneration.

1. Leave the thermos at stable room temperature for at least 2 hours.

   The temperature range for the test is 18-22°C.

   - *Temperature fluctuations during the test procedure will produce erratic results.*

2. Replace the intake filter disc.

   Refer to page 12 of the 431 manual.

3. Replace the septum.

   Unscrew the septum holder assembly's cap and using your trimmer tool, push the old septum out. Insert a new septum (yellow side toward the small hole) into the cap.

4. Plug the septum assembly into the instrument's intake and tighten the intake tube nut to ensure an airtight seal.

   Refer to page A5.

5. Attach a zero air filter to the septum assembly.

6. Press power ON.

7. Take 3 samples.

   If the average meter reading is less than .005, continue to step 8.

   If the average meter reading is greater than .005, stop here and go to Functional Test Trouble Shooting, page A7.

8. Note the temperature of the thermos.

9. WHEN THE DISPLAY FLASHES, Inject 1cc of mercury vapor according to the Syringe Technique described on page A5.

   NOTE: To minimize error, it is important to carefully follow this procedure.

10. Record the meter reading.

11. Repeat steps 9 and 10 three times.

    The last three 1cc injections should be within +/- 5% of each other. If not, refer to page A5 for proper syringe technique and repeat the procedure.

12. Refer to the Temperature Conversion Chart, page A6, for the acceptable range.

    The average of the last three digital meter readings should fall within the range shown in the chart.

    IF THE AVERAGE IS WITHIN RANGE, THE JEROME 431 IS FUNCTIONING PROPERLY. stop here if within range

    If the average is not within range, proceed to the next step.

13. Perform a Sensor Regeneration. Press ZERO and turn the ZERO ADJUST, using the trimmer tool, until the digital meter reads .0.

    - *If the meter reads .H, turn the ZERO ADJUST counter-clockwise;*
    - *if the meter reads .L, turn the ZERO ADJUST clockwise.*

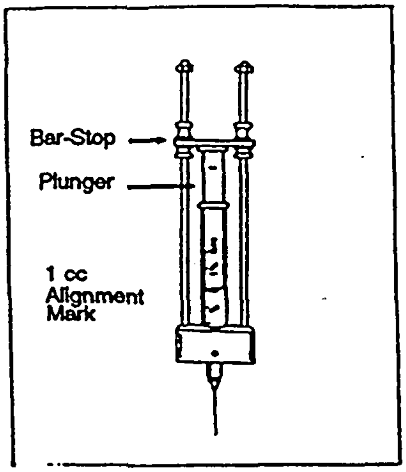
    Refer to page 5, in the 431 Manual for the complete SENSOR REGENERATION procedure.

14. Wait 1 hour before proceeding to step 15.

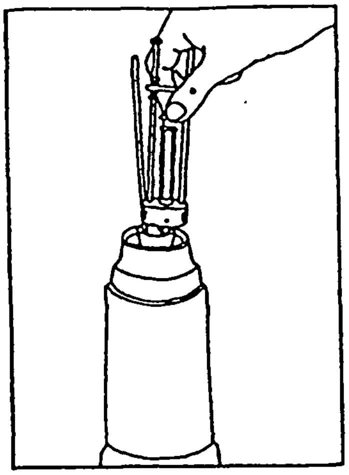
15. Repeat steps 9-12 of this test procedure.

    If the average of the digital meter readings is still not within range, refer to page A7, Functional Test Trouble Shooting.

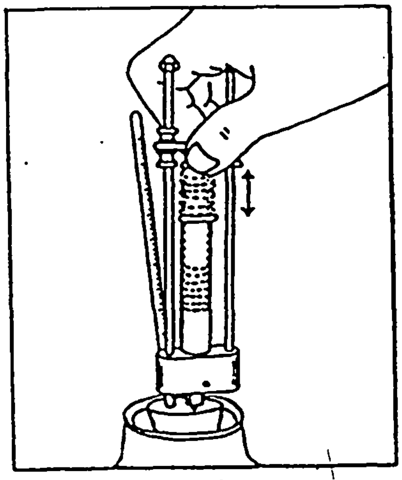
Syringe Technique



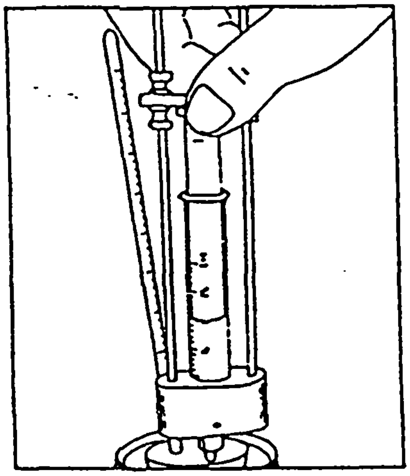
1. Check bar-stop Setting (1cc).



