

ROWE INDUSTRIES SUPERFUND SITE
SAG HARBOR, NEW YORK
SOIL REMEDIATION DESIGN

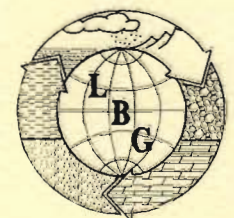
VOLUME II of II

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APPENDIX G
HEALTH AND SAFETY AND CONTINGENCY PLAN
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Prepared For

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APPENDIX G
HEALTH AND SAFETY AND CONTINGENCY PLAN
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

1.0 INTRODUCTION

This Health and Safety and Contingency Plan (HSP) is intended to provide a basic framework for the safe conduct of the soil remediation at the Rowe Industries site in Sag Harbor, New York. The procedures provided herein are intended as a guide for LBG Engineering Services, P.C. (LBGES) and subcontractor employees who will be involved in the performance of the project. At a minimum, all precautions taken to safeguard the employees health and welfare shall be in accordance with 29 CFR Parts 1900 through 1910, inclusive, and any applicable local rules and regulations. Copies of 29 CFR Parts 1900 through 1910 and Part 1926 are to be maintained at the site for reference.

1.1 Remedial Action - Soil

The remedial action (RA) includes the excavation of approximately 225 cy (cubic yards) of soil, treatment of in-situ soils with soil-vapor extraction (SVE), and onsite treatment of excavated soils prior to disposal, as necessary. The sequence of work will be as follows:

- construct a soil impoundment to store volatile organic compound (VOC)-impacted soils at the site prior to transport and disposal;
- conduct excavation;
- all excavated soil will be taken to soil impoundment for treatment prior to ultimate disposal;
- backfill, compact and regrade work area;
- drill boreholes and install SVE wells, air-spargers, ground-water monitoring wells and soil-vapor monitoring points;
- excavate trenches, install pipe for SVE and AS wells and backfill trenches; and

- install and secure treatment shed and remedial equipment.

1.2 Objectives

The primary objective of the Health and Safety Plan (HSP) is to establish work-safety guidelines, requirements and procedures before field activities begin. The following information was prepared specifically for field operations by personnel to enforce and adhere to the established rules as specified in the HSP. The approved HSP will be provided to all personnel to aid in accomplishing the following objectives:

- monitoring the effectiveness of the HSP as it is conducted in the field by performing field operation audits;
- following up on any necessary corrective actions;
- interacting with United States Environmental Protection Agency (EPA) field representatives regarding modifications of health and safety actions; and
- stopping work should work-site conditions warrant such action.

The Sag Harbor Industries property, at one time owned by Aurora Plastics, a subsidiary of Nabisco, Inc., is an active industrial facility. Mr. Paul Scheerer, President of Sag Harbor Industries, will be consulted prior to onsite activity to determine if any safety precautions should be taken in addition to those mentioned herein.

1.3 Responsibility for Implementation

An organizational chart for LBG Engineering Services, P.C. (LBGES) personnel and its subcontractors with regard to health and safety operations is presented in figure HS-1. The organization and responsibilities for implementing safe site investigation procedures, and specifically for the requirements contained in this manual, are described in this section.

1.3.1 Project Manager

The LBGES Project Manager, Mary Jo La Fever, will be responsible for the overall implementation and monitoring of the health and safety program by:

- ensuring appropriate and sufficient protective equipment is available and properly used by all personnel, in accordance with the HSP;
- ensuring personnel health and safety awareness by providing them with proper training and familiarity with procedures and contingency plans;
- ensuring all personnel are apprised of potential hazards associated with the site conditions and operations;
- supervising and monitoring the safety performance of all personnel to ensure their work practices are conducted in accordance with the HSP;
- correcting any work practices or conditions that would expose personnel to possible injury or hazardous conditions;
- communications with the onsite Health and Safety Officer (HSO);
- promptly initiating emergency alerts; and
- communicating with the client and/or regulatory agency representatives.

1.3.2 Onsite HSO

The onsite HSO will be onsite during all site remedial activities and will also supervise portions of the field program. Monitoring technicians may be designated, as required, to supplement the HSO. The HSO will be accountable for the direct supervision of personnel from the subcontractors and other LBGES personnel with regard to:

- assuring compliance with the provisions of the HSP as presented herein;
- assuring compliance with the rules and regulations of OSHA, particularly 29 CFR Subpart 1910.120;
- maintaining a high level of health and safety consciousness among employees at the work site;
- reporting accidents within LBGES jurisdiction and undertaking corrective action; and
- air monitoring throughout the project (on personnel and in the area of the excavation).

1.3.3 Field Personnel

All field personnel will report directly to the onsite HSO with regard to all health and safety matters, and will be required to:

- be familiar with, and conform to, provisions of the HSP;
- ensure that they are well informed of potential hazards at the work site and exercise informed consent in their work;
- report any accidents, hazardous conditions or uncontrolled air emissions to the onsite HSO; and
- have complete familiarity with their job requirements and the health and safety procedures involved.

Prior to the start of field activities, a meeting will be held to discuss the potential hazards at the site, with a review of the required protective clothing and procedures observed at this site. As needed, daily meetings may be held to discuss any changes in the hazards present at the site.

1.4 Coordination with Local Agencies

Local police, fire and emergency services identified in the contingency plan presented in Section 9.0, inclusive, will be apprised of the RA through the issuance of a copy of the HSP to the addresses indicated therein.

2.0 HAZARD EVALUATION

The onsite HSO is responsible for determining the level of personal protective equipment (PPE) required. The HSO will perform a hazard assessment in accordance with OSHA regulations to determine personal protective equipment requirements once the site has been entered. When work site conditions warrant, the onsite HSO will modify the level of protection to be utilized. The existence of a situation more hazardous than anticipated will result in the suspension of work until the Project Manager and client's representative have been notified and appropriate instructions have been provided to the field team.

2.1 Chemicals

The presence of 1,1,1-trichloroethane, tetrachloroethylene, trichloroethylene, 1,1-dichloroethane, 1,2-dichloroethylene and 1,1-dichloroethylene in the soils to be handled comprise the major chemical concerns for personal health. The protection of personnel from exposure to these substances by inhalation, oral ingestion, dermal absorption or eye contact is the primary purpose of this plan.

In addition to the chemicals identified during initial site investigations, a number of chemicals will be brought onto the site during the remedial activities. Accordingly, a Material Safety Data Sheet (MSDS) shall be maintained at the site for each chemical identified during the initial site investigations as well as materials brought onto the site (e.g., fire fighting chemicals, gasoline and fuel oil). At a minimum, the MSDS shall present the Chemical Abstract Service (CAS) number for the chemical, physical properties (e.g., flash point, vapor pressure, vapor density and boiling point), symptoms of overexposure, possible chronic effects and first aid treatment for exposure. A preliminary compilation of MSDSs is presented in Appendix HS-1 of this document. This compilation will be reviewed and maintained by the HSO during the implementation of the RA.

The potential inhalation and explosive hazards for chemicals likely to be encountered on the site are shown on table HS-1. Also shown in this table are the Permissible Exposure Limit (PEL), Immediately Dangerous to Life or Health (IDLH) Level, Lower Explosive Limit (LEL), and Upper Explosive Limit (UEL), as applicable, for the chemicals identified on site. Table HS-2

shows the selected chemical and physical properties and health hazards associated with overexposure of the identified hazardous substances.

2.2 Physical & Biological

In addition to the chemical hazards onsite, there are physical and biological hazards as well. All field work will be performed outdoors and, therefore, is dependent on weather conditions. Warm weather, combined with the Level C clothing, increases the risk of heat stress.

Heat stress occurs in several forms, ranging from heat cramps, heat exhaustion and, most serious, heat stroke. Regular consumption of water and regular break periods from work will reduce the risk of heat stress. A more comprehensive discussion of heat stress is presented in Sections 3.2 and 9.0 of this report.

The site area is approximately five acres, but the majority of the work will be conducted in the rear parking area of the SHI building. The work area is relatively level, but is overgrown with small saplings and shrubbery. The small pond located approximately in the middle of the site is very shallow and is a natural haven to mosquitoes. The entire area likely has ticks which may harbor the virus responsible for Lyme disease. These biological hazards can be alleviated by wearing protective clothing and utilizing insect repellent.

2.3 Permit Required Work Areas

In addition to the hazards identified above, there are a number of areas and work conditions which present a unique set of hazards and for which OSHA has special requirements. Entry into confined spaces, work on tanks containing flammable or combustible materials and work in and about areas containing machinery or conduit which, if energized, could result in injury or death, require special review and oversight. A review of the remedial action shows no requirements for the issuance of Lockout/Tagouts during the RA.

The soil excavation will be a permit required confined space as defined by 29 CFR 1910.146 and work conducted in the excavation must comply with this standard. The general requirements for work conducted in confined spaces are listed in Exhibit HS-1. Measures will be implemented to prevent unauthorized entry into the confined space including issuance and

use of entry permits. A copy of an entry permit is attached as Exhibit HS-2. Before entry begins, the entry supervisor shall sign the entry permit to authorize entry.

Construction of the soil impoundment is not regulated by 29 CFR 1910.146 - Permit Required Confined Spaces. However, the impoundment will be an "enclosed space" and all employees required to enter the enclosed space will be instructed as to the nature of the hazards involved and the necessary precautions to be taken. Precautions include: having more than one means of ingress and egress; having necessary equipment for safe ingress and egress such as ladders equipped with skid pads; and barriers as necessary to protect entrants from external hazards.

2.4 Other Potential Hazards

In addition to the chemical, physical, biological and permitted work area hazards presented above, Section 9.0 of this report lists potential hazardous situations which may apply to the planned remedial activities, as well as preventative measures and response procedures.

3.0 MONITORING REQUIREMENTS

3.1 Air

Prior to and during the remedial construction phase, the potential air emission impacts to local receptors from remedial activities specified in the Record of Decision (ROD) and implemented under the Remedial Action (RA) will be monitored. The upwind and downwind ambient air monitoring locations will be stationary throughout the day but may move from day to day based on wind direction.

3.1.1 Establishment of Background Concentrations

Background total volatile organic vapor (TOV) concentrations will be measured with a photoionization detector (PID) for one week (five working days) prior to the mobilization of the Contractor(s) to the site for each phase of work described below. Background TOV concentrations will be obtained at one location upwind of the site and two locations downwind in the

morning, mid-day and afternoon for a sampling period specified in accordance with the manufacturer's requirements to obtain accurate and representative samples.

Tetrachloroethylene (PCE), Trichloroethylene (TCE) and 1,1,1-Trichloroethane (TCA) background concentrations will be measured at the same three sampling locations using Gilian Model HFS 513 air samplers and charcoal solid sorbent tubes for two days prior to the mobilization of the Contractor(s) to the site. These samples will be collected for a period of eight hours in order to obtain Time Weighted Averages (TWAs) for each of the three contaminants. These samples will be shipped overnight to the certified 'third party' analytical laboratory and analyzed per National Institute for Occupational Safety and Health (NIOSH) Methods 1003 and 1501 for chlorinated and aromatic hydrocarbons, respectively. Results of the laboratory analyses will be returned within three to five days to the site.

TOVs will be measured using a HNU Model HW-101 or a Thermoenvironmental Model OVM580B with a 11.7 eV lamp, or a performance equivalent with the same lamps. PID measurement was chosen for this site due to its ability to measure the compounds in question (PCE, TCE and TCA) at low concentrations; its ease of use with no flames, igniters or hydrogen fuel; and its portability due to its light weight (less than 10 pounds). Data regarding PIDs in general and the specific instruments listed above is included in the Attachments to the SAMP.

3.1.2 Soil Remediation - Excavation

Air monitoring during the excavation phase of soil remediation will consist of recording local weather conditions daily, monitoring ambient TOV concentrations and monitoring particulate concentrations. Real-time ambient TOV concentrations will be measured down-wind and up-wind during remediation activities using a PID. The PID will be equipped with a visual alarm to supplement the audible alarm and further alert the Contractor of exceedances above the background levels. PID monitoring will be verified at stationary sampling points using a Gilian Model HFS 513 air sampler and charcoal solid sorbent tubes which are then sent for laboratory analyses. Particulates will be monitored in real-time at up and downwind locations.

3.1.2.1 Air Monitoring - Real Time

Monitoring of the air quality in and around the work areas will be completed during remedial activities. Air monitoring will be conducted for real-time TOVs and particulates. Real-time monitoring indicates that readings are direct and immediate rather than requiring samples to be sent elsewhere from the site for analysis. Support activities, including backfilling, grading, soil transport and mobilization/demobilization will not require air monitoring.

3.1.2.2 Continuous Air Monitoring - TOVs

TOV air monitoring will be completed using a HNU Model HW-101, Thermo-environmental Model OVM580B or performance equivalent. The minimum detection limit for the PID will be 2 ppm (parts per million) of isobutylene with a sensitivity of 0.1 ppm isobutylene. The PID will be calibrated at the start of each work shift according to procedures presented in Appendix M. The PID will be used to monitor sustained concentrations in excess of 5 ppm over observed background concentrations established prior to the commencement of remedial activities. The PID will be set to alarm at 5 ppm above the established background concentration. The alarm will be both a visual as well as an audible alarm. Air monitoring for TOV will be conducted prior to the start of remedial activities once each day, and a minimum of once every two hours thereafter.

Air monitoring for TOVs will be conducted from one upwind and two downwind locations at the perimeter of the active work areas. One of the two downwind locations will be established at approximately 200 feet from the work area or half the distance to the nearest residential or commercial property. Specific monitoring locations will be determined based on readings collected from an onsite wind gauge and will be selected by the site manager. Air monitoring will be conducted at respirable height, approximately 4 to 6 feet above grade.

3.1.2.3 Speciated Monitoring - TOVs

Air speciated monitoring for TOVs will be completed using battery-operated Gilian air samplers and charcoal solid sorbent tubes or performance equivalent. The sampling pumps will be calibrated prior to each sampling event according to manufacturer's specifications. Based on the compounds likely to be encountered during the excavation and their relatively low American

Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) and OSHA Permissible Exposure Limits (PELs), PCE and TCE analysis will be the focus of the air sampling. Monitoring will be conducted according to procedures presented in Appendix M. Samples will be analyzed per NIOSH Methods 1003 and 1501 for chlorinated and aromatic hydrocarbons, respectively.

Samples collected for field analysis will be from three locations, one upwind and two downwind of the active work areas. Samples from the three locations will be collected daily during the first week of soil remedial activities and twice per week for each subsequent week until the excavation is complete.

For sustained concentrations in excess of 5 ppm above observed background concentrations as indicated during ambient monitoring with the PID, additional speciated monitoring as needed with Gilian Model HFS 513 air samplers and charcoal solid sorbent tubes will be completed. The results of the analysis will be used to verify PID monitoring results and develop a correlation between the PID readings and individual compound concentrations.

3.1.2.4 Vapor Emission Response Plan

Only the CIH has the authority to halt work activities based on the vapor emissions. Exceedances of greater than 5 ppm of TOVs above background at the perimeter of the work area (the closest to the excavation of the two downwind stations) will require that all activities be halted in the work area and air monitoring continued. If the airborne levels decrease to below 5 ppm above background, work activities can resume. If the levels exceed 5 ppm but are less than 25 ppm at the perimeter of the work area, and the levels are less than 5 ppm above background at the other downwind station (either 200 feet downwind or half the distance to the nearest residential or commercial structure), then work activities can resume.

If the TOVs levels exceed 25 ppm at the perimeter of the work area, work must be halted. Air monitoring downwind will continue to determine if the TOVs will impact the nearest residential or commercial structure. If TOVs exceed 5 ppm over background at the second downwind site (200 feet downwind from the work area or half the distance to the nearest residential or commercial structure, whichever is less), this will constitute a 'Major Vapor

Emission', as defined by the New York State Department of Health's Community Air Monitoring Plan.

During a Major Vapor Emission, all work activities will be halted. Efforts will be undertaken to abate the emission source. If TOVs at the second downwind site persist above 5 ppm above background despite the efforts to abate the emission source, air monitoring will be conducted within 20 feet of the perimeter of the nearest residential or commercial structure (20 Foot Zone). If TOVs exceed 10 ppm above background at any time in the 20 Foot Zone, or exceed 5 ppm above background for more than 30 minutes, the Major Vapor Emission Response Plan, as defined by the New York State Department of Health's Community Air Monitoring Plan, will be placed into effect. The Community Air Monitoring Plan has been included in the Attachments to the SAMP.

If the TOV concentration does not exceed 5 ppm, but there are nuisance odors detected in the area around the excavation, the Contractor will make every effort to locate the source of the odor and to mitigate the source.

3.1.2.5 Real Time Monitoring - Particulates

Particulate matter (i.e., dust) less than 10 μm (micrometers) in size (PM-10) will be monitored in real-time during the soil remediation activities. Air monitoring for real-time particulates will be completed using a GCA Miniram aerosol monitor or performance equivalent. The real-time monitoring unit will be calibrated daily according to procedures presented in Appendix M. Real-time particulate levels will be monitored continuously at each active work area during periods of soil disturbance. Particulate levels will be recorded in the field notebook on an hourly basis, and more frequently during periods of wind gusts. Air monitoring for real-time particulates will be collected at a specific upwind and two downwind locations at respirable heights, approximately 4 to 6 feet above grade. Exceedances of greater than 150 $\mu\text{g}/\text{m}^3$ between the upwind and downwind monitors will indicate the need to institute dust control measures in the work area.

3.1.2.6 Speciated Monitoring - Particulates

In addition to the real-time monitoring, samples will be collected only during the soil excavation activities using flow-controlled personal sampling pumps, 10 mm Dorr-Oliver cyclone and tared 37 mm-diameter 5 $\mu\text{g}/\text{m}$ PVC filters or performance equivalent as described in NIOSH Method 0600 in Appendix M. The CIH will determine how many people will be monitored with the personal sampling pumps. The personal sampling pumps will be Gilian Model HFS 513 air samplers or performance equivalents. The Gilian pumps are user programmable for start time, run time, tolerated low-flow time and intermittent run time. User flow rate will be 1,700 cc/min as specified in NIOSH Method 0600. Air sampling for particulates and specific pump calibration will be completed with procedures outlined in Appendix M.

During the first week of remedial activities, one sample from each location (one upwind and two downwind) will be collected daily at respirable heights and analyzed per NIOSH Method 0600 for respirable nuisance dust. The results of the analysis will be used to verify the real-time monitoring results. Samples from the three locations will be collected and analyzed twice per week for each subsequent week until the excavation is complete.

3.1.2.7 Weather Monitoring

An Automet Meteorological Monitoring weather station, or performance equivalent, capable of measuring wind speed, wind direction, relative humidity and temperature will be used to maintain continuous measurement of local weather conditions. The weather station will be equipped with a visual indicator of wind direction. The weather station will be equipped with a data logger capable of interfacing with a personal computer and will have a 20-day data storage capacity. The weather station and data logger will comply with the response and performance specifications as dictated in "On-site Meteorological Program Guidance for Regulatory Modeling Application", EPA-450/4-87, Sections 5.0 and 8.0. The weather station will be positioned atop the SHI building in a location generally visible to onsite workers.

3.1.3 Soil Remediation - Soil Impoundment Operation

Air monitoring during operation of the onsite soil impoundment will consist of recording local weather conditions, monitoring ambient TOV concentrations and monitoring TOV emissions from any vapor treatment equipment that may be used. Operation and Monitoring (O&M) visits will be completed daily for the first week of operation, semi-weekly for the next three weeks and then monthly until the soil treatment goals are obtained. Real-time ambient TOV concentrations will be measured downwind using a PID during O&M visits to the subject site. PID monitoring will be verified using Gilian Model HFS 513 air samplers and charcoal solid sorbent tubes as described in Section 3.1.2.3 of this plan. Air samples will be collected from the effluent stack of the vapor treatment equipment during the O&M visits from a stop cock using a tedlar bag. The air samples will be submitted to a state-certified laboratory for direct injection into a Gas Chromatography/Mass Spectrometer (GC/MS) and analyzed for the compounds of concern. The results of the analysis will be compared to the New York State Ambient Guidelines to demonstrate compliance.

3.1.3.1 Real Time Monitoring With PID - TOVs

The minimum detection limit for the PID will be 2 ppm of isobutylene with a sensitivity of 0.1 ppm isobutylene. The PID will be calibrated at the start of each work shift according to procedures presented in Appendix M. The PID will be used to monitor sustained concentrations of TOVs in excess of 5 ppm over observed background concentrations established prior to the commencement of remedial activities. Measurements will be collected at one upwind and two downwind locations at the impoundment following the O&M schedule outlined under Section 3.1.3. The PID will be set to alarm at 5 ppm above established background. The alarm will be both a visual as well as an audible alarm.

3.1.3.2 Speciated Monitoring - TOVs

For sustained concentrations in excess of 5 ppm above observed background concentrations as indicated during ambient monitoring with the PID, speciated monitoring with air samplers and charcoal solid sorbent tubes will be completed. Air speciated monitoring will be completed using Gilian Model HFS 513 air samplers or performance equivalent. Based on the compounds likely

to be encountered and their relative ACGIH and OSHA exposure limits, PCE and TCE measurements will be conducted. Monitoring will be conducted according to procedures outlined in Appendix M. Measurements will be collected at the locations with a PID concentration (real time monitoring) in excess of 5 ppm above background concentrations.

3.1.3.3 Weather Monitoring

Weather monitoring will be completed during this phase of soil remediation as described in Section 3.1.2.7 of this plan.

3.1.4 Recordkeeping and Reporting

All air sampling results obtained prior to and during the remedial activities will be kept in a log book maintained by the Contractor on the site. The log book will be available for review by USEPA and New York State regulatory personnel during site visits during normal work hours.

A summary of all air sampling results will be included in the monthly progress report to the USEPA.

3.2 Heat Index

The HSO will determine the heat index during periods of high temperature and relative humidity. The heat index is to be determined from the chart presented on figure HS-2 based on the relative humidity and temperature. The HSO will establish air temperature in work areas with a thermometer and regional relative humidity through the National Weather Service at 516-924-0259 or by listening to local radio broadcasts. The National Weather Service broadcasts hourly weather reports at 162.475 Megahertz. A heat index in excess of 105° will cause a cessation of all work activities. A heat index of between 90° and 105° will prompt the HSO to direct all personnel to watch closely for heat injury and take frequent breaks. A heat index of between 80° and 90° will prompt the HSO to caution all personnel to avoid overexertion, watch for heat stress/fatigue and drink water during breaks.

3.3 Wind Chill Factor

During periods of cold weather, the HSO shall, based on ambient temperature and wind speed, determine the wind chill factor from table HS-3. In no event shall work proceed if the wind chill factor is -20°F or below.

3.4 Inclement Weather Conditions

The HSO will watch for inclement weather conditions which could create a risk of injury to site personnel by monitoring local radio broadcasts and consulting the National Weather Service, as appropriate and presented below.

- National Weather Service: 516-924-0259
- Broadcast: 162.475 Megahertz

3.5 Local Ambient Conditions

Due to the proximity of residential and commercial receptors both offsite and onsite, ambient monitoring of local air quality and meteorology is required. The requirements of ambient monitoring of local air quality have been developed in accordance with the following: United States Environmental Protection Agency (USEPA) regulations regarding Superfund sites, including EPA's "Guidance for Ambient Air Monitoring at Superfund Sites"; Occupational Safety and Health Administration (OSHA) regulations - 1910.120 Hazardous waste operations and emergency response; and New York State Department of Health regulations, including the Department's Community Air Monitoring Plan.

Air monitoring during the excavation phase of soil remediation will consist of monitoring ambient Total Organic Volatiles (TOVs) concentrations and monitoring particulate concentrations. Real-time ambient TOV concentrations will be measured down-wind and up-wind during remediation activities using a Photoionization Detector (PID). All ambient monitoring station locations are presented on Plate S-8A, Site Control Plan. Real-time monitoring indicates that readings are direct and immediate rather than requiring samples to be sent elsewhere from the site for analysis. The PID will be equipped with a visual alarm to supplement the audible alarm and further alert the Contractor of exceedances above the background levels. PID monitoring will be

verified using Gilian Model HFS 513 air samplers and charcoal solid sorbent tubes at stationary sampling points which are then sent for laboratory analyses.

Particulates will be monitored in real-time at up-wind and down-wind locations. In addition to the real-time monitoring, particulate samples will be collected only during the soil excavation activities using flow-controlled personal sampling pumps, 10 mm Dorr-Oliver cyclone and tared 37 mm-diameter 5 $\mu\text{g}/\text{m}$ PVC filters or performance equivalent as described in NIOSH Method 0600 in Appendix M.

Monitoring of the air quality in and around the work areas will be completed during remedial activities. Support activities including backfilling, grading, soil transport and mobilization/demobilization will not require air monitoring.

CERCLA stipulates that meteorological conditions which may affect the migration of chemicals offsite be monitored. A weather station capable of measuring wind speed, wind direction, relative humidity and temperature shall be employed to maintain continuous measurement of local weather conditions. The weather station shall be equipped with a data logger capable of interfacing with a personal computer located in the job trailer. The weather station and data logger will meet or exceed response and performance specifications as dictated in "On-site Meteorological Program Guidance for Regulatory Modeling Applications", EPA-450/4-87, Sections 5.0 and 8.0. The weather station will be located atop the Sag Harbor Industries (SHI) building as shown on Plate S-8A. Additionally, a wind sock shall be placed atop the SHI building in a location generally visible to members of the work team.

4.0 LEVELS OF PROTECTION

The level of protection anticipated during remedial activities is Level D for respiratory protection and Level C for skin for workers likely to come into contact with contaminated soils (e.g., laborers and equipment operators within the exclusion zone during excavation activities). Only protective equipment deemed suitable by the onsite HSO for use at the work site will be worn. Any changes in protection levels shall be determined and documented by the onsite HSO. Field personnel should exercise informed judgment on protective equipment requirements at active work sites or at work sites that have been repeatedly entered or occupied without apparent harm. In any case where doubt exists, the safest course of action must be taken.

For the compounds associated with the site, the 8-hour exposure limits range between 25 and 350 ppm. Accordingly, PPE will be selected based on PID readings at the lower end of this range in the absence of speciated monitoring. IN THE ABSENCE OF SPECIATED DATA, ALL PID READINGS WILL BE CORRELATED TO PCE BASED ON THE CALIBRATION GAS USED AND THE MANUFACTURER'S RELEVANT RESPONSE DATA. The onsite HSO will direct when the protective clothing and respirators will be utilized based on the conditions encountered at the work site. The levels of protection available to the HSO, and the conditions under which they shall be employed, are detailed below. Variations of the detailed levels of protection may be employed by the HSO only after consultation with the Project Manager. All changes and the rationale for such changes will be duly recorded in the HSO's field log.

It is important that PPE and safety requirements be appropriate to protect against any potential physical hazards. As such, physical hazards will be identified, listed and marked in accordance with 29 CFR 1910.144. Therefore, at a minimum, protective equipment for personnel will include:

- safety boots/shoes as required by 29 CFR 1910.136;
- eye protection as required by 29 CFR 1910.151(c) and 29 CFR 1910.133;
- gloves as required by 29 CFR 1910.138;
- emergency stop switches for machinery as required by 29 CFR 1926.416(f)(5) Subpart K, General Requirements Electrical; and
- hearing protection as required by 29 CFR 1910.95(c).

It shall be the responsibility of the HSO to dictate the use of any additional PPE which may be further required to protect workers under any of the levels of protection detailed in the following subsections.

4.1 Level D

Level D protection is the minimum protection required by workers on the site, whether in cold or hot zones. When work-site conditions dictate, additional PPE, such as protective gloves and chemical-resistant boots for personnel handling contaminated soils, water or vapors or hearing protection when working about heavy machinery, shall be employed. The breathing zone in the work areas will be measured every 30 minutes by PID or when odors are observed. All PID readings will be recorded in the HSO's field log. Should sustained levels of organic vapor greater than 25 ppm above background levels as detected by the PID in the breathing zone, work will stop and all personnel will upgrade to Level C protection. The following minimum PPE is specified for Level D protection.

- hard hat;
- safety glasses, shatter-proof prescription glasses or chemical splash goggles;
- boots/shoes, leather or chemical-resistant,
- coveralls; and
- gloves, leather or chemical resistant.

The site hazards for which Level D PPE was selected include the presence of heavy equipment, the potential for excessive noises during drilling and/or pollution control equipment operation, and the potential for soil and small particles to enter the eyes. Ambient air monitoring of hazardous substances is not expected to exceed 25 ppm during any part of the design activities. Typical work mission durations for personnel in Level D protection is four hours.

Prior to dressing in PPE, all of the material will be inspected for rips, tears or loose stitching that would not allow the PPE to function properly and create the potential for exposure. PPE will also be inspected periodically during use and immediately after use for the defects described above. Any indication that PPE will not function properly will be considered sufficient justification for replacement. General donning procedures for Level D PPE are outlined below:

- put coveralls on;
- put boots on feet;

- place hearing protection over or in ears (when applicable);
- put gloves on hands;
- put safety goggles over eyes; and
- put hard hat on head.

Doffing procedures for Level D PPE are conducted in the exact reverse order as dressing or donning as presented above.

4.2 Level C

Level C protection will be considered for consistent PID readings of 25 to 100 ppm above background. A concentration of 100 ppm was chosen for the upper level because the respirator cartridges will provide at least four hours of protection at that level from the chemicals associated with the site, based on breakthrough times supplied by the manufacturer. Continuous air monitoring by PID and employee air sampling using the Gilian Model HFS 513 air samplers and charcoal solid sorbent tubes will be used in level C respiratory protection. The following minimum PPE is specified for Level C protection.

- hard hat;
- boots: chemical resistant,
- gloves, chemical resistant, solvex;
- Tyvek or Saranex coveralls; and
- Air purifying respirator with organic vapor cartridge and HEPA filter.

The site hazards for which Level C PPE would be selected primarily include the presence of increased levels of hazardous substances in the air. Additional hazards include, the presence of heavy equipment, the potential for excessive noises during drilling and/or pollution control equipment operation, and the potential for soil and small particles to enter the eyes. Typical work mission durations for personnel in Level C protection is two hours. Workers will be required to take longer and more frequent breaks while in level C protection due to the increased potential for heat stress.

Prior to dressing in PPE, all of the material will be inspected for rips, tears or loose stitching that would not allow the PPE to function properly and create the potential for exposure. Face masks will be inspected for loose connections, dry-rot, the presence of foreign objects, cracks in the face piece window and generally poor conditions. PPE will also be inspected periodically during use and immediately after use for the defects described above. Any indication that PPE will not function properly will be considered sufficient justification for replacement. General donning procedures for Level C PPE are outlined below:

- select appropriate cartridge and install on full-face respirator;
- put cotton coverall insert on;
- put Tyvek® or Saranex® coveralls on;
- put boots on feet;
- put chemical resistant boots over boots, and over legs of coveralls;
- place hearing protection over or in ears (when applicable);
- put surgical glove inserts on;
- put chemical resistant gloves on hands;
- tape all seams where boots and gloves come in contact with the Tyvek® or Saranex® coveralls;
- put full-face respirator on head;
- conduct positive and negative pressure test on respirator; and
- put hard hat on head.

Doffing procedures for Level C PPE are presented in Section 7.1.2 of this plan.

4.3 Level B

Level B will be considered for sustained PID readings of 100 to 500 ppm above background in the breathing zone. Continuous air monitoring by PID and employee air sampling using the Gilian Model HFS 513 air samplers and charcoal solid sorbent tubes will be used in Level B respiratory protection. In addition, a portable GC will be used for real-time speciation of individual compounds. The following minimum PPE is specified for Level B protection.

- pressure-demand, self-contained breathing apparatus;
- standby escape pack;
- chemical resistant clothing (Saranex suit);
- outer gloves (Solvex);
- inner gloves (surgical);
- boots, chemical resistant, ; and
- hard hat.

4.4 Level A

Level A protection is not anticipated during the remedial activities. Any recommendation of the HSO to upgrade to Level A protection will be cause to stop work and prepare an alternate work plan. Sustained PID readings in excess of 500 ppm in the breathing zone will prompt the HSO to halt work activities and re-evaluate the relevant work plans with the Project Manager.

Appendix HS-2 presents manufacturer's data sheets for the PPE corresponding to the various levels of protection identified above, with the exception of Levels A and B. In the event that Level A or B is required, the data sheets for the associated PPE will be provided to amend the HSP. The enclosed data sheets present compatibility with the compounds known to be present at the site as well as their appropriate uses and limitations.

The new and unused PPE selected will be stored onsite in the office trailer for security and accessibility purposes. Unused coveralls, gloves and booties will be stored in their original boxes until needed for use. Personnel authorized to enter the work zones will be responsible for maintaining their individual respirators and/or breathing apparatus when required. At a minimum, vapor cartridges will be changed once a day and full-face respirators will be cleaned with a moist towelette and alcohol wipe.

Gloves, boots, safety glasses and coveralls used in all levels of protection will be fitted such that they are comfortable and allow for sufficient mobility to accomplish the specific task(s) required. Supplied air and air-purifying respirators will be fitted so that they provide a tight seal to workers' faces. At no time will respirators be worn with facial hair. The HSO will assure that each individual involved with hazardous waste site operations has PPE that fits properly. This will be accomplished by visual inspection and review of personnel records regarding periodic respirator fit tests.

The effectiveness of the PPE program will be determined by the HSO and Project Manager. The basis for determining the effectiveness will be incident reports, communication with workers and visual inspection of program performance.

5.0 GENERAL SAFE WORK PRACTICES

In addition to the use of protective equipment, the following procedures will be followed to minimize risk:

- all consumptive activities including eating, drinking or smoking are prohibited in the work and decontamination areas;
- emergency eye washes will be located in the office trailer;
- an adequate source of potable water for emergency use will be available in the office trailer;
- all vehicles, except passenger vehicles, will be equipped with audible backup alarms;
- fire extinguishers will be available within the work trailer and on all heavy equipment;
- an adequately stocked first-aid kit will be maintained in the work trailer;
- work during periods of sustained winds in excess of 20 mph, severe, sustained rain and electrical storms will be prohibited; and
- hand to mucous membrane (e.g., mouth and eyes) shall be restricted in the work area.

6.0 SITE CONTROLS

Due to the nature of the work and the concentrations of halogenated hydrocarbons in the soils to be excavated, controls will be required to regulate access and egress from the work areas. Site controls shall consist of the establishment of exclusion zones (hot zones), contamination reduction zones (CRZ or warm zones), and staging areas or support zones (cold zones). The exclusion zone is where the remedial activities will take place, the CRZ is where the decontamination of personnel and equipment will take place, and the support zone is the zone where equipment is stored and protective clothing is not required.

In no event are any personnel to enter the CRZ or hot zones without first being briefed by the HSO. Personnel without an approved 40-hour OSHA training course will not be allowed within the work areas or CRZ.

6.1 Support Zones

The support zone is that zone in which personnel and material necessary to keep operations within the CRZ and exclusion zones running are located. The support zone, or zones, is outside of the CRZ and Exclusion zones, as established. The Site Control Plan shows the support zone as the location of the office trailer. The location of the support zone has been established after a review of the prevailing winds. While PPE required to protect against hazards relevant to the chemicals associated with the site is not required in the support zone, general safety requirements still apply within the support zone.

6.2 Contamination Reduction Zones

The CRZ is the area in which decontamination of personnel and material exiting the exclusion zone occurs. While strictly not within the exclusion zone, the CRZs established for the site will be within the chain link fence enclosing the exclusion zone. The primary and secondary CRZs for the site are depicted on the Site Control Plan .

The buddy system will be observed in the exclusion and contamination reduction zones. These zones will be set up with the clean zone being furthest upwind. An area will be set aside within the exclusion zone for decontamination. The type of decontamination procedures used will be based on the level of protection required in the work area.

6.3 Exclusion Zones

The exclusion zone about the general work area shall be enclosed by fencing or high visibility marking as detailed on the Soil Excavation Plan (Plate S-5) and Site Control Plan. At the close of business hours or when no attendant is on duty all gates will be secured and locked to prevent unauthorized access to the site and work areas.

The exclusion zone will be entered in Level D protection. However, individual work sites within the zone may require higher levels of protection based on air monitoring results during the various activities and the particular work activities being undertaken. If this becomes the case, separate work sites will be established based on the level of protection required. Field personnel are to leave the area if monitoring shows readings above the permissible exposure limits for the level of protection. The HSO will be apprised of any indicated upgrade or downgrade in level of protection, and will be responsible for authorizing such. Factors which may influence this decision include the level of observed or suspected hazards, period of time required to complete activity and weather conditions.

6.4 Site Posting and Labeling

All signage and labeling shall be in accordance with 29 CFR Subpart 1910.144, and as otherwise required by law. Notwithstanding, the following signage shall be posted at the site.

- All chain link fence enclosing the exclusion zone will bear signs warning personnel of the restricted nature of the area. Such signs shall bear, minimally, the word "Danger" and "Authorized Personnel Only." Furthermore, the signs shall be placed generally at eye level and in a number sufficient so that at least one sign is visible from anywhere along the fence line. Such signs shall be legible from a minimum distance of 25 feet during daylight.
- All gates shall be prominently posted with warning signs, a description of the general nature of the site hazards and the 24 hr telephone number of the person to be contacted in the case of an emergency.

6.5 Communications

Lines of communications shall be maintained at all times during the design activities to facilitate safe and efficient operations. As such, onsite and offsite lines of communication shall be maintained during all phases of the design activities.

Onsite communications shall minimally consist of the use of predetermined hand signals and the use of emergency horns. Visual contact shall be maintained between the HSO and the Project Team Leader while any personnel are within the work areas. Emergency horns (e.g., compressed-air horns) will be made available for use in declaring site emergencies. The HSO shall establish communication protocols during site preparation, including those involved in emergency signaling, detail those protocols in his log, post those protocols in the support zone and brief all personnel entering the site on the established protocols.

Offsite communications shall consist of the provision of a dedicated facsimile transmission line and voice line. Personnel coordinating site preparation activities shall provide sufficient lead time for the installation and connection of these lines.

6.6 Site Illumination

Nighttime activities are not anticipated during the remedial action. However, if activities must be conducted when it is dark, portable lights will be used to illuminate all areas of the exclusion zone and selected areas of the CRZ and support zone to minimize the potential for injury. Portable lights will be energized electrically from line power or a portable generator. The portable lights will consist of two, heavy-duty, quartz light-carts equipped with two 500-watt bulbs (or with a minimum illumination potential of 5-foot candle equivalence). Each light cart will have a 360-degree horizontal and a 270-degree vertical range of motion. In addition to the portable lights, each worker involved with nighttime activities will be supplied with an intrinsically safe, hand-held flashlight. Flashlights will have a three D-size battery capacity with the ability to focus flood to spot beam by twisting the head. Spare bulbs and batteries, dedicated for use during the design activities, will be kept in the job trailer. The job trailer will have interior lighting that supplies a minimum illumination of 10-foot candles.

6.7 Site Security

To maintain security during working hours, a fence will be erected around the construction area, a guard station will be erected, and access will be restricted to the site. To maintain security during off-duty hours, a security guard will patrol the site boundary and all equipment will be secured at the end of the work day.

7.0 DECONTAMINATION

The materials to be handled during the excavation activities are F Listed Wastes. That is, the soils contain spent halogenated degreasing solvents classified as F001 waste. Accordingly, the excavated soils must be handled and disposed of as an F waste stream.

Only VOCs have been identified onsite. Because of the high volatility of the identified compounds, contamination within thin soil layers (e.g., those likely to smear onto clothing and cover tools and machinery) is not likely to persist for more than several hours. Any contaminated soils adhering to machinery, tools, equipment and PPE will be readily removed with a water solution and any residual contamination left on surfaces would completely volatilize within minutes.

In consideration of the above, all decontamination strategies are based on the physical removal of large pieces of dirt and spraying the residue off with water. No cleaning solutions other than water use of water are anticipated to enhance the decontamination process. All decontamination water will be contained and disposed of in accordance with RCRA provisions. Relevant schematic drawings and decontamination details are presented on figure HS-3, Decontamination Schematic. Materials accumulated in the bottom of the decontamination collection units will be emptied daily and covered overnight.

All tools, equipment and vehicles will be clean and free of soil prior to their entry into the work area. This measure is aimed at precluding unnecessary decontamination upon exiting the work area.

The following subsections present decontamination strategies based on the foregoing observations.

7.1 Personnel

7.1.1 Procedure for Level D Decontamination

Decontamination of Level D protective wear will consist of brushing heavily soiled boots to solely remove soils. Heavily soiled or stained clothing suspected of bearing contaminated soils will be placed in plastic bags before leaving the work zone.

7.1.2 Procedure for Level C & B Decontamination

Station 1: Segregated Equipment Drop

Deposit equipment used onsite (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths or in different containers with plastic liners. Segregation at the drop reduces the probability of cross-contamination.

Equipment: various size containers
plastic liners
plastic drop cloths

Station 2: Suit/Boot Wash & Outer Glove Removal

Thoroughly wash splash suit and safety boots. Scrub with long-handle, soft-bristle scrub brush and copious amounts of decon solution or detergent/water. Repeat as many times as necessary.

Equipment: pan
container (30 to 50 gallons)
water
2 to 3 long-handle, soft-bristle scrub brushes
water spray unit

Station 3: Tank or Canister Change

If worker leaves Exclusion Zone to change canister (or SCBA tank), this is the last step in the decontamination procedure. Worker's canisters will be exchanged, depositing the old canisters in containers with plastic liners. The worker will enter the work area and return to duty.

If exiting the work zone in Level B, SCBA tanks will be left at this station. While still wearing face piece, remove backpack and place on table. Disconnect hose from regulator valve and proceed to next station.

Equipment: table
 canisters (or tanks)
 boot covers (if used)
 gloves

Station 4: Overboot, Innerglove, & Splash Suit Removal

Remove overboots, innergloves and splash suit and deposit in container with plastic liner.

Equipment: container (30 to 50 gallons)
 plastic liners
 bench or stool
 boot jack

Station 5: Removal of Face Masks

Remove face piece. Avoid touching face with gloves. Deposit face piece in container with plastic liner.

Equipment: container (30 to 50 gallons)
 plastic liners

Masks will be collected, cleaned and stored in the office trailer. Cleaning will be performed as follows:

- remove all cartridges, canisters and filters (or tanks), plus gaskets or seals not affixed to their seats;
- remove elastic headbands;
- remove exhalation cover;
- remove speaking diaphragm or speaking diaphragm-exhalation valve assembly;
- remove inhalation valves;
- wash face piece and breathing tube in cleaner mixed with warm water, preferably at 120°F to 140°F; wash components separately from the face mask; remove heavy soil from surfaces with a hand brush;
- remove all parts from the wash water and rinse twice in clean warm water;
- air dry parts in a designated clean area; and
- wipe face piece, valves and seats with a damp lint-free cloth to remove any remaining soap or other foreign materials.

Station 6: Redress

Put on clean clothes in the office trailer.

7.2 Trucks Hauling Waste

Trucks hauling waste from the work area will be inspected for soil adhering to the body and undercarriage. All gross soils found on the trucks will be removed with brushes and the residue removed with a high pressure water spray. Drivers of all waste hauling trucks shall remain in level D protection within the cab of the tractor, with all windows rolled up to preclude the entry of waste soils into the cab. Therefore, drivers will not require PPE, except respiratory protection as determined by the HSO, and will not require decontamination. Details of the Truck Decontamination Area are shown on Plate S-8B.

7.3 Other Heavy Equipment

Heavy equipment (e.g., front end loaders and excavators) exiting the work area will be inspected for soil adhering to the body and undercarriage. All gross soils found on heavy equipment will be removed with brushes and the residue removed with a high pressure water spray. Trucks transporting material to the clean fill area will not be cleaned with a high pressure water spray but will be brushed off before leaving the work area.

7.4 Tools and Equipment

Tools and equipment exiting the work area will be inspected for soil. All gross soils found on tools and equipment will be removed with brushes and the residue removed with a water spray.

8.0 DISPOSAL OF REMEDIATION DERIVED WASTE

Materials which may require disposal during the execution of design activities include sample jars, bailers, rope, paper towels, polyethylene sheeting and sorbent pads. Used PPE which may require disposal include gloves, coveralls, booties and organic vapor cartridges. All solid waste materials and PPE waste will be temporarily placed in plastic bags and stored in drums (30- or 55-gallon capacities, as needed). The drums will be stored at SHI no longer than 90 days until their transportation offsite and disposal. The solid waste stored in drums will be sampled and analyzed for waste characterization for subsequent disposal at a New York State Department of Environmental Conservation (NYSDEC) approved disposal facility. Representative samples

will be collected by compositing swatches of PPE and other materials from the drums. The results of the waste characterization samples will dictate whether these drums are disposed of as hazardous waste or non-hazardous, regulated waste. Waste solvents and the associated decontamination water will be collected and placed in 55-gallon drums. The drums will be temporarily stored at SHI. The liquids in the drums will be sampled and analyzed for waste characterization prior to disposal. This waste will be stored onsite for no longer than 90 days after completion of the remedial activities. Disposal as hazardous waste or non-hazardous, regulated waste will depend on the results of the waste characterization samples. Only a NYSDEC approved disposal facility will be used for disposal of these wastes. The general approval process for disposal facilities is presented in the main text of the Soil Design Report.

9.0 CONTINGENCY PLAN

This section addresses the hazards most likely to be encountered during the RA including those previously mentioned in Section 2.0 of this report. This plan is not, however, to be construed as a compilation of all possible emergencies or hazards which might occur or exist at the site. It is the sole responsibility of the HSO to ensure, minimally, that the RA is conducted in conformance with the Occupational Safety and Health Agency (OSHA) regulations detailed in 29 CFR Parts 1900 through 1926, inclusive, and the provisions of the site HSP. A copy of this plan, adequate for posting and review, along with all pertinent drawings, maps, and lists, to include address and phone number, of all concerned emergency agencies shall be conspicuously posted at the facility.

POTENTIAL HAZARDS - NATURAL

Windstorm/Hurricane

- Preventative Measures:
 1. Monitor local radio broadcasts and consult the National Weather Service.
 2. Supplies needed to cover work areas will be onsite.

- Response Procedures:
 1. Stop all work during periods of sustained winds in excess of 20 mph.
 2. Cover excavation and stockpiles.
 3. Secure equipment.

Rain and Surface Runoff

- Preventative Measures:
 1. Monitor local radio broadcasts and consult the National Weather Service.
 2. Supplies needed to cover work areas will be onsite.
 3. Preventative measures will be taken during design for runoff controls (see design report and specifications).
- Response Procedures:
 1. Cover excavation and stockpiles.
 2. Control runoff.
 3. Stop all work until weather improves.

Snow/Ice Storm

- Preventative Measures:
 1. Monitor local radio broadcasts and consult the National Weather Service.
- Response Procedures:
 1. Cover excavation and stockpiles.
 2. Control runoff.
 3. Stop all work until weather improves.
 4. Take measures to prevent slip/fall accidents.
 5. Prior to starting work again, de-ice equipment.

Fire

- Preventative Measures:
 1. Fire extinguishers capable of fighting class A, B, and C fires as defined by Underwriter's Laboratories will be available in job trailer, adjacent to storage areas and on all heavy equipment.
 2. Prohibit smoking onsite.
 3. Site will have designated fuel storage area.
- Response Procedures:
 1. Call fire department (see emergency site contact list, Section 9.1 below, for phone number).
 2. Retrieve fire extinguisher and attempt to extinguish fire.

Biological

- Preventative Measures:
 1. Wear proper PPE.
 2. Use insect repellent
- Response Procedures:
 1. Administer first aid as necessary (See Appendix HS-3 for guides taken from the American Red Cross Standard First Aid, 1991).

WASTE AND MATERIAL RELATED

Spills

- Preventative Measures:
 1. Site will have a hazardous material storage area.
 2. Absorbent materials (Sol Speed Dri or equal) will be available at all times (400 pounds).
 3. Neutralizing agents such as sodium bicarbonate for acid spills and boric acid for caustic spills will be available on site (50 pounds of each).
 4. Containers adequate for containment and clean-up of spills will be available on site (a minimum of 4 empty 17H drums).

5. Shovels and brooms will be available onsite.
- Response Procedures:
 1. Call DEC (see emergency site contact list, Section 9.1 below, for phone number).
 2. Put on appropriate PPE.
 3. Acid spills will be covered with an absorbent, liberally covered with sodium bicarbonate, mixed, and placed into a container for removal.
 4. Caustic spills will be covered with an absorbent, liberally covered with boric acid, mixed, and placed into a container for removal.
 5. Solvent and oil spills will be covered with an absorbent and placed into a container for removal.
 6. All containers will be sealed as they are filled or at the end of clean-up activities.
 7. In the event of a substantive release of a hazardous substance, call Miller Environmental Group (MEG) to assist site employees in hazardous waste cleanup (see Section 9.3 below for phone number).

Explosion

- Preventative Measures:
 1. Keep fire and flames away from flammable materials.
 2. Keep flammable materials out of direct sunlight.
- Response Procedures:
 1. Evacuate site
 2. Call fire department (see Section 9.2.3 below for phone number).
 3. Notify emergency site contacts listed in Section 9.1 below.

Toxic Vapor Release

- Response Procedures:
 1. Exceedances of greater than 5 ppm of TOVs above background at the perimeter of the work area (the first of the two down-wind stations) will require that all activities be halted in the work area and air monitoring continued.

2. If TOVs exceed 10 ppm above background at any time in the 20-foot zone, or exceed 5 ppm above background for more than 30 minutes, the Major Vapor Emission Response Plan, as defined by the New York State Department of Health's Community Air Monitoring Plan, will be placed into effect.

WORK RELATED

Personal Injury Potentially Caused By Slippery Surfaces

- Preventative Measures:
 1. An adequately stocked first-aid kit will be maintained in the work trailer.
 2. Take measures to clean up any slippery surfaces.
- Response Procedures:
 1. Administer first aid as necessary (see Appendix HS-3 for guides taken from the American Red Cross Standard First Aid, 1991).
 2. Clean up slippery area.

Personal Injury Potentially Caused by Falling Into Pit

- Preventative Measures:
 1. Restrict access to immediate work area.
 2. Secure site.
 3. Contractor will have emergency stabilization procedures on hand in accordance with the design specifications.
 4. Rescue equipment will be onsite.
 5. An adequately stocked first-aid kit will be maintained in the work trailer.
- Response Procedures:
 1. Assess the situation.
 2. Call 911 or ambulance (see Sections 9.2 and 9.2.1 for phone numbers) and notify them that someone is trapped in an excavation pit.

Personal Injury Potentially Caused by Tripping Over Object

- Preventative Measures:
 1. Maintain neat work area and avoid precariously placed objects.
 2. Site will be illuminated as necessary.
 3. An adequately stocked first-aid kit will be maintained in the work trailer.
- Response Procedures:
 1. Administer first aid as necessary (see Appendix HS-3 for guides taken from the American Red Cross Standard First Aid, 1991).

Personal Injury Potentially Caused by Vehicle Accidents

- Preventative Measures:
 1. An adequately stocked first-aid kit will be maintained in the work trailer.
 2. All vehicles, except passenger vehicles, will be equipped with audible back-up alarms.
 3. Only authorized vehicles will be allowed onsite.
- Response Procedures:
 1. Administer first aid as necessary (See Appendix HS-3 for guides taken from the American Red Cross Standard First Aid, 1991).

Personal Injury Potentially Caused by Getting Hit by Equipment

- Preventative Measures:
 1. An adequately stocked first-aid kit will be maintained in the work trailer.
 2. Wear hard hats while in work area at all times.
 3. Restrict personnel in work area.

- Response Procedures:
 1. Administer first aid as necessary (See Appendix HS-3 for guides taken from the American Red Cross Standard First Aid, 1991).

Personal Injury Potentially Caused by Heat Stress

- Preventative Measures:
 1. Workers will drink a 16-ounce glass of water prior to work (in the morning and after lunch). Workers will be encouraged to drink approximately every 20 minutes during days of extreme heat.
 2. Workers will be encouraged to wear long cotton underwear under the heat-retaining protective clothing required by Levels C and B.
 3. Rest breaks in cool or shaded areas will be enforced as needed.
 4. Toilet facilities will be available to site workers at the office trailer.
 5. Good hygiene practices will be encouraged, stressing the importance of allowing the clothing to dry during rest periods. Anyone who notices skin problems should receive medical attention immediately.
 6. Support personnel outside the work zone will observe the workers in the exclusion zone to monitor signs of stress, frequency of breaks, etc.
 7. The heat index will be monitored, as appropriate, and work monitored accordingly.
 8. Watch for symptoms of heat stress: nausea, cramps, dizziness, sudden cessation of perspiration in hot weather, confusion.
- Response Procedures: Heat exhaustion
 1. Take victim to a cooler area.
 2. Remove any excessive layers of clothing.
 3. If victim is conscious, give water to drink.
 4. Allow victim to rest.
- Response Procedures: Heat stroke
 1. Take victim to a cooler area.

2. Remove any excessive layers of clothing.
3. If victim is conscious, give water to drink.
4. Cool the victim with water, cold compress, and/or rapid fanning.
5. Call ambulance.

Personal Injury Potentially Caused by Cold Exposure

- Preventative Measures:
 1. Monitor the temperature and wind chill factor.
 2. Wear clothing in layers.
 3. Workers will take breaks in a heated vehicle or building if possible, and care should be taken to remove outer layer of clothing during the break.
 4. Workers will have on hand extra inner clothing in case perspiration builds up.
 5. Keep insulated containers of warm liquids available for breaks outside of the exclusion zone.
 6. Be aware of the signs of the frostbite such as severe shivering.
 7. An adequately stocked first-aid kit will be maintained in the work trailer.
- Response Procedures:
 1. Administer first aid as necessary (See Appendix HS-3 for guides taken from the American Red Cross Standard First Aid, 1991).

Personal Injury Potentially Caused by Chemical Exposure

- Preventative Measures:
 1. Air monitoring will be conducted onsite.
 2. All consumptive activities including eating, drinking or smoking will be prohibited in the work and decontamination areas.
 3. Hand to mucous membrane (e.g., mouth and eyes) will be restricted in the work area.
 4. Emergency eye washes will be located in the office trailer.

5. An adequately stocked first-aid kit will be maintained in the work trailer.
 6. Select proper PPE.
- Response Procedures:
 1. If exposure is to the eyes, immediately wash the eyes with large amounts of water, occasionally lifting the lower and upper lids.
 2. Call 911.
 3. If exposure is to the skin, promptly wash the contaminated skin with soap and water.
 4. Call 911.
 5. If chemical is inhaled, move the person to fresh air.
 6. If breathing has stopped, perform mouth-to-mouth resuscitation.
 7. Keep the victim warm and at rest.
 8. Call 911.
 9. If chemical is swallowed, call 911.

Personal Injury Potentially Caused by Noise

- Preventative Measures:
 1. Proper ear protection will be worn by workers in work area.
- Response Procedures:
 1. Address on case-by-case basis.

Personal Injury Potentially Caused by PPE Failure

- Preventative Measures:
 1. An adequately stocked first-aid kit will be maintained in the work trailer.
 2. Prior to dressing in PPE, all of the material will be inspected for rips, tears or loose stitching that would not allow the PPE to function properly and create the potential for exposure. PPE will also be inspected periodically during use and immediately after use for the defects described above.

- Response Procedures:
 1. Evacuate victim from work area.
 2. Administer first aid as necessary (See Appendix HS-3 for guides taken from the American Red Cross Standard First Aid, 1991).

Personal Injury Potentially Caused by Toxic Vapors

- Preventative Measures:
 1. Air monitoring will be conducted onsite.
- Response Procedures:
 1. Select proper PPE.

Electrical Hazards

- Preventative Measures:
 1. Comply with all applicable codes.
 2. Mark out all electrical utilities prior to work.
- Response Procedures:
 1. Notify electric utility (see Section 9.4 below for phone number).
 2. Call ambulance if necessary (see Section 9.2.1 below for phone number).

Work Stoppage

- Preventative Measures:
- Response Procedures:
 1. Secure site.

SITE RELATED

Unauthorized Entry

- Preventative Measures:

1. Fence around work zone.
 2. Signage and labeling (see Section 6.4).
 3. Restrict access to work area.
- Response Procedures:
 1. Escort person off of property.
 2. Call police (see Section 9.2.2 below for phone number).

9.1 Emergency Site Contacts

In the event of a safety or health emergency, appropriate corrective measures must immediately be taken to assist those who have been injured or exposed and to protect the health and welfare of the public at large as well as the site workers. The HSO shall be responsible for responding to all emergency situations and notifying all appropriate personnel and agencies. Should, for any reason, the HSO be unavailable, the following are listed as emergency contacts, as appropriate.

- Sag Harbor Industries
1668 Sag Harbor Turnpike
Sag Harbor, NY 11963
(516) 725-0440
President: Paul Scheerer
- Leggette, Brashears & Graham, Inc.
126 Monroe Turnpike
Trumbull, CT 06611
(203) 452-3100
(203) 452-3110
Principal-in-Charge: Robert Lamonica
Project Manager: Mary Jo LaFever

- Nabisco, Inc.
7 Campus Drive
Parsippany, NJ 07054
(201) 503-3776
Senior Director: Chuck Bennett

- United States Environmental Protection Agency, Region II
Emergency and Remedial Response Division
26 Federal Plaza
New York, NY 10278
(212) 637-4255
Project Manager: Pamela Tames, P.E.

- New York State Department of Environmental Conservation
Office of Environmental Remediation
50 Wolf Road
Albany, NY 12233-7010
(518) 457-3976
Project Manager: James Quinn

- Abacus Environmental, Inc.
123 Pinney Street
Ellington, CT 06029
(860) 871-6216
(800) 343-9970
President: Donald Weekes

9.2 Emergency Services

In the event of an emergency, contacts are provided for reference in the following subsections. In general, any emergency can usually be handled by dialing a centralized number, instead of contacting the sources listed in the following subsections. This general number is presented below.

- General Emergency: 911

9.2.1 Hospital & Ambulance

Directions to Southampton Hospital are as follows. Go south on Sag Harbor Bridgehampton Turnpike for about 3.5 miles (turn left out of the facility). At Montauk Highway (Route 27), turn right. After about 5.5 miles, turn left on Town Road. The Hospital is about 1/3-mile down the road on the right hand side. Plate P-8 shows the location of the hospital in relation to the facility.

- Southampton Hospital
2420 Meeting House Lane
Southampton, NY 11968
Emergency Room: (516) 726-8420
General Information: (516) 726-8200
- Sag Harbor Volunteer Ambulance Corp.
2725 Columbia Street
Sag Harbor, NY 11963
(516) 324-6550

9.2.2 Police

- Town of Southampton Police Department
110 Old Riverhead Road
Hampton Bays, NY 11946
(516) 728-3400
- New York State Police, Troop L
State Route 24
Hampton Bays, NY 11946
(516) 727-2727

9.2.3 Fire

- Sag Harbor Fire Department
Brick Kiln Road
Sag Harbor, NY 11963
Emergency: (516) 324-6550
General Information: (516) 725-0252

9.3 **Spills**

Spills or incidents involving reportable quantities of hazardous or toxic waste or materials (as defined in 40 CFR Subpart 172.101) will be reported, without delay, to the agencies presented below.

- **NYSDEC Spill Response**
Region I: (516) 444-0320
24-Hour Line: (800) 457-7362

- **Suffolk County Spill Response**
Otto Rennenburg (9AM-5PM): (516) 854-2537
Medical Examiner (5PM-9AM): (516) 853-5555

- **Miller Environmental Group**
538 Edwards Avenue
P.O. Box 610
Calverton, NY 11933
(516) 369-4900

In the event of a substantive release of a hazardous substance, MEG will be notified to assist site employees in hazardous waste cleanup. MEG is located approximately 20 miles from Sag Harbor. Appendix HS-4 presents MEG's current status and capabilities with respect to hazardous waste spill response.

9.4 Electric Utility

- Long Island Lighting Company
117 Doctor's Path
Riverhead, NY 11901
Emergency: (516) 755-6000

9.5 Equipment Breakdown and Maintenance

In the event of equipment malfunction, several alternatives are available depending on the magnitude of the malfunction. The following actions listed for each machine to be operated at the facility are prioritized; that is, the first recourse listed is the first action to be attempted. Should a certain action be inadequate to address the malfunction, the next action listed will be attempted. The following actions will be taken, as appropriate, to remedy equipment malfunctions:

- troubleshoot and repair; and
- procure alternate equipment.

9.6 Site Evacuation

In the event that the emergency response gear maintained at the facility is inadequate for the task at hand and the nature of the emergency is such that there is a real and present risk of injury to the site personnel, the site will be evacuated. Appropriate agencies, specifically the police, shall be immediately notified of such a decision so that any dangers to the public at large may be promptly and adequately assessed. The senior person at the site will make the decision to evacuate the site and will, at that time, indicate his decision by verbally notifying all personnel, should such action be possible, and activating an alarm dedicated to such an evacuation. The evacuation will proceed according to posted evacuation routes, personnel will assemble in predesignated assembly areas, and roll calls will be performed at the assembly areas so that all personnel may be accounted for. Evacuation routes will be labeled as per 29 CFR 1910.120 and 29 CFR 1926.65 and any applicable, local rules and regulations. The assembly areas are depicted on the Site Control Plan.

10.0 TRAINING & CERTIFICATION REQUIREMENTS

Any process that increases the skills and abilities of the employees to do a specific job is referred to as "training." Training is usually distinguished from "education," the process of increasing one's understanding. Obviously, there are overlaps between the two processes. It will be the responsibility of the Project Team Leader to assure that all personnel, old and new, know how to perform in a manner that will promote the establishment and maintenance of a safe working environment. Institution of new techniques or modification of procedures will be accompanied by careful consideration of the training required to perform safely. All personnel will be adequately trained to safely carry out their designated on site duties. Training of personnel will be both intramural and extramural as required by law.

Intramural training will be provided on the job and may range from working closely with a person familiar with the facility operations and safety requirements to formally structured Health and Safety presentations. Specifically, intramural training will cover and instruct employees in the following areas:

1. the facility layout; specifically the location of exits, eyewash and shower stations, and first aid and safety equipment.
2. the correct use of safety equipment, including, but not limited to, gloves, masks, eye protection, and safety boots;
3. the site HSP;
4. specific workplace practices, specifically:
 - a. hand washing;
 - b. working around heavy equipment;
 - c. routine examinations of equipment;
 - d. disposal of contaminated materials;

- e. decontamination and cleaning of equipment and machinery; and
 - f. the correct and safe operation of all on site fire fighting equipment; and
5. the particular hazardous substances which could be encountered during the RA.

Extramural training occurs outside of the general work environment. Specifically, extramural training consists of, but is not limited to, attending seminars, receiving first aid training, and attending safety courses. All site workers, including site managers, will provide documentation to the onsite HSO that the field personnel have been trained in the proper use of protective clothing and equipment in accordance with 29 CFR Part 1 Personnel Protective Equipment 1910.132, and 29 CFR Part 1910.120. All site workers, including site managers, will provide, minimally, documentation to the onsite HSO that they have been properly trained in accordance with the OSHA Interim Final Standard 29 CFR 1910 or as may be amended. The HSO will maintain copies of all presented training and fitness certifications, including, but not limited to:

- certification of 40-hour training as required under HAZWOPER regulations;
- fit tests;
- certification of enrollment in an ongoing medical surveillance program which includes baseline and annual physicals; and
- medical certification of fitness.

11.0 MEDICAL SURVEILLANCE

A medical surveillance program shall be instituted by the employer for the following employees:

- all employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits, or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year;
- all employees who wear a respirator as required by 1910.134; and

- all employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation.

Medical examinations and consultations shall be made available by the employer to each employee covered under this standard on the following schedules:

- prior to assignment;
- at least once every twelve months for each employee covered unless the attending physician believes a longer interval (not greater than biennially) is appropriate;
- at termination of employment or reassignment to an area where the employee would not be covered if the employee has not had an examination within the last six months;
- as soon as possible upon notification by an employee that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or that the employee has been injured or exposed above the permissible exposure limits or published exposure levels in an emergency situation;
- at more frequent times, if the examining physician determines that an increased frequency of examination is medically necessary.

All medical examinations and procedures shall be performed by or under the supervision of a licensed physician, preferably one knowledgeable in occupational medicine, and shall be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

The employer shall provide one copy of this standard and its appendices to the attending physician, and in addition the following for each employee:

- a description of the employee's duties as they relate to the employee's exposures;
- the employee's exposure levels or anticipated exposure levels;
- a description of any PPE used or to be used;

- information from previous medical examinations of the employee which is not readily available to the examining physician; and
- information required by 1910.134.

The employer shall obtain and furnish the employee with a copy of a written opinion from the attending physician containing the following:

- the physician's opinion as to whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response, or from respirator use;
- the physician recommended limitations upon the employee's assigned work;
- the result of the medical examination and tests if requested by the employee; and
- a statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

skd
May 29, 1996
Revised September 1997
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EXHIBITS

EXHIBIT HS-1

WORK IN CONFINED SPACES

General Requirements

1. Required Supervision

Work performed in confined spaces shall be done only under the authorization and direction of competent work supervisors who are thoroughly familiar with the hazards that may be encountered.

A. Such supervisors shall be adequately trained in fire and accident prevention procedures and first aid and rescue measures.

2. Employee Warning

All employees required to work in a confined space shall be advised of the hazards they may encounter.

3. Protective Equipment

All protective equipment required shall be provided by the employer and shall be maintained in proper working condition.

A. Before the start of a job, the work supervisor shall make certain:

1. That all necessary protective equipment and tools are of the proper type.
2. That such equipment is clean and in good condition.
3. That the workmen are instructed properly in their use.

B. Before entry is permitted, the work supervisor shall make certain that the protective equipment and air supply system is functioning properly to insure the worker will receive clean air in sufficient quantity.

4. Employee Training

Every employee required or directed to enter a confined space, perform stand-by duties, provide emergency service, give first aid or act in rescue operations, shall be instructed and trained thoroughly in his particular responsibilities.

5. **Required Emergency Personnel**

While work is being performed in a confined space, at least one designated person shall be immediately available to secure or render assistance in the event of an emergency.

- A. Under no condition shall such designated person leave the vicinity of the confined space for any time whatever unless replaced.

Special Requirements

1. **Space Preparation**

Before any confined space is entered it shall, where appropriate, be prepared as follows:

- A. All pipelines, valves, fittings and connections conveying substances to a confined space shall be disconnected or provided with a solid blank before entry shall be permitted.
- B. Tests of the atmosphere for possible hazards shall be made, by a trained designated person, with instrument-type testing devices approved for the use intended.
 - 1. Records of all tests shall be available at the job site.
- C. If the test indicates that the atmospheric conditions are hazardous, the confined space shall be purged. Atmospheric conditions shall be termed hazardous if the test shows any of the following:
 - 1. The presence of oxygen below or above the breathing air range of 16.5 percent to 21.9 percent by volume.
 - 2. The presence of any toxic substances in concentrations above the threshold limit values established by the Commissioner.
 - 3. The presence of a flammable vapor.
- D. After purging the confined space, it shall be retested and, if necessary, repurged.
- E. If the atmospheric conditions are still hazardous and the confined space cannot be purged free of contamination, the work shall only be performed utilizing appropriate protective equipment. The use of oxygen to ventilate a confined space is prohibited.

- F. If the percentage of combustible vapor in the confined space atmosphere is greater than 14 percent of the lower explosive limit, no work shall be performed in such confined space.

Special Precautions

1. Flame and Spark Restrictions

Open flames, welding equipment, general purpose type electrical equipment, light sources, or other spark or flame-producing agents, other than explosive-proof equipment, shall not be used in any confined space until it has been demonstrated by tests that a flammable vapor does not exist.

2. Equipment Grounding

Portable electrical devices used in confined spaces shall be properly grounded.

3. Life Lines and Safety Lines

Whenever a worker is required to enter a confined space, he shall wear an approved safety belt with life line attached and secured outside of the confined space.

- A. No life line shall be secured to any vehicle unless said vehicle is rendered inoperable.

4. Life Lines Not Required

The use of a life line is not required in the following cases:

- A. Where the concentration of workers within the confined space is such that the use of life lines is likely to result in line entanglement which would impede rescue.
- B. Where it has been established by tests that the atmosphere of the confined space is free of contamination and periodic testing is continued to assure an uncontaminated atmosphere.

5. Adequate Fire Protection

Sufficient and proper fire extinguisher equipment to cope with the hazards which may be encountered shall be provided and maintained readily available.

exhibiths-1/h:lbgrl/soil

EXHIBIT HS-2
ENTRY PERMIT AND CHECK LIST

- ☐ CONFINED SPACE ENTRY PERMIT
☐ HAZARDOUS AREA ENTRY PERMIT

ALL COPIES OF PERMIT
WILL REMAIN AT THE JOB SITE
UNTIL THE JOB IS COMPLETED.

LOCATION AND DESCRIPTION
OF CONFINED SPACE _____

Date _____

PURPOSE OF ENTRY _____

Time _____

DEPARTMENT/BRANCH _____

Expiration _____

JOB FOREMAN _____

CREW MEMBERS

CREW MEMBERS

SPECIAL REQUIREMENTS

Yes

No

Yes

No

Lock Out - De-energize

Escape Harness/Life Line

Lines Broken - Capped or Blanked

Retrieval System

Purge - Flush and vent

Portable Eyewash

Ventilation

Fire Extinguishers

Secure Area

Lighting (Explosion Proof)

Supplied Air Equipment

Protective Clothing (Specified on Job Set-up Sheet)

Standby Person

Respirator (Air Purifying)

TEST(S) TO BE TAKEN

LIMITS

Y
E
S

N
O

DATE

DATE

DATE

DATE

DATE

DATE

DATE

DATE

% of Oxygen

-19.5% -23%

% of LEL

Any % over 5

Carbon Monoxide

35 ppm (PEL)

Hydrogen Sulfide

10 ppm (PEL)

Other (Specify):

Note: Continuous or periodic tests shall be established before beginning the job. If there are any questions pertaining to test requirements, contact the project manager/coordinator or the site safety officer.

MONITORING EQUIPMENT

Brand Name

Type

Identification No.

COMMENTS

LEL - Lower Explosion Level

PEL - Permissible Exposure Limit

Supervisor authorizing all above conditions satisfied

PRINT NAME

Copy to Billing

SIGNATURE

CONFINED SPACE ENTRY CHECKLIST

Date: _____

Job No.: _____

Supervisor: _____ Confined Space Location: _____

Link or Vessel No./Name: _____

ATMOSPHERIC TESTS

TIME	PERCENT LOWER EXPLOSION LIMIT	PERCENT OXYGEN	BENZENE (ppm)	TOLUENE (ppm)	XYLENE (ppm)	H ₂ S (ppm)	CO (ppm)	(ppm)	OTHERS (ppm)	(ppm)	INITIAL

CHECKLIST

Initial
Yes No Don't Know

Confined space entry permit complete. _____

All lines leading to and from the confined space have been banded or disconnected. _____

Electrical service disconnected or locked out. _____

All grounding and bonding cables are in place. _____

_____ ing, fittings, and extension cords are approved explosion proof equipment. _____

_____ and Fault Circuit Interrupter (GFCI) checked and functioning. _____

All ignition sources have been isolated. _____

Breathing supply and alarms checked and are in proper condition. _____

The complete respiratory supply system has been checked and is in proper condition. _____

All safety harnesses and lifelines checked and in proper condition. _____

Safety harnesses and lifelines utilized. _____

Required protective clothing, gloves, boots, etc., being used (consult Job Set-up Sheet). _____

Employees have been trained in the use, care, and limitations of their respiratory protective equipment. _____

Outside safety watch trained in emergency procedures and resuscitation. _____

Vessel contains leaded product. _____

All emergency systems such as air packs, fire extinguishers, backup breathing supply, alarms, etc., ready for use. _____

Special warning/caution signs posted. _____

Ventilation equipment in use. _____

No employee with facial hair, eye glasses, or other gas tight seal obstructions will do work which requires a respirator, or act as emergency standby. _____

Monitoring equipment properly calibrated and operational. _____

PERSONNEL PROTECTIVE EQUIPMENT UTILIZED

EYES

- ☐ Chemical Goggles
- ☐ Face Shield
- ☐ Safety Glasses

EXTREMITIES

- ☐ Hard Hat
- ☐ Gloves
- ☐ Boots ☐ PVC ☐ Neoprene
- ☐ Hoods ☐ PVC ☐ Neoprene
- ☐ Foot Coverings, Disposable

BODY

- ☐ Escapement Suit ☐ PVC ☐ Suit
- ☐ Heavy Suit ☐ PVC ☐ Neoprene
- ☐ Intermediate ☐ PVC ☐ Other
- ☐ Light Suit ☐ PVC ☐ Other
- ☐ Tyvek Suit ☐ Yellow ☐ Silver

RESPIRATORY

- ☐ Self-Contained Breathing Apparatus
- ☐ Air Line Respirator
- ☐ Air Line w/Expirator
- ☐ Canister Respirator
- ☐ Canister Type

OTHER

- ☐ Hearing Protection
- ☐ Full Body Harness and Lifeline (Top Entry)
- ☐ Waist Harness and Lifeline (Side Entry)

Remarks:

Supervisor (Print Name): _____

Signature: _____

TABLES

TABLE HS-1

**SOIL REMEDIATION DESIGN
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

**NIOSH^{1/}/OSHA^{2/} Exposure Limits for
Compounds Likely to be Encountered During the Remedial Action**

	PCE	TCE	1,1,1-TCA	1,2-DCE	Methylene chloride	1,1-DCA	Xylenes	Toluene	Ethyl- benzene
NIOSH-REL ^{3/} TWA ^{2/} STEL ^{2/} Ceiling	Ca ^{4/} 25 ppm	Ca 25 ppm	NL ^{6/} NL 350 ppm (15 min.)	* 200 ppm NL NL	Ca NL NL NL	* 100 ppm NL NL	* 100 ppm 150 ppm NL	* 100 ppm 150 ppm NL	* NL NL NL
OSHA-PEL ^{3/} TWA ^{2/} STEL ^{2/} Ceiling	100 ppm ^{2/} NL 200 ppm	100 ppm ^{2/} 200 ppm 200 ppm	350 ppm 450 ppm NL	NL NL NL	500 NL 1,000	NL NL NL	100 ppm 150 ppm NL	200 ppm ^{2/} 500 ppm 300 ppm	100 ppm 125 ppm NL
1 ppm = X $\frac{\text{mg}}{\text{m}^3}$	6.89	5.4	5.55	4.03	3.53	4.12	4.41	3.83	4.41
IDLH ^{10/}	500 ppm	1,000 ppm	1,000 ppm	4,000 ppm	5,000 ppm	4,000 ppm	1,000 ppm	2,000 ppm	2,000 ppm
UEL	NA	10.5%	12.5%	12.8%	22%	11.4% ^{11/}	7.0%	7.1%	6.8% ^{11/}
LEL	NA	8%	7.5%	5.6%	14%	5.6%	1.0%	1.2%	1.2% ^{11/}

1/ National Institute for Occupational Safety and Health.

2/ Occupational Safety and Health Administration.

3/ Recommended Exposure Limits.

4/ Carcinogen.

5/ Time-weighted average for up to a 10-hour work day for a 40-hour work week.

6/ Not listed.

7/ Short-term exposure limit for a 15-minute TWA.

8/ Permissible exposure limit.

9/ Time-weighted average for up to a 8-hour work day for a 40-hour work week.

10/ Immediately dangerous to life or health.

11/ Sax, 1984.

TABLE HS-2

**SOIL REMEDIATION DESIGN
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

**Physical Properties and Associated Health Effects
of Overexposure to Compounds Likely to be
Encountered During the Remedial Action**

	PCE	TCE	1,1,1-TCA	1,2-DCE	Methylene chloride	1,1-DCA	Xylenes	Toluene	Ethyl- benzene
Vapor pressure ^{1/}	14 mm Hg	58 mm Hg	100 mm Hg	180 mm Hg	350 mm	230 mm Hg	9 mm Hg	20 mm Hg	7 mm Hg
Ionization potential ^{1/}	9.32 eV	9.45 eV	11.00 eV	9.65 eV	11.32 eV	11.06 eV	8.56 eV	8.82 eV	8.76 eV
Odor threshold ^{2/}	4.68 ppm ^{2/}	18.5 ppm ^{6/}	12.6 ppm ^{6/}	272.95 ppm ^{8/}	79.3 ppm ^{6/}	120 ppm ^{5/}	0.4 to 20 ppm ^{4/}	40 ppm ^{4/}	0.45 to 0.59 ppm ^{5/}
Target organs ^{3/}	Central nervous system Kidney Liver Skin						Blood Bone marrow Eyes Skin Liver Kidney Respiratory system Central nervous system		
Potential health effects ^{3/}	Central nervous system: depression, decreased alertness, headache, sleepiness, loss of consciousness, defatting dermatitis. Kidney changes: decreased urine flow, swelling around eyes, anemia. Liver changes: fatigue, malaise, dark urine, liver enlargement, jaundice.						Central nervous system: depression, decreased alertness, headaches, sleepiness, loss of consciousness, defatting dermatitis.		

1/ Source: National Institute for Occupational Health and Safety.

2/ Source: Handbook of Environmental Data on Organic Chemicals, Second Edition.

3/ Source: OSHA Guidance Manual for Hazardous Waste Site Activities, 1985.

4/ 100 Percent Recognition Concentration.

5/ Threshold Concentration.

6/ Recognition Concentration.

7/ 100 Percent Population Identification Threshold.

8/ 50 Percent Recognition Threshold.

TABLE HS-3

**SOIL REMEDIATION DESIGN
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

Wind Chill Chart

Apparent Temperature (Wind Chill) as a Function of Wind Speed and Actual Temperature * in °F																			
Wind speed (mph)	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
4	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
5	32	31	30	29	28	27	26	25	24	23	22	21	20	19	17	16	15	14	13
6	30	29	27	26	25	24	23	22	21	20	19	18	17	15	14	13	12	11	10
7	27	26	25	24	23	22	21	20	18	17	16	15	14	13	12	10	9	8	7
8	25	24	23	22	21	20	18	17	16	15	14	13	11	10	9	8	7	6	4
9	24	23	21	20	19	18	17	15	14	13	12	11	9	8	7	6	5	3	2
10	22	21	20	18	17	16	15	13	12	11	10	9	7	6	5	4	2	1	0
11	21	19	18	17	16	14	13	12	11	9	8	7	6	4	3	2	0	-1	-2
12	19	18	17	15	14	13	12	10	9	8	6	5	4	3	1	0	-1	-3	-4
13	18	17	15	14	13	11	10	9	8	6	5	4	2	1	0	-2	-3	-4	-6
14	17	15	14	13	11	10	9	7	6	5	4	2	1	0	-2	-3	-4	-6	-7
15	16	14	13	12	10	9	8	6	5	4	2	1	0	-2	-3	-5	-6	-7	-9
16	15	13	12	11	9	8	6	5	4	2	1	0	-2	-3	-4	-6	-7	-9	-10
17	14	12	11	10	8	7	5	4	3	1	0	-2	-3	-4	-6	-7	-8	-10	-11
18	13	11	10	9	7	6	4	3	2	0	-1	-3	-4	-5	-7	-8	-10	-11	-12
19	12	10	9	8	6	5	3	2	1	-1	-2	-4	-5	-6	-8	-9	-11	-12	-13
20	11	10	8	7	5	4	3	1	0	-2	-3	-5	-6	-7	-9	-10	-12	-13	-15

TABLE HS-3
(continued)

SOIL REMEDIATION DESIGN
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Wind Chill Chart

Apparent Temperature (Wind Chill) as a Function of Wind Speed and Actual Temperature * in °F																			
Wind speed (mph)	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
21	10	9	7	6	5	3	2	0	-1	-3	-4	-5	-7	-8	-10	-11	-13	-14	-15
22	10	8	7	5	4	2	1	0	-2	-3	-5	-6	-8	-9	-11	-12	-14	-15	-16
23	9	8	6	5	3	2	0	-1	-3	-4	-6	-7	-9	-10	-11	-13	-14	-16	-17
24	8	7	5	4	3	1	0	-2	-3	-5	-6	-8	-9	-11	-12	-14	-15	-17	-18
25	8	6	5	3	2	0	-1	-3	-4	-6	-7	-8	-10	-11	-13	-14	-16	-17	-19
26	7	6	4	3	1	0	-2	-3	-5	-6	-8	-9	-11	-12	-14	-15	-17	-18	-20
27	7	5	4	2	1	-1	-2	-4	-5	-7	-8	-10	-11	-13	-14	-16	-17	-19	-20
28	6	5	3	2	0	-1	-3	-4	-6	-7	-9	-10	-12	-13	-15	-16	-18	-19	-21
29	6	4	3	1	0	-2	-3	-5	-6	-8	-9	-11	-12	-14	-15	-17	-18	-20	-22
30	5	4	2	1	-1	-2	-4	-5	-7	-8	-10	-11	-13	-14	-16	-18	-19	-21	-22
31	5	3	2	0	-1	-3	-4	-6	-7	-9	-10	-12	-13	-15	-16	-18	-20	-21	-23
32	5	3	2	0	-2	-3	-5	-6	-8	-9	-11	-12	-14	-15	-17	-19	-20	-22	-23
33	4	3	1	0	-2	-4	-5	-7	-8	-10	-11	-13	-14	-16	-17	-19	-21	-22	-24
34	4	2	1	-1	-2	-4	-5	-7	-9	-10	-12	-13	-15	-16	-18	-19	-21	-22	-24
35	4	2	0	-1	-3	-4	-6	-7	-9	-10	-12	-14	-15	-17	-18	-20	-21	-23	-24

TABLE HS-3
(continued)

**SOIL REMEDIATION DESIGN
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

Wind Chill Chart

Apparent Temperature (Wind Chill) as a Function of Wind Speed and Actual Temperature * in °F																			
Wind speed (mph)	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
36	3	2	0	-1	-3	-5	-6	-8	-9	-11	-12	-14	-15	-17	-19	-20	-22	-23	-25
37	3	1	0	-2	-3	-5	-6	-8	-10	-11	-13	-14	-16	-17	-19	-20	-22	-24	-25
38	3	1	0	-2	-4	-5	-7	-8	-10	-11	-13	-15	-16	-18	-19	-21	-22	-24	-26
39	3	1	-1	-2	-4	-5	-7	-9	-10	-12	-13	-15	-16	-18	-20	-21	-23	-24	-26
40	2	1	-1	-2	-4	-6	-7	-9	-10	-12	-13	-15	-17	-18	-20	-21	-23	-25	-26

* Courtesy of the National Weather Service.

hsp.tbl/h:lbgrl/soil

TABLE HS-3

**SOIL REMEDIATION DESIGN
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

Wind Chill Chart

Apparent Temperature (Wind Chill) as a Function of Wind Speed and Actual Temperature * in °F																		
Wind speed (mph)	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	-1
4	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	-1
5	12	11	10	9	8	7	6	5	4	3	2	1	0	-1	-2	-4	-5	-6
6	9	8	7	6	5	3	2	1	0	-1	-2	-3	-4	-5	-6	-8	-9	-10
7	6	5	4	3	1	0	-1	-2	-3	-4	-5	-7	-8	-9	-10	-11	-12	-13
8	3	2	1	0	-1	-3	-4	-5	-6	-7	-8	-10	-11	-12	-13	-14	-15	-17
9	1	0	-2	-3	-4	-5	-6	-8	-9	-10	-11	-12	-14	-15	-16	-17	-18	-20
10	-1	-3	-4	-5	-6	-7	-9	-10	-11	-12	-14	-15	-16	-17	-18	-20	-21	-22
11	-3	-5	-6	-7	-8	-10	-11	-12	-13	-15	-16	-17	-18	-20	-21	-22	-23	-25
12	-5	-6	-8	-9	-10	-12	-13	-14	-15	-17	-18	-19	-20	-22	-23	-24	-26	-27
13	-7	-8	-9	-11	-12	-13	-15	-16	-17	-19	-20	-21	-22	-24	-25	-26	-28	-29
14	-8	-10	-11	-12	-14	-15	-16	-18	-19	-20	-22	-23	-24	-26	-27	-28	-30	-31
15	-10	-11	-13	-14	-15	-17	-18	-19	-21	-22	-23	-25	-26	-27	-29	-30	-31	-33
16	-11	-13	-14	-15	-17	-18	-19	-21	-22	-24	-25	-26	-28	-29	-30	-32	-33	-34
17	-13	-14	-15	-17	-18	-19	-21	-22	-24	-25	-26	-28	-29	-30	-32	-33	-35	-36
18	-14	-15	-17	-18	-19	-21	-22	-24	-25	-26	-28	-29	-30	-32	-33	-35	-36	-37
19	-15	-16	-18	-19	-21	-22	-23	-25	-26	-28	-29	-30	-32	-33	-35	-36	-37	-39

TABLE HS-3
(continued)

SOIL REMEDIATION DESIGN
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Wind Chill Chart

Apparent Temperature (Wind Chill) as a Function of Wind Speed and Actual Temperature * in °F																		
Wind speed (mph)	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	-1
20	-16	-17	-19	-20	-22	-23	-24	-26	-27	-29	-30	-32	-33	-34	-36	-37	-39	-40
21	-17	-18	-20	-21	-23	-24	-26	-27	-28	-30	-31	-33	-34	-36	-37	-38	-40	-41
22	-18	-19	-21	-22	-24	-25	-27	-28	-29	-31	-32	-34	-35	-37	-38	-40	-41	-42
23	-19	-20	-22	-23	-25	-26	-28	-29	-30	-32	-33	-35	-36	-38	-39	-41	-42	-44
24	-20	-21	-23	-24	-25	-27	-28	-30	-31	-33	-34	-36	-37	-39	-40	-42	-43	-45
25	-20	-22	-23	-25	-26	-28	-29	-31	-32	-34	-35	-37	-38	-40	-41	-43	-44	-46
26	-21	-23	-24	-26	-27	-29	-30	-32	-33	-35	-36	-37	-39	-40	-42	-43	-45	-46
27	-22	-23	-25	-26	-28	-29	-31	-32	-34	-35	-37	-38	-40	-41	-43	-44	-46	-47
28	-22	-24	-25	-27	-28	-30	-31	-33	-35	-36	-38	-39	-41	-42	-44	-45	-47	-48
29	-23	-25	-26	-28	-29	-31	-32	-34	-35	-37	-38	-40	-41	-43	-44	-46	-47	-49
30	-24	-25	-27	-28	-30	-31	-33	-34	-36	-37	-39	-40	-42	-43	-45	-46	-48	-50
31	-24	-26	-27	-29	-30	-32	-33	-35	-36	-38	-39	-41	-43	-44	-46	-47	-49	-50
32	-25	-26	-28	-29	-31	-32	-34	-35	-37	-39	-40	-42	-43	-45	-46	-48	-49	-51
33	-25	-27	-28	-30	-31	-33	-34	-36	-38	-39	-41	-42	-44	-45	-47	-48	-50	-51
34	-26	-27	-29	-30	-32	-33	-35	-36	-38	-40	-41	-43	-44	-46	-47	-49	-50	-52
35	-26	-28	-29	-31	-32	-34	-35	-37	-38	-40	-42	-43	-45	-46	-48	-49	-51	-52

TABLE HS-3
(continued)

SOIL REMEDIATION DESIGN
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Wind Chill Chart

Apparent Temperature (Wind Chill) as a Function of Wind Speed and Actual Temperature * in °F																		
Wind speed (mph)	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	-1
36	-26	-28	-30	-31	-33	-34	-36	-37	-39	-40	-42	-44	-45	-47	-48	-50	-51	-53
37	-27	-28	-30	-31	-33	-35	-36	-38	-39	-41	-42	-44	-46	-47	-49	-50	-52	-53
38	-27	-29	-30	-32	-33	-35	-37	-38	-40	-41	-43	-44	-46	-48	-49	-51	-52	-54
39	-27	-29	-31	-32	-34	-35	-37	-38	-40	-42	-43	-45	-46	-48	-49	-51	-53	-54
40	-28	-29	-31	-32	-34	-36	-37	-39	-40	-42	-43	-45	-47	-48	-50	-51	-53	-55

* Courtesy of the National Weather Service.

hsp.tbl/h:lbgrl/soil

FIGURES

Leggette, Brashears & Graham, Inc.
Principal In Charge
Robert K. Lamonica

LBG Engineering Services, P.C.
Lead Engineer
William K. Beckman, P.E.

Project Manager
Alfred N. Kovalik

OFFSITE

ONSITE

Project Team Leader

Health And Safety Officer

Work Party

Monitoring Team

- Note:1. Health And Safety Officer Will
Act As The Decontamination
Station Officer
2. Project Team Leader Will Also
Act As The Field Team Leader
And Command Post Supervisor

NABISCO, INC.
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

ORGANIZATION CHART

DATE REVISED

PREPARED BY:

LBG ENGINEERING SERVICES, P.C.
Professional Environmental and Civil Engineers
126 Monroe Turnpike
Trumbull, CT 06611
(203) 452-3110

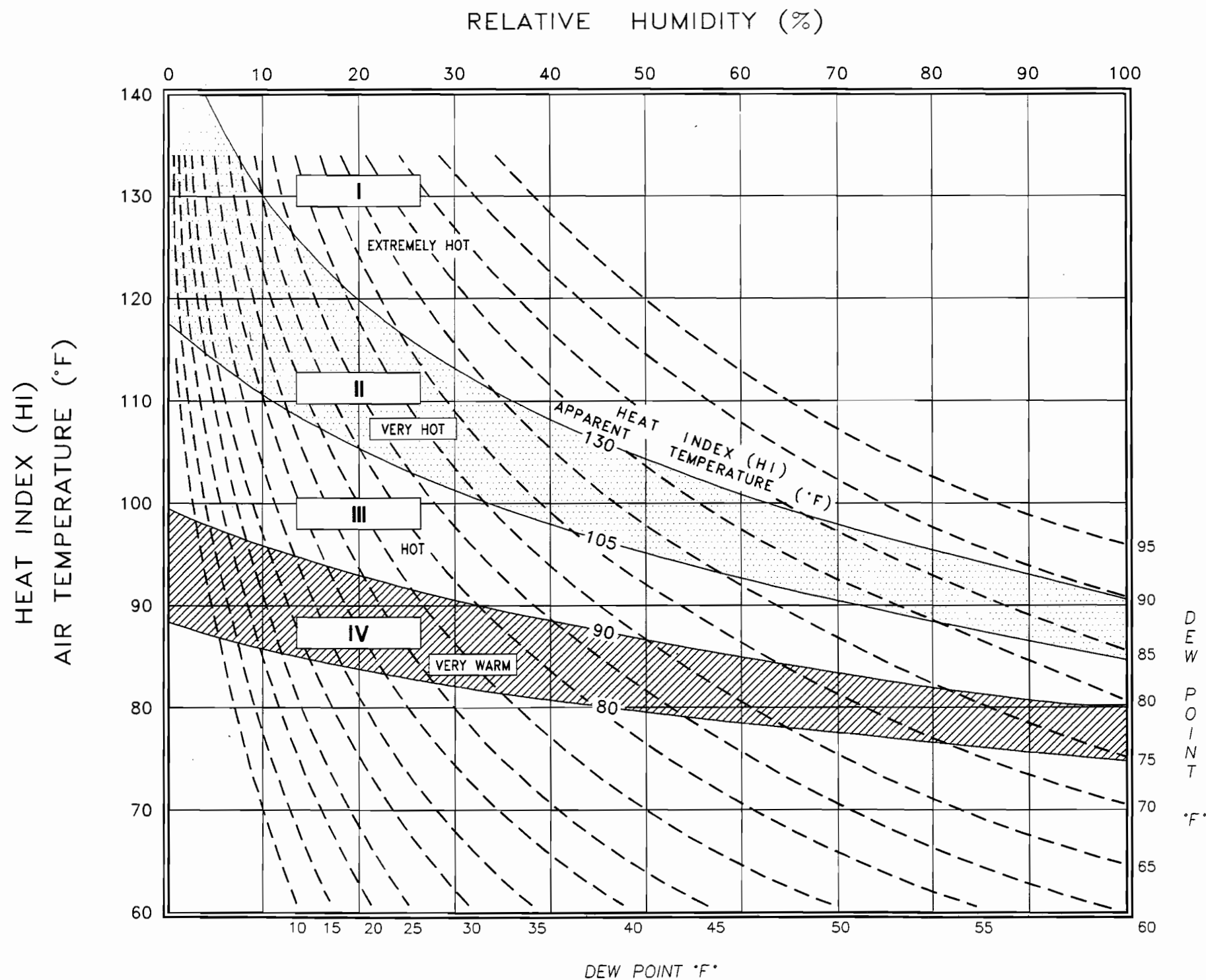


DRAWN: TLC

CHECKED: ANK

DATE: 5/1/96

FIGURE: HS-1



CATEGORY	HEAT INDEX	APPARENT (°F) TEMPERATURE	GENERAL EFFECT OF HEAT INDEX ON PEOPLE IN HIGHER RISK GROUPS
I	130° OR HIGHER		HEAT/SUNSTROKE <u>HIGHLY LIKELY</u> WITH CONTINUED EXPOSURE
II	105° - 130°		SUNSTROKE, HEAT CRAMPS, OR HEAT EXHAUSTION <u>LIKELY</u> , AND HEATSTROKE <u>POSSIBLE</u> WITH PROLONGED EXPOSURE AND/OR PHYSICAL ACTIVITY
III	90° - 105°		SUNSTROKE, HEAT CRAMPS AND HEAT EXHAUSTION <u>POSSIBLE</u> WITH PROLONGED EXPOSURE AND/OR PHYSICAL ACTIVITY
IV	80° - 90°		FATIGUE <u>POSSIBLE</u> WITH PROLONGED EXPOSURE AND/OR PHYSICAL ACTIVITY

**SOIL REMEDIATION DESIGN
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

HEAT INDEX CHART

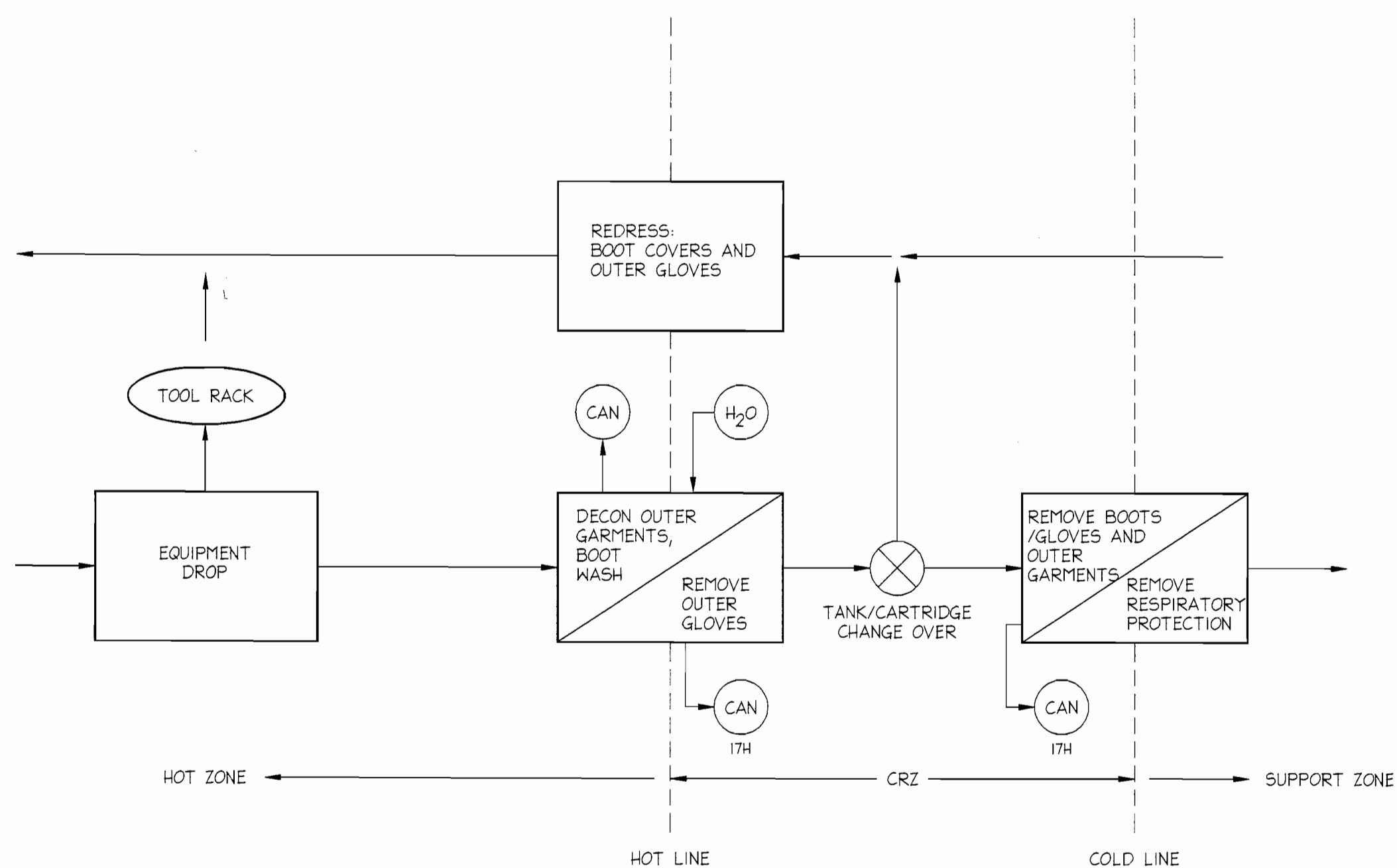
DATE	REVISED	PREPARED BY:



LBG ENGINEERING SERVICES, P.C.
Professional Environmental and Civil Engineers
126 Monroe Turnpike
Trumbull CT 06611
(203) 452-3110

DRAWN: MRV **CHECKED:** ANK **DATE:** 4/24/95 **FIGURE:** HS-2

COURTESY OF NATIONAL WEATHER SERVICE



SOIL REMEDIATION DESIGN ROWE INDUSTRIES SITE SAG HARBOR, NEW YORK

LEVEL C PERSONNEL AND EQUIPMENT DECONTAMINATION SCHEMATIC

DATE	REVISED	PREPARED BY:
		LBG ENGINEERING SERVICES, P.C.
		Professional Environmental and Civil Engineers
		126 Monroe Turnpike
		Trumbull CT 06611
		(203) 452-3110
DRAWN: TLC	CHECKED: ANK	DATE: 5/1/96
		FIGURE: HS-3

APPENDIX G

Health and Safety and Contingency Plan

APPENDIX HS-1

Material Safety Data Sheets

U.S. DEPARTMENT OF LABOR
WORKPLACE STANDARDS ADMINISTRATION
Bureau of Labor Standards

MATERIAL SAFETY DATA SHEET

SECTION I

MANUFACTURER'S NAME U. S. Borax & Chemical Corporation		EMERGENCY TELEPHONE NO. (213) 381-5311
ADDRESS (Number, Street, City, State, and Zip Code) 3075 Wilshire Blvd., Los Angeles, California 90010		
CHEMICAL NAME AND SYNONYMS Boric Acid		TRADE NAME AND SYNONYMS Boric Acid
CHEMICAL FAMILY Borate	FORMULA H₃BO₃	

SECTION II HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE Does Not Apply			METALLIC COATINGS Does Not Apply		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
NONE		

SECTION III PHYSICAL DATA

BOILING POINT (°F.) Does Not Apply	SPECIFIC GRAVITY (H ₂ O=1) 1.51
VAPOR PRESSURE (mm Hg.) Does Not Apply	PERCENT VOLATILE BY VOLUME (%) None
VAPOR DENSITY (AIR=1) Does Not Apply	EVAPORATION RATE (____=1) Does Not Apply
SOLUBILITY IN WATER Moderate	
APPEARANCE AND ODOR White, odorless solid	

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) Does Not Apply	FLAMMABLE LIMITS Does Not Apply	Let	Unit
EXTINGUISHING MEDIA None. Product inherent fire retardant			
SPECIAL FIRE FIGHTING PROCEDURES None			
UNUSUAL FIRE AND EXPLOSION HAZARDS None			

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE

10mg/M³ for B₂O₃ (Amer. Conf. of Gov't Hygienists, 3rd Edition, 1971)

EFFECTS OF OVEREXPOSURE

Used as eye wash in dilute solutions

EMERGENCY AND FIRST AID PROCEDURES

Wash with water where large doses in eyes result.

SECTION VI REACTIVITY DATA

STABILITY

UNSTABLE

CONDITIONS TO AVOID

None

STABLE

XX

INCOMPATIBILITY (Materials to avoid)

None

HAZARDOUS DECOMPOSITION PRODUCTS

None

HAZARDOUS
POLYMERIZATION

MAY OCCUR

CONDITIONS TO AVOID

None

WILL NOT OCCUR

XX

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Standard disposal procedures - presents no health hazard

WASTE DISPOSAL METHOD

Standard disposal procedures - presents no health hazard

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)

No specific protection required

VENTILATION

LOCAL EXHAUST

Normal

SPECIAL

MECHANICAL (General)

OTHER

PROTECTIVE GLOVES

Not needed

EYE PROTECTION

Avoid eye contact

OTHER PROTECTIVE EQUIPMENT

None

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

None needed

OTHER PRECAUTIONS

None needed

*Theoretical B₂O₃ value in boric acid: 56.3% B₂O₃
not listed in the American Conference of Gov't Hygienists.

HEXANES
HEXANES
HEXANES

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY NUMBER: (201) 796-7100
CHEMTREC ASSISTANCE: (800) 424-9300

THIS INFORMATION IS BELIEVED TO BE ACCURATE AND REPRESENTS THE BEST INFORMATION CURRENTLY AVAILABLE TO US. HOWEVER, WE MAKE NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, WITH RESPECT TO SUCH INFORMATION, AND WE ASSUME NO LIABILITY RESULTING FROM ITS USE. USERS SHOULD MAKE THEIR OWN INVESTIGATIONS TO DETERMINE THE SUITABILITY OF THE INFORMATION FOR THEIR PARTICULAR PURPOSES.

SUBSTANCE IDENTIFICATION

SUBSTANCE: **HEXANES**

TRADE NAMES/SYNONYMS:

N-HEXANE; NCI-C60571; HEXYLHYDRIDE; NORMAL HEXANE; SKELLYSOLVE B;
STCC 4908183; UN 1208; H291; N3; H302; H303; H292; H300; H334; H302SK; H33;
C6H14;

CHEMICAL FAMILY:
HYDROCARBON, ALIPHATIC

MOLECULAR FORMULA: C6-H14

MOLECULAR WEIGHT: 86.20

CERCLA RATINGS (SCALE 0-3): HEALTH=0 FIRE=3 REACTIVITY=0 PERSISTENCE=1
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: N-HEXANE CAS# 110-54-3	PERCENT: VARIES
COMPONENT: 2-METHYLPENTANE CAS# 107-83-5	PERCENT: VARIES
COMPONENT: 3-METHYLPENTANE CAS# 96-14-0	PERCENT: VARIES
COMPONENT: 2,3-DIMETHYLBUTANE CAS# 79-29-8	PERCENT: VARIES
COMPONENT: METHYLCYCLOPENTANE CAS# 96-37-7	PERCENT: VARIES
COMPONENT: 2,2-DIMETHYLPENTANE CAS# 590-35-2	PERCENT: VARIES
2,4-DIMETHYLPENTANE	

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:

N-HEXANE:

50 PPM (180 MG/M3) OSHA TWA
50 PPM (180 MG/M3) ACGIH TWA
50 PPM (180 MG/M3) NIOSH RECOMMENDED TWA
50 PPM (180 MG/M3) DFG MAK TWA;
100 PPM (360 MG/M3) DFG MAK 30 MINUTE PEAK, AVERAGE VALUE, 4 TIMES/SHIFT

MEASUREMENT METHOD: CHARCOAL TUBE; CARBON DISULFIDE; GAS CHROMATOGRAPHY WITH
FLAME IONIZATION DETECTION; (NIOSH VOL. III # 1500, HYDROCARBONS).

HEXANE, ALL ISOMERS OTHER THAN N-HEXANE:

500 PPM (1800 MG/M3) OSHA TWA; 1000 PPM (3600 MG/M3) OSHA STEL
500 PPM (1800 MG/M3) ACGIH TWA; 1000 PPM (3600 MG/M3) ACGIH STEL

MEASUREMENT METHOD: CHARCOAL TUBE; CARBON DISULFIDE; GAS CHROMATOGRAPHY WITH
FLAME IONIZATION DETECTION; (NIOSH VOL. III # 1500, HYDROCARBONS).

ALKANES (C5-C8):

350 MG/M3 NIOSH RECOMMENDED 10 HOUR TWA;
1800 MG/M3 NIOSH RECOMMENDED 15 MINUTE CEILING

**OSHA LIMITS ADOPTED JANUARY 19, 1989 ARE SUBJECT TO THE DECISION OF THE
11TH CIRCUIT COURT OF APPEALS (AFL-CIO V. OSHA) AS OF JULY 7, 1992.**

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID, FAINT ODOR, VERY VOLATILE

BOILING POINT: 136 F (58 C) MELTING POINT: -139 F (-95 C)

SPECIFIC GRAVITY: 0.7 VAPOR PRESSURE: 124 MMHG @ 20 C

SOLUBILITY IN WATER: INSOLUBLE VAPOR DENSITY: 3.0

SOLVENT SOLUBILITY: ALCOHOL, CHLOROFORM, ETHER

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:

DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE
OF IGNITION AND FLASH BACK.

VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

DUE TO LOW ELECTROCONDUCTIVITY OF THE SUBSTANCE, FLOW OR AGITATION MAY
GENERATE ELECTROSTATIC CHARGES RESULTING IN SPARKS WITH POSSIBLE IGNITION.

FLASH POINT: -7 F (-22 C) (CC) UPPER EXPLOSIVE LIMIT: 7.5%

LOWER EXPLOSIVE LIMIT: 1.1% AUTOIGNITION TEMP.: 437 F (223 C)

FLAMMABILITY CLASS(OSHA): 1B

ACC10751

PAGE 03

FIREFIGHTING MEDIA:

DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR REGULAR FOAM
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR REGULAR FOAM
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

F) REFIGHTING:

MOVE CONTAINER FROM FIRE AREA IF YOU CAN DO IT WITHOUT RISK. APPLY COOLING WATER TO SIDES OF CONTAINERS THAT ARE EXPOSED TO FLAMES UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM ENDS OF TANKS. FOR MASSIVE FIRE IN CARGO AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES; IF THIS IS IMPOSSIBLE, WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF TANK DUE TO FIRE. ISOLATE FOR 1/2 MILE IN ALL DIRECTIONS IF TANK, RAIL CAR OR TANK TRUCK IS INVOLVED IN FIRE (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5, GUIDE PAGE 27).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG. SOLID STREAMS MAY NOT BE EFFECTIVE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER. APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS; KEEP UPWIND. EVACUATE TO A RADIUS OF 1500 FEET FOR UNCONTROLLABLE FIRES. CONSIDER EVACUATION OF DOWNWIND AREA IF MATERIAL IS LEAKING.

WATER MAY BE INEFFECTIVE (NFPA 325M, FIRE HAZARD PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND VOLATILE SOLIDS, 1991)

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49-CFR 172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49-CFR 172.101 AND
SUBPART E:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49-CFR 173.119
EXCEPTIONS: 49-CFR 173.118

FINAL RULE ON HAZARDOUS MATERIALS REGULATIONS (HMR, 49 CFR PARTS 171-180),
DOCKET NUMBERS HM-181, HM-181A, HM-181B, HM-181C, HM-181D AND HM-204.
EFFECTIVE DATE OCTOBER 1, 1991. HOWEVER, COMPLIANCE WITH THE REGULATIONS IS
AUTHORIZED ON AND AFTER JANUARY 1, 1991. (55 FR 52402, 12/21/90)

EXCEPT FOR EXPLOSIVES, INHALATION HAZARUS, AND INFECTIOUS SUBSTANCES, THE
EFFECTIVE DATE FOR HAZARD COMMUNICATION REQUIREMENTS IS EXTENDED TO
OCTOBER 1, 1993. (56 FR 47158, 09/18/91)

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
HEXANES-UN 1208

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
3 - FLAMMABLE LIQUID

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG 11

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101
AND SUBPART E:
FLAMMABLE LIQUID

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.150
NON-BULK PACKAGING: 49 CFR 173.202
BULK PACKAGING: 49 CFR 173.242

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 5 L
CARGO AIRCRAFT ONLY: 60 L

TOXICITY

N-HEXANE:

IRRITATION DATA: 10 MG EYE-RABBIT MILD.

TOXICITY DATA: 190 PPM/8 WEEKS INHALATION-HUMAN TCLO; 120 GM/KG

INHALATION-MOUSE LCLO; 28,710 MG/KG ORAL-RAT LD50; 831 MG/KG

INTRAVENOUS-MOUSE LCLO; 132 MG/KG INTRAVENOUS-RABBIT LCLO; 9100 MG/KG

INTRAPERITONEAL-RAT LCLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS
DATA (RTECS).

CARCINOGEN STATUS: NONE.

LOCAL EFFECTS: IRRITANT- SKIN, EYE.

ACUTE TOXICITY LEVEL: RELATIVELY NON-TOXIC BY INGESTION.

TARGET EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT; NEUROTOXIN.

AT INCREASED RISK FROM EXPOSURE: PERSONS WITH SKIN, PULMONARY, LIVER, OR
KIDNEY DISORDERS.

ADDITIONAL DATA: ALCOHOL MAY ENHANCE THE TOXIC EFFECT. A LOW ORDER OF
MYOCARDIAL SENSITIZATION TO EPINEPHRINE MAY OCCUR. ACETONE AND METHYL ETHYL
KETONE MAY ENHANCE THE TOXIC EFFECTS.

2-METHYLPENTANE:

CARCINOGEN STATUS: NONE.

LOCAL EFFECTS: IRRITANT- INHALATION, SKIN, EYES.

ACUTE TOXICITY LEVEL: NO DATA AVAILABLE.

TARGET EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT.

ADDITIONAL DATA: STIMULANTS SUCH AS EPINEPHRINE MAY INDUCE VENTRICULAR
FIBRILLATION.

3-METHYLPENTANE:

CARCINOGEN STATUS: NONE.

LOCAL EFFECTS: IRRITANT- SKIN, EYE, MUCOUS MEMBRANES.

ACUTE TOXICITY LEVEL: NO DATA AVAILABLE.

TARGET EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT.

ADDITIONAL DATA: CONSUMPTION OF ALCOHOL MAY POTENTIATE THE TOXIC EFFECTS. USE
OF STIMULANTS SUCH AS EPINEPHRINE MAY INDUCE VENTRICULAR FIBRILLATION.

2,3-DIMETHYLBUTANE:

CARCINOGEN STATUS: NONE.

LOCAL EFFECTS: IRRITANT- INHALATION, SKIN, EYE.

ACUTE TOXICITY LEVEL: NO DATA AVAILABLE.

TARGET EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT.

ADDITIONAL DATA: ALCOHOL MAY ENHANCE THE TOXIC EFFECTS. STIMULANTS SUCH AS
EPINEPHRINE MAY INDUCE VENTRICULAR FIBRILLATION.

METHYLCYCLOPENTANE:

TOXICITY DATA: 95,000 MG/H3 INHALATION-ROUSE LCLO.

CARCINOGEN STATUS: NONE.

LOCAL EFFECTS: IRRITANT- INHALATION, SKIN, EYE.

ACUTE TOXICITY LEVEL: INSUFFICIENT DATA.

TARGET EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT.

ADDITIONAL DATA: ALCOHOL MAY ENHANCE THE TOXIC EFFECTS. USE OF STIMULANTS SUCH AS EPINEPHRINE MAY INDUCE VENTRICULAR FIBRILLATION.

2,2-DIMETHYLPENTANE:

CARCINOGEN STATUS: NONE.

ACUTE TOXICITY LEVEL: NO DATA AVAILABLE.

TARGET EFFECTS: POISONING MAY AFFECT THE CENTRAL NERVOUS SYSTEM.*

* MAY BE BASED ON GENERAL ALIPHATIC HYDROCARBON INFORMATION.

2,4-DIMETHYLPENTANE:

CARCINOGEN STATUS: NONE.

ACUTE TOXICITY LEVEL: NO DATA AVAILABLE.

TARGET EFFECTS: NO DATA AVAILABLE.

HEALTH EFFECTS AND FIRST AID

INHALATION:

N-HEXANE:

IRRITANT/NARCOTIC/NEUROTOXIN.

5000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- 880 PPM FOR 15 MINUTES HAS CAUSED UPPER RESPIRATORY TRACT IRRITATION. EXPOSURE TO 1000-5000 PPM MAY PRODUCE HEADACHE, NAUSEA, AND DIZZINESS. OTHER EFFECTS MAY INCLUDE GIDDINESS, COUGHING, NUMBNESS IN THE EXTREMITIES, DIFFICULTY WALKING, DEFECTS OF MEMORY, EXCITEMENT FOLLOWED BY DEPRESSION, AND UNCONSCIOUSNESS. ANESTHESIA OF SHORT DURATION WITHOUT SEQUELA IS POSSIBLE. PULMONARY EDEMA, CARDIAC ARRHYTHMIAS, BRAIN DAMAGE, CARDIAC ARREST AND DEATH MAY RESULT. HIGH CONCENTRATIONS MAY PRODUCE ASPHYXIA. CONVULSIONS HAVE BEEN PRODUCED IN ANIMALS.

CHRONIC EXPOSURE- RESULTS IN AXONAL NEUROPATHY. NEUROPATHY IS OF AN INSIDIOUS BILATERAL, SYMMETRICAL, SENSORIMOTOR, PERIPHERAL NATURE. 100 PPM DAILY MAY PRODUCE CHANGES IN MUSCLE STRENGTH. PROLONGED EXPOSURE MAY CAUSE EFFECTS AS IN ACUTE EXPOSURE AS WELL AS MEMORY LOSS, PROGRESSIVE WEAKNESS, ACHING MUSCLES, SENSORY LOSS IN FEET AND HANDS, GALE CRAMPS, FACIAL NUMBNESS, IMPOTENCE, BLURRED VISION, COLOR VISION ABNORMALITIES, AND PARALYSIS OF MUSCLES USUALLY OF LOWER LIMBS. EXAMINATION REVEALS HYPOACTIVE DEEP KNEE REFLEXES, BILATERAL FOOTDROP, REDUCTION IN NERVE AND SENSITIVE CONDUCTION VELOCITIES, MODIFICATION OF DISTAL LATENCY, DIMINISHING OF SENSORY POTENTIAL, AND NEUROGENIC ATROPHY OF SKELETAL MUSCLE. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

HEXANES (OTHER THAN N-HEXANE):

IRRITANT/NARCOTIC.

ACUTE EXPOSURE- MAY CAUSE IRRITATION TO THE MUCOUS MEMBRANES. LIQUID ALIPHATICS, C5-C9, HAVE ANESTHETIC AND CENTRAL NERVOUS SYSTEM DEPRESSANT ACTIONS. SYMPTOMS MAY INCLUDE, BUT ARE NOT LIMITED TO, DIZZINESS, DROWSINESS, INCOORDINATION, CONVULSIONS, COLLAPSE OR COMA. SOME ISOHEXANE ISOMERS HAVE BEEN DOCUMENTED TO SENSITIZE THE MYOCARDIUM TO EPINEPHRINE.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE TO ALIPHATIC HYDROCARBONS MAY RESULT IN EFFECTS AS DESCRIBED IN ACUTE EXPOSURE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:

N-HEXANE:

IRRITANT.

ACUTE EXPOSURE- VAPOR MAY CAUSE IRRITATION WITH REDNESS. 2 ML/KG/4 HOURS ON RABBIT SKIN RESULTED IN ATAXIA AND RESTLESSNESS. AT 5 ML/KG/4 HOURS SOME DEATHS OCCURRED.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE DERMATITIS DUE TO DEFATTING. BLISTER FORMATION, LICHENING, ERYTHEMA, PIGMENTATION AND PAIN HAVE BEEN REPORTED. SKIN EXPOSURES MAY ENHANCE NEUROTOXIC EFFECTS FROM INHALATION EXPOSURE.

HEXANES (OTHER THAN N-HEXANE):

IRRITANT.

ACUTE EXPOSURE- MAY CAUSE IRRITATION AND BE ABSORBED THROUGH THE SKIN.

CHRONIC EXPOSURE- THE C5 AND HIGHER LIQUID ALIPHATIC HYDROCARBONS ARE FAT SOLVENTS, AND REPEATED OR PROLONGED CONTACT MAY RESULT IN DEFATTING DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:

N-HEXANE:

IRRITANT.

ACUTE EXPOSURE- CONTACT MAY CAUSE IRRITATION WITH REDNESS AND PAIN. VAPORS AT 880 PPM FOR 15 MINUTES CAUSED IRRITATION.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH IRRITANTS MAY CAUSE CONJUNCTIVITIS.

HEXANES (OTHER THAN N-HEXANE):

IRRITANT.

ACUTE EXPOSURE- MAY CAUSE IRRITATION. MOST LIQUID HYDROCARBONS CAUSE LITTLE OR NO INJURY ON DIRECT EXTERNAL CONTACT WITH THE EYE.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH IRRITANTS MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:

N-HEXANE:

NARCOTIC.

ACUTE EXPOSURE- MAY CAUSE CENTRAL NERVOUS SYSTEM EFFECTS, HEADACHE, NAUSEA, VOMITING, VERTIGO, BRONCHIAL AND GENERAL INTESTINAL IRRITATION WITH ABDOMINAL SWELLING AND PAIN. THE FATAL HUMAN DOSE MAY BE ABOUT 50 GRAMS. MAY VAPORIZE WHEN ASPIRATED INTO THE TRACHEOBRONCHIAL TREE WITH A RESULTANT RAPID DILUTION OF ALVEOLAR AIR AND MARKED FALL IN ITS OXYGEN CONTENT, WITH CONSEQUENT BRAIN DAMAGE OR CARDIAC ARREST.

CHRONIC EXPOSURE- REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

HEXANES (OTHER THAN N-HEXANE):

NARCOTIC.

ACUTE EXPOSURE- MAY CAUSE GASTROINTESTINAL DISTURBANCES. IF SUFFICIENT AMOUNTS OF ALIPHATIC HYDROCARBONS ARE INGESTED AND RETAINED, CENTRAL NERVOUS SYSTEM DEPRESSION MAY OCCUR. SYMPTOMS MAY INCLUDE, BUT ARE NOT LIMITED TO, NAUSEA, VOMITING, DIZZINESS, DROWSINESS, INCOORDINATION, CONVULSIONS, AND COMA. IN ANIMAL STUDIES, ASPIRATION OF 0.2 ML OF C6-C8 ALIPHATICS CAUSED ALMOST IMMEDIATE DEATH DUE TO RESPIRATORY PARALYSIS, ASPHYXIA AND LARYNGEAL ARREST.

CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- EXTREME CARE MUST BE USED TO PREVENT ASPIRATION. USE GASTRIC LAVAGE WITH ACTIVATED CHARCOAL AND A CUFFED ENDOTRACHEAL TUBE WITHIN 15 MINUTES. IN THE ABSENCE OF DEPRESSION OR CONVULSIONS OR IMPAIRED GAG REFLEX, IFECAC EMESIS CAN BE DONE. WHEN VOMITING BEGINS, KEEP HEAD LOWER THAN HIPS TO PREVENT ASPIRATION. AFTER VOMITING STOPS, GIVE 30-60 MILLILITERS OF FLEET'S PHOSPHO-SODA DILUTED 1:4 IN WATER. MAINTAIN AIRWAY, BLOOD PRESSURE AND RESPIRATION. (GREISBACH, HANDBOOK OF POISONING, 11TH ED.) TREATMENT MUST BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL. GET MEDICAL ATTENTION.

ANTIDOTE:

NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY
REACTIVITY:

STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:**N-HEXANE:**

CALCIUM HYPOCHLORITE: FIRE AND EXPLOSION HAZARD.
 CHLORINE (LIQUID): FIRE AND EXPLOSION HAZARD.
 DINITROGEN TETRAOXIDE: POSSIBLE EXPLOSION HAZARD.
 OXIDIZERS (STRONG): FIRE AND EXPLOSION HAZARD.
 OXYGEN (CONCENTRATED): FIRE AND EXPLOSION HAZARD.
 PLASTICS, RUBBER, AND COATINGS: MAY BE ATTACKED.
 SODIUM HYPOCHLORITE: FIRE AND EXPLOSION HAZARD.

DECOMPOSITION:

THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:

HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSEVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

****STORAGE****

STORE IN ACCORDANCE WITH 29 CFR 1910.106.

BONDING AND GROUNDING: SUBSTANCES WITH LOW ELECTROCONDUCTIVITY, WHICH MAY BE IGNITED BY ELECTROSTATIC SPARKS, SHOULD BE STORED IN CONTAINERS WHICH MEET THE BONDING AND GROUNDING GUIDELINES SPECIFIED IN NFPA 77-1983, RECOMMENDED PRACTICE ON STATIC ELECTRICITY.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

***DISPOSAL**

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262, EPA HAZARDOUS WASTE NUMBER D001, 100 POUND CERCLA SECTION 103 REPORTABLE QUANTITY.

***** CONDITIONS TO AVOID

AVOID CONTACT WITH HEAT, SPARKS, FLAMES, OR OTHER SOURCES OF IGNITION. VAPORS MAY BE EXPLOSIVE. AVOID OVERHEATING OF CONTAINERS; CONTAINERS MAY VIOLENTLY RUPTURE IN HEAT OF FIRE. AVOID CONTAMINATION OF WATER SOURCES.

***** SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND RESTRICT ENTRY.

----- PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
THE FOLLOWING RESPIRATORS ARE RECOMMENDED BASED ON INFORMATION FOUND IN THE PHYSICAL DATA, TOXICITY AND HEALTH EFFECTS SECTIONS. THEY ARE RANKED IN ORDER FROM MINIMUM TO MAXIMUM RESPIRATORY PROTECTION.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST BE BASED ON THE SPECIFIC OPERATION, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND MUST BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

ANY TYPE 'C' SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE, HELMET OR HOOD OPERATED IN CONTINUOUS-FLOW MODE.

ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

ANY SELF-CONTAINED BREATHING APPARATUS THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

ANY SUPPLIED-AIR RESPIRATOR THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

CLOTHING:

EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:

EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:

EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

EMERGENCY EYE WASH: WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC, INC.
CREATION DATE: 05/23/85 REVISION DATE: 10/12/92

-ADDITIONAL INFORMATION-

THIS INFORMATION IS BELIEVED TO BE ACCURATE AND REPRESENTS THE BEST INFORMATION CURRENTLY AVAILABLE TO US. HOWEVER, WE MAKE NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, WITH RESPECT TO SUCH INFORMATION, AND WE ASSUME NO LIABILITY RESULTING FROM ITS USE. USERS SHOULD MAKE THEIR OWN INVESTIGATIONS TO DETERMINE THE SUITABILITY OF THE INFORMATION FOR THEIR PARTICULAR PURPOSES.



Material Safety Data Sheet

Emergency Telephone (313) 281-0930

SECTION I — PRODUCT IDENTIFICATION

Product		RELLAD
PC	2962A	R 5/82
Description		Chemical Mixture — Alkaline Soak Cleaner

SECTION II — HAZARDOUS INGREDIENTS

CAS Number	Chemical Component	%	TLV (Units)	Hazard Data
1303-96-4	Sodium borate	<75	-	Severely irritating to eyes, skin and mucous membranes.

SECTION III — PHYSICAL DATA

☒ Solid ☐ Liquid	Appearance and Odor	White, free-flowing granular powder
Specific Gravity	pH at 25°C	
64 lbs/ft ³	1% solution 9.4	
Solubility in Water	Freezing Point	
Complete	N/A	
Percent Volatiles (by weight)	Phosphorus	
None	None	

SECTION IV — FIRE AND EXPLOSIVE HAZARD DATA

Flash Point (method)	Flammable Limits	LFL	UFL
N/A	Not combustible	-	-
Extinguishing Media			
Water, water fog			
Special Fire Hazards and Equipment Required			
Product makes alkaline solution when dissolved in water. Good firefighting practice dictates the use of self-contained breathing apparatus and turn-out gear for fires in the areas where product is stored.			

SECTION V — REACTIVE HAZARDS

Product	Unstable at	Hazardous Polymerization	Will Not Occur
Yes	— °F — °C	None	May Occur
Conditions			
Do not mix with acids as heat may be generated.			
Avoid			
Incompatibility			
None known.			
(Materials to Avoid)			
Hazardous			
May form some carbon monoxide and dioxide during			

SECTION VI — HEALTH HAZARDS

Eyes Severe irritation or burns may result in redness, pain and possible reversible corneal damage.

Irritating to skin.

Ingestion May cause pain, nausea and gastric distress. Large amounts may cause central nervous system effects and kidney damage.

Inhalation Avoid breathing dust which is irritating to nose, throat and lung tissue.

Threshold Limit Value
Not established

Principal Routes of Absorption

Ingestion, inhalation or topical contact.

Acute Effects of Overexposure

Irritation due to aklaline nature of ingredients.

Chronic Effects of Overexposure

None known.

FIRST AID PROCEDURE—NEVER GIVE FLUIDS OR INDUCE VOMITING IF PATIENT IS UNCONSCIOUS OR HAVING CONVULSIONS. CALL A PHYSICIAN.

Eyes Flush eyes immediately with water for at least 15 minutes. Get immediate medical attention.

Skin Flush with water. If irritation develops, contact a physician.

Ingestion If swallowed, drink large amounts of water or milk. DO NOT induce vomiting. Get medical attention.

Inhalation If inhaled, remove to fresh air. If breathing difficulty persists, get medical attention.

SECTION VII — NORMAL HANDLING PROCEDURES

Precautions to be taken
in Handling and Storage.

Store in a cool, dry area. Do not store with acids.
KEEP OUT OF REACH OF CHILDREN.

Do not contaminate food or feed.

Protective Equipment

Eyes Goggles or side-shield safety glasses

Gloves Rubber or chemical resistant

Other Clothing to prevent skin contact

Ventilation Requirements

Mechanical to control dust or mist.

Corrosive Action on
Materials

None known.

SECTION VIII — SPILL OR LEAK CONTROL PROCEDURES

Steps to be taken in case of Spills. Sweep up and place in a metal container. Bury in an approved chemical landfill. Rinse affected areas.

Waste Disposal
Methods

Makes alkaline solutions with water. May require neutralization with dilute acids to a specific pH before discharge to a sanitary sewer. Consult local regulations.

The above information is believed to be accurate and discloses the known hazards for this product as of this date. No additional warranties are made.

Date 10/22/82

Signed

Beryaffe

JUN 17 1983

MATERIAL SAFETY DATA SHEET

Page 1 of 3

IDENTIFICATION

Name Nitric Acid, 38°, 40°, 42° Bé Tech and Reagent Grades	Chemical Family Inorganic Acid
Synonyms Weak Nitric Acid	CAS Registry No. 7697-37-2
CAS Name Nitric Acid	Chemical Formula: HNO ₃ (in water)
I.D. Nos./Codes NIOSH Registry No: QU 57750	Product Information and Emergency Phone (302) 774-2421
Wiswesser Code = HN-03	Transportation Emergency Phone (800) 424-9300
Manufacturer/Distributor E. I. Du Pont de Nemours & Co., (Inc.)	
Address Wilmington, DE 19898	

HAZARDOUS COMPONENTS

Material(s) Nitric Acid 38° 40° 42° Reagent	Approximate % 56.5 61.4 67.2 70.4

PHYSICAL DATA

Boiling Point , 760 mm Hg 119-122°C (246-252°F)	Melting Point -20° to -41°C (-4° to -42°F)
Specific Gravity 1.355-1.422 @ 15.6°C (60°F) (H ₂ O = 1)	Vapor Pressure mm Hg @ 25°C (77°F) = 9-10; @ 37.7°C (100°F) = 19-20
Vapor Density 1 (Air = 1)	Solubility in H₂O 100%
% Volatiles by Vol. 100%	Evaporation Rate (Butyl Acetate = 1) ~1
Form Liquid	Color Colorless to light brown
Appearance Clear	Odor Acrid
pH Information < 1	Octanol/Water Partition Coefficient

FIRE AND EXPLOSION DATA

Flash Point Will not burn	Method	Autoignition Temperature
Flammable Limits in Air, % by Vol.	Lower	Upper

Fire and Explosion Hazards Oxidizer. Nitric acid increases combustibility and can cause ignition of organic or oxidizable materials. Fire or spillage may produce extremely toxic nitrogen oxide gases. Reaction with many metals gives flammable/explosive hydrogen gas.

Extinguishing Media: For Fires in area, use water spray to cool nitric acid tanks or containers.

Special Fire Fighting Instructions Wear self-contained breathing apparatus and full acid protective clothing (see PROTECTION INFORMATION on back of page) where possibility of fumes or acid contact exists.

Instability

Releases toxic gases with heat.

Incompatibility Cyanides and sulfides. Reacts vigorously with organics (especially turpentine), oxidizable inorganics, metals (especially powders), and carbides.

Decomposition

Can occur, as above.

Polymerization

Will not occur.

HEALTH HAZARD INFORMATION

Exposure Limits

OSHA 8-hour Time Weighted Average (TWA) Nitric Acid = 2 ppm, 5 mg/m³; ceiling (nitrogen dioxide) = 5 ppm, 9 mg/m³; ACGIH TLV® - 2 ppm, 5 mg/m³ (Nitric Acid).

Routes of Exposure and Effects

Liquid and vapor cause severe burns.

Harmful if inhaled. May cause delayed lung injury.

Toxic oxides of nitrogen and other dangerous gases may be released when nitric acid is used.

First Aid

SEE ATTACHED.

PROTECTION INFORMATION

Ventilation Use only with ventilation adequate to maintain air concentration below exposure limit. Keep in well ventilated room.

Personal Protective Equipment Coverall chemical safety glasses, rubber gloves and footwear. If potential for major exposure, wear full protective clothing including rubber acid suit, hard hat and air-supplied respirator.

DISPOSAL PROCEDURES

Aquatic Toxicity

TLm 96 = 100-10 ppm.

Spill, Leak or Release Keep upwind of leak; evacuate until gas has dispersed. Dike major spills. Neutralize with lime or soda ash. Flush spill area with plenty of water to wastewater treatment system. Do not flush concentrated acid into sewers.

Waste Disposal: Dispose of in accordance with Federal, State & local regulations. If approved, drain neutralized or dilute acid to sewer to waste treatment plant.

SHIPPING PRECAUTIONS

Transportation DOT Shipping Name - Nitric Acid (over 40%). DOT Hazard Class = oxidizer. STC Code 49 185 28. UN No. 2031. IMCO Class 8.

Shipping Containers

Railroad tank cars, tank trucks.

Storage Conditions

SEE ATTACHED.

REFERENCES AND ADDITIONAL INFORMATION

Do not breathe vapor.

Do not get in eyes, on skin or clothing.

Wash thoroughly after handling.

For more information refer to: Du Pont Nitric Acid Storage & Handling Bulletin
Du Pont Nitric Acid Data Sheet

DATE: 2/80



NITRIC ACID, 38°, 40°, 42° & REAGENT MSDS ATTACHMENTHEALTH HAZARD INFORMATIONFirst Aid

In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse.

If inhaled, remove person to fresh air immediately. Have patient lie down and keep quiet. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a physician.

If swallowed, call a physician. Do not induce vomiting. Give large quantities of water containing any of the following: Milk of Magnesia, milk, magnesium oxide, whites of eggs, or olive oil. Avoid carbonates. Never give anything by mouth to an unconscious person.

SHIPPING PRECAUTIONSStorage Conditions

Keep container closed. Keep out of sun and away from heat. Keep away from fire, sparks and flame. Loosen closures carefully. Never use pressure to empty. Container must not be washed out or used for other purposes. Do not store near cyanides, sulfides, organics, metal powders, carbides, or other readily oxidizable materials.

DATE: 2/80

SECTION V - HEALTH HAZARD DATA

TESTED LIMIT VALUE

NONE

EFFECTS OF OVEREXPOSURE

WASH WITH COOL WATER

EMERGENCY AND FIRST AID PROCEDURES

WASH WITH COOL WATER & SOAP

SECTION VI - REACTIVITY DATA

STABILITY

UNSTABLE

CONDITIONS TO AVOID

STABLE

INCOMPATIBILITY (Materials to avoid)

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS
POLYMERIZATION

MAY OCCUR

CONDITIONS TO AVOID

WILL NOT OCCUR

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

WASTE DISPOSAL METHOD

FLUSH DOWN WATERWAYS

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)

1 NORMAL WORK CLOTHING

VENTILATION

LOCAL EXHAUST

YES

SPECIAL

MECHANICAL (General)

OTHER

PROTECTIVE GLOVES

EYE PROTECTION

OTHER PROTECTIVE EQUIPMENT

HANDLE AS A TOXIC BY ORAL INGESTION. OBSERVE GOOD HOUSE-KEEPING MEASURES.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Dept. of Transportation Shipping Name (CFR 49 Sec.172.101)

Dept. of Transportation Hazard Class (CFR 49 Sec.172.101)

Dept. of Transportation Label Req'd. (CFR 49 Sec.172.407 - 172.450)

Signature of Authorized Agent

Name (Printed) of Agent CARL C. LODICO

Position PRESIDENT

Company ALCOR CHEMICAL COMPANY, INC.

Date NOVEMBER 30, 1982

MATERIAL SAFETY DATA SHEET

JUN 17 1983

Page 1 of 3

IDENTIFICATION

Name

Hydrochloric Acid, 20° Technical & Food Processing, and Reagent

Synonyms Muriatic Acid, hydrogen chloride, Chemical Family

chlorohydric acid

Inorganic Acid

CAS Name

CAS Registry No.

Hydrochloric Acid

7647-01-0

I.D. Nos./Codes NIOSH Access No. = MW40250

Chemical Formula:

Wiswesser Line Notation = G.H.

HCl (aqueous solution)

Manufacturer/Distributor

Product Information and Emergency Phone

E. I. du Pont de Nemours & Co., (Inc.)

(302) 774-2421

Address

Transportation Emergency Phone

Wilmington, DE 19898

(800) 424-9300

HAZARDOUS COMPONENTS

Material(s)

Approximate %

Hydrogen Chloride

31.5%

20° tech. & F.P.

37.4%

Reagent

PHYSICAL DATA

Boiling Point, 760 mm Hg

20° = 83°C (181°F) Reagent = 50°C (122°F) 20° = 46°C (-51°F) Reagent = 26°C (15°F)

Specific Gravity

(60°/60°F): 20° = 1.16; Reagent = 1.19

Vapor Pressure:

mm Hg @ 25°C: 20° = 35; Reagent 240

@ 37.7°C: 20° = 77 Reagent = 470

Vapor Density

Solubility in H₂O

1.27

100

% Volatiles by Vol.

Evaporation Rate (Butyl Acetate = 1) > 1

100%

Form

Appearance

Color Colorless to

Odor

Liquid

Clear

Light Yellow

Pungent, acrid

pH Information < 1

Octanol/Water Partition Coefficient

FIRE AND EXPLOSION DATA

Flash Point

Method

Autoignition Temperature

Not flammable

Flammable Limits in Air, % by Vol.

Lower

Upper

Fire and Explosion Hazards May generate flammable and potentially explosive hydrogen gas upon contact with metals. Explosive concentration of hydrogen may accumulate inside metal equipment.

Extinguishing Media

For fires in area, water, foam, dry chemical, CO₂.

Special Fire Fighting Instructions Neutralize with chemically alkaline substances, such as soda ash or slaked lime to avoid formation of potentially explosive hydrogen gas. Cool tanks with water, if exposed to fire.

Instability

Stable, but reacts with many chemicals.

Incompatibility

See attached page 3.

Decomposition

Heat can cause release of gaseous HCl.

Polymerization

Will not occur.

HEALTH HAZARD INFORMATION**Exposure Limits**

OSHA 8-hour Time Weighted Average (TWA); ACGIH TLV® = 5 ppm, 7 mg/m³.

Routes of Exposure and Effects Causes eye and skin burns. Ingestion causes severe burns of mouth, esophagus and stomach. Vapor extremely irritating.

First Aid

See attached page 3.

PROTECTION INFORMATION**Ventilation**

Use only with adequate ventilation. Keep in well ventilated room.

Personal Protective Equipment

Chemical splash goggles, rubber or plastic gloves, rubber boots, chemical suit.

Other**DISPOSAL PROCEDURES****Aquatic Toxicity****Spill, Leak or Release**

See attached page 3.

Waste Disposal

See attached page 3.

SHIPPING PRECAUTIONS

Transportation DOT Shipping Name: Hydrochloric Acid. DOT Hazard Class: Corrosive Material. STCC Code = 49 302 28. UN No. 1789. IMCO Class 8.

Shipping Containers

Railroad tank cars, tank trucks, drums, carboys and bottles.

Storage Conditions

See attached page 3.

REFERENCES AND ADDITIONAL INFORMATION

Do not get in eyes, on skin or clothing.

Avoid breathing vapor.

Wash thoroughly after handling.

For more information, refer to: Du Pont Hydrochloric Acid Storage & Handling Bulletin.
Du Pont Hydrochloric Acid Data Sheet.

DATE: 8/79



JUN 17 1983

HYDROCHLORIC ACID MSDS ATTACHMENTHAZARDOUS REACTIVITYIncompatibility

Corrosive to most metals, with evolution of hydrogen. Oxidizing materials. Cyanides, sulfides, formaldehyde (may release toxic HCN, H₂S, or OSHA regulated carcinogen bischloromethyl ether).

HEALTH HAZARD INFORMATIONFirst Aid

In case of contact, immediately flush eyes or skin with plenty of water, for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse.

If swallowed, do not induce vomiting. Have patient drink large quantities of water immediately. Call a physician. Do not give carbonates. Do not give anything by mouth to an unconscious person.

If inhaled, remove person to fresh air immediately, have patient lie down and keep quiet. Apply artificial respiration, preferably mouth-to-mouth, if breathing has stopped. Administer oxygen if breathing is difficult. Call a physician.

DISPOSAL PROCEDURESSpill, Leak or Release

Evacuate area; keep upwind until gas has dispersed. Wear self-contained breathing apparatus if necessary to enter spill area. Dike large spills. Flush with plenty of water applied to entire spill area. Neutralize washings with lime or soda ash. Do not flush to sewer before neutralizing.

Waste Disposal

Comply with Federal, State and Local regulations. If approved, drain neutralized washings to sewer to waste treatment plant, or give to disposal contractor.

SHIPPING PRECAUTIONSStorage Conditions

Keep container tightly closed. Keep away from heat, sparks & flame. Keep in cool place. Do not store or mix with cyanides, sulfides or formaldehyde. Protect container from damage.



Properties: A clear, colourless to slightly yellow aqueous solution of hydrogen chloride (HCl); has an irritating pungent odour and is highly corrosive; fumes in moist air; highly soluble in water with the evolution of heat; available in 20° Bé and 23° Bé grades.

• Specific gravity	1.1600	20.0 Be
at 15.5°C (60°F)	1.1885	23.0 Be
• Hydrochloric acid (HCl)	31.45%	20.0 Be
	37.14%	23.0 Be
• Freezing point	-40°C (-40°F)	20.0 Be
(approx)	-27°C (-17°F)	23.0 Be
• Boiling point	99°C (210°F)	20.0 Be
at 760 mm Hg	82°C (180°F)	23.0 Be

Specification:	20° Bé Grade	23° Bé Grade
Baume gravity at 15.5°C (60°F)	20.0 Be min	23.0 Be min
Total sulphates (as H ₂ SO ₄)	40 ppm max	40 ppm max
Free chlorine (Cl)	10 ppm max	10 ppm max
Iron (Fe)	2 ppm max	2 ppm max
Heavy metals (as Hg)	2 ppm max	2 ppm max
Arsenic (As)	0.01 ppm max	0.01 ppm max
Colour (APHA)	5-10*	5-10*

*Water white on request.

Both grades of CIL manufactured hydrochloric acid meet F.C.C. specifications.

Containers: 20° Bé acid is shipped in 19 liters (5 U.S. g) polyethylene containers — delcans (returnable), cubitainers and galaxee (both non-returnable); in 205 liters (45 I.G.) polyethylene Plast-I-Cube and polylined steel drums (both returnable); in tank trucks and tank cars; 23° Bé acid is shipped in tank trucks and tank cars.

Fire hazards: Nonflammable, but can cause ignition of combustible materials; attacks most metals with the evolution of hydrogen gas which may form explosive mixtures with air; when heated, hydrogen chloride is released which is corrosive and extremely irritating.

Health hazards: A corrosive mineral acid which causes severe burns to eyes and skin. Vapours are extremely irritating to eyes, nose and throat.

- Avoid breathing vapour; do not get in eyes, on skin, on clothing.

- Adequate ventilation systems should be provided; threshold limit value 5 ppm; vapours are heavier than air; vapour density 1.3; H₂ gas is lighter than air.
- Wear acid goggles, rubber gloves and protective clothing when handling.
- Safety showers and eye-wash fountains should be installed in storage and handling areas.
- In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes; remove contaminated clothing and shoes.
- In case of exposure, remove to fresh air. If not breathing, give artificial respiration, preferably mouth to mouth. If breathing is difficult, give oxygen.
- If swallowed, give three to four glasses of milk or water; do not induce vomiting.
- Get medical help promptly.

Storage: Store containers in dry well-ventilated location away from metals and oxidizing materials (particularly nitric acid and chlorates); safeguard from mechanical damage; keep out of sun and away from all direct sources of heat.

Handling materials: Use P.T.F.E. (Fluon, Teflon), rubber, rubber-lined steel, PVC, polyethylene, fiber-glass reinforced plastics, polypropylene, carbon, glass, ceramics and tantalum for all equipment coming in contact with hydrochloric acid; consult materials supplier on handling and storage requirements before making final selection.

Handling procedures:

Warning! Causes burns
Vapour harmful

Make sure closure on any container is securely fastened before moving; do not drop containers or strike against sharp objects; loosen closure slowly and carefully before opening; contents may be dispensed by syphon, displacement pump, or by pouring; use suitable safe tilting device when necessary; do not use air pressure to dis-



C-I-L Chemicals, Inc.
55 Post Road West
West Port, CT. 06881

Hydrochloric Acid

HCl

Muriatic Acid

pense acid; when diluting, always add acid slowly to water; do not add water to acid stored in shipping container; always refasten closure securely after completing dispensing operation; in case of minor spillage, neutralize acid with soda ash or other mild alkali before washing away with plenty of water; if spillage is liable to affect

environment, notify nearest pollution control authority promptly (mandatory in most provinces); always drain and rinse disposable containers thoroughly with water before discarding; always drain returnable containers completely and fasten all closures securely before shipping.

DISTRIBUTED BY

THE HUBBARD-HALL CHEMICAL CO.

Waterbury, CT 06725
(203) 756 5521



C-I-L Chemicals, Inc.
55 Post Road West
West Port, CT. 06881

MATERIAL SAFETY DATA SHEET

Product Name: Poison Oak-N-Ivy ARMOR
Tec Laboratories, Inc.

Page 1 of 4
Issue Date: 09/08/93

SECTION I - COMPANY AND PRODUCT INFORMATION

MANUFACTURER:
Tec Laboratories, Inc.
P. O. Box 1958
Albany, OR 97321

PRODUCT NAME:
Poison Oak-N-Ivy ARMOR

CHEMICAL FAMILY:
Lotion

EMERGENCY TELEPHONE NUMBERS:
(503) 926-4577
(503) 926-0769

CAS NUMBER:
Not available for this mixture

PRODUCT DESCRIPTION:
Lotion for conditioning skin before
exposure to poison oak, ivy and
sumac.

SECTION II - HAZARDOUS INGREDIENTS

CAS #	CHEMICAL NAME	PERCENT BY WEIGHT	TLV	ACGIH

*****NO HAZARDOUS INGREDIENTS*****

HAZARD SUMMARY

Rating	Definitions
Health 0	0 - least
Fire 1	1 - slight
Reactivity 0	2 - moderate
	3 - high
	4 - extreme

SECTION III - COMPOSITION

CAS #	CHEMICAL NAME	PERCENT BY WEIGHT
125643-43-8	Tricaprylyl citrate (trioctyl citrate)	PI*
8042-47-5	White mineral oil	"
8021-89-3	Bleached beeswax	"
1337-33-3	Monostearyl citrate	"
8006-90-4	Triple distilled peppermint oil	"
88-04-0	Chloroxyleneol	"

* PI = Proprietary information

Product Name: Poison Oak-N-Ivy ARMOR
Tec Laboratories, Inc.

Page 2 of 4
Issue Date: 09/08/93

***** **SECTION IV - HEALTH HAZARD AND FIRST AID INFORMATION** *****

OCCUPATIONAL EXPOSURE LIMIT: Not established

CARCINOGENICITY: Not listed by NTP, IARC or OSHA

PRIMARY ROUTES OF ENTRY: Skin, eyes

SYMPTOMS AND EFFECTS OF OVEREXPOSURE	ROUTE OF ENTRY	EMERGENCY AND FIRST AID PROCEDURES
Product is unlikely to produce eye irritation or corneal injury.	EYES	If eyes become irritated, flush eyes with large amounts of water until irritation subsides. If product is hot, treat for thermal burns and get medical attention immediately.
Product is non-irritant under normal use. Repeated, long-term exposure may cause minor irritation.	SKIN	Discontinue use and wash affected skin with soap and water. Remove contaminated clothing. If a rash or other symptoms develop, get medical attention.
Low vapor pressure makes inhalation hazard unlikely.	INHALATION	Remove to fresh room temperature air.
Ingestion is relatively non-toxic unless aspiration occurs. This product may have laxative properties and may result in abdominal cramps and diarrhea.	INGESTION	DO NOT INDUCE VOMITING. Give large quantities of water to dilute. Never give anything by mouth to an unconscious person. Call a physician.

NOTE TO PHYSICIAN: There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition.

***** **SECTION V - PERSONAL PROTECTION INFORMATION** *****

--WHEN HANDLING BULK QUANTITIES--

EYE PROTECTION: OSHA approved plastic face shield or splash-proof safety goggles.

PROTECTIVE CLOTHING: No skin protection is required for single, short duration exposures. For prolonged or repeated exposures, use impervious clothing (boots, gloves, aprons, etc.) over parts of the body subject to exposure. If handling hot material, use insulated protective clothing.

VENTILATION: If vapor or mist is generated when the material is heated or handled, adequate ventilation in accordance with good engineering practice must be provided to maintain concentrations below the specified exposure or flammable limits.

RESPIRATORY PROTECTION: Not required in under conditions of normal use. If vapor or mist is generated when the material is heated or handled, use an organic vapor respirator with a dust and mist filter. All respirators must be NIOSH certified. Do not use compressed oxygen in hydrocarbon atmospheres.

--WHEN USING PRODUCT ACCORDING TO DIRECTIONS FOR USE--

EYE PROTECTION: Avoid applying product in eyes.

PROTECTIVE CLOTHING: None required for normal use.

VENTILATION: Normal room ventilation is satisfactory.

RESPIRATORY PROTECTION: None required for normal use.

