

Former N.L. Industries

Depew, NY

Community Air Monitoring Plan

Prepared For:

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C915200

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Tighe&Bond

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1.1 OVERVIEW

Environmental air monitoring and visual observation will be conducted during the remediation activities at the Former N.L. Industries Site, located at 3241 Walden Avenue, in Depew NY. The proposed program consists of two primary forms of environmental monitoring: Work Area Monitoring required by law for environmental remediation projects and intended to monitor the efficacy of project engineering controls; and voluntary Community Monitoring intended to gauge and document the impact (or lack thereof) of the project to the surrounding area.

This report provides requirements for the Contractor in preparing the Site Health and Safety (HASP) as well as implementing the Community Air Monitoring Plan (CAMP) Component of the HASP, as developed by the Engineer. The requirements shall apply to all work performed by the Contractor.

The following shall be submitted by the Contractor in advance of field work and shall become a major component of this Work Plan:

- Corporate health and safety program
- Site HASP
- Worker training certification and medical clearance
- Air monitoring logs
- Equipment decontamination plan
- Spill and discharge control plan

1.2 REGULATORY REQUIREMENTS

The Contractor's work performed under this contract will help ensure compliance with applicable federal, state, and local safety and occupational health laws and regulations. This includes, but is not limited to, Occupational Health and Safety Administration (OSHA) standards, 29 Code of Federal Regulations (CFR) 1910.120, "Hazardous Waste Site Operations and Emergency Response" and 29 CFR 1926.65, "Hazardous Waste Site Operations and Emergency Response." Matters of interpretation of standards shall be submitted to the appropriate administrative agency for resolution before starting work. Where the requirements of the HASP, CAMP, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements shall apply.

1.3 SAFETY AND HEALTH PROGRAM

OSHA Standards 29 CFR 1910.120(b) and 29 CFR 1926.65(b) require contractors to develop and implement a written Health and Safety Program for workers involved in hazardous waste operations. The site-specific program requirements of the OSHA Standards shall be integrated into one site-specific document, the HASP. The HASP shall interface with the Contractor's overall Health and Safety Program. Any portions of the overall Health and Safety Program that are referenced in the HASP shall be included as appendices to the HASP. The Contractor is responsible for creating the Site HASP. The Contractors HASP is included in Appendix A.

1.3.1 Site Health and Safety Plan Requirements

The HASP covers work to be performed by the Contractor and all subcontractors. The Health and Safety Manager shall be responsible for the development, implementation and oversight of the HASP. The HASP establishes, in detail, the protocols necessary for the anticipation, recognition, evaluation, and control of hazards associated with each task performed. The HASP addresses site-specific health and safety requirements and procedures based upon site-specific conditions. The level of detail provided in the HASP is tailored to the type of work, complexity of operations to be performed, and hazards anticipated. Details about some activities may not be available when the initial HASP is prepared and submitted. Therefore, the HASP addresses, in as much detail as possible, anticipated tasks, their related hazards, and anticipated control measures.

A copy of the written HASP will be maintained onsite. As work proceeds, the HASP shall be adapted to new situations and new conditions. Changes and modifications to the accepted HASP shall be made with the knowledge and concurrence of the Health and Safety Manager, the Site Superintendent, and the Engineer. Should any unforeseen hazard become evident during the performance of the work, the Site Health and Safety Officer shall bring such hazard to the attention of the Health and Safety Manager, the Site Superintendent, and the Engineer, both verbally and in writing, for resolution as soon as possible.

In the interim, necessary action shall be taken to re-establish and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Disregard for the provisions of the accepted HASP shall be cause for stopping work until the matter has been rectified. Topics required by 29 CFR 1910.120(b) (4) and 29 CFR 1926.65 (b) (4) and those described in this section will be addressed in the HASP. Where the use of a specific topic is not applicable to the project, the HASP shall include a statement to justify its omission or reduced level of detail and establish that adequate consideration was given the topic. At a minimum, the following topics shall be addressed:

- health and safety organization

- site description and hazard evaluation
- health and safety risk or hazard analysis
- provisions for employee training
- use of personal protective equipment
- medical surveillance requirements
- air monitoring requirements (personnel and community)
- site control measures
- personnel and equipment decontamination procedures
- standard operating work practices
- confined space entry procedures
- emergency response procedures
- first aid procedures
- temperature extremes monitoring

The Health and Safety Manager establishes appropriate levels of protection for each work activity based on review of historical site information, existing data, an evaluation of the potential for exposure (inhalation, dermal, ingestion, and injection) during each task, past air monitoring results, and a continuing health and safety monitoring program. The Health and Safety Manager also establishes action levels for upgrade or downgrade in levels of PPE from the specified levels of protection. These are shown in the Contractor's HASP in Appendix A. Protocols and the communication network for changing the level of protection are described in the HASP. The PPE reassessment protocol addresses air monitoring results, potential for exposure, changes in site conditions, work phases, job tasks, weather, temperature extremes, individual medical considerations, etc.

The Health and Safety Manager prepares and implements an exposure monitoring/air sampling program to identify and quantify health and safety hazards and airborne levels of site, related substances in order to assure proper selection of engineering controls, work practices and personal protective equipment for affected site personnel. Available site information is reviewed and the exposure monitoring/air sampling program is expanded and/or revised for submittal as part of the HASP.

2.1 COMMUNITY AIR MONITORING PLAN OVERVIEW

In addition to air monitoring to protect site personnel, the New York State Department of Health (NYSDOH) requires the implementation of a Community Air Monitoring Plan (CAMP) for all ground intrusion activities, including contaminated soil excavation and handling.

The CAMP is not intended to establish safe working conditions for personnel onsite; it is meant to protect offsite receptors (including residences and businesses) from potential airborne releases and document the conditions to prevent potential claims of exposure. The contents of the CAMP are based on the type of intrusive work being performed onsite (i.e., excavation, loading, and transportation of soil). The CAMP includes, but is not limited to, the following activities:

2.2 SELECTION OF CAMP MONITORING LOCATIONS

Monitoring locations shall be positioned at three locations along the property boundary areas down wind and at one location within up wind of potential contaminant generating activities. The Engineer shall identify each monitoring location and the rationale for its placement in the sampling data in Appendix B. In addition, the Engineer shall include a contingency for moving the monitoring locations based on the prevailing wind direction during site activities. A portable weather station will be used to continuously record wind direction and velocity with time. Monitoring shall be performed at these locations. Potential sampling locations are shown on site plan included in Appendix C.

2.3 ACTION AND RESPONSE LEVELS

The Air Sampling Summary included in Appendix D specifies the action and response levels for contaminants detected during monitoring. The appropriate response actions shall be taken to control contaminants before active remedial measures are allowed to resume.

2.4 DOCUMENTATION

The forms in Appendix B provide a method for recording all measurements collected during the plan's implementation. All records shall be made available to NYSDOH and NYSDEC upon request. At a minimum, a daily log shall be kept to document monitoring results, wind speed, direction, and weather conditions.

2.5 BACKGROUND SAMPLES

Background samples will be collected for contaminants prior to any excavation activity on the site. All monitoring data collected during the course of the project will be compared to the background samples and action levels. The action levels for each target compound will be adjusted as needed based upon the background and up-wind samples.

2.6 EXCAVATION PHASE MONITORING

During the excavation phase, soil will be removed from the western portion of the site, down to the native silty clay layer and transferred, consolidated and compacted in the central area where it will eventually be capped. During this time, contaminants will be continuously monitored.

2.7 BACKFILLING/CONSTRUCTION PHASE MONITORING

During the backfilling phase, clean soil will be transferred on-site to fill and re-grade the West excavated area. During this time, contaminants will be intermittently monitored at the discretion of the NYSDEC and NYSDOH officials.

2.8 SAMPLING FREQUENCY

Sampling for dust using the DataRAMs will be conducted throughout the project at three locations along the property line downwind of the site, and one location along the property line upwind of the site, according to the prevailing wind direction. The DataRAMs should be placed equidistant depending on the prevailing downwind direction.

When excavation begins, one high volume sampler will be placed up-wind and one will be placed down wind of the site, operating side by side with a DataRAM at each location. These high volume samples will be analyzed for lead at an outside laboratory. If it is determined that the levels monitored during the first week of excavation do not trigger action levels for lead, high volume lead monitoring will be discontinued.

To monitor VOCs, one Summa canister will be placed up wind and one will be placed downwind during the first week of excavation. These canisters will be analyzed for VOCs at an outside laboratory. If it is determined that the levels monitored during the first week of excavation do not trigger action levels for VOCs, VOC monitoring will be discontinued.

In the event that the prevailing wind direction changes during the course of a sample, the Engineer will relocate the monitoring equipment to a downwind location as soon as feasible. In order to achieve this, a portable weather station will be installed on-site to continuously record the wind direction and velocity.

2.9 SAMPLING EQUIPMENT/SET-UP/RESPONSE

2.9.1 Dust

Real-time air monitoring for PM-10 or Total Suspended Particulate (TSP) will be accomplished with direct reading DataRAM4 Particle Counters. Please see Appendix E for Sampling Equipment Specifications.

As dust monitoring will be conducted on a real-time basis, any exceedances of the National Ambient Air Quality Standards (NAAQS) of 150 ug/m³ over a 24-hr period or 450 ug/m³ over an 8-hr period will be immediately communicated to NYSDOH and NYSDEC on-site employees. Engineering controls (i.e. water, salt, plastic, foam, etc.) will be used to keep dust levels at a minimum. Please see Appendix F for PM10 action level documentation.

2.9.2 Lead

Monitoring for lead will be conducted using a High Volume Sampler with a filter. Analysis of the samples will be conducted at a certified laboratory off-site. In the event that the lead levels detected in the samples exceed an average of 5 ug/m³ over a 24-hr period or 15 ug/m³ over an 8-hr period, the results will be immediately communicated to NYSDOH and NYSDEC on-site employees. Engineering controls (i.e. water, salt, plastic, foam, etc.) will be used to keep lead levels at a minimum. Please see Appendix F for lead action level documentation.

2.9.3 VOCs

Monitoring for Volatile Organic Compounds (VOCs) will be conducted using a Summa canister via Toxic Organic Method 15 (TO-15). Analysis of the samples will be conducted at a certified laboratory off-site.

Three VOCs are present at levels of concern including Benzene, Xylene and Trimethylbenzene. The Department of Health and Human Services Agency for Toxic Substance and Disease Registry (ASTDR) has developed minimum risk levels (MRLs) for Benzene (0.009 parts per million [ppm]) and Xylene (2.0 ppm). MRLs are screening levels that are not expected to cause adverse health effects to the general population. MRLs used in this study are based on 1 to 14 day exposures. Please see Appendix F for VOC action level documentation.

Trimethylbenzene does not have an established MRL. However, the MRLs for Xylene and Benzene are approximately 100 times lower than the OSHA worker levels. Based on the preceding information, we propose an action level of 0.25 ppm for Trimethylbenzene, which is the OSHA worker level of 25 ppm divided by 100.

In the event that the VOC levels detected in the samples exceed healthy levels, NYSDOH and NYSDEC will be immediately notified and engineering controls (i.e. water, salt, plastic, foam, etc.) will be used to keep VOC levels at a minimum.

Appendix A
Contractors Health and Safety Plan

**AAA Environmental, Inc.
Site Specific Health and Safety Plan
for**

Tighe and Bond

**Norampac, Former NL Industries Soil
Remediation Project
At Depew, New York Facility**

Prepared by

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Date Prepared: October 24, 2007

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1.0 INTRODUCTION

1.1_ Background

This Site Specific Health and Safety Plan (HASP) provides procedures and guidelines that will be used by AAA Environmental, Inc. employees to minimize their potential exposure to both physical and chemical hazards. This HASP has been developed in accordance with the Occupational Safety and Health Administration (OSHA) regulations, 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response ("HAZWOPER"). Applicable Federal, State and Local regulations related to health and safety requirements for work of this nature are also incorporated into this Health and Safety Plan (HASP).

This HASP is intended to outline the procedures to be implemented during the work activities of this project. Use of this HASP shall be limited to AAA employees and approved subcontractors only.

1.2 Site Description

The work on this project will take place at the Former NL Industries Facility, City of Depew, County of Erie, State of New York.

Existing Site Data includes is included in Appendix A.

1.3 Scope of Work

The scope of work includes the following major tasks:

1. Mobilization and site set-up
2. Clearing and Grubbing
3. Soil Excavation and Consolidation
4. Backfilling and Final Restoration

The safety organization and procedures found in this HASP are designed to address and minimize the potential hazards associated with these activities.

Note: If the scope of work changes, or if unexpected conditions are encountered, or if the directions in this HASP are unclear or appear to be inadequate for the actual work use ***SAM-GO***

- **STOP**
- **Ask questions. Consult with Site Project Manager and AAA personnel.**
- **MAKE a new plan. Get approval from Project Manager and Health and Safety Manager.**
- **GO BACK to work, following the revised Health and Safety Plan.**

1.4 Key Personnel and Project Contact Information

Key personnel and Project Contact Information is summarized in Table 1.4. (See appendix A). Typical site personnel roles and functions are summarized below:

1.4.1 PROJECT MANAGER

The Project Manager's role includes:

- Review and approval of work plans and drawings pertaining to the site.
- Identifies deficiencies and proposes modifications to performance standards and schedule.
- Monitors progress of activities.
- Provide notification and documentation to client and regulatory agencies as necessary.

The Project Manager, as the site competent person, holds the authority to correct or halt work activities at the site. He/she will take necessary actions to alleviate imminent or substantial endangerment to worker or public health or welfare.

The Project Manager may designate another individual (Designee) to carry out Contractor Project Manager tasks in his/her absence.

1.4.2 OPERATIONS MANAGER

The Operation Manager will be responsible for:

- Assigning qualified workers to perform the tasks in the work plan.
- Coordinating the activities of the Remediation Area, including subcontractor work.
- Conformance with the provisions of this Health and Safety Plan and local, state and federal regulations.
- Communication with the senior project manager and corporate staff, including Health and Safety Department.

1.4.3 SITE SAFETY OFFICER (SSO) / SUPERINTENDENT

The SSO / Super will be responsible for ensuring safe working conditions related to the remediation project. The SSO / Super will have the knowledge and experience in health and safety regulations and worker protection. The SSO / Super will be responsible for ensuring safe working conditions on a daily basis.

The responsibilities of the SSO / Super include:

1. Prior to the commencing of work, the SSO will brief workers on the health and safety requirements of this document. The health and safety briefing will provide information on:
 - Site-related hazards (i.e., chemical, physical, mechanical, and biological hazards),
 - Location of and route to the nearest medical facility,

- The location of the assembly area in case of evacuation,
 - Monitoring procedures
 - Federal, State and other pertinent health and safety protocols and regulations
2. Assure that a copy of this HASP is maintained on site and be aware of its provisions;
 3. Assure that appropriate Personal Protective Equipment (PPE) is available and properly utilized, if necessary;
 4. Ensure that the contractor and sub-contractors are performing work in accordance with the HASP;
 5. Perform daily tailgate safety meetings for site personnel;
 6. Provide instruction in work practices necessary to ensure safety;
 7. Confirm planned procedures for dealing with emergencies (evacuation routes, gathering place, etc.);
 8. Review and correct any work practices or conditions that may result in injury or potential exposure to hazardous substances;
 9. Prepare accident/incident reports for accidents, incidents and near miss events;
 10. Monitor equipment and tools being used for safety features;
 11. Perform occupational health monitoring activities
 12. Assure that monitoring equipment used for occupational surveys and sampling are functional and calibrated.
 13. Consult with the corporate safety staff as needed.

The SSO has the authority to stop work. In the event an emergency arises warranting cessation of work, the SSO will be responsible for determining when work may resume.

1.4.4 SUPERVISORS/FOREMEN

Project supervisors and foremen must build safety into their daily activities. These are the front line representatives of the company in many ways. Environmental Health and Safety concerns are among their primary responsibilities. Specifically they are responsible for the following:

1. Understanding the requirements of OSHA and all other pertinent safety regulations and guidelines.
2. Enforcing all safety rules and regulations within the scope of their work assignment.
3. Providing safety leadership by setting a good example. Correcting unsafe acts or unsafe conditions.
4. Requesting help from the Superintendent whenever necessary.
5. Explaining all safety rules and regulations to employees and training the assigned employees in the safest way to perform assigned tasks.
6. Educating new employees in operating and safety rules.
7. Determining that each employee is qualified and able to perform the work, conducting frequent "Tool Box" safety talks and documenting participation at those talks.
8. Obtaining, distributing, and maintaining personal protective equipment necessary for performing the job; i.e. safety glasses, hard hats, goggles, respirators, gloves, boots, etc.

9. Pre-planning each job, using a Job Safety Analysis (JSA) or Health & Safety Plan (HASP).
10. Providing necessary protection to employees, the public, and equipment.
11. Reporting all injuries, damages, or losses immediately to the Superintendent and Health & Safety Department.
12. Arranging for necessary first aid or medical care and taking action to prevent further injuries or damages after an incident.
13. Investigating and completing a record of all injuries or damages of any nature that result from work performed by the crew.
14. Reporting to their superintendent any employee who fails to follow the company's safe work policies and procedures.
15. Attending safety meetings and training for supervision.
16. Forwarding to the superintendent all requests, suggestions, and complaints made with regard to safe working conditions.
17. Cooperating in the rehabilitation and return of injured employees to useful work.

1.4.5 WORKERS/LABORERS

Workers/laborers, under routine conditions, have the potential for exposure to contaminants. Non-contact trade workers/laborers, under routine conditions, do not have the potential for exposure to contaminants from remedial activities. All workers must read and understand the requirements of this Construction HASP and acknowledge their acceptance of its requirements by signing the HASP acceptance form (Attachment 1).

1.4.6 VISITOR

A Visitor is a non-worker. From time-to-time, visitors (such as client representatives, public groups, government representatives, and other interested parties) may be at the site for tours of asbestos abatement activities. The Project Manager (or Designee) must escort visitors. The Project Manager (or Designee) will brief visitors on the requirements of the Construction HASP prior to gaining access to the work area.

1.5 *Training/Medical Surveillance Program*

All AAA Environmental employees assigned to this project will have received training in accordance with OSHA 29 CFR 1910.120, HAZWOPER. Their refresher classes must be up to date and properly documented. These personnel are included in AAA Environmental's medical surveillance program, also compliant with the requirements of 29 CFR 1910.120.

Ongoing training will include daily "*Toolbox Talks*." These daily talks will cover safety-related topics as well as Federal OSHA and New York State laws and regulatory compliance issues, especially those topics applicable to that particular day's work. Documentation of attendance and understanding will be maintained.

Employees who are required to wear respiratory protection will be trained in the company's

respiratory protection program, and will have passed both a pulmonary function test and a fit test within the past twelve months. Workers assigned to tasks that may involve occupational exposure to hazardous materials will be included in AAA Environmental's medical surveillance program for HAZWOPER workers.

2.0 WORK ZONES

To minimize the movement of contaminants from the work site to uncontaminated areas, three distinct zones will be established. The three zones will be clearly delineated and will include the following:

- Zone 1: Exclusion Zone (EZ)
- Zone 2: Contamination Reduction Zone ("CRZ" or "Decon")
- Zone 3: Support Zone (SZ)

2.1 ZONE 1: Exclusion Zone

This Exclusion Zone is the area that contains or could contain hazardous chemicals in potentially harmful concentrations. All persons entering this zone must wear appropriate PPE as set forth in this HASP. Levels of protection required are based on the different types of field activities to be performed and the relative risk of contacting the contaminants which may be present.

If actual Containment structures are not required, exclusion zone boundaries will be delineated by the use of hazard tape or equivalent. In addition, Confined Space Warning signs may be posted.

Exclusion zone boundaries will remain in place until the work in each respective area is completed.

2.2 ZONE 2: Contamination Reduction Zone (Decon)

This is a structure or area adjacent to the Exclusion Zone that acts as a buffer between clean areas and contaminated areas. It provides an area where personnel and equipment can safely remove PPE, change into street clothing and decontaminate equipment. A temporary equipment decontamination pad will be installed in the contamination reduction zone.

2.3 ZONE 3: Support Zone (SZ)

Site areas adjacent to, but outside the Exclusion Zone and Contamination Reduction Zone will be considered the Support Zone. This provides an area for on-site personnel to take work breaks, eat lunches, etc., away from potentially contaminated areas. An emergency eye wash station and first aid kit will be available in the Support Zone.

Note: The Ingestion pathway for contamination will be controlled on this site by prohibiting any eating, drinking, smoking or other use of tobacco products in the Exclusion Zone and by requiring all field personnel to decontaminate themselves upon leaving the Exclusion Zone. All drinking of liquids should take place only after decontamination has taken place, except in a heat stress emergency situation.

2.4 Site Access and Security

Access to the site will be regulated and limited to authorized personnel. The Site Safety Officer (SSO) must be aware of all persons visiting the EZ or CRZ. When activities are taking place outside site fencing, specific controls must be established to protect the safety of motorists and pedestrians.

Any visitor who must enter the Exclusion Zone or the Contamination Reduction Zone will be made aware of the potential hazards at the site, the established emergency response procedures, and shall review AAA's HASP prior to entry. All visitors must sign the Site Visitors Log (found in Appendix B, Forms).

2.5 Traffic Control

Traffic control devices and measures will be used to maintain order and safety. Traffic control devices and measures include signs, cones, barricades, warning lights, vehicle placement and flag persons.

Where site work activities may impact local traffic, the local authorities must be made aware of the anticipated impact and dates.

2.5.1 General Requirements

To be effective, a traffic control device should:

1. Fulfill a specific need
2. Command attention and respect
3. Convey a clear, simple meaning, and
4. Give adequate time for motorists to respond

NOTE:

Where traffic control devices are used for nighttime or poor visibility conditions, they should be reflective.

2.5.5 Flag Persons

Where a flag person is warranted, the following rules should be followed:

1. A high visibility vest must be worn. The vest must be reflective if working at night.
2. The flag person must remain highly visible to oncoming traffic at a distance sufficient to permit adequate driver response.
3. The flag person should stand adjacent to the shoulder or within a barricaded zone; never stand in a lane used by moving traffic.
4. Signs, cones or other warning devices should precede flag person stations.
5. Two-way radios may prove helpful when two flag-persons must coordinate their efforts.

3.0 POTENTIAL HAZARDS and MITIGATION STRATEGIES

The primary hazards that may occur during this project and the necessary monitoring and control measures are summarized in Tables 3.1-3.4, found in Appendix A.

- Table 3.1, Job Safety Analysis
- Table 3.2, Contaminant Safety Analysis
- Table 3.3, Air Monitoring Requirements
- Table 3.4, Action Levels and Response Summary

3.1. *Levels of Personal Protective Equipment*

The documentation in this Health and Safety Plan provides a certification of hazard assessment performed in accordance with OSHA 29 CFR 1910.132, Personal Protective Equipment. The assessment was performed by this document's author prior to the effective date shown on the cover page. The hazards assessed include:

- Excavations
- Impact: being struck by objects
- Penetration: sharp objects
- Compression: Objects or devices that could squash or mangle body parts (arms, toes, etc...)
- Chemical hazards
- Thermal: heat or cold hazards
- Harmful dust
- Light/optical hazards (welding, cutting, lasers, etc...)

Levels of Personal Protective Equipment (PPE) required on this project are described below:

<u>Job Function</u>	<u>Level of Protection</u>	<u>Location</u>
Mobilization and site set-up	Level D	Support Zone
Clearing and Grubbing	Level C or Modified "D"	Exclusion Zone

Soil Excavation / Consolidation	Level C or Modified "D"	Exclusion Zone
Backfilling / Compaction	Modified Level D	Exclusion Zone
Demobilization	Level D	

NOTES:

- **All on-site personnel will be required to comply with the minimum personal protective levels specified unless a revision to this HASP is issued.**
- **Certain action levels shown in table 3.4 require PPE upgrades.**

A description of required equipment for each level of Personal Protective Equipment is given below.

Level D Protection

- Work clothing appropriate for the weather. Long pants for Level D. Shirts must have at least short or half sleeves.
- Steel toe work boots
- Safety glasses or goggles
- Face shield when projectiles or chemical splashes pose a risk
- Hearing protection if noise levels exceed 85 dba
- Outer work gloves of leather for mechanical hazards. Chemical resistant gloves of nitrile or neoprene may be occasionally required for chemical hazards
- Hard hat

Modified Level D Protection

Level D plus:

- Tyvek coveralls or equivalent

Level C Protection

Level D plus:

- Air purifying respirator (APR) with P100 cartridges for lead abatement
- Tyvek coveralls, or equivalent
- Chemical resistant overboots, when chemicals could contaminate footwear

Level B Protection

**** Not Anticipated**

Level D plus:

- Positive pressure self-contained breathing apparatus (SCBA), or air line respirator
- Supplied air will be Grade D breathing air quality
- Chemical resistant suit (e.g., Saranex, PVC) taped to boots and gloves
- Chemical resistant overboots
- Outer chemical resistant gloves with cotton inner gloves

Level A Protection

**** Not Anticipated**

Level D plus:

- Positive pressure (SCBA) or air line respirator
- Fully encapsulating, chemical resistant suit
- Chemical resistant overboots
- Outer chemical resistant gloves with protective inner gloves ("double gloving")

3.1.1 Respiratory Protection

Respirator cartridges to be used will bear NIOSH approvals. At the end of each day, respirator care will include:

- Clean with soap and water, then rinse with clean water
- Disinfect
- Air dry
- Place in clean plastic bags for storage

Respirators will be inspected daily for damage, missing parts, and proper function. Cartridges will be replaced after eight hours of service at or near Permissible Exposure Limits (PEL), or if breathing resistance increases, or if breakthrough is detected.

NOTE:

The SSO has the authority to increase the required levels of protection in the field as noted above when conditions warrant. Any modifications to lesser levels of protection not explicitly stated in this HASP must be approved by the Health and Safety Manager.

3.2 Chemical Hazards

Chemical contaminants (constituents of concern) and their health effects are summarized in Table 3.2 (see Appendix A).

3.2.1 MSDS's

Material Safety Data Sheets (MSDS's) for site chemical contaminants and for other chemicals used on the site by AAA Environmental, (i.e., cleaners, diesel fuels, etc.) are contained in Appendix C. In some cases where MSDSs could not be found, information about those compounds is provided from Sax's Dangerous Properties of Industrial Materials or an equivalent authoritative source.

3.3 Air Monitoring Requirements

Air monitoring requirements are summarized in Table 3.3 (see Appendix A).

3.4 Action Levels

Action levels and the necessary responses are summarized in Table 3.4 (see Appendix A).

3.5 Temperature Related Hazards

Heat Stress

The threat of heat related illness/heat stress may increase when wearing certain types of protective equipment, particularly during periods of warm weather. Heat stress is caused by the interplay of a variety of factors, including ambient temperature, workload, clothing, and the physical characteristics of each worker. The major symptoms of heat stress are listed in Table 3-5. If the temperature in the work area is at or above 80 degrees F workers should be monitored for heat stress during rest periods according to the following procedures:

- Take pulse over a 30 second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one third and keep the rest time the same. If, at the next rest period, the heart rate still exceeds 110 beats per minute, shorten the following work period again by one third. Continue the process as necessary.
- Take body temperature at the end of each work cycle before drinking anything. If the temperature exceeds 99.6 degrees F, shorten the next work period by one third without changing the rest period. If the temperature still exceeds 99.6 degrees F at the beginning of the next rest period, shorten the following work cycle by one third. Chemical protective coveralls reduce the body's ability to cool itself by the normal evaporation of sweat. No worker will be permitted to wear a semi-permeable or impermeable garment if their temperature exceeds 100.6 degrees F.

TABLE 3-5.1
SIGNS AND SYMPTOMS OF HEAT EXHAUSTION

Heat exhaustion occurs from increased stress on various body organs, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

* fainting	* nausea
* pale, cool, moist skin	* heavy swelling
* dizziness	

TABLE 3-5.2
SIGNS AND SYMPTOMS OF HEAT STROKE

Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occurs. Competent medical help must be obtained. Signs and symptoms are:

* red, hot, usually dry skin	* dizziness and confusion
* lack of or reduced perspiration	* strong, rapid pulse
* nausea	* coma, death

Heat stress can be controlled using one or more of the following measures:

- During hot working conditions, maximum sweat rate may be as high as one liter per hour, increasing the risk of a heat related illness. Workers must replace water and salt lost from sweating. Workers should be encouraged to drink more than the amount required to satisfy thirst. Thirst satisfaction is not a reliable indicator of adequate salt and fluid retention. Electrolyte replacement fluids such as Gatorade, may be provided.
- Establish a work regimen that will provide adequate rest periods for cooling down.
- All rest breaks will be taken in a shaded rest area.
- Employees will remove impermeable protective garments during rest periods.
- Employees will not be assigned other tasks during rest periods.
- All employees will be informed of the importance of adequate rest, acclimatization, and proper diet in the prevention of heat stress.

Cold Stress

3.6 Snake and Insect Hazards

Several types of animals are found on the work site that can inflict injury on workers by the action of their venom. These include venomous snakes and various species of insects including fire ants, black flies, bees and wasps, deer flies, and mosquitos.

Snake bites: Snakes do not usually attack man unless they feel menaced, are disturbed, or are walked upon. High top leather work boots provide the basic protection. If workers are more than one-half hour away from medical treatment they should carry an anti-venom snakebite kit with a sterilized syringe. It should be understood however, that bites from even the most venomous snakes are seldom fatal since the amount of venom injected is usually small.

Snake bite First Aid Treatment: Two factors influence how effective first aid will be: speed of specific treatment and the proximity to a hospital/shock care facility. Immediately after a bite has occurred, a tourniquet should be placed above the wound - *only if applied within 20 minutes of the snake bite!* - afterwards it may produce serious consequences. The patient should make no unnecessary effort, the part of the body bitten should be immobilized and the bite washed in cold water. An incision should be made between the two points of the bite. The venom should then be sucked out and spat out by a person with no lip or mouth sores. If an anti-venom syringe is available, it should be injected into the skin in the region of the bite within 20 minutes of the accident. Get help immediately and transfer the patient to an emergency room/primary care facility as soon as possible.

Insect bites: Insects may inject venom into the body through their mouth parts or via their sting. Preventative measures are limited to increased body coverings and the use of a topical insect repellent.

Insect bite First Aid Treatment: In the case of bee stings, the sting should be removed with sterilized tweezers. Following the removal of the sting, topical anti-cortisone and/or antihistamine lotions, sprays, or creams can be applied to the site of the injury. These topical treatments can also be used after bites by other insects. As always, prevention is easier than treatment.

3.7 Poison Ivy

The poison ivy plant can cause an itchy skin rash when in direct contact with skin. The first signs of a poison ivy rash are redness and swelling at the site of contact on the skin. Itching gradually becomes intense with blistering of the skin appearing within 24-72 hours. The rash will continue for up to two weeks unless the skin is broken by scratching, which could complicate the condition worse.

The poison ivy rash can be prevented by avoiding contact with the toxic oil of the plant. Long pants and sleeves are very important when working in an area that is not well known. If possible, wearing boots, gloves, and a hat will help to prevent the rash.

If direct contact with the plant is unavoidable:

- Wash all exposed areas of the skin with cool water. Flowing water is better to irrigate and remove the oil from the skin. Use a nearby stream, river or garden hose if available. If soap is used, wash it off the body and do not spread to other areas.
- Wash all clothing as this may have been contaminated by the oil.
- Wash all possible contaminated gear.
- Contact your healthcare practitioner.

3.8 Trenching and Excavation

Scope and Purpose

Cave-ins are often fatal. Due to the great variability in factors that affect excavation wall stability, special precautions must be taken when excavation activities are to take place on a project. This program will be in effect on all AAA Environmental, Inc. projects which involve excavations. In facilities or work areas where site/client excavation programs are in effect AAA Environmental, Inc.'s program shall be used in conjunction with these programs.

Location of Underground Utilities

Prior to the start of excavation activities all underground utilities must be located. The local "DIGSAFE" (formerly UFPO) must be notified at least 48 hours prior to the start of excavation so that all utility companies involved can mark their underground facilities in the area of excavation. Also any permits that are required prior to the start of excavation activities must be obtained. In emergency situations the local DIGSAFE office should be informed immediately once it has been determined that excavation will take place. DIGSAFE should also be informed of the emergency so that they can expedite the location of the utilities.

General Safety Precautions

- Any excavation operation over 4 ft. deep which requires personnel entry shall have entry/exit ladders placed every 25 ft. along its length.
- For any excavation deeper than four feet in depth, consider the need for air monitoring. This is especially important in contaminated soils, if sources of carbon monoxide are present or if flammable gasses from utility leakage is a possibility.
- There shall be no standing water in an excavation while personnel are in the excavation.
- Spoil piles at the excavation site must be set back at least two feet from the edge of the excavation edge to prevent the hazard of falling objects.
- Special care should be taken when excavating in areas that have been previously back-filled since voids or soft spots may appear.
- Also, excavations near heavy equipment, undercut structures, high traffic areas, and utilities require special planning and precautions. AAA Environmental, Inc.'s competent person on site will contact the Office of Health and Safety if any of these special situations are encountered.

Factors Affecting Excavation Stability

Many factors affect the stability of an excavation including soil classification, depth of excavation, water content of soil, weather conditions, superimposed loads, vibration,

and other activities in the area of excavation. Soil type or classification will help determine the amount of sloping or the type of shoring required for an excavation. Weather conditions can affect the amount of water in the soil and affect the type of shoring to be used. Superimposed loads and vibrations will increase the potential of excavation cave-in. Due to the variability of the conditions affecting excavation stability a competent person shall supervise all excavation operations carried out by AAA Environmental, Inc. personnel in order to recognize potential hazards and prevent accidents. The competent supervisor shall make a daily inspection of the excavation to assess any changing conditions that may present special hazards.

Precautions

- All excavation operations must be cleared through the Health and Safety office prior to starting work to ensure proper safety precautions are being taken. An excavation permit will be issued.
- Open excavations shall be barricaded, fenced or otherwise controlled to prevent falls.
- If an excavation is left open overnight, reflective cones must be placed unless the area is completely secured from all traffic.

Sloping and Shoring

In order to prevent cave-in's, all excavations over 5 ft. which will require personnel entry into the trench shall be properly sloped or shored. Sloping will be carried out according to OSHA regulations. All slopes will be 1 foot vertical on 1.5 feet horizontal, unless the competent person has classified the soil according to the OSHA regulations. In that event, the excavation sides may be sloped in accordance with the required sloping angles for different soil classifications. If sloping is determined to be inadequate or inappropriate, then one of the following must be used:

1. A shoring system designed strictly in accordance with OSHA regulations 29 CFR 1926.650 - 652
2. A shoring system designed and stamped by a registered professional engineer, or
3. A shield ("trench box") which is engineered and manufactured specifically for cave-in control of excavations

AAA ENVIRONMENTAL, INC.
EXCAVATION PERMIT

Project Name / Client _____

Date _____ Job Number _____

Location of Excavation _____

Purpose of Excavation _____

Depth of Excavation _____

Supervisor / Competent Person _____ / _____
Print Sign

YES NO

Have the underground utilities been located? _____

Are ladders provided every 25 feet for entry/exit? _____

Are traffic vests being worn if required? _____

If hazardous atmospheres are possible, has the AAA Environmental,
Inc. Confined Space Policy been implemented and permit completed? _____

Is water accumulating in the excavation?
If yes, then what steps are being taken to eliminate it?

Are any structures, walls, fences, walks, or other installations threatened
by the excavation? _____
If yes, then what steps are being taken to protect employees?

Are sides sloped at least 1.5 horizontal to 1 vertical if sloping is used? _____

Have shielding or shoring systems been properly designed
and installed? _____

Are there indications of any other hazardous conditions? _____

3.9 Lead Program

Introduction / Policy Statement

Lead is a basic chemical element. It has been used for thousands of years for piping, ceramic glazing and many other industrial uses. Lead adds strength and corrosion resistance to paints and industrial coatings, where we frequently encounter it during building maintenance, renovation and demolition.

Lead can be toxic in various ways to the nervous, muscular, urinary, reproductive, skeletal, and blood systems. Various regulatory programs have been developed to control activities, such as construction, demolition and building maintenance that have potential to result in worker and/or environmental exposures to lead.

It is the policy of AAA Environmental, Inc. to comply with all rules and regulations affecting health, safety, and environmental issues. The purpose of this program is to provide guidance in meeting that goal when working with lead.

Health Hazards of Lead

Lead may enter the body by inhalation and ingestion. Most lead compounds are not absorbed through the skin. Once the lead enters the respiratory or gastrointestinal tract it is absorbed into the blood stream where it is circulated throughout the body and is stored in various organs.

Short term severe overexposure may lead to potent systemic poisoning. The symptoms are acute encephalopathy (swelling of the brain), seizures, coma, and death due to cardiac arrest. Muscular weakness may develop at the same time, which may lead to paralysis. This is often observed as a characteristic wrist or foot drop.

Long term overexposure may cause damage to blood forming cells, the nervous, reproductive, and urinary systems (especially the kidneys).

Common symptoms include the loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache and nervous irritability.

Worker Training

Lead worker training, certification, and licensing requirements differ depending upon the client and governmental agencies at the federal, state, and even local levels. It is the responsibility of the Project Manager or Engineer to ascertain the requirements for a particular jurisdiction and to plan for meeting those requirements for the project.

The following, minimum training program will be presented to AAA Environmental, Inc. workers prior to assignment to lead-related projects:

- A. The content of the OSHA Standard for Lead in the Construction Industry, 29 CFR 1926.62, including its appendices.
- B. The nature of operations that could result in personal exposure to lead.
- C. Training as required under the AAA Environmental, Inc. Respiratory Protection Program for the designated level of respiratory protection.
- D. The purpose and design of the AAA Environmental, Inc. Medical Surveillance Program for lead, the adverse health effects associated with excessive exposure to lead (including reproductive hazards, both male and female, and potential fetal and infant effects), and the medical removal protection program. This will also include instruction as to the inappropriateness of chelation therapy except under the direction of a physician.
- E. Engineering and work practice controls required by this program or elsewhere that will reduce the employee's exposure potential.
- F. The employee's rights of access to records under 29 CFR 1910.1020.
- G. The employee will be provided the OSHA Standard for lead in the Construction Industry, 29 CFR 1926.62, including its appendices.

AAA Environmental, Inc.'s lead abatement operations shall be undertaken only by personnel trained as above.

Medical Surveillance

AAA Environmental, Inc.'s policy for its' medical surveillance program for lead may be summarized as follows:

Employees exposed on any day above the action level, 30 micrograms per cubic meter (ug/m^3) as a time-weighted average (TWA)) are required to have the initial medical surveillance (biological monitoring) consisting of blood lead determination. Employees exposed at or above the action level for more than 30 days per year have to have biological monitoring every 2 months for 6 months and every 6 months thereafter plus full medical examinations. In addition to AAA Environmental, Inc.'s standard medical protocols for HAZWOPER employees, this standard requires a detailed history for past lead exposure and blood, kidney, circulatory, reproductive, or neurological problems.

Medical removal protection

The OSHA standard and AAA Environmental, Inc.'s policy also dictate that an employee working on lead-related projects who demonstrates a blood lead of 50 ug/dl or higher

must be removed from lead exposure. The standard and policy further require that the employee's wages are paid, seniority is maintained, and other employee rights and benefits are maintained. This section provides up to 18 months of such protection for each time an employee is removed from exposure.

AAA Environmental, Inc.'s policy is to provide continued non-lead-related employment to any employee whose blood lead monitoring triggers this policy.

Medical Surveillance

AAA Environmental, Inc. maintains a Medical Surveillance Program that complies with OSHA Regulation 29 CFR 1926.62 for workers exposed to lead. A summary of the program follows.

All employees who are exposed to lead at or near the OSHA action level, (30 micrograms per cubic meter), are part of the medical surveillance program for lead. All medical examinations and procedures will be performed by or under the supervision of a licensed physician.

Biological monitoring in the form of blood sampling and analysis for lead levels will be made available to all employees who are part of the medical surveillance program for lead. Employees whose last blood sampling and analysis indicated a blood lead level at or above 40 micrograms per 100 grams of whole blood (ug/dl) will receive free tests every two (2) months. This frequency will be continued until two consecutive blood samples and analysis indicates a blood lead level below 40 ug/dl. Testing will be conducted monthly during the removal period of each employee removed from exposure to lead due to an elevated blood lead level.

Whenever the results of a blood lead level test indicate that any employee's blood level exceeds the AAA Environmental, Inc. medical criterion of 40 ug/dl for medical removal, AAA Environmental, Inc. will provide a second (follow-up) blood sampling test within two weeks after the employee receives the results of the first sampling test.

The testing laboratory analyzing the blood samples will meet the requirements described in the OSHA lead regulations.

AAA Environmental, Inc. will notify all employees with blood levels in excess of 40 ug/dl within five (5) working days after receipt of the biological monitoring.

The frequency of medical examinations for covered employees will be as follows:

- At least annually for each employee for whom a blood sampling test conducted at any time during the preceding 12 months indicated a blood lead level at or above 40 ug/dl.
- Prior to assignment for each employee for the first time to an area in which airborne concentrations of lead at or above the action level for 30 days per year.

- As soon as possible after an employee notifies AAA Environmental, Inc. of signs or symptoms normally associated with lead exposure.
- As medically appropriate for each employee either removed from exposure to lead.

Medical examinations for lead for covered employees shall include the following elements:

1. A detailed work history and a medical history.
2. A thorough physical examination with particular attention to teeth, gums, hematologic, gastrointestinal, renal, cardiovascular, and neurological systems. Pulmonary status should be evaluated if respiratory protection will be used.
3. A blood pressure measurement.
4. A blood sample and analysis which determines:
 - a. Blood lead level
 - b. Hemoglobin and hematocrit determinations, red cell indices, and examination of peripheral smear morphology
 - c. Blood urea nitrogen
 - d. Serum creatinine
5. A routine urine analysis with microscopic examination
6. Any laboratory or other test which the examining physician deems necessary by sound medical practice. The content of medical examinations for employees with lead exposure symptoms and those that have been removed due to elevated blood lead levels shall be determined by an examining physician and, if requested by an employee, shall include pregnancy testing or laboratory evaluation of male fertility.
7. Medical monitoring can be performed by taking blood samples and analyzing for lead content. The results are reported as micrograms of lead per 100 grams of blood. Blood lead results should be less than forty micrograms of lead per 100 grams of blood.

AAA Environmental, Inc. will maintain an accurate record of all monitoring required in the Medical Surveillance Program. These records are kept for at least 40 years or for the duration of employment plus 20 years, whichever is longer. This medical surveillance program is part of the required recordkeeping. In addition, the record shall include:

1. The name, social security number, and description of duties of the employee.
2. A copy of the physician's written opinions.
3. Results of any airborne exposure monitoring done for that employee, and the representative exposure levels supplied to the physician.
4. Any employee medical complaints related to lead.

The examining physician or AAA Environmental, Inc. will keep and maintain all medical records of examinations and tests for exposure to lead.

AAA Environmental, Inc. will establish and maintain an accurate record for each employee removed from current exposure to lead.

AAA Environmental, Inc. will make available upon request, all records required to be maintained to OSHA and to employees and their representatives.

Personnel Exposure Assessment

Employee monitoring is required in order to establish exposure levels for OSHA compliance purposes whenever work practices and exposure potential indicate the need for such monitoring. AAA Supervisors/foremen will assure that personal air monitoring is representative of the exposure for each employee who is exposed to lead. This will require the identification of all job activities and full-shift monitoring that represents all identified activities.

Project air sampling plans will be developed by the AAA Project Manager in coordination with the Health and Safety Department for each project involving potential lead exposure. Employees will be notified in writing of the results of the representative monitoring.

Worker Hygiene Practices

Certain procedures and practices are basic to the prevention of worker exposure. Others minimize the risks of cross contamination between the work place and the worker's home or the environment by contaminants carried on the worker or his clothing.

A. Work Practices

Feasible work practice controls must be implemented in order to reduce worker exposures to the lowest possible level. The following are examples of work practice controls that must be implemented whenever appropriate:

1. HEPA vacuuming for cleanup of contaminated dust, dirt, and debris must be used. Dry sweeping should not be used.

2. Compressed air usage for cleanup is prohibited except when used with a capturing exhaust system.
3. Surfaces should be maintained as free as possible from accumulations of lead. The work area and any other area where exposure to lead or lead contaminated materials occurs should be cleaned at the end of each day of all visible contaminated materials.
4. Prior removal of lead paint from an area of a steel structural member that is to be torch cut.

B. Engineering Controls

Feasible engineering controls also must be implemented in order to reduce worker exposures to the lowest possible level. The following are examples of engineering controls that must be implemented whenever appropriate:

1. Powered hand tools (needle guns, roto peens, sanders, etc.) should be equipped with dust collecting hoods that can be attached to a HEPA vacuum.
2. Building containment systems with negative pressure ventilation designed to draw contaminants away from workers in abrasive blasting and other lead-based work activities.
3. Removing and replacing interior woodwork, window systems, etc. rather than scraping or other means to remove existing coatings.

C. Respiratory Protection

Respiratory protection for lead operations must be implemented in accordance with the AAA Environmental, Inc. Respiratory Protection Program and the OSHA Standard for lead in the Construction Industry, 29 CFR 1926.62.

Half-face air-purifying respirators and PAPR's will be the respirators of choice for manual or power tool removal. An employee may request a PAPR if he so chooses and it provides adequate protection.

Special respirators will be required for abrasive blasting operations (supplied air respirators).

Whenever a chemical stripper (for example, a solvent or caustic material) is used, the use of a combination cartridge appropriate to the exposure may be warranted unless a supplied-air respirator is used.

OSHA set maximum use concentrations for respirators in this standard also, these are:

- < 10 x PEL for the half face
- < 50 x PEL for the full face.
- < 1000 x PEL for the PAPR.
- < 2000 x PEL for supplied air with a full face piece.
- > 2000 x PEL for SCBAs.

D. Protective Work Clothing and Equipment

AAA Environmental, Inc. shall provide protective clothing. During lead abatement and cleaning operations all persons in the work area shall, at a minimum, wear the following protective disposable clothes: Full-body coveralls ("Tyvek") with hood, hard hat, protective eyewear, boot or shoe covers, gloves, and respirator as required.

E. Hygiene Facilities

Clean change areas with storage facilities, showers, and eating facilities are required when exposures exceed the PEL. Hand and face washing facilities are required for any lead exposure areas.

All hygiene facilities should be located as close to the work area as feasible to minimize contamination migration caused by worker traffic.

Employees shall not be permitted to eat, drink, smoke, and chew (gum or tobacco), or apply cosmetics in the work or changing area.

F. Signs

Signs warning that lead abatement operations are being conducted shall be posted at all approaches to the work area. Such signs shall include the words:

**WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING**

in bold lettering not smaller than 2 inches tall, with additional language that may be required by a particular jurisdiction.

Recordkeeping

Records from lead-related projects that are personnel and/or safety and health related must be maintained for at least 30 years. This includes training, medical surveillance, exposure

monitoring, compliance plans, and respirator program records.

Exposure Limits and Air Monitoring For Lead

According to the OSHA Lead Standard, the action level is set at thirty ug/m³ (micrograms per cubic meter) of air and the PEL is set at 50 ug/m³. Above the PEL warning signs are to be posted.

Air monitoring is performed by the NIOSH 7082 method, which utilized a thirty-seven millimeter cassette, attached to a personal air sampling pump set to draw one to four liters of air per minute. The minimum volume is 200 liters, the maximum is 1200 liters of air.

3.10 Confined Space Entry

Introduction

OSHA has a standard, 29 CFR 1910.146, for Permit-Required Confined Spaces. The purpose of this section is to outline procedures for employees of AAA Environmental, Inc. to follow in an effort to reduce the hazards of entry into an OSHA-defined "Confined Space."

Definitions

"Confined Space" means a Space that:

1. Is large enough that an employee can bodily enter and perform assigned work, and
2. Has limited or restricted means for entry or exit (for example tanks, silos, hoppers, vaults, and pits), and
3. Is not designed for continuous human occupancy.

"Permit-Required Confined Space" means a Confined Space (see definition above) that has one or more of the following characteristics:

1. Contains or has a potential to contain a hazardous atmosphere (see definition below).
2. Contains a material that has the potential for engulfing an entrant.
3. Has an internal configuration such that an entrant could be trapped or asphyxiated, or
4. Contains any other recognized serious safety or health hazard.

"Hazardous Atmosphere" means an atmosphere that may expose employees to the risk of death, incapacitation, injury, impairment of ability to self-rescue or acute illness from one or more of the following causes:

1. Flammable/Explosive gas, vapor, or mist in excess of 10 percent of its lower explosive limit (LEL).
2. Airborne combustible dust at a concentration that meets or exceeds its LEL (Note: this concentration may be approximated as a condition in which dust obscures vision at a distance of 5 feet or less).
3. Atmospheric oxygen concentration below 19.5% or above 23.5%.
4. Atmospheric concentration of any substance that could result in death, incapacitation, injury or impairment of the ability to self-rescue.
5. Any other atmospheric condition that is Immediately Dangerous to Life or Health (IDLH).

Note: Ventilation may be used to eliminate hazardous atmospheres. Air monitoring results must be documented on the permit prior to entry.

"Ordinary or Non-Permit Confined Space" means a Confined Space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

Confined Space Entry Program

1. Coordination with Site Contact
The Project Manager, or Supervisor in charge of entry will:
 - a. Obtain any available information regarding Confined Space hazards from the Site Contact.
 - b. Coordinate entry operations with the Site Contact when persons other than AAA Environmental personnel will be working in or near the same Permit-Required Spaces.
 - c. Follow the Site's Confined Space entry program whenever possible.
2. Determining the classification of a Confined Space
Should AAA Environmental employees need to enter a Confined Space that has not been classified, then the following procedures will be used:
 - a. Determine whether the Space meets the definition of a Confined Space.
 - b. If the Space meets the definition of a Confined Space, then determine whether it meets the definition of a Permit-Required Confined Space. If the Confined Space does not meet the definition of a Permit-Required Confined Space, employees may enter the Space after the appropriate safety pre-

cautions have been implemented.

Note: All Confined Spaces are considered to be Permit-Required unless proven otherwise.

- c. If the Space is a Permit-Required Confined Space, one of two procedures may be followed:
 1. A full permit must be completed in accordance with Part 3, "Entry Procedures, or
 2. The hazard(s) may be eliminated without entry (purging the air, for example) and the Space may then be reclassified into an ordinary (Non Permit -Required) Confined Space

If a Space is to be re-classified, complete the re-classification portion of the permit (gray shaded areas)

Upon completion of the re-classification form, the "Permit-Required Confined Space" can now be re-classified as an ordinary Confined Space. This re-classification method should only be used in well-understood Confined Spaces where all potential hazards have been eliminated. Otherwise, use the full Confined Space Entry Permit.

3. Entry Procedures

- a. A Permit will be completed prior to entry into a Permit-Required Confined Space or a Re-Classified Confined Space. The Permit's purpose is to:
 - Pre-plan the entry procedure
 - Eliminate any anticipated hazards, and
 - Describe in advance the emergency and rescue procedures to be used
- b. Before an employee enters the Space, the internal atmosphere will be tested with a calibrated direct-reading instrument for the following conditions:
 - Oxygen content
 - Flammable gases and vapors
 - Potential toxic air contaminants
- c. If the Space is large or is part of a continuous system, such as a sewer or large boiler, pre-entry testing will be performed to the extent feasible before entry is authorized. For example, a hose may be lowered to test for heavier-than-air gasses that have collected near the ground.

In a large or continuous system, the atmosphere will be continuously monitored in the areas where authorized entrants are working.

Roles of the Confined Space Entry Team

1. The **Supervisor** in charge of entry shall:

- a. Identify and evaluate the hazards before employees enter the Permit Space. The hazards identified must be eliminated before entry or they must be managed so that work procedures and emergency planning assure the health and safety of each team member
- b. Verify that conditions in the Permit Space are acceptable for entry throughout the duration of an authorized entry
- c. Confirm that the necessary PPE and safety equipment is available and that employees are trained to use it
- d. Verify that an emergency rescue plan is in effect.
- e. Prior to entry, sign the permit to authorize entry
- f. Post the completed and signed permit at the entry point so that the entrants can confirm that pre-entry preparations have been completed

2. Authorized **Entrants** shall:

- a. Know the hazards they face during entry, including information on the signs or symptoms of exposure
- b. Follow the requirements stated on the entry permit
- c. Sign in and out on the permit
- d. Exit from the permit Space as quickly as possible whenever a dangerous situation arises or they are told to exit by the attendant or supervisor

3. **Attendants** Shall:

- a. Review the permit and know the hazards involved
- b. Maintain continuous communication with entrants. This may be visual, verbal, by lifelines or other effective means.
- c. Continuously maintain an accurate count of all authorized entrants in the Space. The permit should show an accurate record of who is in the Space.
- d. NEVER enter the Confined Space to attempt a rescue of the entrants. Instead, follow the emergency plan, alert the rescue team, etc. without entering the Space.

Attendants will perform no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

Attendants will order entrants to evacuate immediately when the attendant detects a situation inside or outside the Space that could endanger entrants.

Training

Each employee who is required to enter a Permit-Required Confined Space will be trained in the safe performance of their duties.

Rescue and Emergency Services

1. Non-Entry Rescue

To facilitate non-entry rescue, retrieval systems or methods will be used whenever an authorized entrant enters a Permit-Required Confined Space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant.

Retrieval systems will meet the following requirements:

- a. Each authorized entrant will use a chest or full body harness with a retrieval line attached to a mechanical device or fixed point outside the Permit Space.
 - b. A mechanical device (i.e., winch) must be available to retrieve personnel from vertical type Permit-Required Confined Spaces that are more than 5 feet deep.
2. If a rescue team is to be used instead of non-entry procedures, arrangements must be made prior to entry. All necessary rescue PPE must be readily available and the rescuers must be trained and familiar with the location and hazards of the Confined Space in question. Members of a rescue team must have up-to-date certifications in First Aid and Cardiopulmonary Resuscitation (CPR).

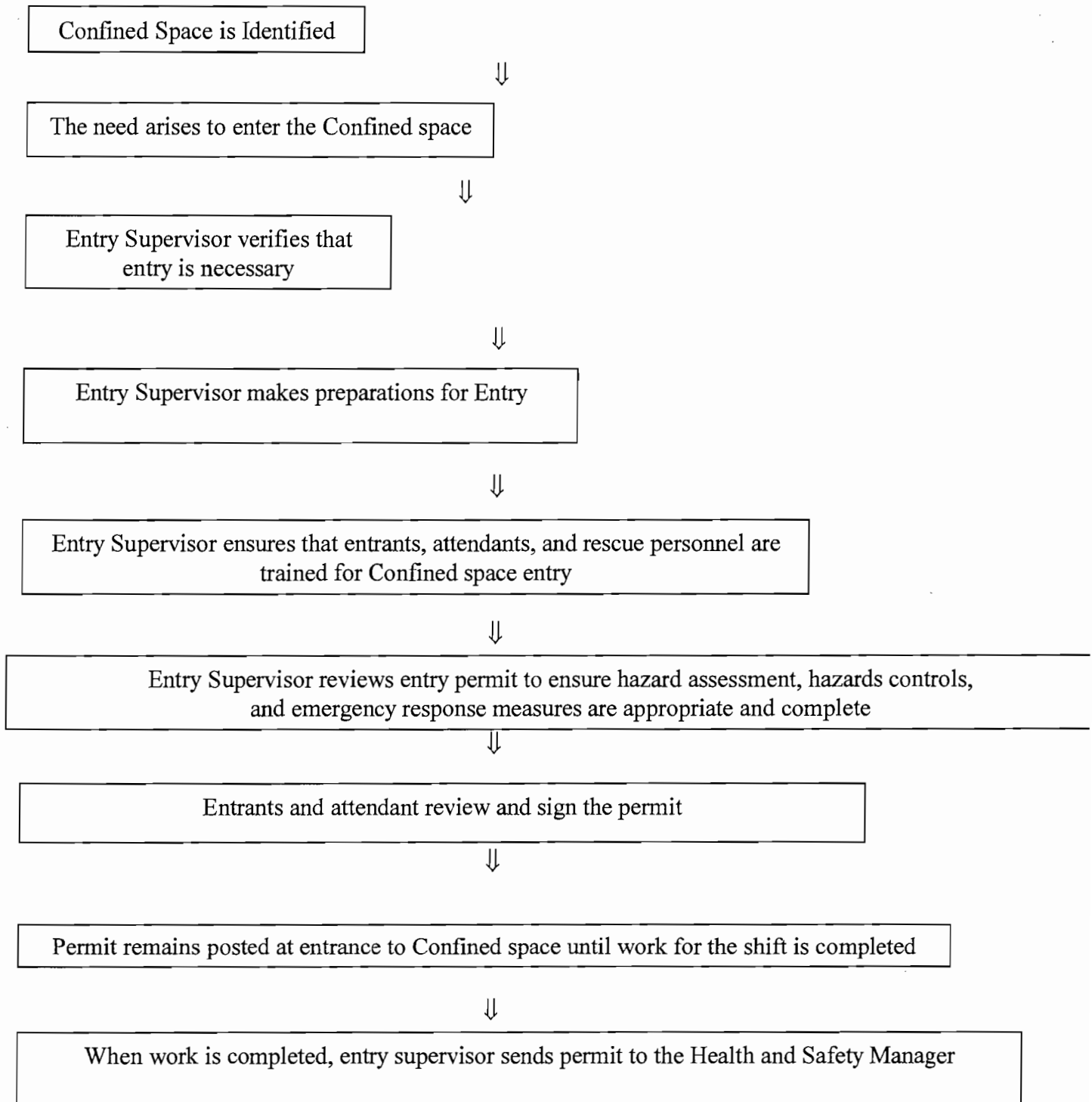
Records

1. The Confined Space entry permit shall be completed prior to entry into any Permit Required Confined Space.
2. Closed-out permits should be forwarded to the Health and Safety Manager for review, then retained in the job files.

Evaluation of Program

The Permit-Required Confined Space Entry Program will be audited annually. The program will be revised as necessary to confirm that employees are adequately protected from Confined Space hazards.

Confined Space Entry Permit Flow Diagram



Confined Space Permit - add

4.0 DECONTAMINATION PROCEDURES

4.1 General

- Decontamination of equipment and on-site personnel will be performed to limit the migration of contamination off-site and between work areas on the site.
- All equipment, tools, materials, and vehicles will be inspected before leaving the site by the SSO or a designee.
- All waste materials that are generated as a result of decontamination will be disposed of as Potentially Contaminated Waste.

4.2 Equipment / Worker Decontamination

All reusable equipment, tools, and construction equipment used in contact with contaminated materials will be decontaminated prior to leaving the Exclusion Zone by the following means:

- Gross manual removal by scraping, shoveling, etc. Then,
- Pressure washing or scrubbing with detergent until clean.
- Decontaminated water will be collected, containerized, characterized and disposed of in accordance with applicable local, state, and federal regulations.

Personnel must doff PPE and decon before leaving the CRZ and entering the Support Zone.

The SSO will be responsible for inspecting all equipment leaving the site for adequacy of decontamination. The release criteria are visual inspection.

5.0 CONTINGENCY PLAN AND EMERGENCY RESPONSE PROCEDURES

The purpose of this section of the HASP is to address how site personnel will respond to emergencies. The types of potential emergencies that are addressed by this plan include:

- Spill prevention and response
- Chemical exposures to site personnel; and
- Physical injuries to site personnel.

The emergency notification list and directions to the hospital are summarized in Table 5.0.

5.1 Spill Prevention and Response

Releases of chemicals to the environment which would impact the general public, property, or the environment are not anticipated during this project since the work will take place in areas secured from the general public. Specified decontamination procedures will be followed to prevent the spread of contamination off-site.

Given the nature of abatement activities on site, it is unlikely that releases of hazardous materials to the environment will occur. However, planned use of chemicals or on-site fueling of equipment may occur. Absorbent materials will be stored on site for use in the event of a minor release of chemical or petroleum product.

Should a major release of hazardous materials occur, AAA Environmental's Spill Response

Team or a team contracted locally will respond to contain and cleanup the spill. The proper authorities will be notified (see "Emergency Response Procedures," Table 5.0, Appendix A).

5.2 Emergency Recognition and Prevention

5.2.1 Chemical Exposures

Work shall be performed in such a manner that exposure to contaminants through skin or eye contact, inhalation, or ingestion is minimized. Work practices to reduce chemical exposures include:

- PPE for the appropriate work activities and areas as defined by this HASP shall be used by all personnel involved in work activities.
- Minimize all skin and eye contact with contaminants by engineering controls and approved work practices.
- Standard personal hygiene and personnel decontamination will be performed to minimize the potential effects of contaminants on this site.

Early recognition of chemical exposure symptoms is essential to the prevention of serious chemical exposure incidents. MSDS's (see Appendix C) summarize symptoms of chemical exposures that could occur on this project.

If a person experiences any of these symptoms, or recognizes any of the symptoms in a fellow worker, they should stop work and report the symptoms to the SSO. If symptoms are serious, work activities in the area where the person was exposed may be altered or discontinued. The SSO may arrange for the individual to report to an Occupational Medicine Clinic or a hospital for medical evaluation or treatment.

5.2.2 Hazardous Physical Conditions

Site personnel should constantly look for potential safety hazards such as

- holes or ditches
- overhead objects that may fall
- sharp objects such as nails, metal shards, wood splinters, and broken glass
- protruding objects at eye or head level
- slippery surfaces, steep grades, uneven terrain
- unstable surfaces that may give way
- Any other recognized safety hazard

Site personnel should inform the SSO of any potential hazards that are identified so that corrective action can be taken.

5.2.3 Confined Space Entry Procedures

If the need for entry into a confined space arises, the AAA Environmental Confined Space Entry Program and Permit shall be used. Confined space hazards will be eliminated or minimized prior to entry.

Where hazardous atmospheres may potentially be present, monitoring of the atmosphere must be performed prior to entry and at specified intervals throughout the job. Natural ventilation or mechanical ventilation should be used whenever possible to eliminate any potential atmospheric hazards prior to entry. The appropriate level of Respiratory

Protection will be determined and required based upon an evaluation of potential atmospheric hazards by a competent person. This may include air-supplied respirators as needed.

Mechanical means of extracting a confined space entrant will be used when *vertical* entry into a Permit Required Space greater than four feet deep is necessary. This typically includes a winch, a tripod or approved attachment point, full body harnesses, and life-line.

A full body harness, wristlets or anklets may be used as modes of *horizontal* retrieval as appropriate.

A person who is trained as a confined space attendant will be assigned to remain on the outside of the confined space and will remain in constant contact with the employees in the confined space area.

If an emergency occurs, the attendant will contact all appropriate emergency officials as described in the Confined Space Rescue Plan and will initiate retrieval of the employee. The designated attendant shall not enter the confined space for any reason.

5.3 Emergency Response Personnel and Roles

AAA Environmental personnel will notify the SSO in case of an emergency. The SSO will provide direction for matters related to emergencies. In the event the exclusion zone needs to be evacuated, an air horn blast will be utilized.

5.4 Medical Emergencies

In the event of a Medical Emergency, the following guidelines should be followed:

- Survey the area for hazardous conditions
- Eliminate or minimize recognized hazards. Do not become a second victim
- Provide First Aid to the victim as necessary. Do not exceed the limits of your training
- Arrange for transportation to an Occupational Medicine Clinic or hospital
- Evacuate other personnel to a safe place until the Site Supervisor or Project Manager (assisted by the SSO) determines that it is safe to resume work
- Develop procedures, in accordance with the Site Supervisor and Project Manager to prevent a recurrence

5.5 Emergency Decontamination Procedures

Decontamination of an injured or exposed person shall be performed only if decontamination does not interfere with essential treatment.

If decontamination can be done prior to transportation:

- Wash, rinse or remove protective clothing and equipment
- Wash and rinse contamination from the victim

If decontamination cannot be done prior to transportation:

Wrap the victim in blankets or equivalent to reduce the contamination of others

Alert emergency medical personnel to potential contamination

- The SSO or another person familiar with the incident and site contaminants should

accompany the victim to the clinic or hospital

- Transport MSDS or chemical fact sheets to the hospital or arrange to have them faxed

In the event of an emergency, AAA will direct outside emergency services to Gate 2 (or other gate as appropriate) and have a designated person meet them at the gate to open it up and guide them to the scene.

APPENDIX A

Section 1 Site Data

Table 1.4 Key Personnel and Project Contact Information

Table 3.1 Job Safety Analysis

Table 3.2 Contaminant Safety Analysis

Table 3.3 Air Monitoring Requirements

Table 3.4 Action Levels and Response Summary

Table 5.0 Emergency Procedures

Table 3.1
Job Safety Analysis

High Risk Exposure Checklist	Controls
Motor Vehicles	Traffic control: use of established roadways, barricades, tape, daily vehicle inspections, seat belt use, speed control
Falling Objects/Falls from Heights	Fall protection barricades to be built around pits and any fall exposure 6 ft. or greater. Harnesses to be worn in aerial lifts. Daily inspection of lifts. Demolition (exclusion and warning) Zones, barricades.
Electrocution Hazard	Keep 10' (min) from overhead lines. Use GFCI's and inspected extension cords. Electric power tools must be grounded or double insulated. All Electric lines will be probed for voltage before cutting them.
Confined Space	Entry permits. Air monitoring. Lockout/Tagout. Trained entrants and attendants.
Fire/explosion hazard	Signs at fuel dump/tank area. Fire extinguishers Staged at fuel dump, in general work area and during fuel transfer. Hot work permits
Caught-in/Struck by Equipment	Avoid pinch points, Maintain machinery guards in place, Leave 10'safety zone around heavy equipment. No pedestrians behind heavy equipment.
Slip, trip, falls	Good housekeeping: clear walkways, no oil or grease on walkways. Salt or sand icy walking areas if applicable. Identify or restrict access to slip hazard areas Site safety inspections.
Lifting hazards: back injury	Proper lifting technique Use material handling equipment or get help

Table 3.2
Hazard Evaluation

The following substances and safety hazards are known or suspected to be on, or to be used on site. The primary hazards of each are identified.

Substance/Hazard	Location	Primary Concern
Lead	Throughout the site	Inhalation and ingestion hazard. See Lead section
Dust generation on Roadways in the area	Throughout the site	Use of water trucks to spray dirt roads and minimize generation and spread of dust.
Biological Hazards (inc. Insects, snakes)	Throughout the site	See Section K
Confined Space	Excavation	See Confined Space Entry program
Heat Stress	Throughout the site	See Heat Stress Program
Material Handling	Throughout the site	See Material Handling section
Slip, Trip, Fall Hazards	Uneven surfaces	See Elevated Work section

Table 3.3
Air Monitoring Requirements

Chemical	Instrument	Location	Frequency
Lead	Hi volume sample pump	Work area	Pre work, daily, final clearance
Lead	Low Volume pump w/ 25 mm Filter	Personals: 20% of work force for each exposure activity	Each day of operation until a negative exposure can be generated
Respirable Dust	Low flow pump with cyclone separator prior to filter.	Sampling required in non lead areas if lead results are consistently high, indicating high dust levels on site.	Based on IH input.
VOCs (benzene, trimethylbenzene, xylene)	PID	In and around excavations / confined spaces	At beginning of day, and: 4 X per day in work areas if gasoline equipment is in use
Hydrogen sulfide	4 gas meter with H ₂ S detector	In and around excavations / confined spaces	At beginning of day, any time sulfur odor is detected, and: 4 X per day in work area
Carbon Monoxide (CO)	CO Meter	In and around excavations / confined spaces	At equipment startup, and: ▪ 4 X per day in work areas if gasoline equipment is in use

Table 3.4 Action Levels and Response Summary

Contaminant (or Class)	Action Level (AL)	Response
Lead	30 Micrograms/m ³ >500 Micrograms/m ³	Modified Level C with ½ Face APR with P100/HEPA cartridges will be worn if action level is met Upgrade respiratory protection to full face APR or PAPR w/ P100/HEPA cartridges. Institute engineering controls
Respirable Dust	Lead Levels in excess of 100 mg./m ³	Upgrade respiratory protection to full face APR or PAPR w/ P100/HEPA cartridges. Institute engineering controls
VOC	1 PPM	Investigation to assure levels are below recommended limits Upgrade respiratory protection to full face APR or PAPR w/ P100/HEPA cartridges.
Carbon Monoxide (CO)	0 – 25 ppm NOTE: 50 ppm = OSHA PEL 25 ppm = ACGIH TLV >25 ppm	Normal operations. Investigate & Resolve. Ventilate area.

PEL = OSHA Permissible Exposure Limit
TLV = ACGIH Threshold Limit Value

Table 5.0

Emergency Procedures - POST IN A VISIBLE LOCATION

The AAA Environmental, Inc. Emergency Procedures Plan will be in effect at the site.