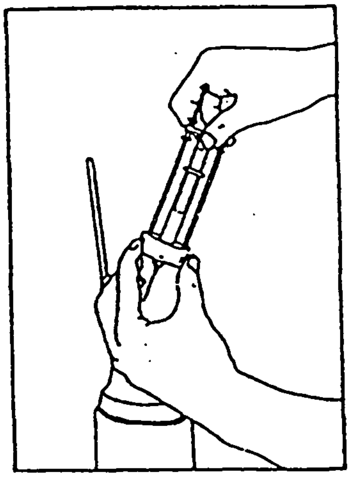
2. Insert needle into thermos.



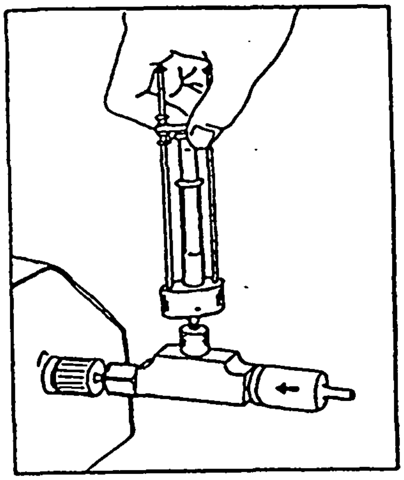
3. Pump plunger 2 times.



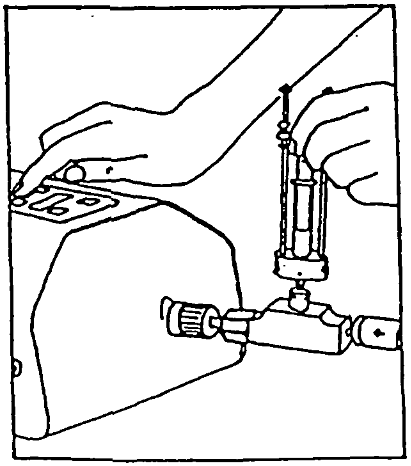
4. Pull plunger quickly and smoothly to bar-stop.



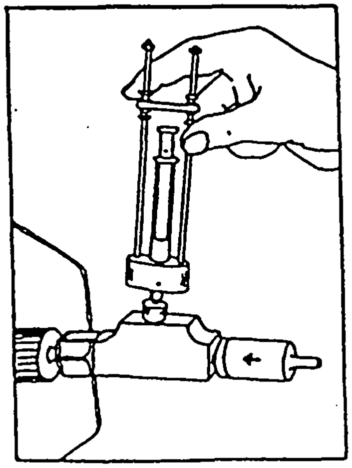
5. Hold plunger firmly against bar stop and remove syringe from thermos.



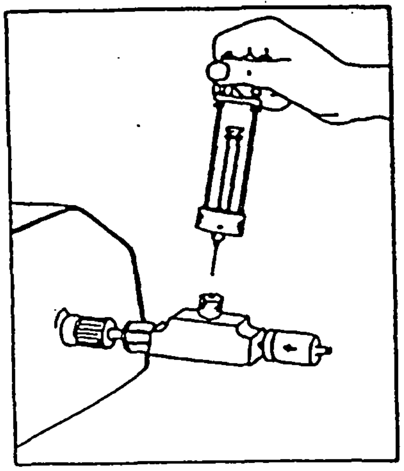
6. Insert syringe needle into setpum.



7. Press Sample.



8. When the display flashes, release the plunger so that gravity feeds Hg vapor into 431 airstream. Aid if necessary, by pushing plunger completely closed.



9. Remove syringe needle from septum.

431 TEMPERATURE CONVERSION CHART

Temp °C	Digital Meter Response
16	.091 to .123
17	.100 to .135
18	.108 to .146
19	.118 to .159
20	.129 to .174
21	.138 to .187
22	.151 to .204
23	.164 to .222
24	.177 to .240

FUNCTIONAL TEST TROUBLE SHOOTING

If you don't achieve good results with the test procedure, go over the following:

- Ensure to inject the Hg vapor ONLY when the diplay flashes.
- Ensure the thermos temperature is stable.
- Ensure there is no oxidation on the mercury drop in the thermos.
- Ensure the instrument's intake is not blocked with foreign matter.
- Straighten or replace crimped or blocked internal tubing.

and...