***** **SECTION VI - STORAGE AND SPECIAL HANDLING INFORMATION** *****

Avoid contact with eyes and mucous membranes. Store at room temperature. Do not transfer to unmarked bottles.

***** **SECTION VII - SPILL OR LEAK RESPONSE INFORMATION** *****

PRECAUTIONS IN CASE OF SPILLS OR LEAKS: Dike and absorb material for disposal.

WASTE DISPOSAL METHOD: Sanitary landfill or incineration according to local, state and federal regulations for non-hazardous substances.

RCRA/CERCLA HAZARDOUS WASTE: This product contains no hazardous waste.

Product Name: Poison Oak-N-Ivy ARMOR
Tec Laboratories, Inc.

Page 4 of 4
Issue Date: 09/08/93

***** **SECTION VIII - FIRE AND EXPLOSION HAZARD INFORMATION** *****

FLASH POINT (open cup): greater than 300°F

FLAMMABLE LIMITS: unknown
(in air, % by volume)

EXTINGUISHING MEDIA: Foam, dry chemical, or carbon dioxide.

UNUSUAL FIRE AND EXPLOSION HAZARDS: None, except smoke may be generated when burning.

SPECIAL FIRE FIGHTING PROCEDURES: Keep away from surfaces above 260°F.
Treat as an oil fire.

***** **SECTION IX - REACTIVITY INFORMATION** *****

STABILITY: Stable.

INCOMPATIBILITY (MATERIALS TO AVOID): None

HAZARDOUS DECOMPOSITION PRODUCTS: Unknown

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: None

***** **SECTION X - PHYSICAL DATA** *****

APPEARANCE: Yellowish-white oily liquid

ODOR: Peppermint

SOLUBILITY IN WATER (% by weight): insoluble

SPECIFIC GRAVITY: 0.913 @ 25° C

BOILING POINT: above 300°F

WEIGHT PER GALLON: 7.62 lbs/gal

VISCOSITY: 3 - 10 cps

AUTO IGNITION TEMPERATURE: not established

MATERIAL SAFETY DATA SHEET

Product Name: Tecnu[®] Poison Oak-N-Ivy Cleansing Treatment
Tec Laboratories, Inc.

Page 1 of 4
Issue Date: 09/07/93

SECTION I - COMPANY AND PRODUCT INFORMATION

MANUFACTURER:
Tec Laboratories, Inc.
P. O. Box 1958
Albany, OR 97321

PRODUCT NAME:
Tecnu[®] Poison Oak-N-Ivy Cleansing
Treatment

EMERGENCY TELEPHONE NUMBERS:
(503) 926-4577
(503) 926-0769

CHEMICAL FAMILY:
Detergent

CAS NUMBER:
Not available for this mixture

PRODUCT DESCRIPTION:
Cleanser for removal of poison
plant oils.

SECTION II - HAZARDOUS INGREDIENTS

CAS #	CHEMICAL NAME	PERCENT BY WEIGHT	OSHA PEL	ACGIH TLV

***** NO HAZARDOUS INGREDIENTS *****

HAZARD SUMMARY

Rating	Definitions
Health 0	0 - least
Fire 2	1 - slight
Reactivity 0	2 - moderate
	3 - high
	4 - extreme

SECTION III - COMPOSITION

CAS #	CHEMICAL NAME	PERCENT BY WEIGHT
7732-18-5	Water	PI*
6471-65-7	Deodorized mineral spirits	"
57-55-6	Propylene glycol	"
61790-12-3	Octylphenoxy-polyethoxyethanol surfactant	"
9036-19-5	Mixed fatty acid soap	"
N/A	Fragrance	"
25322-68-3	Polyethylene glycol	"

*PI = Proprietary information

Product Name: Tecnu Poison Oak-N-Ivy Cleansing Treatment
Tec Laboratories, Inc.

Page 2 of 4
Issue Date: 09/07/90

***** **SECTION IV - HEALTH HAZARD AND FIRST AID INFORMATION** *****

OCCUPATIONAL EXPOSURE LIMIT: Not established

CARCINOGENICITY: Not listed by NTP, IARC or OSHA

PRIMARY ROUTES OF ENTRY: Skin, eyes

SYMPTOMS AND EFFECTS OF OVEREXPOSURE	ROUTE OF ENTRY	EMERGENCY AND FIRST AID PROCEDURES
Causes to moderate to extreme irritation, with possible corneal injury	EYES	Immediately flush with large amounts of water for 15 minutes. Get medical attention.
Extended use may cause drying of skin. Prolonged contact may cause dermatitis or chemical burns on sensitive skin.	SKIN	Immediately flush skin with running water. If irritation persists, get medical attention.
Due to low vapor pressure, inhalation is very unlikely.	INHALATION	Remove to fresh air.
Will cause nausea if swallowed. Stomach cramps may also occur.	INGESTION	DO NOT INDUCE VOMITING. Call doctor immediately. Treat for petroleum jelly ingestion.

NOTE TO PHYSICIAN: There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition.

***** **SECTION V - PERSONAL PROTECTION INFORMATION** *****

--WHEN HANDLING BULK QUANTITIES--

EYE PROTECTION: OSHA approved monogoggles or face shield.

PROTECTIVE CLOTHING: Wear rubber gloves. To avoid excessive exposure, wear impervious boots and clothing.

VENTILATION: Normal room ventilation should be satisfactory.

RESPIRATORY PROTECTION: Not necessary

--WHEN USING PRODUCT ACCORDING TO DIRECTIONS FOR USE--

EYE PROTECTION: Avoid applying product in and around eyes.

PROTECTIVE CLOTHING: None required for normal use.

VENTILATION: Normal room ventilation is satisfactory.

RESPIRATORY PROTECTION: None required for normal use.

***** **SECTION VI - STORAGE AND SPECIAL HANDLING INFORMATION** *****

Keep away from heat, sparks, and flame. Avoid contact with eyes. Store at room temperature.

***** **SECTION VII - SPILL OR LEAK RESPONSE INFORMATION** *****

PRECAUTIONS IN CASE OF SPILLS OR LEAKS: Material is not considered toxic. Absorb with dry sand or oil absorbents. All materials are bio-degradable. Clean spill area with detergent solution and flush down sewer with water.

WASTE DISPOSAL METHOD: Waste materials should be dumped or buried in an approved industrial waste landfill. Large quantities may be disposed of by incineration.

RCRA/CERCLA HAZARDOUS WASTE: This product contains no hazardous waste.

***** **SECTION VIII - FIRE AND EXPLOSION HAZARD INFORMATION** *****

FLASH POINT (open cup): 158°F

FLAMMABLE LIMITS: unknown
(in air, % by volume)

EXTINGUISHING MEDIA: Foam for large fires; carbon dioxide or dry chemical
for small fires.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Smoke may be generated when burning.

SPECIAL FIRE FIGHTING PROCEDURES: Keep away from heat or hot surfaces above
150°F. Above 150°F, treat vapors as you would odorless spirits. Treat as oil
fire.

***** **SECTION IX - REACTIVITY INFORMATION** *****

STABILITY: Stable.

INCOMPATIBILITY (MATERIALS TO AVOID): Strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS: Waxy mixed alkanes at high temperatures.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: None

***** **SECTION X - PHYSICAL DATA** *****

APPEARANCE: Creamy white, slightly viscous

ODOR: Lavender

SOLUBILITY IN WATER (% by weight): 100%

SPECIFIC GRAVITY: 1.0 @ 25°C

BOILING POINT: 164°F

WEIGHT PER GALLON: 8.35#

VISCOSITY: 1,200 - 1,700 cps

AUTO IGNITION TEMPERATURE: unknown

MATERIAL SAFETY DATA SHEET

Product Name: Clearly Cala-Gel™
Tec Laboratories, Inc.

Page 1 of 4
Issue Date: 08/30/93

SECTION I - COMPANY AND PRODUCT INFORMATION

MANUFACTURER:
Tec Laboratories, Inc.
P. O. Box 1958
Albany, OR 97321

PRODUCT NAME:
Clearly Cala-Gel™

CHEMICAL FAMILY:
Topical Analgesic

EMERGENCY TELEPHONE NUMBERS:
(503) 926-4577
(503) 926-0769

CAS NUMBER:
Not available for this mixture

PRODUCT DESCRIPTION:
Topical Analgesic/Antihistamine; Skin
Protectant; First Aid Antiseptic Gel

SECTION II - HAZARDOUS INGREDIENTS

CAS #	CHEMICAL NAME	PERCENT BY WEIGHT	TLV	ACGIH

*****NO HAZARDOUS INGREDIENTS*****

HAZARD SUMMARY

Rating	Definitions
Health 1	0 - least
Fire 0	1 - slight
Reactivity 0	2 - moderate
	3 - high
	4 - extreme

SECTION III - COMPOSITION

CAS #	CHEMICAL NAME	PERCENT BY WEIGHT

Active ingredients:

147-24-0	Diphenhydramine hydrochloride	1.80%
2216-51-5	Menthol	0.11%
121-54-0	Benzethonium chloride	0.15%
557-34-6	Zinc acetate	0.21%

Other ingredients:

Purified water, Hydroxypropyl methylcellulose, Polysorbate 20, Disodium EDTA, and Fragrance.

Product Name: Clearly Cala-Gel™
Tec Laboratories, Inc.

Page 2 of 4
Issue Date: 08/30/93

***** **SECTION IV - HEALTH HAZARD AND FIRST AID INFORMATION** *****

OCCUPATIONAL EXPOSURE LIMIT: Not established

CARCINOGENICITY: Not listed by NTP, IARC or OSHA

PRIMARY ROUTES OF ENTRY: Skin, eyes, ingestion

SYMPTOMS AND EFFECTS OF OVEREXPOSURE	ROUTE OF ENTRY	EMERGENCY AND FIRST AID PROCEDURES
Eye irritation. Corneal injury is unlikely.	EYES	Flush thoroughly with water for 15 minutes. Get medical attention.
Repeated, long-term contact may cause irritation and/or drying of skin. May cause allergic reaction in small percentage of population.	SKIN	Discontinue use and wash affected skin with soap and water. Remove contaminated clothing. If a rash or other symptoms develop, get medical attention.
Low vapor pressure makes inhalation hazard unlikely.	INHALATION	Remove to fresh room temperature air.
Ingestion may cause unknown effects.	INGESTION	DO NOT INDUCE VOMITING. Give large quantities of water. Call physician immediately. Never give anything by mouth to an unconscious person.

NOTE TO PHYSICIAN: There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition.

***** **SECTION V - PERSONAL PROTECTION INFORMATION** *****

--WHEN HANDLING BULK QUANTITIES--

EYE PROTECTION: OSHA approved monogoggles or face shield.

PROTECTIVE CLOTHING: Wear rubber gloves. To avoid excessive exposure, wear impervious boots and clothing.

VENTILATION: General (mechanical) room ventilation should be satisfactory.

RESPIRATORY PROTECTION: Not required in most conditions.

--WHEN USING PRODUCT ACCORDING TO DIRECTIONS FOR USE--

EYE PROTECTION: Do not apply product in and around eyes.

PROTECTIVE CLOTHING: None required for normal use.

VENTILATION: Normal room ventilation is satisfactory.

RESPIRATORY PROTECTION: None required for normal use.

***** **SECTION VI - STORAGE AND SPECIAL HANDLING INFORMATION** *****

Avoid contact with eyes and mucous membranes. Store at room temperature.

***** **SECTION VII - SPILL OR LEAK RESPONSE INFORMATION** *****

PRECAUTIONS IN CASE OF SPILLS OR LEAKS: Product is very slippery. Flush area with plenty of water (hot water works best) to dilute to a thin liquid and flush down sewer or dike and absorb with absorbent material. Flush small spills with water.

WASTE DISPOSAL METHOD: Absorbed material should be landfilled in closed containers according to Federal, State, and local regulations.

RCRA/CERCLA HAZARDOUS WASTE: This product contains no hazardous waste.

***** **SECTION VIII - FIRE AND EXPLOSION HAZARD INFORMATION** *****

FLASH POINT (closed cup): not applicable

FLAMMABLE LIMITS: not applicable
(in air, % by volume)

EXTINGUISHING MEDIA: not applicable; non-flammable material

UNUSUAL FIRE AND EXPLOSION HAZARDS: None

SPECIAL FIRE FIGHTING PROCEDURES: Not applicable

***** **SECTION IX - REACTIVITY INFORMATION** *****

STABILITY: Stable.

INCOMPATIBILITY (MATERIALS TO AVOID): None

HAZARDOUS DECOMPOSITION PRODUCTS: None

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: None

***** **SECTION X - PHYSICAL DATA** *****

APPEARANCE: Clear, colorless viscous liquid.

ODOR: Medicinal odor

SOLUBILITY IN WATER (% by weight): 100%

SPECIFIC GRAVITY: 0.97 @ 25° C

BOILING POINT: 212° F

WEIGHT PER GALLON: 8.3435#/gal

VISCOSITY: 17,000 - 40,000 cps

AUTO IGNITION TEMPERATURE: N/A

MATERIAL SAFETY DATA SHEET

Product Name: The 10-Hour Insect Repellent
Tec Laboratories, Inc.

Page 1 of 4
Issue Date: 09/07/93

SECTION I - COMPANY AND PRODUCT INFORMATION

MANUFACTURER:
Tec Laboratories, Inc.
P. O. Box 1958
Albany, OR 97321

PRODUCT NAME:
The 10-Hour Insect Repellent

CHEMICAL FAMILY:
Pesticides

EMERGENCY TELEPHONE NUMBERS:
(503) 926-4577
(503) 926-0769

CAS NUMBER:
134-62-3

PRODUCT DESCRIPTION:
Topical Insect Repellent

SECTION II - HAZARDOUS INGREDIENTS

CAS #	CHEMICAL NAME	PERCENT BY WEIGHT	TLV	ACGIH

*****NO HAZARDOUS INGREDIENTS*****

HAZARD SUMMARY

Rating	Definitions
Health 1	0 - least
Fire 0	1 - slight
Reactivity 0	2 - moderate
	3 - high
	4 - extreme

SECTION III - COMPOSITION

CAS #	CHEMICAL NAME	PERCENT BY WEIGHT

Active ingredients:

134-62-3	N,N-diethyl-m-toluamide	95.0%
	Diethyl ortho toluamide	<5.0%
	Diethyl para toluamide	<5.0%

Product Name: The 10-Hour Insect Repellent
Tec Laboratories, Inc.

Page 2 of 4
Issue Date: 09/07/93

***** **SECTION IV - HEALTH HAZARD AND FIRST AID INFORMATION** *****

OCCUPATIONAL EXPOSURE LIMIT: Not established

CARCINOGENICITY: Not listed by NTP, IARC or OSHA

PRIMARY ROUTES OF ENTRY: Skin, eyes, inhalation

SYMPTOMS AND EFFECTS OF OVEREXPOSURE	ROUTE OF ENTRY	EMERGENCY AND FIRST AID PROCEDURES
Can cause severe irritation and may possibly cause permanent damage.	EYES	Immediately flush with large amounts of water for at least 15 minutes. If irritation persists, get medical attention.
Can cause irritation and red- dening of the skin, especially on areas occluded from air (inside gloves, under watch bands, etc.).	SKIN	Immediately flush affected areas with water. Remove contaminated clothing and wash affected areas with soap and water. If irritation persists, get medical attention.
Excessive inhalation can cause nasal and respiratory irritation.	INHALATION	Remove affected person to fresh air. Give oxygen, if necessary. If breathing has stopped, administer artificial respiration and get immediate medical attention.
Can cause stomach irritation, resulting in nausea, cramps, and vomiting.	INGESTION	DO NOT INDUCE VOMITING. Give affected person two glasses of water. Keep them warm and quiet and get immediate medical attention.

Acute Dermal Toxicity - LD(50) = 10 g/kg (Rabbits)
Acute Oral Toxicity - LD(50) = 1.95 g/kg (Rats)

**ALPHAGAZ**

DIVISION OF LIQUID AIR CORPORATION

Material Safety Data Sheet

LIQUID AIR CORPORATION ALPHAGAZ DIVISION California Plaza, Suite 350 2121 N. California Blvd. Walnut Creek, California 94596 ISSUE DATE JUNE 4, 1990 AND REVISIONS CORPORATE SAFETY DEPT.	PRODUCT NAME 100 PPM Isobutylene in Air	CAS NUMBER See Last Page
	TELEPHONE (415) 977-5500 EMERGENCY RESPONSE INFORMATION ON PAGE 2	NFPA 704 NUMBER (HFR) 0 0 0
	TRADE NAME AND SYNONYMS 100 PPM Isobutene in Air	CHEMICAL FAMILY Gas Mixture
	CHEMICAL NAME AND SYNONYMS 100 Molar PPM iso-Butene in Air	
	FORMULA See Last Page	MOLECULAR WEIGHT 28.96

HEALTH HAZARD DATA

TIME WEIGHTED AVERAGE EXPOSURE LIMIT

None listed (ACGIH 1989-1990) or by OSHA

SYMPTOMS OF EXPOSURE

The amount of iso-butylene in this mixture should not present any symptoms of toxicity if this mixture is breathed. Air is nontoxic and necessary to support life. Inhalation of air in a high pressure environment such as underwater diving, caissons or hyperbaric chambers can result in symptoms similar to overexposure to pure oxygen. These include tingling of fingers and toes, abnormal sensations, impaired coordination and confusion. Decompression sickness pains or "bends" are possible following rapid decompression.

TOXICOLOGICAL PROPERTIES

High pressure effects (greater than two atmospheres of oxygen) are on the central nervous system. Improper decompression results in the accumulation of nitrogen in the blood.

Neither isobutylene or air are listed in the IARP, NTP or by OSHA as a carcinogen or potential carcinogen.

Listed as Carcinogen or Potential Carcinogen	National Toxicology Program	Yes ☐ No ☒	I.A.R.C. Monographs	Yes ☐ No ☒	OSHA	Yes ☐ No ☒

RECOMMENDED FIRST AID TREATMENT

Facilities or practices at which air is breathed in a high pressure environment should be prepared to deal with the illnesses associated with decompression (bends or caisson disease). Decompression equipment may be required.

Judgements as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Liquid Air Corporation extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or consequences of its use. Since Liquid Air Corporation has no control over the use of this product, it assumes no liability for damage or loss of product resulting from proper (or improper) use or application of the product. Data Sheets may be changed from time to time. Be sure to consult the latest edition.

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SPECIAL PROTECTION INFORMATION

Page 3

RESPIRATORY PROTECTION (Specify type)				N/A	
VENTILATION N/A		LOCAL EXHAUST	N/A	SPECIAL	N/A
		MECHANICAL (Gen.)	N/A	OTHER	N/A
PROTECTIVE GLOVES		Any material			
EYE PROTECTION		Safety goggles or glasses			
OTHER PROTECTIVE EQUIPMENT		Safety shoes			

SPECIAL PRECAUTIONS*

SPECIAL LABELING INFORMATION	
DOT Shipping Name: Compressed Gas, n.o.s.	DOT Hazard Class: Nonflammable Gas
DOT Shipping Label: Nonflammable Gas	I.D. No.: UN 1956
SPECIAL HANDLING RECOMMENDATIONS	
Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (<3,000 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder. Do not tamper with (valve) safety device. Close valve after each use and when empty. For additional handling recommendations consult L'Air Liquide's Encyclopedia de Gaz or Compressed Gas Association Pamphlet P-1.	
SPECIAL STORAGE RECOMMENDATIONS	
Protect cylinders from physical damage. Store in cool, dry, well-ventilated area away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 130F (54C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in - first out" inventory system to prevent full cylinders being stored for excessive periods of time. For additional storage recommendations consult L'Air Liquide's Encyclopedia de Gaz or Compressed Gas Association Pamphlet P-1.	
SPECIAL PACKAGING RECOMMENDATIONS	
If this mixture is dry it is noncorrosive and may be used with all materials of construction. Moisture causes metal oxides which are formed with air to be hydrated so that they increase in volume and lose their protective role (rust formation). Concentrations of SO₂, Cl₂, salt, etc. in the moisture enhances the rusting of metals in this mixture.	
OTHER RECOMMENDATIONS OR PRECAUTIONS	
Compressed gas cylinders should not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with his (written) consent is a violation of Federal Law (49CFR). Always secure cylinders in an upright position before transporting them. NEVER transport cylinders in trunks of vehicles, enclosed vans, truck cabs or in passenger compartments. Transport cylinders secured in open flatbed or in open pick-up type vehicles.	

*Various Government agencies (i.e., Department of Transportation, Occupational Safety and Health Administration, Food and Drug Administration and others) may have specific regulations concerning the transportation, handling, storage or use of this product which may not be contained herein. The customer or user of this product should be familiar with these regulations.

SULFURIC ACID
SULFURIC ACID
SULFURIC ACID

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY NUMBER: (201) 796-7100
CHEMTREC ASSISTANCE: (800) 424-9300

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 7664-93-9

SUBSTANCE: **SULFURIC ACID**

TRADE NAMES/SYNONYMS:

OIL OF VIIRIOL; BOV; DIPPING ACID; VIIRIOL BROWN OIL; HYDROGEN SULFATE;
NORHAUSEN ACID; DIHYDROGEN SULFATE; SULPHURIC ACID; HAITING ACID;
DITHIONIC ACID; STCC4930040; UN 1830; A300; A300C; A300SI; A300S;
A298; A510; A468; SDA174; A484; SA170; SA176; A302; A305; H204S;

CHEMICAL FAMILY:
INORGANIC ACID

MOLECULAR FORMULA: H2-S-O4

MOLECULAR WEIGHT: 98.07

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=2 PERSISTENCE=0
NEPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=2

COMPONENTS AND CONTAMINANTS

COMPONENT: SULFURIC ACID
CAS# 7664-93-9

PERCENT: 70.0-100.0

COMPONENT: WATER

PERCENT: 0-30.0

OTHER CONTAMINANTS: NONE.

EXPOSURE LIMITS:

SULFURIC ACID:

1 MG/M3 OSHA TWA
1 MG/M3 ACGIH TWA; 3 MG/M3 ACGIH STEL
1 MG/M3 NIOSH RECOMMENDED TWA
1 MG/M3 DFG MAK TWA;
2 MG/M3 DFG MAK 5 MINUTE PEAK, MOMENTARY VALUE, 8 TIMES/SHIFT

MEASUREMENT METHOD: SILICA GEL TUBE; SODIUM BICARBONATE/SODIUM CARBONATE;
ION CHROMATOGRAPHY; (NIOSH VOL. III # 7903, INORGANIC ACIDS).

1000 POUNDS SARA SECTION 302 THRESHOLD PLANNING QUANTITY
1000 POUNDS SARA SECTION 304 REPORTABLE QUANTITY
1000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

PHYSICAL DATA

DESCRIPTION: ODOORLESS, CLEAR, COLORLESS, DENSE HYGROSCOPIC OILY LIQUID WITH
A MARKED ACID TASTE WHEN PURE. BOILING POINT: 426 F (330 C)
MELTING POINT: 50 F (10 C) SPECIFIC GRAVITY: 1.84
VAPOR PRESSURE: (0.001 @ 20 C PH: (3 SOLUBILITY IN WATER: SOLUBLE
ODOR THRESHOLD: >1 MG/M3 (MIST) VAPOR DENSITY: 3.4
SOLVENT SOLUBILITY: DECOMPOSES IN ALCOHOL.
@ 340 C IT DECOMPOSES INTO SULFUR TRIOXIDE AND WATER

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
NEGLECTIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

OXIDIZER: OXIDIZERS DECOMPOSE, ESPECIALLY WHEN HEATED, TO YIELD OXYGEN OR
OTHER GASES WHICH WILL INCREASE THE BURNING RATE OF COMBUSTIBLE MATTER.
CONTACT WITH EASILY OXIDIZABLE, ORGANIC, OR OTHER COMBUSTIBLE MATERIALS
MAY RESULT IN IGNITION, VIOLENT COMBUSTION OR EXPLOSION.

FIREFIGHTING MEDIA:
DRY CHEMICAL OR CARBON DIOXIDE
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FOR LARGER FIRES, FLOOD AREA WITH WATER FROM A DISTANCE
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FIREFIGHTING:
DO NOT GET WATER INSIDE CONTAINER. DO NOT GET SOLID STREAM OF WATER ON
SPILLED MATERIAL. MOVE CONTAINER FROM FIRE AREA IF YOU CAN DO IT WITHOUT RISK.
APPLY COOLING WATER TO SIDES OF CONTAINERS THAT ARE EXPOSED TO FLAMES UNTIL
WELL AFTER FIRE IS OUT. STAY AWAY FROM ENDS OF TANKS (1990 EMERGENCY RESPONSE
GUIDEBOOK, DOT P 5800.5 GUIDE PAGE 39).

USE AGENT SUITABLE FOR TYPE OF FIRE; USE FLOODING AMOUNTS OF WATER AS A FOG.
COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER, APPLY FROM AS FAR A DISTANCE
AS POSSIBLE. AVOID BREATHING CORROSIVE VAPORS, KEEP UPWIND.

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49-CFR 172.101:
CORROSIVE MATERIAL

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49-CFR 172.101 AND
SUBPART E:
CORROSIVE

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49-CFR 173.272
EXCEPTIONS: 49-CFR 173.244

FINAL RULE ON HAZARDOUS MATERIALS REGULATIONS (HMR, 49 CFR PARTS 171-180),
DOCKET NUMBERS HM-181, HM-181A, HM-181B, HM-181C, HM-181D AND HM-204.
EFFECTIVE DATE OCTOBER 1, 1991. HOWEVER, COMPLIANCE WITH THE REGULATIONS IS
AUTHORIZED ON AND AFTER JANUARY 1, 1991. (55 FR 52402, 12/21/90)

EXCEPT FOR EXPLOSIVES, INHALATION HAZARDS, AND INFECTIOUS SUBSTANCES, THE
EFFECTIVE DATE FOR HAZARD COMMUNICATION REQUIREMENTS IS EXTENDED TO
OCTOBER 1, 1993. (56 FR 47158, 09/18/91)

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
SULFURIC ACID-UN 1830

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
B - CORROSIVE MATERIAL

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG II

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101
AND SUBPART E:
CORROSIVE

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: NONE
NON-BULK PACKAGING: 49 CFR 173.202
BULK PACKAGING: 49 CFR 173.242

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 1 L
CARGO AIRCRAFT ONLY: 30 L

TOXICITY

SULFURIC ACID:
IRRITATION DATA: 250 UG EYE-RABBIT SEVERE; 5 MG/30 SECONDS RINSED EYE-RABBIT
SEVERE.
TOXICITY DATA: 3 MG/M3/24 WEEKS INHALATION-HUMAN LC50; 510 MG/M3/2 HOURS
INHALATION-RAT LC50; 320 MG/M3/2 HOURS INHALATION-MOUSE LC50; 18 MG/M3
INHALATION-GUINEA PIG LC50; 2140 MG/KG ORAL-RAT LD50; 135 MG/KG ORAL-MAN
LD50 (KENNECOTT MSDS); 135 MG/KG UNREPORTED-MAN LD50; MUTAGENIC DATA
(RIECS); REPRODUCTIVE EFFECTS DATA (RIECS).
CARCINOGEN STATUS: NONE. OCCUPATIONAL EXPOSURE TO STRONG INORGANIC ACID MISTS
CONTAINING SULFURIC ACID IS BEING EVALUATED BY IARC. AN EPIDEMIOLOGICAL
STUDY OF WORKERS AT A REFINERY AND CHEMICAL PLANT SUGGESTS AN INCREASED RISK
FROM LARYNGEAL CANCER FROM EXPOSURE TO HIGH CONCENTRATIONS OF SULFURIC ACID.
LOCAL EFFECTS: CORROSIVE- INHALATION, SKIN, EYE AND INGESTION.
ACUTE TOXICITY LEVEL: HIGHLY TOXIC BY INHALATION; MODERATELY TOXIC BY
INGESTION.
TARGET EFFECTS: NO DATA AVAILABLE.

HEALTH EFFECTS AND FIRST AID

INHALATION:

SULFURIC ACID:

CORROSIVE/HIGHLY TOXIC. 80 MG/M3 IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- INHALATION OF MIST MAY CAUSE MUCOUS MEMBRANE IRRITATION

PRINCIPALLY AFFECTING THE RESPIRATORY TRACT EPITHELIUM. LOW

CONCENTRATIONS, 0.35-5 MG/M3, MAY CAUSE INCREASED PULMONARY AIR FLOW

RESISTANCE AND SUBSEQUENT SHALLOWER AND MORE RAPID BREATHING. HOT

CONCENTRATED MISTS MAY CAUSE RAPID LOSS OF CONSCIOUSNESS WITH POSSIBLE

DAMAGE TO LUNG TISSUE. VAPORS MAY CAUSE NASAL SECRETIONS, SNEEZING, A

BURNING OR TICKLING SENSATION IN THE NOSE AND THROAT AND RETROSTERNAL

REGION, FOLLOWED BY COUGH, RESPIRATORY DISTRESS, TRACHEOBRONCHITIS,

CHEMICAL PNEUMONITIS AND POSSIBLE SPASM OF THE VOCAL CORDS. HIGH

CONCENTRATIONS MAY PRODUCE BLOODY NASAL SECRETIONS AND SPUTUM, HEMATEMESIS

GASTRITIS, AND PULMONARY EDEMA. A SINGLE OVEREXPOSURE MAY LEAD TO

LARYNGEAL, TRACHEOBRONCHIAL AND PULMONARY EDEMA. ONE INDIVIDUAL SPRAYED

IN THE FACE WITH SULFURIC ACID LIQUID EXPERIENCED DELAYED SYMPTOMS OF

PULMONARY FIBROSIS, RESIDUAL BRONCHITIS, AND PULMONARY EMPHYSEMA.

VAPORS FROM DILUTE SOLUTIONS MAY IRRITATE MUCOUS MEMBRANES. THE LETHAL

DOSE REPORTED IN RATS IS 510 MG/M3/2 HOURS.

CHRONIC EXPOSURE- REPEATED EXPOSURE TO THE MIST MAY CAUSE INFLAMMATION

OF THE UPPER RESPIRATORY TRACT. CHRONIC BRONCHITIS AND ETCHING OF THE

CENIAL ENAMEL. THE CENTRAL AND LATERAL INCISORS ARE PRIMARILY AFFECTED.

REPEATED EXCESSIVE EXPOSURE OVER LONG PERIODS OF TIME HAVE RESULTED IN

BRONCHITIC SYMPTOMS, RHINORRHEA, FREQUENT RESPIRATORY TRACT INFECTIONS,

EMPHYSEMA, STOMATITIS AND DIGESTIVE DISTURBANCES. CHRONIC INHALATION

MAY CAUSE ALKALINE DEPLETION OF THE BODY PRODUCING AN ACIDOSIS WHICH

AFFECTS THE NERVOUS SYSTEM AND PRODUCES AGITATION, HESITANT GAIT AND

GENERALIZED WEAKNESS. AN EPIDEMIOLOGICAL STUDY OF WORKERS AT A REFINERY

AND CHEMICAL PLANT SUGGESTS AN INCREASED RISK OF LARYNGEAL CANCER

FROM EXPOSURE TO HIGH CONCENTRATIONS OF SULFURIC ACID. REPRODUCTIVE

EFFECTS HAVE BEEN REPORTED IN ANIMALS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING

HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD

PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND

AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN

SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION

IMMEDIATELY.

SKIN CONTACT:

SULFURIC ACID:

CORROSIVE.

ACUTE EXPOSURE- CONTACT WITH CONCENTRATED SULFURIC ACID MAY CAUSE SEVERE

SECOND AND THIRD DEGREE SKIN BURNS WITH NECROSIS DUE TO ITS AFFINITY

FOR WATER AND SUBSEQUENT SEVERE DEHYDRATING ACTION, AND ITS EXOTHERMIC

REACTION WITH MOISTURE. POSSIBLE CHARRING MAY OCCUR LEADING TO SHOCK

AND COLLAPSE DEPENDING ON THE AMOUNT OF TISSUE INVOLVED. THE RESULTING

WOUNDS MAY BE LONG IN HEALING AND MAY CAUSE EXTENSIVE SCARRING THAT

MAY RESULT IN FUNCTIONAL INHIBITION. CONTACT WITH DILUTE SOLUTIONS MAY

CAUSE SKIN IRRITATION.

CHRONIC EXPOSURE- REPEATED CONTACT WITH LOW CONCENTRATIONS MAY CAUSE

SKIN DESICCATION AND ULCERATION OF THE HANDS, AND PARONYCHIA OR CHRONIC

PURULENT INFLAMMATION AROUND THE NAILS. REPEATED CONTACT WITH DILUTE

SOLUTIONS MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
SULFURIC ACID:
CORROSIVE.

ACUTE EXPOSURE- EXPOSURE TO THE VAPORS MAY CAUSE A BURNING OR STINGING SENSATION IN THE EYES WITH LACRIMATION, BLURRED VISION AND CONJUNCTIVAL CONGESTION. SPLASHES OF ACID IN THE EYES MAY PRODUCE DEEP CORNEAL ULCERATION, KERATO-CONJUNCTIVITIS AND PALPEBRAL LESIONS WITH SEVERE SEQUELAE. IRREFRABLE CORNEAL DAMAGE AND BLINDNESS AS WELL AS SCARRING OF THE EYELIDS MAY OCCUR. SEVERE SULFURIC ACID EYE BURNS HAVE INCLUDED GLAUCOMA AND CATARACT AS COMPLICATIONS IN THE MOST SEVERE CASES. CONTACT WITH DILUTED ACID MAY PRODUCE MORE TRANSIENT EFFECTS FROM WHICH RECOVERY MAY BE COMPLETE.

CHRONIC EXPOSURE- REPEATED EXPOSURE MAY RESULT IN LACRIMATION AND CHRONIC CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). CONTINUE IRRIGATING WITH NORMAL SALINE UNTIL THE PH HAS RETURNED TO NORMAL (30-60 MINUTES). COVER WITH STERILE BANDAGES. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
SULFURIC ACID:
CORROSIVE.

ACUTE EXPOSURE- INGESTION MAY CAUSE BURNING PAIN IN THE MOUTH, THROAT, ESOPHAGUS AND ABDOMEN, A SOUR TASTE AND NAUSEA FOLLOWED BY VOMITING AND DIARRHEA OF CHARRED BLACK STOMACH CONTENTS. DEHYDRATION AND CARBONIZATION OF TISSUE MAY OCCUR WITH ESCHARS ON THE LIPS AND MOUTH. BROWNISH OR YELLOWISH STAINS MAY BE FOUND AROUND THE MOUTH, INTENSE THIRST, DIFFICULT SWALLOWING, ACIDEMIA, STOMATITIS, RAPID AND WEAK PULSE, SHALLOW BREATHING, SHOCK AND POSSIBLE CONVULSIONS AND DEATH MAY OCCUR. ALBUMIN, BLOOD AND CASTS IN URINE, ANURIA, ESOPHAGEAL AND DELAYED GASTRIC STENOSIS HAS BEEN REPORTED. POSSIBLE PERFORATION OF THE GASTROINTESTINAL TRACT MAY RESULT IN PERITONITIS.

CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- DO NOT USE GASTRIC LAVAGE OR EMESIS. DILUTE THE ACID IMMEDIATELY BY DRINKING LARGE QUANTITIES OF WATER OR MILK. IF VOMITING PERSISTS, ADMINISTER FLUIDS REPEATEDLY. INGESTED ACID MUST BE DILUTED APPROXIMATELY 100 FOLD TO RENDER IT HARMLESS TO TISSUES. MAINTAIN AIRWAY AND TREAT SHOCK (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). GET MEDICAL ATTENTION IMMEDIATELY. IF VOMITING OCCURS, KEEP HEAD BELOW HIPS TO HELP PREVENT ASPIRATION.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:

SULFURIC ACID:

VIOLENT EXOTHERMIC REACTION WITH WATER.

INCOMPATIBILITIES:

SULFURIC ACID:

ACETALDEHYDE: VIOLENTLY POLYMERIZED BY CONCENTRATED ACID.

ACETIC ANHYDRIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.

ACETONE + NITRIC ACID: VIOLENT DECOMPOSITION.

ACETONE + POTASSIUM DICHROMATE: IGNITION.

ACETONE CYANHYDRIN: PRESSURE INCREASE WITH POSSIBLE EXPLOSIVE RUPTURE OF VESSEL.

ACETONITRILE: VIOLENT EXOTHERM ON HEATING; SULFUR TRIOXIDE REDUCES INITIATION TEMPERATURE.

ACROLEIN: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.

ACRYLONITRILE: VIGOROUS EXOTHERMIC POLYMERIZATION.

ALCOHOL: EXOTHERMIC REACTION AND CONTRACTION OF VOLUME.

ALCOHOLS AND HYDROGEN PEROXIDE: POSSIBLE EXPLOSION.

ALLYL ALCOHOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.

ALLYL CHLORIDE: VIOLENT POLYMERIZATION.

ALKYL NITRATES: MAY CAUSE VIOLENT REACTION.

2-AMINOETHANOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.

AMMONIUM HYDROXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.

AMMONIUM IRON(III) SULFATE DODECAHYDRATE: VIOLENT, EXOTHERMIC REACTION ON HEATING.

AMMONIUM TRIPERCHROMATE: FIRE OR EXPLOSION HAZARD.

ANILINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.

BASES: VIOLENT REACTION.

BENZYL ALCOHOL: MAY DECOMPOSES EXPLOSIVELY AT ABOUT 180 C.

BROMATES + METALS: POSSIBLE IGNITION.

BROMINE PENTAFLUORIDE: VIOLENT REACTION WITH POSSIBLE IGNITION.

TERT-BUTYL-H-XYLENE: VIOLENT EXOTHERMIC REACTION WITHOUT AGITATION.

N-BUTYRALDEHYDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.

CARBIDES: HAZARDOUS MIXTURE.

CESIUM ACETYLIDE: IGNITION ON CONTACT.

1-CHLORO-2,3-EPOXYPROPANE: VIOLENT INTERACTION.

4-CHLORONITROBENZENE AND SULFUR TRIOXIDE: POSSIBLE EXPLOSIVE REACTION.

CHLORATES: ALL CHLORATES, WHEN BROUGHT IN CONTACT WITH SULFURIC ACID MAY GIVE OFF EXPLOSIVE CHLORINE DIOXIDE GAS. A VIOLENT EXPLOSION IS USUAL.

CHLORATES + METALS: POSSIBLE IGNITION.

CHLORINE TRIFLUORIDE: VIOLENT REACTION.

CHLOROSULFONIC ACID: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.

CHROMATES: FIRE AND EXPLOSION HAZARD.

COATINGS: ATTACKED.

COMBUSTIBLE MATERIALS (FINELY DIVIDED): MAY IGNITE.

COPPER: EVOLUTION OF SULFUR DIOXIDE.

CUPROUS NITRIDE: VIOLENT REACTION.

2-CYANO-4-NITROBENZENE DIAZONIUM HYDROGEN SULFATE: EXOTHERMIC REACTION.

2-CYANO-2-PROPANOL: VIOLENT REACTION WITH INCREASE IN PRESSURE.

CYCLOPENTADIENE: VIOLENT OR EXPLOSIVE REACTION.

CYCLOPENTANONE OXIME: VIOLENT REACTION.

1,3-DIAZIOBENZENE: IGNITION FOLLOWED BY EXPLOSIVE REACTION.

DIETHYLAMINE: EXOTHERMIC REACTION.

DIISOBUTYLENE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.

DIMETHYLBENZYL CARBINOL + HYDROGEN PEROXIDE: EXPLODES.

DIMETHOXYANTHRAQUINONE: EXOTHERMIC REACTION ABOVE 150 C.
4-DIMETHYLANINO BENZALDEHYDE: EXOTHERMIC REACTION.
2,5-DINITRO-3-METHYLBENZOIC ACID + SODIUM AZIDE: EXPLOSIVE REACTION.
1,5-DINITRONAPHTHALENE + SULFUR: EXOTHERMIC REACTION.
EPICHLOROHYDRIN: VIOLENT REACTION.
ETHOXYLATED NONYLPHENOL: POSSIBLE IGNITION.
ETHANOL + HYDROGEN PEROXIDE: POSSIBLE EXPLOSION.
ETHYLENE CYANOHYDRIN: VIOLENT REACTION.
ETHYLENE DIAMINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ETHYLENE GLYCOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ETHYLENIMINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
FULMINATES: EXTREMELY HAZARDOUS MIXTURE.
HEXALITHIUM DISILICIDE: INCANDESCENT REACTION.
HYDROCHLORIC ACID: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
HYDROGEN PEROXIDE (>50%): EXPLOSIVE REACTION AFTER EVAPORATION.
HYDROFLUORIC ACID: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
INDANE + NITRIC ACID: POSSIBLE EXPLOSION.
IODINE HEPTAFLUORIDE: THE ACID BECOMES EFFERVESCENT.
IRON: POSSIBLE EXPLOSION DUE TO HYDROGEN GAS FROM THE ACID-METAL REACTION.
ISOPRENE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
LITHIUM SILICIDE: INCANDESCENT REACTION.
MERCURY NITRIDE: EXPLOSION ON CONTACT.
METHYL OXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
METALS: MAY LIBERATE FLAMMABLE HYDROGEN GAS.
METALS (POWDERED): EXTREMELY HAZARDOUS MIXTURE.
METAL ACETYLIDES: IGNITION REACTION.
METAL CHLORATES: VIOLENT EXPLOSION UNLESS PROPERLY COOLED.
METAL PERCHLORATES: FORMATION OF EXPLOSIVE PERCHLORIC ACID.
4-METHYLPYRIDINE: EXOTHERMIC REACTION.
NITRAMIDE: MAY DECOMPOSE EXPLOSIVELY ON CONTACT.
NITRATES: INCOMPATIBLE.
NITRIC ACID + GLYCERIDES: EXPLOSION.
NITRIC ACID + ORGANIC MATERIAL: MAY CAUSE VIOLENT REACTION.
NITRIC ACID + TOLUENE: POSSIBLE VIOLENT REACTION OR EXPLOSION.
NITROARYL BASES AND DERIVATIVES: MAY CAUSE VIOLENT REACTION OR EXPLOSION.
NITROBENZENE: EXOTHERMIC REACTION AT ELEVATED TEMPERATURES.
3-NITROBENZENESULFONIC ACID: EXOTHERMIC REACTION.
NITROMETHANE: FORMATION OF EXPLOSIVE MIXTURE.
N-NITROMETHYLAMINE: EXPLOSIVE DECOMPOSITION.
4-NITROTOLUENE: EXPLOSIVE AT 80 C.
ORGANICS: VIOLENT EXOTHERMIC REACTION.
PENTASILVER TRIHYDROXYDIAMIDOPHOSPHATE: EXPLOSION ON CONTACT.
PERCHLORATES: POSSIBLE EXPLOSION.
PERCHLORIC ACID: FORMATION OF DANGEROUS ANHYDROUS PERCHLORIC ACID.
PERMANGANATES: FORMATION OF PERMANGANIC ACID.
PERMANGANATES + BENZENE: POSSIBLE EXPLOSION.
1-PHENYL-2-METHYL-PROPYL ALCOHOL + HYDROGEN PEROXIDE: POSSIBLE EXPLOSION.
PHOSPHORUS (WHITE OR YELLOW): IGNITION IN CONTACT WITH BOILING ACID.
PHOSPHORUS ISOCYANATE: VIOLENT REACTION.
PHOSPHORUS TRIOXIDE: VIOLENT OXIDATION WITH POSSIBLE IGNITION.
PICRATES: EXTREMELY HAZARDOUS MIXTURE.
PLASTICS: ATTACKED.
POLYSILOXANE: EXPLOSION ON CONTACT.
POTASSIUM: EXPLOSIVE INTERACTION.
POTASSIUM IODIDE: IGNITION.
POTASSIUM CHLORATE: POSSIBLE FIRE AND EXPLOSION.
POTASSIUM PERMANGANATE: POSSIBLE EXPLOSION IN THE PRESENCE OF MOISTURE.
POTASSIUM PERMANGANATE + POTASSIUM CHLORIDE: VIOLENT EXPLOSION.

PROPIOLACTONE (BEIA): TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
 PROPYLENE OXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
 3-PROPYNOL: POSSIBLE EXPLOSION UNLESS ADEQUATELY COOLED.
 PYRJOINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
 REDUCING AGENTS: REACTS.
 RUBBER: ATTACKED.
 RUPIDIUM ACETYLIDE: IGNITION ON CONTACT.
 SILVER PERMANGANATE (MOIST): EXPLOSIVE REACTION.
 SILVER PEROXOCHROMATE: EXPLOSIVE REACTION.
 SODIUM: EXPLOSIVE REACTION WITH AQUEOUS ACID.
 SODIUM CARBONATE: VIOLENT REACTION.
 SODIUM CHLORATE: POSSIBLE FIRE OR EXPLOSION.
 SODIUM HYDROXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
 SODIUM TETRAHYDROBORATE: VIOLENT, EXOTHERMIC REACTION.
 SODIUM THIOCYANATE: VIOLENT EXOTHERMIC WITH EVOLUTION OF CARBONYL SULFIDE.
 STEEL: POSSIBLE EXPLOSION DUE TO HYDROGEN GAS FROM THE ACID-METAL REACTION.
 STYRENE MONOMER: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
 SUCROSE: FORMATION OF CARBON MONOXIDE.
 TETRAMETHYLBENZENES: VIOLENT REACTION IN CLOSED CONTAINERS.
 1,2,4,5-TETRAZINE: VIOLENT DECOMPOSITION ON CONTACT.
 THALLIUM(I) AZIODITHIOCARBONATE: MAY EXPLODE ON CONTACT.
 1,3,5-TRINITROHEXAHYDRO-1,3,5-TRIAZINE: EXPLOSIVE DECOMPOSITION ON CONTACT.
 VINYL ACETATE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
 ZINC CHLORATE: LIKELY TO CAUSE FIRES AND EXPLOSIONS.
 ZINC IODIDE: VIOLENT INTERACTION.

DECOMPOSITION:

THEPHAL DECOMPOSITION MAY RELEASE TOXIC OXIDES OF SULFUR.

POLYMERIZATION:

HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

----- STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

STORE IN COOL, DRY, WELL-VENTILATED LOCATION. SEPARATE FROM COMBUSTIBLES AND OTHER REACTIVE MATERIALS. SEPARATE FROM CARBIDES, CHLORATES, FULMINATES, NITRATES, PICRATES, AND POWDERED METALS. (NFPA 49, HAZARDOUS CHEMICALS DATA, 1991).

STORE IN A TIGHTLY CLOSED CONTAINER.

AVOID DIRECT SUNLIGHT.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

THRESHOLD PLANNING QUANTITY (TPQ):

THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 302 REQUIRES THAT EACH FACILITY WHERE AN EXTREMELY HAZARDOUS SUBSTANCE IS PRESENT IN A

QUANTITY EQUAL TO OR GREATER THAN THE TPQ ESTABLISHED FOR THAT SUBSTANCE NOTIFY THE STATE EMERGENCY RESPONSE COMMISSION FOR THE STATE IN WHICH IT IS LOCATED. SECTION 303 OF SARA REQUIRES THESE FACILITIES TO PARTICIPATE IN LOCAL EMERGENCY RESPONSE PLANNING (40 CFR 355.30).

DISPOSAL

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262. EPA HAZARDOUS WASTE NUMBER D002.

100 POUND CERCLA SECTION 103 REPORTABLE QUANTITY.

CONDITIONS TO AVOID

MAY IGNITE OTHER COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). VIOLENT REACTION WITH WATER. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN CONFINED SPACES. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

SPILL AND LEAK PROCEDURES

SOIL SPILL:

DIG HOLDING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.

DIKE FLOW OF SPILLED MATERIAL USING SOIL OR SANDBAGS OR FOAMED BARRIERS SUCH AS POLYURETHANE OR CONCRETE.

USE CEMENT POWDER OR FLY ASH TO ABSORB LIQUID MASS.

NEUTRALIZE SPILL WITH SLAKED LIME, SODIUM BICARBONATE OR CRUSHED LIMESTONE.

AIR SPILL:

APPLY WATER SPRAY TO KNOCK DOWN AND REDUCE VAPORS. KNOCK-DOWN WATER IS CORROSIVE AND TOXIC AND SHOULD BE DIKE FOR CONTAINMENT AND LATER DISPOSAL.

WATER SPILL:

NEUTRALIZE WITH AGRICULTURAL LIME, SLAKED LIME, CRUSHED LIMESTONE, OR SODIUM BICARBONATE.

OCCUPATIONAL SPILL:

KEEP COMBUSTIBLES (WOOD, PAPER, OIL, ETC.) AWAY FROM SPILLED MATERIAL. DO NOT TOUCH SPILLED MATERIAL. DO NOT GET WATER INSIDE CONTAINER. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. DO NOT PUT WATER ON LEAK OR SPILL AREA. CLEAN UP ONLY UNDER THE SUPERVISION OF AN EXPERT. DIKE SPILL FOR LATER DISPOSAL. DO NOT APPLY WATER UNLESS DIRECTED TO DO SO. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY. VENTILATE CLOSED SPACES BEFORE ENTERING.

REPORTABLE QUANTITY (RQ): 1000 POUNDS

THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:

PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:

THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS; NIOSH CRITERIA DOCUMENTS OR BY THE U.S. DEPARTMENT OF LABOR, 29 CFR 1910 SUBPART Z.

THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

SULFURIC ACID:

25 MG/M3- ANY POWERED AIR-PURIFYING RESPIRATOR WITH AN ACID GAS CARTRIDGE(S) AND HAVING A HIGH-EFFICIENCY PARTICULATE FILTER.
ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.

50 MG/M3- ANY CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACEPIECE AND ACID GAS CARTRIDGE(S) IN COMBINATION WITH A HIGH-EFFICIENCY PARTICULATE FILTER.

ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.

ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ACID GAS CANISTER HAVING A HIGH-EFFICIENCY PARTICULATE FILTER.

80 MG/M3- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ACID GAS CANISTER HAVING A HIGH-EFFICIENCY PARTICULATE FILTER.

ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

ANY SELF-CONTAINED BREATHING APPARATUS THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

ANY SUPPLIED-AIR RESPIRATOR THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

CLOTHING:

WEAR APPROPRIATE PROTECTIVE CLOTHING TO AVOID ANY POSSIBILITY OF SKIN CONTACT WITH LIQUIDS CONTAINING MORE THAN 1% SULFURIC ACID. AVOID REPEATED OR PROLONGED SKIN CONTACT WITH LIQUIDS CONTAINING 1% OR LESS SULFURIC ACID.

GLOVES:

EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS

SUBSTANCE.

ACC22350

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EYE PROTECTION:

EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A
FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

EMERGENCY WASH FACILITIES:

WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE
EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN
AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC, INC.

CREATION DATE: 11/28/84

REVISION DATE: 10/19/92

-ADDITIONAL INFORMATION-

THIS INFORMATION IS BELIEVED TO BE ACCURATE AND REPRESENTS THE BEST
INFORMATION CURRENTLY AVAILABLE TO US. HOWEVER, WE MAKE NO WARRANTY OF
MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, WITH RESPECT TO
SUCH INFORMATION, AND WE ASSUME NO LIABILITY RESULTING FROM ITS USE. USERS
SHOULD MAKE THEIR OWN INVESTIGATIONS TO DETERMINE THE SUITABILITY OF THE
INFORMATION FOR THEIR PARTICULAR PURPOSES.

MATERIAL SAFETY DATA SHEET

24-HOUR EMERGENCY ASSISTANCE	GENERAL ASSISTANCE	NFPA FIRE HAZARD SYMBOL*
BP America (In Ohio): 800-362-8059 (Outside Ohio): 800-321-8642 CHEMTREC Assist: 800-424-9300	216-586-6499	Flammability Health Reactivity Special Hazards 4-Extreme 3-High 2-Moderate 1-Slight 0-Insignificant *See Text 3 10
MSDS Number > AD8		

MANUFACTURER: The Standard Oil Company and its Subsidiaries
ADDRESS: 200 Public Square, Cleveland, OH 44114-2375

PRODUCT IDENTIFICATION

TRADE NAME: **GASOLINE, BP NO LEAD**

CAS NUMBER: None

SYNONYM(S): MOTOR FUEL; GASOLINE

CHEMICAL FAMILY: Hydrocarbon

MOLECULAR FORMULA: Mixture

MOLECULAR WEIGHT: Mixture

PRODUCT CODE: P 1649

HIERARCHY: 040.040

PRODUCT HAZARD SUMMARY

HEALTH

DANGER!

HARMFUL OR FATAL IF SWALLOWED

ASPIRATION HAZARD

VAPORS MAY BE HARMFUL

LONG-TERM EXPOSURE TO VAPORS HAS CAUSED CANCER IN SOME LABORATORY ANIMALS

MAY BE IRRITATING TO THE SKIN, EYES AND RESPIRATORY TRACT

FLAMMABILITY

DANGER!

EXTREMELY FLAMMABLE LIQUID

VAPORS MAY EXPLODE

REACTIVITY

STABLE

PRODUCT HEALTH HAZARD INFORMATION

EFFECTS OF OVEREXPOSURE

INGESTION:

MODERATELY TOXIC. Human LDLo = ~10-30 gms. Aspiration into lungs may cause pneumonitis. May cause gastrointestinal disturbances. Symptoms may include irritation, nausea, vomiting and diarrhea. May cause harmful central nervous system effects. Effects may

individuals should be followed for changes in blood variables and the delayed appearance of pulmonary edema and chemical pneumonitis. Such patients should be followed for several days or weeks for delayed effects, including bone marrow toxicity, hepatic and renal impairment. Individuals with chronic pulmonary disease will be more seriously impaired, and recovery from inhalation exposure may be complicated. In case of skin injection, prompt debridement of the wound is necessary to minimize necrosis and tissue loss.

PERSONAL PROTECTION INFORMATION

SKIN PROTECTION:

Wear impervious gloves and protective clothing to prevent skin contact.

RESPIRATORY PROTECTION:

Use NIOSH or MSHA approved equipment when airborne exposure limits are exceeded. NIOSH/MSHA approved breathing equipment must be available for non-routine and emergency use. Ventilation may be used to control or reduce airborne concentrations.

PHYSICAL PROPERTIES

BOILING POINT: 13.0 C (55 F)

SPECIFIC GRAVITY: 0.72 - 0.74 @ 60 F

MELTING POINT: NA

% VOLATILE: 100.0 @ 437 F

VAPOR PRESSURE: 760.00 MM HG @ 100 F

EVAPORATION RATE (WATER=1): >1

VAPOR DENSITY (AIR=1): 1.2 AS VAPOR

VISCOSITY: ND

% SOLUBILITY IN WATER: NEGLIGIBLE

POUR POINT: ND

pH: ND

APPEARANCE/ODOR: CLEAR LIQUID WITH A STRONG HYDROCARBON ODOR.

FIRE AND EXPLOSION DATA

FLASH POINT: -37.0 C (-35 F) TCC

AUTOIGNITION TEMPERATURE: 444.0 C (833 F)

FLAMMABILITY LIMITS IN AIR (% BY VOL.) LOWER: 1.4 UPPER: 7.6

BASIC FIREFIGHTING PROCEDURES:

Use dry chemical, foam or carbon dioxide to extinguish fire. Water may be ineffective but should be used to cool fire-exposed containers, structures and to protect personnel. If leak or spill has not ignited, ventilate area and use water spray to disperse gas or vapor and to protect personnel attempting to stop a leak. Use water to flush spills away from sources of ignition. Do not flush down public sewers.

UNUSUAL FIRE AND EXPLOSION HAZARDS:

Dangerous when exposed to heat or flame. Vapors form flammable or explosive mixtures with air at room temperature. Vapor or gas may spread to distant ignition sources and flash back. Vapors may concentrate in confined areas. Runoff to sewer may cause fire or explosion hazard. Containers may explode in heat of fire. Irritating or toxic substances may be emitted upon thermal decomposition. Exposed firefighters should wear MSHA/NIOSH approved self-contained breathing apparatus, with full face mask and full protective equipment.

II/III. Any unusual introduction of this substance into the facility's process streams, stormwater and/or wastewater could result in the violation of U.S. Federal Law. Facilities must notify the USEPA as soon as they know, or have reason to believe, that any activity has occurred, or will occur, which would result in the discharge of a toxic pollutant which is not regulated in the facility's NPDES permit. Notification levels are described in 40 CFR 122.42(a)(1) and 122.42(a)(2). Refer to spill section for additional regulations. There may be specific regulations at the local, regional or state level that pertain to this material.

SPECIAL PRECAUTIONS/SUPPLEMENTAL INFORMATION

HANDLING/STORAGE:

Store in tightly closed containers in cool, dry, isolated, well-ventilated area away from heat, sources of ignition and incompatibles. Ground lines and equipment used during transfer to reduce the possibility of static spark-initiated fire or explosion.

Empty containers may contain toxic, flammable/combustible or explosive residue or vapors. Do not cut, grind, drill, weld or reuse containers unless adequate precautions are taken against these hazards.

TRANSPORTATION REQUIREMENTS

D.O.T. HAZARD CLASS (49 CFR 172.101): FLAMMABLE LIQUID
D.O.T. PROPER SHIPPING NAME (49 CFR 172.101): GASOLINE, FLAMMABLE LIQUID UN 1203
D.O.T. LABELS REQUIRED (49 CFR 172.101): FLAMMABLE LIQUID UN 1203
D.O.T. PLACARDS REQUIRED: FLAMMABLE
BILL OF LADING DESCRIPTION: GASOLINE - FLAMMABLE LIQUID, UN 1203
UN/NA CODE: UN 1203

INGREDIENTS/HEALTH HAZARD INFORMATION

COMPONENT	CAS NO.	%	EXPOSURE LIMITS - REFERENCE
Gasoline	None	90-95	300 ppm TWA; 500 ppm STEL (ACGIH)
Gasoline has been shown to cause an increased rate of kidney tumors in laboratory animals.			
Benzene	71-43-2	0-5	1 ppm 8-hour TWA; 5 ppm STEL (OSHA) 1 ppm 60-minute CEIL (NIOSH); 10 ppm (30 mg/M3) TLV (ACGIH 1987-88).

Harmful or fatal if swallowed, inhaled or absorbed through the skin. Dog oral LDLo = 2000 mg/kg. Rat LC50 = 10,000 ppm/7 hours. Aspiration hazard. Moderately irritating to the skin. May cause allergic reactions in some individuals. Severely irritating to the eye. Acute benzene poisoning causes central nervous system depression. Benzene is carcinogenic to laboratory animals when given by intubation or by inhalation. Chronic exposure affects the hematopoietic system causing blood disorders including anemia and pancytopenia. There is an association between occupational exposure to benzene and human leukemia. This association is based on limited information and is currently unresolved. Mutagenic and clastogenic in mammalian and non-mammalian test systems. Reproductive toxicant only at doses that are maternally toxic, based on tests with animals. Carcinogenic determinations: IARC--Human positive and animal suspected carcinogen; NTP--Known carcinogen; ACGIH--Suspected carcinogen.

EXXON COMPANY, U.S.A.
A DIVISION OF EXXON CORPORATION

DATE ISSUED: 08/31/89
SUPERSEDES DATE: 06/01/89

MATERIAL SAFETY DATA SHEET

EXXON COMPANY, U.S.A. P.O. BOX 2180 HOUSTON, TX 77252-2180

A. IDENTIFICATION AND EMERGENCY INFORMATION

PRODUCT NAME CAT PET-LTD PT #2 H.O.	PRODUCT CODE 190602 - 00753
CHEMICAL NAME Petroleum Distillate Fuel	CAS NUMBER 68476-30-2
PRODUCT APPEARANCE AND ODOR Clear liquid, yellow color Faint petroleum hydrocarbon odor	
MEDICAL EMERGENCY TELEPHONE NUMBER (713) 656-3424	

B. COMPONENTS AND HAZARD INFORMATION

COMPONENTS	CAS NO. OF COMPONENTS	APPROXIMATE CONCENTRATION
Fuel Oil No. 2	68476-30-2	100%

See Section E for Health and Hazard Information.
See Section H for additional Environmental Information.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM (HMIS)

Health	Flammability	Reactivity	BASIS
1	2	0	Recommended by Exxon

EXPOSURE LIMIT FOR TOTAL PRODUCT

100 ppm (900 mg/m3) for an 8-hour workday	BASIS Recommended by Exxon

C. PRIMARY ROUTES OF ENTRY AND EMERGENCY AND FIRST AID PROCEDURES

EYE CONTACT

If splashed into the eyes, flush with clear water for 15 minutes or until irritation subsides. If irritation persists, call a physician.

SKIN

In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water.

INHALATION

Vapor pressure is very low. Vapor inhalation under ambient conditions is normally not a problem. If overcome by vapor from hot product, remove from exposure and call a physician immediately. If breathing is irregular or has stopped, start resuscitation, administer oxygen, if available.

INGESTION

If ingested, DO NOT induce vomiting; call a physician immediately.

D. FIRE AND EXPLOSION HAZARD INFORMATION

FLASH POINT (MINIMUM)

COMBUSTIBLE - Per DOT 49 CFR 173.115
38°C (100°F)
ASTM D 56, Tag Closed Cup

AUTOIGNITION TEMPERATURE

Approximately 210°C (410°F)

NOTE: Minimum may be higher where required by applicable laws or regulations.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) - HAZARD IDENTIFICATION

Health Flammability Reactivity
0 2 0

BASIS

Recommended by the National Fire Protection Association

HANDLING PRECAUTIONS

This liquid is volatile and gives off invisible vapors. Either the liquid or vapor may settle in low areas or travel some distance along the ground or surface to ignition sources where they may ignite or explode.

Keep product away from ignition sources, such as heat, sparks, pilot lights, static electricity, and open flames.

FLAMMABLE OR EXPLOSIVE LIMITS (APPROXIMATE PERCENT BY VOLUME IN AIR)

Estimated values: Lower Flammable Limit 0.9%

Upper Flammable Limit 7%

EXTINGUISHING MEDIA AND FIRE FIGHTING PROCEDURES

Foam, water spray (fog), dry chemical, carbon dioxide and vaporizing liquid type extinguishing agents may all be suitable for extinguishing fires involving this type of product, depending on size or potential size of fire and circumstances related to the situation. Plan fire protection and response strategy through consultation with local fire protection authorities or appropriate specialists.

The following procedures for this type of product are based on the recommendations in the National Fire Protection Association's "Fire Protection Guide on Hazardous Materials", Eighth Edition (1984):

Use water spray, dry chemical, foam or carbon dioxide to extinguish the fire. Use water to keep fire-exposed containers cool. If a leak or spill has not ignited, use water spray to disperse the vapors and to provide protection for men attempting to stop a leak. Water spray may be used to flush spills away from exposures. Minimize breathing of gases, vapor, fumes or decomposition products. Use supplied-air breathing equipment for enclosed or confined spaces or as otherwise needed.

DECOMPOSITION PRODUCTS UNDER FIRE CONDITIONS

Fumes, smoke, carbon monoxide, aldehydes and other decomposition products, in the case of incomplete combustion.

"EMPTY" CONTAINER WARNING

"Empty" containers retain residue (liquid and/or vapor) and can be dangerous. DO NOT PRESSURIZE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Do not attempt to clean since residue is difficult to remove. "Empty" drums should be completely drained, properly bunged and promptly returned to a drum reconditioner. All other containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations. For work on tanks refer to Occupational Safety and Health Administration regulations, ANSI Z49.1, and other governmental and industrial references pertaining to cleaning, repairing, welding, or other contemplated operations.

E. HEALTH AND HAZARD INFORMATION

VARIABILITY AMONG INDIVIDUALS

Health studies have shown that many petroleum hydrocarbons and synthetic lubricants pose potential human health risks which may vary from person to person. As a precaution, exposure

CAT PET-LTD PT #2 H.O.

to liquids, vapors, mists or fumes should be minimized.

EFFECTS OF OVEREXPOSURE (Signs and symptoms of exposure)

Prolonged or repeated liquid contact with the skin will dry and defat the skin, leading to possible irritation and dermatitis.

High vapor concentrations (greater than approximately 1000 ppm, attainable at temperatures well above ambient) are irritating to the eyes and the respiratory tract, and may cause headaches, dizziness, anesthesia, drowsiness, unconsciousness, and other central nervous system effects, including death.

NATURE OF HAZARD AND TOXICITY INFORMATION

Prolonged or repeated skin contact with this product tends to remove skin oils, possibly leading to irritation and dermatitis; however, based on human experience and available toxicological data, this product is judged to be neither a "corrosive" nor an "irritant" by OSHA criteria.

Product contacting the eyes may cause eye irritation.

Lifetime skin painting studies conducted by the American Petroleum Institute, Exxon and others have shown that similar products boiling between 175-370°C (350-700°F) usually produce skin tumors and/or skin cancer in laboratory mice. The degree of carcinogenic response was weak to moderate with a relatively long latent period. The implications of these results for humans have not been determined.

Limited studies on oils that are very active carcinogens have shown that washing the animals' skin with soap and water between applications greatly reduces tumor formation. These studies demonstrate the effectiveness of cleansing the skin after contact.

Potential risks to humans can be minimized by observing good work practices and personal hygiene procedures generally recommended for petroleum products. See Section I for recommended protection and precautions.

Laboratory animal studies have shown that prolonged and repeated inhalation exposure to light hydrocarbon vapors in the same naphtha boiling range as this product can produce adverse kidney effects in male rats. However, these effects were not observed in similar studies with female rats and male and female mice and in limited studies with other animal species. Additionally, in a number of human studies, there was no clinical evidence of such effects at normal occupational levels. It is therefore highly unlikely that the kidney effects observed in male rats have significant implications for humans exposed at or below the recommended vapor limits in the workplace.

Product has a low order of acute oral and dermal toxicity, but minute amounts aspirated into the lungs during ingestion or vomiting may cause mild to severe pulmonary injury and possibly death.

This product is judged to have an acute oral LD50 (rat) greater than 5 g/kg of body weight, and an acute dermal LD50 (rabbit) greater than 3.16 g/kg of body weight.

Inhalation of components of exhaust from burning, such as carbon monoxide, may cause death at high concentrations.

Long-term repeated exposure of laboratory animals to whole diesel exhaust has resulted in an increased incidence of lung cancer.

Exposure to exhaust from burning and diesel exhaust should be minimized.

PRE-EXISTING MEDICAL CONDITIONS WHICH MAY BE AGGRAVATED BY EXPOSURE

Petroleum Solvents/Petroleum Hydrocarbons - Skin contact may aggravate an existing dermatitis.

F. PHYSICAL DATA

The following data are approximate or typical values and should not be used for precise design purposes.

BOILING RANGE

160-350°C (320-650°F)

VAPOR PRESSURE

Less than 1 mm Hg @ 20°C

SPECIFIC GRAVITY (15.6 C/15.6 C)

0.87

VAPOR DENSITY (AIR = 1)

Greater than 5

MOLECULAR WEIGHT
Approximately 212 average

PERCENT VOLATILE BY VOLUME
100

PH
Essentially neutral

EVAPORATION RATE @ 1 ATM. AND 25 C (77 F)
(n-BUTYL ACETATE = 1)
0.05

POUR, CONGEALING OR MELTING POINT
-29°C (-20°F)
Pour Point by ASTM D 97

SOLUBILITY IN WATER @ 1 ATM. AND 25 C (77 F)
Negligible; less than 0.1%

VISCOSITY
2.7 cSt @ 40°C

G. REACTIVITY

This product is stable and will not react violently with water. Hazardous polymerization will not occur. Avoid contact with strong oxidants such as liquid chlorine, concentrated oxygen, sodium hypochlorite or calcium hypochlorite.

H. ENVIRONMENTAL INFORMATION

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Shut off and eliminate all ignition sources. Keep people away. Recover free product. Add sand, earth or other suitable absorbent to spill area. Minimize breathing vapors. Minimize skin contact. Ventilate confined spaces. Open all windows and doors. Keep product out of sewers and watercourses by diking or impounding. Advise authorities if product has entered or may enter sewers, watercourses, or extensive land areas. Assure conformity with applicable governmental regulations.

THE FOLLOWING INFORMATION MAY BE USEFUL IN COMPLYING WITH VARIOUS STATE AND FEDERAL LAWS AND REGULATIONS UNDER VARIOUS ENVIRONMENTAL STATUTES:

REPORTABLE QUANTITY (RQ), EPA REGULATION 40 CFR 302 (CERCLA Section 102)
No RQ for product or any constituent greater than 1% or 0.1% (carcinogen).

THRESHOLD PLANNING QUANTITY (TPQ), EPA REGULATION 40 CFR 355 (SARA Sections 301-304)
No TPQ for product or any constituent greater than 1% or 0.1% (carcinogen).

TOXIC CHEMICAL RELEASE REPORTING, EPA REGULATION 40 CFR 372 (SARA Section 313)
No toxic chemical is present greater than 1% or 0.1% (carcinogen).

HAZARDOUS CHEMICAL REPORTING, EPA REGULATION 40 CFR 370 (SARA Sections 311-312)

	Acute	Chronic	Fire	Pressure	Reactive	Not Applicable
EPA HAZARD CLASSIFICATION CODE:	Hazard	Hazard	Hazard	Hazard	Hazard	
	XXX	XXX	XXX			

I. PROTECTION AND PRECAUTIONS

VENTILATION

Use only with ventilation sufficient to prevent exceeding recommended exposure limit or buildup of explosive concentrations of vapor in air.

RESPIRATORY PROTECTION

Use supplied-air respiratory protection in confined or enclosed spaces, if needed.

PROTECTIVE GLOVES

Use chemical-resistant gloves, if needed, to avoid prolonged or repeated skin contact.

EYE PROTECTION

Use splash goggles or face shield when eye contact may occur.

OTHER PROTECTIVE EQUIPMENT

Use chemical-resistant apron or other impervious clothing, if needed, to avoid contaminating regular clothing, which could result in prolonged or repeated skin contact.

WORK PRACTICES / ENGINEERING CONTROLS

Keep containers closed when not in use. Do not store near heat, sparks, flame or strong oxidants.

In order to prevent fire or explosion hazards, use appropriate equipment.

Information on electrical equipment appropriate for use with this product may be found in the latest edition of the National Electrical Code (NFPA-70). This document is available from the National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269.

PERSONAL HYGIENE

Minimize breathing vapor, mist or fumes. Avoid prolonged or repeated contact with skin. Remove contaminated clothing; launder or dry-clean before re-use. Remove contaminated shoes and thoroughly clean before re-use; discard if oil-soaked. Cleanse skin thoroughly after contact, before breaks and meals, and at end of work period. Product is readily removed from skin by waterless hand cleaners followed by washing thoroughly with soap and water.

J. TRANSPORTATION AND OSHA RELATED LABEL INFORMATION

TRANSPORTATION INCIDENT INFORMATION

For further information relative to spills resulting from transportation incidents, refer to latest Department of Transportation Emergency Response Guidebook for Hazardous Materials Incidents, DOT P 5800.3.

DOT IDENTIFICATION NUMBER

Fuel Oil, No. 2 / Combustible Liquid / NA 1993

OSHA REQUIRED LABEL INFORMATION

In compliance with hazard and right-to-know requirements, the following OSHA Hazard Warnings should be found on a label, bill of lading or invoice accompanying this shipment.

DANGER!

COMBUSTIBLE

**LONG-TERM, REPEATED EXPOSURE MAY
CAUSE SKIN CANCER**

Note: Product label will contain additional non-OSHA related information.

The information and recommendations contained herein are, to the best of Exxon's knowledge and belief, accurate and reliable as of the date issued. Exxon does not warrant or guarantee their accuracy or reliability, and Exxon shall not be liable for any loss or damage arising out of the use thereof.

The information and recommendations are offered for the user's consideration and examination, and it is the user's responsibility to satisfy itself that they are suitable and complete for its particular use. If buyer repackages this product, legal council should be consulted to insure proper health, safety and other necessary information is included on the container.

The Environmental Information included under Section H hereof as well as the Hazardous Materials Identification System (HMIS) and National Fire Protection Association (NFPA) ratings have been included by Exxon Company, U.S.A. in order to provide additional health and hazard classification information. The ratings recommended are based upon the criteria supplied by the developers of these rating systems, together with Exxon's interpretation of the available data.

FOR ADDITIONAL INFORMATION ON HEALTH
EFFECTS CONTACT:
DIRECTOR OF INDUSTRIAL HYGIENE
EXXON COMPANY, U.S.A.
P. O. BOX 2180 ROOM 3157
HOUSTON, TX 77252-2180
(713) 656-2443

FOR OTHER PRODUCT INFORMATION CONTACT:
MANAGER, MARKETING TECHNICAL SERVICES
EXXON COMPANY, U.S.A.
P. O. BOX 2180 ROOM 2355
HOUSTON, TX 77252-2180
(713) 656-5949

BASIC TESTING SPECIFICATIONS

9/15/92

PRODUCT	GRAVITY	FLASH MIN		COLOR	REMARKS
	MIN - MAX	F	C		
EXXON SUPREME	REPORT	NO TESTING		REPORT	LEAD .025 MAX
EXXON PLUS	REPORT	NO TESTING		REPORT	LEAD .025 MAX
EXXON REGULAR	REPORT	NO TESTING		REPORT	LEAD .025 MAX
SHELL PREMIUM	REPORT	NO TESTING		REPORT	LEAD .025 MAX
AVIATION 100LL	REPORT	NO TESTING		BLUE	RVP 5.9 TO 6.7
TURBO FUEL A	37.3 - 50.7	103	39	+16 MIN	
KEROSENE	37.0 MIN	104	40	+16 MIN	
HEATING OIL	30.0 MIN	124	51	2.0 MAX	
EXXON DIESEL	39.0 MAX	144	62	2.0 MAX	

EXXON LAB SPEC FOR RACK & CUSTOMER SALES

NOTE* ALL INCOMING PRODUCT SHOULD BE ACCOMPANIED BY A CERTIFICATE OF ANALYSIS (C of A). OCCASIONALLY THIS RULE MAY NOT APPLY, EXAMPLE MAY BE SHELL PREMIUM. THE PLANT SUPERINTENDENT WILL NOTIFY LAB WHEN THIS OCCURS.

MOTOR FUEL (GASOLINE) RVP POSTED ABOVE ARE SEASONAL. NO RVP TESTING IS NEEDED BEGINING SEPTEMBER 15, 1992. COMPARE COLOR/GRAVITY RVP WITH CERTIFICATE OF ANALYSIS. VESSEL INDIVIDUAL COMPARTMENTS MAY VARY IN RVP AND GRAVITY. (NON-EXXON GASOLINE) SPECIFICATIONS SAME.

AVIATION 100LL - MAXIMUM SPREAD ON GRAVITY 1 DEGREE PLUS OR MINUS
EXAMPLE (C of A GRAVITY REPORTED 67.0 RANGE OF ACCEPTANCE WOULD BE BETWEEN 66.0 AND 68.0)

TURBO FUEL A - MAXIMUM SPREAD ON GRAVITY 1 DEGREE PLUS OR MINUS
MAXIMUM SPREAD ON FLASH 5 DEGREES FAHRENHEIT PLUS OR MINUS. EXAMPLE (C of A FLASH REPORTED 120F RANGE OF ACCEPTANCE WOULD BE BETWEEN 115F AND 125F.

VESSEL INDIVIDUAL COMPARTMENTS MAY VARY IN GRAVITY AND FLASH AS REPORTED ON C of A. IN THIS CASE COMPARE LOW AND HIGH VALUES.
EXAMPLE 1-PORT GRAVITY 42.0 FLASH 115F 2-PORT GRAVITY 43.5 FLASH 122F
RANGE OF ACCEPTANCE WOULD BE GRAVITY 42.0 TO 43.5, FLASH 115F TO 122F

JAI/LAB

ACETONE
ACETONE
ACETONE

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY NUMBER: (201) 796-7100
CHEMTREC ASSISTANCE: (800) 424-9300

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 67-64-1

SUBSTANCE: **ACETONE**

TRADE NAMES/SYNONYMS:

2-PROPANONE; DIMETHYLFORMALDEHYDE; DIMETHYL KETONE; BETA-KETOPROPANE;
METHYL KETONE; PROPANONE; PYROACETIC ETHER; RCRA U002; SIC 4908105;
UN 1090; A949; A40; A20; A19; A946; A18; A18S; A18SK; A11; A11S; A16P; A16S;
A949SK; A929; A930; C3H6O;

CHEMICAL FAMILY:
KETONE, ALIPHATIC

MOLECULAR FORMULA: C-H3-C-(O)-C-H3

MOLECULAR WEIGHT: 58.08

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: ACETONE PERCENT: 100.0
CAS# 67-64-1

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:

ACETONE:

750 PPM (1280 MG/M3) OSHA TWA; 1000 PPM (2375 MG/M3) OSHA STEL
750 PPM (1280 MG/M3) ACGIH TWA; 1000 PPM (2375 MG/M3) ACGIH STEL
250 PPM (590 MG/M3) NIOSH RECOMMENDED 10 HOUR TWA
1000 PPM (2375 MG/M3) DEQ MAX TWA;
2000 PPM (4750 MG/M3) DEQ MAX 60 MINUTE PEAK, MOMENTARY VALUE, 3 TIMES/SHIFT

MEASUREMENT METHOD: CHARCOAL TUBE; CARBON DISULFIDE; GAS CHROMATOGRAPHY
WITH FLAME IONIZATION DETECTION; (NIOSH VOL. III # 1300, KETONES I).

5000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY

**OSHA LIMITS ADOPTED JANUARY 19, 1987 ARE SUBJECT TO THE DECISION OF THE
11TH CIRCUIT COURT OF APPEALS (AFL-CIO V. OSHA) AS OF JULY 7, 1992.**

PHYSICAL DATA

DESCRIPTION: CLEAR, COLORLESS, VOLATILE LIQUID WITH A CHARACTERISTIC
SWEETISH MINT-LIKE ODOR AND SWEETISH TASTE. BOILING POINT: 133 F (56 C)
MELTING POINT: -139 F (-95 C) SPECIFIC GRAVITY: 0.7899 VOLATILITY: 100X
VAPOR PRESSURE: 180 MMHG @ 20 C EVAPORATION RATE: (BUTYL ACETATE=1) 6
SOLUBILITY IN WATER: VERY SOLUBLE ODOR THRESHOLD: 20 PPM
VAPOR DENSITY: 2.0
SOLVENT SOLUBILITY: SOLUBLE IN ALCOHOL, ETHER, BENZENE, CHLOROFORM, MOST
DIMETHYLFORMAMIDE AND MOST OILS.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.
VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE
OF IGNITION AND FLASH BACK.
VAPOR-AIR MIXTURES ARE EXPLOSIVE.
FLASH POINT: -4 F (-20 C) (CC) UPPER EXPLOSIVE LIMIT: 13X
LOWER EXPLOSIVE LIMIT: 2.5% AUTOIGNITION TEMP.: 869 F (465 C)
FLAMMABILITY CLASS(OSHA): IB
FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR ALCOHOL-RESISTANT FOAM
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).
FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL-RESISTANT FOAM
(1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).
ALCOHOL FOAM
(NFPA 325M, FIRE HAZARD PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND VOLATILE
SOLIDS, 1991).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF YOU CAN DO IT WITHOUT RISK. APPLY COOLING
WATER TO SIDES OF CONTAINERS THAT ARE EXPOSED TO FLAMES UNTIL WELL AFTER FIRE
IS OUT. STAY AWAY FROM ENDS OF TANKS. FOR MASSIVE FIRE IN CARGO AREA, USE
UNMANNED HOSE HOLDER OR MONITOR NOZZLES; IF THIS IS IMPOSSIBLE, WITHDRAW FROM
AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM
VENTING SAFETY DEVICE OR ANY DISCOLORATION OF TANK DUE TO FIRE. ISOLATE FOR
1/2 MILE IN ALL DIRECTIONS IF TANK, RAIL CAR OR TANK TRUCK IS INVOLVED IN FIRE

EXTINGUISH ONLY IF FLOW CAN BE STOPPED. USE FLOODING AMOUNTS OF WATER AS A FOG; SOLID STREAMS MAY BE INEFFECTIVE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING VAPORS; KEEP UPWIND. IF FIRE IS UNCONTROLLABLE OR CONTAINERS ARE EXPOSED TO DIRECT FLAME, EVACUATE TO A RADIUS OF 1500 FEET. CONSIDER EVACUATION OF DOWNWIND AREA IF MATERIAL IS LEAKING.

WATER MAY BE INEFFECTIVE (NFPA 325K, FIRE HAZARD PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND VOLATILE SOLIDS, 1991)

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49-CFR 172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49-CFR 172.101 AND
SUBPART E:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49-CFR 173.119
EXCEPTIONS: 49-CFR 173.118

FINAL RULE ON HAZARDOUS MATERIALS REGULATIONS (HMR, 49 CFR PARTS 171-180),
DOCKET NUMBERS HM-181, HM-181A, HM-181B, HM-181C, HM-181D AND HM-204,
EFFECTIVE DATE OCTOBER 1, 1991. HOWEVER, COMPLIANCE WITH THE REGULATIONS IS
AUTHORIZED ON AND AFTER JANUARY 1, 1991. (55 FR 52402, 12/21/90)

EXCEPT FOR EXPLOSIVES, INHALATION HAZARDS, AND INFECTIOUS SUBSTANCES, THE
EFFECTIVE DATE FOR HAZARD COMMUNICATION REQUIREMENTS IS EXTENDED TO
OCTOBER 1, 1993. (56 FR 42156, 09/18/91)

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
ACETONE-UN 1090

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
3 - FLAMMABLE LIQUID

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG II

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101
AND SUBPART E:
FLAMMABLE LIQUID

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.150
NON-BULK PACKAGING: 49 CFR 173.202
BULK PACKAGING: 49 CFR 173.242

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 5 L
CARGO AIRCRAFT ONLY: 60 L

TOXICITY

ACETONE:

IRRITATION DATA: 395 MG OPEN SKIN-RABBIT MILD; 500 MG/24 HOURS SKIN-RABBIT MILD; 500 PPM EYE-HUMAN; 20 MG EYE-RABBIT SEVERE; 20 MG/24 HOURS EYE-RABBIT NOOEFAE.

TOXICITY DATA: 500 PPM INHALATION-HUMAN LCLO; 440 MG/M3/6 MINUTES INHALATION-MAN LCLO; 10 MG/M3/6 HOURS INHALATION-MAN LCLO; 12000 PPM/4 HOURS INHALATION-MAN LCLO; 50100 MG/M3/8 HOURS INHALATION-RAT LC50; 110 GM/M3/1 HOUR INHALATION-MOUSE LCLO; 20 GM/KG SKIN-RABBIT LD50; 2857 MG/KG ORAL-MAN LDLO; 5800 MG/KG ORAL-RAT LD50; 3000 MG/KG OPAL-MOUSE LD50; 8 GM/KG OPAL-DOG LDLO; 5340 MG/KG ORAL-RABBIT LD50; 5 GM/KG SUBCUTANEOUS-DOG LDLO; 5 GM/KG SUBCUTANEOUS-GUINEA PIG LDLO; 5500 MG/KG INTRAVENOUS-RAT LD50; 4 GM/KG INTRAVENOUS-MOUSE LDLO; 1576 MG/KG INTRAVENOUS-RABBIT LDLO; 500 MG/KG INTRAPERITONEAL-RAT LDLO; 1297 MG/KG INTRAPERITONEAL-MOUSE LD50; 8 GM/KG INTRAPERITONEAL-DOG LDLO; 1157 MG/KG UNREPORTED-MAN LDLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS).

CARCINOGEN STATUS: NONE.

LOCAL EFFECTS: IRRITANT- INHALATION, SKIN, EYE.

ACUTE TOXICITY LEVEL: SLIGHTLY TOXIC BY INHALATION, DERMAL ABSORPTION, INGESTION.

TARGET EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT.

AT INCREASED RISK FROM EXPOSURE: PERSONS WITH CHRONIC RESPIRATORY OR SKIN DISEASES.

ADDITIONAL DATA: ALCOHOL MAY ENHANCE THE TOXIC EFFECTS.

HEALTH EFFECTS AND FIRST AID

INHALATION:

ACETONE:

IRITANT/NARCOTIC. 20,000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- VAPOR CONCENTRATIONS AROUND 1000 PPM MAY CAUSE SLIGHT TRANSIENT IRRITATION OF THE UPPER RESPIRATORY TRACT. EXPOSURE TO 12,000 PPM HAS CAUSED THROAT IRRITATION AND CENTRAL NERVOUS SYSTEM DEPRESSION WITH WEAKNESS OF THE LEGS, HEADACHE, DIZZINESS, DROWSINESS, NAUSEA AND A GENERAL FEELING OF MALAISE. OTHER POSSIBLE EFFECTS FROM EXPOSURE TO HIGH CONCENTRATIONS INCLUDE DRYNESS OF THE MOUTH AND THROAT, INCOORDINATION OF MOTION AND SPEECH, RESTLESSNESS, ANOREXIA, ABDOMINAL PAIN, VOMITING, SOMETIMES FOLLOWED BY HEMATEMESIS, HYPOTHERMIA, DYSPNEA, SLOW, IRREGULAR RESPIRATION, SLOW, WEAK PULSE, PROGRESSIVE COLLAPSE WITH STUPOR, AND IN SEVERE CASES, COMA. LIVER DAMAGE MAY BE INDICATED BY HIGH UROBILIN LEVELS AND JAUNDICE. KIDNEY DAMAGE MAY BE INDICATED BY ALBUMIN AND RED AND WHITE BLOOD CELLS IN THE URINE. BLOOD GLUCOSE LEVELS MAY BE AFFECTED AND FATAL KETOSIS IS POSSIBLE.

CHRONIC EXPOSURE- WORKERS EXPOSED TO 500 PPM/6 HOURS/6 DAYS EXPERIENCED MUCOUS MEMBRANE IRRITATION, AN UNPLEASANT SMELL, HEAVY EYES, OVERNIGHT HEADACHE, AND GENERAL WEAKNESS ACCOMPANIED BY HEMATOLOGIC CHANGES. RECOVERY OCCURRED IN SEVERAL DAYS. WORKERS EXPOSED TO 1000 PPM FOR 3 HOURS/DAY FOR 7-15 YEARS REPORTED CHRONIC INFLAMMATION OF THE RESPIRATORY TRACT, STOMACH AND DUODENUM, DIZZINESS, LOSS OF STRENGTH, AND ASTHENIA. DROWSINESS, VERTIGO, SENSATION OF HEAT, AND COUGHING HAVE ALSO BEEN REPORTED FROM CHRONIC EXPOSURE TO LOW CONCENTRATIONS. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST.

TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:

ACETONE:

IRRITANT.

ACUTE EXPOSURE- CONTACT WITH THE LIQUID CAUSED MILD IRRITATION IN RABBITS. CELLULAR DAMAGE TO THE OUTER LAYERS OF THE EPITHELIUM WITH MILD EDEMA AND HYPEREMIA HAS BEEN DEMONSTRATED IN HUMANS, BUT WAS READILY REVERSIBLE. SMALL AMOUNTS MAY BE ABSORBED THROUGH INTACT SKIN.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE DERMATITIS WITH DRYING, CRACKING, AND ERYTHEMA DUE TO THE DEFATTING ACTION ACCOMPANIED BY PERSISTENT PARESTHESIA OF THE FINGERS. THE AMOUNT ABSORBED THROUGH THE SKIN INCREASES DIRECTLY WITH THE FREQUENCY AND EXTENT OF THE EXPOSURE. 2 OR 3 GUINEA PIGS EXPOSED BY SKIN CONTACT FOR 3 WEEKS DEVELOPED CATARACTS BY THE END OF THREE MONTHS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:

ACETONE:

IRRITANT.

ACUTE EXPOSURE- IN HUMANS, VAPORS PRODUCE ONLY SLIGHT IRRITATION WHEN THE CONCENTRATION IS AT OR BELOW 1000 PPM. HOWEVER, HIGH VAPOR CONCENTRATIONS HAVE CAUSED CORNEAL EPITHELIAL AND CONJUNCTIVAL INJURY IN ANIMALS. LIQUID SPLASHED IN HUMAN EYES CAUSES AN IMMEDIATE STINGING SENSATION AND, IF WASHED PROMPTLY, DAMAGE ONLY TO THE CORNEAL EPITHELIUM CHARACTERIZED BY MICROSCOPIC GRAY DOTS AND A FOREIGN BODY SENSATION, WHICH HEALS COMPLETELY IN 1-2 DAYS.

CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE TO THE VAPORS MAY CAUSE IRRITATION OR CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:

ACETONE:

NARCOTIC.

ACUTE EXPOSURE- MAY CAUSE A FRUITY ODOR OF THE BREATH AND MUCOUS MEMBRANE AND GASTROENTERIC IRRITATION. IN ACUTE CASES, A LATENT PERIOD MAY BE FOLLOWED BY RESTLESSNESS, DIARRHEA, NAUSEA AND VOMITING PROCEEDING TO HEMATEMESIS AND PROGRESSIVE COLLAPSE WITH STUPOR. HEPATORENAL LESIONS HAVE BEEN REPORTED. THE BLOOD GLUCOSE LEVEL MAY BE AFFECTED AND KETOSIS MAY BE FATAL. 10-20 MILLILITERS HAVE BEEN TOLERATED WITHOUT ILL EFFECTS. LARGE AMOUNTS HAVE PRODUCED LETHARGY, PHARYNGEAL AND SOFT PALATE EROSIONS AND ERYTHEMA. 200 MILLILITERS HAVE CAUSED STUPOR WITHIN A HALF HOUR, FLUSHED CHEEKS, SHALLOW RESPIRATION, AND COMA WHICH LASTED FOR 12 HOURS. RENAL GLUCOSURIA PERSISTED FOR 5 MONTHS.

CHRONIC EXPOSURE- RATS ADMINISTERED 25,000 PPM IN THEIR DRINKING WATER FOR 14 DAYS SHOWED DEPRESSED GROWTH, FLUID INTAKE AND FEED CONSUMPTION. RATS GIVEN 100,000 PPM SHOWED MILD DEBILITATION, DEPRESSED WEIGHT GAIN, EMACIATED APPEARANCE, AND BONE MARROW HYPERPLASIA. MALE RATS IN 13 WEEK STUDIES DEVELOPED DEPRESSED SPERM MOTILITY AND CAUDAL AND EPIDIDYMAL UEGHTIS, AN INCREASED INCIDENCE OF ABNORMAL SPERM AND NEPHROPATHY. RATS DEVELOPED ANEMIA AND SPLENIC PIGMENTATION (HEMOSIDEROSIS) AT LEVELS OF

20,000 AND 50,000 PPM. IN BOTH THE 14 DAY AND 13 WEEK STUDIES, MICE DEVELOPED CENTRILOBULAR HEPATOCELLULAR HYPERTROPHY.

FIRST AID: IF THE PERSON IS CONSCIOUS AND NOT CONVULSING, INDUCE EMESIS BY GIVING SYRUP OF IPECAC FOLLOWED BY WATER. (IF VOMITING OCCURS KEEP THE HEAD BELOW THE HIPS TO PREVENT ASPIRATION). REPEAT IN 20 MINUTES IF NOT EFFECTIVE INITIALLY. GIVE ACTIVATED CHARCOAL. IN PATIENTS WITH DEPRESSED RESPIRATION OR IF EMESIS IS NOT PRODUCED, PERFORM GASTRIC LAVAGE CAUTIOUSLY (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GASTRIC LAVAGE SHOULD BE PERFORMED BY QUALIFIED MEDICAL PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:

NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:

STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:

ACETONE:

ACIDS: INCOMPATIBLE.
 AMINES (ALIPHATIC): INCOMPATIBLE.
 BROMINE: VIOLENT REACTION WITH EXCESS AMOUNTS OF BROMINE.
 BROMINE TRIFLUORIDE: EXPLOSION ON CONTACT.
 BROMOFORM: VIOLENT REACTION IN PRESENCE OF BASES (E.G. POTASSIUM HYDROXIDE).
 CHLOROFORM: VIOLENT REACTION IN PRESENCE OF A BASE.
 CHROMIUM TRIOXIDE: IGNITION ON CONTACT AT AMBIENT TEMPERATURE.
 CHROMYL CHLORIDE: INCANDESCENT REACTION.
 DIOXYGEN DIFLUORIDE + SOLID CARBON DIOXIDE: EXPLOSION AT -78 C.
 HEXACHLOROMELAMINE: POSSIBLE EXPLOSION.
 HYDROGEN PEROXIDE: EXPLOSION.
 NITRIC ACID: IGNITION.
 NITRIC + ACETIC ACID MIXTURE: POSSIBLE EXPLOSION.
 NITRIC + SULFURIC ACID MIXTURE: VIOLENT OXIDATION.
 NITROSYL CHLORIDE: EXPLOSIVE REACTION.
 NITROSYL PERCHLORATE: IGNITION AND EXPLOSION.
 NITRYL PERCHLORATE: IGNITION AND EXPLOSION.
 OXIDIZERS (STRONG): FIRE AND EXPLOSION HAZARD.
 PERMONOSULFURIC ACID: EXPLOSION.
 PLASTICS: INCOMPATIBLE.
 PLATINUM + NITROSYL CHLORIDE: POSSIBLE EXPLOSION.
 POTASSIUM-TERT-BUTOXIDE: IGNITION.
 RAYON: INCOMPATIBLE.
 SODIUM HYPOBROMITE: EXPLOSION.
 SODIUM HYPOIODITE: POSSIBLE EXPLOSION.
 SULFUR DICHLORIDE: VIOLENT REACTION.
 SULFURIC ACID AND POTASSIUM BICHROMATE: IGNITION.
 THIODIGLYCOL + HYDROGEN PEROXIDE: POSSIBLE EXPLOSION.
 THIOTRIAZYL PERCHLORATE: POSSIBLE EXPLOSION.
 1,1,1-TRICHLOROETHANE: EXOTHERMIC CONDENSATION BY A BASIC CATALYST.
 TRICHLOROMELAMINE: POSSIBLE EXPLOSION.
 SEE ALSO KETONES.

KETONES:

ACETALDEHYDE: VIOLENT CONDENSATION REACTION.

NITRIC ACID + HYDROGEN PEROXIDE: FORMATION OF EXPLOSIVE PRODUCT.
PERCHLORIC ACID: VIOLENT RECOMPOSITION.

DECOMPOSITION:

THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:

HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

****STORAGE****

STORE IN ACCORDANCE WITH 29 CFR 1910.106.

BONDING AND GROUNDING: SUBSTANCES WITH LOW ELECTROCONDUCTIVITY, WHICH MAY BE IGNITED BY ELECTROSTATIC SPARKS, SHOULD BE STORED IN CONTAINERS WHICH MEET THE BONDING AND GROUNDING GUIDELINES SPECIFIED IN NFPA 77-1983, RECOMMENDED PRACTICE ON STATIC ELECTRICITY.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

****DISPOSAL****

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40CFR 262, EPA HAZARDOUS WASTE NUMBER U002.

CONDITIONS TO AVOID

AVOID CONTACT WITH HEAT, SPARKS, FLAMES, OR OTHER SOURCES OF IGNITION. VAPORS MAY BE EXPLOSIVE AND POISONOUS; DO NOT ALLOW UNNECESSARY PERSONNEL IN AREA. DO NOT OVERHEAT CONTAINERS; CONTAINERS MAY VIOLENTLY RUPTURE AND TRAVEL A CONSIDERABLE DISTANCE IN HEAT OF FIRE.

SPILL AND LEAK PROCEDURES**OCCUPATIONAL SPILL:**

SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 5000 POUNDS

THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE

AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:

PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:

THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS; NIOSH CRITERIA DOCUMENTS OR BY THE U.S. DEPARTMENT OF LABOR, 29 CFR 1910 SUBPART Z.

THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

ACETONE:

1000 PPM- ANY CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S).
ANY POWERED, AIR-PURIFYING RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S).
ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

6250 PPM- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS-FLOW MODE.

12,500 PPM- ANY AIR-PURIFYING FULL-FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE, FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.

20,000 PPM- ANY SUPPLIED-AIR RESPIRATOR THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING, FULL-FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE, FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY APPROPRIATE ESCAPE-TYPE, SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

ANY SELF-CONTAINED BREATHING APPARATUS THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

ANY SUPPLIED-AIR RESPIRATOR THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

CLOTHING:

EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

EMERGENCY EYE WASH: WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC, INC.
CREATION DATE: 09/06/84 REVISION DATE: 10/12/92

--ADDITIONAL INFORMATION--

THIS INFORMATION IS BELIEVED TO BE ACCURATE AND REPRESENTS THE BEST INFORMATION CURRENTLY AVAILABLE TO US. HOWEVER, WE MAKE NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, WITH RESPECT TO SUCH INFORMATION, AND WE ASSUME NO LIABILITY RESULTING FROM ITS USE. USERS SHOULD MAKE THEIR OWN INVESTIGATIONS TO DETERMINE THE SUITABILITY OF THE INFORMATION FOR THEIR PARTICULAR PURPOSES.

***** **SECTION V - PERSONAL PROTECTION INFORMATION** *****

--WHEN HANDLING BULK QUANTITIES--

EYE PROTECTION: OSHA approved safety glasses, goggles or face shield.

PROTECTIVE CLOTHING: Wear rubber gloves. To avoid excessive exposure, wear impervious boots and clothing.

VENTILATION: Mechanical ventilation should be used when handling this product in enclosed spaces.

RESPIRATORY PROTECTION: In the absence of proper ventilation, use a respirator approved by NIOSH/MSHA for use with pesticides and organic solvents.

--WHEN USING PRODUCT ACCORDING TO DIRECTIONS FOR USE--

EYE PROTECTION: Avoid applying product in and around eyes.

PROTECTIVE CLOTHING: None required for normal use.

VENTILATION: Normal room ventilation is satisfactory.

RESPIRATORY PROTECTION: None required for normal use.

***** **SECTION VI - STORAGE AND SPECIAL HANDLING INFORMATION** *****

Store containers upright and closed. Store in areas that are cool, dry and well-ventilated. Keep away from heat, ignition sources and strong oxidizers. Do not contaminate water, feed or food by storage, handling, or disposal. Read and observe all precautions and instructions on the product label.

***** **SECTION VII - SPILL OR LEAK RESPONSE INFORMATION** *****

PRECAUTIONS IN CASE OF SPILLS OR LEAKS: Eliminate all ignition sources. Contain the spill (prevent this product from reaching surface waters or other water supplies). Soak up the spill with an appropriate absorbent and transfer into waste containers for disposal. Clean the spill area with detergent and water.

WASTE DISPOSAL METHOD: Contaminated absorbent and wash water should be disposed of according to local, state and federal regulations.

RCRA/CERCLA HAZARDOUS WASTE: This product contains no hazardous waste.

Product Name: The 10-Hour Insect Repellent
Tec Laboratories, Inc.

Page 4 of 4
Issue Date: 09/07/93

***** **SECTION VIII - FIRE AND EXPLOSION HAZARD INFORMATION** *****

FLASH POINT (closed cup): 302°F. This product is classified as a non-combustible liquid.

FLAMMABLE LIMITS: not established
(in air, % by volume)

EXTINGUISHING MEDIA: Foam, carbon dioxide or dry chemical.

UNUSUAL FIRE AND EXPLOSION HAZARDS: None

SPECIAL FIRE FIGHTING PROCEDURES: Treat as an oil fire. Use a full-faced self-contained breathing apparatus along with full protective gear. Keep nearby containers and equipment cool with a water spray. Contain the runoff, if possible, for proper disposal.

***** **SECTION IX - REACTIVITY INFORMATION** *****

STABILITY: Stable.

INCOMPATIBILITY (MATERIALS TO AVOID): Water, heat or acidic or alkaline conditions may cause this product to break down. Contact with strong oxidizers may produce an explosive situation.

HAZARDOUS DECOMPOSITION PRODUCTS: Unknown.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: None

***** **SECTION X - PHYSICAL DATA** *****

APPEARANCE: Clear, colorless liquid.

ODOR: Mild aromatic odor.

SOLUBILITY IN WATER (% by weight): Insoluble.

SPECIFIC GRAVITY: 0.9960 @ 20° C

BOILING POINT: 320° F (@ 19 mm-Hg)

AUTO IGNITION TEMPERATURE: unknown

VAPOR PRESSURE: 1.67 x 10⁽⁻³⁾ mm-Hg (@ 25°C)

MATERIAL SAFETY DATA SHEET

Product Name: Solarepel Sunscreen SPF 25
Tec Laboratories, Inc.

Page 1 of 4
Issue Date: 08/30/93

SECTION I - COMPANY AND PRODUCT INFORMATION

MANUFACTURER:
Tec Laboratories, Inc.
P. O. Box 1958
Albany, OR 97321

PRODUCT NAME:
Solarepel Sunscreen SPF 25

CHEMICAL FAMILY:
Sunscreen

EMERGENCY TELEPHONE NUMBERS:
(503) 926-4577
(503) 926-0769

CAS NUMBER:
Not available for this mixture

PRODUCT DESCRIPTION:
Topical Sunscreen; Sun Protection
Factor (SPF) 25.

SECTION II - HAZARDOUS INGREDIENTS

CAS #	CHEMICAL NAME	PERCENT BY WEIGHT	TLV	ACGIH

*****NO HAZARDOUS INGREDIENTS*****

HAZARD SUMMARY

Rating	Definitions
Health 0	0 - least
Fire 1	1 - slight
Reactivity 0	2 - moderate
	3 - high
	4 - extreme

SECTION III - COMPOSITION

CAS #	CHEMICAL NAME	PERCENT BY WEIGHT

Active ingredients:

21245-02-3	Padimate O	8.00%
5466-77-3	Octyl methoxycinnamate	7.50%
131-57-7	Oxybenzone	6.00%

Other ingredients:

Isopropyl myristate, Lanolin oil, Orange oil, Vitamin E (d alpha tocopherol), Citronella oil, and Chloroxyleneol.

Product Name: Solarepel Sunscreen SPF 25
Tec Laboratories, Inc.

Page 2 of 4
Issue Date: 08/30/93

***** **SECTION IV - HEALTH HAZARD AND FIRST AID INFORMATION** *****

OCCUPATIONAL EXPOSURE LIMIT: Not established

CARCINOGENICITY: Not listed by NTP, IARC or OSHA

PRIMARY ROUTES OF ENTRY: Skin, eyes, inhalation. Ingestion is unlikely.

SYMPTOMS AND EFFECTS OF OVEREXPOSURE	ROUTE OF ENTRY	EMERGENCY AND FIRST AID PROCEDURES
Eye irritation. Corneal injury is unlikely.	EYES	Flush thoroughly with water for 15 minutes. Get medical attention if irritation persists.
Repeated, long-term contact may cause irritation. May cause photosensitivity in those with very sensitive skin.	SKIN	Discontinue use and wash affected skin with soap and water. Remove contaminated clothing. If a rash or other symptoms develop, get medical attention.
Excessive inhalation of spray mist may cause unknown effects.	INHALATION	Remove to fresh room temperature air. Get immediate medical attention if symptoms such as dizziness, acute nausea or loss of consciousness occur.
Ingestion may cause unknown effects.	INGESTION	If victim is conscious and able to swallow, quickly have victim drink 2 glasses of water to dilute. Do <u>not</u> give sodium bicarbonate or fruit juices. Induce vomiting by sticking finger down back of throat. Never give anything by mouth to an unconscious person.

NOTE TO PHYSICIAN: There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition.

***** **SECTION V - PERSONAL PROTECTION INFORMATION** *****

--WHEN HANDLING BULK QUANTITIES--

EYE PROTECTION: OSHA approved monogoggles or face shield.

PROTECTIVE CLOTHING: Wear rubber gloves. To avoid excessive exposure, wear impervious boots and clothing.

VENTILATION: General (mechanical) room ventilation should be satisfactory.

RESPIRATORY PROTECTION: Not required in most conditions.

--WHEN USING PRODUCT ACCORDING TO DIRECTIONS FOR USE--

EYE PROTECTION: Do not apply product in and around eyes.

PROTECTIVE CLOTHING: None required for normal use.

VENTILATION: Normal room ventilation is satisfactory.

RESPIRATORY PROTECTION: None required for normal use. Avoid breathing spray mist.

***** **SECTION VI - STORAGE AND SPECIAL HANDLING INFORMATION** *****

Avoid contact with eyes and mucous membranes. Store at room temperature.

***** **SECTION VII - SPILL OR LEAK RESPONSE INFORMATION** *****

PRECAUTIONS IN CASE OF SPILLS OR LEAKS: Contain all spills and leaks to prevent discharge into environment. For small spills, soak up with absorbent cloth and wash area with soap and water.

WASTE DISPOSAL METHOD: Absorbed material should be landfilled in closed containers according to Federal, State, and local regulations.

RCRA/CERCLA HAZARDOUS WASTE: This product contains no hazardous waste.

Product Name: Solarepel Sunscreen SPF 25
Tec Laboratories, Inc.

Page 4 of 4
Issue Date: 08/30/93

***** **SECTION VIII - FIRE AND EXPLOSION HAZARD INFORMATION** *****

FLASH POINT (open cup): 300°F

FLAMMABLE LIMITS: not determined
(in air, % by volume)

EXTINGUISHING MEDIA: For oil fire; dry chemical or carbon dioxide

UNUSUAL FIRE AND EXPLOSION HAZARDS: None

SPECIAL FIRE FIGHTING PROCEDURES: Treat as oil fire. For optimum safety, wear self-contained breathing apparatus and protective clothing to prevent contact of hot material with skin and eyes.

***** **SECTION IX - REACTIVITY INFORMATION** *****

STABILITY: Stable.

INCOMPATIBILITY (MATERIALS TO AVOID): None

HAZARDOUS DECOMPOSITION PRODUCTS: None

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: None

***** **SECTION X - PHYSICAL DATA** *****

APPEARANCE: Clear amber oily liquid

ODOR: orange and citronella

SOLUBILITY IN WATER (% by weight): Negligible

SPECIFIC GRAVITY: 0.86 @ 25° C

BOILING POINT: greater than 300°F.

WEIGHT PER GALLON: 7.2 lbs./gal

VISCOSITY: nonviscous

AUTO IGNITION TEMPERATURE: N/A

APPENDIX HS-2

Manufacturer's Data Sheets for PPE

INTERMITTENT CHEMICAL EXPOSURE GUIDE FOR BEST N-DEX[®] NITRILE GLOVES





INTERMITTENT CHEMICAL EXPOSURE GUIDE FOR BEST N-DEX® NITRILE GLOVES

This guide is provided to show you that for **brief contact, such as splash or intermittent exposure**, you should seriously consider Best N-DEX nitrile gloves as suitable hand protection against many specific chemicals. The information in our guide is intended to help you determine the general suitability of our N-DEX gloves for such applications and does not constitute any form of warranty. The level and type of protection needed for your specific application, of course, is ultimately your responsibility; however, we hope this guide will help you determine whether or not our N-DEX is the proper glove for the job.

If you have any questions about the use of this guide, the test methods used to generate the data in the guide or specific chemicals or chemical mixtures in which our N-DEX would be suitable, please call Don Groce, our analytical lab manager, at 1-800-241-0323. Don is an analytical chemist and will help you determine if our N-DEX is the glove for *your* particular application.

Presently, there is no ASTM or other *standard* for degradation testing of gloves. Proposed ASTM draft protocol 23.30.03 rates gloves based on percent weight change after four hours total chemical immersion (the "worst-case" scenario). Although this test method generates excellent information, it is categorically biased against thin-gauge gloves such as our N-DEX. Not all applications fit the "worst-case" scenario; in many, the only potential exposure is from splash or intermittent contact with a chemical. In these applications, our N-DEX *may* be a suitable glove for the job.

The third chemical listed in our guide, Acetone, is a perfect example. Using data generated by ASTM draft protocol 23.30.03, which simulates the "worst-case" scenario, our 8-mil N-DEX Plus would not be recommended. However, using data generated by our own test method, which simulates intermittent chemical exposure, not only would our N-DEX Plus be recommended, but our 6-mil N-DEX Long Cuff and even our 4-mil N-DEX would be suggested for on-the-job evaluation.

Chemists in the Best Analytical Lab developed this state-of-the-art test method in response to numerous questions from the field about the N-DEX's chemical-resistance characteristics and because of the lack of an *unbiased*, existing test method simulating

brief chemical exposure to thin gauge gloves.

Our method is similar to ASTM draft protocol 23.30.03, however in our test, brief, intermittent chemical immersions were simulated instead of total chemical immersion for four hours. One brief exposure was performed every ten minutes for two hours for a total of twelve exposures. The weighed glove material was quickly dipped into a test chemical. Degradation was measured as the percent of weight change (See key below).

In neither our test or ASTM draft protocol 23.30.03 are any other physical parameters, such as tensile strength or modulus change, measured. Significantly, however, visual observation shows that our N-DEX nitrile gloves almost never become tacky, as do thin-gauge natural rubber gloves, after chemical exposure. The only visual, physical changes are slight swelling and, sometimes, discoloration, depending on the chemical.

NOTE: To help maintain their integrity, N-DEX nitrile gloves should always be blotted dry when a splash occurs. When handling acids and bases, the glove should be rinsed first, then blotted dry. Gloves should be changed at the first sign of swelling to minimize exposure.

The information in this guide applies to Best N-DEX gloves only. Since the actual use of our gloves may differ from that anticipated by us, you must determine their suitability for your specific application through on-the-job testing. Upon written request, we will provide glove or material samples to aid your evaluation.

Remember that conditions in our lab may not totally simulate actual job conditions; for example, heat and relative humidity may differ and can alter test results significantly. Remember, too, that lab testing is performed on pure chemicals, not mixtures, which would also alter the results.

This guide is designed to help you evaluate the N-DEX's suitability for your particular application. Neither this guide nor any other statement made by or on behalf of Best Manufacturing Company herein is a warranty that any Best glove is suitable for a particular purpose, and Best shall not be liable to anyone with regards to this information.

We emphasize that our N-DEX nitrile gloves are *not* designed for total chemical immersion; they provide protection from splash and intermittent contact only.

Key

% Weight Change

0-10
11-20
21-30
31-50
Above 50

Degradation Rating

E = excellent
G = good
F = fair
P = poor
NH = not recommended

P = poor
NR = not recommended

[illegible]

[illegible]



Best Manufacturing Company
Edison Street
Menlo, Georgia 30731

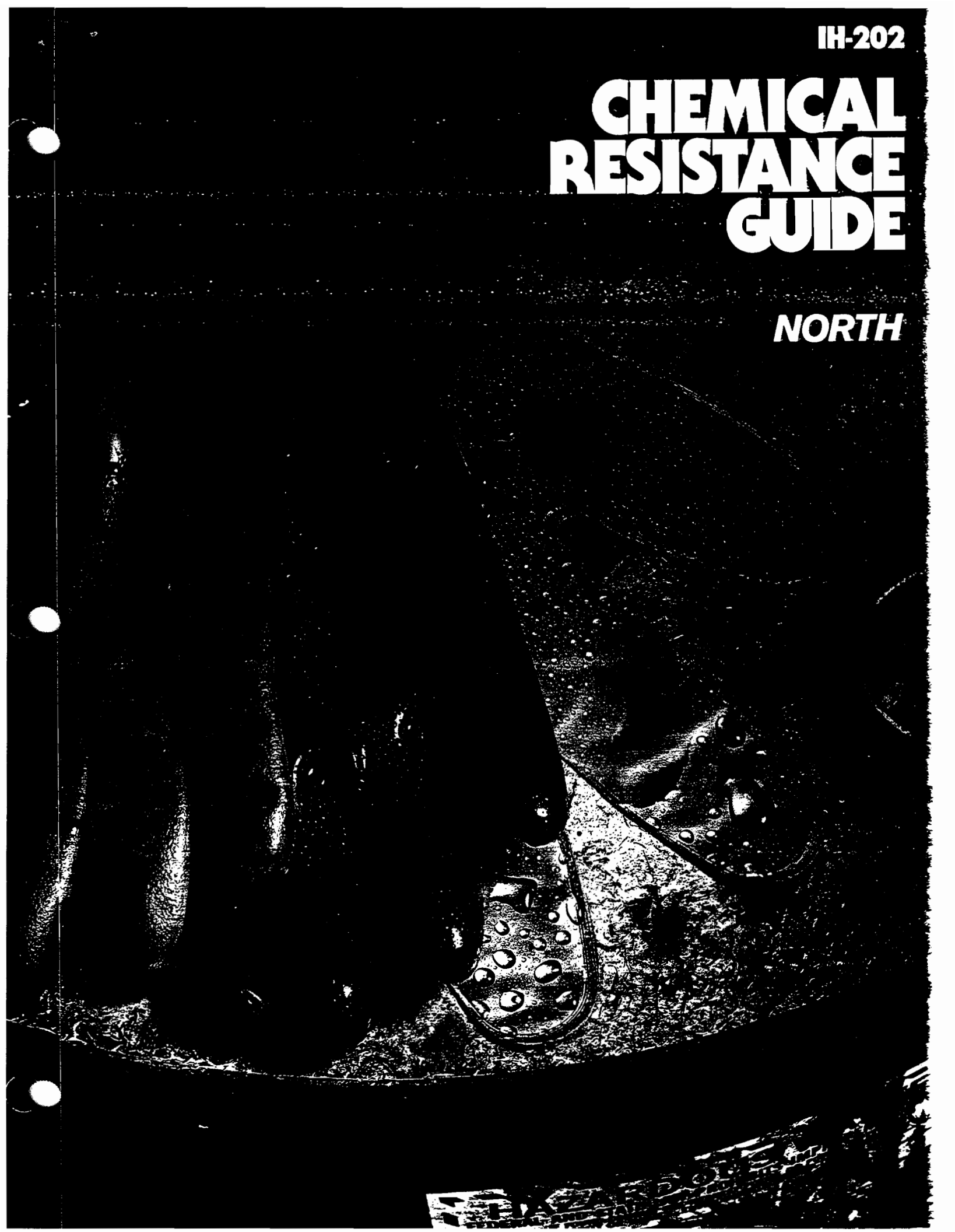


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IH-202

CHEMICAL RESISTANCE GUIDE

NORTH



LEXARDO
FEDERAL POLICE

NORTH CHEMICAL RESISTANCE GUIDE

This Chemical Resistance Guide incorporates three types of information. First, the guide indicates breakthrough time and permeation rate. Breakthrough time is defined as the elapsed time between initial contact of the liquid chemical with the outside surface of the glove and the time at which the chemical can be detected at the inside surface of the glove by means of analytical equipment. WHEN BREAKTHROUGH OCCURS, THE GLOVE IS NO LONGER PROVIDING TOTAL PROTECTION.

Permeation rate, measured in milligrams per square meter per second (mg/m²/sec) is the measured steady state flow of the permeating chemical through the glove elastomer. Glove thickness plays an important role in resistance to permeation.

Secondly, this guide indicates degradation resistance. Degradation is a deleterious change in one or more of the glove's physical properties. The most obvious forms of degradation are the loss of the glove's strength and excessive swelling. Several published degradation lists (primarily "The General Chemical Resistance of Various Elastomers" by the Los Angeles Rubber Group, Inc.) were used to determine degradation.

The third item of information provided by this chart is the color code that gives the user a general recommendation on which

gloves should be evaluated and tested first. The color code incorporates data from other sources.

The permeation data in this guide are based on permeation tests performed in accordance with ASTM Standard F 739 under laboratory conditions by North Hand Protection or an independent AIHA accredited laboratory. Neither North Hand Protection nor the independent laboratory assumes any responsibility for the suitability of an end user's selection of gloves based on this guide.

Data on chemicals not listed here can be obtained by calling the North Hand Protection Customer Service Department at (803) 745-5900 or your North Hand Protection Territory Manager.

User Precautions

Protective gloves and other protective apparel selection must be based on the user's assessment of the workplace hazards. Apparel materials do not provide unlimited protection against all chemicals, and the user must determine before use that the apparel will resist permeation and degradation by the chemicals (including chemical mixtures) in the environment of intended use.

To obtain maximum life, protective gloves and other protective apparel should have chemicals removed from the surface by washing or other appropriate methods after each use. The apparel should be stored away from the contaminating atmosphere.

Punctured, torn or otherwise ruptured apparel must be removed from service; unservicable apparel may be disposed of only in accordance with applicable waste disposal regulations.

Key to Degradation and Permeation Ratings

E	Excellent	Fluid has no effect
G	Good	Fluid has minor effect
F	Fair	Fluid has moderate effect
P	Poor	Fluid has severe effect, ranging from moderate to complete destruction
ND		None detected
ID		Insufficient data, data not available or conflicting data

Physical Performance Chart

Physical Characteristics	Silver Shield*	Viton†	Butyl	Nitrile
Abrasion Resistance	F	G	G	E
Cut Resistance	P	G	G	E
Puncture (Snag) Resistance	F	G	G	E
Flexibility	E	G	G	E
Heat Resistance	F	G	G	G
Ozone Resistance	E	E	G	F
Tensile Strength	E	G	G	E
Low Gas	E	E	E	P
Permeability				

Note: Products in these categories vary in capabilities. Laboratory tests are necessary for specific recommendations.

†Viton is a Registered Trademark of Du Pont Company.

Permeation Chart Color Key

	Good for Total Immersion
	Good for Accidental Splash/Intermittent Exposure
	Not Recommended

CHEMICAL	D	Silver Shield (4 Mil)		D	Viton (9 Mil)		D	Butyl (17 Mil)		D	Nitrile Latex (11 Mil)	
		BT	PR		BT	PR		BT	PR		BT	PR
Acetaldehyde	E			P	0 min	281.9	E	0.066		F	4 min	161
Acetone	E			P	ID	ID	E	ID	ID	P	ID	ID
Acetonitrile	E			ID	ID	ID	E	ID	ID	ID	ID	ID
Acrylic Acid	ID	ID	ID	G	5.9 hrs	0.23	E	ID	ID	F	ID	ID
Acrylonitrile	E			F	1 min	176	G	3.1 hrs	0.00048	P	3 min	176
Aldehyde	E			P	0 min	281.9	E	0.066		P	4 min	161
Aniline	E			G	10 min	18.7	F	ID	ID	P	1.1 hrs	45.0
Benzaldehyde	ID	ID	ID	F			E	ID	ID	P	ID	ID
Benzene	E			G	6 hrs	0.012	P	31 min	32.3	P	ID	ID
Benzoyl Chloride	ID	ID	ID	E			F	6.2 hrs	16.6	P	ID	ID
Bromobenzene	E			E			P	32 min	39.8	P	13 min	9.1
Butyl Acetate	E			P	ID	ID	G	1.9 hrs	7.61	P	29 min	54.4
p-Butyltoluene	E			E			G	1.7 hrs	8.0	P	ID	ID
Butyraldehyde	E			P	14 min	0.0	E			P	ID	ID
Carbon Disulfide	G			E			P	7 min	98.0	P	1 min	51
Carbon Tetrachloride	E			E			P	ID	ID	G	3.4 hrs	5
Cellosolve	G			F	ID	ID	G			P	ID	ID
Chlorobenzene	E			E			P	35 min	308	P	ID	ID
Chloroform	P	10 min	0.009	E			P	ID	ID	P	4 min	352
Chloronaphthalene	E			E			P	ID	ID	P	2.9 hrs	1.32
Chloroprene	ID	ID	ID	ID			P	28 min	18	ID	ID	ID
Cyclohexane	E			E			P	1.1 hrs	20.3	P	ID	ID
Cyclohexanol	E			E			E			E	ID	ID
Cyclohexanone	E			P	20 min	86.3	E			P	ID	ID
Dibutylphthalate	E			E			E			E	ID	ID

Cyclohexanol	E		E		E	11 hrs	ND	E		ND
Cyclohexanone	E		P		E	16 hrs	ND	P		ID
Diethylphthalate	E		E		E	16 hrs	ND	E		ID
Dichloroethane	ID	2.4 hrs	6	G		31	ID	P	ID	ID
1,2-Dichloroethane	E		E		P	2 hrs	53	P	8 min	311
Diethylamine	E		P		P	35 min	852	E	47 min	ID
Diethylmethanol	E		E		E	18 hrs	ND	E	8 hrs	ND
1,1-Diethylene Dioxide	ID		P		E	23 min	26.8	P	28 min	77.1
Diethylenetriamine	ID	ID	E		E	18 hrs	ND	P	ID	ID
Diisobutyl Ketone 80%	E		F		G	1.2 hrs	90.6	F	3 hrs	48.9
Dimethyl Acetamide	ID	1.5 hrs	0.728	P	ID	15 min	3.3	ID	ID	ID
Dimethyl Formamide	E		P		E	4 min	8.5	F	1 min	15
Dimethyl sulfoxide	G		F		E	1.5 hrs	5	F	ID	ID
Dioxane	E		F		E	23 min	26.8	P	28 min	77.1
Divinyl Benzene	E		E		F	2.2 hrs	238	P	ID	ID
Epichlorohydrin	ID	ID	ID	P	G	2 hrs	4	P	ID	ID
Ether	ID		P		P	12 min	21.5	P	14 min	21.8
Ethyl Acetate	E		P		G	ID	ID	P	8 min	145
Ethyl Ether	ID		P		P	12 min	21.5	P	14 min	21.8
Ethylamine (70% in water)	E	47 min	7.6	P	E	ID	ID	F	1.1 hrs	30.1
Ethylene Dichloride	E		E		F	3.3 hrs	6.0	P	ID	ID
Formaldehyde (37% in water)	E		E		E	16 hrs	ND	E	ID	ID
Furan	ID	ID	ID	P	P	1.3 hrs	10	P	ID	ID
Furfural	E		F		E	3.6 hrs	14.8	P	28 min	265
Glutaraldehyde	E		E		E	18 hrs	ND	P	ID	ID
n Hexane	E		ID		P	ID	ID	E	ID	ID
Hydrazine (70% in water)	G		P		E	ID	ID	G	ID	ID
Hydrochloric Acid (37%)	E		E		E	ID	ID	P	ID	ID
Hydrofluoric Acid (50%)	G		G		F	ID	ID	P	ID	ID
Isobutyl Alcohol	E		E		E	8 hrs	ND	G	2.4 hrs	ND
Isobutyraldehyde	E		P		E	1 min	11.5	P	ID	ID
Methacrylic Acid	ID	ID	ID	F	G	8 hrs	ND	P	1.7 hrs	23
Methacrylonitrile	E	ID	ID	F	G	4 min	462	P	7 min	560
Methyl Chloroform	ID		E		P	ID	ID	P	41 min	76.4
Methyl Cyanide	ID		ID	ID	E	18 hrs	ND	ID	ID	ID
Methyl Ethyl Ketone	E		P		E	18 hrs	ND	P	ID	ID
Methyl Isocyanate	ID		P		P	2 min	121	P	ID	ID
Methylamine (40% in water)	F	1.9 hrs	2.0	E	E	15 hrs	ND	G	ID	ND
Methylene Chloride	G		F		P	24 min	133	P	4 min	766
Methylene Dianiline	E		E		E	24 hrs	ND	F	ID	ID
Monoisopropylamine	ID	ID	ID	P	F	4.06 hrs	6	ID	ID	ID
Morpholine	E		G		E	1.9 hrs	97	P	48 min	206
Nitric Acid (3 Molar)	E		G		F	ID	ID	P	ID	ID
Nitrobenzene	E		E		E	23 hrs	ND	F	33 min	17
Nitropropane	E		P		E	1 min	26.1	P	16 min	29.5
Oxalic Acid	E		E		E	18 hrs	ND	G	ID	ID
PCB (Aroclor 1254 (50%))	E		E		P	ID	ID	F	ID	ID
Pentachlorophenol (1% in kerosene)	E		ID		P	ID	ID	E	ID	ND
n Pentane	E		E		P	ID	ID	E	ID	ID
Perchloroethylene	E		E		P	ID	ID	F	> 13 hrs	5.5
Phenol (85% in water)	G		E		E	39 min	1500	P	39 min	1500
Propyl Acetate	E		P		G	2.7 hrs	2.86	P	17 min	72.5
n Propyl Acetate	ID		P		G	2.7 hrs	2.86	P	17 min	72.5
Propylenediamine	ID	ID	ID	E	E	18 hrs	ND	F	ID	ID
Pyridine	ID	ID	ID	P	G	3 min	7.0	P	ID	ID
Red Fuming Nitric Acid	P	35 min	ID	P	P	ID	ID	P	ID	ID
Sodium Hydroxide 50%	E		G		E	ID	ID	G	ID	ID
Styrene	G	> 4 hrs	ND	G	P	ID	ID	P	ID	ID
Sulfuric Acid (3 Molar)	E		E		G	ID	ID	P	ID	ID
Tetrachloroethylene	E		E		P	ID	ID	F	1.3 hrs	5.5
Tetraethylenepentamine	ID	ID	ID	E	E	18 hrs	ND	F	ID	ID
Tetrafluoroethylene	E		E		E	18 hrs	ND	ID	ID	ID
Tetrahydrofuran	E		P		F	31 min	112	P	4 min	167
Thiophene	ID	ID	ID	E	P	1.8 hrs	17	P	ID	ID
Toluene	E		E		F	21 min	22.1	P	11 min	68.1
Toluene Disocyanate	E		E		E	3.7 hrs	1.8	G	3.7 hrs	1.8
Trichloroethylene	E		G		P	18 min	650	P	8 min	283
1,1,1-Trichloroethane	E		E		P	ID	ID	F	21 min	76.4
1,1,2-Trichloroethane	ID	ID	ID	E	P	5.7 hrs	7.0	P	ID	ID
Triethylamine	ID	ID	ID	E	P	ID	ID	E	ID	ID
Vinyl Chloride	E		G		P	4.4 hrs	0.098	G	5.7 hrs	0.14
Xylene	E		E		P	ID	ID	P	ID	ID

D = Degradation, BT = Breakthrough Time, PR = Permeation Rate, ND = None Detected, ID = Insufficient Data



SS104M



F101



B161R

B174



LA102G

LA111EB

Silver Shield® Gloves

Made from Norfoil®, a remarkable lightweight, flexible laminate which resists permeation and breakthrough by an array of toxic/hazardous chemicals. An excellent choice for chemical and petrochemical laboratories, spill cleanups, hazmat control operations, photo finishing, medical laboratories and a host of other applications.

Style	Description	Size	U/M	Pkg	Pkg/Case
SS104S	Silver Shield Gloves 15 1/4"	Small	PR	10 pr	10
SS504S	Silver Shield Gloves 15 1/4"	Small	PR	50 pr	4
SS104M	Silver Shield Gloves 15 1/4"	Medium	PR	10 pr	10
SS504M	Silver Shield Gloves 15 1/4"	Medium	PR	50 pr	4
SS104L	Silver Shield Gloves 15 1/4"	Large	PR	10 pr	10
SS504L	Silver Shield Gloves 15 1/4"	Large	PR	50 pr	4

North Viton† Gloves

North Viton gloves are made specifically for handling chlorinated and aromatic solvents. They exhibit a high degree of impermeability to these solvents and can be used in or around water and water-based solutions.

Industrial applications include: automotive industry, aircraft maintenance, chemical industry and degreasing operations. Superior resistance to PCBs.

Style	Description
10 Mil F101	Length 11". Sizes: 8, 9, 10
12 Mil F124	Length 14". Sizes: 8, 9, 10, 11

† Viton is a registered trademark of Du Pont Company

North Butyl Gloves

North Butyl gloves exhibit the highest permeation resistance to gas or water vapors of any glove compound available today. Ideal for use in ketones (M.E.K., M.I.B.K., Acetone) and esters (Tricresyl Phosphate, Amyl Acetate, Ethyl Acetate).

Style	Description
B131*	LIGHT WEIGHT, 11" length. Sizes: 7, 8, 9, 10, 11
B161*	MEDIUM WEIGHT, 11" length. Sizes: 7, 8, 9, 10, 11
B174*	MEDIUM WEIGHT, except 14" length. Sizes: 8, 9, 10, 11
B324*	HEAVYWEIGHT, 14" length. Sizes: 8, 9, 10, 11

*Add suffix "R" for rough "Grip-Saf" finish. (Example: B131R)

North Nitrile Latex Gloves

North's Nitrile gloves are a most effective replacement for neoprene, natural rubber, and vinyl unsupported gloves. North's blue Nitrile gloves have won wide acceptance as a premium product. Coupling those styles with the addition of green Nitrile, North offers two Nitrile glove lines that equal or exceed the performance of other Nitrile gloves.

Style	Description	Length	Sizes
Blue Nitrile			
LA111EB	Blue, 11 mil. Satinized Interior	13"	7, 8, 9, 10, 11
LA111EBFL	Blue, 14 mil. Flocked Interior	13"	7, 8, 9, 10, 11
LA254EB	Blue, 25 mil. Satinized Interior	14"	9, 10, 11
LA258EB	Blue, 25 mil. Satinized Interior	18"	9, 10, 11
Green Nitrile			
LA102G	Green, 10 mil. Satinized Interior	13"	7, 8, 9, 10, 11
LA132G	Green, 13 mil. Flocked Interior	13"	7, 8, 9, 10, 11
LA142G	Green, 14 mil. Satinized Interior	13"	7, 8, 9, 10, 11
LA172G	Green, 17 mil. Flocked Interior	13"	7, 8, 9, 10, 11

Warranties: North Hand Protection products are warranted to be free from defects in materials and workmanship. North's only obligation under this warranty will be, at its sole option, to repair or replace any part proving defective or to refund the purchase price thereof. *The owner/user assumes all other risks, if any, such as the risk of any direct, indirect or consequential loss or damage arising out of the use of, or inability to use, the product. This warranty is made in lieu of the warranties of merchantability, fitness for particular purpose, and all other warranties, express or implied, and may not be varied or extended except in writing by an authorized official of North.*



North Hand Protection

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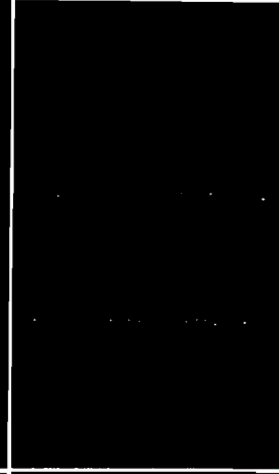


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SAFETY EQUIPMENT
FOR THE INDUSTRIAL LABORER

INDUSTRIAL GLOVES

CHEMICAL RESISTANCE GUIDE
DEGRADATION & PERMEATION TEST DATA



CHEMICAL RESISTANCE GUIDE

FOR MAPA PIONEER INDUSTRIAL GLOVES

CHEMICAL TESTED	CAS NUMBER	STANSOLV® NITRILE							STANZOIL® NEOPRENE							NATURAL RUBBER							PYLOX® PVC						
		DEGRADATION RATING				PERMEATION BREAKTHROUGH			DEGRADATION RATING				PERMEATION BREAKTHROUGH			DEGRADATION RATING				PERMEATION BREAKTHROUGH			DEGRADATION RATING				PERMEATION BREAKTHROUGH		
		Time In Min.				BTT	LDL	Rate	Time In Min.				BTT	LDL	Rate	Time In Min.				BTT	LDL	Rate	Time In Min.				BTT	LDL	Rate
		5	30	60	240	Min.	PPM	ug/CM²/MIN	5	30	60	240	Min.	PPM	ug/CM²/MIN	5	30	60	240	Min.	PPM	ug/CM²/MIN	5	30	60	240	Min.	PPM	ug/CM²/MIN
1. ACETALDEHYDE	75-07-0	NT				NT			E	E	E	E	21	.1	108	E	E	E	E	2	.4	78	NT				NT		
2. ACETIC ACID GLACIAL	64-19-7	NT				118	.1	1326	NT				NT			NT				21	.1	12	NT				85	.1	1.8
3. ACETIC ACID 50%	64-19-7	E	E	E	E	>480	.02	ND	E	E	E	E	>480	.1	ND	E	E	E	E	31	.02	18	E	E	E	E	47	.02	0.36
4. ACETONE	67-64-1	G	P	P	P	NT			E	E	E	E	12	—	210	E	E	E	E	7	.05	30	G	P	P	P	<1	—	#
5. ACETONITRILE	75-05-8	NT				NT			E	E	E	E	40	—	42	NT				NT			NT				NT		
6. ACRYONITRILE	107-13-1	P	P	P	P	12	.001	>50	E	G	G	G	40	.07	>50	NT				NT			NT				NT		
7. AMMONIUM HYDROXIDE 29%	1336-21-6	E	E	E	E	>480	1.0	ND	E	E	E	E	>480	1.0	ND	E	E	E	E	58	1.0	108	E	E	E	E	>480	1.0	ND
8. ANILINE	62-53-3	G	G	P	P	72	.001	18	E	E	E	E	>480	.005	ND	E	E	E	E	>480	.008	ND	E	E	G	G	>480	.009	ND
9. AROCLOR 1254 (50%PCB/50%TCB)		NT				343	1.0	216	NT				>480	1.0	ND	NT				NT			NT				NT		
10. BENZENE	71-43-2	E	F	P	P	27	.03	582	NT				16	—	798	NT				NT			NT				2	—	1500
11. BENZENE CHLORIDE	108-90-7	NT				15	—	960	NT				NT			NT				NT			NT				NT		
12. BIS (2-HYDROXYETHYL) AMINE	111-42-2	E	E	E	E	>480	1.1	ND	E	E	E	E	>480	1.1	ND	E	E	E	E	>480	1.1	ND	E	E	E	E	>480	1.1	ND
13. 2-BUTANONE	78-93-3	NT				6	—	522	E	G	G	G	22	—	930	E	E	G	G	6	—	522	NT				1	—	#
14. 2-BUTOXYETHANOL	111-76-2	E	E	E	E	>480	.5	ND	E	E	E	E	147	1.0	30	E	E	E	E	12	1.0	162	NT				NT		
15. BUTYL ACETATE	123-86-4	E	G	F	F	101	.1	144	NT				52	—	318	NT				NT			NT				NT		
16. BUTYL CELLOSOLVE	111-76-2	E	E	E	E	>480	.5	ND	E	E	E	E	147	1.0	30	E	E	E	E	12	1.0	162	NT				NT		
17. CARBOLIC ACID	108-95-2	NT				>480	—	ND	E	E	E	E	>480	.2	ND	E	E	E	G	>480	.06	ND	NT				32	—	78
18. CARBON DICHLORIDE (CARBON BICHLORIDE)	127-18-4	E	G	G	F	373	.0002	27	NT				28	.0002	453	NT				NT			NT				NT		
19. CARBON DISULFIDE (CARBON BISULFIDE)	75-15-0	E	G	F	F	20	.2	516	NT				NT			NT				NT			NT				NT		
20. CARBON TETRACHLORIDE	56-23-5	E	E	G	F	341	1.0	48	G	F	P	P	31	—	1512	NT				NT			NT				NT		
21. CELLOSOLVE	110-80-5	E	E	E	G	416	.03	24	E	E	E	E	352	.06	18	E	E	E	E	10	.03	12	NT				NT		
22. CELLOSOLVE ACETATE	111-15-9	E	G	F	P	162	.1	72	E	G	G	G	76	.07	252	E	E	G	G	13	—	—	NT				NT		
23. CHLOROBENZENE	108-90-7	NT				15	—	960	NT				NT			NT				NT			NT				NT		
24. CHLOROFORM	67-66-3	NT				NT			F	P	P	P	12	.2	1368	NT				NT			NT				NT		
25. CHLOROTHENE	71-55-6	F	P	P	P	131	.05	264	F	P	P	P	27	—	1182	NT				NT			NT				NT		
26. o-CHLOROTOLUENE	95-49-8	NT				52	—	984	NT				NT			NT				NT			NT				NT		
27. p-CHLOROTOLUENE	106-43-4	NT				25	—	888	NT				NT			NT				NT			NT				NT		
28. CHROMIC ACID 50%	7738-94-5	E	E	E	E	>175	.1	#	NT				NT			NT				NT			NT				>480	.1	ND
29. m-CRESOL (3-CRESOL)	108-39-4	E	G	F	F	210	5.0	126	E	E	E	E	>480	5.0	ND	E	E	E	G	150	5.0	12	E	E	E	E	150	5.0	36
30. CUMENE	98-82-8	E	E	G	G	271	.03	48	E	G	F	P	41	.4	216	NT				NT			NT				NT		
31. CYCLOHEXANE	110-82-7	E	E	E	E	>480	.02	ND	E	E	E	E	159	.03	42	NT				NT			NT				16	—	102
32. DIAMINE	302-50-1	E	E	E	E	>480	.7	ND	E	E	E	E	>480	.7	ND	E	E	E	E	218	.7	12	E	E	E	E	>480	.7	ND
33. 1,2-DICHLOROBENZENE (o-DICHLOROBENZENE)	95-55-01	NT				37	—	1140	NT				NT			NT				NT			NT				NT		

31. CYCLOHEXANE	110-82-7	E	E	E	E	>480	.02	ND	E	E	E	E	159	.03	42	NI				NI				NI				10	—	102
32. DIAMINE	302-50-1	E	E	E	E	>480	.7	ND	E	E	E	E	>480	.7	ND	E	E	E	E	218	.7	12	E	E	E	E	>480	.7	ND	
33. 1,2-DICHLOROBENZENE (o-DICHLOROBENZENE)	95-55-01	NT				37	—	1140	NT				NT				NT				NT				NT					
34. 1,3-DICHLOROBENZENE	541-73-1	G	F	P	P	73	.3	174	NT				NT				NT				NT				NT					
35. DICHLORODIFLUOROMETHANE	75-71-8	NT				>480	.08	ND	NT				>480	.03	ND	NT				NT				NT						
36. 1,2-DICHLOROETHANE	107-06-2	P	P	P	P	16	.06	1752	E	P	P	P	33	.09	1482	NT				NT				NT						
37. DICHLOROMETHANE	75-09-2	NT				NT			G	F	F	F	6	—	1434	NT				NT				NT						
38. DIETHANOLAMINE	111-42-2	E	E	E	E	>480	1.1	ND	E	E	E	E	>480	1.1	ND	E	E	E	E	>480	1.1	ND	E	E	E	E	>480	1.1	ND	
39. DIETHYL ETHER	60-29-7	E	E	E	E	64	.1	78	E	E	E	E	18	.1	486	NT				NT				NT						
40. 1,4-DIETHYLENE DIOXIDE	123-91-1	NT				NT			NT				28	—	372	NT				NT				NT				6	—	1500
41. DIMETHYL ACETAMIDE (DMAC)	127-19-5	G	P	P	P	28	.001	#	E	G	G	P	NT			E	F	F	F	NT			G	#	#	#	20	.005	#	
42. DIMETHYL FORMAMIDE (DMF)	68-12-2	NT				35	.2	246	E	E	E	E	110	.1	246	E	E	E	E	67	.1	246	NT				NT			
43. DIMETHYL SULFOXIDE (DMSO)	67-68-5	E	E	G	P	0	.004	6	E	E	E	E	0	.004	0	E	E	E	E	240	.004	0	E	E	G	G	60	.004	0	
44. 1,4-DIOXANE	123-91-1	NT				NT			NT				28	—	372	NT				NT				NT				6	—	1500
45. ETHANOL	64-17-5	E	E	E	E	>480	.002	ND	E	E	E	E	>480	.002	ND	E	E	E	E	>480	.02	ND	E	E	E	E	20	—	30	
46. 2-ETHOXYETHANOL	110-80-5	E	E	E	G	416	.03	24	E	E	E	E	352	.06	18	E	E	E	E	10	.03	12	NT				NT			
47. 2-ETHOXYETHYL ACETATE	111-15-9	E	G	F	P	162	.1	72	E	G	G	G	76	.07	252	E	E	G	G	13	—	—	NT				NT			
48. ETHYL ACETATE	141-78-6	NT				NT			E	G	G	G	34	.08	1068	NT				NT				NT				NT		
49. ETHYL ALCOHOL (ETHANOL)	64-17-5	E	E	E	E	>480	.002	ND	E	E	E	E	>480	.002	ND	E	E	E	E	>480	.02	ND	E	E	E	E	20	—	30	
50. ETHYL ETHER	74-96-4	E	E	E	E	64	.1	78	E	E	E	E	18	.1	486	NT				NT				NT				NT		
51. ETHYLENE DICHLORIDE	107-06-2	P	P	P	P	16	.06	1752	E	P	P	P	33	.09	1482	NT				NT				NT				NT		
52. ETHYLENE GLYCOL	107-21-1	E	E	E	E	>480	—	ND	E	E	E	G	>480	—	ND	E	E	E	E	>480	—	ND	E	E	E	E	>480	—	ND	
53. ETHYLENE GLYCOL MONETHYL ETHER ACETATE	111-15-9	E	G	F	P	162	.1	72	E	G	G	G	76	.07	252	E	E	G	G	13	—	—	NT				NT			
54. ETHYLENE GLYCOL MONOETHYL ETHER	110-80-5	E	E	E	G	416	.03	24	E	E	E	E	352	.06	18	E	E	E	E	10	.03	12	NT				NT			
55. ETHYLENE OXIDE	75-21-8	NT				32	.3	126	NT				31	3.0	60	NT				NT				NT				NT		
56. FORMALDEHYDE 37%	50-00-0	E	E	E	E	>480	8.0	ND	E	E	E	E	>480	3.0	ND	E	E	E	E	>480	.01	ND	G	G	G	G	>480	.01	ND	
57. FORMALIN SOLUTION	50-00-0	E	E	E	E	>480	8.0	ND	E	E	E	E	>480	3.0	ND	E	E	E	E	>480	.01	ND	G	G	G	G	>480	.01	ND	
58. FREON 12	75-71-8	NT				>480	.08	ND	NT				>480	.03	ND	NT				NT				NT				NT		
59. FREON TF	76-13-1	E	E	E	E	>480	.01	ND	E	E	E	E	>480	.2	ND	NT				NT				NT				11	—	192
60. FURFURAL	98-01-1	P	P	P	P	61	.05	>50	E	E	F	F	95	.2	>50	NT				NT				NT				NT		
61. GASOLINE	8006-61-9	E	E	E	E	>480	.1	ND	E	E	E	E	96	.2	96	NT				NT				NT				NT		
62. HEPTANE	142-82-5	E	E	E	E	2	.01	0.018	E	E	E	E	124	.02	12	NT				NT				NT				NT		
63. HEXANE	110-54-3	E	E	E	E	>480	.08	ND	E	E	E	E	39	.08	36	NT				NT				NT				NT		
64. HYDRAZINE	302-01-2	E	E	E	E	>480	.7	ND	E	E	E	E	>480	.7	ND	E	E	E	E	218	.7	12	E	E	E	E	>480	.7	ND	
65. HYDROCHLORIC ACID 37.5% (HCL)	7647-01-0	E	E	E	E	>480	.4	ND	E	E	E	E	>480	4.0	ND	E	E	E	E	211	4.0	1308	E	E	E	E	>480	4.0	ND	
66. HYDROFLUORIC ACID 48% (HF)	7664-39-3	E	E	E	G	134	.001	30	E	E	E	E	>480	1.0	ND	E	E	E	E	>480	1.0	ND	E	E	E	E	110	1.0	0	
67. ISOAMYL ACETATE	123-92-2	NT				NT			NT				30	—	312	NT				NT				NT				5	—	1602
68. ISOBUTYL ALCOHOL	78-83-1	E	E	E	E	>480	.01	ND	E	E	E	E	>480	.03	ND	NT				NT				NT				NT		
69. ISOPROPANOL (IPA)	67-63-0	E	E	E	E	>480	.05	ND	E	E	E	E	>60	.0006	ND	E	E	E	E	>60	—	ND	E	E	E	E	208	—	0	
70. ISOPROPYL ALCOHOL (ISOPROPANOL, IPA)	67-63-0	E	E	E	E	>480	.05	ND	E	E	E	E	>60	.0006	ND	E	E	E	E	>60	—	ND	E	E	E	E	208	—	0	
71. ISOPROPYL BENZENE	98-82-8	E	E	E	G	271	.03	48	E	G	F	P	41	.4	216	NT				NT				NT				NT		
72. KEROSENE	8008-20-6	E	E	E	E	>480	.007	ND	E	E	E	E	>480	.00005	ND	NT				NT				NT				NT		
73. METHANE DICHLORIDE	75-09-2	NT				NT			G	F	F	F	6	—	1434	NT				NT				NT				NT		
74. METHANOL	67-56-1	E	E	E	E	118	.08	18	E	E	E	E	>60	—	ND	E	E	E	E	>60	—	ND	NT				3	—	18	
75. METHYL ALCOHOL (METHANOL)	67-56-1	E	E	E	E	118	.08	18	E	E	E	E	>60	—	ND	E	E	E	E	>60	—	ND	NT				3	—	18	
76. METHYL CHLOROFORM	71-55-6	F	P	P	P	131	.05	264	F	P	P	P	27	—	1182	NT				NT				NT				NT		
77. METHYL CYANIDE	75-05-8	NT				NT			E	E	E	E	40	—	42	NT				NT				NT				NT		
78. METHYL ETHYL KETONE (MEK)	78-93-3	NT				6	—	522	E	G	G	G	22	—	930	E	E	G	G	6	—	522	NT				1	—	#	

60. METHYL ISOBUTYL KETONE (MIBK)	108-10-1	G	P	P	P	57	.01	>50	F	P	P	P	50	.01	>50	NT	NT	NT	NT											
81. n-METHYL-2-PYRONE	872-50-4	P	P	P	P	108	.01	24	E	G	P	P	448	.01	.7	NT	NT	NT	NT											
82. METHYLENE CHLORIDE	75-09-2	NT				NT				G	F	F	F	6	—	1434	NT	NT	NT	NT										
83. m-METHYLPHENOL (3-METHYLPHENOL)	108-39-4	E	G	F	F	210	5.0	126	E	E	E	E	>480	5.0	ND	E	E	E	E	150	5.0	36								
84. MINERAL SPIRITS	8030-30-6	E	E	E	E	>480	.02	ND	E	E	E	E	126	.002	12	NT	NT	NT	NT											
85. MURIATIC ACID	7647-01-0	E	E	E	E	>480	.4	ND	E	E	E	E	>480	4.0	ND	E	E	E	E	211	4.0	1308	E	E	E	E	>480	4.0	ND	
86. NAPHTHA	8030-30-6	E	E	E	E	>480	.02	ND	E	E	E	E	126	.002	12	NT	NT	NT	NT											
87. NITRIC ACID 50%	7697-37-2	E	G	G	P	72	.07	1206	E	E	E	E	>480	.0003	ND	E	E	E	G	233	.1	#	E	E	E	E	114	.08	0	
88. NITROBENZENE	98-95-3	G	P	P	P	60	1.0	90	E	E	G	P	60	1.0	120	NT	NT	NT	NT											
89. OLEIC ACID	112-80-1	E	E	E	E	NT				E	E	E	E	NT				NT	NT	NT	NT									
90. PENTANE	109-66-0	NT				NT				NT				38	—	18	NT	NT	NT	NT	9	—	102							
91. PERCHLOROETHYLENE	127-18-4	E	G	G	F	373	.0002	27	NT				28	.0002	453	NT	NT	NT	NT											
92. PETROLEUM ETHER	8032-32-4	E	E	E	E	>480	.02	ND	E	E	E	E	126	.002	12	NT	NT	NT	NT											
93. PHENOL SAT.	108-95-2	NT				>480	—	ND	E	E	E	E	>480	.2	ND	E	E	E	G	>480	.06	ND	NT				32	—	78	
94. PHOSPHORIC ACID 85%	7664-38-2	E	E	E	E	>480	.04	ND	E	E	E	E	>480	.04	ND	E	E	E	E	>480	.04	ND	E	E	E	E	>480	.04	ND	
95. POLYCHLORINATED BIPHENYLS (PCBs 50%)		NT				343	1.0	216	NT				>480	1.0	ND	NT	NT	NT	NT											
96. POTASSIUM HYDROXIDE 50% (KOH)	1310-58-3	E	E	E	E	>480	.4	ND	E	E	E	E	>480	.3	ND	E	E	E	E	>480	.3	ND	E	E	E	E	>480	.4	ND	
97. PYRIDINE	110-86-1	NT				NT				NT				26	—	702	NT	NT	NT	NT	1	—	#							
98. RULE 66 SOLVENT		E	E	E	E	>480	.001	ND	E	E	E	E	332	.03	0	NT	9	.002	126	E	E	E	E	42	.02	60				
99. SODIUM HYDROXIDE 50% (NaOH)	1310-73-2	E	E	E	E	>480	.1	ND	E	E	E	E	>480	.1	ND	E	E	E	E	>480	.1	ND	E	E	E	E	>480	.04	ND	
100. SULFURIC ACID 50%	7664-93-9	E	E	E	E	>480	.04	ND	E	E	E	E	>480	.04	ND	E	E	E	E	.480	.1	ND	E	E	E	E	>480	.04	ND	
101. 1,1,2,2-TETRACHLOROETHANE	79-34-5	NT				NT				NT				18	—	1398	NT	NT	NT	NT	6	—	2502							
102. 1,1,2,2-TETRACHLOROETHYLENE	127-18-4	E	G	G	F	373	.0002	27	NT				28	.0002	453	NT	NT	NT	NT											
103. TETRAHYDROFURAN (THF)	109-99-9	G	P	P	P	17	.08	4026	E	P	P	P	11	.08	4026	NT	NT	NT	NT	1	—	#								
104. TOLUENE (TOLUOL)	108-88-3	G	P	P	P	28	.002	150	NT				14	—	2256	NT	NT	NT	NT	3	—	2100								
105. TOLUENE DIISOCYANATE (TDI)	584-84-9	E	F	F	P	>480	.3	ND	NT				NT				E	E	G	F	>480	.1	ND	E	G	F	P	>480	.06	ND
106. TOLUOL	108-88-3	G	P	P	P	28	.002	150	NT				14	—	2256	NT	NT	NT	NT	3	—	2100								
107. 1,1,1-TRICHLOROETHANE	71-55-6	F	P	P	P	131	.05	264	F	P	P	P	27	—	1182	NT	NT	NT	NT											
108. TRICHLOROETHYLENE (TCE)	79-01-6	P	P	P	P	9	.002	372	NT				11	—	3966	NT	NT	NT	NT											
109. TRICHLOROTRIFLUOROETHANE	76-13-1	E	E	E	E	>480	.01	ND	E	E	E	E	>480	.2	ND	NT	NT	NT	NT	11	—	192								
110. TRIETHANOLAMINE (TEA)	102-71-6	E	E	E	E	>480	5.0	ND	E	E	E	E	>480	5.0	ND	E	E	E	E	>480	5.0	ND	E	E	E	E	>480	6.0	ND	
111. TRIFLUOROETHANOL	75-89-8	NT				NT				NT				>60	—	ND	NT	NT	NT	NT	15	—	1302							
112. TRIHYDROXYTRIETHYLAMINE	102-71-6	E	E	E	E	>480	5.0	ND	E	E	E	E	>480	5.0	ND	E	E	E	E	>480	5.0	ND	E	E	E	E	>480	6.0	ND	
113. TURPENTINE	8006-64-2	E	E	E	E	>480	.0009	ND	E	E	E	E	>480	.02	ND	NT	NT	NT	NT											
114. VINYL ACETATE	108-05-4	E	F	F	F	30	.08	402	E	E	G	G	30	.03	198	NT	NT	NT	NT											
115. XYLENES (XYLOLS)	1330-20-7	E	G	F	P	92	.002	24	NT				23	—	798	NT	NT	NT	NT	4	—	1698								
116. XYLOLS	1330-20-7	E	G	F	P	92	.002	24	NT				23	—	798	NT	NT	NT	NT	4	—	1698								

KEY TO DEGRADATION RATINGS:

Performance Rating

(E) Excellent
(G) Good
(F) Fair
(P) Poor

Weight Change

0 to 10%
11 to 20%
21 to 30%
Over 30%

KEY TO PERMEATION AND BREAKTHROUGH RATE:

BTT - Breakthrough time

LDL - Lower detection limit

PPM - Parts per million at breakthrough

ug/CM²/MIN - Microgram per centimeter square per minute

ND - None Detected

> - Greater than < - Less than

NT - Not tested

- Rate too large to measure

HIGHLIGHTED CHEMICALS ARE EITHER KNOWN OR SUSPECTED CARCINOGENS.