First-aid equipment is available on site at the following locations:

First-aid kit	Support zone
Emergency eye wash	Support zone

EMERGENCY CALL LIST (Posted in work area and field office)

Fires - Spills	Depew Fire Department -	EMERGENCY.....	911
	Depew Police -	EMERGENCY.....	911
Emergency			
Medical Services	24-Hour Ambulance -	EMERGENCY	911
Hospital	St. Joseph Hospital (EMERGENCY)		716-891-2400

SPILL NOTIFICATION

Agencies

National Response Center.....	800-424-8802
CHEMTREC.....	800-424-9300
AAA Environmental - Syracuse Office.....	315-454-2000

Provide the following information:

• Name of the person making the call	• Time of release
• Company and location	• Action(s) taken to correct the problem
• Nature of fire (fire calls only)	• Type of injury and first aid action(s)
- taken
- Name and estimated amount of chemical released (spills only)

CONTACT PERSONNEL

NAME	PHONE	PAGER	CELL PHONE
AAA - Rob Lychok			585-303-6805
Mike Pickering	315-454-2000		315-436-6116
Wes Jones	315-454-2000		315-415-3136

A Map to St. Josephs hospital is found in Figure 1.

MAPQUEST.

Start: 3241 Walden Ave
Depew, NY 14043-2848, US

End: St Joseph Hospital:
716-891-2400
2605 Harlem Rd, Cheektowaga,
NY 14225, US

Notes:

**Do you know
YOUR Score?**

Your
Credit Score

Your
Interest Rate

Find out instantly!

Directions

Distance

Total Est. Time: 9 minutes

Total Est. Distance: 4.89 miles



1: Start out going WEST on WALDEN AVE toward W 3RD ST.

4.3 miles



2: Turn RIGHT onto HARLEM RD / NY-240.

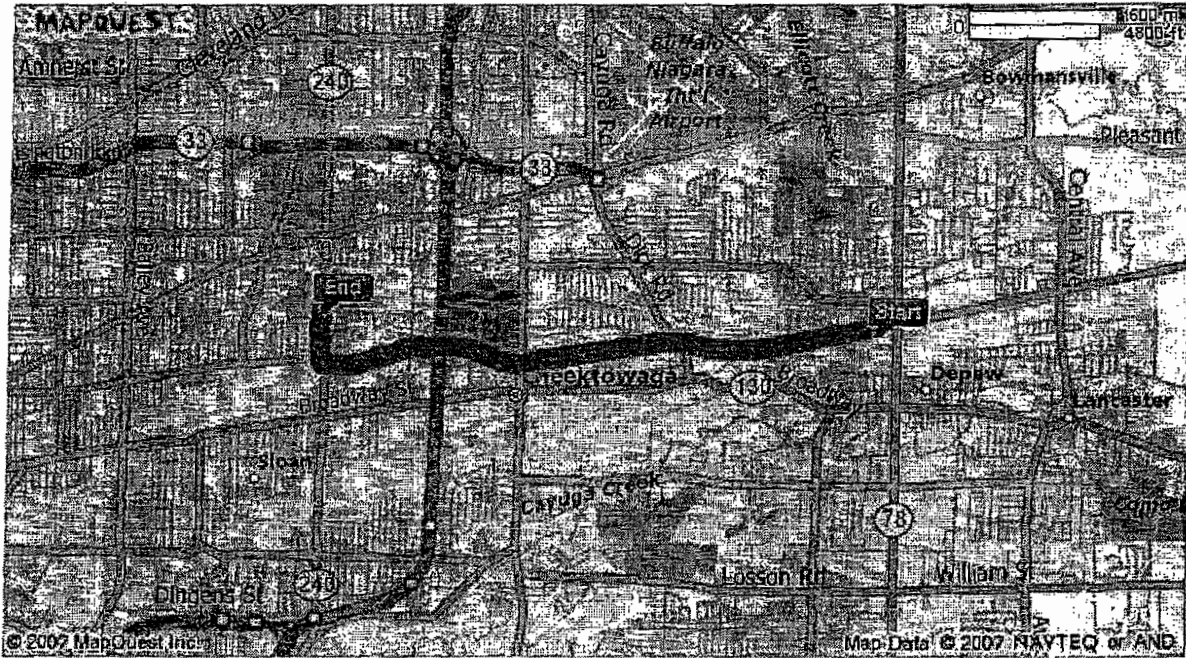
0.4 miles



3: End at **St Joseph Hospital:**
2605 Harlem Rd, Cheektowaga, NY 14225, US

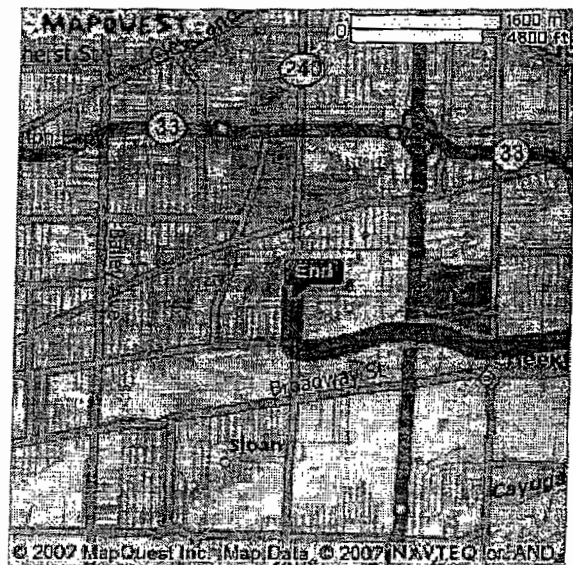
Total Est. Time: 9 minutes

Total Est. Distance: 4.89 miles



Start:
3241 Walden Ave
Depew, NY 14043-2848, US

End:
St Joseph Hospital: 716-891-2400
2605 Harlem Rd, Cheektowaga, NY
14225, US



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These directions are informational only. No representation is made or warranty given as to their content, road conditions or route usability or expeditiousness. User assumes all risk of use. MapQuest and its suppliers assume no responsibility for any loss or delay resulting from such use.

Key Personnel and Project Contact Information

Title	Name	Contact Information
AAA Environmental, Inc. Project Manager	Wes Jones	Cell: 315-415-3136
AAA Environmental, Inc. Operations Manager	Mike Pickering	Ph: 315.454-2000 Cell: 315. 436-6116
AAA Environmental, Inc. Vice President	Pete Breen	Ph: 585-426-6060 Cell: 585-750-2811
AAA Site Supervisor / Safety Officer	Rob Lychok	Cell: 585-303-6805

Client Contacts

Company	Name	Contact Information
Tighe and Bond	Jim Olsen	Office: 860-704-4761 Cell: 860-805-8776
NYSDEC	????	Office:

APPENDIX B, FORMS

- *Site Visitors Log*
- *Job Site Safety Meeting Log*
- *JSA/Pre-Task Planner*
- *Calibration Record*
- *Daily Air Monitoring Log*
- *(Air) Sample Sheet*
- *Air Sample Log and Chain of Custody*
- *Site Health and Safety Audit*
- *Safety Inspection Form*
- *Field Accident Report Form*
- *Accident Investigation Form*
- *Accident/Incident Follow-Up*
- *Disciplinary Action Report*
- *Near Miss/Lessons Learned Memo*
- *Respiratory Protection: Fit Test Record*
- *Equipment Inspection Checklist*
- *Aerial Lift Inspection Checklist*
- *Lockout/Tagout Form*
- *Hot Work Permit*
- *Excavation Entry Permit*
- *Confined Space Entry Permit*
- *Health and Safety Plan Revision*

Site Visitors Log

Client: _____

Project: _____

Personnel signing below have read and understand the above site specific Health & Safety Plan

[illegible]

AAA ENVIRONMENTAL, INC. JOB SITE SAFETY MEETING LOG

Client/Job Site: _____

Job #: _____

Date: _____

Time: _____

This is to certify that I, _____, gave a "tool-box" safety meeting based
upon AAA Environmental, Inc.'s Health & Safety Program and _____'s
basic safety rules and regulations. This meeting covered, but was not limited to:

- Wearing hard hats, steel-toed boots, and eye protection on every work site.
- Hearing protection where required.
- Safety harness, belts, and lines where required.
- Site specific hazards (see below).
- Clean-shaven face on jobs where respiratory protection is needed.
- On asbestos or hazardous material jobs, the wearing of Tyvek™ coveralls at all times.
- On asbestos or hazardous material jobs, the wearing of proper respiratory protection at all times.
- The wearing of other personal protective equipment (gloves, over-boots, etc.) as required.

In addition, the following site-specific hazards may be found on this job:

By signing below you are acknowledging that you have been informed about the above referenced safety program, rules, regulations, and site-specific hazards, and that you understand them. Anyone who violates these rules and regulations can be dismissed from the job site immediately by the Supervisor or Foreman in charge, and be subject to further disciplinary action, up to and including termination of employment.

SIGN-IN

Name	Name	Name

AAA Environmental Inc. J.S.A. / PRE-TASK PLANNER

Date _____ Job site _____
 Supervisor _____ Job # _____
 Job Activity _____

EVALUATING YOUR WORK AREA (Circle Yes or No)

- Yes No Have you walked your work area?
 Yes No Are you working around live systems? (Active boiler, Running Equipment, Ect.)
 Yes No Does your task require special training? (Water blast, Vactruck, Confined space Ect.)
 Yes No Is an MSDS review necessary for this task?
 Yes No Do you have the proper PPE for this task?
 Yes No Have all tools/equipment/Fire Extinguishers been inspected before use?
 Yes No Should the safety Dept. be involved in this projects planning?
 Yes No Is there a safety issue that has not been addressed?
 Yes No Is air monitoring required?
 Yes No Are work permits required for this task?
 Yes No Are all workers familiar with evacuation routes?
 Yes No Does the task involve a confined space?
 Yes No Are the proper materials & tools Available?
 Yes No Has emergency equipment such as fire ext, eye wash, Safety Shower & Phones been Located?
 Yes No If the work area is congested, has the work plan been coordinated with others?

Potential hazard checklist (Place a check mark if applicable)

☐ Motor Vehicles	☐ Falls From Heights (6')	☐ Electrical	☐ Confined Space	☐ Caught in & struck by
☐ High Noise Levels	☐ Manual Lifting	☐ Falling objects	☐ Chemical Burns	☐ Eye Hazards
☐ Thermal Burns	☐ Plant Operations	☐ Trenches / Excavation	☐ Fire / Explosion	☐ Aerial Lifts
☐ Poor Housekeeping	☐ Heat / cold Stress	☐ Lock / Tagout	☐ Inadequate access	☐ Crane / Rigging
☐ Hazardous Chemicals	☐ Scaffolding	☐ Ladders	☐ Inhalation Hazards	☐ Sharp Objects/ Tools
☐ Line Breaking	☐ _____	☐ _____	☐ _____	☐ _____

Personal Protective Equipment (List all PPE Required)

☐ Safety Glasses	☐ Hard Hat	☐ Work Boots	☐ Gloves, _____	☐ Respirator
☐ Ear Plugs	☐ Goggles	☐ Harness	☐ Tyvek	☐ Coated Tyvek
☐ Face Shield	☐ Rain Gear	☐ Torching Jacket	☐ _____	☐ _____

Emergency Numbers

Fire _____ Police: _____ Ambulance _____ Plant _____

Description of work being performed	Hazards Associated	Actions to Eliminate Hazard

AAA Environmental Inc.
J.S.A. / PRE-TASK PLANNER

Description of work being performed	Hazards Associated	Actions to Eliminate Hazard

This is to certify that I, _____, gave a A "tool-box" safety meeting based
Supervisor's Name
 upon AAA Environmental, Inc.'s Health & Safety Program and _____'s
Client's Name
 basic safety rules and regulations. This meeting covered, but was not limited to:

- ☆ Wearing hard hats, Safety shoes, and eye protection on every work site.
- ☆ Hearing protection where required.
- ☆ Safety harness, and lanyards when working at heights over 6'.
- ☆ Clean-shaven face on jobs where respiratory protection is needed.
- ☆ On asbestos or hazardous material jobs, wear proper respiratory protection at all times.
- ☆ Wearing other personal protective equipment (gloves, over-boots, etc.) as required.
- ☆ Site specific hazards (see below).

In addition, the following site-specific hazards were covered:

By signing below you are acknowledging that you have been informed about the above referenced safety program, rules, regulations, and site-specific hazards, and that you understand them. Anyone who violates these rules and regulations can be dismissed from the job site immediately by the Supervisor or Foreman in charge, and be subject to further disciplinary action, up to and including termination of employment.

Work crew sign-off (Signature)

Instrument Calibration Record

Client/Site: _____

Job #: _____

Date: _____

Time: _____

Instrument/Model: _____ Serial #: _____

Calibration Std/Concentration: _____ / _____ Lot #: _____

		<u>Pass Criteria</u>
Bump Check pass?	Y N N/A	Instrument responds
Calibration check pass?	Y N N/A	+ or - 10% of Cal Std
Full calibration performed?	Y N N/A	Follow manufacturer instructions
Instrument Zero Completed	Y N N/A	Stable zero baseline
Is instrument ready for use?	Y N N/A	Meets above criteria

Instrument/Model: _____ Serial #: _____

Calibration Std/Concentration: _____ / _____ Lot #: _____

		<u>Pass Criteria</u>
Bump Check pass?	Y N N/A	Instrument responds
Calibration check pass?	Y N N/A	+ or - 10% of Cal Std
Full calibration performed?	Y N N/A	Follow manufacturer instructions
Instrument Zero Completed	Y N N/A	Stable zero baseline
Is instrument ready for use?	Y N N/A	Meets above criteria

Technician: _____

Print

Sign

Notes: _____

IH Monitoring Results

Client: _____

Date: _____

Location: _____

Job # _____

Task: _____

Parameter: _____

Instrument: _____

Tech: _____

Time	Reading	Notes
	Units: _____	

Notes:

Sample Sheet

Job Name: _____
 Site Location and Description: _____
 Sample Tech.: _____

Meter	Test	Reading	Time	Date	Instrument Model / Type	Cal Date
4 Gas meter	O2					
	LEL					
	CO					
	H2S					
PID Meter	VOC					

Notes: _____

Air Sample Log and Chain of Custody

Job #:	Project/Client:	Supervisor:
Date:	Location:	Rotometer:
		Sampler's Signature:

Sample Number	Location/Person	Sample Type	Social Security #	Task or Activity	Start Time	Stop Time	Total Minutes	Pump Number	Pump Flow Liters/min

Sample Type: B=Background E=Environmental P=Personal WA=Work Area BL=Excursion Limit PA=Pre-Abatement F=Final

Personal Protective Equipment Worn. Check all that apply:

Respirator:	Clothing:	Gear:
Half face	Tyvek	Hard hat
Full face	Coated Tyvek	Safety shoes
PAPR	Other (specify)	Safety glasses
Cartridge: HEPA/Stacked	Boots	Safety goggles
SCBA or Airline	Gloves	Face shield

Relinquished By (Sign)	Date/Time	Received By (Sign)	Date/Time
1]	/	2]	/
Relinquished By (Sign)	Date/Time	Relinquished By (Sign)	Date/Time
3]	/	4]	/
Method of Shipment	Received For Laboratory		Date/Time

By signing above, I acknowledge that the data recorded on this form were collected by accurately following air-sample procedures outlined in NYSDOL Industrial Code Rule 56, OSHA 29CFR 1910 and 1926, and all other applicable state and federal regulations.

Site Health and Safety Audit

Location: _____

Date: _____

Client: _____

Job #: _____

Supervisor/Foreman: _____

Other Workers: _____

Observations

Opportunities for Improvement

Actions Needed

Action

Person

Target Date

Actions completed/verified: _____

Signature

Date

Asbestos Job Inspection Report

Date: _____
 Job #: _____
 Supervisor: _____
 Inspector: _____

Yes	NO	N/A	Item
			Building occupant notice posted at all doors
			Pre air sampling is completed before AAA starts any work
			AAA Contractors license posted
			DOL notification posted
			DOL notification Start & end dates correct
			DOL variances posted
			Men have Handlers cards on site
			Handlers card is not expired
			There is a decon
			There is a wasteout
			The clean room has a bench
			The clean room has lockers
			The clean room has a shelf
			The clean room has hooks
			The clean room is stocked with tyveks, bath towels, resp. cart, etc.
			All person are signed into the work area & signed onto the job
			There is an airlock from cleanroom to shower with min. of 3' between flaps
			Airlock flaps are staggered and are weighted
			The shower has hot and cold water at the tap
			There is 1 shower head for every 6 men
			There is a shower filter with 3 filters, smallest being 5 micron w/ spares on site
			Discharge of shower water goes to sanitary drain
			There is an airlock from shower to Dirty room w/ min. of 3' between flaps
			Dirty room has a bag hung in it to put used PPE into
			The dirty room is clean
			There is an airlock from Dirty room to work area w/ min. of 3' between flaps
			There is a walk off pan just inside the work area
			The waste out has airlock, dirty room, airlock, holding room
			There are supplies in the holding room (i.e., extra bags, tools, watersprayers)
			There are negair units set up w/ a min. of 4 air changes per hour
			Neg air is discharged to outside the building and is 50' from any air intake of building
			All power is hooked up to GFCI's
			Large Project: Air sampling is being done daily
			Small Project: Pre's and post sampling has been done

			Personal air samples are being done daily (1 for every 5 men)
			Excursion sampling is done daily (one per day)
Yes	No	N/A	Item
			The supervisor has a daily log starting from the first day of job
			Once Neg air is running there is a smoke test and barrier insp. done daily and logged in the log book
			Plywood is used on all areas that are greater then 32 sqft
			All power in work area is turned off
			All critical barriers are covered with 2 layers of 6 mill poly
			All walls, floors & ceilings are covered with 2 layers of 6 mill poly
			Asbestos signs are placed around the work area
			All removal is being done using Amended water
			All waste is bagged up and there are no piles of asbestos
			There is a bug sprayer or airless sprayer in the work area
			Cleaning sequence is followed with 12 hour waits
			Dumpster is polyed and locked at night
			There is asbestos signs on all 4 sides of dumpster
			All bags in dumpster are doubled and taped closed
			There are generator stickers on all bags in dumpster

NOTES:

AAA Environmental, Inc.

Field Accident Report Form

This form must be filled out by the field supervisor and returned to the Syracuse Health and Safety Department within 24 Hours of the incident to ensure insurance protection.

AAA FAX: 315 455 8740 Health and Safety Department 315 454 2000

Name of injured: _____ Sex _____ Soc.Sec. # _____
Date of Birth: _____ Number of Dependents (Children): _____ Marital Status M / S _____
Home Address: _____
(Street) (City) (State) (Zip)

Home Phone: () _____

Job Title: _____ Department: _____ Hire Date: _____

Where hired: _____ Hourly Wage: _____ Full/ Part Time: _____

Date of Incident: _____ Time of Incident: _____ Time Incident was Reported: _____

To Whom: _____ Project/Location Name: _____ Number: _____

Address: _____
(Street) (City) (State) (Zip)

Phone: () _____

Were prescriptions issued? _____ Is a follow up visit required? _____

Time Shift began: _____ Time Employee Left Work: _____ Employee return to work? _____

Duties Restricted? _____ Lower Wage? _____

Did the employee receive medical attention? _____ If so, where? _____

Address: _____
(Street) (City) (State) (Zip)

Phone Number: ()

If the employee refuses Medical Attention (Sign Here): _____

Were there any witnesses? : _____

Witnesses Name(s): _____ Telephone Number(s): () _____

Statement Attached? _____ (Attach additional pages if necessary)

Nature of Injury: _____ Exact Body Part: _____

Job Assignment at time of incident: _____

Was the employee performing normal occupational duties? _____

Describe Incident; step by step:

Was safety equipment provided? _____ Was safety equipment used? _____

Were Equipment or Chemicals in use at that time? (If so which chemicals or equipment)

What unsafe condition led to the incident?

What Corrective Action has been taken to prevent reoccurrence?

Supervisor: _____ Supervisor Signature: _____ Date: _____
(Print Name)

Employee: I accept that all these statements are correct to the best of my knowledge.

Employee Name: _____ Employee Signature: _____ Date: _____
(Print Name)

Accident Investigation Form

1. Accident investigation team: _____
2. Accident location: _____
3. Accident date: _____
4. Injured person(s): _____
5. Injuries sustained: _____
6. Describe the accident that caused the injuries: _____

7. Identify the causes of the accident:

Worker Factors

Supervision/Management Factors

Environmental
Conditions

Machine/Material
Defects

8. List corrective actions that will prevent similar accidents in the future:

Action

Person Responsible

Target Date

1.

2.

3.

4.

Accident/Incident Follow-Up

Your Name: _____ Date of Incident: ____/____/____

Location of Incident: _____

1. *Briefly describe the incident:*

2. *What factors contributed to the incident (circle all that apply):*

Equipment Problem Company Policies/Procedures

Worker Error Environment (heat, cold, ice, rain, etc)

3. *What must we do to be sure a similar incident never happens again?*

4. *Management review/comments:*

5. *Manager: Discussion held with worker?*

AAA Environmental, Inc.

DISCIPLINARY ACTION REPORT

VERBAL WARNING _____ FIRST OFFENSE
WRITTEN WARNING _____ SECOND OFFENSE

DATE OF INCIDENT: _____ (A)

DATE OF WARNING: _____

LOCATION: _____

NAME OF EMPLOYEE: _____

NAME OF SUPERVISOR: _____

NATURE OF INCIDENT: (CHECK AS MANY AS NECESSARY)

- 1) UNEXCUSED ABSENCE _____
- 2) UNEXCUSED LATENESS _____
- 3) NOT SIGNING IN _____
- 4) NOT SIGNING OUT _____
- 5) INSUBORDINATION (1) _____
- 6) ABUSIVE LANGUAGE _____
- 7) HARASSMENT (1) _____
- 8) UNSATISFACTORY PERFORMANCE (1) _____
- 9) JOB REFUSAL (1) _____
- 10) SAFETY VIOLATION (1) _____
- 11) OTHER _____

(1) EXPLAIN
INCIDENT: _____

WITNESSES: _____

EMPLOYEE EXPLANATION (IF DIFFERENT FROM ABOVE) : _____

ALLWASH OF SYRACUSE, INC.

ACKNOWLEDGED

DATE

SUPERVISOR

EMPLOYEE

(A) All minor violations will remain on an employee's personnel record for a period of one year from date of incident



AAA Environmental, Inc.

Near Miss/Lessons Learned Memo

- Serious accidents often have similar events leading up to them.
- Let's learn from our near-miss events. Report all minor incidents or close calls.
- Use a "no name/no blame" format.

Describe the work that was going on:

What went wrong?

How can we prevent a similar incident from occurring again?

Initials (optional): _____

Mail to Jerry Clark, Health & Safety Manager

AAA Environmental, Inc.
Record of Respiratory Training and Fit-Testing

I agree that I have received and understand the respirator training provided by AAA Environmental, Inc. on this date, relative to use and care of the respirator(s) indicated below. I also agree that the respirator(s) provided me with a good fit as determined by a _____ quantitative fit test (Portacount); or by a _____ qualitative fit test (_____ irritant smoke or _____ banana oil).

I also understand how to perform, and the importance of performing negative and positive fit checks when donning an air-purifying respirator. I further agree that I have been provided a copy of, read, and will follow the AAA Environmental, Inc. Respiratory Protection Program.

Please circle the respirators that you have been trained and fit tested on.

AIR PURIFYING	MANUFACTURER	MODEL	SIZE
HALF-FACE	SURVIVAIR	BLUE	S / M / L
	GLENAIRE		
	MSA	COMFO-ELITE	
FULL-FACE	MSA	DUO-TWIN	S/M M/L
PAPR	RACAL	BREATH-EASY	
		POWERFLOW	
SUPPLIED-AIR	MANUFACTURER	MODEL	SIZE
Full-Face Pressure Demand with Escape Bottle	MSA	COMBINATION UNIT	
Full-Face Pressure Demand with HEPA Egress	MSA	POSITIVE PRESSURE	
SCBA	SURVIVAIR	MARK 1 MARK 2	

Name (Print): _____ Date: _____

Signature: _____ SSN: _____

Fit-Test Technician: _____

Equipment Inspection Checklist

Week of: _____

Equipment type: _____
 Directions: Write okay or not okay in the corresponding box. If you check not okay, use the space provided under comments to describe the problem.

	Brakes	Brake Lights	Reverse Signal	Alarm	Horns	Tires	Steering	Seat Belts	Operating Controls	Fire Extinguisher	Lights	Coupling Devices	Windshield	Windshield Wiper	Guards	Free of Leaks	Brake/Hydraulic Lines	Brake Fluid Level	Hydraulic Fluid	Engine Oil Level	Other	
Monday																						
Odometer: _____																						
Comments: _____																						
	Date of Inspection: _____ Time: _____ AM/PM																					
Tuesday																						
Odometer: _____																						
Comments: _____																						
	Date of Inspection: _____ Time: _____ AM/PM																					
	Signature: _____																					
Wednesday																						
Odometer: _____																						
Comments: _____																						
	Date of Inspection: _____ Time: _____ AM/PM																					
	Signature: _____																					
Thursday																						
Odometer: _____																						
Comments: _____																						
	Date of Inspection: _____ Time: _____ AM/PM																					
	Signature: _____																					
Friday																						
Odometer: _____																						
Comments: _____																						
	Date of Inspection: _____ Time: _____ AM/PM																					
	Signature: _____																					
Saturday																						
Odometer: _____																						
Comments: _____																						
	Date of Inspection: _____ Time: _____ AM/PM																					
	Signature: _____																					
Sunday																						
Odometer: _____																						
Comments: _____																						
	Date of Inspection: _____ Time: _____ AM/PM																					
	Signature: _____																					

AERIAL LIFT DAILY INSPECTION CHECKLIST

Equipment ID#: _____

Equipment Hours: _____

Operator Name: _____

Date: _____

Walk Around Inspection

OK	NOT OK	ITEM	PROCEDURE	ACCEPTABLE CRITERIA
		Tires/Lugs	Visually inspect tires, attempt to rotate each lug counter-clockwise	Tires are fully inflated, lug bolts should not move
		Basket	Visually inspect, grasp & shake guardrail and gate	No visible cracks, guardrails & gate are secure, no debris or other tripping hazards
		Hydraulic Lift Cylinders	Visually inspect cylinder(s) & hoses for leaks	No visible leaks
		Hydraulic/Oil/Coolant Leaks	Visually inspect ground under lift for leaking fluids	No fluids should be on ground
		Fluid Oil/ Coolant Levels	Open engine compartment, measure fluid levels	Fluid levels within normal operating ranges
		Engine/Battery	Visually inspect engine and battery	No loose cables or hoses, battery contacts clean
		Fuel Levels	Check fuel levels	Contains enough fuel to operate

Function Test

		Extension Boom/ Hydraulic Cylinder	Operate through full motion	Operates smoothly to full height, no leaks
		Basket Rotator	Rotate basket through full motion	Operates smoothly, no leaks
		Back-up Alarm	Place lift in reverse gear	Buck-up alarm sounds
		Lights	Turn on lights	Lights must function
		Gauges	Visually inspect gauges	Gauges read in normal operating ranges
		Safety Limit Switch	Operate safety limit switch	Operates smoothly

Signature: _____

AAA ENVIRONMENTAL, INC. LOCKOUT/TAGOUT FORM

Name of Client: _____

Job Description: _____

Date: _____

Job #: _____

Type(s) of hazardous energy (circle):

Electrical

Hydraulic

Pneumatic

Chemical

Thermal

Mechanical

Other: _____

Other: _____

Name(s) of AAA employees who will apply Locks and Tags:

Are there any type(s) of Stored Energy to be released:

Location of Locks and Tags:

Lockout/Tagout has been performed in accordance with plant and AAA safety procedures and it is safe to proceed.

Site Supervisor _____
(signature)

AAA ENVIRONMENTAL, INC.

HOT WORK PERMIT

DATE: _____ CLIENT: _____ AAA JOB No.: _____
JOB SITE: _____
SUPERVISOR: _____
HOT WORK TO BE DONE: _____
START TIME: _____ COMPLETION TIME: _____

HOT WORK SAFETY CHECKLIST: (If any answer is NO, explain below)

YES NO N/A

—	—	—	1).	Can the hot work be moved to a safer location?
—	—	—	2).	Are all flammable or combustible materials removed from the work area?
—	—	—	3).	If flammable or combustible materials can not be moved from the work area are they shielded to prevent contact with sparks or ignition sources?
—	—	—	4).	Are all compressed gas cylinders removed from the area?
—	—	—	5).	Is any combustible dust in the hot work area?
—	—	—	6).	Is there any potential for explosive atmospheres?
—	—	—	7).	Is there any potential for toxic fume formation?
—	—	—	8).	Is proper fire extinguishing equipment and alarm systems available?
—	—	—	9).	Is fire watch personnel in place for the hot work?
—	—	—	10).	Has the container been adequately cleaned and inerted?
—	—	—	11).	Has a tool-box safety meeting occurred prior to the start of work?
—	—	—	12).	Any special hazards?

Explanation/Comments: _____

FIRE WATCH SIGN OFF - Work area and all adjacent areas to which sparks and heat might spread have been inspected during the fire watch period.

(print name) (Signature)

FINAL CHECK - Work area and all adjacent areas were rechecked and found to be safe for a minimum of thirty (30) minutes after the completion of work.

(print name) (Signature)

AAA ENVIRONMENTAL, INC.
EXCAVATION ENTRY PERMIT

Project Name / Client _____

Date _____ Job Number _____

Location of Excavation _____

Purpose of Excavation _____

Depth of Excavation _____

Supervisor / Competent Person _____ / _____

Print

Sign

YES

NO

Have the underground utilities been located? _____

Are ladders provided every 25 feet for entry/exit? _____

Are traffic vests being worn if required? _____

If hazardous atmospheres are possible, record air readings:

O₂: _____ LEL: _____ CO: _____ H₂S: _____

Is water accumulating in the excavation? _____

If yes, then what steps are being taken to eliminate it?

Are any structures, walls, fences, walks, or other installations threatened by the excavation? _____

If yes, then what steps are being taken to protect employees?

Are sides sloped at least 1.5 horizontal to 1 vertical if sloping is used? _____

Have shielding or shoring systems been properly designed and installed? _____

Are there indications of any other hazardous conditions? _____



AAA Environmental, Inc.

CONFINED SPACE ENTRY PERMIT

JOB #

- ☐ PERMIT REQUIRED CONFINED SPACE (PRCS)
☐ ALTERNATE ENTRY CONFINED SPACE (AE) [omit * items]
☐ RECLASSIFY (RECL.) [complete items]

PERMIT VALID FOR 8 HOURS. ALL COPIES OF PERMIT WILL REMAIN AT WORK SITE UNTIL JOB IS COMPLETED.

SITE LOCATION AND DESCRIPTION		DATE		
PURPOSE OF ENTRY				
PERSON AUTHORIZING ENTRY				
AUTHORIZED ENTRANT(S) ATTACH LIST IF NECESSARY				
*ATTENDANT(S)				
REQUIREMENTS COMPLETED		TIME OF VERIFICATION	DO YOU NEED	TIME OF VERIFICATION
Lockout/Tagout (Procedure)	Yes ☐		*Breathing Apparatus for Entry	Yes ☐ No ☐
Notified Area Supervisor of Entry (Required)	Yes ☐		Protective Clothing	Yes ☐ No ☐
Notified Guard/Rescue Team Before Entry (Required)	Yes ☐		Lighting (Explosive Proof)	Yes ☐ No ☐
*Full Body Harness w/D-Ring on All Entrants for Permit Req'd Space	Yes ☐		Purge Space, Flush and Vent#	Yes ☐ No ☐
Pre-Entry Briefing (Required)	Yes ☐		Hot Works Permit	
Secure Area (Post and Flag)	Yes ☐			
Note: Enter N/A or Cross Out Items That Do Not Apply Note: #Vent Time Required: minimum 10 minutes				
PERSON MONITORING ATMOSPHERE		INSTRUMENT: MODEL/TYPE		CALIBRATION DATE
TEST (S) TO BE TAKEN**		PERMISSIBLE ENTRY LEVEL	DATE TIME	
Percent of Oxygen		19.5% to 23.5%		
Lower Explosive Limit (LEL)		Under 10%		
Carbon Monoxide		135 PPM		
Hydrogen Sulfide		110 PPM @ 15 PPM		
Note: **CONTINUOUS MONITORING REQUIRES RESULTS TO BE MONITORED EVERY 2 HOURS. Note: 1 Short-term exposure limit (STEL); Employees can work in area up to 15 minutes. Note: @ 8 hour Time Weighted Average (TWA); Employee can work in area up to 8 hours (longer with appropriate respiratory protection).				
Type of Hazard				
Hazard removed @ Time				
Signature of person removing hazard				
DAY/SHIFT RESCUE TEAM		Shift	Nearest Phone #	
Work Crew Supervisor, all above conditions satisfied (Signature)		TIME OF ENTRY		TIME OF CLOSURE
Dept		Phone		
Emergency Phone Numbers		Fire:	Ambulance:	AAA Environmental, Inc.:

Health and Safety Plan Revision

Client: _____ Job#: _____

Location: _____

Proposed Revision:

Reason for Revision:

Person Proposing Revision: _____

EHS Manager Approval: _____ / _____
sign date

APPENDIX C, MSDS

MSDSs



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Regulations (Standards - 29 CFR)

**Substance data sheet for occupational exposure to lead -
1910.1025 App A**

[Regulations \(Standards - 29 CFR\) - Table of Contents](#)

• Part Number:	1910
• Part Title:	Occupational Safety and Health Standards
• Subpart:	Z
• Subpart Title:	Toxic and Hazardous Substances
• Standard Number:	<u>1910.1025 App A</u>
• Title:	Substance data sheet for occupational exposure to lead

I. SUBSTANCE IDENTIFICATION

A. Substance: Pure lead (Pb) is a heavy metal at room temperature and pressure and is a basic chemical element. It can combine with various other substances to form numerous lead compounds.

B. Compounds Covered by the Standard: The word "lead" when used in this standard means elemental lead, all inorganic lead compounds and a class of organic lead compounds called lead soaps. This standard does not apply to other organic lead compounds.

C. Uses: Exposure to lead occurs in at least 120 different occupations, including primary and secondary lead smelting, lead storage battery manufacturing, lead pigment manufacturing and use, solder manufacturing and use, shipbuilding and ship repairing, auto manufacturing, and printing.

D. Permissible Exposure: The Permissible Exposure Limit (PEL) set by the standard is 50 micrograms of lead per cubic meter of air (50 ug/m(3)), averaged over an 8-hour workday.

E. Action Level: The standard establishes an action level of 30 micrograms per cubic meter of air (30 ug/m(3)), time weighted average, based on an 8-hour work-day. The action level initiates several requirements of the standard, such as exposure monitoring, medical surveillance, and training and education.

II. HEALTH HAZARD DATA

A. Ways in which lead enters your body. When absorbed into your body in certain doses lead is a toxic substance. The object of the lead standard is to prevent absorption of harmful quantities of lead. The standard is intended to protect you not only from the immediate toxic effects of lead, but also from the serious toxic effects that may not become apparent until years of exposure have passed.

Lead can be absorbed into your body by inhalation (breathing) and ingestion (eating). Lead (except for certain organic lead compounds not covered by the standard, such as tetraethyl lead) is not absorbed through your skin. When lead is scattered in the air as a dust, fume or mist it can be inhaled and absorbed through your lungs and upper respiratory tract. Inhalation of airborne lead is generally the most important source of occupational lead absorption. You can also absorb lead through your digestive system if lead gets into your mouth and is swallowed. If you handle food, cigarettes, chewing tobacco, or make-up which have lead on them or handle them with hands contaminated with lead, this will contribute to ingestion.

A significant portion of the lead that you inhale or ingest gets into your blood stream. Once in your blood stream, lead is circulated throughout your body and stored in various organs and body tissues. Some of this lead is quickly filtered out of your body and excreted, but some remains in the blood and other tissues. As exposure to lead continues, the amount stored in your body will increase if you are absorbing more lead than your body is excreting. Even though you may not be aware of any immediate symptoms of disease, this lead stored in your tissues can be slowly causing irreversible damage, first to individual cells, then to your organs and whole body systems.

B. Effects of overexposure to lead - (1) Short term (acute) overexposure. Lead is a potent, systemic poison that serves no known useful function once absorbed by your body. Taken in large enough doses, lead can kill you in a matter of days. A condition affecting the brain called acute encephalopathy may arise which develops quickly to seizures, coma, and death from cardiorespiratory arrest. A short term dose of lead can lead to acute encephalopathy. Short term occupational exposures of this magnitude are highly unusual, but not impossible. Similar forms of encephalopathy may, however, arise from extended, chronic exposure to lower doses of lead. There is no sharp dividing line between rapidly developing acute effects of lead, and chronic effects which take longer to acquire. Lead adversely affects numerous body systems, and causes forms of health impairment and disease which arise after periods of exposure as short as days or as long as several years.

(2) Long-term (chronic) overexposure. Chronic overexposure to lead may result in severe damage to your blood-forming, nervous, urinary and reproductive systems. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pain or soreness, fine tremors, numbness, dizziness, hyperactivity and colic. In lead colic there may be severe abdominal pain.

Damage to the central nervous system in general and the brain (encephalopathy) in particular

is one of the most severe forms of lead poisoning. The most severe, often fatal, form of encephalopathy may be preceded by vomiting, a feeling of dullness progressing to drowsiness and stupor, poor memory, restlessness, irritability, tremor, and convulsions. It may arise suddenly with the onset of seizures, followed by coma, and death. There is a tendency for muscular weakness to develop at the same time. This weakness may progress to paralysis often observed as a characteristic "wrist drop" or "foot drop" and is a manifestation of a disease to the nervous system called peripheral neuropathy.

Chronic overexposure to lead also results in kidney disease with few, if any, symptoms appearing until extensive and most likely permanent kidney damage has occurred. Routine laboratory tests reveal the presence of this kidney disease only after about two-thirds of kidney function is lost. When overt symptoms of urinary dysfunction arise, it is often too late to correct or prevent worsening conditions, and progression to kidney dialysis or death is possible.

Chronic overexposure to lead impairs the reproductive systems of both men and women. Overexposure to lead may result in decreased sex drive, impotence and sterility in men. Lead can alter the structure of sperm cells raising the risk of birth defects. There is evidence of miscarriage and stillbirth in women whose husbands were exposed to lead or who were exposed to lead themselves. Lead exposure also may result in decreased fertility, and abnormal menstrual cycles in women. The course of pregnancy may be adversely affected by exposure to lead since lead crosses the placental barrier and poses risks to developing fetuses. Children born of parents either one of whom were exposed to excess lead levels are more likely to have birth defects, mental retardation, behavioral disorders or die during the first year of childhood.

Overexposure to lead also disrupts the blood-forming system resulting in decreased hemoglobin (the substance in the blood that carries oxygen to the cells) and ultimately anemia. Anemia is characterized by weakness, pallor and fatigability as a result of decreased oxygen carrying capacity in the blood.

(3) Health protection goals of the standard. Prevention of adverse health effects for most workers from exposure to lead throughout a working lifetime requires that worker blood lead (PbB) levels be maintained at or below forty micrograms per one hundred grams of whole blood (40 ug/100g). The blood lead levels of workers (both male and female workers) who intend to have children should be maintained below 30 ug/100g to minimize adverse reproductive health effects to the parents and to the developing fetus.

The measurement of your blood lead level is the most useful indicator of the amount of lead being absorbed by your body. Blood lead levels (PbB) are most often reported in units of milligrams (mg) or micrograms (ug) of lead (1 mg=1000 ug) per 100 grams (100g), 100 milliliters (100 ml) or deciliter (dl) of blood. These three units are essentially the same. Sometime PbB's are expressed in the form of mg% or ug%. This is a shorthand notation for 100g, 100 ml, or dl.

PbB measurements show the amount of lead circulating in your blood stream, but do not give

any information about the amount of lead stored in your various tissues. PbB measurements merely show current absorption of lead, not the effect that lead is having on your body or the effects that past lead exposure may have already caused. Past research into lead-related diseases, however, has focused heavily on associations between PbBs and various diseases. As a result, your PbB is an important indicator of the likelihood that you will gradually acquire a lead-related health impairment or disease.

Once your blood lead level climbs above 40 ug/100g, your risk of disease increases. There is a wide variability of individual response to lead, thus it is difficult to say that a particular PbB in a given person will cause a particular effect. Studies have associated fatal encephalopathy with PbBs as low as 150 ug/100g. Other studies have shown other forms of diseases in some workers with PbBs well below 80 ug/100g. Your PbB is a crucial indicator of the risks to your health, but one other factor is also extremely important. This factor is the length of time you have had elevated PbBs. The longer you have an elevated PbB, the greater the risk that large quantities of lead are being gradually stored in your organs and tissues (body burden). The greater your overall body burden, the greater the chances of substantial permanent damage.

The best way to prevent all forms of lead-related impairments and diseases-both short term and long term- is to maintain your PbB below 40 ug/100g. The provisions of the standard are designed with this end in mind. Your employer has prime responsibility to assure that the provisions of the standard are complied with both by the company and by individual workers. You as a worker, however, also have a responsibility to assist your employer in complying with the standard. You can play a key role in protecting your own health by learning about the lead hazards and their control, learning what the standard requires, following the standard where it governs your own actions, and seeing that your employer complies with provisions governing his actions.

(4) Reporting signs and symptoms of health problems. You should immediately notify your employer if you develop signs or symptoms associated with lead poisoning or if you desire medical advice concerning the effects of current or past exposure to lead on your ability to have a healthy child. You should also notify your employer if you have difficulty breathing during a respirator fit test or while wearing a respirator. In each of these cases your employer must make available to you appropriate medical examinations or consultations. These must be provided at no cost to you and at a reasonable time and place.

The standard contains a procedure whereby you can obtain a second opinion by a physician of your choice if the employer selected the initial physician.

[56 FR 24686, May 31, 1991]

◀ [Next Standard \(1910.1025 App B\)](#)

◀ [Regulations \(Standards - 29 CFR\) - Table of Contents](#)

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Regulations (Standards - 29 CFR)

Substance safety data sheet, Benzene - 1910.1028 App A

[Regulations \(Standards - 29 CFR\) - Table of Contents](#)

• Part Number:	1910
• Part Title:	Occupational Safety and Health Standards
• Subpart:	Z
• Subpart Title:	Toxic and Hazardous Substances
• Standard Number:	1910.1028 App A
• Title:	Substance safety data sheet, Benzene

I. Substance Identification

A. Substance: Benzene.

B. Permissible Exposure: Except as to the use of gasoline, motor fuels and other fuels subsequent to discharge from bulk terminals and other exemptions specified in 1910.1028(a)(2):

1. Airborne: The maximum time-weighted average (TWA) exposure limit is 1 part of benzene vapor per million parts of air (1 ppm) for an 8-hour workday and the maximum short-term exposure limit (STEL) is 5 ppm for any 15-minute period.

2. Dermal: Eye contact shall be prevented and skin contact with liquid benzene shall be limited.

C. Appearance and odor: Benzene is a clear, colorless liquid with a pleasant, sweet odor. The odor of benzene does not provide adequate warning of its hazard.

II. Health Hazard Data

A. Ways in which benzene affects your health. Benzene can affect your health if you inhale it, or if it comes in contact with your skin or eyes. Benzene is also harmful if you happen to swallow it.

B. Effects of overexposure. 1. Short-term (acute) overexposure: If you are overexposed to

high concentrations of benzene, well above the levels where its odor is first recognizable, you may feel breathless, irritable, euphoric, or giddy; you may experience irritation in eyes, nose, and respiratory tract. You may develop a headache, feel dizzy, nauseated, or intoxicated. Severe exposures may lead to convulsions and loss of consciousness.

2. Long-term (chronic) exposure. Repeated or prolonged exposure to benzene, even at relatively low concentrations, may result in various blood disorders, ranging from anemia to leukemia, an irreversible, fatal disease. Many blood disorders associated with benzene exposure may occur without symptoms.

III. Protective Clothing and Equipment

A. Respirators. Respirators are required for those operations in which engineering controls or work practice controls are not feasible to reduce exposure to the permissible level. However, where employers can document that benzene is present in the workplace less than 30 days a year, respirators may be used in lieu of engineering controls. If respirators are worn, they must have joint Mine Safety and Health Administration and the National Institute for Occupational Safety and Health (NIOSH) seal of approval, and cartridge or canisters must be replaced before the end of their service life, or the end of the shift, whichever occurs first. If you experience difficulty breathing while wearing a respirator, you may request a positive pressure respirator from your employer. You must be thoroughly trained to use the assigned respirator, and the training will be provided by your employer.

B. Protective Clothing. You must wear appropriate protective clothing (such as boots, gloves, sleeves, aprons, etc.) over any parts of your body that could be exposed to liquid benzene.

C. Eye and Face Protection. You must wear splash-proof safety goggles if it is possible that benzene may get into your eyes. In addition, you must wear a face shield if your face could be splashed with benzene liquid.

IV. Emergency and First Aid Procedures

A. Eye and face exposure. If benzene is splashed in your eyes, wash it out immediately with large amounts of water. If irritation persists or vision appears to be affected see a doctor as soon as possible.

B. Skin exposure. If benzene is spilled on your clothing or skin, remove the contaminated clothing and wash the exposed skin with large amounts of water and soap immediately. Wash contaminated clothing before you wear it again.

C. Breathing. If you or any other person breathes in large amounts of benzene, get the exposed person to fresh air at once. Apply artificial respiration if breathing has stopped. Call for medical assistance or a doctor as soon as possible. Never enter any vessel or confined space where the benzene concentration might be high without proper safety equipment and at least one other person present who will stay outside. A life line should be used.

D. Swallowing. If benzene has been swallowed and the patient is conscious, do not induce vomiting. Call for medical assistance or a doctor immediately.

V. Medical Requirements

If you are exposed to benzene at a concentration at or above 0.5 ppm as an 8-hour time-weighted average, or have been exposed at or above 10 ppm in the past while employed by your current employer, your employer is required to provide a medical examination and history and laboratory tests within 60 days of the effective date of this standard and annually thereafter. These tests shall be provided without cost to you. In addition, if you are accidentally exposed to benzene (either by ingestion, inhalation, or skin/eye contact) under emergency conditions known or suspected to constitute toxic exposure to benzene, your employer is required to make special laboratory tests available to you.

VI. Observation of Monitoring

Your employer is required to perform measurements that are representative of your exposure to benzene and you or your designated representative are entitled to observe the monitoring procedure. You are entitled to observe the steps taken in the measurement procedure, and to record the results obtained. When the monitoring procedure is taking place in an area where respirators or personal protective clothing and equipment are required to be worn, you or your representative must also be provided with, and must wear the protective clothing and equipment.

VII. Access to Records

You or your representative are entitled to see the records of measurements of your exposure to benzene upon written request to your employer. Your medical examination records can be furnished to yourself, your physician or designated representative upon request by you to your employer.

VIII. Precautions for Safe Use, Handling and Storage

Benzene liquid is highly flammable. It should be stored in tightly closed containers in a cool, well ventilated area. Benzene vapor may form explosive mixtures in air. All sources of ignition must be controlled. Use nonsparking tools when opening or closing benzene containers. Fire extinguishers, where provided, must be readily available. Know where they are located and how to operate them. Smoking is prohibited in areas where benzene is used or stored. Ask your supervisor where benzene is used in your area and for additional plant safety rules.

◀ [Next Standard \(1910.1028 App B\)](#)

◀ [Regulations \(Standards - 29 CFR\) - Table of Contents](#)

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Disclaimer: The information contained in these guidelines is intended for reference purposes only. It provides a summary of information about chemicals that workers may be exposed to in their workplaces. The information may be superseded by new developments in the field of industrial hygiene. Readers are therefore advised to regard these recommendations as general guidelines and to determine whether new information is available.

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR XYLENE

INTRODUCTION

This guideline summarizes pertinent information about xylene for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information is available.

SUBSTANCE IDENTIFICATION

*** Formula**

$C(6)H(4)(CH(3))(2)$

*** Structure**

(For Structure, see paper copy)

*** Synonyms**

Dimethyl benzene; xylol; methyl toluene; 1,4-dimethyl-benzene; Violet 3.

*** Identifiers**

1. CAS 1330-20-7.
2. RTECS ZE2100000.
3. DOT UN: 1307 27.
4. DOT label: Flammable Liquid.

* Appearance and odor

The xylene in commercial use is composed of a mixture of the three isomers ortho-xylene, meta-xylene, and para-xylene; the meta isomer predominates in these mixtures. o-Xylene and m-xylene are clear, colorless, flammable liquids that have characteristically sweet, balsam-like odors. At low temperatures, the para-isomer occurs in the form of clear, colorless plates.

CHEMICAL AND PHYSICAL PROPERTIES

* Physical data

1. Molecular weight: 106.
2. Boiling point (760 torr): 135 to 145 degrees C (275 to 293 degrees F).
3. Specific gravity (water = 1): 0.86 at 20 degrees C (68 degrees F).
4. Vapor density (air = 1 at boiling point of xylene): 3.7.
5. Melting point: -25 degrees C (-13 degrees F).
6. Vapor pressure at 20 degrees C (68 degrees F): 7 to 9 torr.
7. Solubility: Insoluble in water; soluble in alcohol, ether, acetone, and benzene.
8. Evaporation rate (butyl acetate = 1): 0.6.

* Reactivity

1. Conditions contributing to instability: Heat, sparks, or open flame.
2. Incompatibilities: Contact of xylene with strong oxidizers may cause fires and explosions.

3. Hazardous decomposition products: Toxic gases (such as carbon monoxide) may be released in a fire involving xylene.

4. Special precautions: Xylene attacks some coatings and some forms of plastic and rubber.

* Flammability

The National Fire Protection Association has assigned a flammability rating of 3 (severe fire hazard) to xylene.

1. Flash point: 27 to 32 degrees C (81 to 90 degrees F).

2. Autoignition temperature: 464 degrees C (867 degrees F).

3. Flammable limits in air (percent by volume): Lower, 1; upper, 7.

4. Extinguishant: Use foam, dry chemical, or carbon dioxide to fight fires involving xylene. Water may be used to reduce the rate of burning or to cool fire-exposed containers.

Fires involving xylene should be fought upwind and from the maximum distance possible. Keep unnecessary people away; isolate hazard area and deny entry. Emergency personnel should stay out of low areas and ventilate closed spaces before entering. Vapor explosion and poison hazards may occur indoors, outdoors, or in sewers. Vapors may travel to a source of ignition and flash back. Containers of xylene may explode in the heat of the fire and should be moved from the fire area if it is possible to do so safely. If this is not possible, cool containers from the sides with water until well after the fire is out. Stay away from the ends of containers. Personnel should withdraw immediately if a rising sound from a venting safety device is heard or if there is discoloration of a container due to fire. Dikes should be used to contain fire-control water for later disposal. If a tank car or truck is involved in a fire, personnel should isolate an area of a half a mile in all directions. Firefighters should wear a full set of protective clothing, including a self-contained breathing apparatus, when fighting fires involving xylene. Firefighters' protective clothing may provide limited protection against fires involving xylene.

* Warning properties

The odor threshold for xylene is 1 part per million (ppm) parts of air. Because this value is below the Occupational Safety and Health Administration (OSHA) current permissible exposure limit (PEL) of 100

ppm [29 CFR 1910.1000, Table Z-1-A], xylene is considered to have adequate warning properties.

* Eye irritation properties

The eye irritation threshold for xylene is 200 ppm (870 mg/m(3)).

EXPOSURE LIMITS

The current OSHA PEL for xylene is 100 ppm (435 milligrams per cubic meter (mg/m(3)) of air) as an 8-hour time-weighted average (TWA) concentration and 150 ppm (655 mg/m(3)) as a 15-minute TWA short-term exposure limit (STEL). A STEL is the maximum 15-minute concentration to which workers may be exposed during any 15-minute period of the working day [29 CFR 1910.1000, Table Z-1-A]. The National Institute for Occupational Safety and Health (NIOSH) recommended exposure limits (RELs) for xylene are 100 ppm (435 mg/m(3)) as a TWA for up to a 10-hour workshift and a 40-hour workweek and 200 ppm (868 mg/m(3)) for 10 minutes as a short-term limit [NIOSH Recommendations, 1988]. The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned xylene a threshold limit value (TLV) of 100 ppm (435 mg/m(3)) as a TWA for a normal 8-hour workday and a 40-hour workweek and a short-term exposure limit (STEL) of 150 ppm (655 mg/m(3)) for periods not to exceed 15 minutes [ACGIH 1988, p. 42]. The OSHA and ACGIH limits are based on the risk of irritant, narcotic, and chronic effects associated with exposure to xylene, and the NIOSH limit is based on xylene's potential to cause central nervous system depression and respiratory irritation.

HEALTH HAZARD INFORMATION

* Routes of exposure

Exposure to xylene can occur via inhalation, ingestion, eye or skin contact, and, to a small extent, by absorption through the skin.

* Summary of toxicology

1. Effects on Animals: Xylene exposure produces central nervous system depression and irritation of the eyes and skin in animals. Xylene is also fetotoxic and teratogenic in several species of experimental animals when administered by the oral or inhalation routes [RTECS 1989]. The LC(50) in the rat for a 4-hour xylene inhalation exposure is 5000 ppm, and the oral LD(50) in the same species is 4300 mg/kg [RTECS 1989].

The meta isomer may be more acutely toxic than the o- or p-isomer: mice exposed for 24 hours to 2010 ppm of the m-isomer or to 3062 ppm of the o-isomer died, while exposure for the same period to 4912 ppm of the p-isomer did not cause death [Proctor, Hughes, and Fischman 1988, p. 511]. Rats exposed to a 1600-ppm concentration of xylene (isomer unspecified) for 2 or 4 days showed signs of irritation, became uncoordinated, lost weight, had an increased red blood cell count, exhibited signs of narcosis, and died [Proctor, Hughes, and Fischman 1988, p. 511]. Rats exposed to a 980-ppm concentration of xylene for 7 days developed leukopenia, and autopsy revealed kidney congestion and hyperplasia of the bone marrow and spleen [Proctor, Hughes, and Fischman 1988, p. 511]. In contact with the eye, xylene causes irritation of the conjunctiva, turbidity of the cornea, swelling, and tearing in rabbits [Clayton and Clayton 1981, p. 3292]. Repeated application to rabbit skin of a 95- or 100-percent solution of xylene causes redness, moderate irritation, and slight necrosis [Proctor, Hughes, and Fischman 1988, p. 511; RTECS 1989]. Rabbits exposed for 40 to 55 days to a xylene concentration of 1150 ppm developed a decrease in their red and white blood cell counts and an increase in thrombocytes, but these effects were reversible [Proctor, Hughes, and Fischman 1988, p. 571]. In chronic inhalation studies, rats and dogs exposed to 800 ppm for 6 hours/day for 65 days showed no measurable ill effects [ACGIH 1986, p. 637]. No signs of carcinogenicity were noted in long-term gavage studies in rats and mice [Proctor, Hughes, and Fischman 1988, p. 511]. Administered subcutaneously to rats at 300 mg/kg/day for 6 weeks or at 700 mg/kg/day for 9 weeks, xylene failed to cause hematopoietic effects; earlier reports of xylene's myelotoxicity appear to have been based on exposures to xylene contaminated with benzene, a known myelotoxin [HSDB 1986; ACGIH 1986, p. 637]. The offspring of pregnant rats inhaling 50 mg/m³ xylene for 6 hours on days 1 to 21 of pregnancy or 250 or 600 mg/m³ for 24 hours on days 7 to 15 of pregnancy had an increased incidence of musculoskeletal abnormalities, and the offspring of pregnant mice administered xylene by inhalation or oral dosing also showed developmental abnormalities [RTECS 1989].

2. Effects on Humans: Xylene is an irritant of the eyes and mucous membranes at concentrations below 200 ppm, and it is narcotic at high concentrations [AIHA 1978; Proctor, Hughes, and Fischman 1988, p. 511]. The estimated oral LD(50) for humans is 50 mg/kg [EPA Health Advisory, 1987, p. 4]. Of three workers exposed to xylene concentrations of approximately 10,000 ppm for 18.5 hours, one died and two recovered slowly after a period of unconsciousness and retrograde amnesia; disturbances of liver and kidney function were noted in these workers [ACGIH 1986, p. 637; Baselt 1980, p. 286; Clayton and Clayton

1981, p. 3292]. Ingestion of xylene causes gastrointestinal distress and may cause toxic hepatitis [Clayton and Clayton 1981, p. 3294]. Aspiration of xylene or acute exposure to high vapor concentrations of this substance may cause chemical pneumonitis, hemorrhage into the air spaces, and pulmonary edema [Clayton and Clayton 1981, p. 3294; Klaassen, Amdur, and Doull 1986, p. 351]. A worker exposed to the vapors of a solvent containing 75 percent xylene (approximate airborne xylene concentration of 60 to 350 ppm) developed giddiness, anorexia, and vomiting [Proctor, Hughes, and Fischman 1988, p. 511]. After inhalation of high (not further specified) concentrations of xylene, workers may become flushed, feel hot, and experience confusion, dizziness, tremors, and other signs or symptoms of central nervous system toxicity [Clayton and Clayton 1981, p. 3294]. Blood dyscrasias that have proven fatal in at least one case are reported to have been the result of chronic xylene exposure, but these hematopoietic effects are now believed to have been caused by benzene, formerly a common contaminant of xylene [ACGIH 1986, p. 637]. Chronic exposure to xylene may cause central nervous system depression, anemia, mucosal hemorrhage, bone marrow hyperplasia, liver enlargement, liver necrosis, and nephrosis [Clayton and Clayton 1981, p. 3295]. Repeated contact of the skin with xylene causes drying and dermatitis [Clayton and Clayton 1981, p. 3295].

* Signs and symptoms of exposure

1. Acute exposure: The signs and symptoms of acute exposure to xylene include headache, fatigue, irritability, lassitude, nausea, anorexia, flatulence, irritation of the eyes, nose, and throat, and motor incoordination and impairment of equilibrium. Flushing, redness of the face, a sensation of increased body heat, increased salivation, tremors, dizziness, confusion, and cardiac irritability have also been reported.

2. Chronic exposure: The signs and symptoms of chronic exposure to xylene may include conjunctivitis; dryness of the nose, throat, and skin; dermatitis; and kidney and liver damage.

* Emergency procedures:

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate the following emergency procedures:

1. Eye exposure: If xylene or a solution containing xylene gets into the eyes, immediately flush the eyes with large amounts of water for a

minimum of 15 minutes, lifting the lower and upper lids occasionally. Get medical attention as soon as possible.

2. Skin exposure: If xylene or a solution containing xylene contacts the skin, the contaminated skin should be washed with soap and water. If irritation persists, get medical attention.

3. Inhalation: If xylene vapors are inhaled, move the victim at once to fresh air and get medical care as soon as possible. If the victim is not breathing, perform cardiopulmonary resuscitation; if breathing is difficult, give oxygen. Keep the victim warm and quiet until medical help arrives.

4. Ingestion: DO NOT INDUCE VOMITING. If xylene or a solution containing xylene is ingested, give the victim several glasses of water to drink. Get medical help immediately. Keep the victim warm and quiet until medical help arrives.

5. Rescue: Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the Material Safety Data Sheet required by OSHA's Hazard Communication Standard, 29 CFR 1910.1200). All workers should be familiar with emergency procedures and the location and proper use of emergency equipment.

EXPOSURE SOURCES AND CONTROL METHODS

The following operations may involve xylene and lead to worker exposures to this substance:

- Blending of motor and aviation fuels
- Use as a diluent or solvent in lacquers, varnishes, inks, paints, surface coatings, dyes, adhesives, cleaning fluids, and rubber cements
- Use as a feedstock for xylidenes, benzoic acid, phthalic anhydride, and isophthalic and terephthalic acids and their esters
- Manufacture of quartz crystal oscillators, hydrogen peroxide, perfumes, insect repellents, dyes, pharmaceuticals, vitamins, and leather, and use as a sterilizing agent for cat-gut
- Formulation of insecticides
- Use with Canada balsam as oil-immersion fluid in microscopy and as a cleaning agent in laboratory applications

Methods that are effective in controlling worker exposures to xylene, depending on the feasibility of implementation, are

- Process enclosure,
- Local exhaust ventilation,
- General dilution ventilation, and
- Personal protective equipment.

The following publications are good sources of information on control methods:

1. ACGIH [1986]. Industrial ventilation--a manual of recommended practice. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
2. Burton DJ [1986]. Industrial ventilation--a self study companion. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
3. Alden JL, Kane JM [1982]. Design of industrial ventilation systems. New York, NY: Industrial Press, Inc.
4. Wadden RA, Scheff PA [1987]. Engineering design for control of workplace hazards. New York, NY: McGraw-Hill.
5. Plog BA [1988]. Fundamentals of industrial hygiene. Chicago, IL: National Safety Council.

MEDICAL MONITORING

Workers who may be exposed to chemical hazards should be monitored in a systematic program of medical surveillance that is intended to prevent occupational injury and disease. The program should include education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety or health, early detection of adverse health effects, and referral of workers for diagnosis and treatment. The occurrence of disease or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical monitoring program is intended to supplement, not replace, such measures. To place workers effectively and to detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) periodically during the period of employment, and (3) at the time of job transfer or termination.

* Preplacement medical evaluation

Before a worker is placed in a job with a potential for exposure to xylene, the examining physician should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the central nervous system, blood, liver, kidneys, and skin.

A preplacement medical evaluation is recommended to assess an individual's suitability for employment at a specific job and to detect and assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to xylene at or below the prescribed exposure limit. The examining physician should consider the probable frequency, intensity, and duration of exposure as well as the nature and degree of any applicable medical condition. Such conditions (which should not be regarded as absolute contraindications to job placement) include a history and other findings consistent with diseases of the central nervous system, blood, liver, kidneys, or skin.

* Periodic medical examinations and biological monitoring

Occupational health interviews and physical examinations should be performed at regular intervals during the employment period, as mandated by any applicable Federal, State, or local standard. Where no standard exists and the hazard is minimal, evaluations should be conducted every 3 to 5 years or as frequently as recommended by an experienced occupational health physician. Additional examinations may be necessary if a worker develops symptoms attributable to xylene exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of xylene on the central nervous system, blood, liver, kidneys, or skin. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

Biological monitoring involves sampling and analyzing body tissues or fluids to provide an index of exposure to a toxic substance or metabolite. Xylene can be detected in the end-exhaled air, venous blood, and urine of exposed individuals. However, urinary levels of methylhippuric acid, a metabolite of xylene, appear to correlate better with airborne xylene concentrations than blood or breath concentrations of xylene. Some sources report that a urinary concentration of 1.5 gram methyl-hippuric acid per gram creatinine in urine correlates with an 8-hour exposure to an airborne concentration of 100 ppm xylene and a moderate level of work activity.

* Medical examinations recommended at the time of job transfer or termination

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic or laboratory tests that were conducted at the time of placement should be repeated at the time of job transfer or termination to determine the worker's medical status at the end of his or her employment. Any changes in the worker's health status should be compared with those expected for a suitable reference population. Because occupational exposure to xylene may cause diseases with prolonged latent periods, the need for medical monitoring may extend well beyond the termination of employment.

WORKPLACE MONITORING AND MEASUREMENT PROCEDURES

Determination of a worker's exposure to airborne xylene is made using a charcoal tube (100/50 mg sections, 20/40 mesh). Samples are collected at a maximum flow rate of 0.2 liter per minute until a maximum air volume of 12 liters is collected. The sample is then treated with carbon disulfide to extract the xylene. Analysis is conducted by gas chromatography using a flame ionization detector. This method has a sampling and analytical error of 0.10 and is included as NIOSH Method 1501 in the **NIOSH Manual of Analytical Methods**, 3rd edition, Volume 2 [NIOSH 1984].

PERSONAL HYGIENE PROCEDURES

If xylene contacts the skin, workers should immediately wash the affected areas with soap and water.

Clothing contaminated with xylene should be removed immediately, and provisions should be made for the safe removal of the chemical from the clothing. Persons laundering the clothes should be informed of the hazardous properties of xylene, particularly its potential to cause dryness and irritation of the skin.

A worker who handles xylene should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, or using toilet facilities.

Workers should not eat, drink, or use tobacco products in areas where xylene is handled, processed, or stored.

STORAGE

Xylene should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with OSHA's Hazard Communication Standard [29 CFR 1910.1200]. Outside or detached storage is preferred; inside storage must be in a standard flammable liquids storage room or cabinet. The ventilation used in storage areas must be of explosion-proof design. Containers of xylene should be protected from physical damage and should be stored separately from strong oxidizers, heat, sparks, and open flame. Only nonsparking tools may be used to handle xylene. To prevent static sparks, containers must be grounded and bonded for transfers. Because empty containers that formerly contained xylene may still hold product residues, they should be handled appropriately.

SPILLS AND LEAKS

In the event of a spill or leak involving xylene, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup has been completed. The following steps should be undertaken following a spill or leak:

1. Do not touch the spilled material; stop the leak if it is possible to do so without risk.
2. Notify safety personnel.
3. Remove all sources of heat and ignition.
4. Ventilate potentially explosive atmospheres using maximally explosion-proof equipment.
5. Use nonsparking tools for cleanup.
6. Water spray may be used to reduce vapors, but the spray may not prevent ignition in closed spaces.
7. For small liquid spills, take up with sand or other noncombustible absorbent material and place into closed containers for later disposal.
8. For large liquid spills, build dikes far ahead of the spill to contain the xylene for later reclamation or disposal.

EMERGENCY PLANNING, COMMUNITY RIGHT-TO-KNOW, AND HAZARDOUS WASTE MANAGEMENT REQUIREMENTS

The Environmental Protection Agency's (EPA's) regulatory requirements for emergency planning, community right-to-know, and hazardous waste management may vary over time. Users are therefore advised to determine periodically whether new information is available.

* Emergency planning requirements

Xylene is not subject to EPA emergency planning requirements under the Superfund Amendments and Reauthorization Act (Title III).

* Reportable quantity requirements (releases of hazardous substances)

A hazardous substance release is defined by EPA as any spilling, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of containers) of hazardous substances. In the event of a release that is above the reportable quantity for that chemical, employers are required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to notify the proper Federal authorities.

The reportable quantity for xylene is 1000 pounds. If an amount equal to or greater than this quantity is released within a 24-hour period, CERCLA [40 CFR Part 302.6] requires employers to notify the National Response Center IMMEDIATELY at (800) 424-8802 (in Washington, D.C. at (202) 426-2675).

* Community right-to-know requirements

Employers who own or operate facilities in SIC codes 20-39 that employ 10 or more employees and that manufacture 25,000 pounds or more of xylene per calendar year or otherwise use 10,000 pounds or more of xylene per calendar year are required by EPA (49 CFR Part 372.30) to submit a Toxic Chemical Release Inventory form (Form R) to EPA reporting the amount of xylene emitted or released from their facility annually.

* Hazardous waste management requirements

EPA considers a waste to be hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity, as defined in 40 CFR 261.21-261.24. Under the Resource Conservation and Recovery Act (RCRA), EPA has specifically listed many chemical wastes as hazardous. Xylene is listed as a hazardous waste under RCRA and has

been assigned EPA Hazardous Waste No. U239. It is approved for land disposal as long as the concentration of xylene in the waste or treatment residual does not exceed 28 mg/kg. Xylene also may be disposed of in an organometallic or organic lab pack that meets the requirements of 40 CFR 264.316 or 265.316.

Providing more information about the removal and disposal of specific chemicals is beyond the scope of this guideline. EPA, U.S. Department of Transportation, and State and local regulations should be followed to ensure that removal, transport, and disposal of this substance are conducted in accordance with existing regulations. To be certain that chemical waste disposal meets EPA regulatory requirements, employers should address any questions to the RCRA hotline at (202) 382-3000 (in Washington, D.C.) or toll-free at (800) 424-9346 (outside Washington, D.C.). In addition, relevant State and local authorities should be contacted for information on any requirements they may have for the waste removal and disposal of this substance.

RESPIRATORY PROTECTION

*** Conditions for respirator use**

Good industrial hygiene practice requires that engineering controls be used where feasible to reduce workplace concentrations of hazardous materials to the prescribed exposure limit. However, some situations may require the use of respirators to control exposure. Respirators must be worn if the ambient concentration of xylene exceeds prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work operations such as maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

*** Respiratory protection program**

Employers should institute a complete respiratory protection program that, at a minimum, complies with the requirements of OSHA's Respiratory Protection Standard [29 CFR 1910.134]. Such a program must include respirator selection (see Table 1), an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic workplace monitoring, and regular respirator maintenance, inspection, and cleaning. The

implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly. For additional information on the selection and use of respirators and on the medical screening of respirator users, consult the **NIOSH Respirator Decision Logic** [NIOSH 1987c] and the **NIOSH Guide to Industrial Respiratory Protection** [NIOSH 1987a].