- Use a new syringe needle.

If you find the above does not solve your problems, follow these steps to determine if your flow system is contaminated:

1. Insert your zero air filter in the instrument's intake and tighten the intake tube nut to ensure an airtight seal.
2. Take 3 samples.

   If the average meter reading is less than .005, there is no mercury contamination. If the average meter reading is greater than .005, proceed to step 3.
3. Remove and replace the zero air filter.
4. Take 3 samples.

   If the average reading is less than .005, the old zero air filter was contaminated.

   If still greater than .005, proceed to step 5.
5. Change the internal filters.

   Refer to page 12 of the 431 Manual.
6. Take 3 more samples.

   If the average meter reading is less than .005, the internal filters were contaminated.

If the average is still greater than .005--

Please call Customer Service, Toll Free (800) 528-7411 for help.

APPENDIX B-4

Real-Time Particulate Monitoring Procedures

2.0 SPECIFICATIONS

- Concentration Measurement ranges (auto-ranging)[1]:

  0.1 to 999.9 μg/m^3 (resolution : 0.1 μg/m^3)
  1.00 to 39.99 mg/m^3 (resolution : 0.01 mg/m^3)
  40.0 to 399.9 mg/m^3 (resolution : 0.1 mg/m^3)

- Scattering coefficient range: 1.5×10^{-7} to $6 \times 10^{-1} m^{-1}$ (approx.) at $\lambda = 880$nm.
- Concentration display averaging/updating time[2]: 1 or 10 seconds.
- Precision/repeatability over 1-hour (2-sigma)[3]:

  ± 0.3 μg/m^3 for 10 second averaging
  ± 1.0 μg/m^3 for 1 second averaging

- Accuracy[1]: ± 5% of reading or ± 5 μg/m^3, whichever is greater.
- Particle size range of maximum response: 0.1 to 10μm.
- Sampling flowrate[2]: 1.7 to 2.3 liters/minute.
- Sampling flowrate stability (long term)[4]: ± 5% (up to max. pump loading).
- Purge/clean air HEPA cartridge filter replacement time (typical): >5 years (@ constant 1 mg/m^3).
- Alarm level adjustment range[2] : 0.1 μg/m^3 to 399.9 mg/m^3.
- Alarm integration time[2]: real time (1 or 10 sec.), or STEL (15 min.).
- Data logging averaging periods[2] : 1 second to 4 hours.
- Total number of data points in memory: 10,000 (each point: average, minimum and maximum concentrations).
- Logged data:
  - For each data point: average, minimum and maximum concentrations, time/date, and data point number.
  - Run summary: tag number of logged points, start time/date, total run elapsed time, averaging time, data logging averaging period, calibration factor, STEL concentration, STEL occurrence time after start, overall average concentration, overall maximum and minimum concentrations with data point number.
- Number of data tags: 10
- Real-time and date data: seconds, minutes, hours, day of month, month and year, with leap year compensation.
- Clock accuracy: ± 1 minute/month, or better.
- Elapsed time range: 1 second to 99 days.
- Time keeping and data storage duration: >10 years.
- Automatic zeroing time interval range[2]: 1 to 20 hours
- Readout display: LCD 120 x 64 dots, 15 characters x 8 lines, 57.6 x 38.4 mm active area.
- Internal battery: rechargeable sealed lead-acid, 6.5 Ahr, 6 V nominal.
- Operating time with initial full battery charge[4]: >20 hours (new battery).
- Operating time with charger: continuous and unlimited.
- Charging time: 12 hours nominal (with DataRAM charger).

---

[1] Referred to gravimetric calibration with AC Fine test dust (mmd = 2 to 3 μm, $\sigma g = 2.5$).
[2] User selectable.
[3] At constant temperature.
[4] At 25°C.