[illegible]

TRIonic® Cleanroom Gloves Chemical Resistance Guide

TRIPLE POLYMER BLEND in TRIonic and Rollpruf gloves has distinctive advantages over natural rubber latex. Along with lower extractables and a tougher less abradable film, the triple polymer blend offers superior resistance to the aggressive and toxic chemicals used in cleanroom applications.

TEST RESULTS are averages based on triplicate tests performed by the Radian Corporation on randomly selected production of E-194 gloves.

PRODUCT PROTECTION is also very important for cleanroom gloves. Tests for particulate, extractables and contribution to corrosion should also be considered in making a glove selection.

OTHER CONSIDERATIONS in glove selection, such as length, dexterity, grip and resistance to cuts, snags and abrasion are important in making a glove selection.

CHEMICALS TESTED	Degradation % Weight Change Time In Minutes				Permeation Breakthrough Time Minutes	Lower Detection Limit Parts Per Million	Permeation Rate At Steady State — ug/CM ² /MIN
	5	30	60	240			

ELECTRONIC PROCESS CHEMICAL MIXTURES

Aluminum Etch (1)	0	0	0	3	>480	na	ND
Buffered Oxide Etch (2)	0	0	0	0	>480	na	ND
Dichromate Cleaning Solution (3)	0	0	0	1	>480	0.01	ND
Nitride Etch (4)	0	0	0	0	>480	0.08	ND
Potassium Hydroxide Etch (5)	0	0	0	1	278	0.26	.1
Slope Etch (6)	0	0	0	3	260	0.32	.03

INORGANIC CHEMICALS

Hydrochloric Acid (37%)	0	0	0	<2	140	0.77	17
Hydrofluoric Acid (49%)	0	0	0	<3	91	1.10	5
Hydrofluoric Acid (10%)	0	0	0	0	>480	1.10	ND
Hydrogen Peroxide (30%)	0	0	0	0	>480	750.00	ND
Nitric Acid (99%)	0	0	0	18	211	0.31	—
Nitric Acid (10%)	0	0	0	0	>480	0.50	ND
Phenol (90%)	0	0	0	<6	102	0.05	18
Phosphoric Acid (85%)	0	0	0	0	>480	0.08	ND
Sodium Hydroxide (50%)	0	0	0	0	>480	0.05	ND
Sulfuric Acid (96%)	4	20	—	—	108	0.0002	160
Sulfuric Acid (10%)	0	0	0	0	>480	0.04	ND

ORGANIC CHEMICALS

Acetic Acid (99%)	0	0	0	8	32	0.20	.1
Acetone (98%)	0	0	0	<3	12	0.02	120
N-Butyl Acetate (99%)	0	0	0	83	7	0.03	121
Butyl Cellosolve (99%)	0	0	0	6	53	0.05	23
Butyl Cellosolve Acetate (85%)	0	0	0	34	35	0.67	538
Cellosolve (99%)	0	0	0	2	27	0.20	14
Cellosolve Acetate (99%)	0	0	0	19	4	0.02	77
Freon TF (99%)	81	—	—	—	20	0.05	410
Isopropyl Alcohol (99%)	0	0	0	1	38	0.04	4
Methanol (85%)	0	0	0	0	19	0.04	7
Methyl Cellosolve (99%)	0	0	0	2	40	0.30	10
Methyl Cellosolve Acetate (98%)	0	0	0	6	27	0.06	53
Perchloroethylene (99%)	110	—	—	—	16	0.11	—
Trichloroethylene (99%)	70	—	—	—	11	0.04	—
Xylenes Mixture	64	—	—	—	4	0.01	60

(1) 81% Phosphoric Acid (85%) 9% Nitric Acid (89%) 1% Triton X-100	(3) 10% Potassium Dichromate 8% Sulfuric Acid (96%) 84% DI Water 1% Triton X-100	(5) 78% Potassium Hydroxide (45%) 11% Sec-Butyl Alcohol 11% Propanol
(2) 14% Hydrofluoric Acid (49%) 28% Ammonium Fluoride 15% Glycerine 1% Triton X-100	(4) Phosphoric Acid (85%)	(6) 69% Phosphoric Acid (85%) 20% Acetic Acid (99%) 10% Nitric Acid (89%) 1% Triton X-100

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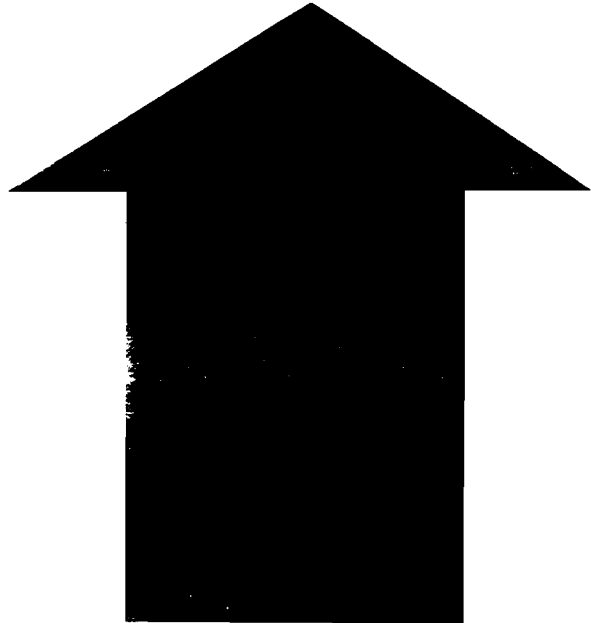


5th Edition

Ansell Edmont Chemical Resistance Guide

With new Permeation Information
& Degradation Data

In November 1980, Edmont published the first version of *A Preliminary Guide to Permeation Resistance* for its products, which was the first such document available from any manufacturer. In the ten years since then, the *Guide* has been repeatedly expanded, updated and revised. The edition you're now holding is the first to come from the merged Ansell Edmont organization, and is still the best and most complete document of its kind available from any manufacturer. Data on natural rubber gloves has been revised in this edition to reflect the merger of Ansell and Edmont, and data on PVA™ gloves has been revised to reflect recent improvements in the materials used to make these gloves.



**Ansell
Edmont
Industrial**

One Company. One Source.
One Commitment to Quality and Performance.

When selecting gloves and clothing to help protect workers from the harmful effects of toxic, corrosive or other hazardous liquid chemicals, there are several performance factors to consider. One of those is *permeation* resistance, and Ansell Edmont has long been a driving force in the development of permeation data. As a result of increased demand for this data, an official American Society for Testing and Materials (ASTM) permeation test standard has been established. Ansell Edmont was the *first* glove and protective clothing manufacturer to work with ASTM, and to conduct tests on its own line over a broad range of chemicals using the ASTM standards.

Not only is Ansell Edmont the industry leader in developing and communicating permeation data, but also the innovative leader in the design and manufacture of high quality safety apparel, including the broadest line of chemical-resistant gloves in the industry. Ansell Edmont products such as SOL-VEX[®], Supported PVA[™] and neoprene help provide excellent resistance to hazardous chemicals, especially many of the aromatic, chlorinated and petroleum solvents and strong oxidizing acids.

Keep in mind that permeation tests are conducted under laboratory conditions, and that actual workplace conditions usually dictate a *combination* of performance capabilities. A product's resistance to cuts, snags, abrasion, punctures or tears must also be taken into consideration as a critical usage factor. A glove or article of clothing with excellent permeation resistance can be worthless if it tears or punctures easily. **ONCE THE PROTECTIVE FILM HAS BEEN DAMAGED, YOU ARE DEALING WITH PENETRATION AND ARE NO LONGER CONCERNED WITH THE ISSUE OF PERMEATION, AND YOU SHOULD NOT USE THE DAMAGED GLOVE WITH HAZARDOUS CHEMICALS.**

Ansell Edmont's complete line of gloves and protective clothing is manufactured in a broad range of special compounds and materials to help provide protection from hazardous chemicals, as well as cuts, abrasion, snags and punctures.

The results of Ansell Edmont ASTM standard permeation tests are provided on the following pages to complement current Ansell Edmont degradation data, and serve as an aid in determining the general suitability of various Ansell Edmont products for use with specific chemicals. **HOWEVER, YOU MUST CONDUCT YOUR OWN EVALUATIONS TO DETERMINE THE CRITICAL COMBINATION OF PERMEATION AND DEGRADATION RESISTANCE IN YOUR PARTICULAR APPLICATIONS AND CONDITIONS.**

What are the differences in effects hazardous chemicals have on protective gloves and clothing?

First of all, the effects are categorized as penetration, degradation and permeation.

Penetration is the flow of a chemical through zippers, stitched seams, pores or imperfections in the material. In selecting chemical-resistant clothing, it is important to choose styles that are designed to resist penetration in these critical areas. Gloves and clothing which can be penetrated are designed only to prevent cuts, abrasions, thermal burns and other similar hazards, and are not suitable for use with hazardous chemicals.

Degradation is a reduction in one or more physical properties of a glove or protective clothing material due to contact with a chemical. Exposed products may get harder, stiffer and brittle, or they may get softer, weaker and swell to several times their original size. Although degradation resistance testing alone is not enough, it is essential to worker safety.

Permeation is a process by which a chemical can pass through a protective film without going through pinholes, pores or other visible openings. Individual molecules of the chemical enter the film, figuratively squirm through by passing between the film molecules, and leave the film on the other side. In some cases, the permeated material appears unchanged to the human eye.

Chemical permeation can be described in simple terms by comparing it to what happens to the air in an inflated balloon after several hours. Although there are no holes or defects and the balloon is tightly sealed, the air gradually goes through (permeates) its walls and escapes. In this simple example we are using gas permeation, but the principle is the same with liquids, passing through some type of film or coating by liquid permeation.

Why is Permeation testing important?

It provides an extra measure of safety information for hazardous chemical applications. For many years, the selection of protective gloves and clothing for those applications was commonly based on degradation data alone, but some chemicals will permeate rapidly through certain materials which have acceptable degradation resistance. This means that workers may be exposed even when they believe they are adequately protected.

Degradation data is also essential.

Current Ansell Edmont degradation data on specific products tested has also been included in these charts for comparison. The Degradation Guide for Ansell Edmont products also appears in our current catalog. Any samples rated "Poor" or "Not Recommended" in degradation testing were not tested for permeation resistance. It should be noted that permeation and degradation do not always correlate.



PVC
Polyvinyl Chloride



Neoprene
Unsupported



Natural
Rubber



Neox[®]
Neoprene Supported



Sol-Vex[®]



PVA[™]

The first square in each column for each glove type is color coded. This is an easy-to-read indication of how we rate this type of glove in relation to its applicability for each chemical listed. The color represents an overall rating for both degradation and permeation. The letter in each square is for Degradation alone...

-  **GREEN:** The glove is very well suited for application with that chemical.
-  **YELLOW:** The glove is suitable for that application under careful control of its use.
-  **RED:** Avoid use of the glove with this chemical.

Permeation/Degradation Resistance Guide for Ansell Edmont Gloves

	SOL-VEX® NITRILE NBR			NEOPRENE UNSUPPORTED			NEOX® SUPPORTED NEOPRENE			PVA™ SUPPORTED POLYVINYL ALCOHOL			POLYVINYL CHLORIDE PVC			NATURAL RUBBER		
	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate
1. Acetaldehyde		—	—	E	10min.	P	E	17min.	P		—	—		—	—	E	7min.	F
2. Acetic Acid, Glacial		4½hr.	—		7hr.	—		>6hr.	—		—	—	F	3hr.	—		1½hr.	—
3. Acetone		—	—	G	5min.	F	G	10min.	F		—	—		—	—	E	10min.	F
4. Acetonitrile	F	30min.	F		30min.	VG		1½hr.	E	—	2½hr.	G		—	—	E	4min.	VG
5. Acrylic Acid	G	2hr.	—	G	1½hr.	—	F	ND	E		—	—		—	—		1½hr.	—
6. Ammonium Fluoride, 40%		ND	—		ND	—		ND	—		—	—		ND	—		ND	—
7. Ammonium Hydroxide, Conc.		ND	—		>6hr.	—		>6hr.	—		—	—		4hr.	—		1½hr.	—
8. Amyl Acetate		60min.	G		—	—		—	—		ND	E		—	—		—	—
9. Amyl Alcohol		30min.	E		>6hr.	E		ND	E		3hr.	G	G	12min.	E	E	25min.	VG
10. Aniline		—	—		35min.	VG		3hr.	VG	F	ND	E	F	3hr.	VG	E	25min.	VG
11. Aqua Regia	F	ND	—	G	45min.	—		ND	—		—	—		2hr.	—		—	—
12. Benzaldehyde		—	—		—	—		—	—		ND	E		—	—	G	10min.	VG
13. Benzene, Benzol		—	—		—	—		—	—		ND	E		—	—		—	—
14. Bromopropionic Acid	F	2hr.	—		3hr.	—		4hr.	—		—	—		3hr.	—		3½hr.	—
15. Butyl Acetate	F	1½hr.	F		—	—		—	—		ND	E		—	—		—	—
16. Butyl Alcohol		ND	E		4hr.	VG		>8hr.	E	F	1¼hr.	G		3hr.	VG	E	20min.	VG
17. Butyl Cellosolve®		1½hr.	VG		1½hr.	VG		ND	E	—	2hr.	G		—	—		45min.	G
18. γ-Butyrolactone		—	—	E	10min.	VG	G	—	—		2hr.	VG		—	—		60min.	G
19. Carbon Disulfide	G	30min.	F		—	—		—	—		ND	E		—	—		—	—
20. Carbon Tetrachloride		2½hr.	G		—	—		—	—		ND	E	F	25min.	F		—	—
21. Cellosolve® Acetate	F	1½hr.	G	F	25min.	G		1¼hr.	VG		ND	E		—	—	E	10min.	G
22. Cellosolve® Solvent		3½hr.	G		45min.	E		4hr.	E	—	1¼hr.	G		—	—	E	25min.	VG
23. Chlorobenzene		—	—		—	—		—	—		ND	E		—	—		—	—
24. Chloroform		—	—		—	—		—	—		ND	E		—	—		—	—
25. Chloronaphthalene		—	—		—	—		—	—		ND	E		—	—		—	—
26. Chlorothene® VG	F	1½hr.	P		—	—		—	—		ND	E		—	—		—	—
27. Chromic Acid, 50%	F	4hr.	—		—	—		—	—		—	—		ND	—		—	—
28. Citric Acid, 10%		ND	—		ND	—		ND	—	F	50min.	—		ND	—		ND	—
29. Cyclohexanol		ND	E		2½hr.	VG		3hr.	E		ND	E		6hr.	E	E	10min.	G
30. Diacetone Alcohol		4hr.	E		5hr.	E		ND	E	—	2½hr.	G		—	—	E	15min.	VG
31. Dibutyl Phthalate		ND	E	F	2hr.	E	F	5hr.	VG		ND	E		—	—	E	20min.	—
32. Diethylamine	F	45min.	F		—	—		—	—		—	—		—	—		—	—
33. Di-Isobutyl Ketone, DIBK	E	2hr.	F		—	—		—	—		ND	E		—	—		—	—
34. Dimethyl Acetamide, DMAC		—	—		—	—		—	—		—	—		—	—	E	15min.	G
35. Dimethyl Formamide, DMF		—	—	G	10min.	G		1hr.	G		—	—		—	—	E	25min.	VG
36. Dimethyl Sulfoxide, DMSO		>4hr.	VG		ND	E		>3hr.	G		—	—		—	—		3hr.	E
37. Dioctyl Phthalate, DOP		>6hr.	E		>6hr.	E		2hr.	E	E	30min.	F		—	—		—	—
38. Dioxane		—	—		—	—		—	—		—	—		—	—	F	5min.	F
39. Electroless Copper (MacDermid® 9048)		ND	—		ND	—		ND	—		—	—		ND	—		ND	—
40. Electroless Nickel (MacDermid® J60/61)		ND	—		ND	—		ND	—		—	—		ND	—		ND	—
41. Epichlorohydrin		—	—		—	—	F	10min.	F		5hr.	E		—	—	E	5min.	F
42. Ethyl Acetate		—	—	F	15min.	G	F	20min.	G	F	ND	E		—	—	G	5min.	F

Cellosolve® is a registered trademark of Union Carbide Corp.
Chlorothene® is a registered trademark of Dow Chemical Co.

THIS INFORMATION
APPLIES ONLY TO
ANSELL EDMONT
BRAND GLOVES

	SOL-VEX® NITRILE NBR			NEOPRENE UNSUPPORTED			NEOX® SUPPORTED NEOPRENE			PVA™ SUPPORTED POLYVINYL ALCOHOL			POLYVINYL CHLORIDE PVC			NATURAL RUBBER		
	Degradation Rating	Permeation Breakthrough	Permeation Rate	Degradation Rating	Permeation Breakthrough	Permeation Rate	Degradation Rating	Permeation Breakthrough	Permeation Rate	Degradation Rating	Permeation Breakthrough	Permeation Rate	Degradation Rating	Permeation Breakthrough	Permeation Rate	Degradation Rating	Permeation Breakthrough	Permeation Rate
43. Ethyl Alcohol		4hr.	VG		1½hr.	VG		3hr.	VG		—	—		1hr.	VG	E	15min.	VG
44. Ethylene Dichloride		—	—		—	—		—	—		ND	E		—	—		—	—
45. Ethylene Glycol		ND	E		ND	E		ND	E	F	2hr.	VG		ND	E		ND	E
46. Ethyl Ether		2hr.	G	E	10min.	G	E	10min.	G		ND	E		—	—		—	—
47. Ethyl Glycol Ether		3½hr.	G		45min.	E		4hr.	E	—	1¼hr.	G		—	—	E	25min.	VG
48. Formaldehyde		ND	E		2hr.	E		2hr.	VG		—	—		1½hr.	VG	E	10min.	G
49. Formic Acid 90%	F	4hr.	—		ND	—		ND	—		—	—		>6hr.	—		2½hr.	—
50. Freon® TMC		—	—		—	—		—	—		ND	E		—	—		—	—
51. Freon® TF		ND	E		4hr.	E		2hr.	VG		ND	E		—	—		—	—
52. Furfural		—	—	G	20min.	G		2hr.	G	F	ND	E		—	—	E	15min.	VG
53. Gasoline (White)		ND	E		—	—		—	—		ND	E		—	—		—	—
54. Hexamethyldisilazane		ND	—		50min.	—		60min.	—		ND	—		—	—	F	15min.	F
55. Hexane		ND	E	E	45min.	F		1½hr.	G		ND	E		—	—		—	—
56. Hydrazine 65%		ND	—		ND	—		ND	—		—	—		ND	—		2½hr.	VG
57. Hydrochloric Acid, Conc.		ND	—		ND	—		ND	—		—	—		>5hr.	—		4½hr.	—
58. Hydrochloric Acid, 10%		ND	—		ND	—		ND	—		—	—		ND	—		ND	—
59. Hydrofluoric Acid, 48%	E	2hr.	—	E	1hr.	—	E	1¼hr.	—		—	—	G	40min.	—		3¼hr.	—
60. Hydrogen Peroxide, 30%		ND	—	E	5min.	—	E	7min.	—		—	—		ND	—		ND	—
61. Hydroquinone, Saturated		ND	E		ND	E		ND	E		—	—		ND	E		ND	E
62. Isobutyl Alcohol		ND	E	E	10min.	E		ND	E		—	—	F	10min.	VG	E	15min.	VG
63. Iso-Octane		6hr.	E		1hr.	G		6hr.	E		ND	E		—	—		—	—
64. Isopropyl Alcohol		ND	E		ND	E		ND	E		—	—		2½hr.	E	E	20min.	VG
65. Kerosene		ND	E		>6hr.	E		ND	E		ND	E	F	>6hr.	E		—	—
66. Lactic Acid, 85%		ND	E		ND	E		ND	E	F	ND	E		ND	E		ND	—
67. Lauric Acid, 36%/EtOH		ND	—		ND	—		ND	—		—	—	F	15min.	—		ND	—
68. Maleic Acid, Saturated		ND	—		ND	—		ND	—		—	—		ND	—		ND	—
69. Methyl Alcohol	E	11min.	F		1hr.	E	E	15min.	E		—	—		45min.	G	E	20min.	VG
70. Methylamine		ND	E		4½hr.	G		6hr.	E		—	—		2¼hr.	VG		55min.	VG
71. Methyl Cellosolve®	F	11min.	G	E	25min.	G		70min.	VG	G	30min.	G		—	—	E	20min.	VG
72. Methylene Bromide		—	—		—	—		—	—		ND	E		—	—		—	—
73. Methylene Chloride		—	—		—	—		—	—		ND	E		—	—		—	—
74. Methyl Ethyl Ketone, MEK		—	—		—	—		—	—	F	1½hr.	VG		—	—	F	5min.	F
75. Methyl Glycol Ether	F	11min.	G	E	25min.	G		70min.	VG	G	30min.	G		—	—	E	20min.	VG
76. Methyl Iodide		—	—		—	—		—	—	F	ND	E		—	—		—	—
77. Methyl Isobutyl Ketone, MIBK		—	—		—	—		—	—	F	ND	E		—	—		—	—
78. Methyl Methacrylate		—	—		—	—		—	—		ND	E		—	—		—	—
79. N-Methyl-2-Pyrrolidone, NMP		—	—		—	—		—	—		—	—		—	—		1½hr.	VG
80. Methyl t-Butyl Ether, MTBE		ND	E		—	—		—	—		ND	E		—	—		—	—
81. Mineral Spirits, Rule 66		ND	E		1½hr.	VG		ND	E		ND	E	F	2½hr.	VG		—	—
82. Monoethanolamine		ND	E		ND	E		ND	E	F	ND	E		ND	E		50min.	E
83. Morpholine		—	—		—	—		—	—		1½hr.	G		—	—	G	20min.	G
84. Muriatic Acid		ND	—		ND	—		ND	—		—	—		>5hr.	—		4½hr.	—
85. Naphtha VM&P		ND	E	G	15min.	F		ND	E		>7hr.	E	F	2hr.	VG		—	—

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SPECIAL NOTE:

The chemicals in this guide highlighted in BLUE are experimental carcinogens, according to the seventh edition of Sax' *Dangerous Properties of Industrial Materials*. Chemicals highlighted in GRAY are listed as suspected carcinogens, experimental carcinogens at extremely high dosages, and other materials which pose a lesser risk of cancer.

**THIS INFORMATION
APPLIES ONLY TO
ANSELL EDMONT
BRAND GLOVES**

	SOL-VEX® NITRILE NBR			NEOPRENE UNSUPPORTED			NEOX® SUPPORTED NEOPRENE			PVA™ SUPPORTED POLYVINYL ALCOHOL			POLYVINYL CHLORIDE PVC			NATURAL RUBBER		
	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate
VG		ND	—		ND	—		ND	—		—	—		ND	—		ND	—
—		—	—	G	2½hr.	—	G	ND	—		—	—	F	5¾hr.	—		—	—
E		—	—		—	—		—	—		—	—		—	—		—	—
—		—	—		—	—		—	—		ND	E		—	—	F	15min.	G
VG	F	30min.	F		1hr.	VG		1½hr.	E		ND	E		—	—	E	10min.	G
G		—	—	G	5min.	F		1hr.	G		>6hr.	E		—	—	E	5min.	G
—		ND	E		7hr.	E		>7hr.	E		ND	E	F	>6hr.	E		30min.	VG
—		ND	E		1hr.	VG		2½hr.	E		1hr.	E	F	1½hr.	VG	F	ND	—
—		ND	—		ND	—		ND	—		—	—		ND	—		ND	—
VG	G	30min.	—		ND	—		ND	—		—	—		1½hr.	—	G	5min.	—
—		ND	E	E	30min.	F		45min.	VG		ND	E		—	—		—	—
F		ND	E	E	6min.	E	E	6min.	E	E	5min.	F	F	3hr.	E		—	—
—		ND	—		ND	—		ND	—		—	—		ND	—	F	ND	—
VG		5hr.	VG		—	—		—	—		ND	E		—	—		—	—
—		—	—		3hr.	G		>6½hr.	E	F	ND	E		1½hr.	VG		1½hr.	—
—		ND	—		ND	—		ND	—		—	—		ND	—	F	ND	—
—		2¾hr.	VG		2½hr.	VG		3hr.	VG		—	—		40min.	VG	—	—	—
E		ND	—		ND	—		ND	—		—	—		ND	—		ND	—
VG	F	20min.	G		—	—		—	—		2hr.	VG		—	—		—	—
—		ND	E		2½hr.	E		ND	E		—	—	F	1½hr.	VG	E	20min.	VG
VG		—	—		—	—		—	—	G	35min.	G		—	—		—	—
—		—	—		—	—		—	—	G	10min.	F		—	—	F	10min.	F
—		ND	E	G	30min.	G		1hr.	G		ND	E		—	—		—	—
—		—	—		ND	—		ND	—		—	—	F	2½hr.	—		—	—
VG		—	—		—	—		—	—	F	—	—		—	—		—	—
VG		ND	—		ND	—		ND	—		—	—		ND	—		ND	—
VG		ND	E		3hr.	VG		ND	E		ND	E	F	6hr.	E		—	—
—		—	—		—	—		—	—		ND	E		—	—		—	—
—		—	—	F	3hr.	—	F	>6hr.	—		—	—	*G	3¾hr.	—		—	—
—	E	ND	—		ND	—		ND	—		—	—		ND	—		ND	—
F		ND	E		ND	E		ND	E		—	—		ND	E		ND	—
VG		5hr.	VG		—	—		—	—		ND	E		—	—		—	—
—		—	—		—	—		—	—	P	1½hr.	G		—	—		—	—
—	F	10min.	F		—	—		—	—		ND	E		—	—		—	—
VG		—	—		—	—		—	—		ND	E		—	—	G	7min.	G
—	F	1½hr.	P		—	—		—	—		ND	E		—	—		—	—
—		—	—		—	—		—	—		ND	E		—	—		—	—
—		ND	E	F	ND	E	F	ND	E		ND	E	F	ND	E		45min.	E
E		ND	E		ND	E		ND	E		ND	E		ND	E		ND	E
G		30min.	E		—	—		—	—		ND	E		—	—		—	—
—	G	1¼hr.	F		—	—		—	—		ND	E		—	—		—	—
—		—	—		—	—		—	—		—	—		—	—		—	—

*For hot sulfuric acid or fuming oleum, PVC is Not Recommended. Skydrol® is a registered trademark of Monsanto.

**Ansell
Edmont**
Industrial

Permeation/Degradation Resistance Guide for Ansell Edmont Clothing

THIS INFORMATION APPLIES ONLY TO ANSELL EDMONT BRAND CLOTHING	WET-WEAR® 550, LINED VINYL			WET-WEAR® 600, VINYL			WET-WEAR® 700, VINYL BLEND		
	Degradation Rating	Permeation Breakthrough	Permeation Rate	Degradation Rating	Permeation Breakthrough	Permeation Rate	Degradation Rating	Permeation Breakthrough	Permeation Rate
1. Acetaldehyde		—	—	F	5min.	P	F	3min.	P
2. Acetic Acid, Glacial	G	30min.	—	F	6min.	—	F	16min.	—
3. Acetone		—	—		—	—		—	—
4. Ammonium Hydroxide, Conc.		ND	—	E	18min.	—	E	11min.	—
5. Aniline	F	12min.	VG	F	30min.	VG	F	10min.	VG
6. Butyl Acetate		—	—		—	—		—	—
7. Butyl Alcohol	G	8min.	G		40min.	G		35min.	VG
8. Chromic Acid, 50%		ND	—		ND	—		ND	—
9. Cyclohexanol	E	20min.	E		ND	E	E	15min.	VG
10. Dibutyl Phthalate		—	—	F	ND	—	F	ND	—
11. Diethylamine		—	—		—	—		—	—
12. Dimethyl Formamide, DMF		—	—		—	—		—	—
13. Dioctyl Phthalate, DOP	F	11min.	—		ND	E	G	25min.	—
14. Ethyl Acetate		—	—		—	—		—	—
15. Ethylene Glycol	E	20min.	—		ND	E		ND	E
16. Ethyl Ether		—	—		—	—		—	—
17. Formaldehyde	E	5min.	VG		6hr.	G		30min.	VG
18. Freon® TF	G	6min.	F	F	60min.	G	F	15min.	F
19. Formic Acid, 90%	E	25min.	—		1¼hr.	—	E	30min.	—
20. Gasoline (White)	F	6min.	G	F	5min.	F	F	5min.	F
21. Hydrazine, 65%	E	—	—		ND	—		ND	—
22. Hydrochloric Acid, 38%		ND	—	F	5hr.	—	F	55min.	—
23. Hydrofluoric Acid, 48%	G	1¼hr.	—	F	1½hr.	—	F	5min.	—
24. Isobutyl Alcohol	G	20min.	VG		2hr.	VG	E	7min.	VG
25. Kerosene	G	10min.	VG		3hr.	G		1¼hr.	G
26. Maleic Acid, Sat.		ND	—		ND	—		ND	—
27. Methyl Alcohol	G	5min.	G		30min.	G	E	20min.	VG
28. Methyl Acetate		—	—		—	—		—	—
29. Methylamine, 40%	E	5min.	E		60min.	VG		30min.	G
30. Methylene Chloride		—	—		—	—		—	—
31. Methyl Isobutyl Ketone, MIBK		—	—		—	—		—	—
32. Methyl Methacrylate		—	—		—	—		—	—
33. Monethanolamine		ND	—		ND	—		ND	—
34. Naphtha, VM&P	F	6min.	VG	F	20min.	G	F	9min.	G
35. Nitric Acid, 70%	F	45min.	—	F	2½hr.	—	F	6min.	—
36. Nitric Acid, 10%		ND	—		4¼hr.	—		ND	—
37. Nitropropane		—	—		—	—	F	<5min.	G
38. Octyl Alcohol		45min.	E	E	9min.	E		ND	E
39. Pentane	F	4min.	G		—	—	F	11min.	G
40. Perchloroethylene	F	4min.	G		—	—	F	5min.	F
41. Phenol 90%	F	35min.	VG	F	1½hr.	VG	F	50min.	VG
42. Phosphoric Acid, Conc.		ND	—	F	ND	—	F	ND	—
43. Potassium Hydroxide KOH, 50%		ND	—		ND	—		ND	—
44. Propylene Glycol		ND	E		ND	—		ND	—
45. Sodium Hydroxide NaOH, 50%		ND	—		ND	—		ND	—
46. Sulfuric Acid, 10%		1hr.	—		2½hr.	—		2hr.	—
47. Sulfuric Acid, 95%	F	5min.	—	F	1hr.	—	F	37min.	—
48. 1,1,1-Trichloroethane	F	4min.	G	F	2min.	F	F	6min.	P
49. Tricresyl Phosphate, TCP	F	20min.	—		ND	—		ND	—
50. Turpentine	F	10min.	VG	F	6min.	G	F	16min.	G
51. Xylene		—	—		—	—	F	>3min.	G

These permeation ratings are based on laboratory evaluations, and they reflect the best judgment of Ansell Edmont in the light of data available to us at the time of their preparation and in accordance with the current revision of ASTM F 739. They are intended to guide and inform Industrial Hygienists, Safety Specialists and other qualified professionals engaged in assuring safety in the workplace. Because the conditions of ultimate use are beyond our control, and because we cannot run permeation tests in all possible work environments and across all combinations or chemical solutions, these guides are advisory only. The suitability of the product for a specific job must be determined by testing by the purchaser.

Ansell Edmont believes this information is the best currently available. It is subject to revision as additional knowledge and experience are gained. Test data herein reflects laboratory performance of partial gloves and not necessarily the complete unit. Anyone intending to use suggestions contained in this publication should first verify that the glove selected is suitable for the intended use and meets all appropriate health standards.

NEITHER THIS GUIDE NOR ANY OTHER STATEMENT MADE HEREIN BY OR ON BEHALF OF ANSELL EDMONT SHOULD BE CONSTRUED AS A WARRANTY OF MERCHANTABILITY OR THAT ANY ANSELL EDMONT PRODUCT IS FIT FOR A PARTICULAR PURPOSE. ANSELL EDMONT ASSUMES NO RESPONSIBILITY FOR THE SUITABILITY OR ADEQUACY OF AN END USER'S SELECTION OF GLOVES OR CLOTHING FOR A SPECIFIC APPLICATION.

Upon written request, Ansell Edmont will provide a sample of material to aid you in making your own selection under your own individual safety requirements.

How to Read the Charts

Three categories of data are represented for each Ansell Edmont product and corresponding chemical: (1) overall degradation resistance rating; (2) permeation breakthrough time, and (3) permeation rate.

The breakthrough times indicated are the shortest times observed from the start of the test to first detection of the chemical on the other side of the sample. They represent how long an article of clothing or a glove can be expected to provide the most effective resistance against a hazardous event.

The permeation rates for our data table were the highest flow rates recorded for the permeating chemicals through the protective films during a six-hour test. These qualitative ratings are comparisons of permeation rates to each other.

Standards for Color Coding in the Fifth Edition of the Guide

A glove-solvent combination ranks **GREEN** if: The degradation rating is Excellent or Good; the permeation breakthrough is 30 minutes or longer, and; the permeation rate is Excellent, Very Good or Good.

Where the necessary data is available, all three of these conditions must be fulfilled to assign a **GREEN** rating. However, if data required to test for all three conditions is not available, as for example, in testing acids and bases, professional judgment was used to determine the rating.

A glove-solvent combination rates **RED** if: the degradation rating is Poor or Not Recommended...regardless of the permeation rating.

All other glove-solvent combinations rate **YELLOW**. In other words, any glove-solvent combination that does not meet all three of the conditions required for a **GREEN** rating or does not have a degradation rating of Poor or Not Recommended for a **RED** rating, will receive a **YELLOW** rating.

Key to Permeation Rate	Simply Stated Drops Per Hour Through A Glove (Eyedropper size drop)
ND—None Detected during a six-hour test (Equivalent to Excellent)	None
E—Excellent; permeation rate of less than 0.9 µg/cm²/min.	0 to 1/2 drop
VG—Very Good; permeation rate of less than 9 µg/cm²/min.	1 to 5 drops
G—Good; permeation rate of less than 90 µg/cm²/min.	6 to 50 drops
F—Fair; permeation rate of less than 900 µg/cm²/min.	51 to 500 drops
P—Poor; permeation rate of less than 9000 µg/cm²/min.	501 to 5000 drops
NR—Not Recommended; permeation rate greater than 9000 µg/cm²/min.	5001 drops up
Note: The current revision to the ASTM standard permeation test calls for permeation to be reported in micrograms of chemical permeated per square centimeter of garment exposed per minute of exposure, "µg/cm²/min."	

Key to Permeation Breakthrough

> Greater than (time) < Less than (time)

Key to Degradation Ratings:

E—Excellent; fluid has very little degrading effect.
G—Good; fluid has minor degrading effect.
F—Fair; fluid has moderate degrading effect.
P—Poor; fluid has pronounced degrading effect.
NR—Fluid is not recommended with this material.

NOTE: ANY TEST SAMPLES RATED P (POOR) OR NR (NOT RECOMMENDED) IN DEGRADATION TESTING WERE NOT TESTED FOR PERMEATION RESISTANCE. A DASH (—) APPEARS IN THOSE CASES.

Specific gloves used for testing:	Degradation	Permeation
Nitrile NBR	Sol-Vex® 37-145 (11 mil/0.28 mm)	Sol-Vex® 37-165 (22 mil/0.54 mm)
Neoprene Unsupported	29-840 (15 mil/0.38 mm)	29-840 (15 mil/0.38 mm)
Neoprene Supported	Neox®	Neox®
PVA™ Supported	PVA™	PVA™
PVC	Snorkel® and Ever-Flex™	Monkey Grip™
Natural Rubber	392 (19 mil/0.48 mm)	392 (19 mil/0.48 mm)
Single palm thickness is listed in both mil and metric millimeter (mm) for Unsupported Gloves. Supported Gloves are specified by glove weight, not thickness.		

Why is a product with a shorter breakthrough time sometimes given a better rating than one with a longer breakthrough time?

One glove has a breakthrough time of just 4 minutes. It is rated "very good" while another with a breakthrough time of 30 minutes is rated only "fair." Why? Because in some cases, the rate is more significant than the time. In principle it's similar to liquids flowing through two different faucets. In one the liquid gets to the valve fast but the valve is only open a fraction of a turn, allowing only a trickle to flow through. In the other, the liquid gets to the valve slowly but the valve is closed so the liquid backs up. Suddenly, the valve is opened and the liquid gushes out. Although the former starts earlier, the latter emits more liquid once it starts. Which is better? It all depends on the chemical, the application, and how the glove or clothing is used.

Ansell Edmont Chemical Resistant Gloves

Natural Rubber**	• FL200/FL400
Natural Rubber	• Orange Heavyweight
Natural Rubber	• OMNI®
Natural Rubber	• Chemi-Pro®
Natural Rubber	• PVL®
Natural Rubber	• Natural Blue
Natural Rubber	• Cannons and Handlers
Natural Rubber	• Technicians
Natural Rubber	• Tan Rubber
Natural Rubber	• Grab-It® (Chemical Resistant Style)
Natural Rubber	• Surgical Gloves
Natural Rubber	• Premium White Rubber
Natural Rubber	• Conform®
Neoprene	• Neoprene
Neoprene	• Scorpio®
Neoprene	• Neox®
Neoprene	• Redmont™
PVC	• Grappler® (Chemical Resistant Style)
PVC	• Snorkel®
PVC	• Ever-Flex™
PVC	• Ever-Flex Fireball™
PVC	• Monkey Grip™
PVC	• Winter Monkey Grip™ (Up to Knitwrist)
PVC	• Winter Fireball™ (Up to Knitwrist)
PVA™	• PVA™ (Caution: Coating is water sensitive)
NBR	• Sol-Vex® Nitrile

**"Rubber" here refers to Natural Rubber Latex

In general, thicker chemical resistant gloves may help provide greater protection than thinner gloves.

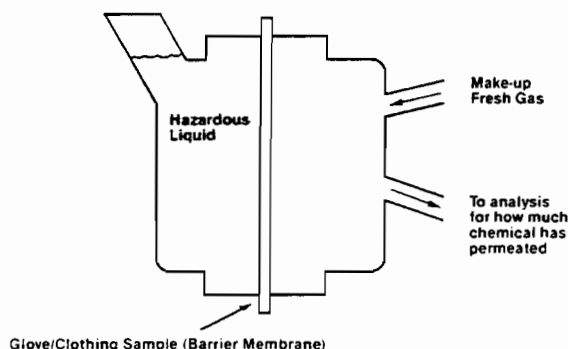
How does Ansell Edmont conduct permeation tests?

As the leader in permeation testing among Safety Wearing Apparel Manufacturers, Ansell Edmont has, for a number of years, invested a substantial amount of time, effort and capital resources in testing Ansell Edmont products, and has participated in the work of ASTM Committee F-23 on Protective Clothing, playing an active role in the development of standard test methods.

In accord with the standard established under ASTM Method F 739, this is how Ansell Edmont permeation tests are conducted: A specimen cut from the protective glove or clothing is clamped into a test cell as a barrier membrane. The "exterior" side of the specimen is exposed to the hazardous chemical. Then, at timed intervals the "interior" side of the test cell is checked to determine the presence of the permeated chemical and the extent to which it has permeated the material.

The standard allows a variety of options in analytical technique and collecting mediums. At Ansell Edmont, gas chromatography with FID detection is used as the analytical technique and dry nitrogen as the collecting medium. When testing inorganic acids and bases that are not amenable to FID detection, a simpler colorimetric method based on a British and proposed ISO standard is used. The collecting medium is water and detection is by change in color of a pH indicator.

PERMEATION TEST CELL



How does Ansell Edmont conduct degradation tests?

Films of the test material are made. These films are weighed and measured and then completely immersed in the test chemical for 30 minutes. The percentage of change in size is determined and then films are dried to calculate the percentage of weight change. Observed physical changes are also recorded. Ratings are based on the combined data.

Testing for material in this guide has been conducted by Ansell Edmont Research and Development Department, in accordance with ASTM Standard, Method F 739.

Ansell Edmont

Industrial

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Permeation Guide for DuPont Tychem™ Fabrics

Revised May 1994

This guide replaces all previously published guides and is valid through December 1994.

Call 1-800-558-9329 (1-800-55-TYFAX) for additional information.

New TyFax™ Data Service

The DuPont Tychem™ Permeation Database is available around the clock from the DuPont TyFax™ Data Service. Call 1-800-558-9329 (1-800-55-TYFAX) and follow the recorded instructions to receive a fax about a specific chemical within minutes of your request. For a full index of information available from the TyFax™ Data Service, which lists more than 700 chemicals and synonyms, call 1-800-44-TYVEK.

New Tychem™ 10,000

For our highest level of chemical protection, count on the newest member of the DuPont Tychem family. It consistently rates excellent on permeation performance. When we ran permeation tests on Tychem 10,000 against the ASTM F1001 list of challenge chemicals (see pg. 5), no breakthrough was detected during the 480-minute test duration. For more information about Tychem 10,000, call 1-800-44-TYVEK.

How to Use this Permeation Guide

The permeation data is organized by chemical class. The chemical classification system used in this Permeation Guide is defined in ASTM F1186, "Standard Classification System for Chemicals According to Functional Groups."

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This classification system was developed by ASTM Committee F23 to assist highly trained and skilled individuals in selecting proper chemical protective clothing.

Locate your specific chemical in the Chemical Index on page 2, and note the corresponding Chemical Sub-Class Number. Then locate that Chemical Sub-Class number in the Permeation Data Table starting on page 6. If your chemical is not listed in the index or in the synonym list on page 3, call the TyFax Data Service on 1-800-558-9329 (1-800-55-TYFAX).

New Chemicals Added to the DuPont Permeation Guide

Chemicals added to the Permeation Guide:

- Chloromethyl methyl ether
- Dimethyl sulfate
- Dimethyl sulfoxide
- d-Limonene
- Methyl isobutyl ketone
- Methyl mercaptan
- Oxalic acid
- Pyrrolidine
- Stoddard solvent

Independent Testing

All permeation tests are conducted for DuPont by independent AIHA-accredited testing laboratories. The breakthrough times and permeation rates listed in this guide were determined by ASTM F739, "Test Method for Resistance of Protective Clothing Materials to Permeation by Liquids and Gases."

All permeation tests were conducted with pure chemicals at standard temperature and pressure, unless otherwise specified. The physical phase of each tested chemical (solid, liquid, or gas) is listed in the permeation data table.

Copies of individual laboratory reports are available by calling 1-800-44-TYVEK.

This information is based upon technical data that DuPont believes to be reliable. It is subject to revision as additional knowledge and experience are gained. DuPont makes no guarantee of results and assumes no obligation or liability in connection with this information.

It is the user's responsibility to determine the level of toxicity and the proper personal protective equipment needed. The information set forth herein reflects laboratory performance of fabrics, not complete garments, under controlled conditions. It is intended for informational use by persons having technical skill for evaluation under their specific end-use conditions, at their own discretion and risk.

Anyone intending to use this information should first verify that the garment selected is suitable for the intended use. In many cases, seams and closures have shorter breakthrough times and higher permeation rates than the fabric. Please contact the garment manufacturer for specific data. If fabric becomes torn, abraded, or punctured, end user should discontinue use of garment to avoid potential exposure to chemical. Since conditions of use are outside our control, we make no warranties, express or implied, including, without limitation, no warranties of merchantability or fitness for a particular use and assume no liability in connection with any use of this information. This information is not intended as a license to operate under or a recommendation to infringe any patent or technical information of DuPont or others covering any material or its use.

WARNING:

- Tychem fabrics are not flame resistant and should not be used around heat, flame, sparks, or in potentially flammable or explosive environments.
- Garments made of Tychem fabrics should have slip-resistant or antislip materials on the outer surface of boots, shoecovers, or other garment surfaces in conditions where slipping could occur.

CHEMICAL INDEX

Chemical name	Sub-Class Number	CAS Number	Chemical name	Sub-Class Number	CAS Number
Acetic acid	102	64-19-7	Hexamethylenediisocyanate	211	822-06-0
Acetone	391	67-64-1	n-Hexane	291	110-54-3
Acetonitrile	431	75-05-8	Hydrazine	280	302-01-2
Acetyl chloride	111	75-36-5	Hydrochloric acid	370	7647-01-0
Acrolein	121	107-02-8	Hydrocyanic acid	345	74-90-8
Acrylic acid	102	79-10-7	Hydrofluoric acid	370	7664-39-3
Acrylonitrile	431	107-13-1	Hydrogen chloride gas	350	7647-01-0
Allyl alcohol	311	107-18-6	Hydrogen fluoride gas	350	7664-39-3
Ammonia (anhydrous)	350	7664-41-7	Hydrogen peroxide	300	7722-84-1
Ammonium hydroxide	380	1336-21-6	Iodine	330	7553-56-2
n-Amyl acetate	222	628-63-7	Jet A fuel	291	N/A
Aniline	145	62-53-3	JP-4	291	N/A
Antimony pentachloride	360	7647-18-9	d-Limonene	294	5989-27-5
Benzene	292	71-43-2	Mercuric chloride	340	7487-94-7
Benzonitrile	432	100-47-0	Mercury	330	7439-97-6
Benzoyl chloride	112	98-88-4	Methanol	311	67-56-1
Blood (human)	590	N/A	Methylamine	141	74-89-5
Bromine	330	7726-95-6	Methyl bromide	261	74-83-9
1,3-Butadiene	294	106-99-0	Methyl cellosolve	245	109-86-4
n-Butanol	311	71-36-3	Methyl cellosolve acetate	245	110-49-6
Butyl cellosolve	245	111-76-2	Methyl chloride	261	74-87-3
Butyl ether	241	142-96-1	4,4'-Methylene bis (o-chloroaniline)	149	101-14-4
Butyraldehyde	121	123-72-8	Methyl ethyl ketone	391	78-93-3
Carbon disulfide	502	75-15-0	Methyl ethyl ketoxime	590	96-29-7
Carbon tetrachloride	261	56-23-5	Methyl isobutyl ketone	391	108-10-1
Chlorine gas	350	7782-50-5	Methyl isocyanate	211	624-83-9
Chloroacetic acid	103	79-11-8	Methyl mercaptan	501	74-93-1
Chloroacetone	391	78-95-5	Methyl methacrylate	223	80-62-6
4-Chloroaniline	145	106-47-8	Methyl t-butyl ether	241	1634-04-4
Chlorobenzene	263	108-90-7	Mineral spirits	291	N/A
2-Chloroethanol	315	107-07-3	Nicotine	271	54-11-5
Chloroform	261	67-66-3	Nitric acid	370	7697-37-2
Chloromethyl methyl ether	241	107-30-2	Nitrobenzene	441	98-95-3
o-Chlorotoluene	263	95-49-8	Nitrogen dioxide	350	10102-44-0
Chromic acid	370	1333-82-0	Nitrogen tetroxide	350	10544-72-6
Cresol (mixed isomers)	316	95-48-7	Nitromethane	441	75-52-5
Cyclohexane	291	110-82-7	Oleum	370	8014-95-7
3,4-Dichloroaniline	145	95-76-1	Oxalic acid	104	144-62-7
1,4-Dichloro-2-butene	261	110-57-6	Parabromofluorobenzene	263	460-00-4
Dichloromethane	261	75-09-2	PCB	263	11097-69-1
2,3-Dichloropropene	261	78-88-6	Phenol	316	108-95-2
1,1-Dichlorotetrafluoroethane	261	374-07-2	Phosphoric acid	370	7664-38-2
Diesel fuel	291	N/A	Phosphorus trichloride	360	7719-12-2
Diethyl ether	241	60-29-7	Potassium acetate	340	127-08-2
Diethylamine	142	109-89-7	Potassium chromate	340	7789-00-6
Di (2-ethylhexyl) phthalate	226	117-81-7	Potassium cyanide	345	15-50-8
N,N-Dimethylacetamide	132	127-19-5	1,2-Propylene oxide	275	75-56-9
N,N-Dimethylformamide	132	68-12-2	Pyrrolidine	274	123-75-1
1,1-Dimethylhydrazine	280	57-14-7	Sodium cyanide	345	143-33-9
Dimethyl sulfate	507	77-78-1	Sodium fluoride	340	7681-49-4
Dimethyl sulfoxide	503	67-68-5	Sodium hydroxide	380	1310-73-2
4,4'-Diphenyl methane diisocyanate	212	101-68-8	Sodium hypochlorite	340	7681-52-9
Epichlorohydrin	275	106-89-8	Stoddard solvent	291	8052-41-30
Ethyl acetate	222	141-78-6	Styrene	292	100-42-5
Ethylbenzene	292	100-41-4	Sulfur dioxide	350	7446-09-5
Ethyl cellosolve	245	110-80-5	Sulfuric acid	370	7664-93-9
Ethyl cellosolve acetate	245	111-15-9	1,1,2,2-Tetrachloroethane	261	79-34-5
Ethylenediamine	148	107-15-3	Tetrachloroethylene	264	127-18-4
Ethylene dibromide	261	106-93-4	1,1,1,2-Tetrafluoroethane	261	811-97-2
Ethylene dichloride	261	107-06-2	Tetrahydrofuran	241	109-99-9
Ethylene diglycol monoethyl ether	245	111-90-0	Toluene	292	108-88-3
Ethylene glycol	314	107-21-1	Toluene-2,4-diisocyanate	212	584-84-9
Ethylene oxide	275	75-21-8	m-Toluidine	145	108-44-1
Fluorobenzene	263	460-06-6	o-Toluidine	145	95-53-4
Formaldehyde, 37%	121	50-00-0	1,2,4-Trichlorobenzene	263	120-82-1
Formalin, 10%	121	50-00-0	1,1,1-Trichloroethane	261	71-55-6
Formic acid	102	64-18-6	2,2,2-Trichloroethanol	315	115-20-8
Freon® 113	261	76-13-1	Trichloroethylene	264	79-01-6
2-Furaldehyde	277	98-01-1	Triethylamine	143	121-44-8
Gasohol	590	N/A	2,2,2-Trifluoroethanol	315	75-89-8
Gasoline, leaded	292	N/A	Vinyl acetate	222	108-05-4
Gasoline, unleaded	292	N/A	Vinyl chloride	264	75-01-4
Glutaraldehyde	121	111-30-8	Xylene (mixed isomers)	292	1330-20-7

CHEMICAL SYNONYMS

Synonym	Chemical Name	Synonym	Chemical Name
Acetic acid amyl ester	Amyl acetate	Cyanide	Hydrocyanic acid
Acetic acid vinyl ester	Vinyl acetate	Diamine	Hydrazine
Acetic ether	Ethyl acetate	1,2-Diaminoethane	Ethylenediamine
Acetonyl chloride	Chloroacetone	Dibromoethane	Ethylene dibromide
Acetylene trichloride	Trichloroethylene	Dibutyl ether	Butyl ether
Acrylaldehyde	Acrolein	1,2-Dichloroethane	Ethylene dichloride
Allyl aldehyde	Acrolein	Dichloropropylene	2,3-Dichloropropene
Alochlor 1254	PCB	Diethylene oxide	Tetrahydrofuran
Aminic acid	Formic acid	Dihydrogen dioxide	Hydrogen peroxide
1-Amino-2-methylbenzene	o-Toluidine	Dimethyl ketone	Acetone
Aminobenzene	Aniline	Dimethylacetone amide	Dimethylacetamide
1-Amino-4-chlorobenzene	4-Chloroaniline	Dimethylbenzene	Xylene
Aminomethane	Methylamine	Dimethylene oxide	Ethylene oxide
Aminotoluene	o-Toluidine	Diethyl phthalate	Di (2-ethylhexyl) phthalate
Ammonia aqueous	Ammonium hydroxide	Disulfuric acid	Oleum
Ammonia gas	Ammonia	Dithiocarbonic anhydride	Carbon disulfide
Anhydrous ammonia	Ammonia	Dithionic acid	Oleum
Benzene carbonyl chloride	Benzoyl chloride	DMAC	Dimethylacetamide
Benzene chloride	Chlorobenzene	DMFA	Dimethylformamide
Bis (2-ethylhexyl) phthalate	Di (2-ethylhexyl) phthalate	Dowanol EB	Butyl cellosolve
Bivinyll	1,3-Butadiene	1,2-Epoxyethane	Ethylene oxide
4-Bromofluorobenzene	Parabromofluorobenzene	Epoxypropane	1,2-Propylene oxide
Bromomethane	Methyl bromide	1,2-Ethanediamine	Ethylenediamine
1-Butanol	n-Butanol	1,2-Ethenediol	Ethylene glycol
2-Butanone	Methyl ethyl ketone	Ethanoyl chloride	Acetyl chloride
2-Butanone oxime	Methyl ethyl ketoxime	Ethynyl trichloride	Trichloroethylene
2-Butoxy-1-ethanol	Butyl cellosolve	Ethoxyethane	Diethyl ether
1-Butoxybutane	Butyl ether	2-Ethoxyethanol	Ethyl cellosolve
Butyl alcohol	n-Butanol	2-(2-Ethoxyethoxy)ethanol	Ethylene diglycol monoethyl ether
n-Butyl ether	Butyl ether	Ethoxyethyl acetate	Ethyl cellosolve acetate
Butylene oxide	Tetrahydrofuran	Ethyl benzol	Ethyl benzene
2-Butylenedichloride	1,4-Dichloro-2-butene	Ethyl carbitol	Ethylene diglycol monoethyl ether
Carbitol	Ethylene diglycol monoethyl ether	Ethyl ether	Diethyl ether
Carbitol cellosolve	Ethylene diglycol monoethyl ether	Ethylene alcohol	Ethylene glycol
Carbon bisulfide	Carbon disulfide	Ethylene glycol methyl ether	Methyl cellosolve
Carbon dichloride	1,1,2,2-Tetrachloroethane	Ethylene glycol monomethyl ether	Methyl cellosolve acetate
Carbon sulfide	Carbon disulfide	Ethyl methyl ketoxime	Methyl ethyl ketoxime
Carbona	Carbon tetrachloride	Ethylene tetrachloride	Tetrachloroethylene
Caustic soda	Sodium hydroxide	Ethylic acid	Acetic acid
Cellosolve	Ethyl cellosolve	Formylic acid	Formic acid
Cellosolve acetate	Ethyl cellosolve acetate	Fuel oil	Diesel fuel
CFC 114	1,1-Dichlorotetrafluoroethane	Fuming sulfuric acid	Oleum
CFC 134A	1,1,1,2-Tetrafluoroethane	Fural	2-Furaldehyde
Chlorine bleach	Sodium hypochlorite	Furfural	2-Furaldehyde
p-Chloroaniline	4-Chloroaniline	Gasoline/alcohol mixture	Gasohol
1-Chloro-2,3-epoxypropane	Epichlorohydrin	Glycol chlorohydrin	2-Chloroethanol
1-Chloro-2-methylbenzene	o-Chlorotoluene	Glycol monobutyl ether	Butyl cellosolve
3-Chloro-1,2-propylene oxide	Epichlorohydrin	Glycol monoethyl ether acetate	Ethyl cellosolve acetate
Chlorohydric acid	Hydrochloric acid	HCl gas	Hydrogen chloride
Chloromethane	Methyl chloride	HCN	Hydrocyanic acid
Chloropropanone	Chloroacetone	Hexahydrobenzene	Cyclohexane
Chromium trioxide	Chromic acid	Hexamethylene	Cyclohexane
Chromium(IV) oxide	Chromic acid	HF	Hydrogen fluoride
Clorox	Sodium hypochlorite	HMDI	Hexamethylenediisocyanate
Coal naphtha	Benzene	Hydrochloride	Hydrochloric acid

CHEMICAL SYNONYMS (Cont'd.)

Synonym	Chemical Name	Synonym	Chemical Name
Hydrogen cyanide	Hydrocyanic acid	Oil of vitriol	Sulfuric acid
Hydrogen fluoride anhydrous	Hydrogen fluoride	Orthophosphoric acid	Phosphoric acid
Hydrogen nitrate	Nitric acid	Oxirane	Ethylene oxide
Hydrogen sulfate	Sulfuric acid	Oxomethane	Formaldehyde
Hydroxybenzene	Phenol	1,5-Pentanedial	Glutaraldehyde
Isocyanic acid methyl ester	Methyl isocyanate	Perchloroethylene	Tetrachloroethylene
Kerosene	Jet A fuel	Perclene	1,1,2,2-Tetrachloroethane
Lye	Sodium hydroxide	Petrol	Gasoline
MBOCA	Methylene bis-o-chloroaniline	Petroleum spirits	Mineral spirits
MDI	4,4'-Diphenyl methane diisocyanate	Phenyl chloride	Chlorobenzene
MDM	N,N-Dimethylformamide	Phenyl cyanide	Benzonitrile
MEK	Methyl ethyl ketone	Phenyl hydride	Benzene
Methacrylic acid methyl ester	Methyl methacrylate	Phenylamine	Aniline
Methane trichloride	Chloroform	Phenylmethane	Toluene
Methanecarboxylic acid	Acetic acid	Phosphorus chloride	Phosphorous trichloride
Methanoic acid	Formic acid	Polychlorinated biphenyls	PCB 1254
Methyl alcohol	Methanol	2-Propanone	Acetone
2-Methoxyethanol	Methyl cellosolve	2-Propenal	Acrolein
2-Methoxyethyl acetate	Methyl cellosolve acetate	Propene acid	Acrylic acid
Methyl acetone	Methyl ethyl ketone	Propenitrile	Acrylonitrile
Methyl cyanide	Acetonitrile	2-Propenoic acid	Acrylic acid
2-Methyl-2-methoxypropane	Methyl t-butyl ether	Propenol	Allyl alcohol
Methyl ketone	Acetone	Prussic acid	Hydrocyanic acid
1-Methyl-2-(3-pyridyl)pyrrolidine	Nicotine	Pyrosulfuric acid	Oleum
Methylaniline	o-Toluidine	Quicksilver	Mercury
Methylbenzene	Toluene	Refrigerant 113	Freon® 113
Methylchloroform	1,1,1-Trichloroethane	Roach salt	Sodium fluoride
Methylene chloride	Dichloromethane	Sodium hydrate	Sodium hydroxide
Methylene dichloride	Dichloromethane	Solvent naphtha	Mineral spirits
Methylene oxide	Formaldehyde	Sulfurous acid	Sulfur dioxide
Methylphenol	Cresol	TDI	Toluenediisocyanate
Methyltoluene	Xylene	Tetrachloromethane	Carbon tetrachloride
Mirbane oil	Nitrobenzene	TFE	2,2,2-Trifluoroethanol
MOCA	4,4'-Methylene bis-o-chloroaniline	Toluol	Toluene
Monochloroacetic	Chloroacetic acid	Trichloromethane	Chloroform
Monoethylene glycol	Ethylene glycol	Triclene	Trichloroethylene
MTBE	Methyl t-butyl ether	Trifluorotrichloroethane	Freon® 113
Muriatic acid	Hydrochloric acid, 37%	VCM	Vinyl chloride
n-Butyl aldehyde	Butyraldehyde	Vinegar naphtha	Ethyl acetate
N-Ethylethanamine	Diethylamine	Vinyl cyanide	Acrylonitrile
Naphtha	Mineral spirits	Vinylbenzene	Styrene
Nitrobenzol	Nitrobenzene	White caustic	Sodium hydroxide
Nitrocarbol	Nitromethane	Wood alcohol	Methanol
Nitrogen peroxide	Nitrogen dioxide		

ASTM Recommended List of Liquid and Gaseous Chemicals for Evaluating Protective Clothing Materials in Testing Programs (ASTM F1001)

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This list of chemicals is not inclusive of all chemical challenges or chemical classes. The chemicals were chosen to represent broad ranges of liquid and gaseous chemical classes and properties. Other chemicals, especially those of interest to the

manufacturer or user, should be tested in addition to those recommended.

For additional test data on Tychem™ 7500, Tychem™ 9400, and Tychem™ 10,000, call **1-800-558-9329 (1-800-55-TYFAX)**.

Chemical Name	Physical Phase	TYVEK® QC		TYVEK®/SARANEX 23-P		TYCHEM™ 7500		BARRICADE®		TYCHEM™ 9400		TYCHEM™ 10,000	
		Normalized Breakthrough Time	Permeation Rate	Normalized Breakthrough Time	Permeation Rate	Normalized Breakthrough Time	Permeation Rate	Normalized Breakthrough Time	Permeation Rate	Normalized Breakthrough Time	Permeation Rate	Normalized Breakthrough Time	Permeation Rate
		(minutes)	(µg/cm²/min)	(minutes)	(µg/cm²/min)	(minutes)	(µg/cm²/min)	(minutes)	(µg/cm²/min)	(minutes)	(µg/cm²/min)	(minutes)	(µg/cm²/min)
Acetone	L	immed.	10	24	1.6	338	0.16	>480	ND	>480	ND	>480	ND
Acetonitrile	L	immed.	16	13	2.8	14	180	>480	ND	>480	ND	>480	ND
Ammonia (anhydrous)	G	immed.	3.1	32	0.15	125	0.5	47	0.4	47	0.4	>480	ND
1,3-Butadiene	G	8	12	>480	ND	>480	ND	>480	ND	>480	ND	>480	ND
Carbon disulfide	L	immed.	high	8	>50	>480	ND	>480	ND	>480	ND	>480	ND
Chlorine gas	G	immed.	>50	>480	ND	>480	ND	>480	ND	>480	ND	>480	ND
Dichloromethane	L	immed.	>50	7	>50	5	11	404	0.13	404	0.13	>480	ND
Diethylamine	L	immed.	64	12	>50	>480	ND	>480	ND	>480	ND	>480	ND
N,N-Dimethylformamide	L	7	0.72	113	0.4	>480	ND	226†	1.7	226†	1.7	>480	ND
Ethyl acetate	L	immed.	12.7	36†	6.6	>480	ND	>480	ND	>480	ND	>480	ND
Ethylene oxide	G	immed.	168	7	8.4	75	2.7	>480	ND	>480	ND	>480	ND
n-Hexane	L	immed.	high	146	0.48	>480	ND	>480	ND	>480	ND	>480	ND
Hydrogen chloride	G	immed.	9.3	>480	ND	180	0.54	>480	ND	>480	ND	>480	ND
Methanol	L	immed.	2.2	>480	ND	71	0.17	104	0.7	104	0.7	>480	ND
Methyl chloride	G	immed.	0.3	>480	ND	>480	ND	>480	ND	>480	ND	>480	ND
Nitrobenzene	L	immed.	18	102	2.3	>480	ND	>480	ND	>480	ND	>480	ND
Sodium hydroxide, 50%	L	>480	ND	>480	ND	>480	ND	>480	ND	>480	ND	>480	ND
Sulfuric acid (conc.)	L	>480	ND	>480	ND	>480	ND	>480	ND	>480	ND	>480	ND
Tetrachloroethylene	L	immed.	410	8	5.7	>480	ND	>480	ND	>480	ND	>480	ND
Tetrahydrofuran	L	immed.	183	immed.	>50	316	0.19	>480	ND	>480	ND	>480	ND
Toluene	L	immed.	high	immed.	30	>480	ND	>480	ND	>480	ND	>480	ND

ND=none detected >=greater than <=less than S=solid L=liquid G=gas

† Actual breakthrough time. Normalized value not available at time of printing.

NOTE: Numbers reported are averages of samples tested by the ASTM F739 test method. Sample results do vary and therefore averages for these results are reported.

Tyvek and Barricade are registered trademarks of DuPont. Tychem and TyFax are trademarks of DuPont.

Saranex 23-P is a registered trademark of the Dow Chemical Company.

Warning:

1. Tychem fabrics (Tyvek QC, Tyvek/Saranex 23P, Tychem 7500, Barricade, Tychem 9400, and Tychem 10,000) should not be used around heat, flames, sparks or in potentially flammable or explosive environments.
2. Garments made of Tychem fabrics should have slip-resistant or antislip materials on the outer surface of boots, shoe covers, or other garment surfaces in conditions where slipping could occur.

Class	Sub-Class	Chemical	Physical Phase	TYVEK® QC					TYVEK®/SARANEX 23-P					BARRICADE®							
				Breakthrough Time		Permeation Rate		SDL (ppm)	MDPR (µg/cm²/min)	Breakthrough Time		Permeation Rate		SDL (ppm)	MDPR (µg/cm²/min)	Breakthrough Time		Permeation Rate		SDL (ppm)	MDPR (µg/cm²/min)
				Normalized (min)	Actual (min)	(µg/cm²/min)				Normalized (min)	Actual (min)	(µg/cm²/min)				Normalized (min)	Actual (min)	(µg/cm²/min)			
Acids, Carboxylic	102 Aliphatic and Alicyclic, Unsubstituted	Acetic acid, glacial	L		7	3	0.05			>480	ND	0.3			339	180	0.67	0.05	0.002		
		Acrylic acid	L		7	5.4	0.2			>480	ND	0.3			79	6	0.21				
		Formic acid	L		immed.	0.33	190			>480	ND	0.05			>480	ND	0.01				
	103 Aliphatic and Alicyclic, Substituted	Chloroacetic acid, sat.	L		>480	ND	0.001		nt	nt	nt	nt	nt	nt	nt	nt	nt	nt			
	104 Aliphatic and Alicyclic, Polybasic	Oxalic acid	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	1	0.1			
Acid Halides, Carboxylic	111 Aliphatic and Alicyclic	Acetyl chloride	L	nt	nt	nt	nt	nt		37	1.1	280			186	160	2.3	0.5	0.007		
	112 Aromatic	Benzoyl chloride	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		>480	ND	0.12				
Aldehydes	121 Aliphatic and Alicyclic	Acrolein	L	nt	nt	nt	nt	nt	11	11	5.3	0.04	0.1	>480	>480	ND	0.02		0.1		
		Butyraldehyde	L	immed.	immed.	22	0.3	0.006	50	47	6.1	0.3	0.006		>480	ND	0.35				
		Formaldehyde, 37%	L		immed.	0.31	0.5	0.14		>480	ND	0.5	0.14		>480	ND	1				
		Formalin, 10%	L	>480	immed.	.003	.01	.001	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		
		Glutaraldehyde, 5% aqueous solution	L	>480	>480	ND	1.4	0.02	>480	>480	ND	4	0.04		nt	nt	nt	nt	nt		
Amides	132 Aliphatic and Alicyclic	N,N-Dimethylacetamide	L	nt	nt	nt	nt	nt		64	2	12			>480	ND	0.26				
		N,N-Dimethylformamide	L	7	immed.	0.72	0.01	0.001	113	113	0.4	0.01	0.1		226	1.7	1				
Amines	141 Aliphatic and Alicyclic, Primary	Methylamine	G	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	105	105	40	0.01	0.1			
		Methylamine (50% solution)	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	251	203	1.6	0.01	0.001			
	142 Aliphatic and Alicyclic, Secondary	Diethylamine	L	Immed.	immed.	64	0.02		12	10	>50	0.02	0.001	>480	>480	ND	0.01	0.001			
	143 Aliphatic and Alicyclic, Tertiary	Triethylamine	L	nt	nt	nt	nt	nt		>480	ND	2		nt	nt	nt	nt	nt			
	145 Aromatic, Primary	Aniline	L		immed.	2.1	0.5	0.14	>480	168	0.09	0.001	0.001		>480	ND	1				
		p-Chloroaniline (70°C)	L	nt	nt	nt	nt	nt	<4	<4	90	0.04	0.001		344	323	9.4	0.01	0.001		
		p-Chloroaniline	S	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.9	0.09			
		3,4-Dichloroaniline (70°C)	L	nt	nt	nt	nt	nt	5	4	17	0.02	0.001		284	216	2.4	0.02	0.001		
		3,4-Dichloroaniline	S	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.25	0.001			
		m-Toluidine	L	nt	nt	nt	nt	nt	>480	>480	ND	0.01	0.001		nt	nt	nt	nt	nt		
		o-Toluidine	L		immed.	1		0.03		255	0.36	1	0.28	>480	>480	ND	0.01	0.001			
		148 Aliphatic and Alicyclic Polyamines	Ethylenediamine	L		169	2.8	0.2	1.1		>480	ND	0.6		nt	nt	nt	nt	nt		
	149 Aromatic Polyamines	4,4'-Methylene bis (o-chloroaniline) sat. solution in methanol	L	nt	nt	nt	nt	nt	>480	>480	ND	0.9	0.1	>480	>480	ND	0.9	0.1			
Isocyanates	211 Aliphatic and Alicyclic	Hexamethylenediisocyanate	L	nt	nt	nt	nt	nt		>480	ND	0.001			>480	ND	1				
		Methyl isocyanate	L	nt	nt	nt	nt	nt	6	5	99	0.9	0.005	>480	>480	ND	0.8	0.01			
	212 Aromatic	4,4'-Diphenyl methane diisocyanate	S	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.3	0.07			
		Toluene-2,4-diisocyanate	L		immed.	42	1			>480	ND	1			>480	ND	1				
Esters, Carboxylic	222 Acetates	n-Amyl acetate	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		>480	ND	0.08				
		Ethyl acetate	L	immed.	immed.	12.7	0.11			36	6.6	0.8		>480	72	.001	0.2	0.01			
		Vinyl acetate	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.01	1			
	223 Acrylates and Methacrylates	Methyl methacrylate	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	2.7	0.02			
	226 Benzoates and Phthalates	Di (2-ethyl hexyl) phthalate	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	2	0.07			

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				Breakthrough Time		Permeation Rate		SDL (ppm)	MDPR (µg/cm²/min)	Breakthrough Time		Permeation Rate		SDL (ppm)	MDPR (µg/cm²/min)	Breakthrough Time		Permeation Rate	
				Normalized (min)	Actual (min)	(µg/cm²/min)	(µg/cm²/min)			Normalized (min)	Actual (min)	(µg/cm²/min)	(µg/cm²/min)			Normalized (min)	Actual (min)	(µg/cm²/min)	(µg/cm²/min)
Ethers	241 Aliphatic and Alicyclic	Butyl ether	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	396	0.001	0.01	0.001
		Chloromethyl methyl ether	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	305	0.03	0.03	0.001
		Diethyl ether	L	nt	nt	nt	nt	nt		immed.	1.8	0.1			>480	ND	0.05		
		Methyl t-butyl ether	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.01	.007
		Tetrahydrofuran	L	immed.	immed.	183	0.1		immed.	immed.	>50	0.01	0.001		>480	>480	ND	0.4	0.008
	245 Glycol Ethers	Butyl cellosolve	L	nt	nt	nt	nt	nt		>480	ND	0.09			nt	nt	nt	nt	nt
		Ethyl cellosolve	L	nt	nt	nt	nt	nt		>480	ND	0.2			>480	ND	0.3		
		Ethyl cellosolve acetate	L	nt	nt	nt	nt	nt		39	1.8	0.6			>480	>480	ND	0.06	0.002
		Ethylene diglycol monoethyl ether	L	nt	nt	nt	nt	nt		>480	ND	8.7			nt	nt	nt	nt	nt
		Methyl cellosolve	L	nt	nt	nt	nt	nt		80	109	100			nt	nt	nt	nt	nt
		Methyl cellosolve acetate	L	nt	nt	nt	nt	nt		260	1.1	30			nt	nt	nt	nt	nt
Halogen Compounds	261 Aliphatic and Alicyclic	Carbon tetrachloride	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.4	0.015
		Chloroform	L		immed.	350	1			immed.	200	1			>480	>480	ND	0.1	0.004
		1,4-Dichloro-2-butene	L		75	250	1		nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
		Dichloromethane	L	immed.	immed.	>50	0.01	0.001	7	immed.	>50	0.01	0.001	404	318	0.13	0.01	0.001	
		2,3-Dichloropropene	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.03	0.008
		1,1-Dichlorotetrafluoroethane	L	nt	nt	nt	nt	nt	>480	>480	ND	0.5	0.1		nt	nt	nt	nt	nt
		Ethylene dibromide	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.01	0.1
		Ethylene dichloride	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		>480	ND	0.07	
		Freon® 113	G	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		>480	ND	0.06	
		Methyl bromide	G	nt	nt	nt	nt	nt		47	0.0003	0.11			nt	nt	nt	nt	nt
		Methyl chloride	G	immed.	immed.	0.3	0.01	0.001	>480	>480	ND	0.15	0.006	>480	>480	ND	0.02	0.001	
		1,1,2,2-Tetrachloroethane	L	nt	nt	nt	nt	nt		75	12	0.2			>480	>480	ND	0.1	0.007
		1,1,1,2-Tetrafluoroethane	L	nt	nt	nt	nt	nt	>480	>480	ND	2	0.1		nt	nt	nt	nt	nt
		1,1,1-Trichloroethane	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		>480	ND	0.1	
	263 Aromatic	Chlorobenzene	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		>480	ND	0.02	
		o-Chlorotoluene	L	nt	nt	nt	nt	nt		26	30	0.1			>480	ND	0.002		
		Fluorobenzene	L	nt	nt	nt	nt	nt	immed.	immed.	high	0.001	0.1	>480	>480	ND	.01	0.1	
Parabromofluorobenzene		L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.03	0.001	
PCB 1254		L	55	20	>3.6	2	0.03		>480	ND	0.7	0.2	nt	nt	nt	nt	nt	nt	

ND = none detected nt = not tested > = greater than < = less than S = solid L = liquid G = gas
sat. = saturated solution in water nm = not measured

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Class	Sub-Class	Chemical	Physical Phase	TYVEK® QC					TYVEK®/SARANEX 23-P					BARRICADE®				
				Breakthrough Time		Permeation Rate		MDPR (µg/cm²/min)	Breakthrough Time		Permeation Rate		MDPR (µg/cm²/min)	Breakthrough Time		Permeation Rate		MDPR (µg/cm²/min)
				Normalized (min)	Actual (min)	(µg/cm²/min)	SDL (ppm)		Normalized (min)	Actual (min)	(µg/cm²/min)	SDL (ppm)		Normalized (min)	Actual (min)	(µg/cm²/min)	SDL (ppm)	
Halogen Compounds (continued)	263 Aromatic (continued)	50% PCB 1254/50% trichlorobenzene	L	nt	nt	nt	nt	nt		>480	ND	0.7	0.2		>480	ND	0.01	
		See sub-class 590 for data on other PCB mixtures																
	264 Vinyllic	1,2,4-Trichlorobenzene	L		immed.	8.4	0.01	0.001		115	0.9	1	0.28	>480	>480	ND	1	0.28
		Tetrachloroethylene	L	immed.	immed.	410	0.1		8	immed.	5.7	0.01	0.001	>480	>480	ND	0.2	0.01
		Trichloroethylene	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.01	0.1
		Vinyl chloride	G	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.01	.001
Heterocyclic Compounds	271 Nitrogen, Pyridines	Nicotine	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.01	0.1
	274 Nitrogen, Others	Pyrolidine	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	413	407	9.2	2.1	0.012
	275 Oxygen, Epoxides	Epichlorohydrin	L	nt	nt	nt	nt	nt		57	52	11		>480	>480	ND	0.5	0.014
		Ethylene oxide	L	immed.	immed.	168	0.7	0.02	7	6	8.4	0.2		>480	>480	ND	0.9	0.03
		1,2-Propylene oxide	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.1	0.002
	277 Oxygen, Furans	Furaldehyde	L	nt	nt	nt	nt	nt		245	0.2	1	0.28		>480	ND	0.5	0.14
Hydrazines	280 Hydrazines	1,1-Dimethylhydrazine	L	nt	nt	nt	nt	nt		12	6	0.5			>480	ND	5.0	
		Hydrazine	L	nt	nt	nt	nt	nt		>480	ND	1			>480	ND	0.05	
Hydrocarbons	291 Aliphatic and Alicyclic, Saturated	Cyclohexane	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.1	0.003
		Diesel fuel	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		195	0.09	0.5	0.016
		n-Hexane	L	immed.	immed.	high	0.05		146	7	0.48	0.03	0.001	>480	>480	ND	0.02	0.0004
		Jet A fuel	L	nt	nt	nt	nt	nt	58	25	0.59	0.13	0.001	nt	nt	nt	nt	nt
		JP-4	L	nt	nt	nt	nt	nt	18	4	2.1	0.01	0.001	>480	>480	ND	0.05	0.002
		Mineral spirits	L		immed.	nm	<02			>480	ND	10			>480	ND	1.0	
		Stoddard solvent	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.01	0.001
	292 Aromatic	Benzene	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		>480	ND	.03	
		Ethylbenzene	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		>480	ND	0.02	
		Gasoline, leaded	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		>480	ND	0.06	
		Gasoline, unleaded	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.01	.001
		Styrene	L	nt	nt	nt	nt	nt		43	70	2			>480	ND	0.05	
		Toluene	L	immed.	immed.	high	0.03		immed.	30			0.8	>480	>480	ND	0.03	0.001
		Xylene (mixed isomers)	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		>480	ND	0.1	
	294 Aliphatic and Alicyclic, Unsaturated	1,3-Butadiene	G	8	immed.	12	0.01	0.001	>480	>480	ND	0.01	0.001	>480	>480	ND	0.01	0.001
		d-Limonene	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.05	0.001
Peroxides	300 Peroxides	Hydrogen peroxide, 30%	L	>480	>480	ND	7	0.1	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
Hydroxylic Compounds	311 Aliphatic and Alicyclic, Primary	Allyl Alcohol	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.01	0.1
		n-Butanol	L		3	1.6	0.06		nt	nt	nt	nt	nt		>480	ND	0.01	
		Methanol	L	immed.	immed.	2.2	0.18		>480	>480	ND	0.01	0.001	104	92	0.7	0.04	0.001
	314 Aliphatic and Alicyclic, Polyols	Ethylene glycol	L		>480	ND	1			>480	ND	1	0.33	nt	nt	nt	nt	nt

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				Breakthrough Time		Permeation Rate		SDL (ppm)	Breakthrough Time		Permeation Rate		SDL (ppm)	Breakthrough Time		Permeation Rate		SDL (ppm)
				Normalized (min)	Actual (min)	(µg/cm²/min)	MDPR (µg/cm²/min)		Normalized (min)	Actual (min)	(µg/cm²/min)	MDPR (µg/cm²/min)		Normalized (min)	Actual (min)	(µg/cm²/min)	MDPR (µg/cm²/min)	
Hydroxylic Compounds (continued)	315 Aliphatic and Alicyclic, Substituted	2-Chloroethanol	L		3	3.1	0.06		nt	nt	nt	nt		>480	>480	ND	0.4	0.008
		2,2,2-Trichloroethanol	L	nt	nt	nt	nt			19	13.2	140		>480	>480	ND	0.2	0.01
		2,2,2-Trifluoroethanol	L		6	high	0.03		nt	nt	nt	nt		>480	>480	ND	0.05	0.001
	316 Aromatic, Phenols	Cresol (mixed isomers)	L	112	8	0.43	0.01	0.001	>480	153	0.17	0.01	0.001	nt	nt	nt	nt	nt
		Phenol, 85%	L		immed.	0.4	1	0.28		>480	ND	1	0.28		>480	ND	1	
Elements	330 Elements	Bromine	L		immed.	high	3100		nt	nt	nt	nt			9	520	0.3	
		Iodine	S		440	30	0.5			>480	ND	70		nt	nt	nt	nt	nt
		Mercury	L	nt	nt	nt	nt			210	<.001	0.006			>480	ND	0.0003	
Inorganic Salts (Solutions)	340 Inorganic Salts (Solutions)	Mercuric chloride, sat.	L	nt	nt	nt	nt			>480	ND	0.3	0.28		>480	ND	0.3	0.28
		Potassium acetate, sat.	L	nt	nt	nt	nt			>480	ND	0.5	0.51		>480	ND	0.5	0.49
		Potassium chromate, sat.	L	nt	nt	nt	nt			>480	ND	0.5	0.51		>480	ND	0.5	0.51
		Sodium fluoride, sat.	L	nt	nt	nt	nt			>480	ND	0.3	0.28	nt	nt	nt	nt	nt
		Sodium hypochlorite, 5.25%	L		>480	nd	0.05			>480	ND	0.05		nt	nt	nt	nt	nt
	345 Inorganic Cyano Compounds	Hydrocyanic acid	L		60	110	300		nt	nt	nt	nt		104	94	1.7	6.3	0.02
		Potassium cyanide, 10%	L	>480	>480	ND	1	0.1	nt	nt	nt	nt		nt	nt	nt	nt	nt
		Sodium cyanide, 95%	L	nt	nt	nt	nt			>480	ND	0.3	0.28		>480	ND	0.3	
Inorganic Gases and Vapors	350 Inorganic Gases and Vapors	Ammonia, anhydrous	G	immed.	immed.	3.1	0.04	0.001	32	8	0.15	0.05	0.001	47	35	0.37	0.05	0.001
		Chlorine (20ppm)	G		>480	ND	0.1			>480	ND	0.1		nt	nt	nt	nt	nt
		Chlorine gas	G	immed.	immed.	>50	3	0.2	>480	>480	ND	12	0.7	>480	>480	ND	9	0.5
		Hydrogen chloride	G	immed.	immed.	9.3	0.4	0.1	>480	>480	ND	0.4	0.1	>480	>480	ND	0.4	0.1
		Hydrogen fluoride	G		7	6	0.2			20	3	0.2		135	135	2.3	1	0.001
		Nitrogen dioxide	G	nt	nt	nt	nt			>480	ND	0.003		nt	nt	nt	nt	nt
		Nitrogen tetroxide	G	nt	nt	nt	nt		nt	nt	nt	nt			24	66	0.03	
		Sulfur dioxide	G		immed.	>29	3	0.14	>480	>480	ND	0.1	0.1		>480	ND	0.04	
Inorganic Acid Halides	360 Inorganic Acid Halides	Antimony pentachloride	L	nt	nt	nt	nt		>480	>480	ND	1	0.1	nt	nt	nt	nt	nt
		Phosphorus trichloride	L	nt	nt	nt	nt		20	20	28.3	5	0.1	>480	>480	ND	0.5	0.1
Inorganic Acids	370 Inorganic Acids	Chromic acid	L	>480	>480	ND	1	0.1	>480	>480	ND	1	0.1	nt	nt	nt	nt	nt
		Hydrochloric acid, 37%	L	86	86	1.1	0.02	0.1	>480	>480	ND	0.04	0.036		>480	ND	0.006	
		Hydrofluoric acid, 50%	L		180	0.08	0.02	0.024	>480	>480	ND	0.02	0.024		>480	ND	0.01	
		Hydrofluoric acid, 70%	L	nt	nt	nt	nt	nt	immed.	immed.	0.6	1	0.1	nt	nt	nt	nt	nt
		Hydrofluoric acid, 92% (90°C)	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		67	2.8	0.02	0.07
		Nitric acid, 70%	L		397	0.5	0.04	0.19		>480	ND	0.1	0.13		>480	ND	0.1	0.13

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				Breakthrough Time		Permeation Rate			Breakthrough Time		Permeation Rate			Breakthrough Time		Permeation Rate		
				Normalized (min)	Actual (min)	(µg/cm²/min)	SDL (ppm)	MDPR (µg/cm²/min)	Normalized (min)	Actual (min)	(µg/cm²/min)	SDL (ppm)	MDPR (µg/cm²/min)	Normalized (min)	Actual (min)	(µg/cm²/min)	SDL (ppm)	MDPR (µg/cm²/min)
Inorganic Acids (continued)	370 Inorganic Acids (continued)	Oleum, 40% free SO ₃	L		235	0.2	0.04	0.04	>480	>480	ND	0.04	0.04	>480	>480	ND	0.04	0.04
		Phosphoric acid, 85%	L	nt	nt	nt	nt	nt		>480	ND	0.2	0.18		>480	ND	0.2	0.18
		Sulfuric acid, 16%	L		>480	ND				>480	ND			nt	nt	nt	nt	nt
		Sulfuric acid, 50%	L		>480	ND				>480	ND			nt	nt	nt	nt	nt
		Sulfuric acid, 93%	L	>480	>480	ND	1	0.1	>480	>480	ND	1	0.1	nt	nt	nt	nt	nt
		Sulfuric acid, 95%	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	1	0.1
		Sulfuric acid, 98%	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	1	0.1
Inorganic Bases	380 Inorganic Bases	Ammonium hydroxide, 28%	L	immed.	immed.	62	17000		>480	>480	ND	1	0.1	160	160	5.6	1	0.1
		Sodium hydroxide, 50%	L	>480	>480	ND	1	0.1	>480	>480	ND	1	0.1	>480	>480	ND	1.0	0.1
		Sodium hydroxide, sat.	L	>480	>480	ND	1	0.1	>480	>480	ND	1	0.1	nt	nt	nt	nt	nt
Ketones	391 Aliphatic and Alicyclic	Acetone	L	immed.	immed.	10	0.11		24	15	1.6	0.1	0.002	>480	>480	ND	0.1	0.002
		Chloroacetone	L	nt	nt	nt	nt	nt	>480	360	0.1	0.06	0.001	nt	nt	nt	nt	nt
		Methyl ethyl ketone	L	nt	nt	nt	nt	nt		29	7.8	4.1		>480	>480	ND	0.3	0.007
		Methyl isobutyl ketone	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	120	0.001	0.01	0.001
Nitriles	431 Aliphatic and Alicyclic	Acetonitrile	L	immed.	immed.	16	0.23		13	11	2.8	0.01	0.001	>480	>480	ND	0.04	0.004
		Acrylonitrile	L		5	<.01	1000			23	<0.1	1000			>480	ND	0.03	
	432 Aromatic	Benzonitrile	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		>480	ND	0.15	
Nitro Compounds	441 Unsubstituted	Nitrobenzene	L	immed.	immed.	18	0.01	0.001	102	78	2.3	0.03	0.001	>480	>480	ND	0.02	0.001
		Nitromethane	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt		>480	ND	0.3	
Sulfur Compounds	501 Thiols	Methyl mercaptan	G	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.01	0.001
	502 Sulfides and Disulfides	Carbon disulfide	L	immed.	immed.	high	0.11		8	immed.	>50	0.01	0.001	>480	>480	ND	0.1	0.003
	503 Sulfones and Sulfoxides	Dimethyl sulfoxide	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	374	0.003	0.01	0.001
	507 Sulfonates, Sulfates, and Sulfites	Dimethyl sulfate	L	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	>480	>480	ND	0.03	0.001
Miscellaneous (Not classified)	590 Miscellaneous	Blood (human)	L		>480	ND	1		nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
		Gasohol	L	immed.	immed.	7.8	0.2	0.002	>480	>480	ND	0.2	0.003	244	170	0.2	0.4	0.011
		Methyl ethyl ketoxime	L	nt	nt	nt	nt	nt	>480	>480	ND	0.01	0.1	>480	>480	ND	0.01	0.1
		PCB 50%, mineral oil 50%	L	nt	nt	nt	nt	nt		>480	ND			nt	nt	nt	nt	nt
		PCB 1%, mineral spirits 99%	L	nt	nt	nt	nt	nt		>480	ND			nt	nt	nt	nt	nt
		PCB 4%, TCB 6%, min. spir. 90%	L	nt	nt	nt	nt	nt		60	0.04	0.001		nt	nt	nt	nt	nt

ND = none detected nt = not tested > = greater than < = less than S = solid L = liquid G = gas
sat. = saturated solution in water nm = not measured

Tyvek and Barricade are registered trademarks of DuPont. Tychem and TyFax are trademarks of DuPont.
Saranex 23-P is a registered trademark of the Dow Chemical Company.

NOTE: Numbers reported are averages of samples tested by the ASTM F739 test method. Sample results do vary and therefore averages for these results are reported.

Warning:

1. Tychem fabrics (Tyvek QC, Tyvek/Saranex 23P, Tychem 7500, Barricade, Tychem 9400, and Tychem 10,000) should not be used around heat, flames, sparks or in potentially flammable or explosive environments.
2. Garments made of Tychem fabrics should have slip-resistant or antislip materials on the outer surface of boots, shoe covers, or other garment surfaces in conditions where slipping could occur.

How Permeation Tests are Conducted

Permeation is the process by which a chemical moves through protective clothing material on a molecular level. Permeation tests are conducted following the ASTM F739 test method: "Test Method for Resistance of Protective Clothing Materials to Permeation by Liquids and Gases." The outside surface of a test fabric is exposed to a challenge chemical using a special test cell (see Figure 1).

Breakthrough to the inside fabric surface is monitored by sampling the collection side of the cell and analytically determining when the chemical has permeated the fabric. Breakthrough time is the average elapsed time between initial contact of the chemical with the outside surface of the fabric and detection of the chemical on the inside surface of the fabric. Permeation rate is the average constant rate of permeation that occurs after breakthrough when the chemical contact is continuous and all forces affecting permeation have reached equilibrium.

ASTM F739 Test Cell

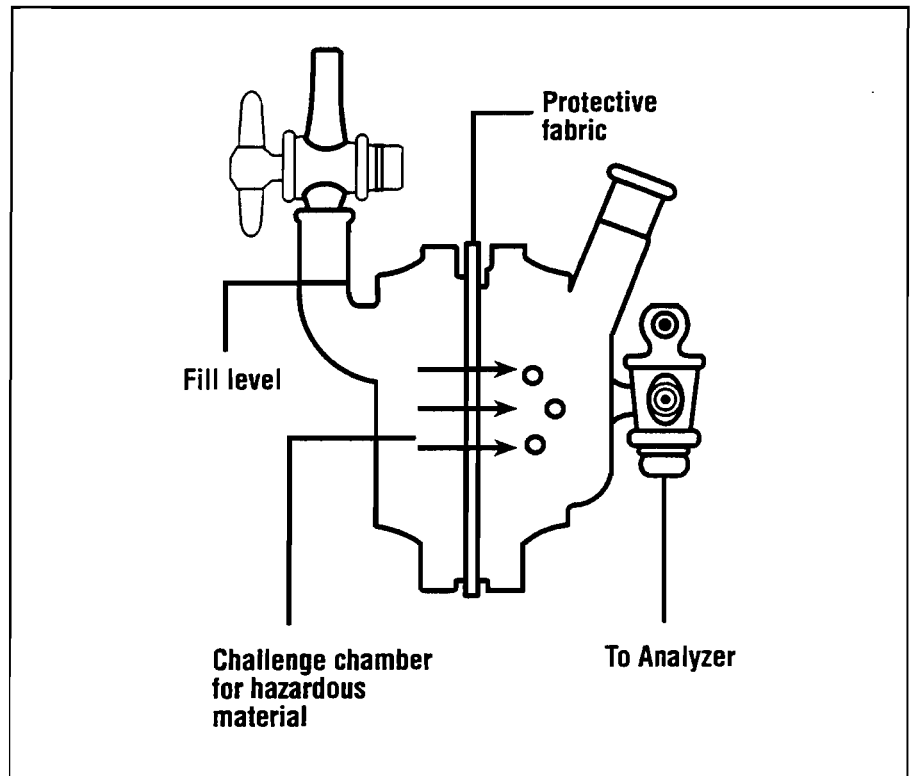


Figure 1

Definitions of Terms

Actual breakthrough time: the average elapsed time between initial contact of the chemical with the outside surface of the fabric and detection of the chemical on the inside surface of the fabric. DuPont permeation tests are run for 480 minutes to simulate a typical 8-hour work shift, unless otherwise specified in this guide. If a breakthrough time is shown as >480, this means that no breakthrough was detected during the 480-minute test period. If a breakthrough time is shown as immediate, this means that chemical breakthrough was detected when the first collection medium sample was analyzed.

CAS number: Chemical Abstract Service Registry Number. The number in format "xxxxxx-xx-x" is unique for each chemical.

MDPR (minimum detectable permeation rate): the minimum permeation rate that can be detected by the analytical system.

Normalized breakthrough time: the time at which the permeation rate reaches 0.1 $\mu\text{g}/\text{cm}^2/\text{min}$. Normalized breakthrough times are useful for comparing barrier performance of different fabrics.

Permeation: the process by which a chemical moves through a protective clothing material on a molecular level.

Permeation rate: the average constant rate of permeation that occurs after breakthrough when the chemical contact is continuous and all forces affecting permeation have reached equilibrium.

Physical phase: phase (solid, liquid, or gas) of a chemical as tested.

SDL (system detection limit): the minimum amount of chemical breakthrough that can be detected by the analytical system. Lower SDLs result in lower (or earlier) breakthrough times.

The Tychem family of fabrics for limited-use protective apparel.

This line of chemical protective fabrics reflects the ongoing commitment of DuPont to continually improve and broaden our product offering to meet industry needs for quality, high-performance limited-use protective garments.

Tyvek® QC

Tyvek QC offers splash protection against many inorganic acids, bases and other liquid chemicals such as pesticides. This fabric is made from Tyvek that has been "quality coated" with 1.25 mils polyethylene. Tyvek QC is available in yellow, white or gray.

Tyvek® laminated with Saranex 23-P

Tyvek laminated with Saranex 23-P offers effective protection against a broader range of chemicals than Tyvek QC and is the only Saranex 23-P laminated fabric for which DuPont provides permeation data and technical support. This fabric is lightweight and offers economical protection. It is available in white or gray.

Tychem™ 7500

This fabric provides a higher level of chemical splash protection than Tyvek laminated with Saranex 23-P. Tychem 7500 also features higher tensile and burst strengths. Tychem 7500 is available in light blue and meets all fabric requirements of NFPA 1993.

Barricade®

Barricade, a multilayer laminate, provides excellent protection against liquid chemicals and is used in Haz-Mat, industrial and other chemical applications. Barricade is strong, durable and offers the low cost, convenience and safety of a limited-use fabric. Barricade is available in yellow and meets all fabric requirements of NFPA 1993.

Tychem™ 9400

This state-of-the-art fabric provides excellent chemical protection against a broad range of chemicals. It is more durable than Barricade and features greater puncture- and tear-resistance with the convenience and safety of a limited-use fabric. Tychem 9400 is available in yellow and meets all fabric requirements of NFPA 1993.

Tychem™ 10,000

This newest member of the DuPont Tychem family of fabrics provides our highest level of durability and chemical protection. Available only in Tychem ChemWear™ garments, Tychem 10,000 consistently rates excellent on permeation performance against a wide variety of chemicals, and is durable enough to handle emergency response and remediation work. Tychem 10,000 is available in high-visibility lime yellow and meets all fabric requirements of NFPA 1993.

For more information about the DuPont family of fabrics for limited-use protective apparel, call **1-800-558-9329 (1-800-55-TYFAX)**.

Warning:

1. Tychem fabrics (Tyvek QC, Tyvek/Saranex 23P, Tychem 7500, Barricade, Tychem 9400, and Tychem 10,000) should not be used around heat, flames, sparks or in potentially flammable or explosive environments.
2. Garments made of Tychem fabrics should have slip-resistant or antislip materials on the outer surface of boots, shoe covers, or other garment surfaces in conditions where slipping could occur.

Tyvek and Barricade are registered trademarks of DuPont.
Tychem, TyFax and ChemWear are trademarks of DuPont.

Saranex 23-P is a registered trademark of the Dow Chemical Company.



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SAFETY YOU CAN WEAR
TYVEK® • BARRICADE® • BLOCKADE™ • TYVEK® QC

FLAMMABILITY DATA SHEET

Du Pont Protective Apparel Fabrics are all rated "Class 1: Normal Flammability" when tested as directed

All fabrics were tested in accordance with the U.S. Flammable Fabrics Act, 16 CFR Part 1610, "Standard for the Flammability of Clothing Textiles" (formerly known as CS-191-53).

The test method specified by this standard is a 45° flammability test that calls for ignition of the face of the fabric, and then measures the time required to burn a specified distance of 5 inches. Longer burn times indicate lower flammability characteristics.

Class 1 fabrics take longer than 4 seconds to burn the specified distance.

Class 1 fabrics are "...generally accepted by the trade as having no unusual burning characteristics".

See NFPA Standards 1991, 1992, and 1993 for specific flammability standards for protective apparel for firefighters.

FABRIC	TEST RESULTS
<i>UNCOATED TYVEK® STYLES</i>	
TYVEK® Style 1422	Class 1
TYVEK® Style 1443	Class 1
TYVEK® Style 1445	Class 1
TYVEK® Style 1622	Class 1
TYVEK® FC	Class 1
<i>LAMINATED FABRICS</i>	
TYVEK® QC	Class 1
TYVEK®/SARANEX®23-P	Class 1
BARRICADE®	Class 1

As shown above, Du Pont Protective Apparel Fabrics are not flame resistant and should not be used around heat, flame, sparks, or in potentially flammable or explosive environments.

We believe this information is the best currently available. It is subject to revision as additional knowledge and experience are gained. Du Pont makes no guarantee of results and assumes no obligation or liability in connection with this information. It is the user's responsibility to determine the level of toxicity and the proper personal protective equipment needed. The information set forth herein reflects laboratory performance of fabrics, not complete garments, under controlled conditions. It is intended for informational use by persons having the technical skill for evaluation under their specific end-use conditions, at their own discretion and risk. Anyone intending to use this information should first verify that the garment selected is suitable for the intended use. Since conditions of use are outside our control, we make no warranties, express or implied, and assume no liability in connection with any use of this information.

WARNINGS:	(1) TYVEK, TYVEK FC, TYVEK QC, TYVEK/SARANEX 23-P, and BARRICADE are not flame resistant and should not be used around heat, flame, sparks, or in potentially flammable or explosive environments.
	(2) Garments of TYVEK, TYVEK QC, TYVEK/SARANEX 23-P, and BARRICADE should have slip resistant or antislip materials on the outer surface of boots, shoe covers, or other garment surfaces where a concern about slippage exists.

Du Pont manufactures fabrics for both hazardous and non-hazardous protective apparel applications. For more information on these materials call 1-800-32-TYVEK.

TYVEK, TYVEK FC, TYVEK QC, and BARRICADE are registered trademarks of Du Pont. SARANEX 23-P is a registered trademark of The Dow Chemical Co.

Replaces all previously published flammability data sheets. Revised January, 1992.
H-35313



SAFETY YOU CAN WEAR

TYVEK® • BARRICADE® • BLOCKADE™ • TYVEK® QC

STATIC PROPERTIES DATA SHEET

Evaluation of end-use conditions is important to determine what type of static protection system is needed for your application

All fabrics were tested in accordance with NFPA Standard 99, "Standard for Health Care Facilities", which incorporates NFPA 56A, "Standard on the Use of Inhalation Anesthetics". This standard (NFPA 56A), among other things, specifies a minimum level of static performance for textiles to be used with explosive anesthetics.

The test method specified by these standards is Method 4046 of Federal Test Method Standard 101C; the fabrics listed are tested with a modification of the conditioning criteria. The test samples are preconditioned at 70° F and 50% RH for 25 hours prior to testing. The test is conducted at 70° F and 50% RH. After a specimen has received its maximum charge from the application of 5000 volts, the time for the indicated specimen potential to drop to 10 percent of its maximum value is measured.

To meet the requirement of NFPA 99, the charge decay time must be less than 0.5 second. As shown in the table, these Du Pont Protective Apparel Fabrics, as shipped from Du Pont, meet that requirement.

Despite the above test results, Du Pont Protective Apparel Fabrics should not be used in potentially flammable or explosive environments for two reasons. First, these test results are achieved by the use of a water-soluble anti-static agent which may have been washed off garments before use. Secondly, grounding of persons working in flammable/explosive atmospheres is of primary importance. Anti-static clothing cannot insure the safety of an ungrounded person or of a person wearing other non-antistatic garments, gloves, boots, or combinations of these.

We believe this information is the best currently available. It is subject to revision as additional knowledge and experience are gained. Du Pont makes no guarantee of results and assumes no obligation or liability in connection with this information. It is the user's responsibility to determine the level of toxicity and the proper personal protective equipment needed. The information set forth herein reflects laboratory performance of fabrics, not complete garments, under controlled conditions. It is intended for informational use by persons having the technical skill for evaluation under their specific end-use conditions, at their own discretion and risk. Anyone intending to use this information should first verify that the garment selected is suitable for the intended use. Since conditions of use are outside our control, we make no warranties, express or implied, and assume no liability in connection with any use of this information.

WARNINGS: (1) TYVEK, TYVEK FC, TYVEK QC, and TYVEK/SARANEX 23-P are not flame resistant and should not be used around heat, flame, sparks, or in potentially flammable or explosive environments.
(2) Garments of TYVEK, TYVEK QC, and TYVEK/SARANEX 23-P should have slip resistant or antislip materials on the outer surface of boots, shoe covers, or other garment surfaces where a concern about slippage exists.

Du Pont manufactures TYVEK® spunbonded olefin and laminates of TYVEK as protective fabrics for both hazardous and non-hazardous protective apparel applications. For more information on these materials call 1-800-44-TYVEK.

TYVEK, TYVEK FC, and TYVEK QC are registered trademarks of Du Pont.
SARANEX 23-P is a registered trademark of The Dow Chemical Company.

Replaces all previously published data sheets for static properties. Revised April, 1992.
H-35312

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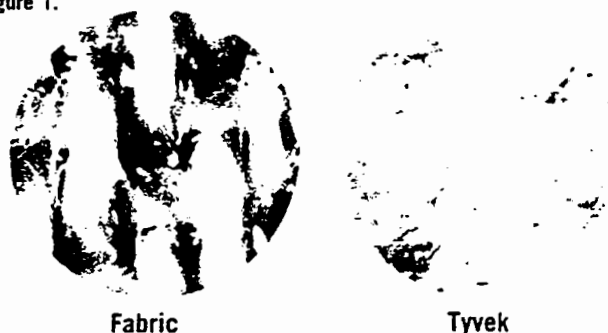
Properties

Disposable Clothing of TYVEK® Provides Maximum Protection at Minimum Cost

Excellent Barrier Properties

Tyvek has a unique structure. Millions of very fine continuous polyethylene fibers overlap to form a dense sheet structure that functions as an excellent protective shield. The photomicrographs (25x magnification) in Figure 1 show why Tyvek acts as an effective particle barrier and resists liquid splash penetration.

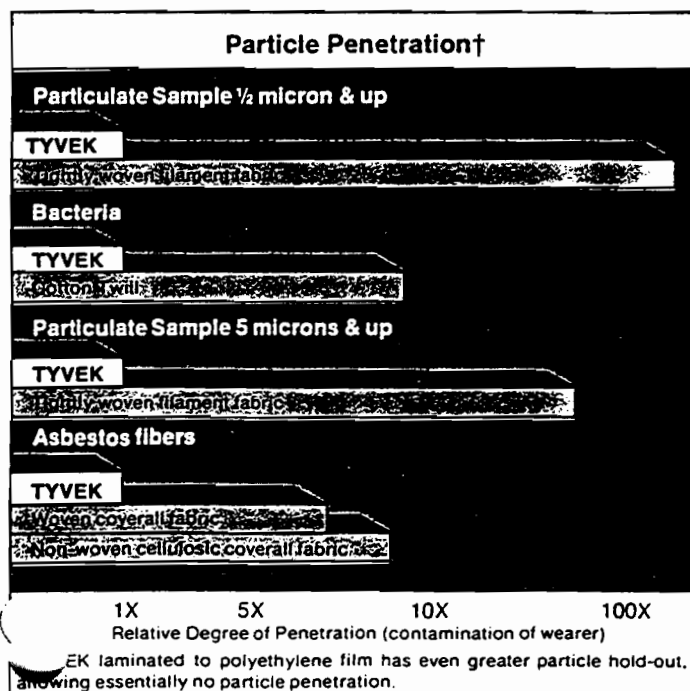
Figure 1.



These photomicrographs compare a heavy-duty 7.5-ounce twill coverall fabric on the left to Tyvek. The interstices in the woven fabric allow particles to penetrate freely, while the spunbonded fiber structure of Tyvek holds out most particles down to half-micron size.

Particle Hold-Out — Laboratory tests show that Tyvek is an effective particle barrier. Figure 2 compares Tyvek with other clothing materials showing the degree to which the materials are penetrated by particles of various sizes and types. In another test, Tyvek was challenged by asbestos

Figure 2.



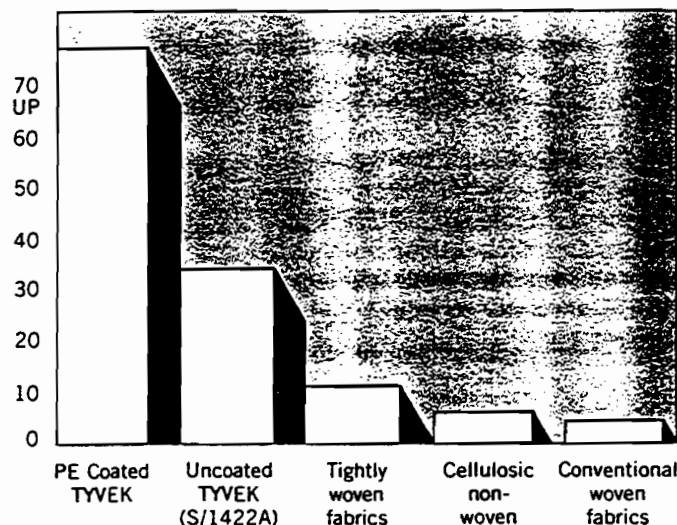
fibers with a median diameter of 0.12 microns — it stopped (or filtered out) more than 98% of these fibers. A test with pesticide dust containing 5% carbaryl also confirmed its outstanding ability to stop penetration of very fine particles — more than 97% of the particles were held out. An additional advantage of Tyvek is that the relatively slick surface tends to prevent particle entrapment and therefore reduces garment contamination. Whether the particles are radioactive or bacteriological, organic or inorganic, carcinogenic or just plain dust, Tyvek reduces exposure to the wearer.

Liquid Hold-Out — Where splash protection is needed, Tyvek again displays excellent hold-out properties to many liquids. Additional protection can be achieved by using a garment of coated Tyvek. The comparative liquid (water) hold-out properties for various protective clothing materials are shown in Figure 3.

Figure 3. Comparative Liquid (water) Hold-Out Values

Hydrostatic head

(inches of water before penetration)



Chemical Protection — Tyvek is 100% polyethylene and essentially chemically and biologically inert. Its physical properties are virtually unaffected by most organic and inorganic chemicals including acids, bases and salts. It does, however, absorb certain organic solvents. This may cause slight swelling of the Tyvek before the solvent evaporates.

The effectiveness of the barrier hold-out properties of Tyvek when exposed to chemicals, especially those in liquid or gaseous states, can only be determined by permeation testing. Depending on the challenge chemical, it can be a very simple test or it may involve sophisticated analytical

Figure 4. Preferred Tyvek® Candidates for Hazardous Chemical Protection

Chemical	Preferred Tyvek Candidate(s)	Permeation Data Summary
Polychlorinated Biphenyl (PCB)	Saranex** Laminated Tyvek	Breakthrough time greater than 60 minutes
1, 2, 4,-Trichlorobenzene	Saranex** Laminated Tyvek	Breakthrough time greater than 15 minutes
Cresols (Technical grades of 54% meta-cresol, 29% para-cresol and 19% other phenols)	Saranex** Laminated Tyvek	No detectable permeation after 2 hours of continuous exposure
Ortho-Toluidine (Reagent grade an experimental carcinogen)	Saranex** Laminated Tyvek	No detectable permeation after 2 hours of continuous exposure
Sodium Dichromate (Metal Finishing Solution 10% sulfuric acid, 87% water and 3% Sodium dichromate, a suspect carcinogen)	PE Coated Tyvek or Saranex** Laminated Tyvek	No detectable permeation after 8 hours of continuous exposure
Sulfuric Acid (up to 98%)	PE Coated Tyvek or Saranex** Laminated Tyvek	No detectable permeation after 8 hours continuous exposure
Sodium Hydroxide (40% Solution)	PE Coated Tyvek or Saranex** Laminated Tyvek	No detectable permeation after 8 hours continuous exposure

**Registered trademark of Dow Chemical Company

procedures. Figure 4 summarizes the results of permeation tests on Tyvek. These data are to be used only as a guide. Appropriate tests should be conducted with the garment to determine if it provides the wearer the necessary protection in the complex work environment.

• Toughness and Durability

Tyvek has high tensile/tear strength in all directions, wet or dry. Water has practically no effect on its strength and it retains its toughness and flexibility down to -100°F. The network of minute polyethylene fibers gives Tyvek good puncture and abrasion resistance. Unlike films, Tyvek has exceptional resistance to tear propagation. Because of this toughness and durability, garments of Tyvek can be worn and laundered repeatedly. Yet, they are inexpensive enough to be disposed of after one wearing.

• Flammability Characteristics

The flammability characteristics of Tyvek, a synthetic nonwoven material, are similar to those of most synthetic fibers. When exposed to a flame, Tyvek shrinks away rapidly. If the flame is made to follow the shrinking sheet, Tyvek will reach ignition temperature, 650°F, and burn. Type 14 and 16 Tyvek meet the flammability requirements of the Federal Flammable Fabrics Act for Clothing Textiles (16CFR-1610) NFPA #703 (Chapter 1) for Textile Wearing Apparel, and NFPA #702 (Chapter 5), the Vertical Flammability Test for "non-textiles."

• Static Protection

Tyvek Types 14 and 16 are treated with an antistatic agent to minimize static build-up and prevent garment cling. Tyvek passes NFPA - 56A requirements. This allows use in areas where flammable gases or solvent vapors are present. This antistatic coating, like that used on other materials of synthetic fibers, is water soluble and is removed by washing or dry cleaning. The antistat can be reapplied during a normal laundry rinse to regain static protection.

• Breathable/Comfortable Type 16 Tyvek

Type 16 Tyvek is lightweight and comfortable and allows free passage of air. It will not, of course, give the same degree of protection as Type 14 Tyvek. A typical coverall weighs only 5 ounces and has a Frazier air permeability of 45 cubic feet/minute or about the same as most work clothing fabrics. As a result, garments made of Type 16 are considered comfortable at most temperature/humidity levels. Garment comfort can be further enhanced by proper design and sizing.

Clean Rooms

A clean room is an enclosed area in which particulate matter in the air is controlled. Clean rooms are used in the manufacturing, assembly, or packaging of electronic parts, pharmaceuticals, etc., where the prevention of contamination is of utmost importance. All items worn in a clean room must be specifically designed for that application.

One of the biggest potential sources of contamination in a clean room is particulate matter on the workers themselves. Therefore, specifically designed garments are necessary to keep the microscopic particles of contamination normally on the human body from reaching the work area. Such garments cover the entire body including head and feet. They are sewn with continuous filament thread to prevent linting, and they have closures around the sleeves.

In the past, all clean room garments have been made of fabrics woven with continuous filament fibers. Tyvek Type 14 is the first non-woven material to prove acceptable for clean room operations. The key reasons for its acceptability are its continuous filament structure, absence of any fillers or adhesives which may flake off, and superior barrier properties. Like woven clean room garments, garments of Tyvek require special cleaning before each use in a clean room environment.

DuPont TYVEK® spunbonded olefin is a unique non-woven material of very fine polyethylene fibers. The material is neither film, woven fabric, nor paper but combines the best features of all three.

TYVEK® has high tensile/tear strength unaffected by water and retains its toughness and flexibility down to minus 100°F.

TYVEK® has a superior ability to hold out particulate matter, including radioactive or bacteriological, organic or inorganic. Because of its relatively slick surface, TYVEK® does not tend to entrap particles the way a woven fabric will.

TYVEK® is 100% polyethylene and is considered to be essentially a chemically and biologically inert material. Its physical properties are virtually unaffected by most organic and inorganic chemicals, including acids, bases and salts.

TYVEK® is an inherently lightweight material. The total weight of a typical coverall is only 5 ounces. Principally because of this, garments fabricated of TYVEK® have been judged comfortable at most temperature/humidity levels.

• REGISTERED TRADEMARK OF E. I. DUPONT CO.

Typical Properties of TYVEK® Types 14 & 16 Spunbonded Olefin (English Units)

	STYLE 1422A/R AVERAGE RANGE ⁽¹⁾	STYLE 1443R AVERAGE RANGE ⁽¹⁾	STYLE 1445A AVERAGE RANGE ⁽¹⁾	STYLE 1622E AVERAGE RANGE ⁽¹⁾	STYLE 1621C AVERAGE RANGE ⁽¹⁾	TEST METHOD
Basis Weight oz./sq. yd.	1.15 1.10-1.20	1.25 1.20-1.30	1.35 1.30-1.40	1.15 1.10-1.20	1.15 1.10-1.20	ASTM D 3776 ⁽²⁾
Strip Tensile (MD) lbs./in.	7.5 5.2-9.8	8.5 5.9-11.1	11.5 8.9-14.1	7.3 5.0-9.6	7.0 4.7-9.3	ASTM D 1117 ⁽³⁾
Strip Tensile (XD) lbs./in.	9.0 6.7-11.3	10.5 7.9-13.1	14.0 11.4-16.6	9.0 6.7-11.3	—	ASTM D 1117 ⁽³⁾
Tongue Tear (MD & XD) lbs.	2.4 1.4-3.4	2.7 1.7-3.7	2.5 1.5-3.5	1.8 1.0-2.6	1.8 1.0-2.6	ASTM D 2261 ⁽⁴⁾
Air Permeability, Frazier ft. ³ /ft. ² -min.	—	—	—	40 27-53	45 32-58	ASTM D 737
Water Resistance Hydrostatic Head, in.	40 (A):10(R)	—	31 26-36	—	—	AATCC 127
Electrical Resistivity Log R	7.8 7.0-8.6	7.8 7.0-8.6	7.8 7.0-8.6	7.8 7.0-8.6	7.8 7.0-8.6	AATCC 76 ⁽⁵⁾
Treatment	A-Antistat Only Both Sides R-Corona/ Antistat Both Sides	Corona/Antistat Both Sides	Antistat Only Both Sides	Corona/Antistat Both Sides Needle Perforated	Corona Both Sides Needle Perforated	

⁽¹⁾Ranges are estimates only for 95% of the product based upon roll average standard deviations.⁽²⁾1 sq. yd.⁽³⁾Out Strip: CRE tensile tester, crosshead speed 2 in./min., gauge length 5 in.⁽⁴⁾Run at Cross Head Speed of 5 in./min. and 1 in. gauge length⁽⁵⁾Converted to Log R

Canisters

Replacement Canisters for Chin Type Gas Masks

MSA Canister Identification	Purifying Protection Code	Color Coding	Approval	Maximum Use Conditions	Part No.
GMA-C	OV	■	TC-14G-87	0.5% organic vapors*	448974
GMC-C	OV/AG		TC-14G-107	0.5% organic vapors and acid gases*	466222
GMCF-C	OV/AG/ FORM	■	TC-14G-176	0.5% organic vapors and acid gases, or formaldehyde*	491379
GMD-C	AM/MA	■	TC-14G-88	0.5% ammonia*	448973
GML-C	CL ₂	□	TC-14G-89	0.5% chlorine*	460113
GMP-C	OV/PEST	■	TC-14G-86	0.5% pesticides and organic vapors*	448972
GMDL-C	OV/CL ₂ / AM/MA	■	TC-14G-112	0.5% ammonia, chlorine and organic vapors*	469041
GMR-I	OV/I ₂	■	TC-14G-108	0.5% organic vapors, also effective against organic iodides and iodide vapors†	466220
GMHF-C	HF	■	TC-14G-135	0.2% hydrogen fluoride, also effective against chlorine, acid gases and organic vapors†	475942

Replacement Canisters for Industrial Size Gas Masks

MSA Canister Identification	MSA Response Code	Color Coding	Approval	Maximum Use Conditions	Part No.
GMA	OV	■	TC-14G-97	2% organic vapors*	449888
GMD	AM/MA	■	TC-14G-101	2% ammonia*	448967
GML	CL ₂	□	BM-14F-60	1% chlorine*	77711
GMP	OV/PEST	■	TC-14G-99	2% pesticides and organic vapors†	465326

Replacement Canisters for Super Size Gas Masks

MSA Canister Identification	MSA Response Code	Color Coding	Approval	Maximum Use Conditions	Part No.
GMA-SS	OV	■	TC-14G-97	2% organic vapors*	448965
GMC-SS	OV/AG		TC-14G-100	2% organic vapors and acid gases; and escape only from hydrogen cyanide*	460117
GMD-SS	AM/MA	■	TC-14G-101	3% ammonia*	448964
GMN-SSW		■	Not approved	2% rocket fuels and oxidizers†	92372
GMHS-SSW	OV/PHOS/ CLO ₂ /CL ₂ / H ₂ S	■	TC-14G-158	0.15% phosphine; 2% organic vapors or chlorine; 1% hydrogen sulfide*	487103
GMEO-SSW	ETO/DM	■	TC-14G-134	0.5% ethylene oxide* Window-Cator canister has end-of-service indicator	473881
VCM-SS	VYCL	■	TC-14G-84	25 parts per million vinyl chloride*	461480

MSA Canisters contain particulate filters for the removal of dust and certain other particulate matter, as indicated by a gray or orange stripe on the canister.

*Canister contains a particulate filter, identified by a gray or orange stripe on the canister, which is effective against dusts, fumes, and mists having a TWA less than 0.05 milligrams per cubic meter or 2 million particles per cubic foot.

†Canister contains an Ultra Filter which has an initial efficiency of 99.7% against 0.3 micron DOP smoke, and provides protection against dusts, fumes, and mists having a TWA less than 0.05 milligrams per cubic meter, asbestos-containing dusts and mists, and radionuclides.

PERMISSIBLE CHEMICAL CARTRIDGE FOR ORGANIC VAPORS; PESTICIDES; PAINTS, LACQUER AND ENAMEL MISTS AND DUSTS, FUMES, MISTS AND RADIONUCLIDES



MINE SAFETY AND HEALTH ADMINISTRATION NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
APPROVAL NO. TC-23C-155
ISSUED TO MINE SAFETY APPLIANCES COMPANY, Pittsburgh, Pennsylvania, U.S.A.



LIMITATIONS

Approved for respiratory protection against organic vapors, pesticides, mists of paints, lacquers and enamels. Do not exceed maximum use concentrations established by regulatory standards.

Approved for respiratory protection against dusts, fumes, and mists having a time-weighted average less than 0.05 milligram per cubic meter, asbestos-containing dusts and mists and radionuclides.

Do not wear for protection against organic vapors with poor warning properties or those which generate high heats of reaction with sorbent material in the cartridge.

Not approved for fumigants.

Not for use in atmospheres containing less than 19.5 percent oxygen.

Not for use in atmospheres immediately dangerous to life or health.

If using a 7-752-1, 7-752-2, 7-752-3, 7-753-1, 7-753-2, 7-753-3, 7-1049-1, 7-1049-2, or 7-1049-3 facepiece on an Ultra-Twin Respirator; 7-752-1, 7-752-2, 7-752-3, 7-1049-1, 7-1049-2, or 7-1049-3 facepiece on a Constant Flow Duo-Twin or SUITable-AIRE Respirator the D/PD Exhalation Valve must remain in the "OUT" position.

If using a 7-752-1, 7-752-2, 7-752-3, 7-1049-1, 7-1049-2, or 7-1049-3 facepiece with pressure demand class respirators, the D/PD valve must remain in the "IN" position.

CAUTION

In making renewals or repairs, parts identical with those furnished by the manufacturer under the pertinent approval shall be maintained.

Follow the manufacturer's instructions for changing cartridges.

Refer to pesticide label for limitations of respirator use.

MSHA-NIOSH Approval TC-23C-155 Issued to Mine Safety Appliances Company - March 6, 1992

The approved respirators utilize the 460842 (TC-23C-155) cartridges, and as a minimum, the following other MSA Parts:

1. Comfo Elite and Comfo II Respirators - 7-201-1, 7-201-2, 7-201-3, 7-202-1, 7-202-2, 7-202-3, 7-423-1, 7-423-2, 7-423-3, or 449703 facepiece.
2. Ultra-Twin Respirator - 7-204-1, 7-204-2, or 7-204-3 facepiece, or 7-203-1, 7-203-2, 7-203-3, 7-753-1, 7-753-2, or 7-753-3 facepiece with 481740, 484679, or 491766 adapter, or 7-708-1, 7-708-2, 7-708-3, 7-752-1, 7-752-2, or 7-752-3 facepiece with 486566 plug, 7-1049-1, 7-1049-2, or 7-1049-3 facepiece with 96547 adapter and 486566 plug, or 7-842-1, 7-842-2, or 7-842-3 facepiece with 491766 adapter.
3. CF Duo-Twin Respirator - 7-708-1, 7-708-2, 7-708-3, 7-752-1, 7-752-2, or 7-752-3 facepiece, or 7-1049-1, 7-1049-2, or 7-1049-3 facepiece with 96547 adapter; 456651, or 457158 breathing tube; 5-622-1, or 5-713-1 valve connector; 7-977-1, 9961, 473902, or 487446 belt; and 7-664-1, 7-664-2, 7-665-1, or 5-511-1 air supply hose.
4. PD Duo-Twin Respirator - 7-752-1, 7-752-2, or 7-752-3 facepiece, or 7-1049-1, 7-1049-2, or 7-1049-3 facepiece with 96547 adapter; 456651 or 457158 breathing tube; 7-679-1 regulator and valve assembly; 7-977-1, 9961, 473902, or 487446 belt; and 7-664-1, 7-664-2, 7-665-1, or 5-511-1 air supply hose.
5. SUITable-AIRE Respirator - 7-708-1, 7-708-2, 7-708-3, 7-752-1, 7-752-2, or 7-752-3 facepiece, or 7-1049-1, 7-1049-2, or 7-1049-3 facepiece with 96547 adapter; 456651, 457158, or 470734 breathing tube; 7-862-1 valve; 7-977-1, 9961, 473902, or 487446 belt; 472470 harness, or 7-630-1 coverall with belt clip loop (respirator support); 7-664-1, 7-664-2, 7-665-1, or 5-511-1 air supply hose; and 69542, or 628232 union adapter.
6. Duo-Twin MMR - 7-752-1, 7-752-2, 7-752-3 facepiece, or 7-1049-1, 7-1049-2, or 7-1049-3 facepiece and 96547 adapter with 7-1048-1 regulator, or 7-1049-1, 7-1049-2, or 7-1049-3 facepiece with 492495 quick disconnect adapter with 7-1047-1 regulator, or 7-1049-1, 7-1049-2, or 7-1049-3 facepiece with 7-1046-1 regulator; 7-1082-1 supply unit; 7-977-1 belt assembly; 7-664-1, 7-664-2, 7-665-1, or 5-511-1 air supply hose; and 69542 or 628232 union adapter. Accessories consist of the following: 454819 spectacle kit; and 4-280-1 air supply hose connection. Below 32° F add 471539, 471540, 471541, or 96621 noseclip to the above.
7. Duo-Twin MMR PremAire - 7-752-1, 7-752-2, 7-752-3 facepiece, or 7-1049-1, 7-1049-2, or 7-1049-3 facepiece and 96547 adapter with 7-1048-1 regulator, or 7-1049-1, 7-1049-2, or 7-1049-3 facepiece with 492495 quick disconnect adapter with 7-1047-1 regulator, or 7-1049-1, 7-1049-2, or 7-1049-3 facepiece with 7-1046-1 regulator; 7-1064-1 manifold and 497131 plug assembly; 7-977-1 belt assembly; 7-664-1, 7-664-2, 7-665-1, or 5-511-1 air supply hose; and 69542 or 628232 union adapter. Accessories consist of the following: 7-1055-1 dual supply kit; 7-119-1 cool vortex kit or 7-1120-1 warn/cool vortex kit; 454819 spectacle kit; and 4-280-1 air supply hose connection. Below 32° F add 471539, 471540, 471541, or 96621 noseclip to the above.

Respirator Use Limitations:

The wearer must not exceed any of the following MSA respirator use limitations:

1. Maximum use concentration — Do not exceed any of the following:
 - a. Full facepiece — 100 times the exposure limit for the contaminant present, or lower if the result of the respirator fitting test indicates a protection factor less than 100. (See respirator instructions for more information).
Half mask — 10 times the exposure limit for the contaminant present, or lower if the result of the respirator fitting test indicates a protection factor less than 10. (See respirator instructions for more information).
 - b. Organic vapor respirators — 1,000 parts per million organic vapors.
 - c. Immediately dangerous to life or health (IDLH) concentration for the contaminant.
2. The limitations outlined in the applicable NIOSH/MSHA Approval.
3. Any applicable limitation contained in a standard established by a regulatory agency (such as OSHA) with jurisdiction over the wearer.

LAB SAFETY SUPPLY CO.
Janesville, WI 53547
300-355-0783

instructions:

18815 -

when odors of vapors or gases become noticeable and/or resistance to breathing becomes difficult it is a sign that the cartridges have served their useful life and should be replaced. to replace cartridges proceed as follows:

1. remove expended cartridges from the respirator and discard.
2. remove the replacement cartridges and insert into the threaded receptacles of the respirator, making sure the gaskets are in their proper place in the cartridge holders.
3. carefully hand tighten the cartridges to prevent damage to threads: to insure a good seal against the gaskets, tighten each cartridge by gripping as much of the circumference of the receptacle as possible and then slowly turning the cartridge until tight.

APPENDIX HS-3

American Red Cross Standard First Aid

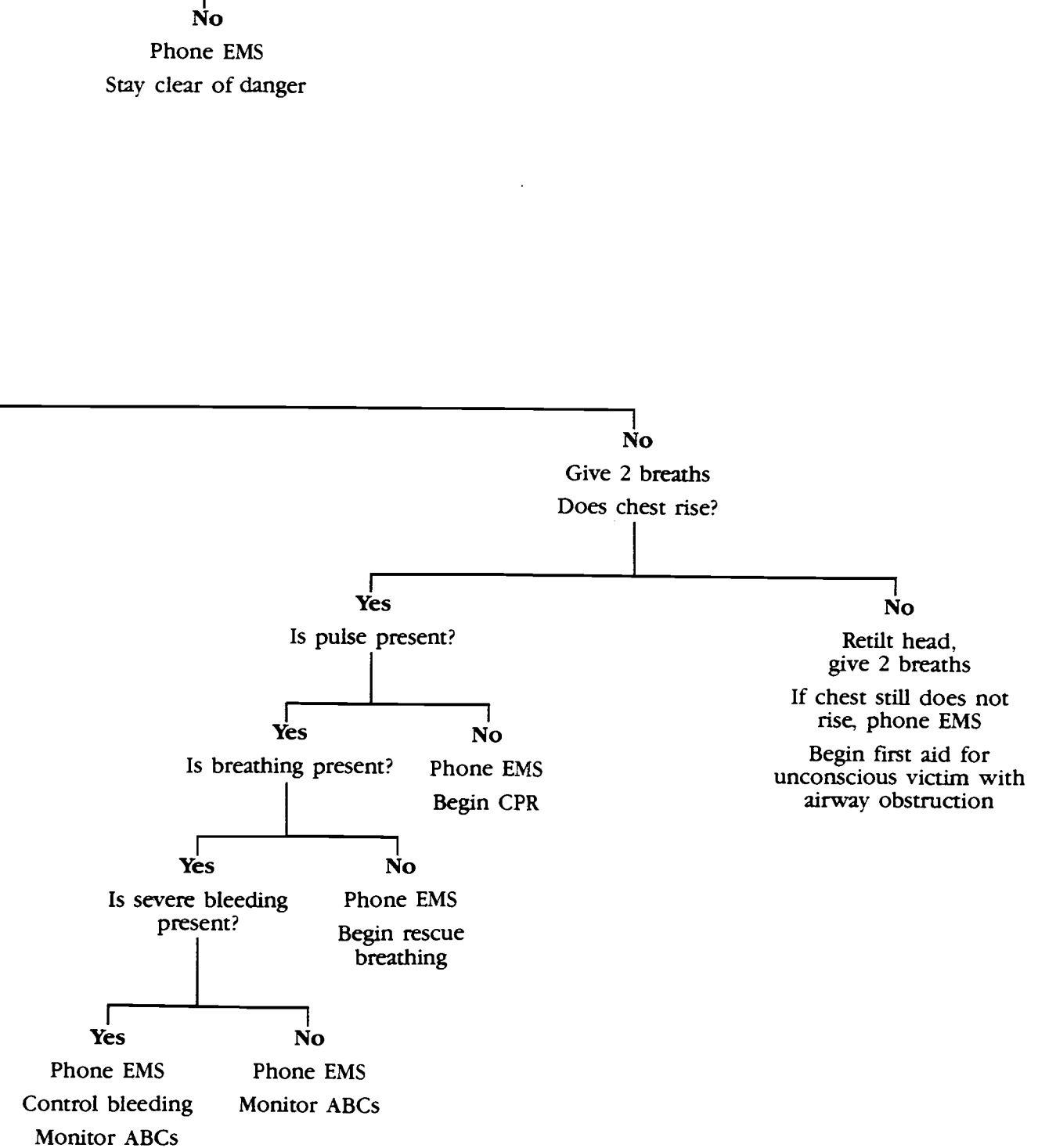
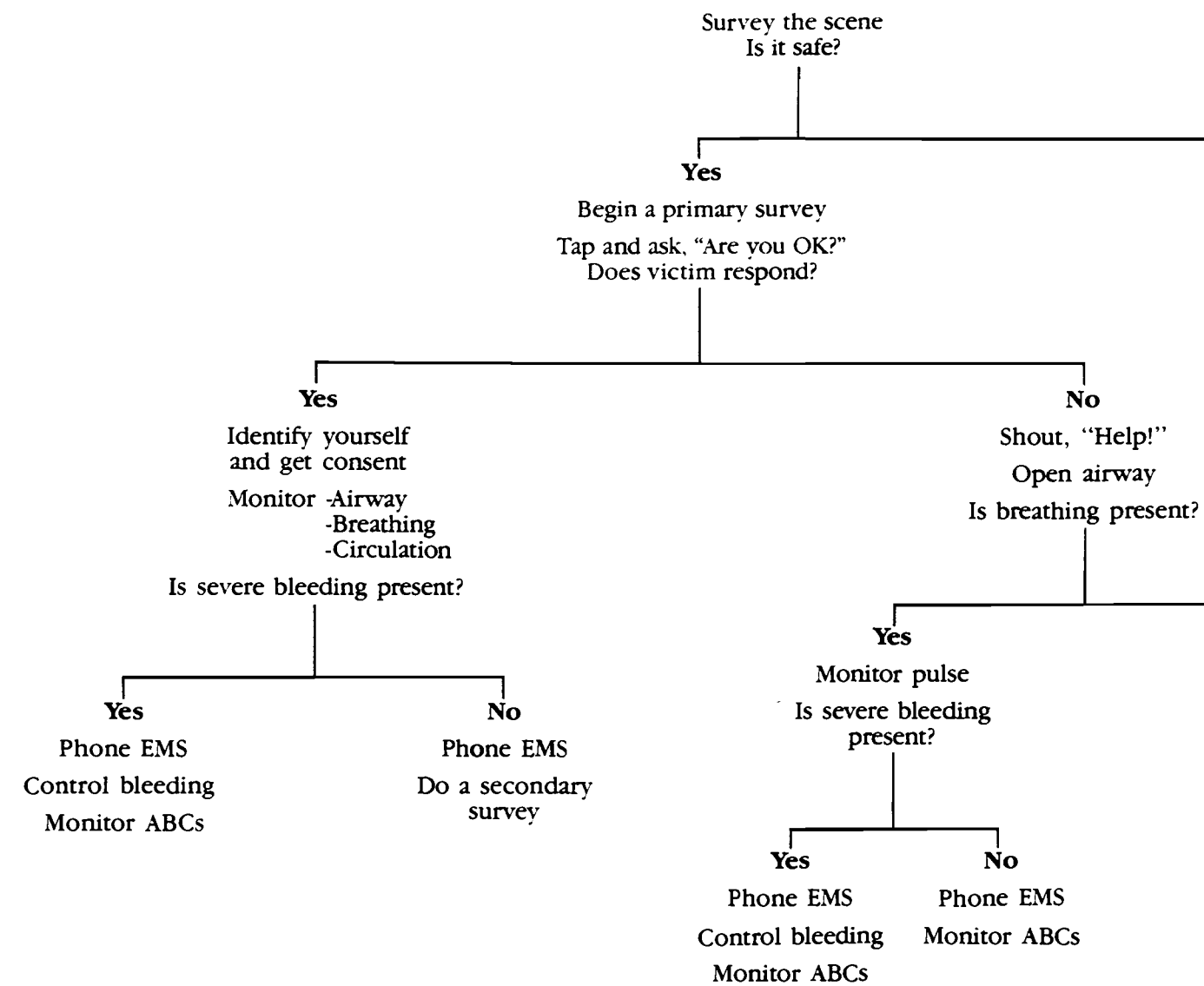
APPENDIX HS-3
American Red Cross Standard First Aid, 1991

Emergency Medical and First Aid

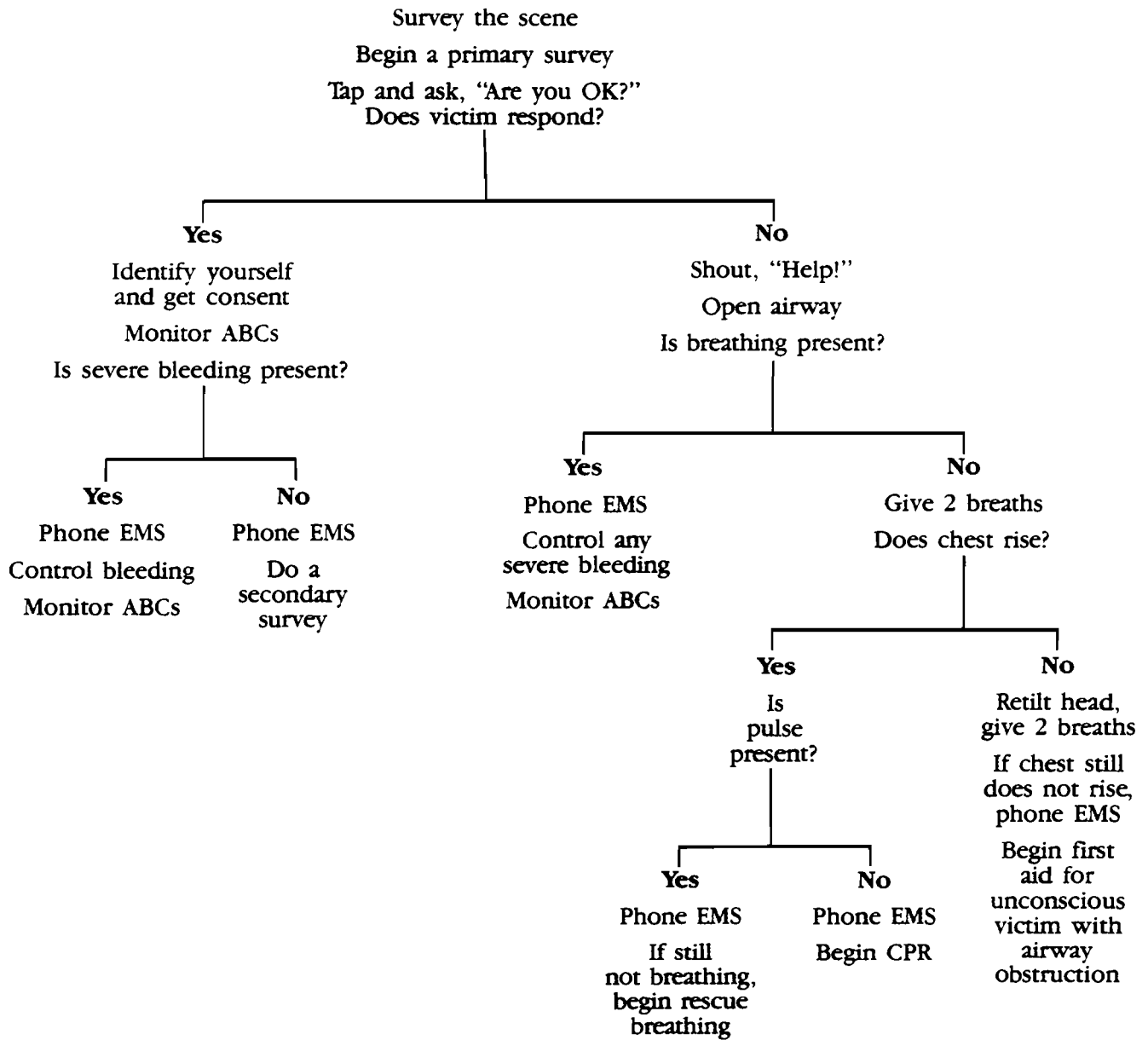
First aid should only be administered by qualified personnel and if possible, with the consent of the patient. Exhibit IV of this appendix presents copies of guides taken from the American Red Cross Standard First Aid, 1991, for administering first aid and decision making in first aid situations. Guides are presented for the following:

- emergency action principles;
- rescue breathing;
- choking (airway obstruction);
- heart attack, cardiac arrest, and CPR;
- bleeding and shock (external, internal, shock);
- burns (heat, chemical, electrical);
- eye and nose injuries;
- human and insect bites;
- insect stings;
- snake bites;
- fractures, dislocations, sprains and strains;
- poisoning (swallowed, inhaled, adsorbed);
- diabetic emergencies;
- strokes;
- seizures;
- temperature extremes (heat, cold); and
- rescues;

Emergency Action Principles Action Guide

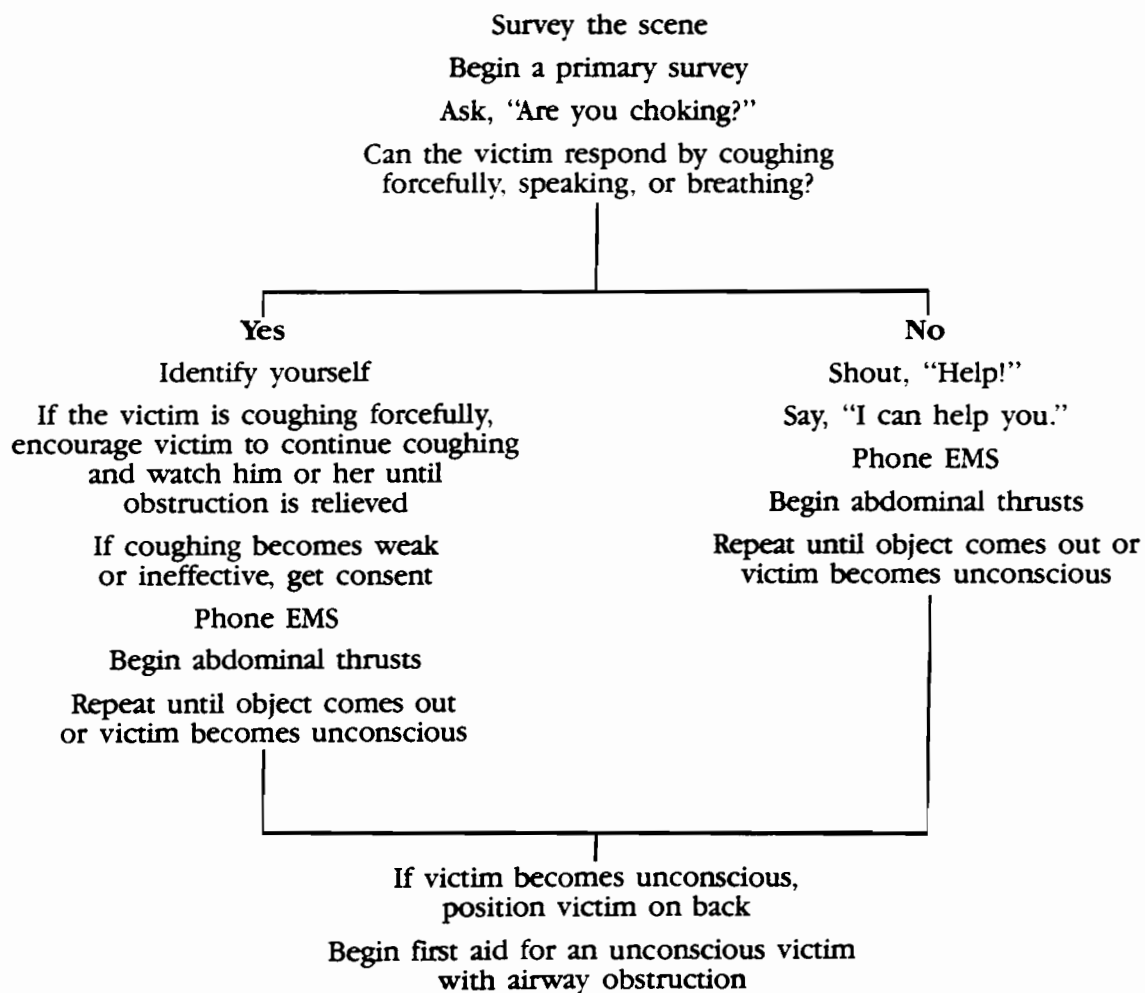


Rescue Breathing Action Guide



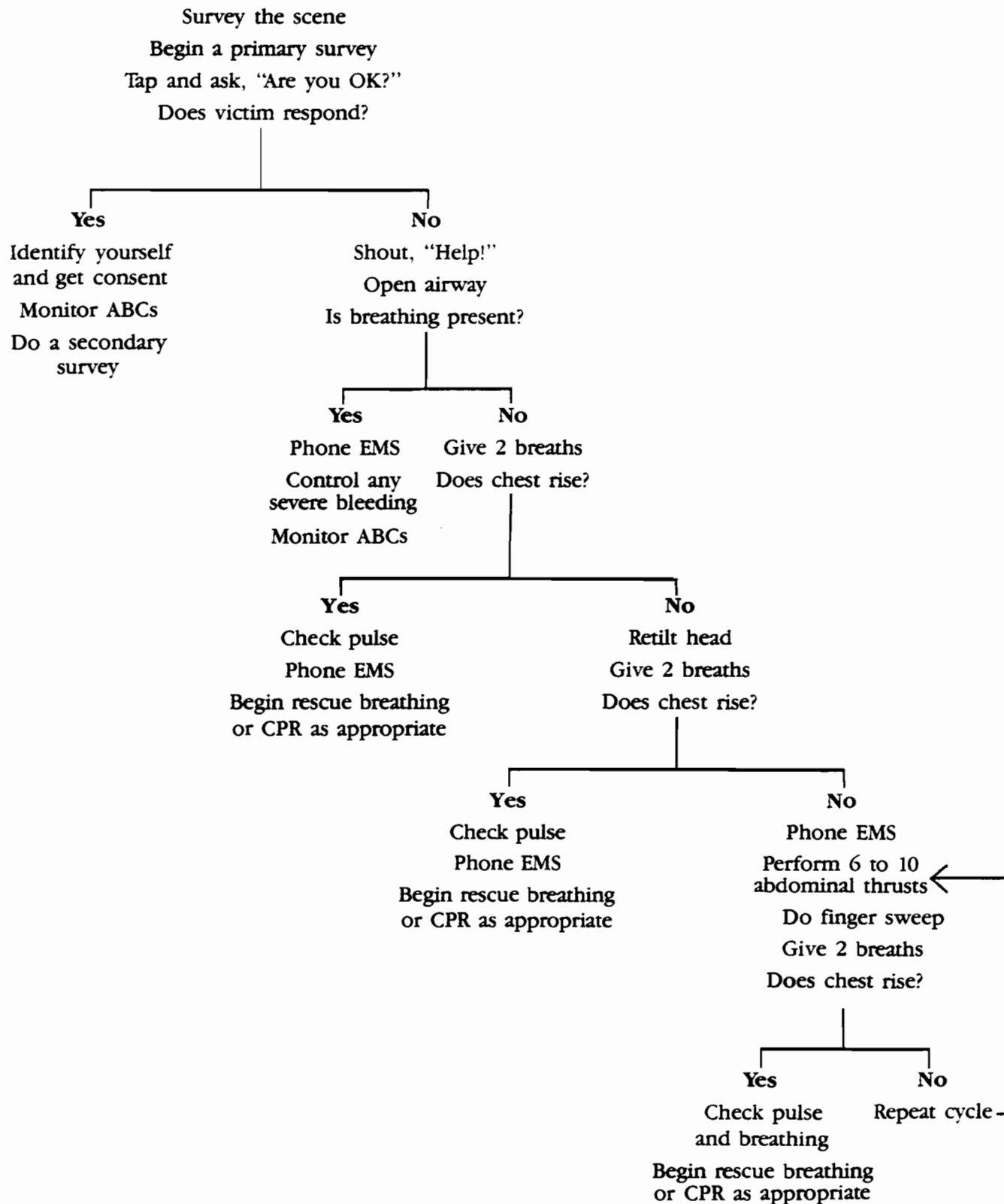
Choking (Airway Obstruction) Action Guides

Conscious Victim

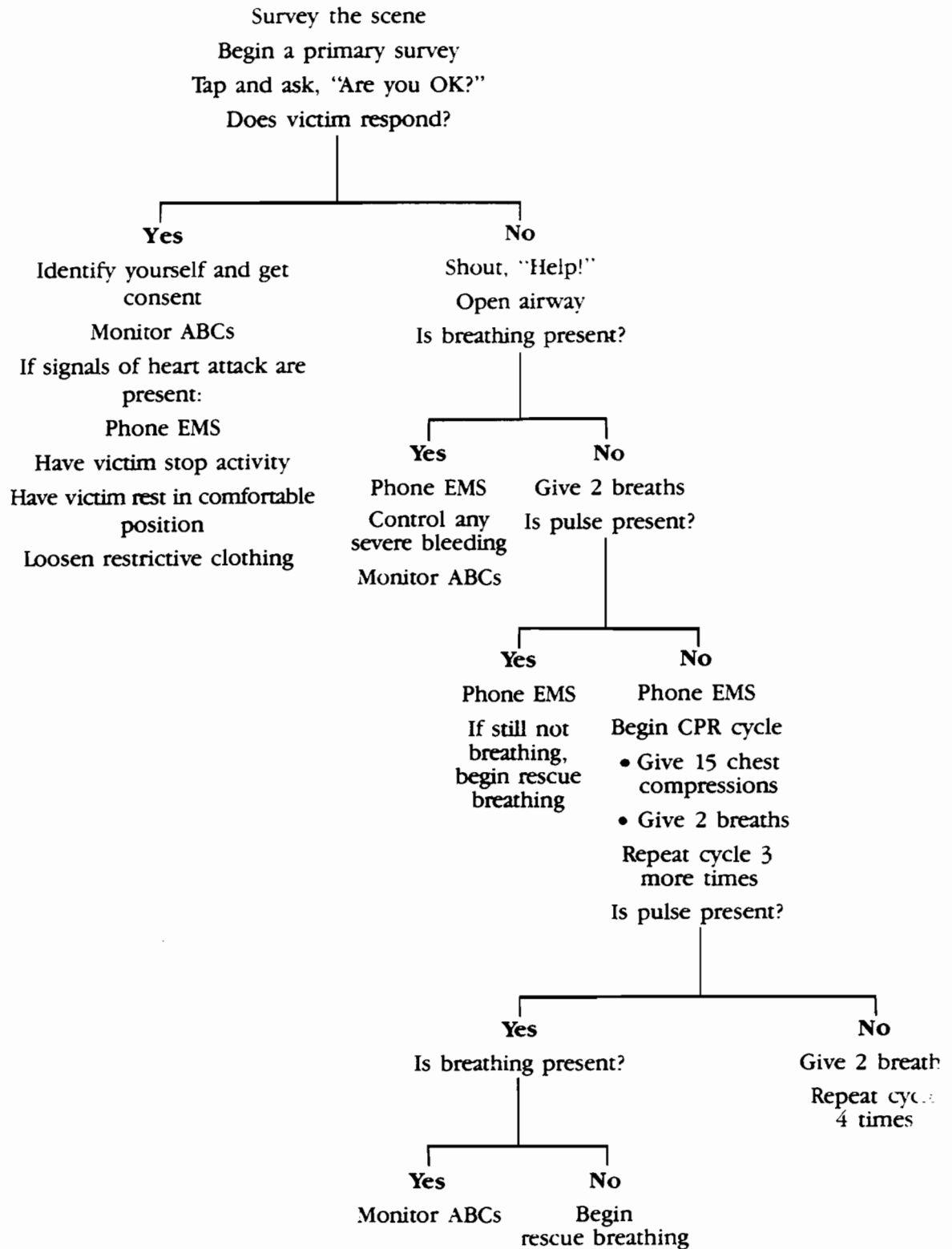


Choking (Airway Obstruction) Action Guides

Unconscious Victim

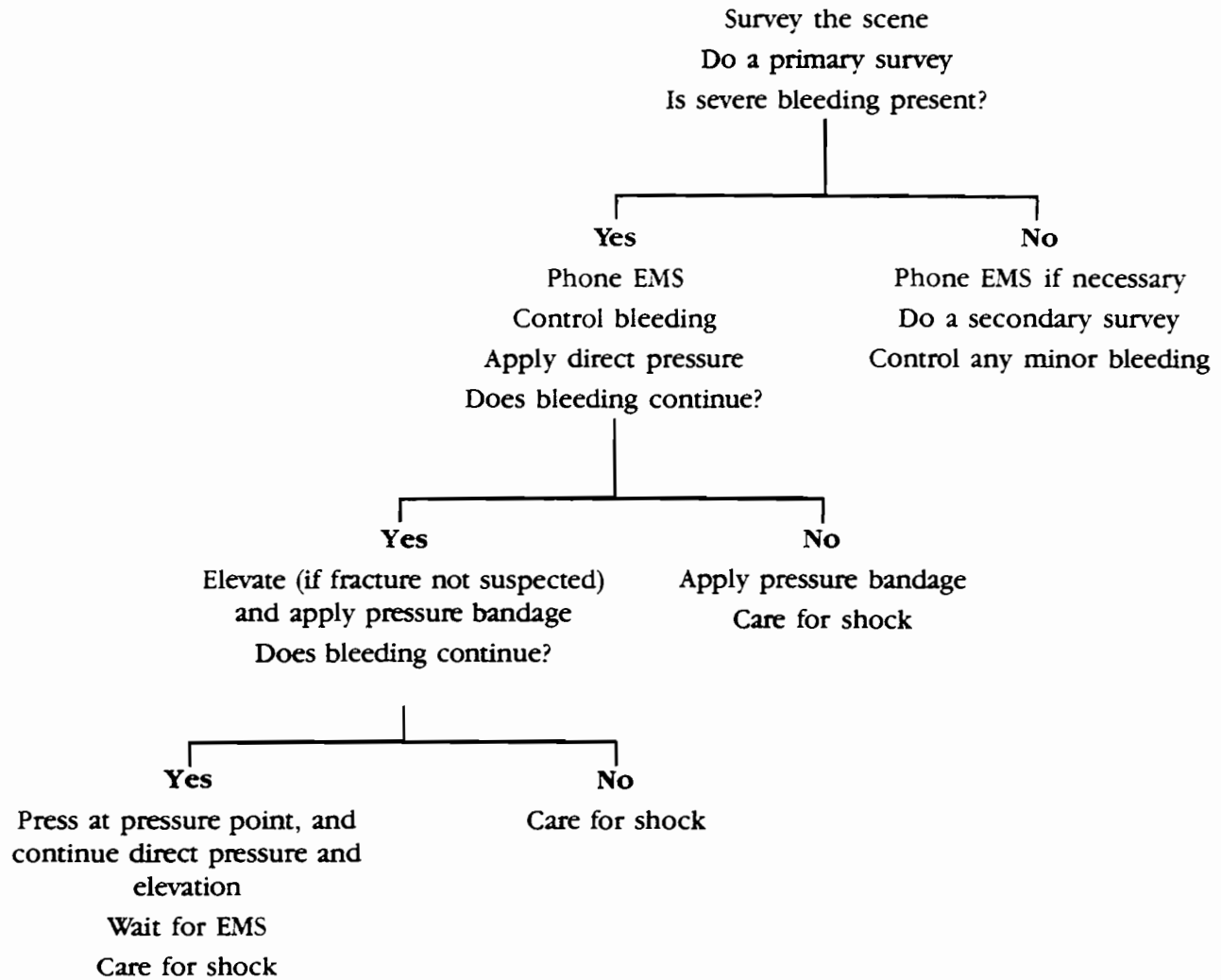


Heart Attack, Cardiac Arrest, and CPR Action Guide



Bleeding and Shock Action Guides

External Bleeding

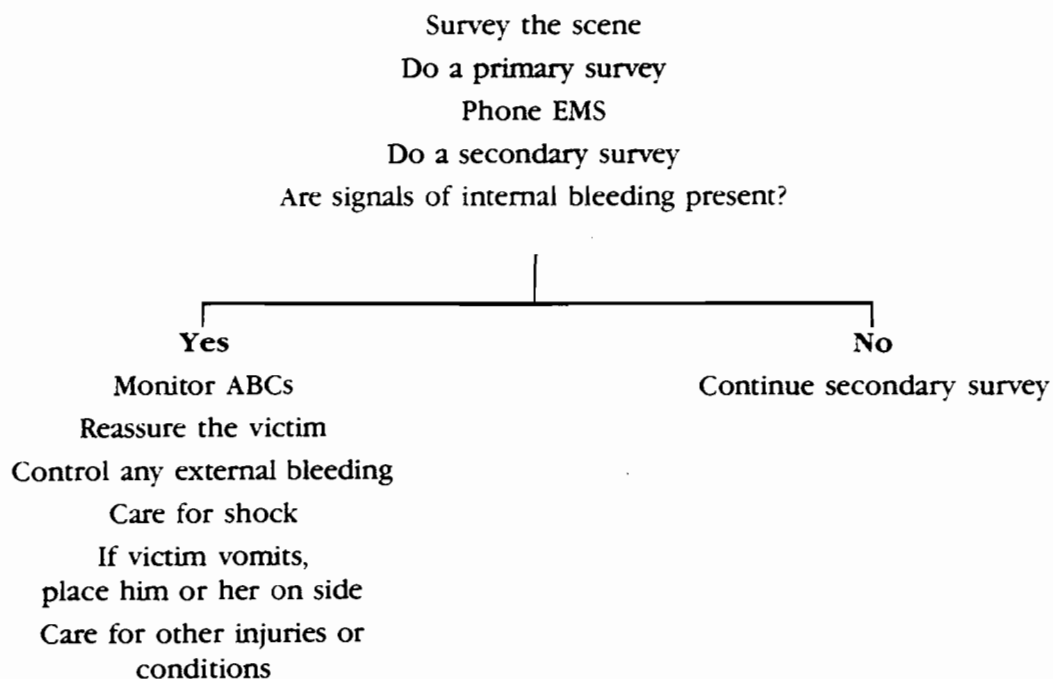


To reduce the risk of infectious disease transmission when you attempt to control bleeding, use some sort of barrier, such as several dressings, latex gloves, or a piece of plastic wrap.