Table 1 lists the respiratory protection that NIOSH recommends for workers exposed to xylene. The recommended protection may vary over time because of changes in the exposure limit for xylene or in respirator certification requirements. Users are therefore advised to determine periodically whether new information is available.

PERSONAL PROTECTIVE EQUIPMENT

Protective clothing should be worn to prevent skin contact with xylene. Impervious gloves, boots, aprons, gauntlets, and other protective clothing are recommended for use as necessary [Genium MSDS 1988, No. 318]. Chemical protective clothing should be selected on the basis of available performance data, manufacturers' recommendations, and evaluation of the clothing under actual conditions of use. The following materials have been recommended for use against permeation by xylene and may provide protection for periods greater than 8 hours: polyvinyl alcohol and Viton. Materials that may withstand permeation for more than 4 but fewer than 8 hours are Teflon and polyethylene/ethylene vinyl alcohol [Forsberg and Mansdorf 1989, p. 46]. Natural rubber, butyl rubber, neoprene, a nitrile rubber and polyvinyl chloride mixture, nitrile rubber, polyethylene, polyvinyl chloride, and a neoprene and natural rubber mixture have demonstrated poor resistance to permeation by xylene [Schwope et al. 1987, p. 99; Forsberg and Mansdorf 1989, p. 46].

If xylene is dissolved in an organic solvent, the permeation properties of both the solvent and the mixture must be considered when selecting personal protective equipment and clothing.

Safety glasses, goggles, or faceshields should be worn during operations in which xylene might contact the eyes (e.g., through splashes of solution). Eyewash fountains and emergency showers should be available within the immediate work area whenever the potential exists for eye or skin contact with xylene. Contact lenses should not be worn if the potential exists for xylene exposure [NIOSH/OSHA Occupational Health Guideline 1981, p. 3; Genium MSDS 1988, No. 318].

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Table 1
Respiratory protection recommended by NIOSH for workers exposed to xylene*

Condition	Recommended respiratory protection**
Airborne concentration of xylene:	
100 to 200(+) ppm (2 X REL)	Any air-purifying, half mask respirator (including a disposable respirator) equipped with organic vapor cartridges, or Any supplied-air respirator equipped with a half mask and operated in a demand (negative-

pressure) mode, or

Any supplied-air respirator equipped with a half mask and operated in a pressure-demand or other positive-pressure mode

100 to 1000 ppm
(10 X REL)

Any air-purifying, full-facepiece respirator equipped with organic vapor cartridges or an organic vapor canister, or

Any powered, air-purifying respirator equipped with a loose-fitting hood or helmet and organic vapor cartridges or an organic vapor canister, or

Any powered, air-purifying respirator equipped with a tight-fitting face-piece and organic vapor cartridges or an organic vapor canister, or

Any supplied-air respirator equipped with a full facepiece and operated in a demand (negative-pressure) mode, or

Any supplied-air respirator equipped with a hood or helmet and operated in a continuous-flow mode, or

Any supplied-air respirator equipped with a tight-fitting facepiece and operated in a continuous-flow mode, or

Any supplied-air respirator equipped with a full facepiece and operated in a pressure-demand or other positive-pressure mode, or Respiratory protection recommended by NIOSH for workers exposed to xylene (continued)*

Any self-contained respirator equipped with a full facepiece and operated in a demand (negative-pressure) mode

Entry into
IDLH(++) or
unknown
concentrations

Any self-contained respirator equipped with a full facepiece and operated in a pressure-demand or other positive-pressure mode, or

Any supplied-air respirator equipped with a full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with

an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode

Firefighting Any self-contained respirator equipped with a full facepiece and operated in a pressure-demand or other positive-pressure mode

Escape Any air-purifying, full-facepiece respirator equipped with an organic vapor canister, or

Any escape-type, self-contained breathing apparatus with a suitable service life (number of minutes required to escape the environment)

The NIOSH REL is 100 ppm (435 mg/m³) as a TWA for up to a 10-hour workshift and a 40-hour workweek.

** Only NIOSH/MSHA-approved equipment should be used. Also, note the following:

1. Respirators accepted for use at higher concentrations may be used at lower concentrations; respirators must not, however, be used at concentrations higher than those for which they are approved.

2. Air-purifying respirators may not be used in oxygen-deficient atmospheres or in airborne concentrations that are immediately dangerous to life or health (IDLH).

(+) Only full-facepiece respirators should be used in concentrations of xylene over 200 ppm because of its irritant effects on the eyes.

(++) The xylene concentration that is immediately dangerous to life and health (IDLH) is 1000 ppm [NIOSH 1987b].

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<http://www.osha.gov/index.html>

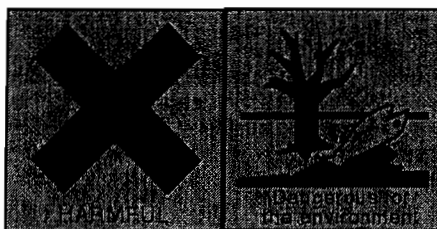
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Occupational Safety & Health Administration
200 Constitution Avenue, NW
Washington, DC 20210

Safety data for 1,2,4-trimethylbenzene



Glossary of terms on this data sheet.

The information on this web page is provided to help you to work safely, but it is intended to be an overview of hazards, not a replacement for a full Material Safety Data Sheet (MSDS). MSDS forms can be downloaded from the web sites of many chemical suppliers.

General

Synonyms: pseudocumene, asym-trimethylbenzene, psi-cumene, pseudocumol, as-trimethylbenzene

Molecular formula: C_9H_{12}

CAS No: 95-63-6

EINECS No: 202-436-9

Annex I Index No: 601-043-00-3

Physical data

Appearance: colourless liquid

Melting point: -43.8 C

Boiling point: 169 C

Vapour density:

Vapour pressure:

Density ($g\ cm^{-3}$): 0.876

Flash point: 48 C (closed cup)

Explosion limits: 0.9 - 6.4%

Autoignition temperature: 515 C

Water solubility: slightly soluble

Stability

Stable. Incompatible with strong oxidizing agents. Flammable.
May form explosive mixtures with air.

Toxicology

Typical STEL 35 ppm. Typical TWA 25 ppm. Harmful by inhalation. Skin, eye and respiratory irritant.

Toxicity data

(The meaning of any toxicological abbreviations which appear in this section is given [here](#).)

ORL-RAT LD50 5000 mg kg⁻¹

IPN-RAT LDLO 2000 mg kg⁻¹

IHL-MUS 8147 ppm acute

IPN-GPG LDLO 1566 mg kg⁻¹

Risk phrases

(The meaning of any risk phrases which appear in this section is given [here](#).)

R10 R20 R36 R37 R38 R51 R53.

Environmental information

Toxic to aquatic organisms - may cause long-term damage in the environment.

Transport information

(The meaning of any UN hazard codes which appear in this section is given [here](#).)

UN No 3295. Hazard class 3. Packing group III.

Personal protection

Safety glasses, adequate ventilation.

Safety phrases

(The meaning of any safety phrases which appear in this section is given [here](#).)

S26 S61.

APPENDIX D

OSHA Lead Standard (Construction)

[Code of Federal Regulations]
[Title 29, Volume 8]
[Revised as of July 1, 2003]
From the U.S. Government Printing Office via GPO Access
[CITE: 29CFR1926.62]

[Page 85-116]

TITLE 29--LABOR

CHAPTER XVII--OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, DEPARTMENT OF LABOR

PART 1926--SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION--Table of Contents

Subpart D--Occupational Health and Environmental Controls

Sec. 1926.62 Lead.

(a) Scope. This section applies to all construction work where an employee may be occupationally exposed to lead. All construction work excluded from coverage in the general industry standard for lead by 29 CFR 1910.1025(a)(2) is covered by this standard. Construction work is defined as work for construction, alteration and/or repair, including painting and decorating. It includes but is not limited to the following:

- (1) Demolition or salvage of structures where lead or materials containing lead are present;
- (2) Removal or encapsulation of materials containing lead;
- (3) New construction, alteration, repair, or renovation of structures, substrates, or portions thereof, that contain lead, or materials containing lead;
- (4) Installation of products containing lead;
- (5) Lead contamination/emergency cleanup;
- (6) Transportation, disposal, storage, or containment of lead or materials containing lead on the site or location at which construction activities are performed, and
- (7) Maintenance operations associated with the construction activities described in this paragraph.

(b) Definitions.

Action level means employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air (30 $\mu\text{g}/\text{m}^3$) calculated as an 8-hour time-weighted average (TWA).

Assistant Secretary means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

Competent person means one who is capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has authorization to take prompt corrective measures to eliminate them.

Director means the Director, National Institute for Occupational

Safety and Health (NIOSH), U.S. Department of Health and Human Services,
or designee.

Lead means metallic lead, all inorganic lead compounds, and organic lead soaps. Excluded from this definition are all other organic lead compounds.

This section means this standard.

(c) Permissible exposure limit. (1) The employer shall assure that no employee is exposed to lead at concentrations greater than fifty micrograms per cubic meter of air ($50 \mu\text{g}/\text{m}^3$) averaged over an 8-hour period.

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(2) If an employee is exposed to lead for more than 8 hours in any work day the employees' allowable exposure, as a time weighted average (TWA) for that day, shall be reduced according to the following formula:

Allowable employee exposure (in $\mu\text{g}/\text{m}^3$) = 400 divided by hours worked in the day.

(3) When respirators are used to limit employee exposure as required under paragraph (c) of this section and all the requirements of paragraphs (e)(1) and (f) of this section have been met, employee exposure may be considered to be at the level provided by the protection factor of the respirator for those periods the respirator is worn. Those periods may be averaged with exposure levels during periods when respirators are not worn to determine the employee's daily TWA exposure.

(d) Exposure assessment--(1) General. (i) Each employer who has a workplace or operation covered by this standard shall initially determine if any employee may be exposed to lead at or above the action level.

(ii) For the purposes of paragraph (d) of this section, employee exposure is that exposure which would occur if the employee were not using a respirator.

(iii) With the exception of monitoring under paragraph (d)(3), where monitoring is required under this section, the employer shall collect personal samples representative of a full shift including at least one sample for each job classification in each work area either for each shift or for the shift with the highest exposure level.

(iv) Full shift personal samples shall be representative of the monitored employee's regular, daily exposure to lead.

(2) Protection of employees during assessment of exposure. (i) With respect to the lead related tasks listed in paragraph (d)(2)(i) of this section, where lead is present, until the employer performs an employee exposure assessment as required in paragraph (d) of this section and documents that the employee performing any of the listed tasks is not exposed above the PEL, the employer shall treat the employee as if the employee were exposed above the PEL, and not in excess of ten (10) times

the PEL, and shall implement employee protective measures prescribed in paragraph (d)(2)(v) of this section. The tasks covered by this requirement are:

(A) Where lead containing coatings or paint are present: Manual demolition of structures (e.g, dry wall), manual scraping, manual sanding, heat gun applications, and power tool cleaning with dust collection systems;

(B) Spray painting with lead paint.

(ii) In addition, with regard to tasks not listed in paragraph (d)(2)(i), where the employee has any reason to believe that an employee performing the task may be exposed to lead in excess of the PEL, until the employer performs an employee exposure assessment as required by paragraph (d) of this section and documents that the employee's lead exposure is not above the PEL the employer shall treat the employee as if the employee were exposed above the PEL and shall implement employee protective measures as prescribed in paragraph (d)(2)(v) of this section.

(iii) With respect to the tasks listed in paragraph (d)(2)(iii) of this section, where lead is present, until the employer performs an employee exposure assessment as required in paragraph (d) of this section, and documents that the employee performing any of the listed tasks is not exposed in excess of 500 $\mu\text{g}/\text{m}^3$, the employer shall treat the employee as if the employee were exposed to lead in excess of 500 $\mu\text{g}/\text{m}^3$ and shall implement employee protective measures as prescribed in paragraph (d)(2)(v) of this section. Where the employer does establish that the employee is exposed to levels of lead below 500 $\mu\text{g}/\text{m}^3$, the employer may provide the exposed employee with the appropriate respirator prescribed for such use at such lower exposures, in accordance with Table 1 of this

section. The tasks covered by this requirement are:

(A) Using lead containing mortar; lead burning

(B) Where lead containing coatings or paint are present: rivet busting; power tool cleaning without dust collection systems; cleanup activities where dry expendable abrasives are used; and abrasive blasting enclosure movement and removal.

(iv) With respect to the tasks listed in paragraph (d)(2)(iv) of this section,

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where lead is present, until the employer performs an employee exposure assessment as required in paragraph (d) of this section and documents that the employee performing any of the listed tasks is not exposed to lead in excess of 2,500 $\mu\text{g}/\text{m}^3$ (50xPEL), the employer shall

treat the employee as if the employee were exposed to lead in excess of 2,500 $\mu\text{g}/\text{m}^3$ and shall implement employee protective measures as prescribed in paragraph (d)(2)(v) of this section. Where the

employer does establish that the employee is exposed to levels of lead below 2,500 $\mu\text{g}/\text{m}^3$, the employer may provide the exposed employee with

the appropriate respirator prescribed for use at such lower exposures, in accordance with Table I of this section. Interim protection as described in this paragraph is required where lead containing coatings

or paint are present on structures when performing:

- (A) Abrasive blasting,
- (B) Welding,
- (C) Cutting, and
- (D) Torch burning.

(v) Until the employer performs an employee exposure assessment as required under paragraph (d) of this section and determines actual employee exposure, the employer shall provide to employees performing the tasks described in paragraphs (d)(2)(i), (d)(2)(ii), (d)(2)(iii), and (d)(2)(iv) of this section with interim protection as follows:

(A) Appropriate respiratory protection in accordance with paragraph (f) of this section.

(B) Appropriate personal protective clothing and equipment in accordance with paragraph (g) of this section.

(C) Change areas in accordance with paragraph (i)(2) of this section.

(D) Hand washing facilities in accordance with paragraph (i)(5) of this section.

(E) Biological monitoring in accordance with paragraph (j)(1)(i) of this section, to consist of blood sampling and analysis for lead and zinc protoporphyrin levels, and

(F) Training as required under paragraph (l)(1)(i) of this section regarding 29 CFR 1926.59, Hazard Communication; training as required under paragraph (l)(2)(ii)(C) of this section, regarding use of respirators; and training in accordance with 29 CFR 1926.21, Safety training and education.

(3) Basis of initial determination. (i) Except as provided under paragraphs (d)(3)(iii) and (d)(3)(iv) of this section the employer shall

monitor employee exposures and shall base initial determinations on the employee exposure monitoring results and any of the following, relevant considerations:

(A) Any information, observations, or calculations which would indicate employee exposure to lead;

(B) Any previous measurements of airborne lead; and

(C) Any employee complaints of symptoms which may be attributable to exposure to lead.

(ii) Monitoring for the initial determination where performed may be limited to a representative sample of the exposed employees who the employer reasonably believes are exposed to the greatest airborne concentrations of lead in the workplace.

(iii) Where the employer has previously monitored for lead exposures, and the data were obtained within the past 12 months during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations, the employer may rely on such earlier monitoring results to satisfy the requirements of paragraphs (d)(3)(i) and (d)(6) of this section if the sampling and analytical methods meet the accuracy and confidence levels of paragraph (d)(10) of this section.

(iv) Where the employer has objective data, demonstrating that a particular product or material containing lead or a specific process, operation or activity involving lead cannot result in employee exposure to lead at or above the action level during processing, use, or handling, the employer may rely upon such data instead of implementing

initial monitoring.

(A) The employer shall establish and maintain an accurate record documenting the nature and relevancy of objective data as specified in paragraph (n)(4) of this section, where used in assessing employee exposure in lieu of exposure monitoring.

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(B) Objective data, as described in paragraph (d)(3)(iv) of this section, is not permitted to be used for exposure assessment in connection with paragraph (d)(2) of this section.

(4) Positive initial determination and initial monitoring. (i)

Where

a determination conducted under paragraphs (d)(1), (2) and (3) of this section shows the possibility of any employee exposure at or above the action level the employer shall conduct monitoring which is representative of the exposure for each employee in the workplace who is exposed to lead.

(ii) Where the employer has previously monitored for lead exposure, and the data were obtained within the past 12 months during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations, the employer may rely on such earlier monitoring results to satisfy the requirements of paragraph (d)(4)(i) of this section if the sampling and analytical methods meet the accuracy and confidence levels of paragraph (d)(10) of this section.

(5) Negative initial determination. Where a determination, conducted under paragraphs (d)(1), (2), and (3) of this section is made that no employee is exposed to airborne concentrations of lead at or above the action level the employer shall make a written record of such determination. The record shall include at least the information specified in paragraph (d)(3)(i) of this section and shall also include the date of determination, location within the worksite, and the name and social security number of each employee monitored.

(6) Frequency. (i) If the initial determination reveals employee exposure to be below the action level further exposure determination need not be repeated except as otherwise provided in paragraph (d)(7) of this section.

(ii) If the initial determination or subsequent determination reveals employee exposure to be at or above the action level but at or below the PEL the employer shall perform monitoring in accordance with this paragraph at least every 6 months. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are below the action level at which time the employer may discontinue monitoring for that employee except as otherwise provided in paragraph (d)(7) of this section.

(iii) If the initial determination reveals that employee exposure is above the PEL the employer shall perform monitoring quarterly. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are at or below the PEL but at or above the action level at which time the

employer shall repeat monitoring for that employee at the frequency specified in paragraph (d)(6)(ii) of this section, except as otherwise provided in paragraph (d)(7) of this section. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are below the action level at which time the employer may discontinue monitoring for that employee except as otherwise provided in paragraph (d)(7) of this section.

(7) Additional exposure assessments. Whenever there has been a change of equipment, process, control, personnel or a new task has been initiated that may result in additional employees being exposed to lead at or above the action level or may result in employees already exposed at or above the action level being exposed above the PEL, the employer shall conduct additional monitoring in accordance with this paragraph.

(8) Employee notification. (i) Within 5 working days after completion of the exposure assessment the employer shall notify each employee in writing of the results which represent that employee's exposure.

(ii) Whenever the results indicate that the representative employee exposure, without regard to respirators, is at or above the PEL the employer shall include in the written notice a statement that the employees exposure was at or above that level and a description of the corrective action taken or to be

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taken to reduce exposure to below that level.

(9) Accuracy of measurement. The employer shall use a method of monitoring and analysis which has an accuracy (to a confidence level of 95%) of not less than plus or minus 25 percent for airborne concentrations of lead equal to or greater than $30[\mu\text{g}/\text{m}^3]$.

(e) Methods of compliance. (1) Engineering and work practice controls. The employer shall implement engineering and work practice controls, including administrative controls, to reduce and maintain employee exposure to lead to or below the permissible exposure limit to the extent that such controls are feasible. Wherever all feasible engineering and work practices controls that can be instituted are not sufficient to reduce employee exposure to or below the permissible exposure limit prescribed in paragraph (c) of this section, the employer shall nonetheless use them to reduce employee exposure to the lowest feasible level and shall supplement them by the use of respiratory protection that complies with the requirements of paragraph (f) of this section.

(2) Compliance program. (i) Prior to commencement of the job each employer shall establish and implement a written compliance program to achieve compliance with paragraph (c) of this section.

(ii) Written plans for these compliance programs shall include at least the following:

(A) A description of each activity in which lead is emitted; e.g. equipment used, material involved, controls in place, crew size, employee job responsibilities, operating procedures and maintenance practices;

(B) A description of the specific means that will be employed to achieve compliance and, where engineering controls are required engineering plans and studies used to determine methods selected for controlling exposure to lead;

- (C) A report of the technology considered in meeting the PEL;
- (D) Air monitoring data which documents the source of lead emissions;
- (E) A detailed schedule for implementation of the program, including documentation such as copies of purchase orders for equipment, construction contracts, etc.;
- (F) A work practice program which includes items required under paragraphs (g), (h) and (i) of this section and incorporates other relevant work practices such as those specified in paragraph (e)(5) of this section;
- (G) An administrative control schedule required by paragraph (e)(4) of this section, if applicable;
- (H) A description of arrangements made among contractors on multi-contractor sites with respect to informing affected employees of potential exposure to lead and with respect to responsibility for compliance with this section as set-forth in Sec. 1926.16.
- (I) Other relevant information.
- (iii) The compliance program shall provide for frequent and regular inspections of job sites, materials, and equipment to be made by a competent person.
- (iv) Written programs shall be submitted upon request to any affected employee or authorized employee representatives, to the Assistant Secretary and the Director, and shall be available at the worksite for examination and copying by the Assistant Secretary and the Director.
- (v) Written programs shall be revised and updated at least every 6 months to reflect the current status of the program.
- (3) Mechanical ventilation. When ventilation is used to control lead exposure, the employer shall evaluate the mechanical performance of the system in controlling exposure as necessary to maintain its effectiveness.
- (4) Administrative controls. If administrative controls are used as a means of reducing employees TWA exposure to lead, the employer shall establish and implement a job rotation schedule which includes:
 - (i) Name or identification number of each affected employee;
 - (ii) Duration and exposure levels at each job or work station where each affected employee is located; and
 - (iii) Any other information which may be useful in assessing the reliability of administrative controls to reduce exposure to lead.
- (5) The employer shall ensure that, to the extent relevant, employees follow

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good work practices such as described in Appendix B of this section.

(f) Respiratory protection. (1) General. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

- (i) Periods when an employee's exposure to lead exceeds the PEL.
- (ii) Work operations for which engineering and work-practice controls are not sufficient to reduce employee exposures to or below the PEL.
- (iii) Periods when an employee requests a respirator.

(iv) Periods when respirators are required to provide interim protection of employees while they perform the operations specified in paragraph (d)(2) of this section.

(2) Respirator program. (i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).

(ii) If an employee has breathing difficulty during fit testing or respirator use, the employer must provide the employee with a medical examination in accordance with paragraph (j)(3)(i)(B) of this section to determine whether or not the employee can use a respirator while performing the required duty.

(3) Respirator selection. (i) The employer must select the appropriate respirator or combination of respirators from Table I of this section.

(ii) The employer must provide a powered air-purifying respirator when an employee chooses to use such a respirator and it will provide adequate protection to the employee.

Table 1--Respiratory Protection for Lead Aerosols

Airborne concentration of lead or condition of use ¹	Required respirator
Not in excess of 500 ug/m³... \1/2\ mask air purifying respirator with	high efficiency filters.²
³	\1/2\ mask supplied air respirator operated in demand (negative pressure) mode.
Not in excess of 1,250 ug/m³. Loose fitting hood or helmet powered air	purifying respirator with high efficiency filters.³ Hood or helmet supplied air respirator operated in a continuous-flow mode-- e.g., type CE abrasive blasting respirators operated in a continuous- flow mode.
Not in excess of 2,500 ug/m³. Full facepiece air purifying respirator	with high efficiency
filters.³	Tight fitting powered air purifying respirator with high efficiency filters.³ Full facepiece supplied air respirator operated in demand mode. \1/2\ mask or full facepiece supplied
air	respirator operated in a continuous-
flow	mode.

	Full facepiece self-contained breathing apparatus (SCBA) operated in demand mode.
Not in excess of 50,000 ug/m ³	\1/2\ mask supplied air respirator operated in pressure demand or other positive-pressure mode.
Not in excess of 100,000 ug/m ³ .	Full facepiece supplied air respirator operated in pressure demand or other positive-pressure mode--e.g., type CE abrasive blasting respirators operated in a positive-pressure mode.
Greater than 100,000 ug/m ³	Full facepiece SCBA operated in pressure unknown concentration, or demand or other positive-pressure mode. fire fighting.

- \1\ Respirators specified for higher concentrations can be used at lower concentrations of lead.
- \2\ Full facepiece is required if the lead aerosols cause eye or skin irritation at the use concentrations.
- \3\ A high efficiency particulate filter (HEPA) means a filter that is a 99.97 percent efficient against particles of 0.3 micron size or larger.

(g) Protective work clothing and equipment--(1) Provision and use. Where an employee is exposed to lead above the PEL without regard to the use of respirators, where employees are exposed to lead compounds which may cause skin or eye irritation (e.g. lead arsenate, lead azide), and as interim protection for employees performing tasks as specified in paragraph (d)(2) of this section, the employer shall provide at no cost to the employee and assure that the employee uses appropriate protective work clothing and equipment that prevents contamination of the employee and the employee's garments such as, but not limited to:

- (i) Coveralls or similar full-body work clothing;
- (ii) Gloves, hats, and shoes or disposable shoe coverlets; and

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(iii) Face shields, vented goggles, or other appropriate protective equipment which complies with Sec. 1910.133 of this chapter.

(2) Cleaning and replacement. (i) The employer shall provide the protective clothing required in paragraph (g)(1) of this section in a clean and dry condition at least weekly, and daily to employees whose exposure levels without regard to a respirator are over 200 $\mu\text{g}/\text{m}^3$ of lead as an 8-hour TWA.

(ii) The employer shall provide for the cleaning, laundering, and disposal of protective clothing and equipment required by paragraph (g)(1) of this section.

(iii) The employer shall repair or replace required protective clothing and equipment as needed to maintain their effectiveness.

(iv) The employer shall assure that all protective clothing is removed at the completion of a work shift only in change areas provided for that purpose as prescribed in paragraph (i)(2) of this section.

(v) The employer shall assure that contaminated protective clothing which is to be cleaned, laundered, or disposed of, is placed in a closed container in the change area which prevents dispersion of lead outside the container.

(vi) The employer shall inform in writing any person who cleans or launders protective clothing or equipment of the potentially harmful effects of exposure to lead.

(vii) The employer shall assure that the containers of contaminated protective clothing and equipment required by paragraph (g)(2)(v) of this section are labeled as follows:

Caution: Clothing contaminated with lead. Do not remove dust by blowing or shaking. Dispose of lead contaminated wash water in accordance with applicable local, state, or federal regulations.

(viii) The employer shall prohibit the removal of lead from protective clothing or equipment by blowing, shaking, or any other means which disperses lead into the air.

(h) Housekeeping--(1) All surfaces shall be maintained as free as practicable of accumulations of lead.

(2) Clean-up of floors and other surfaces where lead accumulates shall wherever possible, be cleaned by vacuuming or other methods that minimize the likelihood of lead becoming airborne.

(3) Shoveling, dry or wet sweeping, and brushing may be used only where vacuuming or other equally effective methods have been tried and found not to be effective.

(4) Where vacuuming methods are selected, the vacuums shall be equipped with HEPA filters and used and emptied in a manner which minimizes the reentry of lead into the workplace.

(5) Compressed air shall not be used to remove lead from any surface unless the compressed air is used in conjunction with a ventilation system designed to capture the airborne dust created by the compressed air.

(i) Hygiene facilities and practices. (1) The employer shall assure that in areas where employees are exposed to lead above the PEL without regard to the use of respirators, food or beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied.

(2) Change areas. (i) The employer shall provide clean change areas for employees whose airborne exposure to lead is above the PEL, and as interim protection for employees performing tasks as specified in paragraph (d)(2) of this section, without regard to the use of respirators.

(ii) The employer shall assure that change areas are equipped with separate storage facilities for protective work clothing and equipment and for street clothes which prevent cross-contamination.

(iii) The employer shall assure that employees do not leave the workplace wearing any protective clothing or equipment that is required to be worn during the work shift.

(3) Showers. (i) The employer shall provide shower facilities, where

feasible, for use by employees whose airborne exposure to lead is above the PEL.

(ii) The employer shall assure, where shower facilities are available, that employees shower at the end of the work shift and shall provide an adequate supply of cleansing agents and towels for use by affected employees.

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(4) Eating facilities. (i) The employer shall provide lunchroom facilities or eating areas for employees whose airborne exposure to lead is above the PEL, without regard to the use of respirators.

(ii) The employer shall assure that lunchroom facilities or eating areas are as free as practicable from lead contamination and are readily accessible to employees.

(iii) The employer shall assure that employees whose airborne exposure to lead is above the PEL, without regard to the use of a respirator, wash their hands and face prior to eating, drinking, smoking or applying cosmetics.

(iv) The employer shall assure that employees do not enter lunchroom facilities or eating areas with protective work clothing or equipment unless surface lead dust has been removed by vacuuming, downdraft booth, or other cleaning method that limits dispersion of lead dust.

(5) Hand washing facilities. (i) The employer shall provide adequate handwashing facilities for use by employees exposed to lead in accordance with 29 CFR 1926.51(f).

(ii) Where showers are not provided the employer shall assure that employees wash their hands and face at the end of the work-shift.

(j) Medical surveillance--(1) General. (i) The employer shall make available initial medical surveillance to employees occupationally exposed on any day to lead at or above the action level. Initial medical

surveillance consists of biological monitoring in the form of blood sampling and analysis for lead and zinc protoporphyrin levels.

(ii) The employer shall institute a medical surveillance program in accordance with paragraphs (j)(2) and (j)(3) of this section for all employees who are or may be exposed by the employer at or above the action level for more than 30 days in any consecutive 12 months;

(iii) The employer shall assure that all medical examinations and procedures are performed by or under the supervision of a licensed physician.

(iv) The employer shall make available the required medical surveillance including multiple physician review under paragraph (j)(3)(iii) without cost to employees and at a reasonable time and place.

(2) Biological monitoring--(i) Blood lead and ZPP level sampling and analysis. The employer shall make available biological monitoring in the form of blood sampling and analysis for lead and zinc protoporphyrin levels to each employee covered under paragraphs (j)(1)(i) and (ii) of

this section on the following schedule:

(A) For each employee covered under paragraph (j)(1)(ii) of this section, at least every 2 months for the first 6 months and every 6 months thereafter;

(B) For each employee covered under paragraphs (j)(1)(i) or (ii) of this section whose last blood sampling and analysis indicated a blood lead level at or above 40 $\mu\text{g/dl}$, at least every two months. This frequency shall continue until two consecutive blood samples and analyses indicate a blood lead level below 40 $\mu\text{g/dl}$; and

(C) For each employee who is removed from exposure to lead due to an elevated blood lead level at least monthly during the removal period.

(ii) Follow-up blood sampling tests. Whenever the results of a blood lead level test indicate that an employee's blood lead level exceeds the numerical criterion for medical removal under paragraph (k)(1)(i) of this section, the employer shall provide a second (follow-up) blood sampling test within two weeks after the employer receives the results of the first blood sampling test.

(iii) Accuracy of blood lead level sampling and analysis. Blood lead level sampling and analysis provided pursuant to this section shall have an accuracy (to a confidence level of 95 percent) within plus or minus 15 percent or 6 $\mu\text{g/dl}$, whichever is greater, and shall be conducted by a laboratory approved by OSHA.

(iv) Employee notification. (A) Within five working days after the receipt of biological monitoring results, the employer shall notify each employee in writing of his or her blood lead level; and

(B) The employer shall notify each employee whose blood lead level exceeds 40 $\mu\text{g/dl}$ that the standard requires temporary medical removal with Medical Removal Protection benefits when an employee's blood lead

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level exceeds the numerical criterion for medical removal under paragraph (k)(1)(i) of this section.

(3) Medical examinations and consultations--(i) Frequency. The employer shall make available medical examinations and consultations to each employee covered under paragraph (j)(1)(ii) of this section on the following schedule:

(A) At least annually for each employee for whom a blood sampling test conducted at any time during the preceding 12 months indicated a blood lead level at or above 40 $\mu\text{g/dl}$;

(B) As soon as possible, upon notification by an employee either that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice concerning the effects of current or past exposure to lead on the employee's ability to procreate a healthy child, that the employee is pregnant, or that the employee has demonstrated difficulty in breathing during a respirator fitting test or during use; and

(C) As medically appropriate for each employee either removed from exposure to lead due to a risk of sustaining material impairment to

health, or otherwise limited pursuant to a final medical determination.

(ii) Content. The content of medical examinations made available pursuant to paragraph (j)(3)(i)(B)-(C) of this section shall be determined by an examining physician and, if requested by an employee, shall include pregnancy testing or laboratory evaluation of male fertility. Medical examinations made available pursuant to paragraph (j)(3)(i)(A) of this section shall include the following elements:

(A) A detailed work history and a medical history, with particular attention to past lead exposure (occupational and non-occupational), personal habits (smoking, hygiene), and past gastrointestinal, hematologic, renal, cardiovascular, reproductive and neurological problems;

(B) A thorough physical examination, with particular attention to teeth, gums, hematologic, gastrointestinal, renal, cardiovascular, and neurological systems. Pulmonary status should be evaluated if respiratory protection will be used;

(C) A blood pressure measurement;

(D) A blood sample and analysis which determines:

(1) Blood lead level;

(2) Hemoglobin and hematocrit determinations, red cell indices, and examination of peripheral smear morphology;

(3) Zinc protoporphyrin;

(4) Blood urea nitrogen; and,

(5) Serum creatinine;

(E) A routine urinalysis with microscopic examination; and

(F) Any laboratory or other test relevant to lead exposure which the examining physician deems necessary by sound medical practice.

(iii) Multiple physician review mechanism. (A) If the employer selects the initial physician who conducts any medical examination or consultation provided to an employee under this section, the employee may designate a second physician:

(1) To review any findings, determinations or recommendations of the initial physician; and

(2) To conduct such examinations, consultations, and laboratory tests as the second physician deems necessary to facilitate this review.

(B) The employer shall promptly notify an employee of the right to seek a second medical opinion after each occasion that an initial physician conducts a medical examination or consultation pursuant to this section. The employer may condition its participation in, and payment for, the multiple physician review mechanism upon the employee doing the following within fifteen (15) days after receipt of the foregoing notification, or receipt of the initial physician's written opinion, whichever is later:

(1) The employee informing the employer that he or she intends to seek a second medical opinion, and

(2) The employee initiating steps to make an appointment with a second physician.

(C) If the findings, determinations or recommendations of the second physician differ from those of the initial physician, then the employer and the employee shall assure that efforts are

made for the two physicians to resolve any disagreement.

(D) If the two physicians have been unable to quickly resolve their disagreement, then the employer and the employee through their respective physicians shall designate a third physician:

(1) To review any findings, determinations or recommendations of the prior physicians; and

(2) To conduct such examinations, consultations, laboratory tests and discussions with the prior physicians as the third physician deems necessary to resolve the disagreement of the prior physicians.

(E) The employer shall act consistent with the findings, determinations and recommendations of the third physician, unless the employer and the employee reach an agreement which is otherwise consistent with the recommendations of at least one of the three physicians.

(iv) Information provided to examining and consulting physicians.

(A) The employer shall provide an initial physician conducting a medical examination or consultation under this section with the following information:

(1) A copy of this regulation for lead including all Appendices;

(2) A description of the affected employee's duties as they relate to the employee's exposure;

(3) The employee's exposure level or anticipated exposure level to lead and to any other toxic substance (if applicable);

(4) A description of any personal protective equipment used or to be used;

(5) Prior blood lead determinations; and

(6) All prior written medical opinions concerning the employee in the employer's possession or control.

(B) The employer shall provide the foregoing information to a second

or third physician conducting a medical examination or consultation under this section upon request either by the second or third physician, or by the employee.

(v) Written medical opinions. (A) The employer shall obtain and furnish the employee with a copy of a written medical opinion from each examining or consulting physician which contains only the following information:

(1) 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 exposure to lead;

(2) Any recommended special protective measures to be provided to the employee, or limitations to be placed upon the employee's exposure to lead;

(3) Any recommended limitation upon the employee's use of respirators, including a determination of whether the employee can wear a powered air purifying respirator if a physician determines that the employee cannot wear a negative pressure respirator; and

(4) The results of the blood lead determinations.

(B) The employer shall instruct each examining and consulting physician to:

(1) Not reveal either in the written opinion or orally, or in any other means of communication with the employer, findings, including

laboratory results, or diagnoses unrelated to an employee's occupational exposure to lead; and

(2) Advise the employee of any medical condition, occupational or nonoccupational, which dictates further medical examination or treatment.

(vi) Alternate physician determination mechanisms. The employer and an employee or authorized employee representative may agree upon the use of any alternate physician determination mechanism in lieu of the multiple physician review mechanism provided by paragraph (j)(3)(iii) of this section so long as the alternate mechanism is as expeditious and protective as the requirements contained in this paragraph.

(4) Chelation. (i) The employer shall assure that any person whom he retains, employs, supervises or controls does not engage in prophylactic chelation of any employee at any time.

(ii) If therapeutic or diagnostic chelation is to be performed by any person in paragraph (j)(4)(i) of this section, the employer shall assure that it be done under the supervision of a licensed physician in a clinical setting with thorough and appropriate medical

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monitoring and that the employee is notified in writing prior to its occurrence.

(k) Medical removal protection--(1) Temporary medical removal and return of an employee--(i) Temporary removal due to elevated blood lead level. The employer shall remove an employee from work having an exposure to lead at or above the action level on each occasion that a periodic and a follow-up blood sampling test conducted pursuant to this section indicate that the employee's blood lead level is at or above 50 [mu]g/dl; and,

(ii) Temporary removal due to a final medical determination. (A) The employer shall remove an employee from work having an exposure to lead at or above the action level on each occasion that a final medical determination results in a medical finding, determination, or opinion that the employee has a detected medical condition which places the employee at increased risk of material impairment to health from exposure to lead.

(B) For the purposes of this section, the phrase final medical determination means the written medical opinion on the employees' health status by the examining physician or, where relevant, the outcome of the multiple physician review mechanism or alternate medical determination mechanism used pursuant to the medical surveillance provisions of this section.

(C) Where a final medical determination results in any recommended special protective measures for an employee, or limitations on an employee's exposure to lead, the employer shall implement and act consistent with the recommendation.

(iii) Return of the employee to former job status. (A) The employer shall return an employee to his or her former job status:

(1) For an employee removed due to a blood lead level at or above 50

[mu]g/dl when two consecutive blood sampling tests indicate that the employee's blood lead level is at or below 40 [mu]g/dl;

(2) For an employee removed due to a final medical determination, when a subsequent final medical determination results in a medical finding, determination, or opinion that the employee no longer has a detected medical condition which places the employee at increased risk of material impairment to health from exposure to lead.

(B) For the purposes of this section, the requirement that an employer return an employee to his or her former job status is not intended to expand upon or restrict any rights an employee has or would have had, absent temporary medical removal, to a specific job classification or position under the terms of a collective bargaining agreement.

(iv) Removal of other employee special protective measure or limitations. The employer shall remove any limitations placed on an employee or end any special protective measures provided to an employee pursuant to a final medical determination when a subsequent final medical determination indicates that the limitations or special protective measures are no longer necessary.

(v) Employer options pending a final medical determination. Where the multiple physician review mechanism, or alternate medical determination mechanism used pursuant to the medical surveillance provisions of this section, has not yet resulted in a final medical determination with respect to an employee, the employer shall act as follows:

(A) Removal. The employer may remove the employee from exposure to lead, provide special protective measures to the employee, or place limitations upon the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status.

(B) Return. The employer may return the employee to his or her former job status, end any special protective measures provided to the employee, and remove any limitations placed upon the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status, with two exceptions.

(1) If the initial removal, special protection, or limitation of the employee resulted from a final medical determination which differed from the findings, determinations, or recommendations of the initial physician or;

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(2) If the employee has been on removal status for the preceding eighteen months due to an elevated blood lead level, then the employer shall await a final medical determination.

(2) Medical removal protection benefits--(i) Provision of medical removal protection benefits. The employer shall provide an employee up to eighteen (18) months of medical removal protection benefits on each occasion that an employee is removed from exposure to lead or otherwise limited pursuant to this section.

(ii) Definition of medical removal protection benefits. For the purposes of this section, the requirement that an employer provide medical removal protection benefits means that, as long as the job the employee was removed from continues, the employer shall maintain the total normal earnings, seniority and other employment rights and benefits of an employee, including the employee's right to his or her former job status as though the employee had not been medically removed from the employee's job or otherwise medically limited.

(iii) Follow-up medical surveillance during the period of employee removal or limitation. During the period of time that an employee is medically removed from his or her job or otherwise medically limited, the employer may condition the provision of medical removal protection benefits upon the employee's participation in follow-up medical surveillance made available pursuant to this section.

(iv) Workers' compensation claims. If a removed employee files a claim for workers' compensation payments for a lead-related disability, then the employer shall continue to provide medical removal protection benefits pending disposition of the claim. To the extent that an award is made to the employee for earnings lost during the period of removal, the employer's medical removal protection obligation shall be reduced by such amount. The employer shall receive no credit for workers' compensation payments received by the employee for treatment-related expenses.

(v) Other credits. The employer's obligation to provide medical removal protection benefits to a removed employee shall be reduced to the extent that the employee receives compensation for earnings lost during the period of removal either from a publicly or employer-funded compensation program, or receives income from employment with another employer made possible by virtue of the employee's removal.

(vi) Voluntary removal or restriction of an employee. Where an employer, although not required by this section to do so, removes an employee from exposure to lead or otherwise places limitations on an employee due to the effects of lead exposure on the employee's medical condition, the employer shall provide medical removal protection benefits to the employee equal to that required by paragraph (k)(2)(i) and (ii) of this section.

(1) Employee information and training--(1) General. (i) The employer shall communicate information concerning lead hazards according to the requirements of OSHA's Hazard Communication Standard for the construction industry, 29 CFR 1926.59, including but not limited to the requirements concerning warning signs and labels, material safety data sheets (MSDS), and employee information and training. In addition, employers shall comply with the following requirements:

(ii) For all employees who are subject to exposure to lead at or above the action level on any day or who are subject to exposure to lead compounds which may cause skin or eye irritation (e.g. lead arsenate, lead azide), the employer shall provide a training program in accordance with paragraph (1)(2) of this section and assure employee participation.

(iii) The employer shall provide the training program as initial training prior to the time of job assignment or prior to the start up date for this requirement, whichever comes last.

(iv) The employer shall also provide the training program at least

annually for each employee who is subject to lead exposure at or above the action level on any day.

(2) Training program. The employer shall assure that each employee is trained in the following:

(i) The content of this standard and its appendices;

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(ii) The specific nature of the operations which could result in exposure to lead above the action level;

(iii) The purpose, proper selection, fitting, use, and limitations of respirators;

(iv) The purpose and a description of the medical surveillance program, and the medical removal protection program including information concerning the adverse health effects associated with excessive exposure to lead (with particular attention to the adverse reproductive effects on both males and females and hazards to the fetus and additional precautions for employees who are pregnant);

(v) The engineering controls and work practices associated with the employee's job assignment including training of employees to follow relevant good work practices described in Appendix B of this section;

(vi) The contents of any compliance plan in effect;

(vii) Instructions to employees that chelating agents should not routinely be used to remove lead from their bodies and should not be used at all except under the direction of a licensed physician; and

(viii) The employee's right of access to records under 29 CFR 1910.20.

(3) Access to information and training materials. (i) The employer shall make readily available to all affected employees a copy of this standard and its appendices.

(ii) The employer shall provide, upon request, all materials relating to the employee information and training program to affected employees and their designated representatives, and to the Assistant Secretary and the Director.

(m) Signs--(1) General. (i) The employer may use signs required by other statutes, regulations or ordinances in addition to, or in combination with, signs required by this paragraph.

(ii) The employer shall assure that no statement appears on or near any sign required by this paragraph which contradicts or detracts from the meaning of the required sign.

(2) Signs. (i) The employer shall post the following warning signs in each work area where an employees exposure to lead is above the PEL.

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

(ii) The employer shall assure that signs required by this paragraph are illuminated and cleaned as necessary so that the legend is readily visible.

(n) Recordkeeping--(1) Exposure assessment. (i) The employer shall establish and maintain an accurate record of all monitoring and other data used in conducting employee exposure assessments as required in paragraph (d) of this section.

(ii) Exposure monitoring records shall include:

(A) The date(s), number, duration, location and results of each of the samples taken if any, including a description of the sampling procedure used to determine representative employee exposure where applicable;

(B) A description of the sampling and analytical methods used and evidence of their accuracy;

(C) The type of respiratory protective devices worn, if any;

(D) Name, social security number, and job classification of the employee monitored and of all other employees whose exposure the measurement is intended to represent; and

(E) The environmental variables that could affect the measurement of employee exposure.

(iii) The employer shall maintain monitoring and other exposure assessment records in accordance with the provisions of 29 CFR 1910.20.

(2) Medical surveillance. (i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance as required by paragraph (j) of this section.

(ii) This record shall include:

(A) The name, social security number, and description of the duties of the employee;

(B) A copy of the physician's written opinions;

(C) Results of any airborne exposure monitoring done on or for that employee and provided to the physician; and

(D) Any employee medical complaints related to exposure to lead.

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(iii) The employer shall keep, or assure that the examining physician keeps, the following medical records:

(A) A copy of the medical examination results including medical and work history required under paragraph (j) of this section;

(B) A description of the laboratory procedures and a copy of any standards or guidelines used to interpret the test results or references to that information;

(C) A copy of the results of biological monitoring.

(iv) The employer shall maintain or assure that the physician maintains medical records in accordance with the provisions of 29 CFR 1910.20.

(3) Medical removals. (i) The employer shall establish and maintain an accurate record for each employee removed from current exposure to lead pursuant to paragraph (k) of this section.

(ii) Each record shall include:

(A) The name and social security number of the employee;

(B) The date of each occasion that the employee was removed from current exposure to lead as well as the corresponding date on which the employee was returned to his or her former job status;

(C) A brief explanation of how each removal was or is being accomplished; and

(D) A statement with respect to each removal indicating whether or not the reason for the removal was an elevated blood lead level.

(iii) The employer shall maintain each medical removal record for at least the duration of an employee's employment.

(4) Objective data for exemption from requirement for initial monitoring. (i) For purposes of this section, objective data are

information demonstrating that a particular product or material containing lead or a specific process, operation, or activity involving lead cannot release dust or fumes in concentrations at or above the action level under any expected conditions of use. Objective data can be

obtained from an industry-wide study or from laboratory product test results from manufacturers of lead containing products or materials.

The

data the employer uses from an industry-wide survey must be obtained under workplace conditions closely resembling the processes, types of material, control methods, work practices and environmental conditions in the employer's current operations.

(ii) The employer shall maintain the record of the objective data relied upon for at least 30 years.

(5) Availability. The employer shall make available upon request all records required to be maintained by paragraph (n) of this section to affected employees, former employees, and their designated representatives, and to the Assistant Secretary and the Director for examination and copying.

(6) Transfer of records. (i) Whenever the employer ceases to do business, the successor employer shall receive and retain all records required to be maintained by paragraph (n) of this section.

(ii) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records required to be maintained by this section for the prescribed period, these records shall be transmitted to the Director.

(iii) At the expiration of the retention period for the records required to be maintained by this section, the employer shall notify the Director at least 3 months prior to the disposal of such records and shall transmit those records to the Director if requested within the period.

(iv) The employer shall also comply with any additional requirements involving transfer of records set forth in 29 CFR 1910.20(h).

(o) Observation of monitoring. (1) Employee observation. The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to lead conducted pursuant to paragraph (d) of this section.

(2) Observation procedures. (i) Whenever observation of the monitoring of employee exposure to lead requires entry into an area where the use of respirators, protective clothing or equipment is required, the employer shall provide the observer with and assure the use of such respirators, clothing and equipment, and shall require the observer to comply with all other applicable safety and health procedures.

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(ii) Without interfering with the monitoring, observers shall be entitled to:

(A) Receive an explanation of the measurement procedures;

(B) Observe all steps related to the monitoring of lead performed at the place of exposure; and

(C) Record the results obtained or receive copies of the results

when returned by the laboratory.

(p) Effective date. This standard (Sec. 1926.62) shall become effective June 3, 1993.

(q) Appendices. The information contained in the appendices to this section is not intended by itself, to create any additional obligations not otherwise imposed by this standard nor detract from any existing obligation.

(r) Startup dates. (1) The requirements of paragraphs (c) through (o) of this section, including administrative controls and feasible work practice controls, but not including engineering controls specified in paragraph (e)(1) of this section, shall be complied with as soon as possible, but no later than 60 days from the effective date of this section.

(2) Feasible engineering controls specified by paragraph (e)(1) of this section shall be implemented as soon as possible, but no later than 120 days from the effective date of this section.

Appendix A to Sec. 1926.62--Substance Data Sheet for Occupational Exposure to Lead

I. Substance Identification

A. Substance: Pure lead (Pb) is a heavy metal at room temperature and pressure and is a basic chemical element. It can combine with various other substances to form numerous lead compounds.

B. Compounds covered by the standard: The word lead when used in this interim final standard means elemental lead, all inorganic lead compounds and a class of organic lead compounds called lead soaps. This standard does not apply to other organic lead compounds.

C. Uses: Exposure to lead occurs in several different occupations in the construction industry, including demolition or salvage of structures where lead or lead-containing materials are present; removal or encapsulation of lead-containing materials, new construction, alteration, repair, or renovation of structures that contain lead or materials containing lead; installation of products containing lead. In addition, there are construction related activities where exposure to lead may occur, including transportation, disposal, storage, or containment of lead or materials containing lead on construction sites, and maintenance operations associated with construction activities.

D. Permissible exposure: The permissible exposure limit (PEL) set by the standard is 50 micrograms of lead per cubic meter of air (50 [mu]g/m³), averaged over an 8-hour workday.

E. Action level: The interim final standard establishes an action level of 30 micrograms of lead per cubic meter of air (30 [mu]g/m³), averaged over an 8-hour workday. The action level triggers several ancillary provisions of the standard such as exposure monitoring, medical surveillance, and training.

II. Health Hazard Data

A. Ways in which lead enters your body. When absorbed into your body

in certain doses, lead is a toxic substance. The object of the lead standard is to prevent absorption of harmful quantities of lead. The standard is intended to protect you not only from the immediate toxic effects of lead, but also from the serious toxic effects that may not become apparent until years of exposure have passed. Lead can be absorbed into your body by inhalation (breathing) and ingestion (eating). Lead (except for certain organic lead compounds not covered by the standard, such as tetraethyl lead) is not absorbed through your skin. When lead is scattered in the air as a dust, fume respiratory tract. Inhalation of airborne lead is generally the most important source of occupational lead absorption. You can also absorb lead through your digestive system if lead gets into your mouth and is swallowed. If you handle food, cigarettes, chewing tobacco, or make-up which have lead on them or handle them with hands contaminated with lead, this will contribute to ingestion. A significant portion of the lead that you inhale or ingest gets into your blood stream. Once in your blood stream, lead is circulated throughout your body and stored in various organs and body tissues. Some of this lead is quickly filtered out of your body and excreted, but some remains in the blood and other tissues. As exposure to lead continues, the amount stored in your body will increase if you are absorbing more lead than your body is excreting. Even though you may not be aware of any immediate symptoms of disease, this lead stored in your tissues can be slowly causing irreversible damage, first to individual cells, then to your organs and whole body systems.

B. Effects of overexposure to lead--(1) Short term (acute) overexposure. Lead is a potent, systemic poison that serves no known useful function once absorbed by your body. Taken in large enough doses, lead can kill you in a matter of days. A condition affecting the brain called acute encephalopathy may arise

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which develops quickly to seizures, coma, and death from cardiorespiratory arrest. A short term dose of lead can lead to acute encephalopathy. Short term occupational exposures of this magnitude are highly unusual, but not impossible. Similar forms of encephalopathy may, however, arise from extended, chronic exposure to lower doses of lead. There is no sharp dividing line between rapidly developing acute effects of lead, and chronic effects which take longer to acquire. Lead adversely affects numerous body systems, and causes forms of health impairment and disease which arise after periods of exposure as short as days or as long as several years.

(2) Long-term (chronic) overexposure. Chronic overexposure to lead may result in severe damage to your blood-forming, nervous, urinary and reproductive systems. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety,

constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pain or soreness, fine tremors, numbness, dizziness, hyperactivity and colic. In lead colic there may be severe abdominal pain. Damage to the central nervous system

in general and the brain (encephalopathy) in particular is one of the most severe forms of lead poisoning. The most severe, often fatal, form of encephalopathy may be preceded by vomiting, a feeling of dullness progressing to drowsiness and stupor, poor memory, restlessness, irritability, tremor, and convulsions. It may arise suddenly with the onset of seizures, followed by coma, and death. There is a tendency for muscular weakness to develop at the same time. This weakness may progress to paralysis often observed as a characteristic "wrist drop" or "foot drop" and is a manifestation of a disease to the nervous system called peripheral neuropathy. Chronic overexposure to lead also results in kidney disease with few, if any, symptoms appearing until extensive and most likely permanent kidney damage has occurred. Routine laboratory tests reveal the presence of this kidney disease only after about two-thirds of kidney function is lost. When overt symptoms of urinary dysfunction arise, it is often too late to correct or prevent worsening conditions, and progression to kidney dialysis or death is possible. Chronic overexposure to lead impairs the reproductive systems of both men and women. Overexposure to lead may result in decreased sex drive, impotence and sterility in men. Lead can alter the structure of sperm cells raising the risk of birth defects. There is evidence of miscarriage and stillbirth in women whose husbands were exposed to lead or who were exposed to lead themselves. Lead exposure also may result in

decreased fertility, and abnormal menstrual cycles in women. The course of pregnancy may be adversely affected by exposure to lead since lead crosses the placental barrier and poses risks to developing fetuses. Children born of parents either one of whom were exposed to excess lead levels are more likely to have birth defects, mental retardation, behavioral disorders or die during the first year of childhood. Overexposure to lead also disrupts the blood-forming system resulting in

decreased hemoglobin (the substance in the blood that carries oxygen to the cells) and ultimately anemia. Anemia is characterized by weakness, pallor and fatigability as a result of decreased oxygen carrying capacity in the blood.

(3) Health protection goals of the standard. Prevention of adverse health effects for most workers from exposure to lead throughout a working lifetime requires that a worker's blood lead level (BLL, also expressed as PbB) be maintained at or below forty micrograms per deciliter of whole blood (40 [mu]g/dl). The blood lead levels of workers

(both male and female workers) who intend to have children should be maintained below 30 [mu]g/dl to minimize adverse reproductive health effects to the parents and to the developing fetus. The measurement of your blood lead level (BLL) is the most useful indicator of the amount of lead being absorbed by your body. Blood lead levels are most often reported in units of milligrams (mg) or micrograms ([mu]g) of lead (1 mg=1000 [mu]g) per 100 grams (100g), 100 milliliters (100 ml) or deciliter (dl) of blood. These three units are essentially the same. Sometime BLLs are expressed in the form of mg% or [mu]g%. This is a shorthand notation for 100g, 100 ml, or dl. (References to BLL measurements in this standard are expressed in the form of [mu]g/dl.)

BLL measurements show the amount of lead circulating in your blood stream, but do not give any information about the amount of lead stored in your various tissues. BLL measurements merely show current absorption of lead, not the effect that lead is having on your body or the effects that past lead exposure may have already caused. Past research into lead-related diseases, however, has focused heavily on associations between BLLs and various diseases. As a result, your BLL is an important indicator of the likelihood that you will gradually acquire a lead-related health impairment or disease.

Once your blood lead level climbs above 40 [mu]g/dl, your risk of disease increases. There is a wide variability of individual response to lead, thus it is difficult to say that a particular BLL in a given person will cause a particular effect. Studies have associated fatal encephalopathy with BLLs as low as 150 [mu]g/dl. Other studies have shown other forms of diseases in some workers with BLLs well below 80 [mu]g/dl. Your BLL is a crucial indicator of the risks to your health, but one other factor is also extremely important. This factor is the length of time you have

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had elevated BLLs. The longer you have an elevated BLL, the greater the risk that large quantities of lead are being gradually stored in your organs and tissues (body burden). The greater your overall body burden, the greater the chances of substantial permanent damage. The best way to prevent all forms of lead-related impairments and diseases--both short term and long term--is to maintain your BLL below 40 [mu]g/dl. The provisions of the standard are designed with this end in mind.

Your employer has prime responsibility to assure that the provisions of the standard are complied with both by the company and by individual workers. You, as a worker, however, also have a responsibility to assist your employer in complying with the standard. You can play a key role in protecting your own health by learning about the lead hazards and their control, learning what the standard requires, following the standard where it governs your own actions, and seeing that your employer complies with provisions governing his or her actions.

(4) Reporting signs and symptoms of health problems. You should immediately notify your employer if you develop signs or symptoms associated with lead poisoning or if you desire medical advice concerning the effects of current or past exposure to lead or your ability to have a healthy child. You should also notify your employer if you have difficulty breathing during a respirator fit test or while wearing a respirator. In each of these cases, your employer must make available to you appropriate medical examinations or consultations. These must be provided at no cost to you and at a reasonable time and place. The standard contains a procedure whereby you can obtain a second opinion by a physician of your choice if your employer selected the initial physician.

Appendix B to Sec. 1926.62--Employee Standard Summary

This appendix summarizes key provisions of the interim final standard for lead in construction that you as a worker should become familiar with.

I. Permissible Exposure Limit (PEL)--Paragraph (C)

The standard sets a permissible exposure limit (PEL) of 50 micrograms of lead per cubic meter of air ($50 \text{ } \mu\text{g}/\text{m}^3$), averaged over an 8-hour workday which is referred to as a time-weighted average (TWA). This is the highest level of lead in air to which you may be permissibly exposed over an 8-hour workday. However, since this is an 8-hour average, short exposures above the PEL are permitted so long as for each 8-hour work day your average exposure does not exceed this level. This interim final standard, however, takes into account the fact that your daily exposure to lead can extend beyond a typical 8-hour workday as the result of overtime or other alterations in your work schedule. To deal with this situation, the standard contains a formula which reduces your permissible exposure when you are exposed more than 8 hours. For example, if you are exposed to lead for 10 hours a day, the maximum permitted average exposure would be $40 \text{ } \mu\text{g}/\text{m}^3$.

II. Exposure Assessment--Paragraph (D)

If lead is present in your workplace in any quantity, your employer is required to make an initial determination of whether any employee's exposure to lead exceeds the action level ($30 \text{ } \mu\text{g}/\text{m}^3$ averaged over an 8-hour day). Employee exposure is that exposure which would occur if the employee were not using a respirator. This initial determination requires your employer to monitor workers' exposures unless he or she has objective data which can demonstrate conclusively that no employee will be exposed to lead in excess of the action level. Where objective data is used in lieu of actual monitoring the employer must establish and maintain an accurate record, documenting its relevancy in assessing exposure levels for current job conditions. If such objective data is available, the employer need proceed no further on employee exposure assessment until such time that conditions have changed and the determination is no longer valid.

Objective data may be compiled from various sources, e.g., insurance companies and trade associations and information from suppliers or exposure data collected from similar operations. Objective data may also comprise previously-collected sampling data including area monitoring. If it cannot be determined through using objective data that worker exposure is less than the action level, your employer must conduct monitoring or must rely on relevant previous personal sampling, if available. Where monitoring is required for the initial determination, it may be limited to a representative number of employees who are reasonably expected to have the highest exposure levels. If your employer has conducted appropriate air sampling for lead in the past 12

months, he or she may use these results, provided they are applicable to the same employee tasks and exposure conditions and meet the requirements for accuracy as specified in the standard. As with objective data, if such results are relied upon for the initial determination, your employer must establish and maintain a record as to the relevancy of such data to current job conditions.

If there have been any employee complaints of symptoms which may be attributable to exposure to lead or if there is any other information or observations which would indicate employee exposure to lead,

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this must also be considered as part of the initial determination.

If this initial determination shows that a reasonable possibility exists that any employee may be exposed, without regard to respirators, over the action level, your employer must set up an air monitoring program to determine the exposure level representative of each employee exposed to lead at your workplace. In carrying out this air monitoring program, your employer is not required to monitor the exposure of every employee, but he or she must monitor a representative number of employees and job types. Enough sampling must be done to enable each employee's exposure level to be reasonably represent full shift exposure. In addition, these air samples must be taken under conditions which represent each employee's regular, daily exposure to lead. Sampling performed in the past 12 months may be used to determine exposures above the action level if such sampling was conducted during work activities essentially similar to present work conditions.

The standard lists certain tasks which may likely result in exposures to lead in excess of the PEL and, in some cases, exposures in excess of 50 times the PEL. If you are performing any of these tasks, your employer must provide you with appropriate respiratory protection, protective clothing and equipment, change areas, hand washing facilities, biological monitoring, and training until such time that an exposure assessment is conducted which demonstrates that your exposure level is below the PEL.

If you are exposed to lead and air sampling is performed, your employer is required to notify you in writing within 5 working days of the air monitoring results which represent your exposure. If the results indicate that your exposure exceeds the PEL (without regard to your use of a respirator), then your employer must also notify you of this in writing, and provide you with a description of the corrective action that has been taken or will be taken to reduce your exposure.

Your exposure must be rechecked by monitoring, at least every six months if your exposure is at or over the action level but below the PEL. Your employer may discontinue monitoring for you if 2 consecutive measurements, taken at least 7 days apart, are at or below the action level. Air monitoring must be repeated every 3 months if you are exposed over the PEL. Your employer must continue monitoring for you at this frequency until 2 consecutive measurements, taken at least 7 days apart, are below the PEL but above the action level, at which time your employer must repeat monitoring of your exposure every six months and may discontinue monitoring only after your exposure drops to or below

the action level. However, whenever there is a change of equipment, process, control, or personnel or a new type of job is added at your workplace which may result in new or additional exposure to lead, your employer must perform additional monitoring.

III. Methods of Compliance--Paragraph (E)

Your employer is required to assure that no employee is exposed to lead in excess of the PEL as an 8-hour TWA. The interim final standard for lead in construction requires employers to institute engineering and work practice controls including administrative controls to the extent feasible to reduce employee exposure to lead. Where such controls are feasible but not adequate to reduce exposures below the PEL they must be used nonetheless to reduce exposures to the lowest level that can be accomplished by these means and then supplemented with appropriate respiratory protection.

Your employer is required to develop and implement a written compliance program prior to the commencement of any job where employee exposures may reach the PEL as an 8-hour TWA. The interim final standard identifies the various elements that must be included in the plan. For example, employers are required to include a description of operations in which lead is emitted, detailing other relevant information about the operation such as the type of equipment used, the type of material involved, employee job responsibilities, operating procedures and maintenance practices. In addition, your employer's compliance plan must specify the means that will be used to achieve compliance and, where engineering controls are required, include any engineering plans or studies that have been used to select the control methods. If administrative controls involving job rotation are used to reduce employee exposure to lead, the job rotation schedule must be included in the compliance plan. The plan must also detail the type of protective clothing and equipment, including respirators, housekeeping and hygiene practices that will be used to protect you from the adverse effects of exposure to lead.

The written compliance program must be made available, upon request, to affected employees and their designated representatives, the Assistant Secretary and the Director.

Finally, the plan must be reviewed and updated at least every 6 months to assure it reflects the current status in exposure control.

IV. Respiratory Protection--Paragraph (F)

Your employer is required to provide and assure your use of respirators when your exposure to lead is not controlled below the PEL by other means. The employer must pay the cost of the respirator. Whenever you request one, your employer is also required to provide you a respirator even if your air exposure level is not above the PEL. You

might desire a respirator when, for example, you have received medical advice that your lead absorption should be decreased. Or, you may intend

to have children in the near future, and want to reduce the level of lead in your body to minimize adverse reproductive effects. While respirators are the least satisfactory means of controlling your exposure, they are capable of providing significant protection if properly chosen, fitted, worn, cleaned, maintained, and replaced when they stop providing adequate protection.

Your employer is required to select respirators from the types listed in Table I of the Respiratory Protection section of the standard (Sec. 1926.62 (f)). Any respirator chosen must be approved by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 42 CFR part 84. This respirator selection table will enable your employer to choose a type of respirator that will give you a

proper amount of protection based on your airborne lead exposure. Your employer may select a type of respirator that provides greater protection than that required by the standard; that is, one recommended for a higher concentration of lead than is present in your workplace. For example, a powered air-purifying respirator (PAPR) is much more protective than a typical negative pressure respirator, and may also be more comfortable to wear. A PAPR has a filter, cartridge, or canister to

clean the air, and a power source that continuously blows filtered air into your breathing zone. Your employer might make a PAPR available to you to ease the burden of having to wear a respirator for long periods of time. The standard provides that you can obtain a PAPR upon request.

Your employer must also start a Respiratory Protection Program.

This

program must include written procedures for the proper selection, use, cleaning, storage, and maintenance of respirators.

Your employer must ensure that your respirator facepiece fits properly. Proper fit of a respirator facepiece is critical to your protection from airborne lead. Obtaining a proper fit on each employee may require your employer to make available several different types of respirator masks. To ensure that your respirator fits properly and that facepiece leakage is minimal, your employer must give you either a qualitative or quantitative fit test as specified in Appendix A of the Respiratory Protection standard located at 29 CFR 1910.134.

You must also receive from your employer proper training in the use of respirators. Your employer is required to teach you how to wear a respirator, to know why it is needed, and to understand its limitations.

The standard provides that if your respirator uses filter elements, you must be given an opportunity to change the filter elements whenever an increase in breathing resistance is detected. You also must be permitted to periodically leave your work area to wash your face and respirator facepiece whenever necessary to prevent skin irritation. If you ever have difficulty in breathing during a fit test or while using a

respirator, your employer must make a medical examination available to you to determine whether you can safely wear a respirator. The result of

this examination may be to give you a positive pressure respirator (which reduces breathing resistance) or to provide alternative means of protection.

V. Protective Work Clothing and Equipment--Paragraph (G)

If you are exposed to lead above the PEL as an 8-hour TWA, without regard to your use of a respirator, or if you are exposed to lead compounds such as lead arsenate or lead azide which can cause skin and eye irritation, your employer must provide you with protective work clothing and equipment appropriate for the hazard. If work clothing is provided, it must be provided in a clean and dry condition at least weekly, and daily if your airborne exposure to lead is greater than 200 $\mu\text{g}/\text{m}^3$. Appropriate protective work clothing and equipment can include coveralls or similar full-body work clothing, gloves, hats, shoes or disposable shoe coverlets, and face shields or vented goggles. Your employer is required to provide all such equipment at no cost to you. In addition, your employer is responsible for providing repairs and replacement as necessary, and also is responsible for the cleaning, laundering or disposal of protective clothing and equipment.

The interim final standard requires that your employer assure that you follow good work practices when you are working in areas where your exposure to lead may exceed the PEL. With respect to protective clothing and equipment, where appropriate, the following procedures should be observed prior to beginning work:

1. Change into work clothing and shoe covers in the clean section of the designated changing areas;
2. Use work garments of appropriate protective gear, including respirators before entering the work area; and
3. Store any clothing not worn under protective clothing in the designated changing area.

Workers should follow these procedures upon leaving the work area:

1. HEPA vacuum heavily contaminated protective work clothing while it is still being worn. At no time may lead be removed from protective clothing by any means which result in uncontrolled dispersal of lead into the air;
2. Remove shoe covers and leave them in the work area;

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3. Remove protective clothing and gear in the dirty area of the designated changing area. Remove protective coveralls by carefully rolling down the garment to reduce exposure to dust.

4. Remove respirators last; and
5. Wash hands and face.

Workers should follow these procedures upon finishing work for the day (in addition to procedures described above):

1. Where applicable, place disposal coveralls and shoe covers with the abatement waste;
2. Contaminated clothing which is to be cleaned, laundered or disposed of must be placed in closed containers in the change room.
3. Clean protective gear, including respirators, according to standard procedures;
4. Wash hands and face again. If showers are available, take a shower and wash hair. If shower facilities are not available at the work site, shower immediately at home and wash hair.

VI. Housekeeping--Paragraph (H)

Your employer must establish a housekeeping program sufficient to maintain all surfaces as free as practicable of accumulations of lead dust. Vacuuming is the preferred method of meeting this requirement, and the use of compressed air to clean floors and other surfaces is generally prohibited unless removal with compressed air is done in conjunction with ventilation systems designed to contain dispersal of the lead dust. Dry or wet sweeping, shoveling, or brushing may not be used except where vacuuming or other equally effective methods have been tried and do not work. Vacuums must be used equipped with a special filter called a high-efficiency particulate air (HEPA) filter and emptied in a manner which minimizes the reentry of lead into the workplace.

VII. Hygiene Facilities and Practices--Paragraph (I)

The standard requires that hand washing facilities be provided where occupational exposure to lead occurs. In addition, change areas, showers (where feasible), and lunchrooms or eating areas are to be made available to workers exposed to lead above the PEL. Your employer must assure that except in these facilities, food and beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied, where airborne exposures are above the PEL. Change rooms provided by your employer must be equipped with separate storage facilities for your protective clothing and equipment and street clothes to avoid cross-contamination. After showering, no required protective clothing or equipment worn during the shift may be worn home. It is important that contaminated clothing or equipment be removed in change areas and not be worn home or you will extend your exposure and expose your family since lead from your clothing can accumulate in your house, car, etc.