- Charging input power: 100/240 VAC, 50/60 Hz, 50 VA
- External d.c. power (optional): 6V @ 3 A
- Analog output (auto-ranging)[5]: 0 to 5V, for 0 to 4 mg/m^3
  0.5 to 5V, for 4 to 40 mg/m^3
  0.5 to 5V, for 40 to 400 mg/m^3
- Digital output: RS232, 9600 baud, data bit: 8, stop bits: 1, parity: none.
- Alarm output: switched, 1A @ 10V max., resistance < 0.1 Ω.
- Alarm sound intensity: 90dB @ 1m
- Fuse: 1A, fast.
- Operating environment: 0°C to 40°C (32°F to 104°F), 0 to 95% RH
- Storage environment: -20°C to 60°C
- Dimensions: 134 mm H (5.28 in) x 184 mm W (7.25 in) x 346 mm D (13.63 in)
- Weight: 5.3 kg (11.7 lbs)

---

[5] Range identified on LCD screen.

MIE

INSTRUCTIONS FOR THE USE OF THE MODEL DR-PM10/2.5

1.0 Description

The MIE Model DR-PM10/2.5 Inlet Head is an accessory designed for use with the MIE model DR-2000 DataRAM. The DR-PM10/2.5 is an in-line jet-to-plate type impactor designed to provide either a 10 μm cut point (aerodynamic equivalent particle diameter), or a 2.5 μm cut point. The 2.5 μm cut point is obtained when a small removable nozzle, provided with this accessory, is threaded onto the central flow tube. When that small nozzle is removed, the central flow tube becomes the 10μm impaction nozzle. These cut points are obtained at a flowrate of 2 liters/minute. The impaction surface consists of a 25 mm diameter glass fiber filter supported by one section a standard plastic filter holder.

The DR-PM10/2.5 is shipped for PM-10 operation, i.e. with the 2.5 μm conversion nozzle provided separately (not installed). If PM-2.5 operation is desired, that nozzle needs to be installed (see below). Normally, especially for ambient air monitoring, the DR-PM10/2.5 Inlet Head is used in combination with the DR-OSI Omnidirectional Sampling Inlet. In that case, the DR-OSI precedes the DR-PM10/2.5 which, in turn, can either be connected directly to the DataRAM inlet, or to a DR-TCH Temperature Conditioning Heater followed by the DataRAM, as shown in Figure 1. Alternatively the DR-PM10/2.5 can be used alone with the DataRAM.

2.0 Installation

Whether the DR-PM10/2.5 is used alone with a DataRAM, or in combination with other ambient sampling accessories, as described above, the quick-connect fittings of the DR-PM10/2.5 can be used with any of these devices or to connect directly to the DataRAM inlet. To do so, align quick-connect fitting with knurled sleeve with the corresponding male fitting stem (either of DR-TCH or the DataRAM) and slide the spring-loaded knurled sleeve back (upwards), pushing flow connector down on stem until it bottoms, and release knurled sleeve. Ensure that quick-connect fitting is seated properly. If a DR-OSI is used, connect that accessory to the DR-PM10/2.5 following the same procedure.

Figure 1 illustrates the case where all three ambient monitoring accessories are interconnected. Alternatively, the DR-PM10/2.5 (usually in combination with a DR-OSI) can be mounted separately from the DataRAM (e.g. roof mounting) with a connection to that instrument's inlet using the tubing adapter set provided with the DR-OSI.

3.0 Disassembly

In order to either replace the impaction substrate (25 mm glass fiber filter), or to install or remove the 2.5 μm nozzle, the DR-PM10/2.5 must be opened. Proceed as follows:

- Using the Allen-wrench supplied with the DR-PM10/2.5, remove the 3 small socket-head screws on the outside of the body (see Figure 2)

- Separate the lower body section from the upper cover section, exposing the transparent plastic filter holder. The small colored plastic plug on its back side should be left in place at all times.

- To either replace the impaction substrate, or to install or remove the 2.5 µm nozzle, pull the plastic filter holder away from the metal cover section.

- To replace the glass fiber filter impaction substrate pry it out of the plastic holder and install a fresh filter making sure that the "fluffy" side faces upwards. Firmly reinsert plastic holder onto cover section.

- To install the 2.5 µm nozzle, thread it onto the central stainless steel stem of the cover section, as far as it will turn. Us a pair of pliers or a wrench. Do not overtighten. To remove 2.5 µm nozzle reverse this procedure. Without this nozzle the device is designed to provide a 10 µm cut.

- Reassemble cover section and body section carefully aligning the 3 screw openings on those two sections and reinstall the 3 screws tightening them with the Allen-wrench.