Always wash your hands as soon as you can after giving first aid. After touching one victim, always change the gloves or wash your hands before touching another to avoid cross-contamination.

Bleeding and Shock Action Guides

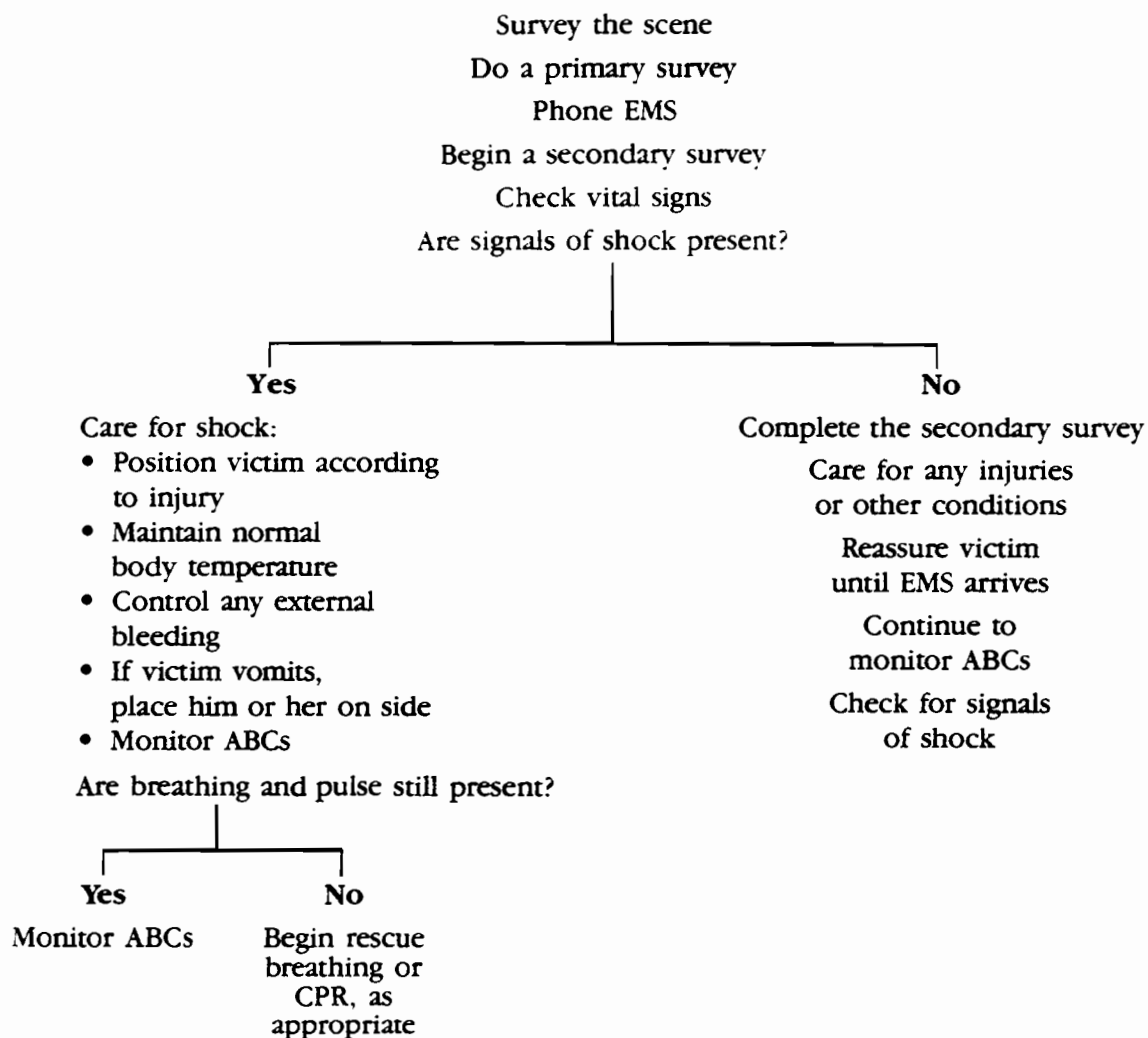
Internal Bleeding



Signals of internal bleeding include bruising or discoloration in the injured area; tender, swollen or hard abdomen; anxiety or restlessness; fast pulse and breathing; cool, moist, pale, or bluish skin; nausea and vomiting; thirst; changes in consciousness.

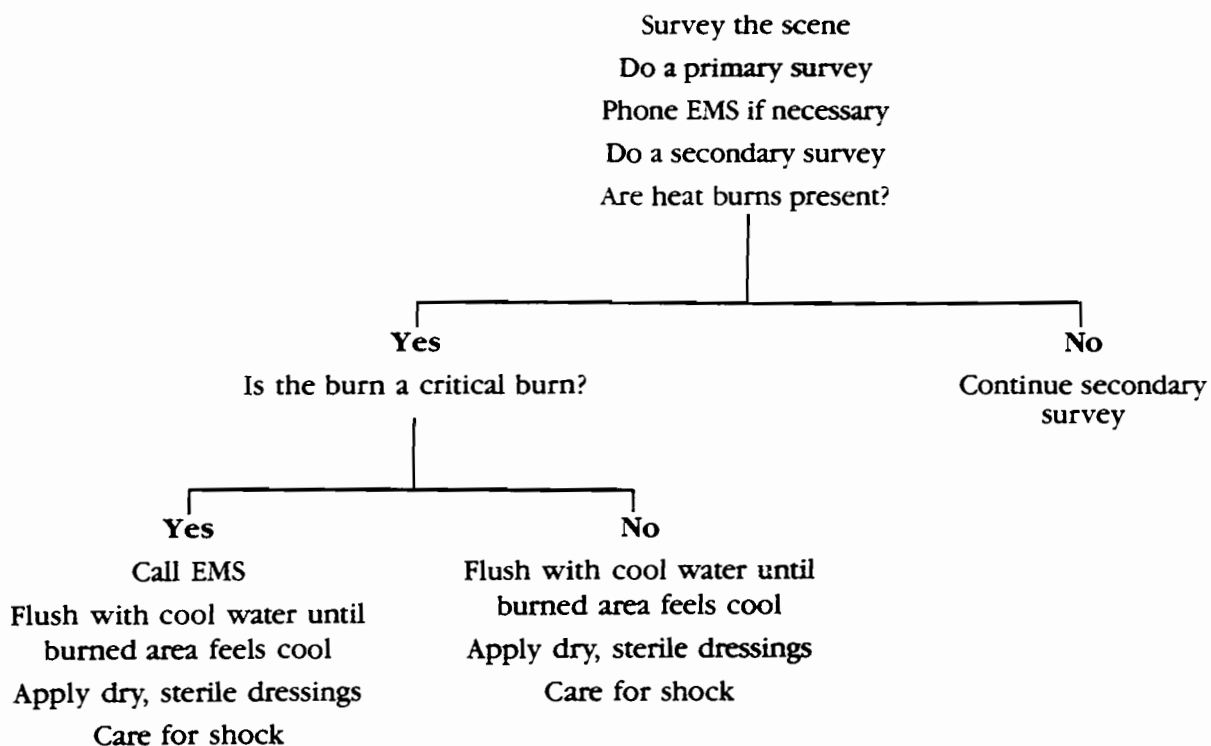
Bleeding and Shock Action Guides

Shock



Burns Action Guides

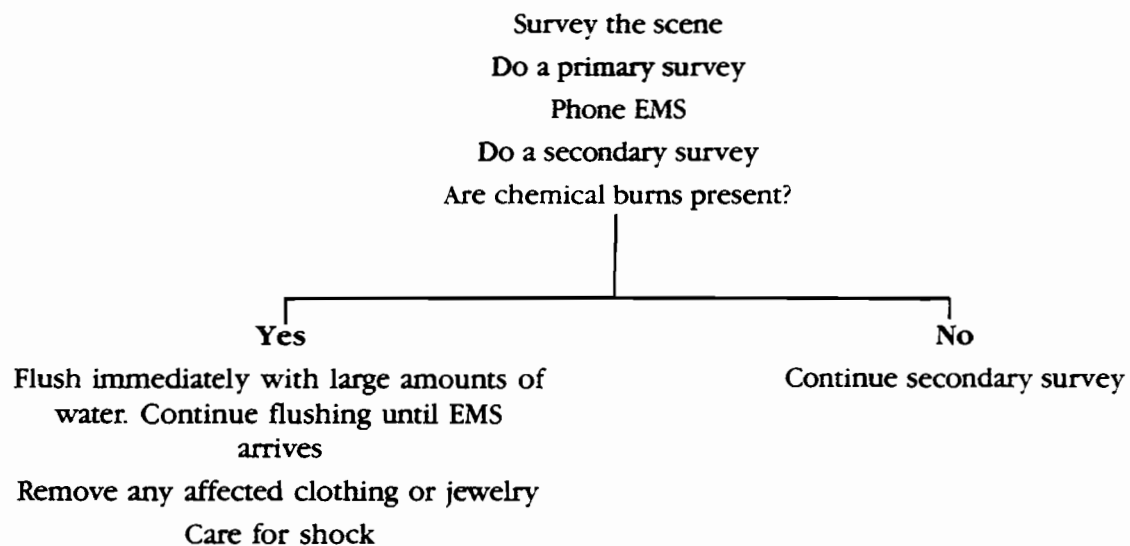
Heat Burns



For a nonsevere burn, wash, apply an antibiotic ointment, and watch for signals of infection. If you suspect the victim has inhaled smoke or chemicals (victim is hoarse and wheezing, breath smells like smoke), remove victim from source of injury if it is safe for you to do so, monitor ABCs, and phone EMS.

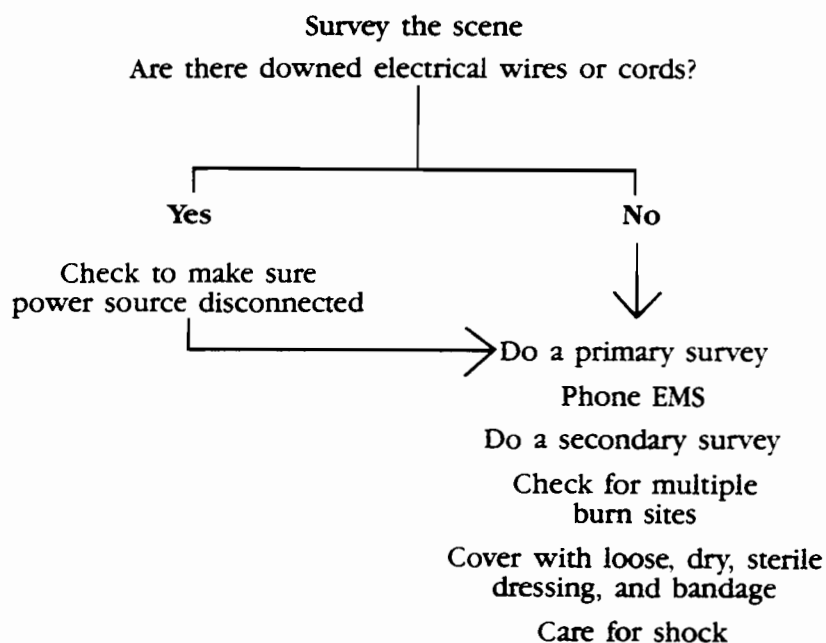
Burns Action Guides

Chemical Burns



Burns Action Guides

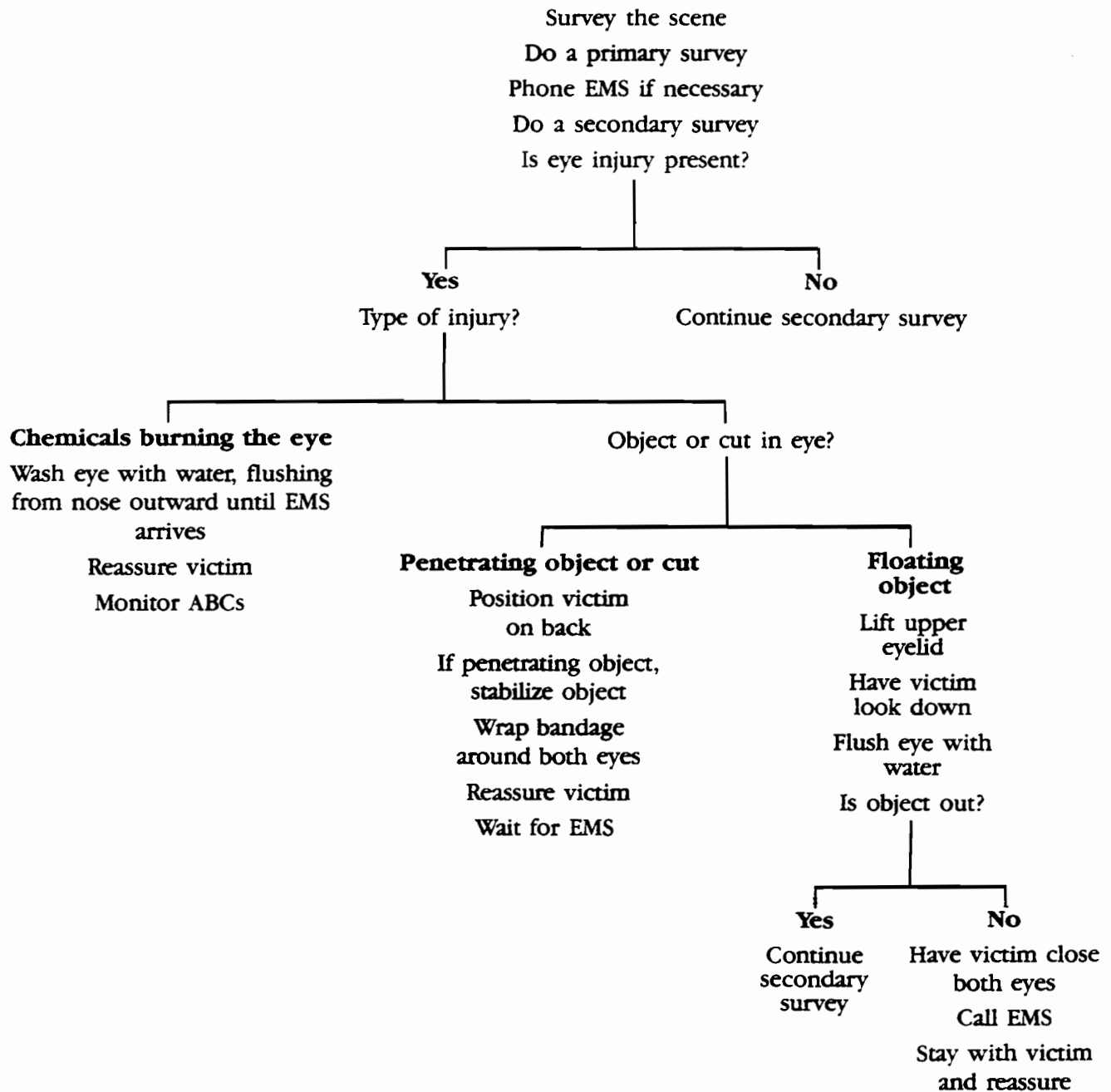
Electrical Burns



In electrical emergencies, check for the source of electrical current. If inside, turn off the current at the fuse box or circuit breaker. If outside, call the power company. Never touch downed power lines. Keep bystanders well away from live current.

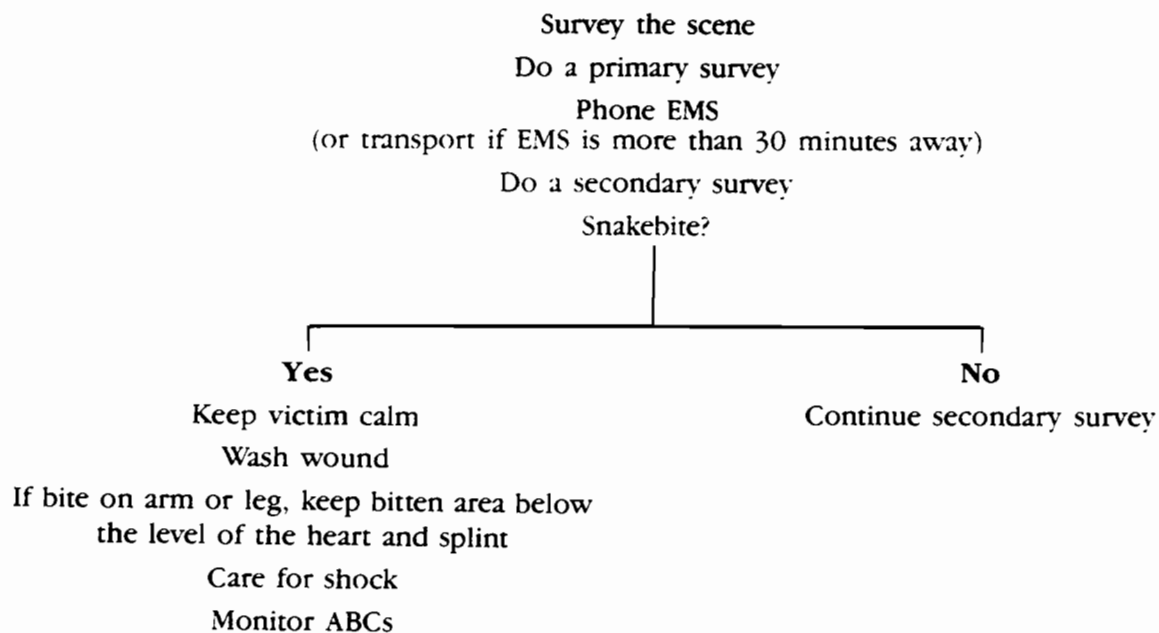
Eye and Nose Injuries Action Guides

Eye Injuries

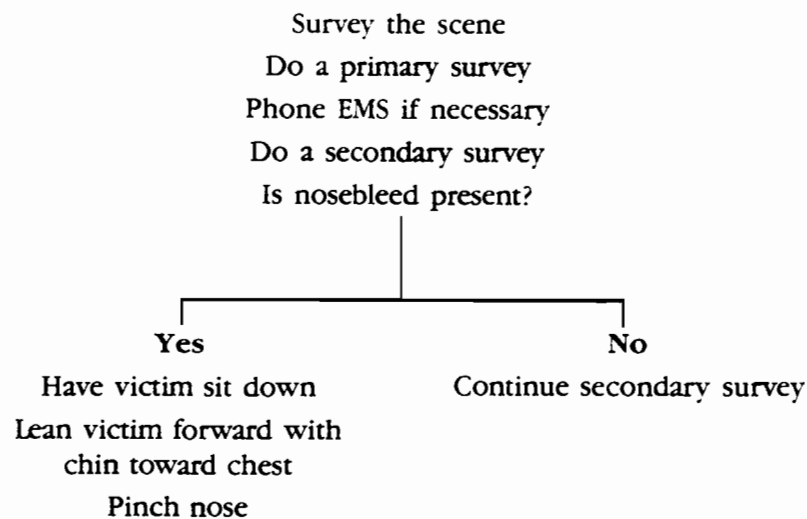


Bites and Stings Action Guides

Snakebites



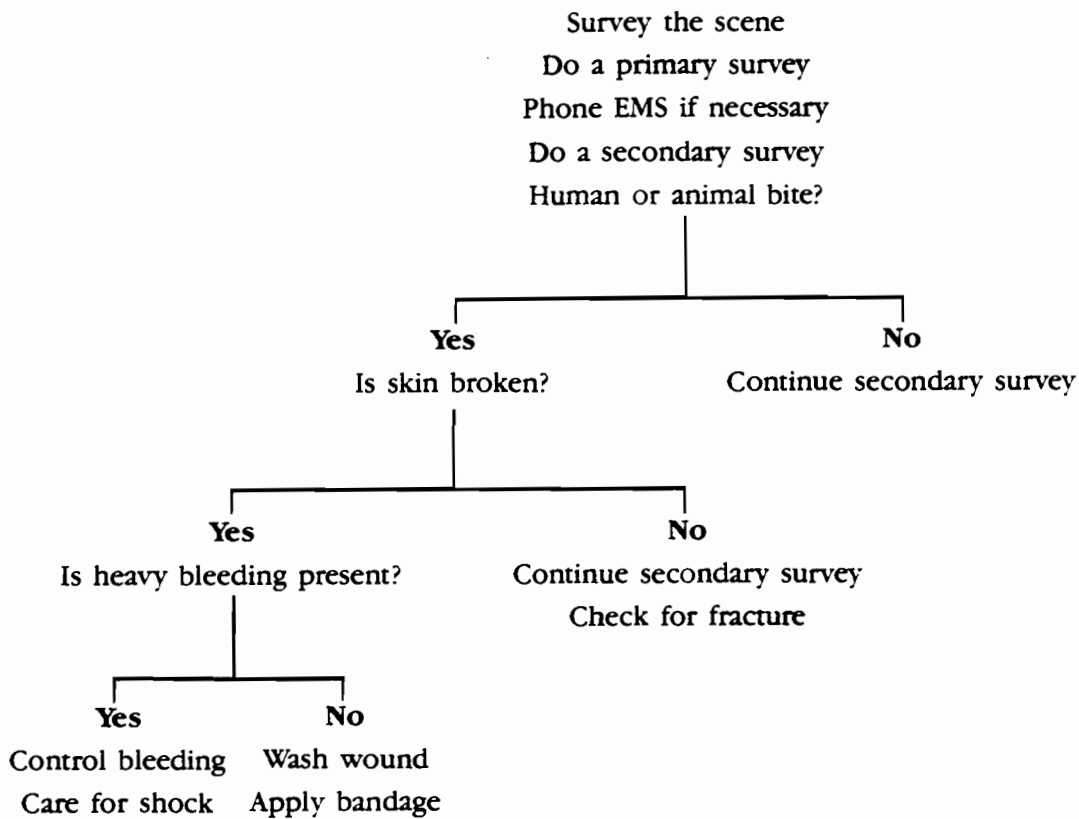
Nose Injuries



Nose injuries can indicate a possible head, neck, or back injury. Signals of such injuries can include any or all of these: pain and swelling, unequal pupil size, blood or clear fluid draining from the nose or ears, bruising under the eyes or behind the ears, loss of feeling in hands or feet, and an inability to move hands or feet. If you suspect a head, neck, or back injury, do not move the victim or stop the flow of blood and clear fluids coming from the nose or ears.

Bites and Stings Action Guides

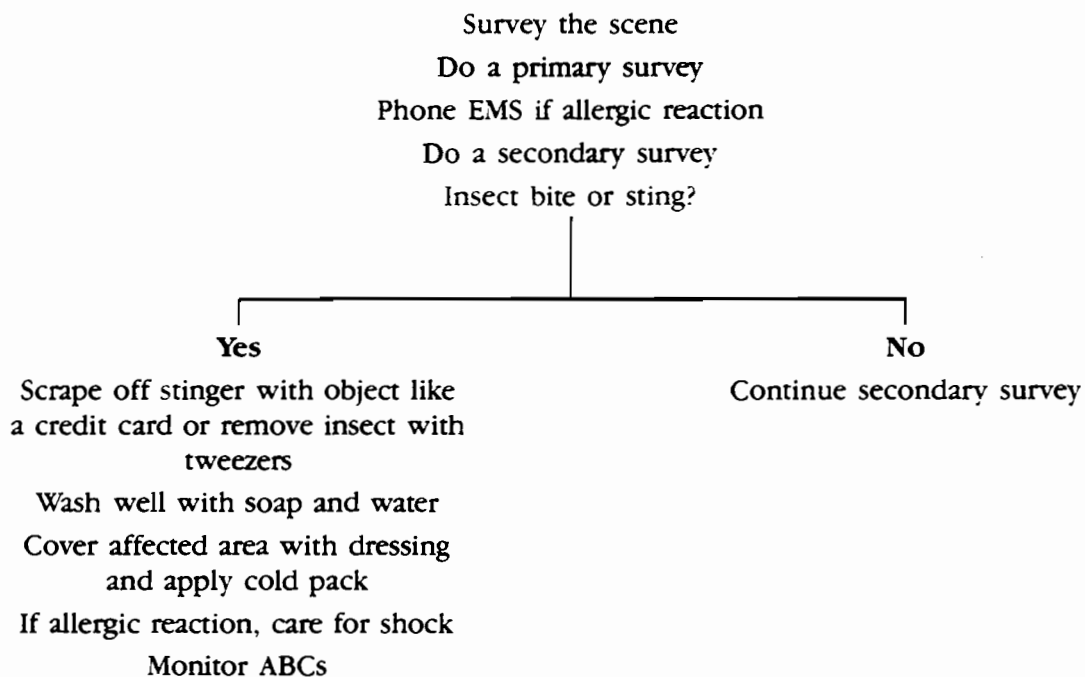
Human and Animal Bites



In the case of an animal bite, the animal needs to be captured for observation to check for rabies. Do not attempt to do this yourself. The proper authorities, such as the police and animal control, will try to capture the animal to observe it for rabies.

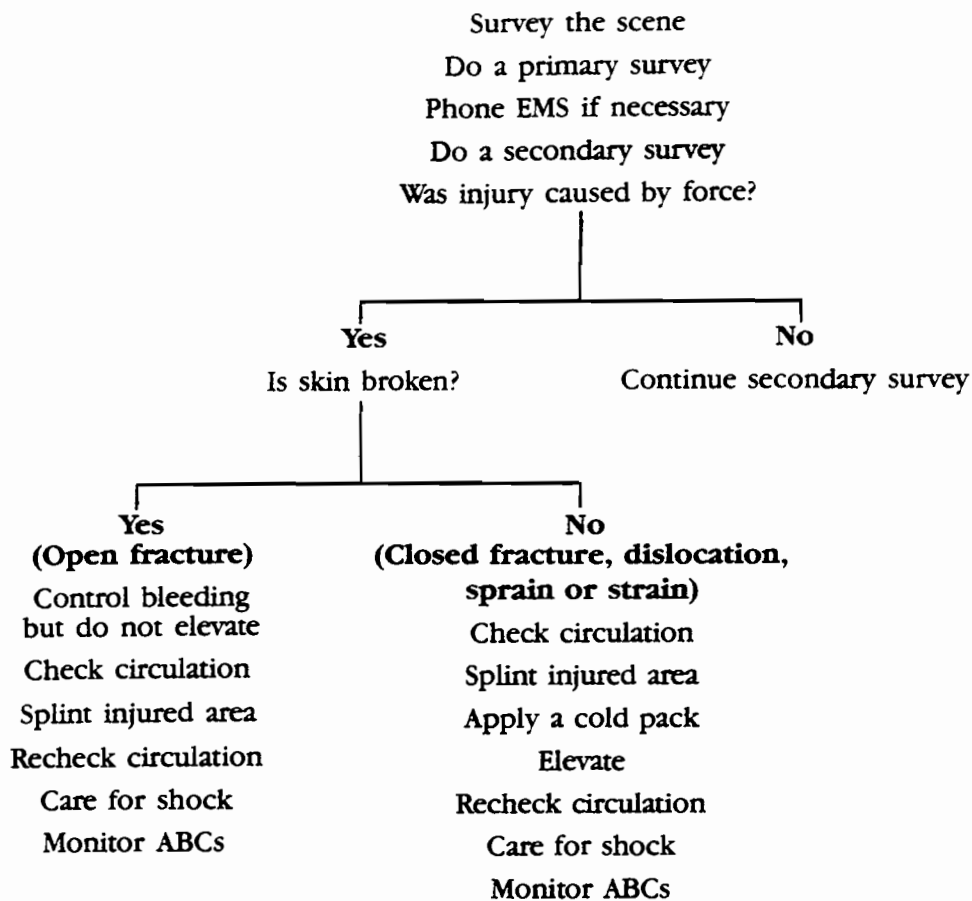
Bites and Stings Action Guides

Insect Bites and Stings



Signals of allergic reaction include: pain, swelling of the throat, redness or discoloration at the site, itching, hives, decreased consciousness, or difficult or noisy breathing.

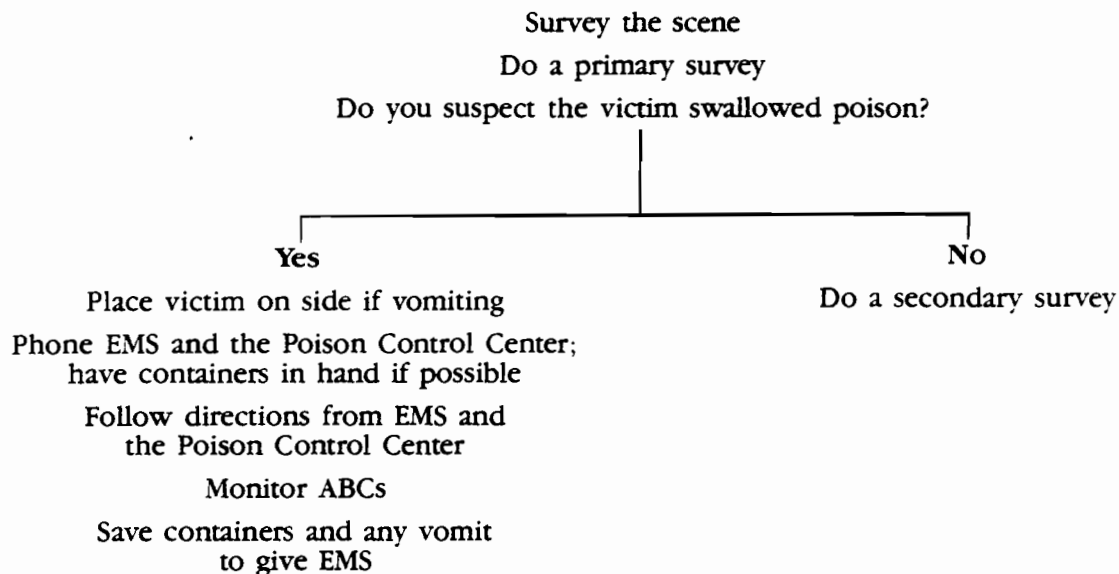
Fractures, Dislocations, Sprains, and Strains Action Guide



Sometimes a forceful blow can cause a head, neck, or back injury. Signals of these injuries can include any or all of these: pain and swelling, changes in level of consciousness, blood or clear fluid draining from the nose or ears, bruising under the eyes or behind the ears, loss of feeling in hands or feet, and an inability to move hands or feet. If you suspect a head, neck, or back injury, do not move the victim or stop the flow of blood or clear fluids coming from the nose or ears.

Poisoning Action Guides

Swallowed Poison

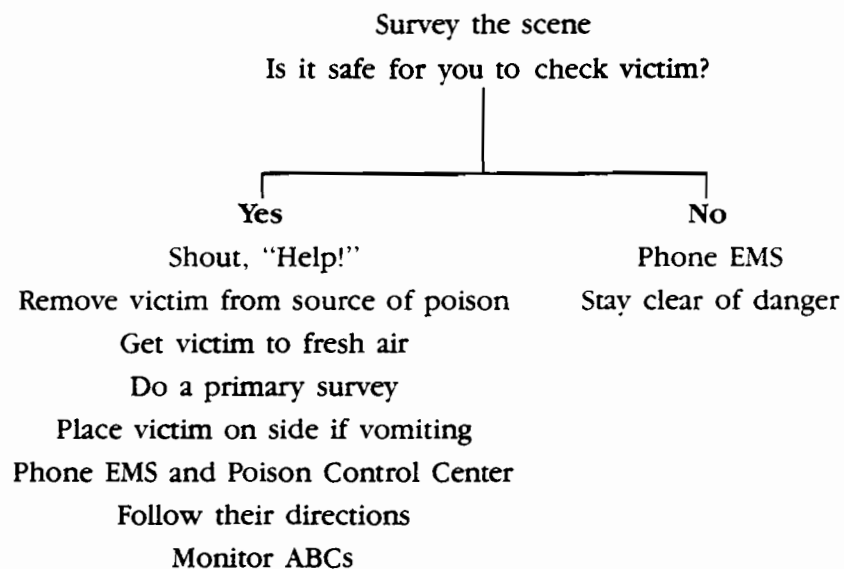


Be Prepared for Poisoning Emergencies

1. Keep the number of the Poison Control Center near each phone. Fill out the list of emergency phone numbers at the end of this workbook, and put a copy by each phone. The Poison Control Center number for your community is _____.
2. Keep syrup of ipecac and activated charcoal on hand. Use these only when the Poison Control Center or other medical professionals instruct you to do so.

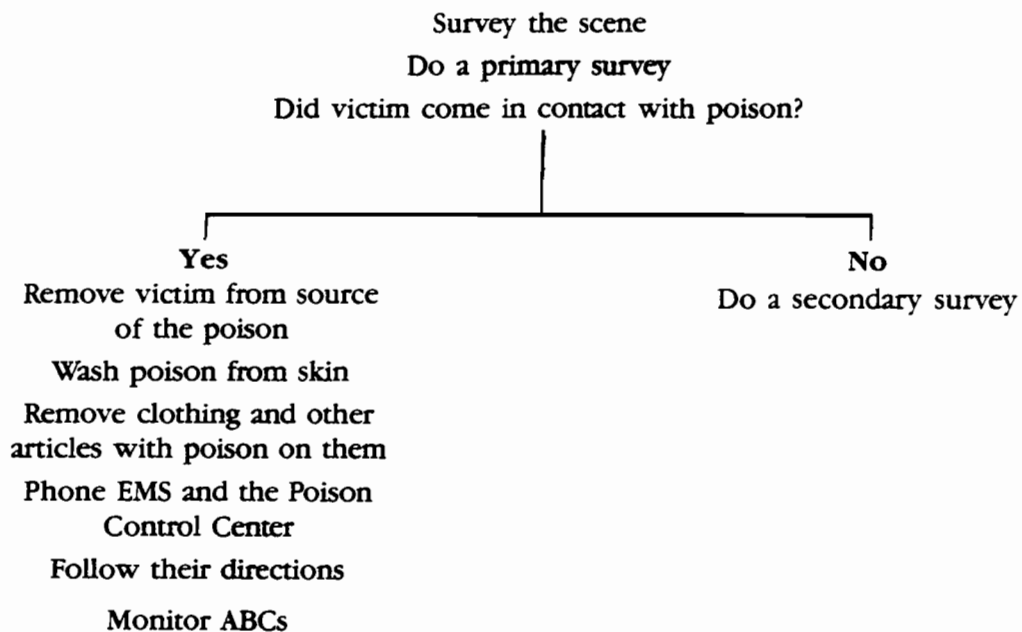
Poisoning Action Guides

Inhaled Poison

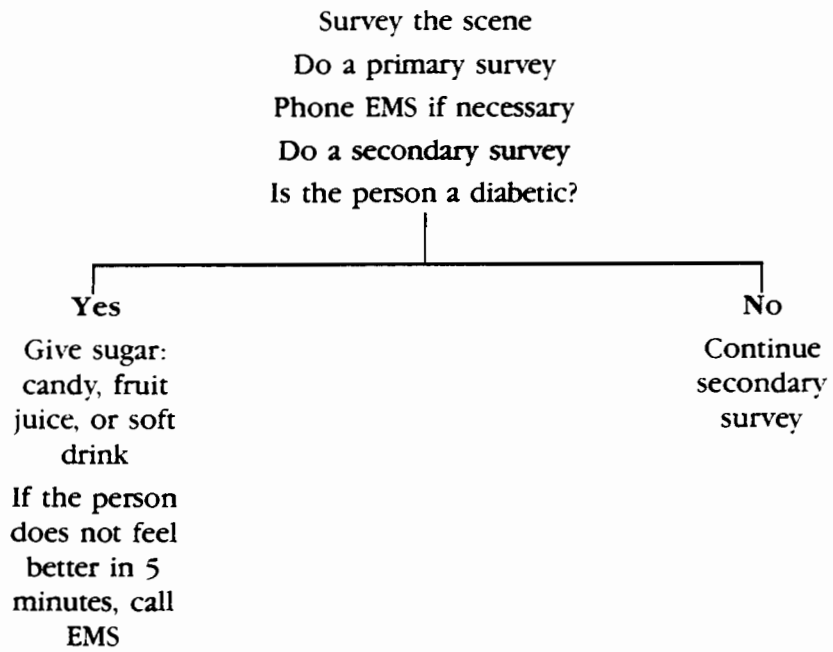


Poisoning Action Guides

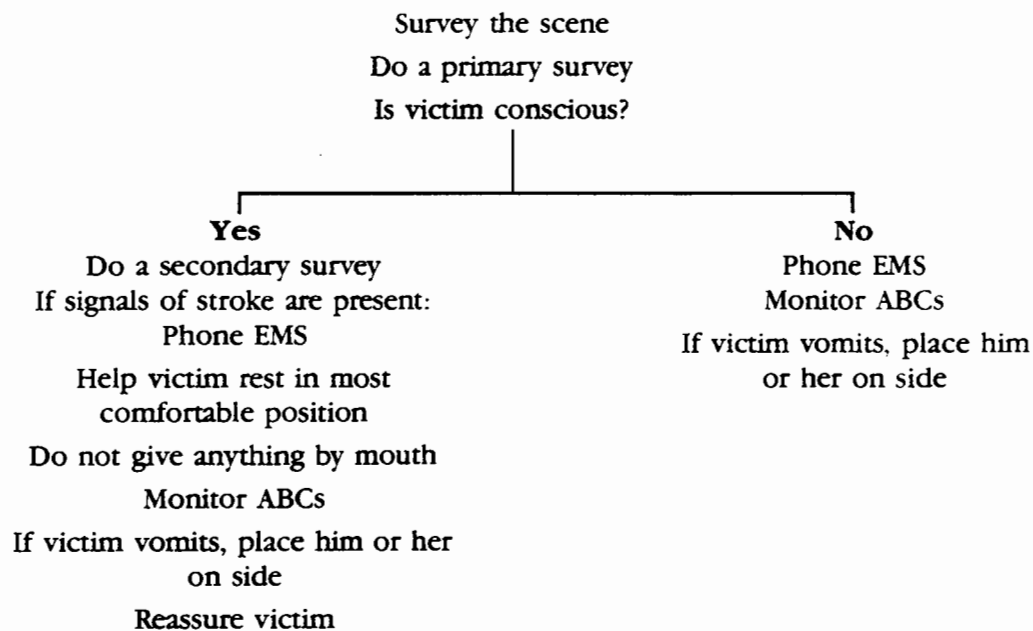
Absorbed Poison



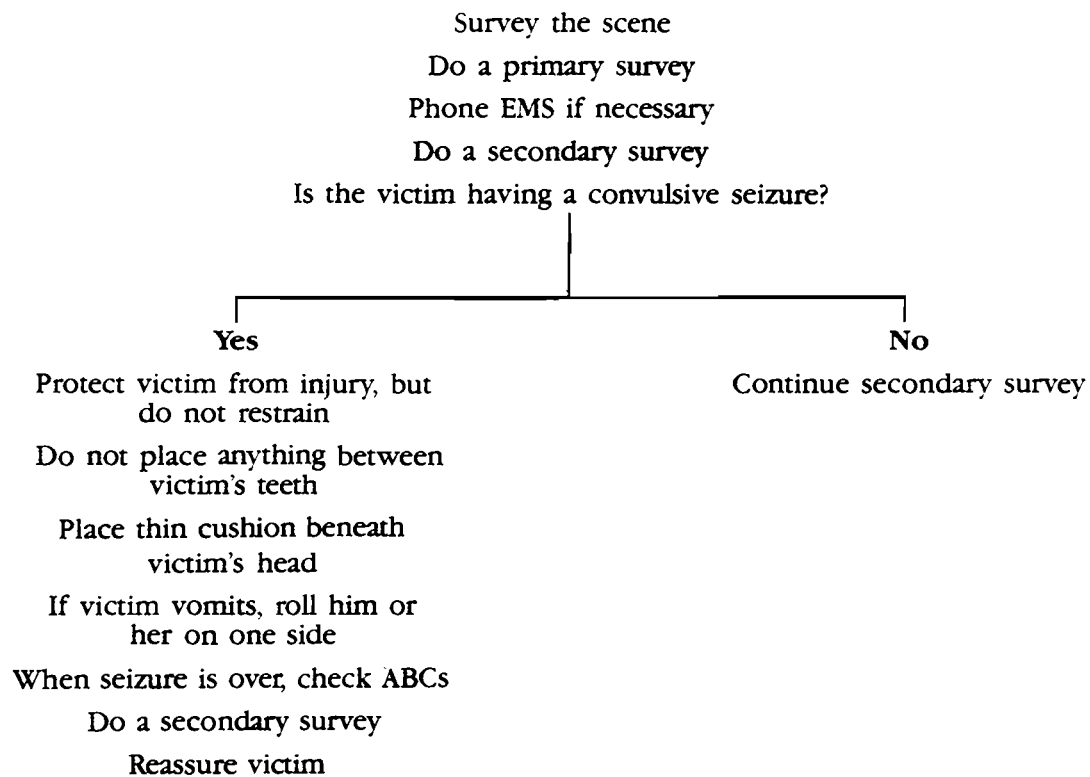
Diabetic Emergencies Action Guide



Stroke Action Guide

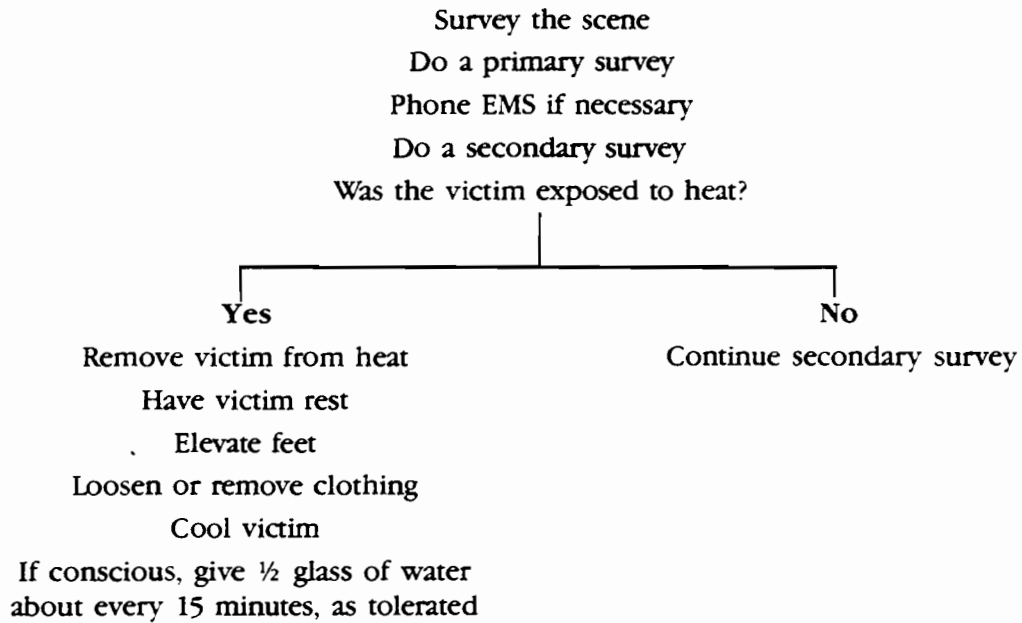


Seizures Action Guide



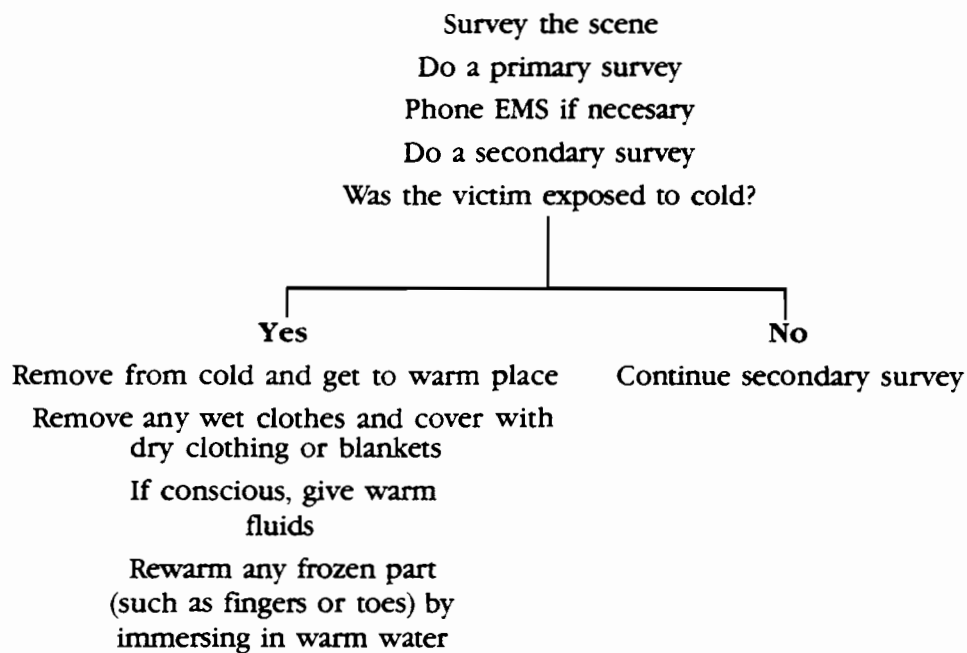
Temperature Extremes Action Guides

Heat Emergencies



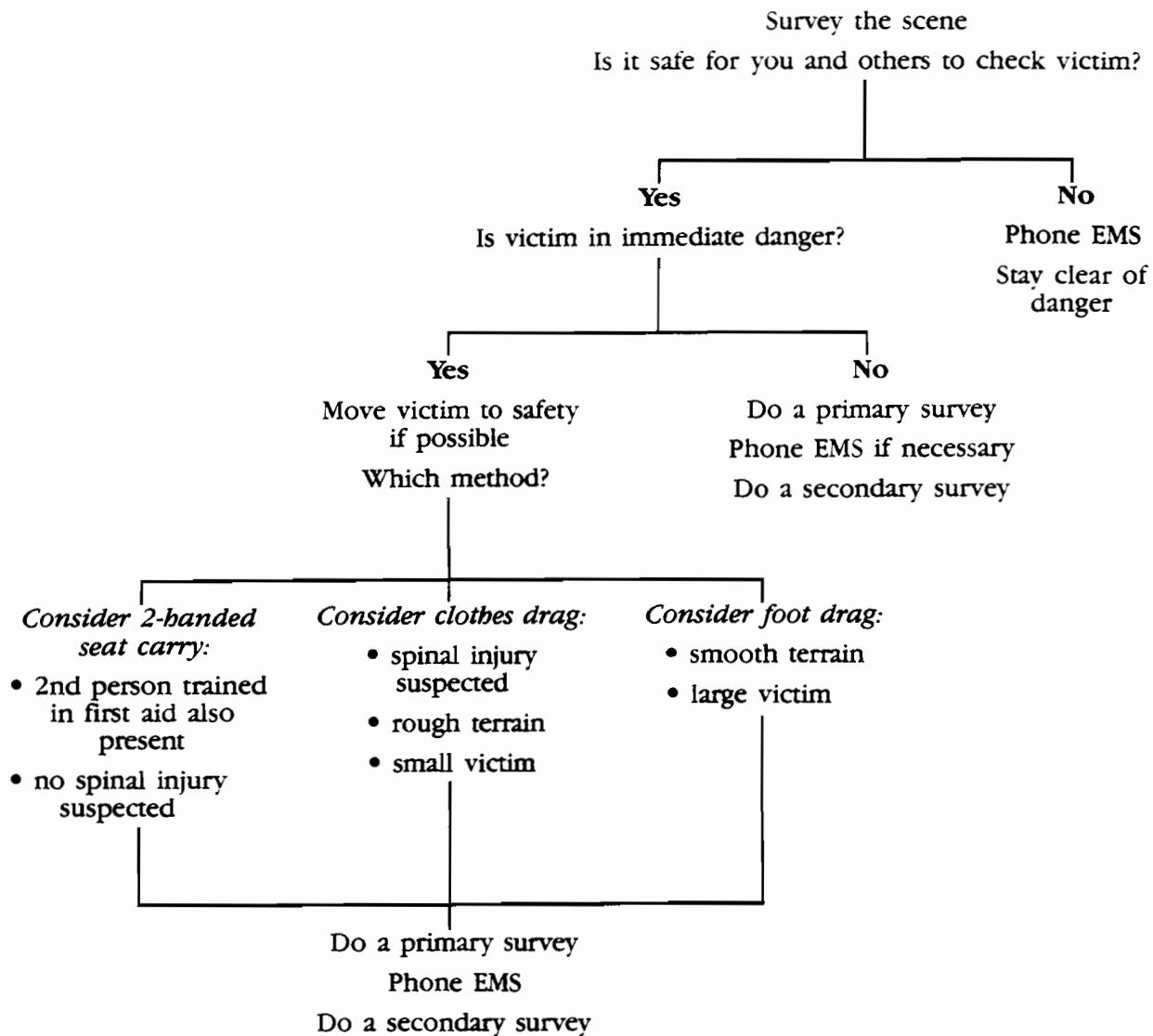
Temperature Extremes Action Guides

Cold Emergencies



Do not give beverages containing alcohol or caffeine.
Give warm broth or water.

Rescues Action Guide



APPENDIX HS-4

Miller Environmental Group's Information

HISTORY OF MILLER ENVIRONMENTAL GROUP, INC.

Miller Environmental Group, Inc. (MEG Environmental Services) was incorporated in 1971 primarily to service the various oil companies with facilities on Long Island. This work began with the placing of oil containment boom and rapidly expanded into oil spill clean up. The areas being serviced also expanded.

The experience and equipment utilized in marine oil spill clean up was applied towards the clean up of surface spills such as truck and tank leaks. In the early years, the MEG staff consisted of about twelve employees. Today, the MEG workforce consists of Environmental Specialists, Transportation and Cargo Specialists, Geologists and Groundwater Technicians as well as Operations Managers to oversee a full complement of equipment operators, well drillers, drivers and trained laborers.

In 1978, MEG signed a contract with the New York State Department of Transportation to provide oil spill response. This contract was not only for surface spills, but also for the relatively new area of groundwater investigation and restoration. By 1980, MEG was operating drill rigs and full groundwater recovery operations on the entire Eastern Seaboard.

Today, MEG offers complete remedial pollution clean up for both hazardous and non hazardous waste. We are licensed by the US Environmental Protection Agency (#NYD986908085), the New York State Department of Environmental Conservation (#1A-041), the New Jersey Department of Environmental Protection (#S-07691), the Connecticut Department of Environmental Protection (#CT-HW-75), and the New York City Fire Department to transport hazardous and non-hazardous regulated waste to EPA regulated facilities for disposal. We hold Emergency Spill Response Contracts with the states of New York, New Jersey and Connecticut.

Our innovative techniques and expanding expertise has enabled MEG to serve the various needs of clients as well as implement the newest technologies in all areas of environmental response and restoration.

Should you require any environmental remedial service, please do not hesitate to call us 24 hours a day, seven days a week.

MILLER ENVIRONMENTAL GROUP, INC.

HEADQUARTERS:

Miller Environmental Group, Inc.
460 Edwards Avenue
PO Box 610
Calverton, NY 11933
(516) 369-4900 - 24 Hour

OPERATION FACILITIES:

Miller Environmental Group, Inc.
Newburgh Operation Center
39 River Road
P.O. Box 2425
Newburgh, NY 12550
914-569-1200

MARINE TERMINALS:

J & H Marine Services, Inc.
Beach Street
Port Jefferson, NY

Miller's Marine
South Wood Avenue
Linden, NJ

James Miller Marine Services, Inc.
Pier 7-1/2
Staten Island, NY

MEG is a pollution remediation contractor servicing the New York Metropolitan area. We are a fully licensed transporter (EPA #NYD986908085). We are also permitted in the states of New York (#1A-041), New Jersey (#S-07691), Connecticut (#CT-HW-75). In addition to the above, we are also New York City permitted. MEG holds emergency spill response contracts with New York State Department of Environmental Conservation, several major oil companies, three public utility companies, the United States Coast Guard, New Jersey Department of Environmental Protection and the State of Connecticut. Our HazMat trained personnel are OSHA 1910 certified with both field and classroom training.

Following is a list of services available:

POLLUTION REMEDIATION SERVICES:

- *Emergency Oil Spills
- *Hazardous Waste Spills
- *Bulk Transport (Liquid & Solid)
- *Power Plant Cleaning
- *Oil/Water Separator Cleaning
- *PCB Transformer Cleanup
- *Field Sampling
- *Soil Excavation
- *Drum Removal
- *Industrial Cleaning
- *Tank Cleaning
- *PCB Capacitor Cleanup

GROUNDWATER SERVICES:

- *Air Stripping Towers
- *Soil Venting Systems
- *Contaminant Recovery
- *Treatment Systems for Aquifers and Soils
- *Restoration
- *Observation Well Installations
- *Recovery Well Installations
- *Dewatering Pump Installations and Repairs
- *Monitoring and Maintenance of Wells and
- *Recovery Systems
- *Environmental Audits

MEG ENVIRONMENTAL TRAINING
RESOURCES CENTER

- *OSHA, 40, 24, and 8 hour Hazwoper Training
- *Confined Space Entry
- *DOT HM181
- *OPA-90 - OSRO Training

Today, our workforce consists of Environmental Specialists, Transportation and Cargo Specialists, Geologists, Engineers and Groundwater Technicians as well as Operations Managers to oversee a full complement of Hazardous Materials Technicians, Equipment Operators, Well Drillers, Drivers and Trained Laborers.

LAND EQUIPMENT

Guzzler
 Guzzler Support Truck
 Case-Trac Excavator
 Backhoe (Dynaohoe 160)
 Backhoe (Dynaohoe 190 or Case 680)
 Payloader (1 yd)
 Payloader (2 yd)
 Payloader (4 yd)
 Payloader (5 yd)
 Bulldozer - D45
 Track Loader (4/1 Bucket)
 Skidloader (Bobcat)
 6 Wheel Dump Truck
 10 Wheel Dump Truck
 Tractor Trailer Dump Truck
 Rolloff Truck
 Rolloff Container
 Tractor
 Equipment Trailer
 Boom Truck
 Air Compressor
 Jackhammer (Air Driven)
 Jackhammer (Electric)
 Compactor
 Asphalt/Concrete Cutter
 Sawsall
 Sod Cutter
 Rigid Electric Snake
 Conveyor Belt
 Cement Mixer
 Welder
 Weed Wacker
 Chain Saw
 Rototiller
 Trencher (Ditch Witch)
 Wood Chipper
 Cutting Torches
 Hydraulic Power Pack
 Hammer Drill
 Vacuum Truck
 Vacuum Trailer and Tractor
 Skid Mounted Vacuum Unit
 Demurrage of Vac Trucks

Weir Oil Skimmerhead
 Stainless Steel Storage Trailer
 Mercury Vac
 Portable Vac
 Sewer Jet
 Emergency Response Vans
 Drum Box Truck
 Drum Recovery Truck
 Hotsy Truck
 Supply Vans
 Rack Truck
 Box Trailer
 4 x 4 Vehicles
 Utility Trucks/Sedans
 Command Center
 Light Truck (5 KW)
 Light Trailer (5 KW)
 Small Generators
 Flood Lights
 High Pressure Hot Water Washers (Hotsy)
 Hydro Laser
 Steam Jenny
 High Volume Hydraulic Pumping System
 Flammable Liquids Transfer Pump
 2" Pump
 3" Pump
 4" Pump
 5" Pump
 6" Pump
 Electric Blower (Explosion Proof)
 Pneumatic Ventilator
 Waterra Power Pump
 Canterra Rig
 Rotary Drill Rig
 Auger Drill Rig
 Portable Well Driver
 Portable Well Auger
 Sampling Pump
 Geoguard Pumping System
 Support Truck
 Sampling Van
 Boom Truck
 High Pressure Water Blaster 10,000 PSI

GROUNDWATER OPERATIONS EQUIPMENT

Rotary & Auger Drill Rigs
 Dewatering Pumps
 Air Stripping Towers
 Carbon Treatment Canisters
 Sampling Vans

Geoguard Pumping System
 Waterra Power Pump
 Photo-Ionization Detectors
 Interface Tapes
 Product Only Recovery Equipment. Various MFG's

MARINE EQUIPMENT

VESSELS

Staten Island, NY

- (2) 65' Utility Boat
- (2) 42' Crew Boats
- (4) 32' Utility Boats
- (2) 18' Outboard Workboat
- (1) 24' Workboat
- (1) 40' Spill Response Platform
- (4) Camels

New York Harbor, NY

- (1) 56' LCM

Port Jefferson, NY

- (3) 65' Utility Boats
- (1) 56' LCMs
- (1) 50' Utility Boats
- (2) 24' Inboard Workboats

Oceanside, NY

- (1) 32' Utility Boat

Calverton, NY

- (3) 24' Outboard Workboats
- (1) 14' Aluminum Outboard Workboat
- (4) 16' Aluminum Outboard Workboats
- (3) 12' Aluminum Outboard Workboats
- (6) 18' Outboard Workboats

Linden, NJ

- (2) 24' Workboat

Bayview, NJ

- (1) 24' Workboat

Newburgh, NY

- (1) 24' Workboat
- (1) 18' Outboard Workboat

CONTAINMENT BOOM

Calverton, NY

- (1) 18" 19,600'
- (1) 36" 1300'

Staten Island, NY

- (1) 18" 7000'

Newburgh, NY

- (1) 18" 1200'

RECOVERY SKIMMERS

Calverton, NY

- (1) MEG 3000 Disk Skimmer
- (2) MEG 1000 Disk Skimmer
- (1) JBF Belt Skimmer
- (1) Parker Float Skimmer
- (1) Slurp Float Skimmer
- (1) Skimpak Float Skimmer
- (1) Hydrator Float Skimmer
- (1) Stop Submersible Weirbox
- (5) Vacuum Trucks

Staten Island, NY

- (1) 3000 Disk Skimmer

Newburgh, NY

- (1) 1000 Disk Skimmer
- (1) Vacuum Truck

APPENDIX H

Access and Approvals Report

**APPENDIX H
ACCESS AND APPROVALS REPORT
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

Prepared For

Nabisco, Inc.

May 1996

Revised September 1997

LBG ENGINEERING SERVICES, P.C.
Professional Environmental Engineering Services
126 Monroe Turnpike
Trumbull, CT 06611

LBG ENGINEERING SERVICES, P.C.

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**APPENDIX H
ACCESS AND APPROVALS REPORT
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

1.0 INTRODUCTION

The purpose of this report is to identify the person(s) and agencies that will require written agreements in order to complete the Scope of Work as described in the Soil Design Report.

2.0 REQUIRED ACCESS

An access agreement with Mr. and Mrs. Richard Hagerman, owners of the property on which the former drum storage area is located will be required. In addition, an access agreement with Mr. and Mrs. James Christensen, owners of the property adjacent to the former drum storage area, will be required. Work on these properties will include soil-vapor sampling, soil sampling, installation of vapor/vacuum monitor points and ground-water monitor wells, and soil excavation and removal. In addition, an access agreement between Nabisco, Inc. and Sag Harbor Industries (SHI) will be required as the remedial activities will be completed on the property now owned by SHI.

2.1 Hagerman Property

There is an existing access agreement for environmental testing on the Hagerman's property. A new agreement for the remedial work has been drafted and submitted to the Hagermans by the Potentially Responsible Parties (PRPs) who are awaiting execution by the Hagermans.

2.2 Christensen Property

There is no current access agreement for the Christensen's property. The agreement for the remedial work has been drafted by the PRPs and submitted to the Christensens and also will require execution by the Christensens.

2.3 Sag Harbor Industries Property

SHI is a Potentially Responsible Party and a signatory to the Consent Order. As such, no formal access agreement is anticipated to be necessary.

3.0 PERMITS AND APPROVALS

3.1 Permits and Regulatory Requirements

The following subsections list permit and notification requirements necessary to conduct soil remedial activities at the Rowe Site. It is noted that the Remedial Design/Remedial Action (RD/RA) is a CERCLA action and, therefore, is not subject to permitting requirements of State and local jurisdictions. However, the EPA has directed that all design criteria meet established State and local regulations, and that such compliance shall be established through the filing of all required permit applications. Under the CERCLA framework, it is not necessary to obtain State and local permits to proceed with the RA. Accordingly, the following subsections detail the relevant State and local regulatory framework and specify which permit applications shall be filed with agencies which would otherwise have jurisdiction over the Rowe Site.

- No permanent structures and all restoration to original conditions. Therefore no building permits are required.
- There are no Federal permits required for the RD developed for soils remediation.
- There are no Town of Southampton permits required for the RD developed for soils remediation.
- NYSDEC Air Permit application is required.

According to Robert Seyforth of the Suffolk County Department of Health Services (SCDHS) an Article 12 Permit is not required for the remedial systems which will be in place for 6 months or less. The SCDHS requests copies of the plan so they can evaluate run-on and run-off

controls, and they require the soil to be non-saturated. The SCDHS will receive copies of the pertinent portions of the Soil Design Report for their review and comment.

3.2 NYSDEC Air Permit

Under its SIP filed with the EPA, New York State regulates discharges to local and regional air sheds. Accordingly, a Permit Application to Construct and Operate a Process, Exhaust or Ventilation System (Air Permit) is required for the soil venting operations detailed in the RD. The permit application will be prepared in accordance with requirements specified in Title 6 NYCRR, Part 201, and guidelines presented in the NYSDEC's AIR GUIDE-1. The permit application has been filed with the following office.

NYSDEC, Bureau of Eastern Remedial Action, Division of Hazardous Waste Remediation
Mr. James Quinn
50 Wolf Road
Albany, NY 12233-7010

skd
May 28, 1996
Revised September 1997
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APPENDIX I

Photographic Documentation Plan

**APPENDIX I
PHOTOGRAPHIC DOCUMENTATION PLAN
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

Prepared For

Nabisco, Inc.

May 1996

Revised September 1997

LBG ENGINEERING SERVICES, P.C.
Professional Environmental Engineering Services
126 Monroe Turnpike
Trumbull, CT 06611

LBG ENGINEERING SERVICES, P.C.

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APPENDIX I
PHOTOGRAPHIC DOCUMENTATION PLAN
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

1.0 INTRODUCTION

1.1 Purpose

In conducting operations at CERCLA sites, a wide range of activities are completed in below-grade excavations which are backfilled and obscured from subsequent observation, or are undertaken which have the potential for incurring a number a liabilities. Accordingly, it is important to fully document all aspects of the work. An integral part of this documentation is the creation of a photo journal depicting the course of work. It is the purpose of this document to specify the manner in which photographic documentation of the soil remediation will be completed.

1.2 Frequency & Logging

Photographs will be taken daily of all general activities completed during the remedial action. More frequent photographs will be taken of critical activities as described in Sections 2 through 9, inclusive.

A separate, bound photographic log will be maintained during the remedial action to record pertinent information regarding the photographs, as required under Sections 1.4 and 1.6 of this plan, and to preclude potential mislabeling of the photographs. The log shall additionally depict, in plan, the relationship of the photographer in relation to the activity being photographed and the location of the activity on the site. All log entries shall be in indelible, waterproof ink.

1.3 Labeling

All photographs taken during the Remedial Action (RA) will minimally bear, on the back side, in waterproof, indelible ink, a description of the activity depicted, the time and date on which the photograph was taken, the location and compass bearing (e.g., former drum storage area, looking northwest) of the photograph, and the name of the person taking the photograph on

the back of the photograph. Additionally, each photograph will be numbered sequentially in the order it was taken.

1.4 Presentation to USEPA

Representative and critical photographs, with appropriate titles, shall be reproduced in the Soil Remedial Action Report to be submitted to the USEPA.

1.5 Archiving

All photographs (and negatives thereof) will be preserved in a bound archive document (photo album). All photographs will appear in chronological order within the archive document, with the negatives serving to separate each roll of film. This will allow the rapid identification and reproduction of both representative and critical photographs. All photographic archives shall be made available for inspection by the USEPA upon demand.

1.6 Photographic Media

All photographs will be taken using a 35 mm (or larger) format. All photographs shall be reproduced in a 3"X 5" format for archiving. Film shall be color with an ASA rating suitable to field conditions.

2.0 SITE CONTROLS

The erection of controls will be photographed. Photographs shall be of a nature and in sufficient number to show and locate all site controls, specifically, but not limited to, access and egress points, the office trailer, fencing and warning labeling.

3.0 SOIL EXCAVATIONS AND KEY ACTIVITIES

All soil excavations will be photographed at the beginning and end of excavation and at points during excavation to document changes in soil or conditions. Photographs shall be of a nature and in sufficient number to show the extent of excavation and any stabilization measures

employed. Photographs shall also be taken of activities that comprise the installation and construction of the remediation system. These activities include:

- SVE well installation
- Vapor/vacuum monitor point and ground-water monitor well installation
- Trenching, and
- Treatment equipment, piping and electrical equipment installation

4.0 STORMWATER & EROSION CONTROLS

The emplacement of controls to preclude stormwater from entering or exiting the excavations and soil impoundment areas, will be fully documented with photographs. Photographs shall be of a nature and in sufficient number to show all regrading completed and covers emplaced to control stormwater entry into the work areas and to control or preclude runoff from the soil impoundment.

Erosion controls, if employed, will be photographed in a manner consistent to obtain a representative depiction of their use and installation.

5.0 IMPOUNDMENT AREA

All areas in which soils are impounded will be photographed during their construction and operation. Photographs of any soil impoundment areas shall be of a nature and in sufficient number to show all aspects of the construction and operation and maintenance, including, but not limited to underlayment, bracing, waterproofing, caulking and venting systems. Photographs shall be taken daily, at the close of operations, showing the condition of all and impoundment areas.

6.0 BULK SHIPMENTS OF WASTE

All bulk shipments of waste will be photographed prior to their release from the site. Photographs shall be of a nature and in sufficient number to show the trailer plate, required placards, labels and markings and the manner in which the waste is contained.

7.0 DECONTAMINATION AREAS

All decontamination areas will be photographed during their construction and use. Photographs shall be of a nature and in sufficient number to show the typical construction details and general usage.

8.0 SITE MONITORING

All site monitoring activities will be photographed during their use. Monitoring depicted shall include work space monitoring, ambient conditions monitoring (including the weather station) and any other monitoring program undertaken during the remedial action. Photographs shall be of a nature and in sufficient number to show general calibration procedures, setup and typical use.

9.0 GENERAL ACTIVITIES

Additional photographs shall be taken in a manner and number to sufficiently document actions not otherwise covered in this plan. Furthermore, additional photographs will be taken as directed by any of the Project Managers, the Health & Safety Officer or Team Leader.

Skd
May 28, 1996
Revised September 1997
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APPENDIX J

Operation and Maintenance Plan Outline

The following presents an Operation and Maintenance (O&M) Plan outlined as required by the Statement of Work. A complete O&M Plan will be submitted to the EPA for review and approval no later than three months prior to the start-up of the on-site soil impoundment vapor extraction equipment.

APPENDIX J

Operation and Maintenance Plan Outline

APPENDIX J
OPERATION AND MAINTENANCE PLAN OUTLINE
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK

Prepared For

Nabisco, Inc.

May 1996

LBG ENGINEERING SERVICES, P.C.
Professional Environmental Engineering Services
126 Monroe Turnpike
Trumbull, CT 06611

**APPENDIX J
OPERATION AND MAINTENANCE PLAN OUTLINE
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

- 1.0 INTRODUCTION**
- 2.0 STATEMENT OF PURPOSE**
- 3.0 DESCRIPTION OF SYSTEM**
 - 3.1 Equipment and Controls**
 - 3.2 Normal Operation**
- 4.0 START-UP PROCEDURES**
 - 4.1 Initial**
 - 4.2 Restarts**
- 5.0 MONITORING**
 - 5.1 Operation of Equipment**
 - 5.2 Air Effluent Quality**
- 6.0 MAINTENANCE**
 - 6.1 Equipment**
 - 6.2 Spare Parts List**
- 7.0 ASSESSING STATUS OF REMEDIATION**
- 8.0 EQUIPMENT MANUALS AND OPERATING GUIDES**
- 9.0 OPERATING FORMS**

APPENDIX K
Engineering Calculations

**APPENDIX K
ENGINEERING CALCULATIONS
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

Prepared For

Nabisco, Inc.

May 1996

LBG Engineering Services, P.C.
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126 Monroe Turnpike
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**APPENDIX K
ENGINEERING CALCULATIONS
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

LIST OF ENGINEERING CALCULATIONS

- Volume and Weight of Soil in Drywells

- PID and PCE Correlation
- Weighted Averages in Excavation Layers
- PCE Contours in Excavation Layers

- Estimated Production Rate for Excavator
- Sheet Pile Penetration Depth

- Geometry and Stability of Soil Impoundment
- Geometry and Stability of Staging Cells
- Friction Losses from Soil Impoundment Piping
- Vapor Concentration in Soil Impoundment Effluent

NOTE: ppm used in these calculations refers to parts per million as read on the PID instrument.

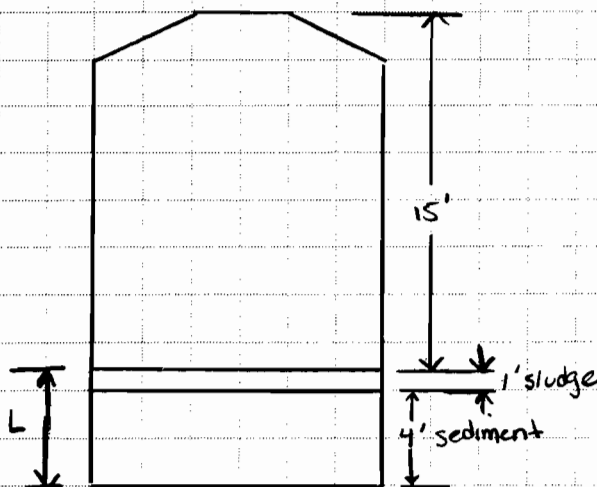
Problem Statement: Determine amount of sediment/solids to be removed from Dry wells

Problem Constraints:

1. Dry wells C, D and F will be remediated
2. Contamination is limited to the uppermost 4 ft of sediment in each dry well
3. The liquid/water in each dry well will be removed at the same time as the soil using a high vacuum truck.
4. Solids will not have to be treated prior to disposal
5. A layer of sludge 1 ft thick exists on top of the sediment in Drywells C + D + a layer 3.2 ft thick is present in Drywell F.
6. Assume unit weight of soil $92 \frac{\text{lb}}{\text{ft}^3}$ (1.24 tons/cy). Use 1.5 tons/cy [Table 1.3, DAS]

ANALYSIS

1. Dry well C

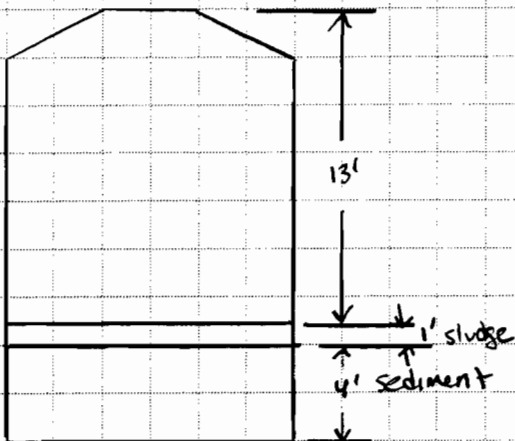


$$\begin{aligned} \text{Volume} &= L \pi r^2 \\ &= 5 \cdot \pi \cdot 3^2 \\ \text{Volume} &= 141.4 \text{ ft}^3 \end{aligned}$$

$$\text{Volume} = 141.4 \text{ ft}^3 \times \frac{1 \text{ cy}}{27 \text{ ft}^3} = 5.2 \text{ cy}$$

$$5.2 \text{ cy} \times 1.5 = 7.8 \text{ tons}$$

2. Dry well D



$$\text{Volume} = L\pi r^2$$

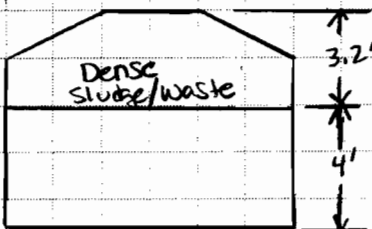
$$\text{Volume} = 5 \cdot \pi \cdot 3^2$$

$$\text{Volume} = 141.4 \text{ ft}^3$$

$$\text{Volume} = 141.4 \text{ ft}^3 \times \frac{1 \text{ cy}}{27 \text{ ft}^3} = 5.2 \text{ cy}$$

$$5.2 \text{ cy} \times 1.5 = 7.8 \text{ tons}$$

3. Dry well F



$$\text{Volume} = L\pi r^2$$

$$\text{Volume} = 7.2 \times \pi \times 5^2$$

$$\text{Volume} = 565.5 \text{ ft}^3$$

$$\text{Volume} = 565.5 \text{ ft}^3 \times \frac{1 \text{ cy}}{27 \text{ ft}^3} = 20.9 \text{ cy}$$

$$20.9 \text{ cy} \times 1.5 = 31.4 \text{ tons}$$

ROWE INDUSTRIES SITE

SOIL REMEDIATION SAG HARBOR, NEW YORK

Signed: ANK

Checked: WKS

Date: 5/29/96

CALCULATION OF PID AND PCE CORRELATION VALUES

Calculated by: Alfred Kovalik

Checked by: WILLIAM K. BECKMAN

STATEMENT OF PROBLEM:

Calculate with at least 90% confidence a PCE concentration that correlates to a specified PID range.

ASSUMPTIONS

1. The PID and PCE data set used is designated as Nabdata and was obtained from the soil boring program conducted during pre-design phase of work scope. The data set essentially consists of all soil samples that were analyzed by a laboratory for VOCs, including PCE, and were screened in the field for total VOCs using a PID with a 10.2 eV bulb.

ANALYSIS

The data was imported from another file and is listed below as Nabdata. Column zero (0) in Nabdata lists PID concentrations in parts per million (ppm) and column one (1) lists the sample's corresponding PCE concentrations in micrograms per kilogram (ug/kg).

The data was sorted using the "csort" command so the PID concentrations could be presented in ascending order. The sorted data set is shown below as matrix SN.

Nabdata := READPRN(nabdata)

Nabdata: PID (ppm), PCE (ug/kg)

Nabdata =

	0	1
0	124	$1.2 \cdot 10^4$
1	258	96
2	12	27
3	137	480
4	524	$2.8 \cdot 10^3$
5	45	13
6	131	130

Table continues

Sorted_Nabdata := csort(Nabdata, 0)

SN := Sorted_Nabdata

SN =

	0	1
0	11	8
1	12	27
2	13	2
3	14	19
4	18	22
5	29	3
6	39	2
7	42	47

Table continues

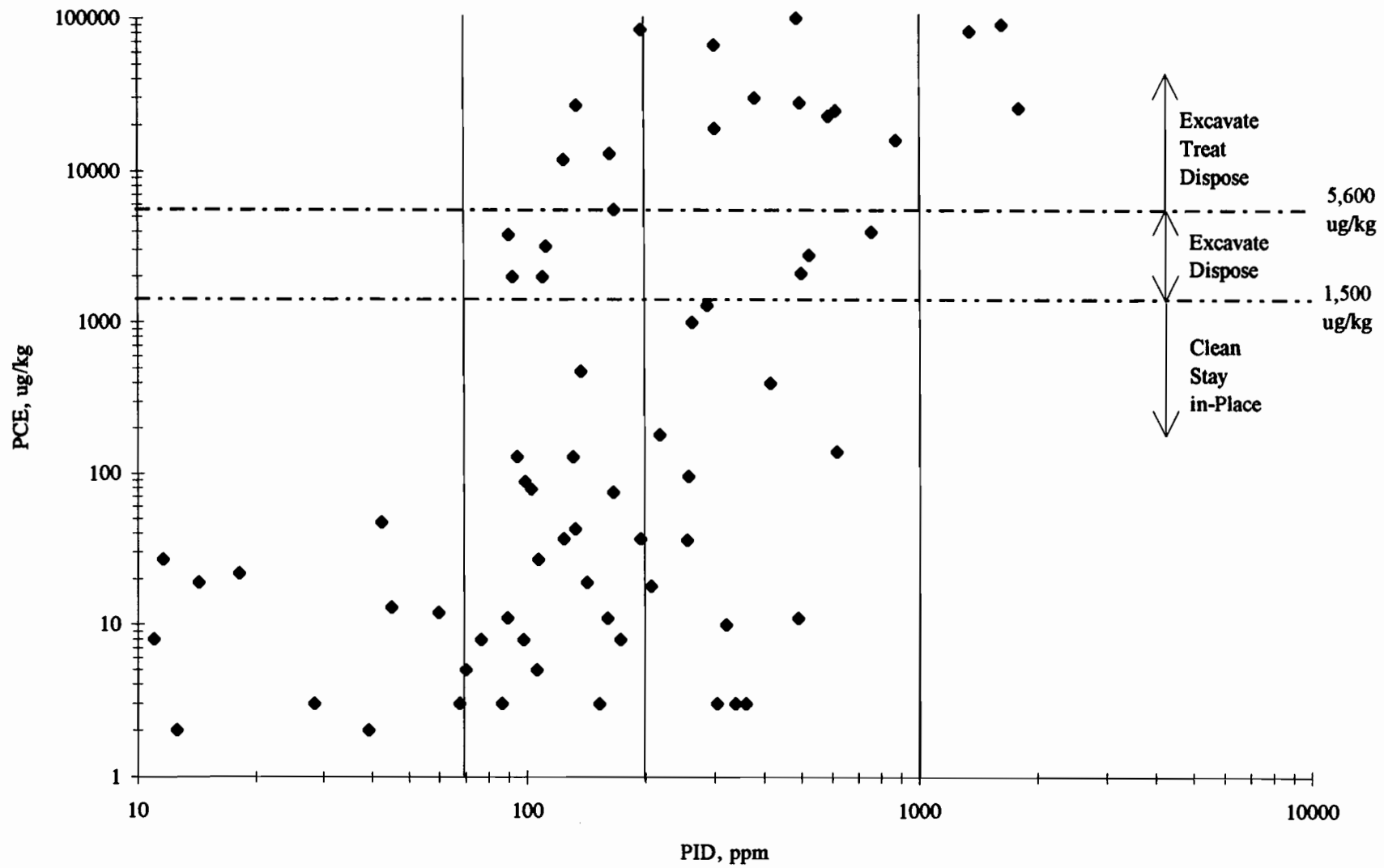
ROWE INDUSTRIES SITE

A scatter plot shown on the following page shows the relationship between PCE and PID concentrations. As shown in the graph no direct correlation could be made. However, there appeared to be natural boundaries in the data at PID readings of 70 and 200 ppm. Accordingly, the data was divided into three sets: PID concentrations of 0 to 70 ppm, 70 to 200 ppm, and 200 to 1000 ppm. Only three concentrations were greater than 1000 ppm and were discarded and considered outliers.

A correlated PCE concentration was determined, with 90% confidence, which corresponded to PID readings in the range of 0 to 70 ppm. The correlated PCE concentration (PCEcorr) was determined by using a frequency distribution for the PCE values with PID readings from 0 to 70 ppm. The PCE concentration which had at least 90% of the PCE values in the 0 to 70 ppm subset less than it was chosen as PCEcorr. This relationship means that 90% of the time, PCE readings corresponding to PID readings in the range of 0 to 70 ppm would be less than or equal to this number. This process was then repeated for the other two groups (i.e. PID from 70 to 200 ppm and PID from 200 to 1000 ppm). This process is demonstrated below for each of the three groups. The correlated PCE values are used in subsequent calculations to ultimately determine PCE contours to guide excavation activities.

SOIL REMEDIATION DESIGN

PCE versus PID



ROWE INDUSTRIES SITE

Histogram Development

PID 0 to 70 ppm

A submatrix was developed which sorted the PCE concentrations corresponding to the PID readings which were between 0 and 70 ppm. The submatrix, consisting of 12 data points, was then listed in ascending order. The PCE values ranged from 2 to 47 ug/kg. These values are presented below as PCE70.

A histogram was developed by dividing the submatrix into 6 groups. The first group has PCE concentrations from 0-8 ug/kg and the last group has PCE concentrations from 40 to 48 ug/kg. The frequency was calculated to see how many values were in each group and then a histogram was developed to graphically represent the results.

submatrix(A, rowi, rowj, columni, columnj)

j := 11

PID_Range_0to70 := submatrix(SN, 0, j, 0, 1)

PCE70 := sort(PID_Range_0to70<1>)

let n1 := 6 groups, and

$\text{delta} := \text{ceil}\left(\frac{\text{PCE70}_j}{n1}\right)$ so $\text{delta} = 8$

let PCEint1₀ := 0 and u := 0..n1 - 1

$\text{PCEint1}_{u+1} := (\text{PCEint1}_u) + \text{delta}$

Using the Mathcad histogram function, $\text{Freq70} := \text{hist}(\text{PCEint1}, \text{PCE70})$ yields..

0
2
2
3
3
5
8
12
13
19
22
27
47

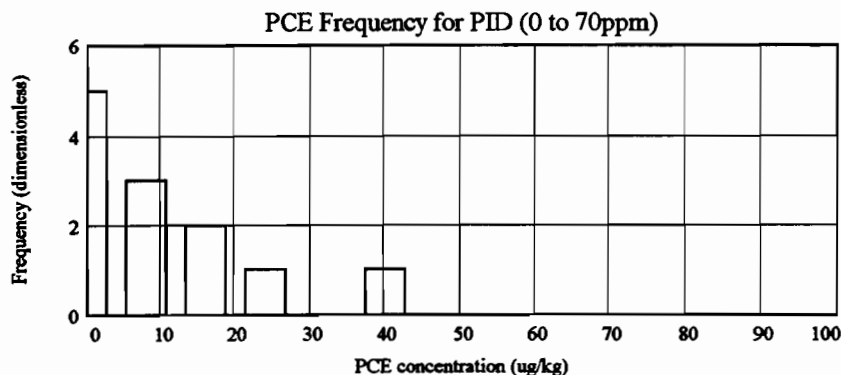
PCE70 =

$$\text{Freq70} = \begin{bmatrix} 5 \\ 3 \\ 2 \\ 2 \\ 1 \\ 0 \\ 1 \end{bmatrix} \quad \text{PCEint1} = \begin{bmatrix} 0 \\ 8 \\ 16 \\ 24 \\ 32 \\ 40 \\ 48 \end{bmatrix}$$

mean(PCE70) = 13.583
stdev(PCE70) = 12.9

Graph Freq70_k versus PCEint1_k for

k1 := 0..n1 - 1



ROWE INDUSTRIES SITE

Histogram Development

PID 70 to 200 ppm

A submatrix was developed which sorted the PCE concentrations corresponding to the PID readings which were between 70 and 200 ppm. The submatrix, consisting of 28 data points, was then listed in ascending order. These values are presented below as PCE200. The PCE values ranged from 3 to 8.5×10^4 ug/kg. However the PCE value of 8.5×10^4 ug/kg was eliminated from the evaluation. This concentration corresponds to a PID reading of 196 ppm and was considered an outlier.

A histogram was developed by dividing the submatrix into 15 groups. The first group has PCE concentrations from 0 to 1.8×10^3 ug/kg and the last group has PCE concentrations from 2.52×10^4 to 2.7×10^4 ug/kg. The frequency was calculated to see how many values were in each group and then a histogram was developed to graphically represent the results.

$$p := 39$$

$$\text{PID\_Range\_70to200} := \text{submatrix}(\text{SN}, j+1, p, 0, 1)$$

$$\text{PCE200} := \text{sort}(\text{PID\_Range\_70to200}^{<1>})$$

let $n2 := 15$ groups, and

$$\text{delta} := \text{ceil}\left[\frac{\text{PCE200}_{p-(j+2)}}{n2}\right] \text{ so } \text{delta} = 1.8 \cdot 10^3$$

Note: the subscript $p-(j+2)$ serves to eliminate the PCE value with a concentration of 8.5×10^4 ug/kg.

$$\text{PCE200} =$$

let $\text{PCEint2}_0 := 0$ and, $u := 0..n2$

$$\text{PCEint2}_{u+1} := (\text{PCEint2}_u) + \text{delta}$$

Using the Mathcad histogram function, $\text{Freq200} := \text{hist}(\text{PCEint2}, \text{PCE200})$ yields..

	0
0	19
1	3
2	1
3	1
4	0
5	0
6	1
7	1
8	0
9	0
10	0

$$\text{Freq200} =$$

Table continues

	0
0	0
1	$1.8 \cdot 10^3$
2	$3.6 \cdot 10^3$
3	$5.4 \cdot 10^3$
4	$7.2 \cdot 10^3$
5	$9 \cdot 10^3$
6	$1.08 \cdot 10^4$
7	$1.26 \cdot 10^4$

$$\text{PCEint2} =$$

Table continues

	0
0	3
1	3
2	5
3	8
4	8
5	8
6	11
7	11
8	19
9	27
10	37
11	37
12	43
13	75
14	79
15	89
16	130
17	130
18	480
19	$2 \cdot 10^3$
20	$2 \cdot 10^3$
21	$3.2 \cdot 10^3$

Table continues

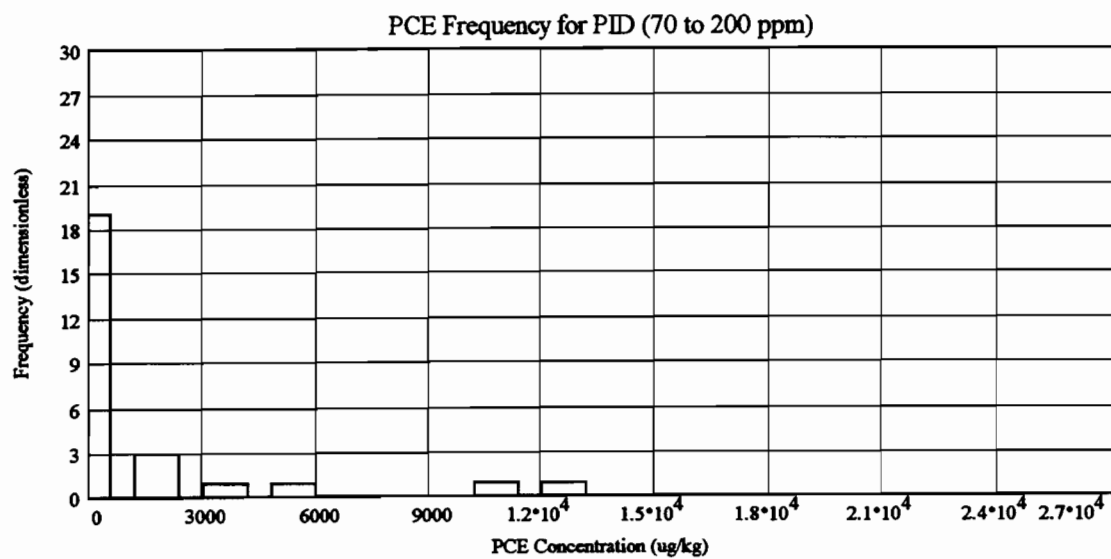
$$\text{mean}(\text{PCE200}) = 5.529 \cdot 10^3$$

$$\text{stdev}(\text{PCE200}) = 1.634 \cdot 10^4$$

ROWE INDUSTRIES SITE

Graph Freq200_k versus PCEint2_k for

$k2 := 0..n2 - 1$



ROWE INDUSTRIES SITE

Histogram Development

PID 200 to 1000 ppm

A submatrix was developed which sorted the PCE concentrations corresponding to the PID readings which were between 200 and 1000 ppm. The submatrix, consisting of 24 data points, was then listed in ascending order. These values are presented below as PCE1000. The PCE values ranged from 3 to 1×10^5 ug/kg.

A histogram was developed by dividing the submatrix was divided into 8 groups. The first group has PCE concentrations from 0 to 1.3×10^4 ug/kg and the last group has PCE concentrations from 1×10^5 to 1.1×10^5 ug/kg. The frequency was calculated to see how many values were in each group and then a histogram was developed to graphically represent the results.

$$m := 63$$

$$\text{PID\_Range\_200to1000} := \text{submatrix}(\text{SN}, p + 1, m, 0, 1)$$

$$\text{PCE1000} := \text{sort}(\text{PID\_Range\_200to1000}^{<1>})$$

$$n3 := 8 \quad \text{groups, and}$$

$$\text{delta} := \text{ceil}\left[\frac{\text{PCE1000}_{m-(p+1)}}{n3}\right] \quad \text{so} \quad \text{delta} = 1.25 \cdot 10^4$$

$$\text{let} \quad \text{PCEint3}_0 := 0 \quad \text{and,} \quad u := 0..n3$$

$$\text{PCEint3}_{u+1} := \text{PCEint3}_u + \text{delta}$$

Using the Mathcad histogram function, $\text{Freq1000} := \text{hist}(\text{PCEint3}, \text{PCE1000})$ yields..

$$\text{Freq1000} = \begin{bmatrix} 16 \\ 3 \\ 3 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \\ 0 \\ 1 \end{bmatrix}$$

	0
0	0
1	$1.3 \cdot 10^4$
2	$2.5 \cdot 10^4$
3	$3.8 \cdot 10^4$
4	$5 \cdot 10^4$
5	$6.3 \cdot 10^4$
6	$7.5 \cdot 10^4$
7	$8.8 \cdot 10^4$
8	$1 \cdot 10^5$
9	$1.1 \cdot 10^5$

$$\text{PCEint3} =$$

	0
0	3
1	3
2	3
3	10
4	11
5	18
6	36
7	96
8	140
9	180
10	400
11	$1 \cdot 10^3$
12	$1.3 \cdot 10^3$
13	$2.1 \cdot 10^3$
14	$2.8 \cdot 10^3$
15	$4 \cdot 10^3$
16	$1.6 \cdot 10^4$
17	$1.9 \cdot 10^4$
18	$2.3 \cdot 10^4$
19	$2.5 \cdot 10^4$
20	$2.8 \cdot 10^4$

$$\text{PCE1000} =$$

Table continues

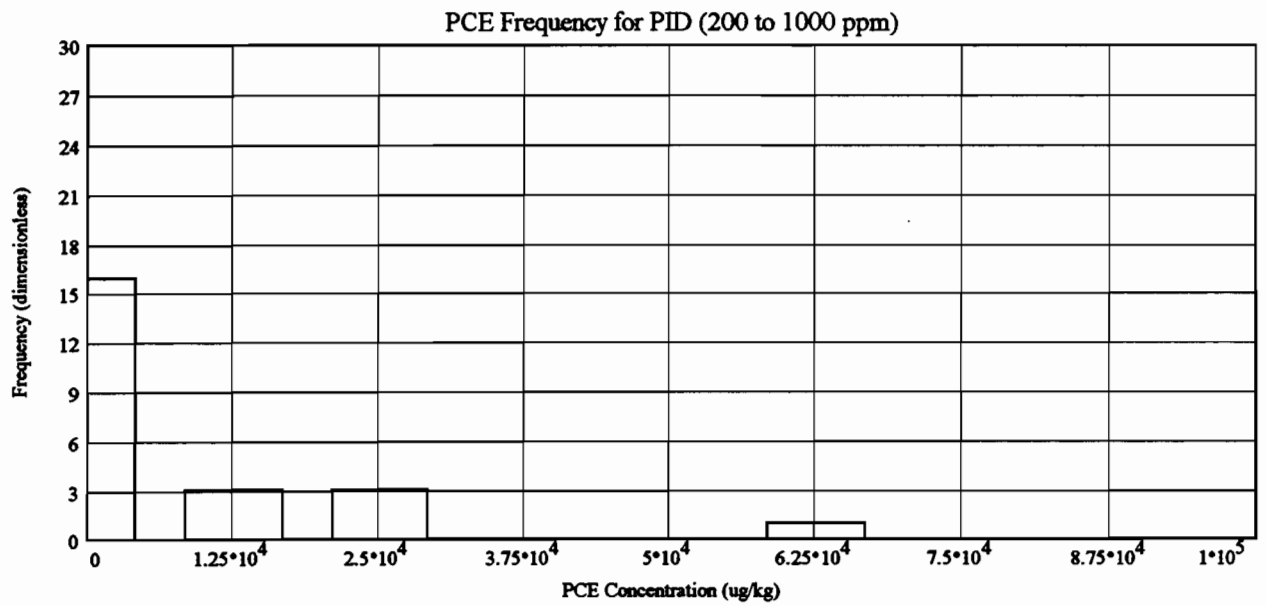
$$\text{mean}(\text{PCE1000}) = 1.334 \cdot 10^4$$

$$\text{stdev}(\text{PCE1000}) = 2.39 \cdot 10^4$$

ROWE INDUSTRIES SITE

Graph Freq1000_k versus PCEint3_k for

$k3 := 0..n3 - 1$



ROWE INDUSTRIES SITE

Correlation Exercise

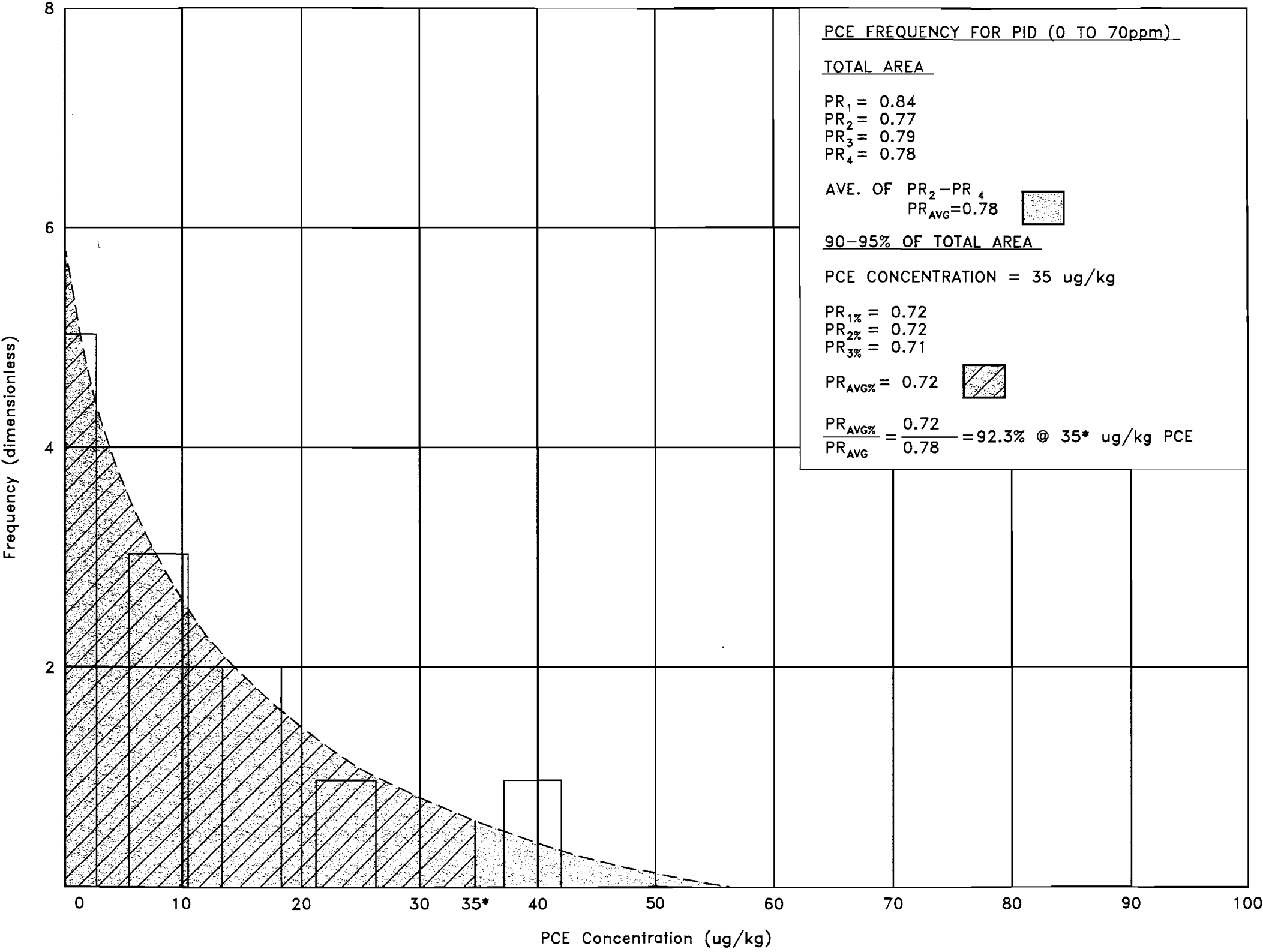
The following figures show the three histograms developed using the methodology previously described. The trend of the histogram bars were approximated using dashed lines. The colored areas beneath the dashed lines were measured using a planimeter. Several planimeter readings (PR) were taken and then averaged to estimate the total area beneath the trend lines.

A trial and error method was used to determine the PCE concentration that encompassed 90% of the PCE values in each PID range. The 90% criteria was checked by measuring the area beneath the dashed line and the selected PCE value. These areas were also measured using the planimeter readings and are designated as PR%. The 90% criteria was checked by dividing the average PR% ($PR_{ave\%}$) by PR_{ave} . Only the PCE concentration and area measurements for the final correlation values are shown.

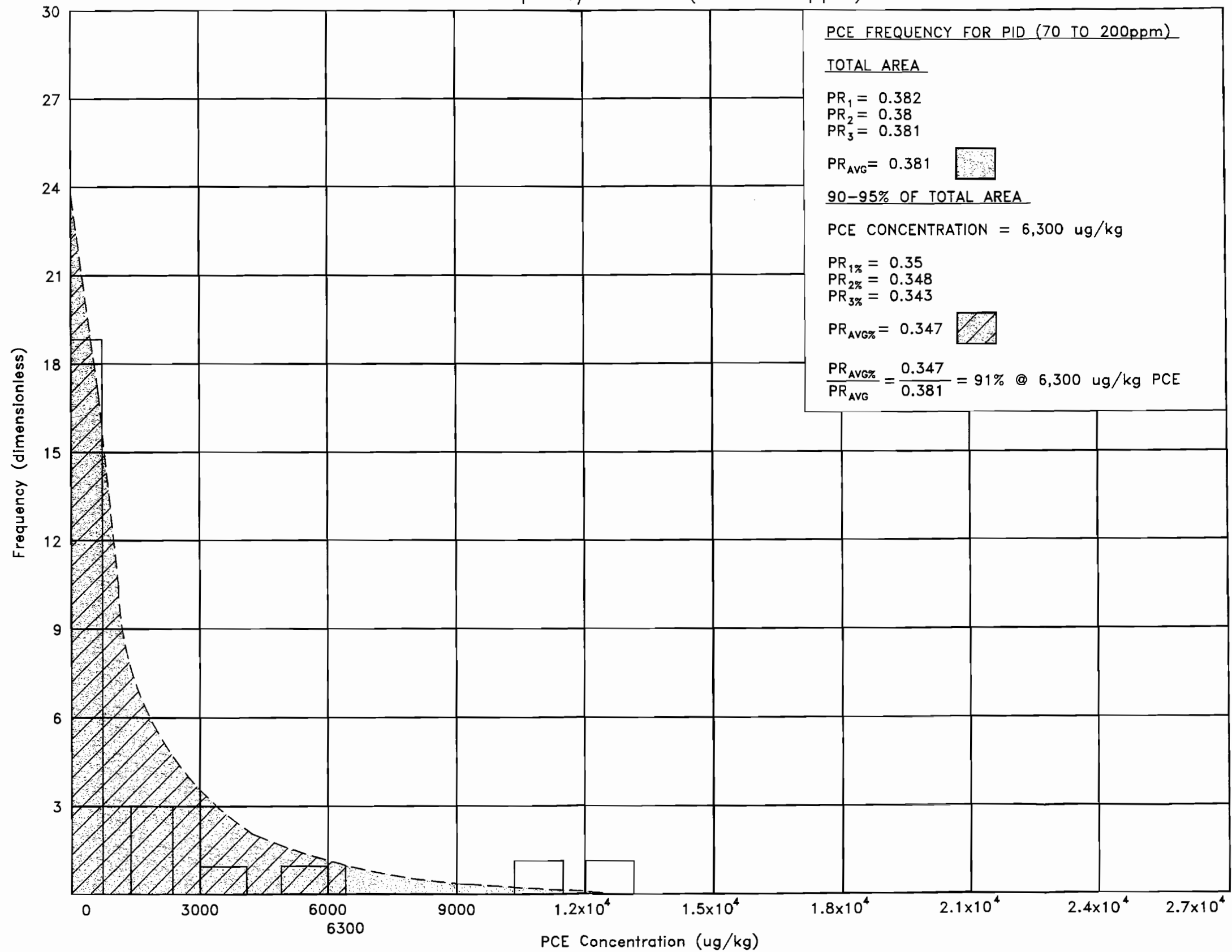
RESULTS

1. The PID range of 0 to 70 ppm can be correlated to a PCE concentration of 35 ug/kg or less with 92.3% confidence.
2. The PID range of 70 to 200 ppm can be correlated to a PCE concentration of 6,300 ug/kg or less with 91% confidence.
3. The PID range of 200 to 1000 ppm can be correlated to a PCE concentration of 33,750 ug/kg or less with 92% confidence.

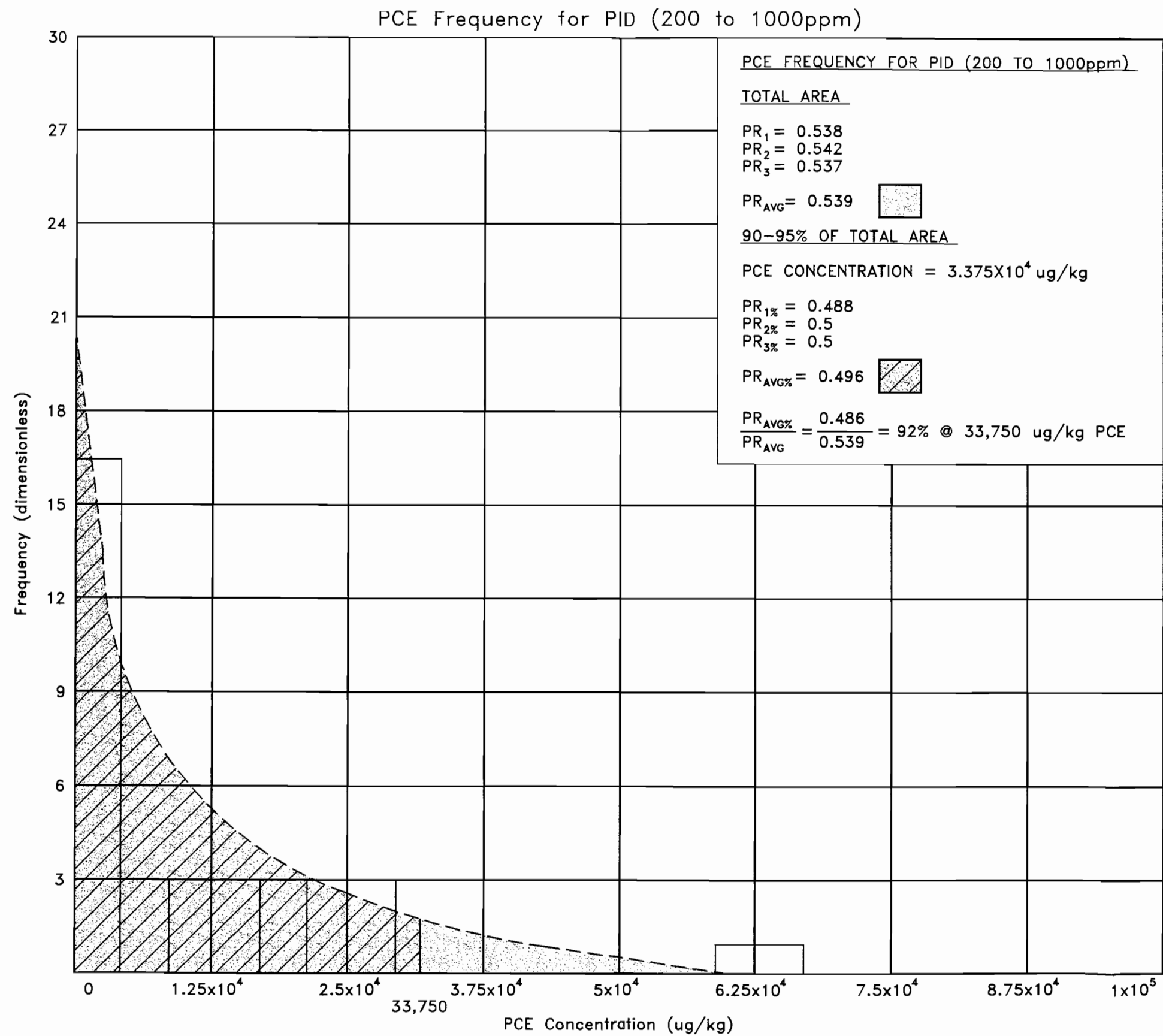
PCE Frequency for PID (0 to 70ppm)



PCE Frequency for PID (70 to 200ppm)



LEGGETTE, BRASHEARS & GRAHAM, INC.



ROWE INDUSTRIES SITE

SOIL REMEDIATION SAG HARBOR, NEW YORK

Signed: GS
Checked: AK
Date: 4/16/96

CALCULATION OF PID AND PCE WEIGHTED AVERAGES

Calculated by: Greg Souza
Checked by: ALFRED N. KOVALIK

STATEMENT OF PROBLEM

Calculate the weighted average concentration of PCE or PID readings from soil samples collected from two consecutive soil borings.

ASSUMPTIONS

1. Scenario 1: Both soil samples have analytical PCE data available.
Scenario 2: PCE analytical data is available for the bottom soil sample and the top PCE concentration is estimated based on the PID-PCE correlation.
Scenario 3: PCE analytical data is available for the top soil sample and the bottom PCE concentration is estimated based on the PID-PCE correlation.
Scenario 4: PCE data is not available for either soil sample. PID readings for both the top and bottom soil samples are available. The weighted average of PID readings will be calculated and the PCE concentration will be estimated using the PID-PCE correlation.
2. The average concentration in each excavation layer can be approximated by a weighted average of two consecutive borings within the specified layer.
3. There is a full two feet of recovery for each soil boring.

GENERAL EQUATIONS

The equation numbers below correspond to the scenarios listed above.

1. $\text{weightedPCE} := \frac{(\text{PCEb}) \cdot (\text{deltab}) + (\text{PCEt}) \cdot (\text{deltat})}{2}$
2. $\text{weightedPCE} := \frac{(\text{PCEb}) \cdot (\text{deltab}) + (\text{PCEcorr}) \cdot (\text{deltat})}{2}$
3. $\text{weightedPCE} := \frac{(\text{PCEcorr}) \cdot (\text{deltab}) + (\text{PCEt}) \cdot (\text{deltat})}{2}$
4. $\text{weightedPID} := \frac{(\text{PIDb}) \cdot (\text{deltab}) + (\text{PIDt}) \cdot (\text{deltat})}{2}$

where: PCEb = PCE analytical data for the bottom soil sample, micrograms per kilogram
PCEt = PCE analytical data for the top soil sample, micrograms per kilogram
PIDb = PID reading for the bottom soil sample, parts per million
PIDt = PID reading for the top soil sample, parts per million
deltat = distance from the top elevation of excavation layer to the soil boring sample elevation, feet
deltab = depth of excavation layer (2.0 feet) minus deltat, feet

ROWE INDUSTRIES SITE

RB-1			
deltat = 1.83			
deltab = 0.17			
depth ft MSL			weighted avg. conc
27 to 29	PIDt	175	165
	PIDb	62	
25 to 27	PCEcorr	35	1,052
	PCEb	12,000	
23 to 25	PCEt	12,000	10,988
	PCEb	96	
21 to 23	PCEt	96	91
	PCEb	39	
19 to 21	PCEt	39	39
	PCEcorr	35	
17 to 19	PIDt	30	28
	PIDb	2	
15 to 17	PIDt	2	2
	PIDb	4	
13 to 15	PIDt	4	4
	PIDb	1	

RB-2			
deltat = 0.33			
deltab = 1.67			
depth ft MSL			weighted avg. conc
25 to 27	PIDt	8	16
	PIDb	18	
23 to 25	PIDt	18	17
	PIDb	17	
21 to 23	PIDt	17	6
	PIDb	4	
19 to 21	PIDt	4	1
	PIDb	0	
17 to 19	PCEcorr	35	6
	PCEb	0	
15 to 17	PCEt	0	29
	PCEcorr	35	
13 to 15	PIDt	8	3
	PIDb	2	

MSL = Mean Sea Level

ROWE INDUSTRIES SITE

RB-3			
		deltat = 1.03	
		deltab = 0.97	
depth ft MSL			weighted avg. conc
25 to 27	PIDt	6	5
	PIDb	3	
23 to 25	PIDt	3	2
	PIDb	1	
21 to 23	PCEcorr	35	31
	PCEb	27	
19 to 21	PCEt	27	31
	PCEcorr	35	
17 to 19	PIDt	3	3
	PIDb	4	
15 to 17	PIDt	4	3
	PIDb	1	
13 to 15	PIDt	1	13
	PIDb	26	

RB-4			
		deltat= 0.13	
		deltab= 1.87	
depth ft MSL			weighted avg. conc
25 to 27	PIDt	58	50
	PIDb	49	
23 to 25	PIDt	49	19
	PIDb	17	
21 to 23	PCEcorr	35	451
	PCEb	480	
19 to 21	PCEt	480	2,649
	PCEb	2,800	
17 to 19	PCEt	2,800	194
	PCEb	13	
15 to 17	PCEt	13	34
	PCEcorr	35	
13 to 15	PIDt	5	96
	PIDb	102	

ROWE INDUSTRIES SITE

RB-5			
		deltat=	1.23
		deltab=	0.77
depth ft MSL			weighted avg. conc
27 to 29	PIDt	20	15
	PIDb	7	
25 to 27	PIDt	7	10
	PIDb	14	
23 to 25	PIDt	14	11
	PIDb	7	
21 to 23	PCEcorr	35	72
	PCEb	130	
19 to 21	PCEt	130	93
	PCEcorr	35	
17 to 19	PCEcorr	35	36
	PCEb	37	
15 to 17	PCEt	37	36
	PCEcorr	35	
13 to 15	PIDt	24	19
	PIDb	10	

RB-6			
		deltat =	1.83
		deltab =	0.17
depth ft MSL			weighted avg. conc
29 to 30	PCEt	35	8,532
	PCEcorr	100,000	
27 to 29	PCEt	100,000	92,036
	PCEcorr	6,300	
25 to 27	PIDt	328	335
	PIDb	406	
23 to 25	PIDt	406	455
	PIDb	982	
21 to 23	PCEcorr	33,750	38,616
	PCEb	91,000	
19 to 21	PCEt	91,000	83,265
	PCEb	3	
17 to 19	PCEt	3	538
	PCEcorr	6,300	
15 to 17	PCEcorr	6,300	5,799
	PCEb	400	

ROWE INDUSTRIES SITE

RB-7			
		deltat =	0.03
		deltab =	1.97
depth ft MSL			weighted avg. conc
27 to 29	PCEcorr	6,300	5,611
	PCEb	5,600	
25 to 27	PCEt	5,600	111
	PCEb	27	
23 to 25	PCEt	27	178
	PCEb	180	
21 to 23	PCEt	180	33,246
	PCEcorr	33,750	
19 to 21	PIDt	393	734
	PIDb	739	
17 to 19	PIDt	739	56
	PIDb	46	
15 to 17	PCEcorr	35	15,761
	PCEb	16,000	
13 to 15	PCEt	16,000	33,484
	PCEcorr	33,750	

RB-8			
		deltat =	1.78
		deltab =	0.22
depth ft MSL			weighted avg. conc
29 to 31	PCEcorr	35	9,381
	PCEb	85,000	
27 to 29	PCEt	85,000	79,363
	PCEcorr	33,750	
25 to 27	PIDt	290	274
	PIDb	144	
23 to 25	PIDt	144	175
	PIDb	428	
21 to 23	PIDt	428	525
	PIDb	1,309	
19 to 21	PIDt	1,309	1,310
	PIDb	1,316	
17 to 19	PCEcorr	33,750	39,168
	PCEb	83,000	
15 to 17	PCEt	83,000	77,583
	PCEcorr	33,750	
13 to 15	PIDt	1,008	1,021
	PIDb	1,123	

ROWE INDUSTRIES SITE

RB-9			
		deltat = 1.5	
		deltab = 0.5	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	75	71
	PIDb	60	
25 to 27	PCEcorr	35	526
	PCEb	2,000	
23 to 25	PCEt	2,000	2,500
	PCEb	4,000	
21 to 23	PCEt	4,000	3,009
	PCEcorr	35	
19 to 21	PCEcorr	35	3,276
	PCEb	13,000	
17 to 19	PCEt	13,000	9,750
	PCEb	0	
15 to 17	PCEt	0	9
	PCEcorr	35	

RB-10			
		deltat = 0.43	
		deltab = 1.57	
depth ft MSL			weighted avg. conc
25 to 27	PIDt	38	61
	PIDb	67	
23 to 25	PIDt	67	27
	PIDb	16	
21 to 23			
19 to 21			
17 to 19	PIDt	8	10
	PIDb	11	
15 to 17	PIDt	11	16
	PIDb	18	
13 to 15	PCEcorr	35	9
	PCEb	2	

ROWE INDUSTRIES SITE

RB-11			
deltat = 1.13 deltab = 0.87			
depth ft MSL			weighted avg. conc
27 to 29	PIDt	2	4
	PIDb	6	
25 to 27	PIDt	6	8
	PIDb	10	
23 to 25	PIDt	10	10
	PIDb	10	
21 to 23	PCEcorr	35	23
	PCEb	8	
19 to 21	PCEt	8	14,686
	PCEb	33,750	
17 to 19	PCEt	33,750	19,074
	PCEb	11	
15 to 17	PCEt	11	10
	PCEb	8	
13 to 15	PCEt	8	20
	PCEcorr	35	

RB-12			
deltat = 0.33 deltab = 1.67			
depth ft MSL			weighted avg. conc
27 to 29	PCEcorr	35	2,678
	PCEb	3,200	
25 to 27	PCEt	3,200	3,701
	PCEb	3,800	
23 to 25	PCEt	3,800	693
	PCEb	79	
21 to 23	PCEt	79	1,099
	PCEb	1,300	
19 to 21	PCEt	1,300	28,396
	PCEcorr	33,750	
17 to 19	PCEcorr	33,750	26,444
	PCEb	25,000	
15 to 17	PCEt	25,000	4,154
	PCEcorr	35	
13 to 15	PIDt	33	281
	PIDb	330	

ROWE INDUSTRIES SITE

RB-13			
		deltat = 1.38	
		deltab = 0.62	
depth ft MSL			weighted avg. conc
27 to 29	PCEt	120,000	83,420
	PCEb	2,000	
25 to 27	PCEt	2,000	1,403
	PCEb	75	
23 to 25	PCEt	75	66
	PCEb	47	
21 to 23	PCEt	47	73
	PCEb	130	
19 to 21	PCEt	130	101
	PCEb	36	
17 to 19	PCEt	36	27
	PCEb	8	
15 to 17	PCEt	8	6
	PCEb	2	
13 to 15	PCEt	2	10,464
	PCEcorr	33,750	

RB-14			
		deltat = 1.93	
		deltab = 0.07	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	59	65
	PIDb	225	
25 to 27	PIDt	225	219
	PIDb	42	
23 to 25	PIDt	42	43
	PIDb	82	
21 to 23	PCEcorr	6,300	6,080
	PCEb	5	
19 to 21	PCEt	5	6
	PCEcorr	35	
17 to 19	PIDt	24	26
	PIDb	70	
15 to 17	PIDt	70	68
	PIDb	22	

ROWE INDUSTRIES SITE

RB-15			
		deltat = 1.33	
		deltab = 0.67	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	109	77
	PIDb	13	
25 to 27	PCEcorr	35	358
	PCEb	1,000	
23 to 25	PCEt	1,000	8,370
	PCEb	23,000	
21 to 23	PCEt	23,000	15,307
	PCEcorr	35	
19 to 21	PCEcorr	18	25
	PCEb	40	
17 to 19	PIDt	40	37
	PIDb	30	
15 to 17	PIDt	30	40
	PIDb	61	

RB-16			
		deltat = 0.23	
		deltab = 1.77	
depth ft MSL			weighted avg. conc
25 to 27	PIDt	3	6
	PIDb	6	
23 to 25	PIDt	6	8
	PIDb	8	
21 to 23	PIDt	8	12
	PIDb	13	
19 to 21	PIDt	13	11
	PIDb	11	
17 to 19	PIDt	11	14
	PIDb	14	
15 to 17	PIDt	14	8
	PIDb	7	
13 to 15	PCEcorr	7	1
	PCEb	0	

ROWE INDUSTRIES SITE

RB-17			
		deltat =	0.48
		deltab =	1.52
depth ft MSL			weighted avg. conc
27 to 29	PIDt	6	5
	PIDb	5	
25 to 27	PIDt	5	3
	PIDb	3	
23 to 25	PCEcorr	35	23
	PCEb	19	
21 to 23	PCEt	19	31
	PCEcorr	35	

RB-18			
		deltat =	1.83
		deltab =	0.17
depth ft MSL			weighted avg. conc
29 to 31	PIDt	47	45
	PIDb	27	
27 to 29	PCEcorr	35	32
	PCEb	5	
25 to 27	PCEt	5	16
	PCEb	140	
23 to 25	PCEt	140	2,997
	PCEcorr	33,750	
21 to 23	PCEcorr	33,750	32,241
	PCEb	16,000	
19 to 21	PCEt	16,000	17,509
	PCEcorr	33,750	
17 to 19	PIDt	2,885	2,721
	PIDb	958	
15 to 17	PIDt	958	902
	PIDb	304	

ROWE INDUSTRIES SITE

RB-19			
		deltat = 0.48	
		deltab = 1.52	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	27	27
	PIDb	27	
25 to 27	PIDt	27	39
	PIDb	43	
23 to 25	PIDt	43	34
	PIDb	31	
21 to 23	PCEcorr	35	18
	PCEb	12	
19 to 21	PCEt	12	5
	PCEb	3	
17 to 19	PCEt	3	9
	PCEb	11	

RB-20			
		deltat = 0.63	
		deltab = 1.37	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	72	74
	PIDb	75	
25 to 27	PCEcorr	6,300	2,014
	PCEb	43	
23 to 25	PCEt	43	17,824
	PCEb	26,000	
21 to 23	PCEt	26,000	31,309
	PCEcorr	33,750	
19 to 21	PCEcorr	33,750	10,638
	PCEb	10	
17 to 19	PCEt	10	3
	PCEb	0	
15 to 17	PCEt	0	24
	PCEcorr	35	
13 to 15	PIDt	63	159
	PIDb	203	

ROWE INDUSTRIES SITE

RB-21			
		deltat = 0.88	
		deltab = 1.12	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	163	361
	PIDb	516	
25 to 27	PIDt	516	696
	PIDb	837	
23 to 25	PIDt	837	1,104
	PIDb	1,313	
21 to 23	PCEcorr	33,750	14,852
	PCEb	3	
19 to 21	PCEt	3	21
	PCEcorr	35	
17 to 19	PCEcorr	35	17
	PCEb	3	
15 to 17	PCEt	3	3,529
	PCEcorr	6,300	
13 to 15	PIDt	193	126
	PIDb	73	

RB-22			
		deltat = 1.78	
		deltab = 0.22	
depth ft MSL			weighted avg. conc
29 to 30	PIDt	6	6
	PIDb	6	
27 to 29	PIDt	6	6
	PIDb	7	
25 to 27	PIDt	7	8
	PIDb	13	
23 to 25	PCEcorr	35	34
	PCEb	22	

ROWE INDUSTRIES SITE

RB-23			
		deltat = 1.53	
		deltab = 0.47	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	28	37
	PIDb	68	
25 to 27	PCEcorr	35	35
	PCEb	37	
23 to 25	PCEt	37	1,509
	PCEcorr	6,300	
21 to 23	PIDt	106	106
	PIDb	104	
19 to 21	PCEcorr	6,300	4,821
	PCEb	8	
17 to 19	PCEt	8	7,937
	PCEcorr	33,750	
15 to 17	PCEcorr	33,750	25,819
	PCEb	3	
13 to 15	PCEt	3	1,483
	PCEcorr	6,300	

RB-24			
		deltat = 1.88	
		deltab = 0.12	
depth ft MSL			weighted avg. conc
29 to 31	PCEt	27,000	25,382
	PCEcorr	35	
27 to 29	PCEcorr	35	38
	PCEb	89	
25 to 27	PCEt	89	86
	PCEcorr	35	
23 to 25	PIDt	21	23
	PIDb	58	
21 to 23	PIDt	58	55
	PIDb	0	
19 to 21	PIDt	0	1
	PIDb	20	
17 to 19	PIDt	20	23
	PIDb	76	
15 to 17	PIDt	76	73
	PIDb	34	
13 to 15	PIDt	34	40
	PIDb	140	

ROWE INDUSTRIES SITE

RB-25			
		deltat = 1.13	
		deltab = 0.87	
depth ft MSL			weighted avg. conc
27 to 29	PCEt	19	26
	PCEcorr	35	
25 to 27	PCEcorr	35	21
	PCEb	3	
23 to 25	PCEt	3	17
	PCEcorr	35	
21 to 23	PIDt	1	23
	PIDb	52	
19 to 21	PIDt	52	32
	PIDb	5	
17 to 19	PIDt	5	10
	PIDb	17	
15 to 17	PIDt	17	32
	PIDb	51	
13 to 15	PIDt	51	29
	PIDb	0	

RB-26			
		deltat = 0.23	
		deltab = 1.77	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	0	0
	PIDb	0	
25 to 27	PIDt	0	1
	PIDb	1	
23 to 25	PIDt	1	32
	PIDb	36	
21 to 23	PIDt	36	4
	PIDb	0	
19 to 21	PIDt	0	15
	PIDb	17	
17 to 19	PIDt	17	5
	PIDb	4	
15 to 17	PCEcorr	35	4
	PCEb	0	
13 to 15	PCEt	0	5,576
	PCEcorr	6,300	

ROWE INDUSTRIES SITE

RB-27			
		deltat =	1.78
		deltab =	0.22
depth ft MSL			weighted avg. conc
27 to 29	PIDt	17	16
	PIDb	12	
25 to 27	PIDt	12	15
	PIDb	35	
23 to 25	PCEcorr	35	33
	PCEb	18	
21 to 23	PCEt	18	20
	PCEcorr	35	
19 to 21	PIDt	55	52
	PIDb	27	
17 to 19	PIDt	27	32
	PIDb	69	
15 to 17	PCEcorr	35	32
	PCEb	11	

B-9			
		deltat =	0.13
		deltab =	1.87
depth ft MSL			weighted avg. conc
25 to 27	PIDt	200	294
	PIDb	300	
23 to 25	PIDt	300	253
	PIDb	250	
21 to 23	PCEcorr	33,750	19,959
	PCEb	19,000	
19 to 21	PCEt	19,000	32,791
	PCEcorr	33,750	
17 to 19	PIDt	290	66
	PIDb	50	
15 to 17	PIDt	50	134
	PIDb	140	
13 to 15	PIDt	140	26
	PIDb	18	

ROWE INDUSTRIES SITE

B-10			
		deltat = 1.35	
		deltab = 0.65	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	300	326
	PIDb	380	
25 to 27	PCEcorr	33,750	32,531
	PCEb	30,000	
23 to 25	PCEt	30,000	31,219
	PCEcorr	33,750	
21 to 23	PIDt	250	266
	PIDb	300	
19 to 21	PIDt	300	268
	PIDb	200	
17 to 19	PCEcorr	33,750	44,556
	PCEb	67,000	
15 to 17	PCEt	67,000	47,273
	PCEcorr	6,300	
13 to 15	PIDt	150	118
	PIDb	50	

B-11			
		deltat = 0.9	
		deltab = 1.1	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	3	67
	PIDb	120	
25 to 27	PIDt	120	104
	PIDb	90	
23 to 25	PIDt	90	85
	PIDb	80	
21 to 23	PIDt	80	201
	PIDb	300	
19 to 21	PIDt	300	190
	PIDb	100	
17 to 19	PIDt	100	89
	PIDb	80	

ROWE INDUSTRIES SITE

B-12			
		deltat =	0.29
		deltab =	1.71
depth ft MSL			weighted avg. conc
25 to 27	PIDt	12	70
	PIDb	80	
23 to 25	PIDt	80	46
	PIDb	40	
21 to 23	PIDt	40	134
	PIDb	150	
19 to 21	PIDt	150	124
	PIDb	120	
17 to 19	PIDt	120	180
	PIDb	190	
15 to 17	PIDt	190	79
	PIDb	60	

B-13			
		deltat =	1.46
		deltab =	0.54
depth ft MSL			weighted avg. conc
27 to 29	PIDt	110	161
	PIDb	300	
25 to 27	PIDt	300	246
	PIDb	100	
23 to 25	PIDt	100	122
	PIDb	180	
21 to 23	PIDt	180	212
	PIDb	300	
19 to 21	PCEcorr	33,750	25,205
	PCEb	2,100	

ROWE INDUSTRIES SITE

B-14			
		deltat =	1.15
		deltab =	0.85
depth ft MSL			weighted avg. conc
27 to 29	PIDt	20	46
	PIDb	80	
25 to 27	PIDt	80	89
	PIDb	100	
23 to 25	PIDt	100	100
	PIDb	100	
21 to 23	PIDt	100	228
	PIDb	400	
19 to 21	PIDt	400	379
	PIDb	350	
17 to 19	PIDt	350	286
	PIDb	200	

ROWE INDUSTRIES SITE

SOIL REMEDIATION
SAG HARBOR, NEW YORK

Signed: GJS
Checked: ANK
Date: 4/16/96

CALCULATION OF CONTOURS

Calculated by: Greg Souza

Checked by: Alfred N. Kovalik

STATEMENT OF PROBLEM

Given concentrations C1 and C2 separated by a distance D, determine the location of an arbitrary concentration C3 ($C1 < C3 < C2$). The two concentrations to be solved for are 1,500 ug/kg and 5,600 ug/kg. 1,500 ug/kg is the soil cleanup criteria for PCE required in the ROD and 5,600 ug/kg is the land disposal restriction concentration for PCE.

ASSUMPTIONS

1. Concentration varies linearly with distance between C1 and C2.
2. Distance, D, is measured in feet.
3. Concentrations used with each excavation layer were determined, in part, by PID-PCE correlations and weighting average procedures.