Lunchrooms or eating areas may not be entered with protective clothing or equipment unless surface dust has been removed by vacuuming, downdraft booth, or other cleaning method. Finally, workers exposed above the PEL must wash both their hands and faces prior to eating, drinking, smoking or applying cosmetics.

All of the facilities and hygiene practices just discussed are essential to minimize additional sources of lead absorption from inhalation or ingestion of lead that may accumulate on you, your clothes, or your possessions. Strict compliance with these provisions can virtually eliminate several sources of lead exposure which significantly contribute to excessive lead absorption.

VIII. Medical Surveillance--Paragraph (J)

The medical surveillance program is part of the standard's comprehensive approach to the prevention of lead-related disease. Its

purpose is to supplement the main thrust of the standard which is aimed at minimizing airborne concentrations of lead and sources of ingestion. Only medical surveillance can determine if the other provisions of the standard have affectively protected you as an individual. Compliance with the standard's provision will protect most workers from the adverse

effects of lead exposure, but may not be satisfactory to protect individual workers (1) who have high body burdens of lead acquired over past years, (2) who have additional uncontrolled sources of non-occupational lead exposure, (3) who exhibit unusual variations in lead absorption rates, or (4) who have specific non-work related medical conditions which could be aggravated by lead exposure (e.g., renal disease, anemia). In addition, control systems may fail, or hygiene and respirator programs may be inadequate. Periodic medical surveillance of individual workers will help detect those failures. Medical surveillance

will also be important to protect your reproductive ability-regardless of whether you are a man or woman.

All medical surveillance required by the interim final standard must

be performed by or under the supervision of a licensed physician. The employer must provide required medical surveillance without cost to employees and at a reasonable time and place. The standard's medical surveillance program has two parts--periodic biological monitoring and medical examinations. Your employer's obligation to offer you medical surveillance is triggered by the results of the air monitoring program. Full medical surveillance must be made available to all employees who are or may be exposed to lead in excess of the action level for more than 30 days a year

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and whose blood lead level exceeds 40 $\mu\text{g/dl}$. Initial medical surveillance consisting of blood sampling and analysis for lead and zinc protoporphyrin must be provided to all employees exposed at any time (1 day) above the action level.

Biological monitoring under the standard must be provided at least every 2 months for the first 6 months and every 6 months thereafter until your blood lead level is below 40 $\mu\text{g/dl}$. A zinc protoporphyrin (ZPP) test is a very useful blood test which measures an adverse metabolic effect of lead on your body and is therefore an indicator of lead toxicity.

If your BLL exceeds 40 $\mu\text{g/dl}$ the monitoring frequency must be increased from every 6 months to at least every 2 months and not reduced until two consecutive BLLs indicate a blood lead level below 40 $\mu\text{g/dl}$. Each time your BLL is determined to be over 40 $\mu\text{g/dl}$, your employer must notify you of this in writing within five working days of his or her receipt of the test results. The employer must also inform you that the standard requires temporary medical removal with economic protection when your BLL exceeds 50 $\mu\text{g/dl}$. (See Discussion of Medical

Removal Protection-Paragraph (k).) Anytime your BLL exceeds 50 $\mu\text{g/dl}$ your employer must make available to you within two weeks of receipt of these test results a second follow-up BLL test to confirm your BLL. If the two tests both exceed 50 $\mu\text{g/dl}$, and you are temporarily removed,

then your employer must make successive BLL tests available to you on a monthly basis during the period of your removal.

Medical examinations beyond the initial one must be made available on an annual basis if your blood lead level exceeds 40 [mu]g/dl at any time during the preceding year and you are being exposed above the airborne action level of 30 [mu]g/m³ for 30 or more days per year. The initial examination will provide information to establish a baseline to which subsequent data can be compared.

An initial medical examination to consist of blood sampling and analysis for lead and zinc protoporphyrin must also be made available (prior to assignment) for each employee being assigned for the first time to an area where the airborne concentration of lead equals or exceeds the action level at any time. In addition, a medical examination

or consultation must be made available as soon as possible if you notify

your employer that you are experiencing signs or symptoms commonly associated with lead poisoning or that you have difficulty breathing while wearing a respirator or during a respirator fit test. You must also be provided a medical examination or consultation if you notify your employer that you desire medical advice concerning the effects of current or past exposure to lead on your ability to procreate a healthy child.

Finally, appropriate follow-up medical examinations or consultations

may also be provided for employees who have been temporarily removed from exposure under the medical removal protection provisions of the standard. (See Part IX, below.)

The standard specifies the minimum content of pre-assignment and annual medical examinations. The content of other types of medical examinations and consultations is left up to the sound discretion of the

examining physician. Pre-assignment and annual medical examinations must

include (1) a detailed work history and medical history; (2) a thorough physical examination, including an evaluation of your pulmonary status if you will be required to use a respirator; (3) a blood pressure measurement; and (4) a series of laboratory tests designed to check your

blood chemistry and your kidney function. In addition, at any time upon your request, a laboratory evaluation of male fertility will be made (microscopic examination of a sperm sample), or a pregnancy test will be given.

The standard does not require that you participate in any of the medical procedures, tests, etc. which your employer is required to make available to you. Medical surveillance can, however, play a very important role in protecting your health. You are strongly encouraged, therefore, to participate in a meaningful fashion. The standard contains

a multiple physician review mechanism which will give you a chance to have a physician of your choice directly participate in the medical surveillance program. If you are dissatisfied with an examination by a physician chosen by your employer, you can select a second physician to conduct an independent analysis. The two doctors would attempt to resolve any differences of opinion, and select a third physician to resolve any firm dispute. Generally your employer will choose the

physician who conducts medical surveillance under the lead standard- unless you and your employer can agree on the choice of a physician or physicians. Some companies and unions have agreed in advance, for example, to use certain independent medical laboratories or panels of physicians. Any of these arrangements are acceptable so long as required

medical surveillance is made available to workers.

The standard requires your employer to provide certain information to a physician to aid in his or her examination of you. This information

includes (1) the standard and its appendices, (2) a description of your duties as they relate to occupational lead exposure, (3) your exposure level or anticipated exposure level, (4) a description of any personal protective equipment you wear, (5) prior blood lead level results, and (6) prior written medical opinions concerning you that the employer has.

After a medical examination or consultation the physician must prepare a

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written report which must contain (1) the physician's opinion as to whether you have any medical condition which places you at increased risk of material impairment to health from exposure to lead, (2) any recommended special protective measures to be provided to you, (3) any blood lead level determinations, and (4) any recommended limitation on your use of respirators. This last element must include a determination of whether you can wear a powered air purifying respirator (PAPR) if you

are found unable to wear a negative pressure respirator.

The medical surveillance program of the interim lead standard may at

some point in time serve to notify certain workers that they have acquired a disease or other adverse medical condition as a result of occupational lead exposure. If this is true, these workers might have legal rights to compensation from public agencies, their employers, firms that supply hazardous products to their employers, or other persons. Some states have laws, including worker compensation laws, that

disallow a worker who learns of a job-related health impairment to sue, unless the worker sues within a short period of time after learning of the impairment. (This period of time may be a matter of months or years.) An attorney can be consulted about these possibilities. It should be stressed that OSHA is in no way trying to either encourage or discourage claims or lawsuits. However, since results of the standard's medical surveillance program can significantly affect the legal remedies

of a worker who has acquired a job-related disease or impairment, it is proper for OSHA to make you aware of this.

The medical surveillance section of the standard also contains provisions dealing with chelation. Chelation is the use of certain drugs

(administered in pill form or injected into the body) to reduce the amount of lead absorbed in body tissues. Experience accumulated by the medical and scientific communities has largely confirmed the effectiveness of this type of therapy for the treatment of very severe lead poisoning. On the other hand, it has also been established that

there can be a long list of extremely harmful side effects associated with the use of chelating agents. The medical community has balanced the advantages and disadvantages resulting from the use of chelating agents in various circumstances and has established when the use of these agents is acceptable. The standard includes these accepted limitations due to a history of abuse of chelation therapy by some lead companies. The most widely used chelating agents are calcium disodium EDTA, (Ca Na₂ EDTA), Calcium Disodium Versenate (Versenate), and d-penicillamine (pencillamine or Cupramine).

The standard prohibits ``prophylactic chelation'' of any employee by any person the employer retains, supervises or controls. Prophylactic chelation is the routine use of chelating or similarly acting drugs to prevent elevated blood levels in workers who are occupationally exposed to lead, or the use of these drugs to routinely lower blood lead levels to predesignated concentrations believed to be ``safe''. It should be emphasized that where an employer takes a worker who has no symptoms of lead poisoning and has chelation carried out by a physician (either inside or outside of a hospital) solely to reduce the worker's blood lead level, that will generally be considered prophylactic chelation. The use of a hospital and a physician does not mean that prophylactic chelation is not being performed. Routine chelation to prevent increased or reduce current blood lead levels is unacceptable whatever the setting.

The standard allows the use of ``therapeutic'' or ``diagnostic'' chelation if administered under the supervision of a licensed physician in a clinical setting with thorough and appropriate medical monitoring. Therapeutic chelation responds to severe lead poisoning where there are marked symptoms. Diagnostic chelation involved giving a patient a dose of the drug then collecting all urine excreted for some period of time as an aid to the diagnosis of lead poisoning.

In cases where the examining physician determines that chelation is appropriate, you must be notified in writing of this fact before such treatment. This will inform you of a potentially harmful treatment, and allow you to obtain a second opinion.

IX. Medical Removal Protection--Paragraph (K)

Excessive lead absorption subjects you to increased risk of disease.

Medical removal protection (MRP) is a means of protecting you when, for whatever reasons, other methods, such as engineering controls, work practices, and respirators, have failed to provide the protection you need. MRP involves the temporary removal of a worker from his or her regular job to a place of significantly lower exposure without any loss of earnings, seniority, or other employment rights or benefits. The purpose of this program is to cease further lead absorption and allow your body to naturally excrete lead which has previously been absorbed. Temporary medical removal can result from an elevated blood lead level, or a medical opinion. For up to 18 months, or for as long as the job the employee was removed from lasts, protection is provided as a result of either form of removal. The vast majority of removed workers, however, will return to their former jobs long before this eighteen month period

expires.

You may also be removed from exposure even if your blood lead level is below 50 [mu]g/dl if a final medical determination indicates

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that you temporarily need reduced lead exposure for medical reasons. If the physician who is implementing your employers medical program makes a

final written opinion recommending your removal or other special protective measures, your employer must implement the physician's recommendation. If you are removed in this manner, you may only be returned when the doctor indicates that it is safe for you to do so.

The standard does not give specific instructions dealing with what an employer must do with a removed worker. Your job assignment upon removal is a matter for you, your employer and your union (if any) to work out consistent with existing procedures for job assignments. Each removal must be accomplished in a manner consistent with existing collective bargaining relationships. Your employer is given broad discretion to implement temporary removals so long as no attempt is made

to override existing agreements. Similarly, a removed worker is provided

no right to veto an employer's choice which satisfies the standard.

In most cases, employers will likely transfer removed employees to other jobs with sufficiently low lead exposure. Alternatively, a worker's hours may be reduced so that the time weighted average exposure is reduced, or he or she may be temporarily laid off if no other alternative is feasible.

In all of these situation, MRP benefits must be provided during the period of removal--i.e., you continue to receive the same earnings, seniority, and other rights and benefits you would have had if you had not been removed. Earnings includes more than just your base wage; it includes overtime, shift differentials, incentives, and other compensation you would have earned if you had not been removed. During the period of removal you must also be provided with appropriate follow-

up medical surveillance. If you were removed because your blood lead level was too high, you must be provided with a monthly blood test. If a

medical opinion caused your removal, you must be provided medical tests or examinations that the doctor believes to be appropriate. If you do not participate in this follow up medical surveillance, you may lose your eligibility for MRP benefits.

When you are medically eligible to return to your former job, your employer must return you to your ``former job status.'' This means that you are entitled to the position, wages, benefits, etc., you would have had if you had not been removed. If you would still be in your old job if no removal had occurred that is where you go back. If not, you are returned consistent with whatever job assignment discretion your employer would have had if no removal had occurred. MRP only seeks to maintain your rights, not expand them or diminish them.

If you are removed under MRP and you are also eligible for worker compensation or other compensation for lost wages, your employer's MRP benefits obligation is reduced by the amount that you actually receive from these other sources. This is also true if you obtain other

employment during the time you are laid off with MRP benefits.

The standard also covers situations where an employer voluntarily removes a worker from exposure to lead due to the effects of lead on the employee's medical condition, even though the standard does not require removal. In these situations MRP benefits must still be provided as though the standard required removal. Finally, it is important to note that in all cases where removal is required, respirators cannot be used as a substitute. Respirators may be used before removal becomes necessary, but not as an alternative to a transfer to a low exposure job, or to a lay-off with MRP benefits.

X. Employee Information and Training--Paragraph (L)

Your employer is required to provide an information and training program for all employees exposed to lead above the action level or who may suffer skin or eye irritation from lead compounds such as lead arsenate or lead azide. The program must train these employees regarding the specific hazards associated with their work environment, protective measures which can be taken, including the contents of any compliance plan in effect, the danger of lead to their bodies (including their reproductive systems), and their rights under the standard. All employees must be trained prior to initial assignment to areas where there is a possibility of exposure over the action level.

This training program must also be provided at least annually thereafter unless further exposure above the action level will not occur.

XI. Signs--Paragraph (M)

The standard requires that the following warning sign be posted in work areas where the exposure to lead exceeds the PEL:

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

These signs are to be posted and maintained in a manner which assures that the legend is readily visible.

XII. Recordkeeping--Paragraph (N)

Your employer is required to keep all records of exposure monitoring for airborne lead. These records must include the name and job classification of employees measured, details of the sampling and analytical techniques, the results of this sampling, and

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the type of respiratory protection being worn by the person sampled. Such records are to be retained for at least 30 years. Your employer is also required to keep all records of biological monitoring and medical examination results. These records must include the names of the

employees, the physician's written opinion, and a copy of the results of the examination. Medical records must be preserved and maintained for the duration of employment plus 30 years. However, if the employee's duration of employment is less than one year, the employer need not retain that employee's medical records beyond the period of employment if they are provided to the employee upon termination of employment.

Recordkeeping is also required if you are temporarily removed from your job under the medical removal protection program. This record must include your name and social security number, the date of your removal and return, how the removal was or is being accomplished, and whether or

not the reason for the removal was an elevated blood lead level. Your employer is required to keep each medical removal record only for as long as the duration of an employee's employment.

The standard requires that if you request to see or copy environmental monitoring, blood lead level monitoring, or medical removal records, they must be made available to you or to a representative that you authorize. Your union also has access to these records. Medical records other than BLL's must also be provided upon request to you, to your physician or to any other person whom you may specifically designate. Your union does not have access to your personal

medical records unless you authorize their access.

XIII. Observation of Monitoring--Paragraph (O)

When air monitoring for lead is performed at your workplace as required by this standard, your employer must allow you or someone you designate to act as an observer of the monitoring. Observers are entitled to an explanation of the measurement procedure, and to record the results obtained. Since results will not normally be available at the time of the monitoring, observers are entitled to record or receive the results of the monitoring when returned by the laboratory. Your employer is required to provide the observer with any personal protective devices required to be worn by employees working in the area that is being monitored. The employer must require the observer to wear all such equipment and to comply with all other applicable safety and health procedures.

XIV. Effective Date--Paragraph (P)

The standard's effective date is June 3, 1993. Employer obligations under the standard begin as of that date with full implementation of engineering controls as soon as possible but no later than within 4 months, and all other provisions completed as soon as possible, but no later than within 2 months from the effective date.

XV. For Additional Information

A. A copy of the interim standard for lead in construction can be obtained free of charge by calling or writing the OSHA Office of Publications, room N-3101, United States Department of Labor, Washington, DC 20210: Telephone (202) 219-4667.

B. Additional information about the standard, its enforcement, and your employer's compliance can be obtained from the nearest OSHA Area Office listed in your telephone directory under United States

Government/Department of Labor.

Appendix C to Sec. 1926.62--Medical Surveillance Guidelines

Introduction

The primary purpose of the Occupational Safety and Health Act of 1970 is to assure, so far as possible, safe and healthful working conditions for every working man and woman. The interim final occupational health standard for lead in construction is designed to protect workers exposed to inorganic lead including metallic lead, all inorganic lead compounds and organic lead soaps.

Under this interim final standard occupational exposure to inorganic lead is to be limited to 50 $\mu\text{g}/\text{m}^3$ (micrograms per cubic meter) based on an 8 hour time-weighted average (TWA). This permissible exposure limit (PEL) must be achieved through a combination of engineering, work practice and administrative controls to the extent feasible. Where these controls are in place but are found not to reduce employee exposures to or below the PEL, they must be used nonetheless, and supplemented with respirators to meet the 50 $\mu\text{g}/\text{m}^3$ exposure limit.

The standard also provides for a program of biological monitoring for employees exposed to lead above the action level at any time, and additional medical surveillance for all employees exposed to levels of inorganic lead above 30 $\mu\text{g}/\text{m}^3$ (TWA) for more than 30 days per year and whose BLL exceeds 40 $\mu\text{g}/\text{dl}$.

The purpose of this document is to outline the medical surveillance provisions of the interim standard for inorganic lead in construction, and to provide further information to the physician regarding the examination and evaluation of workers exposed to inorganic lead.

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Section 1 provides a detailed description of the monitoring procedure including the required frequency of blood testing for exposed workers, provisions for medical removal protection (MRP), the recommended right of the employee to a second medical opinion, and notification and recordkeeping requirements of the employer. A discussion of the requirements for respirator use and respirator monitoring and OSHA's position on prophylactic chelation therapy are also included in this section.

Section 2 discusses the toxic effects and clinical manifestations of lead poisoning and effects of lead intoxication on enzymatic pathways in heme synthesis. The adverse effects on both male and female reproductive capacity and on the fetus are also discussed.

Section 3 outlines the recommended medical evaluation of the worker exposed to inorganic lead, including details of the medical history, physical examination, and recommended laboratory tests, which are based on the toxic effects of lead as discussed in Section 2.

Section 4 provides detailed information concerning the laboratory tests available for the monitoring of exposed workers. Included also is a discussion of the relative value of each test and the limitations and precautions which are necessary in the interpretation of the laboratory

results.

I. Medical Surveillance and Monitoring Requirements for Workers Exposed to Inorganic Lead

Under the interim final standard for inorganic lead in the construction industry, initial medical surveillance consisting of biological monitoring to include blood lead and ZPP level determination shall be provided to employees exposed to lead at or above the action level on any one day. In addition, a program of biological monitoring is to be made available to all employees exposed above the action level at any time and additional medical surveillance is to be made available to all employees exposed to lead above 30 $\mu\text{g}/\text{m}^3$ TWA for more than 30 days each year and whose BLL exceeds 40 $\mu\text{g}/\text{dl}$. This program consists of periodic blood sampling and medical evaluation to be performed on a schedule which is defined by previous laboratory results, worker complaints or concerns, and the clinical assessment of the examining physician.

Under this program, the blood lead level (BLL) of all employees who are exposed to lead above 30 $\mu\text{g}/\text{m}^3$ for more than 30 days per year or whose blood lead is above 40 $\mu\text{g}/\text{dl}$ but exposed for no more than 30 days per year is to be determined at least every two months for the first six months of exposure and every six months thereafter. The frequency is increased to every two months for employees whose last blood lead level was 40 $\mu\text{g}/\text{dl}$ or above. For employees who are removed from exposure to lead due to an elevated blood lead, a new blood lead level must be measured monthly. A zinc protoporphyrin (ZPP) measurement is strongly recommended on each occasion that a blood lead level measurement is made.

An annual medical examination and consultation performed under the guidelines discussed in Section 3 is to be made available to each employee exposed above 30 $\mu\text{g}/\text{m}^3$ for more than 30 days per year for whom a blood test conducted at any time during the preceding 12

months indicated a blood lead level at or above 40 $\mu\text{g}/\text{dl}$. Also, an examination is to be given to all employees prior to their assignment to an area in which airborne lead concentrations reach or exceed the 30 $\mu\text{g}/\text{m}^3$ for more than 30 days per year. In addition, a medical examination must be provided as soon as possible after notification by an employee that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice regarding lead exposure and the ability to procreate a healthy child, or that the employee has demonstrated difficulty in breathing during a respirator fitting test or during respirator use. An examination is also to be made available to each employee removed from exposure to lead due to a risk of sustaining material impairment to health, or otherwise limited or specially protected pursuant to medical recommendations.

Results of biological monitoring or the recommendations of an examining physician may necessitate removal of an employee from further lead exposure pursuant to the standard's medical removal protection (MRP) program. The object of the MRP program is to provide temporary

medical removal to workers either with substantially elevated blood lead levels or otherwise at risk of sustaining material health impairment from continued substantial exposure to lead.

Under the standard's ultimate worker removal criteria, a worker is to be removed from any work having an eight hour TWA exposure to lead of

30 $\mu\text{g}/\text{m}^3$ when his or her blood lead level reaches 50 $\mu\text{g}/\text{dl}$ and is confirmed by a second follow-up blood lead level performed within two weeks after the employer receives the results of the first blood sampling test. Return of the employee to his or her job status depends on a worker's blood lead level declining to 40 $\mu\text{g}/\text{dl}$.

As part of the interim standard, the employer is required to notify in writing each employee whose blood lead level exceeds 40 $\mu\text{g}/\text{dl}$. In addition each such employee is to be informed that the standard requires

medical removal with MRP benefits, discussed below, when an employee's blood lead level exceeds the above defined limit.

In addition to the above blood lead level criterion, temporary worker removal may

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also take place as a result of medical determinations and recommendations. Written medical opinions must be prepared after each examination pursuant to the standard. If the examining physician includes a medical finding, determination or opinion that the employee has a medical condition which places the employee at increased risk of material health impairment from exposure to lead, then the employee must

be removed from exposure to lead at or above 30 $\mu\text{g}/\text{m}^3$. Alternatively, if the examining physician recommends special protective measures for an employee (e.g., use of a powered air purifying respirator) or recommends limitations on an employee's exposure to lead, then the employer must implement these recommendations.

Recommendations may be more stringent than the specific provisions of the standard. The examining physician, therefore, is given broad flexibility to tailor special protective procedures to the needs of individual employees. This flexibility extends to the evaluation and management of pregnant workers and male and female workers who are planning to raise children. Based on the history, physical examination, and laboratory studies, the physician might recommend special protective

measures or medical removal for an employee who is pregnant or who is planning to conceive a child when, in the physician's judgment, continued exposure to lead at the current job would pose a significant risk. The return of the employee to his or her former job status, or the

removal of special protections or limitations, depends upon the examining physician determining that the employee is no longer at increased risk of material impairment or that special measures are no longer needed.

During the period of any form of special protection or removal, the employer must maintain the worker's earnings, seniority, and other employment rights and benefits (as though the worker had not been removed) for a period of up to 18 months or for as long as the job the

employee was removed from lasts if less than 18 months. This economic protection will maximize meaningful worker participation in the medical surveillance program, and is appropriate as part of the employer's overall obligation to provide a safe and healthful workplace. The provisions of MRP benefits during the employee's removal period may, however, be conditioned upon participation in medical surveillance.

The lead standard provides for a multiple physician review in cases where the employee wishes a second opinion concerning potential lead poisoning or toxicity. If an employee wishes a second opinion, he or she

can make an appointment with a physician of his or her choice. This second physician will review the findings, recommendations or determinations of the first physician and conduct any examinations, consultations or tests deemed necessary in an attempt to make a final medical determination. If the first and second physicians do not agree in their assessment they must try to resolve their differences. If they cannot reach an agreement then they must designate a third physician to resolve the dispute.

The employer must provide examining and consulting physicians with the following specific information: A copy of the lead regulations and all appendices, a description of the employee's duties as related to exposure, the exposure level or anticipated level to lead and any other toxic substances (if applicable), a description of personal protective equipment used, blood lead levels, and all prior written medical opinions regarding the employee in the employer's possession or control.

The employer must also obtain from the physician and provide the employee with a written medical opinion containing blood lead levels, the physicians's opinion as to whether the employee is at risk of material impairment to health, any recommended protective measures for the employee if further exposure is permitted, as well as any recommended limitations upon an employee's use of respirators.

Employers must instruct each physician not to reveal to the employer

in writing or in any other way his or her findings, laboratory results, or diagnoses which are felt to be unrelated to occupational lead exposure. They must also instruct each physician to advise the employee of any occupationally or non-occupationally related medical condition requiring further treatment or evaluation.

The standard provides for the use of respirators where engineering and other primary controls are not effective. However, the use of respirator protection shall not be used in lieu of temporary medical removal due to elevated blood lead levels or findings that an employee is at risk of material health impairment. This is based on the numerous inadequacies of respirators including skin rash where the facepiece makes contact with the skin, unacceptable stress to breathing in some workers with underlying cardiopulmonary impairment, difficulty in providing adequate fit, the tendency for respirators to create additional hazards by interfering with vision, hearing, and mobility, and the difficulties of assuring the maximum effectiveness of a complicated work practice program involving respirators. Respirators do,

however, serve a useful function where engineering and work practice controls are inadequate by providing supplementary, interim, or short-term protection, provided they are properly selected for the environment

in which the employee will be working, properly fitted to the employee,

maintained and cleaned periodically, and worn by the employee when required.

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In its interim final standard on occupational exposure to inorganic lead in the construction industry, OSHA has prohibited prophylactic chelation. Diagnostic and therapeutic chelation are permitted only under the supervision of a licensed physician with appropriate medical monitoring in an acceptable clinical setting. The decision to initiate chelation therapy must be made on an individual basis and take into account the severity of symptoms felt to be a result of lead toxicity along with blood lead levels, ZPP levels, and other laboratory tests as appropriate. EDTA and penicillamine which are the primary chelating agents used in the therapy of occupational lead poisoning have significant potential side effects and their use must be justified on the basis of expected benefits to the worker. Unless frank and severe symptoms are present, therapeutic chelation is not recommended, given the opportunity to remove a worker from exposure and allow the body to naturally excrete accumulated lead. As a diagnostic aid, the chelation mobilization test using CA-EDTA has limited applicability. According to some investigators, the test can differentiate between lead-induced and other nephropathies. The test may also provide an estimation of the mobile fraction of the total body lead burden.

Employers are required to assure that accurate records are maintained on exposure assessment, including environmental monitoring, medical surveillance, and medical removal for each employee. Exposure assessment records must be kept for at least 30 years. Medical surveillance records must be kept for the duration of employment plus 30 years except in cases where the employment was less than one year. If duration of employment is less than one year, the employer need not retain this record beyond the term of employment if the record is provided to the employee upon termination of employment. Medical removal records also must be maintained for the duration of employment. All records required under the standard must be made available upon request to the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health. Employers must also make environmental and biological monitoring and medical removal records available to affected employees and to former employees or their authorized employee representatives. Employees or their specifically designated representatives have access to their entire medical surveillance records.

In addition, the standard requires that the employer inform all workers exposed to lead at or above 30 $\mu\text{g}/\text{m}^3$ of the provisions of the standard and all its appendices, the purpose and description of medical surveillance and provisions for medical removal protection if temporary removal is required. An understanding of the potential health effects of lead exposure by all exposed employees along with full understanding of their rights under the lead standard is essential for an effective monitoring program.

II. Adverse Health Effects of Inorganic Lead

Although the toxicity of lead has been known for 2,000 years, the knowledge of the complex relationship between lead exposure and human response is still being refined. Significant research into the toxic properties of lead continues throughout the world, and it should be anticipated that our understanding of thresholds of effects and margins of safety will be improved in future years. The provisions of the lead standard are founded on two prime medical judgments: First, the prevention of adverse health effects from exposure to lead throughout a working lifetime requires that worker blood lead levels be maintained at

or below 40 $\mu\text{g}/\text{dl}$ and second, the blood lead levels of workers, male or female, who intend to parent in the near future should be maintained below 30 $\mu\text{g}/\text{dl}$ to minimize adverse reproductive health effects to the

parents and developing fetus. The adverse effects of lead on reproduction are being actively researched and OSHA encourages the physician to remain abreast of recent developments in the area to best advise pregnant workers or workers planning to conceive children.

The spectrum of health effects caused by lead exposure can be subdivided into five developmental stages: Normal, physiological changes

of uncertain significance, pathophysiological changes, overt symptoms (morbidity), and mortality. Within this process there are no sharp distinctions, but rather a continuum of effects. Boundaries between categories overlap due to the wide variation of individual responses and

exposures in the working population. OSHA's development of the lead standard focused on pathophysiological changes as well as later stages of disease.

1. Heme Synthesis Inhibition. The earliest demonstrated effect of lead involves its ability to inhibit at least two enzymes of the heme synthesis pathway at very low blood levels. Inhibition of delta aminolevulinic acid dehydrase (ALA-D) which catalyzes the conversion of delta-aminolevulinic acid (ALA) to protoporphyrin is observed at a blood

lead level below 20 $\mu\text{g}/\text{dl}$. At a blood lead level of 40 $\mu\text{g}/\text{dl}$, more

than 20% of the population would have 70% inhibition of ALA-D. There is an exponential increase in ALA excretion at blood lead levels greater than 40 $\mu\text{g}/\text{dl}$.

Another enzyme, ferrochelatase, is also inhibited at low blood lead levels. Inhibition of ferrochelatase leads to increased free erythrocyte

protoporphyrin (FEP) in the blood which can then bind to zinc to yield zinc protoporphyrin. At a blood lead level of 50

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$\mu\text{g}/\text{dl}$ or greater, nearly 100% of the population will have an increase

in FEP. There is also an exponential relationship between blood lead levels greater than 40 $\mu\text{g}/\text{dl}$ and the associated ZPP level, which has led to the development of the ZPP screening test for lead exposure.

While the significance of these effects is subject to debate, it is OSHA's position that these enzyme disturbances are early stages of a

disease process which may eventually result in the clinical symptoms of lead poisoning. Whether or not the effects do progress to the later stages of clinical disease, disruption of these enzyme processes over a working lifetime is considered to be a material impairment of health.

One of the eventual results of lead-induced inhibition of enzymes in the heme synthesis pathway is anemia which can be asymptomatic if mild but associated with a wide array of symptoms including dizziness, fatigue, and tachycardia when more severe. Studies have indicated that lead levels as low as 50 $\mu\text{g}/\text{dl}$ can be associated with a definite decreased hemoglobin, although most cases of lead-induced anemia, as well as shortened red-cell survival times, occur at lead levels exceeding 80 $\mu\text{g}/\text{dl}$. Inhibited hemoglobin synthesis is more common in chronic cases whereas shortened erythrocyte life span is more common in acute cases.

In lead-induced anemias, there is usually a reticulocytosis along with the presence of basophilic stippling, and ringed sideroblasts, although none of the above are pathognomonic for lead-induced anemia.

2. Neurological Effects. Inorganic lead has been found to have toxic effects on both the central and peripheral nervous systems. The earliest stages of lead-induced central nervous system effects first manifest themselves in the form of behavioral disturbances and central nervous system symptoms including irritability, restlessness, insomnia and other sleep disturbances, fatigue, vertigo, headache, poor memory, tremor, depression, and apathy. With more severe exposure, symptoms can progress to drowsiness, stupor, hallucinations, delirium, convulsions and coma.

The most severe and acute form of lead poisoning which usually follows ingestion or inhalation of large amounts of lead is acute encephalopathy which may arise precipitously with the onset of intractable seizures, coma, cardiorespiratory arrest, and death within 48 hours.

While there is disagreement about what exposure levels are needed to produce the earliest symptoms, most experts agree that symptoms definitely can occur at blood lead levels of 60 $\mu\text{g}/\text{dl}$ whole blood and therefore recommend a 40 $\mu\text{g}/\text{dl}$ maximum. The central nervous system effects frequently are not reversible following discontinued exposure or chelation therapy and when improvement does occur, it is almost always only partial.

The peripheral neuropathy resulting from lead exposure characteristically involves only motor function with minimal sensory damage and has a marked predilection for the extensor muscles of the most active extremity. The peripheral neuropathy can occur with varying degrees of severity. The earliest and mildest form which can be detected in workers with blood lead levels as low as 50 $\mu\text{g}/\text{dl}$ is manifested by slowing of motor nerve conduction velocity often without clinical symptoms. With progression of the neuropathy there is development of painless extensor muscle weakness usually involving the extensor muscles

of the fingers and hand in the most active upper extremity, followed in severe cases by wrist drop or, much less commonly, foot drop.

In addition to slowing of nerve conduction, electromyographical studies in patients with blood lead levels greater than 50 [mu]g/dl have

demonstrated a decrease in the number of acting motor unit potentials, an increase in the duration of motor unit potentials, and spontaneous pathological activity including fibrillations and fasciculations.

Whether these effects occur at levels of 40 [mu]g/dl is undetermined.

While the peripheral neuropathies can occasionally be reversed with therapy, again such recovery is not assured particularly in the more severe neuropathies and often improvement is only partial. The lack of reversibility is felt to be due in part to segmental demyelination.

3. Gastrointestinal. Lead may also affect the gastrointestinal system producing abdominal colic or diffuse abdominal pain, constipation, obstipation, diarrhea, anorexia, nausea and vomiting. Lead

colic rarely develops at blood lead levels below 80 [mu]g/dl.

4. Renal. Renal toxicity represents one of the most serious health effects of lead poisoning. In the early stages of disease nuclear inclusion bodies can frequently be identified in proximal renal tubular cells. Renal function remains normal and the changes in this stage are probably reversible. With more advanced disease there is progressive interstitial fibrosis and impaired renal function. Eventually extensive interstitial fibrosis ensues with sclerotic glomeruli and dilated and atrophied proximal tubules; all represent end stage kidney disease. Azotemia can be progressive, eventually resulting in frank uremia necessitating dialysis. There is occasionally associated hypertension and hyperuricemia with or without gout.

Early kidney disease is difficult to detect. The urinalysis is normal in early lead nephropathy and the blood urea nitrogen and serum creatinine increase only when two-thirds of kidney function is lost. Measurement of creatinine clearance can often detect earlier disease as can other methods of measurement of glomerular filtration rate. An abnormal Ca-EDTA mobilization test has

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been used to differentiate between lead-induced and other nephropathies,

but this procedure is not widely accepted. A form of Fanconi syndrome with aminoaciduria, glycosuria, and hyperphosphaturia indicating severe injury to the proximal renal tubules is occasionally seen in children.

5. Reproductive effects. Exposure to lead can have serious effects on reproductive function in both males and females. In male workers exposed to lead there can be a decrease in sexual drive, impotence, decreased ability to produce healthy sperm, and sterility. Malformed sperm (teratospermia), decreased number of sperm (hypospermia), and sperm with decreased motility (asthenospermia) can all occur. Teratospermia has been noted at mean blood lead levels of 53 [mu]g/dl and hypospermia and asthenospermia at 41 [mu]g/dl. Furthermore, there appears to be a dose-response relationship for teratospermia in lead exposed workers.

Women exposed to lead may experience menstrual disturbances including dysmenorrhea, menorrhagia and amenorrhea. Following exposure to lead, women have a higher frequency of sterility, premature births, spontaneous miscarriages, and stillbirths.

Germ cells can be affected by lead and cause genetic damage in the egg or sperm cells before conception and result in failure to implant, miscarriage, stillbirth, or birth defects.

Infants of mothers with lead poisoning have a higher mortality during the first year and suffer from lowered birth weights, slower growth, and nervous system disorders.

Lead can pass through the placental barrier and lead levels in the mother's blood are comparable to concentrations of lead in the umbilical cord at birth. Transplacental passage becomes detectable at 12-14 weeks of gestation and increases until birth.

There is little direct data on damage to the fetus from exposure to lead but it is generally assumed that the fetus and newborn would be at least as susceptible to neurological damage as young children. Blood lead levels of 50-60 $\mu\text{g/dl}$ in children can cause significant neurobehavioral impairments and there is evidence of hyperactivity at blood levels as low as 25 $\mu\text{g/dl}$. Given the overall body of literature concerning the adverse health effects of lead in children, OSHA feels that the blood lead level in children should be maintained below 30 $\mu\text{g/dl}$ with a population mean of 15 $\mu\text{g/dl}$. Blood lead levels in the fetus and newborn likewise should not exceed 30 $\mu\text{g/dl}$.

Because of lead's ability to pass through the placental barrier and also because of the demonstrated adverse effects of lead on reproductive function in both the male and female as well as the risk of genetic damage of lead on both the ovum and sperm, OSHA recommends a 30 $\mu\text{g/dl}$ maximum permissible blood lead level in both males and females who wish to bear children.

6. Other toxic effects. Debate and research continue on the effects of lead on the human body. Hypertension has frequently been noted in occupationally exposed individuals although it is difficult to assess whether this is due to lead's adverse effects on the kidney or if some other mechanism is involved. Vascular and electrocardiographic changes have been detected but have not been well characterized. Lead is thought to impair thyroid function and interfere with the pituitary-adrenal axis, but again these effects have not been well defined.

III. Medical Evaluation

The most important principle in evaluating a worker for any occupational disease including lead poisoning is a high index of suspicion on the part of the examining physician. As discussed in Section 2, lead can affect numerous organ systems and produce a wide array of signs and symptoms, most of which are non-specific and subtle in nature at least in the early stages of disease. Unless serious concern for lead toxicity is present, many of the early clues to diagnosis may easily be overlooked.

The crucial initial step in the medical evaluation is recognizing that a worker's employment can result in exposure to lead. The worker will frequently be able to define exposures to lead and lead containing materials but often will not volunteer this information unless specifically asked. In other situations the worker may not know of any exposures to lead but the suspicion might be raised on the part of the

physician because of the industry or occupation of the worker.

Potential

occupational exposure to lead and its compounds occur in many occupations in the construction industry, including demolition and salvaging operations, removal or encapsulation of materials containing lead, construction, alteration, repair or renovation of structures containing lead, transportation, disposal, storage or containment of lead or lead-containing materials on construction sites, and maintenance

operations associated with construction activities.

Once the possibility for lead exposure is raised, the focus can then

be directed toward eliciting information from the medical history, physical exam, and finally from laboratory data to evaluate the worker for potential lead toxicity.

A complete and detailed work history is important in the initial evaluation. A listing of all previous employment with information on job description, exposure to fumes or dust, known exposures to lead or other toxic substances, a description of any personal protective equipment used, and previous medical surveillance should all be included in the worker's record. Where exposure to

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lead is suspected, information concerning on-the-job personal hygiene, smoking or eating habits in work areas, laundry procedures, and use of any protective clothing or respiratory protection equipment should be noted. A complete work history is essential in the medical evaluation of

a worker with suspected lead toxicity, especially when long term effects

such as neurotoxicity and nephrotoxicity are considered.

The medical history is also of fundamental importance and should include a listing of all past and current medical conditions, current medications including proprietary drug intake, previous surgeries and hospitalizations, allergies, smoking history, alcohol consumption, and also non-occupational lead exposures such as hobbies (hunting, riflery).

Also known childhood exposures should be elicited. Any previous history of hematological, neurological, gastrointestinal, renal, psychological, gynecological, genetic, or reproductive problems should be specifically noted.

A careful and complete review of systems must be performed to assess

both recognized complaints and subtle or slowly acquired symptoms which the worker might not appreciate as being significant. The review of symptoms should include the following:

1. General--weight loss, fatigue, decreased appetite.
2. Head, Eyes, Ears, Nose, Throat (HEENT)--headaches, visual disturbances or decreased visual acuity, hearing deficits or tinnitus, pigmentation of the oral mucosa, or metallic taste in mouth.
3. Cardio-pulmonary--shortness of breath, cough, chest pains, palpitations, or orthopnea.
4. Gastrointestinal--nausea, vomiting, heartburn, abdominal pain, constipation or diarrhea.

5. Neurologic--irritability, insomnia, weakness (fatigue), dizziness, loss of memory, confusion, hallucinations, incoordination, ataxia, decreased strength in hands or feet, disturbances in gait, difficulty in climbing stairs, or seizures.

6. Hematologic--pallor, easy fatigability, abnormal blood loss, melena.

7. Reproductive (male and female and spouse where relevant)--history of infertility, impotence, loss of libido, abnormal menstrual periods, history of miscarriages, stillbirths, or children with birth defects.

8. Musculo-skeletal--muscle and joint pains.

The physical examination should emphasize the neurological, gastrointestinal, and cardiovascular systems. The worker's weight and blood pressure should be recorded and the oral mucosa checked for pigmentation characteristic of a possible Burtonian or lead line on the gingiva. It should be noted, however, that the lead line may not be present even in severe lead poisoning if good oral hygiene is practiced.

The presence of pallor on skin examination may indicate an anemia which, if severe, might also be associated with a tachycardia. If an anemia is suspected, an active search for blood loss should be undertaken including potential blood loss through the gastrointestinal tract.

A complete neurological examination should include an adequate mental status evaluation including a search for behavioral and psychological disturbances, memory testing, evaluation for irritability, insomnia, hallucinations, and mental clouding. Gait and coordination should be examined along with close observation for tremor. A detailed evaluation of peripheral nerve function including careful sensory and motor function testing is warranted. Strength testing particularly of extensor muscle groups of all extremities is of fundamental importance.

Cranial nerve evaluation should also be included in the routine examination.

The abdominal examination should include auscultation for bowel sounds and abdominal bruits and palpation for organomegaly, masses, and diffuse abdominal tenderness.

Cardiovascular examination should evaluate possible early signs of congestive heart failure. Pulmonary status should be addressed particularly if respirator protection is contemplated.

As part of the medical evaluation, the interim lead standard requires the following laboratory studies:

1. Blood lead level
2. Hemoglobin and hematocrit determinations, red cell indices, and examination of the peripheral blood smear to evaluate red blood cell morphology
3. Blood urea nitrogen
4. Serum creatinine
5. Routine urinalysis with microscopic examination.
6. A zinc protoporphyrin level.

In addition to the above, the physician is authorized to order any further laboratory or other tests which he or she deems necessary in accordance with sound medical practice. The evaluation must also include pregnancy testing or laboratory evaluation of male fertility if

requested by the employee. Additional tests which are probably not warranted on a routine basis but may be appropriate when blood lead and ZPP levels are equivocal include delta aminolevulinic acid and coproporphyrin concentrations in the urine, and dark-field illumination for detection of basophilic stippling in red blood cells.

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If an anemia is detected further studies including a careful examination of the peripheral smear, reticulocyte count, stool for occult blood, serum iron, total iron binding capacity, bilirubin, and, if appropriate, vitamin B12 and folate may be of value in attempting to identify the cause of the anemia.

If a peripheral neuropathy is suspected, nerve conduction studies are warranted both for diagnosis and as a basis to monitor any therapy.

If renal disease is questioned, a 24 hour urine collection for creatinine clearance, protein, and electrolytes may be indicated. Elevated uric acid levels may result from lead-induced renal disease and a serum uric acid level might be performed.

An electrocardiogram and chest x-ray may be obtained as deemed appropriate.

Sophisticated and highly specialized testing should not be done routinely and where indicated should be under the direction of a specialist.

IV. Laboratory Evaluation

The blood lead level at present remains the single most important test to monitor lead exposure and is the test used in the medical surveillance program under the lead standard to guide employee medical removal. The ZPP has several advantages over the blood lead level. Because of its relatively recent development and the lack of extensive data concerning its interpretation, the ZPP currently remains an ancillary test.

This section will discuss the blood lead level and ZPP in detail and will outline their relative advantages and disadvantages. Other blood tests currently available to evaluate lead exposure will also be reviewed.

The blood lead level is a good index of current or recent lead absorption when there is no anemia present and when the worker has not taken any chelating agents. However, blood lead levels along with urinary lead levels do not necessarily indicate the total body burden of

lead and are not adequate measures of past exposure. One reason for this

is that lead has a high affinity for bone and up to 90% of the body's total lead is deposited there. A very important component of the total lead body burden is lead in soft tissue (liver, kidney, and brain).

This

fraction of the lead body burden, the biologically active lead, is not entirely reflected by blood lead levels since it is a function of the dynamics of lead absorption, distribution, deposition in bone and excretion. Following discontinuation of exposure to lead, the excess body burden is only slowly mobilized from bone and other relatively stable body stores and excreted. Consequently, a high blood lead level

may only represent recent heavy exposure to lead without a significant total body excess and likewise a low blood lead level does not exclude an elevated total body burden of lead.

Also due to its correlation with recent exposures, the blood lead level may vary considerably over short time intervals.

To minimize laboratory error and erroneous results due to contamination, blood specimens must be carefully collected after thorough cleaning of the skin with appropriate methods using lead-free blood containers and analyzed by a reliable laboratory. Under the standard, samples must be analyzed in laboratories which are approved by

OSHA. Analysis is to be made using atomic absorption spectrophotometry, anodic stripping voltammetry or any method which meets the accuracy requirements set forth by the standard.

The determination of lead in urine is generally considered a less reliable monitoring technique than analysis of whole blood primarily due

to individual variability in urinary excretion capacity as well as the technical difficulty of obtaining accurate 24 hour urine collections. In

addition, workers with renal insufficiency, whether due to lead or some other cause, may have decreased lead clearance and consequently urine lead levels may underestimate the true lead burden. Therefore, urine lead levels should not be used as a routine test.

The zinc protoporphyrin test, unlike the blood lead determination, measures an adverse metabolic effect of lead and as such is a better indicator of lead toxicity than the level of blood lead itself. The level of ZPP reflects lead absorption over the preceding 3 to 4 months, and therefore is a better indicator of lead body burden. The ZPP requires more time than the blood lead to read significantly elevated levels; the return to normal after discontinuing lead exposure is also slower. Furthermore, the ZPP test is simpler, faster, and less expensive

to perform and no contamination is possible. Many investigators believe it is the most reliable means of monitoring chronic lead absorption.

Zinc protoporphyrin results from the inhibition of the enzyme ferrochelatase which catalyzes the insertion of an iron molecule into the protoporphyrin molecule, which then becomes heme. If iron is not inserted into the molecule then zinc, having a greater affinity for protoporphyrin, takes the place of the iron, forming ZPP.

An elevation in the level of circulating ZPP may occur at blood lead

levels as low as 20-30 $\mu\text{g/dl}$ in some workers. Once the blood lead level has reached 40 $\mu\text{g/dl}$ there is more marked rise in the ZPP value

from its normal range of less than 100 $\mu\text{g/dl}$ 100 ml. Increases in blood lead levels beyond 40 $\mu\text{g/100 g}$ are associated with exponential increases in ZPP.

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Whereas blood lead levels fluctuate over short time spans, ZPP levels remain relatively stable. ZPP is measured directly in red blood cells and is present for the cell's entire 120 day life-span.

Therefore,

the ZPP level in blood reflects the average ZPP production over the previous 3-4 months and consequently the average lead exposure during

that time interval.

It is recommended that a hematocrit be determined whenever a confirmed ZPP of 50 $\mu\text{g}/100\text{ ml}$ whole blood is obtained to rule out a significant underlying anemia. If the ZPP is in excess of 100 $\mu\text{g}/100\text{ ml}$ and not associated with abnormal elevations in blood lead levels, the

laboratory should be checked to be sure that blood leads were determined

using atomic absorption spectrophotometry anodic stripping voltammetry, or any method which meets the accuracy requirements set forth by the standard by an OSHA approved laboratory which is experienced in lead level determinations. Repeat periodic blood lead studies should be obtained in all individuals with elevated ZPP levels to be certain that an associated elevated blood lead level has not been missed due to transient fluctuations in blood leads.

ZPP has a characteristic fluorescence spectrum with a peak at 594 nm

which is detectable with a hematofluorimeter. The hematofluorimeter is accurate and portable and can provide on-site, instantaneous results for

workers who can be frequently tested via a finger prick.

However, careful attention must be given to calibration and quality control procedures. Limited data on blood lead-ZPP correlations and the ZPP levels which are associated with the adverse health effects discussed in Section 2 are the major limitations of the test. Also it is

difficult to correlate ZPP levels with environmental exposure and there is some variation of response with age and sex. Nevertheless, the ZPP promises to be an important diagnostic test for the early detection of lead toxicity and its value will increase as more data is collected regarding its relationship to other manifestations of lead poisoning.

Levels of delta-aminolevulinic acid (ALA) in the urine are also used

as a measure of lead exposure. Increasing concentrations of ALA are believed to result from the inhibition of the enzyme delta-aminolevulinic acid dehydrase (ALA-D). Although the test is relatively easy to perform, inexpensive, and rapid, the disadvantages include variability in results, the necessity to collect a complete 24 hour urine sample which has a specific gravity greater than 1.010, and also the fact that ALA decomposes in the presence of light.

The pattern of porphyrin excretion in the urine can also be helpful in identifying lead intoxication. With lead poisoning, the urine concentrations of coproporphyrins I and II, porphobilinogen and uroporphyrin I rise. The most important increase, however, is that of coproporphyrin III; levels may exceed 5,000 $\mu\text{g}/\text{l}$ in the urine in lead

poisoned individuals, but its correlation with blood lead levels and ZPP

are not as good as those of ALA. Increases in urinary porphyrins are not

diagnostic of lead toxicity and may be seen in porphyria, some liver diseases, and in patients with high reticulocyte counts.

Summary. The Occupational Safety and Health Administration's interim

standard for inorganic lead in the construction industry places significant emphasis on the medical surveillance of all workers exposed to levels of inorganic lead above 30 $\mu\text{g}/\text{m}^3$ TWA. The

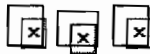
physician has a fundamental role in this surveillance program, and in the operation of the medical removal protection program.

Even with adequate worker education on the adverse health effects of lead and appropriate training in work practices, personal hygiene and other control measures, the physician has a primary responsibility for evaluating potential lead toxicity in the worker. It is only through a careful and detailed medical and work history, a complete physical examination and appropriate laboratory testing that an accurate assessment can be made. Many of the adverse health effects of lead toxicity are either irreversible or only partially reversible and therefore early detection of disease is very important.

This document outlines the medical monitoring program as defined by the occupational safety and health standard for inorganic lead. It reviews the adverse health effects of lead poisoning and describes the important elements of the history and physical examinations as they relate to these adverse effects. Finally, the appropriate laboratory testing for evaluating lead exposure and toxicity is presented.

It is hoped that this review and discussion will give the physician a better understanding of the OSHA standard with the ultimate goal of protecting the health and well-being of the worker exposed to lead under his or her care.

[58 FR 26627, May 4, 1993, as amended at 58 FR 34218, June 24, 1993; 61 FR 5510, Feb. 13, 1996; 63 FR 1296, Jan. 8, 1998]



APPENDIX E

Corporate AAA Health and Safety Plan

Corporate Health and Safety Manual

For

**AAA Environmental, Inc.
6679 Moore Road
Syracuse, N.Y. 13211
Select Procedures for HASP**

AAA Environmental Inc. Health and Safety Manual

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SECTION 2.04 MEDICAL SURVEILLANCE PROGRAM

Initial and Annual Medical Examination

AAA Environmental, Inc. has established a medical surveillance program for several reasons. Three primary reasons are:

- 1 - The safety and health of all employees.
- 2 - Regulatory requirements.
- 3 - Legal and liability concerns.

All new AAA Environmental, Inc. employees who could be exposed to hazardous materials and who are required to wear a respirator as part of their job duties receive, at a minimum, the following medical examination before any exposure. This examination is also given annually to those workers covered by this Medical Surveillance Program.

- Medical history and examination to elicit any past or present medical problems.
- Chest x-ray, for asbestos work
- Pulmonary function test

Additional tests and medical surveillance requirements for specific chemical compounds are presented in the following sections.

Note: Exit physicals will be performed for employees who give proper notice before separation with the company and whose job required them to work in respiratory protection for 30 days per year or more or were exposed to hazardous agents at or near occupational exposure limits.

Respirators

Employees required to wear respirators (half face, full face, supplied air or self contained breathing apparatus) are provided with a physical. This physical includes a pulmonary function test, and a medical history to determine if the employee is physically able to wear and use a respirator during normal work activities.

Asbestos

AAA Environmental, Inc. maintains a Medical Surveillance Program that complies with OSHA Regulations 29 CFR 1926.1101 for workers exposed to asbestos. A summary of the program follows.

The medical surveillance program consists of pre-placement and annual exams. In the construction industry workers are often hired whom have current examinations given by former employers or their unions. If an employee can provide adequate records of an examination given

within the last year, then he need not be re-examined.

AAA Environmental, Inc.'s medical surveillance program protects workers' safety and health in many ways. The initial exam will:

1. Establish a baseline health condition against which to compare future exams.
2. Identify any health conditions that predispose the individual to risk from asbestos. This could be preexisting pneumoconiosis, poor pulmonary function, x-ray abnormalities, or other condition that could increase the possibility of problems from asbestos.
3. Point out any health conditions that could limit the person's capacity to wear respiratory protection. Examples are:
 - Restrictive or obstructive lung disease
 - Certain heart disease
 - Hypertension
 - Epilepsy
 - Diabetes
 - Ruptured eardrums.

Periodic exams serve to monitor the health condition of the individual and assure that any changes in health status are responded to as quickly as possible. Termination exams, although recommended, are not required by the regulations.

Employees exposed to asbestos will receive a medical examination before exposure and annually thereafter. This medical examination consists of at a minimum a pulmonary function test, a chest x-ray (per OSHA schedule), and a medical history to discover previous or present respiratory problems, predisposing factors, smoking history, and work history.

At the termination of employment, AAA Environmental, Inc. may provide a comprehensive medical examination which shall include a chest x-ray, a pulmonary function test, and a medical history. However, no medical examination will be given if the employee has received an acceptable asbestos physical within the past one (1) year period.

Medical records for each employee shall be kept for his period of employment plus at least 30 years. Records of the medical examinations shall be provided upon request to employees, designated representatives, to OSHA, and to NIOSH. The examining physician shall make available to the AAA Environmental, Inc. employee medical records pertinent to the asbestos physicals.

HAZWOPER

AAA Environmental, Inc. employees performing work covered by OSHA's Hazardous Waste Operations and Emergency Response (HAZWOPER) regulation (29 CFR 1910.120) are

provided medical surveillance in compliance with paragraph (f) of that standard. These employees include:

1. Employees at covered clean-up operations.
2. Employee/members of AAA Environmental, Inc.'s Hazardous Materials Team.

The content of the medical exams required by this section will include the following:

- Occupational and medical history
- Physical examination
- Determination of fitness for duty
- Ability to work while wearing protective equipment
- Predisposing factors for heat stress or chemical sensitivity

Additionally, work that involves specific substances may require specific testing to be performed as described in the following sections of this policy.

These examinations will be provided at least annually or whenever AAA Environmental, Inc. is notified of a particular employee's development of signs or symptoms possibly related to exposure to the substances present at the employee's work site. The exams will be provided upon termination of employment or reassignment to a non-covered work site if the employee's last exam was more than six months prior to the termination or reassignment and the regulations require such an exam.

Inorganic Arsenic

AAA Environmental, Inc. maintains a Medical Surveillance Program that is as stringent as OSHA Regulations 29 CFR 1910.1018 for workers exposed to arsenic. The following summarizes the program.

Before an employee is exposed to hazardous levels of inorganic arsenic he will receive a medical examination for any exposure to inorganic arsenic even if the exposure is below the OSHA action level (5 micrograms per cubic meter).

All employees who will be exposed to hazardous levels of inorganic arsenic will receive a physical examination as described below:

- A work history and a medical history, which shall include a smoking history and the presence and degree of respiratory symptoms such as breathlessness, cough, sputum production, and wheezing.
- A pulmonary function test
- A chest x-ray
- A nasal and skin examination
- A qualitative test to determine if arsenic is present in the blood. If arsenic is found to be present, a second, quantitative, blood test will be given to determine the concentration of

- arsenic in the workers blood.
- Other examinations which the physicians believe appropriate because of the employee's exposure to inorganic arsenic or because of required respirator use.

AAA Environmental, Inc. will provide the above examinations at least annually for covered employees less than 45 years of age with fewer than 10 years of exposure over the action level, without regard to respirator use. AAA Environmental, Inc. will provide examinations at least semiannually for other covered employees. Whenever a covered employee has not taken the specified examinations within six months preceding the termination of employment, AAA Environmental, Inc. will provide such examinations to the employee upon termination of employment.

AAA Environmental, Inc. will provide additional examinations or emergency medical treatment if an employee develops symptoms or signs commonly associated with exposure to inorganic arsenic.

AAA Environmental, Inc. will provide the following items to the examining physician:

- (1) 29 CFR 1910.1018 - Arsenic standard;
- (2) A description of the affected employee's duties as they relate to the employee's exposures;
- (3) Employee's anticipated or representative exposure levels;
- (4) Description of personal protective equipment used or to be used;
- (5) Information from previous medical examinations of the affected employee(s) which is not readily available to the examining physician.

AAA Environmental, Inc. shall have on file a written opinion from the examination physician which will include:

- (1) Medical examination and test results performed on the employee;
- (2) The physician's opinion as to whether the employee has any detected medical conditions which would place the employee's health at increased risk of material impairment from exposure to inorganic arsenic;
- (3) Any recommended limitations upon the employee's exposure to inorganic arsenic or upon the use of protective clothing or equipment such as respirators, and;
- (4) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which required further explanation or treatment;
- (5) AAA Environmental, Inc. will instruct the physician not to reveal in the written opinion specific findings or diagnosis unrelated to occupational exposure and;

- (6) AAA Environmental, Inc. will provide a copy of the written opinion to the affected employee.

AAA Environmental, Inc. maintains an accurate record of all monitoring required by the Medical Surveillance Program. This record contains:

- (1) The name, social security number, and description of duties of the employee.
- (2) A copy of the physician's written opinion.
- (3) Results of exposure monitoring done for the employees and the representative exposure levels supplied to the physician.
- (4) Any employee medical complaints related to exposure to inorganic arsenic.

AAA Environmental, Inc. will assure that the examining physician will keep employee medical records from all examination as part of this Medical Surveillance Program. These records shall be kept for at least 30 years past the last date of employment.

AAA Environmental, Inc. will make available upon request all records required to be maintained to OSHA, employees, and their designated representatives.

Whenever AAA Environmental, Inc. should cease to do business, the successive employer shall receive and retain all records required to be maintained by this section. Whenever AAA Environmental, Inc. should cease to do business and there is no successive employer, the records required to be maintained shall be transmitted to the Director of OSHA.

At the expiration of the retention period for the records required to be maintained, AAA Environmental, Inc. will notify the Director of OSHA at least three (3) months prior to the disposal of such records and shall transmit those records to the Director if he requests them within the three month period.

All OSHA regulations and amendments pertaining to arsenic are available for the employee's review.

Lead

AAA Environmental, Inc. maintains a Medical Surveillance Program that is as stringent as OSHA Regulations 29 CFR 1926.62 for workers exposed to lead. A summary of the program follows.

All employees who are exposed to lead at or near the OSHA action level, (30 micrograms per cubic meter), are part of the medical surveillance program for lead. AAA Environmental, Inc.

will assure that all medical examinations and procedures are performed by or under the supervision of a licensed physician.

Biological monitoring in the form of blood sampling and analysis for lead levels will be made available to all employees who are part of the medical surveillance program for lead. The tests will be conducted every six (6) months. Employees whose last blood sampling and analysis indicated a blood lead level at or above 40 micrograms per 100 grams of whole blood (ug/dl) will receive tests every month. This frequency will be continued until two consecutive blood samples and analysis indicates a blood lead level below 40 ug/dl. Testing will be conducted monthly during the removal period of each employee removed from exposure to lead due to an elevated blood lead level.

Whenever the results of a blood lead level test indicate that any employee's blood level exceeds the AAA Environmental, Inc. medical criterion of 40 ug/dl for medical removal, AAA Environmental, Inc. will provide a second (follow-up) blood sampling test within two weeks after the employee receives the results of the first sampling test.

The testing laboratory analyzing the blood samples will be as described in 29 CFR 1926.62.

AAA Environmental, Inc. will notify all employees with blood levels in excess of 40 ug/dl within five (5) working days after receipt of the biological monitoring.

The frequency of medical examinations for covered employees will be as follows:

- At least annually for each employee for whom a blood sampling test conducted at any time during the preceding 12 months indicated a blood lead level at or above 40 ug/dl.
- Prior to assignment for each employee for the first time to an area in which airborne concentrations of lead at or above the action level for 30 days per year.
- As soon as possible after an employee notifies AAA Environmental, Inc. of signs or symptoms normally associated with lead intoxication.
- As medically appropriate for each employee removed from exposure to lead.

Medical examinations for lead for covered employees shall include the following elements:

- (A) A detailed work history and a medical history.
- (B) A thorough physical examination with particular attention to teeth, gums, hematologic gastrointestinal, renal, cardiovascular, and neurological systems. Pulmonary status should be evaluated if respiratory protection will be used.

(C) A blood pressure measurement.

(D) A blood sample and analysis which determines:

- (1) Blood lead level
- (2) Hemoglobin and hematocrit determinations, red cell indices, and examination of peripheral smear morphology
- (3) Blood urea nitrogen
- (4) Serum creatinine

(E) A routine urine analysis with microscopic examination

(F) Any laboratory or other test which the examining physician deems necessary by sound medical practice. The content of medical examinations for employees with lead intoxication symptoms and those that have been removed due to elevated blood lead levels shall be determined by an examining physician and, if requested by an employee, shall include pregnancy testing or laboratory evaluation of male fertility.

OSHA has established a complex set of regulations pertaining to multiple medical review and removal of employees with elevated blood lead levels and are detailed in 29 CFR 1926.62 and in 29 CFR 1910.1025 (j)(3)(iii)(vi) and (k).

AAA Environmental, Inc. has established and maintains an accurate record of all monitoring required in the Medical Surveillance Program. These records are kept for at least 30 years past the last date of employment. This medical surveillance program is part of the required recordkeeping. In addition, the record shall include:

- (A) The name, social security number, and description of duties of the employee.
- (B) A copy of the physician's written opinions.
- (C) Results of any airborne exposure monitoring done for that employee, and the representative exposure levels supplied to the physician.
- (D) Any employee medical complaints related to lead.

AAA Environmental, Inc. will assure that the examining physician or AAA Environmental, Inc. will keep and maintain all medical records of examinations and tests for exposure to lead.

AAA Environmental, Inc. will establish and maintain an accurate record for each employee removed from current exposure to lead.

AAA Environmental, Inc. will make available upon request, all records required to be

maintained to OSHA and to employees and their representatives.

Whenever AAA Environmental, Inc. ceases to do business, the successor employer shall receive and retain all required records. Whenever AAA Environmental, Inc. ceases to do business and there is no successor employer, all records will be transferred to the Director of OSHA. At the expiration of the retention period for the records required to be maintained by this section, AAA Environmental, Inc. will notify the Director of OSHA at least three (3) months prior to the disposal of such records to the Director if requested within the period.

PCBs

AAA Environmental, Inc. maintains a Medical Surveillance Program for workers exposed to hazardous levels of PCBs. When working with hazardous levels of PCB's the worker receives a medical examination that asks for a medical history and contains the following tests:

- Pulmonary function test
- Chest x-ray
- Physical exam with focus on the skin and liver
- Triglycerides and cholesterol
- Serum PCB levels
- Liver function

On Completion of the project, a worker receives follow-up blood work that includes:

- Serum PCB levels
- Liver function

Silica Dust

AAA Environmental, Inc. maintains a Medical Surveillance Program for workers exposed to dust containing crystalline silica. Before a worker is exposed to hazardous levels of silica containing dust, he receives a medical examination that asks for a medical history and contains the following tests:

- A pulmonary function test
- A chest x-ray

This comprehensive medical examination is given annually to AAA Environmental, Inc. employees exposed to silica dust at hazardous levels.

Other Hazardous Materials

As the need arises, AAA Environmental, Inc. develops and implements medical surveillance procedures when workers could be exposed to chemicals other than those previously listed. Medical tests and examinations are given to workers at the advice of AAA Environmental, Inc.'s physician and according to OSHA Regulations 29 CFR part 1910 (general industry) or part 1926

(construction).

The basic AAA Environmental, Inc. physical is comprehensive and generally is sufficient to monitor workers who are exposed to such chemicals as corrosives, oxidizers, solvents, and oils. However, specific tests, when available for particular chemicals or substances, will be provided to monitor the health of AAA Environmental, Inc. employees when appropriate.

AAA ENVIRONMENTAL, INC.

MEDICAL RELEASE AUTHORIZATION

To Whom It May Concern:

I hereby request and authorize any licensed physician, medical practitioner, hospital, clinic or other medical or medically related facility, insurance company or other organization, institution or person that has any knowledge, records or knowledge of me to disclose, whenever requested to do so by AAA Environmental, Inc. or its representative, any and all medical information in your custody including but not limited to records, reports correspondence, x-rays, MRI's, tests, office notes, itemized bills, treatment dates or other information. A photostatic copy of this authorization shall be considered as effective and valid as the original.

Employee Name:

D.O.B.

S.S.#

Signed:

Date:

Witness:

SECTION 2.07 RECORD KEEPING AND POSTINGS

Scope and Objectives

Records must be maintained and kept up to date by the Supervisor at each job site and/or the Main office. These records must be available for review at all times. The following records must be maintained:

1. Reports of all injuries and accidents (main office).
2. OSHA Log, Form 300 (main office and on any long-term jobsite, i.e.>30 days).
3. Job Site Safety Inspections (job site and main office).
4. Records of Tool Box Talk and any training meetings, including names and signatures of employees who were present (job site and main office).
5. Equipment inspections and preventative maintenance records (main office).
6. Hazard Communications Program with Material Data Sheets and the NYS Right to Know Poster (job site).
7. Records of training certifications, medical clearance, respiratory protection clearance and fit test (if applicable).
8. The AAA Environmental, Inc. Health and Safety Plan (HASP) (job site).
9. The Site Specific Health and Safety Plan or Job Safety Analysis (JSA).
10. Emergency Telephone Numbers Poster (job site).
11. Mini Poster – includes Equal Employment Opportunity, Minimum Wage, Employee Polygraph Protection Notice and OSHA – Job Safety and Health (job site and main office).
12. The company's Equal Employment Policy (job site and main office).

SECTION 3.03 EMERGENCY RESPONSE PLAN

Scope and Objectives

The purpose of this program is to describe appropriate actions to be taken in the event of a fire or other emergency at a AAA Environmental, Inc. work site. Nearly all of AAA's work is performed away from our shop(s), therefore the following procedures will protect AAA employees on the work site, in the event of an emergency.

Responsibilities

The job supervisor has the primary responsibility to find out what emergency procedures are in place at the work site. Our work takes us to various customers, and each has specific fire, emergency, and evacuation procedures. The Job Supervisor must find these out prior to the start of work, and get his information into the hands of the work crew. The Job Supervisor then must make sure those procedures are followed. Employees have the responsibility to follow those procedures.

Fire and Emergency Procedures

In the event of an emergency, employees may be directed to evacuate the facility. An emergency could be defined as a natural disaster, a fire, or a chemical emergency. Alarm systems may include plant alarms, air horns, radios or verbal instruction. Employees must gather in a location designated by the job supervisor and the supervisor will take roll. At remote operations the client's emergency plans and exits will be followed.

In the event of a fire in a hazardous materials job (chemical clean-up, asbestos, etc.) employees are to proceed to the nearest exits. These could be through the decontamination areas, or through a designated emergency exit. On asbestos jobs the emergency exits should be marked with duct tape or paint. During an emergency, decontamination procedures may be minimized or bypassed. Proceed to the designated meeting area so that the job supervisor may locate any missing employees. If a remote shower has been designated you will now proceed there. If a remote shower has not been identified, isolate yourself from any other evacuees until one has been designated. This may mean the use of a temporary or portable trailer for decontamination.

The reentry into a controlled area after an emergency must be done with caution. The site safety and health officer or competent person must assess the damage and determine what personal protection is required and the extent of the damage. This may include air monitoring to determine air concentrations in adjacent areas or the procurement of additional equipment and supplies.

In the event of an injury, First Aid should be provided.

If AAA Environmental, Inc. was involved in any way in causing the emergency, a thorough investigation must take place. Careful documentation of the investigation is essential.

SECTION 3.04 HAZARD COMMUNICATION PROGRAM

Purpose

The purpose of this policy is to set forth minimum standards for the administrative controls regarding potential chemical hazards.

Scope

This policy is intended to cover all AAA Environmental, Inc. employees who may have an actual or a potential exposure to hazardous chemicals. Training will orient employees to this policy, the Occupational Health and Safety Administration's (OSHA) Hazard Communication Standard (HCS), the Right-to-Know Law of New York State, and to potential chemical hazards that may exist in their work environments. This policy will come under annual review by the Health and Safety Department.

This written program is available to all employees of the company. Its contents are to be specifically reviewed with those workers who regularly handle hazardous materials, who may be exposed to leaks and spills, or whose duties may take them into areas where these materials are stored or used.