4.0 Maintenance

The only routine maintenance required is the replacement of the impaction substrate. This substrate is a 25 mm glass fiber filter (for example Type A/E, 25 mm from Gelman Sciences, Ann Arbor, Michigan). This filter will require replacement on a monthly basis for typical ambient conditions when sampling continuously. Otherwise, replacement is advisable when that filter appears obviously soiled.

When using the 2.5 µm nozzle, inspect for any obstruction whenever the filter is being replaced. Clean this nozzle, if necessary.

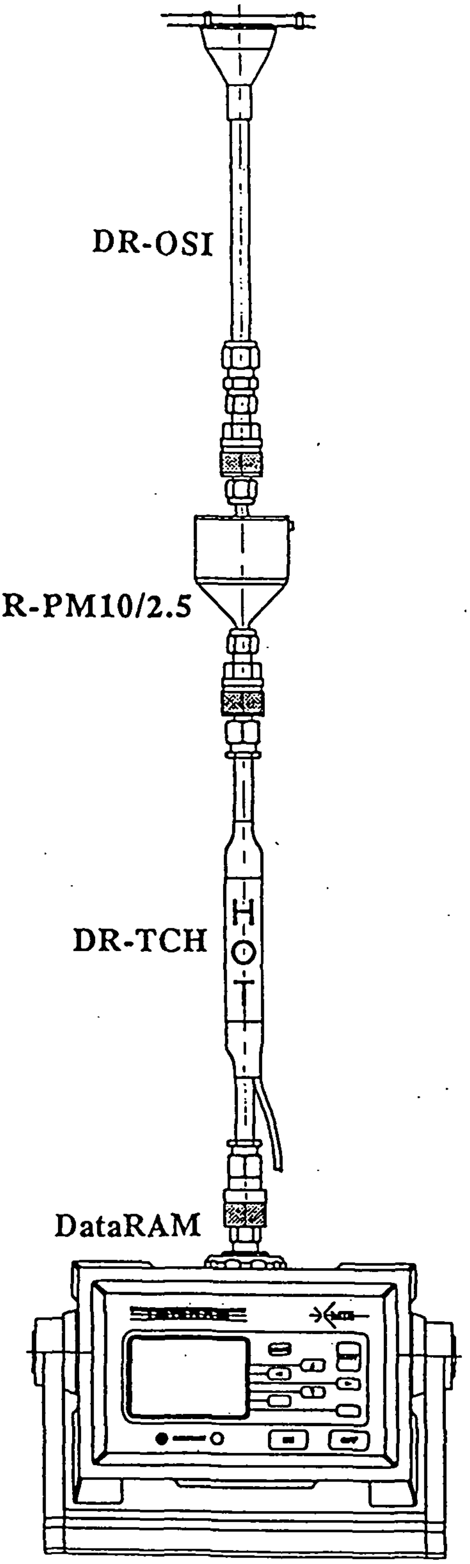


Figure 1.