GENERAL EQUATIONS

Using Linear interpolation:

$$X1 := D \cdot \frac{(1500 - C1)}{(C2 - C1)}$$

$$X2 := D \cdot \frac{(5600 - C1)}{(C2 - C1)}$$

where:

X1 = distance from C1 to 1,500 micrograms per kilogram

X2 = distance from C1 to 5,600 micrograms per kilogram

ROWE INDUSTRIES SITE

SOLUTION

Excavation Layer ELEVATION 29 to 31

		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	6,300	35	39	9.12	34.64
RB-21	RB-25	6,300	19	39.5	9.31	35.10
RB-24	RB-26	25,382	35	65	3.76	14.27
RB-24	RB-18	25,382	35	101	5.84	22.17
RB-15	RB-25	6,300	19	46	10.85	40.87
RB-15	RB-23	6,300	35	40	9.35	35.53
RB-9	RB-23	6,300	35	25	5.85	22.21
RB-1	RB-23	6,300	35	19	4.44	16.88
RB-1	RB-14	6,300	35	51	11.93	45.30
RB-8	RB-18	9,381	35	26	4.08	15.48
RB-8	B-14	9,381	35	45	7.05	26.79
RB-8	RB-14	9,381	35	53.5	8.39	31.86
RB-6	RB-18	8,532	35	46	7.93	30.13
RB-6	RB-19	8,532	35	44	7.59	28.82
RB-6	RB-14	8,532	35	30	5.17	19.65
RB-7	RB-19	6,300	35	34	7.95	30.20
RB-7	RB-12	6,300	35	20	4.68	17.77
RB-13	B-14	120,000	35	22	0.27	1.02
RB-13	RB-12	120,000	35	33	0.40	1.53
B-10	RB-12	33,750	35	31	1.35	5.12
B-10	RB-5	33,750	35	21	0.91	3.47

Example of formulas used in spreadsheet

<u>Elevation 29 to 31</u>		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	6,300	35	39	$\frac{39(1500 - 35)}{(6300 - 35)}$	$\frac{39(5600 - 35)}{(6300 - 35)}$

ROWE INDUSTRIES SITE

Excavation Layer

ELEVATION 27 to 29

		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	33,750	35	39	1.69	6.44
RB-21	RB-25	33,750	35	39.5	1.72	6.52
RB-21	RB-24	33,750	38	42	1.82	6.93
RB-15	RB-25	6,300	35	46	10.76	40.86
RB-15	RB-23	6,300	35	40	9.35	35.53
RB-9	RB-23	6,300	35	25	5.85	22.21
RB-1	RB-23	6,300	35	24	5.61	21.32
RB-1	RB-14	6,300	35	51	11.93	45.30
RB-20	RB-24	6,300	38	43	10.04	38.19
RB-8	RB-24	79,363	38	90.5	1.67	6.35
RB-8	RB-18	79,363	32	26	0.48	1.82
RB-8	B-14	79,363	35	45	0.83	3.16
RB-8	RB-14	79,363	35	53.5	0.99	3.75
RB-6	RB-18	92,036	32	46	0.73	2.78
RB-6	RB-19	92,036	35	44	0.70	2.66
RB-6	B-14	92,036	35	30	0.48	1.81
RB-7	RB-19	5,611	35	34	8.93	33.93
RB-7	RB-12	5,611	2,678	20		19.92
RB-12	B-11	2,678	35	28	15.52	
B-10	RB-5	33,750	35	21	0.91	3.47
B-10	RB-12	33,750	2,678	31	-1.18	2.92
B-10	RB-10	33,750	35	36	1.56	5.94
B-10	RB-4	33,750	35	21	0.91	3.47
B-13	RB-4	6,300	35	33	7.72	29.31
RB-13	B-14	83,420	35	22	0.39	1.47
B-9	RB-2	33,750	35	13	0.56	2.15
B-9	RB-14	33,750	35	17	0.74	2.81
B-9	B-14	33,750	35	37	1.61	6.11
B-9	B-12	33,750	35	48	2.09	7.92

ROWE INDUSTRIES SITE

Excavation Layer ELEVATION 25 to 27

		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	33,750	35	39	1.69	6.44
RB-21	RB-25	33,750	21	39.5	1.73	6.53
RB-21	RB-24	33,750	86	42	1.76	6.88
RB-21	RB-15	33,750	358	33	1.13	5.18
RB-20	RB-24	2,014	86	43	31.54	
RB-20	RB-9	2,014	526	27	17.67	
RB-20	RB-15	2,014	358	31	21.38	
RB-8	RB-20	33,750	2,014	57		6.44
RB-8	RB-18	33,750	35	26	1.13	4.29
RB-8	RB-1	33,750	1,052	56	0.77	7.79
RB-8	RB-24	33,750	86	90.5	3.80	14.82
RB-8	RB-9	33,750	526	68	1.99	10.39
RB-6	RB-18	33,750	35	46	2.00	7.59
RB-6	RB-19	33,750	35	44	1.91	7.26
RB-6	RB-13	33,750	1,403	28	0.08	3.63
RG-6	RB-7	33,750	111	15	0.62	2.45
RB-12	RB-7	3,701	111	20	7.74	
B-11	RB-12	6,300	3,701	28		20.46
B-11	RB-11	6,300	35	19	4.44	16.88
B-11	RB-5	6,300	35	5	1.17	4.44
B-11	RB-19	6,300	35	63	14.73	55.96
RB-12	RB-19	3,701	35	42	16.78	
B-10	RB-5	32,531	35	21	0.95	3.60
B-10	RB-12	32,531	3,701	31		2.04
B-10	RB-10	32,531	35	36	1.62	6.17
B-10	RB-4	32,531	35	21.5	0.97	3.68
B-13	RB-13	33,750	1,403	4	0.01	0.52
B-13	RB-4	33,750	35	33	1.43	5.45
B-12	RB-4	6,300	35	5	1.17	4.44
B-12	RB-10	6,300	35	25	5.85	22.21
B-12	RB-3	6,300	35	51	11.93	45.30
RB-12	RB-13	3,701	1,403	33	1.39	
B-14	RB-13	6,300	1,403	22	0.44	18.86
B-9	RB-2	33,750	35	13	0.56	2.15
RB-14	RB-2	33,750	35	21	0.91	3.47
RB-14	RB-1	33,750	35	51	2.22	8.42

ROWE INDUSTRIES SITE

Excavation Layer ELEVATION 23 to 25

		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	33,750	35	39	1.69	6.44
RB-21	RB-25	33,750	17	39.5	1.74	6.54
RB-21	RB-24	33,750	35	42	1.83	6.93
RB-15	RB-25	8,370	17	46	8.17	30.75
RB-15	RB-24	8,370	35	51	8.96	34.05
BB-15	RB-9	8,370	2,500	22		11.62
RB-15	RB-23	8,370	1,509	40		23.85
RB-15	RB-27	8,370	33	53.5	9.41	35.72
RB-20	RB-24	17,824	35	43	3.54	13.45
RB-20	RB-9	17,824	2,500	27		5.46
RB-20	RB-18	17,824	2,997	76		13.34
RB-1	RB-9	10,988	2,500	25		9.13
RB-1	RB-23	10,988	1,509	24		10.36
RB-1	RB-14	10,988	35	51	6.82	25.91
RB-1	RB-2	10,988	35	60	8.03	30.48
RB-23	RB-27	1,509	33	19	18.88	
RB-18	RB-22	2,997	34	70	34.63	
RB-18	RB-17	2,997	23	79	39.23	
RB-18	RB-19	2,997	35	67	33.14	
RB-6	RB-7	33,750	178	15	0.59	2.42
RB-6	RB-19	33,750	35	44	1.91	7.26
RB-6	RB-18	33,750	2,997	46		3.89
RB-6	RB-13	33,750	66	28	1.19	4.60
RB-8	RB-18	6,300	2,997	26		20.49
B-14	RB-14	6,300	35	32	7.48	28.42
B-14	RB-13	6,300	66	22	5.06	19.53
B-13	RB-13	6,300	66	4	0.92	3.55
B-11	RB-12	6,300	693	28	4.03	24.50
B-11	RB-11	6,300	35	19	4.44	16.88
B-11	RB-5	6,300	35	5	1.17	4.44
B-10	RB-5	31,219	35	21	0.99	3.75
B-10	RB-4	31,219	35	21.5	1.01	3.84
B-10	RB-10	31,219	35	36	1.69	6.42
B-10	RB-12	31,219	693	30.5	0.81	4.90
B-9	B-12	33,750	35	49	2.13	8.09
B-9	RB-2	33,750	35	13	0.56	2.15
B-9	RB-14	33,750	35	18	0.78	2.97
B-13	RB-4	6,300	35	33	7.72	29.31
B-13	RB-13	6,300	66	4	0.92	3.55
RB-8	RB-14	6,300	35	53.5	12.51	47.52

ROWE INDUSTRIES SITE

Excavation Layer
ELEVATION 21 to 23

		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	14,852	35	39	3.86	14.65
RB-21	RB-25	14,852	35	39.5	3.91	14.84
RB-21	RB-24	14,852	35	42	4.15	15.77
RB-15	RB-24	15,307	35	51	4.89	18.58
RB-15	RB-25	15,307	35	46	4.41	16.76
RB-15	RB-9	15,307	3,009	22		4.64
RB-15	RB-27	15,307	20	53.5	5.18	19.53
RB-20	RB-9	31,309	3,009	27		2.47
RB-20	RB-1	31,309	91	42	1.90	7.41
RB-9	RB-1	3,009	91	25	12.07	
RB-23	RB-9	6,300	3,009	25		19.68
RB-23	RB-1	6,300	91	24	5.45	21.29
RB-23	RB-27	6,300	20	19	4.48	16.88
RB-20	RB-24	31,309	35	43	2.01	7.65
RB-18	RB-24	32,241	35	101	4.59	17.45
RB-18	RB-22	32,241	22	70	3.21	12.12
RB-18	RB-17	32,241	31	79	3.60	13.66
RB-18	RB-19	32,241	18	67	3.08	11.61
RB-6	RB-19	38,616	18	44	1.69	6.36
RB-7	RB-19	33,246	18	34	1.52	5.71
RB-6	RB-13	38,616	73	28	1.04	4.02
RB-7	RB-13	33,246	73	31	1.33	5.16
B-14	RB-13	33,750	73	23	0.97	3.77
B-13	RB-13	33,750	73	4	0.17	0.66
RB-7	RB-12	33,246	1,099	20	0.25	2.80
B-11	RB-12	33,750	1,099	28	0.34	3.86
B-11	RB-11	33,750	23	19	0.83	3.14
B-11	RB-5	33,750	72	5	0.21	0.82
B-10	RB-5	33,750	72	21	0.89	3.45
B-10	RB-10	33,750	35	36	1.56	5.94
B-10	RB-4	33,750	451	21.5	0.68	3.32
B-12	RB-10	6,300	35	25	5.85	22.21
B-12	RB-4	6,300	451	5	0.90	4.40
B-13	RB-4	33,750	451	33	1.04	5.10
B-9	RB-2	19,959	35	13	0.96	3.63
RB-14	RB-2	6,080	35	21	5.09	19.33
RB-14	RB-1	6,080	91	50.5	11.88	46.45
B-12	RB-3	6,300	31	51	11.95	45.31

ROWE INDUSTRIES SITE

Excavation Layer						
<u>ELEVATION 19 to 21</u>		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-20	RB-24	10,638	35	43	5.94	22.57
RB-20	RB-15	10,638	25	31	4.31	16.28
RB-20	RB-9	10,638	3,276	27		8.52
RB-20	RB-1	10,638	39	42	5.79	22.04
RB-9	RB-15	3,276	25	22	9.98	
RB-9	RB-1	3,276	39	25	11.28	
RB-23	RB-1	4,821	39	24	7.33	
RB-23	RB-15	4,821	25	40	12.30	
RB-23	RB-27	4,821	35	19	5.82	
RB-8	RB-24	33,750	35	90.5	3.93	14.94
RB-8	RB-1	33,750	39	56	2.43	9.24
RB-8	RB-14	33,750	6	53.5	2.37	8.87
RB-18	RB-24	17,509	35	101	8.47	32.17
RB-18	RB-19	17,509	5	67	5.72	21.42
RB-6	RB-19	83,265	5	44	0.79	2.96
RB-6	RB-13	83,265	101	28	0.47	1.85
RB-7	RB-19	33,750	5	34	1.51	5.64
RB-7	RB-13	33,750	101	31	1.29	5.07
RB-12	RB-19	28,396	5	42	2.21	8.28
RB-12	RB-5	28,396	93	28	1.39	5.45
RB-12	RB-13	28,396	101	33	1.63	6.41
B-11	RB-19	6,300	5	63	14.96	55.99
B-11	RB-5	6,300	93	5	1.13	4.44
RB-11	RB-19	14,686	5	79	8.04	30.11
RB-11	RB-16	14,686	35	19	1.90	7.22
RB-11	RB-5	14,696	93	19	1.83	7.17
B-10	RB-5	33,750	93	21	0.88	3.44
B-10	RB-10	33,750	35	36	1.56	5.94
B-10	RB-4	33,750	2,649	21.5		2.04
B-10	RB-13	33,750	101	29	1.21	4.74
B-13	RB-13	33,750	101	4	0.17	0.65
B-13	RB-4	33,750	2,649	33		3.13
B-14	RB-13	33,750	101	22	0.91	3.60
B-14	RB-14	33,750	6	32	1.42	5.30
RB-4	RB-10	2,649	35	25	14.01	
B-12	RB-10	6,300	35	25	5.85	22.21
B-12	RB-3	6,300	31	51	11.95	45.31
B-9	RB-2	32,791	35	13	0.58	2.21
B-9	RB-14	32,791	6	18	0.82	3.07

ROWE INDUSTRIES SITE

Excavation Layer						
<u>ELEVATION 17 to19</u>		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-23	RB-27	7,937	35	19	3.52	13.38
RB-23	RB-15	7,937	35	40	7.42	28.17
RB-23	RB-1	7,937	35	24	4.45	16.90
RB-9	RB-20	9,750	3	27	4.15	15.50
RB-9	RB-15	9,750	35	22	3.32	12.60
RB-9	RB-1	9,750	35	25	3.77	14.32
RB-8	RB-24	39,168	35	90.5	3.39	12.87
RB-8	RB-20	39,168	3	57	2.18	8.15
RB-8	RB-1	39,168	35	56	2.10	7.96
RB-8	RB-14	39,168	35	53.5	2.00	7.61
RB-8	RB-6	39,168	538	52	1.29	6.81
RB-18	RB-24	33,750	35	101	4.39	16.67
RB-18	RB-19	33,750	9	67	2.96	11.10
RB-18	RB-7	33,750	35	58	2.52	9.57
RB-18	RB-6	33,750	538	46	1.33	7.01
RB-12	RB-19	26,444	9	42	2.37	8.88
RB-12	RB-5	26,444	36	28	1.55	5.90
RB-12	RB-13	26,444	27	33	1.84	6.96
RB-12	RB-7	26,444	35	20	1.11	4.21
B-11	RB-19	6,300	9	63	14.93	55.99
B-11	RB-5	6,300	36	5	1.17	4.44
RB-11	RB-19	19,074	9	63	4.93	18.48
RB-11	RB-16	19,074	35	19	1.46	5.55
RB-11	RB-5	19,074	36	19	1.46	5.55
RB-11	RB-10	19,074	35	45	3.46	13.15
B-10	RB-5	44,556	36	21	0.69	2.62
B-10	RB-10	44,556	35	36	1.18	4.50
B-10	RB-4	44,556	194	21.5	0.63	2.62
B-12	RB-10	6,300	35	25	5.85	22.21
B-12	RB-4	6,300	194	5	1.07	4.43
B-12	RB-3	6,300	35	51	11.93	45.30
B-12	B-9	6,300	35	49	11.46	43.53
B-13	RB-4	25,205	194	33	1.72	7.13
B-13	RB-13	25,205	27	4	0.23	0.89
B-13	B-9	25,205	35	45	2.62	9.95
B-14	RB-13	33,750	27	22	0.96	3.64
B-14	RB-6	33,750	538	37	1.07	5.64
B-14	RB-14	33,750	35	32	1.39	5.28
B-14	B-9	33,750	35	27	1.17	4.46

ROWE INDUSTRIES SITE

Excavation Layer						
<u>ELEVATION 15 to 17</u>		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	3,529	4	39	16.55	
RB-21	RB-25	3,529	35	39.5	16.56	
RB-24	RB-26	6,300	4	65	15.44	57.77
RB-24	RB-20	6,300	24	43	10.11	38.20
RB-24	RB-15	6,300	35	51	11.93	45.30
RB-23	RB-15	25,819	35	40	2.27	8.63
RB-23	RB-27	25,819	32	19	1.08	4.10
RB-23	RB-1	25,819	35	24	1.36	5.18
RB-23	RB-2	25,819	29	72	4.11	15.55
RB-23	RB-9	25,819	9	25	1.44	5.42
RB-8	RB-20	77,583	24	57	1.08	4.10
RB-8	RB-1	77,583	35	56	1.06	4.02
RB-8	RB-14	77,583	35	53.5	1.01	3.84
RB-18	RB-19	33,750	11	67	2.96	11.10
RB-6	RB-19	5,799	11	44	11.32	42.49
RB-6	RB-13	5,799	6	28	7.22	27.04
RB-7	RB-19	15,761	11	34	3.21	12.07
RB-7	RB-13	15,761	6	31	2.94	11.01
RB-7	RB-12	15,761	4,154	20		2.49
RB-12	RB-19	4,154	11	42	15.09	
B-11	RB-19	6,300	11	63	14.92	55.99
B-11	RB-11	6,300	10	19	4.50	16.89
B-11	RB-5	6,300	36	5	1.17	4.44
B-10	RB-5	47,273	36	21	0.65	2.47
B-10	RB-11	47,273	10	45	1.42	5.32
B-10	RB-16	47,273	35	54	1.67	6.36
B-10	RB-10	47,273	35	36	1.12	4.24
B-10	RB-4	47,273	34	21.5	0.67	2.53
B-10	RB-13	47,273	6	30	0.95	3.55
B-10	RB-12	47,273	4,154	31		1.04
B-12	RB-4	6,300	34	5	1.17	4.44
B-12	RB-10	6,300	35	25	5.85	22.21
B-12	RB-3	6,300	35	51	11.93	45.30
B-13	RB-13	2,100	6	4	2.85	10.69
B-14	RB-13	33,750	6	22	0.97	3.65
B-14	RB-14	33,750	35	32	1.39	5.28
B-9	RB-13	6,300	6	46	10.92	40.88
B-9	RB-14	6,300	35	18	4.21	15.99
B-9	RB-2	6,300	29	13	3.05	11.55

ROWE INDUSTRIES SITE

Excavation Layer ELEVATION 13 to 15

		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	6,300	5,576	39		1.29
RB-21	RB-25	6,300	35	39.5	9.24	35.09
RB-21	RB-24	6,300	35	42	9.82	37.31
RB-21	RB-15	6,300	35	33	7.72	29.31
RB-20	RB-24	6,300	35	43	10.06	38.20
RB-20	RB-15	6,300	35	31	7.25	27.54
RB-20	RB-9	6,300	35	27	6.31	23.98
RB-20	RB-1	6,300	35	22	5.14	19.54
RB-8	RB-24	33,750	35	90.5	3.93	14.94
RB-8	RB-9	33,750	35	68	2.95	11.22
RB-8	RB-6	33,750	400	52	1.72	8.11
RB-18	RB-24	33,750	35	101	4.39	16.67
RB-18	RB-6	33,750	400	46	1.52	7.17
RB-7	RB-6	33,484	400	15	0.50	2.36
RB-13	RB-6	10,464	400	28	3.06	14.47
RB-13	RB-14	10,464	35	49	6.88	26.15
RB-12	RB-5	33,750	35	28	1.22	4.62
B-10	RB-5	6,300	35	21	4.91	18.65
B-10	RB-10	6,300	9	36	8.53	31.99
RB-4	RB-10	6,300	9	20	4.74	17.77
RB-4	B-9	6,300	35	51	11.93	45.30
RB-26	RB-24	5,576	35	65	17.19	65.28
RB-26	RB-25	5,576	35	56	14.81	56.24

PROBLEM STATEMENT: Estimate daily volume of soil which can be excavated & Tempa Staged onsite during soil Remediation

PROBLEM CONSTRAINTS:

1. Caterpillar Model 350 with Reach Boom with 2.88 yd³ General purpose bucket. Pay load [1, page 4-72]
2. 6 hour work Day taking into account start-up, down-time, etc.
3. 0.60% Digging / Job efficiency taking into account stops in digging or sampling.
4. 0.42 minutes/cycle, 2.88 yd³ Bucket Payload, yields ≈ 412 Loose yd³/hr [1, page 4-106-4-108]

REFERENCES:

[1] CATERPILLAR PERFORMANCE HANDBOOK, 1973

ANALYSIS:

$$\text{Actual yd}^3/\text{hr} = 412 \text{ yd}^3/\text{hr} \times 0.60 = 247 \text{ yd}^3/\text{hr}$$

$$\text{Actual yd}^3/\text{day} = 247 \text{ yd}^3/\text{hr} \times 6 \text{ hrs} = 1482 \text{ yd}^3/\text{day}$$

Conclusion:

Model type may be excessive for job, However physical Restraints (i.e. depth of excavation & Access to excavation) this model type is Required.

PROBLEM STATEMENT: Determine Sheet Pile penetrating Depth. BASED ON RESULTS, DETERMINE IF A CANTELEVER TYPE WALL IS ACCEPTABLE.

PROBLEM CONSTRAINTS:

1. Loose uniform Sand
2. Angle of Repose for Sand, $\phi \approx 30^\circ$ [Table 1.3, DAS]
3. Unit weight of Sand, $\gamma_{\text{soil}} = 92.16/\text{ft}^3$ [Table 1.3, DAS]
4. Depth of Cut = 18 ft
5. Depth of Water Table = 17 ft [1]
6. Weight of excavator (CAT 350, General purpose bucket)
104,960 lb [3]
1.1 LOAD FACTOR
115,456 $\rightarrow$ USE 116 k.p

REFERENCES:

- [1] LBG, RI Appendix XI, Boring Logs, 1992.
- [2] DAS, BRAJA, PRINCIPLES OF FOUNDATION ENGINEERING, PWS-KENT, Boston, 1990.
- [3] CATERPILLAR, INC., CATERPILLAR PERFORMANCE HANDBOOK, 1993.

ASSUMPTION

$$\text{Unit weight of SATURATED SAND, } \gamma_{\text{SAT}} = \frac{G_s \gamma_w + e \gamma_w}{1 + e} \quad [\text{Eq. 1.15, DAS}]$$

where G_s = Specific gravity of soil ≈ 2.65 [Table 1.2, DAS]

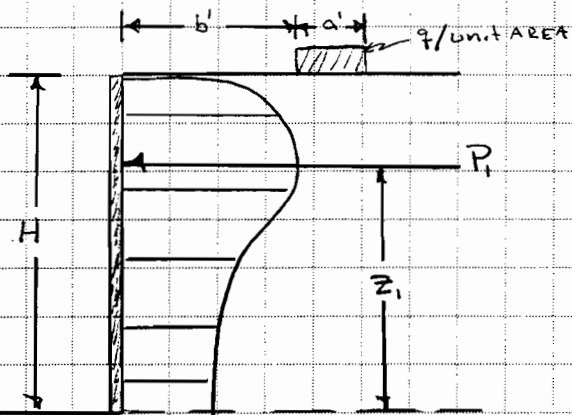
γ_w = Unit weight of water $\approx 62.4 \text{ lb/ft}^3$

e = Void Ratio = 0.8 (loose sand) [Table 1.3, DAS]

$$\gamma_{\text{SAT}} = \frac{(2.65)(62.4 \text{ lb/ft}^3) + 0.8(62.4 \text{ lb/ft}^3)}{1 + 0.8} = 119.6 \text{ lb/ft}^3$$

ANALYSIS:

Determine the Maximum Pressure (P_1) on the sheet pile wall, caused by the Strip load of the excavator + location of the center of the Pressure, P_1 .



Set $b' = 0$ to get Max. P_1
 $a' = 1$ (assume outrigger 1 ft²)
 $H = 18$ ft - depth of cut
 $q = \frac{W}{4(\# \text{ of outriggers})} = \frac{116,000}{4}$
 $= 29,000 \text{ lb/ft}^2$

$$\theta_1 = \tan^{-1}\left(\frac{b'}{H}\right) = \tan^{-1}\left(\frac{0}{18}\right) = 0 \quad [\text{Ex. 5.40, DAS}]$$

$$\theta_2 = \tan^{-1}\left(\frac{a' + b'}{H}\right) = \tan^{-1}\left(\frac{1}{18}\right) = 3.18 \quad [\text{Ex. 5.41, DAS}]$$

[DAS]

$$P_1 = \frac{q}{90} [H(\theta_2 - \theta_1)] = \frac{(29,000)(18)}{90} [(18)(3.18)] = 18,444 \text{ lb/ft} \quad [\text{Ex. 5.39, DAS}]$$

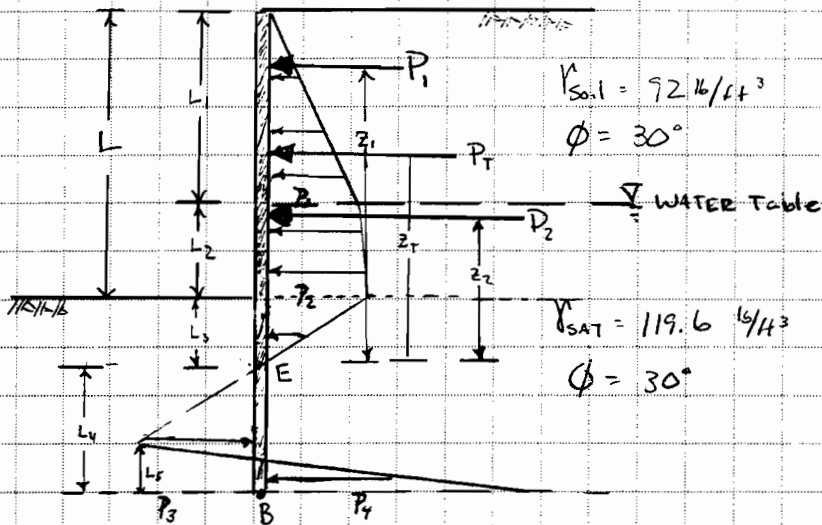
$$z_1 = \frac{H^2(\theta_2 - \theta_1) - (R - Q) + 57.3 a' H}{2 H (\theta_2 - \theta_1)} \quad [\text{Ex. 5.42, DAS}]$$

$$R = (a' + b')^2 (90 - \theta_2) = (1)^2 (90 - 3.18) = 86.82 \text{ ft} \quad [\text{Ex. 5.43, DAS}]$$

$$Q = (b')^2 (90 - \theta_1) = 0 \quad [\text{Ex. 5.44, DAS}]$$

$$z_1 = \frac{(18)^2 (3.18) - (86.82 \text{ ft}) + 57.3 (1)(18)}{2 (18)(3.18)} = 17.25 \text{ ft.}$$

Determine the Pressure Distribution due to Earth Pressure above point E.



given: $L_1 = 17 \text{ ft}$
 $L_2 = 1 \text{ ft}$

$$K_a = \text{Rankine Active Pressure Coefficient} = 0.2973 \quad [\text{Table 5.3 DAS}]$$

$$K_p = \text{Rankine Passive Pressure Coefficient} = 3.0 \quad [\text{Table 5.4 DAS}]$$

$$\begin{aligned} \gamma' &= \text{effective unit weight of soil} = \gamma_{\text{sat}} - \gamma_w \\ &= 119.6 - 62.4 \\ \gamma' &= 57.2 \text{ lb/ft}^3 \end{aligned}$$

$$P_1 = \gamma L_1 K_a = (92 \text{ lb/ft}^3)(17 \text{ ft})(0.2973) = 465.0 \text{ lb/ft}^2 \quad [\text{Eq. 6.1, DAS}]$$

$$P_2 = (\gamma L_1 + \gamma' L_2) K_a = [(92 \text{ lb/ft}^3)(17 \text{ ft}) + (57.2 \text{ lb/ft}^3)(1 \text{ ft})](0.2973) = 482.0 \text{ lb/ft}^2 \quad [\text{Eq. 6.2, DAS}]$$

$$L_3 = \frac{P_2}{\gamma' (K_p - K_a)} = \frac{482 \text{ lb/ft}^2}{(57.2 \text{ lb/ft}^3)(3 - 0.2973)} = 3.18 \text{ ft} \quad [\text{Eq. 6.6, DAS}]$$

Determine Pressure (P_z) due to Earth Pressure above point E.

$$\begin{aligned} P_z &= \frac{1}{2} p_1 L_1 + p_1 L_2 + \frac{1}{2} (p_2 - p_1) L_2 + \frac{1}{2} p_2 L_3 \\ &= \frac{1}{2} (465 \text{ lb/ft}^2) (17 \text{ ft}) + (465 \text{ lb/ft}^2) (1 \text{ ft}) + \frac{1}{2} (482 - 465 \text{ lb/ft}^2) (1 \text{ ft}) + \frac{1}{2} (482 \text{ lb/ft}^2) (3.18 \text{ ft}) \\ &= 3953 \text{ lb/ft} + 465 \text{ lb/ft} + 8.5 \text{ lb/ft} + 766.3 \text{ lb/ft} \\ &= 5192 \text{ lb/ft} \end{aligned}$$

Take Moment about point E to determine location of the center of P_z above point E.

$$\begin{aligned} z_z &= \frac{1}{P_z} \left[\frac{1}{2} p_1 L_1 \left(L_3 + L_2 + \frac{L_1}{3} \right) + p_1 L_2 \left(L_3 + \frac{L_2}{2} \right) + \frac{1}{2} (p_2 - p_1) L_2 \left[L_3 + \frac{L_2}{3} \right] + \frac{1}{2} p_2 L_3 \left(\frac{2L_3}{3} \right) \right] \\ &= \frac{1}{5192} \left[3953 \text{ lb/ft} \left(3.18 + 1 + \frac{17}{3} \right) \text{ ft} + 465 \text{ lb/ft} \left(3.18 + \frac{1}{2} \right) \text{ ft} + 8.5 \text{ lb/ft} \left(3.18 + \frac{1}{3} \right) \text{ ft} + 766.3 \text{ lb/ft} \left(3.18 \right) \left(\frac{2}{3} \right) \text{ ft} \right] \\ &= 8.15 \text{ ft} \end{aligned}$$

Determine Total Pressure (P_T) due to Surcharge Pressure (P_1) & Earth Pressure (P_2)

$$P_T = P_1 + P_2 = 18,444 \text{ lb/ft} + 5192 \text{ lb/ft} = 23,636 \text{ lb/ft}$$

Take Moment about E to determine location of the center of P_T above point E.

$$\begin{aligned} z_T &= \frac{P_1(z_1 + L_3) + P_2 z_z}{P_T} = \frac{18444 \text{ lb/ft} (17.25 + 3.18) + (5192 \text{ lb/ft}) (8.15 \text{ ft})}{23,636 \text{ lb/ft}} \\ &= 17.73 \text{ ft} \end{aligned}$$

$$P_4 = P_3 + \gamma' L_4 (k_p - k_a) \quad [\text{Eq. 6.10, DAS}]$$

$$= 5355 \text{ lb/ft}^2 + (57.2 \text{ lb/ft}^3)(3 - 0.2973)(41.4) = 11,755 \text{ lb/ft}^2$$

$$P_3 = \gamma' (k_p - k_a) L_4 = (57.2 \text{ lb/ft}^3)(3 - 0.2973)(41.4) = 6400 \text{ lb/ft}^2 \quad [\text{Eq. 6.7 DAS}]$$

$$L_5 = \frac{P_3 L_4 - 2 P_4}{P_3 + P_4} = \frac{(6400)(41.4) - 2(23,636)}{6400 + 11,755} \quad [\text{Eq. 6.15, DAS}]$$

$$L_5 = 11.99 \text{ ft}$$

Theoretical depth of penetration:

$$D_r = L_3 + L_4 = 3.18' + 41.4 = 44.58 \quad [\text{Eq. 6.12, DAS}]$$

Actual depth of penetration = 1.2 Depth of Theoretical

(Actual depth of penetration is increased by 20-30%) [2]

$$D_a = 1.2 D_r = 1.2(44.58) = 53.5 \text{ ft}$$

CONCLUSION

SHRIMP DESIGNED TO BE IT IS STRICTLY AS A CANTILEVER WALL IS IMPRACTICAL DUE TO THE ACTUAL PENETRATION DEPTH REQUIRED. THEREFORE, ANOTHER FORM OF SHRIMP SHOULD BE EMPLOYED (I.E. ANCHORED SHEET PILING);

LBG ENGINEERING SERVICES, INC.

126 MONROE TURNPIKE

TRUMBULL, CT 06611

(203) 452-3110 • FAX (203) 452-3119

JOB _____

SHEET NO. _____

OF _____

CALCULATED BY _____

DATE _____

CHECKED BY _____

DATE _____

SCALE _____

Determine the net lateral pressure at the bottom of the sheet pile, point B.

1. calculate P_B

$$P_B = (\gamma L_1 + \gamma' L_2) k_p + \gamma' L_3 (k_p - k_a) \quad [\text{Eq. 6.11, DAS}]$$

$$= [(92.4/43)(17.4) + (57.2/43)(1.4)](3) + (57.2/43)(3.18)(3 - 0.2973)$$

$$= 5355 \text{ lb/ft}^2$$

2. calculate L_y using the following (from taken moment of all forces about point B)

$$A_1 = \frac{P}{\gamma' (k_p - k_a)} = \frac{5355}{(57.2)(3 - 0.2973)} = 34.6 \quad [\text{Eq. 6.17, DAS}]$$

$$A_2 = \frac{8 P_T}{\gamma' (k_p - k_a)} = \frac{8(23,636)}{57.2(3 - 0.2973)} = 1223 \quad [\text{Eq. 6.18, DAS}]$$

$$A_3 = \frac{6 P_T [2 z_T \gamma' (k_p - k_a) + P_B]}{\gamma'^2 (k_p - k_a)^2} = \frac{6(23,636) [2(17.73)(57.2)(3 - 0.2973) + 5355]}{(57.2)^2 (3 - 0.2973)^2} = 64,304 \quad [\text{Eq. 6.19, DAS}]$$

$$A_4 = \frac{P_T (6 z_T P_B + 4 P_T)}{\gamma'^2 (k_p - k_a)^2} = \frac{(23,636) [6(17.73)(5355) + 4(23,636)]}{(57.2)^2 (3 - 0.2973)^2} = 656,887 \quad [\text{Eq. 6.20, DAS}]$$

$$L_y^4 + A_1 L_y^3 - A_2 L_y^2 - A_3 L_y - A_4 = 0 \quad [\text{Eq. 6.16, DAS}]$$

$$L_y^4 + 34.6 L_y^3 - 1223 L_y^2 - 64,304 L_y - 656,887 = 0$$

$$L_y = 41.4 \text{ feet}$$

ROW 112.95' 2' 5" SW
SPG 112.95' 2' 5" SW

PROBLEM STATEMENT

DETERMINE GEOMETRY OF SOIL IMPOUNDMENT AND
CHECK STABILITY OF STRUCTURE IF DESIGNED AS A
"DURE" GRAVITY RETAINING WALL.

ASSUMPTIONS:

1. SOIL TO BE TREATED CONSISTS OF LOOSE SAND (UNIFORM) [2]
2. UNIT WEIGHT OF CONCRETE ≈ 150 lb/c.f.
3. FRICTION COEFFICIENT FOR ASPHALT & CONCRETE CAN BE
APPROXIMATED BY μ FOR WOOD ON BRICK $\rightarrow 0.6$ [2]
4. APPROXIMATE VOLUME OF SOIL TO BE TREATED, V_T , IS
744 cy (20,090 c.f.)
5. APPROXIMATE FOOTPRINT OF SOIL IMPOUNDMENT IS
20 FEET $\times$ 80 FEET (BASED ON SITE CONSTRAINTS)
6. ANGLE OF REPOSE FOR SAND, $\phi \approx 30^\circ$ [3]

ANALYSIS

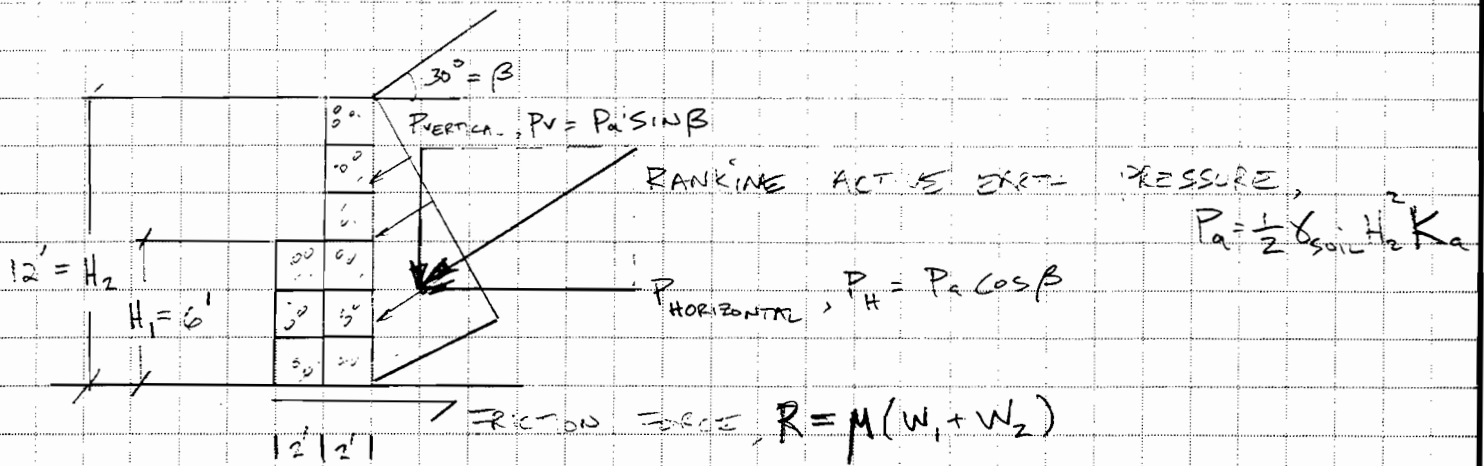
1. DETERMINING APPROXIMATE HEIGHT OF IMPOUNDMENT.

$$\frac{\text{VOLUME}}{\text{AREA}} = \text{HEIGHT} \quad , \quad \frac{20,090 \text{ c.f.}}{(20 \text{ ft} \times 80 \text{ ft})} = 12.55, \text{ USE 12 FEET}$$

2. USE CONCRETE BLOCKS FOR STRUCTURE. STANDARD BLOCK SIZES ARE:

$$\begin{aligned} 2 \text{ ft} \times 2 \text{ ft} &= 4 \text{ sq ft} \\ 2 \text{ ft} \times 2 \text{ ft} &= 4 \text{ sq ft} \\ 2 \text{ ft} \times 2 \text{ ft} &= 4 \text{ sq ft} \end{aligned}$$

3. THE FORCES ACTING ON A 2 FT HIGH WALL ARE
GRAPHICALLY SHOWN AS [3]



4. γ_{soil} FOR LOOSE UNIFORM SAND $\approx 92 \frac{\text{lb}}{\text{ft}^3}$ [2]

5. DETERMINE VALUES FOR FORCES REQUIRED IN ANALYSIS.

• WITH A $\beta = 30^\circ$, $K_a = 0.866$ [3]

$$P_a = \frac{1}{2} \left(92 \frac{\text{lb}}{\text{ft}^3} \right) (12')^2 (0.866) = 5736 \frac{\text{lb}}{\text{ft}}$$

$$P_V = 5736 \sin 30^\circ = 2868 \frac{\text{lb}}{\text{ft}}$$

$$P_H = 5736 \cos 30^\circ = 4968 \frac{\text{lb}}{\text{ft}}$$

• $W_1 = (6')(2') \left(92 \frac{\text{lb}}{\text{ft}^3} \right) = 1800 \frac{\text{lb}}{\text{ft}}$

$$W_2 = (12')(2') \left(150 \frac{\text{lb}}{\text{ft}^3} \right) = 3600 \frac{\text{lb}}{\text{ft}}$$

$$R = 0.6 (1800 + 3600) = 3240 \frac{\text{lb}}{\text{ft}}$$

6. FACTOR OF SAFETY FOR SLIDING = $\frac{\text{FORCE RESISTING}}{\text{FORCE DRIVING}} = \frac{R}{P_H}$

$$(F.S.)_{\text{SLIDING}} = \frac{3240}{4968} = 0.65 < 1 \quad \therefore \text{NO GOOD.}$$

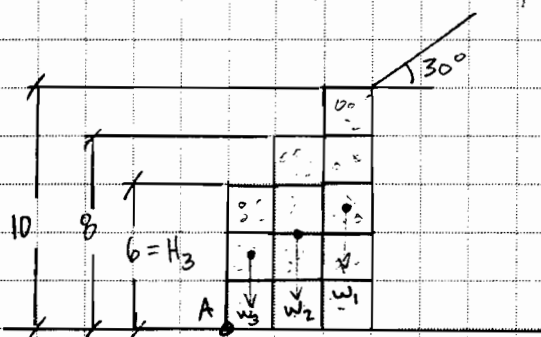
7. TO REDUCE THE DRIVING FORCE, CHANGE H_2 TO 10 FEET.

$$F_o = \frac{1}{2} (32)(10)^2 (0.866) = 3030 \quad \text{AND} \quad P_H = 3030 \cos 30^\circ = 3450 \frac{\text{lb}}{\text{ft}}$$

$$R = 0.6 [(2)(6) - (2)(3) - (2)(10)] (150) = 2880 \frac{\text{lb}}{\text{ft}}$$

F.S. STILL NO GOOD

8. ATTEMPT TO INCREASE RESISTING FORCE BY USING THE FOLLOWING CONFIGURATIONS



$$P_H = 3450 \frac{\text{lb}}{\text{ft}} \quad \& \quad R = 0.6 [(2)(6) - (2)(3) - (2)(10)] (150) = 4320 \frac{\text{lb}}{\text{ft}}$$

$$(F.S.)_{\text{SLIDING}} = \frac{4320}{3450} = 1.25 \quad \text{ACCEPTABLE F.S. FOR APPLICATION}$$

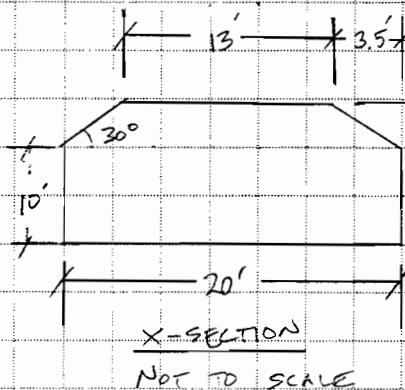
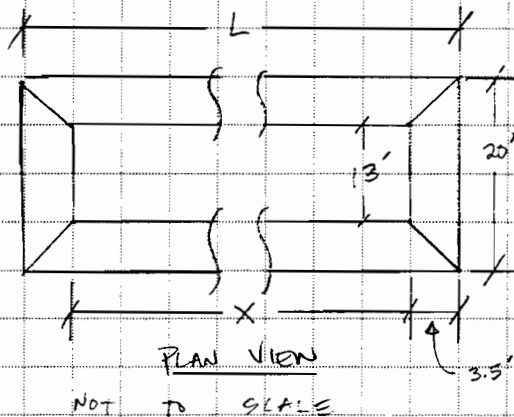
$$9. \text{FACTOR OF SAFETY FOR OVERTURNING} = \frac{\text{MOMENT}_{\text{RESISTING}}}{\text{MOMENT}_{\text{DRIVING}}}$$

$$\frac{(\text{MOMENT})_{\text{RESISTING}}}{(\text{MOMENT})_{\text{DRIVING}}} = \frac{(W_3)(1) + (W_2)(3) + (W_1)(5) + P_H(6)}{P_H \left(\frac{1}{3} \right) (H_1)} = (F.S.)_{\text{OVERTURNING}}$$

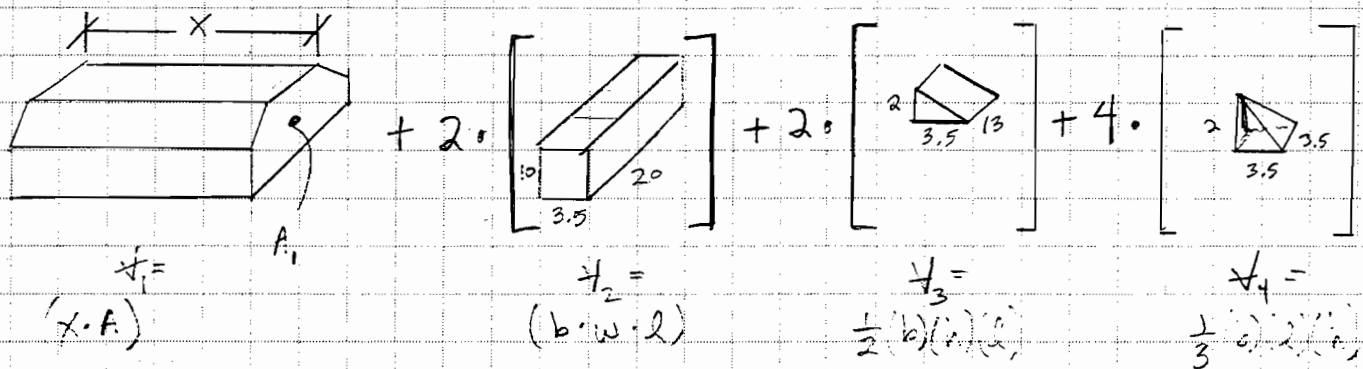
$$(F.S.)_{\text{OVERTURNING}} = \frac{(2)(6)(150)(1) + (2)(3)(150)(3) + (2)(10)(150)(5) + 3984 \sin 30^\circ (6)}{3450 \left(\frac{1}{3} \right) (10)}$$

$$(F.G.) \text{ DRAINAGE} = \frac{35,250 \frac{\text{cu. ft.}}{\text{ft.}}}{11,500 \frac{\text{cu. ft.}}{\text{ft.}}} = 3.2 \quad \text{ACCEPTED FOR FILLING}$$

10. THE SOIL IN THE IMPONEMENT WILL BE STORED USING THE FOLLOWING SECTIONS:



11. THE VOLUME OF SOIL STORED IN THE IMPONEMENT IS EQUIVALENT TO THE SUM OF THE FOLLOWING IMPONEMENT SUBSECTIONS:



$$A_1 = (13)(20) + 2(3.5)(10) + 2\left(\frac{1}{2}\right)(3.5)(2)$$

$$A_1 = 233 \text{ S.F.}$$

12. VOLUME OF SOIL IN X IS EQUAL TO:

$$V_1 = X \cdot A_1 = V_1 - 2V_2 - 2V_3 - 4V_4 \quad \text{SO,}$$

$$X = \frac{V_1 - 2V_2 - 2V_3 - 4V_4}{A_1}$$

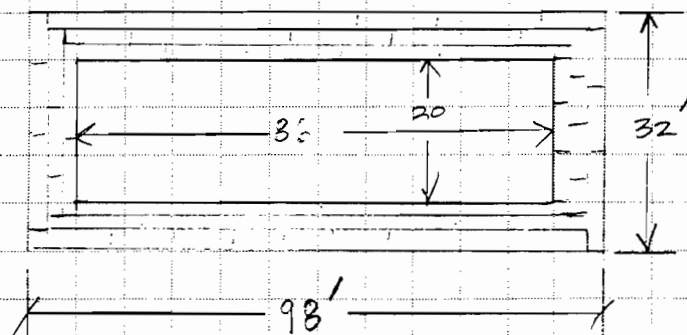
$$X = \frac{20,090 - 2(10)(3.5)(20) - 2\left(\frac{1}{2}\right)(2)(3.5)(13) - 4\left(\frac{1}{3}\right)(3.5)(3.5)(2)}{255 \text{ s.f.}}$$

$$X = 79.6 \text{ Feet}$$

13. IF $L = X + 2(3.5)$, THEN

$$L = 79.6 + 7 = 86.6 \text{ Feet, USE } 86 \text{ Feet}$$

14. GIVEN THE GEOMETRY OF THE INDEPENDENT STRUCTURE THE FOOT PRINT OF THE INDEPENDENT IS:



Problem Statement: Determine Size & Stability of the Gravity Wall

Problem Constraints:

1. loose uniform sand [1]
2. Unit weight of concrete
Block = 4200 lb. for Concrete Block 2 ft x 2 ft x 8 ft [2]
3. Friction coefficient, μ Asphalt & concrete
 $\approx \mu$ of wood on brick = 0.6 [3]
4. Angle of Repose for Sand $\phi = 30^\circ$ [4]

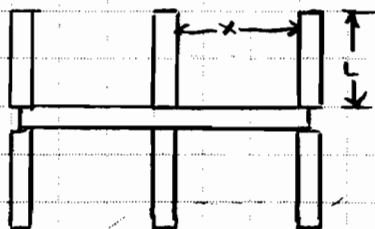
References:

- [1] LBG, RI, Appendix XI, Boring logs, 1992.
- [2] Personal Correspondence with Suffolk Cement Precast, NY.
- [3] Das, BRISA, Principles of Foundation Engineering, PWS-KENT, Boston, 1980.
- [4] Bowles, Joseph, Foundation Analysis and design, McGraw-Hill, 1988.

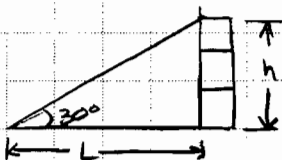
ANALYSIS:

1. Storage Cell Sizing

- calculate the Height of a temporary Holding Cell sized to hold approximately 10-15 c.y. of soil



Assume: $x = 10 \text{ ft}$
 $L = 10 \text{ ft}$



$$h = L \tan 30^\circ$$

$$h = 10 \cdot \tan 30^\circ$$

$$h = 5.77 \text{ ft} \quad \text{use } h = 6 \text{ ft}$$

$$V = \frac{1}{2} h \cdot L \cdot x$$

$$= \frac{1}{2} (6.0)(10)(10)$$

$$V = 300 \text{ cf} = 11.1 \text{ cy} \quad \text{OK}$$

1- Storage Cell Step-up

- need to contain 10-15 c.y. of soil in each cell

- Concrete Blocks for walls; Block size come as:

2' x 2' x 4'

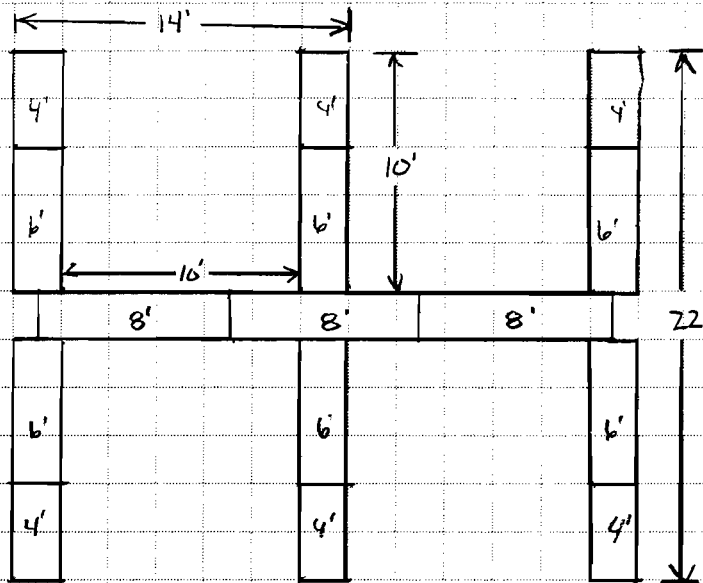
2' x 2' x 6'

2' x 2' x 8'

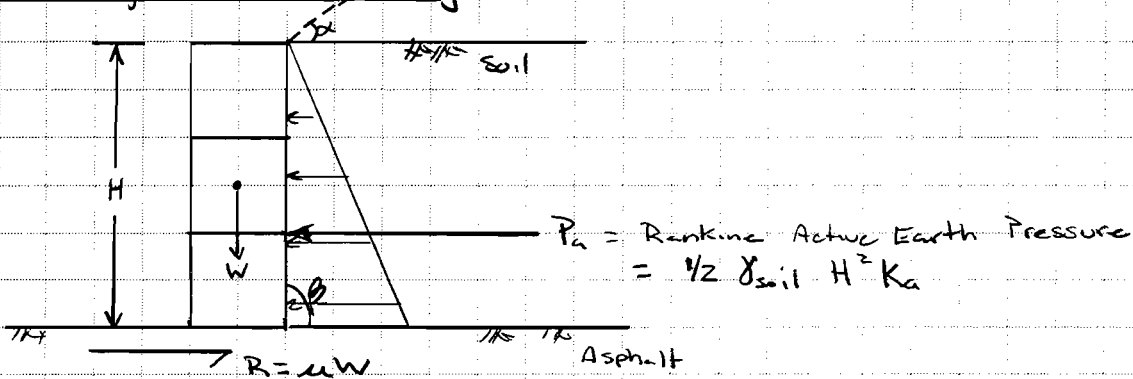
- height of the cells = 6 ft (3 blocks high)

- each cell is 10' x 10' x 6' = 600 ft³ = 22.22 c.y.

the following Block set-up is needed



2. Storage Cell Stability



$$\gamma_{\text{soil}} (\text{loose uniform sand}) \approx 92 \text{ lb/ft}^3 \quad [3, \text{Table 1.3}]$$

$$\gamma_{\text{conc.}} \approx \frac{4200 \text{ lb}}{2' \times 2' \times 8'} = 131 \text{ lb/ft}^3$$

$$\text{Let } \alpha = 0 \quad \beta = 90^\circ$$

$$\therefore K_a = 0.333$$

[3, Table 1.3]

$$W = (2' \times 6') \times 131 \text{ lb/ft}^3 = 1572 \text{ lb/ft}$$

$$R = 0.6 (1572 \text{ lb/ft}) = 943 \text{ lb/ft}$$

$$P_a = \frac{1}{2} (92 \text{ lb/ft}^3) (6')^2 (0.333) = 551 \text{ lb/ft}$$

$$\text{Factor of Safety (FS) for Sliding} = \frac{F_{\text{resisting}}}{F_{\text{driving}}} = \frac{R}{P_a}$$

$$(FS)_s = \frac{943}{551} = 1.71 \quad (\text{ok})$$

$$\text{Factor of Safety (FS) for overturning} = \frac{(\text{Moment})_{\text{resisting}}}{(\text{Moment})_{\text{driving}}} = \frac{1ft \cdot W}{\frac{1}{3} H P_a}$$

$$(FS)_{\text{overturning}} = \frac{(1ft)(1572 \text{ lb/ft})}{\frac{1}{3}(6ft)(551 \text{ lb/ft})} = 1.43 \quad (\text{ok})$$

ROWE INDUSTRIES SITE
**SOIL REMEDIATION DESIGN
SAG HARBOR, NEW YORK**

Signed:

Checked:

Date:

M. Hurst
A. K. W. R. I. C.
5/27/96

This spreadsheet calculates the friction losses associated with the vapor extraction system for the soil impoundment. The total pressure drop includes a 15 percent factor of safety. This model run is for the scenario if four inch diameter piping was used for the impoundment and manifold piping. The friction losses were calculated for the screens that would have the highest friction loss per group of extraction points. The total pressure drop for this scenario is 0.96 inches of H₂O.

ASSUMPTIONS:

SOIL GAS TEMPERATURE 70 Degrees F
SOIL GAS KINEMATIC VISCOSITY 9.17E-03 ft²/min
SOIL GAS DYNAMIC VISCOSITY 4.28E-02 lb/ft-hr

PIPE TYPE PVC-SMOOTH
SOIL GAS MASS DENSITY 7.81E-02 lb/ft³

NODE ^u		FITTING ^u			AIR FLOW	DUCT SIZE	VEL.	VEL. PRESS.	PIPE LENGTH	FITTING LOSS COEF.	PIPE PRESS. DROP	TOTAL PRESS. DROP	PRES. DROP (SAFETY)	REYNOLDS NUMBER	FRICTION FACTOR	SECTIONAL PRESSURE DROP
FROM	TO	#	SOURCE	TYPE	(CFM)	(IN)	(FT/MIN)	(" of H2O)	(FEET)	Co	(" of H2O)	(" of H2O)	(" of H2O)	(DIM)	(DIM)	(" of H2O)
1	2	1	Screen 1	PIPE	30.00	4.00	343.77	0.01	56.00	-	0.04	0.04	0.04	12546	0.0299	0.10
2	3	2	2	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
3	4	3	Man. Pipe	PIPE	30.00	4.00	343.77	0.01	6.50	-	0.00	0.00	0.01	12546	0.0299	
4	5	4		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
5	6	5	5	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
6	7	6	Screen 2	PIPE	30.00	4.00	343.77	0.01	27.00	-	0.02	0.02	0.02	12546	0.0299	0.14
7	8	7	7	Tee, branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
8	9	8	Man Pipe	PIPE	30.00	4.00	343.77	0.01	7.00	-	0.00	0.00	0.01	12546	0.0299	
9	10	9		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
10	11	10	10	Tee, Branch	60.00	4.00	687.55	0.03	-	2.08	-	0.06	0.07	25092	0.0251	
11	12	11	Screen 3	Pipe	30.00	4.00	343.77	0.01	1.00	-	0.00	0.00	0.00	12546	0.0299	0.0227
12	13	12	12	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
13	14	13	Man Pipe	Pipe	30.00	4.00	343.77	0.01	7.50	-	0.01	0.01	0.01	12546	0.0299	
14	15	14		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
15	16	15	15	Tee, Branch	90.00	4.00	1031.32	0.07	-	2.08	-	0.14	0.17	37638	0.0227	

																0.21
16	17	16	16	90 Elbow	90.00	4.00	1031.32	0.07	-	0.22	-	0.02	0.02	37638	0.0227	
17	18	17		Venturi	90.00	4.00	1031.32	0.07	-	1.00	-	0.07	0.08	37638	0.0227	
18	19	18	18	Valve	90.00	4.00	1031.32	0.07	-	2.00	-	0.14	0.16	37638	0.0227	
19	20	19		90 Elbow	90.00	4.00	1031.32	0.07	-	0.22	-	0.02	0.02	37638	0.0227	
20	21	20	20	Pipe	90.00	4.00	1031.32	0.07	3.50	-	0.02	0.02	0.02	37638	0.0227	
																0.29
21	22	21	Screen 4	PIPE	30.00	4.00	343.77	0.01	56.00	-	0.04	0.04	0.04	12546	0.0299	
22	23	22	22	90 Elbow	30.00	4.00	343.77	0.01	-	0.22	-	0.00	0.00	12546	0.0299	
23	24	23	Imp Pipe	Pipe	30.00	4.00	343.77	0.01	9.00	-	0.01	0.01	0.01	12546	0.0299	
24	25	24		90 Elbow	30.00	4.00	343.77	0.01	-	0.22	-	0.00	0.00	12546	0.0299	
25	26	25	Man Pipe	Pipe	30.00	4.00	343.77	0.01	2.00	-	0.00	0.00	0.00	12546	0.0299	
26	27	26	26	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
27	28	27	Man. Pipe	PIPE	30.00	4.00	343.77	0.01	6.00	-	0.00	0.00	0.00	12546	0.0299	
28	29	28		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
29	30	29	29	Tee, Branch	90.00	4.00	1031.32	0.07	-	2.08	-	0.14	0.17	37638	0.0227	
																0.21
30	31	30	Screen 5	PIPE	30.00	4.00	343.77	0.01	27.00	-	0.02	0.02	0.02	12546	0.0299	
31	32	31	31	90 Elbow	30.00	4.00	343.77	0.01	-	0.22	-	0.00	0.00	12546	0.0299	
32	33	32	Imp Pipe	Pipe	30.00	4.00	343.77	0.01	9.00	-	0.01	0.01	0.01	12546	0.0299	
33	34	33		90 Elbow	30.00	4.00	343.77	0.01	-	0.22	-	0.00	0.00	12546	0.0299	
34	35	34	Man Pipe	Pipe	30.00	4.00	343.77	0.01	2.00	-	0.00	0.00	0.00	12546	0.0299	
35	36	35	35	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
36	37	36	Man. Pipe	PIPE	30.00	4.00	343.77	0.01	6.00	-	0.00	0.00	0.00	12546	0.0299	
37	38	37		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
38	39	38	38	Tee, Branch	60.00	4.00	687.55	0.03	-	2.08	-	0.06	0.07	25092	0.0251	
																0.12
39	40	39	Screen 6	PIPE	30.00	4.00	343.77	0.01	1.00	-	0.00	0.00	0.00	12546	0.0299	
40	41	40	40	90 Elbow	30.00	4.00	343.77	0.01	-	0.22	-	0.00	0.00	12546	0.0299	
41	42	41	Imp Pipe	Pipe	30.00	4.00	343.77	0.01	9.00	-	0.01	0.01	0.01	12546	0.0299	
42	43	42		90 Elbow	30.00	4.00	343.77	0.01	-	0.22	-	0.00	0.00	12546	0.0299	
43	44	43	Man Pipe	Pipe	30.00	4.00	343.77	0.01	2.00	-	0.00	0.00	0.00	12546	0.0299	
44	45	44	44	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
45	46	45	Man. Pipe	PIPE	30.00	4.00	343.77	0.01	6.00	-	0.00	0.00	0.00	12546	0.0299	
46	47	46		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
47	48	47	47	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	

																0.06
48	49	48	48	90 Elbow	90.00	4.00	1031.32	0.07	-	0.22	-	0.02	0.02	37638	0.0227	
49	50	49		Venturi	90.00	4.00	1031.32	0.07	-	1.00	-	0.07	0.08	37638	0.0227	
50	51	50		Valve	90.00	4.00	1031.32	0.07	-	2.00	-	0.14	0.16	37638	0.0227	
51	52	51	51	Pipe	90.00	4.00	1031.32	0.07	1.00	-	0.00	0.00	0.01	37638	0.0227	
																0.26
52	53	52	Screen 7	PIPE	30.00	4.00	343.77	0.01	1.00	-	0.00	0.00	0.00	12546	0.0299	
53	54	53	53	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
54	55	54	Man. Pipe	PIPE	30.00	4.00	343.77	0.01	7.50	-	0.01	0.01	0.01	12546	0.0299	
55	56	55		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
56	57	56	56	Tee, Branch	90.00	4.00	1031.32	0.07	-	2.08	-	0.14	0.17	37638	0.0227	
																0.21
57	58	57	Screen 8	PIPE	30.00	4.00	343.77	0.01	27.00	-	0.02	0.02	0.02	12546	0.0299	
58	59	58	58	Tee, branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
59	60	59	Man Pipe	PIPE	30.00	4.00	343.77	0.01	7.00	-	0.00	0.00	0.01	12546	0.0299	
60	61	60		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
61	62	61	61	Tee, Branch	60.00	4.00	687.55	0.03	-	2.08	-	0.06	0.07	25092	0.0251	
																0.14
62	63	62	Screen 9	Pipe	30.00	4.00	343.77	0.01	56.00	-	0.04	0.04	0.04	12546	0.0299	
63	64	63	63	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
64	65	64	Man Pipe	Pipe	30.00	4.00	343.77	0.01	6.50	-	0.00	0.00	0.01	12546	0.0299	
65	66	65		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
66	67	66	66	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
																0.10
67	68	67		90 Elbow	90.00	4.00	1031.32	0.07	-	0.22	-	0.02	0.02	37638	0.0227	
68	69	68		Venturi	90.00	4.00	1031.32	0.07	-	1.00	-	0.07	0.08	37638	0.0227	
69	70	69		Valve	90.00	4.00	1031.32	0.07	-	2.00	-	0.14	0.16	37638	0.0227	
70	71	70		90 Elbow	90.00	4.00	1031.32	0.07	-	0.22	-	0.02	0.02	37638	0.0227	
71	72	71	71	Pipe	90.00	4.00	1031.32	0.07	7.00	-	0.03	0.03	0.04	37638	0.0227	
																0.31
72	73	72	72	Cross	270.00	4.00	3093.96	0.62	-	0.44	-	0.27	0.31	112915	0.0172	
73	74	73	Infl Pipe	Pipe	270.00	4.00	3093.96	0.62	10.00	-	0.32	0.32	0.37	112915	0.0172	
																0.31

[illegible]

ROWE INDUSTRIES SITE
**SOIL REMEDIATION DESIGN
SAG HARBOR, NEW YORK**

Signed: *M. Muntell*
Checked: *A. Kaurik*
Date: *5/27/96*

This spreadsheet calculates the friction losses associated with the vapor extraction system for the soil impoundment. The total pressure drop includes a 15 percent factor of safety. This model run is for the scenario if two inch diameter piping was used for the impoundment piping and four inch diameter piping was used for the manifold. The friction losses were calculated for the screens that would have the highest friction loss per group of extraction points. The total pressure drop for this scenario is 2.16 inches of H₂O.

ASSUMPTIONS:																
SOIL GAS TEMPERATURE				70 Degrees F				PIPE TYPE		PVC-SMOOTH						
SOIL GAS KINEMATIC VISCOSITY				9.17E-03 ft^2/min				SOIL GAS MASS DENSITY		7.81E-02 lb/ft^3						
SOIL GAS DYNAMIC VISCOSITY				4.28E-02 lb/ft-hr												
NODE ^u		FITTING ^u			AIR FLOW	DUCT SIZE	VEL.	VEL. PRESS.	PIPE LENGTH	FITTING LOSS COEF.	PIPE PRESS. DROP	TOTAL PRESS. DROP	PRES. DROP (SAFETY)	REYNOLDS NUMBER	FRICTION FACTOR	SECTIONAL PRESSURE DROP
FROM	TO	#	SOURCE	TYPE	(CFM)	(IN)	(FT/MIN)	(" of H2O)	(FEET)	Co	(" of H2O)	(" of H2O)	(" of H2O)	(DIM)	(DIM)	(" of H2O)
1	2	1	Screen 1	PIPE	30.00	2.00	1375.10	0.12	56.00	-	1.04	1.04	1.19	25092	0.0251	
2	3	2	2	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
3	4	3	Man. Pipe	PIPE	30.00	4.00	343.77	0.01	6.50	-	0.00	0.00	0.01	12546	0.0299	
4	5	4		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
5	6	5	5	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
																1.25
6	7	6	Screen 2	PIPE	30.00	2.00	1375.10	0.12	27.00	-	0.50	0.50	0.57	25092	0.0251	
7	8	7	7	Tee, branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
8	9	8	Man Pipe	PIPE	30.00	4.00	343.77	0.01	7.00	-	0.00	0.00	0.01	12546	0.0299	
9	10	9		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
10	11	10	10	Tee, Branch	60.00	4.00	687.55	0.03	-	2.08	-	0.06	0.07	25092	0.0251	
																0.69
11	12	11	Screen 3	Pipe	30.00	2.00	1375.10	0.12	1.00	-	0.02	0.02	0.02	25092	0.0251	
12	13	12	12	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
13	14	13	Man Pipe	Pipe	30.00	4.00	343.77	0.01	7.50	-	0.01	0.01	0.01	12546	0.0299	
14	15	14		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
15	16	15	15	Tee, Branch	90.00	4.00	1031.32	0.07	-	2.08	-	0.14	0.17	37638	0.0227	

																0.23
16	17	16	16	90 Elbow	90.00	4.00	1031.32	0.07	-	0.22	-	0.02	0.02	37638	0.0227	
17	18	17		Venturi	90.00	4.00	1031.32	0.07	-	1.00	-	0.07	0.08	37638	0.0227	
18	19	18	18	Valve	90.00	4.00	1031.32	0.07	-	2.00	-	0.14	0.16	37638	0.0227	
19	20	19		90 Elbow	90.00	4.00	1031.32	0.07	-	0.22	-	0.02	0.02	37638	0.0227	
20	21	20	20	Pipe	90.00	4.00	1031.32	0.07	3.50	-	0.02	0.02	0.02	37638	0.0227	
																0.29
21	22	21	Screen 4	PIPE	30.00	2.00	1375.10	0.12	56.00	-	1.04	1.04	1.19	25092	0.0251	
22	23	22	22	90 Elbow	30.00	4.00	343.77	0.01	-	0.22	-	0.00	0.00	12546	0.0299	
23	24	23	Imp Pipe	Pipe	30.00	4.00	343.77	0.01	9.00	-	0.01	0.01	0.01	12546	0.0299	
24	25	24		90 Elbow	30.00	4.00	343.77	0.01	-	0.22	-	0.00	0.00	12546	0.0299	
25	26	25	Man Pipe	Pipe	30.00	4.00	343.77	0.01	2.00	-	0.00	0.00	0.00	12546	0.0299	
26	27	26	26	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
27	28	27	Man. Pipe	PIPE	30.00	4.00	343.77	0.01	6.00	-	0.00	0.00	0.00	12546	0.0299	
28	29	28		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
29	30	29	29	Tee, Branch	90.00	4.00	1031.32	0.07	-	2.08	-	0.14	0.17	37638	0.0227	
																0.21
30	31	30	Screen 5	PIPE	30.00	2.00	1375.10	0.12	27.00	-	0.50	0.50	0.57	25092	0.0251	
31	32	31	31	90 Elbow	30.00	4.00	343.77	0.01	-	0.22	-	0.00	0.00	12546	0.0299	
32	33	32	Imp Pipe	Pipe	30.00	4.00	343.77	0.01	9.00	-	0.01	0.01	0.01	12546	0.0299	
33	34	33		90 Elbow	30.00	4.00	343.77	0.01	-	0.22	-	0.00	0.00	12546	0.0299	
34	35	34	Man Pipe	Pipe	30.00	4.00	343.77	0.01	2.00	-	0.00	0.00	0.00	12546	0.0299	
35	36	35	35	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
36	37	36	Man. Pipe	PIPE	30.00	4.00	343.77	0.01	6.00	-	0.00	0.00	0.00	12546	0.0299	
37	38	37		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
38	39	38	38	Tee, Branch	60.00	4.00	687.55	0.03	-	2.08	-	0.06	0.07	25092	0.0251	
																0.12
39	40	39	Screen 6	PIPE	30.00	2.00	1375.10	0.12	1.00	-	0.02	0.02	0.02	25092	0.0251	
40	41	40	40	90 Elbow	30.00	4.00	343.77	0.01	-	0.22	-	0.00	0.00	12546	0.0299	
41	42	41	Imp Pipe	Pipe	30.00	4.00	343.77	0.01	9.00	-	0.01	0.01	0.01	12546	0.0299	
42	43	42		90 Elbow	30.00	4.00	343.77	0.01	-	0.22	-	0.00	0.00	12546	0.0299	
43	44	43	Man Pipe	Pipe	30.00	4.00	343.77	0.01	2.00	-	0.00	0.00	0.00	12546	0.0299	
44	45	44	44	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
45	46	45	Man. Pipe	PIPE	30.00	4.00	343.77	0.01	6.00	-	0.00	0.00	0.00	12546	0.0299	
46	47	46		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
47	48	47	47	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	

																0.06
48	49	48	48	90 Elbow	90.00	4.00	1031.32	0.07	-	0.22	-	0.02	0.02	37638	0.0227	
49	50	49		Venturi	90.00	4.00	1031.32	0.07	-	1.00	-	0.07	0.08	37638	0.0227	
50	51	50		Valve	90.00	4.00	1031.32	0.07	-	2.00	-	0.14	0.16	37638	0.0227	
51	52	51	51	Pipe	90.00	4.00	1031.32	0.07	1.00	-	0.00	0.00	0.01	37638	0.0227	
																0.26
52	53	52	Screen 7	PIPE	30.00	2.00	1375.10	0.12	1.00	-	0.02	0.02	0.02	25092	0.0251	
53	54	53	53	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
54	55	54	Man. Pipe	PIPE	30.00	4.00	343.77	0.01	7.50	-	0.01	0.01	0.01	12546	0.0299	
55	56	55		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
56	57	56	56	Tee, Branch	90.00	4.00	1031.32	0.07	-	2.08	-	0.14	0.17	37638	0.0227	
																0.23
57	58	57	Screen 8	PIPE	30.00	2.00	1375.10	0.12	27.00	-	0.50	0.50	0.57	25092	0.0251	
58	59	58	58	Tee, branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
59	60	59	Man Pipe	PIPE	30.00	4.00	343.77	0.01	7.00	-	0.00	0.00	0.01	12546	0.0299	
60	61	60		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
61	62	61	61	Tee, Branch	60.00	4.00	687.55	0.03	-	2.08	-	0.06	0.07	25092	0.0251	
																0.69
62	63	62	Screen 9	Pipe	30.00	2.00	1375.10	0.12	56.00	-	1.04	1.04	1.19	25092	0.0251	
63	64	63	63	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
64	65	64	Man Pipe	Pipe	30.00	4.00	343.77	0.01	6.50	-	0.00	0.00	0.01	12546	0.0299	
65	66	65		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
66	67	66	66	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	
																1.25
67	68	67		90 Elbow	90.00	4.00	1031.32	0.07	-	0.22	-	0.02	0.02	37638	0.0227	
68	69	68		Venturi	90.00	4.00	1031.32	0.07	-	1.00	-	0.07	0.08	37638	0.0227	
69	70	69		Valve	90.00	4.00	1031.32	0.07	-	2.00	-	0.14	0.16	37638	0.0227	
70	71	70		90 Elbow	90.00	4.00	1031.32	0.07	-	0.22	-	0.02	0.02	37638	0.0227	
71	72	71	71	Pipe	90.00	4.00	1031.32	0.07	7.00	-	0.03	0.03	0.04	37638	0.0227	
																0.31
72	73	72	72	Cross	270.00	4.00	3093.96	0.62	-	0.44	-	0.27	0.31	112915	0.0172	
73	74	73	Infl Pipe	Pipe	270.00	4.00	3093.96	0.62	10.00	-	0.32	0.32	0.37	112915	0.0172	
																0.31

[illegible]

ROWE INDUSTRIES SITE
**SOIL REMEDIATION DESIGN
SAG HARBOR, NEW YORK**

Signed: *M. Martell*
Checked: *A. Karmia*
Date: *5/29/96*

This spreadsheet calculates the friction losses associated with the vapor extraction system for the soil impoundment. The total pressure drop includes a 15 percent factor of safety. This model run is for the scenario if two inch diameter piping was used for the impoundment and manifold piping. The friction losses were calculated for the screens that would have the highest friction loss per group of extraction points. The total pressure drop for this scenario is 15.89 inches of H₂O.

ASSUMPTIONS:

SOIL GAS TEMPERATURE 70 Degrees F
SOIL GAS KINEMATIC VISCOSITY 9.17E-03 ft²/min
SOIL GAS DYNAMIC VISCOSITY 4.28E-02 lb/ft-hr

PIPE TYPE PVC-SMOOTH
SOIL GAS MASS DENSITY 7.81E-02 lb/ft³

NODE ^u		FITTING ^u		AIR FLOW	DUCT SIZE	VEL.	VEL. PRESS.	PIPE LENGTH	FITTING LOSS COEF.	PIPE PRESS. DROP	TOTAL PRESS. DROP	PRES. DROP (SAFETY)	REYNOLDS NUMBER	FRICTION FACTOR	SECTIONAL PRESSURE DROP
FROM	TO	#	SOURCE	TYPE	(CFM)	(IN)	(FT/MIN)	(inches of H ₂ O)	C _f	(inches of H ₂ O)	(inches of H ₂ O)	(inches of H ₂ O)	(DIM)	(DIM)	(inches of H ₂ O)
1	2	1	Screen 1	PIPE	30.00	2.00	1375.10	0.12	56.00	-	1.04	1.04	1.19	25092	0.0251
2	3	2	2	Tee, Branch	30.00	2.00	1375.10	0.12	-	2.08	-	0.26	0.29	25092	0.0251
3	4	3	Man. Pipe	PIPE	30.00	2.00	1375.10	0.12	6.50	-	0.12	0.12	0.14	25092	0.0251
4	5	4		Valve	30.00	2.00	1375.10	0.12	-	2.00	-	0.25	0.28	25092	0.0251
5	6	5	5	Tee, Branch	30.00	2.00	1375.10	0.12	-	2.08	-	0.26	0.29	25092	0.0251
															2.20
6	7	6	Screen 2	PIPE	30.00	2.00	1375.10	0.12	27.00	-	0.50	0.50	0.57	25092	0.0251
7	8	7	7	Tee, branch	30.00	2.00	1375.10	0.12	-	2.08	-	0.26	0.29	25092	0.0251
8	9	8	Man Pipe	PIPE	30.00	2.00	1375.10	0.12	7.00	-	0.13	0.13	0.15	25092	0.0251
9	10	9		Valve	30.00	2.00	1375.10	0.12	-	2.00	-	0.25	0.28	25092	0.0251
10	11	10	10	Tee, Branch	60.00	2.00	2750.19	0.49	-	2.08	-	1.02	1.17	50185	0.0211
															2.47
11	12	11	Screen 3	Pipe	30.00	2.00	1375.10	0.12	1.00	-	0.02	0.02	0.02	25092	0.0251
12	13	12	12	Tee, Branch	30.00	2.00	1375.10	0.12	-	2.08	-	0.26	0.29	25092	0.0251
13	14	13	Man Pipe	Pipe	30.00	2.00	1375.10	0.12	7.50	-	0.14	0.14	0.16	25092	0.0251
14	15	14		Valve	30.00	2.00	1375.10	0.12	-	2.00	-	0.25	0.28	25092	0.0251
15	16	15	15	Tee, Branch	90.00	2.00	4125.29	1.10	-	2.08	-	2.30	2.64	75277	0.0191

																3.40
16	17	16	16	90 Elbow	90.00	2.00	4125.29	1.10	-	0.22	-	0.24	0.28	75277	0.0191	
17	18	17		Venturi	90.00	2.00	4125.29	1.10	-	1.00	-	1.10	1.27	75277	0.0191	
18	19	18	18	Valve	90.00	2.00	4125.29	1.10	-	2.00	-	2.21	2.54	75277	0.0191	
19	20	19		90 Elbow	90.00	2.00	4125.29	1.10	-	0.22	-	0.24	0.28	75277	0.0191	
20	21	20	20	Pipe	90.00	2.00	4125.29	1.10	3.50	-	0.44	0.44	0.51	75277	0.0191	
																4.88
21	22	21	Screen 4	PIPE	30.00	2.00	1375.10	0.12	56.00	-	1.04	1.04	1.19	25092	0.0251	
22	23	22	22	90 Elbow	30.00	2.00	1375.10	0.12	-	0.22	-	0.03	0.03	25092	0.0251	
23	24	23	Imp Pipe	Pipe	30.00	2.00	1375.10	0.12	9.00	-	0.17	0.17	0.19	25092	0.0251	
24	25	24		90 Elbow	30.00	2.00	1375.10	0.12	-	0.22	-	0.03	0.03	25092	0.0251	
25	26	25	Man Pipe	Pipe	30.00	2.00	1375.10	0.12	2.00	-	0.04	0.04	0.04	25092	0.0251	
26	27	26	26	Tee, Branch	30.00	2.00	1375.10	0.12	-	2.08	-	0.26	0.29	25092	0.0251	
27	28	27	Man. Pipe	PIPE	30.00	2.00	1375.10	0.12	6.00	-	0.11	0.11	0.13	25092	0.0251	
28	29	28		Valve	30.00	2.00	1375.10	0.12	-	2.00	-	0.25	0.28	25092	0.0251	
29	30	29	29	Tee, Branch	90.00	2.00	4125.29	1.10	-	2.08	-	2.30	2.64	75277	0.0191	
																3.39
30	31	30	Screen 5	PIPE	30.00	2.00	1375.10	0.12	27.00	-	0.50	0.50	0.57	25092	0.0251	
31	32	31	31	90 Elbow	30.00	2.00	1375.10	0.12	-	0.22	-	0.03	0.03	25092	0.0251	
32	33	32	Imp Pipe	Pipe	30.00	2.00	1375.10	0.12	9.00	-	0.17	0.17	0.19	25092	0.0251	
33	34	33		90 Elbow	30.00	2.00	1375.10	0.12	-	0.22	-	0.03	0.03	25092	0.0251	
34	35	34	Man Pipe	Pipe	30.00	2.00	1375.10	0.12	2.00	-	0.04	0.04	0.04	25092	0.0251	
35	36	35	35	Tee, Branch	30.00	2.00	1375.10	0.12	-	2.08	-	0.26	0.29	25092	0.0251	
36	37	36	Man. Pipe	PIPE	30.00	2.00	1375.10	0.12	6.00	-	0.11	0.11	0.13	25092	0.0251	
37	38	37		Valve	30.00	2.00	1375.10	0.12	-	2.00	-	0.25	0.28	25092	0.0251	
38	39	38	38	Tee, Branch	60.00	2.00	2750.19	0.49	-	2.08	-	1.02	1.17	50185	0.0211	
																1.92
39	40	39	Screen 6	PIPE	30.00	2.00	1375.10	0.12	1.00	-	0.02	0.02	0.02	25092	0.0251	
40	41	40	40	90 Elbow	30.00	2.00	1375.10	0.12	-	0.22	-	0.03	0.03	25092	0.0251	
41	42	41	Imp Pipe	Pipe	30.00	2.00	1375.10	0.12	9.00	-	0.17	0.17	0.19	25092	0.0251	
42	43	42		90 Elbow	30.00	2.00	1375.10	0.12	-	0.22	-	0.03	0.03	25092	0.0251	
43	44	43	Man Pipe	Pipe	30.00	2.00	1375.10	0.12	2.00	-	0.04	0.04	0.04	25092	0.0251	
44	45	44	44	Tee, Branch	30.00	2.00	1375.10	0.12	-	2.08	-	0.26	0.29	25092	0.0251	
45	46	45	Man. Pipe	PIPE	30.00	2.00	1375.10	0.12	6.00	-	0.11	0.11	0.13	25092	0.0251	
46	47	46		Valve	30.00	4.00	343.77	0.01	-	2.00	-	0.02	0.02	12546	0.0299	
47	48	47	47	Tee, Branch	30.00	4.00	343.77	0.01	-	2.08	-	0.02	0.02	12546	0.0299	

																0.50
48	49	48	48	90 Elbow	90.00	2.00	4125.29	1.10	-	0.22	-	0.24	0.28	75277	0.0191	
49	50	49		Venturi	90.00	2.00	4125.29	1.10	-	1.00	-	1.10	1.27	75277	0.0191	
50	51	50		Valve	90.00	2.00	4125.29	1.10	-	2.00	-	2.21	2.54	75277	0.0191	
51	52	51	51	Pipe	90.00	2.00	4125.29	1.10	1.00	-	0.13	0.13	0.15	75277	0.0191	
																4.24
52	53	52	Screen 7	PIPE	30.00	2.00	1375.10	0.12	1.00	-	0.02	0.02	0.02	25092	0.0251	
53	54	53	53	Tee, Branch	30.00	2.00	1375.10	0.12	-	2.08	-	0.26	0.29	25092	0.0251	
54	55	54	Man. Pipe	PIPE	30.00	2.00	1375.10	0.12	7.50	-	0.14	0.14	0.16	25092	0.0251	
55	56	55		Valve	30.00	2.00	1375.10	0.12	-	2.00	-	0.25	0.28	25092	0.0251	
56	57	56	56	Tee, Branch	90.00	2.00	4125.29	1.10	-	2.08	-	2.30	2.64	75277	0.0191	
																3.40
57	58	57	Screen 8	PIPE	30.00	2.00	1375.10	0.12	27.00	-	0.50	0.50	0.57	25092	0.0251	
58	59	58	58	Tee, branch	30.00	2.00	1375.10	0.12	-	2.08	-	0.26	0.29	25092	0.0251	
59	60	59	Man Pipe	PIPE	30.00	2.00	1375.10	0.12	7.00	-	0.13	0.13	0.15	25092	0.0251	
60	61	60		Valve	30.00	2.00	1375.10	0.12	-	2.00	-	0.25	0.28	25092	0.0251	
61	62	61	61	Tee, Branch	60.00	2.00	2750.19	0.49	-	2.08	-	1.02	1.17	50185	0.0211	
																2.47
62	63	62	Screen 9	Pipe	30.00	2.00	1375.10	0.12	56.00	-	1.04	1.04	1.19	25092	0.0251	
63	64	63	63	Tee, Branch	30.00	2.00	1375.10	0.12	-	2.08	-	0.26	0.29	25092	0.0251	
64	65	64	Man Pipe	Pipe	30.00	2.00	1375.10	0.12	6.50	-	0.12	0.12	0.14	25092	0.0251	
65	66	65		Valve	30.00	2.00	1375.10	0.12	-	2.00	-	0.25	0.28	25092	0.0251	
66	67	66	66	Tee, Branch	30.00	2.00	1375.10	0.12	-	2.08	-	0.26	0.29	25092	0.0251	
																2.20
67	68	67		90 Elbow	90.00	2.00	4125.29	1.10	-	0.22	-	0.24	0.28	75277	0.0191	
68	69	68		Venturi	90.00	2.00	4125.29	1.10	-	1.00	-	1.10	1.27	75277	0.0191	
69	70	69		Valve	90.00	2.00	4125.29	1.10	-	2.00	-	2.21	2.54	75277	0.0191	
70	71	70		90 Elbow	90.00	2.00	4125.29	1.10	-	0.22	-	0.24	0.28	75277	0.0191	
71	72	71	71	Pipe	90.00	2.00	4125.29	1.10	7.00	-	0.89	0.89	1.02	75277	0.0191	
																5.39
72	73	72	72	Cross	270.00	2.00	12375.86	9.94	-	0.44	-	4.37	5.03	225831	0.0151	
73	74	73	Infl Pipe	Pipe	270.00	2.00	12375.86	9.94	10.00	-	9.01	9.01	10.36	225831	0.0151	
																5.03

ROWE INDUSTRIES SITE

SOIL REMEDIATION SAG HARBOR, NEW YORK

Signed: AMK
Checked: WKS
Date: 5/29/96

CALCULATION OF ESTIMATED VAPOR CONCENTRATION FROM EX-SITU SVE SYSTEM

Calculated by: Alfred N. Kovalik
Checked by: William K. Beckman

STATEMENT OF PROBLEM:

Estimate the effluent concentration of PCE from the vapor extraction system in the Soil Impoundment.

ASSUMPTIONS

1. Volume of soil with PCE concentrations above land disposal restrictions and placed in the Soil Impoundment is designated as "vol_imp".
 $\text{vol\_imp} := 744 \text{ yd}^3$
2. The estimated average PCE concentration in the Soil Impoundment is designated as "conc_imp" (estimate based on results from soil boring program.)
 $\text{conc\_imp} := 10 \frac{\text{mg}}{\text{kg}}$
3. Vapor flowrate from the vapor extraction system is "Q" cfm.
 $Q := 270 \text{ cfm}$
4. PCE concentration in the soil must be reduced to at least 5.6 mg/kg to dispose of it a Chemical Waste Landfill. As a factor of safety, make the remediation goal 80% of LDRs.
 $\text{conc\_ldr} := 5.6 \frac{\text{mg}}{\text{kg}}$
 $\text{conc\_rem} := 0.80 \cdot \text{conc\_ldr}$
 $\text{conc\_rem} = 4.48 \frac{\text{mg}}{\text{kg}}$
5. Soil must be remediated after 6 months of operation.
 $t_{\text{rem}} := 6 \text{ months}$
6. The ideal gas constant is:
 $R := 8.314$

GENERAL EQUATIONS

1. Mass of PCE in soil (kg) at beginning of remediation:

$$\text{Mass\_beginning\_kg} := (\text{vol\_imp} \cdot \text{conc\_imp}) \cdot (27) \cdot 0.4536 \cdot \left(\frac{1}{10^6} \right) \cdot (92) \quad \text{Mass\_beginning\_kg} = 8.383 \text{ kg}$$

where:

27 = cubic feet per cubic yard

0.4536 = kilogram per pound

92 = estimated unit weight of soil, lb/ft³

1/10⁶ = kilograms per milligram

ROWE INDUSTRIES SITE

2. Mass of contaminant in soil (kg) at the end of remediation:

$$\text{Mass\_end\_kg} := (\text{vol\_imp} \cdot \text{conc\_rem}) \cdot (27) \cdot 0.4536 \cdot \left(\frac{1}{10^6}\right) \cdot (92) \quad \text{Mass\_end\_kg} = 3.756 \text{ kg}$$

where:

27 = cubic feet per cubic yard

0.4536 = kilogram per pound

92 = estimated unit weight of soil, lb/ft³

1/10⁶ = kilograms per milligram

3. Mass of contaminant to be removed from the soil in "t_rem" months of operation.:

$$\text{Mass\_rem\_kg} := \text{Mass\_beginning\_kg} - \text{Mass\_end\_kg} \quad \text{Mass\_rem\_kg} = 4.627 \text{ kg}$$

4. Acceptable contaminant removal rate required to achieve the desired goal is given by:

$$\text{R\_acceptable} := \left(\frac{\text{Mass\_rem\_kg}}{\text{t\_rem}} \right) \cdot \frac{10^9}{30 \cdot 24 \cdot 60} \quad \text{R\_acceptable} = 1.785 \cdot 10^4 \frac{\text{ug}}{\text{min}}$$

where:

30 = days per month

24 = hours per day

60 = minutes per hour

10⁹ = kilograms per microgram

5. Given acceptable removal rate and the estimated vapor extraction flow-rate, the concentration of PCE in the Soil Impoundment effluent is:

$$\text{PCEair\_ug\_per\_cm} := \left(\frac{\text{R\_acceptable}}{Q} \right) \cdot 35.31 \quad \text{PCEair\_ug\_per\_cm} = 2.335 \cdot 10^3 \frac{\text{ug}}{\text{m}^3}$$

where:

35.31 = cubic feet per cubic meter

6. Contaminant Concentration Conversion from ug/m³ to ppm (Ideal Gas Law):

$$\text{Cp}(T, \text{Cu}, P, \text{MW}) := \frac{R \cdot T \cdot \text{Cu}}{P \cdot \text{MW}}$$

where:

Cp = concentration

T = Temperature, K

P = pressure, Pa

Cu = contaminant concentration, ug/m³

MW = molecular weight

ROWE INDUSTRIES SITE

ANALYSIS

Initial Parameters

$$P := 101.325 \cdot 10^3 \text{ Pa}$$

$$T := 293 \text{ K}$$

$$MW := 165.8$$

$$Cu := \text{PCEair\_ug\_per\_cm} \quad Cu = 2.335 \cdot 10^3 \frac{\text{ug}}{\text{m}^3}$$

Conversion of the estimated PCE concentration in the Soil Impoundment effluent is given by:

$$Cp(Cu, T, P, MW) = 0.339 \text{ ppm}$$

CONCLUSION

Based on the above calculations, the estimated PCE concentration in the air extracted from the Soil Impoundment is $2.335 \times 10^3 \text{ ug/m}^3$ (339 ppb). The NYSDEC ambient guideline concentration for the emission of PCE is 0.075 ug/m^3 . Therefore, vapor treatment appears to be needed prior to discharge to the atmosphere.

Vapor concentrations are expected to be higher during the initial operation of the Soil Impoundment and decrease as the remediation time increases. The analysis completed above assumes a constant contaminant removal rate from the impoundment. Therefore, the predicted effluent concentration of 339 ppb will be low for the initial stages of remediation, and high towards the end of remediation. To select a vapor treatment process that is appropriate, a concentration of 3 to 4 times the predicted value (1017 to 1356 ppb) will be used in the design process.

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APPENDIX K
Engineering Calculations

**APPENDIX K
ENGINEER CALCULATIONS
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

Prepared For

Nabisco, Inc.

May 1996

Revised September 1997

LBG Engineering Services, P.C.
Professional Environmental Engineering Services
126 Monroe Turnpike
Trumbull, CT 06611

**APPENDIX K
ENGINEERING CALCULATIONS
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

LIST OF ENGINEERING CALCULATIONS

- Size of Soil Impoundment
 - Friction Losses from SVE System
 - Soil Vapor Extraction Rate for the Impoundment and Blower Size
 - Spacing for SVE Wells
 - Blower Sizing for Parking Lot and Former Drum Storage Area SVE Systems
 - Volume and Weight of Soil in Drywells
-
- PID and PCE Correlation
 - Weighted Averages in Excavation Layers
 - PCE Contours in Excavation Layers

NOTE: ppm used in these calculations refers to parts per million as read on the PID instrument.

Rowe Industries

**Soil Remediation
Sag Harbor, NY**

Signed: [Signature]
Checked: [Signature]
Date: 7/31/97

Calculation of Soil Impoundment

Calculated by: Greg Souza

Checked by: William K. Beckman

PROBLEM STATEMENT:

Determine size of soil impoundment to hold the estimated volume of excavated soil. Soil impoundment sidewalls are to be 4 feet in height and the soil is to be placed at 30 degree angle of repose. Size soil impoundment to these constraints.

ANALYSIS:

- I. Volume of soil to be removed to a depth of 4 feet below grade.
 - Area of soil to be removed (shaded area on Plate S-4) calculated by CADD = 1,097 ft²
 - Volume = 1,097 ft² x 4 ft = 4,388 ft³ = 162 cubic yards (in-situ volume)
 - Excavated volume = 162 cy x fluff factor of 1.2 x factor of safety of 1.1 = 214 cy
- II. Soil Impoundment.
 1. Assume an area of 20 ft x 45 ft
 2. Volume of Impoundment
 - height of soil at 30 degrees = 10 ft x tan 30 = 5.8 ft
 - volume: base = 900 ft² x 4 ft = 3,600 ft³
top = $\frac{1}{2}(25' \times 20' \times 5.8') + 2[(20' \times 10' \times 5.8')/3] = 2,223 \text{ ft}^3$
Total = 3,600 ft³ + 2,223 ft³ = 5,823 ft³ = 215 cy

CONCLUSION:

Soil impoundment inside dimension of 20 ft x 45 ft x 4 ft with soil placed at a 30 degree angle from the top of the wall will hold the soil to be excavated.

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ROWE INDUSTRIES SITE
**SOIL REMEDIATION DESIGN
SAG HARBOR, NEW YORK**

Signed: *MJS*
Checked: *W09*
Date: *7/31/97*

This spreadsheet calculates the pressure drop due to friction losses associated with the operation of SVE System 1; the results to be used to define the operating points of the blower. The total pressure drop includes a 15 percent factor of safety. This calculation is based on the use of four, six and eight inch diameter piping in the SVE system; the diameters reflecting the different airflow rates at different locations in the system. The pressure drops were calculated for the manifold that would be expected to have the highest pressure drop, Manifold C. The total pressure drop for this manifold is 22.81 inches of H₂O.

ASSUMPTIONS:																
SOIL GAS TEMPERATURE				70	Degrees F			PIPE TYPE		PVC-SMOOTH						
SOIL GAS KINEMATIC VISCOSITY				9.17E-03	ft^2/min			SOIL GAS MASS DENSITY	7.81E-02	lb/ft^3						
SOIL GAS DYNAMIC VISCOSITY				4.28E-02	lb/ft-hr											
NODE ^M		FITTING ^M			AIR FLOW	DUCT SIZE	VEL.	VEL. PRESS.	PIPE LENGTH	FITTING LOSS COEF.	PIPE PRESS. DROP	TOTAL PRESS. DROP	PRES. DROP (SAFETY)	REYNOLDS NUMBER	FRICTION FACTOR	SECTIONAL PRESSURE DROP
FROM	TO	#	SOURCE	TYPE	(CFM)	(IN)	(FT/MIN)	(" of H2O)	(FEET)	Co	(" of H2O)	(" of H2O)	(" of H2O)	(DIM)	(DIM)	(" of H2O)
			Manifold C													
			Well 12													
1	4	2	-	Pipe	55.00	4.00	630.25	0.03	3.00	-	0.00	0.00	0.00	107356	0.0174	
		3	-	90 Elbow	55.00	4.00	630.25	0.03	-	0.22	-	0.01	0.01	107356	0.0174	
		4	-	Pipe	55.00	4.00	630.25	0.03	20.00	-	0.03	0.03	0.03	107356	0.0174	
			Well 13													0.04
2	4	6	-	Pipe	55.00	4.00	630.25	0.03	4.00	-	0.01	0.01	0.01	107356	0.0174	
		7	-	Tee, Branch	110.00	4.00	1260.50	0.10	-	2.08	-	0.21	0.25	214712	0.0152	
			Well 14													0.25
3	4	9	-	Pipe	55.00	4.00	630.25	0.03	5.00	-	0.01	0.01	0.01	107356	0.0174	
		10	-	90 Elbow	55.00	4.00	630.25	0.03	-	0.22	-	0.01	0.01	107356	0.0174	
		11	-	Pipe	55.00	4.00	630.25	0.03	20.00	-	0.03	0.03	0.03	107356	0.0174	
			Well 15													0.05
			Main													
4	5	12	-	Tee, Branch	165.00	4.00	1890.76	0.23	-	2.08	-	0.48	0.55	322068	0.0141	
		13	-	Pipe	165.00	4.00	1890.76	0.23	27.00	-	0.27	0.27	0.31	322068	0.0141	

		53	-	Pipe	870.00	6.00	4430.86	1.27	8.00	-	0.23	0.23	0.27	1132117	0.0113	
		54	-	Carbon 1A	870.00	6.00	4430.86	1.27	-	-	-	3.25	3.74	1132117	0.0113	
		55	-	Pipe	870.00	6.00	4430.86	1.27	10.00	-	0.29	0.29	0.33	1132117	0.0113	
		56	-	Carbon 1B	870.00	6.00	4430.86	1.27	-	-	-	3.25	3.74	1132117	0.0113	
		57	-	Pipe	870.00	6.00	4430.86	1.27	15.00	-	0.43	0.43	0.50	1132117	0.0113	
		Atmosphere		-	-	-	-	-	-	-	-	-	-	-	-	
																12.84
								PRESSURE LOSS ASSOCIATED WITH MANIFOLD C								22.81
Note: The increased temperature after the blower was checked and the impact on the pressure drop was insignificant.																

ROWE INDUSTRIES SITE

SOIL REMEDIATION
SAG HARBOR, NEW YORK

Signed: MJS
Checked: WBF
Date: 8/1/97

CALCULATION OF IMPOUNDMENT BLOWER CAPACITY

Calculated by: Michael Shortell
Checked by: William Beckman

STATEMENT OF PROBLEM

Estimate the soil vapor extraction rate for the impoundment and size the blower.

ASSUMPTIONS

1. The quantity of soil contained within the Impoundment (Impd) is: 215 yd³
2. The porosity of the soil in the impoundment is: 20 %
3. The No. of air volume (Vol.) changes per hour is: 7

CONVERSION

1. Conversion of the quantity of soil from cubic yards to cubic feet is: 5805 ft³

GENERAL EQUATIONS

Vol. of Air in the Impd (ft³) = Quantity of Soil (ft³) x Porosity 1161 ft³

Vol. of Air Change Per Hour (ft³) = Vol. of Air in the Impd (ft³) x No. of Vol. Changes Per Hour 8127 ft³

Minimum Extraction Rate (cfm) = Vol. of Air Change Per Hour (ft³) / 60 minutes 135 cfm

CONCLUSIONS

The minimum blower capacity to remove seven volume changes per hour would be 135 cfm. Therefore a 3 Hp blower capable of 150 cfm at a vacuum of approximately 20 inches of water column, assuming approximately 15 inches of water for friction losses, was used to size the blower for the impoundment.

ROWE INDUSTRIES

SOIL REMEDIATION
SAG HARBOR, NY

Signed: MSJ
Checked: WBS
Date: 7/31/97

CALCULATION OF SPACING OF SVE WELLS

Calculated by: Mary Jo LaFever
Checked by: William Beckman

PROBLEM STATEMENT

Select spacing for SVE wells.

ANALYSIS

1. The locations for SVE wells in System 1 were selected so that no well was further than 10 feet from soil impacted with concentrations of PCE greater than 10 ppm.
2. The SVE wells for System 2 were located to effectively collect the vapor plume using the least number of wells.
3. The screened intervals were selected to be open to the elevations where the high PCE concentrations were detected during previous site investigations.
4. An approximate radius of influence of each SVE well was estimated to be 30 feet. The radius of influence expected during operation may be closer to 60 feet based on previous SVE experience in similar soil types. The design using a 30-foot radius of influence is an aggressive approach to remediate the hot spots of PCE present in the soils beneath the former drum storage area.

CONCLUSION

SVE wells were located so that a 30-foot radius of influence at each well would remediate the contaminated soils in the System 1 area and the trapped vapors in the area of System 2. Locations of SVE wells are shown on Plate S-5.

ROWE INDUSTRIES

**SOIL REMEDIATION
SAG HARBOR, NY**

Signed: MDJ
Checked: WBS
Date: 7/21/97

CALCULATION OF BLOWER CAPACITY FOR SYSTEMS 1 AND 2

Calculated by: Mary Jo LaFever
Checked by: William Beckman

PROBLEM STATEMENT

Size the blower to be used for SVE operation of Systems 1 and 2.

ASSUMPTIONS

1. The blower will be sized to provide approximately 15 inches of water vacuum at each SVE wellhead.
2. Friction losses between the wells and the blower will result in a pressure drop of no more than approximately 23 inches of water (see accompanying friction loss calculation).
3. The blower will be sized to provide 5.5 cfm of air flow rate per foot of screen in each well. Each well is designed with 10 feet of screen and, subsequently, the air-flow rate is 55 cfm per well.
4. The total air-flow rate for System 1 is 495 cfm (nine wells at 55 cfm each).
The total air-flow rate for System 2 is 275 cfm (five wells at 55 cfm each).
The total air-flow rate for the blower is 770 cfm.

CONCLUSION

A 20 HP blower capable of 770 cfm at 40 inches of water vacuum was selected.

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ROWE INDUSTRIES

SOIL REMEDIATION
SAG HARBOR, NY

Signed: MDL
Checked: WBS
Date: 9/7/97

SIZING OF CARBON UNITS FOR IN-SITU SVE SYSTEM AND SOIL IMPOUNDMENT

Calculated by: Mary Jo LaFever
Checked by: William Beckman

PROBLEM STATEMENT

Estimate the size of the granular activated carbon units required for treatment of VOC contaminated vapors from soil at the Rowe Industries Site.

ASSUMPTIONS

1.	Total air flow rate for System 1:	495 cfm
	Total air flow rate for System 2:	275 cfm
	Total air flow rate for impoundment:	<u>140 cfm</u>
	Total air flow rate	910 cfm
2. High concentrations of PCE expected during initial stages of SVE operation
 3. High concentrations of PCE expected at air-sparging wells start-up

CONCLUSION

Based on the projected total air flow rate, the carbon units must have an air-flow capacity of at least 910 cfm with minimal head loss across the unit. Because of the potential for relatively high concentrations of VOCs in the vapors during start-up and initial operation, provide a minimum of two units positioned in series, each with at least 1,000 pounds of carbon. To meet these requirements, use two 1,500 pound GAC units.

h:\soil\engcals\carbncalc.txt

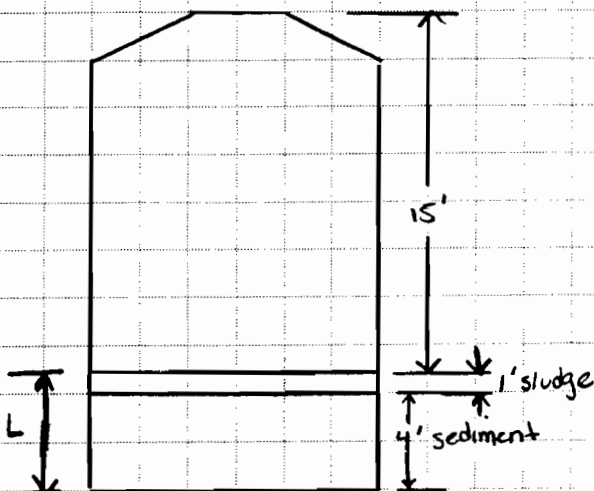
Problem Statement: Determine amount of sediment/solids to be removed from Dry wells

Problem Constraints:

1. Dry wells C, D and F will be remediated
2. Contamination is limited to the uppermost 4 ft of sediment in each dry well
3. The liquid/water in each dry well will be removed at the same time as the soil using a high vacuum truck.
4. Solids will not have to be treated prior to disposal
5. A layer of sludge 1 ft thick exists on top of the sediment in Drywells C + D + a layer 3.2 ft thick is present in Drywell F.
6. Assume unit weight of soil $92 \frac{\text{lb}}{\text{ft}^3}$ (1.24 tons/cy). Use 1.5 tons/cy [Table 6.3, DAS]

ANALYSIS

1. Dry well C

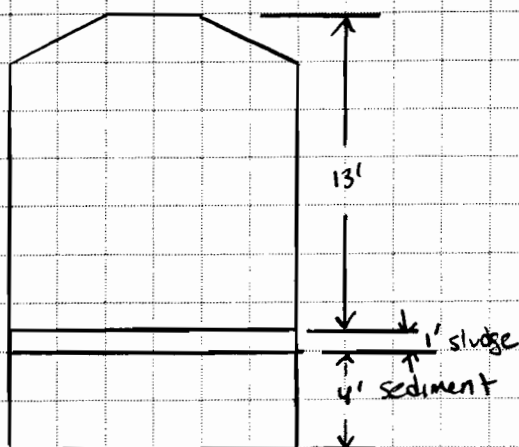


$$\begin{aligned}\text{Volume} &= L\pi r^2 \\ &= 5 \cdot \pi \cdot 3^2 \\ \text{Volume} &= 141.4 \text{ ft}^3\end{aligned}$$

$$\text{Volume} = 141.4 \text{ ft}^3 \times \frac{1 \text{ cy}}{27 \text{ ft}^3} = 5.2 \text{ cy}$$

$$5.2 \text{ cy} \times 1.5 = 7.8 \text{ tons}$$

2. Dry well D



$$\text{Volume} = L\pi r^2$$

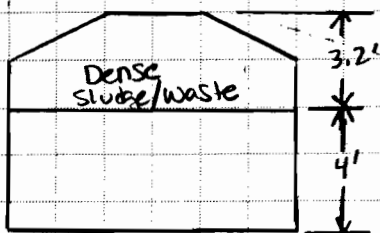
$$\text{Volume} = 5 \cdot \pi \cdot 3^2$$

$$\text{Volume} = 141.4 \text{ ft}^3$$

$$\text{Volume} = 141.4 \text{ ft}^3 \times \frac{1 \text{ cy}}{27 \text{ ft}^3} = 5.2 \text{ cy}$$

$$5.2 \text{ cy} \times 1.5 = 7.8 \text{ tons}$$

3. Dry well F



$$\text{Volume} = L\pi r^2$$

$$\text{Volume} = 7.2 \times \pi \times 5^2$$

$$\text{Volume} = 565.5 \text{ ft}^3$$

$$\text{Volume} = 565.5 \text{ ft}^3 \times \frac{1 \text{ cy}}{27 \text{ ft}^3} = 20.9 \text{ cy}$$

$$20.9 \text{ cy} \times 1.5 = 31.4 \text{ tons}$$

ROWE INDUSTRIES SITE

SOIL REMEDIATION SAG HARBOR, NEW YORK

Signed: ANK
Checked: WKB
Date: 5/29/96

CALCULATION OF PID AND PCE CORRELATION VALUES

Calculated by: Alfred Kovalik

Checked by: WILLIAM K. BECKMAN

STATEMENT OF PROBLEM:

Calculate with at least 90% confidence a PCE concentration that correlates to a specified PID range.

ASSUMPTIONS

1. The PID and PCE data set used is designated as Nabdata and was obtained from the soil boring program conducted during pre-design phase of work scope. The data set essentially consists of all soil samples that were analyzed by a laboratory for VOCs, including PCE, and were screened in the field for total VOCs using a PID with a 10.2 eV bulb.

ANALYSIS

The data was imported from another file and is listed below as Nabdata. Column zero (0) in Nabdata lists PID concentrations in parts per million (ppm) and column one (1) lists the sample's corresponding PCE concentrations in micrograms per kilogram (ug/kg).

The data was sorted using the "csort" command so the PID concentrations could be presented in ascending order. The sorted data set is shown below as matrix SN.

Nabdata := READPRN(nabdata)

Nabdata: PID (ppm), PCE (ug/kg)

Nabdata =

	0	1
1	124	$1.2 \cdot 10^4$
2	258	96
3	12	27
4	137	480
5	524	$2.8 \cdot 10^3$
6	45	13
7	131	130

Table continues

Sorted_Nabdata := csort(Nabdata, 0)

SN := Sorted_Nabdata

SN =

	0	1
0	11	8
1	12	27
2	13	2
3	14	19
4	18	22
5	29	3
6	39	2
7	42	47

Table continues

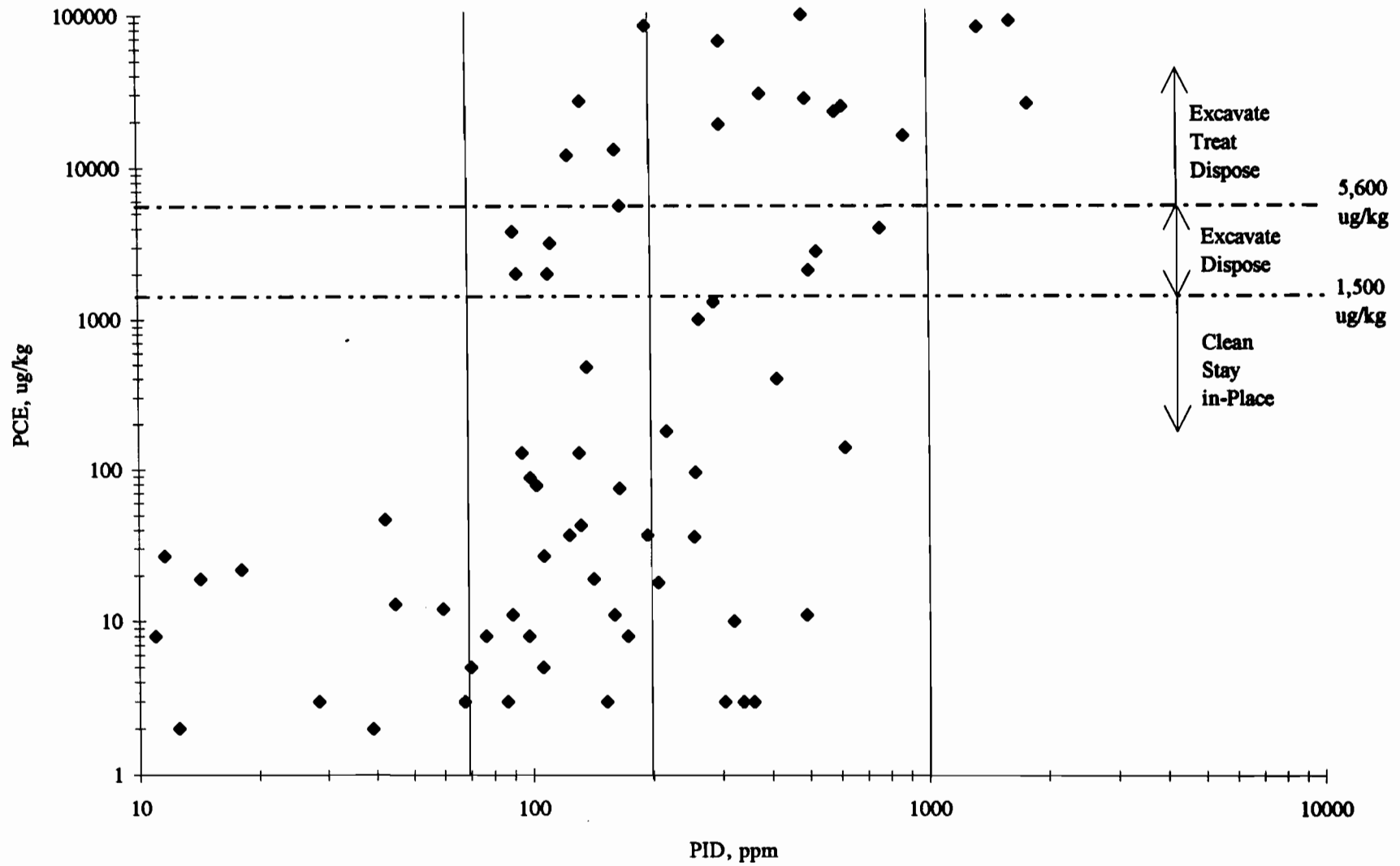
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A scatter plot shown on the following page shows the relationship between PCE and PID concentrations. As shown in the graph no direct correlation could be made. However, there appeared to be natural boundaries in the data at PID readings of 70 and 200 ppm. Accordingly, the data was divided into three sets: PID concentrations of 0 to 70 ppm, 70 to 200 ppm, and 200 to 1000 ppm. Only three concentrations were greater than 1000 ppm and were discarded and considered outliers.

A correlated PCE concentration was determined, with 90% confidence, which corresponded to PID readings in the range of 0 to 70 ppm. The correlated PCE concentration (PCEcorr) was determined by using a frequency distribution for the PCE values with PID readings from 0 to 70 ppm. The PCE concentration which had at least 90% of the PCE values in the 0 to 70 ppm subset less than it was chosen as PCEcorr. This relationship means that 90% of the time, PCE readings corresponding to PID readings in the range of 0 to 70 ppm would be less than or equal to this number. This process was then repeated for the other two groups (i.e. PID from 70 to 200 ppm and PID from 200 to 1000 ppm). This process is demonstrated below for each of the three groups. The correlated PCE values are used in subsequent calculations to ultimately determine PCE contours to guide excavation activities.

SOIL REMEDIATION DESIGN

PCE versus PID



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Histogram Development

PID 0 to 70 ppm

A submatrix was developed which sorted the PCE concentrations corresponding to the PID readings which were between 0 and 70 ppm. The submatrix, consisting of 12 data points, was then listed in ascending order. The PCE values ranged from 2 to 47 ug/kg. These values are presented below as PCE70.

A histogram was developed by dividing the submatrix into 6 groups. The first group has PCE concentrations from 0-8 ug/kg and the last group has PCE concentrations from 40 to 48 ug/kg. The frequency was calculated to see how many values were in each group and then a histogram was developed to graphically represent the results.

```
submatrix(A, rowi, rowj, columni, columnj)
```

```
j := 11
```

```
PID_Range_0to70 := submatrix(SN, 0, j, 0, 1)
```

```
PCE70 := sort(PID_Range_0to70<1>)
```

```
let n1 := 6 groups, and
```

```
delta := ceil( $\frac{PCE70_j}{n1}$ ) so delta = 8
```

```
let PCEint10 := 0 and u := 0..n1 - 1
```

```
PCEint1u+1 := (PCEint1u) + delta
```

Using the Mathcad histogram function, $Freq70 := hist(PCEint1, PCE70)$ yields..

	P
0	2
1	2
2	3
3	3
4	5
5	8
6	12
7	13
8	19
9	22
10	27
11	47

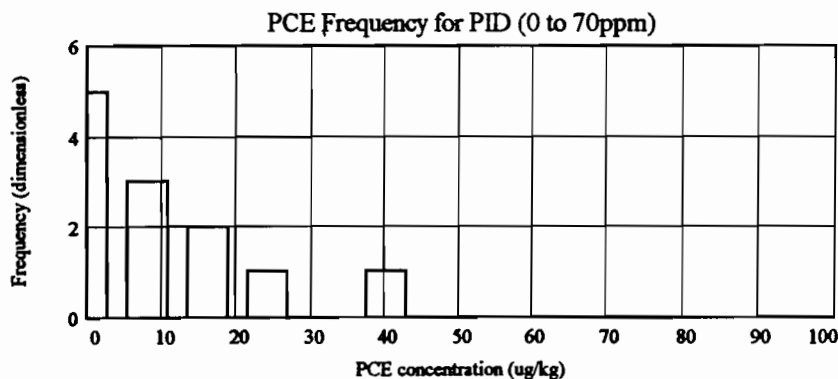
PCE70 =

$$Freq70 = \begin{bmatrix} 5 \\ 3 \\ 2 \\ 1 \\ 1 \\ 0 \\ 1 \end{bmatrix} \quad PCEint1 = \begin{bmatrix} 0 \\ 8 \\ 16 \\ 24 \\ 32 \\ 40 \\ 48 \end{bmatrix}$$

mean(PCE70) = 13.583
stdev(PCE70) = 12.9

Graph $Freq70_k$ versus $PCEint1_k$ for

$k1 := 0..n1 - 1$



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Histogram Development

PID 70 to 200 ppm

A submatrix was developed which sorted the PCE concentrations corresponding to the PID readings which were between 70 and 200 ppm. The submatrix, consisting of 28 data points, was then listed in ascending order. These values are presented below as PCE200. The PCE values ranged from 3 to 8.5×10^4 ug/kg. However the PCE value of 8.5×10^4 ug/kg was eliminated from the evaluation. This concentration corresponds to a PID reading of 196 ppm and was considered an outlier.

A histogram was developed by dividing the submatrix into 15 groups. The first group has PCE concentrations from 0 to 1.8×10^3 ug/kg and the last group has PCE concentrations from 2.52×10^4 to 2.7×10^4 ug/kg. The frequency was calculated to see how many values were in each group and then a histogram was developed to graphically represent the results.

$$p := 39$$

$$\text{PID\_Range\_70to200} := \text{submatrix}(\text{SN}, j + 1, p, 0, 1)$$

$$\text{PCE200} := \text{sort}(\text{PID\_Range\_70to200}^{<1>})$$

let $n2 := 15$ groups, and

$$\text{delta} := \text{ceil}\left[\frac{\text{PCE200}_{p-(j+2)}}{n2}\right] \text{ so } \text{delta} = 1.8 \cdot 10^3$$

Note: the subscript $p-(j+2)$ serves to eliminate the PCE value with a concentration of 8.5×10^4 ug/kg.

$$\text{PCE200} =$$

$$\text{let } \text{PCEint2}_0 := 0 \text{ and, } u := 0..n2$$

$$\text{PCEint2}_{u+1} := (\text{PCEint2}_u) + \text{delta}$$

Using the Mathcad histogram function, $\text{Freq200} := \text{hist}(\text{PCEint2}, \text{PCE200})$ yields..

	0
0	19
1	3
2	1
3	1
4	0
5	0
6	1
7	1
8	0
9	0
10	0

Table continues

	0
0	0
1	$1.8 \cdot 10^3$
2	$3.6 \cdot 10^3$
3	$5.4 \cdot 10^3$
4	$7.2 \cdot 10^3$
5	$9 \cdot 10^3$
6	$1.08 \cdot 10^4$
7	$1.26 \cdot 10^4$

Table continues

	0
0	3
1	3
2	5
3	8
4	8
5	8
6	11
7	11
8	19
9	27
10	37
11	37
12	43
13	75
14	79
15	89
16	130
17	130
18	480
19	$2 \cdot 10^3$
20	$2 \cdot 10^3$
21	$3.2 \cdot 10^3$

Table continues

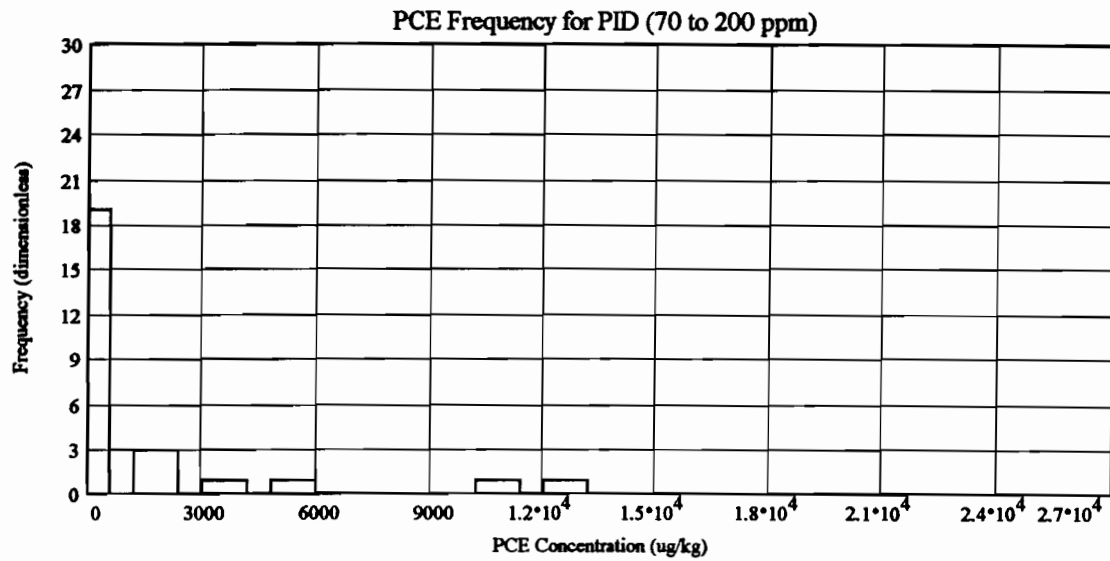
$$\text{mean}(\text{PCE200}) = 5.529 \cdot 10^3$$

$$\text{stdev}(\text{PCE200}) = 1.634 \cdot 10^4$$

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Graph Freq200_k versus PCEint2_k for

k2 := 0..n2 - 1



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Histogram Development

PID 200 to 1000 ppm

A submatrix was developed which sorted the PCE concentrations corresponding to the PID readings which were between 200 and 1000 ppm. The submatrix, consisting of 24 data points, was then listed in ascending order. These values are presented below as PCE1000. The PCE values ranged from 3 to 1×10^5 ug/kg.

A histogram was developed by dividing the submatrix was divided into 8 groups. The first group has PCE concentrations from 0 to 1.3×10^4 ug/kg and the last group has PCE concentrations from 1×10^5 to 1.1×10^5 ug/kg. The frequency was calculated to see how many values were in each group and then a histogram was developed to graphically represent the results.

$$m := 63$$

$$\text{PID\_Range\_200to1000} := \text{submatrix}(\text{SN}, p + 1, m, 0, 1)$$

$$\text{PCE1000} := \text{sort}(\text{PID\_Range\_200to1000}^{<1>})$$

$$n3 := 8 \quad \text{groups, and}$$

$$\text{delta} := \text{ceil}\left[\frac{\text{PCE1000}_{m-(p+1)}}{n3}\right] \quad \text{so} \quad \text{delta} = 1.25 \cdot 10^4$$

$$\text{let} \quad \text{PCEint3}_0 := 0 \quad \text{and,} \quad u := 0..n3$$

$$\text{PCEint3}_{u+1} := \text{PCEint3}_u + \text{delta}$$

Using the Mathcad histogram function, $\text{Freq1000} := \text{hist}(\text{PCEint3}, \text{PCE1000})$ yields..

$$\text{Freq1000} = \begin{bmatrix} 16 \\ 3 \\ 3 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \\ 1 \end{bmatrix}$$

	0
0	
1	$1.3 \cdot 10^4$
2	$2.5 \cdot 10^4$
3	$3.8 \cdot 10^4$
4	$5 \cdot 10^4$
5	$6.3 \cdot 10^4$
6	$7.5 \cdot 10^4$
7	$8.8 \cdot 10^4$
8	$1 \cdot 10^5$
9	$1.1 \cdot 10^5$

$$\text{PCEint3} =$$

	0
0	3
1	3
2	3
3	10
4	11
5	18
6	36
7	96
8	140
9	180
10	400
11	$1 \cdot 10^3$
12	$1.3 \cdot 10^3$
13	$2.1 \cdot 10^3$
14	$2.8 \cdot 10^3$
15	$4 \cdot 10^3$
16	$1.6 \cdot 10^4$
17	$1.9 \cdot 10^4$
18	$2.3 \cdot 10^4$
19	$2.5 \cdot 10^4$
20	$2.8 \cdot 10^4$

$$\text{PCE1000} =$$

Table continues

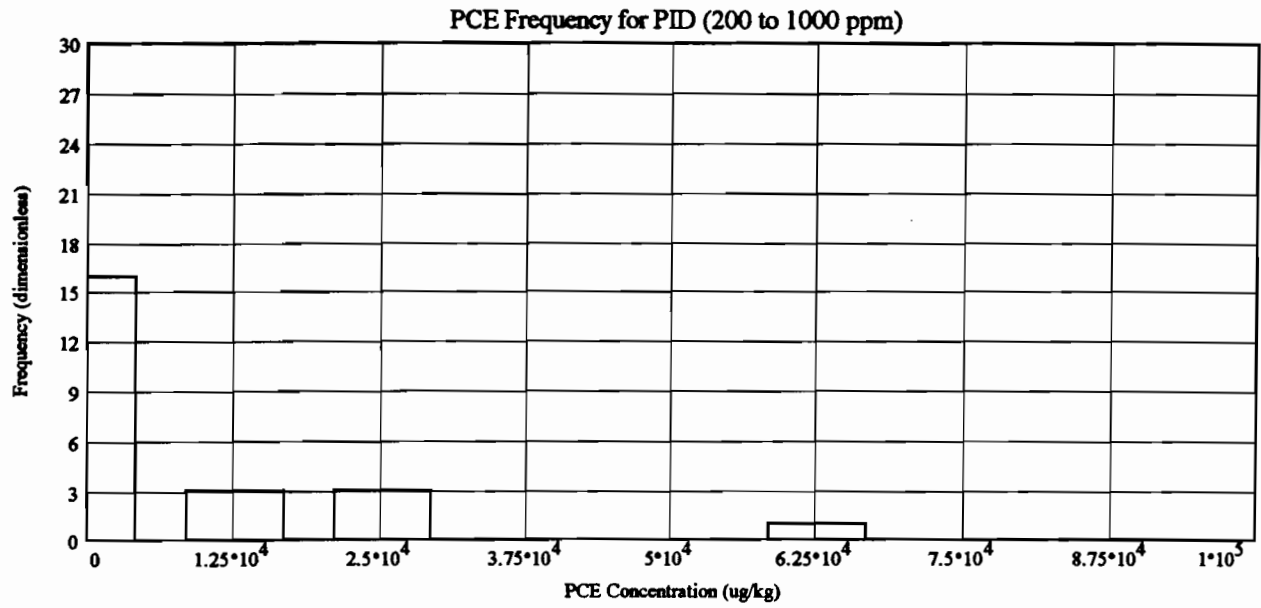
$$\text{mean}(\text{PCE1000}) = 1.334 \cdot 10^4$$

$$\text{stdev}(\text{PCE1000}) = 2.39 \cdot 10^4$$

ROWE INDUSTRIES SITE

Graph Freq1000_k versus PCEint3_k for

$k3 := 0..n3 - 1$



ROWE INDUSTRIES SITE

Correlation Exercise

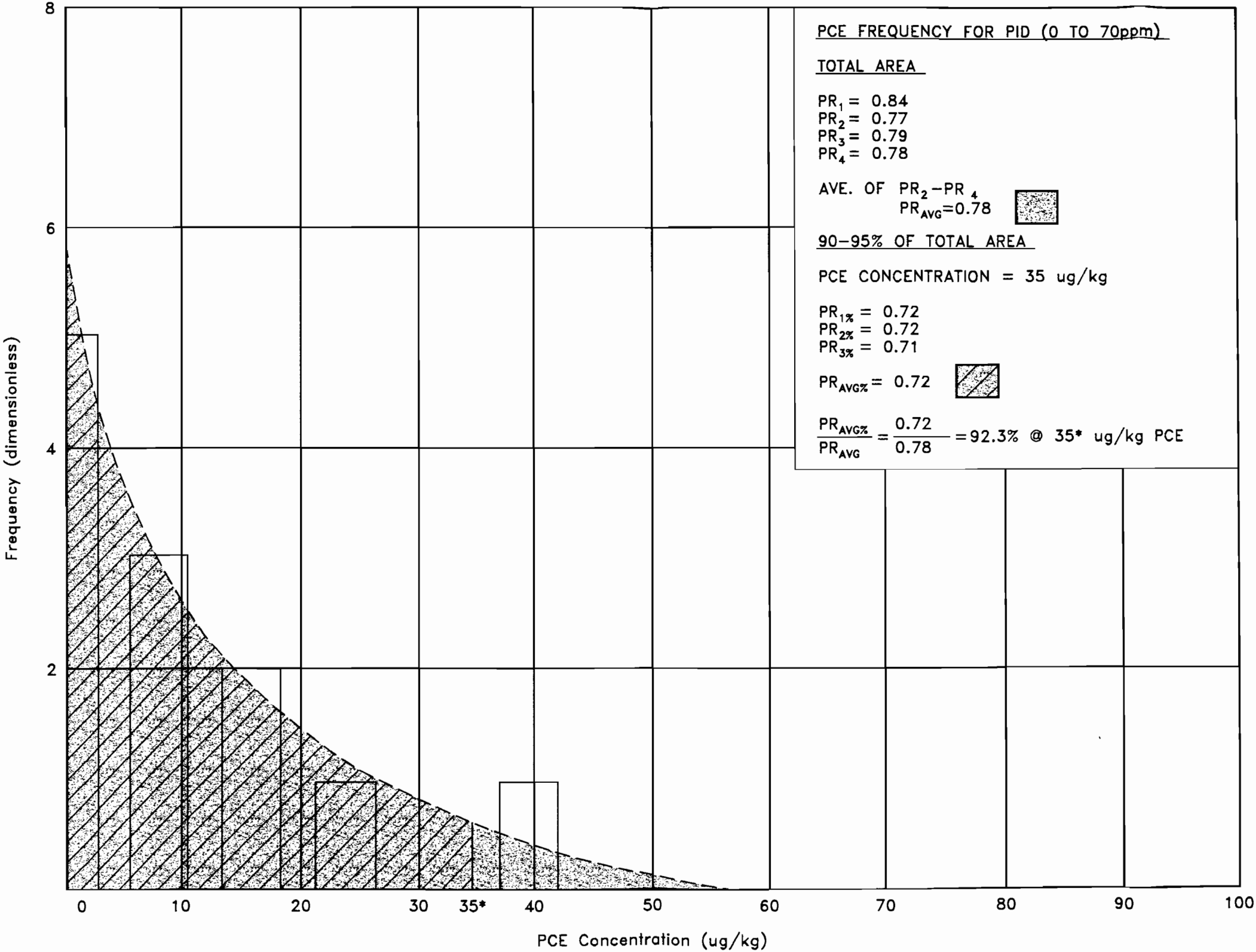
The following figures show the three histograms developed using the methodology previously described. The trend of the histogram bars were approximated using dashed lines. The colored areas beneath the dashed lines were measured using a planimeter. Several planimeter readings (PR) were taken and then averaged to estimate the total area beneath the trend lines.

A trial and error method was used to determine the PCE concentration that encompassed 90% of the PCE values in each PID range. The 90% criteria was checked by measuring the area beneath the dashed line and the selected PCE value. These areas were also measured using the planimeter readings and are designated as PR%. The 90% criteria was checked by dividing the average PR% ($PR_{ave\%}$) by PR_{ave} . Only the PCE concentration and area measurements for the final correlation values are shown.

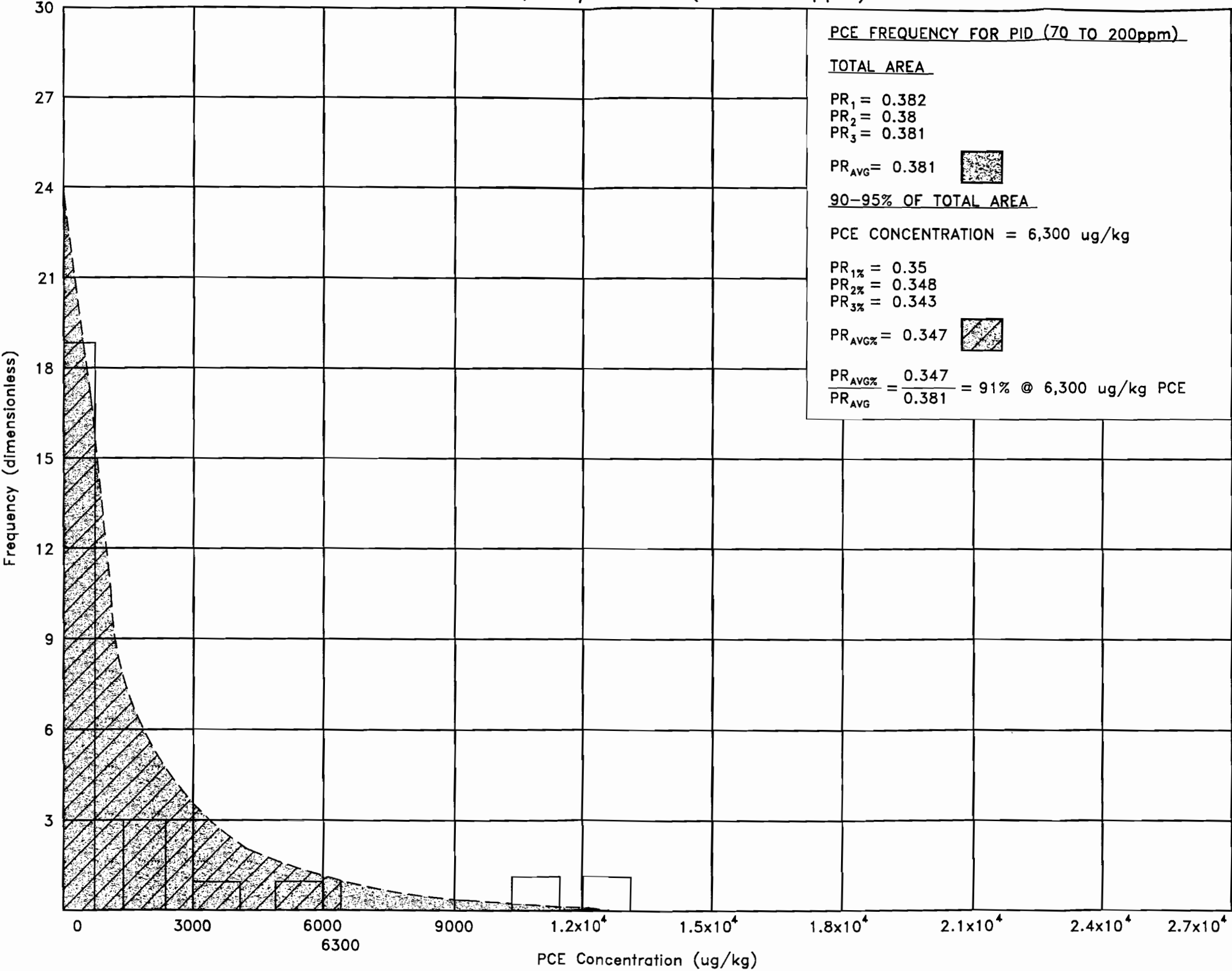
RESULTS

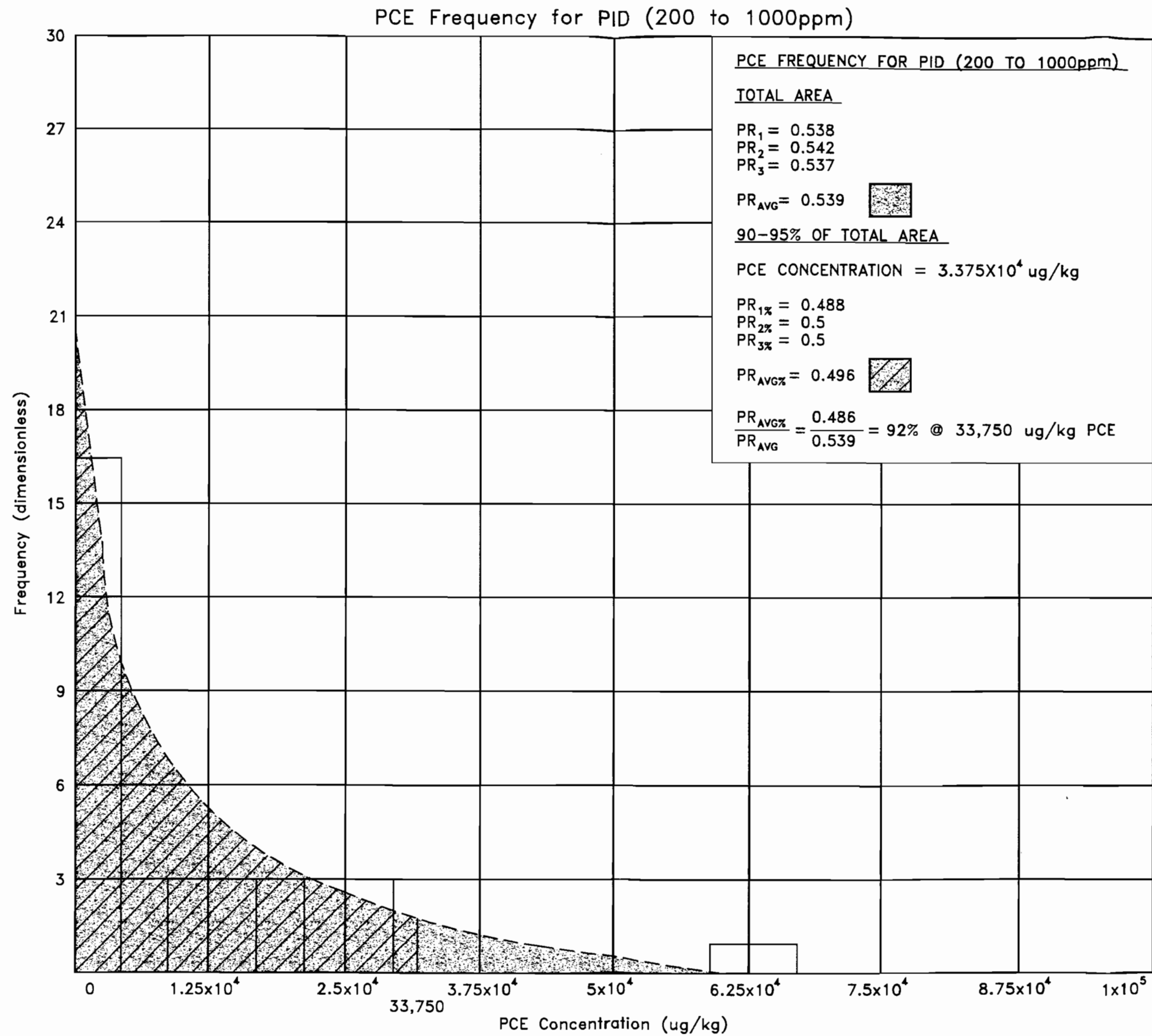
1. The PID range of 0 to 70 ppm can be correlated to a PCE concentration of 35 ug/kg or less with 92.3% confidence.
2. The PID range of 70 to 200 ppm can be correlated to a PCE concentration of 6,300 ug/kg or less with 91% confidence.
3. The PID range of 200 to 1000 ppm can be correlated to a PCE concentration of 33,750 ug/kg or less with 92% confidence.

PCE Frequency for PID (0 to 70ppm)



PCE Frequency for PID (70 to 200ppm)





ROWE INDUSTRIES SITE

SOIL REMEDIATION SAG HARBOR, NEW YORK

Signed: GS
Checked: ADK
Date: 4/16/96

CALCULATION OF PID AND PCE WEIGHTED AVERAGES

Calculated by: Greg Souza
Checked by: ALFRED N. KOVALIK

STATEMENT OF PROBLEM

Calculate the weighted average concentration of PCE or PID readings from soil samples collected from two consecutive soil borings.

ASSUMPTIONS

1. Scenario 1: Both soil samples have analytical PCE data available.
Scenario 2: PCE analytical data is available for the bottom soil sample and the top PCE concentration is estimated based on the PID-PCE correlation.
Scenario 3: PCE analytical data is available for the top soil sample and the bottom PCE concentration is estimated based on the PID-PCE correlation.
Scenario 4: PCE data is not available for either soil sample. PID readings for both the top and bottom soil samples are available. The weighted average of PID readings will be calculated and the PCE concentration will be estimated using the PID-PCE correlation.
2. The average concentration in each excavation layer can be approximated by a weighted average of two consecutive borings within the specified layer.
3. There is a full two feet of recovery for each soil boring.

GENERAL EQUATIONS

The equation numbers below correspond to the scenarios listed above.

1. $\text{weightedPCE} := \frac{(\text{PCEb}) \cdot (\text{deltab}) + (\text{PCEt}) \cdot (\text{deltat})}{2}$
2. $\text{weightedPCE} := \frac{(\text{PCEb}) \cdot (\text{deltab}) + (\text{PCEcorr}) \cdot (\text{deltat})}{2}$
3. $\text{weightedPCE} := \frac{(\text{PCEcorr}) \cdot (\text{deltab}) + (\text{PCEt}) \cdot (\text{deltat})}{2}$
4. $\text{weightedPID} := \frac{(\text{PIDb}) \cdot (\text{deltab}) + (\text{PIDt}) \cdot (\text{deltat})}{2}$

where: PCEb = PCE analytical data for the bottom soil sample, micrograms per kilogram
PCEt = PCE analytical data for the top soil sample, micrograms per kilogram
PIDb = PID reading for the bottom soil sample, parts per million
PIDt = PID reading for the top soil sample, parts per million
deltat = distance from the top elevation of excavation layer to the soil boring sample elevation, feet
deltab = depth of excavation layer (2.0 feet) minus deltat, feet

ROWE INDUSTRIES SITE

RB-1			
deltat = 1.83 deltab = 0.17			
depth ft MSL			weighted avg. conc
27 to 29	PIDt	175	165
	PIDb	62	
25 to 27	PCEcorr	35	1,052
	PCEb	12,000	
23 to 25	PCEt	12,000	10,988
	PCEb	96	
21 to 23	PCEt	96	91
	PCEb	39	
19 to 21	PCEt	39	39
	PCEcorr	35	
17 to 19	PIDt	30	28
	PIDb	2	
15 to 17	PIDt	2	2
	PIDb	4	
13 to 15	PIDt	4	4
	PIDb	1	

RB-2			
deltat = 0.33 deltab = 1.67			
depth ft MSL			weighted avg. conc
25 to 27	PIDt	8	16
	PIDb	18	
23 to 25	PIDt	18	17
	PIDb	17	
21 to 23	PIDt	17	6
	PIDb	4	
19 to 21	PIDt	4	1
	PIDb	0	
17 to 19	PCEcorr	35	6
	PCEb	0	
15 to 17	PCEt	0	29
	PCEcorr	35	
13 to 15	PIDt	8	3
	PIDb	2	

MSL = Mean Sea Level

ROWE INDUSTRIES SITE

RB-3			
		deltat = 1.03	
		deltab = 0.97	
depth ft MSL			weighted avg. conc
25 to 27	PIDt	6	5
	PIDb	3	
23 to 25	PIDt	3	2
	PIDb	1	
21 to 23	PCEcorr	35	31
	PCEb	27	
19 to 21	PCEt	27	31
	PCEcorr	35	
17 to 19	PIDt	3	3
	PIDb	4	
15 to 17	PIDt	4	3
	PIDb	1	
13 to 15	PIDt	1	13
	PIDb	26	

RB-4			
		deltat= 0.13	
		deltab= 1.87	
depth ft MSL			weighted avg. conc
25 to 27	PIDt	58	50
	PIDb	49	
23 to 25	PIDt	49	19
	PIDb	17	
21 to 23	PCEcorr	35	451
	PCEb	480	
19 to 21	PCEt	480	2,649
	PCEb	2,800	
17 to 19	PCEt	2,800	194
	PCEb	13	
15 to 17	PCEt	13	34
	PCEcorr	35	
13 to 15	PIDt	5	96
	PIDb	102	

ROWE INDUSTRIES SITE

RB-5			
		deltat= 1.23	
		deltab= 0.77	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	20	15
	PIDb	7	
25 to 27	PIDt	7	10
	PIDb	14	
23 to 25	PIDt	14	11
	PIDb	7	
21 to 23	PCEcorr	35	72
	PCEb	130	
19 to 21	PCEt	130	93
	PCEcorr	35	
17 to 19	PCEcorr	35	36
	PCEb	37	
15 to 17	PCEt	37	36
	PCEcorr	35	
13 to 15	PIDt	24	19
	PIDb	10	

RB-6			
		deltat = 1.83	
		deltab = 0.17	
depth ft MSL			weighted avg. conc
29 to 30	PCEt	35	8,532
	PCEcorr	100,000	
27 to 29	PCEt	100,000	92,036
	PCEcorr	6,300	
25 to 27	PIDt	328	335
	PIDb	406	
23 to 25	PIDt	406	455
	PIDb	982	
21 to 23	PCEcorr	33,750	38,616
	PCEb	91,000	
19 to 21	PCEt	91,000	83,265
	PCEb	3	
17 to 19	PCEt	3	538
	PCEcorr	6,300	
15 to 17	PCEcorr	6,300	5,799
	PCEb	400	

ROWE INDUSTRIES SITE

RB-7			
depth		deltat = 0.03	
ft MSL		deltab = 1.97	
			weighted avg. conc
27 to 29	PCEcorr	6,300	5,611
	PCEb	5,600	
25 to 27	PCEt	5,600	111
	PCEb	27	
23 to 25	PCEt	27	178
	PCEb	180	
21 to 23	PCEt	180	33,246
	PCEcorr	33,750	
19 to 21	PIDt	393	734
	PIDb	739	
17 to 19	PIDt	739	56
	PIDb	46	
15 to 17	PCEcorr	35	15,761
	PCEb	16,000	
13 to 15	PCEt	16,000	33,484
	PCEcorr	33,750	

RB-8			
depth		deltat = 1.78	
ft MSL		deltab = 0.22	
			weighted avg. conc
29 to 31	PCEcorr	35	9,381
	PCEb	85,000	
27 to 29	PCEt	85,000	79,363
	PCEcorr	33,750	
25 to 27	PIDt	290	274
	PIDb	144	
23 to 25	PIDt	144	175
	PIDb	428	
21 to 23	PIDt	428	525
	PIDb	1,309	
19 to 21	PIDt	1,309	1,310
	PIDb	1,316	
17 to 19	PCEcorr	33,750	39,168
	PCEb	83,000	
15 to 17	PCEt	83,000	77,583
	PCEcorr	33,750	
13 to 15	PIDt	1,008	1,021
	PIDb	1,123	

ROWE INDUSTRIES SITE

RB-9			
		deltat = 1.5	
		deltab = 0.5	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	75	71
	PIDb	60	
25 to 27	PCEcorr	35	526
	PCEb	2,000	
23 to 25	PCEt	2,000	2,500
	PCEb	4,000	
21 to 23	PCEt	4,000	3,009
	PCEcorr	35	
19 to 21	PCEcorr	35	3,276
	PCEb	13,000	
17 to 19	PCEt	13,000	9,750
	PCEb	0	
15 to 17	PCEt	0	9
	PCEcorr	35	

RB-10			
		deltat = 0.43	
		deltab = 1.57	
depth ft MSL			weighted avg. conc
25 to 27	PIDt	38	61
	PIDb	67	
23 to 25	PIDt	67	27
	PIDb	16	
21 to 23			
19 to 21			
17 to 19	PIDt	8	10
	PIDb	11	
15 to 17	PIDt	11	16
	PIDb	18	
13 to 15	PCEcorr	35	9
	PCEb	2	

ROWE INDUSTRIES SITE

RB-11			
		deltat = 1.13	
		deltab = 0.87	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	2	4
	PIDb	6	
25 to 27	PIDt	6	8
	PIDb	10	
23 to 25	PIDt	10	10
	PIDb	10	
21 to 23	PCEcorr	35	23
	PCEb	8	
19 to 21	PCEt	8	14,686
	PCEb	33,750	
17 to 19	PCEt	33,750	19,074
	PCEb	11	
15 to 17	PCEt	11	10
	PCEb	8	
13 to 15	PCEt	8	20
	PCEcorr	35	

RB-12			
		deltat = 0.33	
		deltab = 1.67	
depth ft MSL			weighted avg. conc
27 to 29	PCEcorr	35	2,678
	PCEb	3,200	
25 to 27	PCEt	3,200	3,701
	PCEb	3,800	
23 to 25	PCEt	3,800	693
	PCEb	79	
21 to 23	PCEt	79	1,099
	PCEb	1,300	
19 to 21	PCEt	1,300	28,396
	PCEcorr	33,750	
17 to 19	PCEcorr	33,750	26,444
	PCEb	25,000	
15 to 17	PCEt	25,000	4,154
	PCEcorr	35	
13 to 15	PIDt	33	281
	PIDb	330	

ROWE INDUSTRIES SITE

RB-13			
		deltat = 1.38	
		deltab = 0.62	
depth ft MSL			weighted avg. conc
27 to 29	PCEt	120,000	83,420
	PCEb	2,000	
25 to 27	PCEt	2,000	1,403
	PCEb	75	
23 to 25	PCEt	75	66
	PCEb	47	
21 to 23	PCEt	47	73
	PCEb	130	
19 to 21	PCEt	130	101
	PCEb	36	
17 to 19	PCEt	36	27
	PCEb	8	
15 to 17	PCEt	8	6
	PCEb	2	
13 to 15	PCEt	2	10,464
	PCEcorr	33,750	

RB-14			
		deltat = 1.93	
		deltab = 0.07	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	59	65
	PIDb	225	
25 to 27	PIDt	225	219
	PIDb	42	
23 to 25	PIDt	42	43
	PIDb	82	
21 to 23	PCEcorr	6,300	6,080
	PCEb	5	
19 to 21	PCEt	5	6
	PCEcorr	35	
17 to 19	PIDt	24	26
	PIDb	70	
15 to 17	PIDt	70	68
	PIDb	22	

ROWE INDUSTRIES SITE

RB-15			
		deltat = 1.33	
		deltab = 0.67	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	109	77
	PIDb	13	
25 to 27	PCEcorr	35	358
	PCEb	1,000	
23 to 25	PCEt	1,000	8,370
	PCEb	23,000	
21 to 23	PCEt	23,000	15,307
	PCEcorr	35	
19 to 21	PCEcorr	18	25
	PCEb	40	
17 to 19	PIDt	40	37
	PIDb	30	
15 to 17	PIDt	30	40
	PIDb	61	

RB-16			
		deltat = 0.23	
		deltab = 1.77	
depth ft MSL			weighted avg. conc
25 to 27	PIDt	3	6
	PIDb	6	
23 to 25	PIDt	6	8
	PIDb	8	
21 to 23	PIDt	8	12
	PIDb	13	
19 to 21	PIDt	13	11
	PIDb	11	
17 to 19	PIDt	11	14
	PIDb	14	
15 to 17	PIDt	14	8
	PIDb	7	
13 to 15	PCEcorr	7	1
	PCEb	0	

ROWE INDUSTRIES SITE

RB-17			
depth		deltat = 0.48	
ft MSL		deltab = 1.52	
			weighted avg. conc
27 to 29	PIDt	6	5
	PIDb	5	
25 to 27	PIDt	5	3
	PIDb	3	
23 to 25	PCEcorr	35	23
	PCEb	19	
21 to 23	PCEt	19	31
	PCEcorr	35	

RB-18			
depth		deltat = 1.83	
ft MSL		deltab = 0.17	
			weighted avg. conc
29 to 31	PIDt	47	45
	PIDb	27	
27 to 29	PCEcorr	35	32
	PCEb	5	
25 to 27	PCEt	5	16
	PCEb	140	
23 to 25	PCEt	140	2,997
	PCEcorr	33,750	
21 to 23	PCEcorr	33,750	32,241
	PCEb	16,000	
19 to 21	PCEt	16,000	17,509
	PCEcorr	33,750	
17 to 19	PIDt	2,885	2,721
	PIDb	958	
15 to 17	PIDt	958	902
	PIDb	304	

ROWE INDUSTRIES SITE

RB-19			
		deltat = 0.48	
		deltab = 1.52	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	27	27
	PIDb	27	
25 to 27	PIDt	27	39
	PIDb	43	
23 to 25	PIDt	43	34
	PIDb	31	
21 to 23	PCEcorr	35	18
	PCEb	12	
19 to 21	PCEt	12	5
	PCEb	3	
17 to 19	PCEt	3	9
	PCEb	11	

RB-20			
		deltat = 0.63	
		deltab = 1.37	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	72	74
	PIDb	75	
25 to 27	PCEcorr	6,300	2,014
	PCEb	43	
23 to 25	PCEt	43	17,824
	PCEb	26,000	
21 to 23	PCEt	26,000	31,309
	PCEcorr	33,750	
19 to 21	PCEcorr	33,750	10,638
	PCEb	10	
17 to 19	PCEt	10	3
	PCEb	0	
15 to 17	PCEt	0	24
	PCEcorr	35	
13 to 15	PIDt	63	159
	PIDb	203	

ROWE INDUSTRIES SITE

RB-21			
deltat = 0.88			
deltab = 1.12			
depth ft MSL			weighted avg. conc
27 to 29	PIDt	163	361
	PIDb	516	
25 to 27	PIDt	516	696
	PIDb	837	
23 to 25	PIDt	837	1,104
	PIDb	1,313	
21 to 23	PCEcorr	33,750	14,852
	PCEb	3	
19 to 21	PCEt	3	21
	PCEcorr	35	
17 to 19	PCEcorr	35	17
	PCEb	3	
15 to 17	PCEt	3	3,529
	PCEcorr	6,300	
13 to 15	PIDt	193	126
	PIDb	73	

RB-22			
deltat = 1.78			
deltab = 0.22			
depth ft MSL			weighted avg. conc
29 to 30	PIDt	6	6
	PIDb	6	
27 to 29	PIDt	6	6
	PIDb	7	
25 to 27	PIDt	7	8
	PIDb	13	
23 to 25	PCEcorr	35	34
	PCEb	22	

ROWE INDUSTRIES SITE

RB-23			
		deltat = 1.53	
		deltab = 0.47	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	28	37
	PIDb	68	
25 to 27	PCEcorr	35	35
	PCEb	37	
23 to 25	PCEt	37	1,509
	PCEcorr	6,300	
21 to 23	PIDt	106	106
	PIDb	104	
19 to 21	PCEcorr	6,300	4,821
	PCEb	8	
17 to 19	PCEt	8	7,937
	PCEcorr	33,750	
15 to 17	PCEcorr	33,750	25,819
	PCEb	3	
13 to 15	PCEt	3	1,483
	PCEcorr	6,300	

RB-24			
		deltat = 1.88	
		deltab = 0.12	
depth ft MSL			weighted avg. conc
29 to 31	PCEt	27,000	25,382
	PCEcorr	35	
27 to 29	PCEcorr	35	38
	PCEb	89	
25 to 27	PCEt	89	86
	PCEcorr	35	
23 to 25	PIDt	21	23
	PIDb	58	
21 to 23	PIDt	58	55
	PIDb	0	
19 to 21	PIDt	0	1
	PIDb	20	
17 to 19	PIDt	20	23
	PIDb	76	
15 to 17	PIDt	76	73
	PIDb	34	
13 to 15	PIDt	34	40
	PIDb	140	

ROWE INDUSTRIES SITE

RB-25			
deltat = 1.13			
deltab = 0.87			
depth ft MSL			weighted avg. conc
27 to 29	PCEt	19	26
	PCEcorr	35	
25 to 27	PCEcorr	35	21
	PCEb	3	
23 to 25	PCEt	3	17
	PCEcorr	35	
21 to 23	PIDt	1	23
	PIDb	52	
19 to 21	PIDt	52	32
	PIDb	5	
17 to 19	PIDt	5	10
	PIDb	17	
15 to 17	PIDt	17	32
	PIDb	51	
13 to 15	PIDt	51	29
	PIDb	0	

RB-26			
deltat = 0.23			
deltab = 1.77			
depth ft MSL			weighted avg. conc
27 to 29	PIDt	0	0
	PIDb	0	
25 to 27	PIDt	0	1
	PIDb	1	
23 to 25	PIDt	1	32
	PIDb	36	
21 to 23	PIDt	36	4
	PIDb	0	
19 to 21	PIDt	0	15
	PIDb	17	
17 to 19	PIDt	17	5
	PIDb	4	
15 to 17	PCEcorr	35	4
	PCEb	0	
13 to 15	PCEt	0	5,576
	PCEcorr	6,300	

ROWE INDUSTRIES SITE

RB-27			
		deltat = 1.78	
		deltab = 0.22	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	17	16
	PIDb	12	
25 to 27	PIDt	12	15
	PIDb	35	
23 to 25	PCEcorr	35	33
	PCEb	18	
21 to 23	PCEt	18	20
	PCEcorr	35	
19 to 21	PIDt	55	52
	PIDb	27	
17 to 19	PIDt	27	32
	PIDb	69	
15 to 17	PCEcorr	35	32
	PCEb	11	

B-9			
		deltat = 0.13	
		deltab = 1.87	
depth ft MSL			weighted avg. conc
25 to 27	PIDt	200	294
	PIDb	300	
23 to 25	PIDt	300	253
	PIDb	250	
21 to 23	PCEcorr	33,750	19,959
	PCEb	19,000	
19 to 21	PCEt	19,000	32,791
	PCEcorr	33,750	
17 to 19	PIDt	290	66
	PIDb	50	
15 to 17	PIDt	50	134
	PIDb	140	
13 to 15	PIDt	140	26
	PIDb	18	

ROWE INDUSTRIES SITE

B-10			
		deltat = 1.35	
		deltab = 0.65	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	300	326
	PIDb	380	
25 to 27	PCEcorr	33,750	32,531
	PCEb	30,000	
23 to 25	PCEt	30,000	31,219
	PCEcorr	33,750	
21 to 23	PIDt	250	266
	PIDb	300	
19 to 21	PIDt	300	268
	PIDb	200	
17 to 19	PCEcorr	33,750	44,556
	PCEb	67,000	
15 to 17	PCEt	67,000	47,273
	PCEcorr	6,300	
13 to 15	PIDt	150	118
	PIDb	50	

B-11			
		deltat = 0.9	
		deltab = 1.1	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	3	67
	PIDb	120	
25 to 27	PIDt	120	104
	PIDb	90	
23 to 25	PIDt	90	85
	PIDb	80	
21 to 23	PIDt	80	201
	PIDb	300	
19 to 21	PIDt	300	190
	PIDb	100	
17 to 19	PIDt	100	89
	PIDb	80	

ROWE INDUSTRIES SITE

B-12			
		deltat = 0.29	
		deltab = 1.71	
depth ft MSL			weighted avg. conc
25 to 27	PIDt	12	70
	PIDb	80	
23 to 25	PIDt	80	46
	PIDb	40	
21 to 23	PIDt	40	134
	PIDb	150	
19 to 21	PIDt	150	124
	PIDb	120	
17 to 19	PIDt	120	180
	PIDb	190	
15 to 17	PIDt	190	79
	PIDb	60	

B-13			
		deltat = 1.46	
		deltab = 0.54	
depth ft MSL			weighted avg. conc
27 to 29	PIDt	110	161
	PIDb	300	
25 to 27	PIDt	300	246
	PIDb	100	
23 to 25	PIDt	100	122
	PIDb	180	
21 to 23	PIDt	180	212
	PIDb	300	
19 to 21	PCEcorr	33,750	25,205
	PCEb	2,100	

ROWE INDUSTRIES SITE

B-14			
deltat = 1.15			
deltab = 0.85			
depth ft MSL			weighted avg. conc
27 to 29	PIDt	20	46
	PIDb	80	
25 to 27	PIDt	80	89
	PIDb	100	
23 to 25	PIDt	100	100
	PIDb	100	
21 to 23	PIDt	100	228
	PIDb	400	
19 to 21	PIDt	400	379
	PIDb	350	
17 to 19	PIDt	350	286
	PIDb	200	

ROWE INDUSTRIES SITE

SOIL REMEDIATION SAG HARBOR, NEW YORK

Signed: GTS
Checked: ANK
Date: 4/16/96

CALCULATION OF CONTOURS

Calculated by: Greg Souza
Checked by: Alfred N. Kovalik

STATEMENT OF PROBLEM

Given concentrations C1 and C2 separated by a distance D, determine the location of an arbitrary concentration C3 ($C1 < C3 < C2$). The two concentrations to be solved for are 1,500 ug/kg and 5,600 ug/kg. 1,500 ug/kg is the soil cleanup criteria for PCE required in the ROD and 5,600 ug/kg is the land disposal restriction concentration for PCE.