Responsibilities

The overall responsibility for implementation and maintenance of this program will rest with the Health and Safety Manager who serves as the Hazard Communication Officer.

It shall be the responsibility of the Operations Manager and the Supervisors to maintain this program at their level and ensure that employees are educated in and comply with its requirements.

It is the responsibility of all employees of the company to familiarize themselves with this program, to comply with its requirements, and to handle all chemicals so as not to expose themselves or others to hazards.

Handling Procedures for all Material Safety Data Sheets (MSDSs)

The Health and Safety Manager will ensure that a Material Safety Data Sheet (MSDS) is maintained for each item in the Hazardous Material Inventory. A master set of current and archived MSDS sheets will be maintained in the Health and Safety Department.

The Operations Managers and Supervisors will maintain a file of MSDS's for items in their inventory. New MSDSs will be posted in a conspicuous place and brought to the attention of all

employees in the department. A copy of the new MSDS will also be forwarded to the Health and Safety Department.

Employees will familiarize themselves with each MSDS for materials to which they may be exposed. The Operations Manager and Supervisors will ensure that MSDS sheets will be reviewed with those employees who have limited or impaired reading ability.

It is the responsibility of any employee receiving a shipment of a chemical product to forward all MSDS's to the Health and Safety Department for proper filing and distribution.

If an MSDS is not received at the time of shipment then the person will notify the Health and Safety Department immediately. The following information will be needed in order to obtain the proper MSDS:

- Product name
- Name, address and telephone number of the distributor
- Date shipment was received by AAA Environmental, Inc.

The Health and Safety Manager will insure that all MSDSs are current, filed, and available to any worker who requests one.

A current MSDS binder containing all MSDSs for items in the Hazardous Material Inventory will be maintained and organized in alphabetical order by trade name. Also an archive MSDS binder or files containing all MSDSs for items previously in the Hazardous Material Inventory will be maintained and organized in alphabetical order by trade name. Both collections of information will be available to any employee for review of hazard information, but only relevant MSDS's will maintained at job sites. An employee may request a MSDS for any chemical they have used or been exposed to in the workplace by submitting the request in writing to the Health and Safety Department.

Labeling

All containers of materials subject to HCS will be labeled as follows:

- Identification of Material (As on MSDS)
- Type of hazard
- Safety precautions

This includes temporary containers such as Hudson Sprayers, etc.

Employees responsible for receipt of deliveries will refuse to accept shipments of known hazardous materials unless containers are correctly labeled.

Employees responsible for shipping these materials will ensure that each container is correctly labeled. Employee who transfers these materials to other containers will ensure that:

- the container is suitable for the material;

- the container is clean and dry; and
- the container is properly labeled.

Containers for immediate use on the site must also be labeled; at no time will unmarked containers be left when an employee completes the shift or departs the immediate work area.

All containers of chemicals that do not have a legible label will have one placed on them.

For any container to be cleaned and reused it must have the previous label either blanked out or removed. A substance incompatible with the product may not be used to clean the container or be placed or stored in the container after cleaning. Periodic inspections of labels will be carried out and any damaged or illegible labels will be replaced as needed. Any employee noticing any damaged or illegible labels will see that they are properly replaced.

Training

Training will inform each employee as to the specific hazards that may be present in his or her work environment. The format will follow the attached outline. Retraining will be conducted when it has been determined that the workplace hazards have changed.

The Health and Safety Manager will maintain training materials appropriate to the types of materials used by this company, and shall ensure that employees receive training suitable to their job duties.

Each employee will have a record of training received maintained by the Health and Safety Department.

Each new employee (or transferee) will receive training appropriate to their job duties. It is the responsibility of the hiring manager to coordinate the scheduling of training with the Health and Safety Department

Employee training sessions will include the following:

- Details of this Hazard Communication Program.
- Instruction on how to read and understand information contained in MSDSs:
- Methods to detect the presence of hazardous substances in the event of an unintended release.
- Any known health hazards to which the employee(s) may be exposed.
- Instructions for proper handling and use of these materials, including container labeling, use of protective equipment, and other safety precautions as necessary to minimize exposure.
- Location of emergency and first aid equipment and their use.
- Procedures to be followed for spills, fires, or other unintended releases of hazardous materials.
- Procedures for employees, their designated representatives, or medical personnel to obtain MSDS information and exposure records.

- Appropriate audio-visual materials as available.

Medical Response

Employees are to report exposures to materials subject to HCS which cause or may cause injury as they would for any other work related injury.

In emergency situations information concerning the materials to which the injured employee was exposed will be immediately communicated to medical personnel.

In non-emergency situations information on hazardous materials will be provided to medical personnel as requested to assist in their diagnosis and treatment of the employee, including medical exposure data. In all non-emergency situations, a written request for records will be made to this company in accordance with OSHA HCS Regulation 29 CFR 1910.1200 (I). Written documentation will be obtained from the medical provider as soon as practical following an emergency situation.

Employee Access to Medical Records

This company shall retain individual medical records and employee exposure records in accordance with OSHA Regulation 29 CFR 1910.1020. Medical records for individual employees shall be maintained in the employee's personnel file for duration of employment plus the time period specified in the regulation (currently 30 years).

General employee exposure records as regulated by any Federal law or rule and any records of voluntary measurement programs of this company shall be maintained by the Health and Safety Department for a period of time as specified in the regulations. (currently 30 years).

In the event that Material Safety Data Sheet records are purged and items are to be disposed of, a copy of the MSDSs maintained by the Operations Manager or Supervisor will be sent to the Health and Safety Department and filed there.

Employees or their designated representatives shall, upon written request, be given access to records within fifteen business days after the receipt of the request.

In the event a department shall cease to do business, the Health and Safety Manager shall ensure that records are maintained and transferred in accordance with OSHA regulations.

Sub-Contractors

Sub-contractors will be informed as to the materials to which they may be exposed while performing their work while on the premises.

Sub-contractors are required to have a Hazard Communication program in place and have

MSDSs available on the job site for any covered materials.

TRAINING OUTLINE

Purpose

The purpose of this training is to familiarize employees of AAA Environmental, Inc. with the use, purpose, and potential hazards of toxic and hazardous materials in use. This training is required by the New York State Right-to-Know Law and the OSHA Hazard Communication Regulation.

Regulations

The New York State Right-to-Know Law and the OSHA Hazard Communication Regulations require that employers maintain information regarding toxic and hazardous materials found in the workplace. This information is found in Material Safety Data Sheets (MSDSs) prepared by manufacturers, importers, and distributors of these materials. Employees are provided access to this information.

The regulations also require that manufacturers, importers, and distributors of these materials determine the nature of the hazards associated with the materials in order to complete the MSDSs correctly. Much of this information is technical in nature and employees must be trained to evaluate the information.

AAA Environmental, Inc. Operations

Hazardous materials used by AAA Environmental, Inc. include asbestos encapsulants, wetting agents, cleaning agents, paints, fuels and oils for equipment.

As a hazardous materials spill and hazardous waste contractor, AAA Environmental, Inc.'s operations sometimes involve dealing with various hazardous materials and wastes. The chemical identity of such materials may not always be known. The problems of dealing with such situations are covered in AAA Environmental, Inc.'s 40-hour HAZWOPER course "Hazardous Waste Operations and Emergency Response".

MSDSs

MSDSs are organized in binders which are kept on all job sites by AAA Environmental, Inc.

Supervisors and foremen. The sheets are organized in alphabetical order by trade name. Additional copies may be requested from the Health and Safety Department. MSDSs contain information in various sections.

A typical MSDS may be arranged by sections as shown below.

Section 1

Contains the manufacturer's name, address, and emergency phone number.

Section 2

Gives product identification information.

- Trade name
- Common name and synonyms
- Chemical family
- Molecular formula

Section 3

Lists hazardous ingredients, their percentage by weight, and the Chemical Abstracts Symbol Number (CAS #).

Section 4

Lists physical and chemical characteristics.

- Boiling point
- Melting point
- Vapor pressure
- Vapor density - relative to air (>1 heavier, <1 lighter)
- Solubility
- pH - acidic or basic
- Density - relative to water (>1 heavier, < 1 lighter)
- Evaporation rate
- Percent volatile - how much will evaporate
- Appearance and odor

Section 5

Gives fire and explosion hazard data.

- Flash point - temperature material must be to ignite with a source of ignition.
- Auto ignition temperature - temperature required for a source of ignition.
- Lower Explosion Limit (LEL) - lowest concentration in air that will ignite (lower is too lean)

Upper Explosion Limit (UEL) - highest concentration in air that will ignite (higher is too rich)
Extinguishing media - what to use
Special procedures
Unusual fire and explosion hazards

Section 6

Gives health hazard information.

- **OSHA PEL / ACGIH TLV** - OSHA's Permissible Exposure Limits (PEL's) and the American Conference of Governmental Industrial Hygienists Threshold Limit Values (TLV's) are limits of exposure usually given in milligrams of a material per cubic meter of air (mg/m^3) or parts per million (ppm) for an eight hour exposure.
- Routes of entry - inhalation, absorption, and ingestion
- Signs and symptoms of exposure
- Emergency first-aid procedures

Section 7

Gives toxicity information.

LC50 – Concentration in air (in ppm or mg/m^3) that will kill 50% (LC = Lethal Concentration) of test animals.

Oral LD50 - milligrams of material per kilogram of body weight to kill (LD = lethal dose) 50% of test animals when given orally.

Dermal LD50 - milligrams of material per kilogram of body weight to kill (LD = lethal dose) 50% of test animals when applied to skin.

Section 8

Gives reactivity data.

- Stability (chemical)
- Conditions to avoid
- Incompatibility
- Hazardous decomposition products
- Hazardous polymerization

Section 9

Gives spill, leak, and disposal guidance and procedures.

Section 10

Lists special protection and equipment necessary.

- Respiratory protection
- Protective clothing
- Eye and face protection
- Boots and gloves
- Ventilation
- Shower / eyewash

Section 11

Gives storage and handling precautions.
Lists any miscellaneous information.
Sheet should be dated.

An MSDS from a manufacturer may not follow this outline completely but it will contain all the same information.

Section 2.3

HAZARDOUS MATERIAL INVENTORY:

The following is a composite listing of the hazardous materials commonly in use at AAA Environmental, Inc. If a product in use is not on this list please contact the Health and Safety Department so a current MSDS sheet can be obtained for our files.

ABATEMENT SPRAY ADHESIVE AS100
ABC DRY CHEMICAL
ACETYLENE
ACRYL 60
ACTIVATED CARBON
AF9020 - GE SILICONE ANTIFOAM
AIR
AMYL ACETATE
ASBESTOS
ASBESTOS ENCAPSULATING PENETRANT (22-P)

BIO T MAX
BIOBLEND M-4
BITUMOUS FLY ASH
BIX TUFF-JOB
BLACK BEAUTY ABRASIVES
BLUE GREASE AERO 13 OZ NET WT

CAPSUR(R)
CARBON DIOXIDE
CARBON DIOXIDE DRY ICE SOLID ONLY

CARBON MONOXIDE-DYNAMATION
CARBON MONOXIDE IN AIR-SCOTT SPECIALTY
CAUSTIC SODA - see SODIUM HYDROXIDE
CERTANE 445 - CLEARCOAT
CERTANE 909
CERTANE 1000
CERTANE 1050
CERTANE 2075
CERTANE 4000 - LEADCOAT
CERTANE 4050
CITRIC ACID
CITROL
CLOR-D-TECT 1000 USED OIL SCREENING KIT
CLOR-N-OIL 50 PCB SCREENING KIT
CLOR-N-SOIL PCB SCREENING KIT
COMPRESSED AIR

COVERED ELECTRODE
CP-50A CHIL-SEAL(R)

DAYTON GO251 FLOOR FINISH
DAYTON GO253 FINISH REMOVER
DEFI-RUST ENAMEL
DIESEL FUEL
DUPONT TYVEK

ECO-MASTIC
EPA - 55 WETTING AGENT
EUCLID FLOOR COAT
EYESALINE CONCENTRATE

FIBERGLASS WOOL
FLY ASH - see BITUMINOUS FLY ASH
FOSTER 32-56 SPRAY POLY FLOOR
FOSTER 32-57 SPRAY POLY WALL
FOSTER 35-00
FOSTER 35-25
FOSTER 36-10
FOSTER 36-25 WEATHERITE MASTIC
FOSTER 60-80

GASOLINE, PREMIUM UNLEADED
GASOLINE, REGULAR UNLEADED
GENERAL CLEANER 940
GALAXY BLEACH - see SODIUM HYPOCHLORITE

HALON 1211
HEXANES
HG ABSORB
HORSEYSET EP II ACTIVATOR
HORSEYSET EP II PART B
HORSEYSET F PART A
HORSEYSET F PART B
HORSEYSET WDE PART A
HORSEYSET WDE PART B
HYDROGEN
HYDROGEN PEROXIDE, 35%

INDUSTRIAL PRODUCTS NON-CHLORINATED AEROSOL ADHESIVE

KEROSENE

LA - 190 AQUEOUS DEGREASER
LAV-GLO RESTROOM CLEANER
LUBRICONE 20 OZ NET WT

MARVEL AIR TOOL OIL
MERCONVAP
METHANE
MINERALS SPIRITS
MIRACLE PLUG - PLUG 'N DIKE
MONNEX DRY CHEMICAL
MP-6 INDUSTRIAL CLEANER
MP-6NP INDUSTRIAL CLEANER
MP-11 INDUSTRIAL CLEANER
MSA CLEANER-SANITIZER II
MSA PENTANE CALIBRATION
MSA VENTILATION SMOKE TUBES
MURATIC ACID, 20 DEGREE
MURIATIC ACID

NAPHTHA
NASHUA 398 SPRAY ADHESIVE
NON ASBESTOS FLASHING

OAKITE 31
OAKITE DISANITE
OAKITE FLEETLINE JC5
OAKITE NRP
OAKITE SPEEDET
OAKITE SUPER FOAM DET
ODOR BANE 5

ORANGE BLOSSOM
OXYGEN

PEEL - AWAY II
PEEL - AWAY 6
PIPE WRAP
PLASTIC SHEETING
PLIO-NAIL
POR-ROK ANCHORING CEMENT
PROPANE
PURPLE K DRY CHEMICAL
PYRO CHEM ABC MULTIPURPOSE

Q4 IN 1 DISINFECTANT

RELIABLE ODOR CONTROL
RESISORB - MERCURY VAPOR ABSORBENT

SAFESTEP SORBENT
SAFETY BOOSTERS
SAFETY KLEEN 105 PARTS WASHING SOLVENT
SAFETY KLEEN IMMERSION CLEANER AND COLD PARTS CLEANER 699
SEAL 341
SENTINEL 7200 MASTIC REMOVER
SERPIFLEX SHIELD
SHELLZONE ANTIFREEZE
SIERRA ANTIFREEZE COOLANT
SIGHT SAVERS BRAND ANTI FOG LIQUID
SILICA SAND
SMOKE TUBES
SMOOTH KOTE
SNO-N-ICE MELTER
SODA ASH
SODIUM BICARBONATE
SODIUM HYDROXIDE 50% LIQUID
SODIUM HYPOCHLORIDE
SODIUM SULFITE
SOIL WHIP
SPECTACULAR 915
SPRA - JEL
SPRAY LUBRICANT
SPRAY NINE
SSS EMULSION BOWL CLEANER
SSS STAINLESS STEEL CLEANER
SUPER D DRY POWDER
SUPERFLO 10W-30

SUPER WATER WETTER
SURE KLEEN #600 DETERGENT
SUPRAKLEEN
SWEEPING COMPOUND NO SAND

TECH 110
THOROSEAL
TORQUE FLUID 56
TRIPLE-ETCH 6877
TYPE X GYPSUM BOARD
TRI-SODIUM PHOSPHATE

ULTRASORB AND DIATOMITE SAFETY ABSORBENT - SPEEDI-DRI
UPRIGHT SAFETY SORBENT
U-TECH DRY STRIP
UTP ECONOCAST 99
VERSI-TITE

SECTION 3.06 LEAD PROGRAM

Introduction / Policy Statement

Lead is a basic chemical element. It has been used for thousands of years for piping, ceramic glazing and many other industrial uses. Lead adds strength and corrosion resistance to paints and industrial coatings, where we frequently encounter it during building maintenance, renovation and demolition.

Lead can be toxic in various ways to the nervous, muscular, urinary, reproductive, skeletal, and blood systems. Various regulatory programs have been developed to control activities, such as construction, demolition and building maintenance, that have potential to result in worker and/or environmental exposures to lead.

It is the policy of AAA Environmental, Inc. to comply with all rules and regulations affecting health, safety, and environmental issues. The purpose of this program is to provide guidance in meeting that goal when working with lead.

Health Hazards of Lead

Lead may enter the body by inhalation and ingestion. Most lead compounds are not absorbed through the skin. Once the lead enters the respiratory or gastrointestinal tract it is absorbed into the blood stream where it is circulated throughout the body and is stored in various organs.

Short term severe overexposure may lead to potent systemic poisoning. The symptoms are acute encephalopathy (swelling of the brain), seizures, coma, and death due to cardiac arrest. Muscular weakness may develop at the same time, which may lead to paralysis. This is often observed as a characteristic wrist or foot drop.

Long term overexposure may cause damage to blood forming cells, the nervous, reproductive, and urinary systems (especially the kidneys).

Common symptoms include the loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache and nervous irritability.

Worker Training

Lead worker training, certification, and licensing requirements differ depending upon the client and governmental agencies at the federal, state, and even local levels. It is the responsibility of the Project Manager or Engineer to ascertain the requirements for a particular jurisdiction and to plan for meeting those requirements for the project.

The following, minimum training program will be presented to AAA Environmental, Inc. workers prior to assignment to lead-related projects:

- A. The content of the OSHA Standard for Lead in the Construction Industry, 29 CFR 1926.62, including its appendices.
- B. The nature of operations that could result in personal exposure to lead.
- C. Training as required under the AAA Environmental, Inc. Respiratory Protection Program for the designated level of respiratory protection.
- D. The purpose and design of the AAA Environmental, Inc. Medical Surveillance Program for lead, the adverse health effects associated with excessive exposure to lead (including reproductive hazards, both male and female, and potential fetal and infant effects), and the medical removal protection program. This will also include instruction as to the inappropriateness of chelation therapy except under the direction of a physician.
- E. Engineering and work practice controls required by this program or elsewhere that will reduce the employee's exposure potential.
- F. The employee's rights of access to records under 29 CFR 1910.1020.
- G. The employee will be provided the OSHA Standard for lead in the Construction Industry, 29 CFR 1926.62, including its appendices.

AAA Environmental, Inc.'s lead abatement operations shall be undertaken only by personnel trained as above.

Medical Surveillance

AAA Environmental, Inc.'s policy for its' medical surveillance program for lead may be summarized as follows:

Employees exposed on any day above the action level, 30 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) as a time-weighted average (TWA)) are required to have the initial medical surveillance (biological monitoring) consisting of blood lead determination. Employees exposed at or above the action level for more than 30 days per year have to have biological monitoring every 2 months for 6 months and every 6 months thereafter plus full medical examinations. In addition to AAA Environmental, Inc.'s standard medical protocols for HAZWOPER employees, this standard requires a detailed history for past lead exposure and blood, kidney, circulatory, reproductive, or

neurological problems.

Medical removal protection

The OSHA standard and AAA Environmental, Inc.'s policy also dictate that an employee working on lead-related projects who demonstrates a blood lead of 50 ug/dl or higher must be removed from lead exposure. The standard and policy further require that the employee's wages are paid, seniority is maintained, and other employee rights and benefits are maintained. This section provides up to 18 months of such protection for each time an employee is removed from exposure.

AAA Environmental, Inc.'s policy is to provide continued non-lead-related employment to any employee whose blood lead monitoring triggers this policy.

Medical Surveillance

AAA Environmental, Inc. maintains a Medical Surveillance Program that complies with OSHA Regulation 29 CFR 1926.62 for workers exposed to lead. A summary of the program follows.

All employees who are exposed to lead at or near the OSHA action level, (30 micrograms per cubic meter), are part of the medical surveillance program for lead. All medical examinations and procedures will be performed by or under the supervision of a licensed physician.

Biological monitoring in the form of blood sampling and analysis for lead levels will be made available to all employees who are part of the medical surveillance program for lead. Employees whose last blood sampling and analysis indicated a blood lead level at or above 40 micrograms per 100 grams of whole blood (ug/dl) will receive free tests every two (2) months. This frequency will be continued until two consecutive blood samples and analysis indicates a blood lead level below 40 ug/dl. Testing will be conducted monthly during the removal period of each employee removed from exposure to lead due to an elevated blood lead level.

Whenever the results of a blood lead level test indicate that any employee's blood level exceeds the AAA Environmental, Inc. medical criterion of 40 ug/dl for medical removal, AAA Environmental, Inc. will provide a second (follow-up) blood sampling test within two weeks after the employee receives the results of the first sampling test.

The testing laboratory analyzing the blood samples will meet the requirements described in the OSHA lead regulations.

AAA Environmental, Inc. will notify all employees with blood levels in excess of 40 ug/dl within five (5) working days after receipt of the biological monitoring.

The frequency of medical examinations for covered employees will be as follows:

- At least annually for each employee for whom a blood sampling test conducted at any time during the preceding 12 months indicated a blood lead level at or above 40 ug/dl.
- Prior to assignment for each employee for the first time to an area in which airborne concentrations of lead at or above the action level for 30 days per year.
- As soon as possible after an employee notifies AAA Environmental, Inc. of signs or symptoms normally associated with lead exposure.
- As medically appropriate for each employee either removed from exposure to lead.

Medical examinations for lead for covered employees shall include the following elements:

1. A detailed work history and a medical history.
2. A thorough physical examination with particular attention to teeth, gums, hematologic, gastrointestinal, renal, cardiovascular, and neurological systems. Pulmonary status should be evaluated if respiratory protection will be used.
3. A blood pressure measurement.
4. A blood sample and analysis which determines:
 - a. Blood lead level
 - b. Hemoglobin and hematocrit determinations, red cell indices, and examination of peripheral smear morphology
 - c. Blood urea nitrogen
 - d. Serum creatinine
5. A routine urine analysis with microscopic examination
6. Any laboratory or other test which the examining physician deems necessary by sound medical practice. The content of medical examinations for employees with lead exposure symptoms and those that have been removed due to elevated blood lead levels shall be determined by an examining physician and, if requested by an employee, shall include pregnancy testing or laboratory evaluation of male fertility.
7. Medical monitoring can be performed by taking blood samples and analyzing for lead content. The results are reported as micrograms of lead per 100 grams of blood. Blood lead results should be less than forty

micrograms of lead per 100 grams of blood.

AAA Environmental, Inc. will maintain an accurate record of all monitoring required in the Medical Surveillance Program. These records are kept for at least 40 years or for the duration of employment plus 20 years, whichever is longer. This medical surveillance program is part of the required recordkeeping. In addition, the record shall include:

1. The name, social security number, and description of duties of the employee.
2. A copy of the physician's written opinions.
3. Results of any airborne exposure monitoring done for that employee, and the representative exposure levels supplied to the physician.
4. Any employee medical complaints related to lead.

The examining physician or AAA Environmental, Inc. will keep and maintain all medical records of examinations and tests for exposure to lead.

AAA Environmental, Inc. will establish and maintain an accurate record for each employee removed from current exposure to lead.

AAA Environmental, Inc. will make available upon request, all records required to be maintained to OSHA and to employees and their representatives.

Personnel Exposure Assessment

Employee monitoring is required in order to establish exposure levels for OSHA compliance purposes whenever work practices and exposure potential indicate the need for such monitoring. AAA Supervisors/foremen will assure that personal air monitoring is representative of the exposure for each employee who is exposed to lead. This will require the identification of all job activities and full-shift monitoring that represents all identified activities.

Project air sampling plans will be developed by the AAA Project Manager in coordination with the Health and Safety Department for each project involving potential lead exposure. Employees will be notified in writing of the results of the representative monitoring.

Worker Hygiene Practices

Certain procedures and practices are basic to the prevention of worker exposure. Others minimize the risks of cross contamination between the work place and the worker's home or the environment by contaminants carried on the worker or his clothing.

A. Work Practices

Feasible work practice controls must be implemented in order to reduce worker exposures to the lowest possible level. The following are examples of work practice controls that must be implemented whenever appropriate:

1. HEPA vacuuming for cleanup of contaminated dust, dirt, and debris must be used. Dry sweeping should not be used.
2. Compressed air usage for cleanup is prohibited except when used with a capturing exhaust system.
3. Surfaces should be maintained as free as possible from accumulations of lead. The work area and any other area where exposure to lead or lead contaminated materials occurs should be cleaned at the end of each day of all visible contaminated materials.
4. Prior removal of lead paint from an area of a steel structural member that is to be torch cut.

B. Engineering Controls

Feasible engineering controls also must be implemented in order to reduce worker exposures to the lowest possible level. The following are examples of engineering controls that must be implemented whenever appropriate:

1. Powered hand tools (needle guns, roto peens, sanders, etc.) should be equipped with dust collecting hoods that can be attached to a HEPA vacuum.
2. Building containment systems with negative pressure ventilation designed to draw contaminants away from workers in abrasive blasting and other lead-based work activities.
3. Removing and replacing interior woodwork, window systems, etc. rather than scraping or other means to remove existing coatings.

C. Respiratory Protection

Respiratory protection for lead operations must be implemented in accordance with the AAA Environmental, Inc. Respiratory Protection Program and the OSHA Standard for lead in the Construction Industry, 29 CFR 1926.62.

Half-face air-purifying respirators and PAPR's will be the respirators of choice for manual or power tool removal. An employee may request a PAPR if he so chooses and it

provides adequate protection.

Special respirators will be required for abrasive blasting operations (supplied air respirators).

Whenever a chemical stripper (for example, a solvent or caustic material) is used, the use of a combination cartridge appropriate to the exposure may be warranted unless a supplied-air respirator is used.

OSHA set maximum use concentrations for respirators in this standard also, these are:

- < 10 x PEL for the half face
- < 50 x PEL for the full face.
- < 1000 x PEL for the PAPR.
- < 2000 x PEL for supplied air with a full face piece.
- > 2000 x PEL for SCBAs.

D. Protective Work Clothing and Equipment

AAA Environmental, Inc. shall provide protective clothing. During lead abatement and cleaning operations all persons in the work area shall, at a minimum, wear the following protective disposable clothes: Full-body coveralls ("Tyvek") with hood, hard hat, protective eyewear, boot or shoe covers, gloves, and respirator as required.

E. Hygiene Facilities

Clean change areas with storage facilities, showers, and eating facilities are required when exposures exceed the PEL. Hand and face washing facilities are required for any lead exposure areas.

All hygiene facilities should be located as close to the work area as feasible to minimize contamination migration caused by worker traffic.

Employees shall not be permitted to eat, drink, smoke, chew (gum or tobacco), or apply cosmetics in the work or changing area.

F. Signs

Signs warning that lead abatement operations are being conducted shall be posted at all approaches to the work area. Such signs shall include the words:

**WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING**

in bold lettering not smaller than 2 inches tall, with additional language that may be required by a particular jurisdiction.

Recordkeeping

Records from lead-related projects that are personnel and/or safety and health related must be maintained for at least 30 years. This includes training, medical surveillance, exposure monitoring, compliance plans, and respirator program records.

Exposure Limits and Air Monitoring For Lead

According to the OSHA Lead Standard, the action level is set at thirty ug/m^3 (micrograms per cubic meter) of air and the PEL is set at 50 ug/m^3 . Above the PEL warning signs are to be posted.

Air monitoring is performed by the NIOSH 7082 method, which utilized a thirty-seven millimeter cassette, attached to a personal air sampling pump set to draw one to four liters of air per minute. The minimum volume is 200 liters, the maximum is 1200 liters of air.

AAA ENVIRONMENTAL, INC.

OSHA LEAD STANDARD (CONSTRUCTION) 29CFR1926:62

SECTION 3.07 MEDICAL SERVICES AND FIRST AID

Introduction

OSHA requires that first aid services and provisions for medical care will be made available for each employee. This section has been developed pursuant to the regulatory requirements in 29 CFR 1910.151 and 29 CFR 1926.50.

General Information

AAA Environmental retains a licensed Medical Doctor as its primary medical advisor and for consultation on matters of occupational health. Regional offices may also have local medical facilities retained. The Safety Manager can be contacted for this information.

In the absence of emergency medical services that are reasonably accessible in terms of time and distance and which are available for the treatment of injured employees, a person who has a valid certificate in first-aid training shall be available at the worksite to render first aid.

Reporting Emergencies

1. Whenever a medical emergency arises, the person reporting the incident should go to the nearest telephone and call for assistance. If possible, the person reporting the incident should be prepared to clearly provide the following information:
 - a. Name of the caller and extension number from which the call is being placed.
 - b. The nature of the emergency and apparent degree of urgency.
 - c. Precise location of the person who is injured or ill.
 - d. Name of the person who is injured or ill.
2. Until the arrival of the emergency response personnel, the employee reporting the incident should disperse curious bystanders, and designate someone to direct emergency response personnel to the scene.

3. In all cases, the incident will be reported using the Field Report of Accident Form.

Field Emergencies

1. Provisions will be made by the Project Manager, Superintendent or Foreman prior to commencement of the project for prompt medical attention in case of serious injury. Treatment for work-related injuries of a non-serious nature will be coordinated through a local occupational medicine provider whenever possible.
2. In the absence of an infirmary, clinic, hospital, or physician, that is reasonably accessible in terms of time and distance to the worksite, a person who has a valid certificate in first-aid training will be available at the worksite to render first aid.
3. First-aid supplies will be easily accessible when required. The first-aid kit will consist of materials in a weatherproof container with individual sealed packages for each type of item. The contents of the first-aid kit will be checked by the Project Manager, Superintendent or Foreman before being sent out on each job and at least weekly on each job to ensure that the expended items are replaced.
4. The Project Manager, Superintendent or Foreman is responsible for obtaining proper equipment for prompt transportation of the injured person to a physician or hospital, or implementing a communication system for contacting necessary ambulance service.
5. The telephone numbers of the physicians, hospitals, or ambulances will be conspicuously posted on every jobsite.
6. All medical treatment for work-related illness or injury will be reported to the Health and Safety Department immediately.

Procedures

1. General Procedures
 - a. Assess the scene. Do not become an additional victim.
 - b. Notify a designated first aid-trained person.
 - c. Do not move the victim unnecessarily.
 - d. The trained first aid-trained person will provide the appropriate emergency first aid, using Universal Precautions against Bloodborne Pathogens.
2. Clothing Fire
 - a. Prevent the victim from running. Stop, Drop and Roll.
 - b. Roll the victim on the floor and wrap in a blanket or coat.
 - c. Douse the victim with water or use an emergency shower.

- d. DO NOT remove wet or burned clothing from the victim's burned areas.
3. Burns from Acids, Caustics, or Other Chemicals
 - a. Immediately move the victim under an emergency shower or running water.
 - b. In the absence of instructions on skin burns, keep the victim under the shower for a minimum of 20 minutes and remove clothing. Provide modesty blankets, towels or clothing.
 - c. Consult the Material Safety Data Sheet.
 4. Over-exposure to Vapors, Fumes, or Gases
 - a. Move over- exposed person(s) to fresh air as quickly as possible.
 - b. If vapors or gases have penetrated clothing and/or are causing skin irritation, immediately get victim under a shower and have clothing removed.
 - c. Have overexposed workers report to a physician for examination.
 - d. Provide the physician with the material safety data sheet and information about the incident.
 - e. Call for medical attention AT ONCE if any symptoms occur after working hours. Some materials have delayed action symptoms.
 5. Electric Shock
 - a. De-energize the circuit. If not possible, use a non-conductor (dry wood, clothing) to remove the electrical source from the victim.
 - b. If the victim is not breathing or has no pulse, a person with a valid CPR certificate should administer CPR.
 - c. If the victim is in water, ensure that no exposed wires are in or near the water.
 - d. DO NOT move the victim unless there is no other way to stop the current flow.

Bloodborne Pathogens

OSHA, in 29 CFR 1910.1030, has set requirements regarding all occupational exposure to blood or other potentially infectious materials. While these requirements are geared towards the health care profession, exposures during first aid procedures may bring employees into contact with potentially infectious materials. Therefore, this section constitutes the Exposure Control Plan as required by the regulation.

1. This exposure control plan will be reviewed annually and whenever necessary to reflect new or modified tasks and procedures which affect occupational exposures and to reflect new or revised employee positions with occupational exposure.
2. Potentially, all employees trained in first aid may have exposure to infectious materials.

3. Handwashing facilities or appropriate antiseptic hand cleanser in conjunction with clean cloth/paper towels or antiseptic towelettes will be available on all jobsites.
4. All employees will wash their hands immediately after potential exposure to infectious materials.
5. No eating, drinking, smoking, or applying cosmetics or lip balm is allowed in first aid areas.
6. Personal protective equipment, such as gloves and CPR shields will be available with all first aid kits.
7. Personal protective equipment will be used by employees who are trained in first aid to prevent blood or other potentially infectious materials to pass through or reach the employee's work clothes, skin, eyes, mouth, or other mucous membranes under normal conditions of use and for the duration of time which the protective equipment will be used.
8. If a garment (including gloves) is penetrated by blood or other potentially infectious materials, the garments will be removed immediately or as soon as feasible and isolated.
9. All equipment and working surfaces will be cleaned and decontaminated with an appropriate disinfectant immediately or as soon as feasible when surfaces are overtly contaminated by any spill of blood or other potentially infectious body fluids.
10. Any employee exposed to bloodborne pathogens who wishes a hepatitis B vaccination may have it provided at no cost to them
11. After an exposure incident, a confidential medical evaluation and follow-up will be made available to the exposed individual.
12. Affected employees will receive training on bloodborne pathogens at least yearly or when new tasks or procedures will affect the employee's occupational exposure.

Section 3.09 Noise and Hearing Protection

Introduction

The preferred method of hearing protection is to eliminate or reduce the noise hazard. Whenever it is not feasible to reduce the noise levels or duration of exposures to those specified in Table 1, Permissible Noise Exposures, AAA Environmental, Inc. employees shall wear hearing protectors.

Monitoring

When activities warrant investigation, the Health and Safety Department will survey work areas to determine background sound levels as well as personal exposure levels to determine if hearing protectors must be used. Employees may observe any noise measurements conducted, if they so desire.

A copy of the Occupational Noise Exposure Standard and Hearing Conservation Amendment can be obtained from the Health and Safety Office, upon written request.

Hearing Protection Specifications

A variety of hearing protectors will be available (plugs and muffs) to employees exposed to an eight-hour time-weighted average of 85 decibels or greater on the A-weighted scale.

Hearing protectors must attenuate employee exposure at least to an eight-hour time-weighted average of 90 decibels, A-weighted.

The Noise Reduction Ratings (NRR) listed on packages of hearing protection were

developed under best-case laboratory situations. The actual sound level reduction that the employee is experiencing (called Field Attenuation) can be estimated by the following equation:

$$\text{Field Attenuation (in decibels, dBA)} = \frac{\text{NRR} - 7}{2}$$

Subtract Field attenuation from actual noise levels to estimate actual employee exposure.

Issuance of Hearing Protectors

Hearing protection is supplied by the company. Each employee is responsible for bringing theirs to the jobsite, as well as wearing them. Replacements may be obtained as necessary.

Use

1. Formable plugs should be rolled and compressed into a very thin cylinder. Reach around the head to pull the ear outward and upward during insertion. This straightens the ear canal. While compressed, insert the plug well into the ear canal.
2. Pre-molded plugs should be inserted by reaching around the back of the head to pull the ear outward and upward while inserting the plug until it feels like it's sealed.
3. The fit of ear plugs can be checked by pressing firmly cupped hands over your ears while listening to a steady noise. With properly fitted plugs, the noise levels should be about the same whether or not the ears are covered.
4. Earmuffs must fully enclose the ears to seal against the head. Adjust the headband so the cushions exert even pressure around the ears. Pull hair back and out from beneath the cushions.

Care and Cleaning

1. Keep formable plugs and ear muff cushions clean and free from material that can irritate the ear canal. Formable plugs and ear muff cushions may be washed in a mild detergent and warm water. Squeeze excess water from the plugs and air dry. Discard plugs if they harden or do not return to their original size and shape.
2. Ear muff cushions normally need replacing whenever they become stiff, cracked, or do not seal.

TABLE -1 - OSHA PERMISSIBLE NOISE EXPOSURES

Duration per day, hours

Sound level, dBA, slow response

8 -----	90
6 -----	92
4 -----	95
3 -----	97
2 -----	100
1 1/2 -----	102
1 -----	105
1/2 -----	110
1/4 or less -----	115

SECTION 3.11 RESPIRATORY PROTECTION PROGRAM

1. Scope and Objectives

AAA's respiratory program describes the conditions under which respiratory protection may be used by AAA Environmental, Inc. ("AAA") employees. Respiratory protection is any device intended to protect the user from airborne contaminants, oxygen deficiency or hazardous atmospheres. The respiratory protection program for AAA employees will establish guidelines with respect to respirator selection, training, care, fit testing, and usage. In this Program, information is presented with regard to:

- 1. Fit-testing procedures*
- 2. Training*
- 3. Medical evaluation*
- 4. Selection of the proper respirator*
- 5. Use of air-supplied respirators*
- 6. Maintenance and care of respirators*
- 7. Assignment of respirators*
- 8. Facial hair and other factors affecting proper fitting*
- 9. Loaning of equipment*
- 10. Standard Operating Procedures*
- 11. Corrective Lenses*

2. Responsibilities

- Administration of the AAA's Respiratory Protection Program will be the responsibility of the Health and Safety Department.
- Implementation of this program will be the responsibility of all job Supervisors and employees.
- All exceptions or special situations must be discussed with and cleared by the Manager of Health and Safety.

3. Types of Respirators Used by AAA Employees

Table 1 lists examples of various types of respiratory protection currently used by AAA personnel. All respirators used by AAA personnel will be NIOSH/MSHA certified. They will be used and maintained in a manner as to maintain the NIOSH/MSHA Certification. Improper respirator use may result in disciplinary action.

TABLE 1: EXAMPLES OF RESPIRATORY PROTECTION

Half-face negative pressure air-purifying respirators (APRs)
Full-face negative pressure air-purifying respirators
Full-face supplied air respirators (SARs)
Powered air-purifying respirators (PAPRs) - full-face and half-face
Supplied-air sand-blasting helmets
Full-face air-supplied-airline respirators with cartridge egress
Full-face air-supplied airline respirators with SCBA escape bottle
Self-contained breathing apparatus (SCBA)

Prior to using any respirator, a AAA employee will be properly trained in the use of the respirator, obtain a medical clearance and be fit-tested.

4. Fit-Testing

With all negative pressure air-purifying respirators, a slight negative pressure is generated in the facepiece whenever the user inhales. If the perimeter of the facepiece is not sealed well to the face, contaminated air can enter the face-piece and be inhaled by the user. Therefore, all employees who use negative pressure respirators will be tested to ensure that the mask assigned to them actually fits their face. AAA uses qualitative fit-test procedures when assigning respirators. The initial fit-test on an employee will be conducted using Isoamyl Acetate (banana oil) or Irritant Smoke as described in Appendix A and Appendix B of the Occupational Safety and Health Administrations' asbestos regulation part 1926, Construction Industry Standard (see Appendix A and Appendix B of this program). Caution should be exercised when administering the irritant smoke test because it causes an involuntary cough reflex if the mask does not fit well.

Once employees are fit-tested and trained for a particular mask, and they have been evaluated by a physician, they are assigned that model of respirator for their personal use.

If an employee is required to use a full-face respirator a fit-test will be done to determine which full-face mask fits him/her best

Fit-testing is required on all tight-fitting respirators as of 4/98, whether or not the respirator operates in a negative pressure or positive pressure modes. Therefore, fit tests will be conducted on supplied-air respirators as well.

Qualitative fit testing will be performed every twelve (12) months.

TABLE 2: RESPIRATORS REQUIRING QUALITATIVE FIT-TESTING

Survivair, Glenaire, MSA half-face negative pressure air-purifying respirators (APRs)
MSA full-face negative pressure air-purifying respirators
Racal powered air-purifying respirators (PAPRs)
MSA pressure-demand supplied airline respirator (SAR) with escape air bottle
MSA pressure-demand airline respirator with cartridge egress
Survivair pressure-demand SCBA
Continuous flow sandblasting hood

5. Respirator Training

Prior to being assigned and using a respirator AAA employees will receive specific training for their assigned respirator.

Respirator training will address the following areas:

- A. *Selection of appropriate respirator*
- B. *Donning instructions*
- C. *Fit-checking*
- D. *Limitations of the respirator*
- E. *Removal and Decontamination Procedures*
- F. *Maintenance and care*
- G. *Special instructions for each type of respirator to be used by an employee*

The general outlines of training classes for various types of respirators are included in this Program as Appendix C. Brief descriptions and highlights of the topics covered in the training sessions are presented below.

6. Selection of Appropriate Respiratory Protection

Users will be trained in the fundamental issues involved in the selection of a respirator, including the nature and concentration of the contaminant, the amount of oxygen present, and exposure levels. On all projects, selection of the correct respirator is the responsibility of the project manager and AAA's Health and Safety Department. A complete discussion of the selection criteria and process is presented later in this program.

7. Donning Instructions

Each employee will be trained in the correct way to don (put on) a respirator. Information will be provided with regard to a pre-use inspection of the device, ensuring that all parts, valves, and straps are functioning properly. Information will also be provided concerning properly seating the air-purifying cartridge, positive fit-checking, and negative fit-checking.

8. Positive and Negative Fit-Checks

Two methods of evaluating the face to facepiece seal during donning will be communicated to employees. The positive-pressure fit-check involves covering the exhalation valve port with the base of the thumb, and exhaling gently. If the mask bulges slightly, away from the face, under the positive pressure and does not leak, the mask passes the positive pressure fit check.

The negative-pressure test involves covering the inlets to the air-purifying cartridges with the palms of the hands, and inhaling gently. The negative pressure fit check passes if the mask collapses against the face and does not leak. Employees will be instructed to check the fit of their mask each time they don the respirator. These tests will not be used to qualitatively fit-test employees, but only to evaluate the extent to which the face to facepiece fit is achieved.

9. Limitations of Respiratory Protection

Users will be instructed on the conditions in which a particular respirator is inadequate or unsuitable for use. Examples may include oxygen deficient atmospheres, atmospheres containing eye or mucous membrane irritants, and atmospheres containing substances which fatigue the sense of smell or have poor warning properties.

Instruction will also be provided as to when the air-purifying element should be replaced. Users will be trained to be alert to a change in breathing resistance or the breakthrough of contaminant into the facepiece.

10. Removal Instructions

The manner in which a respirator is removed can contribute to the exposure of the individual. Training will be provided with regard to the situations in which the proper removal technique is important, and the manner in which removal should be accomplished. Training regarding decontamination procedures for the respirators will also be covered with each employee prior to assignment of a respirator. If decontamination procedures are different for a specific site these will be covered prior to use of respirators on that site by AAA personnel.

11. Maintenance and Care

A poorly maintained respirator will not provide the protection for which it was designed, therefore each user will be instructed in the proper care of their respirator, and be held accountable for its maintenance. Maintenance procedures are described later in this program.

12. Training for Specific Respirator Usage

The complete training agenda for each kind of respirator and category discussed above is contained in Appendix C of this program. All AAA personnel required to wear a respirator will be properly trained by a qualified instructor prior to using the different respirators in AAA's inventory.

13. Medical Evaluation

Prior to using a respirator, each employee will undergo an examination for fitness to wear respiratory protection. If an employee is deemed unable to wear a respirator by virtue of medical limitations, he or she will not (under any circumstances) be permitted to wear one.

The examining physician will inform the AAA of the results of the examination; including whether or not the individual is able to wear a respirator and if any special restrictions apply to the employee regarding respirator use. A more detailed description of the medical evaluation aspect of the Respiratory Protection Program can be found in AAA's Medical Surveillance Program.

14. Selection of the Proper Respirator

The correct respirator for each project shall be selected by the Health and Safety Office and approved by the Manager of Health and Safety after having been consulted by the project manager/salesman. It is the responsibility of the project manager and/or salesman to ensure the Health and Safety Office is informed of all aspects of the project that affect respirator selection and usage. The Health and Safety Office will select the appropriate respirator based on the following criteria:

- A. *The physical and chemical characteristics of the contaminant(s).*
- B. *The concentration of the contaminant(s).*
- C. *The nature of the work being performed.*
- D. *Prior experience with similar operations.*
- E. *The potential for unexpected catastrophic events.*
- F. *The physical characteristics, functional capabilities and limitations of the various types of respirators.*

A. Physical/Chemical Characteristics of the Contaminant

Consideration shall be given to the special characteristics of each substance for which protection is required. For example, if a substance is a mucous membrane irritant, then a full facepiece shall be worn to prevent eye irritation. If a substance has poor warning properties, or can paralyze the sense of smell, then an air-purifying respirator may only be worn if it is equipped with an approved end-of-service-life indicator.

It is important to consider hazards above and beyond those posed by inhalation of a

substance. Protection shall be provided against the whole range of effects inherent in exposure, and not just inhalation hazards. It is crucial to recognize the potential for oxygen deficient, explosive atmospheres, heat stress, and loss of mobility when considering respirator selection.

B. Concentration of Contaminant

When selecting a respirator, the Assigned Protection Factor (APF) shall be considered to be the upper limit of effectiveness (see Table 3). The APF is an index of the functional capability of the respirator, and is nothing more than the ratio of the contaminant concentration outside the facepiece to that inside the facepiece.

$$\text{Assigned Protection Factor} = \text{APF} = \frac{\text{Concentration outside facepiece}}{\text{Concentration inside facepiece}}$$

A respirator with an APF of 100 permits 1% of the contaminant to enter the facepiece. If the APF = 10,000, then only 0.01% of the contaminant is assumed to enter the facepiece, and be inhaled by the user. Use of the APF recognizes that no respirator provides absolute protection, and that other controls, such as work practice, engineering controls, and administrative controls are preferable to the use of respirators if practical. Respiratory protection shall be selected so that the assumed concentration inside the facepiece, as calculated with the APF, is less than the applicable exposure limit.

IN THE EVENT OF A POORLY DEFINED OR UNKNOWN LEVEL OF EXPOSURE, THE CHOICE OF A RESPIRATOR SHALL BE MADE ON THE BASIS OF THE MOST HAZARDOUS CONDITION AND CONCENTRATION TO WHICH THE USER MAY BE EXPOSED.

TABLE 3: TYPICAL ASSIGNED PROTECTION FACTORS

RESPIRATOR	APF⁽¹⁾	USE IN OXYGEN DEFICIENCY?⁽²⁾
Half mask negative pressure air purifying respirator (APR)	10	NO
Full face mask negative pressure air purifying respirator	50	NO
Powered air-purifying respirator w/HEPA cartridge (PAPR)	100	NO
Supplied-airline respirator (SAR), continuous flow with sandblasting hood	25	NO
Supplied-airline respirator, positive pressure-demand w/cartridge	2,000 on air 50 on cartridge	NO
Supplied-airline respirator, pressure-demand with escape bottle	1000 or more	YES
Self-contained breathing apparatus (SCBA), demand mode ⁽³⁾	50	NO ⁽⁴⁾
Self-contained breathing apparatus, pressure-demand mode ⁽³⁾	1000 or more	YES

NOTES:

- (1) APF is Assigned Protection Factor.
- (2) This column identifies those respirators that can be used in an oxygen deficient (less than 19.5% Oxygen) atmosphere.
- (3) The Survivair SCBA's used by AAA operate in the Demand mode when the regulator lever is in the DON position, and in the Positive Pressure Demand Mode when the regulator lever is in the USE position. These two air delivery modes have different APF's assigned to them.
- (4) When entering a work area while wearing a Survivair SCBA it should always be in USE mode.

Another way of using the APF is to calculate the Maximum Use Concentration (MUC) for a particular exposure situation. The MUC is defined as the highest concentration of a substance in which a particular respirator may reasonably be expected to reduce the exposure to or below the applicable exposure standard. The MUC is calculated by multiplying the exposure standard (such as an OSHA Permissible Exposure Limit (PEL) or Threshold Limit Value (TLV)) by the APF.

$$\text{Maximum Use Concentration} = \text{MUC} = (\text{PEL}) \times (\text{APF})$$

As an example, assume a half mask air purifying respirator (APR), with an APF = 10, was being used to control exposure to ammonia, for which the OSHA PEL = 50 PPM. The maximum concentration in which the half mask could be reasonably expected to reduce the exposure to below 50 PPM would equal

$$\text{MUC} = (\text{PEL}) \times (\text{APF}) = 50 \text{ PPM} \times 10 = 500 \text{ PPM}$$

Thus, if the ammonia concentration was expected to exceed 500 PPM, then a more protective respirator would have to be used.

C. Work Scope

In many cases, the nature of the work being performed will affect the selection process. For example, if the work requires mobility, then the least restrictive respirator that would provide the required protection would be selected. If the work was to be performed in a hot environment, and the user was going to be perspiring heavily, then the use of a PAPR may be required to afford a current of air to worker for cooling purposes.

A major consideration is access to and egress from confined spaces. The supplied air respirator (SAR) typically used would not be a self-contained unit because its bulky air tank would make escaping from a confined space more difficult.

Another consideration would be the compatibility of the respirator with other protective equipment, such as that required for welding or sandblasting. The person making the selection of a respirator must take into account all aspects of the exposure situation.

D. Prior Experience

In cases where the exact contaminant concentration is not known, past experience may be helpful in determining what might be expected. Every exposure situation is unique, and absolute certainty is not possible. Therefore, it is necessary to rely on past measurements and evaluations conducted in similar situations to provide guidance in the selection process.

E. Potential For The Unexpected

The selection of respiratory protection should accommodate the potential for unexpected events. An analysis of what could go wrong during an operation will be conducted during the selection process, and the respirator selected should always leave an employee with an avenue of escape if the unexpected should occur.

F. Capabilities and Limitations of the Respirators

A respirator is a tool with finite capabilities and limitations in the environments in which it may be worn. The person selecting the respirator must be aware of these capabilities and limitations, and also must be aware of the work environment in which the respirator will be used. It is the policy of AAA to select respirators in full accordance with all applicable regulatory and scientific guidelines and procedures. Specifically, the information contained in the American National Standard Institute's standard for Respiratory Protection (ANSI Z88.2 1980) forms the technical basis for the selection of respiratory protection.

Since a respirator has defined limitations and capabilities it is essential that the employees wearing the respirator know the capabilities and limitations of the respirator. The training provided to each employee will specifically address the respirators' capabilities and limitations.

15. Use of Supplied Air Respirators (SARs)

Prior to use all employees who are required to use specialty air-supplied respirators will receive additional training and orientation concerning the specific equipment. This training shall be provided no less than annually for members of the Hazardous Material Spill Response Team, and as needed for other employees.

Supplied air respirators are typically used in extreme environments in which the user will be exposed to a substantial risk if the respirator fails. Therefore, the use of respiratory protection in confined spaces is governed by the AAA Confined Space Entry Program. In other situations, supplied air respirators shall be used in groups of at least two trained employees, similarly equipped, and under the direct supervision of a trained foreman or supervisor.

Due to the variety of exposure situations that may be encountered, special instructions and preparations will typically be necessary for each project in which the use of supplied air respirators is necessary. Special training and orientation meetings will be held prior to the commencement of work to communicate important information to employees.

16. Maintenance and Care of Respirators

The respirator assigned to an employee for their individual use is the responsibility of that employee. Instruction in the care of the respirator, and the procedures necessary to maintain the respirator are provided during respiratory protection training.

Maintenance of the central pool of respiratory protective equipment, including the powered air-purifying respirators and the other specialty equipment, is the responsibility of the Manager of Health and Safety and qualified respirator maintenance personnel. Monthly inspections of respirators designed to be used in atmospheres immediately dangerous to Life or Health (IDLH) are performed, and an adequate supply of spare parts and equipment is maintained.

An integral part of the maintenance program is the inspection of the equipment. All air-purifying respirators are inspected before use; those that are assigned to individuals are inspected by those individuals, and those that are cleaned at the central cleaning facility are inspected by the cleaner. In all cases, training is provided so that the inspection addresses the necessary components of the respirator.(see Appendix C)

17. OTHER ISSUES

A. Assignment of Respirators

Whenever possible, individuals are assigned half masks for their own personal use and maintenance. These masks are replaced when necessary due to age or wear, and replacement masks will be available upon return of the damaged mask for repair and/or reconditioning. Full face masks may be assigned to selected individuals, but they are stored and maintained at the main AAA warehouse.

B. Facial Hair and Other Factors Affecting Proper Respirator Fit

No employee shall be permitted to use a respirator, or be fit-tested or trained, if facial hair exists that may interfere with the sealing surface of the respirator. Employees are to report to work clean-shaven, and refusal to shave may result in disciplinary action including termination of employment. Other factors that will affect respirator fit include such things as facial features, bone structure, dental work, changes in body weight, and facial scarring. Due to these factors it is company policy to repeat the fit testing of any employee who has any major changes with respect to these factors. AAA policy requires re-fit testing if an employee gains or loses 20 or more pounds, has major dental work, facial bone fractures, cosmetic surgery, facial scarring or any other problems which may affect proper respirator fit.

C. Equipment Loans

It is AAA policy that respiratory protective equipment shall not be loaned to other contractor's personnel or to non-employees. Exceptions to this rule must be approved by the Health and Safety Manager prior to the loaning of equipment. In these cases, a waiver of liability must be signed by the non AAA employee(s) receiving the equipment.

D. Corrective Lenses

AAA will purchase corrective lens inserts for those employees who require them in full face masks.

18. SUMMARY

The Respiratory Protection Program is an integral component in AAA's overall worker protection and safety program. The administration and implementation of this program is given the highest priority in the day-to-day operations at AAA. AAA takes a pro-active approach to respiratory protection through extensive employee training, proper respirator maintenance, and respirator selection by qualified professionals.

Appendix A: QUANTITATIVE (ISOAMYL ACETATE) FIT TEST PROTOCOL

This method is adapted from the OSHA recommended quantitative fit-test procedure. The basic steps include:

1. Determine if the subject can detect the challenge agent (either Isoamyl Acetate or Irritant Smoke) at low concentrations.
2. Select a comfortable mask, and instruct subject on donning protocol, and checking the face to facepiece seal.
3. Fit-test using the proper quantitative fit-test protocol.

1. Odor Threshold Screening - Isoamyl Acetate

- a. Prepare the stock Isoamyl Acetate (IAA) solution in a room separate from where the tests are to be performed to avoid ambient banana oil vapors. Prepare the stock solution by adding one milliliter (one ml) IAA to 800 ml odorless distilled water in a clean one liter glass bottle with a metal top. Shake for 30 seconds. This solution has a shelf life of one week.
- b. Prepare the test solution by adding 0.4 ml of the stock solution to 500 ml odorless distilled water in a clean one liter glass bottle with a metal top. Shake for 30 seconds and let stand for two to three minutes. This solution has a shelf life of one day.
- c. Prepare a blank solution by adding 500 ml odorless distilled water to a clean one liter glass bottle with a metal top.
- d. Label the odor test solution and the blank solution so that only the test administrator knows which is which. The labels should be switched occasionally to maintain the integrity of the test.
- e. Typed on a card in front of the test subject will be:

"The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water; one also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lids off each bottle. Indicate to the test conductor which contains banana oil."

The test must be conducted in a different room than was used to make up the test and stock solutions.

- f. The banana oil fit test may be administered to the subject if they have demonstrated that they can detect the odor of banana oil at this low concentration.

2. Apparatus

- a. Instrumentation. Corn oil, sodium chloride or other appropriate aerosol generation, dilution, and measurement systems shall be used for quantitative fit test.
- b. Test chamber. The test chamber shall be large enough to permit all test subjects to freely perform all required exercises without distributing the challenge agent concentration or the measurement apparatus. The test chamber shall be equipped and constructed so that the challenge agent is effectively isolated from the ambient air yet uniform in concentration throughout the chamber.
- c. When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high-efficiency particulate (HEPA) filter supplied by the same manufacturer.
- d. The sampling instrument shall be selected so that a strip chart record may be made of the test showing the rise and fall of challenge agent concentration with each inspiration and expiration at fit factors of at least 2,000.
- e. The combination of substitute air-purifying elements (if any), challenge agent, and challenge agent concentration in the test chamber shall be such that the test subject is not exposed in excess of PEL to the challenge agent at any time during the testing process.
- f. The sampling port on the test specimen respirator shall be placed and constructed so that there is no detectable leak around the port, a free air flow is allowed into the sampling line at all times and so there is no interference with the fit or performance of the respirator.
- g. The test chamber and test set-up shall permit the person administering the test to observe one test subject inside the chamber during the test.
- h. The equipment generating the challenge atmosphere shall maintain the concentration of challenge agent constant within a 10 percent variation for the duration of the test.
- i. The time lag (interval between an event and its being recorded on the strip chart) of the instrumentation may not exceed 2 seconds.

- j. The tubing for the test chamber atmosphere and for the respirator sampling port shall be the same diameter, length and material. It shall be kept as short as possible. The smallest diameter tubing recommended by the manufacturer shall be used.
- k. The exhaust flow from the test chamber shall pass through a high-efficiency filter before release to the room.
- l. When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 50 percent.

3. Respirator Selection and Donning Instructions

- a. The subject shall select two types or sizes from either the Survivair, MSA, or Glenaire half mask respirators that are appropriate to the subject's facial shape and size. The trainer will state at the beginning of the respirator selection, "You are asked to choose the most comfortable fitting respirator. Each of these represents a different size and shape and if worn properly will provide adequate protection."
- b. The subject shall be shown how to don the respirator, including checking for operable flaps and valves, checking the strap for proper orientation and elasticity, how to set the respirator on the face and how to attach the air-purifying element. A hand held mirror will be made available for the subject to visually check the fit.
- c. The subject shall be asked to wear the respirator for three to five minutes to assess comfort. It shall be made clear that the respirator will be worn for extended periods of time without a break, and that constant readjustment of the mask will seriously compromise the protection afforded by the mask.
- d. The fit-tester should ensure that the mask fits comfortably across the bridge of the nose and under the chin, that the person can speak without obvious mask deformation and that the strap tension is appropriate. The mask will be seated by moving the head rapidly side to side and up and down while taking a few deep breaths.
- e. Instruction shall be provided with regard to the **positive and negative pressure fit checks**. These fit checks are not performed in place of the qualitative fit-tests, but are performed in the field to assess the quality of the face to facepiece seal.
 - 1. The **positive pressure fit check** is conducted by placing the base of the thumb over the exhalation valve cover, and exhaling gently. The respirator passes the fit check if it lifts-up slightly off the face without leaking.
 - 2. The **negative pressure fit check** is conducted by blocking off the air inlets to the cartridges, and inhaling gently. The respirator passes if the mask tends to collapse slightly against the face without leaking.
- f. If the subject cannot pass the positive and negative pressure fit checks, the strap

tension and valve seating should be checked. If the fit checks still cannot be performed successfully, an alternative mask should be used.

- g. The mask should be removed and readjusted at least once prior to fit-testing.
- h. The trainer will check for comfort and fit by looking for:
 - 1. Mask position on the nose
 - 2. Room for eye protection
 - 3. Room to talk
 - 4. Position of mask on face and cheeks
 - 5. Proper placement of chin
 - 6. Strap tension
 - 7. Fit across the bridge of the nose
 - 8. Distance from chin to nose
 - 9. Tendency to slip

4. Fit testing Procedure

- a. After a facepiece is adjusted, the test subject shall wear the facepiece for at least 5 minutes before conducting a qualitative test by using either of the methods described below and using the exercise regime described in Section 4.e.1-9.
 - 1. Isoamyl acetate (IAA) test. When using organic vapor cartridges, the test subject who can smell the odor should be unable to detect the odor of IAA squirted into the air near the most vulnerable portions of the facepiece seal. In a location which is separated from the test area, the test subject shall be instructed to close her/his eyes during the test period. A combination cartridge or canister with organic vapor and high-efficiency filters shall be used when available for the particular mask being tested. The test subject shall be given an opportunity to smell the odor of IAA before the test is conducted.
 - 2. Irritant smoke test. When using high-efficiency filters, the test subject should be unable to detect the odor of irritant smoke squirted into the air near the most vulnerable portions of the facepiece seal. The test subject shall be instructed to close her/his eyes during the test period.
- b. Before the subject enters the test chamber, a reasonably stable challenge agent concentration shall be measured in the test chamber.
- c. Immediately after the subject enters the test chamber, the challenge agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half-mask and 1 percent for a full facepiece.
- d. A stable challenge agent concentration shall be obtained prior to the actual start of

testing.

Respirator restraining straps may not be overtightened for testing. The straps shall be adjusted by the wearer to give a reasonably comfortable fit typical of normal use.

- e. Test Exercises: Prior to entering the test chamber, the test subject shall be given complete instructions as to her/his part in the test procedures. The test subject shall perform the following exercises, in the order given, for each independent test.
1. Breathe normally for one (1) minute.
 2. Breathe deeply for one (1) minute. Be certain breaths are deep and regular.
 3. Turn head all the way from one side to the other. Be certain movement is complete. Do not bump the respirator on your shoulders. The head shall be held at each extreme position for at least 5 seconds. Perform for at least three complete cycles.
 4. Nod head up and down. Inhale when the head is in the full up position (looking at the ceiling). Be certain motions are complete and made every second. Do not bump the respirator on the chest. The head shall be held at each extreme position for at least 5 seconds. Perform for at least three complete cycles.
 5. Talking. The test subject (keeping eyes closed) shall repeat after the trainer the "rainbow passage" at the end of this section. The subject shall talk slowly and aloud so as to be heard clearly by the trainer. Repeating out loud the Rainbow Passage will result in a wide range of facial movements and thus be useful to satisfy this requirement. Alternate passages which serve the same purpose may be used.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with it's path high above the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

6. Grimace. The test subject shall grimace, smile, frown, and generally contort the face using the facial muscles. Continue for at least 15 seconds.
 7. Bend over and touch toes. The test subject shall bend at the waist and touch toes and return to upright position. Repeat for at least 30 seconds.
 8. Jog in place. The test subject shall jog in place for at least 30 seconds.
 9. Breathe normally for one (1) minute.
- f. The test shall be terminated whenever any single peak penetration exceeds 5 percent for half-masks and 1 percent for full facepieces. The test subject may be refitted and retested. If two of the three required tests are terminated, the fit shall be deemed inadequate.

5. Calculation and Interpretation of Fit Factors

- a. The fit factor determined by the quantitative fit test equals the average concentration inside the respirator.
- b. The average test chamber concentration is the arithmetic average of the test chamber concentration at the beginning and of the end of the test.
- c. The average peak concentration of the challenge agent inside the respirator shall be the arithmetic average peak concentrations for each of the nine exercises of the test which are computed as the arithmetic average of the peak concentrations found for each breath during the exercise.
- d. The average peak concentration for an exercise may be determined graphically if there is not a great variation in the peak concentrations during the single exercise.
- e. Interpretation of Test Results. The fit factor measured by the quantitative fit testing shall be the lowest of the three protection factors resulting from three independent tests.

6. Other Requirements

- a. The test subject shall not be permitted to wear a half-mask or full facepiece mask if the minimum fit factor of 100 or 1,000, respectively, cannot be obtained. If hair growth or apparel interferes with a satisfactory fit, then they shall be altered or removed so as to eliminate interference and allow a satisfactory fit. If a satisfactory fit is still not attained, the test subject must use a positive-pressure respirator such as powered air-purifying respirators, supplied air respirator, or self-contained breathing apparatus.

- b. No fit-test will be conducted if facial hair or clothing will interfere with a proper seal of the facepiece. Testing will be conducted after these conditions have been corrected.
- c. At any time the employee may request another respirator if the one they are using becomes uncomfortable.
- d. Persons passing the Quantitative Fit-test Protocol with a half face respirator may be assigned the use of these respirators in atmospheres of up to 10 times the PEL of airborne asbestos. For atmospheres of greater than 10 times and less than 100 times the PEL, the employee must pass the Quantitative Fit-test protocol for a full face negative pressure respirator.
- e. Quantitative fit-testing will be performed on an employee every six months.
- f. If a test subject exhibits difficulty in breathing during the tests, he or she shall be referred to a physician trained in respirator diseases or pulmonary medicine to determine whether the test subject can wear a respirator while performing her or his duties.
- g. The test subject shall be given the opportunity to wear the assigned respirator for one week. If the respirator does not provide a satisfactory fit during actual use, the test subject may request another Quantitative Fit Test, which shall be performed immediately.
- h. A respirator fit factor card or certificate shall be issued to the test subject with the following information:
 - 1. Name.
 - 2. Date of fit test.
 - 3. Protection factors obtained through each manufacturer, model and approval number of respirator tested.
 - 4. Name and signature of the person that conducted the test.
- i. Filters used for qualitative or quantitative fit testing shall be replaced weekly, whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media. Organic vapor cartridges/canisters shall be replaced daily or sooner if there is any indication of breakthrough by the test agent.
- j. In addition, because the sealing of the respirator may be affected, quantitative fit testing shall be repeated immediately when the test subject has a:
 - 1. Weight change of 20 pounds or more,
 - 2. Significant facial scarring in the area of the facepiece seal,
 - 3. Significant dental changes; i.e., multiple extractions without prosthesis, or acquiring dentures.

4. Reconstructive or cosmetic surgery, or
 5. Any other condition that may interfere with facepiece sealing.
- k. Recordkeeping. A summary of all test results shall be maintained for 3 years. The summary shall include:
1. Name of test subject.
 2. Date of testing.
 3. Name of the test conductor.
 4. Fit factors obtained from every respirator tested (indicate manufacturer, model, size and approval number).

Appendix B: Irritant Smoke Fit Test Protocol

This method is adopted from the OSHA recommended qualitative fit test methods.

CAUTION: The irritant smoke causes an involuntary cough and gag reflex if inhaled, and mucous membrane irritation upon eye contact. This test should not be administered until the subject is aware of these effects.

1. Respirator Selection

- A. The subject shall select the size of the half mask respirator that is appropriate to his facial shape and size. The respirator will be equipped with combination high-efficiency and acid-gas cartridges. The test subject will be allowed to smell a weak concentration of the irritant smoke.
- B. The subject shall be shown how to don the respirator, including checking for operable flaps and valves, checking the strap for proper orientation and elasticity, how to set the respirator on the face and how to attach the air-purifying element. The subject will wear the respirator for several (ie, 10) minutes before starting the test.
- C. The test conductor will review this protocol with the subject before starting this test. It shall be made clear that the respirator will be worn for extended periods of time without a break, and that constant readjustment of the mask will seriously compromise the protection afforded by the mask.
- D. The fit-tester should ensure that the mask fits comfortable across the bridge of the nose and under the chin, that the person can speak without obvious mask deformation and that the strap tension is appropriate. Have the subject seat the mask by moving his head from side to side and up and down while taking a few deep breaths.
- E. Instruction shall be provided with regard to the positive and negative pressure tests. These tests are not performed in place of the qualitative fit-tests, but are performed in the field to assess the integrity of the face to facepiece seal.
 1. The positive pressure test is conducted by placing the base of the thumb over the exhalation valve cover, and exhaling gently. The tests passes if the mask tends to expand and lift up slightly off the face without leaking.
 2. The negative pressure test is conducted by blocking off the air inlets to the cartridges, and inhaling gently. The test passes if the mask tends to collapse slightly against the face without leaking.
- F. If the subject cannot pass the positive and negative pressure tests, the strap tension and valve seating should be checked. If the tests still can not be performed successfully, an alternative mask should be used.

- G. The mask should be removed and readjusted at least once prior to fit-testing.

2. Fit Testing

- A. Instruct the test subject about the purpose of the test, and advise him that the smoke can cause coughing and gagging if inhaled, and mucous membrane irritation upon eye contact. No person who has not been able to pass both the positive and the negative pressure test shall be tested with irritant smoke.
- B. Break both ends of a smoke tube containing stannic oxychloride, and attach a short length of tubing to one end of the smoke tube, attach the other to a low pressure air pump set to deliver approximately 200 ml per minute.
- C. Advise the test subject to close his eyes tightly, and to keep them closed for the duration of the test. This is particularly important while fitting the half mask.
- D. Ensure that the facepiece is equipped with a combination cartridge that provides protection against both acid gases and particulates. The Survivair cartridge # 1093, or the MSA cartridge GMC-H are appropriate cartridges.
- E. Direct a stream of smoke from the tube toward the respirator, starting about 12 inches away and moving in to 1 inch from the facepiece. During this process, the test subject shall be instructed to perform the following exercises, each for one minute:
1. Breathe normally.
 2. Breathe deeply. Be certain breaths are deep and regular.
 3. Turn head from side to side, be certain movement is complete. Make sure that the respirator does not bump on the shoulders.
 4. Move head up and down, inhaling when head is looking upwards. Make sure that the respirator does not bump on the chest. Be certain movements are made every second.
 5. Talking. Talk aloud and slowly for several minutes. The Rainbow Passage is ideal for this, but an alternate passage that serves the same function may be substituted.
 6. Jogging in place.
 7. Breathe normally.
- F. If the irritant smoke is not detected, then the subject has successfully been fitted with the respirator. If the test fails, check the strap tension, valve and flap condition and other factors which may have contributed. Retry the test with another mask until a

fit is achieved. Each subject passing the fit test will be given a sensitivity check from the same tube used to administer the test, if the test subject evokes a response then the test was good; if he does not then the test is voided.