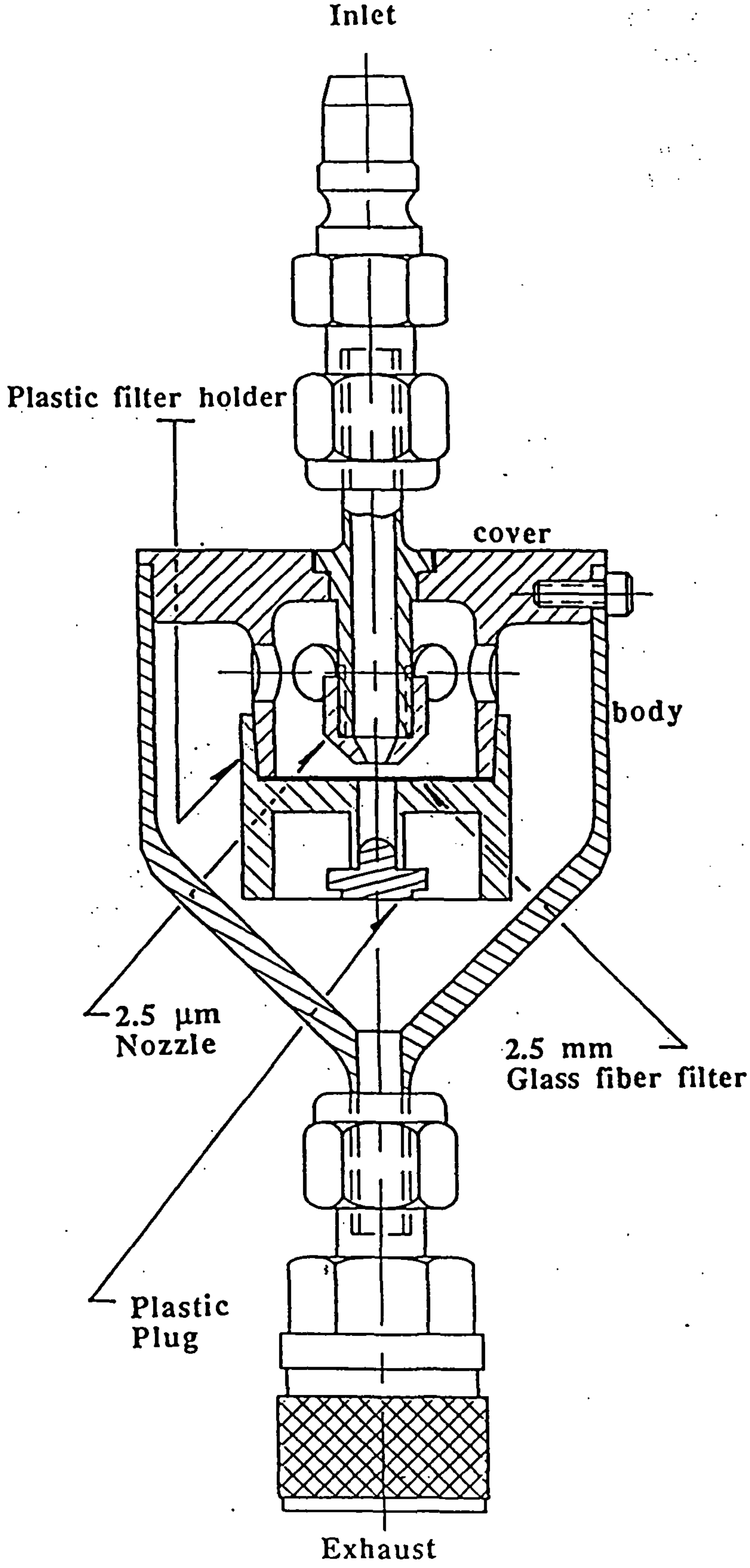


Figure 2.

12.0 ROUTINE MAINTENANCE

When the MINIRAM is not being operated it should be placed in its carrying case which should then be closed. This will minimize the amount of particle contamination of the inner surfaces of the sensing chamber.

After prolonged operation within, and exposure to particulate-laden air, the interior walls and the two glass windows of the sensing chamber may have become contaminated with particles. Although repeated updating of the zero reference following the procedure of section 3.10 will correct errors resulting from such particle accumulations, eventually this contamination could affect the accuracy of the measurements as a result of excessive spurious scattering, and significant attenuation to the radiation passing through the glass windows of the sensing chamber.

An indication of excessive chamber contamination is provided by the zero level reading (section 3.10), which should not exceed 3 mg/m^3, approximately.

In order to clean a soiled sensing chamber remove that chamber as described in section 7.0 and wash it with soap and water, rinsing thoroughly to remove any residues from the glass windows and interior of the chamber. Do not use solvents of any type. Do not rub interior surfaces of the chamber (coated version). Allow the sensing chamber to dry completely and re-insert into the MINIRAM as indicated in section 6.0.

13.0 PRECAUTIONS AND OPERATING POSITIONS

The interior of the MINIRAM sensing chamber should not be exposed to fluctuations of intense light; flashes of sunlight or bright daylight especially, are to be avoided. Such excessive variable illumination of the scattering detector can result in significant measurement errors that may persist over several 10-second display cycles. In order to operate the MINIRAM under those conditions it is advisable to use the Sunshield accessory (MIE model PDM-SNS, see section 16.2).

Another potential source of error is the presence of reflecting surfaces in close proximity to the sensing chamber openings. Such objects should be kept at least 2 cm (3/4 inch) from the chamber openings.

The removable sensing chamber should not be used as a carrying handle, especially not while operating the MINIRAM; holding this chamber may affect the measurements.

When using the MINIRAM for personal monitoring it should be positioned vertically, i.e., with the display/control panel facing upwards, by either clipping the MINIRAM to the belt, shoulder strap, etc.

In general, an approximate vertical position is to be preferred for any long-term monitoring purposes, in that this position minimizes potential particle deposition within the removable sensing chamber.