ASSUMPTIONS

1. Concentration varies linearly with distance between C1 and C2.
2. Distance, D, is measured in feet.
3. Concentrations used with each excavation layer were determined, in part, by PID-PCE correlations and weighting average procedures.

GENERAL EQUATIONS

Using Linear interpolation:

$$X1 := D \cdot \frac{(1500 - C1)}{(C2 - C1)}$$

$$X2 := D \cdot \frac{(5600 - C1)}{(C2 - C1)}$$

where:

X1 = distance from C1 to 1,500 micrograms per kilogram

X2 = distance from C1 to 5,600 micrograms per kilogram

ROWE INDUSTRIES SITE

SOLUTION

Excavation Layer

<u>ELEVATION 29 to 31</u>		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	6,300	35	39	9.12	34.64
RB-21	RB-25	6,300	19	39.5	9.31	35.10
RB-24	RB-26	25,382	35	65	3.76	14.27
RB-24	RB-18	25,382	35	101	5.84	22.17
RB-15	RB-25	6,300	19	46	10.85	40.87
RB-15	RB-23	6,300	35	40	9.35	35.53
RB-9	RB-23	6,300	35	25	5.85	22.21
RB-1	RB-23	6,300	35	19	4.44	16.88
RB-1	RB-14	6,300	35	51	11.93	45.30
RB-8	RB-18	9,381	35	26	4.08	15.48
RB-8	B-14	9,381	35	45	7.05	26.79
RB-8	RB-14	9,381	35	53.5	8.39	31.86
RB-6	RB-18	8,532	35	46	7.93	30.13
RB-6	RB-19	8,532	35	44	7.59	28.82
RB-6	RB-14	8,532	35	30	5.17	19.65
RB-7	RB-19	6,300	35	34	7.95	30.20
RB-7	RB-12	6,300	35	20	4.68	17.77
RB-13	B-14	120,000	35	22	0.27	1.02
RB-13	RB-12	120,000	35	33	0.40	1.53
B-10	RB-12	33,750	35	31	1.35	5.12
B-10	RB-5	33,750	35	21	0.91	3.47

Example of formulas used in spreadsheet

<u>Elevation 29 to 31</u>		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	6,300	35	39	$\frac{39(1500-35)}{(6300-35)}$	$\frac{39(5600-35)}{(6300-35)}$

ROWE INDUSTRIES SITE

Excavation Layer ELEVATION 27 to 29

		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	33,750	35	39	1.69	6.44
RB-21	RB-25	33,750	35	39.5	1.72	6.52
RB-21	RB-24	33,750	38	42	1.82	6.93
RB-15	RB-25	6,300	35	46	10.76	40.86
RB-15	RB-23	6,300	35	40	9.35	35.53
RB-9	RB-23	6,300	35	25	5.85	22.21
RB-1	RB-23	6,300	35	24	5.61	21.32
RB-1	RB-14	6,300	35	51	11.93	45.30
RB-20	RB-24	6,300	38	43	10.04	38.19
RB-8	RB-24	79,363	38	90.5	1.67	6.35
RB-8	RB-18	79,363	32	26	0.48	1.82
RB-8	B-14	79,363	35	45	0.83	3.16
RB-8	RB-14	79,363	35	53.5	0.99	3.75
RB-6	RB-18	92,036	32	46	0.73	2.78
RB-6	RB-19	92,036	35	44	0.70	2.66
RB-6	B-14	92,036	35	30	0.48	1.81
RB-7	RB-19	5,611	35	34	8.93	33.93
RB-7	RB-12	5,611	2,678	20		19.92
RB-12	B-11	2,678	35	28	15.52	
B-10	RB-5	33,750	35	21	0.91	3.47
B-10	RB-12	33,750	2,678	31	-1.18	2.92
B-10	RB-10	33,750	35	36	1.56	5.94
B-10	RB-4	33,750	35	21	0.91	3.47
B-13	RB-4	6,300	35	33	7.72	29.31
RB-13	B-14	83,420	35	22	0.39	1.47
B-9	RB-2	33,750	35	13	0.56	2.15
B-9	RB-14	33,750	35	17	0.74	2.81
B-9	B-14	33,750	35	37	1.61	6.11
B-9	B-12	33,750	35	48	2.09	7.92

ROWE INDUSTRIES SITE

Excavation Layer

ELEVATION 25 to 27

		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	33,750	35	39	1.69	6.44
RB-21	RB-25	33,750	21	39.5	1.73	6.53
RB-21	RB-24	33,750	86	42	1.76	6.88
RB-21	RB-15	33,750	358	33	1.13	5.18
RB-20	RB-24	2,014	86	43	31.54	
RB-20	RB-9	2,014	526	27	17.67	
RB-20	RB-15	2,014	358	31	21.38	
RB-8	RB-20	33,750	2,014	57		6.44
RB-8	RB-18	33,750	35	26	1.13	4.29
RB-8	RB-1	33,750	1,052	56	0.77	7.79
RB-8	RB-24	33,750	86	90.5	3.80	14.82
RB-8	RB-9	33,750	526	68	1.99	10.39
RB-6	RB-18	33,750	35	46	2.00	7.59
RB-6	RB-19	33,750	35	44	1.91	7.26
RB-6	RB-13	33,750	1,403	28	0.08	3.63
RG-6	RB-7	33,750	111	15	0.62	2.45
RB-12	RB-7	3,701	111	20	7.74	
B-11	RB-12	6,300	3,701	28		20.46
B-11	RB-11	6,300	35	19	4.44	16.88
B-11	RB-5	6,300	35	5	1.17	4.44
B-11	RB-19	6,300	35	63	14.73	55.96
RB-12	RB-19	3,701	35	42	16.78	
B-10	RB-5	32,531	35	21	0.95	3.60
B-10	RB-12	32,531	3,701	31		2.04
B-10	RB-10	32,531	35	36	1.62	6.17
B-10	RB-4	32,531	35	21.5	0.97	3.68
B-13	RB-13	33,750	1,403	4	0.01	0.52
B-13	RB-4	33,750	35	33	1.43	5.45
B-12	RB-4	6,300	35	5	1.17	4.44
B-12	RB-10	6,300	35	25	5.85	22.21
B-12	RB-3	6,300	35	51	11.93	45.30
RB-12	RB-13	3,701	1,403	33	1.39	
B-14	RB-13	6,300	1,403	22	0.44	18.86
B-9	RB-2	33,750	35	13	0.56	2.15
RB-14	RB-2	33,750	35	21	0.91	3.47
RB-14	RB-1	33,750	35	51	2.22	8.42

ROWE INDUSTRIES SITE

Excavation Layer

ELEVATION 23 to 25

		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	33,750	35	39	1.69	6.44
RB-21	RB-25	33,750	17	39.5	1.74	6.54
RB-21	RB-24	33,750	35	42	1.83	6.93
RB-15	RB-25	8,370	17	46	8.17	30.75
RB-15	RB-24	8,370	35	51	8.96	34.05
BB-15	RB-9	8,370	2,500	22		11.62
RB-15	RB-23	8,370	1,509	40		23.85
RB-15	RB-27	8,370	33	53.5	9.41	35.72
RB-20	RB-24	17,824	35	43	3.54	13.45
RB-20	RB-9	17,824	2,500	27		5.46
RB-20	RB-18	17,824	2,997	76		13.34
RB-1	RB-9	10,988	2,500	25		9.13
RB-1	RB-23	10,988	1,509	24		10.36
RB-1	RB-14	10,988	35	51	6.82	25.91
RB-1	RB-2	10,988	35	60	8.03	30.48
RB-23	RB-27	1,509	33	19	18.88	
RB-18	RB-22	2,997	34	70	34.63	
RB-18	RB-17	2,997	23	79	39.23	
RB-18	RB-19	2,997	35	67	33.14	
RB-6	RB-7	33,750	178	15	0.59	2.42
RB-6	RB-19	33,750	35	44	1.91	7.26
RB-6	RB-18	33,750	2,997	46		3.89
RB-6	RB-13	33,750	66	28	1.19	4.60
RB-8	RB-18	6,300	2,997	26		20.49
B-14	RB-14	6,300	35	32	7.48	28.42
B-14	RB-13	6,300	66	22	5.06	19.53
B-13	RB-13	6,300	66	4	0.92	3.55
B-11	RB-12	6,300	693	28	4.03	24.50
B-11	RB-11	6,300	35	19	4.44	16.88
B-11	RB-5	6,300	35	5	1.17	4.44
B-10	RB-5	31,219	35	21	0.99	3.75
B-10	RB-4	31,219	35	21.5	1.01	3.84
B-10	RB-10	31,219	35	36	1.69	6.42
B-10	RB-12	31,219	693	30.5	0.81	4.90
B-9	B-12	33,750	35	49	2.13	8.09
B-9	RB-2	33,750	35	13	0.56	2.15
B-9	RB-14	33,750	35	18	0.78	2.97
B-13	RB-4	6,300	35	33	7.72	29.31
B-13	RB-13	6,300	66	4	0.92	3.55
RB-8	RB-14	6,300	35	53.5	12.51	47.52

ROWE INDUSTRIES SITE

Excavation Layer
ELEVATION 21 to 23

		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	14,852	35	39	3.86	14.65
RB-21	RB-25	14,852	35	39.5	3.91	14.84
RB-21	RB-24	14,852	35	42	4.15	15.77
RB-15	RB-24	15,307	35	51	4.89	18.58
RB-15	RB-25	15,307	35	46	4.41	16.76
RB-15	RB-9	15,307	3,009	22		4.64
RB-15	RB-27	15,307	20	53.5	5.18	19.53
RB-20	RB-9	31,309	3,009	27		2.47
RB-20	RB-1	31,309	91	42	1.90	7.41
RB-9	RB-1	3,009	91	25	12.07	
RB-23	RB-9	6,300	3,009	25		19.68
RB-23	RB-1	6,300	91	24	5.45	21.29
RB-23	RB-27	6,300	20	19	4.48	16.88
RB-20	RB-24	31,309	35	43	2.01	7.65
RB-18	RB-24	32,241	35	101	4.59	17.45
RB-18	RB-22	32,241	22	70	3.21	12.12
RB-18	RB-17	32,241	31	79	3.60	13.66
RB-18	RB-19	32,241	18	67	3.08	11.61
RB-6	RB-19	38,616	18	44	1.69	6.36
RB-7	RB-19	33,246	18	34	1.52	5.71
RB-6	RB-13	38,616	73	28	1.04	4.02
RB-7	RB-13	33,246	73	31	1.33	5.16
B-14	RB-13	33,750	73	23	0.97	3.77
B-13	RB-13	33,750	73	4	0.17	0.66
RB-7	RB-12	33,246	1,099	20	0.25	2.80
B-11	RB-12	33,750	1,099	28	0.34	3.86
B-11	RB-11	33,750	23	19	0.83	3.14
B-11	RB-5	33,750	72	5	0.21	0.82
B-10	RB-5	33,750	72	21	0.89	3.45
B-10	RB-10	33,750	35	36	1.56	5.94
B-10	RB-4	33,750	451	21.5	0.68	3.32
B-12	RB-10	6,300	35	25	5.85	22.21
B-12	RB-4	6,300	451	5	0.90	4.40
B-13	RB-4	33,750	451	33	1.04	5.10
B-9	RB-2	19,959	35	13	0.96	3.63
RB-14	RB-2	6,080	35	21	5.09	19.33
RB-14	RB-1	6,080	91	50.5	11.88	46.45
B-12	RB-3	6,300	31	51	11.95	45.31

ROWE INDUSTRIES SITE

Excavation Layer

ELEVATION 19 to 21

		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-20	RB-24	10,638	35	43	5.94	22.57
RB-20	RB-15	10,638	25	31	4.31	16.28
RB-20	RB-9	10,638	3,276	27		8.52
RB-20	RB-1	10,638	39	42	5.79	22.04
RB-9	RB-15	3,276	25	22	9.98	
RB-9	RB-1	3,276	39	25	11.28	
RB-23	RB-1	4,821	39	24	7.33	
RB-23	RB-15	4,821	25	40	12.30	
RB-23	RB-27	4,821	35	19	5.82	
RB-8	RB-24	33,750	35	90.5	3.93	14.94
RB-8	RB-1	33,750	39	56	2.43	9.24
RB-8	RB-14	33,750	6	53.5	2.37	8.87
RB-18	RB-24	17,509	35	101	8.47	32.17
RB-18	RB-19	17,509	5	67	5.72	21.42
RB-6	RB-19	83,265	5	44	0.79	2.96
RB-6	RB-13	83,265	101	28	0.47	1.85
RB-7	RB-19	33,750	5	34	1.51	5.64
RB-7	RB-13	33,750	101	31	1.29	5.07
RB-12	RB-19	28,396	5	42	2.21	8.28
RB-12	RB-5	28,396	93	28	1.39	5.45
RB-12	RB-13	28,396	101	33	1.63	6.41
B-11	RB-19	6,300	5	63	14.96	55.99
B-11	RB-5	6,300	93	5	1.13	4.44
RB-11	RB-19	14,686	5	79	8.04	30.11
RB-11	RB-16	14,686	35	19	1.90	7.22
RB-11	RB-5	14,696	93	19	1.83	7.17
B-10	RB-5	33,750	93	21	0.88	3.44
B-10	RB-10	33,750	35	36	1.56	5.94
B-10	RB-4	33,750	2,649	21.5		2.04
B-10	RB-13	33,750	101	29	1.21	4.74
B-13	RB-13	33,750	101	4	0.17	0.65
B-13	RB-4	33,750	2,649	33		3.13
B-14	RB-13	33,750	101	22	0.91	3.60
B-14	RB-14	33,750	6	32	1.42	5.30
RB-4	RB-10	2,649	35	25	14.01	
B-12	RB-10	6,300	35	25	5.85	22.21
B-12	RB-3	6,300	31	51	11.95	45.31
B-9	RB-2	32,791	35	13	0.58	2.21
B-9	RB-14	32,791	6	18	0.82	3.07

ROWE INDUSTRIES SITE

Excavation Layer

ELEVATION 17 to 19

		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-23	RB-27	7,937	35	19	3.52	13.38
RB-23	RB-15	7,937	35	40	7.42	28.17
RB-23	RB-1	7,937	35	24	4.45	16.90
RB-9	RB-20	9,750	3	27	4.15	15.50
RB-9	RB-15	9,750	35	22	3.32	12.60
RB-9	RB-1	9,750	35	25	3.77	14.32
RB-8	RB-24	39,168	35	90.5	3.39	12.87
RB-8	RB-20	39,168	3	57	2.18	8.15
RB-8	RB-1	39,168	35	56	2.10	7.96
RB-8	RB-14	39,168	35	53.5	2.00	7.61
RB-8	RB-6	39,168	538	52	1.29	6.81
RB-18	RB-24	33,750	35	101	4.39	16.67
RB-18	RB-19	33,750	9	67	2.96	11.10
RB-18	RB-7	33,750	35	58	2.52	9.57
RB-18	RB-6	33,750	538	46	1.33	7.01
RB-12	RB-19	26,444	9	42	2.37	8.88
RB-12	RB-5	26,444	36	28	1.55	5.90
RB-12	RB-13	26,444	27	33	1.84	6.96
RB-12	RB-7	26,444	35	20	1.11	4.21
B-11	RB-19	6,300	9	63	14.93	55.99
B-11	RB-5	6,300	36	5	1.17	4.44
RB-11	RB-19	19,074	9	63	4.93	18.48
RB-11	RB-16	19,074	35	19	1.46	5.55
RB-11	RB-5	19,074	36	19	1.46	5.55
RB-11	RB-10	19,074	35	45	3.46	13.15
B-10	RB-5	44,556	36	21	0.69	2.62
B-10	RB-10	44,556	35	36	1.18	4.50
B-10	RB-4	44,556	194	21.5	0.63	2.62
B-12	RB-10	6,300	35	25	5.85	22.21
B-12	RB-4	6,300	194	5	1.07	4.43
B-12	RB-3	6,300	35	51	11.93	45.30
B-12	B-9	6,300	35	49	11.46	43.53
B-13	RB-4	25,205	194	33	1.72	7.13
B-13	RB-13	25,205	27	4	0.23	0.89
B-13	B-9	25,205	35	45	2.62	9.95
B-14	RB-13	33,750	27	22	0.96	3.64
B-14	RB-6	33,750	538	37	1.07	5.64
B-14	RB-14	33,750	35	32	1.39	5.28
B-14	B-9	33,750	35	27	1.17	4.46

ROWE INDUSTRIES SITE

Excavation Layer

ELEVATION 15 to 17

		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	3,529	4	39	16.55	
RB-21	RB-25	3,529	35	39.5	16.56	
RB-24	RB-26	6,300	4	65	15.44	57.77
RB-24	RB-20	6,300	24	43	10.11	38.20
RB-24	RB-15	6,300	35	51	11.93	45.30
RB-23	RB-15	25,819	35	40	2.27	8.63
RB-23	RB-27	25,819	32	19	1.08	4.10
RB-23	RB-1	25,819	35	24	1.36	5.18
RB-23	RB-2	25,819	29	72	4.11	15.55
RB-23	RB-9	25,819	9	25	1.44	5.42
RB-8	RB-20	77,583	24	57	1.08	4.10
RB-8	RB-1	77,583	35	56	1.06	4.02
RB-8	RB-14	77,583	35	53.5	1.01	3.84
RB-18	RB-19	33,750	11	67	2.96	11.10
RB-6	RB-19	5,799	11	44	11.32	42.49
RB-6	RB-13	5,799	6	28	7.22	27.04
RB-7	RB-19	15,761	11	34	3.21	12.07
RB-7	RB-13	15,761	6	31	2.94	11.01
RB-7	RB-12	15,761	4,154	20		2.49
RB-12	RB-19	4,154	11	42	15.09	
B-11	RB-19	6,300	11	63	14.92	55.99
B-11	RB-11	6,300	10	19	4.50	16.89
B-11	RB-5	6,300	36	5	1.17	4.44
B-10	RB-5	47,273	36	21	0.65	2.47
B-10	RB-11	47,273	10	45	1.42	5.32
B-10	RB-16	47,273	35	54	1.67	6.36
B-10	RB-10	47,273	35	36	1.12	4.24
B-10	RB-4	47,273	34	21.5	0.67	2.53
B-10	RB-13	47,273	6	30	0.95	3.55
B-10	RB-12	47,273	4,154	31		1.04
B-12	RB-4	6,300	34	5	1.17	4.44
B-12	RB-10	6,300	35	25	5.85	22.21
B-12	RB-3	6,300	35	51	11.93	45.30
B-13	RB-13	2,100	6	4	2.85	10.69
B-14	RB-13	33,750	6	22	0.97	3.65
B-14	RB-14	33,750	35	32	1.39	5.28
B-9	RB-13	6,300	6	46	10.92	40.88
B-9	RB-14	6,300	35	18	4.21	15.99
B-9	RB-2	6,300	29	13	3.05	11.55

ROWE INDUSTRIES SITE

Excavation Layer

ELEVATION 13 to 15

		<u>C2</u>	<u>C1</u>	<u>D</u>	<u>X1</u>	<u>X2</u>
RB-21	RB-26	6,300	5,576	39		1.29
RB-21	RB-25	6,300	35	39.5	9.24	35.09
RB-21	RB-24	6,300	35	42	9.82	37.31
RB-21	RB-15	6,300	35	33	7.72	29.31
RB-20	RB-24	6,300	35	43	10.06	38.20
RB-20	RB-15	6,300	35	31	7.25	27.54
RB-20	RB-9	6,300	35	27	6.31	23.98
RB-20	RB-1	6,300	35	22	5.14	19.54
RB-8	RB-24	33,750	35	90.5	3.93	14.94
RB-8	RB-9	33,750	35	68	2.95	11.22
RB-8	RB-6	33,750	400	52	1.72	8.11
RB-18	RB-24	33,750	35	101	4.39	16.67
RB-18	RB-6	33,750	400	46	1.52	7.17
RB-7	RB-6	33,484	400	15	0.50	2.36
RB-13	RB-6	10,464	400	28	3.06	14.47
RB-13	RB-14	10,464	35	49	6.88	26.15
RB-12	RB-5	33,750	35	28	1.22	4.62
B-10	RB-5	6,300	35	21	4.91	18.65
B-10	RB-10	6,300	9	36	8.53	31.99
RB-4	RB-10	6,300	9	20	4.74	17.77
RB-4	B-9	6,300	35	51	11.93	45.30
RB-26	RB-24	5,576	35	65	17.19	65.28
RB-26	RB-25	5,576	35	56	14.81	56.24

APPENDIX L

Specifications

APPENDIX L
Specifications

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**APPENDIX L
SPECIFICATIONS FOR
SOIL REMEDIATION
ROWE INDUSTRIES SITE
SAG HARBOR, NEW YORK**

Prepared For

Nabisco, Inc.

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LBG Engineering Services, P.C.
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LBG ENGINEERING SERVICES, P.C.

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- 15135 Gages and Meters
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- 15190 Mechanical Identification
- 15410 Plumbing Piping
- 15870 Power Ventilators
- 15940 Air Outlets and Inlets
- 15985 Sequence of Operation
- 15990 Testing, Adjusting and Balancing
- 15995 System Operation

DIVISION 16 - ELECTRICAL

- 16010 Basic Electrical Requirements
- 16111 Conduit
- 16123 Building Wire and Cable
- 16130 Boxes
- 16170 Grounding and Bonding
- 16180 Equipment Wiring
- 16190 Supporting Devices
- 16195 Electrical Identification
- 16421 Utility Service Entrance
- 16461 Dry-Type Transformers
- 16470 Panelboards
- 16510 Interior Luminaires
- 16741 Telephone Service, Pathways, and Wiring
- 16800 Instrumentation
- 16864 Electric Space Heating Units

Note: "PRPs' Representative", as used in these Specifications, refers to LBG Engineering Services, P.C. and "Contractor", as used in these Specifications, refers to the General Contractor who will be awarded the Soil Remediation Contract and his subcontractors.

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Contract description.
- B. Contractor use of site and premises.
- C. Work Sequence.
- D. Use of site and premises by all subject private property owners.

1.2 CONTRACT DESCRIPTION

- A. The PRPs' Representative will award a contract for supply and execution of a soil remedial action, which is expected to commence in the late summer/early fall of 1997. All work shall be completed in accordance with the following Specifications. These specifications are an appendix to the Soil Design Report completed by the PRPs' Representative. A copy of the Soil Design Report shall be made available in the onsite job trailer for Contractor review and reference. Where discrepancies between the Specifications and the Soil Design Report exist, the Soil Design Report shall supersede.
- B. The required Work includes furnishing all labor, materials, equipment, facilities and incidentals necessary to excavate, treat and dispose of approximately 215 cubic yards of contaminated soil, and to install and to construct the soil vapor extraction and air sparge systems and the treatment shed, including making operational all equipment. In addition, the Contractor will be responsible for start-up and testing of all equipment. The area to be excavated is shown on the Drawings. The soil from the excavated area will be placed in an impoundment for on-site treatment. At the conclusion of the on-site treatment, the soil will be disposed of at a Resource Conservation and Recovery Act (RCRA) Subtitle C, permitted landfill.

More specifically, the required Work includes:

- 1. Installing a chain-link fence in areas shown on Drawings.
- 2. Preparing the remediation area for excavation of contaminated soil, including removing existing asphalt pavement, chain-link fencing, topsoil and vegetation from areas designated on the Drawings.
- 3. Installing and maintaining erosion controls.

4. Installing a field office, a Contractor field office, personnel and vehicle/equipment decontamination facilities and the soil impoundment in the remediation area shown on the Drawings.
5. Bringing two sets of utilities each consisting of above-grade electric and two telephone services, from existing offsite sources, owned by private utilities companies (Others) and as designated on the Drawings, to the field office trailers; one set of utilities connecting to the PRPs Representative's trailer (provided by the PRPs Representative) and the other set to the trailer provided by the contractor for the contractors use. The corresponding utility service hook-ups at the exterior of the field offices, interior electrical wiring and associated materials interior telephone and facsimile wiring will be completed to made the trailers operational. The utility hook-up work includes, but is not limited to, providing and installing an electric meter on the exterior and a telephone jacks on the interior of each office trailer. Separate accounts will be established for each trailer, with each party responsible for the utility fees associated with their respective trailer. Electric and phone lines as specified will also be installed to the remediation equipment as shown on the Drawings.
6. Removing contaminated soil, sludge and debris associated with existing onsite dry wells and excavating the former drum storage area designated on the Drawings. The drywells will be remediated by utilizing a truck with high vacuum, solids removal capabilities. The Contractor must also be prepared to break apart and loosen any solids (sludge and sediments) that may be present in order to remediate the target materials from the drywells.
7. Drilling boreholes and installing in the boreholes a soil-vapor extraction (SVE) wells, air-sparge wells (AS), ground-water monitoring wells and soil-vapor monitoring points as shown and at locations designated on the Drawings.
8. Excavating trenches, installing piping for the SVE and AS wells, and backfilling trenches as shown on the Drawings.
9. Installing and securing the treatment shed and remedial equipment as shown on the Drawings. All equipment will be tested by the Contractor to ensure correct operation, both as an individual unit and as a component of the entire remediation system. The Contractor will start-up and test the systems to document correct operation and provide instruction to the PRPs' Representative.
10. Restoring the site to pre-remediation conditions, especially in, but not limited to, areas where the required excavation is completed. This item of Work includes: installation of a vapor barrier, importing, backfilling and compacting clean fill in the excavated areas; replacing asphaltic concrete pavement, chain link fencing, topsoil and seeding on subject private properties where shown on the Drawings; and removing the chain link fence, and temporary field office and associated utility services from the remediation area. This Item of Work also includes the offsite disposal of soil that has been treated in the

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Impoundment after a period of approximately six months after the extraction system in the Impoundment has been started. In addition, the Contractor will remove, return or dispose of materials and/or equipment used in the Soil Impoundment.

1.3 CONTRACTOR USE OF SITE AND PREMISES

- A. Limit use of site and premises to allow:
 - 1. Use of the site and premises by all subject private property owners.
 - 2. Work by Others, as required.
- B. Remediation operations shall be limited to the remediation areas shown on Drawings.
- C. Time Restrictions for completing Task IIA.2 as shown in the Drawings: Sixty (60) days. This time constraint does not include pre-construction activities, demobilization, Site Restoration or operation of the Soil Impoundment. This Contract Time will be specified in the terms and conditions of the Contract, which will be supplied by the PRPs' Representative. The project schedule for the Soil Remedial Action is in the Drawings.
- D. Contractor shall be allowed to use onsite water from the spigot designated on the Drawings.

1.4 WORK SEQUENCE

- A. Conduct Work to accommodate requirements of the PRPs and all other subject private property owners during the remediation period, coordinate remediation schedule and operations with PRPs' Representative.

1.5 USE OF SITE AND PREMISES BY ALL SUBJECT PRIVATE PROPERTY OWNERS

- A. The site and premises will continue active manufacturing operations and owners of other subject private properties will use the site during the entire period of remediation.
- B. Cooperate with the PRPs' Representative, who will coordinate the remediation and facility operations with the Facility Representative, and all subject private property owners to minimize conflict and to facilitate the normal site operations of those owners.
- C. Schedule the Work to accommodate this requirement.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01039

COORDINATION AND MEETINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coordination.
- B. Field engineering.
- C. Preconstruction meeting.
- D. Site mobilization meeting.
- E. Pre-installation meetings.
- F. Examination.
- G. Preparation
- H. Cutting and patching.
- I. Alteration procedures.

1.2 COORDINATION

- A. Coordinate scheduling, submittals and Work of the various Sections of these specifications to assure efficient and orderly sequence of implementation of interdependent remediation elements.
- B. Verify that requirements and characteristics of existing utility sources are compatible with utilities to be supplied by the Contractor. Coordinate Work of various Sections having interdependent responsibilities for installing, connecting to and placing in service such utilities.
- C. Coordinate space requirements and installation of Work which are indicated on Drawings. Follow routing shown for utility services as closely as practicable. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance and for repairs.

- D. Coordinate completion and clean up of Work of separate Sections in preparation for Substantial Completion.

1.3 FIELD ENGINEERING

- A. The PRPs' Representative has employed a Licensed Land Surveyor registered in the State of New York for the Work. The Contractor shall employ a Licensed Land Surveyor in the State of New York.
- B. PRPs' Representative will locate and Contractor shall protect survey control and reference points for use during excavation activities.
- C. The survey control datum, elevations, lines and levels shown on the Drawings is that established by the surveyor employed by the PRPs' Representative. The survey datum shall be verified by the Contractor prior to initiation of the Work.
- D. The PRPs' Representative, with required provisions from and assistance by the Contractor, will provide field engineering services. These services will include verifying set-backs and easements, and confirming the dimensions, elevations, lines and levels shown on the Drawings, and utilizing recognized engineering survey practices.

1.4 PRECONSTRUCTION MEETING

- A. PRPs' Representative will schedule a meeting, at a mutually agreeable location for all involved parties, after the Notice of Award is issued.
- B. Attendance Required: PRPs' Representative, Facility Representative, Contractor, major installers and Others (owners of private utilities other than those of the PRPs).
- C. Agenda:
 - 1. Execution of Contract.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Discussion of Contract Documents.
 - 4. Submission of lists of suppliers, installers and Products, schedule of values and remediation schedule.
 - 5. Designation of personnel representing the parties in Contract, including the PRPs' Representative.
 - 6. Procedures and processing of field decisions, submittals, substitutions, invoices, proposal request, Change Orders and Contract closeout procedures.
 - 7. Scheduling.

- D. PRPs' Representative will prepare a meeting summary and distribute copies to participants within 10 working days after meeting, with one copy to each of the meeting participants, including: PRPs, PRPs' Representative, Facility Representative, Contractor, major installers, Others and other parties affected by decisions made.

1.5 SITE MOBILIZATION MEETING

- A. PRPs' Representative will schedule a meeting at the site prior to Contractor mobilization. If mutually agreed upon by all involved parties, this meeting will be scheduled for the same day as the Preconstruction Meeting.
- B. Attendance Required: PRPs' Representative, Facility Representative, Contractor, major installers and Others.
- C. Agenda:
 - 1. Use of premises by Facility, PRP and Contractor.
 - 2. Facility requirements.
 - 3. PRP's requirements.
 - 4. Remedial facilities and controls provided by Owner/Facility.
 - 5. Temporary utilities provided by Owner/Facility.
 - 6. Survey and remediation area layout.
 - 7. Security and housekeeping procedures.
 - 8. Scheduling.
 - 9. Procedures for soil confirmation sampling and testing.
- D. PRPs' Representative will prepare a meeting summary and distribute copies to participants within 10 working days after meeting, with one copy to each of the meeting participants, including: PRPs' Representative, Facility Representative, PRP, Contractor, major installers, Others and other parties affected by decisions made.

1.6 PRE-INSTALLATION MEETINGS

- A. When required by the PRP or PRPs' Representative, convene a pre-installation meeting at work site prior to commencing work of the Section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific Section.
- C. Notify PRPs' Representative 7 working days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of installation, preparation and installation procedures.
 - 2. Review coordination with related work.

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- E. PRPs' Representative will prepare a meeting summary and distribute copies to participants within 10 working days after meeting, with one copy to each of the meeting participants, including: PRPs' Representative, PRP, Facility Representative, Contractor, involved installers and other parties affected by decisions made.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that existing site conditions are acceptable for subsequent Work. Beginning new Work indicates acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification Sections.
- D. Verify that utility services are available, of the correct characteristics, and in the correct location.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance. This applies only to the proposed area of the soil impoundment.
- C. Apply any manufacturer-required or recommended substrate primer, sealer or conditioner prior to applying any new material or substance in contact or bond.

3.3 CUTTING AND PATCHING

- A. Employ skilled and experienced installer to complete cutting and patching, including excavation and fill.
- B. Submit written request in advance of cutting or altering elements which affects:
 - 1. Structural integrity of element.
 - 2. Integrity of weather-exposed or moisture-resistant elements.

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3. Efficiency, maintenance or safety of element.
4. Visual qualities of sight exposed elements.
5. Work of Facility, PRP or Others.

- C. Execute cutting, fitting and patching, including excavation and fill, to complete Work, and to:
 1. Fit the several parts together to integrate with other Work.
 2. Uncover Work to install or correct ill-timed Work.
 3. Remove and replace defective and non-conforming Work.
 4. Remove samples of installed Work for testing.
 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute work by methods which will avoid damage to other Work and provide proper surfaces to receive patching and finishing.
- E. Cut masonry and concrete materials using masonry saw or core drill.
- F. Restore Work with new Products in accordance with requirements of Contract Documents.
- G. Fit Work tight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- H. As applicable, maintain integrity of wall, ceiling or floor construction.
- I. Refinish surfaces to match adjacent surfaces. For continuous surfaces, refinish to nearest intersection.
- J. Inform the PRPs' Representative of any hazardous substance or condition exposed during the Work (including those identified in the HASP) for decision or remedy.

3.4 ALTERATION PROCEDURES

- A. Materials: As specified in Product sections; match existing Products and Work for patching and extending Work.
- B. Employ skilled and experienced installer to complete cutting and patching.
- C. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.

- D. Remove, cut and patch Work in a manner to minimize damage and provide a means of restoring Products and finishes to original or specified condition.
- E. Refinish existing visible surfaces to remain, to specified or renewed condition for each material, with a neat transition to adjacent surfaces.
- F. Where new Work abuts or aligns with existing Work, provide a smooth and even transition. Patch Work to match existing adjacent Work.
- G. When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and submit recommendation to PRPs' Representative for review.
- H. Where a change of plane of more than that specified in individual specification Sections occurs, submit recommendation for providing a smooth transition to PRPs' Representative for review, or request instructions from PRPs' Representative.
- I. Patch or replace portions of existing surfaces which are damaged, lifted, discolored or showing other imperfections.
- J. Finish surfaces as specified in individual Product sections.

END OF SECTION

SECTION 01041

PROJECT COORDINATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Project coordination by the Project Coordinator.
- B. Construction mobilization.
- C. Schedules.
- D. Submittals.
- E. Coordination Drawings.
- F. Closeout procedures.

1.2 RELATED SECTIONS

- A. Section 01039 - Coordination and Meetings: Preconstruction meeting. Site mobilization meetings. Pre-installation meetings.
- B. Section 01700 - Contract Closeout: Contract Closeout Procedures.

1.3 PROJECT COORDINATOR

- A. Project Coordinator: Leggette, Brashears & Graham, Inc., also referred to as PRPs' Representative. Construction Manager: William T. West

1.4 CONSTRUCTION MOBILIZATION

- A. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for access and traffic.
- B. During construction, coordinate use of site and facilities through the Project Coordinator.

- C. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination Drawings, and recommendations; and resolution of ambiguities and conflicts.
- D. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities.
- E. Coordinate field engineering and layout work under instructions of the Project Coordinator.

1.5 SCHEDULES

- A. Submit remediation schedule in accordance with Section 01300.
- B. After review, revise and resubmit schedule to comply with revised Project schedule.
- C. During progress of work revise and resubmit with each Invoice.

1.6 SUBMITTALS

- A. Site Management Plan.
 - 1. Submit list of subcontractors and their respective responsibilities.
 - 2. Submit list of all key employees expected to participate in work, their responsibilities and their resume.
 - 3. Submit a list of all offsite facilities proposed to be used to manage hazardous substances, pollutants, contaminants, or other materials from the site resulting from the construction of the remedy. For each facility, the proposed materials and methods of management shall be described.
 - 4. Submit discussion of the methods by which construction operations shall proceed if they differ from the plans and specifications. Discussion shall include the following:
 - a. timing of and manner in which activities shall be sequenced;
 - b. preparation of the site including security, utilities, decontamination facilities, construction trailers, equipment storage and construction of roadways;
 - c. coordination of construction activities;

- d. site maintenance during the remedial action;
 - e. coordination with local authorities regarding contingency planning and potential traffic obstruction; and
 - f. entry and access to the site during the construction period(s) and periods of inactivity, including provisions for decontamination, erosion control and dust control.
- B. Construction Quality Control Plan
- 1. Discussion of construction quality control shall include the following if they differ from the LQAPP (Appendix F of the SDR):
 - a. submit description of methods of performing the quality control inspections, including when inspections should be made and what to look for;
 - b. submit description of control testing procedures for each specific test. This includes information which authenticates that personnel and laboratories performing the tests are qualified and the equipment and procedures to be used complies with applicable standards;
 - c. submit list of procedures for scheduling and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents; and
 - d. submit list of reporting procedures including frequency of reports and report formats.
- C. Submit preliminary shop Drawings, product data and samples in accordance with Section 01300 for review and compliance with Contract Documents, for field dimensions and clearances, for relation to available space, and for relation to work of separate contracts. Revise and resubmit as required.
- D. Submit requests for interpretation of Contract Documents and obtain instructions through the Project Coordinator.
- E. Process requests for substitutions and change orders through the Project Coordinator.
- F. Deliver closeout submittals for review and preliminary inspection reports for transmittal to Engineer.

1.7 COORDINATION DRAWINGS

A. Provide information required by Project Coordinator for preparation of coordination Drawings.

B. Review Drawings prior to submission to Engineer.

1.8 CLOSEOUT PROCEDURES

A. Submit written certification for contract closeout in accordance with Section 01700.

PART 1 PRODUCTS

Not Used.

PART 2 EXECUTION

Not Used.

END OF SECTION

SECTION 01045

CUTTING AND PATCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements and limitations for cutting and patching of Work.

1.2 RELATED SECTIONS

- A. Section 01010 - Summary of Work.
- B. Section 01300 - Submittals.
- C. Section 01600 - Material and Equipment: Product options and substitutions.
- D. Individual Product Specification Sections:
 - 1. Cutting and patching incidental to work of the section.
 - 2. Advance notification to other sections of openings required in work of those sections.
 - 3. Limitations on cutting structural members.

1.3 SUBMITTALS

- A. Submit written request (as described in the Construction Quality Assurance Plan) in advance of cutting or alteration which affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of PRP or separate contractor.
 - 6. Intent of design as described in the Soil Design Report.
- B. Include in request:
 - 1. Identification of Project.
 - 2. Location and description of affected Work.
 - 3. Necessity for cutting or alteration.
 - 4. Description of proposed Work and Products to be used.
 - 5. Alternatives to cutting and patching.
 - 6. Effect on work of PRP or separate contractor.
 - 7. Written permission of affected separate contractor.

8. Date and time work will be executed.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Primary Products: Those required for original installation.
- B. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01600.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
- B. After uncovering existing Work, assess conditions affecting completion of work.
- C. Beginning of cutting or patching means acceptance of existing conditions.

3.2 PREPARATION

- A. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- B. Provide protection from elements for areas which may be exposed by uncovering work.
- C. Prevent rain and storm-water runoff from entering the excavation.

3.3 CUTTING

- A. Execute cutting and fitting to complete the Work.
- B. Uncover work to install improperly sequenced work.
- C. Remove and replace defective or non-conforming work.
- D. Remove samples of installed work for testing when requested.
- E. Provide openings in the Work for penetration of mechanical and electrical work.

- F. Employ skilled and experienced installer to conduct cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- G. Cut rigid materials using masonry saw or core drill. Pneumatic tools are not allowed without prior approval unless a fire explosion hazard is imminent.

3.4 PATCHING

- A. Execute patching to complement adjacent Work.
- B. Fit Products together to integrate with other Work.
- C. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
- D. Employ original installer to conduct patching for weather exposed and moisture resistant elements, and sight-exposed surfaces.
- E. Restore work with new Products in accordance with requirements of Contract Documents.
- F. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

END OF SECTION

SECTION 01050
FIELD ENGINEERING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Survey and field engineering.
- B. Quality control.
- C. Submittals.
- D. Project record documents.

1.2 RELATED SECTIONS

- A. Section 01700 - Contract Closeout: Project Record Documents.

1.3 QUALITY ASSURANCE

- A. Employ a Land Surveyor registered in the State of New York and acceptable to PRPs' Representative, to perform survey work of this section.
- B. Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.
- C. Employ a Professional Engineer licensed in the State of New York of the discipline required as may be needed for any specific service on Project.

1.4 SUBMITTALS FOR REVIEW

- A. Submit name, address, telephone number and insurance of certificate of Surveyor before starting survey work.
- B. On request, submit documentation verifying accuracy of survey work.
- C. Submit a copy of site drawing and certificate signed by the Land Surveyor, that the elevations and locations of the Work are in conformance with Contract Documents.

1.5 PROJECT RECORD DOCUMENTS

- A. Maintain a complete and accurate log of control and survey work as it progresses.
- B. On completion of major site improvements, prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.
- C. Submit Record Documents under provisions of Section 01700.

1.6 EXAMINATION

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify PRPs' Representative of any discrepancies discovered.

1.7 SURVEY REFERENCE POINTS

- A. Contractor to locate and protect survey control and reference points.
- B. Control datum for survey is that indicated on Drawings.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to PRPs' Representative the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to PRPs' Representative.

1.8 SURVEY REQUIREMENTS

- A. Provide field engineering services. Utilize recognized engineering survey practices.
- B. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.

- C. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for excavation.
- D. Periodically verify layouts by same means.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01090

REFERENCE STANDARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance.

1.2 QUALITY ASSURANCE

- A. For Products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date for receiving bids.
- C. Obtain copies of standards when required by the Contract Documents.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from the PRPs' Representative before proceeding.
- F. Neither the contractual relationship, duties, and responsibilities of the parties in Contract nor those of the PRPs' Representative shall be altered by the Contract Documents by mention or inference otherwise in any reference document.

1.3 SCHEDULE OF REFERENCES

AASHTO	American Association of State Highway and Transportation Officials
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
AMCA	Air Moving and Conditioning Association, Inc.
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CFR	Code of Federal Regulations
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers' Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association

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NIOSH National Institute for Occupational Safety and Health
OSHA Occupational Safety and Health Administration
TAI The Asphalt Institute

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01110

SAFETY, HEALTH AND EMERGENCY RESPONSE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Health and Safety and Contingency Procedures.

1.2 REFERENCES

- A. ACHGIH-02 - Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.
- B. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.
- C. 29 CFR 1910 - Occupational Safety and Health Standards.
- D. 29 CFR 1926 - Safety and Health Regulations for Construction.
- E. NIOSH - Manual of Analytical Methods.
- F. NIOSH - NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01300 - Submittals.
- B. Certification of 40-hour training as required under 29 CFR 1910.120(e)(3).
- C. Fit test documentation of onsite personnel.
- D. Certification of enrollment in an ongoing medical surveillance program which includes baseline and annual physicals.
- E. Medical certification of fitness.

1.4 MEETING

- A. Prior to start of field activities, a meeting will be held to discuss the potential hazards at the site, with a review of the required protective clothing and procedures observed at this site.

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- B. Meetings, as needed, to discuss any changes in the hazards present at the site.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 HEALTH AND SAFETY AND CONTINGENCY PROCEDURES

The Health and Safety and Contingency Plan has been completed and is attached in Appendix G to the Soil Design Report.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittal procedures.
- B. Remediation schedules.
- C. Proposed Products list.
- D. Shop Drawings.
- E. Product Data.
- F. Samples.
- G. Manufacturers' installation instructions.
- H. Manufacturers' certificates.

1.2 RELATED SECTIONS

- A. Section 01700 - Contract Closeout: Contract warranties, bonds, manufacturers' certificates and closeout submittals.

1.3 SUBMITTAL PROCEDURES

- A. Transmit each submittal with form accepted by PRPs' Representative.
- B. Sequentially-number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
- C. Identify Project, Contractor, installer or supplier; pertinent drawing and detail number, and specification Section number, as appropriate.
- D. Apply Contractor's stamp, signed or initialed, certifying that review, verification of required Products, field dimensions, adjacent remedial Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.

- E. Schedule submittals to expedite the Work, and deliver to PRPs' Representative at business address, unless instructed otherwise by the PRPs' Representative. Coordinate submission of related items.
- F. For each submittal to be reviewed, allow 5 working days for review, excluding delivery time to and from the Contractor.
- G. Identify variations from Contract Documents and Product or remedial plan limitations which may be detrimental to successful performance of the completed Work.
- H. Provide space for Contractor and PRPs' Representative review stamps.
- I. Revise and resubmit; identify all changes made since previous submission.
- J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with provisions.
- K. Submittals not requested will not be recognized or processed.

1.4 REMEDIATION SCHEDULES

- A. Submit initial remediation schedule in duplicate within 5 days after Notice of Award.
- B. Revise and resubmit as required.
- C. Submit revised schedules with each Invoice, identifying changes since previous version.
- D. Show on schedules complete sequence of remediation by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates and duration.
- E. Indicate submittal dates required for shop drawings, product data, samples and product delivery dates, including those furnished by PRPs' Representative.

1.5 PROPOSED PRODUCTS LIST

- A. Within 10 working days after Notice of Award date, submit list of major products proposed for use, with name of manufacturer, trade name and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.6 SHOP DRAWINGS

- A. Submit the number of opaque reproductions of shop drawings required by Contractor to PRPs' Representative for review, plus three copies which will be retained by PRPs' Representative.
- B. After review of shop drawings, distribute in accordance with the SUBMITTAL PROCEDURES article above.
- C. Indicate special utility and electrical characteristics, utility connection requirements and location of utility outlets for functional equipment service.

1.7 PRODUCT DATA

- A. Submit the number of copies required by Contractor to PRPs' Representative for review, plus 3 copies which will be retained by the PRPs' Representative.
- B. Mark each copy to identify applicable products, models, options and other data. Supplement manufacturers' standard data to provide information unique to the Work.
- C. Indicate Product utility and electrical characteristics, utility connection requirements and location of utility outlets for functional equipment service.
- D. After review, distribute in accordance with the SUBMITTAL PROCEDURES article above.

1.8 SAMPLES

- A. Submit samples to illustrate functional characteristics of the Product. Coordinate sample submittals for interfacing Work.
- B. Include identification on each sample, with full information unique to the Work.
- C. Submit the type and number of samples specified in individual specification Sections, or, if not specified in individual specification Sections, the type and number of samples specified by the PRPs' Representative; three of which will be retained by PRPs' Representative.
- D. Reviewed samples which may be used in the Work are indicated in individual specification Sections, as applicable.

1.9 MANUFACTURERS' INSTALLATION INSTRUCTIONS

- A. When specified in individual specification Sections or by the PRPs' Representative, submit printed instructions for delivery, storage, assembly and installation to PRPs' Representative, in quantities specified for Product Data.
- B. Indicate special procedures, perimeter conditions requiring special attention and special environmental criteria required for application or installation.

1.10 MANUFACTURERS' CERTIFICATES

- A. When specified in individual specification Sections or by the PRPs' Representative, submit certification by manufacturer to PRPs' Representative, in quantities specified for Product Data.
- B. Indicate that material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to PRPs' Representative.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 SCHEDULE OF SUBMITTALS

A. **Section 01050 - Field Engineering**

- Submit name, address, and telephone number of land surveyor registered in state of New York before start of work.
- Submit documentation verifying accuracy of survey work on request.
- Submit a copy of site drawing and certificate signed by land surveyor, that elevations and locations of work are in conformance with contract documents.

B. Section 01110 - Health and Safety

- Submit certification of 40-hour training, fit test documentation of onsite personnel, certification of enrollment in an ongoing medical surveillance program and medical certification of fitness submitted under provisions of Section 01300.

C. Section 01300 - Submittals

- Submit initial remediation schedule in duplicate within five days after Notice of Award date.
- Submit list of major products proposed for use with name of manufacturer trade name and model number of each product within 10 working days after Notice of Award date.
- Submit the number of opaque reproductions of shop drawings required by contractor to PRPs' representative for review, plus three copies which will be retained by PRPs' representative.

Product Data

- Submit the number of copies by contractor to PRPs' representative for review plus three copies which will be retained by PRPs' representative.

Samples

- Submit the type and number of samples specified in individual specifications sections, or, if not specified in individual specification sections, the type and number of samples specified by PRPs' representative; three of which will be retained by PRPs' representative.

Manufacturer's installation instructions

- Submit printed manufacturer's installation instructions for delivery, storage, assembly and installation to PRPs' representative when specified in individual specification sections or by PRPs' representative, in quantities specified for product data.

Manufacturer's certificate

- Submit certification by manufacturer to PRPs' representative in quantities specified for product data when specified in individual specification sections or by the PRPs' representative.

D. Section 01310 - Construction Progress Schedules

- Submit initial schedules within 15 days after date established in Notice to Proceed. After review, resubmit required revised data within 10 days.
- Submit revised progress schedules consisting of marked-up versions of initial project schedule Monday morning at the start of each work week.

- Submit the number of opaque reproductions which contractor requires plus two copies to be retained by PRPs' representative.

E. Section 01405 - Sampling Procedures and Laboratory Services

- Obtain a letter providing the name, address and telephone number and point of contract for laboratory no later than seven days after Notice to Proceed to expedite the laboratory validation/approval process.
- Test results shall be submitted within 14 days of sample collection or as indicated in this specification.
- Copy of field log entries for each sampling shall be submitted with the test reports require above.

F. Section 01580 - Project Identification and Signs

- Submit shop drawings and product data.

G. Section 01600 - Materials and Equipment

- Owner's representative will consider request for substitutions only within 15 working days after Notice of Award.
 - Submit three copies of request for substitution for consideration.
 - Submit shop drawings, product data and certified test results attesting to the proposed product equivalence.

H. Section 01700 - Contract Closeout

- Submit written certification that contract documents have been reviewed and that work has been inspected and is complete in accordance with contract documents and ready for review.
- Provide required submittal to PRPs' representative as specified by Section 01300.

I. **Section 01730 - Operation and Maintenance Data**

- Submit operation and maintenance manuals for equipment or component parts of equipment put into service during construction and operated by PRP within 10 days after acceptance.
- Submit two sets of revised final volumes in final form within 10 after final inspection.

J. **Section 02100 - Offsite Transportation and Disposal**

- Submit copies of each manifest and any other relevant documentation to PRPs' representative within two business days following shipment and within two business days after notification of receipt of the disposal facility.

K. **Section 02205 - Soil Materials**

- Submit the name of imported materials suppliers.

L. **Section 02207 - Aggregate Materials**

(Same as Section 02205)

M. **Section 02222 - Excavating**

- Submit, under provisions of Section 01300, proposed plans and methods for placing, maintaining and removing all protective structural systems to be installed during work (Plans sealed by P. E.) within 15 working days after Notice of Award or at least 15 working days prior to commencement of remediation, whichever occurs last.

N. **Section 02670 - Wells**

- Submit well permits issued by New York State prior to beginning work and at least 14 days prior to drilling activities at the site.
- Submit product data on well material including riser, screen, filter pack, annular sealants and well heads including curb box and well caps.
- Project record document, accurate locations of well, depth, subsoil strata including but not limited to signed copy of driller's log book statements.
- Copies of well completion reports with 30 days of completion.

O. **Section 02510 - Asphaltic Concrete Paving**

- Submit proposed mix design for review prior to beginning of work and at least 30 days prior to delivery of material to site.

P. **Section 02831 - Chain Link Fences and Gates**

- Submit product data on fabric, posts, accessories, fitting and hardware.
- Shop drawings, indicate plan layout, spacing of components, dimensions of post foundation where needed, hardware anchorage and schedule of components.
- Manufacturer's installation instructions.
- Project record documents, accurately record actual locations of property perimeter posts relative to property lines and easement.

Q. **Section 02950 - Trees, Plants and Ground Cover**

- Submit maintenance data for plants (under Section 01300 procedure for submittals)
- Submit list of plant life sources.

R. **Section 13050 - Soil impoundment structure**

- Submit manufacturer's installation instructions (under Section 01300 procedure for submittals).

S. **Section 15110 - SVE Blower Package- and Carbon Absorption Units**

- Submittals for review: Product data and shop drawings.

T. **Section 15135 - Gauges and Meters**

- Submittals for review: Product data
- Submittals for project closeout: Project record documents and operation and maintenance data.

U. **Section 15140 - Support Anchors**

- Submit shop drawings, product data and manufacturer's installation instructions.

V. **Section 15190 - Mechanical Identification**

- Submit list of wording, symbols, letter size and color coding for mechanical identification.
- Submit valve chart and schedule, including valve tag number, location, function and valve manufacturer's name and model number.
- Submit product data and manufacturer's installation instructions.

W. Section 15410 - Plumbing Piping

- Product data on pipe materials, pipe fitting, valves and accessories.

X. Section 15870 - Power Ventilators

- Submittals for review: Product data.
- Submittals for information: Manufacturer's instructions.
- Submittal for project closeout: Maintenance data and warranty

Y. Section 15940 - Air Outlets and Inlets

- Submit product data.

Z. Section 15980 - Instruments and Control Elements

- Submit project record documents: actual locations of control components.

AA. Section 15985 - Sequence of Operation

- Submit shop drawings indicate mechanical system controlled and control system components.

BB. Section 15990 - Testing, Adjusting and Balancing

- Submit field reports, report defects and deficiencies noted during performance of services which prevent system balance.
- Submit report six months after start up with system checked and adjusted.

CC. Section 16010 - Basic Electrical Requirements

- Submittals of shop drawings.

DD. **Section 16111 - Conduit**

- Submittal under provision of Section 01300: Submit product data
- Submit project record documents.

EE. **Section 16123 - Building Wire and Cable**

- Submittals for review, information.
- Submittals at project closeout - contract closeout, operation and maintenance data, project record documents: Record actual locations of components and circuits.

FF. **Section 16170 - Grounding and Bonding**

- Submittals for review: Product data: provide for grounding electrodes or connections.
- Submittals for information: Test reports (indicate overall resistance to ground), manufacturer's instruction.
- Submittals for closeout: contract closeout, operation and maintenance data, project record documents and certificate of compliance.

GG. **Section 16180 - Equipment Wiring**

- Submittals for review: Product data: provide wiring device manufacturer's catalog information.
- Submittals for information: Manufacturer's instructions.

HH. **Section 16190 - Supporting Devices**

- Submittals for review: Product data.
- Submittals for information: Manufacturer's instructions.

II. **Section 16195 - Electrical Identification**

- Submittal for review: Product data: catalog data for name plates, labels and markers.
- Submittals for information: Manufacturer's instructions.

JJ. **Section 16421 - Utility Service Entrance**

- Submittals for review: Product data (ratings and dimensions of meter bases).
- Submittals for information: submit utility company prepared drawings.

KK. **Section 16470 - Panel Boards**

- Submittals for review: shop drawing.
- Submittals for information: Manufacturer's installation instructions.
- Submittals for closeout: Contract closeout, operation and maintenance data, record actual locations of panel board and record actual circuiting arrangements in project record documents, maintenance data.

LL. **Section 16510 - Interior Luminaries**

- Submittals for review: Shop drawing and Product data.
- Submittals for information: manufacturer's installation instructions.
- Submittals for closeout: Contract closeout, operation and maintenance data, manufacturer's operation and maintenance instructions for each project.

MM. **Section 16741 - Telephone Services, Pathway and Wiring**

- Submit project record documents: record actual locations and sizes of pathway.

NN. **Section 16864 - Electric Space Heating Units**

- Submittal: Product data and manufacturer's installation instruction.
- Submit: operation and maintenance data.

END OF SECTION

SECTION 01310

CONSTRUCTION PROGRESS SCHEDULES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Format.
- B. Content.
- C. Revisions to schedules.
- D. Submittals.

1.2 RELATED SECTIONS

- A. Section 01010 - Summary of Work: Work sequence. Owner occupancy.
- B. Section 01300 - Submittals: Shop drawings, product data, and samples.

1.3 FORMAT

- A. Prepare schedules as a horizontal bar chart with separate bar for each major portion of Work or operation, identifying first work day of each week.
- B. Sequence of Listings: The chronological order of the start of each item of Work.
- C. Scale and Spacing: To provide space for notations and revisions.
- D. Sheet Size: Multiples of 8-1/2 x 11 inches.
- E. PRPs' Representative will incorporate the Contractor's schedule into the overall schedule for the remediation activities.

1.4 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.

- C. Identify work of separate stages and other logically grouped activities.
- D. Provide sub-schedules for each stage of Work identified in Section 01010.
- E. Provide sub-schedules to define critical portions of the entire schedule.
- F. Include conferences and meetings in schedule.
- G. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- H. Provide separate schedule of submittal dates for shop drawings, product data, and samples, and dates reviewed submittals will be required from PRPs' Representative. Indicate decision dates for selection of finishes.

1.5 REVISIONS TO SCHEDULES

- A. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
- B. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
- C. Provide narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect, including the effect of changes on schedules of separate contractors.

1.6 SUBMITTALS

- A. Submit initial schedules within 15 days after date established in Notice to Proceed. After review, resubmit required revised data within ten days.
- B. Submit revised Progress Schedules consisting of marked-up versions of the initial project schedule Monday morning at the start of each work week.
- C. Submit the number of opaque reproductions which Contractor requires, plus two copies which will be retained by PRPs' Representative.

1.7 DISTRIBUTION

- A. Distribute copies of reviewed schedules to Project site file, Subcontractors, suppliers, and other concerned parties.

- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01380

CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

The PRPs' Representative will execute the requirements under this section.

1.1 SECTION INCLUDES

- A. Photography.
- B. Prints.
- C. Negatives.
- D. Technique.
- E. Submittals.

1.2 RELATED SECTIONS

- A. Section 01010 - Summary of Work.

1.3 REFERENCES

- A. Photographic Documentation Plan (Appendix I of the Soil Design Report).

1.4 PHOTOGRAPHY

- A. Provide photographs of site and construction throughout progress of Work produced by an experienced photographer, acceptable to PRPs' Representative. Photographs shall be taken of items in the Photographic Documentation Plan, including but not limited to:
 - 1. Site controls.
 - 2. Site clearing and preparation.
 - 3. Soil excavations and trenches.
 - 4. Drilling activities.
 - 5. Remedial system and construction.
 - 6. Storm-water erosion controls.
 - 7. Impoundment areas.
 - 8. Bulk shipments of waste.
 - 9. Decontamination areas.
 - 10. Site monitoring.

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11. Sample collection.
12. General activities.

1.5 PRINTS

- A. Full color; three prints of each view.
- B. Paper.
 1. Brilliance: Matte.
 2. Texture: Smooth.
 3. Tint: White.
 4. Weight: Single.
- C. Paper Surface: Smooth, matte.
- D. Contrast: High.
- E. Size: 3 x 5 inch; mounted for binder and tabs.
- F. Identify each print on back. Identify name of Project, phase orientation of view, date and time of view, name and address of photographer, and photographer's numbered identification of exposure. The photographs will be numbered sequentially.

1.6 NEGATIVES

- A. The PRPs' Representative will maintain the negatives with the project record documents. Catalog and index negatives in chronological sequence; provide typed table of contents.

1.7 TECHNIQUE

- A. Provide factual presentation.
- B. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

1.8 VIEWS

- A. Provide non-aerial photographs from four cardinal views at each specified time, until Date of Substantial Completion.

1.9 SUBMITTALS

- A. Deliver prints within three days after exposure with transmittal letter specified under Section 01300.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

1.4 TOLERANCES

- A. Monitor tolerance control of installed Products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from PRPs' Representative before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

1.5 REFERENCES

- A. For Products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Except for the specifications, Work shall conform to reference standard by date of issue current on all Contract Documents, except where a specific date is established by code. For the specifications, Work shall conform to reference standard specified in the individual Sections for the corresponding current date of issue.
- C. Obtain copies of standards where required by product specification sections.
- D. Neither the duties, relationship and responsibilities of the major parties involved in the Work, nor those of the PRPs' Representative, shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01400
QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance - control of installation.
- B. Tolerances
- C. References.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals: Submission of manufacturers' instructions and certificates.
- B. Section 01600 - Material and Equipment: Requirements for material and product quality.

1.3 QUALITY ASSURANCE - CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions and workmanship to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from PRPs' Representative before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Complete work utilizing persons qualified to produce workmanship of specified quality.
- F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.
- G. Conform with the Construction Quality Assurance Project Plan (Appendix F of the Soil Design Report).

SECTION 01405

SAMPLING PROCEDURES AND LABORATORY SERVICES

PART 1 GENERAL

This section covers the sampling and analysis of air, soils and water to determine the presence or absence of contamination. The Contractor is responsible for everything included in this section, including offsite analysis of the samples, under the direction of the PRPs and/or the CIH.

1.1 SECTION INCLUDES

- A. Submittals.
- B. Sampling requirements.
- C. Sample summary.
- D. Sampling personnel and data logging.
- E. Quality assurance and quality control samples.
- F. Labeling.
- G. Preservation and storage.
- H. Sampling plan.
- I. Quantities of samples.

1.2 REFERENCES

The references listed below form a part of this specification to the extent referenced. The following publications are referred to in the text by the basic designation only.

A.	SW846	Test Methods for Evaluating Solid Waste Physical/Chemical Methods, 3rd edition, EPA latest revision.
B.	EPA-600/4-79-20	Methods for Chemicals Analysis of Water and Wastes, EPA, Revised March 1983.

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- C. EPA-600/4-84-076 Characterization of Hazardous Waste Sites - A Method Manual: Volume II. Available Sampling Methods, Second Edition, EPA, December 1984, NTIS No. PB85-168771.
- D. EPA/540/G-87/003 Data Quality Objectives for Remedial Response Activities - Development Process, EPA, March 1987.
- E. EPA/CLP/SOW USEPA Contract Laboratory Program Statement of Work for Inorganic, 3/90 and Organic Analysis, 3/90.
- F. SAMP Remedial Construction (Appendix E of the Soil Design Report).

1.3 SUBMITTALS

- A. Obtain a letter providing the name, address, telephone number and point of contact for the laboratory no later than 7 days after Notice to Proceed to expedite the laboratory validation/approval process.
- B. Test results shall be submitted within 14 days of sample collection or as indicated in this specification. Depending upon a variety of factors affecting the pace of remediation activities, this requirement may result in a series of periodic (e.g., weekly) data collection. Data collection shall include the results of all analyses, including quality control (QC) sample analyses (e.g., duplicates and matrix spikes). Results should also include any unusual observations, such as the presence of interferences. Data reporting requirements for test results will be consistent with EPA's Level III Analytical Support Requirements, as given in EPA/540/G-87/003, unless otherwise noted. The test results report shall include information relating to the identity of split QA samples (split QA samples) to QC samples (duplicate samples sent to the Contractor's Laboratory). This information must be provided in order for the Laboratory to conduct a data comparison between split sample results. Test reports should also include all applicable method references and dates for extraction and analysis of field samples.
- C. Copy of field log entries for each sampling shall be submitted with the test reports required above.

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1.4 SAMPLING REQUIREMENTS

A. Laboratory Services

1. Provide and coordinate the services of an environmental chemical laboratory to collect samples, if Contractor is not equipped and experienced to do so, and conduct analyses. Laboratory capabilities must be provided for the duration of the work. The facilities must meet the requirements of this specification and are subject to inspection and prior approval by the PRPs' Representative.

B. Qualification of Laboratory

1. The Contractor's laboratory must be a successful participant in the New York ELAP or USEPA CLP laboratory validation program. If the laboratory does not currently possess ELAP or USEPA CLP validation for all parameters of interest, the validation procedures must be successfully completed prior to collection of project samples.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 SAMPLE SUMMARY

- A. All sampling and analysis will be completed according to the Methods and Procedures presented in the SAMP: Remedial Construction.
- B. Sampling and testing will be used in the following tasks:
1. Air monitoring to assess work conditions during excavation activities.
 2. Sidewall and bottom samples from the excavation.
 3. Characterization of the contaminants in the various media for disposal.
 4. QA/QC.
 5. Backfill quality.
- C. The test parameters specified in this section for the various media are anticipated minimum requirements. The actual test parameters for each remediation action (e.g., disposal, backfill, etc.) shall be selected to comply with all applicable Federal, State and local laws and regulations.

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3.2 SAMPLING PERSONNEL AND DATA LOGGING

- A. Samples are to be collected by qualified personnel only. Personnel shall have documentable experience collecting hazardous waste samples and shall meet all health requirements for this type of work. Field sampling data shall be recorded in a bound log book consisting of the following:
1. Date and time of sampling.
 2. Date and time of removal action.
 3. Sample identification: alphanumeric field sample number.
 4. Sample location: a hand-drawn sketch of the area showing landmarks and sample locations shall be provided. Soil sample locations will be defined by distance measurements to at least two separate, permanent landmarks. Measurements shall be accurate to within a foot.
 5. Depth of sample.
 6. Observations, including descriptions of material sampled, staining (if any), presences of odors, ground water, etc.
 7. Weather conditions (e.g. temperature, wind, clouds, precipitation).
 8. Printed name of sampling personnel.

3.3 QUALITY ASSURANCE AND QUALITY CONTROL SAMPLES

- A. For every ten samples or portion thereof, one QA/QC sample shall be collected in triplicate, with two of the samples being sent to the PRP's primary laboratory (QC Field Duplicate) for analysis, and the third sample sent to the laboratory selected with a CLP certification. The samples shall be transported to the laboratory within two days of collection. The samples shall be clearly identified by the applicable project name Rowe Industries Site. For samples submitted to the QA Laboratory, all project-related documentation (including chain of custody forms) shall contain the QA Laboratory identification number.
- B. In addition, QC samples such as rinsate blanks and trip blanks (volatiles only) will be collected and analyzed at the laboratory. Laboratory quality control samples, including matrix spike/matrix spike duplicate (MS/MSD) and laboratory method blanks, shall be analyzed according to the method requirements (at the stated frequencies) and reported with field samples results. The collection of additional sample volume may be necessary to provide sufficient sample volume for aqueous MS/MSD analysis. Other QC information such as surrogate spike recoveries should also be reported for organic analyses. All QA/QC information shall be reported to the PRPs' Representative.

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3.4 LABELING

- A. Each sample container shall be clearly identified with the name of the project, the field sample number, data and time of sampling, and the name(s) of the sampling personnel. Field information shall be written in indelible ink and the label shall be affixed in such a manner to ensure that it does not become separated from its respective container.

3.5 PRESERVATION AND STORAGE

- A. Properly labeled sample containers shall be stored in an iced durable cooler during sampling operations. Following the conclusion of sampling operations on any given day, samples will either be shipped directly to the appropriate laboratories, or be transferred to refrigerated storage space maintained at 4°C (39°F). In every instance, samples must be received at the appropriate laboratories within two days of sample collection. Samples will be maintained in a refrigerated condition at all times, including during transportation.

3.6 SAMPLING PLAN

A. Sample Types

1. The following is a summary list of sample types that will be collected by the Contractor for laboratory analysis for this project:
 - a. Air monitoring for the Remedial Action.
 - b. Sidewall and bottom samples at the excavation.
 - c. Decontamination wastes.
 - d. Backfill.
 - e. Field and equipment blanks.
 - f. QA/QC.

B. Sampling

1. All sampling to be completed as described in the SAMP: Remedial Construction. Where discrepancies exist between the SAMP and this specification, the SAMP shall supersede.
2. Sample methods and frequency should be completed as follows:
 - a. Air sampling - excavation activities.
 - i. NIOSH Method 1003 (chlorinated hydrocarbons) and NIOSH Method 1501 (aromatic hydrocarbons) samples shall be collected at three locations daily during excavation work.

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- ii. NIOSH Method 0600 (respirable nuisance dust) samples shall be collected at two locations during excavation work.
- b. Sidewall and bottom of excavation - samples will be analyzed by a New York State approved laboratory using SW846 Methods for the TCL volatiles at locations as determined by procedure described in the SAMP.
- c. Waste classification - samples shall be collected and analyzed for the eight RCRA metals using the TCLP extraction procedure. The classification samples also will be analyzed to determine ignitability, corrosivity, reactivity and toxicity. Samples will be collected and analyzed at the rate of one sample per 100 cy of soil to be disposed.
- d. Decontamination wastes - samples will be analyzed using methods required by the waste facility at which the waste will be disposed.
- e. Backfill - samples will be analyzed by a New York State approved laboratory using SW846 Methods for the TCL volatiles at the rate of one sample per 50 cy of backfill from offsite sources and onsite sources. Use SW846 Method 6010 for the TAL metals by ICAP at the rate of 50 cy of backfill from offsite sources.
- f. QA/QC - sample collection and analysis will be completed per the SAMP: Remedial Construction (Appendix E of the Soil Design Report) in a manner sufficient to assure that quality is maintained.

3.7 QUANTITIES OF SAMPLES

- A. The approximate number of field and QA/QC samples expected to be collected for this project has been estimated and is based on the following assumptions:
 - 1. 215 cy of soil will be excavated from the former drum storage area.
 - 2. 215 cy of soil will require disposal after on-site treatment is complete.
 - 3. 215 cy of backfill will be required for the excavation at the former drum storage area; for which about 42 cy of excess material from excavation of the pipe trenches will be available for use..
- B. The number of QC and QA samples is approximately equal to 10% (minimum of 1) of the field samples for each sample type. Sometimes (based on PRP's Representative's judgement) the frequency of QA/QC samples may be reduced if the quantity is disproportionately high for the overall project.

C. Estimated number of samples

Sample Quantities

1. Air sampling - excavation activities	
a. NIOSH 1003	6
b. NIOSH 1501	6

c.	NIOSH 0600	4
2.	Sidewalls and bottom of excavation	
a.	SW846 5030 TCL Volatiles	21
3.	Waste classification	
a.	RCRA 8	17
b.	Hazardous characteristics	17
4.	Decontamination wastes	as needed
5.	Backfill - Offsite Laboratory	
a.	SW846 5030 TCL Volatiles (onsite and offsite sources)	3
b.	SW846 6010 TAL Metals by ICAP (offsite sources)	3
6.	Field and equipment blanks	
a.	SW846 TCL Volatiles	Est. 20
7.	QA/QC	as needed (10% of totals), minimum one per batch
D.	Abbreviations: GC/MS - Gas Chromatography/Mass Spectroscopy; IR - Infrared Spectroscopy; GC - Gas Chromatography; CC - closed cup; GF - Graphite Furnace; DA - Direct Aspiration; ICP - Inductively Coupled Plasma; CV - Cold Vapor; H - Hydride; PID - Photoionization Detector; MTC - Microcoulometric Titration Detector.	
E.	Analysis of RCRA metals in soil samples shall be by Toxicity Characteristic Leaching Procedure (TCLP). Analysis of RCRA Metals in water samples shall be for total metals.	

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary Utilities: Electricity, lighting, heat, telephone service, facsimile service, water supply and sanitary facilities.
- B. Temporary Controls: Ventilation, barriers, fencing, water control, erosion and sediment control, exterior enclosures, protection of installed Work, security, noise, dust, pest, pollution and health and safety.
- C. Construction Facilities: Access roads, progress cleaning and waste removal, field offices, and removal of utilities, facilities and controls.

1.2 RELATED SECTIONS

- A. Section 01540 - Security.
- B. Section 01565 - Dust Control.
- C. Section 01600 - Material and Equipment.
- D. Section 01700 - Contract Closeout: Final cleaning.
- E. Section 02831 - Chain Link Fences and Gates.

1.3 TEMPORARY ELECTRICITY

- A. Provide required power from LILCO pole as shown on Drawings.
- B. Power Capacity and Characteristics: As required.
- C. Provide power outlets for remedial operations and support activities with branch wiring and distribution boxes as required. Provide flexible power cords as required.
- D. Provide terminal lugs to match branch circuit conductor quantities, sizes and materials of operating equipment. Size terminal lugs to NFPA 70, include lugs for terminal box.

- E. Provide minimum 6 foot, or longer as required, flexible power cord and plug including grounding connector for connection to electric wiring system.
- F. Provide main service disconnect and over-current protection at convenient location.
- G. Existing receptacles located on site may not be utilized during remediation.
- H. Provide adequate distribution equipment, wiring and outlets to provide branch circuits, as required, for power and lighting.
 - 1. Provide outlets and circuits, as required, for power tools.
 - 2. Provide branch circuits for lighting, if and as required.
- I. Provide temporary power to the PRPs Representative's and Contractor's field offices; each to be on a separate account that will be maintained by the respective party.

1.4 TEMPORARY LIGHTING

- A. Situations may occur when work has to continue in the dark. Provide and maintain lighting, as required, for remediation operations to continue with sufficient lighting to minimize associated hazards.
- B. Provide and maintain lighting, as required, to field office interior after dark for security purposes.
- C. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails and lamps as required.
- D. Direct lighting or provide shields so as to minimize or eliminate stray light toward adjacent residential areas.
- E. Maintain lighting and provide routine repairs.

1.5 TEMPORARY HEAT

- A. Existing facilities shall not be used.
- B. Provide heating devices and heat as needed to maintain conditions specified in individual specification Sections for remediation operations or field office, or if not specified, as instructed by the PRPs' Representative.
- C. Exercise measures to conserve energy.

1.6 TEMPORARY TELEPHONE SERVICE

- A. Provide temporary telephone service to both the PRPs' Representative's field office and the Contractor's field office at time of remedial mobilization, each with a separate account. The Contractor will maintain the telephone service in the Contractor's field office. The Contractor will maintain the facsimile service in the Contractor's field office.

1.7 TEMPORARY FACSIMILE SERVICE

- A. Provide temporary facsimile service via a dedicated telephone line to both the PRPs' Representative's field office and the Contractor's field office at time of remedial mobilization, the Contractor will maintain the facsimile service in the Contractor's field office, with each line assigned to the utility account for the respective parties.

1.8 TEMPORARY WATER SUPPLY

- A. Provide and maintain suitable quality water required for remedial operations. Water may be taken from a water spigot as shown on the Drawings. Contractor must supplement noted water source if water provided is insufficient for Contractor's operations.
- B. Exercise measures to conserve water.
- C. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide insulation for temporary pipe to prevent freezing, as required.

1.9 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain two (2) temporary portable facilities, with required accessories, at an on-site location to be designated during construction operations. Maintain daily in clean and sanitary condition. Existing facility use is not permitted.
- B. At end of construction, return portable facilities to supplier, and leave the property in the same or better condition as originally found.

1.10 VENTILATION

- A. Ventilate enclosed areas to dissipate humidity and prevent accumulation of dust, fumes, vapors or gases.
- B. Utilize temporary fan units as required to maintain clean air for remediation operations.

1.11 BARRIERS

- A. Provide barriers to prevent unauthorized entry to remediation areas, and to protect remediation and existing facilities and adjacent properties from damage by remedial operations.
- B. Provide protection for plant life designated by the PRPs' Representative to remain, as applicable. Replace damaged plant life in accordance with individual specification Sections.
- C. Protect vehicular traffic of the Facility, subject private property owners or associated employees, stored materials, site and structures from damage.

1.12 FENCING

- A. Install temporary safety-fencing around remedial excavation. Space and install support posts in accordance with manufacturer's instructions.
- B. Install temporary fence around remediation area as shown on the Drawings; equip with vehicular and pedestrian gates with locks. Space and install support posts in accordance with manufacturer's instructions.
- C. Construction: Commercial grade chain-link fence.
- D. Provide 8-foot high fence around construction site; equip with gates and locks. Install and maintain fencing as shown on Drawings.

1.13 WATER CONTROL

- A. Grade remediation area, including unfinished earthwork and associated surfaces, to drain in a manner acceptable to the PRPs' Representative. Maintain excavation free of water. Provide, operate and maintain pumping equipment, as needed.
- B. Protect remediation area from puddling or running water. Provide water barriers as required to protect remediation area from sediment runoff and soil erosion.

1.14 EROSION AND SEDIMENT CONTROL

- A. Plan and execute remediation by methods to control surface drainage from earthwork and soil storage areas. Prevent erosion and sedimentation.
- B. Minimize amount of bare soil exposed at one time.
- C. Provide temporary measures to control water flow as shown on the Drawings.

- D. Construct soil storage areas in locations selected to avoid erosive surfaces as shown on the Drawings.
- E. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- F. Installed silt fences shall be frequently inspected and adjusted/repared as necessary throughout the remedial work period.

1.15 EXTERIOR ENCLOSURES

- A. If instructed by the PRPs' Representative, provide temporary, insulated if required, weather-tight enclosure having exterior openings that will accommodate acceptable working conditions, protect Products, allow for temporary heating and maintenance of required ambient temperatures identified in individual specification Sections, and prevent entry of unauthorized persons. Provide access doors with appropriate hardware and locks.
- B. Provide temporary roofing as required.

1.16 PROTECTION OF INSTALLED WORK

- A. Protect installed Work and provide special protection where specified in individual specification Sections or, if not specified, as instructed by the PRPs' Representative.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills and soffits of openings.
- D. Prohibit traffic or storage upon covered surfaces. If traffic or activity is necessary, obtain recommendations for protection from the cover manufacturer.
- E. Prohibit traffic through all landscaped areas.

1.17 SECURITY

- A. As required, provide security and facilities to protect Work, existing facilities and subject private properties from unauthorized entry, vandalism or theft.
- B. Coordinate Facility security policies and issues with Facility Representative.

1.18 NOISE CONTROL

- A. Provide methods, means and facilities to minimize noise from the operation of the remediation equipment and noise produced by construction operations.

1.19 DUST AND VOC CONTROL

- A. Execute Work by methods to minimize raising dust and VOCs from construction operations.
- B. Provide positive means to prevent airborne dust and VOCs from dispensing into atmosphere as described in the Soil Design Report.

1.20 PEST CONTROL

- A. Provide methods, means and facilities to prevent pests and insects from damaging the Work.

1.21 POLLUTION CONTROL

- A. Provide methods, means and facilities to prevent contamination of soil, water and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations

1.22 HEALTH & SAFETY

- A. The Contractor will adhere to all OSHA regulations and New York State health and safety protocols that are applicable to the described work. The Contractor is responsible for requesting onsite dig clearance for underground utilities by contacting Utility/One Call Center, ((800) 245-2828) prior to initiating the Work.
- B. The Work involves remediating soil that is contaminated with volatile organic compounds (VOCs). Some work activities will expose the Contractor or his employees and installers to VOCs. The Contractor will adhere to all of the provisions described in the Health and Safety Plan (Appendix G of the Soil Design Report).
- C. The Contractor is responsible for adhering to health and safety protocols, as defined by the above-referenced sources, providing his employees and installers with any necessary personal protection equipment, and decontaminating equipment and personnel.
- D. The PRPs' Representative will monitor health and safety conditions at the site and have the authority to enforce health and safety protocols, including halting work and modifying health and safety measures to meet site conditions.

1.23 ACCESS ROADS

- A. Provide detours necessary for unimpeded traffic flow.
- B. Provide and maintain access to fire hydrants, free of obstructions.
- C. Existing on-site roads may be used for remediation traffic.

1.24 PARKING

- A. Arrange for temporary parking areas to accommodate remediation personnel.
- B. When site space is not adequate, provide additional off-site parking.
- C. Do not allow vehicle parking on privately-owned property other than the Facility.

1.25 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris and rubbish. Maintain remediation area in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums and other closed or remote spaces, prior to enclosing the space.
- C. Collect and remove waste materials, debris and rubbish from the site weekly and dispose of off-site.

1.26 FIELD OFFICES

- A. Provide office with electricity, telephone and facsimile for Contractor's use. Other features for the Contractor's Field office are at the discretion of the Contractor. Provide telephone, facsimile and electric to Field office provided by PRPs' Representative. Use separate charge accounts for each Field office for the utilities.
- B. Locate office as shown on the Drawings.

1.27 REMOVAL OF UTILITIES, FACILITIES AND CONTROLS

- A. Remove temporary utilities, equipment, facilities and materials prior to Final Invoice and inspection.
- B. Clean and repair damage caused by installation or use of temporary work.

- C. Restore existing and permanent facilities used during remediation to original condition.

PART 2 PRODUCTS

2.1 TEMPORARY SAFETY-FENCING AROUND REMEDIAL EXCAVATION

- A. 4-foot high, commercial grade polyethylene safety fencing.
- B. Manufacturer: Fluid Systems, Inc., or equivalent as accepted by PRPs' Representative.
- C. Substitutions: Under provisions of Section 01600.
- D. Provide support posts in accordance with manufacturer's recommendations or instructions.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01540

SECURITY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Security program.
- B. Entry control.
- C. Personnel identification.
- D. Security service.
- E. Miscellaneous restrictions.

1.2 RELATED SECTIONS

- A. Section 01010 - Summary of Work.
- B. Section 01500 - Construction Facilities and Temporary Controls: Temporary lighting, enclosures.

1.3 SECURITY PROGRAM

- A. Protect Work from theft, vandalism, and unauthorized entry.
- B. Initiate program at project mobilization.
- C. Maintain program throughout construction period until directed by PRPs' Representative.

1.4 ENTRY CONTROL

- A. Restrict entrance of persons and vehicles into Project site.
- B. Allow entrance only to authorized persons with proper identification.

- C. Maintain log of workers and visitors, make available to PRP and PRPs' Representative on request.

1.5 PERSONNEL IDENTIFICATION

- A. Provide identification badge to each person authorized to enter premises.
- B. Badge To Include: Personal photograph, name and employer.
- C. Maintain a list of accredited persons, submit copy to PRP or PRPs' Representative on request.
- D. Require return of badges at expiration of their employment on the Work.
- E. Only Visitors with the proper OSHA training shall be allowed onsite. Numbered badges will be made available for visitors.

1.6 SECURITY SERVICE

- A. Employ uniformed guard service to provide watch persons at site 24 hours per day, 7 days a week until the Soil Remedial Excavation and backfill tasks are complete.

1.7 MISCELLANEOUS RESTRICTIONS

- A. Do not allow cameras onsite, or photographs to be taken, except by written approval of Owner.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01550

ACCESS ROADS AND PARKING AREAS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preparation.
- B. Access roads.
- C. Parking.
- D. Existing pavements and parking areas.
- E. Maintenance.
- F. Removal, repair.
- G. Mud from site vehicles.

1.2 RELATED SECTIONS

- A. Section 01010 - Summary of Work.
- B. Section 01039 - Coordination and Meetings.
- C. Section 01041 - Project Coordination: Project coordination.
- D. Section 01500 - Construction Facilities and Temporary Controls: Temporary Construction.
- E. Section 01570 - Traffic Regulation: Traffic regulation.
- F. Section 02211 - Rough Grading: Specifications for earthwork and paving bases.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clear areas, provide for surface drainage of road, parking, area premises, and adjacent areas.

3.2 ACCESS ROADS

- A. Provide unimpeded access for emergency vehicles. Maintain 20 foot width driveways with turning space between and around combustible materials.
- B. Provide and maintain access to fire hydrants and control valves free of obstructions.

3.3 PARKING

- A. Arrange for temporary parking areas to accommodate use of construction personnel.
- B. When site space is not adequate, provide additional off-site parking.

3.4 EXISTING PAVEMENTS AND PARKING AREAS

- A. Use of existing on-site streets and driveways used for construction traffic is permitted. Tracked vehicles will not be allowed on paved areas other than the immediate excavation area.
- B. Use of designated areas of existing parking facilities by construction personnel is permitted.
- C. Do not allow heavy vehicles or construction equipment in areas other than those noted on the Drawings.

3.5 MAINTENANCE

- A. Maintain traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow and ice.
- B. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

3.6 REMOVAL, REPAIR

- A. Repair existing facilities damaged by use, to original condition.

3.7 MUD FROM SITE VEHICLES

- A. Provide means of removing mud from vehicle wheels before leaving designated areas.

END OF SECTION

SECTION 01565

DUST AND VOC CONTROL

PART 1 GENERAL

1.1 SUMMARY

The Contractor shall conduct operations and maintain the project site so as to minimize the creation and dispersion of dust and VOCs. Dust and VOC control shall be used throughout the site operations, especially during contaminated soil excavation, material handling and transport, site preparation activities, rough grading, and placement of final soil cover.

1.2 RELATED SECTIONS

- A. Section 02100: Offsite Transportation and Disposal
- B. Section 02222: Excavating.
- C. Section 02223: Backfilling.

1.3 REFERENCES

- A. HASP - Health and Safety and Contingency Plan (Appendix G of the Soil Design Report)

PART 2 PRODUCTS

2.1 DUST CONTROL

- A. Water
 - 1. The contractor shall obtain water from the spigot shown on the Drawings to be used for dust control in any area of the site. The Contractor shall have water available and ready at all times for dust control, to be applied as indicated in the HASP or at the direction of the PRPs' Representative..

2.2 VOC CONTROL

- A. Foam
 - 1. Manufacturer: Rusmar Foam-Technology AC-645 long duration foam, or approved equal.

2. Substitutions: Refer to Section 01600.
3. The Contractor shall have a sufficient quantity of foam material and equipment available and ready at all times for VOC control, to be applied for conditions as indicated in the HASP or as directed by the PRPs' Representative.

PART 3 EXECUTION

3.1 DUST AND VOC CONTROL

A. Execution

1. The Contractor shall apply water or foam to the site when dust or VOC control is necessary, to protect human health, by arranging spray bar height, nozzle spacing, and spray pattern to provide complete coverage of ground or excavation area. Water and/or foam shall be applied without interfering with excavation equipment or site operations and without creating nuisance conditions such as ponding.

END OF SECTION

SECTION 01570

TRAFFIC REGULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Construction parking controls.
- B. Flag persons.
- C. Flares and lights.
- D. Haul routes.
- E. Traffic signs and signals.
- F. Removal.

1.2 RELATED SECTIONS

- A. Section 01010 - Summary of Work.
- B. Section 01039 - Coordination and Meetings.
- C. Section 01041 - Project Coordination: Project coordination.
- D. Section 01500 - Construction Facilities and Temporary Controls: Enclosures, access roads and parking areas.

PART 2 PRODUCTS

2.1 SIGNS, SIGNALS, AND DEVICES

- A. Post Mounted and Wall Mounted Traffic Control and Informational Signs: Specified in Section 01580.
- B. Traffic Control Signals: As approved by local jurisdictions.

- C. Traffic Cones and Drums, Flares and Lights: As approved by local jurisdictions.
- D. Flagperson Equipment: As required by local jurisdictions.

PART 3 EXECUTION

3.1 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and Sag Harbor Industries' operations.
- B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non- designated areas.

3.2 FLAG PERSONS

- A. Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

3.3 FLARES AND LIGHTS

- A. Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic except when a fire and/or explosion hazard is possible.

3.4 HAUL ROUTES

- A. Drawings indicate haul routes onsite. Offsite transportation routes are described in the Soil Design Report.
- B. Confine onsite construction traffic to designated haul routes.
- C. Provide traffic control at critical locations of haul routes to regulate construction and onsite traffic, and to minimize interference with public traffic.

3.5 TRAFFIC SIGNS AND SIGNALS

- A. Install at approaches to site and onsite crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
- B. Relocate signs and signals as Work progresses, to maintain effective traffic control.

3.6 REMOVAL

- A. Remove equipment and devices when no longer required.
- B. Repair damage caused by installation.
- C. Remove post settings to a depth of 2 feet.

END OF SECTION

SECTION 01580

PROJECT IDENTIFICATION AND SIGNS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Project identification sign.
- B. Project informational signs.
- C. Installation.
- D. Maintenance.
- E. Removal.

1.2 RELATED SECTIONS

- A. Section 01010 - Summary of Work.
- B. Section 01500 - Construction Facilities and Temporary Controls.
- C. Section 01570 -Traffic Regulation.

1.3 QUALITY ASSURANCE

- A. Design sign and structure to withstand 60 miles/hr wind velocity.
- B. Sign Painter: Experienced as a professional sign painter for minimum three years.
- C. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Shop drawings and product data.
- B. Show content, layout, lettering, color, structure, sizes.

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PART 2 PRODUCTS

2.1 SIGN MATERIALS

- A. Structure and Framing: New wood, structurally adequate.
- B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch thick, standard large sizes to minimize joints.
- C. Rough Hardware: Galvanized aluminum or brass.
- D. Paint and Primers: Exterior quality, two coats; sign background using color selected by the PRPs' Representative.
- E. Lettering: Exterior quality paint using colors selected by the PRPs' Representative.

2.2 PROJECT IDENTIFICATION SIGN

- A. One painted sign, 32 sq ft (3 sq m) area, bottom 6 feet (2 m) above ground.
- B. Content:
 - 1. Project title as indicated on Contract Documents.
 - 2. Names and titles of authorities.
 - 3. Names and titles of Engineer and Consultants.
 - 4. Name of Prime Contractor and major Subcontractors.
- C. Lettering: Standard Alphabet for Highway Signs, Public Roads Administration, Federal Works Agency.

2.3 PROJECT INFORMATIONAL SIGNS

- A. Painted informational signs of same colors and lettering as Project Identification sign, or standard products; size lettering to provide legibility at 50 foot distance.
- B. Provide at each field office, storage shed, and directional signs to direct traffic into and within site. Relocate as Work progress requires.

- C. Provide municipal traffic agency directional traffic signs to and within site.
- D. Additional signs to warn of the following hazards at a minimum:
 - 1. Flammable materials.
 - 2. Excavation/open pits.
 - 3. Heavy equipment.
 - 4. Electrical/mechanical hazards.
 - 5. Slippery materials.
 - 6. Hazardous materials storage.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install project identification sign within 30 days after date fixed by Notice to Proceed, but no later than the start of mobilization.
- B. Erect at location of high public visibility adjacent to main entrance to site or in locations appropriate to the individual hazard.
- C. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
- D. Install sign surface plumb and level, with butt joints. Anchor securely.
- E. Paint exposed surfaces of sign, supports, and framing.

3.2 MAINTENANCE

- A. Maintain signs and supports clean, repair deterioration and damage.

3.3 REMOVAL

- A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

END OF SECTION

SECTION 01590

FIELD OFFICES AND TREATMENT SHED

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Use of permanent facilities.
- B. Materials, Equipment, Furnishings.
- C. Environmental Control.
- D. Contractor field office.
- E. Treatment Shed.
- F. Maintenance and cleaning.
- G. Removal.

1.2 RELATED SECTIONS

- A. Section 01010 - Summary of Work.
- B. Section 01500 - Construction Facilities and Temporary Controls: Temporary electricity, temporary sanitary facilities, temporary telephone.
- C. Section 01550 - Access Roads and Parking Areas.
- D. Section 01580 - Project Identification and Signs.
- E. Section 01600 - Material and Equipment: Storage and protection.

1.3 USE OF PERMANENT FACILITIES

- A. Permanent facilities shall not be used for field offices or for storage.

PART 2 PRODUCTS

2.1 MATERIALS, EQUIPMENT, FURNISHINGS

- A. Materials, Equipment, Furnishings: Serviceable, new or used, adequate for required purpose.

2.2 ENVIRONMENTAL CONTROL

- A. Heating, Cooling and Ventilating for Office: At discretion of Contractor
- B. Treatment Shed : Heating and ventilation as specified to maintain equipment in accordance with Contract Documents; adequate lighting for maintenance and inspection of equipment .

2.3 CONTRACTOR FIELD OFFICE

- A. Contractor Field Office
 1. Area: Maximum 200 sq ft, maximum dimension 10 ft. width.
 2. Telephone: As specified in Section 01500.
 3. Facsimile: As specified in section 01500.
 4. Other furnishings and amenities: At discretion of Contractor.

2.4 TREATMENT SHED

- A. Cargo Box: 8 ft. wide by 20 ft. long by 8 ft. high; with doors providing open access to full width; with hardware that allows doors to be secured with keyed locks. The cargo box shall be insulated with panel type insulation with an R11 rating. The panels shall be secured to the walls with an appropriate adhesive.
- B. Electrical: As specified in Section 16010.
- C. Mechanical Equipment: As specified in Section 15110.

PART 3 EXECUTION

3.1 PREPARATION

- A. Fill and grade sites as needed to provide a level base for the treatment shed and concrete pad, and to provide drainage away the from building.

3.2 INSTALLATION

- A. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.
- B. Employee Residential Occupancy: Not allowed on SHI property.

3.3 MAINTENANCE AND CLEANING

- A. Weekly janitorial services for office; periodic cleaning and maintenance for office and storage areas.
- B. Maintain approach walks free of mud, water and snow.

3.4 REMOVAL

- A. At completion of Work remove Contractor's Field office and associated foundations, utility services and debris. Restore areas. Treatment Shed and PRPs Field office to remain.

END OF SECTION

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Selection of Products.
- B. Products.
- C. Transportation and handling.
- D. Storage and protection.
- E. Product options.
- F. Substitutions.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control: Product quality monitoring.

1.3 SELECTION OF PRODUCTS

- A. Responsibilities of PRPs' Representative:
 - 1. Consult with Contractor for consideration and selection of Products, suppliers and installers.
 - 2. Select Products and transmit decision to Contractor.
 - 3. Prepare Change Order.
- B. Contractor Responsibilities:
 - 1. Assist PRPs' Representative in selection of Products, suppliers and installers.
 - 2. Obtain proposals from suppliers and installers and offer recommendations.
 - 3. On notification of selection by PRPs' Representative, execute purchase agreement with designated supplier and installer.
 - 4. Arrange for preparation of and process shop drawings, product data and samples. Arrange for delivery.

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5. Promptly inspect Products upon delivery for completeness, damage and defects. Submit claims for transportation damage. Repair, or return and reorder, damaged or defective Products.

- C. Differences in costs will be adjusted by Change Order.

1.4 PRODUCTS

- A. Do not use existing materials removed from the site, except as specifically permitted by the Contract Documents or PRPs' Representative.
- B. Provide interchangeable materials of the same character and composition as materials being replaced.

1.5 TRANSPORTATION AND HANDLING

- A. Transport and handle Products in accordance with manufacturers' instructions.
- B. Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct and Products are undamaged.
- C. Provide equipment and personnel to handle Products by methods which will prevent soiling, disfigurement or damage.

1.6 STORAGE AND PROTECTION

- A. Store and protect Products in accordance with manufacturers' instructions, with seals and labels intact and legible.
- B. Store sensitive Products in weather tight, climate controlled enclosures.
- C. For exterior storage of Products, place on sloped supports, above ground.
- D. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- E. Cover Products subject to deterioration with impervious sheet covering. Provide ventilation, as required, to avoid condensation or potential degradation of Product.
- F. Store loose granular materials on solid, flat surfaces in a well-drained area. Prevent mixing with foreign matter.

- G. Provide equipment and personnel to store Products by methods which will prevent soiling, disfigurement or damage.
- H. Arrange storage of Products to permit access for inspection. Periodically inspect to verify that Products are undamaged and maintained in acceptable condition.

1.7 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or Description Only: Any Product meeting those standards or description.

1.8 SUBSTITUTIONS

- A. Request for substitutions shall be made according to the Construction Quality Assurance Project Plan (Appendix I of the Soil Design Report).
- B. Owner's Representative will consider requests for Substitutions only within 15 working days after Notice of Award.
- C. Substitutions may be considered when a Product becomes unavailable through no fault of the Contractor.
- D. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- E. A request constitutes a representation that the Contractor:
 - 1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
 - 2. Will provide the same warranty for the Substitution as for the specified Product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete.
 - 4. Waives claims for time extension which may subsequently become apparent.
- F. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request or when acceptance will require revision to the Contract Documents.
- G. Substitution Submittal Procedure:
 - 5. Submit 3 copies of request for Substitution for consideration. Limit each request to one proposed Substitution.

6. Submit shop drawings, product data and certified test results attesting to the proposed Product equivalence. Burden of proof is on proposer.
7. The PRPs' Representative will notify Contractor in writing of decision to accept or reject request.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01650

STARTING OF SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Starting systems.
- B. Demonstration and instructions.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control: Manufacturers field reports.
- B. Section 01700 - Contract Closeout: System operation and maintenance data and extra materials.

1.3 STARTING SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify PRPs' Representative seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of PRPs' Representative in accordance with manufacturer's instructions.
- G. Submit a written report in accordance with Section 01300 that equipment or system has been properly installed and is functioning correctly.
- H. Equipment requiring start-up and testing include the soil-vapor extraction blowers, all controls, safety switches and devices, exhaust fans, and heating and lighting equipment.

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- I. Verify that each valve, gage and other mechanical items are functional and operating properly.

1.4 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of Products to PRPs' Representative two weeks prior to date of final inspection.
- B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with PRPs' Representative in detail to explain all aspects of operation and maintenance.
- C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance and shutdown of each item of equipment at agreed time.
- D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- E. The amount of time required for instruction on each item of equipment and system is that specified in individual sections.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Closeout procedures.
- B. Final cleaning.
- C. Warranties.
- D. Extra materials.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals.
- B. Section 01500 - Construction Facilities and Temporary Controls: Progress cleaning.

1.3 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed and that Work has been inspected and is complete in accordance with Contract Documents and ready for review by PRPs' Representative.
- B. Provide required submittals to PRPs' Representative as specified by Section 01300 and governing or other authorities.

1.4 FINAL CLEANING

- A. Execute final cleaning prior to final Work inspection.
- B. Clean surfaces exposed to view and remove foreign substances.
- C. Clean debris from drainage systems.
- D. Clean construction area, sweep paved and concrete areas, rake clean landscaped surfaces.

- E. Remove waste and surplus materials, rubbish and remedial facilities from the site, including temporary sanitary facilities.

1.5 WARRANTIES

- A. Provide duplicate copies.
- B. Execute and assemble transferable warranty documents from installers, suppliers and manufacturers.
- C. Provide Table of Contents and assemble in three D side ring binder with durable plastic cover.
- D. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 5 working days after acceptance, listing date of acceptance as start of warranty period.
- E. Contractor shall warranty all Work accepted by the PRPs' Representative for a period of one (1) year.

1.6 EXTRA MATERIALS

- A. Provide products, maintenance and extra materials in quantities specified in individual specification Sections or by PRPs' Representative if not specified in individual specification Sections.
- B. Deliver to Project site and place in location as instructed by PRPs' Representative; obtain receipt prior to final payment.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Format and content of manuals.
- B. Instruction of PRPs' Representative.
- C. Schedule of submittals.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals: Submittals procedures. Shop drawings, product data, and samples.
- B. Section 01400 - Quality Control.
- C. Section 01410 - Testing Services: Test and balance reports.
- D. Section 01600 - Material and Equipment.
- E. Section 01700 - Contract Closeout: Contract closeout procedures.
- F. Individual Specifications Sections: Specific requirements for operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.4 FORMAT

- A. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

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- B. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, in three parts as follows:
1. Part 1: Directory, listing names, addresses, and telephone numbers of PRPs' Representative, Contractor, Subcontractors and major equipment suppliers.
 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Operating instructions.
 - d. Maintenance instructions for equipment and systems.
 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Certificates.
 - c. Photocopies of warranties.

1.5 CONTENTS, EACH VOLUME

- A. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of PRPs' Representative, Subconsultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
- B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- C. Warranties: Bind in copy of each.

1.6 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter and any special operating instructions.

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- D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing and checking instructions.
- E. Provide servicing and lubrication schedule, and list of lubricants required.
- F. Include manufacturer's printed operation and maintenance instructions.
- G. Include sequence of operation by controls manufacturer.
- H. Provide control diagrams by controls manufacturer as installed.

1.7 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct PRP's designated personnel in operation, adjustment and maintenance of products, equipment and systems, at agreed upon times.
- B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

1.8 SUBMITTALS

- A. For equipment, or component parts of equipment put into service during construction and operated by PRP, submit documents within ten days after acceptance.
- B. Submit two sets of revised final volumes in final form within 10 days after final inspection.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

DIVISION 2 - SITEWORK

SECTION 02100

OFFSITE TRANSPORTATION AND DISPOSAL

PART 1 GENERAL

1.1 SUMMARY

- A. The work specified hereunder in this section shall involve transportation and offsite disposal and treatment of contaminated solid and liquids according to the type of material and degree of contamination.
- B. The Contractor shall ensure that all operations in the loading and hauling of contaminated materials are in compliance with the Federal and State Departments of Transportation (DOT) regulations, 40 CFR Parts 262 and 264, "Revised Procedures for Implementing Off-Site Response Actions", (EPA OSWER Directive Number 9834.11, November 13, 1987), and all local requirements.
- C. Soil which will be designated for disposal at this site has been contaminated by releases of F001 solvent waste from industrial activities.
- D. All soil which exceeds the soil clean-up criteria shall be transported and disposed of offsite at an approved facility which demonstrates compliance with applicable Federal, State and local regulations. The Contractor is responsible for arranging for all transportation and offsite disposal of contaminated soil.
- E. Other materials to be disposed offsite include wastes generated during decontamination activities.

1.2 APPLICABLE REGULATIONS

Contaminated and Hazardous waste material transportation regulations shall include, but not be limited to, the following:

- A. U.S. Department of Transportation regulations, 49 CFR 171 through 179.
- B. Federal Resource Conservation and Recovery Act, as amended.

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- C. Department of Transportation Regulations applicable to method of transport.
- D. USEPA: 40 CFR 263 (48 FR 14153).
- E. OSHA Standards (29 CFR 1904, 1910 and 1926).
- F. Posted weight limitations and roads and bridges.
- G. EPA: 40 CFR 300.440 (55 FR 49200, October 22, 1993).

1.3 REFERENCES

- A. Submit under Provisions of Section 1300 - Submittals.
- B. The Contractor shall submit a plan detailing all proposed disposal facilities and methods for transporting all regulated materials offsite.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Portable Scale Manufacturer.
 - 1. Intercomp: Model PT300.
 - 2. Contractor shall supply two battery-powered portable scale units for onsite use during soil disposal activities upon closure of the Soil Impoundment.
 - 3. Contractor shall calibrate and operate scales according to manufacturer's specifications.

PART 3 EXECUTION

3.1 MANIFESTS

- A. The Contractor shall organize and maintain the material shipment records/manifests required by the Federal Resource Conservation and Recovery Act (RCRA), the State of New York and the state where the treatment/disposal facility is located.
- B. The Contractor shall decontaminate and obtain letters of commitment from the waste haulers and the treatment, disposal or recovery facility to haul and accept shipments. The letter shall indicate agreement to handle and accept the specified material as described in the Contract.

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3.2 HAULING

- A. The Contractor shall coordinate the schedule for truck arrival and material deliveries at the disposal site to meet the approved project schedule. The schedule shall be compatible with the availability of equipment and personnel for material handling operations.
- B. The Contractor shall inspect all vehicles leaving the project site to ensure that the least possible amount of soil adheres to its wheels or undercarriage.
- C. The Contractor shall not deliver waste to any facility other than the disposal facility(ies) listed on the shipping manifest.
- D. The Contractor shall coordinate vehicle inspection and recording of quantities leaving the site with the PRPs' Representative. Trucks to be used for the transportation of contaminated soil shall be weighed by the Contractor using a portable scale upon entering the site. These trucks shall be weighed after being loaded with soil prior to exiting the site to determine the weight of the soil in the trucks and assure compliance with DOT weight restrictions. These quantities shall be verified with recorded quantities at the disposal facility(ies). If any deviation between the two weight records occurs, the matter is to be reported immediately to the PRPs' Representative.
- E. The Contractor shall be held responsible for any and all actions necessary to remedy situations involving material spilled in transit or mud and dust tracked offsite. The cleanup shall be accomplished at the Contractor's expense.
- F. The Contractor shall be responsible for inspecting the access routes for road conditions, overhead clearance and weight restrictions, and shall provide traffic control when needed.
- G. The Contractor shall ensure that trucks are protected against contamination by properly covering and lining them with compatible material or by decontaminating them prior to use for this project.
- H. The Contractor shall only use the transporter(s) identified in his program for the work. Any use of substitute or additional transporters must have previous written approval from the PRPs' Representative.

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- I. The Contractor shall develop, document and implement a policy for accident prevention.
- J. The Contractor shall not combine contaminated materials from other projects with material from the Rowe Industries Site.
- K. The PRPs' Representative will provide a hazardous waste generator identification number for use on the manifest if required.
- L. The PRPs' Representative, as an agent of the PRPs, will sign the manifest as the generator where required.

3.3 OFFSITE DISPOSAL

- A. The Contractor shall use only the treatment, disposal and recovery facility(ies) identified in the Soil Design Report. Substitutions or additions shall not be permitted without prior written approval from the PRPs' Representative.
- B. The Contractor shall be responsible for acceptance of the specific material at an approved treatment, disposal or recovery facility, for ensuring that the facility is properly permitted to accept the stated material, and that the facility provides the stated treatment and/or disposal services.
- C. The Contractor shall submit to the PRPs' Representative, with his program for proposed transportation and disposal, a letter of commitment from the proposed TSD facility(ies).
- D. The PRPs' Representative reserves the right to contact and visit the disposal facilities and regulatory agencies to verify the agreement to accept the stated material and to verify any other information provided. This does not in any way relieve the Contractor of his responsibilities under this contract.
- E. In the event that the identified and approved facility(ies) ceases to accept the stated materials or the facility(ies) ceases operation, it is the Contractor's responsibility to locate an alternate approved and permitted facility(ies) for accepting materials. The Contractor is responsible for making the necessary arrangements to utilize the facility(ies), and the alternate facility(ies) must be approved in writing by the PRPs' Representative in the same manner and meet the same requirements as for the original facility(ies).

3.4 RECORD KEEPING

- A. The Contractor shall obtain manifest forms, obtain material code numbers and complete the shipment manifest records as required by the appropriate regulatory agencies for verifying the material type (Code No.) and quantity of each load in unit of volume and weight. Copies of each manifest and any other relevant documentation shall be submitted to the PRPs' Representative within two (2) business days following shipment, and with two (2) business days after notification of receipt of the disposal facility. Any manifest discrepancies shall be reported immediately to the PRPs' Representative and be resolved by the Contractor.

END OF SECTION

SECTION 02110

SITE CLEARING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of surface debris.
- B. Removal of paving and curbs.
- C. Removal of trees, shrubs, and other plant life.
- D. Topsoil excavation.

1.2 RELATED SECTIONS

- A. Section 02211 - Rough Grading.
- B. Section 02222 - Excavating.
- C. Section 02229 - Rock Removal.

1.3 REGULATORY REQUIREMENTS

- A. Conform to applicable code for environmental requirements and disposal of debris.
- B. Coordinate clearing Work with utility companies.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that existing plant life designated to remain is tagged or identified.
- B. Identify a waste area for placing removed materials.

3.2 PROTECTION

- A. Locate, identify and protect utilities that remain from damage.
- B. Protect trees, plant growth and features designated to remain as final landscaping.
- C. Protect bench marks, survey control points and existing structures from damage or displacement.

3.3 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove trees and shrubs, stumps, surface rock and concrete pads as shown in the Drawings.
- C. Clear undergrowth and deadwood without disturbing subsoil.

3.4 REMOVAL

- A. Remove debris, rock and extracted plant life from site.
- B. Partially remove paving and curbs as indicated. Neatly saw cut edges at right angle to surface.

3.5 TOPSOIL EXCAVATION

- A. Excavate non-impacted topsoil as needed from areas to be used for site activities. Do not mix with foreign materials.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated onsite to depth not exceeding 8 feet and protect from erosion.
- D. Remove excess topsoil not intended for reuse from site.

END OF SECTION

SECTION 02205

SOIL MATERIALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Subsoil and topsoil materials.

1.2 RELATED SECTIONS

- A. Section 01405 - Sampling and Analysis.
- B. Section 02207 - Aggregate Materials.
- C. Section 02211 - Rough Grading.
- D. Section 02223 - Backfilling.
- E. Section 02936 - Seeding.

1.3 REFERENCES

- A. AASHTO M145 - The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.
- B. AASHTO T11 - Amount of Material Finer than 75 μ m Sieve in Aggregate.
- C. AASHTO T27 - Sieve Analysis of Fine and Coarse Aggregates.
- D. AASHTO T88 - Particle Size Analysis of Soils.
- E. ASTM D1140 - Amount of Material in Soils Finer than the No. (200- μ m) Sieve.

1.4 SUBMITTALS

- A. Submit samples of specified soil materials Products if and as instructed by PRPs' Representative.

- B. Materials Source: Submit name of imported materials suppliers. Provide materials from same source throughout the work. Change of source requires approval from PRPs' Representative.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

- A. Subsoil Type S1: Imported material, graded, free of lumps larger than a 3-inch sieve size, rocks larger than a 3-inch sieve size, and debris; material shall be gravelly sands of SW or SP Unified Soil Classification.
- B. Topsoil Type S2: Imported material, graded, free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.
- C. Sand Type S3: Imported material, graded, free of lumps, roots, rocks larger than 1/4 inch, subsoil, topsoil, debris, large weeds and foreign matter. Soil shall be greater than No. 40 sieve and pass through a No. 10 sieve.

2.2 SOURCE QUALITY CONTROL

- A. Materials source inspection, if required, will be completed by the PRPs' Representative.
- B. Tests, if required, will be coordinated by the PRPs' Representative. If these tests indicate that materials do not meet specified requirements, change material at no additional cost to PRPs.
- C. All material brought onsite will be analyzed for TCL and eight RCRA metals using TCLP at the rate of one sample for every 50 cubic yards. No VOCs above regulatory guidelines in the material are acceptable. Sampling and analysis will be completed per the SAMP for Remediation Construction (Appendix E of the Soil Design Report).

PART 3 EXECUTION

3.1 STOCKPILING

- A. Stockpile materials on site at locations designated by PRPs' Representative.
- B. Stockpile in sufficient quantities to meet remediation schedule and requirements.

- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.2 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in a clean and neat condition.

3.3 SCHEDULE

- A. Subsoil Type S1: For backfill of excavation in former drum storage area.
- B. Topsoil Type S2: For areas requiring surface restoration and regrading and planting.
- C. Sand Type S3: For Soil Impoundment beneath liner; for drywells requiring filling.

END OF SECTION

SECTION 02207

AGGREGATE MATERIALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aggregate materials.

1.2 RELATED SECTIONS

- A. Section 01405 - Sampling and Analysis.
- B. Section 02205 - Soil Materials.
- C. Section 02211 - Rough Grading.
- D. Section 02223 - Backfilling.
- E. Section 02231 - Aggregate Base Course.

1.3 REFERENCES

- A. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. AASHTO T164 - Quantitative Extraction of Bitumen from Bituminous Paving Mixtures.

1.4 SUBMITTALS

- A. Submit samples of specified aggregate materials Products if and as instructed by PRPs' Representative.
- B. Materials Source: Submit name of imported materials suppliers. Provide materials from same source throughout the work. Change of source requires approval from PRPs' Representative.

PART 2 PRODUCTS

2.1 AGGREGATE MATERIALS

- A. Coarse Aggregate Type A1 (Gravel): Coarse Stone or Crushed Gravel-Pit run, angular crushed, natural or washed stone; free of shale, clay, friable material and debris; bitumen content shall not exceed 2 percent by weight as determined by AASHTO T164 Method E; graded in accordance with ANSI/ASTM C136; and within the following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 inch	100
3/4 inch	90-100
3/8 inch	50-90
No. 4	35-80(1) 35-70(2)
No. 10	20-65(1) 20-55(2)
No. 40	10-35
No. 200	3-10

- (1) Applies when the aggregate contains 60 percent or less of crushed quarry rock.
(2) Applies when the aggregate contains more than 60 percent of crushed quarry rock.

2.2 SOURCE QUALITY CONTROL

- A. Materials source inspection, if required, will be completed by the PRPs' Representative.
- B. Tests, if required, will be coordinated by the PRPs' Representative. If these tests indicate that materials do not meet specified requirements, change material at no additional cost to PRP.

PART 3 EXECUTION

3.1 STOCKPILING

- A. Stockpile materials on Sag Harbor Industries' property at locations designated by PRPs' Representative.
- B. Stockpile in sufficient quantities to meet remediation schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Cover stockpiles when not in use and provide sediment control measure around perimeter of each stockpile.

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- E. Direct surface water away from stockpile site so as to prevent erosion or deterioration of materials.

3.2 STOCKPILE CLEANUP

- A. Remove stockpile and leave area in a clean and neat condition.

3.3 SCHEDULE

- A. Coarse Aggregate Type A1
 - 1. decontamination area base.
 - 2. base coarse for asphalt pavement.

END OF SECTION

SECTION 02211
ROUGH GRADING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Filling, rough contouring and compacting the site for aggregate base course and topsoil.

1.2 RELATED SECTIONS

- A. Section 01039 - Coordination and Meetings.
- B. Section 01600 - Material and Equipment: Product substitutions and options.
- C. Section 02205 - Soil Materials.
- D. Section 02222 - Excavating: Remedial excavation.
- E. Section 02223 - Backfilling: Backfilling remedial excavation.
- F. Section 02231 - Aggregate Base Course.
- G. Section 02936 - Seeding: Finish-grading topsoil to final contours.

1.3 REFERENCES

- A. ASTM C136 - Method For Sieve Analysis of Fine and Coarse Aggregates.

1.4 QUALITY ASSURANCE

- A. Complete Work in accordance with ASTM C136 standards.

1.5 PROJECT RECORD DOCUMENTS

- A. The PRPs' Representative, with required assistance from the Contractor, will accurately record actual locations of remaining utilities by horizontal dimensions, elevations or inverts and slope gradients.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Subsoil Type S1 as specified in Section 02205.
- B. Topsoil Type S2 as specified in Section 02205.
- C. Plastic Sheeting:
 - 1. Plastic sheeting shall consist either of 6 mil, reinforced polyethylene (PE) or 10 mil Polyvinyl Chloride (PVC) and color shall be at discretion of the Contractor and as accepted by the PRPs' Representative.
 - 2. Manufacturer of and specific Product for the sheeting shall be at discretion of the Contractor and as accepted by the PRPs' Representative.
 - 3. Substitutions shall be made under provisions of Section 01600.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions under provisions of Section 01039.
- B. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.2 PREPARATION

- A. Identify required lines, levels, contours and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify and protect from damage above- and below-grade utilities to remain.
- D. Protect bench marks, survey control point(s), existing structures, fences, sidewalks, paving and curbs from excavating equipment and vehicular traffic.

3.3 FILLING

- A. Fill areas to specified contours and elevations with unfrozen materials.

- B. Place fill material in continuous layers and compact in accordance with the schedule at end of this Section.
- C. Maintain optimum moisture content of fill materials to attain accepted compaction requirements.
- D. Slope grade away from buildings minimum 2 inches in 10 ft (1.5:100), unless otherwise noted on the Drawings or instructed by the PRPs' Representative.
- E. Make grade changes gradual. Blend slope into level areas.
- F. Remove surplus fill materials from site when directed to do so by the PRPs' Representative.

3.4 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1 inch from required elevation.

3.5 FIELD QUALITY CONTROL

- A. If Work does not meet requirements specified in the Contract Documents, remove and replace until accepted by the PRPs' Representative.

3.6 SCHEDULES

- A. Subsoil Type S1:
 - 1. Maximum 12 inches loose depth for each lift.
 - 2. Compact each lift until there is no further evidence of consolidation, with a minimum of two complete passes, with compaction equipment acceptable to the PRPs' Representative.
- B. Topsoil Type S2:
 - 1. Maximum 4 inches loose depth.
 - 2. Roll in areas where seeding is required with roller not exceeding 112 pounds.

END OF SECTION

SECTION 02222

EXCAVATING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removing existing pavement and associated aggregate base course and surface debris (including concrete) in preparation of remedial excavation and associated activities.
- B. Sediment and erosion control measures.
- C. Excavating contaminated soil from the former drum storage area, contaminated sludge, soil and debris associated with existing on-site dry wells, and trenches for conveyance of remedial systems piping.
- D. Impounding and bulking contaminated soil, and contaminated dry well sludge, soil and debris for transport to an offsite chemical waste landfill and coordinating the corresponding disposal.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals.
- B. Section 01400 - Quality Control: Control of installation for inspection of subgrade surfaces.
- C. Section 01500 - Construction Facilities and Temporary Controls: Water control.
- D. Section 01565 - Dust and VOC Control.
- E. Section 01600 - Material and Equipment: Procedures for submittals, Product delivery, storage and handling and Product substitutions and options.
- F. Section 02223 - Backfilling.
- G. Section 13050 - Soil Impoundment.

1.3 REFERENCES

- A. Occupational Health and Safety Administration (OSHA) Regulations.

- B. HASP - Health and Safety Plan (Appendix G of Soil Design Report).

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300, within 15 working days after Notice of Award or at least 15 working days prior to commencement of remediation, whichever occurs last.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver Products to, and store, protect and handle Products on site under provision of Section 01600.

1.6 FIELD MEASUREMENTS

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

PART 2 PRODUCTS

2.1 PLASTIC SHEETING

- A. Plastic sheeting to cover stockpiles or to cover the excavation shall consist either of 6 mil reinforced PE or 10 mil PVC; color shall be at discretion of the Contractor and as accepted by the PRPs' Representative.
- B. Manufacturer of and specific Product for the plastic sheeting shall be at discretion of the Contractor and as accepted by the PRPs' Representative.
- C. Substitutions shall be made under provisions of Section 01600.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to commencing remedial excavation, the Contractor shall make a careful examination of the site to clearly determine the nature and location of the required Work and to confirm the corresponding soil conditions.

3.2 PREPARATION

- A. Identify required lines, levels, contours and datum.

- B. Locate, identify, maintain, protect and support above- and below-grade utilities to remain from damage.
- C. Erosion control measures shall be installed prior to earthwork operations as shown on the Drawings, or, if not shown, as instructed by the PRPs' Representative. Hay bales or other approved erosion control measures shall be installed around all on-site dry wells to prevent sediment from entering those structures. Silt fencing shall be installed along the perimeter of the remediation area and the former drum storage area as indicated on Plate S-5. The Contractor shall be responsible for preventing sediment run-in to the excavation during precipitation events,
- D. Protect bench marks, existing structures, fences, sidewalks, paving and curbs to remain, from excavation equipment and vehicular traffic as designated on the Drawings or by the PRPs' Representative. Existing structures to remain shall include dry wells.
- E. Construct Soil Impoundment and personnel decontamination areas as shown on the Drawings and as instructed by the PRPs' Representative. Contractor will install and connect all of the vapor extraction system (VES) piping to be located along the bottom of the Impoundment prior to placing soil into the Impoundment. The VES piping to be located along the top of the Impoundment will be installed after all of the soil is placed inside of the Soil Impoundment. Exterior piping connections will be completed after all of the soil is placed inside of the Soil Impoundment.

3.3 EXCAVATION

- A. Excavate pavement, underlying aggregate base or subsoil, and surface debris, such as concrete, as required to accommodate site structures, remediation operations, or remediation systems piping. The depth of the excavation in the former drum storage area will be 4 ft below grade. Trenches will be excavated at the locations and to the depths as shown on the Drawings.
- B. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- C. Hand trim excavation. Remove loose matter.
- D. Notify PRPs' Representative of unexpected subsurface conditions encountered during excavating. Discontinue Work in affected area until notified by PRPs' Representative to resume work.
- E. Correct over-excavated areas in accordance with Section 02223.

- F. Stockpile uncontaminated, excavated pavement, underlying aggregate base and soils to height not exceeding 10 feet in on-site area designated by PRPs' Representative. Protect stockpiles from erosion by covering with plastic sheeting and by installing and maintaining perimeter ditches. Remove from site uncontaminated pavement, associated aggregate base materials, and soils not being reused after approval from the PRPs' Representative.

3.4 FIELD QUALITY CONTROL

- A. Field inspection will be completed under provisions of Section 01400.
- B. Provide for visual inspection of subgrade surfaces.
- C. Do not backfill excavated areas until the PRPs' Representative has issued instructions to proceed with backfilling.

3.5 PROTECTION

- A. Do not permit excavating to interfere with 45 degree bearing splay of building foundations.
- B. Protect bottom of excavations, and soil adjacent to and beneath existing foundations, from freezing.
- C. Ensure safe working conditions at all times in and around excavations and adequately mark and barricade excavations to protect pedestrian and vehicular traffic.

3.6 DECONTAMINATION

- A. All temporary protective structures placed during the Work will require subsequent decontamination prior to removal from the remediation area.
 - 1. All temporary protective structures installed in, and earthwork and associated equipment used for, the Work shall be decontaminated prior to removal from the remediation area. The aforementioned structures and equipment shall be steam cleaned until accepted by the PRPs' Representative. The Contractor shall collect, drum and coordinate, including with the PRPs' Representative, off-site disposal of the resulting rinsate at a regulated disposal facility.
 - 2. The surfaces of all protective structures installed during the Work shall be completely free of loose debris prior to removal from the remediation area. If required, or instructed by the PRPs' Representative, clean all subject surfaces by brushing and/or pressure washing. If pressure washing is required, the resulting rinsate will be handled and disposed of as describe above.

3. The exterior surfaces, including beds, cabs, tires and tractor treads, of all earthwork and associated equipment, including excavators, backhoes, trucks and front end loaders, shall be completely free of loose debris prior to removal from the remediation area. If required, or instructed by the PRPs' Representative, clean all subject surfaces by brushing and/or pressure washing. If pressure washing is required, the resulting rinsate will be handled and disposed of as describe above.

END OF SECTION

SECTION 02223

BACKFILLING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fill Materials.
- B. Preparation.
- C. Backfilling.
- D. Tolerances.
- E. Protection of Finished Work.

1.2 RELATED SECTIONS

- A. Section 01500 - Construction Facilities and Temporary Controls: Protection of finished Work.
- B. Section 02205 - Soil Materials.
- C. Section 02207 - Aggregate Materials.
- D. Section 02222 - Excavating.

1.3 REFERENCES

- A. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

- A. Subsoil Type S1 as specified in Section 02205.

- B. Plastic sheeting as specified in Section 02222.
- C. Sand Type S3 as specified in Section 02205.

PART 3 EXECUTION

3.1 PREPARATION

- A. Do not backfill areas excavated for soil remediation until the PRPs' Representative has issued instructions to proceed with backfilling.
- B. Rake the excavated area smooth and remove stone and other undesirable objects greater than 1 inch.
- C. Lay plastic sheeting on base of excavation before proceeding with the backfilling activities.

3.2 BACKFILLING

- A. Backfill and compact remediation areas in continuous lifts not exceeding 12 inches compacted depth.
- B. After the first lift has been placed and compacted, all SVE wells, AS wells and monitoring points will be drilled and associated piping will be installed.
- C. After all wells, monitoring points and piping are in place and the PRP's Representative has issued instructions to proceed, the excavated area will be backfilled to required contours and elevations.
- D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces. Do not use frozen backfill material.
- E. Subsoil Type S1: Place and compact materials in continuous layers not exceeding 12 inches compacted depth.
- F. Sand Type S3: Place and compact materials in continuous layers not to exceed 6 inches for the soil impoundment subbase. Place materials and compact at the surface for the drywells.
- G. Employ a placement method that does not disturb or damage other work.
- H. Maintain optimum moisture content of backfill materials to attain accepted compaction requirements. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.

- I. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
- J. Slope grade away from building minimum 2 inches in 10 ft, unless noted on the Drawings or instructed by the PRPs' Representative otherwise.
- K. Make gradual grade changes. Blend slope into level areas.
- L. Remove uncontaminated, surplus backfill materials from site.
- M. Leave fill material stockpile areas free of excess fill materials.

3.3 TOLERANCES

- A. Top Surface of Backfilling in Areas Excavated for Remediation, General Backfilling and Backfilling in Areas Receiving Aggregate Base Course for Bituminous Pavement: Plus or minus 1 inch from required elevations.

3.4 FIELD QUALITY CONTROL

- A. Field inspection, as applicable, will be completed under provisions of Section 01400.
- B. If Work does not meet the requirements specified in the Contract Documents, remove Work and replace until accepted by the PRPs' Representative, at no additional cost to PRPs'.

3.5 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01500.
- B. Reshape and re-compact fills subjected to vehicular traffic.
- C. Return to site within 3 months after backfill to fill and regrade areas that have settled.

3.6 SCHEDULE

- A. Backfill in Areas Excavated for Remediation, except in drywells, General Backfilling and Backfill in Areas Receiving Aggregate Base Course for Bituminous Pavement:
 - 1. Subsoil Type S1: maximum 12 inches compacted depth for each lift, compact until there is no further evidence of consolidation with minimum of two complete passes, and use of compaction equipment acceptable to the PRPS' REPRESENTATIVE.

B. Base for Soil Impoundment and Drywells:

1. Sand Type S3: compact until there is no further evidence of consolidation with minimum of two complete passes, and use of compaction equipment acceptable to the PRPS' REPRESENTATIVE.

END OF SECTION

SECTION 02225

TRENCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Soil-Vapor Extraction Piping.
- B. Air-Sparge Piping.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control.
- B. Section 01500 - Construction Facilities and Temporary Controls: Water control in excavations.
- C. Section 02205 - Soil Materials.
- D. Section 02207 - Aggregate Materials.
- E. Section 02211 - Rough Grading: Topsoil and subsoil removal from site surface.
- F. Section 02223 - Backfilling: General backfilling.
- G. Section 02229 - Rock Removal: Removal of rock during excavating.
- H. Section 03300 - Cast-in-Place Concrete: Concrete materials.
- I. Section 15410 - Plumbing Piping.
- J. Section 16111 - Conduit.
- K. Section 16123 - Building Wire and Cable.

1.3 REFERENCES

- A. ASTM D1785 - Poly (Vinyl Chloride) PVC Plastic Pipe, Schedules 40, 80 and 120.

1.4 COORDINATION

- A. Coordinate work under provisions of Section 01039.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Fill Type: As specified in Section 02205.

2.2 TRENCH PIPE MATERIALS

- A. Plastic Pipe (PVC): schedule 40, nominal diameter of 4-inch and 6-inch

2.3 ACCESSORIES

- A. Warning Tape: Yellow warning tape reading "Caution Buried Pipeline Below", having a thickness of 4 mils and a width of 6 inches. Emed Co., Inc. (Buffalo, New York), Model UT35279, or an approved equivalent.

PART 3 EXECUTION

3.1 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Protect plant life, lawns and other features remaining as a portion of final landscaping.
- C. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- D. Maintain and protect above and below grade utilities which are to remain.
- E. Saw cut pavement where present to width 1 foot greater than required trench width and centered on center line of trench.

- F. Cut out soft areas of subgrade not capable of compaction in place. Backfill and compact to density equal to or greater than requirements for subsequent backfill material.

3.2 EXCAVATING

- A. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
- B. Do not interfere with 45-degree bearing splay of foundations.
- C. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.
- D. Correct areas over excavated in accordance with Section 02222.

3.3 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

3.4 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Assurance: Field inspection and testing.

3.5 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01500.
- B. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.6 SCHEDULE

A. Soil-Vapor Extraction and Air-Sparge Piping:

1. Cover pipe and bedding with Fill Type S-1 in continuous layers not exceeding 12 inches compacted depth.

END OF SECTION

SECTION 02229
ROCK REMOVAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of discovered rock during excavation.
- B. Expansive tools to assist rock removal.

1.2 RELATED SECTIONS

- A. Section 02211 - Rough Grading.
- B. Section 02223 - Backfilling: Backfill materials.

1.3 DEFINITIONS

- A. Rock: Solid mineral material of a size that cannot be removed with a 3/4 cu yd capacity power shovel.

1.4 SUBMITTALS FOR REVIEW

- A. Section 01300 - Submittals: Procedures for submittals.

1.5 SCHEDULING

- A. Schedule work under the provisions of Section 01300.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions under provisions of Section 01039.

- B. Verify site conditions and note subsurface irregularities affecting work of this section.

3.2 PREPARATION

- A. Identify required lines, levels, contours and datum.

3.3 ROCK REMOVAL BY A MECHANICAL METHOD

- A. Excavate and remove rock by the mechanical method.
- B. Drill holes and utilize expansive tools to fracture rock.
- C. Cut away rock at bottom of excavation to form level bearing.
- D. Remove shaled layers to provide sound and unshattered base for foundations.
- E. Remove excavated materials from site.
- F. Correct unauthorized rock removal in accordance with backfilling and compacting requirements of Section 02223.

3.4 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Assurance: Field inspection.

END OF SECTION

SECTION 02231

AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aggregate base course for use under asphalt pavement.

1.2 RELATED SECTIONS

- A. Section 02207 - Aggregate Materials.
- B. Section 02223 - Backfilling.
- C. Section 02510 - Asphaltic Concrete Paving.

1.3 REFERENCES

- A. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Coarse Aggregate Type A1: As specified in Section 02207.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify substrate has been inspected, gradients and elevations are correct and substrate is dry.

3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping and re-compacting.

- B. Do not place fill on soft, muddy or frozen surfaces, or when air temperature is below 30 degrees F and not rising.

3.3 AGGREGATE PLACEMENT

- A. Spread aggregate over prepared substrate to a total thickness of 6 inches.
- B. Place aggregate in two layers of approximate equal thicknesses and compact each layer to specified requirements.
- C. Level and grade surfaces to elevations and gradients shown on the Drawings.
- D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- E. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

- A. Scheduled Compacted Thickness: Within 1/4 inch.
- B. Variation From Design Elevation: Within 1/2 inch.

3.5 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Assurance: Field inspection.
- B. If Work does not meet the requirements specified in the Contract Documents, remove and replace Work until accepted by the PRPs' Representative, at no additional cost to PRPs.

3.6 SCHEDULES

- A. Under Asphalt Pavement:
 - 1. Compact placed aggregate materials with minimum of four complete passes with compaction equipment acceptable to the PRPs' Representative.

END OF SECTION

SECTION 02510

ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Asphaltic concrete paving, wearing course.
- B. Tack coat.

1.2 RELATED SECTIONS

- A. Section 01039 - Coordination and Meetings.
- B. Section 01400 - Quality Control.
- C. Section 01600 - Material and Equipment.
- D. Section 02211 - Rough Grading.
- E. Section 02231 - Aggregate Base Course: Coarse Aggregate Type A1 for base course.

1.3 REFERENCES

- A. TAI - (The Asphalt Institute) - MS-2 Mix Design Methods for Asphalt Concrete and Other Hot Mix Types.
- B. TAI - (The Asphalt Institute) - MS-3 Asphalt Plant Manual.
- C. TAI - (The Asphalt Institute) - MS-19 Basic Asphalt Emulsion Manual.

1.4 PERFORMANCE REQUIREMENTS

- A. Paving: Designed for parking and movement of heavy commercial vehicles.

1.5 QUALITY ASSURANCE

- A. Mixing Plant: Conform to TAI Manual MS-3.

- B. Obtain materials from same source throughout.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not place asphalt when the ambient temperature of the air in the shade, or of the base surface, is less than 50 degrees F, or base surfaces are wet or frozen.
- B. Place bitumen mixture when temperature is not more than 15 F degrees below bitumen suppliers bill of lading and not more than maximum specified temperature.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Manufacturer of and specific product for asphalt cement, aggregate for wearing course mix, fine aggregate, mineral filler and other materials required for the asphaltic concrete wearing course described in this Section shall be at the discretion of the Contractor and as approved by the PRPs' Representative.
- B. Tack Coat: Homogeneous, medium curing liquid asphalt.
- C. Substitutions: Under provisions of Section 01600.

2.2 ASPHALT PAVING MIX

- A. Use dry material to avoid foaming. Mix uniformly.
- B. Wearing Course: 5 to 7 percent of asphalt cement by weight in mixture in accordance with TAI MS-2.

2.3 SOURCE QUALITY CONTROL AND TESTS

- A. Section 01400 - Quality Control: Provide mix design for asphalt.
- B. Submit proposed mix design for review prior to beginning of work and at least 30 days prior to delivery of material to site.

- C. Test samples in accordance with TAI MS-2.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify base conditions under provisions of Section 01039.
- B. Verify that the prepared (scarified, graded and compacted) subgrade is dry and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.

3.2 AGGREGATE BASE COURSE

- A. Section 02231 - Aggregate Base Course forms the base construction for work of this Section.

3.3 PREPARATION - TACK COAT

- A. Apply bituminous tack coat to surface of the existing asphalt that is cut back, in accordance with manufacturer's instructions or, if instructions are not available, MS-19.
- B. Apply tack coat to contact surfaces of curbs and gutters.
- C. Coat surfaces of dry well and catch basin frames, as applicable, with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.4 PLACING ASPHALT PAVEMENT - SINGLE COURSE

- A. Place asphalt on same work day when tack coat was applied.
- B. Place to compacted thickness identified in schedule at end of Section.
- C. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- D. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.5 TOLERANCES

- A. Flatness: Maximum variation of 3/16 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation from True Elevation: Within 1/2 inch.

3.6 FIELD QUALITY CONTROL

- A. Field inspection and testing, as applicable, will be performed under provisions of Section 01400.
- B. Collect samples and perform tests in accordance with TAI MS-2 to determine compliance with accepted job mix formula.
- C. If Work does not meet the requirements specified in the Contract Documents, remove Work and replace until accepted by the PRPs' Representative, at no additional cost to PRPs.

3.7 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 1 day or until surface temperature is less than 140 degrees F.

3.8 SCHEDULES

- A. Pavement at Parking Areas: Single wearing course of 2-inch compacted thickness, bituminous tack coat on surface of existing asphalt that is cut back and contact surfaces of curbs and gutters.

END OF SECTION

SECTION 02670

WELLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Soil Vapor Extraction Wells.
- B. Air Sparge Wells.
- C. Vapor Monitor Points.
- D. Ground Water Monitor Points.

1.2 RELATED SECTIONS

- A. Section 01039 - Coordination and Meetings.
- B. Section 01600 - Material and Equipment.
- C. Section 01700 - Contract Closeout.
- D. Section 02227 - Waste Disposal.
- E. Section 03300 - Cast-in-Place Concrete.

1.3 REFERENCES

- A. New York State of Regulations Governing the Construction and Use of Wells.
- B. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- C. ASTM D1586 - Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.
- D. ASTM F480 - Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR, SCH 40 and SCH 80).

1.4 REGULATORY REQUIREMENTS

- A. Conform to applicable New York State code and regulations for Work of this section.
- B. Drilling Firm: Company specializing in performing the work of this section with supervising personnel licensed in the New York State to install wells.

1.5 SUBMITTALS FOR INFORMATION

- A. Section 01300 - Submittals: Procedures for Submittals.
- B. Well permits issued by New York State for a minimum of 25 wells.

1.6 SUBMITTALS FOR REVIEW

- A. Section 01300 - Submittals: Procedures for submittals.
- B. Certification that field personnel have been trained in the proper use of protective equipment and clothing in accordance with 29 CFR Part 1910.

1.7 SUBMITTALS AT PROJECT CLOSEOUT

- A. Section 01700 - Contract Closeout: Procedures for submittals.
- B. Accurately record actual locations of well, depth, subsoil strata, and drilling difficulties encountered.
- C. Submit signed copy of driller's log book statements.
- D. Copies of well completion reports. Submit reports to the PRPs' Representative within 30 days of completion.

1.8 JOB CONDITIONS

- A. Conduct work in accordance with OSHA standards including training of personnel.
- B. Clear utilities under provisions of Section 01700.
- C. Provide and maintain necessary lighting, barriers, warning signs and devices, and temporary walkways to assure public safety.

- D. Provide adequate safeguards to protect surrounding properties and improvements from damage resulting from the Work.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01600.

PART 2 PRODUCTS

2.1 WELL MATERIALS

- A. Riser Pipe: ASTM D1785, Schedule 40 PVC.
 - 1. Joints: ASTM F480
 - a) Flush joint thread.
 - b) One Buna "O" Ring for each connection.
- B. Screen: ASTM D1785, Schedule 40 PVC.
 - 1. Joints: ASTM F480
 - a) Flush joint thread.
 - b) One Buna "O" Ring for each connection.
 - 2. Slot Size: 0.020 in. (20-slot).
- C. Filter Pack
 - 1. Manufacturers:
 - a) Morie Company, Inc. (Millville, NJ) Morie No. 1.
 - b) Substitutions: Under provisions of Section 01600.
 - 2. Description: Meets AWWA B-100-89 specifications.
- D. Annular sealants used to seal the annulus may be prepared in slurry or used, un-mixed in a dry pellet, granular, or chip form. Sealants selected must meet all applicable New York State codes and achieve a permeability of 1×10^{-7} centimeters per second or less.
 - 1. Manufacturers:
 - a) CETCO, (Arlington Heights, IL) PureGold Medium Chips and Grout.
 - b) Substitutions: Under provisions of Section 01600.
 - 2. Description: A blend of pure, dried bentonite clay without polymers or organic additives used for sealing of the annular space of monitoring and product recovery wells to control contaminate infiltration and preserve ambient water quality.

- E. Extra Materials: Have on-hand enough of the following materials to substitute for the specified materials should site conditions require substitutions.
 - 1. Filter Pack: 40-60 mesh.

2.2 WELL HEADS

- A. Curb Box
 - 1. Manufacturers: Universal Valve Co., Inc. (Elizabeth, NJ).
 - 2. Description: Flush mount, cast iron curb box with water-tight bolttable cover. Limited access curb box.
- B. Well Cap
 - 1. Manufacturer:
 - a) Longyear Company (Stone Mountain, GA), Model TC-294.
 - b) Substitutions: Under provisions of Section 01600.
 - 2. Description: 2 piece brass and aluminum locking and leak resistant well cap. Cover clearly marked with monitor well warning symbol and labeled "Test Well - No Fill".

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify site conditions under provisions of Section 01039.

3.2 WELL LOCATION

- A. Advance borings at locations indicated on the Drawings. Advance borings at additional or other locations if directed by the PRPs' Representative.

3.3 BOREHOLE ADVANCEMENT

- A. Utilize the hollow-stem auger method.
- B. Complete boring logs which document:
 - 1. The well location.
 - 2. Geotechnical (penetration, blow counts)
 - 3. Descriptive information for each material identified in the borehole either by symbol or word description, or both.
 - 4. Dimensions and materials of the completed well.

- C. Drum soil cuttings and prepare for disposal under provisions of Section 02100.
- D. Abandon all boreholes not completed as wells in accordance with New York State code.
- E. Patch pavement over abandoned boreholes with bituminous asphalt patch.

3.4 SOIL SAMPLING

- A. Collect continuous split-spoon samples for SVE and air sparge wells in accordance with ASTM D1586. Provide at least four samplers.
- B. Provide PRPs' Representative with unopened sampler for sampling and logging.

3.5 DECONTAMINATION

- A. Decontaminate all down-hole equipment between borings with a steam cleaner or pressure washer.
- B. Decontaminate all sampling equipment before each use with a brush and Alconox solution followed by a distilled water rinse.
- C. Contain and drum all wash fluids.
- D. Dispose of drummed waste under provisions of Section 02100.

3.6 WELL COMPLETION

- A. Install wells as indicated in the drawings in accordance with all New York State code regarding water well installation.
- B. Clean all well materials to remove cutting fluids and potential contaminants prior to installation.
- C. Saw cut pavement in straight lines.
- D. Do not allow saw cuts to cross so that pavement adjoining the excavation is damaged. Hand chisel corners where saw cuts meet.

3.7 WELL DEVELOPMENT

- A. Develop air sparge wells and ground water monitor points in accordance with New York State regulations regarding water well installation by surging and purging well until water sediment-free water is obtained. At a minimum, purge 10 well volumes and develop for at least 45 minutes per well.
- B. Drum and dispose of development water under provisions of Section 02100.

3.8 FINAL CLEANING

- A. Clean Work under provisions of Section 01700.

3.9 SCHEDULES

- A. Auger Diameter Schedule
 - 1. Soil Vapor Extraction Wells: 6.25 inch ID minimum.
 - 2. Air sparge, vapor monitor and ground water monitor points: 4.25 inch ID minimum.
- B. Curb Box Schedule
 - 1. Manufacturer:
 - a. Universal Valve Co., Inc.
 - b. Model No. 62-8075.

END OF SECTION

SECTION 02831

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fence framework, fabric and accessories.
- B. Excavation for post bases; concrete foundation for posts, and center drop for gates.
- C. Manual gates and related hardware.

1.2 REFERENCES

- A. ASTM A116 - Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric.
- B. ASTM A121 - Zinc-Coated (Galvanized) Steel Barbed Wire.
- C. ASTM A392 - Zinc-Coated Steel Chain-Link Fence Fabric.
- D. ASTM A428 - Weight of Coating on Aluminum-Coated Iron or Steel Articles.
- E. ASTM A446 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
- F. ASTM A491 - Aluminum-Coated Steel Chain Link Fence Fabric.
- G. ASTM A569 - Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip Commercial Quality.
- H. ASTM A585 - Aluminum Coated Steel Barbed Wire.
- I. ASTM C94 - Ready-mixed Concrete.
- J. ASTM F567 - Installation of Chain-Link Fence.
- K. ASTM F573 - Residential Zinc-Coated Steel Chain Link Fence Fabric.

L. ASTM F668 - Poly (Vinyl Chloride) (PVC) Coated Steel Chain Link Fence Fabric.

M. ASTM F669 - Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence.

N. ASTM F1083 - Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.

O. ASTM F1234 - Protective Coatings on Steel Framework for Fences.

P. Chain Link Fence Manufacturers Institute (CLFMI) - Product Manual.

1.3 SYSTEM DESCRIPTION

A. Fence Height: 8 feet or 10 feet as indicated on Plate S-5.

B. Line Post Spacing: At intervals not exceeding 10 feet.

C. Fence Post and Rail Strength: Conform to ASTM F669 Heavy Industrial Fence quality.

1.4 SUBMITTALS FOR REVIEW

A. Section 01300 - Submittals: Procedures for submittals.

B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.

C. Shop Drawings: Indicate plan layout, spacing of components, dimensions of post foundation where needed, hardware anchorage and schedule of components.

1.5 SUBMITTALS FOR INFORMATION

A. Section 01300 - Submittals: Procedures for submittals.

B. Manufacturer's Installation Instructions: Indicate installation requirements, post foundation anchor bolt templates.

1.6 SUBMITTALS FOR CLOSEOUT

A. Section 01700 - Contract Closeout.

B. Section 01730 - Operation and Maintenance Data.

- C. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.

1.7 QUALITY ASSURANCE

- A. Complete Work in accordance with manufacturer's instructions.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Framing (Steel): ASTM F1083 Schedule 40 galvanized steel pipe, welded construction, minimum yield strength of 25 ksi; coating conforming to ASTM F1234 Type A on pipe exterior and interior.
- B. Fabric Wire (Steel): ASTM A116 galvanized wire.
- C. Barbed Wire: ASTM A121 galvanized steel; 12 gage thick wire, 3 strands, 4 points at 3 inch (75 mm) oc.

2.2 COMPONENTS

- A. Line Posts: 2.38 inch diameter.
- B. Corner and Terminal Posts: 3.5 inch.
- C. Gate Posts: 4.5 inch diameter.
- D. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
- E. Gate Frame: 1.66 inch diameter for fittings and truss rod fabrication.

- F. Gates and Openings: Large enough to allow the proposed heavy equipment and vehicular traffic to pass through.
- G. Fabric: 2 inch diamond mesh interwoven wire, 6 gage thick, top salvage twisted tight, bottom selva twisted tight.

2.3 ACCESSORIES

- A. Caps: Aluminum alloy; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.
- C. Extension Arms: Cast steel galvanized, to accommodate 3 strands of barbed wire, single arm, vertical.
- D. Gate Hardware: Center gate stop and drop rod ; two 180 degree gate hinges per leaf and hardware for padlock.
- E. Privacy Slats: Vinyl coated fabric strips, sized to fit fabric weave.

2.4 FINISHES

- A. Components and Fabric: Galvanized to ASTM A123; 1.8 oz/sq ft coating.
- B. Vinyl Components: as selected.
- C. Hardware: Galvanized to ASTM A153, 1.8 oz/sq ft coating.
- D. Accessories: Same finish as framing.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install framework, privacy slats, accessories and gates in accordance with manufacturer's instructions at locations shown in the Drawings.
- B. Set gate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
- C. Line Post Footing Depth Below Finish Grade: ASTM F567.