- G. If no fit is possible with a half mask, then a full face mask shall be used.
- H. This protocol will be performed in an area with local ventilation sufficient to prevent general contamination of the testing area.
- I. No fit test will be conducted if facial hair or clothing will interfere with a proper seal of the facepiece. Testing will be conducted after these conditions have been corrected.
- J. At any time an employee may request another respirator if the one he is using becomes uncomfortable.
- K. Persons passing the Irritant Smoke Fit Test Protocol with a half face respirator may be assigned the use of these respirators in atmospheres of up to 10 times the PEL of airborne asbestos, for atmospheres of greater than 10 times and less than 100 times the employee must pass the IAA protocol for a full face negative pressure respirator.
- L. Qualitative fit-testing will be performed on an employee annually.
- M. Subjects having difficulty breathing while wearing a respirator will be referred to a physician.
- N. Qualitative fit-testing will be performed on an employee if any of the following conditions have occurred:
 - 1. Gain of 20 pounds or more
 - 2. Facial scarring that may inhibit a proper facial seal
 - 3. Significant dental changes
 - 4. Reconstructive or cosmetic surgery
 - 5. Any other condition that would inhibit a proper facial seal
- O. Record keeping shall include a record of fit-testing with the employees name, test dates, makes, sizes, and models of the respirators they have been trained to use.

Appendix C. TRAINING OUTLINES

1. Half Mask Air Purifying Respirators

A. Components

1. Body
2. Gaskets
3. Valves
4. Valve Seats
5. Valve Covers
6. Straps
7. Cradle headpiece
8. Air Purifying Elements
 - a. Color coded
 - b. Specific to contaminant
 - c. Selected by Health & Safety (H&S) Department
 - d. Composition

B. Function

1. Filtration of contaminated air
2. Necessity of having correct air purifying element
3. Discussion of protection factor, and how it applies

C. Limitations

1. Eye irritants
2. Warning properties
3. Detection of depletion of air-purifying element
 - a. Detection of odor
 - b. Increase in breathing resistance (pressure drop across filter)
 - c. End-of-Service-Life indicator
4. Oxygen deficiency
5. Leaks in face to facepiece seal
6. Facial hair

D. Donning Instructions

1. Cartridge Selection - done by H&S Department
2. Pre-Use Inspection
 - a. Inhalation valves
 - b. Exhalation valves
 - c. Strap orientation and elasticity
 - d. Proper seating of air purifying element
3. Strap placement
 - a. Top strap over the crown of the head

- b. Bottom strap around the back of the neck
 - c. Placement of cradle headpiece
 - d. Tightening of straps - tight but comfortable
- 4. Checking for quality of fit
 - a. Positive pressure test
 - b. Negative pressure test
- 5. Reuse of air purifying elements

E. Care and Maintenance

- 1. Clean after every use
- 2. Disinfection
- 3. Storage
 - a. Cool, dry place
 - b. In sealed plastic bags
- 4. Replacement of worn out parts
- 5. Individual assignment and responsibility

2. Full Face Air Purifying Respirators

A. Components

- 1. Body
- 2. Gaskets
- 3. Valves
- 4. Valve seats
- 5. Valve covers
- 6. Straps
- 7. Cradle headpiece
- 8. Air Purifying Elements
 - a. Color coded
 - b. Specific to contaminant
 - c. Selected by H&S Department
 - d. Composition

B. Function

- 1. Filtration of contaminated air
- 2. Necessity of having correct cartridge
- 3. Discussion of protection factors, and how they apply
- 4. Additional protection afforded over half mask
 - a. Protection against eye irritation
 - b. Protection against splashing

C. Limitations

1. Warning properties
2. Detection of depletion of air-purifying element
 - a. Odor detection
 - b. Increase in resistance
 - c. End-of-Service-Life indicator
3. Oxygen deficiency
4. Leaks in face to facepiece seal
5. Facial hair
6. Fogging of lens - use of nose cup
7. Reduction of field of vision

D. Donning Instructions

1. Cartridge selection - Done by H&S Department
2. Pre-use inspection
 - a. Inhalation valves
 - b. Exhalation valves
 - c. Strap orientation and elasticity
 - d. Proper seating of cartridges
3. Strap tightening
 - a. Go from bottom of mask to top
 - b. Pull tabs out to avoid hair entanglement
4. Checking for quality of fit
5. Reuse of air purifying elements

E. Care and Maintenance

1. Respirators are cleaned after every use
2. Disinfection
3. Storage
 - a. Cool, dry place
 - b. Sealed in plastic bags
4. Replacement of worn out parts

3. Powered Air-Purifying Respirators (PAPR's)

A. Components

1. Facepiece
 - a. Straps
 - b. Lens
 - c. Valves
 - d. Nosecup
 - e. Body
 - f. Lens

2. Air delivery unit
 - a. Battery
 - b. Battery holder
 - c. Pump housing
 - d. Air-purifying elements
 - e. Cartridge seats and holders
 - f. Hose
 - g. Hose fittings
 - h. Belt
 - i. Electrical lead
 - k. On/off switch

B. Function

1. Filtration of contaminated air
2. Use HEPA (High Efficiency Particulate Air) Cartridges
3. Positive facepiece pressure
4. Additional protection afforded over half mask
 - a. Protection against splashing
 - b. Protection against foreign objects in the eyes
 - c. Reduction of leakage due to positive facepiece pressure
 - d. Reduction of resistance to breathing
5. Additional protection afforded over full face mask without pump
 - a. Reduction of leakage due to positive facepiece pressure
 - b. Reduction of resistance to breathing

C. Limitations

1. HEPA cartridge only works for particulates
2. No protection provided for gases or vapors
3. Detection of depletion of air-purifying element - increase in breathing resistance
4. Oxygen deficiency
5. Leaks in face to facepiece seal
6. Facial hair
7. Fogging of lens - Use of nose cup
8. Reduction in field of vision
9. Reduction of mobility
10. Mechanical problems can render respirator unusable - must exit area
 - a. Dead Battery
 - b. Broken pump
 - c. Bad electrical connection

D. Donning Instruction

1. Cartridge selection by H&S Department
 - a. HEPA cartridge used for asbestos
2. Pre-use inspection
 - a. Exhalation valve
 - b. Nose cup with valves
 - c. Hose
 - d. Strap orientation and elasticity
 - e. Battery
 - f. Pump housing
 - g. Proper seating of filters
3. Checking for quality of fit - do negative pressure test with end of hose
4. Proper assembly
5. Turn on pump and check for air flow
6. Don mask and tighten straps
7. Disposal of air-purifying elements

E. Care and Maintenance

1. Cleaned after every use
2. Disinfection
3. Storage
 - a. Cool, dry place
 - b. In sealed plastic bags
4. Recharging of battery
5. Replacement of worn out parts

F. Special Conditions

1. Gradual depletion of breathable air
 - a. Due to depleted battery pack
 - b. High filter loading
2. Sudden unit failure - check integrity of electrical lead

Appendix D. STANDARD OPERATING AND USE PROCEDURES

1. Asbestos

A. Evaluation of the Hazard

Asbestos is a naturally occurring fibrous mineral that was extensively used in industrial and commercial products due to its remarkable resistance to heat and chemicals. Though it is used relatively little today, exposure may still occur when one is working with asbestos-containing materials, such as insulation, brake shoes, construction materials, or pipes.

There are several medical conditions that are associated with exposure to asbestos.

1. Conditions of the Lung

- a. Asbestosis is the most well known disease associated with asbestos. The disease, which is caused by the inhalation of substantial quantities of fibers, develops when the soft and pliable lung tissue becomes rigid, inelastic and fibrotic, and no longer permits the transfer of oxygen into the blood. This makes breathing very difficult and labored, and the most extreme cases are crippled due to lack of lung function.
- b. Asbestos exposure, to about half the extent of cigarette smoking, also causes lung cancer. In fact, smoking and asbestos exposure work together in the development of lung cancer so that the combined effect of the exposures is greater (50 to 80 times) than the separate effects added together. The amount of asbestos exposure necessary to cause lung cancer is much less than that necessary to cause asbestosis.

2. Conditions of the Lining of the Lung (the Pleura)

- a. Asbestos fibers can work their way through the lung and into the lining of the lung, or the pleura. There, the fibers can cause the same kind of scarring as happens with asbestosis, and pleural plaques can develop. Pleural plaques are not considered to be a disease unless they are so widespread that they cause a decrease in lung function; instead, they are evidence that asbestos exposure has occurred, and that the person bears close medical observation.
- b. A rare and deadly form of cancer of the pleura, called pleural mesothelioma, has also been identified among persons exposed to asbestos. This cancer is considered to be incurable, and the victim usually dies within a year of the identification of symptoms.

3. Conditions of the Gastrointestinal Tract

- a. Asbestos can enter the gastrointestinal tract either directly through the mouth, or after it has been inhaled into, and cleared from, the lungs. As a result of their exposure, gastrointestinal cancer can develop, but it is less common than the lung cancer described above.

B. Exposure Standards

1. OSHA's Permissible Exposure Limit (PEL) for asbestos is 0.1 fibers per cubic centimeter (f/cc), calculated as an 8-hour time-weighted-average exposure.
2. NIOSH recommends that the exposure limit be set at 0.1 f/cc, calculated as an 8-hour time-weighted-average exposure.
3. The American Conference of Governmental Industrial Hygienists (ACGIH) has set different Threshold Limit Values (TLV's), ranging from 2.0 to 0.2 f/cc, depending on the type of asbestos involved.
4. AAA policy mandates that no measurable exposure to asbestos occur unless the employee is wearing respiratory protection and protective clothing. Thus, the internal AAA exposure guideline is effectively set at the limit of analytical detection.

C. Selection of Respiratory Protection

Respiratory protection shall be selected on the basis of the hazard(s) to which the employee is exposed, and with the guidance of the following chart:

RESPIRATORY PROTECTION FOR ASBESTOS FIBERS - SELECTION CHART

**Airborne concentration¹ of
asbestos or conditions of use**

Required Respirator

Not in excess of 1 f/cc (10 X PEL).....	Half-mask air purifying respirator other than a disposable respirator, equipped with high efficiency filters.
Not in excess of 5 f/cc (50 X PEL).....	Full facepiece air-purifying respirator equipped with high efficiency filters.
Not in excess of 10 f/cc (100 X PEL).....	Any powered air-purifying respirator equipped with high efficiency filters or any supplied air respirator operated in continuous flow mode.
Not in excess of 100 f/cc (1,000 X PEL).....	Full facepiece supplied air respirator operated in pressure demand mode.
Greater than 100 f/cc (1,000 X PEL) or unknown concentration	Full facepiece supplied air respirator operated in pressure demand mode, equipped with an auxiliary positive pressure self-contained breathing apparatus.

Note: a. Respirators assigned for high environmental concentrations may be used at lower concentrations, or when required respirator use is independent of concentration.

b. A high efficiency filter means a filter that is at least 99.97 percent efficient against mono-dispersed particles of 0.3 micrometers in diameter or larger.

c. The computation formula which shall apply to an employee's exposure to airborne asbestos in order to determine whether an employee is exposed over the regulatory limit (Time Weighted Average) is as follows:

Air concentrations are calculated by the following formula:

$$\frac{\text{fibers (on the filter)}}{\text{Flow Rate (Liters/min) x Time (mins)}} \times \frac{1 \text{ Liter}}{1000 \text{ cc}} = \text{fibers/cc}$$

Employee Exposure (in terms of TWA) is calculated by taking the air concentration and dividing it by 8 (for 8-hours).

⁽¹⁾ Concentration presented as fibers of asbestos per cubic centimeter of air calculated as an 8-hr. Time-weighted average.

[1910.1001(g)(2) Table 1 corrected by 60 FR 33984, June 29, 1995]

Appendix E. RESPIRATOR MAINTENANCE OUTLINE

1. Half Face Respirators

- a. When made available, the respirator will be washed with a commercially prepared cleaner/disinfectant.
- b. The units will be allowed to soak in a soap and water solution between two and five minutes: any longer than five minutes the soap scum becomes a problem. The wash water will be less than 100° F, so as to avoid warping the plastic and scalding the washer.
- c. The units will be fully dismantled before cleaning.
- d. After decontamination all parts will be inspected for wear: these include the mask body, valves, straps and flaps.
- e. Worn parts will be replaced with replacements parts specified by the manufacturer.
- f. Face pieces that are worn, warped, or torn will be taken out of service. Any parts that are still in good working order will be returned to the stock room as spare parts.
- g. All valve seats will be inspected after reassembly.

2. Full Face Negative Pressure Respirators

- a. The Full Face Negative Pressure Respirators will be washed with a commercially prepared cleaner/disinfectant.
- b. The units will be allowed to soak in a soap and water solution between two and five minutes: any longer than five minutes the soap scum becomes a problem. The wash water will be less than 100° F, so as to avoid warping the plastic and scalding the washer.
- c. The units will be fully dismantled, except for the head straps, before cleaning.
- d. After decontamination, all parts will be inspected for wear: these include the mask body, valves, straps and flaps.
- e. Worn parts will be replaced with replacements parts specified by the manufacturer.
- f. Face pieces that are worn, warped or torn will be taken out of service. Any parts that are still in good working order will be returned to the stock room as spare parts.
- g. All valve seats will be inspected after reassembly.

3. Combination Air Feed Units

- a. These units will be dismantled before cleaning: removal of the lens rings, breathing tube, and the lens will facilitate cleaning.
- b. The units will be allowed to soak in a soap and water solution between two and five minutes: any longer than five minutes the soap scum becomes a problem. The wash water will be less than 100° F, so as to avoid warping the plastic and scalding the washer.
- c. The units will be fully dismantled, except for the head straps, before cleaning.
- d. After decontamination, all parts will be inspected for wear: these include the mask body, valves, straps and flaps.
- e. Worn parts will be replaced with replacements parts specified by the manufacturer.
- f. Face pieces that are worn, warped or torn will be taken out of service. Any parts that are still in good working order will be returned to the stock room as spare parts.
- g. All valve seats will be inspected after reassembly.
- h. Tanks will be decontaminated by wiping with a damp soapy towel, and with a wet cloth to remove the soap residue.
- i. The regulators will be disassembled, the diaphragm inspected, and a visual inspection of the levers made. The shortest lever should be below the longer one, and the longer lever should come up even to the top of the regulator housing. If it does not the spring is bad and the unit must be sent out to be repaired. While the unit is opened the diaphragm will be wiped clean along with the inside of the regulator housing. Replace the diaphragm, making sure that the longer lever is on top of the shorter one. Now replace the spring and screw on the regulator cover.
- j. Tank gauge lenses will be inspected and the lenses replaced and the gauges cleaned if necessary.
- k. Tank holsters and straps should be washed in order to decontaminate and to preserve the life of the material.
- l. Exhalation valves will be cleaned according to MSA recommendations.
- m. Breathing tubes that have come into contact with petroleum products and are starting to decompose or are exhibiting excessive wear such as rips and tears will be taken out of service and replaced.

- n. These units will be checked out prior to being put back into service by taking each unit and hooking it up to a tank and monitoring its function.
- o. Tanks will be hydrostatically tested every five years pursuant to DOT regulations.
- p. The units themselves will be bench tested once a year as per the manufacturer's recommendations.
- q. All test dates will be recorded in each unit's file so that we will be able to track the next due date.
- r. Numbers given to the units will be retained as this is the only means the Industrial Hygiene Dept. has of keeping correct and current records of test dates.

4. SCBA's

- a. These units will be dismantled before cleaning. Removal of the lens rings, breathing tube, and the lens will facilitate cleaning.
- b. The units will be allowed to soak in a soap and water solution between two and five minutes; any longer than five minutes the soap scum becomes a problem. The wash water will be less than 100° F, so as to avoid warping the plastic and scalding the washer.
- c. The units will be fully dismantled, except for the head straps, before cleaning.
- d. After decontamination, all parts will be inspected for wear: these include the mask body, valves, straps and flaps.
- e. Worn parts will be replaced with replacements parts specified by the manufacturer.
- f. Face pieces that are worn, warped or torn will be taken out of service. Any parts that are still in good working order will be returned to the stock room as spare parts.
- g. All valve seats will be inspected after reassembly.
- h. Tanks and their backpacks will be decontaminated by wiping with a damp soapy towel, and with a wet cloth to remove the soap residue.
- i. The regulators will NOT BE disassembled, as this will void the warranty. Only certified repair facilities may repair the SCBA's.
- j. Tank straps should be washed in order to decontaminate and to preserve the life of the material.

- k. Breathing tubes that have come into contact with petroleum products and are starting to decompose or are exhibiting excessive wear such as rips and tears will be taken out of service and replaced.
- l. These units will be checked out prior to being put back into service by taking each unit and hooking it up to a tank and monitoring its function by using a visual checklist recommended by the manufacturer. This will also be used to determine whether or not the unit is fit enough to be returned to service.
- m. Tanks will be hydrostatically tested every three years, as these are aluminum wrapped cylinders not the AA steel tanks, pursuant to DOT regulations.
- n. The units themselves will be bench tested once a year as per the manufacturer's specifications. This will maintain the NIOSH approval.
- o. All test dates will be recorded in each unit's file so that we may be able to track the next due date.
- p. Numbers given to the units will be retained as this is the only means the Industrial Hygiene Dept. has of keeping correct and current records of test dates.

To summarize maintenance procedures on SCBA's:

- 1. Perform routine maintenance per manufacturer's instructions and guidelines.
- 2. Keep SCBA's of differing manufacturers and models separate from each other. Do not mix components.
- 3. Refer major repairs to an authorized repair service.

5. PAPR's

- 1. These units will be dismantled before cleaning, removal of the lens rings, breathing tube, and the lens will facilitate cleaning.
- 2. The units will be allowed to soak in a soap and water solution between two and five minutes, any longer than five minutes then soap scum becomes a problem. The wash water will be less than 100° F, so as to avoid warping the plastic and scalding the washer.
- 3. The units will be fully dismantled, except for the head straps, before cleaning.
- 4. After decontamination, all parts will be inspected for wear. These include the mask body, valves, straps and flaps.
- 5. Worn parts will be replaced with replacements parts specified by the manufacturer.

6. Face pieces that are worn, warped or torn will be taken out of service. Any parts that are still in good working order will be returned to the stock room as spare parts.
7. All valve seats will be inspected after reassembly.
8. Breathing tubes that have come into contact with petroleum products and are starting to decompose or are exhibiting excessive wear such as rips and tears will be taken out of service and replaced.
9. The turbo units, blowers for the Powerflow units, and the batteries will be decontaminated by wiping with a damp soapy towel and then with a clean wet towel to remove any soap residue.
10. Before being put back into service the units will be equipped with new filters and a flow meter will be inserted into the exhaust port of the turbo unit, or the blower unit and a minimum of four cubic feet per minute of air must be obtained. If this does not occur, check to see if the filter plugs are still inserted, if they are not check the battery. If both of these are negative then the blower or the turbo unit has gone bad.
11. While the unit is running, make sure that the lead has been inserted into the battery firmly and move the lead back and forth to check for a short. If the unit fails this test have it sent for repairs.
12. If a battery fails from something other than total discharge, check the fuse by removing the belt clip on the battery with a phillips head screw driver, lift out the fuse and replace it with a new one. If the battery now refuses to hold a charge, have it sent for repair.

Section 4.01 Confined Space Entry

Introduction

OSHA has a standard, 29 CFR 1910.146, for Permit-Required Confined Spaces. The purpose of this section is to outline procedures for employees of AAA Environmental, Inc. to follow in an effort to reduce the hazards of entry into an OSHA-defined "Confined Space."

Definitions

"Confined Space" means a Space that:

1. Is large enough that an employee can bodily enter and perform assigned work, and
2. Has limited or restricted means for entry or exit (for example tanks, silos, hoppers, vaults, and pits), and
3. Is not designed for continuous human occupancy.

"Permit-Required Confined Space" means a Confined Space (see definition above) that has one or more of the following characteristics:

1. Contains or has a potential to contain a hazardous atmosphere (see definition below).
2. Contains a material that has the potential for engulfing an entrant.
3. Has an internal configuration such that an entrant could be trapped or asphyxiated, or
4. Contains any other recognized serious safety or health hazard.

"Hazardous Atmosphere" means an atmosphere that may expose employees to the risk of death, incapacitation, injury, impairment of ability to self-rescue or acute illness from one or more of the following causes:

1. Flammable/Explosive gas, vapor, or mist in excess of 10 percent of its lower explosive limit (LEL).
2. Airborne combustible dust at a concentration that meets or exceeds its LEL (Note: this concentration may be approximated as a condition in which dust obscures vision at a distance of 5 feet or less).
3. Atmospheric oxygen concentration below 19.5% or above 23.5%.

4. Atmospheric concentration of any substance that could result in death, incapacitation, injury or impairment of the ability to self-rescue.
5. Any other atmospheric condition that is Immediately Dangerous to Life or Health (IDLH).

Note: Ventilation may be used to eliminate hazardous atmospheres. Air monitoring results must be documented on the permit prior to entry.

"Ordinary or Non-Permit Confined Space" means a Confined Space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

Confined Space Entry Program

1. Coordination with Site Contact
The Project Manager, or Supervisor in charge of entry will:
 - a. Obtain any available information regarding Confined Space hazards from the Site Contact.
 - b. Coordinate entry operations with the Site Contact when persons other than AAA Environmental personnel will be working in or near the same Permit-Required Spaces.
 - c. Follow the Site's Confined Space entry program whenever possible.
2. Determining the classification of a Confined Space
Should AAA Environmental employees need to enter a Confined Space that has not been classified, then the following procedures will be used:
 - a. Determine whether the Space meets the definition of a Confined Space.
 - b. If the Space meets the definition of a Confined Space, then determine whether it meets the definition of a Permit-Required Confined Space. If the Confined Space does not meet the definition of a Permit-Required Confined Space, employees may enter the Space after the appropriate safety precautions have been implemented.

Note: All Confined Spaces are considered to be Permit-Required unless proven otherwise.

- c. If the Space is a Permit-Required Confined Space, one of two procedures may be followed:
 1. A full permit must be completed in accordance with Part 3, "Entry Procedures, or
 2. The hazard(s) may be eliminated without entry (purging the air, for example) and the Space may then be reclassified into an ordinary (Non Permit -Required) Confined Space

If a Space is to be re-classified, complete the re-classification portion

of the permit (gray shaded areas)

Upon completion of the re-classification form, the "Permit-Required Confined Space" can now be re-classified as an ordinary Confined Space. This re-classification method should only be used in well-understood Confined Spaces where all potential hazards have been eliminated. Otherwise, use the full Confined Space Entry Permit.

3. Entry Procedures

- a. A Permit will be completed prior to entry into a Permit-Required Confined Space or a Re-Classified Confined Space. The Permit's purpose is to:
 - Pre-plan the entry procedure
 - Eliminate any anticipated hazards, and
 - Describe in advance the emergency and rescue procedures to be used
- b. Before an employee enters the Space, the internal atmosphere will be tested with a calibrated direct-reading instrument for the following conditions:
 - Oxygen content
 - Flammable gases and vapors
 - Potential toxic air contaminants
- c. If the Space is large or is part of a continuous system, such as a sewer or large boiler, pre-entry testing will be performed to the extent feasible before entry is authorized. For example, a hose may be lowered to test for heavier-than-air gasses that have collected near the ground.

In a large or continuous system, the atmosphere will be continuously monitored in the areas where authorized entrants are working.

Roles of the Confined Space Entry Team

1. The **Supervisor** in charge of entry shall:

- a. Identify and evaluate the hazards before employees enter the Permit Space. The hazards identified must be eliminated before entry or they must be managed so that work procedures and emergency planning assure the health and safety of each team member
- b. Verify that conditions in the Permit Space are acceptable for entry throughout the duration of an authorized entry
- c. Confirm that the necessary PPE and safety equipment is available and that employees are trained to use it
- d. Verify that an emergency rescue plan is in effect.
- e. Prior to entry, sign the permit to authorize entry
- f. Post the completed and signed permit at the entry point so that the entrants can confirm that pre-entry preparations have been completed

2. Authorized **Entrants** shall:

- a. Know the hazards they face during entry, including information on the signs or symptoms of exposure
- b. Follow the requirements stated on the entry permit
- c. Sign in and out on the permit
- d. Exit from the permit Space as quickly as possible whenever a dangerous situation arises or they are told to exit by the attendant or supervisor

3. **Attendants** Shall:

- a. Review the permit and know the hazards involved
- b. Maintain continuous communication with entrants. This may be visual, verbal, by lifelines or other effective means.
- c. Continuously maintain an accurate count of all authorized entrants in the Space. The permit should show an accurate record of who is in the Space.
- d. NEVER enter the Confined Space to attempt a rescue of the entrants. Instead, follow the emergency plan, alert the rescue team, etc. without entering the Space.

Attendants will perform no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

Attendants will order entrants to evacuate immediately when the attendant detects a situation inside or outside the Space that could endanger entrants.

Training

Each employee who is required to enter a Permit-Required Confined Space will be trained in the Safe performance of their duties.

Rescue and Emergency Services

1. **Non-Entry Rescue**

To facilitate non-entry rescue, retrieval systems or methods will be used whenever an authorized entrant enters a Permit-Required Confined Space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant.

Retrieval systems will meet the following requirements:

- a. Each authorized entrant will use a chest or full body harness with a retrieval line attached to a mechanical device or fixed point outside the Permit Space.
 - b. A mechanical device (i.e., winch) must be available to retrieve personnel from vertical type Permit-Required Confined Spaces that are more than 5 feet deep.
2. If a rescue team is to be used instead of non-entry procedures, arrangements must be made prior to entry. All necessary rescue PPE must be readily available and the rescuers must be trained and familiar with the location and hazards of the Confined Space in question. Members of a rescue team must have up-to-date certifications in First Aid and

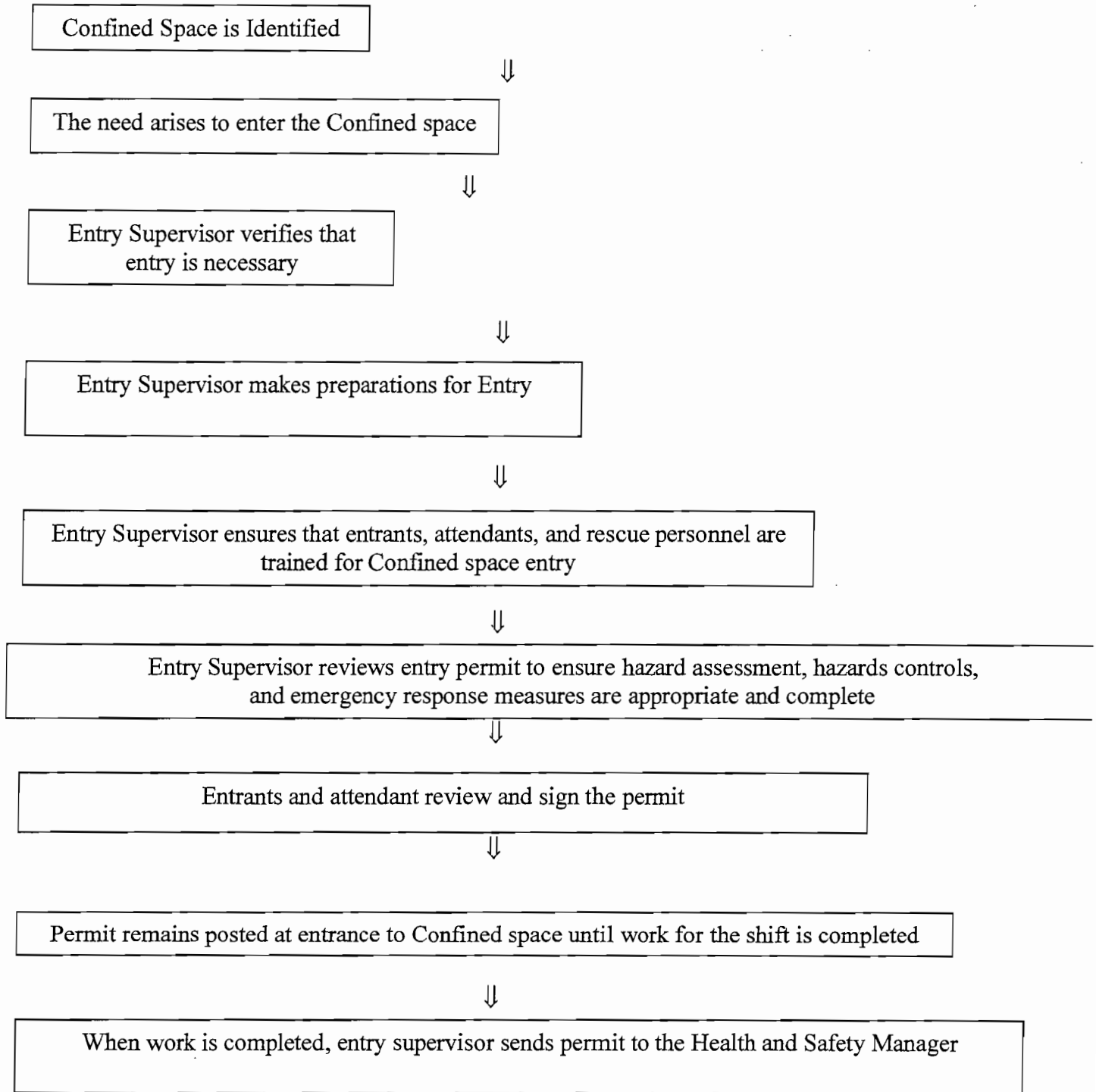
Records

1. The Confined Space entry permit shall be completed prior to entry into any Permit Required Confined Space.
2. Closed-out permits should be forwarded to the Health and Safety Manager for review, then retained in the job files.

Evaluation of Program

The Permit-Required Confined Space Entry Program will be audited annually. The program will be revised as necessary to confirm that employees are adequately protected from Confined Space hazards.

Confined Space Entry Permit Flow Diagram



Confined Space Permit – add

SECTION 4.06 EXCAVATIONS AND TRENCHES

Scope and Purpose

Cave-ins are often fatal. Due to the great variability in factors that affect excavation wall stability, special precautions must be taken when excavation activities are to take place on a project. This program will be in effect on all AAA Environmental, Inc. projects which involve excavations. In facilities or work areas where site/client excavation programs are in effect AAA Environmental, Inc.'s program shall be used in conjunction with these programs.

Location of Underground Utilities

Prior to the start of excavation activities all underground utilities must be located. The local "DIGSAFE" (formerly UFPO) must be notified at least 48 hours prior to the start of excavation so that all utility companies involved can mark their underground facilities in the area of excavation. Also any permits that are required prior to the start of excavation activities must be obtained. In emergency situations the local DIGSAFE office should be informed immediately once it has been determined that excavation will take place. DIGSAFE should also be informed of the emergency so that they can expedite the location of the utilities.

General Safety Precautions

- Any excavation operation over 4 ft. deep which requires personnel entry shall have entry/exit ladders placed every 25 ft. along its length.
- For any excavation deeper than four feet in depth, consider the need for air monitoring. This is especially important in contaminated soils, if sources of carbon monoxide are present or if flammable gasses from utility leakage is a possibility.
- There shall be no standing water in an excavation while personnel are in the excavation.
- Spoil piles at the excavation site must be set back at least two feet from the edge of the excavation edge to prevent the hazard of falling objects.
- Special care should be taken when excavating in areas that have been previously back-filled since voids or soft spots may appear.
- Also, excavations near heavy equipment, undercut structures, high traffic areas, and utilities require special planning and precautions. AAA Environmental, Inc.'s competent person on site will contact the Office of Health and Safety if any of these special situations are encountered.

Factors Affecting Excavation Stability

Many factors affect the stability of an excavation including soil classification, depth of excavation, water content of soil, weather conditions, superimposed loads, vibration, and other activities in the area of excavation. Soil type or classification will help determine the amount of sloping or the type of shoring required for an excavation. Weather conditions can affect the amount of water in the soil and affect the type of shoring to be used. Superimposed loads and vibrations will increase the potential of excavation cave-in. Due to the variability of the

conditions affecting excavation stability a **competent person** shall supervise all excavation operations carried out by AAA Environmental, Inc. personnel in order to recognize potential hazards and prevent accidents. The **competent** supervisor shall make a daily inspection of the excavation to assess any changing conditions that may present special hazards.

Precautions

- All excavation operations must be cleared through the Health and Safety office prior to starting work to ensure proper safety precautions are being taken. An excavation permit will be issued.
- Open excavations shall be barricaded, fenced or otherwise controlled to prevent falls.
- If an excavation is left open overnight, reflective cones must be placed unless the area is completely secured from all traffic.

Sloping and Shoring

In order to prevent cave-in's, all excavations over 5 ft. which will require personnel entry into the trench shall be properly sloped or shored. Sloping will be carried out according to OSHA regulations. All slopes will be 1 foot vertical on 1.5 feet horizontal, unless the competent person has classified the soil according to the OSHA regulations. In that event, the excavation sides may be sloped in accordance with the required sloping angles for different soil classifications. If sloping is determined to be inadequate or inappropriate, then one of the following must be used:

1. A shoring system designed strictly in accordance with OSHA regulations 29 CFR 1926.650 - 652
2. A shoring system designed and stamped by a registered professional engineer, or
3. A shield ("trench box") which is engineered and manufactured specifically for cave-in control of excavations

**AAA ENVIRONMENTAL, INC.
EXCAVATION ENTRY PERMIT**

Project Name / Client _____

Date _____ Job Number _____

Location of Excavation _____

Purpose of Excavation _____

Depth of Excavation _____

Supervisor / Competent Person _____ / _____
Print Sign

NO

YES

Have the underground utilities been located? _____

Are ladders provided every 25 feet for entry/exit? _____

Are traffic vests being worn if required? _____

If hazardous atmospheres are possible, record air readings:

O₂: _____ LEL: _____ CO: _____ H₂S: _____

Is water accumulating in the excavation? _____

If yes, then what steps are being taken to eliminate it?

Are any structures, walls, fences, walks, or other installations threatened
by the excavation? _____

If yes, then what steps are being taken to protect employees?

Are sides sloped at least 1.5 horizontal to 1 vertical if sloping is used? _____

Have shielding or shoring systems been properly designed
and installed? _____

Are there indications of any other hazardous conditions? _____

SECTION 4.16 PERSONAL PROTECTIVE EQUIPMENT (PPE)

1. Company Policy. All employees shall use the Personal Protective Equipment prescribed by AAA Environmental, Inc.'s rules and regulations. Any employee who refuses to use the prescribed protective equipment may be subject to disciplinary action.
2. Ear Plugs or Muffs. Appropriate hearing protection shall be issued and worn in work areas where noise levels exceed established standards (i.e. 85dBA). As a rule of thumb, if you must shout to a person nearby to be heard, noise levels are high enough to require hearing protection.
3. Equipment Return. Protective equipment such as safety goggles, harnesses, respirators, life vests, etc. furnished for a project will be returned to the job site office or warehouse when the project is complete or when employment is terminated. Individuals are responsible for proper care of equipment. Any loss or damage to equipment caused by misuse or negligence may be deducted from an employee's paycheck.
4. Goggles, Safety Glasses, Face Shields, and Helmets. Appropriate ANSI-approved eye (Z87.1) and head (Z89.1) protection will be worn by every employee when:
 - a. welding, burning or cutting with any type of torch;
 - b. using abrasive wheels, portable grinders or files;
 - c. chipping concrete, stone or metals;
 - d. working with any materials subject to scaling, flaking, or chipping;
 - e. working in dusty conditions;
 - f. sand or water blasting;
 - g. using powder actuated fastening or nailing tools;
 - h. working with compressed air or other gases;
 - i. working near any operation that poses a hazard to head, face or eyes.

Note: Regular prescription glasses are not adequate protection unless they are ANSI approved (and stamped as such).

5. Hard Hats. All construction areas will be considered "hard hat areas" during active work periods. All employees and visitors must wear company approved hard hats during work hours while inside construction areas. There is to be no alterations or changes to your issued hard hat which might adversely affect its structural integrity.
6. Life Vests. Life vests will be worn whenever working over or near water in unsecured work areas (i.e. lacking guardrails).
7. Respirators. Approved respirators will be used when excessive dusts, mists, fumes, gases or other atmospheric impurities may be harmful to health. No respirators will be issued until the worker is properly fit tested, medically approved, and trained in the use of the respirator to be issued. No alterations or modifications are to be made to any respirator issued. Copies of worker's fit and pulmonary test results will be provided to employees and clients upon request. Careful selection of cartridge must be made to assure the respirator will remove the atmosphere hazard.

8. Body Harnesses and Lifelines. If unguarded openings or edges could permit a fall of six feet or more, full body harnesses and secured safety lanyards will be used.

Full body harnesses and lanyards will be worn when working in aerial lifts, and when body positioning or tasks on ladders create a fall hazard.

Each employee will also wear a body harness with a safety lanyard secured to a separate lifeline while working from swing scaffolds, bos'n chairs or other suspended work platforms where a falling hazard is present.

9. Steel Toe Work Boots are required on all AAA Environmental jobs where hazards are present that could crush, sever, lacerate or puncture the foot.
10. A Job Safety Analysis (JSA) or Health and Safety Plan (HASP) will be completed before jobs start to assist in the determination of the correct PPE for the job. PPE must be worn as described in the JSA or HASP.

APPENDIX F

Existing Site Conditions

Former N.L. Industries

Depew, NY

Remedial Action Plan

Prepared For:

**Cascades Canada, Inc.
411 rue Marie-Victorin
Kingsley Falls, Quebec
Canada JOA 1BOA**



December 2006

Lighe & Bond

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Tighe&Bond

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SECTION 1 INTRODUCTION

Tighe&Bond

Tighe & Bond, Inc. was retained by Norampac, Inc. (Norampac), to prepare this Remedial Action Work Plan (RAWP), as a voluntary action in accordance with the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program. The subject property is located at 3241 Walden Avenue in Depew, New York.

The preferred remediation strategy was developed in a final remedial investigation/feasibility study (RI/FS) report entitled "Remedial Investigation/Feasibility Study, Former NL Industries Site, 3241 Walden Avenue, Depew, New York," dated December 21, 2004. This RI/FS was prepared by XCG Consultants Ltd. The selected strategy was Alternative C1, which consists of excavating the impacted soil (containing more than 500 ppm of lead) situated in the western portion of the property and consolidating it in the central area. An asphalt parking lot will be constructed on top of the consolidated and compacted material. Alternative G would be utilized for any material which could not fit within the containment area. This alternative consists of chemically-fixating the soil, rendering it non-hazardous, and disposing it at a non-hazardous landfill.

The NYSDEC, in conjunction with the NYSDOH, issued a Decision Document in June 2005 identifying the preferred remedial action for the site. It was issued as a component of the Citizen Participation Plan. The Decision Document summarizes the RI/FS, summarizes the other alternative remedial actions and discusses the reason for the NYSDEC's preference.

During the completion of the final RI/FS report, the trucking yard located west of the building was completely paved with asphalt to provide a better driving surface for the trucks. This new paving will also act as a cover cap for impacted soil in the trucking yard. As such, the soil below the trucking yard, as well as the soil beneath the building and parking lot at the east side, will not be excavated. The rail siding adjacent to the south of the building will be capped with geotextile fabric and crusher run or clear stone. During the paving operation mentioned above, small gas cylinders were found and buried along the South side of the property. These cylinders will be removed and disposed of in an off-site recycling facility at the completion of this project.

The fill to be excavated at the western portion of the property is relatively shallow, and generally extends to depths ranging from approximately 2 to 3 feet (0.6 and 0.9 meters) below grade, and was present to as deep as 4 feet (1.2 meters) at one of the drilling locations. The underlying native soil consists of a silty clay unit. No significant quantities of groundwater are anticipated to be encountered within the excavation depth. Therefore, dewatering activities are not expected to be necessary.

Tighe & Bond will manage the project and serve as the lead engineer (Engineer) for this project. The remediation Contractor has not yet been selected. It is expected that

contract specifications will be prepared and issued for tender in the near future. The laboratory that will be conducting the analytical testing has not been determined. However, the laboratory selected will have the proper NYSDEC Certifications.

SECTION 2 SITE DESCRIPTION

Tighe&Bond

This section presents a brief summary of the property description, and its physical and environmental conditions. Details of the previous investigations are provided in the RI/FS report.

The subject property is located at 3241 Walden Avenue in Depew, New York, which is a suburb to the east of Buffalo. The property is situated on the south side of Walden Avenue, approximately 584.42 feet (178.1 meters) west of the centre line of Transit Road. The property is legally described as Part of Lot 68, Township 11, Range 7 of the Holland Land Company's Survey in the Village of Depew, Town of Cheektowaga, County of Erie. The site is currently occupied by Metro Waste Paper Recovery Inc. (Metro Waste), a member of Norampac.

The subject property is approximately 7.5 acres (3.04 hectares) in size. The site is located in a mixed commercial/industrial and residential area. Commercial/ industrial properties adjoin the east and west sides of the subject site. The properties located across the street, on the north side of Walden Avenue, are a mixture of residential and some commercial sites (e.g. restaurant). The south side of the property is bordered by railway tracks elevated on a berm, while a concrete mixing plant is situated further to the south. The topography of the subject property and immediate surrounding area has a generally flat grade. The property location and layout are shown on Figure 1. The facility is currently used to operate paper fibre recycling activities, and Tighe & Bond understands that it will continue to be used for industrial purposes.

The site has one main building located at the east side of the property. The building is estimated to occupy an area of approximately 63,400 ft² (5,890 m²). The east side of the property is paved with asphalt for employee parking. A rail siding is adjacent to the south side of the building. A truck loading/unloading and trailer parking area is located west of the building. The trucking area was surfaced with gravel during the investigations and at the time of the completion of the final draft version of the RI/FS report (November 4, 2002), and is surrounded by a chain-link fence. In November 1999, the trucking yard was re-surfaced with new gravel. Norampac indicated that approximately 400 tons of gravel was imported to the site to provide a minimum cover of approximately 3 inches (0.08 meters). In December 2004, Metro Waste paved the trucking yard to provide a better driving surface for the daily trucks that enter the property to load and unload shipments. The existing granular surface was considered a sufficient sub-base and was graded prior to installing the asphalt, which consisted of 4.5 inches (0.1 meters) of binder and 1.5 inches (0.04 meters) of asphalt topcoat. In addition to the asphalt, a new concrete apron, approximately 6 inches thick (0.15 meters), was constructed adjacent to the west side of the building.

The area west of the fenced-off trucking yard, to the tree-covered area, is described as the central portion of the property, for the purpose of this report. This area is not used

for the paper fibre recycling activities and is currently vacant. The former lagoon and marsh area was located at the south side of the central undeveloped area. In July 1999, Norampac implemented an Interim Remedial Measures (IRM) program in the central portion of the property. The IRM consisted of constructing a hydroseeded-topsoil cover and erecting a chain link fence surrounding this area. These interim remedial measures were carried out to eliminate potential direct human exposure with the metals impacted fill, until a final remedial solution was developed.

The area between the central portion of the property and the west property line is defined as the west undeveloped area, for the purpose of this report. The west undeveloped area of the property is also vacant and is not used for on-site operations. This area is covered with imported fill, including construction debris (i.e. brick and large concrete fragments), and is partially occupied by heavy equipment and miscellaneous items stored by the adjacent business to the west.

2.1 SITE HISTORY

The site history was reviewed as part of a Limited Phase 1 Environmental Site Assessment (ESA) conducted by Tighe & Bond for Norampac. Details of the findings of this study are provided in Tighe & Bond's report entitled "Limited Phase 1 Environmental Site Assessment, Former N.L. Industries Site, 3241 Walden Avenue, Depew, New York," dated June 11, 1999. The site history is briefly summarized below.

Metro Waste Paper Recovery Inc. (Metro Waste), a member of Norampac, is currently operating paper fibre recycling activities at the subject property. The operations are limited to the east side of the property (i.e. as far west as the fenced-off trucking yard). Paper fibre recycling has been conducted on the site by various companies since 1974.

The subject property was first developed for industrial use in 1892. Past on-site activities have included brass foundry operations conducted between 1892 and 1972 (i.e. 80 years), smelting operations carried out in the early part of the century, and the processing of babbitt. These operations were performed by various companies, beginning with Buffalo Brass Company (Buffalo Brass) at the east side of the property. Magnus Metal Corporation (Magnus) acquired this portion of the subject property from Buffalo Brass in 1899 and continued the brass foundry operations until 1936. During the early-1900s, Empire Smelting Company conducted operations in the area of the current trucking yard. National Lead Company acquired the entire property from Magnus in 1936 and continued the brass foundry operations until 1972, when it vacated the site. The name Magnus remained with the company, and was called Magnus Metal, a Division of National Lead Company. National Lead Company eventually changed its name to NL Industries Inc.

Brass is an alloy of copper and zinc, and babbitt is formed from an alloy of various metals including lead and copper. In addition, antimony is a metallurgical component of babbitt. Waste produced by these operations, including the dredged material from the former settling lagoon, was apparently spread throughout the property. Waste foundry sands were also potentially disposed of on-site. These historical activities explain the elevated levels of lead, zinc, and copper detected in the fill material.

2.2 SITE CONDITIONS

2.2.1 Regional Geology

The regional geology of the study area was provided by a published soil survey document prepared by the United States Department of Agriculture (USDA). The subject property is located in Erie County, which is comprised of two physiographic provinces. The northern half and western edge of Erie County is situated in the Erie-Ontario lake plain province while the southern portion is comprised of the Allegheny Plateau province. The study area is located in the Erie-Ontario lake plain province.

With the exception of areas near the major drainage ways, the Erie-Ontario Plain has little significant relief and its topography is typical of an abandoned lakebed. The elevation slopes upwards to the south to southeast, starting from approximately 569 feet (173 meters) above mean sea level at the Lake Erie shoreline. The study area is situated at approximately 676 feet (206 meters) above mean sea level.

Erie County is underlain by bedrock of the Upper Silurian and the Middle and Upper Devonian periods. The bedrock formations are in bands with an east-west alignment. The oldest formations are located in the northern section of Erie County and become younger towards the south. Bedrock underlying the county is relatively flat, but dips approximately 50 feet per mile (25 meters per kilometers) to the southwest.

The City of Buffalo is underlain by the Onondaga Limestone, which is the lowest formation of the Devonian period in this area. The Hamilton Group is situated above and to the south of the Onondaga Limestone. This formation consists of shales and limestones in a band approximately 4 miles (6.4 kilometers) wide. Depew, which is a suburb to the east of Buffalo, is located near the border of the Onondaga Limestone and Hamilton Group.

The overburden soil is comprised of the Odessa silt loam, which is nearly level (0 to 3 percent slope) and is somewhat poorly drained. This soil contains a high clay content. The surficial layer is typically very dark greyish-brown silt loam less than 1 foot (0.3 meters) thick. The subsoil is a mottled pinkish-grey silty clay in the upper portion and mottled reddish-brown silty clay in the lower part. The substratum consists of a varved

reddish-brown, grey, or reddish-grey silty clay. This silty clay acts as a vertical migration barrier of contaminants present at surface.

The USDA document indicates that there is a perched water table in the upper part of the subsoil from December to May. The permeability in the subsoil and substratum is slow to very slow. This low permeability will hinder the lateral movement of any contaminants in the shallow groundwater flow direction. Groundwater in the area is not used for drinking purposes. The Village of Depew is serviced by municipal water, which is drawn from Lake Erie.

2.2.2 Site Geology

The site-specific geology was determined from the various Phase 2 ESAs conducted at the subject property, including the subsurface investigation carried out as part of the RI. The subsurface conditions at the various portions of the subject property are briefly summarized in this section. In general, the shallow soils across the site consist of varying types of soil overlying a native silty clay stratum. Bedrock was not encountered in any of the deep boreholes drilled across the entire site (26 feet was the deepest borehole). In this report, fill material is defined as surficial soils of varying grades, such as sand, gravel, silty sand, and sandy silt. Further, fill material that has been mixed with metal waste (e.g. foundry sands, smelting residues, babbitt residues, process water residues, etc.) produced from decades of historical on-site industrial operations is referred to as metal-impacted fill. In addition, soil containing mild hydrocarbon odours or residual concentrations is defined as hydrocarbon-impacted fill. The metal waste produced by the foundry operations, smelting operations, and processing of Babbitt, including the dredged material from the former settling lagoon and foundry sands, was apparently mixed and spread throughout the property. As a result, the fill material across the site, which was originally clean, became metal-impacted fill.

The metal-impacted fill encountered at the west side of the property consisted of sand and gravel fill mixed with silty clay, and the metal waste produced by the historical site operations. Brick and concrete fragments were also encountered in the metal-impacted fill. The depth of the metal-impacted fill at the west side of the site was generally between approximately 2 to 3 feet (0.6 and 0.9 meters) below grade, and was present to as deep as 4 feet (1.2 meters) at one of the drilling locations. The metal-impacted fill is underlain by a native silty clay stratum. Occasional pebbles and gravel are present in the silty clay. The consistency of this soil unit increased from very stiff to hard with depth, and became less hard as the depth approached the shallow water-bearing zone. The native silty clay was generally the same throughout the remaining parts of the property.

The metal-impacted fill at the central portion of the property consisted of silty and sandy grades of soil mixed with occasional gravel, and the metal waste from past on-site industrial operations. The depth of the metal-impacted fill typically ranged between approximately 2 to 3 feet (0.6 and 0.9 meters) below grade. The metal-impacted fill in the former lagoon consisted of saturated and very soft silty and sandy type of material. This material was likely the remaining accumulated sediment from the former lagoon, which was used as a settling basin for the past industrial process water. The bottom of the former lagoon extended to as deep as approximately 10 to 12 feet (3.0 to 3.7 meters) below ground surface. In the former marsh area, the metal-impacted fill was encountered to 4 feet (1.2 meters) below grade in both boreholes drilled. In addition to the metal impact, mild hydrocarbon odours were detected in the fill in the former marsh and lagoon. Both of these areas were saturated with perched water.

In the trucking yard, the metal-impacted fill encountered during the drilling programs consisted of sand and gravel at the surface. The metal-impacted fill became a mixture of sand, gravel, and silty clay with depth and was saturated with perched water. The depth of the metal-impacted fill in this area generally ranged between approximately 4 and 5 feet (1.2 and 1.5 meters) below grade, and was encountered as deep as 6 feet (1.8 meters). Mild hydrocarbon odours were detected in the metal-impacted fill at the south side of the trucking yard. As noted previously, the trucking yard was paved with asphalt, with some concrete adjacent to the building, in December 2004.

The parking lot at the east side of the property is surfaced with asphalt, approximately 3 inches (8 centimeters) thick on average. The depth of the underlying metal-impacted fill, which was comprised of coarse sand with gravel, ranged between approximately 1.5 and 2.5 feet (0.5 and 0.75 meters) below grade. The metal-impacted fill in the former basement used to store the oil tanks was present to approximately 10.5 to 11.5 feet (3.2 to 3.5 meters) below ground surface, where refusal was encountered. Mild hydrocarbon odours were detected in the metal-impacted fill within the former basement and the immediate surrounding area.

The overburden material along the rail siding consisted of rail ballast underlain by metal-impacted fill, which was comprised of sand and gravel, and silty clay mixed with metal waste from past on-site industrial operations. The metal-impacted fill was dark brown to black in colour and was saturated with perched water. A mild to moderate hydrocarbon odour and oily sheen was present in the metal-impacted fill in all boreholes advanced along the rail siding. The metal-impacted fill in the rail siding area was encountered at a depth ranging between approximately 3 to 4 feet (0.9 to 1.2 meters). The underlying silty clay stratum did not exhibit any visual or olfactory evidence of petroleum hydrocarbons.

The concrete floor slab was approximately 6 inches (15 centimeters) thick in most of the boreholes drilled inside the building. The underlying metal-impacted fill consisted of different grades of soil, including medium to coarse sand, with some silt and gravel,

mixed with metal waste from historical on-site industrial activities. Hydrocarbon odours and an oily sheen were encountered in four boreholes. The metal-impacted fill thickness below the building ranged between 4 and 8 feet (1.2 and 2.4 meters). The native silty clay below the metal-impacted fill was similar to the conditions found elsewhere on the property.

2.2.3 Site Hydrogeology

The hydrogeology at the site was determined by the installation of seven groundwater monitoring wells throughout the property. There are two different groundwater layers present beneath the site, and are separated by the top of the stiff native silty clay layer. Perched water was encountered in the fill material at various drilling locations; however, the natural shallow groundwater-bearing zone is situated in the native silty clay. The low hydraulic conductivity of the silty clay causes infiltrated surface water to remain "perched" in the fill layer. The perched water is not present in a continuous layer throughout the property. Rather, it is present at selected drilling locations. The upper portion of the silty clay is damp to moist and the consistency is stiff to hard (i.e. not saturated). This soil unit becomes soft and saturated at a greater depth (approximately 15 feet).

The monitoring wells were surveyed to a geodetic benchmark, which was provided by the New York State Department of Transportation. Based on water level measurements taken on two separate occasions, the shallow groundwater is estimated to flow in a northwesterly direction. Scajaquada Creek is located approximately 0.25 miles (0.4 kilometers) to the north of the subject site while Cayuga Creek is situated approximately 0.62 miles (1.0 kilometers) to the south.

2.3 SUMMARY OF PREVIOUS INVESTIGATIONS

The nature and extent of contamination at the subject property were characterized by carrying out several investigations, beginning in 1998 and culminating with the completion of the final RI/FS report in December 2004. Previous investigations were also conducted by others in the mid-1980s, prior to XCG's studies.

NUS Corporation (NUS) conducted the first environmental investigation of the subject property for the United States Environmental Protection Agency (USEPA). NUS completed an off-site reconnaissance of the property in early-1986 and prepared a report entitled "Potential Hazardous Waste Site Preliminary Assessment, N.L. Industries, Inc., 3241 Walden Avenue, Depew, NY, EPA Site ID Number NYD980531636." On March 31, 1987, NUS conducted a site inspection, on behalf of the USEPA, and collected three sediment and four soil samples for laboratory analyses. Elevated concentrations of several polycyclic aromatic hydrocarbons (PAHs) and metals

(e.g. lead, copper, and zinc) were detected in the surficial soils. The results of this investigation are summarized in the NUS report entitled "Site Inspection Report, N.L. Industries/Buffalo Plant, Depew, New York," dated July 29, 1988.

In early 1998, NYSDEC approached Norampac regarding the elevated PAHs and metals detected at the subject property in 1987, and requested that Norampac carry out a subsurface investigation. Since that time, Tighe & Bond has completed a number of subsurface investigations, in addition to the aforementioned Limited Phase 1 ESA. These investigations are summarized as follows:

- "Draft, Limited Phase 2 Environmental Site Assessment, 3241 Walden Avenue, Depew, New York," February 10, 1999;
- "Draft, Limited Phase 2 Environmental Site Assessment, Former Oil Tanks Area, 3241 Walden Avenue, Depew, New York," February 10, 1999;
- "Draft, Additional Phase 2 Environmental Site Assessment, 3241 Walden Avenue, Depew, New York," May 18, 1999; and,
- "Draft, Off-Site Surficial Soil Investigation, 3241 Walden Avenue, Depew, New York," July 26, 1999.

Copies of these documents have been submitted to the NYSDEC. In addition to the above investigations, Tighe & Bond conducted additional surficial sampling in June 1999, primarily at the west undeveloped area with some sampling at the central undeveloped area and trucking yard; however, the analytical results of these samples were not summarized in a report.

2.3.1 Soil Quality

The analytical results of the extensive testing program have provided a clear indication of the lateral and vertical extent of metal impacts throughout the subject property. The hydrocarbon impacts, which are present to a lesser extent, were also clearly defined by the analytical results. A majority of the fill material at the property contains metals and lead in particular, at concentrations that exceeded the Technical and Administrative Guidance Memorandum (TAGM 4046) Cleanup Objectives or Eastern USA/New York State Background Values. In general, soil samples that contained elevated levels of lead also had high copper and zinc concentrations, which were the other two metals historically handled on-site. The Toxicity Characteristic Leaching Procedure (TCLP) results indicate that much of the metal-impacted fill exceeds the regulatory limit for lead in leachate.

The extent of soil contamination in the different sections of the property is briefly summarized below. Details of the analytical results are provided in the RI/FS report.

Central Undeveloped Area

The central undeveloped area consists of an open field with no structures. The former lagoon and marsh is located at the south side of this area. A small portion of the former lagoon is located in the trucking yard, but will be discussed in this section. In the summer of 1999, a surface cap consisting of imported topsoil and hydro-seed was placed over the central area as part of the IRM. In addition, a chain-link fence was placed around the perimeter to limit access to this area. For the purpose of this report, this fenced-in area is defined as the central undeveloped area.

In the soil samples collected from the lagoon, the concentration of a number of metals exceeded the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background values (where no Cleanup Objectives or Site Background values exist), including arsenic, beryllium, mercury, cadmium, chromium, copper, iron, lead, nickel, and zinc. Of greatest concern are the significantly high concentrations of lead, and to a lesser extent copper and zinc, compared to the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values. The concentrations of lead were 1,600 parts per million (ppm), 86,000 ppm, 45,000 ppm and 45,000 ppm, compared to a typical range of 200 to 500 ppm in metropolitan areas (as identified in TAGM 4046). The high end typical value of 500 ppm was used as the Background Value for assessment.

Soil samples from the underlying native silty clay at these three borehole locations were analyzed to determine if the metals were migrating vertically downwards. The concentrations of lead in these three silty clay samples ranged between 18 ppm and 50 ppm, which were well below the Background Values found in metropolitan areas (as identified in TAGM 4046).

In the lagoon area, fill material samples also contained a number of metals that exceeded the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background values, including significantly high concentrations of copper, lead, and zinc. Lead concentrations in two boreholes were 7,900 and 5,200 ppm. The concentration of lead (41 ppm) in a silty clay sample from this area was well below the TAGM 4046 Background Value of 500 ppm.

Samples of the fill material from the former lagoon and marsh were also analyzed for volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs) to address a reported historical #2 fuel oil release located in this area. The concentration of acetone (0.32 ppm) slightly exceeded the TAGM 4046 Cleanup Objective of 0.2 ppm. However, this might be a laboratory artefact as acetone is commonly used for extraction purposes. The PAH results indicate that some low level residual fuel related impacts still remain in the former lagoon and marsh areas.

Soil samples were also collected from boreholes and surface sampling locations in the general central undeveloped area (i.e. beyond the former lagoon and marsh). Analytical results of the fill material from the boreholes in the general central undeveloped area indicated lead concentrations ranging from 4,700 ppm to 39,000 ppm, which exceed the TAGM 4046 Background Value (500 ppm). In nine of the ten surficial soil samples, the lead concentrations (2,600 ppm to 18,000 ppm) exceeded the Background Value.

Two native silty clay samples in the general central undeveloped area were analyzed for metals. The concentrations of lead ranged between 22 and 51 ppm, which is well below the Background Value of 500 ppm. These results further indicate that the native silty clay is acting as an effective barrier to vertical migration of metals.

Four fill material samples from the central undeveloped area were analyzed for TCLP metals analysis to determine the soil waste classification. The concentration of lead in the leachate extracted from each sample exceeded the regulatory level of 5 mg/L (ppm). The sample with the lowest total lead concentration (1,600 ppm) had a leachate lead concentration of 8.7 mg/L. The soil sample with the highest total lead concentration (86,000 ppm) had a leachate concentration of 210 mg/L.

West Undeveloped Area

The west undeveloped area is defined as the land extending from the fenced-in central area to the west property line. This area is essentially vacant with the exception of the storage of some heavy and miscellaneous equipment by the neighbouring business to the west.

Soil was collected from ten boreholes and eleven surface sampling locations. The soil quality in the west undeveloped area is somewhat different than in the central undeveloped area, as the lead concentrations in the fill varied throughout this section of the property. In three fill material samples, the lead concentrations were 11,000 ppm, 20,000 ppm, 8,400 ppm, which is significantly higher than the TAGM 4046 Background Value 500 ppm. In contrast, the lead levels in the fill material from four other boreholes were much lower and closer to the Background Value (520 ppm, 740 ppm, 880 ppm, and 210 ppm). The low and high concentrations of lead are not located in clearly defined areas. Rather, the elevated lead concentrations in the fill material are scattered sporadically throughout the west undeveloped area. This may be a result of random historical placement or grading of metal wastes. At ground surface, the lead concentrations are consistently below the TAGM 4046 Background Value and ranged between 89 ppm and 440 ppm.

The fill material samples from four samples were analyzed for TCLP metals to determine the soil waste classification. In the sample with total lead of 8,400 ppm, the concentration of lead in the extracted leachate was 17 mg/L (ppm), which exceeds the

regulatory level of 5 mg/L (6NYCRR Part 371, Section 371.3). Considering that the total lead concentrations in the fill material from two other samples were higher, the soil at these locations is also likely to be hazardous. The lead concentrations in leachate from the three other fill material samples submitted for TCLP testing were all below the laboratory method detection limit (MDL) of 0.022 mg/L. These samples had total lead concentrations of 740 ppm, 880 ppm, and 210 ppm. The TCLP analytical results indicate that the metal-impacted fill at the west undeveloped area exhibits both hazardous and non-hazardous characteristics. However, the fill material in the entire area is considered to be characteristically hazardous, given that the high lead concentrations in the fill material are present in a scattered pattern in this part of the property.

Samples of the native silty clay from four boreholes were analyzed to determine the vertical extent of metals impacts. The concentrations of lead (13 to 28 ppm) were much lower than the overlying fill material and significantly lower than the TAGM 4046 Background Value of 500 ppm.

Trucking Yard

The exterior operational area of the property is comprised of the trucking yard located adjacent to the west of the building and the rail siding situated along the south side. These two areas are connected and surrounded by a chain-link fence with gates. Trucks conduct loading and unloading activities along the west building wall, while trailers are regularly parked at the west side adjacent to the chain-link fence. Although rarely done, shipping and receiving activities may also be carried out by railway containers on the siding at the south side of the building.

The analytical results of fill material collected from the trucking yard were similar to those found in the central undeveloped area. Fill material samples from seven boreholes contained a number of metals which exceeded the TAGM 4046 Cleanup Objectives or Eastern USA/New York State Background Values. The concentrations of copper, lead, and zinc exceeded the TAGM 4046 values in all seven of these fill samples. The lead concentrations were 7,700 ppm, 31,000 ppm, 18,000 ppm, 25,000 ppm, 4,900 ppm, 19,000 ppm, and 2,300 ppm, which were well above the TAGM 4046 Background Value of 500 ppm. Two surface samples were collected at the north side of the trucking yard in April 1999. The lead concentrations for these two samples were 1,800 ppm and 5,400 ppm.

Petroleum hydrocarbon odours were detected in the fill material in two boreholes at the south side of the trucking yard. Samples of the fill material from these locations were analyzed for VOCs and PAHs. The concentrations of benzene and 1,2,4-trimethylbenzene in one sample were 0.018 ppm and 0.11 ppm, respectively. These levels marginally exceeded the STARS1 TCLP Alternative Guidance Values of 0.014 ppm and 0.1 ppm, respectively. The benzene concentration was, however, below the

three of these fill material samples were above the TAGM 4046 Cleanup Objectives. In addition, at least twelve PAH parameters exceeded the STARS1 TCLP Alternative Guidance Values; however, many of these concentrations were below the STARS1 Human Health Guidance Values and/or TAGM 4046 Cleanup Objectives.

The fill material samples from two boreholes were analyzed for TCLP metals to determine the waste classification in the rail siding area. The concentrations of lead in the leachate were 100 mg/L (total lead was 7,700 ppm) and 1.1 mg/L (total lead was 1,900 ppm), which exceeds the regulatory level of 5 mg/L. Considering the relatively high total lead concentration in the third borehole (13,000 ppm), a majority of the fill material along the rail siding is expected to be characteristically hazardous.

The analytical results of the underlying silty clay samples along the rail siding were similar to those detected in other areas of the property, except for one location. The lead concentrations in two silty clay samples were 19 ppm and 15 ppm. The concentration of lead in the silty clay sample from the third borehole tested was 6,500 ppm. This was the only native silty clay sample of the 23 analyzed on the property that exceeded the TAGM 4046 Background Value. This one exceedance may simply represent contamination at the upper zone of the silty clay unit (i.e. at the fill and silty clay interface).

Parking Lot

Sampling in the parking lot was conducted to address two areas. The initial testing focussed on the south side of the parking lot. Three oil tanks were formerly stored in this area, two of which were located below grade in a concrete-lined basement. The second investigation was carried out from the centre to the north end of the parking lot to determine the general quality of the fill material underlying the asphalt.

Soil samples from two boreholes drilled at the south end of the parking lot were collected from the material used to backfill the former oil tanks basement. The concentration of lead was much lower in this fill than the fill located elsewhere on the property. Lead was detected in these two samples at 18 ppm and 8 ppm, respectively. These values were well below the typical high end Background Value found in metropolitan areas (500 ppm), as identified in TAGM 4046.

Two boreholes were drilled to the south-central and southwest of the former tank area. Lead was detected in these two samples at 1,500 ppm and 1,200 ppm, which exceeded the TAGM 4046 Background Value of 500 ppm.

A borehole drilled just north of the former oil tanks basement had a silty clay sample analyzed for lead. The concentration of lead in this sample (24 ppm) was well below the TAGM 4046 Background Value.

The fill material and native silty clay samples were also analyzed for VOCs and PAHs to address the reported, historical oil tank leaks. Soil samples were collected from two boreholes drilled within the former tank basement. Acetone was detected in these two samples at 0.4 and 0.24 ppm. In soil samples from three boreholes located beyond the former basement perimeter, the concentration of acetone was detected at 0.32 ppm, 0.28 ppm, and 0.74 ppm. The concentrations of acetone in these five samples slightly exceeded the TAGM 4046 Cleanup Objective of 0.2 ppm. However, this might be a laboratory artefact as acetone is commonly used for extraction purposes. The method blank analyzed with these samples contained a detectable concentration of acetone.

In all samples tested from the fill material, both from within and beyond the perimeter of the former oil tank basement, the concentrations of at least two of the PAH parameters exceeded the STARS1 TCLP Alternative Guidance Values; however, many of the results were below the STARS1 Human Health Guidance Values and/or TAGM 4046 Cleanup Objectives. These samples were analyzed from the same fill material samples which contained elevated metals concentrations.

Two boreholes were drilled in the north to central portions of the parking lot. Lead was detected in the fill material in these two boreholes at 22,000 ppm and 6,000 ppm, which exceeded the TAGM 4046 Background Value of 500 ppm.

One of these fill material samples was analyzed for TCLP metals to determine the waste classification in this area. The concentration of lead in leachate in this sample was 7.0 mg/L (total lead was 6,000 ppm), which slightly exceeds the regulatory level of 5 mg/L.

The underlying native silty clay samples from the boreholes in the north and central areas of the parking lot were analyzed to determine the vertical extent of metals impacts. Lead was detected in these two samples at 110 and 16 ppm.

Building

Borehole drilling through the building floor slab was the last phase of field investigations and was conducted as part of the RI to fill-in the data gap in this area of the property. The boreholes were placed at different sections of the building in an effort to develop a good understanding of the subsurface conditions beneath the structure.

Metals analyses were conducted in the fill material at seven locations. In the borehole located in the southeast area of the building, the fill material contained a lead concentration of 250 ppm, which is below the TAGM 4046 Background Value of 500 ppm. However, the lead concentrations in the fill material at the other locations (860 to 27,000 ppm) all exceeded the TAGM 4046 Background Value. Based on these results, a majority of the fill material beneath the floor slab is expected to contain elevated concentrations of lead above the TAGM 4046 Background Value.

Two native silty clay samples from beneath the building were chemically analyzed to determine if the metals were migrating vertically downwards. Similar to the results elsewhere on the property, the lead concentrations (25 ppm and 60 ppm) were well below the TAGM 4046 Background Value.