Other monitoring positions are:

a) horizontal, resting on belt clip

b) hand held (while ensuring that hand and fingers are away from the openings of sensing chamber)

c) Using the optional MINIRAM table stand

d) Wall mounted using belt clip, or the four battery pack attachment screws on the back of the MINIRAM.

14.0 INTRINSIC SAFETY

The MINIRAM has been designed to satisfy the requirements for intrinsically safe operation in methane-air mixtures. The sealed battery pack incorporates a current-limiting resistor that limits the battery short circuit current to less than 14A. MSHA 2G-3532-0 approval has been granted to the PDM-3.

15.0 SPECIFICATIONS

- Measurement ranges: 0.01 to 10 mg/m^3 and 0.1 to 100 mg/m^3
- Precision and stability (for 10 sec. readings)* : ± 0.03 mg/m^3 (2-sigma)
- Precision and stability of time-averaged measurements*:
  ± 0.02 mg/m^3 (for 1 minute averaging)
  ± 0.006 mg/m^3 (for 10 minute averaging)
  ± 0.003 mg/m^3 (for 1 hour averaging)
  ± 0.001 mg/m^3 (for 8 hour averaging)
- Temperature coefficient: 0.005 mg/m^3 per °C (typical)
- Readout resolution: 0.02 mg/m^3 or 0.1 mg/m^3 depending on automatically selected range (3 digit LCD)
- Digital readout updating time: 10 seconds
- Analog output time constant: 0.2 seconds
- Total measurement period: 8 1/3 hours, or indefinite 8 1/3 hour cycles
- Particle size range of maximum response: 0.1 to 10 µm in diameter
- Measurement display: normally 10-second real time measurement; or momentarily: time-weighted average, or 8-hour equivalent shift average, or elapsed sample time (in minutes), or zero value, or identification number, or programmable code
- Data storage: seven concentration averages, sampling periods in minutes (3 significant figure resolution), off time (10 minute resolution), identification number, zero value, programmable code, and check sum
- Real time outputs: analog (0 to 1.5V full scale), and digital ASCII

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* At constant temperature (typ. 25°C)

- Memory playback: either by own LCD display, or by 110, 300 or 600 baud, ASCII digital output (20 mA current loop, or RS232 terminals may be connected with appropriate interface)
- Nominal battery voltage: 7.5V
- Average battery current drain: 40 mA
- Continuous operating time with full battery charge: 10 hours, approximately
- Operating temperature: 0° to 50°C (32 to 120°F) Storage: -20 to 60°C
- Outside dimensions: main body: 10 x 10 x 4 cm (4 x 4 x 2 inches); sensing chamber cover: 7.7 x 3.8 x 1.5 cm (3 x 1.5 x 0.6 inches)
- Weight: 0.45 kg. (16 oz.)

16.0 STANDARD ACCESSORIES

Accessories provided with each MINIRAM are detailed in the following subsections.

16.1 Battery Charger

The battery charger (MIE model PDM-1-157-1) serves the following functions: recharge or maintain the charge of the nickel-cadmium batteries within the MINIRAM, permit continuous a.c. power line operation, and provide power for the operation of pump of the optional MIE model PDM-1FZ Zero Check Module (see section 17.2). The charger cannot be used to power the MINIRAM without its batteries, however, it can be used to charge a separate or spare battery pack (MIE model PDM-1-101-1, see section 7.0). The output of the MINIRAM battery charger is a low voltage a.c. which is converted to d.c. within the MINIRAM.

The standard battery charger is designed for a 120V/60 Hz input, however, it can be obtained for 220V/50 Hz if so specified.

16.2 Sunshield (MIE model PDM-SNS)

The sunshield accessory serves to protect the MINIRAM sensing elements from excessive ambient light fluctuations (see section 13.0). It should be used whenever the MINIRAM is to be operated outdoors or under fluctuating bright light illumination. It is also advisable to use the sunshield to prevent loose clothing or other objects from touching or entering the open sensing chamber. The use of the sunshield causes only a slight retardation of the air exchange rate between the outside and inside of the sensing chamber, an effect that is negligible except when using the analog output in order to follow rapid fluctuations of particle concentration. The sunshield attaches by its two support tabs to the body of the MINIRAM. The sunshield is included with units ordered after April 1987. It is advisable to use the MINIRAM with the sun shield attached at all times, if possible.