- D. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.
- E. Brace each gate and corner post to adjacent line post with horizontal center brace rail. Install brace rail one bay from end and gate posts.
- F. Provide top rail through line post tops and splice with 6 inch long rail sleeves.
- G. Install brace rail on corner gate leaves.
- H. Do not stretch fabric until concrete foundation has cured 28 days.
- I. Install support arms sloped outward and attach barbed wire; tension and secure.
- J. Do not attach the hinged side of gate from building wall; provide gate posts.
- K. Install gate and barbed wire overhang to match fence. Install three hinges per leaf, latch, catches, drop bolt with locks.

3.2 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From True Position: 1 inch.

END OF SECTION

SECTION 02936

SEEDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Placing topsoil.
- C. Fertilizing.
- D. Seeding.
- E. Maintenance.

1.2 RELATED SECTIONS

- A. Section 01039 - Coordination and Meetings.
- B. Section 01600 - Material and Equipment: Delivery, storage and handling of Products, and manufacturer and Product options and substitutions.
- C. Section 02205 - Soil Materials: Topsoil material.
- D. Section 02211 - Rough Grading.
- E. Section 02223 - Backfilling.

1.3 DEFINITIONS

- A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel and Brome Grass.

1.4 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging and location of packaging.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver grass seed mixture in sealed containers. Seed delivered in damaged packaging will not be acceptable.
- B. Deliver fertilizer to site in waterproof bags with labels showing weight, chemical analysis and name of manufacturer.

1.6 COORDINATION

- A. Coordinate work under provisions of Section 01039.

PART 2 PRODUCTS

2.1 SEED SUPPLIERS AND MIXTURE

- A. Seed Mixture:
 - 1. Norlea Perennial Rye: 50-60 percent.
 - 2. Creeping Red Fescue: 20-40 percent.
 - 3. Clover: 10-20 percent.

2.2 SOIL MATERIALS

- A. Topsoil: As specified in Section 02205.

2.3 ACCESSORIES

- A. Mulching Material: Oat or wheat straw, free from weeds and foreign matter detrimental to plant life and in a dry condition. Chopped cornstalks are not acceptable.
- B. Fertilizer: Sum of nitrogen, phosphoric acid and potash shall not be less than 32 percent; and total nitrogen shall not be less than the sum of the phosphoric acid and soluble potash.
- C. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this Section.

3.2 PREPARATION OF SUBSOIL

- A. Prepare subsoil to eliminate uneven areas and low spots in areas to be restored as lawn as indicated on Plate S-9. Maintain lines, levels, profiles and contours to existing contours of the surrounding areas. Make gradual changes in grade. Blend slopes into level areas.
- B. Remove foreign materials, weeds and undesirable plants and their roots.
- C. Scarify subsoil to a depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted the subsoil.

3.3 PLACING TOPSOIL

- A. Spread topsoil to a minimum loose depth of 6 inches over area to be seeded. Rake until smooth.
- B. Place topsoil during dry weather and on dry, unfrozen subgrade.
- C. Remove vegetable matter and foreign, non-organic material from topsoil while spreading.
- D. Grade topsoil to eliminate rough, low or soft areas and to ensure positive drainage.
- E. Install protection at periphery of seeded areas.

3.4 FERTILIZING

- A. When fertilizer having a sum of nitrogen, phosphoric acid and potash greater than 32 percent is used for the work of this section, apply at a rate which shall provide equivalent amounts of these nutrients.
- B. Apply after smooth raking of topsoil and prior to seeding and roller compaction.
- C. When fertilizer is incorporated with topsoil areas, apply just prior to and in conjunction with final discing or harrowing operations.

- D. In the event that the topsoil is manipulated by hand, apply fertilizer just prior to the final raking and leveling.
- E. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- F. Mix thoroughly into upper 2 inches of topsoil.
- G. Lightly water to aid the dissipation of fertilizer.

3.5 SEEDING

- A. Apply seed at a rate of 10 lbs per 1,000 sq ft evenly in two intersecting directions. Rake in lightly.
- B. Planting Season: April through September.
- C. Do not sow immediately following rain, when ground is too dry, or during windy periods.
- D. Roll seeded area with roller not exceeding 112 lbs.
- E. Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.
- F. Apply water with a fine spray immediately after each area has been mulched. Saturate upper 4 inches of soil.
- G. Identify seeded areas with stakes and string around peripheries.

3.6 MAINTENANCE SERVICE

- A. Provide maintenance service of seeded areas immediately after placement and until grass is well established and exhibits a vigorous growing condition. A minimum of two mowings will be completed by the Contractor, if necessary, to demonstrate a stand of grass.
- B. Protect seeded areas with warning signs.
- C. Immediately reseed areas with bare spots.

END OF SECTION

SECTION 02950

TREES, PLANTS, AND GROUND COVER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance.
- C. Regulatory requirements.
- D. Delivery, storage and handling.
- E. Environmental requirements.
- F. Coordination.
- G. Warranty.
- H. Maintenance service.
- I. Trees.
- J. Soil materials.
- K. Mulch materials.
- L. Accessories.
- M. Topsoil mix.
- N. Preparation of subsoil.
- O. Placing topsoil.
- P. Fertilizing.
- Q. Planting.

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R. Plant support.

S. Field quality control.

1.2 RELATED SECTIONS

A. Section 02205 - Soil Materials: Topsoil material.

B. Section 02223 - Backfilling: Rough grading of site.

C. Section 02225 - Trenching: Rough grading over trench cut.

D. Section 02923 - Landscape Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this Section.

E. Section 02936 - Seeding.

1.3 REFERENCES

A. ANSI Z60.1 - Nursery Stock.

1.4 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

B. Plants: Living trees, plants, and ground cover specified in this Section.

1.5 SUBMITTALS - PROJECT CLOSEOUT

A. Section 01700 - Contract Closeout: 01730 - Operation and Maintenance Data: Procedures for submittals.

B. Maintenance Data: Include cutting and trimming method; types, application frequency, and recommended coverage of fertilizer.

C. Submit list of plant life sources.

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1.6 QUALITY ASSURANCE

- A. Nursery Qualifications: Company specializing in growing and cultivating the plants with three years documented experience.
- B. Installer Qualifications: Company specializing in installing and planting the plants with three years documented experience.
- C. Maintenance Services: Performed by installer.

1.7 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of plants, fertilizer and herbicide mixture.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01600 - Material and Equipment: Transport, handle, store and protect products.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- C. Protect and maintain plant life until planted.
- D. Deliver plant life materials immediately prior to placement. Keep plants moist.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not install plant life when ambient temperatures may drop below 35 degrees F (2 degrees C) or rise above 90 degrees F (32 degrees C).
- B. Do not install plant life when wind velocity exceeds 30 mph (48 k/hr).

1.10 COORDINATION

- A. Coordinate work under provisions of Section 01039.

1.11 WARRANTY

- A. Provide one year warranty under provisions of Section 01700.
- B. Warranty: Include coverage for one continuous growing season; replace dead or unhealthy plants.
- C. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

1.12 MAINTENANCE SERVICE

- A. Maintain plant life for three months after Date of Substantial Completion.
- B. Maintain plant life immediately after placement until plants are well established and exhibit a vigorous growing condition. Continue maintenance until termination of warranty period.
- C. Maintenance to include:
 - 1. Cultivation and weeding tree beds.
 - 2. Irrigating sufficient to saturate root system.
 - 3. Pruning, including removal of dead or broken branches, and treatment of pruned areas or other wounds.
 - 4. Disease control.
 - 5. Maintaining wrapping, guys, and stakes. Adjust turnbuckles to keep guy wires tight.
 - 6. Replacement of mulch.

PART 2 PRODUCTS

2.1 TREES

- A. Trees:
 - 1. Douglas Fir: 5 to 6 feet in height and balled and burlapped for delivery.

2.2 SOIL MATERIALS

- A. Topsoil Type S2: As specified in Section 02205.

2.3 SOIL AMENDMENT MATERIALS

- A. Fertilizer: As specified by the nursery.

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- B. Peat Moss or Manure: As specified by the nursery.
- C. Water: Clean, fresh, and free of substances or matter which could inhibit vigorous growth of plants.

2.4 MULCH MATERIALS

- A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

2.5 ACCESSORIES

- A. Wrapping Materials: Burlap.
- B. Stakes: Softwood lumber, pointed end.
- C. Cable, Wire, Eye bolts and Turnbuckles: Non-corrosive, of sufficient strength to withstand wind pressure and resulting movement of plant life.
- D. Plant Protectors: Rubber sleeves over cable to protect plant trunks.

2.6 TOP SOIL MIX

- A. Mixture of Peat or Manure and topsoil as specified by the nursery or manufactures specifications.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that prepared subsoil is ready to receive work.
- B. Saturate soil with water to test drainage.

3.2 PREPARATION OF SUBSOIL

- A. Dig pits and beds 6 inches larger than tree root system at locations within area to be restored with trees as indicated on Plate S-9.
- B. Remove foreign materials, weeds and undesirable plants and their roots.

3.3 PLACING TOPSOIL

- A. Install topsoil into pits and beds intended for tree root balls, to a minimum thickness of 6 inches.

3.4 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions.
- B. Apply after initial raking of topsoil.
- C. Mix thoroughly into upper 2 inches of topsoil.
- D. Lightly water to aid the dissipation of fertilizer.

3.5 PLANTING

- A. Place tree along property boundary as indicated on Plate S-9 to ensure adequate screening between the property boundaries. Trees should be spaced no more than 4 feet apart from trunk to trunk.
- B. Set trees in pits or beds, partly filled with prepared topsoil mix, at a minimum depth of 6 inches under each tree. Remove burlap, ropes, and wires, from the root ball.
- C. Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6 inch layers. Maintain plant life in vertical position.
- D. Saturate soil with water when the pit or bed is half full of topsoil.
- E. Immediately following placement of topsoil to the top of the bed, apply mulch to a thickness of 1/8 inch.
- F. Saturate soil immediately after each tree bed has been mulched.

3.6 PLANT SUPPORT

- A. Brace plants vertically with plant protector wrapped guy wires and stakes to the following:

Tree Caliper	Tree Support Method
Over 4 inches	4 guy wires with eye bolts and turn buckles
4-inches or smaller	3 guy wires to stakes

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3.7 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Assurance: Field inspection and testing.
- B. Plants will be rejected if a ball of earth surrounding roots has been disturbed or damaged prior to or during planting.

3.8 MAINTENANCE

- A. Water to prevent soil from drying out.
- B. Control growth of weeds around tree beds.

END OF SECTION

DIVISION 3 - CONCRETE

SECTION 03100
CONCRETE FORMWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Formwork for cast-in place concrete.
- B. Form stripping.

1.2 RELATED SECTIONS

- A. Section 03300 - Cast-in-Place Concrete.

1.3 REFERENCES

- A. ACI 301 - Structural Concrete for Buildings.
- B. ACI 347 - Recommended Practice For Concrete Formwork.

1.4 DESIGN REQUIREMENTS

- A. Engineer and construct formwork and bracing to conform to design and code requirements; resultant concrete to conform to required shape, line and dimension as shown on Drawings.

1.5 SUBMITTALS FOR REVIEW

- A. Section 01300 - Submittals: Procedures for submittals.

1.6 QUALITY ASSURANCE

- A. Conduct Work in accordance with ACI 347.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for design, fabrication, erection and removal of formwork.

1.8 DELIVERY, STORAGE AND PROTECTION

- A. Section 01600 - Material and Equipment.
- B. Deliver forms and installation instructions in manufacturer's packaging.
- C. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

- A. Form Materials: At the discretion of the Contractor.

2.2 FORMWORK ACCESSORIES

- A. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.2 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping.
- D. Align joints and make watertight. Keep form joints to a minimum.

3.3 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 301.

3.4 FIELD QUALITY CONTROL

- A. Section 01400 - Quality Control.
- B. Inspect erected formwork, shoring and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties and items are secure.

3.5 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Loosen forms carefully.

3.6 SCHEDULE

- A. Slab on grade for support of vapor carbon units, 6 ft by 14 ft by 6 in with 6 x 6-D4D4 WWF reinforcement.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Slabs on grade.

1.2 RELATED SECTIONS

- A. Section 03100 - Concrete Formwork.
- B. Section 03370 - Concrete Curing.

1.3 REFERENCES

- A. ACI 211.1 - Selecting Proportions for Normal, Heavyweight and Mass Concrete.
- B. ACI 211.2 - Selecting Proportions for Structural Lightweight Concrete.
- C. ACI 301 - Structural Concrete for Buildings.
- D. ACI 302 - Guide for Concrete Floor and Slab Construction.
- E. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- F. ACI 308 - Standard Practice for Curing Concrete.
- G. ASTM C33 - Concrete Aggregates.
- H. ASTM C94 - Ready-Mixed Concrete.
- I. ASTM C150 - Portland Cement.

1.4 SUBMITTALS FOR REVIEW

- A. Section 01300 - Submittals: Procedures for submittals.

1.5 SUBMITTALS FOR INFORMATION

- A. Section 01300 - Submittals: Procedures for submittals.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

- A. Accurately record actual locations of embedded utilities and components which are concealed from view.

1.7 QUALITY ASSURANCE

- A. Acquire cement and aggregate from same source for all work.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I - Normal, Portland type.
- B. Fine and Coarse Aggregates: ASTM C33.
- C. Water: Clean and not detrimental to concrete.

2.2 CONCRETE MIX

- A. Mix and deliver concrete in accordance with ASTM C94, Alternative No. 2.
- B. Provide concrete to the following criteria:

<u>Unit</u>	<u>Measurement</u>
Compressive Strength (28 day)	3,000psi
Aggregate Size (maximum)	3/4 inch
Aggregate Size (minimum)	1/4 inch
Slump - Plus or minus 1 inch	5 inches

- C. Use accelerating admixtures in cold weather only when approved by the PRPs' Representative. Use of admixtures will not relax cold weather placement requirements.
- D. Use set retarding admixtures during hot weather only when approved by the PRPs' Representative.

2.3 Reinforcing Steel

- A. Welded wire mesh: WWF 6x6 - D4D4

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions under provisions of Section 01039.

3.2 PREPARATION

- A. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304.
- B. Notify PRPs' Representative minimum 24 hours prior to commencement of operations.
- C. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.
- D. Place concrete continuously between predetermined expansion, control and construction joints.
- E. Do not interrupt successive placement; do not permit cold joints to occur.
- F. Screed slabs on grade as shown on drawings, maintaining a minimum 6-inch slab thickness with wire mesh set 2 inches from the bottom.

3.4 CONCRETE FINISHING

- A. Provide formed concrete surfaces to be left exposed with smooth rubbed finished.
- B. Finish concrete floor surfaces in accordance with ACI 301.
- C. Steel trowel surfaces which are scheduled to be exposed.

3.5 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Cure concrete floor surfaces to requirements of Section 03370.

3.6 FIELD QUALITY CONTROL

- A. Tests of slump cement and aggregates may be conducted to ensure conformance with specified requirements.

3.7 PATCHING

- A. Allow PRPs' Representative to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify PRPs' Representative upon discovery.
- C. Patch imperfections as directed.

3.8 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by the PRPs' Representative.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of PRPs' Representative for each individual area.

3.9 SCHEDULE - CONCRETE TYPES AND FINISHES

- A. Slab for carbon units: 3,000 psi 28 day concrete, broom finish to top surface, strike all top edges, at locations shown on Drawings.

END OF SECTION

SECTION 03370
CONCRETE CURING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Initial and final curing of horizontal concrete surfaces.

1.2 RELATED SECTIONS

- A. Section 03300 - Cast-In-Place Concrete.

1.3 REFERENCES

- A. ACI 302 - Recommended Practice for Concrete Floor and Slab Construction.
- B. ACI 308 - Standard Practice for Curing Concrete.
- C. ASTM C171 - Sheet Materials for Curing Concrete.
- D. ASTM D2103 - Polyethylene Film and Sheeting.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.

1.5 QUALITY ASSURANCE

- A. Conduct Work in accordance with ACI 302.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products under provisions of Section 01600.
- B. Deliver curing materials in manufacturer's packaging including application instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Polyethylene Film Type D: ASTM C171, ASTM D2103, 4 mil (0.1 mm) thick, white opaque color.
- B. Water: Potable, not detrimental to concrete.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify substrate conditions under provisions of Section 01039.
- B. Verify that substrate surfaces are ready to be cured.

3.2 EXECUTION - HORIZONTAL SURFACES

- A. Cure floor surfaces in accordance with ACI 308.
- B. Polyethylene Film: As soon as the concrete has hardened sufficiently to prevent surface damage, spread over floor slab areas, lap edges and sides, maintain in place for 7 days.

3.3 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01500.
- B. Do not permit traffic over unprotected surface.

END OF SECTION

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13050

SOIL IMPOUNDMENT STRUCTURE

PART 1 GENERAL

This section covers the soil impoundment structure construction. The Contractor is responsible for installation, start-up and confirming that the vapor-extraction equipment and the impoundment are functional. The PRPs' Representative is responsible for operational monitoring of the impoundment.

1.1 SECTION INCLUDES

- A. Liner.
- B. Cover.
- C. Concrete Blocks.
- D. Fasteners.
- E. Sand.
- F. Grommets.

1.2 REFERENCES

- A. Section 01090 - Reference Standards.
- B. Section 01400 - Quality Control.
- C. Section 01600 - Material and Equipment.
- D. Section 02205 - Soil Materials.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01300 - Submittals.
- B. Manufacturer's Installation Instructions.

1.4 QUALITY ASSURANCE

- A. Conduct work in accordance with manufacturer's instructions.

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1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 DELIVERY AND HANDLING

- A. Conduct in accordance with Section 01600.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Liner Manufacturer.
 - 1. National Seal Company - 40 mil High Density Polyethylene (HDPE) Geomembrane.
 - 2. Substitutions: Refer to Section 01600.
- B. Cover Manufacturer.
 - 1. Reef Industries, Inc.: Permalon X-210 Alloyed HDPE Membrane.
 - 2. Substitutions: Refer to Section 01600.
- C. Concrete Blocks.
 - 1. Suffolk Cement Products.

2.2 MATERIALS

- A. Liner: 40 mil HDPE Geomembrane.
- B. Cover: Alloyed 18 mil HDPE membrane.
- C. Blocks: Concrete blocks free of debris and of standard dimensions as shown on Drawings.
- D. Fasteners: As shown on Drawings.
- E. Soil Base: Subsoil Type S3 as specified in Section 02205.
- F. Grommet eye hooks.

PART 3 EXECUTION

3.1 INSTALLATION

A. Liner.

1. Earthwork.

- a. Surfaces to be lined shall be smooth and free of debris, roots and angular or sharp rocks. All fill shall consist of well-graded material, free of organics, trash, clayballs or other deleterious material that may cause damage to the geomembrane. The upper six inches (6") of the finished subgrade shall not contain stones or debris larger than one-half inch (1/2"). The subgrade shall be compacted to provide a firm, unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the subgrade without causing rutting or other deleterious effects. The subgrade shall have no sudden sharp or abrupt changes in grade.
- b. Protect the subgrade from desiccation, flooding and freezing. Protection, if required, may consist of a thin plastic protective cover (or other material as approved by the PRPs' Representative) installed over the completed subgrade until such time as the placement of geomembrane liner begins. Subgrades found to have cracks greater than one-half inch (1/2") in width or depth, or which exhibit swelling, heaving, or other similar conditions shall be replaced or reworked by the Contractor to remove these defects.

2. Field panel placement.

- a. Geomembrane deployment will generally not be done during any precipitation, in the presence of excessive moisture (i.e., fog, dew), in an area of standing water, or during high winds.
- b. The method and equipment used to deploy the panels must not damage the geomembrane or the supporting subgrade surface.
- c. No personnel working on the geomembrane will wear shoes that can damage the geomembrane or engage in actions which could result in damage to the geomembrane.
- d. Adequate temporary loading and/or anchoring (i.e., sandbags, tires), which will not damage the geomembrane, will be placed to prevent uplift of the geomembrane by wind.
- e. The geomembrane will be deployed in a manner to minimize wrinkles.
- f. Any area of a panel seriously damaged (torn, twisted or crimped) will be marked and repaired in accordance with Paragraph 3.3 of this section.

3. Geomembrane field seaming.

- a. In general, seams shall be oriented parallel to the slope, i.e., oriented along, not across the slope. Whenever possible, horizontal seams should be located on the base of the cell, not less than five (5') feet from the toe of the slope. Each seam made in the field shall be numbered and indicated on the record drawings. Seaming information to include seam number, welder ID, machine number, temperature setting and weather conditions.
- b. All personnel conducting seaming operations shall be trained in the operation of the specific seaming equipment being used and will qualify by successfully welding a test seam as described in Paragraph 3.1.A.3.c.
- c. Liner shall be attached to concrete blocks as shown on drawings.
- d. Fusion welding consists of placing a heated wedge, mounted on self-propelled vehicular unit, between two (2) overlapped sheets such that the surface of both sheets are heated above the polyethylene's melting point. After being heated by the wedge, the overlapped panels pass through a set of pre-set pressure wheels which compress the two (2) panels together to form the weld. The fusion welder is equipped with a device which continuously monitors the temperature of the wedge.
- e. Extrusion fillet welding consists of introducing a ribbon of molten resin along the edge of the overlap of the two (2) geomembrane sheets to be welded. A hot-air preheat and the addition of the molten polymer cause some of the material of each sheet to be liquefied resulting in a homogeneous bond between the molten weld bead and the surfaces of the overlapped sheets. The extrusion welder is equipped with gauges given the temperature in the apparatus and a numerical setting for the pre-heating unit.
- f. Many factors, such as the geomembrane temperature, humidity, wind, precipitation, etc., can effect the integrity of field seams and must be taken into account when deciding whether or not seaming should proceed. Test seams, as described in Paragraph 3.1.A.3.c., are required prior to daily producing seaming to determine if the weather conditions will effect the ability to produce quality seams.
- g. Fusion welding seam preparation.
 - I. Overlap the panels of geomembrane approximately four (4") to six (6") inches prior to welding.
 - ii. Clean the seam area prior to seaming to assure the area is clean and free of moisture, dust, dirt or debris of any kind. No grinding is required for fusion welding.
 - iii. Adjust the panels so that seams are aligned with the fewest possible number of wrinkles and "fishmouths".
 - iv. A movable protective layer may be used, directly below the overlap of geomembrane that is to be seamed to prevent build-up of dirt or moisture between the panels.

- h. Extrusion fillet welding seam preparation.
 - I. Whenever possible, extrusion welded seams will be pre-beveled prior to heat-tacking into place.
 - ii. Overlap the panels of geomembrane a minimum of three inches (3").
 - iii. Using a hot-air device, temporarily bond the panels of geomembrane to be welded, taking care not to damage the geomembrane.
 - iv. Clean the seam area prior to seaming to assure the area is clean and free of moisture, dust, dirt and debris of any kind.
 - v. Grind seam overlap prior to welding within one (1) hour of the welding operation in a manner that does not damage the geomembrane. Grind marks should be covered with extrudate whenever possible. In all cases grinding should not extend more than one-quarter inch (1/4") past the edge of the area covered by the extrudate during welding.
 - vi. Purge the extruder prior to beginning the seam to remove all heat-degraded extrudate from the barrel. The purged extrudate will be placed on scrap material so as to prevent contact with installed geomembrane.
 - vii. Keep welding rod clean and dry.
- i. Trial welds shall be conducted by Welding Technicians prior to each seaming period, every five (5) hours, as weather conditions dictate, or if welding problems are suspected. All trial welds will be conducted under the same conditions as will be encountered during actual seaming. Once qualified by a passing trial weld, Welding Technicians will not change parameters (temperature, speed, etc.) without conducting another trial weld.
 - I. The trial weld shall be made by jointing two (2) pieces of geomembrane at least six inches (6") in width. Trial welds for fusion welds will be 10 feet long and extrusion weld trial seams will be a minimum of four feet (4') long.
 - ii. Visually inspect the seam for squeeze out, footprint, pressure and general appearance.
 - iii. Cut three (3) one inch (1") wide specimens, one (1) from the middle of the seam and one foot (1') from each end of the trial seam. Specimens shall be obtained using a one inch (1") die cutter. The specimens shall then be tested in peel using field tensiometer.
 - iv. In order for trial weld to be considered acceptable, all three specimens must meet the following criteria:
 - 1. Exhibit Film Tearing Bond (FTB).
 - 2. Meet or exceed the minimum peel strength values listed in the Manufacturer's Material Specification Sheet. If any specimens are in non-conformance, the entire procedure shall be repeated. In the case of double track fusion welded seams, both welds must pass in order to be considered acceptable.

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- vi. If repeat tests utilizing reasonable sets of welding parameters also fail, the seaming apparatus shall not be accepted and shall not be used for seaming until the deficiencies are corrected and a passing test seam is achieved.
 - vii. Record date, time, operator, machine number, ambient and operating temperatures, speed setting, peel values and pass/fail designation.
- j. General seaming procedures.
- I. Seaming shall extend to the outside edge of panels to be placed in the anchor trench.
 - ii. While welding a seam, monitor and maintain the proper overlap.
 - iii. Inspect seam area to assure it is clean and free of moisture, dust, dirt and debris of any kind.
 - iv. Welding Technicians will periodically check machine operating temperature and speed, and will mark this information on the geomembrane.
 - v. Align wrinkles at the seam overlap to allow welding through the wrinkle.
 - vi. "Fishmouths" or wrinkles at seam overlaps, which cannot be welded through, shall be cut along the ridge in order to achieve a flat overlap. The cut "fishmouth" or wrinkle shall be heat-tacked flat and extruded or patched with an oval or round path of the same geomembrane extending a minimum of three inches (3") beyond the cut in all directions.
 - vii. All cross/butt seams between two (2) rows of seamed panels shall be welded during the coolest time of the day to allow for contraction of the geomembrane.
 - viii. Prior to welding cross/butt seams, the top and bottom overlap of intersecting fusion welded seams will be trimmed six inches (6"). Intersecting extrusion fillet welded seams will be ground to flatten the extrusion bead prior to welding butt seams.
 - ix. All "T" joints produced as a result of cross/butt seams shall be extrusion fillet welded. The overlap on each "leg" of the "T" joint will be trimmed back six inches (6"). Then grind three inches (3") minimum on each of the three (3) legs of the "T" and extrusion weld all of the area prepared by grinding.
 - x. Whenever possible, Welding Technicians will cut a one inch (1") peel specimen at the end of every seam. Prior to welding the next seam, the specimen will be tested for peel.
 - xi. In the event non-complying seam test strips are encountered, the welding machine will be taken out of service until a passing trial weld is obtained, and additional peel specimens will be taken to localize the flaw.
 - xii. Results of field seam test strips will be maintained.

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- k. Seaming documentation.
 - I. All seaming operations will be documented by the Construction Quality Assurance Officer or a designated Assistant. Welding Technicians will mark on the liner with Mean Streak permanent markers at the start of all seams information regarding date, time, Welding Technician ID, machine number and machine operating temperature and speed. Record date, time, seam number, Technician ID, machine ID, set temperature, speed and weather conditions.
 - ii. Welding Technicians will periodically check operating temperature and speed and mark the information along the seam.
- B. Cover.
 - 1. Place cover over impoundment at the end of each work day and during any periods of work stoppage.
 - 2. Secure cover to prevent water or debris from entering the impoundment.
 - 3. Place cover in a manner to prevent water from accumulating on top of the cover.
- C. Blocks.
 - 1. Place concrete blocks as shown on drawings and in a manner to ensure that the blocks are secure.
 - 2. Place concrete blocks so as to stagger joints.
 - 3. Place each concrete block directly on top of the one beneath it so that the blocks are properly aligned.
- D. Fasteners.
 - 1. Install as shown on drawings.
- E. Subgrade.
 - 1. Place sand as shown on drawings and described in Section 02211.
- F. Grommet eye hooks.
 - 1. Install as shown on Drawings.
- G. Sandbags
 - 1. Sandbags shall weigh no more than 30 pounds each.
 - 2. Sandbags shall be free of any tears or rips.
 - 3. Sand for the bags shall be from offsite sources and shall be free of debris, rocks and any foreign matter.
 - 4. Place bags end on end and in a manner to ensure that the bags are secure and that there are no gaps for air or water to enter.
 - 5. Inspect bags periodically.

3.2 TESTING

A. Liner seam vacuum testing.

1. Equipment for vacuum testing.
 - a. Vacuum box assembly consisting of a rigid housing with a soft neoprene gasket attached to the bottom, a transparent viewing window, port hole or valve assembly, and a vacuum gauge.
 - b. Vacuum pump assembly equipped with a pressure controller and pipe connection.
 - c. A rubber pressure/vacuum hose with fittings and connections.
 - d. A bucket and means to apply a soapy solution.
 - e. A soapy solution.
2. Procedure for vacuum testing.
 - a. Trim excess overlap from the seam, if any.
 - b. Turn on the vacuum pump to reduce the vacuum box to approximately 10 inches of mercury, i.e., 5 psi gauge.
 - c. Apply generous amount of a strong solution of liquid detergent and water to the area to be tested.
 - d. Place the vacuum box over the area to be tested and apply sufficient downward pressure to "seat" and seal strip against the liner.
 - e. Close the bleed valve and open the vacuum valve.
 - f. Apply a minimum of 5 psi vacuum to the area as indicated by the gauge on the vacuum box.
 - g. Ensure that a leak tight seal is created.
 - h. For a period of approximately 10 to 15 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.
 - I. If no bubbles appear after 15 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum three inch (3") overlap, and repeat the process.
3. Procedure for non-complying test.
 - a. Mark all areas where soap bubbles appear and repair the marked areas in accordance with Paragraph 3.3.c.
 - b. Retest repaired areas.
4. General vacuum testing procedures.
 - a. Vacuum box testing will be conducted by qualified construction personnel.
 - b. Special attention shall be exercised when vacuum testing "T" seams or patch intersections with seams.

5. Vacuum testing documentation.
 - a. Vacuum testing crew will use permanent markers to write on liner indicating tester's initials, date, and pass/fail designation on all areas tested.
 - b. Records of vacuum testing will be maintained by the crew.

3.3 DEFECTS AND REPAIRS

A. Repair Procedures.

1. Any portion of the geomembrane or geomembrane seam showing a flaw, or having a non-destructive test in non-compliance shall be repaired. Procedures available for repair include the following:
 - a. Patching - used to repair large holes and tears. All patches shall extend at least three inches (3") beyond the edges of the defect and all corners of patches shall be rounded.
 - b. Grinding and welding - used to repair sections of extruded fillet seams.
 - c. Spot welding or seaming - used to repair small tears, pinholes, or other minor localized flaws.
 - d. Capping - used to repair lengths of extrusion or fusion welded seams.
 - e. Extruding the exposed overlap along the length of fusion welded seams.
 - f. Removal of a suspect seam and replacement with a strip of new material seamed into place.

B. Verification of repairs.

1. Every repair shall be non-destructively tested. Repairs which pass the non-destructive test shall be deemed acceptable. Non-destructive testing of repairs shall be logged on a Repair Report Form. The repair location shall be recorded on the record drawing.

END OF SECTION

DIVISION 15 - MECHANICAL

SECTION 15110

SOIL-VAPOR EXTRACTION BLOWER PACKAGES AND CARBON ADSORPTION UNITS

PART 1. GENERAL

1.1 SECTION INCLUDES

- A. Soil Vapor Extraction (SVE) Blower Packages.
- B. Activated Carbon Adsorber.
- C. Quick Connect Fitting.

1.2 RELATED SECTIONS

- A. Section 16180 - Equipment Wiring Systems.

1.3 SUBMITTALS FOR REVIEW

- A. Product Data: Provide data on extraction blowers, carbon units and accessories and blower curves with specified operating point clearly plotted, power, RPM, sound power levels and electrical characteristics and connection requirements.
- B. Shop Drawings: Indicate assembly of SVE blower packages and accessories including blower curves with specified operating point clearly plotted, sound power levels and electrical characteristics and connection requirements.

1.4 DELIVERY, STORAGE AND PROTECTION

- A. Section 01600 - Material and Equipment.
- B. Protect motors, shafts and bearings from weather and construction dust.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01600 - Material and Equipment: Environmental conditions affecting products onsite.

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PART 2. PRODUCTS

2.1 SVE BLOWER PACKAGE - INSITU SOIL

- A. Manufacturer: J.E. Gasho and Associates, Inc. Blower Package, Model: EN14BK72MWL, P/N 038760, or approved equivalent.
- B. 20 hp explosion proof, three phase, 460 volt, 60 Hz motor
- C. Blower rating of 920 SCFM at 0 inches of water column, 600 SCFM at 80 inches of water column, has design operating point of 770 cfm at 40 inches of water column.
- D. Includes 6-inch in-line filter, adjustable vacuum relief valve, 4-inch inlet dilution valve assembly with 4-inch butterfly valve and 4-inch inlet filter silencer, Dwyer 1950P low pressure switch and Dwyer 1950P high vacuum switch, vacuum gages (2) (0 to 160 inches of water) with face 2 1/2-inch face and 1/4-inch bottom NPT connection, pressure gage (0 to 160 inches of water) with 2 1/2-inch face with 1/4-inch NPT connection, 6-inch carbon steel pipe and 6-foot by 4-foot elevated skid.
- E. Package unit consists of Moisture Separator Model GX-120 including an explosion-proof liquid level switch .
- F. Blower control package equipped with a motor starter, control transformer, start/stop pushbuttons, alarms, and common alarm contact for an autodialer as shown on Drawing S-12. Blower controls shall be housed in a NEMA 7 control panel and all electrical work shall be explosion-proof.

2.2 SVE BLOWER PACKAGE - IMPOUNDMENT SOIL

- A. Manufacturer: J.E. Gasho and Associates, Inc. Blower Package, Model: EN606M72ML, P/N 038536, or approved equivalent.
- B. 3 hp explosion proof, three phase, 460 volt, 60 Hz motor
- C. Blower rating of 200 SCFM at 0 inches of water column and 40 SCFM at 75 inches of water column, has design operating point of 140 cfm at 40 inches of water column.
- D. Includes 2 1/2-inch in-line filter, adjustable vacuum relief valve, 2-inch inlet dilution valve assembly with 4-inch butterfly valve and 4-inch inlet filter silencer, Dwyer 1950P low pressure switch and Dwyer 1950P high vacuum switch, vacuum

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gages (2) (0 to 160 inches of water) with face 2 1/2-inch face and 1/4-inch bottom NPT connection, pressure gage (0 to 160 inches of water) with 2 1/2-inch face with 1/4-inch NPT connection, 2 1/2-inch carbon steel pipe and 4-foot by 4-foot elevated skid.

- E. Package unit consists of Moisture Separator Model GX-30 including an explosion proof liquid level switch.
- F. Blower control package equipped with a motor starter, control transformer, start/stop pushbuttons, alarms, and common alarm contact for an autodialer as shown on Drawing S-12. Blower controls shall be housed in a NEMA 7 control panel and all electrical work shall be explosion-proof.

2.3 ACTIVATED CARBON ADSORBER

- A. Manufacturer: BISCO Environmental , Inc., Model Air VF-1500.
- B. Carbon Adsorbers are rated for a maximum flow of 1,500 CFM at a maximum pressure of 3 PSI and a maximum temperature of 240 degrees Fahrenheit.
- C. Quality steel vessel containing 1,500 pounds of virgin vapor phase carbon, with a minimum 1-foot diameter changeout access from top of carbon vessel, and operates with upward flow direction.
- D. Inlet and outlet fittings - 6-inch flanges.

2.4 QUICK CONNECT FITTINGS

- A. Manufacturer: Ever-Tite, stainless steel female coupler with hose shank, Model 60CXX.
- B. Manufacturer: Ever-Tite, stainless steel male adaptor, with male thread, Model 60FXX.

PART 3. EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Locate as shown on drawings.

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- C. Provide flexible joint where blower packages are connected to piping to minimize vibration.
- D. Secure blower package to treatment shed floor and secure carbon units to concrete pad.

END OF SECTION

SECTION 15135
GAGES AND METERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flow meters-vapor.
- B. Vacuum gages.
- C. Pressure gages.
- D. Temperature gages.
- E. Gage taps.

1.2 REFERENCES

- A. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.

1.3 SUBMITTALS FOR REVIEW

- A. Product Data: Provide list which indicates use, operating range, total range and location for manufactured components.

1.4 SUBMITTALS AT PROJECT CLOSEOUT

- A. Project Record Documents: Record actual locations of components and instrumentation.
- B. Operation and Maintenance Data.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01600 - Material and Equipment.
- B. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.1 VAPOR FLOW METERS

- A. Manufacturer: PRESO Industries, Model V400-20-BW 316 PVC, or approved equivalent.
- B. Calibrated venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gage in case.

2.2 GAGE TAPPINGS

- A. Gage Cock: Tee or lever handle, brass for maximum 150 psig (1034 kPa).

2.3 TEST PLUGS

- A. Test Plug: 1/2 inch (13 mm) brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Locate test plugs where indicated.

3.2 SCHEDULES

- A. Flow Meter Schedule-Vapor.

location

Manifolds for extraction pipe where indicated on Drawings.

- B. Gage Tapping Schedule

location

Where indicated on Drawings.

- 1. Vacuum Gage

Headers, influent to blowers: 0 to 40 inches of water column.

2. Pressure Gage
Rigid pipe, influent to carbon units: 0 to 5 psi.
3. Temperature Gage
Headers, influent to blowers: 0 to 150 degrees fahrenheit.

END OF SECTION

SECTION 15140

SUPPORTS AND ANCHORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe and equipment supports.

1.2 RELATED SECTIONS

- A. Section 15410 - Plumbing Piping.

1.3 REFERENCES

- A. ASME B31.1 - Power Piping.
- B. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- C. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- D. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- E. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate system layout with location and detail of supports.
- B. Product Data: Provide manufacturers catalog data including load capacity.
- C. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

PART 2 PRODUCTS

2.1 PIPE SUPPORTS

- A. Plumbing Piping:
 - 1. Wall Support: Welded steel bracket and wrought steel clamp.
 - 2. Vertical Support: Steel riser clamps.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.2 PIPE SUPPORTS

- A. Support horizontal piping as needed to prevent sag or movement when system is in operation.
- B. Place supports within 12 inches of each horizontal elbow.
- C. Support vertical piping independently of connected horizontal piping.
- D. Pipe Supports:
 - 1. Install in accordance with manufacturer's specifications.
 - 2. Support horizontal piping as scheduled.
 - 3. Install supports to provide minimum ½ inch space between finished covering and adjacent work.
 - 4. Place supports within 12 inches of each horizontal elbow.
 - 5. Use supports with 1-1/2 inch minimum vertical adjustment. Design supports for pipe movement without disengagement of supported pipe.

3.3 SCHEDULES

A. Pipe Support Spacing:

1. Metal Piping:
 - a. Pipe size: 2 to 4 inches:
 - 1) Maximum support spacing: 10 ft.
2. Plastic Piping:
 - a. All Sizes:
 - 1) Maximum support spacing: 6 ft.

END OF SECTION

SECTION 15190

MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tags.
- B. Pipe Markers.

1.2 RELATED SECTIONS

- A. Section 15110 - Soil Vapor Extraction Blower Packages and Carbon Adsorber Units.

1.3 REFERENCES

- A. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS

- A. Submit list of wording, symbols, letter size and color coding for mechanical identification.
- B. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures and installation.

1.5 PROJECT RECORD DOCUMENTS

- A. Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1 1/2-inch square.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Identify control panels and major control components outside panels with plastic nameplates.
- D. Identify piping, concealed or exposed, interior or exterior, with plastic pipe markers. Use tags on piping 3/4 inch (20 mm) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 15410

PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe, pipe fittings, valves and connections for piping systems.

1.2 RELATED SECTIONS

- A. Section 15140 - Supports and Anchors.
- B. Section 15190 - Mechanical Identification.
- C. Section 01600 - Materials and Equipment.
- D. Section 16180 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCES

- A. ASTM D1785 - Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- B. ASTM D2466 - Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- C. ASTM D2564 - Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- D. ASTM D2855 - Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
- E. MSS SP58 - Pipe Supports - Materials, Design and Manufacturer.
- F. MSS SP69 - Pipe Supports - Selection and Application.
- G. MSS SP89 - Pipe Supports - Fabrication and Installation Practices.

1.4 SUBMITTALS FOR REVIEW

- A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.5 DELIVERY, STORAGE AND PROTECTION

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 PIPE SUPPORTS

- A. Refer to Section 15140.

2.2 BALL VALVES

- A. Manufacturer: Comstock Corporation Compact Ball Valve, Model 1081-040P, or approved equivalent.

2.3 PIPING

- A. Two-inch diameter, 0.20 slot PVC well screen shall be used for the air sparge wells and within the impoundment as indicated on the Drawings.
- B. Two-inch diameter, schedule 40 PVC pipe shall be used for the air sparge wells and on the interior of the impoundment as indicated on the Drawings.
- C. Four-inch diameter, schedule 40 PVC pipe shall be used for the extraction piping, located on the exterior of the impoundment.
- D. Four-inch diameter, 0.20 slot PVC well screen shall be used for the soil vapor extraction wells as indicated on the Drawings.
- E. Four-inch diameter, schedule 40 PVC pipe shall be used for the soil vapor extraction piping as indicated on the Drawings.

- F. Six-inch diameter, schedule 40 PVC pipe shall be used for the extraction piping within the treatment shed and for the discharge piping associated with the carbon adsorbers unless otherwise indicated on the Drawings.
- G. Six-inch, schedule 40 galvanized steel pipe shall be used for the blower effluent piping to the point indicated on the Drawings.

2.4 FLEXIBLE HOSE

- A. Manufacturer: Uni-Flex, Model UL 1100.
- B. Six-inch diameter, fiberglass/teflon flexible hose shall be used for piping between the carbon units as indicated on the Drawings.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Prepare PVC pipes with primer solution approved by the manufacturer.

3.2 INSTALLATION

- A. PVC and CPVC pipes shall be glued and coupled in accordance with manufacturer's instructions. Galvanized steel pipe will be threaded and coupled. Flexible hose will utilize Ever-Tite quick connect fittings.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route interior piping parallel and perpendicular to walls.
- D. Install interior piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.

- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance from structures and other equipment for installation of insulation and access to valves and fittings.
- H. Install valves with stems upright or horizontal, not inverted.
- I. Install unions downstream of valves and at equipment or apparatus connections.
- J. Support all interior piping as specified in Section 15140.
- K. Install exterior piping on compacted bedding; maintaining slope and spacing as shown on the drawings.
- L. Do not place backfill over exterior piping until directed to do so by the PRPs' Representative.
- M. All below-grade piping will be vacuum/pressure tested to either 10psi vacuum or pressure in accordance with the operational mode of the pipe. The Contractor will supply the necessary equipment to conduct the testing. The testing will be conducted under the supervision of the PRPs Representative and the trenches will be backfilled only after successful testing of the pipes.

END OF SECTION

SECTION 015870

POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall exhausters.

1.2 RELATED SECTIONS

- A. Section 16180 - Equipment Wiring Systems.

1.3 REFERENCES

- A. AMCA 99 - Standards Handbook.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

1.4 SUBMITTALS FOR REVIEW

- A. Product Data: Provide data on fan and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.

1.5 SUBMITTALS FOR INFORMATION

- A. Manufacturer's Instructions: Indicate installation instructions.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

- A. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list and wiring diagrams.
- B. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

PART 2 PRODUCTS

2.1 WALL EXHAUSTERS

- A. Manufacturer: Dayton, Model 4C369 Hazardous location exhaust fan, or an approved equivalent.
- B. Performance
 - 1. Air Flow: 2,000 cfm at 0 inches sp.
 - 2. Fan RPM: 1,725.
 - 3. Electrical Characteristics:
 - a. 1/4 hp.
 - b. 115 volts, single phase, 60 Hz.
 - c. 4.5 amperes maximum.
 - d. Refer to Section 16180.
 - 4. Fan shall have automatic louvers that open when fan is engaged.
 - 5. Fan operated by thermostat Cronse-Hinds Model HRC65 or equal and explosion-proof H-O-A switch.
 - 6. Size: 16-inch diameter

PART 3 EXECUTION

3.1 INSTALLATION

- A. Section 01400 - Quality Control: Manufacturer's instructions.
- B. Secure wall exhausters with stainless steel lag screws to structure.

END OF SECTION

SECTION 15940

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Louvers.

1.2 REFERENCES

- A. AMCA 500 - Test Method for Louvers, Dampers and Shutters.
- B. ARI 650 - Air Outlets and Inlets.
- C. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application and noise level.

PART 2 PRODUCTS

2.1 LOUVERS

- A. Manufacturers: Dayton, Model 4C557 Single Panel Shutters, or an approved equivalent.
- B. Fabrication: 16 gage thick extruded aluminum, welded assembly, with factory finish.

2.2 MESH SCREEN: rated for exterior use, mesh size approximately 1/16 to 1/8-inch.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install with mesh screen to prevent entry by insects.

END OF SECTION

SECTION 15980

INSTRUMENTS AND CONTROL ELEMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Thermostats
- B. Incandescent fixtures.
- C. Switches.
- D. Electric Heater.

1.2 RELATED SECTIONS

- A. Section 16180 - Equipment Wiring Systems.

1.3 REFERENCES

- A. NEMA DC 3 - Low-Voltage Room Thermostats.
- B. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS AT PROJECT CLOSEOUT

- A. Project Record Documents: Record actual locations of control components, including panels, thermostats and sensors. Accurately record actual location of control components, including panels, thermostats and sensors.

PART 2 PRODUCTS

2.1 THERMOSTATS

- A. Electric Room Thermostats:
 - 1. Manufacturer: Honeywell Model No. T498A1778.
 - 2. Section 01600 - Materials and Equipment: Product substitutions.
 - 3. Substitutions: Permitted.
 - 4. For automatic control of exhaust fan and heater.

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2.2 INCANDESCENT FIXTURE

- A. Manufacturer: Appleton, Model EDTP2050G Hazardous Location Fixture, 100 watt bulb, or an approved equivalent.

2.3 SWITCH

- A. Manufacturer: Appleton, Model EDSC-175F1 Hazardous Location Switch, or an approved equivalent

2.4 ELECTRIC HEATER

- A. Manufacturer: Q Mark, Model 3UG36 Hazardous Location Electric Convection heater.
- B. Explosion-proof, 3,600 watts
- C. Clearance level of 9 inches from the floor must be maintained to provide adequate area for air flow.
- D. Finish: epoxy paint finish .

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that systems are ready to receive work.
- B. Beginning of installation means installer accepts existing conditions.
- C. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- D. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- E. Ensure installation components is complementary to installation of similar components.

3.2 INSTALLATION

- A. Install in accordance with manufacturers instructions.
- B. Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate 48 inches above floor. Align with lighting switches.

END OF SECTION

SECTION 15985

SEQUENCE OF OPERATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sequence of operation:
 - 1. SVE Blower.
 - 2. Moisture Separator.
 - 3. Heater.
 - 4. Exhaust fan.
 - 5. Incandescent Fixture.
 - 6. Carbon Adsorbers

1.2 RELATED SECTIONS

- A. Section 16180 - Equipment Wiring Systems.

1.3 SYSTEM DESCRIPTION

- A. This Section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices and system components required for control systems are specified in other Sections.

1.4 SUBMITTALS FOR REVIEW

- A. Shop Drawings: Indicate mechanical system controlled and control system components.
 - 1. Label with settings, adjustable range of control and limits. Include written description of control sequence.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 SOIL VAPOR EXTRACTION BLOWER

- A. Time Schedule: Continuous operation. Determine status of blowers by electric current sensing devices.

B. Safety Devices:

1. High Temperature Sensor: Stop blower if motor temperature is beyond normal operating range, activate autodialer.
2. High Vacuum Sensor: Stop blower if vacuum is beyond normal operating range, activate autodialer.
3. High Pressure Sensor: Stop blower if pressure increases beyond normal operating range.
4. Presence of Combustible Vapors: Stop blower if percent LEL is beyond safe operating level, activate autodialer.
5. Explosion Proof: Prevention of spark for ignitable vapors.

3.2 MOISTURE SEPARATOR

A. Configuration

1. 120-gallon moisture separator with drain associated with 20 hp blower.
2. 30-gallon moisture separator with drain associated with the 3 hp blower.

B. Safety Devices:

1. Explosion-Proof High Level Protection: Stop associated blower if fluid level in moisture separator rises to specified level above normal high level of operating range.
2. Explosion-Proof: Prevention of spark for ignitable vapors.

3.3 HEATER

A. Single temperature thermostat set at 40 degrees F.

B. Operate through explosion-proof switch.

C. Safety Devices:

1. Explosion-proof: Prevention of spark for ignitable vapors.

3.4 EXHAUST FAN

A. Single temperature thermostat set at 80 degrees F to operate fan.

B. Operate through explosion-proof switch.

C. Safety Devices:

1. Explosion-Proof: Prevention of spark for ignitable vapors.

3.5 INCANDESCENT FIXTURE

A. Operate through explosion-proof switch.

B. Safety Devices:

1. Explosion-Proof: Prevention of spark for ignitable vapors.

END OF SECTION

SECTION 15990

TESTING, ADJUSTING AND BALANCING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment and balancing of systems.

1.2 RELATED SECTIONS

- A. Section 01650 - Starting of Systems.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Fans and motors are rotating correctly.
- B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- C. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

- A. Provide instruments required for testing, adjusting and balancing operations. Make instruments available to PRPs' Representative to facilitate spot checks during testing.

3.3 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the PRPs.
- C. Check and adjust systems approximately six months after final acceptance and submit report.

3.4 SCHEDULES

- A. Equipment Requiring Testing, Adjusting and Balancing
 - 1. SVE Blowers.
 - 2. Moisture Separators.
 - 3. Heater.
 - 4. Exhaust Fan.
 - 5. Incandescent Light.
- B. Report Forms
 - 1. Title Page:
 - a. Name of Testing, Adjusting and Balancing Agency
 - b. Address of Testing, Adjusting and Balancing Agency
 - c. Telephone number of Testing, Adjusting and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Engineer
 - g. Project Contractor
 - h. Project altitude
 - i. Report date
 - 2. Summary Comments:
 - a. Design versus final performance
 - b. Notable characteristics of system
 - c. Description of systems operation sequence
 - d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
 - e. Nomenclature used throughout report
 - f. Test conditions

3. Instrument List:
 - a. Instrument
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Range
 - f. Calibration date
4. SVE Blowers:
 - a. Manufacturer
 - b. Model/Frame
 - c. Horsepower (HP)
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM
 - f. Starter size, rating
5. Moisture Separator:
 - a. Identification/number
 - b. Location
 - c. Size
 - d. Manufacturer
 - e. Model number
 - f. Serial number
 - g. Design Flow rate
 - h. Design pressure drop
 - i. Actual/final pressure drop
 - j. Actual/final flow rate
6. Heater:
 - a. Manufacturer
 - b. Model/Frame
 - c. HP
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM
 - f. Service factor
 - g. Starter size, rating, heater elements
 - h. Sheave Make/Size/Bore
7. Exhaust Fan Data:
 - a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Air flow, specified and actual
 - f. Total static pressure (total external), specified and actual
 - g. Inlet pressure

- h. Discharge pressure
 - i. Sheave Make/Size/Bore
 - j. Number of Belts/Make/Size
 - k. Fan RPM
8. Incandescent fixtures:
- a. Identification/number
 - b. Location
 - c. Size
 - d. Manufacturer
 - e. Model number
 - f. Serial number
 - g. Wattage

END OF SECTION

SECTION 15995

SYSTEM OPERATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. System of operation:
 - 1. SVE Blower.
 - 2. Moisture Separator.
 - 3. Heater.
 - 4. Exhaust fan.
 - 5. Incandescent Fixture.
 - 6. Carbon Absorbers.

1.2 RELATED SECTIONS

- A. Section 16180 - Equipment Wiring Systems.

1.3 SYSTEM DESCRIPTION

- A. This Section defines the manner and method by which the systems will operate. Equipment, devices, and system components required for control systems are specified in other Sections.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 SVE BLOWER

- A. System will have starter switches that have both manual and automatic modes of operation. When operating in the manual mode, the switch will override all automatic operational sensors. When the system operates in the automatic mode, the systems will operate in accordance with all sensors in the system.
- B. Normal operation: SVE blower will be set in the automatic position and operate continuously, unless the blower shuts down under high vacuum or high temperature conditions. This shutdown will activate the autodialer.

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3.2 MOISTURE SEPARATOR

- A. Normal operation: Moisture separator will remove and collect moisture from the influent vapor stream. A high level fluid sensor within the moisture separator will be triggered if the liquid level within the moisture separator reaches a predetermined level. The triggering of the sensor will result in the shutdown of the SVE Blower and activation of the autodialer.

3.3 HEATER

- A. Normal operation: heater will be thermostatically controlled to keep the temperature within the treatment shed above 40 degrees F.
- B. Manual operation: heater will be activated by the explosion proof switch.

3.4 EXHAUST FAN

- A. Normal operation: fan will be thermostatically controlled to operate if the temperature within the treatment shed reaches 90 degrees F.
- B. Manual operation: fan will be activated by an explosion proof switch.

3.5 INCANDESCENT FIXTURES

- A. Normal operation: lighting fixtures will operate by the activation of an explosion proof switch.

3.6 CARBON ADSORBERS

- A. Normal operation: all vapors generated from the extraction from the SVE wells and the soil impoundment will be passed through the carbon adsorbers.

3.7 OPERATION AND FAULT SUMMARY TABLE

Fault Condition	Sensor Location	Blowers Off	Activate Auto Dialer	Activate/Deactivate Heater	Activate/Deactivate Exhaust Fan	Activate/Deactivate Lights
Thermal Overload (3) (Integral to motors)	Extraction Blowers					
High Fluid Level (2) (Integral to motors)	Moisture Separators					
High Pressure (1)	Carbon Unit					
High Vacuum (2)	Extraction Blowers					
Low Pressure (2)	Extraction Blowers					
Thermostat, On/Off (1)	Exhaust Fan					
Thermostat, On/Off (1)	Heater					
On/Off (1)	Light Switch					
Toxigard Combustible Gas Monitor (1)	Wall Mount					

fault.tbl/h:nabsag/soil/text

END OF SECTION

DIVISION 16 - ELECTRICAL

SECTION 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General requirements for all electrical work on this project. Work under other Divisions of this specification shall conform to Division 16 requirements unless otherwise specified. Applicable requirements of other sections of this specification shall govern all work in this section.

1.2 SCOPE OF WORK

- A. This work shall consist of the furnishing of all labor, materials and services required to complete, make ready for correct operation, all electrical work called for by the drawings and specifications, except for such items as are specifically called for to be done by others. The following is a list of the major items of electrical work, but does not purport to be detailed and complete, and is given for the convenience of the Contractor only.
 - 1. Electrical service
 - 2. Power company metering requirements.
 - 3. Conduit, wire, conduit fittings, supports, etc.
 - 4. Main distribution panel
 - 5. Transformer
 - 6. Low voltage panelboard.
 - 7. Lighting fixtures and lamps.
 - 8. Convection heater.
 - 9. Wiring devices.
 - 10. Telecommunications service conduit and cable.
 - 11. Thermostats.
- B. Contractor shall obtain all required permits and pay all fees.

1.3 GENERAL REQUIREMENTS

- A. Execute the work in the best manner to assure ease of operation and maintenance, as well as satisfactory performance. The various systems shall be completely ready to operate when turned over to the PRPs. The PRPs or PRPs' Representative will interpret the meaning of the contract documents and shall have the power to reject any work and materials which in his judgment do not meet the contract requirements.

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- B. Install the work as quickly as possible and in accordance with construction schedules. Maintain a competent project manager in charge of the work at all times, and facilitate its inspection by the PRPs or PRPs' Representative.
- C. It is recognized that certain materials may have an unusually long delivery time, and where such delivery dates would exceed the scheduled completion date of the contract, this shall be reported to the PRPs Representative.
- D. No allowance shall be made for the Contractor's failure to order materials sufficiently in advance, such that delivery will be made within the duration of the contract.
- E. Examine and coordinate before commencing work, all adjoining work on which the work of this division is in any way dependent for execution. Report any coordination difficulties to the PRPs Representative.
- F. Equipment and materials to be U.L., and/or other nationally recognized testing laboratory listed, and manufactured in accordance with NEMA, IEE, ANSI, AEIC and IPEA standards.
- G. The Contractor must submit in writing any requests for modifications to the plans and specifications. Shop drawings that are submitted to the PRPs' Representative for review do not constitute "in writing" unless it is brought to the attention of the PRPs' Representative that specific changes are being suggested. In any event, changes to the plans are the responsibility of the person initiating such changes.
- H. Job site visits by the PRPs' Representative shall not be construed as a guarantee of the Contractor's conformance with the plans and specifications, nor do they insure safety in, at, on or about the job site.
- I. All work that may be called for in the specifications and not shown on the drawings, or not called for in the specifications but shown on the drawings, shall be completed by the Contractor as if described in both, and should any work be required which is not denoted in the specifications or drawings, but which is nevertheless necessary for the proper carrying out of the intent thereof, the Contractor shall complete all such work as fully as if it were described.
- J. The Contractor shall carefully examine all drawings for the general construction of the building and other onsite structures and equipment, for floor and ceiling heights, and for location of walls, partitions, beams, equipment, etc. and shall be guided accordingly for the setting of all sleeves, inserts and equipment.
- K. The Contractor shall check all dimensions and quantities shown on the drawings and shall notify the PRPs' Representative of any discrepancy or difference in interpretation of the

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drawings and of any error or omission in drawings. The Contractor will not be allowed to take advantage of any error or omission in the drawings or in the specifications, as instructions will be furnished by the PRPs' Representative should such error or omission be discovered. The Contractor shall carry out such instructions as if they had been originally specified.

- L. The Contractor shall, during the progress of the work, maintain an up-to-date set of drawings and specifications at the work site and these items shall be accessible to all.
- M. When specifically detailed and indicated or specified on the plans, the Contractor shall install equipment and conduit, outlets, etc. as shown on the plans. Should the Contractor wish to deviate from the plans, the Contractor shall submit a detailed drawing to the PRPs' Representative for acceptance, which shall be acted on as though it were a shop drawing.
- N. The blower, separator, exhaust fan and NEMA 7 blower starter will be provided under other sections of these specifications, but all electrical connections to these items are required under the provisions of this section.
- O. System ground rod cluster shall include as many ground rods as may be necessary to obtain the code required grounding resistance.

1.4 CODE REQUIREMENTS

- A. All work specified and indicated shall be installed in accordance with the latest rules of the N.E.C., OSHA Regulations, National Electrical Safety Code, Fire Code, and with the rules and regulations of the State and local departments having jurisdiction. Should a discrepancy exist between codes, or between any codes and authorities having jurisdiction, the more stringent requirements shall prevail.

1.5 HAZARDOUS LOCATIONS

- A. All interior electrical work in the treatment shed shall be suitable for Class 1, Division 2, Groups C and D hazardous locations.

1.6 TEMPORARY LIGHT AND POWER

- A. Under provisions of Section 01500.

1.7 OPERATION AND MAINTENANCE MANUAL

- A. Furnish to the PRPs an operation and maintenance manual for the complete electrical and auxiliary systems as specified in Section 01730.

1.8 SUBMITTALS OF SHOP DRAWINGS

- A. Submit under provisions of Section 01300.

1.9 RECORD DRAWINGS

- A. Provide and maintain, in good order at the site of the work, a set of prints on which the Contractor shall record neatly and legible all approved changes immediately as they occur on the job. Also record minor revisions or corrections from layout shown on drawings for conduit, wiring, etc. If radical or numerous changes have been made then, for the sake of clarity, a separate drawing of such changes should be made.
- B. Also obtain a reproducible set of contract drawings. Upon completion of the work, transfer all of the changes recorded on prints to the reproducible drawings and submit three sets of prints of these record drawings to the PRP's Representative for review. Make corrections to the reproducible drawings based on PRP's Representative's comments and submit final record drawings. A certificate of substantial completion will not be issued until the final record drawings are submitted.

1.10 GUARANTEE

- A. The Contractor shall guarantee all materials and workmanship provided by the Contractor for a period of one (1) year after date of acceptance by the PRPs' Representative.

1.11 INSPECTION OF THE WORK

- A. The PRP, his representative, and representatives of regulatory agencies (local, state or federal) having jurisdiction shall at all times have full access to the work and to all materials intended for use in the work.
- B. The Contractor shall provide proper facilities for such access and inspection.
- C. If the work is covered up without the approval or consent of the PRPs or PRPs' Representative, it must, if so directed by the PRPs or PRPs' Representative, be uncovered for inspection at the Contractor's expense.

1.12 ELECTRICAL SERVICE

- A. The Contractor shall furnish and coordinate with the Long Island Lighting Company (LILCO) to furnish a new 400 amp, 480 volt, 3 phase , 60 Hz service, step down transformer, metering, utility poles, and surge and lightning protection as shown on the drawings and required by the LILCO. The electrical service is sized to handle the future groundwater remediation system in addition to the SVE Systems being installed under this contract.

1.13 GROUNDING

- A. All conduit, lighting fixtures, motors, etc. shall be effectively grounded.
- B. All raceways shall have an equipment grounding conductor installed with all other conductors, and the equipment grounding conductor shall have a continuous green colored insulation throughout.
- C. Provide any additional grounding as may be required by the authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MATERIALS AND METHODS

- A. The materials to be furnished under these specifications, unless otherwise indicated, shall be the standard products of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design.
- B. All materials indicated on the drawings or herein specified shall not be used by the Contractor for purposes other than those specified unless specific authorization for its use has been granted by the PRPs' Representative.
- C. Install all materials level and plumb and parallel with walls and ceilings to present a neat and workmanlike appearance.

D. Drawings and specifications indicate approximate locations of equipment. Provide outlets and final connections complete with devices, flexible connections, connectors, etc., for final termination.

E. Provide flexible connections to fixed motors, and other vibrating electrical equipment.

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 16111

CONDUIT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal conduit.
- B. Flexible metal conduit.
- C. Fittings and conduit supports

1.2 RELATED SECTIONS

- A. Section 16170 - Grounding and Bonding.
- B. Section 16190 - Supporting Devices.
- C. Section 16195 - Electrical Identification.

1.3 REFERENCE STANDARDS

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- C. ANSI/NFPA 70 - National Electrical Code.
- D. NECA "Standard of Installation."

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide for metallic conduit, flexible metal conduit, fittings, conduit bodies and conduit seals.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.
- C. All interior electrical work in the treatment shed shall be suitable for Class 1, Division 2, Groups C and D hazardous locations.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle Products to site under provisions of Section 01600.
- B. Accept conduit onsite. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.8 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.

PART 2 PRODUCTS

2.1 CONDUIT

- A. Size: As shown on the drawings or as required by ANSI/NFPA 70 if not shown. Minimum size shall be 1/2 inch.
- B. Type: For all locations, indoor or outdoors, above or below grade, use Rigid Galvanized Steel Conduit or Intermediate Metal Conduit and fittings conforming to ANSI C80.1. Interior conduit and fittings shall be explosion proof.

- C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit; all galvanized steel fittings, NPT threaded conduit type, minimum 5 threads engaged.
- D. Flexible conduit fittings shall be moisture tight as manufactured by Appleton, Crouse-Hinds or approved equal.
- E. Exposed conduit supports shall be single screw malleable iron with cadmium or zinc coating, and malleable iron spacers.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install conduit in accordance with NECA "Standard of Installation."
- B. Use care in cutting conduit to proper length so that ends will fit exactly into the outlet boxes and cabinets. Where conduits terminate in cabinets, they shall be neatly arranged with all ends at the same level. Carefully plug ends of conduits with a bushette to avoid filling with plaster, dust, etc.
- C. Securely fasten exposed conduits in place by supports, fastenings, threaded fittings adaptable for the particular location. Fasten conduits to masonry walls, floor or partitions with malleable pipe straps and spacers, screws and expansion sleeves, at not more than five (5) foot centers. Arrange and fasten conduits parallel to building lines using conduit fittings for taps and direction changes, and as indicated on the plans.
- D. Carefully ream ends of conduit before installation and after the application of the die. Cut conduit with a hacksaw or special approved cutter, taking care to secure a square end.
- E. Provide hangers, supports or fastenings at each elbow at the end of each straight run terminated at a box or cabinet.
- F. During installation of duct runs, plug ends of conduit exposed to the entrance of concrete or other foreign materials. Plug exposed ends of all conduits until cables are installed. Thoroughly clean conduits before cables are installed, by means of rope provided with a duct cleaner, line material "Criss Cross Cleaner" or equal, or size to fit conduits.
- G. Hangers, brackets, etc. shall have all edges filed smooth.

- H. Conduit threads shall be cleaned free of any oxidation by means of NPT dies as required, and all threaded conduit connections shall be made using an approved conductive and sealing compound applied to the threads.
- I. Special fasteners shall comprise miscellaneous type of conduit and box fasteners of a malleable iron or steel with a corrosion-resistant coating of cadmium or zinc. These shall be provided as required or necessary to complete the installation of electrical work. The type selected shall be of adequate strength for the load to which it is subjected and of a design suited to the installation. See Hardware paragraph.
- J. Group related conduits; support using conduit rack. Construct rack using galvanized steel channel.
- K. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports
- L. Arrange conduit to maintain headroom and present neat appearance.
- M. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate or factory elbows for bends in metal conduit larger than 2 inch size.
- N. Provide suitable pull string in each empty conduit except sleeves and nipples.
- O. Ground and bond conduit under provisions of Section 16170.
- P. Identify conduit under provisions of Section 16195.

END OF SECTION

SECTION 16123

WIRE AND CABLE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wire and cable.
- B. In general, only power wiring is shown on the Drawings. Control and instrumentation wiring may not be shown. The Contractor shall provide all wire and conduit as required for a complete operable system as specified or shown.

1.2 RELATED SECTIONS

- A. Section 16195 - Electrical Identification.

1.3 REFERENCE STANDARDS

- A. NECA Standard of Installation (National Electrical Contractors Association).
- B. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- C. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Refer to Section 01300 - Submittals.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 WIRE

- A. Description: Single copper conductor insulated wire.
- B. The minimum wire size for power and lighting shall be No. 12 AWG. The sizes of all conductors shall be as shown on the contract drawings and shall be as required for the particular loading shown.
- C. The neutral and ground wires shall have a white and green outer braid, respectively, throughout the system.
- D. Solid conductors may be used for lighting and receptacle branch circuits.
- E. All conductors for power and control circuits shall be stranded conductors.
- F. All conductors shall be tinned copper, free from splints, flaws and other defects.
- G. Minimum wire size for control wiring shall be No. 14 AWG, except where otherwise noted.
- B. Insulation Voltage Rating: 600 volts.
- C. Insulation: NFPA 70, Type THW, RHW, THHN/THWN.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that mechanical work likely to damage wire and cable has been completed.
- B. Verify that raceway installation is complete and supported.

3.2 INSTALLATION

- A. Route wire and cable as required to meet Project Conditions. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
- B. Install cable in accordance with the NECA "Standard of Installation."
- C. Pull all conductors into raceway at same time.
- D. Protect exposed cable from damage.

- E. Use suitable cable fittings and connectors.
- F. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- G. Clean conductor surfaces before installing lugs and connectors.
- H. Make splices, taps and terminations to carry full capacity of conductors with no perceptible temperature rise.
- I. Use split bolt connectors for copper conductor splices and taps 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- J. Use solderless pressure connectors with insulating covers for copper conductor splices and taps 8 AWG and smaller.
- K. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps 10 AWG and smaller.
- L. All bolted electrical connections at bus bars, straps, etc., as well as all cable connections at lugs, circuit breakers, etc., shall be torqued. The Contractor shall use appropriate torque wrench/screwdriver calibrated in in.-lb. or ft.-lb. as per the specific application. All factory assembled items of equipment, such as panelboards, motor controls, metering equipment, etc., which have bolted electrical connections within shall remove side/rear access panels and torque all bolts/screws in accordance with the manufacturer's recommended torque values. Where such values are not included, or where torquing instructions are vague, the Contractor shall obtain written verification from the manufacturer.

END OF SECTION

SECTION 16130

BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall and ceiling outlet boxes.
- B. Pull and junction boxes.

1.2 RELATED SECTIONS

- A. Section 16470 - Panelboards

1.3 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- C. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. NFPA 70 - National Electrical Code.

1.4 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700
- B. Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

- C. Where used in hazardous areas, all boxes shall be NEMA 7.

PART 2 PRODUCTS

2.1 OUTLET BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Cast Boxes: NEMA FB 1, Type FD, Provide gasketed cover. Provide threaded hubs.

2.2 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- C. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
 - 1. Material: Galvanized cast iron.
 - 2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
 - 3. Cover Legend: ELECTRIC.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install boxes in accordance with NECA "Standard of Installation."
- B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- C. Use cast outlet box in exterior locations exposed to the weather and wet locations.

END OF SECTION

SECTION 16170

GROUNDING AND BONDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding systems.
- B. Electrodes.

1.2 REFERENCES

- A. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- B. NFPA 70 - National Electrical Code.

1.3 GROUNDING SYSTEM DESCRIPTION

- A. Rod electrode.

1.4 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 25 ohms.

1.5 SUBMITTALS

- A. Section 01300 - Submittals: Procedures for submittals.
- B. Product Data: Provide for grounding electrodes and connections.
- C. Test Reports: Indicate overall resistance to ground.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

- E. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

- A. Material: Copper-clad steel.
- B. Diameter: 3/4 inch.
- C. Length: 10 feet (3000 mm).

2.2 MECHANICAL CONNECTORS

- A. Material: Bronze.

2.3 EXOTHERMIC CONNECTIONS

- A. Manufacturers - Cadweld or equal.

2.4 WIRE

- A. Material: Stranded copper.
- B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Verify that final backfill and compaction has been completed before driving rod electrodes.
- B. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- C. Provide bonding to meet Regulatory Requirements.
- D. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus or bushing.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Complete inspections and tests listed in NETA ATS, Section 7.13.

END OF SECTION

SECTION 16180
EQUIPMENT WIRING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical connections to equipment.

1.2 RELATED SECTIONS

- A. Section 16111 - Conduit.
- B. Section 16123 - Building Wire and Cable.
- C. Section 01039 - Coordination.

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Procedures for submittals.
- B. Product Data: Submit wiring device manufacturer's catalog information showing dimensions, configurations and construction.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.5 COORDINATION

- A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams and manufacturer's instructions for equipment furnished under other sections.

- B. Determine connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

1.6 ELECTRICAL CONNECTIONS

- A. Verify that equipment is ready for electrical connection, wiring and energization.
- B. Make electrical connections in accordance with equipment manufacturer's instructions.
- C. Make conduit connections to equipment using flexible conduit.
- D. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- E. Install terminal block jumpers to complete equipment wiring requirements.
- F. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 16190
SUPPORTING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Conduit and equipment supports.
- B. Anchors and fasteners.

1.2 SUBMITTALS FOR REVIEW

- A. Section 01300 - Submittals: Procedures for submittals.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.3 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.
- C. NECA Standard of Installation (National Electrical Contractors Association).

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS

- A. Materials and Finishes: Corrosion resistant.
- B. Select materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit, including weight of wire in conduit.

C. Anchors and Fasteners:

1. Concrete Structural Elements: Use precast inserts, expansion anchors or preset inserts.
2. Steel Structural Elements: Use beam clamps, spring steel clips, steel ramset fasteners and welded fasteners.
3. Concrete Surfaces: Use self-drilling anchors and expansion anchors.
4. Solid Masonry Walls: Use expansion anchors and preset inserts.
5. Sheet Metal: Use sheet metal screws.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Locate and install anchors, fasteners and supports in accordance with NECA "Standard of Installation".
1. Do not fasten supports to pipes, ducts, mechanical equipment or conduit.
 2. Obtain permission from PRPs' Representative before using powder-actuated anchors.
 3. Obtain permission from PRPs' Representative before drilling or cutting structural members.
- B. Fabricate supports from structural steel or formed steel members. Rigidly weld members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- C. Install surface-mounted cabinets and panelboards with minimum of four anchors.

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and labels.

1.2 RELATED SECTIONS

- A. Section 15110 - Soil Vapor Extraction Blower Package and Carbon Adsorption Units.
- B. Section 15870 - Power Ventilators.
- C. Section 16864 - Electric Space Heating Units.

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Procedures for submittals.
- B. Product Data: Provide catalog data for nameplates, labels and markers.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.1 NAMEPLATES AND LABELS

- A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.

- B. Locations:
 - 1. Each electrical distribution and control equipment enclosure.
 - 2. Thermostats.
- C. Letter Size:
 - 1. 1/4-inch (6-mm) letters for identifying grouped equipment and loads.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates.

3.2 INSTALLATION

- A. Section 01400 - Quality Control: Manufacturer's instructions.
- B. Install nameplate parallel to equipment lines.
- C. Secure nameplate to equipment front using screws, rivets or adhesive.

END OF SECTION

SECTION 16421
UTILITY SERVICE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Arrangement with utility company for electric service.
- B. Overhead and building mounted electrical service.
- C. Metering equipment

1.2 REFERENCES

- A. NECA Standard of Installation (National Electrical Contractors Association).
- B. NFPA 70 - National Electrical Code.

1.3 SYSTEM DESCRIPTION

- A. Utility Company: Long Island Lighting Company (LILCO).
- B. System Characteristics: 277/480 three-phase, four-wire 60 Hertz.

1.4 SUBMITTALS

- A. Product Data: Provide ratings and dimensions of meter bases.
- B. Submit utility company prepared drawings.
- C. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.5 PRE-INSTALLATION MEETING

- A. Section 01039 - Coordination and Meetings: Pre-installation meeting.
- B. Convene at least one week prior to commencing work of this section. Review service entrance requirements and details with Utility Company representative.

PART 2 PRODUCTS

2.1 UTILITY METER

- A. Meter will be furnished by Utility Company.

2.2 UTILITY METER BASE

- A. Meter base shall be furnished by Contractor and be approved by LILCO for the location requiring such services as indicated on the drawings.

2.3 RISER AND WEATHERHEAD

- A. Contractor shall provide riser conduit and weatherhead of correct sizes and locations as directed by LILCO and shown on the drawings.
- B. Provide conductors terminated at riser of appropriate lengths required for LILCO electrical service hookup.

PART 3 EXECUTION

3.1 PREPARATION

- A. Arrange with Utility Company to obtain permanent electric service to the Project.

3.2 INSTALLATION

- A. Install weatherheads, meter base, messenger supported aerial cable, treansformer, etc.

END OF SECTION

SECTION 16461

DRY-TYPE TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Dry type transformers

1.2 RELATED SECTIONS

- A. Section 16111 - Conduit: Flexible conduit connections.
- B. Section 16170 - Grounding and Bonding.

1.3 REFERENCES

- A. NEMA ST 20 - Dry-Type Transformers for General Applications.
- B. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association).
- C. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Procedures for submittals.
- B. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE AND HANDLING

- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, finish.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Manufacturer: Square "D", Model 30T2FSS or equal.
- C. Enclosure: Stainless steel.
- D. Primary Voltage: 480 volts, 3 phase.
- E. Secondary Voltage: 208Y/120 volts, 3 phase
- F. Mounting: Wall.

2.2 SOURCE QUALITY CONTROL

- A. Production test each unit according to NEMA ST20.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, 2 feet, (600 mm) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

- C. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.
- D. Provide grounding and bonding in accordance with Section 16170.
- E. Measure primary and secondary voltage and make appropriate tap adjustments.

END OF SECTION

SECTION 16470

PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Distribution and branch circuit panelboards.

1.2 RELATED SECTIONS

- A. Section 16170 - Grounding and Bonding.
- B. Section 16195 - Electrical Identification.

1.3 REFERENCES

- A. NECA Standard of Installation (published by the National Electrical Contractors Association).
- B. NEMA AB1 - Molded Case Circuit Breakers.
- C. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.
- D. NEMA PB 1 - Panelboards.
- E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- F. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).
- G. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Procedures for submittals.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement and sizes.

- C. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers: Square "D" or equal.
- B. Description:
 - Main Distribution Panel: 480Y/277 volt NF Panel, 3 phase, 4 wire.
 - Low Voltage Panel: 208Y/120 volt NQ Panel, 3 phase, 4 wire.
- C. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
- D. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 240 volt panelboard and 18,000 amperes for the 480 volt panelboard.
- E. Molded Case Circuit Breakers: NEMA AB 1, plug-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits. Do not use tandem circuit breakers.
- F. Enclosure: NEMA 4X, stainless steel.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1 and the NECA "Standard of Installation."
- B. Install panelboards plumb.
- C. Height: 6 feet (1800 mm) to top of panelboard.
- D. Provide typed circuit directory for each branch circuit panelboard.
- E. Provide engraved plastic nameplates under the provisions of Section 16195.
- F. Ground and bond panelboard enclosure according to Section 16170.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Conduct inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.
- C. Measure steady state load currents at each panelboard feeder. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

SECTION 16510
INTERIOR LUMINAIRES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires and accessories.
- B. Lamps.
- C. Luminaire accessories.

1.2 REFERENCES

- A. ANSI C78.379 - Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.
- B. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- C. NFPA 70 - National Electrical Code.
- D. NFPA 101 - Life Safety Code.

1.3 SUBMITTALS

- A. Section 01300 - Submittals: Procedures for submittals.
- B. Product Data: Submit dimensions, ratings and performance data.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 LUMINAIRES

- A. Luminaires shall be incandescent, explosion proof lighting fixtures with mounting hood and globe, Appleton Model AAU-1N or equal. Ceiling mounting hood shall be Model AAC-50 with ½" hubs.

2.2 LAMPS

- A. Lamps shall be 100W, Appleton Model A-21 or equal.
- B. Furnish four replacement lamps.

2.3 SWITCH

- A. Light switch shall be Appleton Model EDSC150-F1 or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- B. Install accessories furnished with each luminaire.
- C. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- D. Bond products and metal accessories to branch circuit equipment grounding conductor.
- E. Install specified lamps in each luminaire.

END OF SECTION

SECTION 16741
TELEPHONE SERVICE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Telephone service

1.2 REFERENCES

- A. EIA/TIA-568 - Commercial Building Wiring Standard.
- B. EIA/TIA-569 - Commercial Building Standard for Telecommunication Pathways and Spaces.
- C. NFPA 70 - National Electrical Code.

1.3 SYSTEM DESCRIPTION

- A.. Arrange with the local phone company to bring in the following telephone lines:
 - i. Two lines to the PRP's Representative Field office, one for telephone and one for facsimile.
 - ii. Two lines to the Contractors Filed office, one for the telephone and one for facsimile.
 - iii. One line to the treatment shed exterior wall for use with the autodialer.Establish phone service for each of the lines.
- B. Telephone Service Entrance Pathway: Rigid steel conduit from point of telephone utility connection to building service.
- C. Backbone Pathway: Conform to EIA/TIA 569 using conduit sleeves as indicated.
- D. Horizontal Pathway: Conform to EIA/TIA 569, using raceway, backboards and cabinets as indicated.
- E. Premises Wiring: Complete from wall jacks or alarm auto dialer using wire and cable as specified. Telephone service to the autodialer on the exterior wall of the treatment shed shall use weatherproof jacks and fittings.

- F. Complete Work in accordance with telephone utility's rules and regulations.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish Products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 - Not used.

PART 3 EXECUTION

3.1 INSTALLATION

- C. Install wire and cable in accordance with manufacturer's instructions and in accordance with EIA/TIA 568.
- D. Support raceways, backboards and cabinets under the provisions of Section 16190.
- E. Install termination cabinets plumb and attach securely to building wall at each corner.
- F. Mark all backboards and cabinets with the legend "TELEPHONE" under the provisions of Section 16195.

END OF SECTION

SECTION 16800
INSTRUMENTATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Alarm Monitor/Dialer
- B. Combustible Gas Detector

1.2 RELATED SECTIONS

- A. Section 16170 - Grounding and Bonding.
- B. Section 16195 - Electrical Identification.

1.3 REFERENCES

- A. NECA Standard of Installation (published by the National Electrical Contractors Association).
- B. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.

1.4 SUBMITTALS

- A. Section 01300 - Submittals: Procedures for submittals.
- B. Shop Drawings: Include outline and support point dimensions, manufacturers product data, wiring diagrams, and instructions for storage, handling, protection, examination, preparation and installation of Product.

PART 2 PRODUCTS

2.1 ALARM MONITOR/DIALER

- A. Manufacturers: Phonetics, Inc. Seneaphone Express or equal.
- B. Description: The alarm monitor/dialer shall monitor at a minimum, AC power failure and four dry contact alarm inputs. On an alarm condition, it shall be capable of dialing at least eight (8) different telephone numbers in sequence and continue dialing until

communication is established. It shall deliver a pre-recorded voice message identifying which alarm condition has been energized.

- C. The alarm monitor/dialer shall operate on a 120V power supply and have a rechargeable internal battery back-up with built in charger for power failure for a minimum of twelve (12) hours.
- D. Transmission of messages shall be over a standard phone line with the ability to call and listen to on-site sounds. Capable of delivering four different messages. Call progress shall detect a busy signal or no answer.
- E. Front Panel LED's shall indicate input alarm status, power alarm status, low battery condition and phone status.
- F. In addition to AC power failure, the alarms that shall be monitored are:
 - 1. SVE Blower System Alarm
 - 2. Impoundment Blower System Alarm
 - 3. Combustible Gas Alarm
 - 4. Spare
- G. Enclosure: NEMA 4X, dust tight, high impact, corrosion resistant fiberglass mounted on the exterior of the treatment shed.

2.2 COMBUSTIBLE GAS MONITOR

- A. Manufacturer: Mine Safety Appliances Company (MSA) or equal.
- B. Description: Combustible gas monitor shall be MSA No. 486124 Model 5100 dual channel gas monitor with three discrete alarm levels for each channel. The monitor shall be used with one remote sensor/transmitter, MSA No. 481093.
- B. A three digit LED shall display gas concentration and shall also automatically display alphanumerically monitor trouble alarm conditions.
- C. Sensor/transmitter shall be located in the treatment shed as shown on the electrical drawing and shall be suitable for use in a hazardous area.
- D. The gas monitor shall be housed in a NEMA 4X enclosure mounted on the exterior of the treatment shed.

- E. Cable between sensor and gas monitor shall be 3 conductor shielded cable, #18 AWG minimum in ½ inch conduit.
- F. An auxiliary relay with a minimum of four normally open contacts shall be provided, mounted in the gas monitor enclosure or in a separate NEMA 4X enclosure adjacent to the gas monitor. The alarm contacts for each alarm level and the trouble alarm shall be wired in parallel so that each one will energize the auxiliary relay. Two contacts on the auxiliary relay shall be interlocked, as shown on the blower wiring diagram, to shut down the gas blowers in the event of a gas monitor alarm. A third contact shall activate the alarm monitor/dialer and the fourth contact shall be for use with the future air sparge compressor.
- G. Furnish MSA calibration kit and calibration gas cylinder with type gas as selected by the Engineer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturers instructions.
- B. Provide the services of a manufacturers service representative for each instrument for a minimum period of one day to inspect the installation, calibrate and/or program the instrument and train the PRPs' Representative or designated personnel in the use of the instrument.

END OF SECTION

SECTION 16864

ELECTRIC SPACE HEATING UNIT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electric convection heater.
- B. Thermostats and accessories.

1.2 REFERENCES

- A. NEMA DC 15 - Line Voltage Room Thermostats.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product data: Provide unit size, finish, and performance data.
- C. Submit manufacturer's installation instructions.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01700.
- B. Operation Data: Include instructions for safe operating procedures.
- C. Maintenance Data: Include instructions for replacement parts and troubleshooting diagnostics.
- D. Include recommended cleaning methods, cleaning materials and waxes for interior parts and exterior finishes.

JULY 1, 1997

PART 2 PRODUCTS

2.1 ELECTRIC BASEBOARD UNITS

- A. Description: Wall-mounted electric convection heater with resistance heating element.
- B. Input Power: 480volt, 3 phase, 60 Hz.
- C. Output Rating: 12,280 BtuH, 3,600 Watts
- D. Provide for electrical connection.
- E. Cabinet Finish: Use corrosion-resisting primer and finish with beige baked enamel.
- F. Rating: NEMA 7, Class 1, Division 2, Groups C and D.
- G. Manufacturer: Qmark Model ICG360483A-N (Granger Stock No. 3UG36

2.2 ACCESSORIES

- A. Controls: Provide contactor and 480/120 control transformer in NEMA 7 enclosure wall mounted adjacent to the heater.
- B. Thermostat shall be hazardous location thermostat White Rogers Model 2A20-2 or equal.
- C. NEMA 7, Class 1, Division 2, Groups C and D.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install unit with sufficient clearance from adjacent construction, piping, ductwork and other obstructions to allow access for service and maintenance.
- C. Support unit heater from structure. Mount a minimum of 9 inches above floor to provide adequate area for air flow.

END OF SECTION



APPENDIX M

Standard Operating Procedures

- **SOP for Sensidyne Gas Detector**
- **SOP for GSA Model Mini Ram Real-Time Aerosol Sensor**
- **SOP for DuPont Alpha-1 Air Sampler**
- **SOP for Thermo Environmental Model 580B PID**
- **SOP for HNU HW-101 PID**
- **SOP for Screening Soil Samples for VOCs**
- **SOP for Decontamination**
- **SOP for Wipe Sample Collection Procedures**
- **SOP for NIOSH Method 1501 - Aromatic Hydrocarbons**
- **SOP for NIOSH Method 1003 - Halogenated Hydrocarbon**
- **SOP for NIOSH Method 0600 - Respirable Nuisance Dust**
- **SOP for SW-846 Method 3810 - Headspace**
- **SOP for SW-846 Method 5030 - Purge and Trap**

STANDARD OPERATING PROCEDURE

SENSIDYNE GAS DETECTOR

1. Choose a detector tube for desired compound.
2. Break tips of a fresh detector tube by bending each tube end in the tip breaker located on the pump housing.
3. Insert the tube securely into the rubber inlet of the pump with arrow on the tube pointing toward the pump.
4. Make certain the pump handle is all the way in. Align the guide marks on the shaft and the housing pump.
5. Pull the handle all the way out until it locks on one (1) pump stroke (100 ml). The stroke pull duration should be one (1) minute. Repeat this sampling procedure for recommended strokes per detector tube.
6. Read concentration at the interface of the stained-to-unstained reagent when staining stops after completion of recommended strokes.
7. The sampling procedure and interpretation varies depending on the tube utilized. The instructions provided with the tubes should be reviewed prior to use.

dmt
July 18, 1989
88jb14

EQUIPMENT SPECIFICATIONS
GCA MODEL MINIRAM REAL-TIME AEROSOL SENSOR

Application:	Detection of airborne particulates in ambient air
Method Detection:	Near-forward scattered electromagnetic radiation
Ranges:	0.01 to 10 mg/m ³ and 0.1 to 100 mg/m ³
Sensitivity:	0.1% of full scale
Repeatibility:	<u>±</u> 0.2% of full scale
Operational Temperature:	10°F to 120°F
Response Time:	10 seconds to full scale
Dimensions:	4" x 4" x 2" (approximate)
Power:	7.5 VDC rechargeable battery pack
Maximum Continuous Operation:	12 hours on fully charged battery
Alarm:	Contact closure, internally adjustable
Outputs:	Digital meter real time or time averaged

OPERATION/CALIBRATION: GCA MINIRAM REAL TIME AEROSOL MONITOR1.0 PURPOSE

Describes the operation and calibration techniques for the MINIRAM Aerosol Sampler.

2.0 DEFINITIONS

The MINIRAM real time aerosol monitor is an aerosol sensor designed for personal aerosol monitoring. The MINIRAM provides real time and time averaged concentration readouts of airborne particulates. The digital signal can be read from the front panel. The MINIRAM unit of measure is mg/m^3 and operates in two ranges: 0.01 to 10 mg/m^3 and 0.1 to 100 mg/m^3 .

3.0 RESPONSIBILITIES

- 3.1 The Site Technician will be responsible for the operation and calibration of the MINIRAM.
- 3.2 The Site Technician will check the following:
 - Zero
 - Precision
- 3.3 The Safety Officer will be responsible for insuring that the work is performed and that the required data is collected.

4.0 OPERATION

- 4.1 The normal operation procedure is as follows:

- 1) Turn the unit on and program the internal microprocessor for sample time, averaging time, alarm level, and range per instruction manual.
- 2) Allow the unit to warm up for 5 minutes before calibration or sampling.

4.2 Calibration Check

- 1) The MINIRAM is factory calibrated against a filter-gravimetric reference using standard test dust, and therefore the manufacturer does not recommend a field span calibration.

- 2) If a question is raised as to the accuracy of a field MINIRAM and/or the precision check is out of tolerance, a filter/gravimetric sampler will be used to verify and/or adjust the MINIRAM. This will be done in accordance with the procedure recommended by the manufacturer in the instrument instruction manual.

4.3 Zero Adjust Procedure (Daily)

- 1) Assure that the unit is in the sample mode and the display selector is in real time.
- 2) Attach the zero check/pump module to the unit.
- 3) Sample air and adjust if necessary.
- 4) Return to normal operation.

4.4 Precision Checks

A precision check will be conducted on each field MINIRAM weekly during Active Operations at the Working Site. The precision check is conducted by comparing the reading of the field MINIRAM to that of the standard MINIRAM when their sensors are held close together. The readings of the two units are recorded in the log book as "Precision Check".

5.0 REPAIR AND MAINTENANCE

If the instrument fails to function as per manufacturer's specifications, it will be replaced with a spare. The defective unit will be sent to the factory for repair. Appropriate spare equipment will be available either at the Project Site or at a location near the Durez plant.

CALIBRATION OF THE DUPONT ALPHA-1

- c. Adjustment for the desired flow rate will be made using the low-flow valve. (The high-flow valve may have to be opened slightly if the desired flow rate cannot be attained using the low-flow valve by itself.)
- o High-Flow Range (1000-5000 cc/min)
 - a. Close the bypass valve completely by gently turning it clockwise until it seats.
 - b. Adjustment for the desired flow rate will be made by using the high-flow valve. The low-flow valve may be used as a "fine tuning" control.
- 4.5 In order to simulate the pressure drop that will be encountered during sampling, attach a sample line along with the type of sample collection media that will be utilized for sampling, to the inlet of the pump.
- 4.6 Measure the flow rate through the sampling system with the respective rotameter and adjust the flow control valve to read the approximate desired flow rate. Allow 10 to 15 seconds after adjustment for the flow control mechanism to respond.
- 4.7 Remove the rotameter. Wet down the inside of the bubble tube with soap solution by allowing several bubbles to pass up the full length of the bubble tube. Attach the bubble tube to the pump sample line and collection media system.
- 4.8 Determine the observed volume flow rate. Use a stopwatch to measure the time it takes for one bubble to rise between any two graduated marks. The observed volume is the value difference from one mark to another. This volume divided by the elapsed time will equal the observed flow rate. (The bubble must be allowed to travel at least one liter while being timed with the stopwatch.)

$$\text{Flow Rate} = \text{Volume/Time}$$
- 4.9 If the flow rate needs adjustment, repeat the procedure in 4.6 through 4.8 until the desired flow rate is obtained.
- 4.10 After all adjustments, if any, are completed, run five individual tests with the bubble meter, average the flows, and record the volume and elapsed time on the calibration data sheet.

EQUIPMENT SPECIFICATIONS
DU PONT ALPHA-1 AIR SAMPLER

Application:	Low-flow personal sampling pump
Pump Type:	Dual opposed diaphragm
Flow Rate Range:	5-5000 cc/min constant flow
Preserve Drop Capability:	25" W.C. maximum
Control Capability:	Microprocessor controlled for: • run time • start time • tolerated restricted flow time • flow rate readout • average air temp. readout
Constant Flow Control:	$\pm 5\%$ of set flowrate
Power:	Internal rechargeable battery pack
Dimensions:	2-1/4" x 4" x 5"

CALIBRATION OF THE DUPONT ALPHA-1

1.0 Applicability

This procedure describes the steps necessary for calibration of the DuPont, Alpha-1 Sampling Pump.

2.0 Responsibilities

The site technician or field operator will be responsible for calibrating the DuPont Alpha-1 at the frequency required in the Project Work Plan.

3.0 Supporting Materials

- DuPont Calibrator Case (or other standard bubble tube calibrator with stop watch)
- Two indicating rotameters - 0-500 cc/min and 0-5000 cc/min
- Mercury thermometer
- Aneroid Barometer (or other means of obtaining local, barometric air pressure)
- Calibration Data Sheet

4.0 Procedure

- 4.1 Determine the flow rate and the type of sampling media that will be used for sampling.
- 4.2 Record the date, time, project #, sample media type, pump serial number, ambient temperature and barometric pressure on the calibration data sheet.
- 4.3 Turn "on" the Alpha-1 by pressing the On/Off and Hold/Run push buttons.
- 4.4 Set the flow rate for the Alpha-1 to the desired flow range as follows:
 - Low-Flow Range (5-1000 cc/min)
 - a. Open the bypass valve fully by turning it three turns counterclockwise from the fully closed position.
 - b. Close the high-flow valve completely by gently turning it clockwise until it seats.

CALIBRATION OF THE DUPONT ALPHA-1

4.11 Determine the standard flow rate as follows:

4.11.1 Average the run times for the five tests completed in 4.10 above and record on the calibration data sheet.

4.11.2 Determine the flow rate at standard conditions, (760 mm Hg, 25°C, and 0% water vapor), using the equation below:

$$\text{Standard Flow Rate} = \frac{\text{Vol (ml)}}{\text{Time (min)}} \times \frac{(P - P_v)}{760} \times \frac{298.16}{(273 + T)}$$

where

P = atmospheric pressure, mm Hg

P_v = vapor pressure of water, mm Hg (see Table 4.1)

T = temperature of gas, °C

4.11.3 Record the initial flow rate at standard conditions on the data sheet.

4.12 Disconnect the sample line and sample collection media from the pump.

4.13 The pump is now calibrated and ready for field use. (Note: All pumps should remain running until sampling is completed. Turning the pumps off may affect the calibrated flow rate.)

4.14 Following the sampling period, and before turning the pumps "off" a final flow calibration check will be completed. This will be done by repeating steps 4.7, 4.8, 4.10, 4.11 and 4.12 and, without making any adjustments, record necessary information on the calibration data sheet.

4.15 The average standard flow rate is determined by averaging the pre-test standard flow rate with the post-test standard flow rate.

5.0 Acceptance Criteria

5.1 All blank spaces on the calibration data sheet will be filled out or marked "NA".

CALIBRATION OF THE DUPONT ALPHA-1

- 5.2 The pre-test standard flow rate must agree with the post-test standard flow rate to within $\pm 10\%$. If it does not, re-run the post-calibration tests and re-check temperature readings, pressure readings, and all calculations. If repeated validations of the post calibration test result in flow differentials of $>10\%$ then the average standard flow rate should be treated as suspect. If the corresponding sample is selected for actual analyses then the resulting values should be treated as approximate concentrations.

6.0 Document Submission

- 6.1 All calibration data sheets will be submitted to the program manager or field coordinator within 3 days.

CALIBRATION OF THE DUPONT ALPHA-1

Table 4-1

SATURATION VAPOR PRESSURE OVER WATER ($^{\circ}\text{C}$, mm Hg)^a
 Values for Fractional Degree Between 50 and
 89 Were Obtained By Interpolation

Temp $^{\circ}\text{C}$	00	02	04	06	08	Temp $^{\circ}\text{C}$	00	02	04	06	08
-16	1.436	1.414	1.390	1.368	1.345	42	61.50	62.14	62.80	63.46	64.12
-14	1.560	1.534	1.511	1.483	1.460	43	64.80	65.48	66.16	66.86	67.56
-13	1.691	1.663	1.637	1.611	1.585	44	68.28	68.97	69.69	70.41	71.14
-12	1.834	1.804	1.776	1.748	1.720	45	71.86	72.57	73.30	74.02	74.76
-11	1.987	1.955	1.924	1.893	1.863	46	75.53	76.25	76.98	77.71	78.45
-10	2.149	2.116	2.084	2.050	2.018	47	79.30	80.03	80.77	81.51	82.26
-9	2.320	2.286	2.254	2.219	2.184	48	83.17	83.91	84.66	85.42	86.18
-8	2.514	2.473	2.437	2.399	2.362	49	87.12	87.87	88.63	89.40	90.17
-7	2.715	2.674	2.633	2.594	2.553	50	91.16	91.92	92.69	93.47	94.25
-6	2.931	2.887	2.843	2.800	2.757	51	95.29	96.06	96.84	97.63	98.42
-5	3.163	3.115	3.068	3.022	2.976	52	99.50	100.28	101.07	101.87	102.67
-4	3.410	3.359	3.309	3.259	3.211	53	103.79	104.58	105.38	106.18	106.99
-3	3.673	3.620	3.567	3.514	3.461	54	108.16	108.96	109.77	110.58	111.39
-2	3.956	3.899	3.841	3.785	3.730	55	112.61	113.42	114.23	115.05	115.87
-1	4.258	4.198	4.135	4.073	4.010	56	117.14	117.96	118.78	119.61	120.44
0	4.579	4.513	4.448	4.383	4.320	57	121.74	122.57	123.40	124.23	125.07
1	4.920	4.847	4.773	4.703	4.635	58	126.41	127.25	128.09	128.93	129.78
2	5.284	5.207	5.129	5.053	4.979	59	131.15	132.00	132.85	133.70	134.55
3	5.668	5.586	5.503	5.423	5.343	60	135.96	136.82	137.68	138.54	139.40
4	6.069	5.982	5.894	5.808	5.723	61	140.84	141.71	142.58	143.45	144.32
5	6.493	6.402	6.312	6.223	6.137	62	145.79	146.67	147.55	148.43	149.31
6	6.940	6.845	6.752	6.660	6.571	63	150.81	151.70	152.59	153.48	154.37
7	7.410	7.312	7.217	7.123	7.032	64	155.90	156.80	157.70	158.60	159.50
8	7.903	7.802	7.704	7.608	7.515	65	161.06	162.07	163.08	164.09	165.10
9	8.419	8.315	8.214	8.116	8.021	66	166.29	167.31	168.33	169.35	170.37
10	8.958	8.852	8.748	8.646	8.547	67	171.59	172.62	173.65	174.68	175.71
11	9.520	9.412	9.306	9.202	9.101	68	176.96	178.00	179.04	180.08	181.12
12	10.105	10.000	9.896	9.793	9.692	69	182.40	183.55	184.60	185.65	186.70
13	10.714	10.610	10.507	10.405	10.304	70	187.91	189.07	190.13	191.19	192.25
14	11.348	11.244	11.142	11.041	10.941	71	193.49	194.66	195.73	196.80	197.87
15	12.007	11.904	11.802	11.702	11.603	72	199.14	200.32	201.50	202.68	203.86
16	12.692	12.590	12.488	12.388	12.289	73	204.86	206.05	207.24	208.43	209.62
17	13.404	13.302	13.201	13.102	13.004	74	210.65	211.85	213.05	214.25	215.45
18	14.143	14.041	13.940	13.841	13.743	75	216.51	217.72	218.93	220.14	221.35
19	14.909	14.807	14.706	14.607	14.509	76	222.44	223.66	224.88	226.10	227.32
20	15.702	15.600	15.499	15.399	15.301	77	228.44	229.67	230.90	232.13	233.36
21	16.523	16.421	16.320	16.221	16.123	78	234.51	235.75	236.99	238.23	239.47
22	17.372	17.270	17.169	17.070	16.972	79	240.65	241.90	243.15	244.40	245.65
23	18.249	18.147	18.046	17.947	17.849	80	246.86	248.12	249.38	250.64	251.90
24	19.154	19.052	18.952	18.853	18.755	81	253.14	254.41	255.68	256.95	258.22
25	20.088	19.986	19.886	19.788	19.690	82	259.49	260.77	262.05	263.33	264.61
26	21.052	20.950	20.850	20.752	20.655	83	265.91	267.20	268.49	269.78	271.07
27	22.046	21.944	21.844	21.747	21.650	84	272.40	273.70	274.99	276.29	277.59
28	23.070	22.968	22.868	22.772	22.676	85	278.96	280.27	281.58	282.89	284.20
29	24.124	24.022	23.922	23.827	23.732	86	285.59	286.91	288.23	289.55	290.87
30	25.208	25.106	25.006	24.912	24.818	87	292.29	293.62	294.95	296.28	297.61
31	26.322	26.220	26.120	26.027	25.934	88	299.06	300.40	301.74	303.08	304.42
32	27.466	27.364	27.264	27.172	27.080	89	305.91	307.26	308.61	309.96	311.31
33	28.640	28.538	28.438	28.347	28.256	90	312.83	314.19	315.55	316.91	318.27
34	29.844	29.742	29.642	29.552	29.462	91	319.82	321.19	322.56	323.93	325.30
35	31.078	30.976	30.876	30.787	30.698	92	326.88	328.26	329.64	331.02	332.40
36	32.342	32.240	32.140	32.052	31.964	93	334.01	335.40	336.79	338.18	339.57
37	33.636	33.534	33.434	33.347	33.260	94	341.21	342.61	344.01	345.41	346.81
38	34.960	34.858	34.758	34.672	34.586	95	348.48	349.89	351.30	352.71	354.12
39	36.314	36.212	36.112	36.038	35.964	96	355.82	357.24	358.66	360.08	361.50
40	37.698	37.596	37.496	37.424	37.352	97	363.23	364.66	366.09	367.52	368.95
41	39.112	39.010	38.910	38.848	38.786	98	370.71	372.15	373.59	375.03	376.47
42	40.556	40.454	40.354	40.294	40.234	99	378.26	379.71	381.16	382.61	384.06
43	42.030	41.928	41.828	41.778	41.728	100	385.88	387.34	388.80	390.26	391.72

^aHandbook of Chemistry and Physics, 45th Edition, Chemical
 Rubber Publishing Company, 1965.

DUPONT ALPHA-1 CALIBRATION DATA SHEET

PROJECT #: _____

LOCATION: _____

DATE: _____

SAMPLE MEDIA TYPE: _____

BUBBLE TUBE S/N: _____

PRE-TEST

POST-TEST

TIME: _____

BAROMETRIC PRESS. (mm Hg): _____

VAPOR PRESS. (mm Hg): _____

TEMP. (DEG C): _____

[illegible]

DO PRE-TEST AND POST-TEST STANDARD FLOW RATES FOR EACH PUMP AGREE WITHIN + OR - 10% ? Y N

ARE ALL CALIBRATIONS AND DATA CLEARLY DOCUMENTED ? Y N

DATE: _____ TIME: _____ TECHNICIAN: _____

$$\text{STANDARD FLOW RATE} = \frac{\text{VOL (mL)}}{\text{TIME (min)}} \times \frac{(P - P_v)}{760} \times \frac{298.16}{(273 + t)}$$

STANDARD OPERATION PROCEDURE

THERMO ENVIRONMENTAL MODEL OVM 580B PID

Turn power on by inserting the power plug into the power port of the OVM. Turn pump and lamp on by pressing the ON/OFF switch.

Calibration Procedure

1. Be sure a flashing B symbol does not appear in the upper left corner of display. This indicate the batteries are low and need to be recharged before use.
2. Fill Tedlar bags ½-full with 100 ppm isobutylene span gas by attaching calibrant gas bottle to a regulator.
3. Press mode button, display will read "Log this value?"
Depress the negative (-) button
4. Display will read "R/comm -/PARAM
+/ACCESS 5/CLOCK"
Depress the negative (-) button
5. Meter will display "Conc meter
"Reset" to Chg"
Depress the positive (+) button
6. Meter will display "Auto Logging
Off"
Depress the positive (+) button

7. Meter will display "Average = 0:01
Reset to Charge"
Depress the positive (+) button
8. Meter will display "ALM at 2000"
Depress the positive (+) button
9. Meter will display "Lamp 11.8ev"
(Serial # of Lamp)
Depress the positive (+) button
10. Meter will display "RF = 1.00"
Depress the positive (+) button
11. Display will read "Reset" to Calibrate"
Press the reset button
12. Display will read "Restore Back-up"
Press the negative (-) button
13. Display will read "zero gas"
"Reset" when Ready"
Hit "Reset" button
14. The 580B will then zero the instrument. The meter will display
"MODEL 580B
Zeroing"

Once the 580B has zeroed the meter will display

"SPAN PPM = 100"

Hit the positive (+) button

15. The meter will display

"SPAN GAS

Reset when Ready"

Attach the Tedlar bag to the meter and press reset button.

The display will read

"MODEL 580B

Calibrating"

16. When the OVM displays

"Reset to Calibrate"

Press the Mode/Store button and it will display the calibration measurement in parts per million. The reading should be within 10 percent of the 100 ppm isobutylene span gas. If the value is off by more than 10 percent, recalibrate the OVM again.

17. The OVM is now ready for use. It is best to collect as many soil samples as practical for the job, turn the OVM on to test those samples and then turn it off. Do not unplug the OVM between uses or the instrument will lose the calibration.

18. Refer to instrument manual for trouble-shooting guide if machine is not responding to calibration procedures.

- * The parameters (i.e., type of lamp, RF value, etc.) may be changed by hitting the reset button and entering the new parameter settings.

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May 9, 1996
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STANDARD OPERATING PROCEDURE

HNU HW-101 PID

Attach the probe to the probe extension and then connect the probe to the key interface.

Turn the control knob to the battery position to be sure the instrument is charged. If this indicates that the batteries are low, the instrument should be recharged before use.

Calibration Procedure:

1. Set span dial to 9.8.
2. Turn control knob to the 0-20 scale and use the zero knob to zero the needle.
3. Turn knob to the 0-200 position.
4. Attach a regulator to a canister of 100 ppm isobutylene calibrant gas.
5. With a small piece of tubing attach the regulator to the probe extension tip and open the regulator valve.
6. The HNu needle should display 56 ppm. The span may be changed to move the needle to the desired concentration level. The span should be recorded in a field log book. If the span is below 5.0, then the lamp should be cleaned following the manufacturers specifications and the instrument recalibrated.
7. The Hnu is now ready for use. It is best to collect as many soil samples as practical for the job, turn the HNu on to test those samples and then turn it off.
8. Refer to instrument manual for trouble-shooting, if the machine is not responding to the calibration procedures.

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STANDARD OPERATION PROCEDURE

SCREENING SOIL SAMPLES FOR VOCs

Equipment:

PID

Sample jars with lids (approximately 250 milliliter)

Aluminum foil

Procedures:

1. Transfer a representative portion of the sample into the sample jar and fill it approximately halfway.
2. Seal the jar with a piece of aluminum foil.
3. Store the sample for at least one hour in a warm area.
4. In order to take a measurement, push the intake probe of the PID instrument through the foil, taking care not to allow soil or water to enter the intake.
5. Record the highest reading, which usually occurs within 5 seconds of puncturing the seal. Record measurement on log. Allow meter to return to background before next measurement.

skd

April 29, 1996

sops/nabis

STANDARD OPERATING PROCEDURE

DECONTAMINATION

Sampling Equipment

The decontamination procedure for all sampling equipment will be as follows:

- a. wash and scrub with Alconox detergent (pH 9-9.5);
- b. tap water rinse;
- c. rinse with acetone;
- d. deionized water rinse (demonstrated analyte free);
- e. air dry; and
- f. wrap in aluminum foil, shiny side out, for transport or storage.

Drilling Equipment

All drilling equipment will be steam cleaned before use and between boreholes. Augers will be placed on wood planks prior to cleaning. Split-spoon samples will be decontaminated as follows:

- a. brush off excess soil;
- b. wash and scrub with Alconox detergent (ph 9-9.5);
- c. tap water rinse;
- d. deionized water rinse (demonstrated analyte free);
- e. air dry; and
- f. wrap in aluminum foil, shiny side out, for transport or storage.

Analyte-free deionized water used onsite will be provided by an LBG in-house system. The system is a Milli-Q Plus purification system by Millipore.

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STANDARD OPERATING PROCEDURE

WIPE SAMPLE COLLECTION PROCEDURES

Equipment

Neoprene disposal gloves
container of reagent grade
solvent (isooctane/hexane)

laboratory glassware
box of 11 cm filter paper
(Whatmans 40 ashless or
Whatmans 50 smear tabs)

stainless-steel forceps

ice chests, ice packs, tape

10 x 10 cm² template

Procedure

1. Wearing dedicated disposable gloves, remove one filter paper from the box. A new set of gloves should always be worn when collecting a new sample.
2. Moisten the filter paper with collection solvent (either isooctane or hexane). The filter should be wet, but not dripping.
3. Delineate the sample area by marking with a disposable template.
4. Using either stainless-steel forceps or disposable gloves, thoroughly rub the sample area with the filter paper.
5. Without allowing the filter paper to contact any surface other than the sample area, fold the filter paper with the exposed side in and place the filter paper into the appropriate laboratory glassware.

Table 1

HYDROCARBONS, AROMATIC

METHOD: 1501

ISSUED: 2/15/84

Table 1

NIOSH, ACGIH: Table 2

PROPERTIES: Table 1

GROUPS:	benzene	cumene	α -methylstyrene	styrene	vinyltoluene
ANALYTES:	p-tert-butyltoluene	ethylbenzene	naphthalene	toluene	xylene

Table 1)

SAMPLING	MEASUREMENT
REAGENT: SOLID SORBENT TUBE (coconut shell charcoal, 100 mg/50 mg) DATE, VOLUME: Table 3 PRECAUTIONS: no special precautions STABILITY: not determined 2 to 10 field blanks per set SAMPLE: desirable, 1 to 10 mL; ship in separate containers from samples	TECHNIQUE: GAS CHROMATOGRAPHY, FID ANALYTES: hydrocarbons listed above DESORPTION: 1 mL CS₂; stand 30 min INJECTION VOLUME: 5 μL TEMPERATURE-INJECTION: 225 °C -DETECTOR: 225 °C -COLUMN: see step 11 CARRIER GAS: N₂ or He, 25 mL/min COLUMN: glass, 3.0 m x 2 mm, 10% OV-275 on 100/120 mesh Chromosorb W-AW or equivalent CALIBRATION: analytes in CS₂ RANGE AND PRECISION (s_r): Table 4 ESTIMATED LOD: 0.001 to 0.01 mg per sample with capillary column [1]
ACCURACY	
OVERALL PRECISION (s_r): Table 3	

NOTE: This method is for peak, ceiling and TWA determinations of aromatic hydrocarbons used for simultaneous measurements, though there is the possibility that interactions of analytes may reduce the breakthrough volumes and change desorption efficiencies.

CAUTIONS: Use of the recommended column will prevent interference by alkanes ($\leq$ C₁₀). Conditions of high humidity, the breakthrough volumes may be reduced by as much as 50%. Avoid organic solvents, e.g., alcohols, ketones, ethers and halogenated hydrocarbons, which cause interferences. If interference is suspected, use a less polar column or change the desorption solvent.

REFERENCES: This method is based on and supercedes Methods P&CAM 127, benzene, styrene, xylene [2]; S311, benzene [4]; S22, p-tert-butyltoluene [3]; S23, cumene [3]; S29, toluene [3]; S26, α -methylstyrene [3]; S292, naphthalene [4]; S30, styrene [3]; S343, toluene [3]; S25, vinyltoluene [3]; S318, xylene [4].

REAGENTS:

1. Eluent: Carbon disulfide*, chromatographic quality containing (optional) suitable internal standard.
2. Analytes, reagent grade*
3. Nitrogen or helium, purified
4. Hydrogen, prepurified.
5. Air, filtered.
6. Naphthalene calibration stock solution, 0.40 g/mL in CS₂.

*See Special Precautions.

EQUIPMENT:

1. Sampler: glass tube, 7 cm long, 6 mm OD, 4 mm ID, flame-sealed ends, containing two sections of activated (600 °C) coconut shell charcoal (front = 100 mg, back = 50 mg) separated by a 2-mm urethane foam plug. A silylated glass wool plug precedes the front section and a 3-mm urethane foam plug follows the back section. Pressure drop across the sampler at 1 L/min airflow must be less than 3.4 kPa. Samplers are commercially available.
2. Personal sampling pumps, 0.01 to 1 L/min (Table 3), with flexible connecting tubing.
3. Gas chromatograph, FID, integrator, and column (page 1501-1).
4. Vials, glass, 1-mL, with PTFE-lined caps.
5. Pipet, 1-mL, and pipet bulb.
6. Syringes, 5-, 10-, 25- and 100- μ L.
7. Volumetric flasks, 10-mL.

SPECIAL PRECAUTIONS: Carbon disulfide is toxic and extremely flammable (flash point = -30 °C). Benzene is a suspect carcinogen. Prepare samples and standards in a well-ventilated hood.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Break the ends of the sampler immediately before sampling. Attach sampler to personal sampling pump with flexible tubing.
3. Sample at an accurately known flow rate between 0.01 and 0.2 L/min (to 1 L/min for naphthalene or styrene) for a total sample size as shown in Table 3.
4. Cap the samplers with plastic (not rubber) caps and pack securely for shipment.

SAMPLE PREPARATION:

5. Place the front and back sorbent sections of the sampler tube in separate vials. Discard the glass wool and foam plugs.
6. Add 1.0 mL eluent to each vial. Attach crimp cap to each vial immediately.
7. Allow to stand at least 30 min with occasional agitation.

CALIBRATION AND QUALITY CONTROL:

8. Calibrate daily with at least five working standards over the appropriate range (ca. 0.1 to 10 mg analyte per sample; see Table 4).
 - a. Add known amounts of analyte (calibration stock solution for naphthalene) to eluent in 10-mL volumetric flasks and dilute to the mark.
 - b. Analyze together with samples and blanks (steps 11, 12 and 13).
 - c. Prepare calibration graph (peak area of analyte vs. mg analyte).

Determine desorption efficiency (DE) at least once for each batch of charcoal used for sampling in the calibration range (step 8). Prepare three tubes at each of five levels plus three media blanks.

- Remove and discard back sorbent section of a media blank sampler.
 - Inject a known amount of analyte (calibration stock solution for naphthalene) directly onto front sorbent section with a microliter syringe.
 - Cap the tube. Allow to stand overnight.
 - Desorb (steps 5 through 7) and analyze together with working standards (steps 11, 12 and 13).
 - Prepare a graph of DE vs. mg analyte recovered.
- Analyze three quality control blind spikes and three analyst spikes to insure that the calibration graph and DE graph are in control.

MEASUREMENT:

Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 1501-1. Select appropriate column temperature:

Substance ^a	Approximate Retention Time (min), at Indicated Column Temperature			
	50 °C	100 °C	150 °C	Programmed ^b
benzene	2.5			2.5
toluene	4.3	1.1		4.2
xylene (para)	7.0	1.4		5.2
ethylbenzene	7.0	1.4		5.5
xylene (meta)	7.2	1.5		5.6
cumene	8.3	1.6		6.0
xylene (ortho)	10	1.9		6.5
styrene	16	2.6		7.6
p-methylstyrene		3.2	1.0	8.1
vinyltoluene (meta)		3.8	1.2	8.5
naphthalene		25	4.3	12

Data not available for p-tert-butyltoluene and p-vinyltoluene.

Temperature program: 50 °C for 3 min, then 15 °C/min to 200 °C.

NOTE: Alternatively, column and temperature may be taken from Table 4.

Inject sample aliquot manually using solvent flush technique or with autosampler.

NOTE: If peak area is above the linear range of the working standards, dilute with eluent, reanalyze and apply the appropriate dilution factor in calculations.

Measure peak area.

CALCULATIONS:

Determine the mass, mg (corrected for DE) of analyte found in the sample front (W_f) and back (W_b) sorbent sections, and in the average media blank front (B_f) and back (B_b) sorbent sections.

NOTE: If $W_b > W_f/10$, report breakthrough and possible sample loss.

15. Calculate concentration, C, of analyte in the air volume sampled, V (L):

$$C = \frac{(W_f + W_b - B_f - B_b) \cdot 10^9}{V}, \text{ mg/m}^3.$$

EVALUATION OF METHOD:

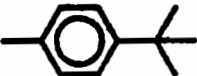
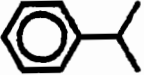
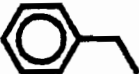
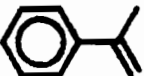
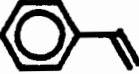
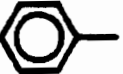
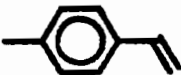
Precisions and biases listed in Table 3 were determined by analyzing generated atmosphere containing one-half, one, and two times the OSHA standard. Generated concentrations were independently verified. Breakthrough capacities were determined in dry air. Storage stability was not assessed. Measurement precisions given in Table 4 were determined by spiking samples with amounts corresponding to one-half, one, and two times the OSHA standard for various air volumes. Desorption efficiencies for spiked samplers containing only one compound are 75%. Reference [12] provides more specific information.

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METHOD REVISED BY: R. Alan Lunsford, Ph.D., and Julie R. Okenfuss; based on results of Contract CDC-99-74-45.

1. Synonyms, formula, molecular weight, properties [5].

Synonyms	Structure	Empirical Formula	Molec- ular Weight	Boiling Point (°C)	Vapor Pressure @ 25 °C		Density @ 20 °C (g/mL)
					(mm Hg)	(kPa)	
#71-43-2		C ₆ H ₆	78.11	80.1	95.2	12.7	0.879
tert-butyltoluene #98-51-1 tert-butyl-4-methylbenzene		C ₁₁ H ₁₆	148.25	192.8	0.7	0.09	0.861
#98-82-8 isopropylbenzene		C ₉ H ₁₂	120.20	152.4	4.7	0.62	0.862
benzene #100-41-4		C ₈ H ₁₀	106.17	136.2	9.6	1.28	0.867
styrene #98-83-9 vinylbenzene (ethylethenyl)-benzene		C ₉ H ₁₀	118.18	165.4	2.5	0.33	0.911
fluorene #91-20-3		C ₁₀ H ₈	128.18	80.2 ^a	0.2	0.03	1.025
#100-42-5 vinylbenzene		C ₈ H ₈	104.15	145.2	6.1	0.81	0.906
#108-88-3 toluene		C ₇ H ₈	92.14	110.6	28.4	3.79	0.867
styrene ^b #25013-15-4 styrene vinylbenzene		C ₉ H ₁₀	118.18	167.7	1.6	0.22	0.898
	(p-vinyltoluene)	(meta)		171.6	1.9	0.26	0.911
		(para)		172.8	1.8	0.24	0.911
		(ortho)		169.8	1.8	0.24	0.904
#130-20-7 p-xylene		C ₈ H ₁₀	106.17	144.4	6.7	0.89	0.880
	(p-xylene)	(meta)		139.1	8.4	1.12	0.864
		(para)		138.4	8.8	1.18	0.861

point.

mixture of meta and para isomers.

of isomers.

Table 2. Permissible exposure limits, ppm [6-11].

Substance	OSHA			NIOSH		ACGIH		mg/m ³ per ppm
	TWA	C	Peak	TWA	C	TLV	STEL	
benzene	10	25	50 ^a	1		10**	25**	3.19
p-tert-butyltoluene	10					10	20	6.06
cumene	50 (skin)					50	75 (skin)	4.91
ethylbenzene	100					100	125	4.34
α-methylstyrene		100				50	100	4.83
naphthalene	10					10	15	5.24
styrene	100	200	600 ^b	50	100	50	100	4.26
toluene	200	300	500 ^a	100	200*	100	150 (skin)	3.77
vinyltoluene	100					50	100	4.83
xylene	100			100	200*	100	150	4.34

^aMaximum duration 10 min in 8 hr.

**ACGIH: suspect carcinogen [10].

^bMaximum duration 5 min in any 3 hr.

* 10-min sample.

Table 3. Sampling flowrate^a, volume, capacity, range, overall bias and precision [3,4,12].

Substance	Sampling			Breakthrough		Range	Overall	
	Flowrate (L/min)	Volume (L)		Volume @ Concentration		at	Bias (%)	Precision (%)
		VOL-NOM	VOL-MAX ^b	(L)	(mg/m ³)	VOL-NOM (mg/m ³)		
benzene	≤0.20	2 ^c	30	>45	149	42- 165	0.8	0.65
p-tert-butyltoluene	≤0.20	10	29	44	112	29- 119	-10.4	0.60
cumene	≤0.20	10	30	>45	480	120- 480	4.6	0.60
ethylbenzene	≤0.20	10	24	35	917	222- 884	-8.1	0.60
α-methylstyrene	≤0.20	3 ^f	30	>45	940	236- 943	-10.8	0.65
naphthalene ^e	≤1.0	200	200	>240	81	19- 83	-0.5	0.60
styrene	≤1.0	5 ^g	14	21	1710	426-1710	-10.7	0.60
toluene	≤0.20	2 ^c	8	12	2294	548-2190	3.8	0.60
vinyltoluene	≤0.20	10	24	36	952	256- 970	-9.5	0.60
xylene	≤0.20	12	23	35	870	218- 870	-2.1	0.60

^aMinimum recommended flow is 0.01 L/min.^bApproximately two-thirds the breakthrough volume, except for naphthalene.^c10-min sample.^dCorrected value, calculated from data in Reference 12.^eNaphthalene shows poor desorption efficiency at low loading; 100-L minimum volume is recommended.^f15-min sample.^g95-min sample.

Measurement range, precision and conditions^a [3,4,12].

	Desorption Volume (mL)	Measurement		Carrier Flow (mL/min)	Column Parameters ^b		
		Range (mg)	Precision (s _r)		t (°C)	Length (m)	Packing ^c
Toluene	1.0	0.09- 0.35	0.036	50	115	0.9	A
	0.5	0.27- 1.09	0.021 ^d	50	115	3.0	B
	0.5	0.86- 3.46	0.010	50	99	3.0	B
Benzene	0.5	2.17- 8.67	0.010	50	85	3.0	B
Styrene	0.5	0.69- 3.57	0.011	50	115	3.0	B
Phenylacetylene	1.0	4.96-19.7	0.019	30	125	3.0	C
Phenylacetylene	0.5	2.17- 8.49	0.013 ^d	50	109	3.0	B
Phenylacetylene	1.0	1.13- 4.51	0.011	50	155	0.9	D
Phenylacetylene	0.5	2.41- 9.64	0.008	50	120	3.0	B
Phenylacetylene	1.0	2.60-10.4	0.010	50	180	0.9	D

^a Injection volume, 5.0 µL; nitrogen carrier gas.

^b Columns stainless steel, 3.2 mm outside diameter.

^c A, 50/80 mesh Porapak P; B, 10% FFAP on 80/100 mesh Chromosorb W AW-DMCS;

^c C, 10% OV-101 on 100/120 mesh Supelcoport; D, 50/80 mesh Porapak Q.

^d Corrected value, calculated from data in [12].

FORMULA: Table 1

HYDROCARBONS, HALOGENATED

M.W.: Table 1

METHOD: 1003

ISSUED: 2/14/84

COMPOUNDS:	benzyl chloride	chlorobromomethane	1,1-dichloroethane	hexachloroethane
(synonyms	bromoform	chloroform	1,2-dichloroethylene	methylchloroform
in Table 1)	carbon tetrachloride	o-dichlorobenzene	ethylene dichloride	propylene dichloride
	chlorobenzene	p-dichlorobenzene		

SAMPLING	MEASUREMENT
SAMPLER: SOLID SORBENT TUBE (coconut shell charcoal, 100 mg/50 mg)	! TECHNIQUE: GAS CHROMATOGRAPHY, FID
FLOW RATE: 0.01 to 0.2 L/min	! ANALYTE: compounds above
VOL-MIN: Table 2	! DESORPTION: 1 mL CS ₂ , stand 30 min
-MAX: Table 2	! INJECTION VOLUME: 5 µL
SHIPMENT: routine	! TEMPERATURES: Table 2
SAMPLE STABILITY: at least 1 week @ 25 °C	! CARRIER GAS: N ₂ or He, 30 mL/min
BLANKS: 2 to 10 field blanks per set	! COLUMN: Table 2; alternates are SP-2100, SP-2100 with 0.1% Carbowax 1500 or DB-1 fused silica capillary column
ACCURACY	! CALIBRATION: solutions of analyte in CS ₂ with internal standard, if necessary
RANGE STUDIED: see EVALUATION OF METHOD [1]	! RANGE: Table 2
BIAS: not significant [1]	! ESTIMATED LOD: 0.01 mg per sample [2]
OVERALL PRECISION (s _r): see EVALUATION OF METHOD [1]	! PRECISION (s _r): see EVALUATION OF METHOD [1]

APPLICABILITY: This method uses a simple desorption and can be used for simultaneous analysis of two or more substances suspected to be present by changing the gas chromatographic conditions (i.e., temperature programmed). High humidity during sampling will prevent organic vapors from being trapped efficiently on the sorbent and greatly decreases breakthrough volume.

INTERFERENCES: None identified. The chromatographic column or separation conditions may be changed to circumvent interference problems.

OTHER METHODS: This method combines and replaces Methods P&CAM 127 [3]; S95, S101, S110, S113, S114, S115, S122, S123 and S133 [4]; and S135, S281, S314, S328 and S351 [5].

REAGENTS:

1. Eluent: Carbon disulfide,* chromatographic quality, containing 0.1% (v/v) toluene, ethyl benzene or other suitable internal standard (see Table 2).
2. Analyte, reagent grade.
3. Calibration stock solutions.
 - a. benzyl chloride, 10 mg/mL in n-heptane.
 - b. bromoform, 10 mg/mL in n-hexane.
 - c. p-dichlorobenzene, 200 mg/mL in carbon disulfide.
 - d. p-dichlorobenzene, 300 mg/mL in acetone.
4. Nitrogen or helium, purified.
5. Hydrogen, prepurified.
6. Air, filtered.

*See Special Precautions.

EQUIPMENT:

1. Sampler: glass tube, 7 cm long, 6 mm OD, 4 mm ID, flame-sealed ends, containing two sections of activated (600 °C) coconut shell charcoal (front = 100 mg; back = 50 mg) separated by a 2-mm urethane foam plug. A silylated glass wool plug precedes the front section and a 3-mm urethane foam plug follows the back section. Pressure drop across the tube at 1 L/min airflow must be less than 3.4 kPa. Tubes are commercially available.
2. Personal sampling pump, 0.01 to 0.2 L/min, with flexible connecting tubing.
3. Gas chromatograph, FID, integrator and column (see Table 1).
4. Vials, 2-mL, glass, PTFE-lined crimp caps.
5. Volumetric flasks, 10-mL.
6. Syringe, 10- μ L, readable to 0.1 μ L.
7. Pipet, 1-mL, with pipet bulb.

SPECIAL PRECAUTIONS: Carbon disulfide is toxic and an acute fire and explosion hazard (flash point = -30 °C); work with it only in a hood.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Break the ends of the sampler immediately before sampling. Attach sampler to personal sampling pump with flexible tubing.
3. Sample at an accurately known flow rate between 0.01 and 0.2 L/min for a total sample size of as shown in Table 2.
4. Cap the samplers with plastic (not rubber) caps and pack securely for shipment.

SAMPLE PREPARATION:

5. Place the front and back sorbent sections of the sampler tube in separate vials. Discard the glass wool and foam plugs.
6. Add 1.0 mL eluent to each vial. Attach crimp cap to each vial.
7. Allow to stand 30 min with occasional agitation.

CALIBRATION AND QUALITY CONTROL:

8. Calibrate daily with at least five working standards over the appropriate range (Table 2).
 - a. Add known amounts of analyte or calibration stock solution to eluent in 10-mL volumetric flasks and dilute to the mark.
 - b. Analyze together with samples and blanks (steps 11 and 12).
 - c. Prepare calibration graph (ratio of peak area of analyte to peak area of internal standard vs. mg analyte).
9. Determine desorption efficiency (DE) at least once for each batch of charcoal used for sampling in the calibration range (step 8). Prepare three tubes at each of five levels plus three media blanks.

- a. Remove and discard back sorbent section of a media blank sampler.
- b. Inject a known amount of analyte or calibration stock solution directly onto front sorbent section with a microliter syringe.
- c. Cap the tube. Allow to stand overnight.
- d. Desorb (steps 5 through 7) and analyze together with working standards (steps 11 and 12).
- e. Prepare a graph of DE vs. mg analyte recovered.
10. Analyze three quality control blind spikes and three analyst spikes to insure that the calibration graph and DE graph are in control.

MEASUREMENT:

11. Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 1003-1. Inject sample aliquot manually using solvent flush technique or with autosampler.
NOTE: If peak area is above the linear range of the working standards, dilute with eluent, reanalyze and apply the appropriate dilution factor in calculations.
12. Measure peak area. Divide the peak area of analyte by the peak area of internal standard on the same chromatogram.

CALCULATIONS:

13. Determine the mass, mg (corrected for DE) of analyte found in the sample front (W_f) and back (W_b) sorbent sections, and in the average media blank front (B_f) and back (B_b) sorbent sections.
NOTE: If $W_b > W_f/10$, report breakthrough and possible sample loss.
14. Calculate concentration, C, of analyte in the air volume sampled, V (L):

$$C = \frac{(W_f + W_b - B_f - B_b) \cdot 10^3}{V}, \text{ mg/m}^3.$$

EVALUATION OF METHOD:

Laboratory testing was performed with spiked samples and generated atmosphere [1]. All analytes are stable at least one week. All methods were validated using SKC Lot 105 coconut shell charcoal. Results were:

Compound	Methods	Range Studied mg/m ³	Sample Size	Precision (s _r)	
				Measurement	Overall
Benzyl chloride	S115 [4]	2 to 8	10 L	0.033	0.096
Bromoform	S114 [4]	3 to 10	10 L	0.047	0.071
Carbon tetrachloride	S314 [5]	65 to 299	15 L	0.037	0.092
Chlorobenzene	S133 [4]	183 to 736	10 L	0.025	0.056
Chlorobromomethane	S113 [4]	640 to 2655	5 L	0.055	0.061
Chloroform	S351 [5]	100 to 416	15 L	0.047	0.057
<i>o</i> -Dichlorobenzene	S135 [5]	150 to 629	3 L	0.014	0.067
<i>p</i> -Dichlorobenzene	S281 [5]	183 to 777	3 L	0.022	0.052
1,1-Dichloroethane	S123 [4]	212 to 838	10 L	0.011	0.057
1,2-Dichloroethylene	S110 [4]	475 to 1915	3 L	0.017	0.052
Ethylene dichloride	S122 [4]	195 to 819	3 L	0.012	0.079
Hexachloroethane	S101 [4]	5 to 25	10 L	0.014	0.121
Methyl chloroform	S328 [5]	904 to 3790	3 L	0.018	0.054
Propylene dichloride	S95 [4]	135 to 665	10 L	0.017	0.056

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METHOD REVISED BY: G. D. Foley; Y. T. Gagnon; and K. J. Williams, NIOSH/DPSE; methods originally validated under NIOSH Contract CDC-99-74-45.

2/15/84

Table 1. General information.

Compounds	Formula	M.W.; mg/m ³ = 1 ppm	Synonyms	OSHA NIOSH [6-10] ACGIH	BP (°C)	VP @ 20 °C	Density (g/mL @ 20 °C)
Benzyl chloride*	$C_6H_5CH_2Cl$ C_7H_7Cl	126.58; 5.17	(chloromethyl) benzene; α-chlorotoluene; CAS #100-44-7	1 ppm — 1 ppm	179	120 kPa	1.098
Bromoform	$CHBr_3$	252.75; 10.33	tribromomethane; CAS #75-25-2	0.5 ppm — 0.5 ppm (skin)	149	670 kPa	2.89
Carbon tetrachloride*	CCl_4	153.84; 6.29	tetrachloromethane; CAS #56-23-5	10 ppm, C 25 ppm 2 ppm/1 hr 5 ppm (skin), STEL 20 ppm	77	12.1 kPa	1.594
Chlorobenzene	C_6H_5Cl	112.56; 4.60	monochlorobenzene; phenyl chloride; CAS #108-90-7	75 ppm — 75 ppm	132	1.2 kPa	1.105
Chlorobromomethane	CH_2BrCl	129.39; 5.29	bromochloromethane; Halon 1011; CAS #74-97-5	200 ppm — 200 ppm, STEL 250 ppm	68	15.6 kPa	1.991
Chloroform*	$CHCl_3$	119.39; 4.88	trichloromethane; CAS #67-66-3	C 50 ppm 2 ppm/1 hr 10 ppm, STEL 50 ppm	61	21.3 kPa	1.481
o-Dichlorobenzene	$1,2-C_6H_4Cl_2$	147.00; 6.01	1,2-dichlorobenzene; CAS #95-50-1	50 ppm — C 50 ppm	180	160 kPa	1.305

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Compounds	Formula	M.W.; mg/m ³ = 1 ppm	OSHA NIOSH [6-10]	VP @ 20 °C	Density (g/mL)

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1003-7
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Compounds	Formula	M.W.; mg/m ³ = 1 ppm	Synonyms	NIOSH [6-10] ACGIH	BP (°C)	20 °C	(g/L) @ 20 °C
p-Dichlorobenzene	1,4-C ₆ H ₄ Cl ₂	147.00; 6.01	1,4-dichlorobenzene; CAS #106-46-7	75 ppm — 75 ppm, STEL 110 ppm	174	50 Pa	1.241
1,1-Dichloroethane	CH ₃ CHCl ₂ ; C ₂ H ₄ Cl ₂	98.96; 4.05	ethylidene chloride; CAS #75-34-3	100 ppm 100 ppm 200 ppm, STEL 250 ppm	57	24.3 kPa	1.174
1,2-Dichloroethylene	ClCH=CHCl; C ₂ H ₂ Cl ₂	96.95; 3.96	acetylene dichloride; 1,2-dichloroethene; CAS #540-59-0	200 ppm 200 ppm 200 ppm, STEL 250 ppm	60 (cis) 47 (trans)	24-35 kPa	1.28
Ethylene dichloride*	ClCH ₂ CH ₂ Cl; C ₂ H ₄ Cl ₂	98.96; 4.05	1,2-dichloroethane; CAS #107-06-2	50 ppm, C 100 ppm 5 ppm; 15 ppm/15 min 10 ppm, STEL 15 ppm	83	8.3 kPa	1.255
Hexachloroethane*	CCl ₃ CCl ₃ ; C ₂ Cl ₆	236.74; 9.68	perchloroethane; CAS #67-72-1	1 ppm (skin) 1 ppm (skin) 10 ppm	187 (sublimes)	30 Pa	2.09
Methylchloroform	CH ₃ CCl ₃ ; C ₂ H ₃ Cl ₃	133.42; 5.45	1,1,1-trichloroethane; CAS #71-55-6	350 ppm 350 ppm/15 min CAS #71-55-6 STEL 450 ppm	74 350 ppm,	13.3 kPa	1.335
Propylene dichloride	CH ₃ CHClCH ₂ Cl; C ₃ H ₆ Cl ₂	112.99; 4.62	1,2-dichloropropane CAS #78-87-5	75 ppm 75 ppm 75 ppm, STEL 110 ppm	95	5.3 kPa	1.156 (25 °C)

*Suspect carcinogen.

METHOD: 1003

HYDROCARBONS, HALOGENATED

Table 2. Operational details.

Compound	Sampling			Measurement				
	Air Sample Volume (L)		Breakthrough in Dry Air	Working Range (mg/m ³)	Column* Column*	t (°C)		Range (mg per sample)
	Min	Max				Injector	Internal Standard	
Benzyl chloride	1 @ 1 ppm	10	48 L @ 8.4 mg/m ³	0.5 to 15 (10 L)	A	160 170 210	n-heptadecane	0.005 to 0.15
Bromoform	1 @ 0.5 ppm	10	48 L @ 10 mg/m ³	0.5 to 15 (10 L)	A	130 170 210	n-pentadecane	0.005 to 0.15
Carbon tetrachloride	2 @ 10 ppm	17	45 L @ 338 mg/m ³	16 to 480 (15 L)	B	60 155 200	decane	0.2 to 7
Chlorobenzene	1 @ 75 ppm	10	44 L @ 693 mg/m ³	35 to 1035 (10 L)	A	105 190 250	---	0.4 to 10
Chlorobromomethane	1 @ 200 ppm	8	8 L @ 2330 mg/m ³	105 to 3150 (5 L)	A	80 170 210	n-undecane	0.5 to 15
Chloroform	1.5 @ 50 ppm	15	46 L @ 473 mg/m ³	25 to 750 (15 L)	B	75 155 200	n-undecane	0.4 to 10
o-Dichlorobenzene	0.5 @ 50 ppm	3	46 L @ 655 mg/m ³	30 to 900 (3 L)	C	140 225 250	nonane	0.1 to 3
p-Dichlorobenzene	1 @ 75 ppm	3	10.8 L @ 778 mg/m ³	75 to 1350 (3 L)	A	140 225 275	---	0.2 to 4

HYDROCARBONS, HALOGENATED

METHOD: 1003

2/15/84

1003-8
288Sampling
Air SampleMeasurement
t (°C)

2/15/84

1003-9
289

Compound	Air Sample Volume (L)		Breakthrough in Dry Air	Working Range (mg/m ³)	Column*	Column Injector Detector	Internal Standard	(mg per sample)
	Min	Max						
1,1-Dichloroethane	1 @ 100 ppm	10	18.3 L @ 838 mg/m ³	40 to 1215 (10 L)	A	50 100 175	---	0.4 to 12
1,2-Dichloroethylene	0.5 @ 200 ppm	3	5.4 L @ 1909 mg/m ³	80 to 2370 (3 L)	A	60 170 210	---	0.2 to 7
Ethylene dichloride	1 @ 50 ppm	10	29 L @ 821 mg/m ³	40 to 1215 (3 L)	A	70 225 250	octane	0.1 to 4
Hexachloroethane	1 @ 1 ppm	10	48 L @ 23 mg/m ³	1 to 30 (10 L)	D	110 170 210	n-tridecane	0.01 to 0.3
Methylchloroform	0.5 @ 350 ppm	6	9.5 L @ 3788 mg/m ³	190 to 5700 (3 L)	A	70 225 250	octane	0.6 to 17
Propylene dichloride	1 @ 75 ppm	10	18 L @ 587 mg/m ³	35 to 1050 (10 L)	A	80 170 210	n-undecane	0.3 to 10

*A = 3' m x 3 mm stainless steel, 10% SP-1000 on 80/100 mesh Supelcoport;

B = 6 m x 3 mm, otherwise same as A;

C = 3 m x 3 mm stainless steel, 10% OV-101 on 100/120 mesh Supelcoport; or

D = 3 m x 6 mm glass, 3% SP-2250 on 80/100 mesh Supelcoport.

1003

HYDROCARBONS, HALOGENATED

FORMULA: The respirable fraction of the dust mass, as specified by the American Conference of Governmental Industrial Hygienists [1]

NUISANCE DUST, RESPIRABLE

METHOD: 0600
ISSUED: 2/15/84

OSHA: 5 mg/m³
NIOSH: no standard
ACGIH: 5 mg/m³

PROPERTIES: Penetrates the non-ciliated portions of the lung; quartz less than 1%

SYNONYMS: boron oxide (CAS #1303-86-2) and nuisance dusts [2], including alumina (CAS #1344-28-1), calcium carbonate (CAS #1317-65-3), cellulose (paper fiber; CAS #9004-34-6), glycerin mist (CAS #56-81-5), limestone (CAS #1317-65-3), etc.

SAMPLING	MEASUREMENT
SAMPLER: CYCLONE + FILTER (10-mm Dorr-Oliver cyclone + tared 5- μ m PVC membrane)	! TECHNIQUE: GRAVIMETRIC (FILTER WEIGHING) !
FLOW RATE: 1.7 L/min	! ANALYTE: mass of respirable dust fraction !
VOL-MIN: 75 L @ 5 mg/m ³ -MAX: 1000 L @ 5 mg/m ³	! BALANCE: 0.01 mg sensitivity or better; use same balance before and after sample collection !
SHIPMENT: routine	! CALIBRATION: National Bureau of Standards Class M weights !
SAMPLE STABILITY: indefinitely	! RANGE: 0.3 to 2 mg per sample !
BLANKS: 2 to 10 field blanks per set	! ESTIMATED LOD: 0.2 mg per sample !
ACCURACY	! PRECISION: 68 μ g with 0.01-mg sensitivity balance [5] !
RANGE STUDIED: 0.5 to 10 mg/m ³ (lab and field)	!
BIAS: depends on dust size distributions [3]	!
OVERALL PRECISION (s_p): 0.043 to 0.145 (lab); 0.144 to 0.227 (field) [4]	!

APPLICABILITY: The method measures the mass concentration of any non-volatile respirable dust. Besides inert dusts [1], the method is recommended for respirable coal dust, which has an OSHA PEL = 2.4 mg/m³. The method may be biased where the respirable fraction is defined by the British Medical Research Council's criteria or the MRE horizontal elutriator [4].

INTERFERENCES: Larger than respirable particles (over 10 μ m) have been found in some cases by microscopic analysis of cyclone filters. Over-sized particles in the sample are known to be caused by inverting the cyclone assembly. Heavy dust loadings, charged particles, fibers and water-saturated dusts also interfere with the cyclone's size-selective properties.

OTHER METHODS: This method is based on and replaces Sampling Data Sheet #29.02 [6].

NUISANCE DUST, RESPIRABLE

EQUIPMENT:

1. Sampler:

- a. Filter: 37-mm diameter, 5.0- μ m pore size, polyvinyl chloride filter or equivalent hydrophobic membrane filter supported with backup pad in a two-piece, 37-mm diameter filter holder held together by tape or cellulose shrink band.
 - b. Cyclone: 10-mm Dorr-Oliver nylon cyclone.
 - c. Sampling head holder: this holder must keep the cassette, cyclone and coupler rigidly so that air enters only at the cyclone inlet.
2. Personal sampling pump, 1.7 L/min $\pm$ 5%, with flexible connecting tubing.
NOTE: Pulsation in the pump flow must be within $\pm$ 20% of the mean flow.
 3. Balance, analytical, with sensitivity of at least 0.01 mg. A more sensitive balance necessary for substances with PEL's below 1 mg/m³.
 4. Static neutralizer, e.g., Po-210; replace nine months after the production date.
 5. Environmental chamber for balance, e.g., 20 °C $\pm$ 0.3 °C and 50% $\pm$ 5% RH.
 6. Vacuum desiccator.

SPECIAL PRECAUTIONS: None.

PREPARATION OF SAMPLERS BEFORE SAMPLING:

1. Dry filters and backup pads under vacuum in the vacuum desiccator for at least 15 min.
2. Release the vacuum, remove the desiccator cover, and equilibrate the filters in the environmental chamber for at least 1 hr.
3. Number the backup pads with a ballpoint pen and place them, numbered side down, in the cassette bottom sections.
4. Weigh the filters in the environmental chamber. Record the filter tare weight, W_f .
 - a. Zero the balance before each weighing;
 - b. Handle the filter with forceps (nylon forceps if further analyses will be done);
 - c. Pass the filter over an antistatic radiation source. Repeat this step if filter does not release easily from the forceps or if filter attracts balance pan. Static electricity can cause erroneous weight readings.
5. Place the weighed filters on top of the backup pads in the filter cassette bottom sections and allow to stand an additional 8 to 16 hrs in the environmental chamber.
6. Reweigh the filters. If this tare weight differs by more than 0.01 mg from the first weight obtained in step 4 above, discard the filter.
NOTE: Insert a rod through the outlet hole of the filter cassette bottom section to the backup pad and filter so that the filter can be grasped with forceps.
7. Assemble the filters in the filter cassettes and close firmly so that leakage around filter will not occur. Place a plug in each opening of the filter cassette. Place a cellulose shrink band around the filter cassette, allow to dry, and mark with the same number as the backup pad.
8. Remove the cyclone's grit cap and vortex finder before use and inspect the cyclone interior. If the inside is visibly scored, discard this cyclone since the dust separation characteristics of the cyclone might be altered. Clean the interior of the cyclone to prevent reentrainment of large particles.
9. Assemble the sampler head. Check alignment of filter holder and cyclone in the sampler head to prevent leakage.

SAMPLING:

10. Calibrate each personal sampling pump to 1.7 L/min with a representative sampler in line.
11. Sample at 1.7 L/min for 45 min to 8 hrs (76 to 816 L). Do not exceed 5 mg dust loading on the filter.

NOTE: Do not allow the sampler assembly to be inverted at any time. Turning the cyclone to anything more than a horizontal orientation may deposit over-sized material from the cyclone body onto the filter.

SAMPLE PREPARATION:

12. Wipe dust from the external surface of the filter cassette with a moist paper towel to minimize contamination. Discard the paper towel.
13. Remove the top and bottom plugs from the filter cassette. Place the filter cassettes in a vacuum desiccator under vacuum for at least 15 min, followed by equilibration for at least 1 hr in the environmental chamber.
14. Remove the filter cassette band, pry open the filter cassette, and remove the filter by inserting a rod in the outlet hole of the filter cassette. Handle the filters very gently by the edge to avoid loss of dust.

NOTE: If the filter sticks to the underside of the cassette top, very gently lift away by using the dull side of a scalpel blade. This must be done carefully or the filter will tear.

CALIBRATION AND QUALITY CONTROL:

15. Zero the microbalance before all weighings. Use the same microbalance for weighing filters before and after sample collection. Calibrate the balance with National Bureau of Standards Class M weights.
16. Take two to four replicate samples for every batch of field samples for quality assurance on the sampling procedures. The set of replicate samples should be exposed to the same dust environment, either in a laboratory dust chamber [7] or in the field [8]. The quality control samples must be taken with the same equipment, procedures and personnel used in the routine field samples. Calculate precision from these replicates and record s_r on control charts. Take corrective action when the precision is out of control [7].

MEASUREMENT:

17. Weigh each filter, including field blanks. Record this post-sampling weight, W_2 (mg), beside its corresponding tare weight. Record anything remarkable about a filter (e.g., visible particles, overloaded, leakage, wet, torn, etc.).

CALCULATIONS:

18. Calculate the concentration of respirable nuisance dust, C (mg/m³), in the air volume sampled, V (L):

$$C = \frac{(W_2 - W_1) + B}{V} \cdot 10^3, \text{ mg/m}^3$$

where: W_1 = tare weight of filter before sampling (mg)

W_2 = post-sampling weight of sample-containing filter (mg)

B = mean change in field blank filter weights between tare and post-sampling (mg)
(+ or -).

EVALUATION OF METHOD:

1. Bias. In respirable dust measurements, the bias in a sample is calculated relative to an appropriate respirable dust criterion. The theory for calculating bias is developed by Bartley and Breuer [3]. For this method, the bias, therefore, depends on the ACGIH criterion for respirable dust, the cyclone's penetration curve at 1.7 L/min flow rate, and the size distribution of the ambient dust. Based on the cyclone's penetration curves for non-pulsating flow measured with a monodisperse aerosol by Caplan, Doemeny and Sorensen [9], the bias in this method is shown in Figure 1.

For dust size distributions in the shaded region, the bias in this method lies within ± 0.10 criterion established by NIOSH for method validation. Bias larger than ± 0.10 would, therefore, be expected for many workplace aerosols, especially those with small median diameters. However, bias within ± 0.20 would be expected for dusts with geometric standard deviations greater than 2.0, which is the case in most workplaces.