Trace hydrocarbon odours and a slight oily sheen were detected in four of the boreholes drilled through the floor slab. Samples of the fill material from these boreholes were analyzed for VOCs and PAHs. At two of these locations, the concentrations of acetone were 0.23 and 0.25 ppm, respectively. These values marginally exceed the TAGM 4046 Cleanup Objective of 0.2 ppm. The sample from one of the samples also contained concentrations of 1,2,4-trimethylbenzene (0.33 ppm) and 1,3,5-trimethylbenzene (0.14) that slightly exceeded the STARS1 TCLP Alternative Guidance Value (0.1 ppm for both parameters). In all four fill material samples, at least three PAH parameters were detected at concentrations above the STARS1 TCLP Alternative Guidance Values, but most results were below the STARS1 Human Health Guidance Values and/or TAGM 4046 Cleanup Objectives. Those organic parameters that did exceed the TAGM 4046 Cleanup Objectives were only slightly above the objectives. As such, the presence of residual petroleum nuisance characteristics beneath the building is not considered a significant concern and does not warrant any action.

Two native silty clay samples situated directly below the fill material were also analyzed for VOCs and PAHs. The concentration of acetone in one of the samples was 0.28 ppm, which marginally exceeded the TAGM 4046 Cleanup Objective. The concentration of benzene in this sample (0.019 ppm) slightly exceeded the STARS1 TCLP Alternative Guidance Value (0.014 ppm), but was below both the Human Health Guidance Value (24 ppm) and TAGM 4046 Cleanup Objective (0.06 ppm). The concentrations of PAH parameters were either below the laboratory's MDLs or detectable but well below the STARS1 TCLP Alternative Guidance Value.

Off-site Sediment Samples

Sediment from the outfall location at Scajaquada Creek, 0.25 miles north of the former N.L. Industries Site, was sampled in 2003. Elevated levels of lead were found in the sample, indicating that contaminated surface soil particles have migrated to the storm water drainage system are ultimately deposited at this outfall location.

2.3.2 Groundwater Quality

In 1998, a total of six water samples were submitted for analyses of various parameters including metals, PAHs, VOCs, and anions. One of these samples was collected from a historical well installed by an unknown party. This well was installed within the fill material of the former lagoon and has since been removed.

The samples from four monitoring wells (three in the central area and one in the trucking yard) were collected from the shallow water-bearing zone in the native silty clay layer. In all samples, the concentrations of magnesium exceeded the Technical and Operational Guidance Series (TOGS) 1.1.1 Guidance Value while sodium exceeded the TOGS 1.1.1 Standard. Considering that the site is located in an urbanized area, the high concentrations of sodium may be attributed to road salting during the winter season. In the well located in the west section of the central area, the concentration of lead was 30 parts per billion (ppb), which slightly exceeded the TOGS 1.1.1 Standard of 25 ppb.

The groundwater sample from the well installed by an unknown party was collected from perched water in the former lagoon. The concentration of copper (220 ppb) slightly exceeded the TOGS 1.1.1 Standard of 200 ppb. Manganese was detected at 1,100 ppb, which exceeded the TOGS 1.1.1 Standard of 300 ppb.

Other than acetone (13 ppb) in Tighe & Bond's well located in the lagoon, the concentrations of VOCs in this groundwater sample as well as the sample collected from the unknown well were below the laboratory's MDLs. The detectable concentration of acetone may be a laboratory artefact. The PAH analytical results in the well located at the north end of the central area and in the lagoon were all below the laboratory's MDLs. Although there was no visual or olfactory evidence of petroleum impact in the groundwater sample from the well located at the west section of the central area, a number of PAH parameters, including benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene, exceeded the TOGS 1.1.1 Guidance Values.

The concentration of all anions, with the exception of bromide in the well located in the trucking yard, were below the TOGS 1.1.1 Standards. Bromide in this well (2,600 ppb) slightly exceeded the TOGS 1.1.1 Guidance Value of 2,000 ppb.

In April 1999, a total of four groundwater samples (including a blind field duplicate) from three newly installed wells (one in the parking lot and two in the west undeveloped area) were submitted for analyses of metals.

The monitoring wells were installed in the native silty clay stratum. The concentrations of iron in the groundwater from the parking lot and the west section of the west undeveloped area were 390 ppb and 320 ppb, respectively. These values exceed the TOGS 1.1.1 Aesthetic Standard of 300 ppb. The concentrations of magnesium in the three monitoring wells ranged between 78,000 ppb and 130,000 ppb, which exceeds the TOGS 1.1.1 Guidance Value of 35,000 ppb. The concentrations of sodium (25,000 to 70,000 ppb) also exceeded the TOGS 1.1.1 Guidance Value of 20,000 ppb. Given that the site is located in an urbanized area, the high concentrations of sodium may be attributed to road salting during the winter season. The concentrations of lead in the

parking lot well (26 ppb) and the well situated at the south end of the west undeveloped area (27 ppb) marginally exceeded the TOGS 1.1.1 Standard of 25 $\mu\text{g/L}$.

In the third round of groundwater sampling, a total of eight groundwater (including a blind field duplicate) samples were collected from the seven monitoring wells. As requested by NYSDEC, four of these samples were analyzed for a full scan Target Compound List (TCL)/Target Analyte List (TAL) analysis. The TCL/TAL parameters included metals, VOCs, semi-VOCs, pesticides, and PCBs.

The analytical results of metals indicated elevated concentrations of iron, magnesium, and sodium. The concentrations of lead in all groundwater samples were below the TOGS 1.1.1 Standard, except for the well located at the west end of the central area (765 ppb). This elevated concentration may have been a result of excessive amounts of suspended solids in the water, as the turbidity at the time of sampling was relatively high (100 NTUs). Tighe & Bond made its best efforts to reduce the turbidity; however, the shallow water-bearing zone is situated in a silty clay soil. In any event, this elevated concentration of lead in the groundwater appears to be an isolated occurrence, based on the results of other testing throughout the property.

Groundwater from monitoring wells located the former lagoon, trucking yard, and west section of the west undeveloped area was also analyzed for VOCs, semi-VOCs, pesticides, and PCBs. The analytical results were either below the laboratory's detection limit or detectable but below the TOGS 1.1.1 Standards or Guidance Values.

Although there are some exceedances of the TOGS 1.1.1 Standards or Guidance Values, with respect to bromide, metals, and PAHs, these values were developed for groundwater that is used as a source of drinking water. The subject property and surrounding area is serviced by a municipal drinking water supply, which draws its water from a surface water body. The Erie County Water Authority indicated to Tighe & Bond that Lake Erie is the water source for water supplied to the Village of Depew. Since the subject property and surrounding land is situated in a well developed urbanized area, the use of water supply wells are not expected to exist in the study area. Mr. Brian Hourigan of the NYSDEC, Division of Water, indicated that its agency does not have a database of water supply wells installed in this area of New York State. Given that the minor exceedances of a few select compounds are based on drinking water standards and the subject property area does not use groundwater for potable purposes, these elevated concentrations are not considered to be a significant concern.

As such, groundwater remediation is not considered warranted. The media of concern on the subject property is the impacted fill and any remediation should focus on this area only.

Appendix B
Sampling Data Log



Client: _____ Job #: _____

Date: _____ Project Manager: _____

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213 Court Street
Middletown, CT 06457
Attn: Brian Conte

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Appendix C

Site Plan

Appendix D
Air Sampling Summary

APPENDIX E – AIR SAMPLING SUMMARY

Tighe&Bond

Parameter	Location	Frequency 8-hr	Equipment	Estimated #	Analysis	Action level	Corrective action
PM10 (dust)	1 Upwind 3 Downwind	Throughout project	DataRAM4	~120	On-site	450 ug/m3 for 8- hours, 150 ug/m3 for 24-hours	Dust suppression with foam, water, salt, cover dirt piles in plastic
VOCs : Benzene Xylene Trimethylbenzene	1 Upwind 1 Downwind	During excavation	SUMMA cans	~10	Laboratory	Benzene: 0.009 ppm Xylene: 2.0 ppm Trimethylbenzene: 0.25 ppm	Dust suppression with foam, water, salt, cover dirt piles in plastic
Lead	1 Upwind 1 Downwind	During excavation	High Volume Sampler	~10	Laboratory	15 ug/m3 for 8 hours, 5 ug/m3 for 24 hours	Dust suppression with foam, water, salt, cover dirt piles in plastic
Lead	Workers*	Throughout project	Pumps	As necessary	Laboratory	OSHA Levels	Personal Protective Equipment
VOCs	Workers*	Throughout project	PID	As necessary	On-site	OSHA Levels	Personal Protective Equipment
PM-10 (dust)	Workers*	Throughout project	Particle Counter	As necessary	On-site	OSHA Levels	Personal Protective Equipment

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Appendix E
Equipment Specifications

Tisch Environmental, Inc.

**TE-5170 Total Suspended Particulate
MFC High Volume Air Sampler**

OPERATIONS MANUAL



145 South Miami Avenue
Village of Cleves, Ohio 45002

Toll Free: (877) 263 -7610 (TSP AND-PM10)
Direct: (513) 467-9000
FAX: (513) 467-9009
Web Site: Tisch-Env.com
Email: sales@tisch-env.com

PREFACE

Tisch Environmental, Inc. is a third generation family owned business. The owners Wilbur J. Tisch and James P. Tisch have been involved in the High Volume Air Pollution field for the last 20 years. Started in March of 1998, they would like to welcome you to their company.

The intent of this manual is to instruct the user with unpacking, assembly, operating and calibration techniques. For information on air sampling principles, procedures and requirements please contact the local Environmental Protection Agency Office serving your area.

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Gabled Rood Assembly	6
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Sampler Operation	19-20
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Motor Brush Replacement & Seating Procedure	22

INTRODUCTION

The High Volume Air Sampler is the recommended instrument for sampling large volumes of air for the collection of TSP (Total Suspended Particulate). The physical design of the sampler is based on aerodynamic principles which result in the collection of particles of 100 microns (Stokes Equivalent Diameter) and less. The TE-5170 TSP MFC sampler consists of a TE-5001 Anodized Aluminum Shelter, TE-5005 Aluminum Blower Motor Assembly, TE-5004 8"x10" Stainless Steel Filter Holder with probe hole, TE-5009 Continuous flow/pressure recorder, TE-5007 7-Day Mechanical Timer, TE-300-310 Mass Flow Controller and TE-5012 Elapsed Time Indicator.

APPLICATIONS

- Ambient air monitoring to determine suspended particulate levels relative to air quality standards.
- Impact of a specific source on ambient levels of suspended particulates by incorporating a "wind direction-activation" modification which permits the sampler to operate only when conditions are such that a source-receptor relationship exists.
- Monitoring of enclosed environments for relatively high levels of particulate matter, particularly toxic materials.
- Monitoring of emissions from large diameter vents where physical conditions preclude the use of conventional stack-testing equipment.

UNPACKING

1. Shelter Box – 46" x 20" x 23" 75 lbs

TE-5170	Anodized Aluminum Shelter with mounted Flow Controller, Timer and TE-5009 Continuous Flow Recorder (or 8WT manometer).
TE-5005	Blower Motor Assembly with tubing
TE-5004	8" x 10" TSP Stainless Steel Filter Holder with probe hole
TE-5005-9	Filter Holder Gasket

Envelope with TE-106 box of charts, and literature.

2. Lid Box – 19" x 14" x 14" 9 lbs

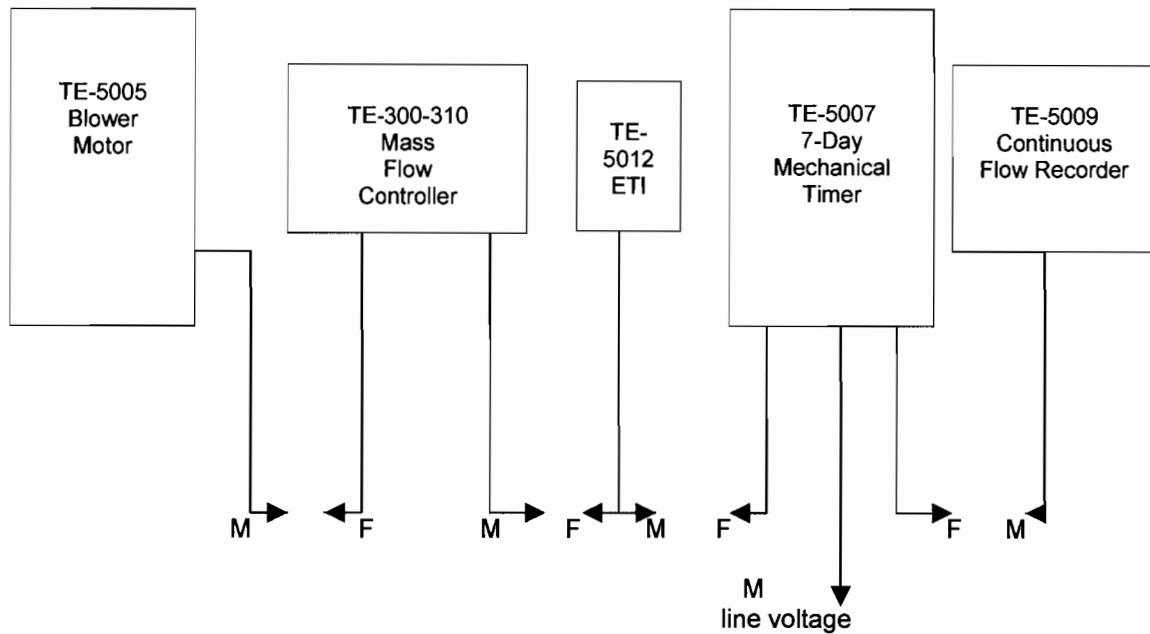
TE-5001-10 Gabled Roof

***** Save the shipping containers and packing material for future use.**

ASSEMBLY:

1. Open shelter box and remove Anodized Aluminum Shelter.
2. Enclosed in the 14" x 11" x 9" box on bottom of shelter is the TE-5005 Blower Motor Assembly. Enclosed in the 14" x 11" x 9" box inside of shelter is the TE-5004 Filter Holder with TE-5005-9 gasket. Remove from boxes.
3. Open lid box and remove 5001-10 Roof (for roof assembly see page 6).
4. If TE-5100 sampler has TE-5008 oil manometer, fill with red gauge oil.
5. Screw TE-5005 Blower Motor Assembly onto TE-5004 Filter Holder (tubing, power cord, and hole in filter holder collar to the right) make sure TE-5005-9 gasket is in place.
6. Lower Filter Holder and Blower Motor down through top support pan on shelter.
7. Take Flow Controller probe and insert into filter holder collar. Before tightening make sure probe slot is turned so air coming into filter holder goes through it. Connect tubing from pressure tap of blower motor to TE-5009 Flow Recorder or TE-5008 oil manometer.

ELECTRICAL HOOK-UP



The TE-5005 Blower Motor male cord set plugs into the TE-300-310 Mass Flow Controller Female cord set.

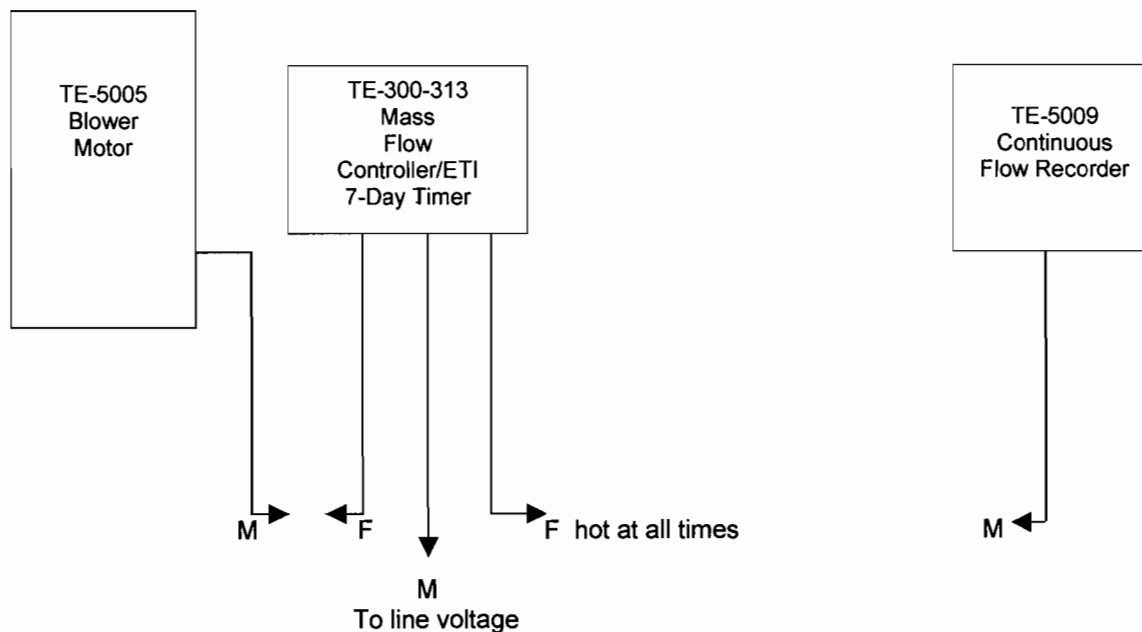
The Mass Flow Controller male cord set plugs into the TE-5012 Elapsed Time Indicator female side.

The male side of the ETI cord set plugs into the TE-5007 7-Day Mechanical Timer timed female cord set which is on the left side of timer.

The other female cord set on timer (on the right) is hot all the time and plugs into the TE-5009 Continuous Flow Recorder male cord set.

The male cord set of timer plugs into the line voltage.

ELECTRICAL HOOK-UP WITH TE-300-313



The TE-5005 Blower Motor male cord set plugs into the TE-300-313 Mass Flow Controller/ETI/Timer **Left** Female cord set (this is the timed cord set).

The Mass Flow Controller/ETI/Timer male cord set plugs into the line voltage.

The other female cord set on Mass Flow Controller/ETI/Timer (on the right) is hot all the time and plugs into the TE-5009 Continuous Flow Recorder male cord set.

GABLED ROOF ASSEMBLY

Lid parts bag contents (taped inside of lid):

5 pcs 10-24 x 1/2 pan head screws
5 pcs 10-24 stop nuts
1 pc 6-32 x 3/8 pan head screw
1 pc 6-32 hex nut
1 pc 20" chain with "S" hook
1 pc TE-5001-10-9 roof back catch
1 pc TE-5001-10-10 front catch
1 pc TE-5001-10-11 rear lid hasp

1. Secure TE-5001-10-10 front catch to the shelter using 2 10-24 pan head screws with stop nuts.
2. Secure TE-5001-10-9 roof back catch to the back of shelter using 10-24 pan head screw with stop nut.
3. Secure TE-5001-10-11 rear lid hasp inside the lid with the slotted end angled up using 2 - 10-24 pan head screws with stop nuts.

Note: These three items may need adjustment after the shelter lid is installed.

4. Remove 4 - 10-24 x 1/2 pan head screws from the nutserts in back of shelter.
5. Attach the lid to the shelter by placing the lid hinge plates on the "**OUTSIDE**" of the shelter top and tighten the 4 - 10-24 x 1/2 pan head screws into the nutserts.
6. Adjust the front catch to be sure that the lid slot lowers over it when closing the lid. The rear lid hasp should align with the roof back catch when the lid is open.
7. Attach the chain and "S" hook assembly to the side of the shelter with a 6-32 pan head screw and nut.
8. The lid can now be secured in an open or closed position with the "S" hook.

GENERAL CALIBRATION REQUIREMENTS

TE-5170 TSP MFC High Volume Air Sampler should be calibrated:

1. Upon installation
2. After any motor maintenance
3. Once every quarter (three months)
4. After 360 sampling hours

CALIBRATION KITS

The two types of calibration kits available for the TE-5170 TSP MFC High Volume Air Sampler are the TE-5025 and the TE-5028.

The TE-5025 utilizes five resistance plates to simulate various filter loading. The TE-5025 calibration kit includes: carrying case, 30" slack tube water manometer, adapter plate, 3' piece of tubing, TE-5025A orifice with flow calibration certificate, and 5 load plates (5, 7, 10, 13, 18).

The TE-5028 is the preferred method to calibrate the TE-5100 MFC TSP High Volume Air Sampler. It simulates change in the resistance by merely rotating the knob on the top of the calibrator. The infinite resolution lets the technician select the desired flow resistance. The TE-5028 calibration kit includes: carrying case, 30" slack tube water manometer, adapter plate, 3' piece of tubing, and TE-5028A orifice with flow calibration certificate.

Each TE-5025A and TE-5028A is individually calibrated on a primary standard positive displacement device (Rootsmeter) which is directly traceable to NIST.

** It is recommended that each calibrator should be re-calibrated annually for accuracy and reliability.

CALIBRATION PROCEDURE

The following is a step by step process of the calibration of a **TE-5170 Mass Flow Controlled Total Suspended Particulate High Volume Sampling Systems**. Following these steps are example calculations determining the calibration flow rates, and resulting slope and intercept for the sampler. These instructions pertain to the samplers which have air flow controlled by electronic mass flow controllers (MFC) in conjunction with a continuous flow recorder or a manometer. This calibration differs from that of a volumetric flow controlled sampler.

The Total Suspended Particulate samplers (TSP) are many times referred to as lead samplers as this is the primary duty given to these instruments in most cases. These instruments are suitable for capturing larger particulates such as heavy metals. Air monitoring studies that are concerned with smaller respirable particulate generally will call for the use of PM-10 particulate samplers which have a different calibration procedure. The TSP samplers have a very wide range of acceptable air flow operating limits, i.e., 1.10 to 1.70 m³/min (39 to 60 CFM).

A mass flow controller will sense a decrease in air flow and increases the voltage to the blower which increases the blower speed in order to compensate. This is necessary when sampling with a PM-10 sampler due to the narrow acceptable air flow range of these types of instruments.

The attached example calibration worksheets can be used with either a **TE-5025 Fixed Orifice Calibrator** which uses resistance plates to vary air flow or a **TE-5028 Variable Orifice Calibrator** which uses an adjustable or variable orifice. The attached worksheet uses a fixed orifice. Either type of orifice is acceptable for calibrating high volume samplers and the calibration process does not change with either type.

Proceed with the following steps to begin the calibration:

Step one: Disconnect the sampler motor from the mass flow controller and connect the motor to a stable AC power source.

Step two: Mount the calibrator orifice and top loading adapter plate to the sampler. A sampling filter is generally not used during this procedure. Tighten the top loading adapter hold down nuts securely for this procedure to assure that no air leaks are present.

Step three: Allow the sampler motor to warm up to its normal operating temperature.

Step four: Conduct a leak test by covering the hole on top of the orifice and pressure tap on the orifice with your hands. Listen for a high-pitched squealing sound made by escaping air. If this sound is heard, a leak is present and the top loading adapter hold-down nuts need to be re-tightened.

Note: Avoid running the sampler for longer than 30 seconds at a time with the orifice blocked. This will reduce the chance of the motor overheating. Also, never try this leak test procedure with a manometer connected to the side tap on the calibration orifice or the blower motor. Liquid from the manometer could be drawn into the system and cause motor damage.

Step five: Connect one side of a water manometer to the pressure tap on the side of the orifice with a rubber vacuum tube. Leave the opposite side of the manometer open to the atmosphere.

Note: Both valves on the manometer have to be open for the liquid to flow freely also to read a manometer one side of the 'U' tube goes up the other goes down; add together this is the "H₂O

Step six: Insert the #18 resistance plate and gasket under the orifice (**TE-5025A**), tighten the threaded collar securely, and record the manometer reading from the orifice and the continuous flow recorder reading (or manometer) from the sampler. A manometer must be held vertically to insure accurate readings. Tapping the backside of the continuous flow recorder will help to center the pen

and give accurate readings. Repeat this procedure until the readings have been taken from all five resistance plates. If you are using a variable orifice (**TE-5028A**), five flow rates are achieved in this step by adjusting the knob on the variable orifice to five different positions and taking five different readings.

Step seven: Record the ambient air temperature, the ambient barometric pressure, the sampler serial number, the orifice s/n, the orifice slope and intercept with date last certified, today's date, site location and the operator's initials.

Step eight: Disconnect the sampler motor from its power source and remove the orifice and top loading adapter plate. Re-connect the sampler motor to the electronic mass flow controller.

An example of a Lead (or TSP) Sampler Calibration Data Sheet has been attached with data filled in from a typical calibration. This includes the transfer standard orifice calibration relationship which was taken from the Orifice Calibration Worksheet that accompanies the calibrator orifice. Since this calibration is for a TSP sampler, the slope and intercept for this orifice uses **standard** flows rather than actual flows and is taken from the Qstandard section of the Orifice Calibration Worksheet. The Qactual flows are used when calibrating a PM-10 sampler.

The five orifice manometer readings taken during the calibration have been recorded in the column on the data worksheet titled Orifice "H₂O". The five continuous flow recorder readings taken during the calibration have been recorded under the column titled I chart (if using a manometer instead of a recorder the five manometer readings are recorded under the column titled FLOW (mano)).

The orifice manometer readings need to be converted to the standard air flows they represent using the following equation:

$$Q_{std} = 1/m[\text{Sqrt}((H_2O)(Pa/760)(298/Ta))-b]$$

where: Q_{std} = actual flow rate as indicated by the calibrator orifice, m³/min
 H_2O = orifice manometer reading during calibration, in. H₂O
 Ta = ambient temperature during calibration, K ($K = 273 + ^\circ C$)
 298 = standard temperature, a constant that never changes, K
 Pa = ambient barometric pressure during calibration, mm Hg
 760 = standard barometric pressure, a constant that never changes, mm Hg
 m = *Qstandard slope of orifice calibration relationship*
 b = *Qstandard intercept of orifice calibration relationship*

Once these standard flow rates have been determined for each of the five run points, they are recorded in the column titled Q_{std} , and are represented in cubic meters per minute.

The continuous flow recorder readings taken during the calibration need to be corrected to the current meteorological conditions using the following equation:

$$IC = I[\text{Sqrt}((Pa/760)(298/Ta))]$$

where: IC = continuous flow recorder readings corrected to current Ta and Pa
 I = continuous flow recorder readings during calibration
 Pa = ambient barometric pressure during calibration, mm Hg.
 760 = standard barometric pressure, a constant that never changes, mm Hg
 Ta = ambient temperature during calibration, K ($K = 273 + ^\circ C$)
 298 = standard temperature, a constant that never changes, K

If using a manometer instead of a continuous flow recorder:

$$\text{FLOW (corrected)} = [\text{Sqrt}(\text{"H}_2\text{O})(\text{Pa}/760)(298/\text{Ta})]$$

Flow (corrected) = sampler manometer readings corrected to current Pa and Ta

"H₂O = sampler manometer reading during calibration

Pa = ambient barometric pressure during calibration, mm Hg

760 = standard barometric pressure, a constant that never changes, mm Hg

Ta = ambient temperature during calibration, K (K= 273 + Celsius)

298 = standard temperature, a constant that never changes, K

After each of the continuous flow recorder readings have been corrected, they are recorded in the column titled IC (corrected) (if using a manometer instead of a recorder use the column titled FLOW (corrected)).

Using Qstd and IC (or FLOW (corrected)) as the x and y axis respectively, a slope, intercept, and correlation coefficient can be calculated using the least squares regression method. The correlation coefficient should never be less than 0.990 after a five point calibration. A coefficient below .990 indicates a calibration that is not linear and the calibration should be performed again. If this occurs, it is most likely the result of an air leak during the calibration.

The equations for determining the slope (m) and intercept (b) are as follows:

$$m = \frac{\frac{(\sum x)(\sum y)}{\sum xy} - \frac{n}{n}}{\frac{(\sum x)^2}{\sum x^2} - \frac{n}{n}} ; \quad b = \bar{y} - m\bar{x}$$

where: n = number of observations

$$\bar{y} = \sum y/n$$

$$\bar{x} = \sum x/n$$

Σ = sum of

The equation for the coefficient of correlation (r) is as follows:

$$r = \frac{\frac{(\sum x)(\sum y)}{\sum xy} - \frac{n}{n}}{\sqrt{\left[\frac{(\sum x)^2}{\sum x^2} - \frac{n}{n} \right] \left[\frac{(\sum y)^2}{\sum y^2} - \frac{n}{n} \right]}}$$

where: n = number of observations

Σ = sum of

The acceptable operating flow range of a TSP sampler is 1.1 to 1.7 m³/min (39 to 60 CFM). Looking at the worksheet column Qstd, the flow rates that are within this range can be identified along with the chart reading (I) that represents them. For instance if you wanted to set this sampler at 1.353 m³/min (47.77 CFM) (Make sure the mass flow controller is plugged in and a filter is in place) you would turn the Flow Adjustment screw

until the continuous flow recorder read 29 on the chart. If using a manometer instead of a continuous flow recorder and you wanted to set the sampler at 1.353 m³/min (47.77 CFM) you would turn the Flow Adjustment screw until the manometer read 4.5 inches of H₂O. By making sure that the sampler is operating at a chart reading (or manometer reading) that is within the acceptable range, it can be assumed that valid TSP data is being collected.

Example Problems

The following example problems use data from the attached calibration worksheet.

After all the sampling site information, calibrator information, and meteorological information have been recorded on the worksheet, standard air flows need to be determined from the orifice manometer readings taken during the calibration using the following equation:

$$1. \quad Q_{std} = 1/m[\text{Sqrt}((H_2O)(Pa/760)(298/Ta)) - b]$$

where: Q_{std} = actual flow rate as indicated by the calibrator orifice, m³/min
 H_2O = orifice manometer reading during calibration, "H₂O
 T_a = ambient temperature during calibration, K ($K = 273 + ^\circ\text{C}$)
 298 = standard temperature, a constant that never changes, K
 P_a = ambient barometric pressure during calibration, mm Hg
 760 = standard barometric pressure, a constant that never changes, mm Hg
 m = *Q*standard slope of orifice calibration relationship
 b = *Q*standard intercept of orifice calibration relationship.

Note that the ambient temperature is needed in degrees Kelvin to satisfy the Q_{std} equation. Also, the barometric pressure needs to be reported in millimeters of mercury. In our case the two following conversions may be needed:

$$2. \quad \text{degrees Kelvin} = [5/9 (\text{degrees Fahrenheit} - 32)] + 273$$

$$3. \quad \text{millimeters of mercury} = 25.4(\text{inches of H}_2\text{O}/13.6)$$

Inserting the numbers from the calibration worksheet run point number one we get:

$$4. \quad Q_{std} = 1/2.01[\text{Sqrt}((11.5)(737/760)(298/294)) - (-.02003)]$$

$$5. \quad Q_{std} = .4975[\text{Sqrt}((11.5)(.9697)(1.0136)) + .02003]$$

$$6. \quad Q_{std} = .4975[\text{Sqrt}(11.296) + .02003]$$

$$7. \quad Q_{std} = .4975[3.361 + .02003]$$

$$8. \quad Q_{std} = .4975[3.381]$$

$$9. \quad Q_{std} = 1.682$$

Throughout these example problems you may find that your answers vary some from those arrived at here. This is probably due to different calculators carrying numbers to different decimal points. The variations are usually slight and should not be a point of concern.

With the Qstd determined, the corrected chart reading (IC) for this run point needs to be calculated using the following equation:

$$10. \quad IC = I[\text{Sqrt}((Pa/760)(298/Ta))]$$

where: IC = continuous flow recorder readings corrected to standard
 I = continuous flow recorder readings during calibration
 Pa = ambient barometric pressure during calibration, mm Hg.
 760 = standard barometric pressure, mm Hg
 Ta = ambient temperature during calibration, K (K = 273 + °C)
 298 = standard temperature, K.

Inserting the data from run point one on the calibration worksheet we get:

$$11. \quad IC = 46[\text{Sqrt}(737/760)(298/294)]$$

$$12. \quad IC = 46[\text{Sqrt}(.983)]$$

$$13. \quad IC = 46[.9914635]$$

$$14. \quad IC = 45.61$$

If using a manometer instead of a continuous flow recorder:

$$\text{FLOW (corrected)} = [\text{Sqrt}("H_2O)(Pa/760)(298/Ta)]$$

FLOW (corrected) = sampler manometer readings corrected to current Pa and Ta

"H₂O = sampler manometer reading during calibration

Pa = ambient barometric pressure during calibration, mm Hg.

760 = standard barometric pressure, a constant that never changes, mm Hg

Ta = ambient temperature during calibration, K (K = 273 + Celsius)

298 = standard temperature, a constant that never changes, K

Inserting the data from run point one from the calibration worksheet (two manometers) we get:

$$\text{FLOW (corrected)} = [\text{Sqrt}(6.9)(737/760)(298/294)]$$

$$\text{FLOW (corrected)} = \text{Sqrt}(6.7822)$$

$$\text{FLOW (corrected)} = 2.6$$

This procedure should be completed for all five run points. EPA guidelines state that at least three of the five Qstd flow rates during the calibration be within or nearly within the acceptable operating limits of 1.10 to 1.70 m³/min (39 to 60 CFM). If this condition is not met, the instrument should be recalibrated.

Using Qstd as our x-axis, and IC (or FLOW (corrected)) as our y-axis, a slope, intercept, and correlation coefficient can be determined using the least squares regression method.

The equations for determining the slope (m) and intercept (b) are as follows:

$$15. \quad m = \frac{\frac{(\sum x)(\sum y)}{\sum xy} - \frac{n}{n}}{\frac{(\sum x)^2}{\sum x^2} - \frac{n}{n}} ; \quad b = \bar{y} - m\bar{x}$$

where: n = number of observations

$$\bar{y} = \sum y/n; \quad \bar{x} = \sum x/n$$

Σ = sum of.

The equation for the coefficient of correlation (r) is as follows:

$$16. \quad r = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sqrt{\left[\sum x^2 - \frac{(\sum x)^2}{n} \right] \left[\sum y^2 - \frac{(\sum y)^2}{n} \right]}}$$

where: n = number of observations
 Σ = sum of

Before these can be determined, some preliminary algebra is necessary. Σx , Σy , Σx^2 , Σxy , $(\Sigma x)^2$, $(\Sigma y)^2$, n , $\bar{x}$, and $\bar{y}$ need to be determined.

$$17. \quad \Sigma x = 1.684 + 1.532 + 1.353 + 1.08 + .851 = 6.5$$

$$18. \quad \Sigma y = 45.65 + 35.73 + 28.78 + 18.86 + 11.91 = 140.93$$

$$19. \quad \Sigma x^2 = (1.684)^2 + (1.532)^2 + (1.353)^2 + (1.08)^2 + (.851)^2 = 8.904$$

$$20. \quad \Sigma y^2 = (45.65)^2 + (35.73)^2 + (28.78)^2 + (18.86)^2 + (11.91)^2 = 4686.392$$

$$21. \quad \Sigma xy = (1.684)(45.65) + (1.532)(35.73) + (1.353)(28.78) + (1.08)(18.86) + (.851)(11.91) = 201.057$$

$$22. \quad n = 5$$

$$23. \quad \bar{x} = \Sigma x / n = 1.3$$

$$24. \quad \bar{y} = \Sigma y / n = 28.186$$

$$25. \quad (\Sigma x)^2 = (6.5)^2 = 42.25$$

$$26. \quad (\Sigma y)^2 = (140.93)^2 = 19861.264$$

Inserting the numbers:

$$27. \quad \text{slope} = \frac{201.057 - \frac{(6.5)(140.93)}{5}}{8.904 - \frac{42.25}{5}}$$

$$28. \quad \text{slope} = \frac{201.057 - \frac{(916.045)}{5}}{8.904 - \frac{42.25}{5}}$$

$$29. \quad \text{slope} = \frac{201.057 - 183.209}{8.904 - 8.45}$$

$$30. \quad \text{slope} = \frac{17.848}{0.454}$$

$$31. \text{ slope} = 39.31$$

$$32. \text{ intercept} = 28.186 - (39.31)(1.3)$$

$$33. \text{ intercept} = 28.186 - 51.103$$

$$34. \text{ intercept} = -22.917$$

$$35. \text{ correlation coeff.} = \frac{201.057 - \frac{(6.5)(140.93)}{5}}{\sqrt{\left[8.904 - \frac{42.25}{5}\right] \left[4686.392 - \frac{19861.264}{5}\right]}}$$

$$36. \text{ correlation coeff.} = \frac{201.057 - \frac{(916.045)}{5}}{\sqrt{[(8.904 - 8.45)] [(4686.392 - 3972.253)]}}$$

$$37. \text{ correlation coeff.} = \frac{(201.057 - 183.209)}{\sqrt{[(8.904 - 8.45)] [(4686.392 - 3972.253)]}}$$

$$38. \text{ correlation coeff.} = \frac{17.848}{\sqrt{(0.454)(714.139)}}$$

$$39. \text{ correlation coeff.} = \frac{17.848}{\sqrt{324.2191}}$$

$$40. \text{ correlation coeff.} = \frac{17.848}{18.006}$$

$$41. \text{ correlation coeff.} = .991$$

A calibration that has a correlation coefficient of less than .990 is not considered linear and should be re-calibrated. As you can see from both worksheets we have 3 Qstd numbers that are in the TSP range (1.1 - 1.7) and the correlation coeff. is > .990, thus a good calibration.

TISCH ENVIRONMENTAL, INC.
TE-5170 MFC SAMPLER CALIBRATION
(DICKSON RECORDER)

Site					
Location: Cleves, Ohio Sampler: TE-5170 MFC			Date: Jan. 01, 2003 Tech: Jim Tisch		
Conditions					
Sampler Elevation (Feet)		400		Corrected Pressure (mm HG)	
Sea Level Pressure (in HG)		29.43		Temperature (deg K)	
Temperature (deg F)		70		Corrected Seasonal (mm HG)	
Seasonal SL Press. (in HG)		29.43		Seasonal Temp. (deg K)	
Seasonal Temp (deg F)		70		737	
Calibration Orifice					
Make: Tisch-Env Model: TE-5025A Serial # 0005			Qstd Slope: 2.01000 Qstd Intercept: -0.02003 Date Certified: Original		
Calibration				Linear Regression	
Plate or Test #	H2O (in)	Qstd (m3/min)	I (Chart)	IC (corrected)	
1	11.50	1.684	46.0	45.65	Slope = 39.2991 Intercept = -22.9067 Corr. coeff. = 0.9911
2	9.50	1.532	36.0	35.73	
3	7.40	1.353	29.0	28.78	
4	4.70	1.080	19.0	18.86	
5	2.90	0.851	12.0	11.91	
Calculations					
Qstd = 1/m [Sqrt (H₂O (Pa/Pstd) (Tstd/Ta)) -b] IC = I [Sqrt (Pa/Pstd) (Tstd/Ta)] Qstd = standard flow rate IC = corrected chart response I = actual chart response m = calibrator Qstd slope b = calibrator Qstd intercept Ta = actual temperature during calibration (deg K) Pa = actual pressure during calibration (mm HG) Tstd = 298 deg K Pstd = 760 mm Hg For subsequent calculation of sampler flow: 1/m ((I) [Sqrt (298/Tav) (Pav/760)] -b) m = sampler slope b = sampler intercept Tav = daily average temperature Pav = daily average pressure					

TISCH ENVIRONMENTAL, INC.
TE-5170 MFC SAMPLER CALIBRATION
(2 MANOMETERS)

Site					
Location: Cleves, Ohio Sampler: TE-5170 MFC			Date: Jan. 01, 2003 Tech: Jim Tisch		
Conditions					
Sampler Elevation (Feet)		400		Corrected Pressure (mm HG)	
Sea Level Pressure (in HG)		29.43		Temperature (deg K)	
Temperature (deg F)		69		Corrected Seasonal (mm HG)	
Seasonal SL Press. (in HG)		29.43		Seasonal Temp. (deg K)	
Seasonal Temp (deg F)		69		294	
Calibration Orifice					
Make: Tisch-Env Model: TE-5025A Serial # 0005			Qstd Slope: 2.01000 Qstd Intercept: -0.02003 Date Certified: Original		
Calibration				Linear Regression	
Plate or Test #	H2O (in)	Qstd (m3/min)	FLOW (mano)	FLOW (corrected)	
18	11.50	1.684	6.9	2.61	Slope = 1.6646 Intercept = -0.1684 Corr. coeff. = 0.9987
13	9.50	1.532	5.8	2.39	
10	7.40	1.353	4.5	2.11	
7	4.70	1.080	2.8	1.66	
5	2.90	0.851	1.5	1.22	
Calculations					
H2O (in) = manometer on orifice Qstd = 1/m [Sqrt (H2O (Pa/Pstd) (Tstd/Ta)) -b] FLOW (mano) = manometer on blower motor port FLOW (mano) = [Sqrt (in H2O) (Pa/Pstd) (tstd/Ta)] Qstd = standard flow rate FLOW (corrected) = corrected flow reading m = calibrator Qstd slope b = calibrator Qstd intercept Ta = actual temperature during calibration (deg K) Pa = actual pressure during calibration (mm HG) Tstd = 298 deg K Pstd = 760 mm Hg For subsequent calculation of sampler flow: 1/m ((Sqrt (in H2O) (Pav/Pstd) (Tstd/Tav)) -b) (in H2O) = manometer on blower motor port m = sampler slope b = sampler intercept Tav = daily average temperature Pav = daily average pressure					

TOTAL VOLUME

TE-5170 MFC TSP with TE-5009 Continuous Flow Recorder

To figure out the total volume of air that flowed through the sampler during your sampling run take a set-up reading (when you set the sampler up manually turn it on and take a continuous flow recorder reading; in our example it should be 29) and a pick-up reading (after the sample has been taken again manually turn sampler on and take a continuous recorder reading; for our example let's say it read 27). Take $29 + 27 = 56$ $56/2 = 28$ so the continuous recorder reading you would use is 28. Put that into the formula (on bottom of worksheet):

$$1/m((l)[\text{Sqrt}(298/T_{av})(P_{av}/760)] - b)$$

m = sampler slope

b = sampler intercept

l = average chart response

T_{av} = daily average temperature

P_{av} = daily average pressure

Sqrt = square root

Example:

$$m^3/\text{min} = 1/39.2991((28)[\text{Sqrt}(298/294)(737/760)] - (-22.9067))$$

$$m^3/\text{min} = .025 ((28)[\text{Sqrt}(1.01)(.97)] + 22.9067)$$

$$m^3/\text{min} = .025 ((28)[\text{Sqrt}(.98)] + 22.9067)$$

$$m^3/\text{min} = .025 ((28)[(.99)] + 22.9067)$$

$$m^3/\text{min} = .025 ((27.72) + 22.9067)$$

$$m^3/\text{min} = .025 (50.627)$$

$$m^3/\text{min} = 1.266$$

$$\text{ft}^3/\text{min} = 1.266 \times 35.31 = 44.70$$

$$\text{Total ft}^3 = \text{ft}^3/\text{min} \times 60 \times \text{hours that sampler ran}$$

Let's say our sampler ran 23.3 hours (end ETI reading - start ETI reading)

**** Make sure ETI is in hours otherwise convert to hours ****

$$\text{Total ft}^3 = 44.70 \times 60 \times 23.3 = 62,490.6 \text{ ft}^3$$

$$\text{Total m}^3 = 1.266 \times 60 \times 23.3 = 1769.87 \text{ m}^3$$

TOTAL VOLUME

TE-5170 MFC TSP with TE-5008 Manometer

To figure out the total volume of air that flowed through the sampler during your sampling run take a set-up reading (when you set the sampler up manually turn it on and take a TE-5008 manometer reading; in our example it should be 4.5 inches of H₂O) and a pick-up reading (after the sample has been taken again manually turn sampler on and take a TE-5008 manometer reading; for our example let's say it read 4.3 inches of H₂O).

Take $4.5 + 4.3 = 8.8$ $8.8/2 = 4.4$ so the 8WT manometer reading you would use is 4.4 . Put that into the formula (on bottom of worksheet):

$$1/m((\text{Sqrt}(\text{in H}_2\text{O})(P_{av}/760)(298/T_{av})) - b)$$

m = sampler slope

b = sampler intercept

in H₂O = average TE-5008 manometer reading

T_{av} = daily average temperature

P_{av} = daily average pressure

Sqrt = square root

Example:

$$m^3/\text{min} = 1/1.6718((\text{Sqrt}(4.4)(298/294)(737/760)) - (-0.1808))$$

$$m^3/\text{min} = .598 ((\text{Sqrt}(4.4)(1.01)(.97)) + 0.1808)$$

$$m^3/\text{min} = .598 ((\text{Sqrt}(4.311)) + 0.1808)$$

$$m^3/\text{min} = .598 ((2.076) + 0.1808)$$

$$m^3/\text{min} = .598 (2.257)$$

$$m^3/\text{min} = 1.349$$

$$\text{ft}^3/\text{min} = 1.349 \times 35.31 = 47.63$$

$$\text{Total ft}^3 = \text{ft}^3/\text{min} \times 60 \times \text{hours that sampler ran}$$

Let's say our sampler ran 23.3 hours (end ETI reading - start ETI reading)

**** Make sure ETI is in hours otherwise convert to hours ****

$$\text{Total ft}^3 = 47.63 \times 60 \times 23.3 = 66,586.74 \text{ ft}^3$$

$$\text{Total m}^3 = 1.349 \times 60 \times 23.3 = 1885.90 \text{ m}^3$$

SAMPLER OPERATION TE-5170 MFC TSP

1. After performing calibration procedure, remove filter holder frame by loosening the four wing nuts allowing the brass bolts and washers to swing down out of the way. Shift frame to one side and remove.
2. Carefully center a new filter, rougher side up, on the supporting screen. Properly align the filter on the screen so that when the frame is in position the gasket will form an airtight seal on the outer edges of the filter.
3. Secure the filter with the frame, brass bolts, and washers with sufficient pressure to avoid air leakage at the edges (make sure that the plastic washers are on top of the frame).
4. Wipe any dirt accumulation from around the filter holder with a clean cloth.
5. Close shelter lid carefully and secure with the "S" hook.
6. Make sure all cords are plugged into their appropriate receptacles and the rubber tubing between the blower motor pressure tap and the TE-5009 continuous flow recorder (or TE-5008 manometer) is connected (be careful not to pinch tubing when closing door).
7. Prepare TE-5009 continuous flow recorder as follows:
 - a) Clean any excess ink and moisture on the inside of recorder by wiping with a clean cloth.
 - b) Depress pen arm lifter to raise pen point and carefully insert a fresh chart.
 - c) Carefully align the tab of the chart to the drive hub of the recorder and press gently with thumb to lower chart center onto hub. Make sure chart is placed under the chart guide clip and the time index clip so it will rotate freely without binding. Set time by rotating the drive hub clock-wise until the correct time on chart is aligned with time index pointer.
 - d) Make sure the TE-160 pen point rests on the chart with sufficient pressure to make a visible trace.
8. Prepare the Timer as instructed on page 20.
9. Manually trip timer switch on to determine if sampler is operating properly and the recorder is inking correctly.
10. Manually trip timer switch off. If the timer is set correctly you are ready to sample.
11. At the end of the sampling period, remove the frame to expose the filter. Carefully remove the exposed filter from the supporting screen by holding it gently at the ends (not at the corners). Fold the filter lengthwise so that sample touches sample.
12. It is always a good idea to contact the lab you are dealing with to see how they may suggest you collect the filter and any other information that they may need.

To prepare the Timer:

TE-5007 7-Day Mechanical Timer

- a) To set the "START" time, attach a (bright) "ON" tripper to the dial face on the desired "START" time. Tighten tripper screw securely.
- b) To set the "STOP" time, attach a (dark) "OFF" tripper to the dial face on the desired "STOP" time. Tighten tripper screw securely.
- c) To set current time and day, grasp dial and rotate **clockwise only** until correct time and day appear at time pointer.

TE-5006 6-Day Mechanical Timer

- a) To set the "START" time, attach a (bright) "A" tripper to the dial face on the desired "START" time that is away from the current time. Tighten tripper screws with fingers only.
- b) If you want to sample 24 hours put a (dark) "B" tripper 24 hours away from the "A" tripper. **Make sure** that the "A" (start) tripper is in front of the "B" (stop) tripper otherwise it will sample for 120 hours instead of 24 hours. Remember this is a six day timer so you will continue to sample every six days.
- c) Set current time by turning dial **clockwise only** until correct military time is obtained.

MAINTENANCE

A regular maintenance schedule will allow a monitoring network to operate for longer periods of time without system failure. Our customers may find the adjustments in routine maintenance frequencies are necessary due to the operational demands on their sampler(s). We recommend that the following cleaning and maintenance activities be observed until a stable operating history of the sampler has been established.

TE-5170 MFC TSP Sampler

1. Make sure all gaskets (including motor cushion) are in good shape and that they seal properly.
2. The power cords should be checked for good connections and for cracks (replace if necessary).

CAUTION: Do not allow power cord or outlets to be immersed in water!

3. Inspect the filter screen and remove any foreign deposits.
4. Inspect the filter holder frame gasket each sample period and make sure of airtight seal.
5. Check or replace motor brushes every 500 hours.
6. Make sure elapsed time indicator is working properly.
7. Make sure continuous flow recorder pen is still inking each time, tubing has no crimps or cracks, and that the door is sealed completely.

MOTOR BRUSH REPLACEMENT TE-5170 MFC TSP

(110v Brush part #TE-33384)

(220v Brush part #TE-33378)

CAUTION: Unplug the unit from any line voltage sources before any servicing of blower motor assembly.

1. Remove the blower motor flange by removing the four bolts. This will expose the gasket and the TE-116311 motor.
2. Turn assembly on side, loosen the cord retainer and then push cord into housing and at the same time let motor slide out exposing the brushes.
3. Looking down at motor, there are 2 brushes, one on each side. Carefully pry the brass quick disconnect tabs (the tabs are pushed into end of brush) away from the expended brushes and toward the armature. Try to pry the tabs as far as you can without damaging the armature.
4. With a screwdriver loosen and remove brush holder clamps and release TE-33384 brushes. Carefully, pull quick disconnect tabs from expended brushes.
5. Carefully slide quick disconnect tabs into tab slot of new TE-33384 brush.
6. Push brush carbon against armature until brush housing falls into brush slot on motor.
7. Put brush holder clamps back onto brushes.
8. Make sure quick disconnect tabs are firmly seated into tab slot. Check field wires for good connections.
9. Assemble motor after brush replacement by placing housing over and down on the motor (at same time pull power cord out of housing), being careful not to pinch any motor wires beneath the motor spacer ring.
10. Secure power cord with the cord retainer cap.
11. Replace blower motor flange on top of motor making sure to center gasket.

****IMPORTANT**** To enhance motor life:

1. Change brushes before brush shunt touches armature.
2. Seat new brushes by applying 50% voltage for 10 to 15 minutes, the TE-5075 brush break in device allows for the 50% voltage.

Integrated Sensor Suite Installation Manual



For Vantage Pro2™ & Vantage Pro2 Plus™ Weather Stations



Davis Instruments, 3465 Diablo Avenue, Hayward, CA 94545 • 510-732-9229 • www.davisnet.com

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FCC Part 15 Class B Registration Warning

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modification not expressly approved in writing by Davis Instruments may void the warranty and void the user's authority to operate this equipment.

FCC ID: IR2DWW6328

IC: 378810-6328

EC EMC Compliance

This product complies with the essential protection requirements of the EC EMC Directive 89/336/EC.

Integrated Sensor Suite Installation Manual

Rev. C, September 14, 2006

Document Part Number: 07395.249

For Vantage Pro2 Weather Stations # 6322, 6322C, 6323, 6327, 6327C, 6328

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Introduction

The Integrated Sensor Suite (ISS) collects outside weather data and sends the data to a Vantage Pro2 console or Weather Envoy. Wireless and cabled versions of the ISS are available, as well as standard and plus versions. The Wireless ISS is solar powered and sends data to the console via a low-power radio. The Cabled ISS sends data and receives power via the console cable.

The standard version of the ISS contains a rain collector, temperature sensor, humidity sensor and anemometer. In addition to the standard weather features, the ISS Plus adds a pre-installed solar radiation sensor and an ultra-violet (UV) radiation sensor. Temperature and humidity sensors are mounted in a passive radiation shield to minimize the impact of solar radiation on sensor readings. The anemometer measures wind speed and direction and can be installed adjacent to the ISS or apart from it. See "Locating the ISS and Anemometer" on page 15 for siting guidelines.

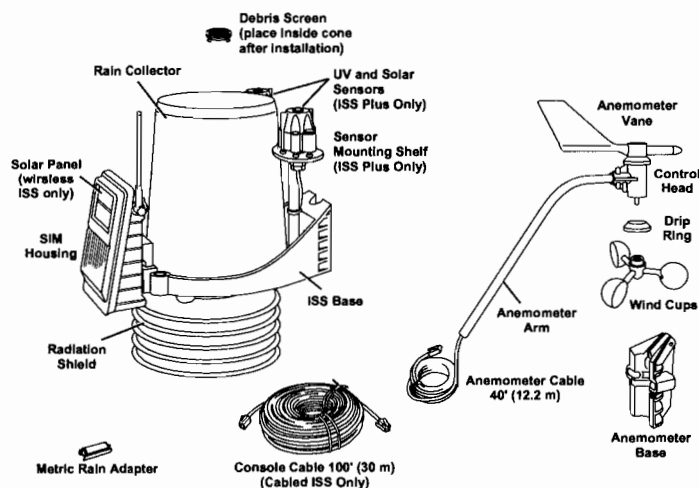
On an ISS Plus, the additional solar and UV sensors are mounted next to the rain collector cone. Solar and UV sensors are available separately to upgrade a standard ISS.

The Sensor Interface Module (SIM) contains the "brains" of the ISS and the radio transmitter. The SIM is located on the front of the radiation shield in the SIM box. The SIM collects outside weather data from the ISS sensors and then transmits the data to your Vantage Pro2 console or Weather Envoy.

Included Components and Hardware

The ISS comes with all the components and hardware shown in the following illustrations. If you purchased your ISS as part of a weather station package containing the Vantage Pro2 console, additional components may be included in the package that are not shown here.

Components

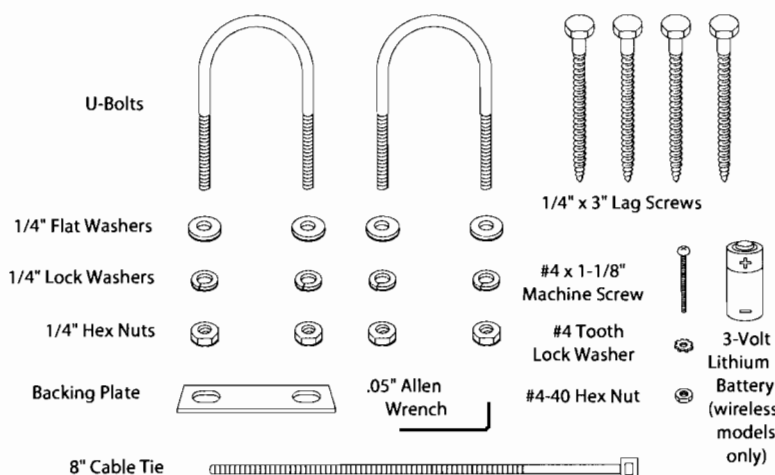


Preparing the ISS for Installation

Note: If the ISS is a Plus model and contains UV and solar sensors, do not touch the small white diffusers on top of the sensors. Oil from skin reduces their sensitivity. If you are concerned that you have touched the diffusers at any time during the installation, clean the UV diffuser using ethyl alcohol with a soft cloth. When cleaning the UV diffuser, DO NOT use rubbing or denatured alcohols because they can affect accuracy of the sensor readings. Ethyl alcohol can be procured through an industrial or laboratory supply store. Clean the solar diffuser with a soft damp cloth.

Hardware

The following hardware is included with the ISS and weather station assembly. Some of the hardware is optional based on how the ISS is assembled and installed. (See "Installing the ISS" on page 19 for more information.)



Note: If any of the hardware components are missing or not included, contact Customer Service toll free at 1-800-678-3669 about receiving replacement hardware or other components.

Tools for Setup

The following are additional tools required to set up and install the ISS:

- Small Phillips head screwdriver
- Scissors or wire-cutters
- Adjustable wrench or 7/16" wrench
- Compass or local area map
- Ballpoint pen or paper clip (or other small pointed object)
- Drill and 3/16" (5 mm) drill bit (if mounting on a vertical surface)

Preparing the ISS for Installation

Please follow the steps in the order they are presented. Each step builds on tasks completed in previous steps.

Note: Using a well-lit work table or work area to prepare the ISS for installation is recommended.

The steps to prepare the ISS for installation are:

- Assemble the anemometer.
- Check the factory-installed sensor cable connections to the SIM.
- Connect the anemometer sensor cable to the SIM.
- Apply power to the ISS and test communication with the console.
- Change the Transmitter ID for wireless communication, if necessary.

Assemble the Anemometer

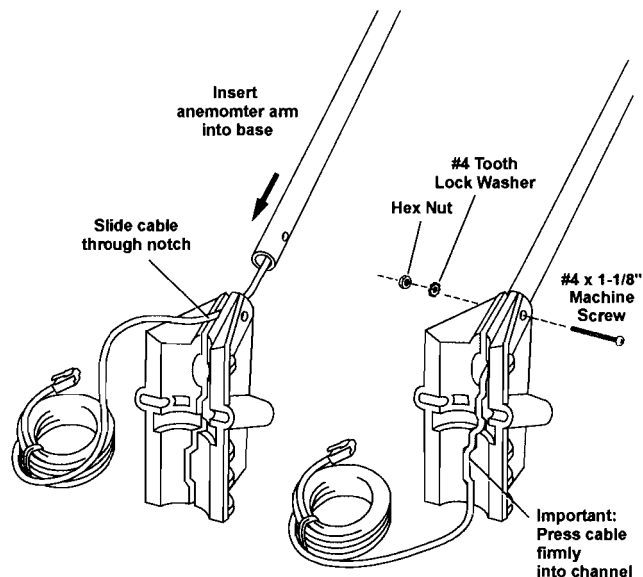
The anemometer measures wind direction and speed. The anemometer arm comes partially assembled with the wind vane attached. The anemometer arm requires assembly before it can be assembled with the rest of the ISS.

Please locate the following parts to prepare the anemometer:

- Anemometer arm (wind vane and cable already attached)
- Anemometer base
- Wind cups
- Drip ring
- Allen wrench (0.05")
- #4 machine screw, #4 tooth-lock washer, #4 hex nut

Attaching Anemometer Arm to Base

1. Insert the anemometer arm into the base, sliding the cable through the notch in the base as shown in illustration.
2. Be sure to line up the small hole in the arm with the holes in the base.
3. Insert the machine screw through the holes in the base and arm.



Check SIM Sensor Connections

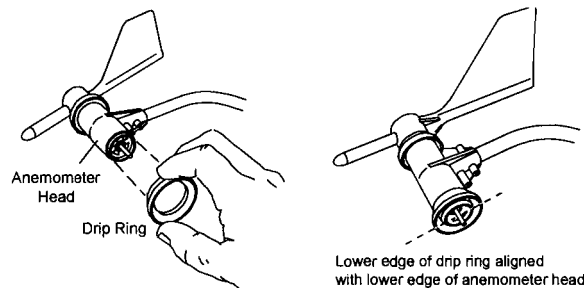
4. Slide the tooth-lock washer and hex nut onto the machine screw. Tighten the hex nut while holding the screw with a Phillips head screwdriver to prevent it from turning.
5. Press the sensor cable firmly and completely into the zig-zagging channel in the base, starting from the arm and progressing downward to the bottom of the base. Be sure to press the cable into the channel at the bottom of the groove.

Note: The pole can pinch or cause wear on the anemometer cable if the cable is not pressed completely into the channel at the bottom of the groove.

Attaching the Drip Ring and Wind Cups

The drip ring attaches to the bottom edge of the anemometer head. It assists in preventing ice from immobilizing the wind cups.

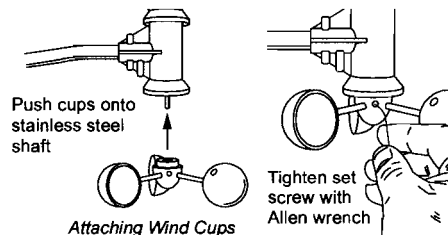
1. Place the black plastic drip ring on the bottom edge of the anemometer head. Gently push the drip ring onto the head until it clicks into place.
2. Make sure the lower edge of the drip ring is aligned with the lower edge of the anemometer head.



Attaching the Drip Ring

3. Push the wind cups up onto the anemometer's stainless steel shaft.
4. Slide the wind cups up the shaft as far as possible.
5. Use the Allen wrench provided to tighten the set screw on the side of the wind cups. The wind cups should drop slightly when you let go.

6. Spin the wind cups. If the wind cups spin freely, the anemometer is ready and can be set aside while you prepare the rest of the ISS for installation.



Note: If the wind cups don't spin freely, take them off and repeat the wind cup installation process.

Check SIM Sensor Connections

The SIM is located in the housing on the front of the ISS station. The SIM contains all the connections for the weather sensors of the ISS. Check the SIM to ensure that all sensors are connected properly.

Open the SIM Box

1. Locate the white box with the solar panel containing the SIM on the front of the ISS unit. The cabled model does not have a solar panel.
2. Locate the white tab at the bottom center of the SIM box cover.
3. Lift the tab away from the box while sliding the cover up.

Look on the side of the SIM box. The box cover can be easily removed from the box when the alignment indicator on the cover is lined up with the alignment indicator on the box.

4. Lift the cover off the box, being careful not to stress the solar panel cable.

The SIM and sensor connectors are visible once the SIM cover has been removed.

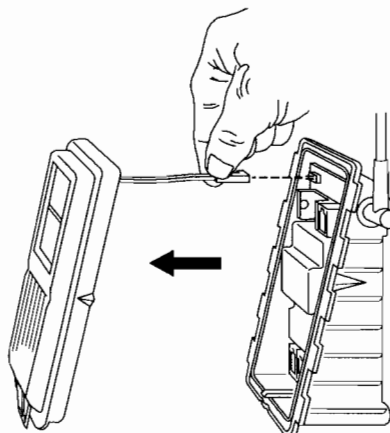


Note: See "SIM Board Display and Contents" on page 30 for information on locating the components and points of interest on the SIM board.

Optional: Disconnect the solar panel connection

The solar panel on the box cover is connected to the SIM by a wire. If the cover cannot be set aside while still connected to the SIM box safely, it should be disconnected from the SIM box. To disconnect the solar power connection:

1. Locate the brown connector for the solar power wire.
2. Pull the connector outward off the brown solar power tab. The solar panel is no longer connected to the SIM.
3. Set the SIM cover aside.

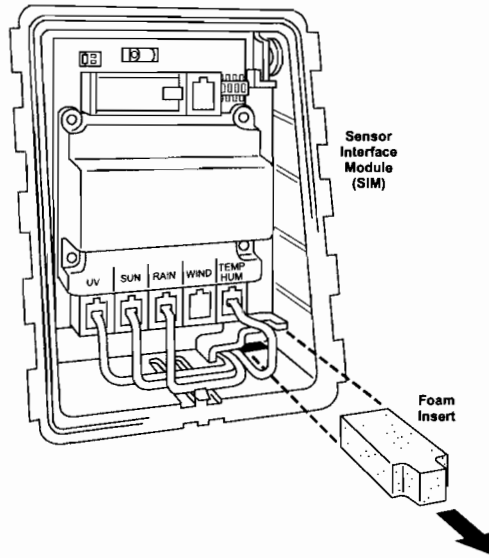


Check the Factory Installed Sensor Connections

1. Verify that the rain collector and temperature/humidity sensor cables are plugged into the receptacles labeled RAIN and TEMP/HUM on the SIM.
2. If the station includes UV and/or solar radiation sensors, verify that the sensor cables are plugged into the receptacles labeled UV and SUN on the SIM.

Connect the Anemometer Cable to the SIM

1. Unwind the coil of cable enough to work with the anemometer. Do not unwind the entire coil of anemometer cable at this time.
2. Pull the foam insert out of cable access port in between the cables and set the foam insert aside.
3. Insert the anemometer cable end into the cable access port from beneath the SIM box.
Slide the cable through the cable access port with the connector lever down.
4. Firmly insert the end of the anemometer cable into the connector labeled WIND. The lever clicks into place.
5. Make sure that the cables lie flat on the bottom the cable access port.
6. Firmly insert the foam in between the cables and at the top of the cable access port, taking care to ensure that the foam seals the access port entirely, leaving no holes or gaps large enough for weather or insects.



Note: Only Plus models have UV and solar cables already attached

Note: If you are assembling a cabled station, wait to reinsert the foam until cable assembly is complete. See "Cabled ISS Assembly" on page 7.

Once the sensor connections have been checked and the anemometer cable has been inserted, a connection between the ISS and the Vantage Pro2 console must be made.

7. Read the following instructions that best apply to your ISS and Vantage Pro2 assembly:
 - See "Cabled ISS Assembly" on page 7 for assembling Vantage Pro2 weather stations that contain a cabled connection between the ISS and the console.
 - See "Wireless ISS Assembly" on page 9 for assembling Vantage Pro2 weather stations that use a wireless connection to transmit and receive data.

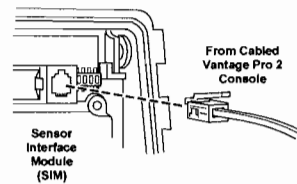
Cabled ISS Assembly

The Cabled ISS system contains a cable for connecting the ISS to a Vantage Pro2 cabled console. Once the anemometer has been installed and the sensors have been checked, a cabled connection between the ISS and the console can be established. Follow the steps below for powering the ISS and connecting to the console.

Applying Power

The 100' (30 m) console cable provides power to the ISS and is used to send data from the ISS to the console. The console cable can be extended up to 1000' (305 m) in length with extension cables purchased from Davis Instruments.

1. Locate the 100' console cable included with your system.
2. Pull the foam insert out of cable access port, if it has been reinserted, and set the foam aside.
3. Insert the console connector cable end into the cable access port from beneath the SIM box. Slide the cable through the cable access port with the connector tab down.
4. On the SIM, firmly insert one end of the 4-conductor cable into the modular connector located apart from the sensor connectors next to the battery insert. This connector is labeled CONSOLE.
If you haven't powered up the console yet, refer to the installation instructions in the *Vantage Pro2 Console Manual* and apply power to the console.
5. On the back of your console, insert the other end of the console cable into the modular receptacle labeled "ISS".
6. Firmly insert the foam in between the cables and at the top of the cable access port, taking care to ensure that the foam seals the access port entirely, leaving no holes or gaps for weather or insects. See the graphic on page 6 for more information on inserting the foam insert.



Plugging the console cable into the console powers the ISS and establishes communication between the ISS and the console. The ISS should immediately begin collecting weather data and start sending the data to the console.

Verifying Communication with the Console

Use these steps to verify reception of ISS data at the Cabled Vantage Pro2 console and to test the operation of the ISS sensors.

1. If the console is in Setup Mode, press and hold DONE until the Current Weather screen displays.
Sensor readings from the ISS should display on the screen.
2. Near the center of the screen, look for the outside temperature.
3. Spin the wind cups to check wind speed, pressing WIND if necessary to alternate between speed and direction in the compass rose.
4. Turn the wind vane, and allow 5 seconds for the wind direction display to stabilize before moving it again.

Troubleshooting Cabled ISS Communication

Approximately one minute after power-up the outside relative humidity reading should be displayed on the console.

5. If the ISS contains a UV sensor and/or solar sensor, press 2ND and then press RAIN YR for current ultraviolet readings or press 2ND then press RAIN DAY for solar radiation readings.

The UV reading displays in the center of the console. The solar reading displays in the bottom right corner of the console display. UV and solar readings should be zero or close to zero if the ISS is inside. Zero is a valid reading. Dashes(--) are displayed if no data comes from the sensors.

6. Current weather data displayed on the console confirms communication.

Once the ISS has been powered and the console has successfully received accurate readings from all the sensors, prepare the ISS for installation. Continue on to "Preparing the ISS for Installation" on page 13 for more information.

If the communication problems still exist between the cabled ISS and the console, see "Troubleshooting Cabled ISS Communication" below.

To ease the installation process of ISS at a location, disconnect the console cable from the SIM. Remove the foam and slide the cable out through access port. Once a location for both the ISS and the console has been arranged, reinsert the cable through the access port, into the console connector, and reinsert the foam.

Troubleshooting Cabled ISS Communication

If the console is not receiving sensor readings from the ISS, please try the following troubleshooting procedures.

- Check the console to make sure it is being powered with the AC adapter supplied in the Vantage Pro2 packaged box or three C batteries.

Note: The supplied adapter is a five-volt positive center AC to DC adapter. Other adapters may not work if the voltage or adapter type is different.

- Make sure the cable is firmly plugged into the ISS connector on the console.
- Make sure that the console cable is firmly plugged into the correct connector on the SIM.
- Verify that all sensor cables are firmly plugged in.
- An LED indicator light on the SIM flashes each time the ISS transmits, which is about once every 2.5 seconds. If the LED remains dark, there is a problem with the ISS transmitter. Call Technical Support. See "Contacting Davis Instruments" on page 27.