Bias can also be caused in a cyclone by the pulsation of the personal sampling pump. Bartley, et al. [10] showed that cyclone samples with pulsating flow can have negative bias as large as -0.22 relative to samples with steady flow. The magnitude of the bias depends on the amplitude of the pulsation at the cyclone aperture and the dust size distribution. For pumps with instantaneous flow rates within 20% of the mean, the pulsation bias is less than -0.02 for most dust size distributions encountered in the workplace.

Electric charges on the dust and the cyclone will also cause bias. Briant and Moss [11] have found electrostatic biases as large as -50%, and show that cyclones made with graphite-filled nylon eliminate the problem.

2. Precision. In a recent review [4], the overall cyclone precision is shown to be most sensitive to two factors: the analytical precision and the sampling procedures, particularly the quality control system used in the maintenance and calibration of samplers. Theoretically, the variance for the overall precision is the sum of the variances from the sampling and analysis. The analytical variance depends on the dust loading on the filter. For the dust loading in an 8-hr sample above 1.5 mg/m³, Bowman, et al. [4] find that the empirically determined sampling error dominates this analytical error.

Because of the effects of the environment, precision estimates for dust samplers are much more variable than those reported for gas and vapor sampling. In laboratory tests with 0.01 mg sensitivity balances, the overall precision of a single respirable dust sample has relative standard deviations (s_r) from 0.043 to 0.145 over concentrations ranging from 0.5 to 5 mg/m³. In the laboratory studies where the dust concentrations in the test chamber are more carefully controlled, the estimated s_r is less than 0.091, which is the target precision value for a bias equal to ± 0.10 in the NIOSH validation criteria.

In the field tests with 0.01 mg sensitivity balances, precision estimates range from 0.144 to 0.227 over concentrations ranging from 1 to 10 mg/m³. Whether the larger s_r values in field tests are due to sampler performance or to more inhomogeneous dust concentrations in the field tests cannot be determined from existing data.

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METHOD 3810

HEADSPACE

1.0 SCOPE AND APPLICATION

1.1 Method 3810 was formerly Method 5020 in the second edition of this manual.

1.2 Method 3810 is a static headspace technique for extracting volatile organic compounds from samples. It is a simple method that allows large numbers of samples to be screened in a relatively short period of time. It is ideal for screening samples prior to using the purge-and-trap method. Detection limits for this method may vary widely among samples because of the large variability and complicated matrices of waste samples. The method works best for compounds with boiling points of less than 125°C. The sensitivity of this method will depend on the equilibria of the various compounds between the vapor and dissolved phases.

1.3 Due to the variability of this method, this procedure is recommended for use only as a screening procedure for other, more accurate determinative methods (Methods 8010, 8015, 8020, 8030, and 8240).

2.0 SUMMARY OF METHOD

2.1 The sample is collected in sealed glass containers and allowed to equilibrate at 90°C. A sample of the headspace gas is withdrawn with a gas-tight syringe for screening analysis using the conditions specified in one of the GC or GC/MS determinative methods (8010, 8015, 8020, 8030, or 8240).

3.0 INTERFERENCES

3.1 Samples can be contaminated by diffusion of volatile organics (particularly chlorofluorocarbons and methylene chloride) through the sample container septum during shipment and storage. A field sample blank prepared from reagent water and carried through sampling and subsequent storage and handling can serve as a check on such contamination.

3.2 Contamination by carryover can occur whenever high-level and low-level samples are sequentially analyzed. To reduce carryover, the sample syringe must be rinsed out between samples with reagent water. Whenever an unusually concentrated sample is encountered, it should be followed by an analysis of reagent water. It may be necessary to wash out the syringe with detergent, rinse with distilled water, and dry in a 105°C oven between analyses.

3.3 Before processing any samples, the analyst should demonstrate daily through the analysis of an organic-free water or solvent blank that the entire analytical system is interference-free.

4.0 APPARATUS AND MATERIALS

4.1 Refer to the specific determinative method for appropriate apparatus and materials.

4.2 Vials: 125-mL Hypo-Vials (Pierce Chemical Co., #12995, or equivalent), four each.

4.3 Septa: Tuf-Bond (Pierce #12720 or equivalent).

4.4 Seals: Aluminum (Pierce #132141 or equivalent).

4.5 Crimper: Hand (Pierce #13212 or equivalent).

4.6 Syringe: 5-mL, gas-tight with shutoff valve and chromatographic needles.

4.7 Microsyringe: 250- or 500-uL.

4.8 Water bath: Heated, with concentric ring cover, capable of temperature control ($\pm 5^{\circ}\text{C}$). The bath should be used in a hood.

5.0 REAGENTS

5.1 Refer to the specific determinative method and Method 8000 for preparation of calibration standards.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 Refer to the introductory material to this chapter, Organic Analytes, Section 4.1.

7.0 PROCEDURE

7.1 Gas chromatographic conditions and Calibration: Refer to the specific determinative method for GC operating conditions and to Method 8000, Section 7.4, for calibration procedures.

7.2 Sample preparation:

7.2.1 Place 10.0 g of a well-mixed waste sample into each of two separate 125-mL septum-seal vials.

7.2.2 Dose one sample vial through the septum with 200 uL of a 50 ng/uL calibration standard containing the compounds of interest. Label this "1-ppm spike."

7.2.3 Dose a separate (empty) 125-mL septum seal vial with 200 uL of the same 50 ng/uL calibration standard. Label this "1-ppm standard."

7.2.4 Place the sample, 1-ppm-spike, and 1-ppm-standard vials into a 90°C water bath for 1 hr. Store the remaining sample vial at 4.0°C for possible future analysis.

7.3 Sample analysis:

7.3.1 While maintaining the vials at 90°C, withdraw 2 mL of the headspace gas with a gas-tight syringe and analyze by direct injection into a GC. The GC should be operated using the same GC conditions listed in the method being screened (8010, 8015, 8020, 8030, or 8240).

7.3.2 Analyze the 1-ppm standard and adjust instrument sensitivity to give a minimum response of at least 2 times the background. Record retention times (RT) and peak areas of compounds of interest.

7.3.3 Analyze the 1-ppm spiked sample in the same manner. Record RTs and peak areas.

7.3.4 Analyze the undosed sample as in Paragraph 7.3.3.

7.3.5 Use the results obtained to determine if the sample requires dilution or methanolic extraction as indicated in Method 5030.

8.0 QUALITY CONTROL

8.1 Before processing any samples, the analyst should demonstrate through the analysis of a distilled water method blank that all glassware and reagents are interference-free. Each time a set of samples is extracted or there is a change in reagents, a method blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement.

8.2 Standard quality assurance practices should be used with this method. Fortified samples should be carried through all stages of sample preparation and measurement; they should be analyzed to validate the sensitivity and accuracy of the analysis. If the fortified waste samples do not indicate sufficient sensitivity to detect less than or equal to 1 ug/g of sample, then the sensitivity of the instrument should be increased.

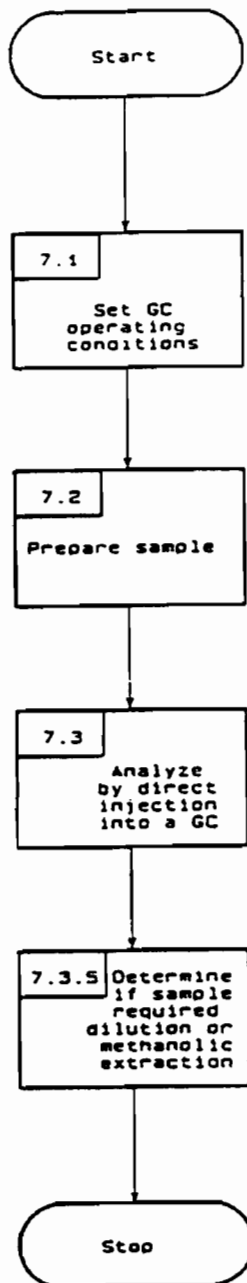
9.0 METHOD PERFORMANCE

9.1 No data provided.

10.0 REFERENCES

1. Hachenberg, H. and A. Schmidt, Gas Chromatographic Headspace Analysis, Philadelphia: Hayden & Sons Inc., 1979.
2. Friant, S.L. and I.H. Suffet, "Interactive Effects of Temperature, Salt Concentration and pH on Headspace Analysis for Isolating Volatile Trace Organics in Aqueous Environmental Samples," Anal. Chem. 51, 2167-2172, 1979.

METHOD 3810
HEADSPACE METHOD



METHOD 5030

PURGE-AND-TRAP

1.0 SCOPE AND APPLICATION

1.1 This method describes sample preparation and extraction for the analysis of volatile organics by a purge-and-trap procedure. The gas chromatographic determinative steps are found in Methods 8010, 8015, 8020, and 8030. Although applicable to Method 8240, the purge-and-trap procedure is already incorporated into Method 8240.

1.2 Method 5030 can be used for most volatile organic compounds that have boiling points below 200°C (vapor pressure is approximately equal to mm Hg @ 25°C) and are insoluble or slightly soluble in water. Volatile water-soluble compounds can be included in this analytical technique; however, quantitation limits (by GC or GC/MS) are approximately ten times higher because of poor purging efficiency. The method is also limited to compounds that elute as sharp peaks from a GC column packed with graphitized carbon lightly coated with a carbowax. Such compounds include low-molecular-weight halogenated hydrocarbons, aromatics, ketones, nitriles, acetates, acrylates, ethers, and sulfides.

1.3 Water samples can be analyzed directly for volatile organic compounds by purge-and-trap extraction and gas chromatography. Higher concentrations of these analytes in water can be determined by direct injection of the sample into the chromatographic system.

1.4 This method also describes the preparation of water-miscible liquids, solids, wastes, and soil/sediments for analysis by the purge-and-trap procedure.

2.0 SUMMARY OF METHOD

2.1 The purge-and-trap process: An inert gas is bubbled through the solution at ambient temperature, and the volatile components are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the volatile components are adsorbed. After purging is completed, the sorbent column is heated and backflushed with inert gas to desorb the components onto a gas chromatographic column.

2.2 If the above sample introduction techniques are not applicable, a portion of the sample is dispersed in methanol to dissolve the volatile organic constituents. A portion of the methanolic solution is combined with water in a specially designed purging chamber. It is then analyzed by purge-and-trap GC following the normal water method.

3.0 INTERFERENCES

3.1 Impurities in the purge gas and from organic compounds out-gassing from the plumbing ahead of the trap account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running laboratory reagent blanks. The use of non-TFE plastic coating, non-TFE thread sealants, or flow controllers with rubber components in the purging device should be avoided.

3.2 Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) through the septum seal of the sample vial during shipment and storage. A field reagent blank prepared from reagent water and carried through sampling and handling protocols serves as a check on such contamination.

3.3 Contamination by carryover can occur whenever high-level and low-level samples are analyzed sequentially. Whenever an unusually concentrated sample is analyzed, it should be followed by an analysis of reagent water to check for cross-contamination. The trap and other parts of the system are subject to contamination; therefore, frequent bake-out and purging of the entire system may be required.

3.4 The laboratory where volatile analysis is performed should be completely free of solvents.

4.0 APPARATUS AND MATERIALS

4.1 Microsyringes: 10-uL, 25-uL, 100-uL, 250-uL, 500-uL, and 1,000 uL: These syringes should be equipped with a 20-gauge (0.006-in I.D.) needle having a length sufficient to extend from the sample inlet to within 1 cm of the glass frit in the purging device. The needle length will depend upon the dimensions of the purging device employed.

4.2 Syringe valve: Two-way, with Luer ends (three each), if applicable to the purging device.

4.3 Syringe: 5-mL, gas-tight with shutoff valve.

4.4 Balance: Analytical, capable of accurately weighing 0.0001 g, and a top-loading balance capable of weighing 0.1 g.

4.5 Glass scintillation vials: 20-mL, with screw-caps and Teflon liners or glass culture tubes with a screw-cap and Teflon liner.

4.6 Volumetric flasks: 10-mL and 100-mL, class A with ground-glass stoppers.

4.7 Vials: 2-mL, for GC autosampler.

4.8 Spatula: Stainless steel.

4.9 Disposable pipets: Pasteur.

4.10 Purge-and-trap device: The purge-and-trap device consists of three separate pieces of equipment: the sample purger, the trap, and the desorber. Several complete devices are commercially available.

4.10.1 The recommended purging chamber is designed to accept 5-mL samples with a water column at least 3 cm deep. The gaseous headspace between the water column and the trap must have a total volume of less than 15 mL. The purge gas must pass through the water column as finely divided bubbles with a diameter of less than 3-mm at the origin. The purge gas must be introduced no more than 5 mm from the base of the water column. The sample purger, illustrated in Figure 1, meets these design criteria. Alternate sample purge devices may be used, provided equivalent performance is demonstrated.

4.10.2 The trap must be at least 25 cm long and have an inside diameter of at least 0.105 in. Starting from the inlet, the trap must contain the following amounts of adsorbents: 1/3 of 2,6-diphenylene oxide polymer, 1/3 of silica gel, and 1/3 of coconut charcoal. It is recommended that 1.0 cm of methyl silicone-coated packing be inserted at the inlet to extend the life of the trap (see Figures 2 and 3). If it is not necessary to analyze for dichlorodifluoromethane or other fluorocarbons of similar volatility, the charcoal can be eliminated and the polymer increased to fill 2/3 of the trap. If only compounds boiling above 35°C are to be analyzed, both the silica gel and charcoal can be eliminated and the polymer increased to fill the entire trap. Before initial use, the trap should be conditioned overnight at 180°C by backflushing with an inert gas flow of at least 20 mL/min. Vent the trap effluent to the hood, not to the analytical column. Prior to daily use, the trap should be conditioned for 10 min at 180°C with backflushing. The trap may be vented to the analytical column during daily conditioning; however, the column must be run through the temperature program prior to analysis of samples.

4.10.3 The desorber should be capable of rapidly heating the trap to 180°C for desorption. The polymer section of the trap should not be heated higher than 180°C, and the remaining sections should not exceed 220°C during bake-out mode. The desorber design illustrated in Figures 2 and 3 meet these criteria.

4.10.4 The purge-and-trap device may be assembled as a separate unit or may be coupled to a gas chromatograph, as shown in Figures 4 and 5.

4.10.5 Trap Packing Materials

4.10.5.1 2,6-Diphenylene oxide polymer: 60/80 mesh, chromatographic grade (Tenax GC or equivalent).

4.10.5.2 Methyl silicone packing: OV-1 (3%) on Chromosorb-W, 60/80 mesh or equivalent.

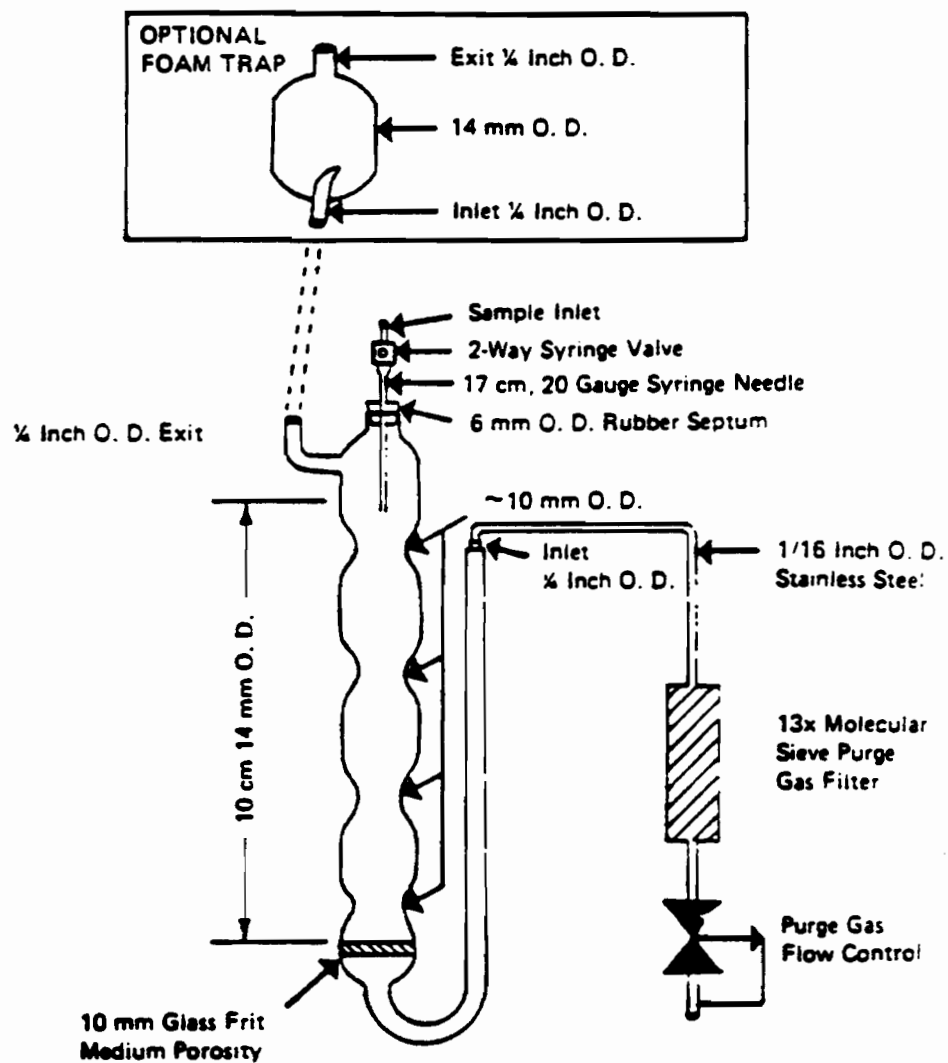


Figure 1. Purging chamber.

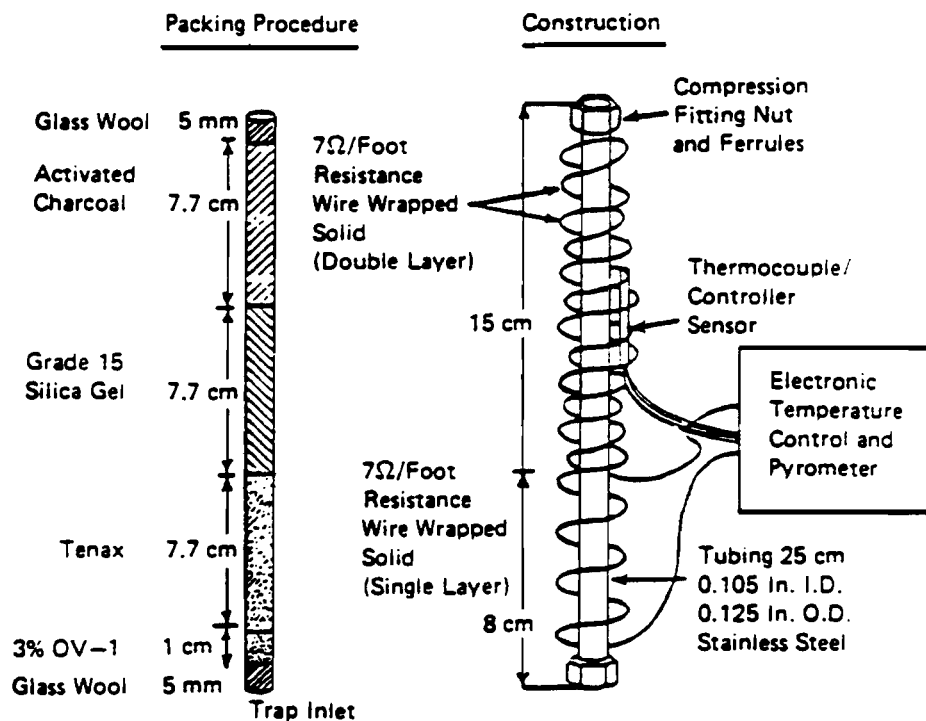


Figure 2. Trap packings and construction for Method 8010.

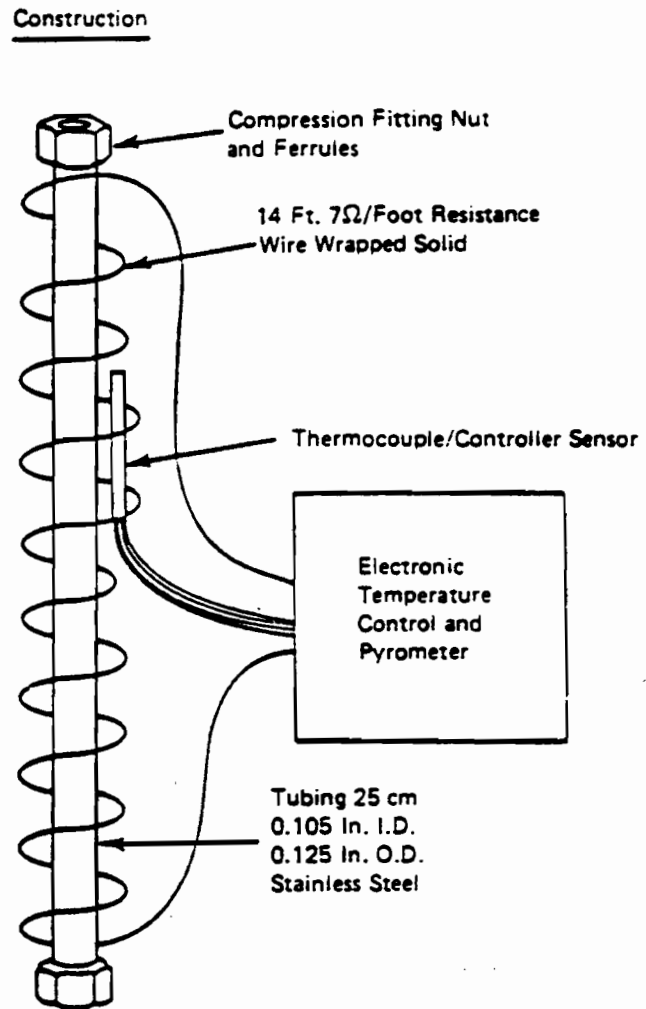
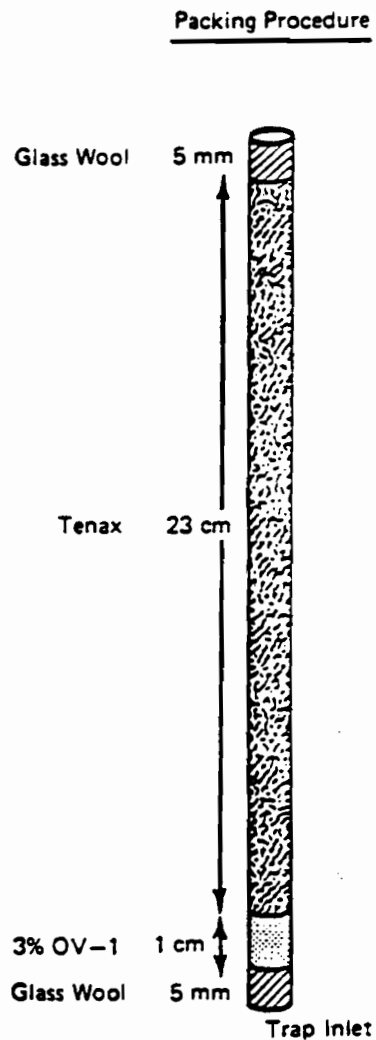


Figure 3. Trap packing and construction for Methods 8020 and 8030.

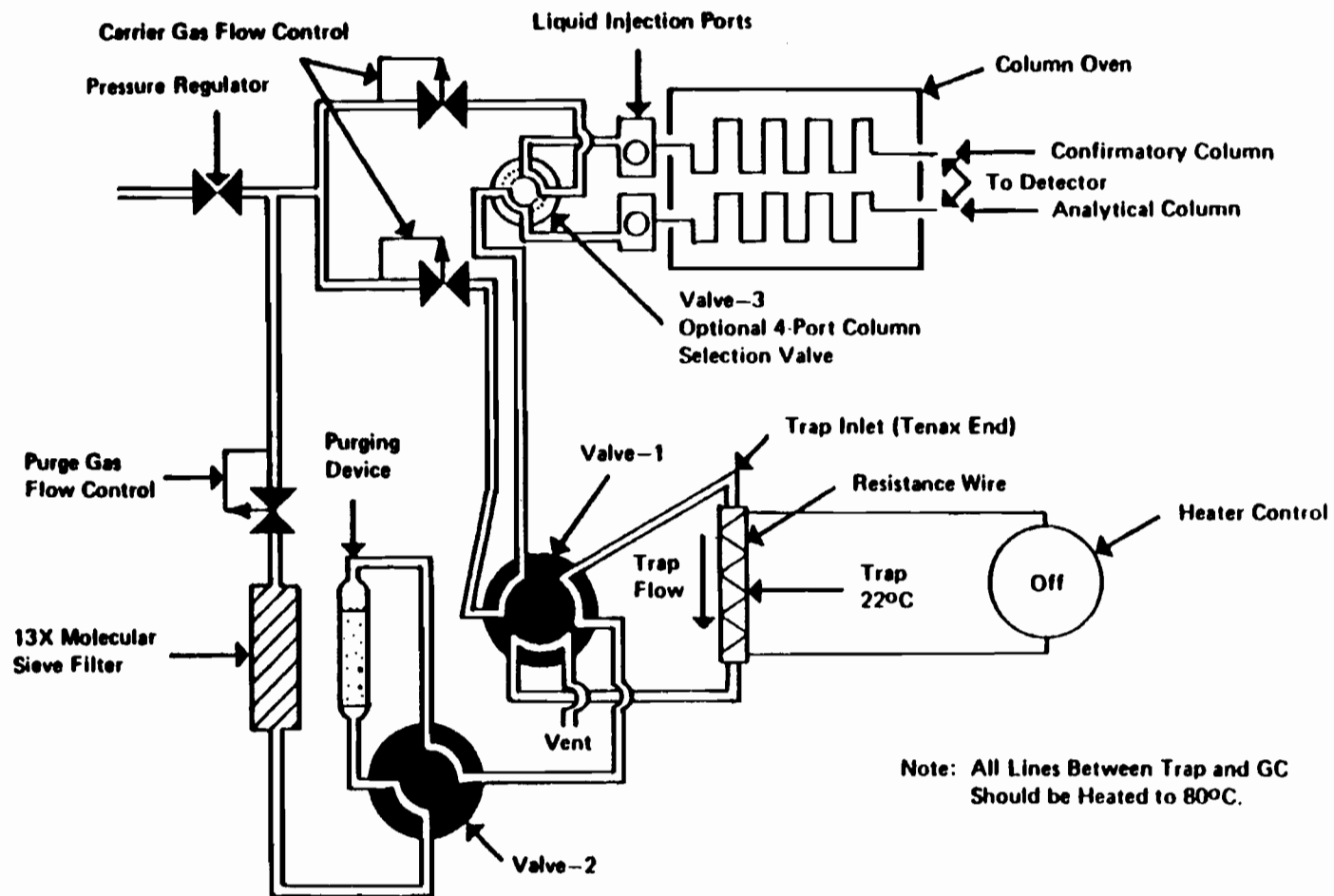


Figure 4. Purge-and-trap system, purge-sorb mode, for Methods 8010, 8020, and 8030.

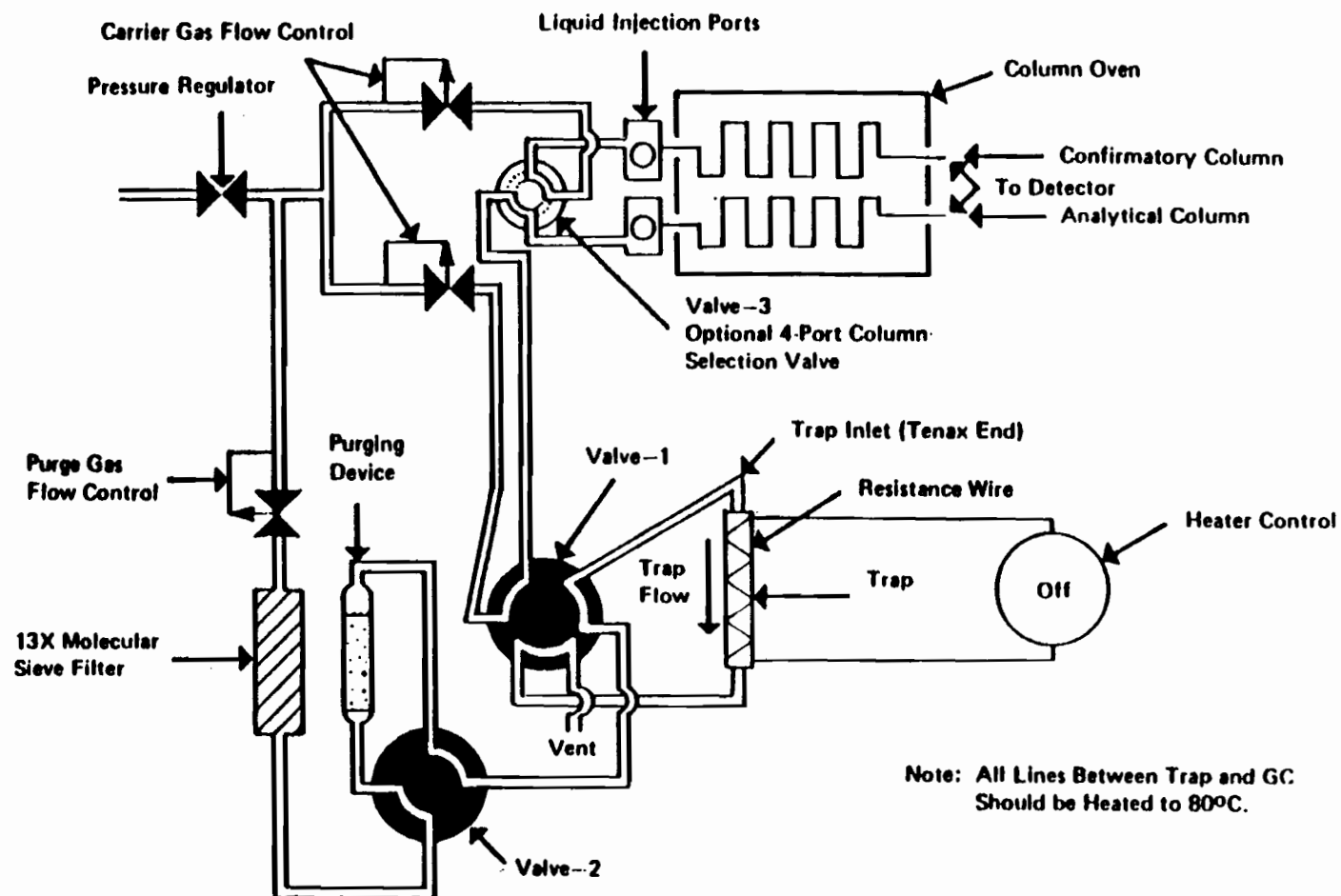


Figure 5. Purge-and-trap system, desorb mode, for Methods 8010, 8020, and 8030.

4.10.5.3 Silica gel: 35/60 mesh, Davison, grade 15 or equivalent.

4.10.5.4 Coconut charcoal: Prepare from Barnebey Cheney, CA-580-26 lot #M-2649, by crushing through 26 mesh screen.

4.11 Heater or heated oil bath: Should be capable of maintaining the purging chamber to within 1°C over a temperature range from ambient to 100°C.

5.0 REAGENTS

5.1 Reagent water: Reagent water is defined as water in which an interferent is not observed at the method detection limit of the compounds of interest.

5.1.1 Reagent water may be generated by passing tap water through a carbon filter bed containing about 500 g of activated carbon (Calgon Corp., Filtrasorb-300 or equivalent).

5.1.2 A water purification system (Millipore Super-Q or equivalent) may be used to generate reagent water.

5.1.3 Reagent water may also be prepared by boiling water for 15 min. Subsequently, while maintaining the water temperature at 90°C, bubble a contaminant-free inert gas through the water for 1 hr. While still hot, transfer the water to a narrow-mouth screw-cap bottle and seal with a Teflon-lined septum and cap.

5.2 Methanol: Pesticide quality or equivalent. Store away from other solvents.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 Refer to the introductory material to this chapter, Organic Analytes, Section 4.1.

7.0 PROCEDURE

7.1 Initial calibration: Prior to using this introduction technique for any GC method, the system must be calibrated. General calibration procedures are discussed in Method 8000, Section 7.4, while the specific determinative methods and Method 3500 give details on preparation of standards.

7.1.1 Assemble a purge-and-trap device that meets the specification in Section 4.10. Condition the trap overnight at 180°C in the purge mode with an inert gas flow of at least 20 mL/min. Prior to use, condition the trap daily for 10 min while backflushing at 180°C with the column at 220°C.

7.1.2 Connect the purge-and-trap device to a gas chromatograph.

7.1.3 Prepare the final solutions containing the required concentrations of calibration standards, including surrogate standards, directly in the purging device. Add 5.0 mL of reagent water to the purging device. The reagent water is added to the purging device using a 5-mL glass syringe fitted with a 15-cm 20-gauge needle. The needle is inserted through the sample inlet shown in Figure 1. The internal diameter of the 14-gauge needle that forms the sample inlet will permit insertion of the 20-gauge needle. Next, using a 10- μ L or 25- μ L micro-syringe equipped with a long needle (Paragraph 4.1), take a volume of the secondary dilution solution containing appropriate concentrations of the calibration standards. Add the aliquot of calibration solution directly to the reagent water in the purging device by inserting the needle through the sample inlet. When discharging the contents of the micro-syringe, be sure that the end of the syringe needle is well beneath the surface of the reagent water. Similarly, add 10 μ L of the internal standard solution. Close the 2-way syringe valve at the sample inlet.

7.1.4 Carry out the purge-and-trap analysis procedure using the specific conditions given in Table 1.

7.1.5 Calculate response factors or calibration factors for each analyte of interest using the procedure described in Method 8000, Section 7.4.

7.1.6 The average RF must be calculated for each compound. A system performance check should be made before this calibration curve is used. If the purge-and-trap procedure is used with Method 8010, the following five compounds are checked for a minimum average response factor: chloromethane; 1,1-dichloroethane; bromoform; 1,1,2,2-tetrachloroethane; and chlorobenzene. The minimum acceptable average RF for these compounds should be 0.300 (0.250 for bromoform). These compounds typically have RFs of 0.4-0.6 and are used to check compound instability and check for degradation caused by contaminated lines or active sites in the system. Examples of these occurrences are:

7.1.6.1 Chloromethane: This compound is the most likely compound to be lost if the purge flow is too fast.

7.1.6.2 Bromoform: This compound is one of the compounds most likely to be purged very poorly if the purge flow is too slow. Cold spots and/or active sites in the transfer lines may adversely affect response.

7.1.6.3 Tetrachloroethane and 1,1-dichloroethane: These compounds are degraded by contaminated transfer lines in purge-and-trap systems and/or active sites in trapping materials.

7.2 On-going calibration: Refer to Method 8000, Sections 7.4.2.3 and 7.4.3.4 for details on continuing calibration.

TABLE 1. PURGE-AND-TRAP OPERATING PARAMETERS

	Analysis Method			
	8010	8015	8020	8030
Purge gas	Nitrogen or Helium	Nitrogen or Helium	Nitrogen or Helium	Nitrogen or Helium
Purge gas flow rate (mL/min)	40	20	40	20
Purge time (min)	11.0 $\pm$ 0.1	15.0 $\pm$ 0.1	12.0 $\pm$ 0.1	15.0 $\pm$ 0.1
Purge temperature ($^{\circ}$ C)	Ambient	85 $\pm$ 2	Ambient	85 $\pm$ 2
Desorb temperature ($^{\circ}$ C)	180	180	180	180
Backflush inert gas flow (mL/min)	20-60	20-60	20-60	20-60
Desorb time (min)	4	1.5	4	1.5

7.3 Sample preparation:

7.3.1 Water samples:

7.3.1.1 Screening of the sample prior to purge-and-trap analysis will provide guidance on whether sample dilution is necessary and will prevent contamination of the purge-and-trap system. Two screening techniques that can be utilized are: the use of an automated headspace sampler (modified Method 3810), interfaced to a gas chromatograph (GC), equipped with a photo ionization detector (PID), in series with an electrolytic conductivity detector (ECD); and extraction of the sample with hexadecane (Method 3820) and analysis of the extract on a GC with a FID and/or an ECD.

7.3.1.2 All samples and standard solutions must be allowed to warm to ambient temperature before analysis.

7.3.1.3 Assemble the purge-and-trap device. The operating conditions for the GC are given in Section 7.0 of the specific determinative method to be employed.

7.3.1.4 Daily GC calibration criteria must be met (Method 8000, Section 7.4) before analyzing samples.

7.3.1.5 Adjust the purge gas flow rate (nitrogen or helium) to that shown in Table 1, on the purge-and-trap device. Optimize the flow rate to provide the best response for chloromethane and bromoform, if these compounds are analytes. Excessive flow rate reduces chloromethane response, whereas insufficient flow reduces bromoform response.

7.3.1.6 Remove the plunger from a 5-mL syringe and attach a closed syringe valve. Open the sample or standard bottle, which has been allowed to come to ambient temperature, and carefully pour the sample into the syringe barrel to just short of overflowing. Replace the syringe plunger and compress the sample. Open the syringe valve and vent any residual air while adjusting the sample volume to 5.0 mL. This process of taking an aliquot destroys the validity of the liquid sample for future analysis; therefore, if there is only one VOA vial, the analyst should fill a second syringe at this time to protect against possible loss of sample integrity. This second sample is maintained only until such time when the analyst has determined that the first sample has been analyzed properly. Filling one 20-mL syringe would allow the use of only one syringe. If a second analysis is needed from a syringe, it must be analyzed within 24 hr. Care must be taken to prevent air from leaking into the syringe.

7.3.1.7 The following procedure is appropriate for diluting purgeable samples. All steps must be performed without delays until the diluted sample is in a gas-tight syringe.

7.3.1.7.1 Dilutions may be made in volumetric flasks (10-mL to 100-mL). Select the volumetric flask that will allow for the necessary dilution. Intermediate dilutions may be necessary for extremely large dilutions.

7.3.1.7.2 Calculate the approximate volume of reagent water to be added to the volumetric flask selected and add slightly less than this quantity of reagent water to the flask.

7.3.1.7.3 Inject the proper aliquot of samples from the syringe prepared in Paragraph 7.3.1.5 into the flask. Aliquots of less than 1-mL are not recommended. Dilute the sample to the mark with reagent water. Cap the flask, invert, and shake three times. Repeat the above procedure for additional dilutions.

7.3.1.7.4 Fill a 5-mL syringe with the diluted sample as in Paragraph 7.3.1.5.

7.3.1.8 Add 10.0 uL of surrogate spiking solution (found in each determinative method, Section 5.0) and, if applicable, 10 uL of internal standard spiking solution through the valve bore of the syringe; then close the valve. The surrogate and internal standards may be mixed and added as a single spiking solution. Matrix spiking solutions, if indicated, should be added (10 uL) to the sample at this time.

7.3.1.9 Attach the syringe-syringe valve assembly to the syringe valve on the purging device. Open the syringe valves and inject the sample into the purging chamber.

7.3.1.10 Close both valves and purge the sample for the time and at the temperature specified in Table 1.

7.3.1.11 At the conclusion of the purge time, attach the trap to the chromatograph, adjust the device to the desorb mode, and begin the gas chromatographic temperature program and GC data acquisition. Concurrently, introduce the trapped materials to the gas chromatographic column by rapidly heating the trap to 180°C while backflushing the trap with inert gas between 20 and 60 mL/min for the time specified in Table 1.

7.3.1.12 While the trap is being desorbed into the gas chromatograph, empty the purging chamber. Wash the chamber with a minimum of two 5-mL flushes of reagent water (or methanol followed by reagent water) to avoid carryover of pollutant compounds into subsequent analyses.

7.3.1.13 After desorbing the sample, recondition the trap by returning the purge-and-trap device to the purge mode. Wait 15 sec; then close the syringe valve on the purging device to begin gas flow

through the trap. The trap temperature should be maintained at 180°C for Methods 8010 and 8020, and 210°C for Methods 8015 and 8030. Trap temperatures up to 220°C may be employed; however, the higher temperature will shorten the useful life of the trap. After approximately 7 min, turn off the trap heater and open the syringe valve to stop the gas flow through the trap. When cool, the trap is ready for the next sample.

7.3.1.14 If the initial analysis of a sample or a dilution of the sample has a concentration of analytes that exceeds the initial calibration range, the sample must be reanalyzed at a higher dilution. When a sample is analyzed that has saturated response from a compound, this analysis must be followed by a blank reagent water analysis. If the blank analysis is not free of interferences, the system must be decontaminated. Sample analysis may not resume until a blank can be analyzed that is free of interferences.

7.3.1.15 All dilutions should keep the response of the major constituents (previously saturated peaks) in the upper half of the linear range of the curve. Proceed to Method 8000 and the specific determinative method for details on calculating analyte response.

7.3.2 Water-miscible liquids:

7.3.2.1 Water-miscible liquids are analyzed as water samples after first diluting them at least 50-fold with reagent water.

7.3.2.2 Initial and serial dilutions can be prepared by pipetting 2 mL of the sample to a 100-mL volumetric flask and diluting to volume with reagent water. Transfer immediately to a 5-mL gas-tight syringe.

7.3.2.3 Alternatively, prepare dilutions directly in a 5-mL syringe filled with reagent water by adding at least 20 μ L, but not more than 100- μ L of liquid sample. The sample is ready for addition of surrogate and, if applicable, internal and matrix spiking standards.

7.3.3 Sediment/soil and waste samples: It is highly recommended that all samples of this type be screened prior to the purge-and-trap GC analysis. These samples may contain percent quantities of purgeable organics that will contaminate the purge-and-trap system, and require extensive cleanup and instrument downtime. See Paragraph 7.3.1.1 for recommended screening techniques. Use the screening data to determine whether to use the low-level method (0.005-1 mg/kg) or the high-level method (>1 mg/kg).

7.3.3.1 Low-level method: This is designed for samples containing individual purgeable compounds of <1 mg/kg. It is limited to sediment/soil samples and waste that is of a similar consistency (granular and porous). The low-level method is based on

purging a heated sediment/soil sample mixed with reagent water containing the surrogate and, if applicable, internal and matrix spiking standards. Analyze all reagent blanks and standards under the same conditions as the samples.

7.3.3.1.1 Use a 5-g sample if the expected concentration is <0.1 mg/kg or a 1-g sample for expected concentrations between 0.1 and 1 mg/kg.

7.3.3.1.2 The GC system should be set up as in Section 7.0 of the specific determinative method. This should be done prior to the preparation of the sample to avoid loss of volatiles from standards and samples. A heated purge calibration curve must be prepared and used for the quantitation of all samples analyzed with the low-level method. Follow the initial and daily calibration instructions, except for the addition of a 40°C purge temperature for Methods 8010 and 8020.

7.3.3.1.3 Remove the plunger from a 5-mL Luerlock type syringe equipped with a syringe valve and fill until overflowing with reagent water. Replace the plunger and compress the water to vent trapped air. Adjust the volume to 5.0 mL. Add 10 uL each of surrogate spiking solution and internal standard solution to the syringe through the valve. (Surrogate spiking solution and internal standard solution may be mixed together.) Matrix spiking solutions, if indicated, should be added (10 uL) to the sample at this time.

7.3.3.1.4 The sample (for volatile organics) consists of the entire contents of the sample container. Do not discard any supernatant liquids. Mix the contents of the sample container with a narrow metal spatula. Weigh the amount determined in Paragraph 7.3.3.1.1 into a tared purge device. Note and record the actual weight to the nearest 0.1 g.

7.3.3.1.5 In certain cases, sample results are desired based on a dry-weight basis. When such data is desired, a portion of sample for moisture determination should be weighed out at the same time as the portion used for analytical determination. Immediately after weighing the sample for extraction, weigh 5-10 g of the sample into a tared crucible. Determine the percent moisture by drying overnight at 105°C. Allow to cool in a desiccator before weighing:

$$\frac{\text{g of sample} - \text{g of dry sample}}{\text{g of sample}} \times 100 = \% \text{ moisture}$$

7.3.3.1.6 Add the spiked reagent water to the purge device, which contains the weighed amount of sample, and connect the device to the purge-and-trap system.

NOTE: Prior to the attachment of the purge device, steps 7.3.3.1.4 and 7.3.3.1.6 must be performed rapidly and without interruption to avoid loss of volatile organics. These steps must be performed in a laboratory free of solvent fumes.

7.3.3.1.7 Heat the sample to $40^{\circ}\text{C} \pm 1^{\circ}\text{C}$ (Methods 8010 and 8020) or to $85^{\circ}\text{C} \pm 2^{\circ}\text{C}$ (Methods 8015 and 8030) and purge the sample for the time shown in Table 1.

7.3.3.1.8 Proceed with the analysis as outlined in Paragraphs 7.3.1.11-7.3.1.15. Use 5 mL of the same reagent water as in the reagent blank. If saturated peaks occurred or would occur if a 1-g sample were analyzed, the high-level method must be followed.

7.3.3.2 High-level method: The method is based on extracting the sediment/soil with methanol. A waste sample is either extracted or diluted, depending on its solubility in methanol. An aliquot of the extract is added to reagent water containing surrogate and, if applicable, internal and matrix spiking standards. This is purged at the temperatures indicated in Table 1. All samples with an expected concentration of >1.0 mg/kg should be analyzed by this method.

7.3.3.2.1 The sample (for volatile organics) consists of the entire contents of the sample container. Do not discard any supernatant liquids. Mix the contents of the sample container with a narrow metal spatula. For sediment/soil and waste that are insoluble in methanol, weigh 4 g (wet weight) of sample into a tared 20-mL vial. Use a top-loading balance. Note and record the actual weight to 0.1 gram and determine the percent moisture of the sample using the procedure in Paragraph 7.3.3.1.5. For waste that is soluble in methanol, weigh 1 g (wet weight) into a tared scintillation vial or culture tube or a 10-mL volumetric flask. (If a vial or tube is used, it must be calibrated prior to use. Pipet 10.0 mL of methanol into the vial and mark the bottom of the meniscus. Discard this solvent.)

7.3.3.2.2 Quickly add 9.0 mL of methanol; then add 1.0 mL of the surrogate spiking solution to the vial. Cap and shake for 2 min.

NOTE: Steps 7.3.3.2.1 and 7.3.3.2.2 must be performed rapidly and without interruption to avoid loss of volatile organics. These steps must be performed in a laboratory free from solvent fumes.

7.3.3.2.3 Pipet approximately 1 mL of the extract to a GC vial for storage, using a disposable pipet. The remainder may be disposed of. Transfer approximately 1 mL of reagent methanol to a separate GC vial for use as the method blank for each set of samples. These extracts may be stored at 4°C in the dark, prior to analysis.

7.3.3.2.4 The GC system should be set up as in Section 7.0 of the specific determinative method. This should be done prior to the addition of the methanol extract to reagent water.

7.3.3.2.5 Table 2 can be used to determine the volume of methanol extract to add to the 5 mL of reagent water for analysis. If a screening procedure was followed, use the estimated concentration to determine the appropriate volume. Otherwise, estimate the concentration range of the sample from the low-level analysis to determine the appropriate volume. If the sample was submitted as a high-level sample, start with 100 uL. All dilutions must keep the response of the major constituents (previously saturated peaks) in the upper half of the linear range of the curve.

7.3.3.2.6 Remove the plunger from a 5.0-mL Luerlock type syringe equipped with a syringe valve and fill until overflowing with reagent water. Replace the plunger and compress the water to vent trapped air. Adjust the volume to 4.9 mL. Pull the plunger back to 5.0 mL to allow volume for the addition of the sample extract and of standards. Add 10 uL of internal standard solution. Also add the volume of methanol extract determined in Paragraph 7.3.3.2.5 and a volume of methanol solvent to total 100 uL (excluding methanol in standards).

7.3.3.2.7 Attach the syringe-syringe valve assembly to the syringe valve on the purging device. Open the syringe valve and inject the water/methanol sample into the purging chamber.

7.3.3.2.8 Proceed with the analysis as outlined in the specific determinative method. Analyze all reagent blanks on the same instrument as that used for the samples. The standards and blanks should also contain 100 uL of methanol to simulate the sample conditions.

7.3.3.2.9 For a matrix spike in the high-level sediment/soil samples, add 8.0 mL of methanol, 1.0 mL of surrogate spike solution and 1.0 mL of matrix spike solution. Add a 100-uL aliquot of this extract to 5 mL of water for purging (as per Paragraph 7.3.3.2.6).

TABLE 2. QUANTITY OF METHANOL EXTRACT REQUIRED FOR ANALYSIS OF HIGH-LEVEL SOILS/SEDIMENTS

Approximate Concentration Range	Volume of Methanol Extract ^a
500-10,000 ug/kg	100 uL
1,000-20,000 ug/kg	50 uL
5,000-100,000 ug/kg	10 uL
25,000-500,000 ug/kg	100 uL of 1/50 dilution ^b

Calculate appropriate dilution factor for concentrations exceeding this table.

^aThe volume of methanol added to 5 mL of water being purged should be kept constant. Therefore, add to the 5-mL syringe whatever volume of methanol is necessary to maintain a volume of 100 uL added to the syringe.

^bDilute an aliquot of the methanol extract and then take 100 uL for analysis.

7.4 Sample analysis:

7.4.1 The samples prepared by this method may be analyzed by Methods 8010, 8015, 8020, 8030, and 8240. Refer to these methods for appropriate analysis conditions.

8.0 QUALITY CONTROL

8.1 Refer to Chapter One for specific quality control procedures and Method 3500 for sample preparation procedures.

8.2 Before processing any samples, the analyst should demonstrate through the analysis of a reagent water method blank that all glassware and reagents are interference free. Each time a set of samples is extracted, or there is a change in reagents, a method blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement.

8.3 Standard quality assurance practices should be used with this method. Field replicates should be collected to validate the precision of the sampling technique. Laboratory replicates should be analyzed to validate the precision of the analysis. Fortified samples should be carried through all stages of sample preparation and measurement; they should be analyzed to validate the sensitivity and accuracy of the analysis. If the fortified samples do not indicate sufficient sensitivity to detect <1 ug/g of the analytes in the sample, then the sensitivity of the instrument should be increased, or the sample should be subjected to additional cleanup.

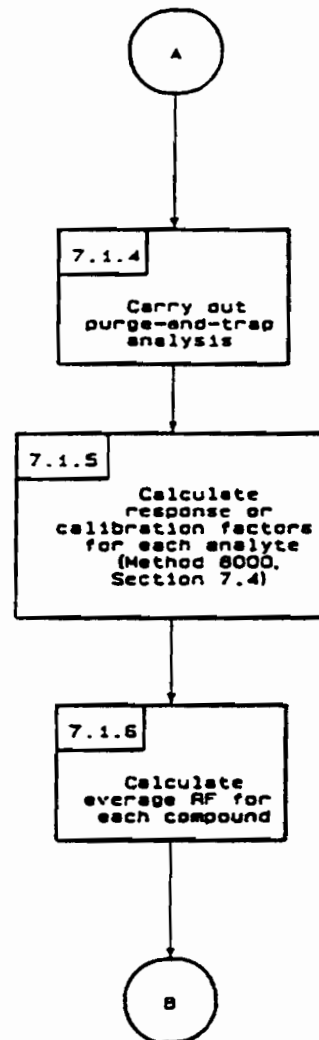
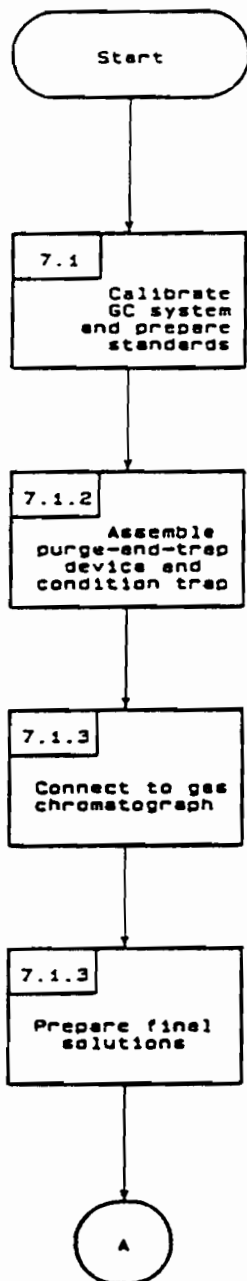
9.0 METHOD PERFORMANCE

9.1 Refer to the determinative methods for performance data.

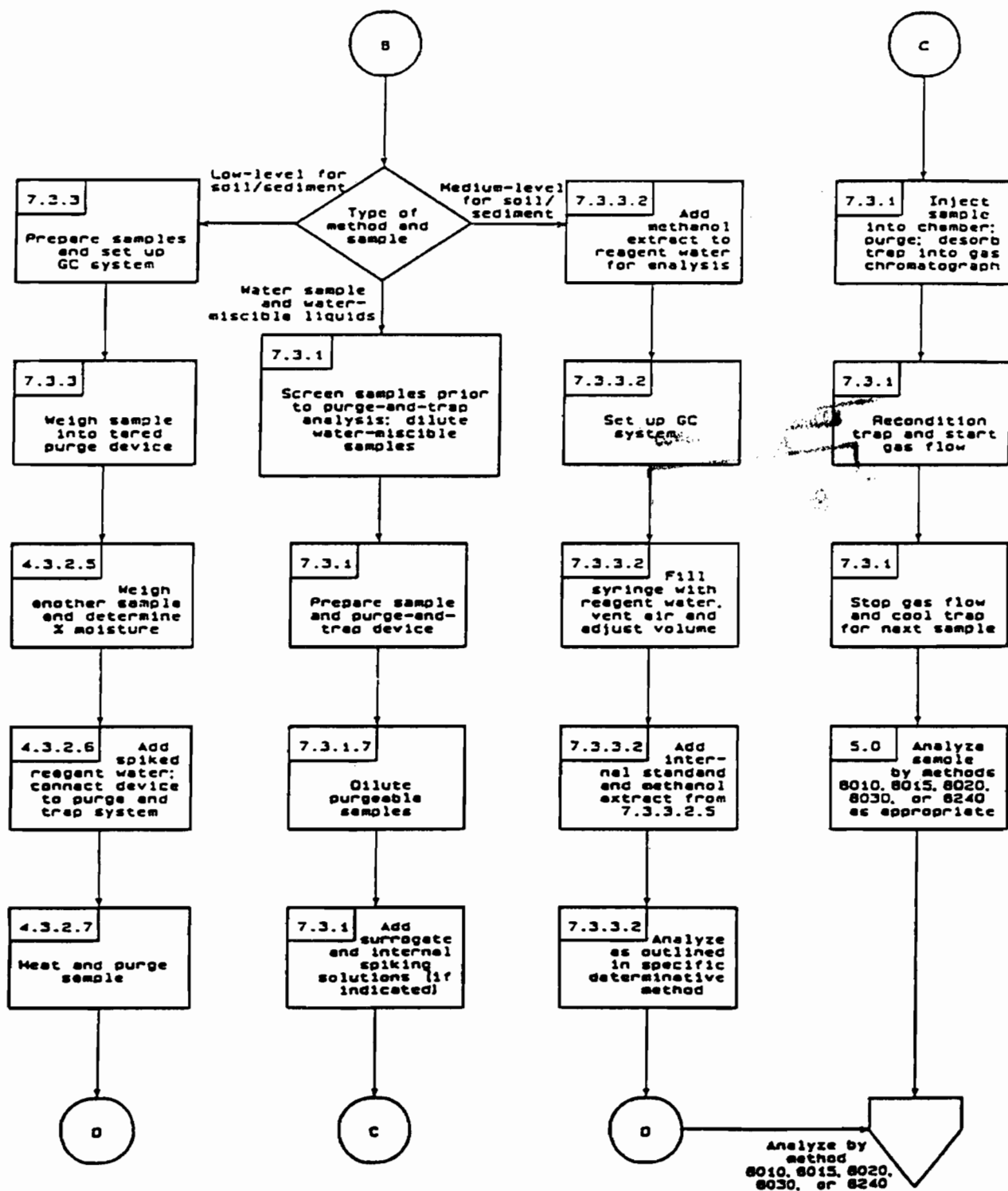
10.0 REFERENCES

1. U.S. EPA 40 CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Final Rule and Interim Final Rule and Proposed Rule," October 26, 1984.

METHOD 5030
PURGE-AND-TRAP METHOD



METHOD 5030
PURGE-AND-TRAP METHOD
(Continued)



APPENDIX N
Cultural Resources Survey

STAGE I-A ARCHIVAL SEARCH
FOR THE
ROWE INDUSTRIES SITE
SAG HARBOR
TOWN OF SOUTHAMPTON, SUFFOLK COUNTY, NEW YORK

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August 1996

ABSTRACT

This report presents the results of a Stage I-A cultural resource assessment of the Rowe Industries site performed by the Institute for Long Island Archaeology, Department of Anthropology, State University of New York at Stony Brook. The purpose of this cultural resource assessment is to determine if the project will potentially impact archaeological remains of prehistoric or historic age. This required archival research and a field inspection.

Based on the results of the Stage I-A survey it does not appear that construction will impact significant archaeological remains. Therefore, no further investigations are recommended.

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INTRODUCTION

This report presents the results of a Stage I-A cultural resource assessment of the Rowe Industries site in Sag Harbor, Town of Southampton, Suffolk County, New York. This site includes the Industries building, which is located at the intersection of Lily Pond Drive and Sag Harbor Turnpike (Figures 1 and 2). The project area consists of two parcels, the first of which is a 20 foot by 20 foot (6.1 meter by 6.1 meter) former chemical storage area which contains a concrete pad. The pad is located near the southeast corner of the Sag Harbor Industries building (Figure 3).

The second area follows a proposed water transmission line which runs from the proposed treatment system adjacent to Sag Harbor Industries and along Sag Harbor Turnpike, Carroll Street, Brick Kiln Road, and Noyack Road to a discharge location on Sag Harbor Cove (Figure 3). The proposed transmission line of approximately 3,160 feet (963 meters) will underlie existing streets (letter from R. LaMonica to D. Bernstein and L. Barber, August 24, 1995; Appendix B), or be located within the 5 foot (1.5 meter) easement immediately adjacent to the road. The width of disturbance is 3 to 4 feet (.9 to 1.2 meters) to accommodate the installation of two 6 inch (15 centimeter) pipes (personal communication with K. DeStefanis, July 24, 1996).

The purpose of this cultural resource assessment is to determine if the Rowe Industries project will adversely impact

prehistoric or historic cultural remains. In order to evaluate the kinds of prehistoric and historic cultural resources that are potentially present within the project area, detailed archival research and a field inspection were undertaken. This report is divided into three parts: archival research, field inspection, and recommendations.

Prior investigations in the vicinity of the project area have indicated that the region contains a diversity of remains important for reconstructing past human activities. In particular, archaeological remains suggest the existence of a lengthy period of both Native American and Euro-American activity occupation in Sag Harbor.

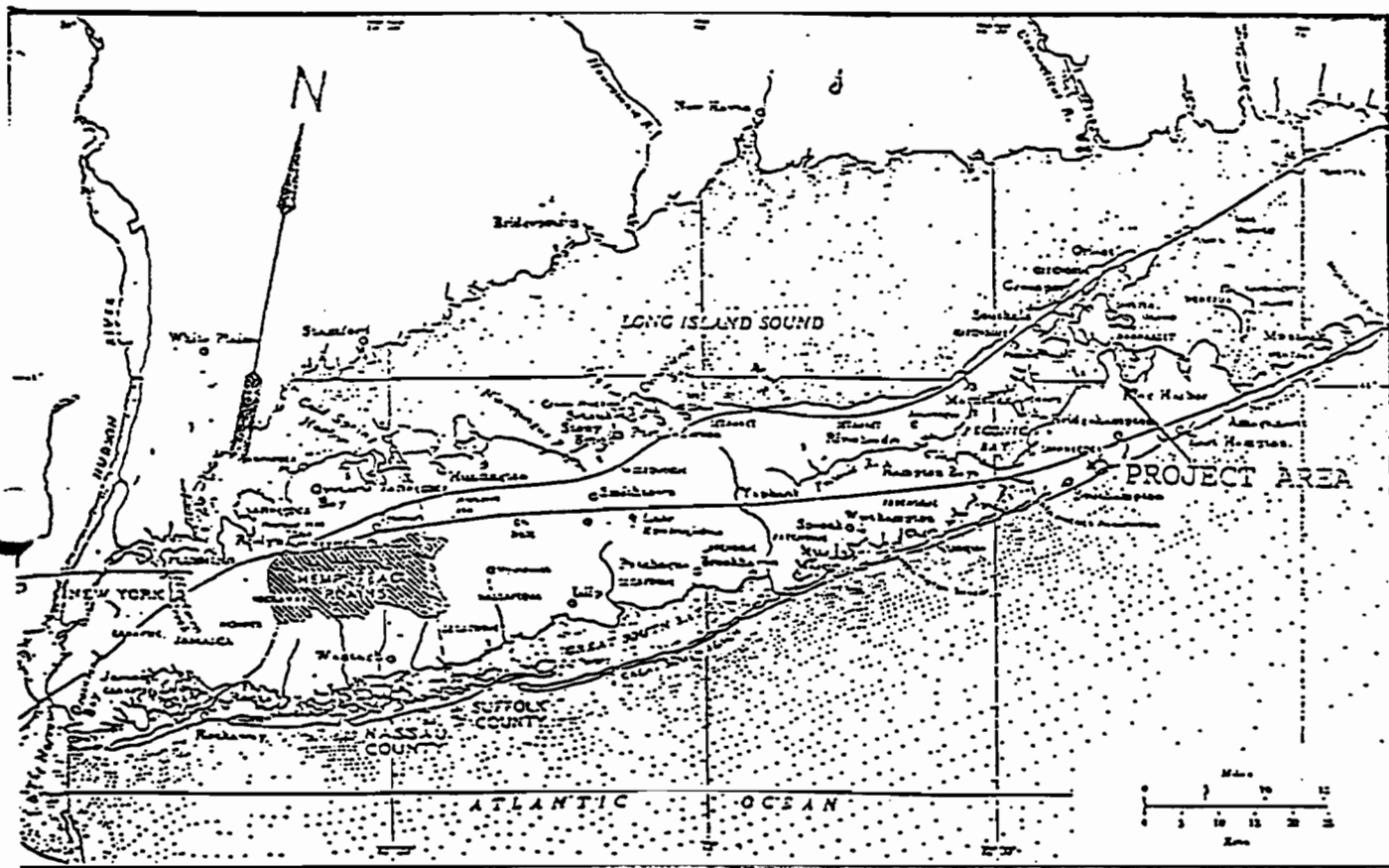


Figure 1. Map of Long Island showing location of Rowe Industries project area.

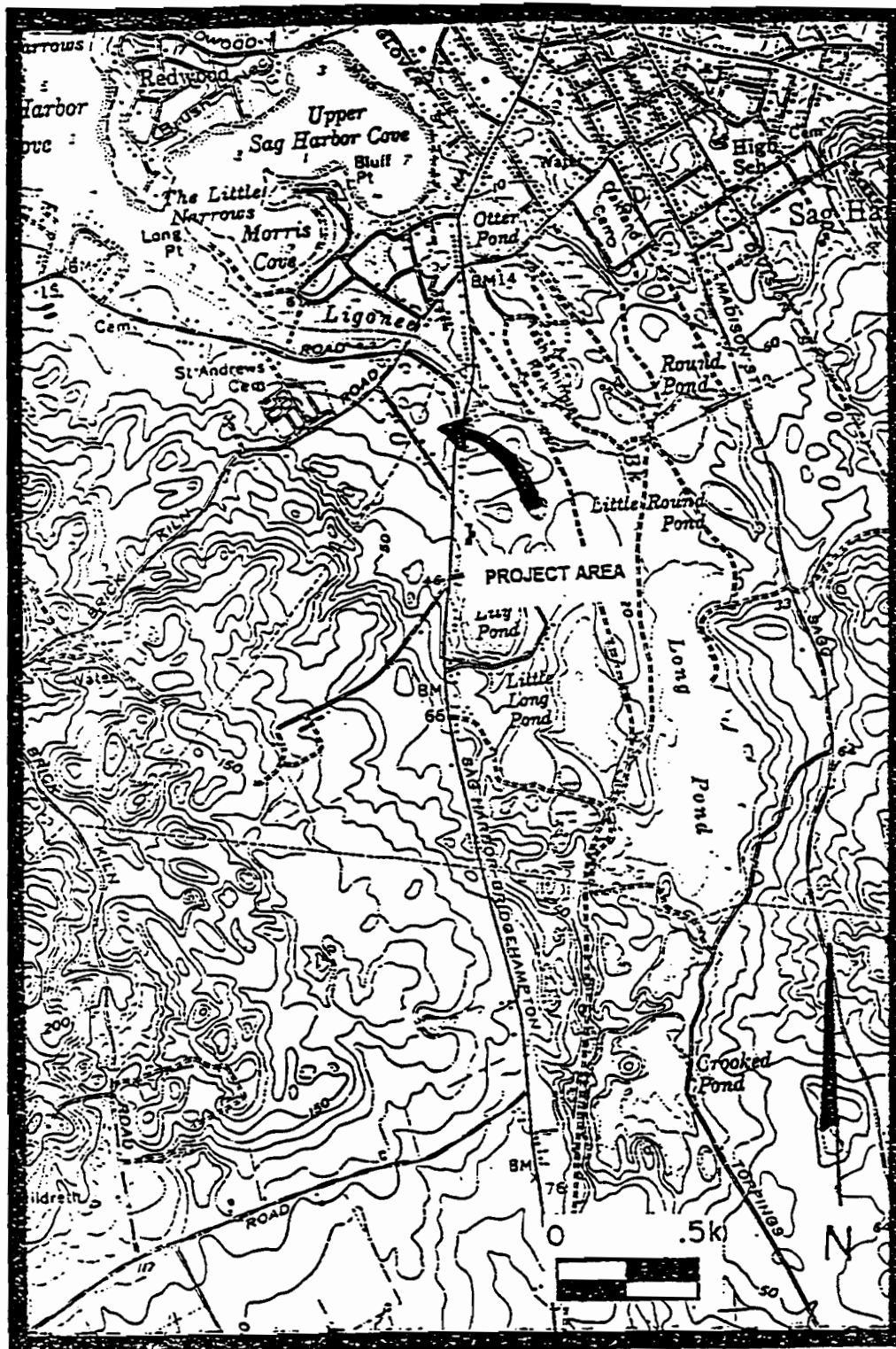


Figure 2. 1956 USGS Topographic Map, Sag Harbor, New York quadrangle.

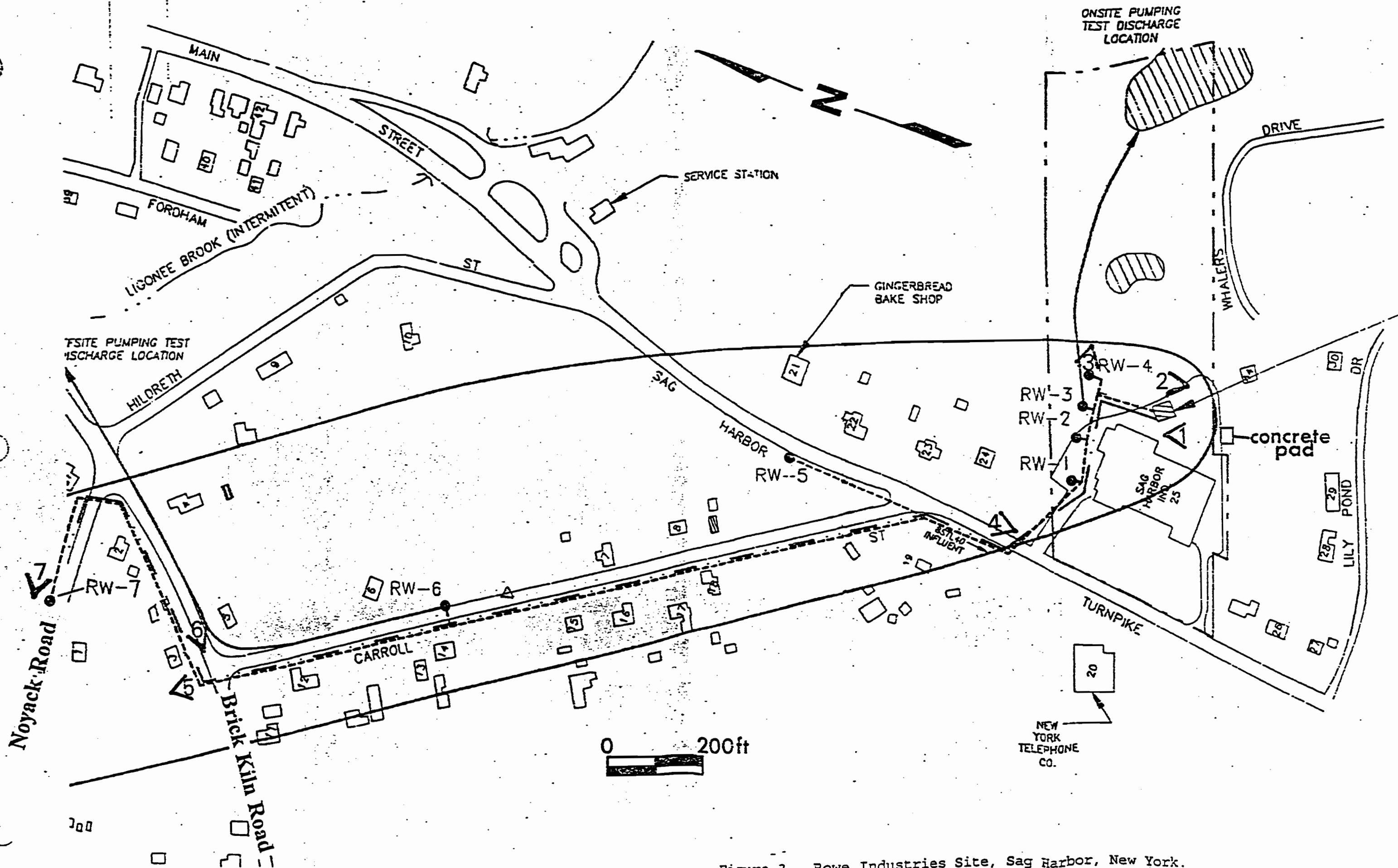


Figure 3. Rowe Industries Site, Sag Harbor, New York.

ARCHIVAL RESEARCH

INTRODUCTION AND METHOD

An evaluation of the natural and cultural history of an area is essential to understanding past land use, as well as determining the likelihood of encountering prehistoric or historic archaeological sites. Human groups locate their settlements in order to best take advantage of the characteristics of the natural and social landscape. Thus knowledge of a region's history and environmental features is crucial in reconstructing past behavior and assessing the probability of locating evidence of early activities.

A brief history of the Rowe Industries parcel is presented in this chapter. The natural history section includes a discussion of the environment and how it has changed over time, and a description of the topography and physical resources of the project area. The culture history includes a discussion of prehistoric and historic settlement patterns and activities.

A search of the available published records and site files was undertaken to determine if any previous studies had documented archaeological remains in, or in the vicinity of, the project area (Appendix A). Pertinent historical records such as maps, photographs, and descriptive histories were examined to obtain information on past activities in the study parcel. This investigation provided data on previous land owners, structures, and the types of land use practices employed.

NATURAL AND CULTURAL HISTORY

Environmental Setting. The formation of Long Island during the Wisconsin stage of the last glaciation left two series of hills, an elevated valley between them, and an expansive outwash plain on the southern portion of the island. The indented coastline, numerous ponds, and topographic relief that surround the project area are a result of the glacial processes that occurred at the end of the Pleistocene, approximately 12,000 to 15,000 years ago. Sag Harbor is on a low plain underlain by lower drift deposited during the retreat of the ice front at the end of the Pleistocene (Sirkin 1995:141).

The project area is situated in a northwest-trending valley that remains from the original south-flowing meltwater channel (Sirkin 1995:139). It is now occupied by Ligonee Brook, a stream flowing from Long Pond to Sag Harbor Cove. This intermittent stream is just north of the project area.

The many glacial depressions, or kettleholes, that surround the project area are a result of outwash from the Ronkonkoma moraine. The distinctive kettle valley system that was formed as a result of the irregular melting pattern of glacial ice extends from the north shore of the South Fork to Bridgehampton. Otter Pond located to the north of the project area and Lily Pond just to the south are included in this topographic feature.

The natural vegetation of the area includes mixed forests dominated by white oak, black oak, scrub oak, and pitch pine with an understory of seasonal herbaceous shrubs. Salt marshes are

located to the north, along the shores of Sag Harbor Cove and Morris Cove. Fresh water marshes or swamps border the nearby kettle ponds and intermittent stream.

The generally level topography of the project area averages about 25 feet (7.5 meters) above mean sea level. Soils consist of Plymouth loamy sand, 0 to 3 percent slopes (PlA) and 3 to 8 percent slopes (PlB), and a small section of Carver and Plymouth sands, 0 to 3 percent slopes (CpA) (Figure 4). The Plymouth series, found on gently sloping to level outwash plains and on undulating to steep moraines, consists of deep, excessively drained, coarse-textured soils that formed in a mantle of loamy sand over coarse sand and gravel (Warner et al. 1975:77). The Carver series exhibits a similar profile, consisting of deep, excessively drained, coarse-textured soils on rolling moraines and broad outwash plains (Warner et al. 1975:66). The Plymouth loamy sand (PlA) that dominates in the project area is found mainly on outwash plains south of the Ronkonkoma moraine (Warner et al. 1975:78).

Human groups living in the vicinity of the Rowe Industries site would have had easy access to a number of major water bodies, including Noyack Bay, Sag Harbor Cove, and Morris Cove. A number of smaller ponds are also present, as are intermittent streams and freshwater wetlands (Figure 2). Feeder streams flowing into Sag Harbor Cove and groundwater seepage provide a freshwater habitat near the project area. Tidal brackish water closer to the bay provides access to shellfish beds.

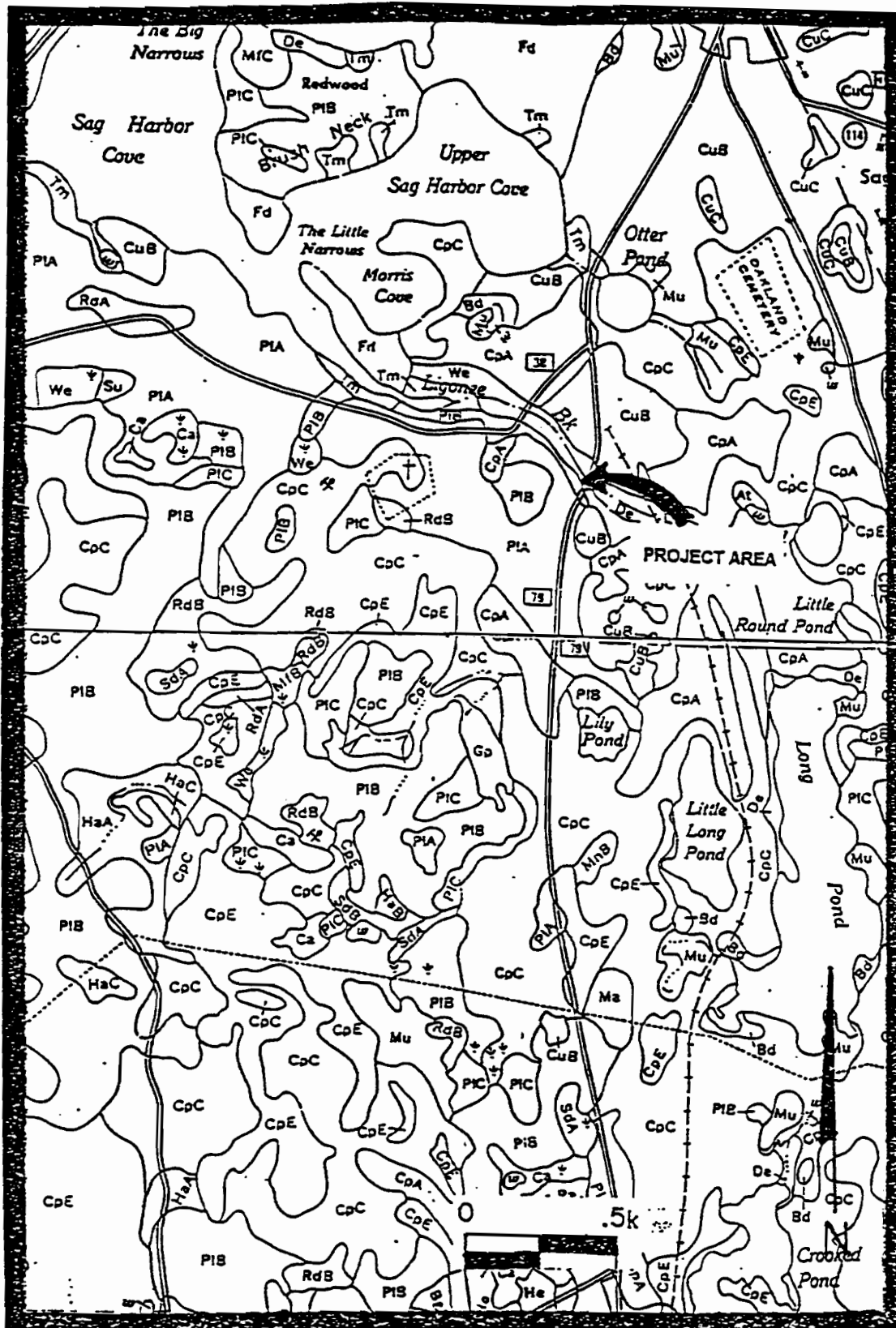


Figure 4. Suffolk County Soil Survey showing soils and intermittent stream.

The environmental attributes of the area indicate the presence of a rich and diverse set of resources that could be exploited by aboriginal hunter-gatherers. Fresh and salt water resources, vegetal food, nuts, and local terrestrial fauna would have been utilized by the Native Americans as part of their generalized subsistence base.

Prehistoric Period. The earliest human presence in the region may date back as far as 12,000 years. The antiquity of human occupation is attested to by two fluted projectile points that have been found on the South Fork. One was recovered east of the project area, on the west side of Three Mile Harbor. The other was found in Bridgehampton, directly south of project area (Saxon 1973:258). These artifacts typically date to between 10,500 and 8,000 B.C.; the so-called Paleo-Indian period.

There are numerous prehistoric remains in the vicinity of the Rowe Industries site, although none are documented within the project area itself. The project area is adjacent to a zone considered to be of high sensitivity for prehistoric Native American activity (Gonzalez and Rutsch 1978). The New York State Museum evaluates the project area as having a high probability of producing prehistoric archaeological data (Appendix A).

An overview of the published literature of Long Island sites indicates the existence of extensive prehistoric activity in the vicinity of the project area. The site files of the New York State Office of Parks, Recreation and Historic Preservation

(OPRHP) and the New York State Museum Anthropological Survey (NYSM) document eight prehistoric sites within two miles. The results of the file searches are presented in the table below. There are no National Register sites located within or adjacent to the project area.

There are many additional sites reported through word of mouth, although many are not well-documented (S. Habib 1996: personal communication). Tooker (1911) describes a large bone fish hook found in a shell midden "in the neighborhood of Sag Harbor" (Rau 1884:126). Adams (1916:30-31) catalogues the assortment of stone tools found throughout the area.

In summary, the archival research suggests that the Sag Harbor region was extensively utilized during the prehistoric period. There would appear to be a high potential for encountering prehistoric archaeological sites within or in the vicinity of the project area provided that traces of former occupation were not obliterated by disturbance (such as road and utility line construction).

Table 1. Archaeological Sites Within 3.2 Kilometers (2 miles) of the Rowe Industries Site

Site Identifier	Site Name	Age/Cultural Affiliation	References	Comments
NYSM #4907, ACP SUFK-38		prehistoric	NYSM, ACP	Extensive village.
NYSM #4910, ACP SUFK-41		prehistoric	NYSM, ACP	Village.
NYSM #4923, ACP SUFK-7		prehistoric	NYSM, ACP	"Traces of occupation."
NYSM #5531, SCAA #21, NCM 120	Long Pond	prehistoric	NYSM, SCAA, NCM, R. Wyatt, Parker 1926, Beaucham 1899	Small quartz chips, two Wading River projectile points.
NYSM #5532, SCAA #22	Otter Pond I	prehistoric	NYSM, SCAA	Shell midden, burial, steatite pipe.
NYSM #5533, SCAA #23	Otter Pond II	prehistoric	NYSM, SCAA, Southampton Town Records v. 7:30	Burial in sitting position, pottery.
NYSM #5534, NCM #18	Round Pond	prehistoric, historic	NYSM, NCM	Camps, wigwams, "historic wigwams."
NYSM #8830, SCAA X01	Wigwagoneck	prehistoric, historic	NYSM, SCAA, Ceci 1977, Tooker 1911	Village, burials. Used as fill for meadow in late 19th cent., wampum manufacture site.
A103-73-0020	Store Site	historic; 1830-early 20th c.	OPRHP, Chace 1855, Beers 1874, Sanborn 1902	Near Otter Pond. Abundance of artifacts such as ceramics, glass, pipes.

Historic Period. The site files list two Native American sites east of the project area that date from the early historic period, and one nineteenth-century site (A103-73-0020) within two miles (3.2 kilometers) (Table 1). There are no documented historic sites within or adjacent to the project area.

The Sag Harbor Village District, listed on the National Register of Historic Places, is located northeast of the project area on the south edge of Sag Harbor Cove. It is:

...an historical environment of 18th and 19th century structures remarkably uninterrupted by 20th century intrusions. Maritime and cultural links with New England associate the village with ports of that region rather than with other communities of New York...the village is extraordinary for the quantity of structures present from the 18th and first half of the 19th century, as well as for the quality of individual buildings (Cornish 1993:1).

The closest leg of the district is approximately .4 kilometers (.25 miles) to the northeast. There are no inventoried structures within the project area, and there are no National or State Register of Historic Place properties within or adjacent to the project area (Appendix A).

Sag Harbor is the easternmost village in the Town of Southampton. The project area is situated just south of the incorporated village of Sag Harbor and west of the Southampton and East Hampton township line. Throughout history, the project area was located southwest of the residential and commercial center of Sag Harbor, and removed from the nucleus of the earliest historic occupation.

The project area is located near the boundary between two

Native American groups, the Shinnecock and Montauk. Permanent settlement by the English did not occur in eastern Long Island until the seventeenth century. At this time eastern Suffolk County was occupied by the Montauk, speakers of a dialect of Algonquin Mohegan-Pequot (Goddard in Bonvillain 1980:5; Salwen 1978) and the Shinnecock.

The mid-seventeenth century (from 1638 to 1660) was a period of unrest for the Native Americans and the English. The Dutch encouraged the Indians to attack the English settlements, while the Pequot of Connecticut raided the Montauk. Native Americans on the east end of Long Island paid tribute first to the Pequots of Connecticut, and later to the English (Adams 1916:20).

The land that was to become the Town of Southampton, called "Agawam" by the natives (Thompson 1839:204), was sold on December 13, 1640 for sixteen coats and sixty bushels of corn, with the further condition that "the white settlers defend them (the Indians) from unlawful and unjust attack of other Indians" (Bayles 1874:306). In 1659, large numbers of Native Americans perished during an outbreak of smallpox or a similar disease (Ales 1979:68).

Sag Harbor and the surrounding tracts of land were formerly known at various times as "Wegwagonock" meaning "at the foot of the hill" (Weisburg et al. 1975), Harbor of Sagg (Tooker 1911:221-222), Bridgehampton Bay (Adams 1918:148), "Great Meadows" or "Sag Head" (Weisburg et al. 1975:47), and Sagaponack Harbor (Munsell 1882:35; Proehl and Shupe 1984:278).

The natural resources of the area were valued by the early colonists as much as they had been by the earlier aboriginal population. The abundant marshes furnished salt hay used for livestock feed and bedding and for mulch. In fact, this resource was so valuable that in 1680, haying privileges were assigned by Southampton through a lottery system (Weisburg et al. 1975:10). Regulations concerning the cutting of grass on the marshes and the clearing of timber from the surrounding forests in the area were routinely enacted at town meetings.

Before colonial settlement could commence, swamps and marshland had to be filled to make the land passable. There appears to have been no permanent settlement near the project area prior to 1730. After the meadowlands and swamps were filled, roads were laid out at the north end of Sag Harbor (furthest from the project area) and the first permanent residences were built (Zaykowski 1991:4-12).

Unlike most areas of Long Island, agriculture and soil productivity were not determining factors in the development of this area. Sag Harbor's development and prosperity were due primarily to its maritime resources and enterprises. Possessing a good harbor, and ready communication by land or water with New York and various points in New England, the village flourished throughout most of its history as a whaling, fishing, ship building, and manufacturing center.

In addition to its significance as an early trading and whaling port, Sag Harbor is noted for the establishment of the

first post office, the first newspaper, and the first printing press on Long Island. As a result, the Sag Harbor village district was listed on the New York State and National Register of Historic Places in 1973 (Appendix A).

At the time of earliest settlement, the north shore of the South Fork was sparsely populated. Early settlements were established along the south shore at Southampton and East Hampton. The lack of good harbors in these areas, however, forced early south shore villages to establish trading ports to the north. The Southampton settlement had a landing at North Sea, while East Hampton utilized Northwest Creek as its landing. As commerce grew, the residents of Sagaponack, or Sagg, also established a landing. "Roads were cut through the woods from Sagg, running five miles to the north to Great Meadows" (Southampton 1965:47). By 1707, this new port of "Sagg Harbour" had caught the attention of the British who objected to the illegal transport of goods through this port (Weisburg et al. 1975:10).

In the earliest years of settlement (late seventeenth and early eighteenth centuries) Sag Harbor was undeveloped, and consisted primarily of woods and meadows. The Sag Harbor men were mostly merchants, ship owners, and sailors (Heatley 1976:5). As early as 1680 a public highway linked North Haven with Sag Harbor and Bridgehampton. This connection was maintained in the eighteenth century to facilitate passage to the ferry (Heatley 1976:2).

The 1797 map (Figure 5) of this area clearly illustrates the close connection of the village to the harbor, as well as the ties of "Sagg Village" on the south shore to Sag Harbor on the north shore. In the early 1700s the colonists established three major east-west routes following previously used Native American trails. The map shows the linkage of these routes to the harbor by two major north-south roads. One of these, Bridgehampton-Sag Harbor Turnpike, which forms a portion of the project area, is identified as "Bull head road to Sagharbor." Noyack Road is also depicted skirting the harbor.

The linear alignment of structures along the roads leading to the harbor, the depiction of sailing ships, and the notation of "Wharf" all underline the importance of maritime activity. The nucleus of development of the village of Sag Harbor is depicted north of the project area (Figure 5). No structures or other significant cultural features are indicated within the project area at this time.

Commerce in Sag Harbor grew during the eighteenth century. "Merchant ships sailed to the British West Indies from Sag Harbor. Whalemen returned with their catch to Sag Harbor and processed the blubber at try-works near the wharf" (Weisburg et al. 1975:12). Shortly after the inauguration of the first president of the United States, Congress designated Sag Harbor as a distinct port of entry and the necessary Custom House officers were appointed (Prime 1845:210).

The 1838 US Coastal Survey (Figure 6) illustrates the expansion and nucleation of Sag Harbor. Otter Pond is shown northeast of the project area. Three of the four roads that comprise the project area are now depicted (Bridgehampton-Sag Harbor Turnpike, Noyack Road, and Brick Kiln Road), and are lined with dispersed homesteads. These structures are located north of the project area along Bridgehampton-Sag Harbor Turnpike, and on the other side of the road from the project area along Noyack Road and Brick Kiln Road (Figure 6).

The Bridgehampton-Sag Harbor Turnpike leads to the project area. During the nineteenth century, private turnpike and toll bridge companies were created in an effort to build and maintain early highways. In the Town of Southampton, the Sag Harbor and Bull's Head Turnpike Company built and supervised the toll road between Bridgehampton and Sag Harbor. The Bridgehampton-Sag Harbor toll was abolished in 1905 and the tollgate house burned down in 1909 (Lightfoot et al. 1984:86). None of these structures were within or adjacent to the project area.

The advent of the railroad fostered the further development of the area. In 1869 tracks were laid from Manor to Sag Harbor, opening the Hamptons for the first time to direct rail communications (Gabriel 1921:140). The nineteenth-century community of Sag Harbor was noted as "the largest village in Suffolk County, and one of the most handsome" (Bayles 1874:337).

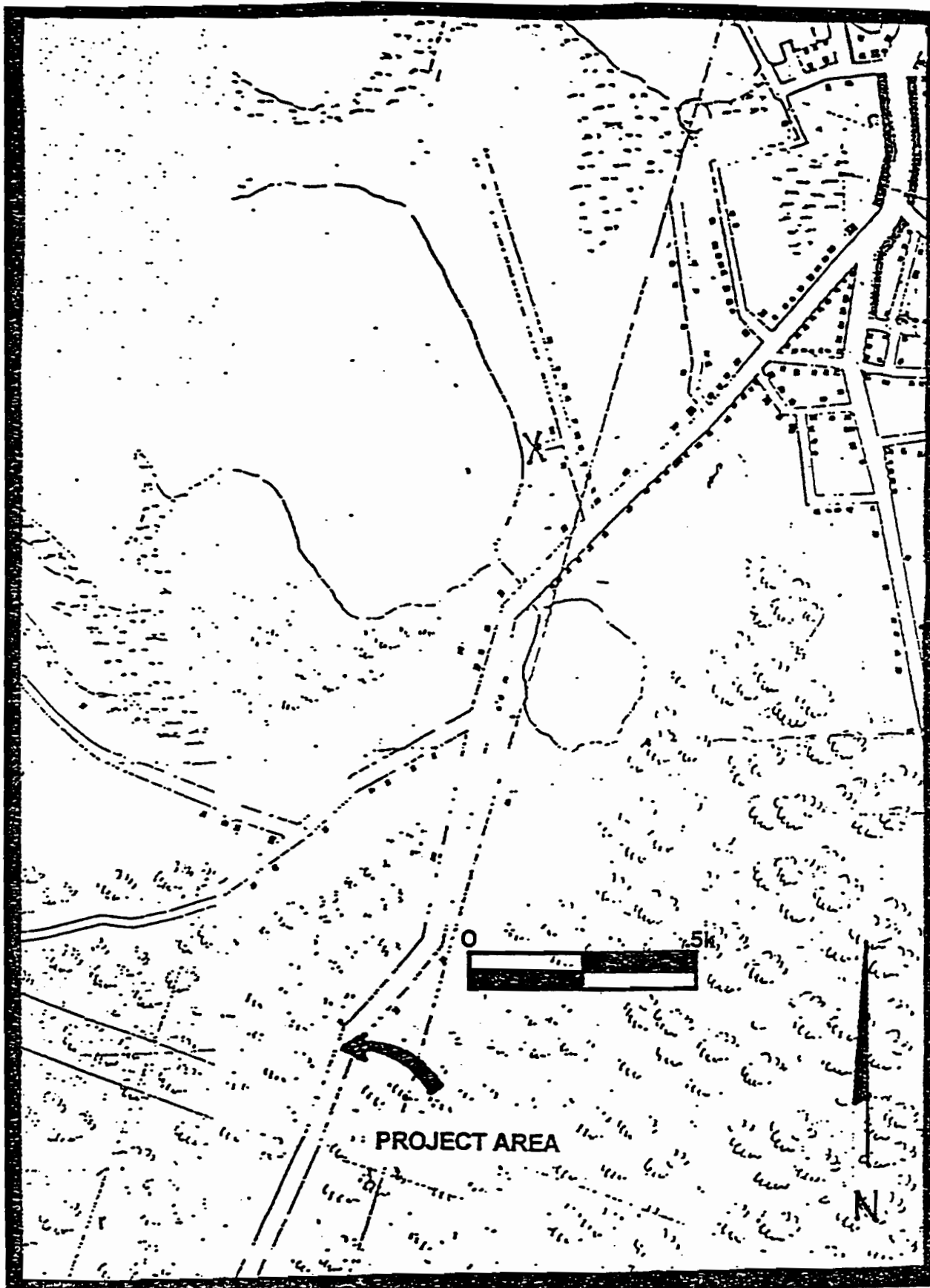


Figure 6. 1838 US Coastal Survey.

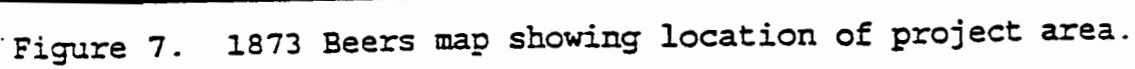
The 1873 Beers map (Figure 7) delineates the Sag Harbor Branch of the railroad running just east of the project area, and a toll gate south of the project area along Bridgehampton-Sag Harbor Turnpike. Lily Pond is depicted immediately south of the project area, as are numerous other basins that extend across the town and surround the project area. This is the first map to show Carroll Street, which forms the center portion of the project area. There are two structures in the vicinity of Carroll Street, but they are a good distance from the road and therefore not within the project area. Settlement is still scattered in the vicinity of the project area, and there are no structures within or immediately adjacent to it.

By the close of the nineteenth century a visit to Sag Harbor revealed:

dingy old storehouses and cooperages that stand down by the wharf mediating upon the scenes of by-gone years; these great blocks of brick buildings which line the business streets; these magnificent churches; these princely residences; these beautiful shade trees, and gas lighted streets, and flagged sidewalks; even these superannuated whaling captains whose silvered locks and time-scarred faces you meet at every turn, are all monuments of that day of prosperity whose glory has faded and gone (Bayles 1874:339).

The 1904 USGS (Figure 8) depicts the level topography of the project area in comparison to the steeper elevations and numerous ponds in the immediate vicinity. All the present-day roads along are represented as well as the intermittent stream to the north. Four structures appear along Carroll Street. The configuration of the roads remains unchanged on the 1956 USGS (Figure 2), but several new structures align both sides of Carroll Street.

Although the project area is outside the southern margins of early historical settlement, Sag Harbor-Bridgehampton Turnpike and Noyack Road were eighteenth-century thoroughfares, while Brick Kiln Road was in use by the early nineteenth century (Figure 6). Structures also appear along these roads at an early date, and with one exception, they align the opposite side of the street from the proposed pipeline (Figure 6). Carroll Street appears later in the nineteenth century along with the gradual construction of residences (Figures 7 and 8).



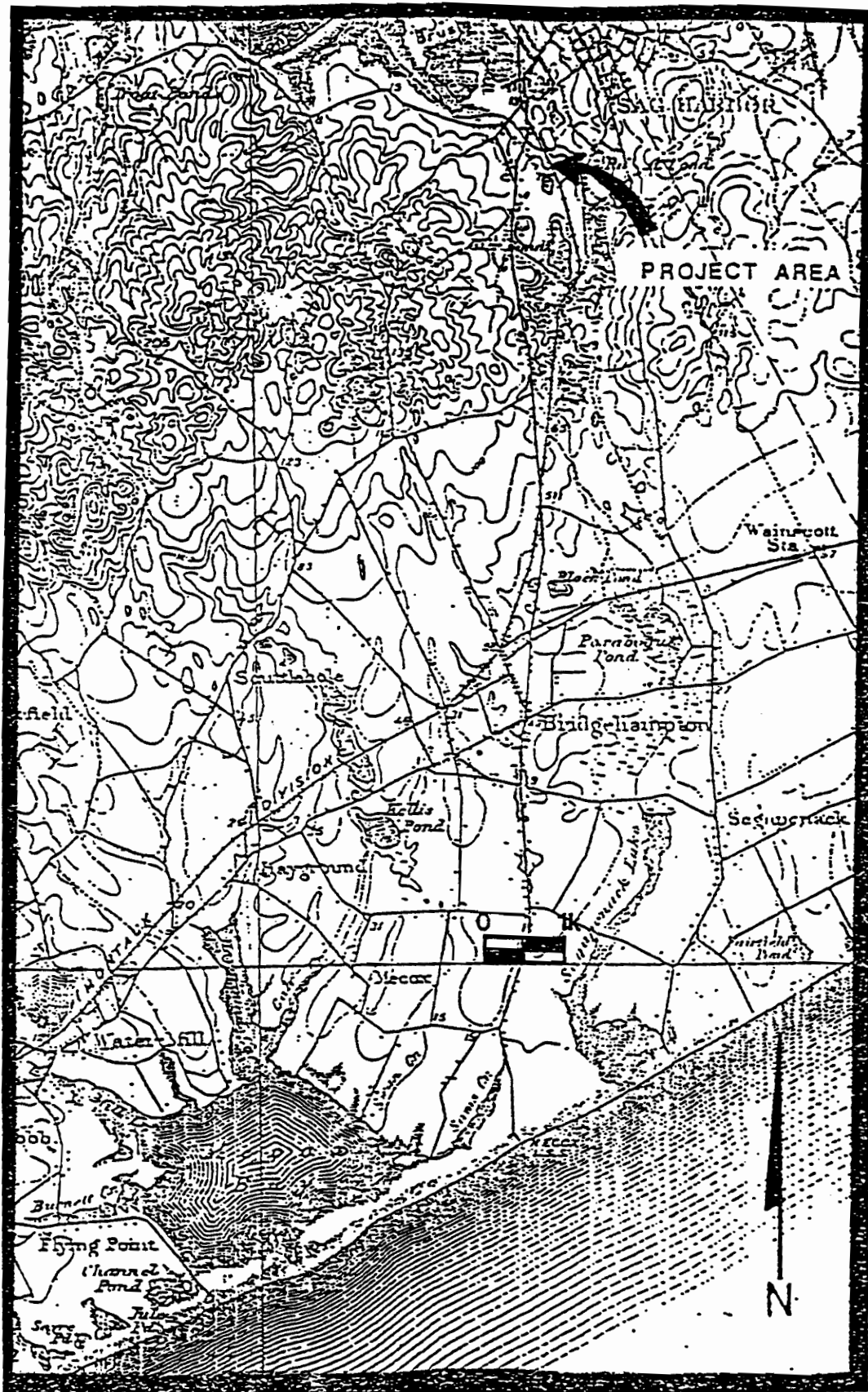


Figure 8. 1904 USGS Topographic map, Sag Harbor, New York quadrangle.

FIELD INSPECTION AND SURFACE SURVEY

An initial surface reconnaissance was conducted on July 25, 1996. The entire parcel was walked over, with special attention given to examining exposed soil for artifacts or other surface manifestations of past cultural activity. Vegetation patterns and topographic features which might provide insight into early land use were also noted.

The project area can be divided into two distinct sections; a commercial area which is the site of the proposed treatment system and the beginning of the proposed pipeline, and a residential area which contains the proposed route of the remainder and largest extent of the pipeline.

The commercial area contains a complex of large concrete buildings surrounded by asphalt and concrete paving. Grading and construction activities have completely disturbed this section. The site of the proposed treatment system is to be located on a former concrete pad (Figure 3), a portion of which is still in existence under soil and vegetation behind a 6 foot (1.83 meters) chain link fence with barbed-wire top rail. The pad is in a wooded area just off a large asphalt parking lot (Plate 1). The volunteer vegetation is indicative of clearing and grading activities that have occurred within the last ten years.

The start of the pipeline is in an area marked by extensive disturbance. It runs through an asphalt parking lot along the rear of a landscape storage yard associated with the Sag Harbor

Industries Building. A submerged oil tank imbedded in concrete adds to the disturbance. The pipeline changes direction before it approaches a wooded area, but does not enter the woods (Plate 2). The pipeline then continues along the edge of the building in the asphalt parking lot (Plate 3).

The next section of the project area, a bucolic neighborhood of residential properties, contains the largest extent of the proposed pipeline. Vegetation is comprised of native plant species (e.g., locust, oak, and cherry) on manicured lawns. The project area runs along the northwest edge of Sag Harbor Turnpike in the Suffolk County water line alignment (Figure 3). The grassy surface has been previously disturbed by road and water line construction (Plate 4).

The proposed pipeline continues on the south side of Carroll Street (Figure 3). The maintained shoulder has been previously disturbed by grading, driveways, and utilities (Plate 5). The project area extends along the west side of Brick Kiln Road between a concrete sidewalk and the road. This narrow strip of grass is all previously disturbed (Plate 6). The project area terminates on the north side of Noyack Road (Figure 3). The grass utility strip is bordered by the road on one side and a concrete sidewalk with split rail fence on the other (Plate 7).

In summary, both the commercial and residential sections of the project area are previously disturbed. An asphalt parking lot blankets the proposed treatment plant while the proposed pipeline route runs in or immediately adjacent to existing

- roadways that exhibit extensive disturbance.

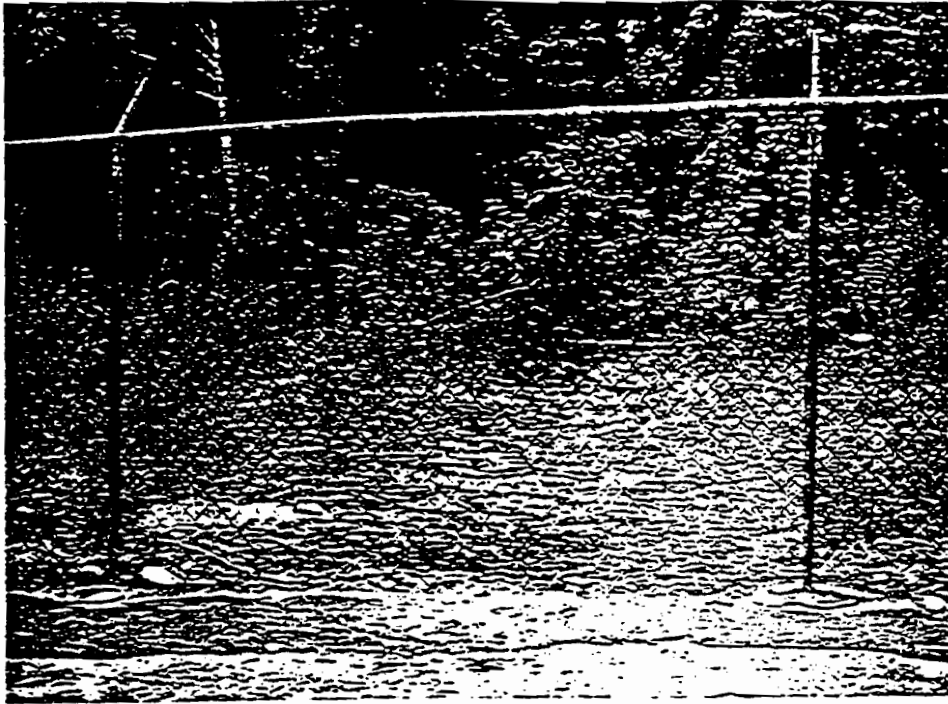


Plate 1. Looking south at concrete pad location behind chain link fence. Pad is partially visible under soil and vegetation.



Plate 2. Looking north at asphalt parking lot, submerged oil tank under concrete, and landscaper's storage yard (all previously disturbed).



Plate 3. Looking southwest at edge of building and asphalt parking lot.



Plate 4. Looking northeast along the northwest edge of Sag Harbor Turnpike at the Suffolk County water alignment (all previously disturbed).



Plate 5. Looking east along south side of Carroll Street at maintained grass shoulder (all previously disturbed).



Plate 6. Looking north at west side of Brick Kiln Road at disturbed grass area between sidewalk and road.



Plate 7. Looking east at grass utility strip bordered by split rail fence and sidewalk on one side and Noyack Road on the other (all previously disturbed).

CONCLUSIONS AND RECOMMENDATIONS

Although the archival review suggests that the project area has a high potential for containing prehistoric cultural remains and a moderate potential for recovering historic cultural materials, field reconnaissance demonstrates otherwise. Both the configuration (narrow transect) and location of the project area (immediately adjacent to the edge or under the existing roadway) mitigate against finding archaeological remains with any extant research potential. Grading activities, asphalt parking, and building construction characterize the site of the proposed treatment system. Proposed pipe locations along the roadways are within the extensive disturbance caused by road grading and construction, utility lines, sidewalks, and landscaping.

Based on the results of the Stage I-A survey it does not appear that construction in the project area will impact significant archaeological remains. Therefore, no further investigations are recommended. However, archival research has shown this area to be both prehistorically and historically sensitive. If any construction should be proposed for areas outside those surveyed for this project, they will also need to be tested for the presence of archaeological materials.

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anonymous

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APPENDIX A

SITE FILE INFORMATION

7/15/96 To: W. A. WARD, ILLA - SUNY AT STONY BROOK

Project: Topo. Maps: SAG HARBOR

Bl/(initials) Anthropological Survey, NYSM

New York State Museum Prehistoric Archaeological Site Files

EVALUATION OF ARCHAEOLOGICAL SENSITIVITY FOR PREHISTORIC (NATIVE AMERICAN) SITES

Examination of the data suggests that the location indicated has the following sensitivity rating:

HIGH PROBABILITY OF PRODUCING PREHISTORIC ARCHAEOLOGICAL DATA.

The reasons for this finding are given below:

- ☒ A RECORDED SITE(S) IS(ARE) INDICATED IN, ADJACENT TO, OR IN THE VICINITY OF THE LOCATION AND WE HAVE REASON TO BELIEVE IT(HEY) COULD BE IMPACTED BY THE PROPOSED ACTIVITY.
- ☒ A RECORDED SITE IS INDICATED IN THE GENERAL VICINITY OR SOME DISTANCE AWAY. DUE TO THE MARGIN OF ERROR IN THE LOCATION DATA IT IS POSSIBLE THE SITE ACTUALLY EXISTS IN OR IMMEDIATELY ADJACENT TO THE LOCATION.
- ☒ THE TERRAIN IN THE LOCATION IS SIMILAR TO TERRAIN IN THE GENERAL VICINITY WHERE RECORDED ARCHAEOLOGICAL SITES ARE INDICATED.
- ☒ THE PHYSIOGRAPHIC CHARACTERISTICS OF THE LOCATION SUGGEST A HIGH PROBABILITY OF PREHISTORIC OCCUPATION OR USE.
- ☐ THE PHYSIOGRAPHIC CHARACTERISTICS OF THE LOCATION SUGGEST A MEDIUM PROBABILITY OF PREHISTORIC OCCUPATION OR USE.
- ☐ THE PHYSIOGRAPHIC CHARACTERISTICS OF THE LOCATION SUGGEST A LOW PROBABILITY OF PREHISTORIC OCCUPATION OR USE.
- ☐ EVIDENCE OF CULTURAL OR NATURAL DESTRUCTIVE IMPACTS SUGGESTS A LOSS OF ORIGINAL CULTURAL DEPOSITS IN THIS LOCATION.
- ☐ THE PHYSIOGRAPHIC CHARACTERISTICS OF THE LOCATION ARE MIXED, A HIGHER THAN AVERAGE PROBABILITY OF PREHISTORIC OCCUPATION OR USE IS SUGGESTED FOR AREAS IN THE VICINITY OF EITHER PRESENT OR PREEXISTING BODIES OF WATER, WATERWAYS, OR SWAMPS. A HIGHER THAN AVERAGE PROBABILITY IS SUGGESTED FOR ROCK FACES WHICH AFFORD SHELTER OR FOR AREAS SHELTERED BY BLUFFS OR HILLS. AREAS IN THE VICINITY OF CHERT DEPOSITS HAVE A HIGHER THAN AVERAGE PROBABILITY OF USE. DISTINCTIVE HILLS OR LOW RIDGES HAVE AN AVERAGE PROBABILITY OF USE AS A BURYING GROUND. LOW PROBABILITY IS SUGGESTED FOR AREAS OF EROSIONAL STEEP SLOPE.
- ☐ PROBABILITY RATING IS BASED ON THE ASSUMED PRESENCE OF INTACT ORIGINAL DEPOSITS, POSSIBILITY UNDER FILL, IN THE AREA. IF NEAR WATER OR IF DEEPLY BURIED, MATERIALS MAY OCCUR SUBMERGED BELOW THE WATER TABLE.
- ☐ INFORMATION ON OTHER SITES MAY BE AVAILABLE IN A REGIONAL INVENTORY MAINTAINED AT THE FOLLOWING LOCATION(S).

COMMENTS:

cc: N.Y.S. OFFICE OF PARKS, RECREATION AND HISTORIC PRESERVATION; H. P. FIELD SERVICES BUREAU

IGZPO, 1944.

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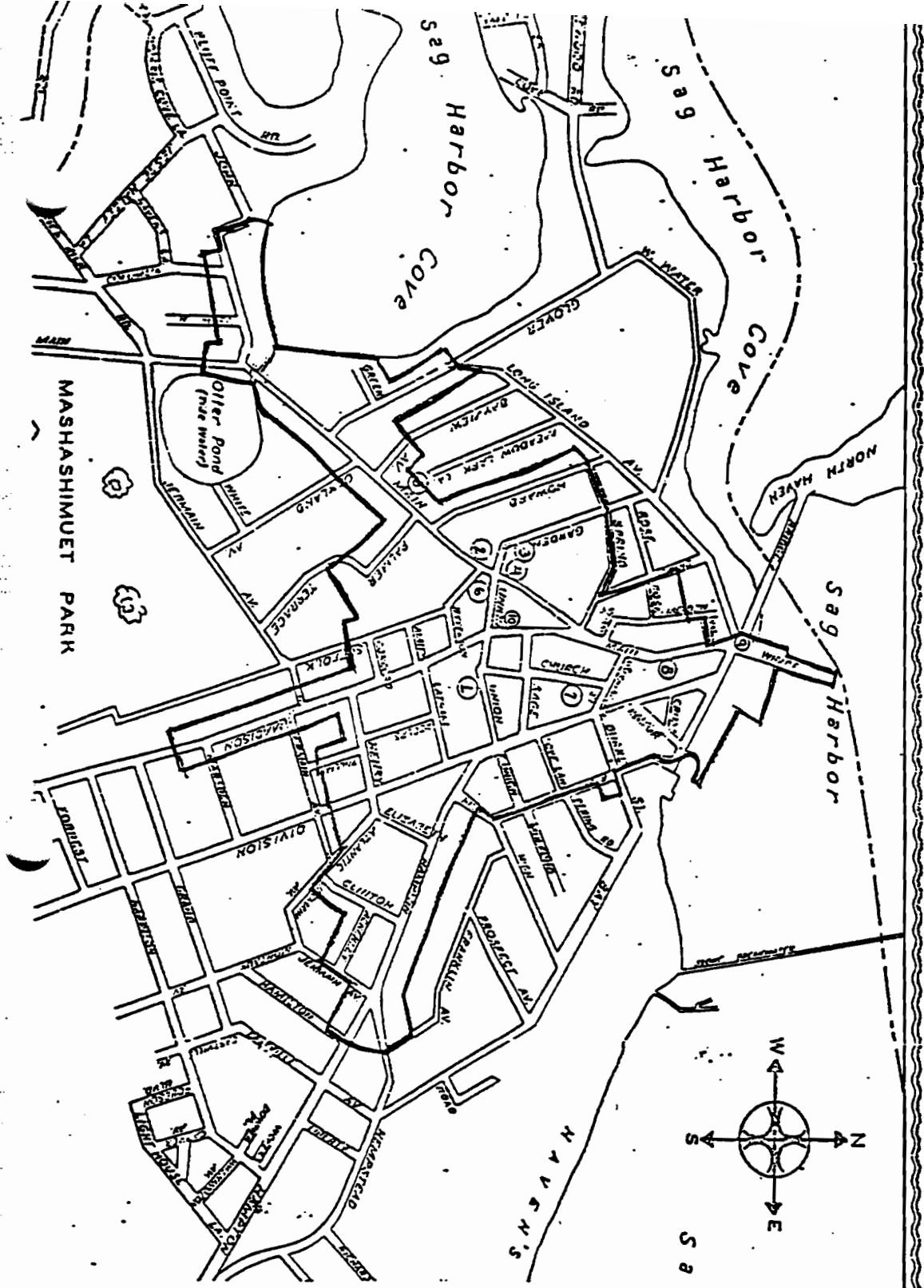
FROM ANTHROPOLOGY DEPT.

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TIME & DATE	SITE NAME	REPORTED: X-STAGES(PHASES) : OCCUP. TYPE : STRATIG.	REMARKS	FIELD TOPIC 7.3.1(15) : COUNT	REPORTER (RECORDED) -EARLIER REPORTER	PROJECT NO. 1. NOTE PUBLICATION 2. MAP: 3. E. 3C
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ACP SUPR NO INFO 1911		X-NO INFO(ING INFO) :VILLAGE :NO INFO		SAG HARBOR (SAG PARKER, A.C. HARBOR: -1)	NO INFO :PARKER /1922	1. 2. 3. 3.7
ACP SUPR NO INFO 1911		X-NO INFO(ING INFO) :TRACES OF OCCUPATION :NO INFO		SAG HARBOR (SAG PARKER, A.C. HARBOR: -1 (NO INFO) :SOF	NO INFO :PARKER /1922	1. 2. 3.7
SCAA 321 LONG POND NCH 2011		X-LAYING INFO :NO INFO :UNOIS?	"SH. QUARTZ CHIPS. 2 WADING AV. PP. 3 4-2-DEEP. REFERENCES INCLUDE "BEACHING 1999".	SAG HARBOR (SAG WYATT, E. HARBOR: -1 (PARKER/1922) :SOF SAUGHAM		1. 2. 3. 3.7
SCA OTTER POND 271	IAWASHACHINUCT	X-BY :(NO INFO) :SHELL WIDEN. BURIALS :NO INFO	"...SHELL HEAPS AND GRAVES... IN 1 SAG STEATITE (PLATEFORM) PIPE..."	SAG HARBOR (SAG NO INFO HARBOR: -1) :SOF		1. 2. 3. 3.7
SCAA OTTER POND II 2311		X-(NO INFO) :BURIAL :NO INFO	"...BURIAL: IN SITTING POSITION. 2 PIECES POTTERY. RELICS. ARROWHEADS..."	SAG HARBOR (SAG NO INFO HARBOR: -1) :SOF	:SOUTHAMPTON N TWM SEC VT: 90	1. 2. 3. 3.7
SCA 1 ROUND POND 1311		X-(NO INFO) :CAMP? VILLAGE? Y ISLAND :NO INFO	"HISTORIC WIGWAG".	SAG HARBOR (SAG NO INFO HARBOR: -1) :SOF	NO INFO : :	1. 2. 3.7
SCAA WISWAGONOCK 2011		X-UN? :NO INFO :VILLAGE, BURIALS :NO INFO	TOOKER "...AREA USED AS FILL FOR WAGONRY. LT. 19TH C.C. CECI "WAGON" MANUFACTURE SITE. BUTCH TRACE". SCAA TOWN IS EAST HAMPTON BUT NOT LOCAT. FROM LAT. -LINE IS SOUTHAMPTON.	SAG HARBOR (SAG CECI /1911 HARBOR: -1 (TOOKER /1911) :SOF	NO INFO :NO INFO	1. 2. 3. 3.7



SAG HARBOR VILLAGE DISTRICT
Sag Harbor, Suffolk County, N.Y.

1. Old Whaler's Church
2. Benjamin Huntting House, Whaling Museum
3. Customs House
4. Hannibal French House
5. Napier-Howell House
6. John Jermain Library
7. Bulova Watch Company (Fahys Watch Case Factory)
8. Municipal Hall and American Hotel
9. Windmill
10. Jared Wade House

Boundaries are intended to follow streets, shorelines, and property lines.

APPENDIX B
CORRESPONDENCE

LEGGETTE, BRASHEARS & GRAHAM, INC.

PROFESSIONAL GROUND-WATER
AND ENVIRONMENTAL SERVICES

126 MONROE TURNPIKE
TRUMBULL, CT 06611
203-452-3100
FAX 203-452-3111

W. JOHN SEIFERT, JR.
FRANK I. GETCHELL
CHARLES W. KREITLER
JEFFREY B. LENNOX

JAYBACK
H. CRUM
EL R. BURKE
T. LAMONICA
M. K. BECKMAN
BUZEA
N. POWERS
ASO, JR.
EY FOX
M.F. GUYTON
V.L. KLUG

DAVID A. WILEY
TERRANCE P. BRENNAN
DAVID M. SCHANTZ
W. THOMAS WEST
CARY G. PIETERICK
DAVID B. TERRY
WILLIAM B. KLENT
THOMAS P. CUSACK
JOHN M. BENVEGNA
KENNETH D. VOGEL

50

Years of Excellence

August 24, 1995

Mr. David Bernstein &
Ms. Linda Barber
Prehistoric Archeology
Historic Archeology
Institute for Long Island Regional
Archeology
Department of Anthropology
State University of New York at Stony Brook
Stony Brook, NY 11794-4364

RE: Request for Proposal
Phase IA Cultural Survey
Rowe Industries Superfund Site
Sag Harbor, New York

Dear Mr. Bernstein & Ms. Barber:

As site representatives for the potentially responsible parties at the Rowe Industries Superfund site in Sag Harbor, New York, we are soliciting proposals to complete a Phase IA Cultural and Archeological Survey for the area in which remedial actions will take place. There are two areas which will be disturbed. The first is a 20 foot by 20 foot former chemical storage area which contains a concrete pad. This feature has been extensively studied through well and test boring activities. No artifacts have been found in the split-spoon samples which cover the entire area being excavated. The second area is a proposed water transmission line as shown on the enclosed drawing. Most of the length of this pipe will underlie existing streets and will parallel a water-supply line installed by the Suffolk County Water Authority.

Leggette, Brashears & Graham, Inc. (LBG) has completed some preliminary research required by the USEPA and the NYSDEC, but we require the services of a Qualified Archeologist to complete the report and make a site determination.

Mr. David Bernstein &
Ms. Linda Barber

-2-

August 24, 1995

Enclosed are the forms and information provided to us by the regulatory agencies, as well as the results of the research completed to date. Please note that the NYSDEC forms are included for information purposes only. The attached comment from the EPA specifies that Department of Interior guidelines must be used for the summary and report. We would appreciate a brief technical proposal (demonstrating an understanding of the assignment) and a cost for completing the Phase IA report. Please enclose a resume of the person who will be performing the work as well as a statement of qualifications. Completion of the 40-hour OSHA HAZWOPER training course will be a requirement if any intrusive work is required in subsequent studies, if they are deemed necessary.

Thank you for your attention. If you are interested in the project, please respond by September 15, 1995.

Very truly yours,

LEGGETTE, BRASHEARS & GRAHAM, INC.



Robert Lamonica, CPG
Vice President

RL:skd
Enclosures
rfq/NAB

APPENDIX O
VOC Suppression Foam Literature

**MATERIAL SAFETY DATA SHEET****AC-645****SECTION I: GENERAL INFORMATION**

Manufacturer's Name: RUSMAR INCORPORATED
Manufacturer's Address: 216 Garfield Avenue
West Chester, PA 19380
Manufacturer's Phone No.: 610-436-4314
Chemical Family: Aqueous anionic surfactant mixture
Trade Name: RUSMAR AC-645

SECTION II: HAZARDOUS INGREDIENTS

Paints, Preservatives, and Solvents – None
Alloys and Metallic Coatings – None
Hazardous Mixtures and Other Materials – None

SECTION III: PHYSICAL DATA

Boiling Point: 100° C	Specific Gravity: 1.01 to 1.06
Vapor Pressure: 25mm Hg at 25° C	% Volatile, By Volume: None
Vapor Density (Air = 1): N/A	Evaporation Rate: N/A
Water Solubility: Complete	
Appearance/Odor: Translucent, white, milk-like, odorless, viscous liquid	

SECTION IV: FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method): Nonflammable
Flammable Limits: N/A
Extinguishing Media: N/A
Special Fire Fighting Procedures: None
Unusual Fire and/or Explosion Hazards: None

SECTION V: HEALTH HAZARD DATA

Threshold Limit Value: Not Determined

Effects of Overexposure: This material is not expected to present an inhalation or ingestion hazard. It may cause an eye or skin irritation upon direct contact.

Emergency and First Aid Procedures: Wash thoroughly with clean water.

SECTION VI: REACTIVITY DATA

Material is stable

No material incompatibility

Hazardous Decomposition Products: Low levels of sulfur oxides on exposure to high temperatures (concentrate). Foam is noncombustible.

Polymerization will not occur

SECTION VII: SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled: If spilled indoors on a hard surface, the spill area may be slippery and should be thoroughly washed with water. Contain spill and absorb material with dirt or other appropriate absorbent.

Waste Disposal Method: This material is completely biodegradable and can be disposed of in a sanitary landfill according to local regulations.

SECTION VIII: SPECIAL PROTECTION INFORMATION

Respiratory Protection: None required for normal operations

Ventilation: No special requirements

Protective Gloves: Not required, but recommended.

Eye Protection: Not required, but recommended.

Other Protective Equipment: None

SECTION IX: SPECIAL PRECAUTIONS

Storing/Handling Precautions: Avoid excessive heat. Material will freeze, but thawing will not cause changes in the product.

Other Precautions: None



To: Al Kovalik, LBG Engineering
203-452-3110 203-452-3111 Fax

From: Laura White, Sales & Marketing Coordinator
Rusmar Incorporated
800-733-3626 610-436-8436 Fax

Date: 1/2/97

Pages: 17

Message:

Al,

I have included a copy of the test results from the TCLP and biodegradation test that were performed on Rusmar AC-645 Long Duration Foam.

Please let me know if you have any questions or require additional information.

Regards,


Laura White

MAY 16 1991

**SSM/Laboratories****ANALYTICAL REPORT**

CLIENT: T.F. O'Neill
 Chester County Solid Waste Authority
 P. O. Box 476
 Honey Brook PA 19344

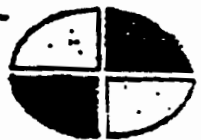
SAMPLE: 1017762
PROJECT: 104606
PO NO:
REPORTED: 14-MAY-91
RECEIVED: 22-APR-91
WORK ORDER:

CLIENT SAMPLE IDENTIFICATION: RUSMAR

SAMPLE DESCRIPTION: AC-645

SAMPLING DATE: 22-APR-91 **BY:** Client

	UNITS	RESULT
pH (Quadruplicate)		
pH (replicate 1)		11.0
pH (replicate 2)		11.1
pH (replicate 3)		11.0
pH (replicate 4)		11.0
Conductance, Specific (Quadruplicate)		
Conductance (replicate 1)	umho/cm	4400
Conductance (replicate 2)	umho/cm	4410
Conductance (replicate 3)	umho/cm	4400
Conductance (replicate 4)	umho/cm	4400
Total Organic Carbon (Quadruplicate)		
TOC (replicate 1)	mg/l	6120
TOC (replicate 2)	mg/l	6140
TOC (replicate 3)	mg/l	6100
TOC (replicate 4)	mg/l	6140
Total Organic Halogens (Quadruplicate)		
TOX (replicate 1)	ug/l	1800
TOX (replicate 2)	ug/l	2025
TOX (replicate 3)	ug/l	2150
TOX (replicate 4)	ug/l	1970
Arsenic	mg/l	< 0.002
Alkalinity, Total	mg/l	2360
Barium, Total	ug/l	78
Nitrogen, Ammonia	mg/l	0.653
Cadmium	ug/l	< 3
Calcium, Total	mg/l	48.4
Chromium, Total	ug/l	15.2
Chloride	mg/l	379



SSM/Laboratories

CLIENT: Chester County Solid Waste Authority
 SAMPLE: 1017762 RUSMAR
 PROJECT: 104606

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 14-MAY-91

Copper, Total	ug/l	188
Iron, Total	ug/l	1500
Lead, Total	ug/l	< 0.2
Fluoride	ug/l	< 0.2
Mercury, Total	ug/l	< 0.0005
Magnesium, Total	ug/l	961
Silver	ug/l	< 6
Nitrate	ug/l	8.97
Zinc, Total	ug/l	23.0
Phenolics	ug/l	2540
Potassium, Total	ug/l	1510000
Sodium, Total	ug/l	500
Sulfate	ug/l	2340
Turbidity, Nephelometric	NTU	6900
Hardness, Total (as CaCO ₃)	ug/l	< 2
Total Petroleum Hydrocarbons	ug/l	130
HSL Purgeables		
Acetone	ug/l	< 1000
Benzene	ug/l	< 100
Bromomethane	ug/l	< 200
Bromodichloromethane	ug/l	< 100
Bromoform	ug/l	< 100
2-Butanone	ug/l	< 1000
Carbon disulfide	ug/l	< 100
Carbon tetrachloride	ug/l	< 100
Chlorobenzene	ug/l	< 100
Chloroethane	ug/l	< 200
Chloroform	ug/l	< 100
Chloromethane	ug/l	< 200
Dibromochloromethane	ug/l	< 100
1,1-Dichloroethane	ug/l	< 100
1,2-Dichloroethane	ug/l	< 100
1,1-Dichloroethene	ug/l	< 100
1,2-Dichloroethane (total)	ug/l	< 100
1,2-Dichloropropane	ug/l	< 100
cis-1,3-Dichloropropene	ug/l	< 100
trans-1,3-Dichloropropene	ug/l	< 100
Ethylbenzene	ug/l	< 100
2-Hexanone	ug/l	< 1000
4-Methyl-2-pentanone	ug/l	< 1000
Methylene chloride	ug/l	< 100
Styrene	ug/l	< 100
1,1,2,2-Tetrachloroethane	ug/l	< 100
Tetrachloroethene	ug/l	< 100
1,1,1-Trichloroethane	ug/l	< 100

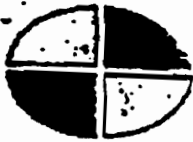


SSM/Laboratories

CLIENT: Chester County Solid Waste Authority
 SAMPLE: 1017762 RUSMAR
 PROJECT: 104606

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1,1,2-Trichloroethane	ug/l	< 100
Trichloroethene	ug/l	< 100
Toluene	ug/l	< 100
Vinyl acetate	ug/l	< 200
Vinyl chloride	ug/l	< 200
Xylenes (total)	ug/l	< 100
Additional Purgeables		
n-Propanol	ug/l	< 10000
Isopropanol	ug/l	< 10000
bis(Chloromethyl) ether		ND
Tetrahydrofuran	ug/l	< 1000
HSL BN/A Extractables		
Acenaphthene	ug/l	< 100
Acenaphthylene	ug/l	< 100
Anthracene	ug/l	< 100
Benzo[a]anthracene	ug/l	< 100
Benzo[b]fluoranthene	ug/l	< 100
Benzo[k]fluoranthene	ug/l	< 100
Benzo[a]pyrene	ug/l	< 100
Benzo[g,h,i]perylene	ug/l	< 100
Benzoic acid	ug/l	< 500
Benzyl alcohol	ug/l	< 100
Benzyl butyl phthalate	ug/l	< 100
Bis(2-chloroethyl) ether	ug/l	< 100
Bis(2-chloroethoxy) methane	ug/l	< 100
Bis(2-ethylhexyl) phthalate	ug/l	< 100
Bis(2-chloroisopropyl) ether	ug/l	< 100
4-Bromophenyl phenyl ether	ug/l	< 100
4-Chloroaniline	ug/l	< 100
2-Chloronaphthalene	ug/l	< 200
4-Chlorophenyl phenyl ether	ug/l	< 100
Chrysene	ug/l	< 100
Dibenzo[a,h]anthracene	ug/l	< 100
Dibenzofuran	ug/l	< 100
Di-n-butylphthalate	ug/l	< 100
1,3-Dichlorobenzene	ug/l	< 100
1,2-Dichlorobenzene	ug/l	< 100
1,4-Dichlorobenzene	ug/l	< 100
3,3'-Dichlorobenzidine	ug/l	< 200
Diethyl phthalate	ug/l	< 100
Dimethyl phthalate	ug/l	< 100
2,4-Dinitrotoluene	ug/l	< 100
2,6-Dinitrotoluene	ug/l	< 100
Di-n-octylphthalate	ug/l	< 100
Fluoranthene	ug/l	< 100



SSM/Laboratories

CLIENT: Chester County Solid Waste Authority
 SAMPLE: 1017762 RUSMAR
 PROJECT: 104606

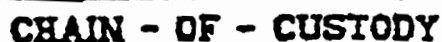
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Fluorene	ug/l	< 100
Hexachlorobenzene	ug/l	< 100
Hexachlorobutadiene	ug/l	< 100
Hexachlorocyclopentadiene	ug/l	< 100
Hexachloroethane	ug/l	< 100
Indeno[1,2,3-cd]pyrene	ug/l	< 100
Isophorone	ug/l	< 100
2-Methylnaphthalene	ug/l	< 100
Naphthalene	ug/l	< 100
2-Nitroaniline	ug/l	< 500
3-Nitroaniline	ug/l	< 500
4-Nitroaniline	ug/l	< 500
Nitrobenzene	ug/l	< 100
n-Nitroso-di-n-propylamine	ug/l	< 100
n-Nitrosodiphenylamine	ug/l	< 100
Phenanthrene	ug/l	< 100
Pyrene	ug/l	< 100
1,2,4-Trichlorobenzene	ug/l	< 100
4-Chloro-3-methylphenol	ug/l	< 100
2-Chlorophenol	ug/l	< 100
2,4-Dichlorophenol	ug/l	< 100
2,4-Dimethylphenol	ug/l	< 100
2,4-Dinitrophenol	ug/l	< 100
2-Methyl-4,6-dinitrophenol	ug/l	< 500
2-Methylphenol (o-Cresol)	ug/l	< 100
4-Methylphenol (p-Cresol)	ug/l	< 100
2-Nitrophenol	ug/l	< 100
4-Nitrophenol	ug/l	< 500
Pentachlorophenol	ug/l	< 500
Phenol	ug/l	< 100
2,4,5-Trichlorophenol	ug/l	< 100
2,4,6-Trichlorophenol	ug/l	< 100
Pesticides, HSL		
Gamma BHC	ug/l	< 1.0
4,4'-DDT	ug/l	< 2.0

< Indicates less than the limit of detection.

Respectfully submitted,

John R. Womer
 John R. Womer,
 Group Leader, General Chemistry



704606

PROJECT I.D.

SAMPLE ID: _____

Use Reverse Side for Special Holes

BIODEGRADATION STUDY REPORT

BIODEGRADABILITY OF AC-645

BY

OECD METHOD 301C

Prepared for:

RUSMAR INCORPORATED
West Chester, PA 19380

Prepared by:

BIOSCIENCE INC.
Bethlehem, PA 18017

April 22, 1993

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Experimental Design for Respirometry Experiments

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Oxygen Demand - Experiment One

Figure 3 -

Oxygen Demand - Experiment Two

Table 4 -

Analytical Results

EXECUTIVE SUMMARY

Bioscience, Inc. was contracted to determine the biodegradability of Rusmar Incorporated AC-645, a product, used in a water-diluted form, to form a foam barrier on a sanitary landfill daily working surface.

Biodegradation was determined utilizing a combination of biochemical oxygen uptake data and chemical oxygen demand (COD) removal data. These data were developed utilizing the standard Organization for Economic Cooperation and Development, OECD 301, testing procedure.

Results indicated that Rusmar Incorporated AC-645 is easily biodegraded by unacclimated microbial seed and is therefore expected to degrade easily in the environment.

BIODEGRADABILITY OF AC-645 BY OECD METHOD 301C

PROCEDURE

The sample, as received, was labelled Rusmar Incorporated AC-645, diluted one part chemical concentrate with six parts ordinary tap water. This product is normally applied, as a foam, at this concentration. A portion of the sample was thoroughly mixed, diluted in deionized water, and analyzed for COD using the procedure described in Standard Methods (1), Method 508 C. The COD value was used as theoretical oxygen demand (TOD), in the absence of a precise chemical formula, for calculation of TOD. Biochemical oxygen uptake data was determined by electrolytic respirometry. This evaluation was performed according to OECD Guidelines for Testing of Chemicals (2), "Ready Biodegradability: Modified MITI Test (I)", Method 301 C.

All reactors were seeded with 10 ml of return activated sludge from the Easton Area Joint Sewer Authority (PA) Sewage Treatment Plant. Each reactor contained a basal salt nutrient solution as defined in OECD Guidelines buffered at pH 7.2. The nutrient solution provides nitrogen, phosphorus, iron, calcium, magnesium and potassium salts. Reactors 2 and 4 were used as endogenous respiration controls (seed blanks). The seed blanks determine endogenous oxygen uptake resulting from microbial metabolism in the absence of added organic matter. Reactors 5 and 6 had 100 mg of aniline added as a reference compound to verify the activity of the microbial seed as suggested in the OECD procedure. Reactors 1 and 3 had 20 mg of test substance added in the first respirometry evaluation. All reactors were diluted to a final volume of 1.00 liter. Respirometry reactor setup is summarized in Table 1.

The first respirometry evaluation (experiment 1) was conducted over a 28 day period. Initial and final samples were removed and analyzed for soluble COD (after filtration through glass fiber filters to remove biological solids). Both COD

BIODEGRADABILITY OF AC-645 BY OECD METHOD 301C

and biochemical oxygen uptake data were used as independent determinations of the degree of biodegradation for each sample to confirm and validate the results.

A second respirometry evaluation (experiment 2) was set up similarly, except that reactors 1 and 3 contained 200 mg of the test sample and additional reactors, 7 and 8, contained 150 mg and 100 mg of test sample respectively. This evaluation was conducted over a 17 day period. Biodegradation of all samples exceeded 65% and the test was terminated.

RESULTS

The net oxygen curves from the respirometry evaluations are presented in Figures 2 and 3. In these curves, seed blank oxygen consumption has been subtracted. Initial and final COD data and final oxygen uptake for the complete respirometry experiment are presented in Table 4.

The viability of the microbial seed was established by the data from the reference sample test. The test is considered valid if 40% of the aniline is degraded in 7 days and 65% is degraded in 14 days. As shown in Table 4, these criteria were met. As shown in Figures 2 and 3, there was a significant lag (around 75 hours) preceding aniline degradation, which is normal for this material. Aniline degradation then proceeded smoothly until completion as shown by the leveling of the cumulative oxygen uptake curve at approximately 125 hours.

BIODEGRADABILITY OF AC-645 BY OECD METHOD 301C

DATA TREATMENT

Raw analytical data from respirometry and COD analyses are shown in the upper section for each experiment in Table 4. Calculated results are shown in the lower section for each experiment. COD added due to test material is calculated from the COD determined for the sample as received and the amount of sample added to each reactor. The TOD of aniline is calculated from the chemical formula and the amount of aniline added. Soluble COD removal is calculated by subtracting soluble COD final from COD initial, then subtracting the COD removal of the seed blank. Percent degradation of each sample is calculated by dividing soluble COD removal by COD (or TOD for aniline) added and multiplying by 100.

Net biological oxygen uptake is calculated by subtracting average oxygen uptake for the endogenous controls from each sample values at the end of the experiment. Percent degradation using oxygen uptake information is calculated by dividing net oxygen uptake by COD (or TOD) added and multiplying by 100.

The two methods used here, soluble COD and oxygen uptake information, provide independent estimates of the degree of biodegradation of the samples. Degradation calculated using oxygen uptake compared to the amount of COD or TOD added results in a low estimate - oxygen uptake does not account for material converted to biomass and thus, only partially oxidized. Therefore 65 to 70% degradation based on oxygen uptake is equivalent to approximately 90% removal of test material. The two estimates of biodegradation agreed very well.

BIODEGRADABILITY OF AC-645 BY OECD METHOD 301C

CONCLUSIONS

The test material, AC-645, was degraded over 80% (average of reactors 1, 3, 7 and 8 in experiment 2) as shown by both oxygen consumption and COD removal. Experiment 2 confirmed the earlier results in experiment 1, in which the test sample concentration was low and the analytical results thus had a high relative error.

The aniline reference material was degraded satisfactorily, as shown by both oxygen consumption and COD removal, to provide a valid test.

This material, Rusmar Incorporated AC-645, therefore meets the criteria for ready biodegradability as established in OECD Method 301C.

REFERENCES

- (1) Standard Methods for the Examination of Water and Wastewater, 16th Edition, APHA, 1985.
- (2) OECD Guidelines for Testing of Chemicals, Organization for Economic Cooperation and Development, 1984.

APPENDIX

Table 1 - Experimental Design for Respirometry Experiments

Figure 2 - Oxygen Demand - Experiment One

Figure 3 - Oxygen Demand - Experiment Two

Table 4 - Analytical Results

TABLE 1. EXPERIMENTAL DESIGN FOR RESPIROMETRY EXPERIMENT.

EXPERIMENT 1.

Reactor	Organic Compound Added	Concentration (mg/l) *	Seed Volume (ml)	Seed Amount (mg TSS+)	Total Liquid Volume (ml)	Nutrients Added ++
1	AC-645-ES	20.2	10	30	1000	Yes
2	None	0	10	30	1000	Yes
3	AC-645-ES	20.2	10	30	1000	Yes
4	None	0	10	30	1000	Yes
5	Aniline	302	10	30	1000	Yes
6	Aniline	299	10	30	1000	Yes

EXPERIMENT 2.

Reactor	Organic Compound Added	Concentration (mg/l) *	Seed Volume (ml)	Seed Amount (mg TSS+)	Total Liquid Volume (ml)	Nutrients Added ++
1	AC-645-ES	203	10	30	1000	Yes
2	None	0	10	30	1000	Yes
3	AC-645-ES	203	10	30	1000	Yes
4	None	0	10	30	1000	Yes
5	Aniline	325	10	30	1000	Yes
6	Aniline	304	10	30	1000	Yes
7	AC-645-ES	152	10	30	1000	Yes
8	AC-645-ES	101	10	30	1000	Yes

Notes:

- * Concentration as COD or TOD
- + Return activated sludge (unacclimated) from Easton Area Joint Sewer Authority wastewater treatment plant. TSS = total suspended solids.
- ++ Nutrients added as specified in OECD 301C method.

Figure 2. Oxygen Demand.
Reference and Test Compounds
Experiment 1.

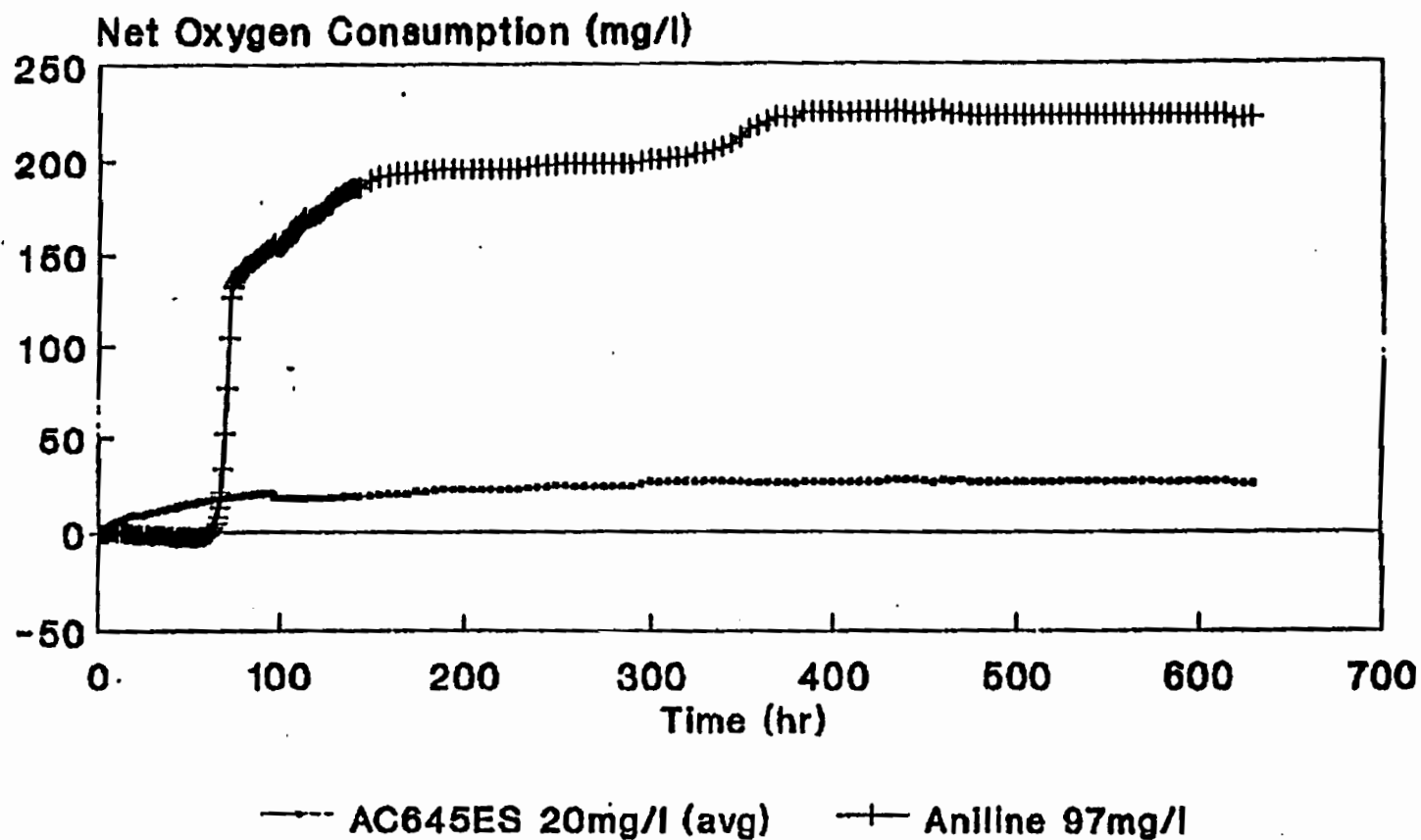


Figure 3. Oxygen Demand
Reference and Test Compounds
Experiment 2.

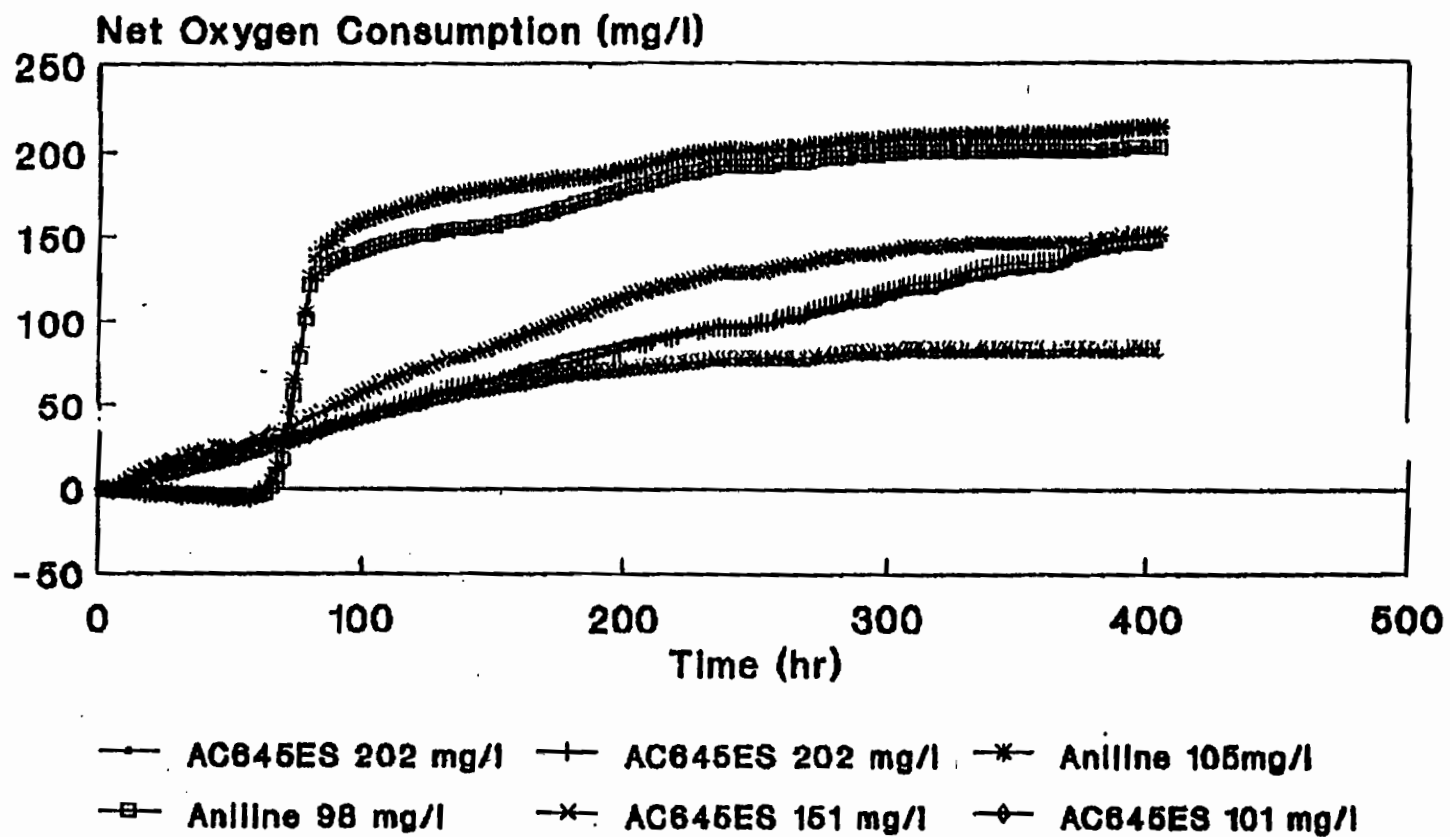


TABLE 4. ANALYTICAL RESULTS

PRELIMINARY TESTING

Rusmar product AC-645-ES as received (diluted 7 parts water to 1 part concentrate)
COD = 67500 mg/l

RESPIROMETRY EXPERIMENTAL RESULTS

EXPERIMENT 1 (terminated at 647 hours)

Reactor #	Test Compound	Aniline	Reactor Contents mg COD/l			Oxygen Consumption (mg/l)	
	Added (mg COD/l)	Added (mg TOD/l)	Initial	Final	Removal	Total	Net
1	20.2	0	39	23	16	105	25
2	0	0	30	30	0	75	NA
3	20.2	0	42	36	6	106	26
4	0	0	25	33	-8	85	NA
5	0	302	253	14	239	303	223
6	0	299	263	32	231	NA	NA

DATA ANALYSIS

Test Compound	1. COD Removal (%)	2. Degradation (%)	@ 7 days	@ 14 days
Aniline	77	126		
	80	74	64	69

EXPERIMENT 2 (terminated at 404 hours)

Reactor #	Test Compound	Aniline	Reactor Contents mg COD/l			Oxygen Consumption (mg/l)	
	Added (mg COD/l)	Added (mg TOD/l)	Initial	Final	Removal	Total	Net
1	202.5	0	230	67	163	184	145
2	0	0	25	11	14	39	NA
3	202.5	0	266	80	186	190	150
4	0	0	26	15	11	38	NA
5	0	325	288	48	240	252	213
6	0	304	255	26	229	240	201
7	151.8	0	187	28	159	190	151
8	101.2	0	123	25	98	123	84

DATA ANALYSIS

Test Compound	1. COD Removal (%)	2. Degradation (%)	@ 7 days	@ 14 days
Aniline	80	81		
	71	66	55	65

1. COD Removal calculated as initial COD minus final COD of test compound (or aniline) minus { initial COD minus final COD of seed blank } divided by COD (or TOD) Added times 100.
 2. Degradation calculated as Net Oxygen Consumption divided by COD (or TOD) Added times 100.
- NA denotes not applicable or not analyzed.