See "SIM Board Display and Contents" on page 30 for information on locating the LED indicator light and the DIP switches.

Note: If the LED is flashing rapidly, call Technical Support. See "Contacting Davis Instruments" on page 27 for more information.

If the console is still not receiving readings, ensure that the console is in Setup Mode and reboot the console by disconnecting the AC power adapter from the console and removing the console batteries for at least 30 seconds. If the console is still not displaying sensor readings from the ISS, please contact Davis Technical Support.

Wireless ISS Assembly

The ISS has a wireless connection to a Vantage Pro2 wireless console. Once the anemometer has been installed and the sensors have been checked, the ISS must be powered and a wireless communication channel must be established between the ISS and the console. Follow the steps below for powering the ISS and establishing a connection to the console.

- Applying Power to a Wireless ISS
- Verifying Communications with the Console
- Verifying Data from the ISS Sensors
- Troubleshooting ISS Reception

Applying Power to a Wireless ISS

1. Insert the 3-volt lithium battery into the SIM.

Once powered, the ISS immediately begins transmitting data to the console.

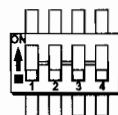
Be sure to match the “+” sign on the battery with the “+” sign on the SIM. See “SIM Board Display and Contents” on page 30.

The SIM stores energy from the solar panel for power at night. The battery is an alternative power source the SIM uses when it is depleted of energy.

Checking Transmitter ID

A Vantage Pro2 console can receive data from up to eight different wireless stations. The default Transmitter ID for the ISS and console is 1.

In most cases it will not be necessary to change the Transmitter ID. The console and ISS should begin communicating automatically when power is applied.



Settings for Transmitter ID 1:
DIP Switch 1 = OFF
DIP Switch 2 = OFF
DIP Switch 3 = OFF

Note: If it is necessary to change the Transmitter ID, remember to use the same ID for the ISS and console. See “SIM Board Display and Contents” on page 30 for locating the components and points of interest on the SIM board.

Verifying Communication with the Console

1. Power the console if it does not already have power. Refer to the *Vantage Pro2 Console Manual* and apply power the console.
The console automatically enters Setup Mode when powered up.
2. If the console is not in Setup Mode, press and hold DONE then press the down arrow.
The message RECEIVING FROM... and STATION NO. followed by the Transmitter IDs that the console detects displays on the console screen.
3. Look for the ISS Transmitter ID. The number 1 displays unless the Transmitter ID has been changed. If the console displays the ISS Transmitter ID, the ISS is detected.

Note: If the console does not display the number of the ISS Transmitter ID setting, see “Troubleshooting Wireless ISS Reception” on page 10 for more information. It can take several minutes for the console to acquire and display all the available Transmitter IDs.

4. Press and hold DONE to view ISS data once the ISS Transmitter ID displays.

Verifying Data from the ISS Sensors

Use these steps to verify reception of ISS data at the wireless Vantage Pro2 console and to test the operation of the ISS sensors.

1. Press and hold DONE until the Current Weather screen displays, if the console is in Setup Mode.

Sensor readings from the ISS should display on the screen.

2. Near the center of the screen, look for the outside temperature.
3. Spin the wind cups to check wind speed, pressing WIND if necessary to alternate between speed and direction in the compass rose.
4. Turn the wind vane, and allow 5 seconds for the wind direction display to stabilize before moving it again.

Approximately one minute after power-up the outside relative humidity reading should be displayed on the console.

5. If the ISS contains a UV sensor and/or solar sensor, press 2ND and then press RAIN YR for current ultraviolet readings or press 2ND then press RAIN DAY for solar radiation readings.

The UV reading displays in the center of the console. The solar reading displays in the bottom right corner of the console display. UV and solar readings should be zero or close to zero if the ISS is inside. Zero is a valid reading — dashes are displayed if no data comes from the sensors.

6. Current weather data displayed on the console confirms successful communication.

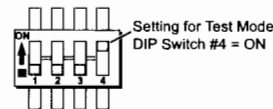
Once the ISS has been powered and the console has successfully received accurate readings from all the sensors, prepare the ISS for installation. Continue on to “Preparing the ISS for Installation” on page 13 for more information.

If the communication problems still exist between the wireless ISS and the console, see “Troubleshooting Wireless ISS Reception.”

Troubleshooting Wireless ISS Reception

If the console isn't displaying data from the ISS, perform the following steps:

1. Verify that the console is powered and is not in Setup Mode.
2. Make sure that all ISS sensor cables are firmly connected to the SIM and the ISS battery is properly installed.
3. Walk around the room with the console, standing for a few moments in various locations, to see if you are picking up signals from the ISS. Look on the screen's lower right corner. An “X” toggles on and off when the console receives a transmission.
4. If you do not see the “X” slowly blinking, no matter where you stand with the console, put your ISS in Test Mode.
 - The DIP switch #4 on the SIM is the Test Mode switch. Switch it to the ON position, using a ball-point pen or paper clip.
 - An LED indicator light on the SIM flashes each time the ISS transmits, which is about once every 2.5 seconds.



Note: If the LED is flashing rapidly, call Technical Support. See "Contacting Davis Instruments" on page 27 for more information.

See "SIM Board Display and Contents" on page 30 for information on locating the components and points of interest on the SIM board.

5. If the LED remains dark, there is a problem with the ISS transmitter. Call Technical Support. See "Contacting Davis Instruments" on page 27.
6. If the LED flashes repeatedly but your console isn't picking up a signal anywhere in the room, it could be related to one of the following causes:
 - You changed the ISS Transmitter ID at the ISS or console, but not at both.
 - Reception is being disrupted by frequency interference from outside sources. Interference has to be strong to prevent the console from receiving a signal while in the same room as the ISS. In high-interference environments, it may be preferable to install the Cabled Vantage Pro2.
 - There is a problem with the console.
7. If a problem with receiving the wireless transmission still exists, please contact Technical Support. See "Contacting Davis Instruments" on page 27.
8. When you are finished testing wireless transmission, set DIP switch # 4 to OFF to take the SIM out of Test Mode.

Note: If the SIM is left in Test Mode, the blinking LED will significantly reduce ISS battery life.

Optional: Changing ISS Transmitter ID

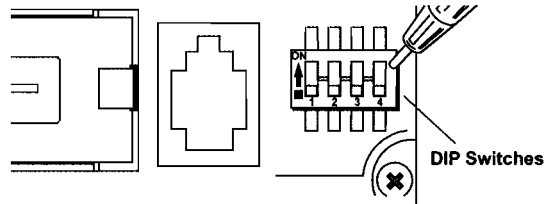
Each wireless transmitting station, including the Integrated Sensor Suite (ISS), uses one of eight selectable Transmitter IDs. DIP switches #1, 2 and 3 on the transmitter control the ID — or channel — the station transmits on. DIP switch #4 is used for transmission testing, not for Transmitter ID.

Note: The transmitter on the ISS and receiver on the console communicate with each other only when both are set to the same ID.

The default Transmitter ID is 1 for both the ISS and the Vantage Pro2 console, and should work fine for most situations. Change the Transmitter ID if any of the following issues are true:

- Another Davis Instruments wireless weather station operating nearby already uses Transmitter ID 1.
- Additional wireless transmitting stations have been purchased with the Vantage Pro2 or Vantage Pro2 Plus and one of the stations has been designated as Station No. 1 instead of the selected ISS.

On the ISS, the Transmitter ID is set using the DIP switches located on the Sensor Interface Module (SIM). To access the SIM, open the SIM housing cover. See "Open the SIM Box" on page 5.



Transmitter ID DIP Switches in Top-right Corner of SIM

To change to another ID, use a ballpoint pen or paper clip to toggle DIP switches #1, 2, and 3. The settings for Transmitter IDs 1 - 8 are shown in the table on the next page.

Set the Vantage Pro2 console to the same ID as the transmitters, as described in the *Vantage Pro2 Console Manual*.

ID CODE	SWITCH 1	SWITCH 2	SWITCH 3
#1 (default)	off	off	off
#2	off	off	ON
#3	off	ON	off
#4	off	ON	ON
#5	ON	off	off
#6	ON	off	ON
#7	ON	ON	off
#8	ON	ON	ON

Using Multiple Transmitting Stations

This table shows the maximum number of each type of station that can be used with a single Vantage Pro2 console.

Station Type	Maximum Number
Integrated Sensor Suite (ISS)	1
Anemometer Transmitter Kit*	1
Leaf & Soil Moisture/Temperature Station	2**
Temperature Station	8
Temperature/Humidity Station	8

**Replaces the ISS anemometer.*

***Two are allowable only if both stations are only partially populated. For example, A network can either have both a Leaf Wetness/Temperature station and a Soil Moisture/Temperature station, or it can have one combined Leaf Wetness and Soil Moisture/Temperature station.*

Preparing the ISS for Installation

Once all the sensors have been connected and communication between the ISS and the console has been successfully established, continue to prepare the ISS unit for installation. The steps for preparing the ISS for installation are as follows.

- Close the SIM Box
- Prepare the Solar Panel
- Prepare the Rain Collector
- Site the ISS and Anemometer

Close the SIM Box

To close the SIM box and continue assembling the ISS:

1. If the solar panel wire was disconnected during ISS assembly, reconnect the wire on the SIM box cover to the solar panel tab on the SIM board.

Note: See "SIM Board Display and Contents" on page 30 for information on locating the solar panel tab.

2. Look on the side of the SIM box. Match up the box cover alignment indicator with the alignment indicator on the SIM box and place the cover against the box.
3. Slide the cover down until it snaps securely in place.

Prepare the Rain Collector

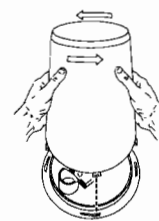
The tipping bucket is secured at the factory to protect it from damage during shipping. To use the ISS properly, the bucket must be released. To release the bucket:

1. Remove the rain collector cone from the ISS base by rotating the cone counter-clockwise. When the cone's latches line up with openings in the base, lift the cone off the ISS base.

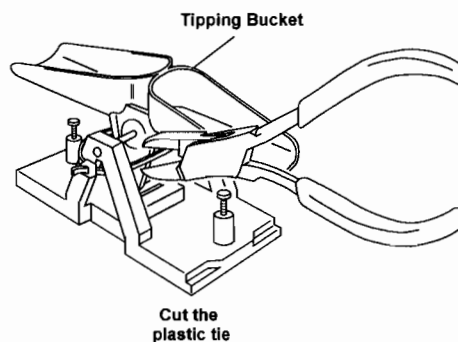
When new, the cone fits tightly in the base and may require extra pressure to remove. Steady the ISS base between your knees when removing the cone.

2. Carefully cut and remove the plastic tie (usually black in color) that holds the tipping bucket in place during shipping.

3. On your console screen, look for the DAILY RAIN display. If the console is cabled to the ISS, reconnect the cable and see if the console is receiving rain readings.



Twist to Open



Prepare the Rain Collector

4. While watching the daily rain display, slowly tip the bucket until it drops to the opposite side. Each tip indicates 0.01" of rain and may take up to a minute to register at the console. If the bucket is tipped too quickly, the number on the console display may not change. Tip the bucket slowly when testing the rain collector.
5. Temporarily reinstall the rain collector cone until you are ready to mount the ISS outside. If you are installing the metric measurement adapter, do not reinstall the rain collector cone.

Optional: Insert the Metric Measurement Adapter

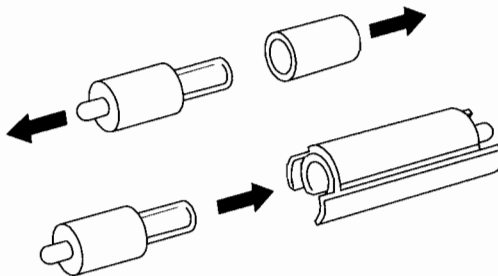
The rain collector tipping bucket mechanism contains a standard measurement weight magnet that takes measurements in 0.01". The ISS hardware kit contains a metric adapter that adjusts the weight of the tipping bucket mechanism so that it reports 0.2 mm metric measurements for every tip of the bucket. To install the metric adapter:

1. Find the metric adapter included in the hardware.
2. Locate the magnet between the arms of the bucket.
3. Open the arms slightly with one hand while pulling the magnet out with the other.



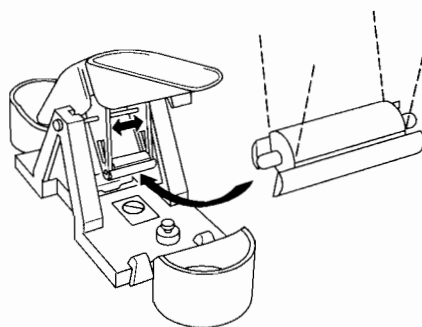
Open plastic tipping mechanism arms, pull out magnet

4. Separate an end cap from one end of the magnet.



Separate magnet from one end cap
Insert magnet with other end cap into metric measurement adapter

5. Slide the magnet, exposed end of magnet first, into the open slot of the metric adapter.
6. Insert the metric adapter and magnet between the arms of the bucket, with the solid side of the metric adapter facing up.



Open plastic arms to insert metric measurement adapter, with adapter in "V" position

Note: The above procedure converts the collector to 0.2 mm measurements. The console must be set accordingly. See the *Vantage Pro2 Console Manual* for more information.

Locating the ISS and Anemometer

For the weather station to perform at its best, use these guidelines to select the optimum mounting locations for the ISS and anemometer. Be sure to take into consideration ease of access for maintenance, sensor cable lengths and wireless transmission range when siting the station.

Note: When selecting a location for installing your ISS, especially on a rooftop, make sure it is a location far from power lines. Seek professional help if you uncertain about the safety of your installation.

General ISS Siting Guidelines

- Place the ISS away from sources of heat such as chimneys, heaters, air conditioners and exhaust vents.
- Place the ISS at least 100' (30 m) away from any asphalt or concrete roadway that readily absorbs and radiates heat in the sun. Avoid installations near fences or sides of buildings that receive a lot of sun during the day.
- Ideally, place the radiation shield of the ISS 5' (1.5 m) above the ground in the middle of gently sloping or flat, regularly mowed grassy or naturally landscaped area that drains well when it rains. For areas with average maximum yearly snow depths over 3' (0.9 m), mount the ISS 2' (0.6 m) above this depth.
- Never install the ISS where it will be directly sprayed by a sprinkler system because it will adversely affect the readings.
- Avoid installations near bodies of water such as swimming pools or ponds.
- Do not locate the ISS under tree canopies or near the side of buildings that create "rain shadows". For heavily forested areas, site the ISS in a clearing or meadow.
- Site the ISS in a location with good sun exposure throughout the day if the ISS is wireless or includes solar radiation or UV radiation sensors.

For *agricultural applications* (Important for evapotranspiration (ET) calculations):

- Install the ISS and anemometer as a single unit with the radiation shield 5' (1.5 m) above the ground and in the middle of the farm between similar crop types (i.e. two orchards, two vineyards or two row crops), if possible.
- Avoid areas exposed to extensive or frequent applications of agricultural chemicals (which can degrade the sensors).
- Avoid installation over bare soils. The ET formula works best when the ISS is installed over well-irrigated, regularly mowed grass.
- If the last three guidelines cannot be met, install the weather station at the edge of the primary crop of interest.

Anemometer Siting Guidelines

- For best results, place the anemometer at least 7' (2.1 m) above surrounding obstructions such as trees or buildings that obstruct wind flow.
- If mounting on a roof, mount the anemometer at least 7' (2.1 m) above the roof apex (when using a Mounting Tripod, install the anemometer at the very top of the pole).
- The standard for meteorological and aviation applications is to place the anemometer 33' (10 m) above the ground. Seek professional help for this type of installation.
- The standard for *agricultural applications* is to place the anemometer 6' (2 m) above the ground. This is important for evapotranspiration (ET) calculations.

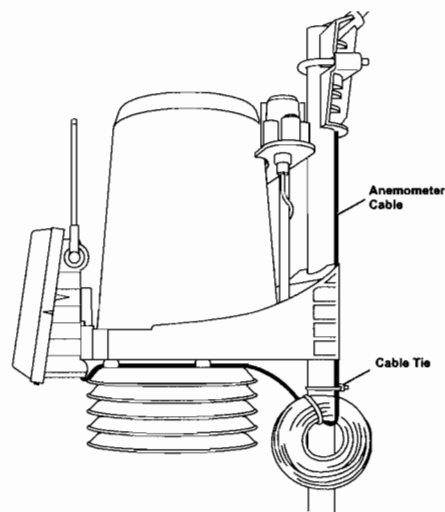
Note: For roof mounting, and ease of installation, we recommend using the optional mounting Tripod (#7716). For other installations, use the Mounting Pole Kit (#7717).

Optional: Anemometer Cable Length Considerations

- All Vantage Pro2 stations include a 40' (12 m) cable to go between the ISS and the anemometer. This can be extended up to 540' (165 m) using optional extension cables purchased from Davis Instruments.
- If most of the anemometer cable length is unused, the coiled cable length can be stowed once the anemometer and ISS have been installed on a site. Attaching the anemometer cable to the mounting pole using the supplied cable tie is the recommended option.

Keep the anemometer cable coiled if possible during the ISS and anemometer assembly so that it is easily stowed once installation is complete.

- The Cabled Vantage Pro2 includes a 100' (30 m) cable to go between the console and the ISS. This can be extended up to 1000' (300 m) using optional cables.



Optional: Wireless Transmission Considerations

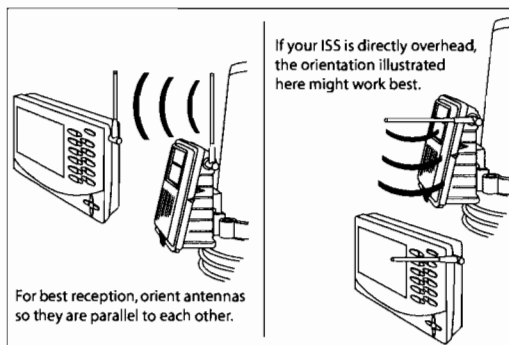
The range of the radio transmission depends on several factors. Try to position the transmitter and the receiver as close as possible for best results.

Typical maximum ranges include:

- Line of sight: 1000 feet (300 m).
- Under most conditions: 200 - 400 feet (60 - 120 m).

Other range and transmission considerations include:

- Range may be reduced by walls, ceilings, trees, foliage, a metal roof or other large metal structures or objects such as aluminum siding, metal ducts, and metal appliances, such as refrigerators, televisions, heaters, or air conditioners.
- Frequency interferers also reduce transmission distance. Cordless phones (900 Mhz) are a common example of frequency interference.
- Transmission between wireless units may be obscured by something unidentifiable, or by some obstacle that can't be worked around.
- For best results, orient the ISS antenna and the console antenna so that the orientation and angles of the antennas are parallel to each other.



- If possible, align the pivot joints of both the ISS and the console antennas so that they are facing each other for maximum signal strength.
- Turn the gain on to improve reception of a weak signal. Refer to the *Vantage Pro2 Console Manual* for information on setting the console gain.
- For better reception over greater distances or for weaker signals, consider using a Wireless Repeater (#7626 or #7627) or Long-Range Wireless Repeater (#7653 or #7654) to strengthen the signal or increase the distance between your ISS and the console.

Testing Wireless Transmission at ISS Location

After a suitable place has been found for the wireless ISS, it is very important to test reception from the installation location before permanently mounting it there.

1. Set the ISS in the desired installation location.
2. Set the console in the desired location.
3. Press and hold TEMP and press HUM to display statistical and reception diagnostics on the console.
 - It's a good idea to test the console's reception anywhere that you might want to use or mount it now or in the future. Take your time. If you aren't picking up a strong signal where you intend to place your console, try rotating the antenna on the console and ISS or try moving the console and ISS to different positions.
 - Irregular terrain in the area may interfere with the signal. For example, if the ISS is mounted downhill from the console, the ground may block a large percentage of the transmitted signal.
4. Press and hold DONE to return to the normal screen when finished testing.

Note: See the Troubleshooting section of the *Vantage Pro2 Console Manual* for information on how to check wireless signal strength and for more information on troubleshooting reception problems.

Installing the ISS

The anemometer and the main part of the ISS can be installed either together as a single unit on a pole, or apart from each other. The main part of the ISS includes the rain collector, the temperature and humidity sensors, the radiation shield, and the SIM housing. Use the U-bolts to install the ISS and anemometer together or separately on a pole. Use the lag screws to install them separately on a flat, vertical surface.

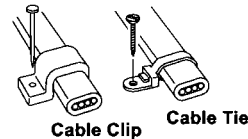
The anemometer comes with a 40' (12 m) cable for flexibility in configuring the system to monitor wind conditions. For example, the anemometer could be mounted at the highest point of a roof, and the ISS could be mounted on a fence closer to ground level.

General ISS Installation Guidelines

- Install the ISS as level as possible to ensure accurate rain measurements. Use a bubble level or carpenter's level to make sure the ISS is level.
- In the Northern Hemisphere, the solar panel should face south for maximum sun exposure.
- In the Southern Hemisphere, the solar panel should face north for maximum sun exposure. Either install the ISS and anemometer separately, each facing north, or mount them as a single unit with solar panel facing north and the wind vane re-oriented to the South. See "Appendix A: Re-orienting the Wind Vane" on page 28.

Optional: Guidelines for Securing Cables

- To prevent fraying or cutting of cables, secure them so they will not whip about in the wind.
- Secure cable to a metal pole using cable ties or by wrapping tape around both the cables and the pole.
- Place clips or ties approximately every 3' – 5' (1 – 1.6 m).
- Mounting clips, cable ties or additional hardware not included with your station can be easily obtained at a hardware or electronics store.



Note: Do not use metal staples or a staple gun to secure cables. Metal staples — especially when installed with a staple gun — have a tendency to cut the cables.

Orient the Wind Vane

The wind vane rotates 360° to display current and dominant wind directions on the compass rose of the console display. To obtain accurate readings, the vane must be *correctly oriented* when mounting the anemometer outside. By default, the wind vane reports the correct wind direction if the anemometer arm points true north.

To ensure correct orientation of the wind vane, do one of the following:

1. Mount the anemometer so that the arm points true north.
The wind vane will be ready for use immediately.
2. If the anemometer is mounted so that it does not aim true north, remove the wind vane and re-attach it aiming toward the preferred direction. Refer to the instructions in "Appendix A: Re-orienting the Wind Vane" on page 28.

Installing the ISS on a Flat Surface

Installation Instructions

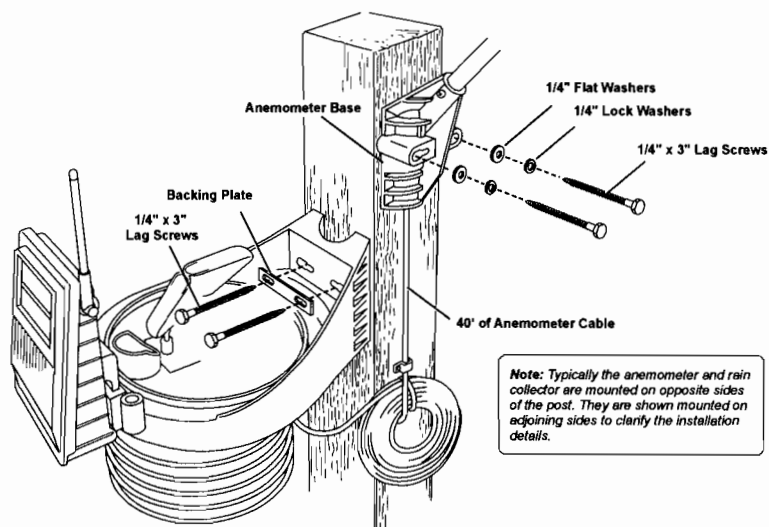
There are several ways to mount and install the ISS unit. The following are installation types that Davis Instruments recommends. Individual ISS locations and installations may vary.

- Installing the ISS on a flat surface
- Installing the Anemometer on a post or flat surface
- Installing the ISS on a pole

Note: All installations require that the rain collector cone be removed for assembly.

Installing the ISS on a Flat Surface

Refer to the following illustration to install the ISS on a post or flat, vertical surface.



Option 1: Installing the ISS on a Post or Flat Surface

1. With a 3/16" (5 mm) drill bit, drill two holes approximately 2-1/8" (54 mm) apart. Use a carpenter's level to ensure the holes are level.
Use the metal backing plate as a guide when marking the holes.
2. Remove the rain collector cone if it is installed on the ISS mounting base.
3. Insert the 1/4" x 3" lag screws through the metal backing plate and the holes in the mounting base into the post.
4. Tighten the lag screws using an adjustable wrench or 7/16" wrench.
5. Re-attach the rain collector cone. Set the cone back on the base so its latches slide downward into the latch openings on the base. Rotate cone clockwise.
6. Place the debris screen (shown in the illustration on page 1) inside the cone, "feet-down" over the funnel hole.

Option 2: Installing the Anemometer on a Post or Flat Surface

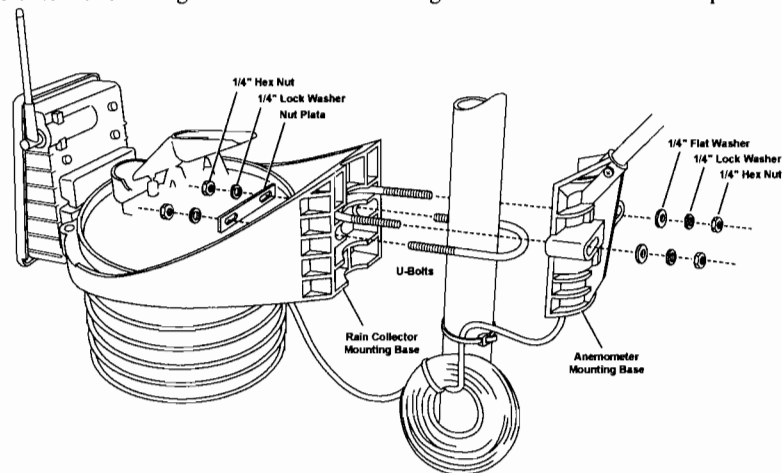
1. With a 3/16" (5 mm) drill bit, drill two holes approximately 2-1/8" (54 mm) apart. Use a carpenter's level to ensure the holes will be level.
2. Insert the 1/4" x 3" lag screws through the flat washers and the holes in the anemometer mounting base into the post.
3. Tighten the lag screws using an adjustable wrench or 7/16" wrench.

If the anemometer arm is not pointing north, follow the instructions in "Appendix A: Re-orienting the Wind Vane" on page 28.

Installing the ISS on a Pole

When installing the ISS on a pole, the rain collector and radiation shield section of the ISS can be mounted as a single unit with the anemometer section, or the two sections can be mounted separately.

Refer to the following illustration when installing the ISS or anemometer on a pole.



Accessories for Pole Mounting

- Use the Mounting Tripod (#7716) for easy roof-mounting.
- Use the Mounting Pole Kit (#7717) to raise the installation height of the ISS by up to 37.5" (0.95 m).

General Guidelines for Installing on a Pole

- With the supplied U-bolts, the ISS can be mounted on a pole having an outside diameter ranging from 1-1/4" to 1-3/4" (32 – 44mm).
- Larger U-bolts (not supplied) can be used to mount to a pole with a maximum outside diameter of 2-1/2" (64mm).
- To mount on a smaller pole, obtain a U-bolt that fits the base openings but that has a shorter threaded section. If mounting the ISS on a smaller pole with the included U-bolts, the bolt interferes with the rain collector cone.

Guidelines for Installing the ISS on a Pole

- When mounting both sides together, remember that whichever side of the ISS is mounted first, the U-bolt from the opposite side must also be placed around the pole before tightening the U-bolts. (If it is not, there is no way to slide it in later.)
- In each side's mounting base, there is a groove to accommodate the other's U-bolt.
- Once the two sides of the ISS have been loosely mounted together on the pole, swivel the unit to the correct direction and then tighten the hex nuts. The desired height can also be achieved by sliding the ISS vertically.

Option 1: Installing ISS and Anemometer Together

Try to install the ISS so the anemometer arm is aiming north. If the arm doesn't point north, re-orient the wind vane. See "Appendix A: Re-orienting the Wind Vane" on page 28.

1. Place the U-bolt for the anemometer around the pole so that its round end fits in the top groove of the side of the rain collector side's plastic mounting base. The groove is right above two large holes.
2. While holding the mounting base of the rain collector against the pole, place the two ends of the remaining U-bolt around the pole and through the two holes in the base.
3. Slide the metal backing plate over the bolt ends as they stick out over the rain collector base. Secure the backing plate with a lock washer and hex nut on each of the bolt ends as shown previously.

Note: Do not tighten the hex nuts yet. Leave the hex nuts loose to swivel the ISS base on the pole.

4. The two ends of the anemometer's U-bolt should now be pointing away from the mounted rain collector side. Slide the anemometer's mounting base over the protruding bolt ends. Place a flat washer, a lock washer and a hex nut on each of the bolt ends as shown above. Do not tighten the nuts yet.
5. Raise the ISS unit to the desired height on the pole and swivel it so the anemometer arm is pointing north.
6. Using an adjustable wrench or 7/16" wrench, tighten all four hex nuts until the ISS is firmly fastened on the pole.
7. Re-attach the rain collector cone by setting the cone back on the base so its latches slide downward into the latch openings on the base, then rotate the cone clockwise.
8. Place the debris screen (shown in the illustration on page 1) inside the cone, "feet-down," over the funnel hole. When installing the ISS as a single unit, we recommend tucking the coil of anemometer cable between the rain collector cone and the ISS base.

Option 2: Installing ISS Only

1. While holding the mounting base against the pole, place the two ends of a U-bolt around the pole and through the two holes in the base.
2. Slide the metal backing plate over the bolt ends as they stick out toward the rain collector cone. Secure the backing plate with a washer, a lock washer, and a hex nut on each of the bolt ends. Do not tighten the nuts yet.
For the wireless ISS, swivel the ISS base so the solar panel is facing south (in the Northern Hemisphere), or north (in the Southern Hemisphere).

3. Tighten the hex nuts using an adjustable wrench or 7/16" wrench.
4. Re-attach the rain collector cone.
Set the cone back on the base so its latches slide downward into the latch openings on the base. Rotate the cone clockwise.
5. Place the debris screen (shown in the illustration on page 1) inside the cone, "feet-down," over the funnel hole.

Option 3: Installing Anemometer Only

1. While holding the mounting base against the pole, place a U-bolt around the pole and through the two holes in the base.
2. Place a flat washer, a lock washer and a hex nut on each of the bolt ends.
3. Swivel the anemometer until the arm is pointing north.
If the anemometer arm is not pointing north, go to "Appendix A: Re-orienting the Wind Vane" on page 28 after tightening the hex nuts.
4. Using an adjustable wrench or 7/16" wrench, tighten the hex nuts.

Finishing the Installation

Level the Solar and UV Sensors

If you have a Vantage Pro2 Plus station that includes a solar or UV sensor, use the bubble level on the sensors as a guide to verify that the sensors are level.

Adjust the level by tightening or loosening the screws that hold the sensor onto the shelf.

Note: If you are installing the solar or UV sensors separately, see the Sensor Mounting Shelf installation manual and the Solar Radiation and UV Sensor Installation manuals for more information.

Clearing Data Collected During Testing and Installation

Now that the ISS is mounted outside, any data that was collected in the Vantage Pro2 console during testing and mounting can be cleared.

To clear all the collected data on the console:

1. Press WIND so that graph icon appears adjacent to the wind data on the display.
2. Press 2ND, then press and hold CLEAR for at least six seconds and until you see "CLEARING NOW" in the console ticker display.

Additional Mounting Options

Extending Wireless Transmission Range

Optional repeater stations can be used to extend the wireless transmission range.

- Wireless Repeater, AC-Powered (#7626)
- Wireless Repeater, Solar-Powered (#7627)
- Long-Range Wireless Repeater, AC-Powered (#7653)
- Long-Range Wireless Repeater, Solar-Powered (#7654)

Extending the Console Cable (Cabled ISS Only)

A Cabled ISS can be extended up to 1000' (300 m) away from the console by using Davis Instruments extension cables (#7876).

Additional Mounting Options

Relocating the Anemometer

Using Extension Cables:

Note: Not all cables are compatible with your Vantage Pro2 system. To be sure they will work, order Davis extension cables from your dealer or directly from Davis Instruments.

The Anemometer can be extended further than 40' from the ISS by using Davis Instruments extension cables (#7876).

Be aware that the maximum measurable wind speed reading decreases as the total length of cable from the anemometer to the ISS increases.

Note: If the cable length is greater than 540' (165m), the maximum measurable wind speed may be less than 100 MPH (161 km/h).

Using the Anemometer Transmitter Kit (Wireless ISS Only)

Use the Anemometer Transmitter Kit (#6332) to add an independent wireless transmitter to the anemometer. The kit allows the anemometer to function as a transmitter station sending wind data directly to the console, instead of transmitting via the ISS.

Remote Mounting the Solar and UV Sensors

The solar and UV sensors have a 3' (0.9 m) cable. If you wish to install these sensors away from the ISS, you can extend the length of the sensor cables up to 125' (38 m) with Davis Instruments extension cables (#7876).

Optional Wireless Stations

You may use our optional wireless sensor stations to collect weather measurements, without the inconvenience of routing cables.

- Wireless Temperature Station (#6372)
- Wireless Temperature/Humidity Station (#6382)
- Wireless Leaf & Soil Moisture/Temperature Station (#6345)

For more details, please visit our website or see the most recent *Davis Precision Weather Instruments* catalog.

Maintenance and Troubleshooting

Maintaining UV and Solar Radiation Sensors

If the ISS is a Plus model and contains UV and solar sensors, do not touch the small white diffusers on top of the sensors. Oil from skin reduces their sensitivity. If you are concerned that you have touched the diffusers at any time, clean the UV diffuser using ethyl alcohol with a soft cloth. When cleaning the UV diffuser, DO NOT use rubbing or denatured alcohols because they can affect accuracy of the sensor readings. Ethyl alcohol can be procured through an industrial or laboratory supply store. Clean the solar diffuser with a soft damp cloth.

Due to the sensitivity of ultraviolet and solar radiation sensors it is common practice for manufacturers to recommend re-calibration after a period of time. Users demanding high accuracy typically recalibrate their sensors annually. Here at Davis Instruments, we have seen less than 2% drift per year on the readings from these sensors.

Contact Technical Support about returning your sensor for calibration. See "Contacting Davis Instruments" on page 27.

Cleaning the Radiation Shield

The outer plating of the radiation shield should be cleaned when there is excessive dirt and build-up on the plating. Use a damp cloth to clean the outer edge of each ring.

Note: Spraying down or using water excessively to clean the radiation shield can damage the sensitive sensors or alter the data and readings the ISS is transmitting.

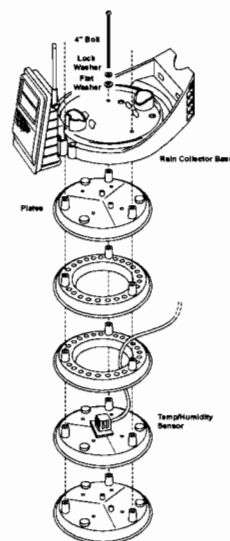
Check the radiation shield for debris or insect nests at least once a year and clean when necessary. A buildup of material inside the shield reduces its effectiveness and may cause inaccurate temperature and humidity readings.

To thoroughly clean the radiation shield

1. Remove the rain collector cone.
2. Using a Phillips head screwdriver, loosen the three 4" (~100mm) bolts holding the radiation shield plates together.
3. Separate the plates as shown and remove all debris from inside the shield.
4. Reassemble the radiation shield plates and fasten them together using the bolts as shown in the illustration. Use a Phillips head screwdriver to tighten the bolts.

Cleaning the Rain Collector

To maintain accuracy, thoroughly clean the rain collector several times a year.



Note: Cleaning the rain collector and tipping buckets may cause false rain readings. Unplug the RAIN sensor from the SIM before cleaning so that no inaccurate readings are logged, or clear the weather data that was logged on the Vantage Pro2 console after cleaning is complete. See your *Vantage Pro2 Console Manual* for instructions on clearing weather data.

Troubleshooting

1. Separate the cone from the base by turning it counter-clockwise.
2. Use soapy water and a soft cloth to remove any debris from the cone, cone screen, and tipping bucket.
3. Use pipe cleaners to clear the funnel hole in the cone and drain screens in the base.
4. When all parts are clean, rinse with clear water.
5. Re-attach the cone and replace the debris screen.

Troubleshooting

If a Sensor Functions Intermittently

Carefully check all connections from the sensor to the ISS. See “Check SIM Sensor Connections” on page 4.

Loose connections account for a large portion of potential problems. Connections should be firmly seated in receptacles and plugged in straight. To check for a faulty connection, try jiggling the cable while looking at the display. If a reading displays intermittently on the console as the cable is jiggled, the connection is faulty. Try removing and then re-installing the cable to correct the faulty connection. If the sensor still functions intermittently contact Technical Support. See “Contacting Davis Instruments” on page 27.

Most Common Rain Collector Problem

If the rain collector seems to be under-reporting rainfall, remove the rain collector cone to clean the tipping bucket and clear out any debris. Make sure the cable tie around the tipping bucket has been cut and removed.

Most Common Anemometer Problems

“The anemometer head is tilted when I mount the anemometer.”

With Allen wrench provided in the supplied hardware, loosen the screws holding the anemometer head on the arm. (The screws are on the bottom of the anemometer head, by the wind cups.) Turn the anemometer head so it is straight and then tighten the screws.

“The wind cups are spinning but my console displays 0 mph.”

The signal from the wind cups may not be making it back to the display. Remove the cups from the anemometer (loosen the set screw). Put the cups back onto the shaft and adjust them up or down 1/16 – 1/8 inch (1.5 – 3 mm). Check your cables for visible nicks and cuts. Look for corrosion in the WIND connector on the SIM and on splices in the cable. If using an extension cable, remove it and test using only the anemometer cable. Contact Technical Support and ask for a wind test cable if the problem has not been resolved.

Note: If the anemometer is sending no data, the wind display indicates 0 speed and a North direction.

“The wind direction is stuck on north, or displays dashes.”

It is likely that there is a short somewhere between the wind vane and the display. Check the cables for visible nicks and cuts. Look for corrosion in the “WIND” jack on the SIM and on splices in the cable (if any). If possible, remove any extensions and try it with the anemometer cable only. If none of these steps get the wind direction working, contact Technical Support and ask for a wind test cable.

"The wind cups don't spin or don't spin as fast as they should."

First check for and clear out any spider webs. Also, the anemometer may be located where wind is blocked by something, or there may be friction interfering with the cups' rotation. Remove the wind cups (loosen the set screw) and clear out any bugs or debris. Turn the shaft the cups rotate on. If it feels gritty or stiff, contact Davis Technical Support.

Note: Do not lubricate the shaft or bearings in any way. When replacing the cups, make sure they are not rubbing against any part of the anemometer head.

"Readings aren't what I expected them to be."

Comparing data from your ISS to measurements from TV, radio, newspapers, or a neighbor is NOT a valid method of verifying your readings. Readings can vary considerably over short distances. How you site the ISS and anemometer can also make a big difference. If you have questions, contact Technical Support.

Contacting Davis Instruments

If you have questions about the ISS or Vantage Pro2 system, or encounter problems installing or operating the weather station, please contact Davis Technical Support.

Note: Please do not return items to the factory for repair without prior authorization.

(510) 732-7814 – Technical Support phone, Monday – Friday, 7:00 a.m. – 5:30 p.m. Pacific Time.

(510) 670-0589 – Technical Support Fax.

support@davisnet.com – E-mail to Technical Support.

info@davisnet.com – General e-mail.

www.davisnet.com – Download manuals and specifications from the Support section. Watch for FAQs and other updates. Subscribe to the e-newsletter.

Appendices

Appendix A: Re-orienting the Wind Vane

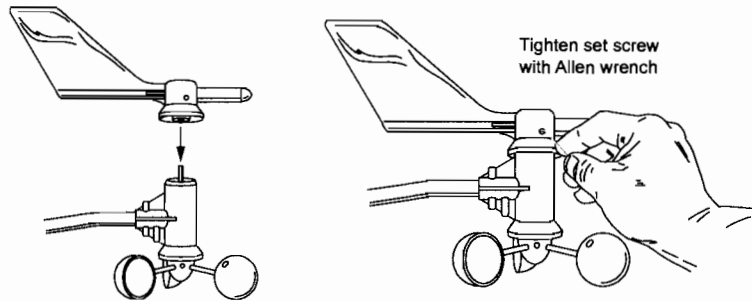
The Vantage Pro2 station is configured to register wind direction correctly if the anemometer points to true north. If the anemometer shaft cannot be mounted to point to true north, use the following instructions to correct the wind vane orientation.

- Do not rely on a compass unless it is properly calibrated. In North America there can be up to 15° variation between true north and a raw compass reading.
- Correct the wind direction readings by calibrating the wind direction in the Vantage Pro2 console. See the *Vantage Pro2 Console Manual* for information.
- To orient the wind vane accurately, look at the console display. Have another person watch the console display while orienting the wind vane.
- Also, re-orient the wind vane before the anemometer is installed if the direction in which the anemometer will be installed is already known.

To re-orient the wind vane:

1. Loosen the wind vane set screw.
2. Pull the vane directly up and off the steel shaft on which it turns.
3. Press WIND on the console to display current wind direction in degrees.
4. Use a reliable map, properly calibrated compass or a landmark to determine which direction is true south.
5. Slowly turn the stainless-steel wind direction shaft with your fingers. Stop turning when the display reaches 180° obtained in step 3.
6. Allow the wind direction display approximately 5 seconds to stabilize after the shaft is turned. Turn the shaft, wait, and turn it again until 180° is displayed on the console.
7. Being careful to keep the stainless-steel shaft from turning, place the wind vane on top of shaft with the vane's nose pointing south.
8. Slide the wind vane down the shaft as far as it will go.
9. Use the Allen wrench provided to tighten the set screw on the side of the wind vane.
10. Test the anemometer by pointing the wind vane in any direction and making sure the console displays the correct wind direction. Remove and re-adjust the vane if it does not. Allow the wind direction display approximately 5 seconds to stabilize after turning the shaft.





Installing Wind Vane on Anemometer Shaft

11. Test the anemometer by pointing the wind vane in any direction and making sure the console displays the correct wind direction. Remove and re-adjust the vane if it does not. Allow the wind direction display approximately 5 seconds to stabilize after turning the shaft.

Appendix B: Specifications

Complete specifications for the ISS and other products are available in the Weather Support section of our website at www.davisnet.com.

Cabled ISS

Temperature range: -40 to 150° Fahrenheit (-40 to 65° Celsius)
 Power input: Console Cable from Vantage Pro2 console Optional
 Vantage Pro2 AC power adapter

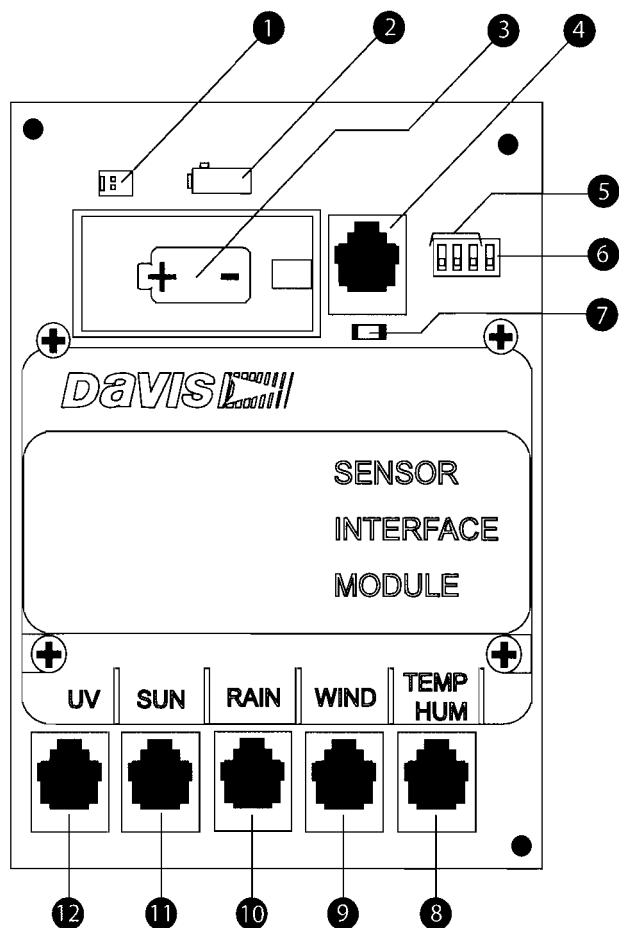
Wireless ISS

Temperature range: -40 to 150° Fahrenheit (-40 to 65° Celsius)
 Transmission frequency: 902 - 928 MHz FHSS for North America
 868.0 - 868.6 MHz FHSS for overseas versions: EU, UK,
 and OV
 Transmitter ID codes: 8 user-selectable
 License: low power (less than 8 mW), no license required
 Primary power: Solar power – Davis solar charger
 Backup power: CR-123A 3-volt lithium battery (8 months without sun-
 light- greater than 2 years depending on solar charging)
 Alternate power AC power adapter

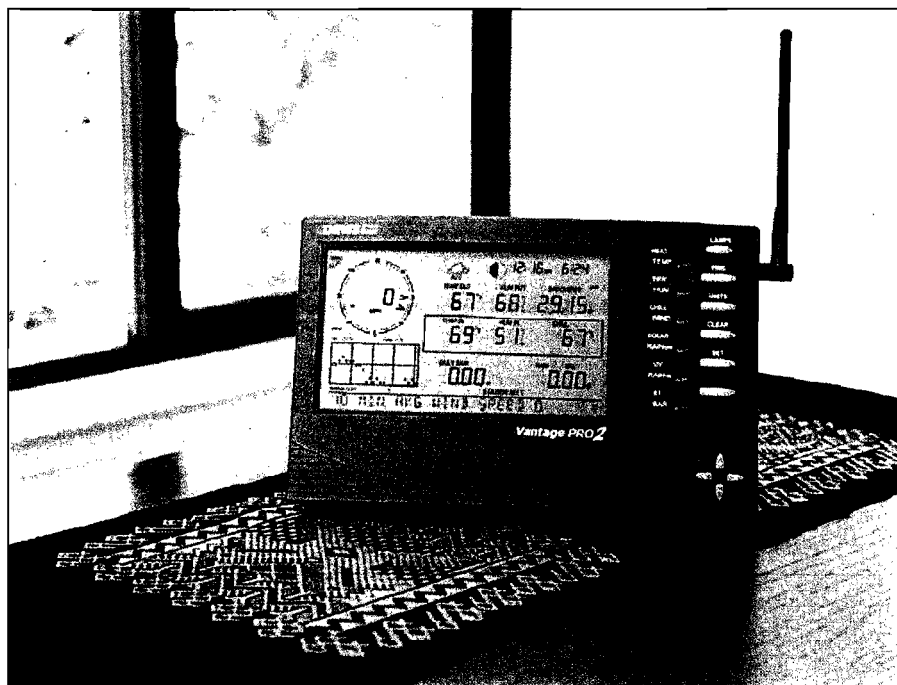
ISS Weather Variable Update Intervals (Transmitter ID Dependent)

Wind speed: 2.5 to 3 seconds
 Wind direction: 2.5 to 3 seconds
 Accumulated rainfall: 10 to 12 seconds
 Rain rate: 10 to 12 seconds
 Outside temperature: 10 to 12 seconds
 Outside humidity: 50 seconds to 1 minute
 Ultraviolet radiation: 50 seconds to 1 minute
 Solar radiation: 50 seconds to 1 minute

SIM Board Display and Contents



① Solar Power Tab	⑦ Test LED
② AC Adapter Socket	⑧ Temperature/Humidity Sensor Connector
③ Battery Socket	⑨ Wind Sensor Connector
④ Cabled Connection	⑩ Rain Sensor Connector
⑤ Transmitter ID DIP Switch	⑪ Solar Radiation Sensor Connector
⑥ Test DIP Switch	⑫ UV Sensor Connector



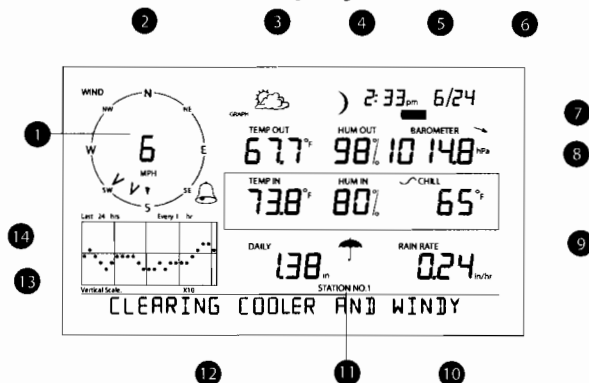
Vantage Pro2™ Console Manual

For Vantage Pro2™ & Vantage Pro2 Plus™ Weather Stations



Davis Instruments, 3465 Diablo Avenue, Hayward, CA 94545 • 510-732-9229 • www.davisnet.com

Vantage Pro2 Console Display Features



Display Features

1. Compass Rose	8. Barometric Trend Arrow
2. Graph & Hi/Low Mode Settings	9. Graph Icon
3. Forecast Icons	10. Current Rain Icon
4. Moon Phase Indicator	11. Station Number Indicator
5. Time/Sunrise Time	12. Weather Ticker
6. Date/Sunset Date	13. Graph Field
7. 2ND Button Indicator	14. Alarm Icon

FCC Part 15 Class B Registration Warning

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modification not expressly approved in writing by Davis Instruments may void the warranty and void the user's authority to operate this equipment.

FCC ID: IR2DWW6328

IC: 378810-6312

EC EMC Compliance

This product complies with the essential protection requirements of the EC EMC Directive 89/336/EC.

Vantage Pro 2 Console Manual

Document Part Number: 07395.234

Rev. G, September 21, 2006

For Vantage Pro2 Consoles # 6312 & 6312C

And Vantage Pro2 Weather Stations # 6152, 6152C, 6153, 6162, 6162C, 6163

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Chapter 1

Welcome to Vantage Pro2™

Welcome to your Vantage Pro2 Weather Station console. The console displays and records your station's weather data, provides graph and alarm functions, and interfaces to a computer using our optional WeatherLink software.

Vantage Pro2 stations are available in two basic versions: cabled and wireless. A cabled Vantage Pro2 station transmits outside sensor data from the Integrated Sensor Suite (ISS) to the console using a straight-through four-conductor cable. A wireless Vantage Pro2 station transmits outside sensor data from the ISS to the console via a low-power radio. Wireless stations can also collect data from optional Vantage Pro2 sensors. See "Optional Sensors" on page 2.

The *Vantage Pro2 Quick Reference Guide* included with your station provides an easy to use reference for most console functions.

Console Features

Keyboard & Display

The keyboard lets you view current and historical data, set and clear alarms, change station models, enter calibration numbers, set up and view graphs, select sensors, and read the forecast. The keyboard consists of 12 command keys located next to the screen display and four navigation keys located below the command keys.

A weather variable or console command is printed on each command key. Just press a key to select the variable or function printed on that key.



Each command key also has a secondary function which is printed above the key on the console case. To select the secondary function, press and release 2ND (on the front of the console, upper right corner) and then immediately press the key for that function.



Note: After pressing 2ND, the 2ND icon displays above the barometer reading on the screen for three seconds. All secondary key functions are enabled during this time. Keys resume normal operation after the icon disappears.

The up arrow, down arrow, left arrow, and right arrow navigation keys are used to select command options, adjust values, and to provide additional functions when used in combination with a command key.



Console Modes

The console operates in five basic modes: Setup, Current Weather, Highs and Lows, Alarm, and Graph. Each mode lets you access a different set of console functions or display a different aspect of your weather data.

Vantage Pro2 Options

Optional Sensors

Vantage Pro2 stations are extremely flexible. Use the following optional sensors and wireless stations to enhance the weather monitoring capabilities of your Vantage Pro2. See our website for complete details: www.davisnet.com.

Optional Sensor and Stations	Description
Wireless Weather Envoy (# 6316) Cabled Weather Envoy (# 6316C)	Performs much of the same functions as a Vantage Pro2 console, but without a display. Use an Envoy to interface your wireless station to a computer when you'd rather place the console in another location for viewing weather conditions.
Anemometer Transmitter Kit (# 6332)	Provides more flexible anemometer placement for wireless stations.
Wireless Leaf & Soil Moisture/Temperature Station (# 6345)	Measures and transmits leaf wetness, soil moisture and temperature data. Also for use with GLOBE.
Wireless Temperature Station (# 6372)	Measures and transmits temperature data.
Wireless Temperature/Humidity Station (# 6382)	Measures and transmits air temperature and humidity data.
Solar Radiation Sensor (# 6450)	Measures solar radiation. Required for calculating evapotranspiration (ET). Available for cabled and wireless stations. Requires Sensor Mounting Shelf (# 6673).
Ultraviolet (UV) Radiation Sensor (# 6490)	Measures UV radiation. Required for calculating the UV dose. Available for Cabled and Wireless stations. Requires Sensor Mounting Shelf (# 6673).

Note: Optional wireless stations can only be used with Wireless Vantage Pro2 Stations.

Optional WeatherLink® Software

The WeatherLink software and data logger connect your Vantage Pro2 station directly to a computer, providing enhanced weather monitoring capabilities, a continuous preserved data record, and powerful Internet features. The WeatherLink data logger fits neatly on the console and stores weather data even when the computer is turned off.

WeatherLink Option	Description
WeatherLink for Windows, USB connection (# 6150USB)	Includes WeatherLink software and USB data logger. Allows you to save and view your weather data on your PC.
WeatherLink for Windows, serial connection (# 6150SER)	Includes WeatherLink software and serial data logger. Allows you to save and view your weather data on your PC.

Vantage Pro2 Options

WeatherLink Option	Description
WeatherLink for Macintosh OS X, USB connection (# 6520)	Includes WeatherLink software and USB data logger. Allows you to save and view your weather data on your Mac.
WeatherLink for APRS, Windows version, with streaming data logger, serial connection (# 6540)	Includes WeatherLink software and streaming serial data logger. Allows real-time display of current weather conditions for use with APRS (Automatic Position Reporting System), for HAM radio users.
WeatherLink for Alarm Output, Windows version, with streaming data logger, serial connection (# 6544)	Includes WeatherLink software and streaming serial data logger. Gives you the ability to control external devices based on various combinations of weather trends and events.
WeatherLink for Emergency Response teams, Windows version, with streaming data logger, serial connection (# 6550)	Includes WeatherLink software and streaming serial data logger. Allows real-time display of current weather conditions for use by emergency response teams.
WeatherLink for Irrigation Control, Windows version, with streaming data logger, serial connection (# 6560)	Includes WeatherLink software and streaming serial data logger. Allows intelligent and efficient control of popular automated irrigation systems using weather data.

Optional Accessories

The following accessories are available from your dealer or may be ordered directly from Davis Instruments.

Sensor Mounting Shelf (# 6673)

Required for mounting the optional Solar Radiation and/or UV sensors. The mounting shelf attaches to the base of the rain collector on the ISS.

USB-to-Serial (DB-9) Cable (# 8434)

Allows the Serial version of WeatherLink (# 6510SER, 6540, 6550, 6560) to connect to a USB port on your computer.

Telephone Modem Adapter (# 6533)

Creates a dialup connection between the station and the computer.

Extension Cables (# 7876)

Allows you to place the Cabled Vantage Pro2 ISS further away from the console using the extension cable provided by Davis Instruments. Maximum cable length is 1000' feet (300 m).

- # 7876-040 Cable, 40' (12 m)
- # 7876-100 Cable, 100' (30 m)
- # 7876-200 Cable, 200' (61 m)

Davis Baseball Cap (# PR725)

100% cotton twill cap is two-toned with a washed khaki crown, dark blue brim, and embroidered Davis logo. Self-fabric closure with brass buckle. One size fits all.

Chapter 2

Installing the Console

The Vantage Pro2 console is designed to give extremely accurate readings. As with any precision instrument, use care in its assembly and handling. Although installing the console is relatively simple, following the steps outlined in this chapter and assembling the Vantage Pro2 correctly from the start will help ensure that you enjoy all of its features with a minimum of time and effort.

Powering the Console

Cabled Vantage Pro2 Stations

Cabled Vantage Pro2 consoles supply power to the Integrated Sensor Suite (ISS) through the console cable. Because of the added power consumption of the ISS, the cabled console requires an AC power adapter used as the main power supply. The console batteries provide backup power for up to four to six weeks.

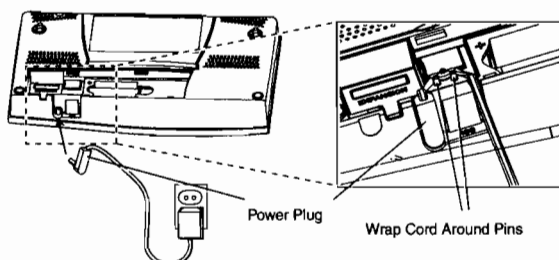
Wireless Vantage Pro2 Stations

Wireless Vantage Pro2 consoles do not require the use of an AC adapter. You may use the included adapter if you wish, but the three C-cell batteries should power a wireless console for up to nine months.

Note: When using an AC Power adapter, be sure to use the power adapter supplied with your Vantage Pro2 Console. Your console may be damaged by connecting the wrong power adapter. The console does not recharge the batteries. Because of this, and because NiCad batteries do not power the console as long as alkaline batteries, use alkaline batteries in the console.

Installing the AC Power Adapter

1. Remove the battery cover located on the back of the console by pressing down on the two latches at the top of the cover.
2. Find the power jack located on the bottom of the console case.

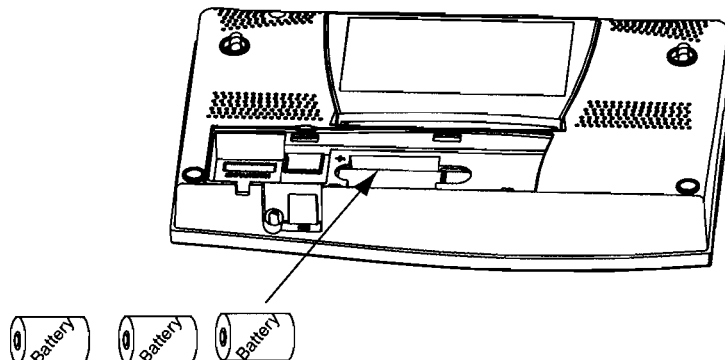


3. Insert the power adapter plug into the console power jack, then plug the other end of the adapter into an appropriate power outlet.
4. Check to make sure the console runs through a brief self-test procedure successfully. On power up, the console displays all the LCD segments and beeps twice. A message displays in the ticker banner at the bottom of the console, followed by the first screen that displays during Setup Mode. Press and hold DONE to skip the message and enter into Setup Mode.

Setup Mode guides you through steps required to configure the station. See “Setup Mode” on page 9 for more information.

Installing Batteries

1. Remove the battery cover located on the back of the console by pressing down on the two latches at the top of the cover.

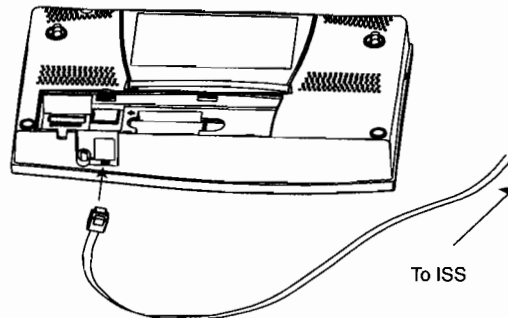


2. Insert three C batteries into the battery channel, negative (or flat) terminal first.
3. Replace the battery cover.

Connecting Cabled Stations

Cabled Vantage Pro2 stations come with 100 feet (30m) of cable. This cable is used for connecting the console to the ISS. Maximum cable length from ISS to the console using Davis Instruments cables is 1000 feet. To connect the console to the ISS:

1. Firmly insert the console end of the straight-through four-conductor wire into the console receptacle marked “ISS” until it clicks into place. Do not force the connector into the receptacle.



2. Ensure that the ISS cable is not twisted through the access port.

Note: The ISS must be assembled and connected to the console so that it is receiving power before the console connection can be tested.

Once the console and ISS are both powered up, cable connection should be tested and established.

Once the console is powered, it automatically enters Setup Mode. You can step through the Setup Mode options, or exit the Setup Mode to test the connection and sensor readings in Current Weather Mode. See "Setup Mode" on page 9 for Setup Mode options. See "Current Weather Mode" on page 18 for viewing and verifying current weather data coming from the cabled console.

To verify that the console is receiving data from the ISS through the console connection, see "Cabled ISS Assembly" in the Integrated Sensor Suite Installation Manual.

Console Location

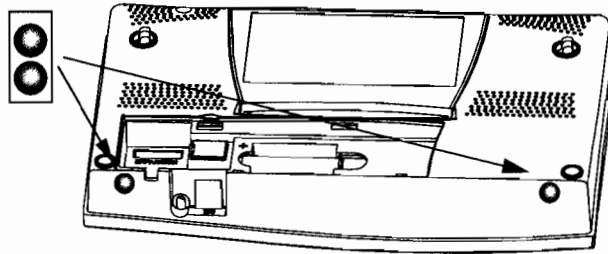
Place the console in a location where the keyboard is easily accessible and the display is easy to read. For more accurate readings, follow these suggestions.

- Avoid placing the console in direct sunlight. This may cause erroneous inside temperature and humidity readings and may damage the unit.
- Avoid placing the console near radiators or heating/air conditioning ducts.
- If you are mounting the console on a wall, choose an interior wall. Avoid exterior walls that tend to heat up or cool down depending on the weather.
- If you have a wireless console, be aware of possible interference from cordless phones or other devices. To prevent interference, maintain a distance of 10 feet between the Vantage Pro2 console and a cordless phone (handset and base).
- Avoid positioning a wireless console near large metallic appliances such as refrigerators, televisions, heaters, or air conditioners.
- The console antenna does not rotate in a complete circle. Avoid forcing the console antenna when rotating it.

Table & Shelf Placement

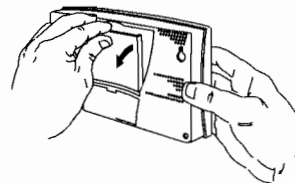
The console kickstand can be set to three different angles allowing five different display angles.

1. Install the two round rubber feet on the bottom of the console. The rubber feet help prevent damage to furniture and surfaces.



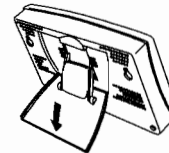
2. Lean the kickstand out by pulling on its top edge.

You'll see the indentation for your finger at the top edge of the console.

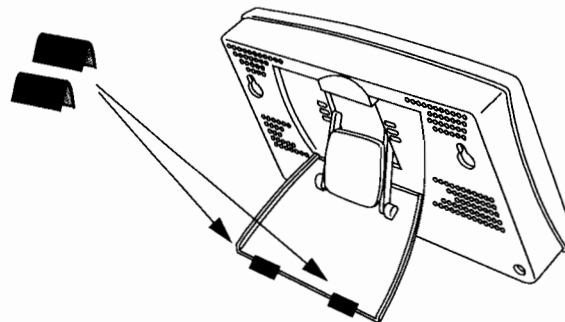


3. Slide the catch to rest the kickstand in the appropriate angle.

Choose low angles for display on a coffee table or other low area. Choose higher angles for display on a desk or shelf.



4. Install the two rubber channel feet on the kickstand.



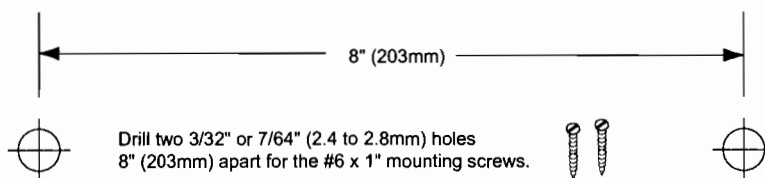
If necessary, pull up on the stand to close it. It will be a little tight, so it's okay to push hard enough to get it to slide.

Wall Mounting

The console mounts to the wall using two keyholes located on the back of the case.

To mount the console on a wall:

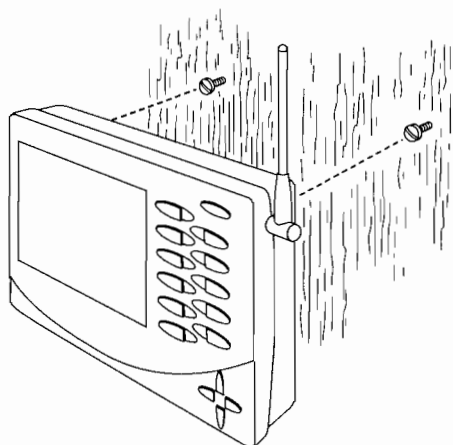
1. Use a ruler to mark two mounting hole positions on the wall 8 inches (203 mm) apart.



This is a representation for the mounting hole positions. This template is not true to size.

If installing a cabled Vantage Pro2 console with sensor cable running inside the wall, mount the console over an empty switch box.

2. Use a drill and a 3/32 or 7/64" (2.5 mm) drill bit to drill two pilot holes for the screws.
3. Using a screwdriver, drive the two #6 x 1" pan head self-threading screws into the wall. Leave at least 1/8" (3 mm) between the wall and the heads of the screws.
4. If the kickstand has been pulled out from the case, push it back into its upright and locked position.
5. Guide the two keyholes on the back of the console over the two screws.



Chapter 3

Using Your Weather Station

The console LCD screen and keyboard provide easy access to your weather information. The large LCD display shows current and past environmental conditions as well as a forecast of future conditions. The keyboard controls console functions for viewing current and historical weather information, setting and clearing alarms, changing stations types, viewing and/or changing station settings, setting up and viewing graphs, selecting sensors, getting the forecast, and so on.

Console Modes

The Vantage Pro2 console operates in five different modes:

Mode	Description
Setup	Use Setup Mode to enter the time, date, and other information required to calculate and display weather data.
Current Weather	Use Current Weather Mode to read the current weather information, change measurement units, and to set, clear or calibrate weather readings.
High/Low	High/Low Mode displays the daily, monthly or yearly high and low readings.
Alarm	Alarm Mode allows you to set, clear, and review alarm settings.
Graph	Graph Mode displays your weather data using over 100 different graphs.

Setup Mode

Setup Mode provides access to the station configuration settings that control how the station operates. Setup Mode consists of a series of screens for selecting console and weather station options. The screens that display in Setup Mode vary depending on the weather station type (cabled or wireless), or if the console has a WeatherLink connection already established. (See the *WeatherLink Getting Started Guide* for more information on connecting your console to your computer.)

Setup Mode Commands

Setup Mode displays when the console is first powered. This mode can be displayed at any time to change any of the console/weather station options. Use the following commands to enter, exit and navigate Setup Mode:

- Enter Setup Mode by pressing DONE and the down arrow (-) at the same time.

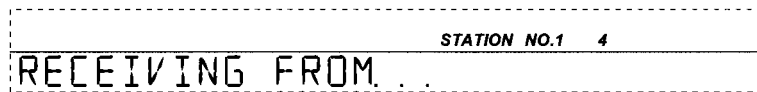
Note: The console automatically enters Setup Mode when first powered.

- Press DONE to move to the next screen in the Setup Mode.
 - Press BAR to display the previous screen in the Setup Mode.
 - Exit Setup Mode by pressing and holding DONE until the Current Weather screen displays.
-

Screen 1: Active Transmitters

Screen 1 displays the message “Receiving from...” and shows the transmitters being received by the console. In addition, an “X” blinks in the lower right-hand corner of the screen every time the console receives a data packet from a station. The rest of the LCD screen is blank.

If you have a cabled station, or if your wireless ISS uses the factory settings and you are receiving the signal, the screen displays “Receiving from station No. 1.” Any optional stations that have been installed should also display.



Screen 1: Active Transmitters

Note: An ISS or optional station must be powered for the console to recognize it. Refer to the *Integrated Sensor Suite Installation Manual* or optional station installation instructions for more information. It may take several minutes for the console to acquire and display a Transmitter ID.

1. Make a note of the station number(s) listed on the screen.
2. Press DONE to move to the next screen.

The console can receive signals from up to eight transmitters total, but there is a limit on the number of certain types of transmitters. The table below lists the maximum number of stations allowable for a receiver:

Station Type	Maximum Number
Integrated Sensor Suite (ISS)	1
Anemometer Transmitter Kit*	1
Leaf & Soil Moisture/Temperature Station	2**
Temperature Station	8
Temperature/Humidity Station	8

Maximum Number of Transmitters in a Network with One Receiver

**Replaces the ISS anemometer.*

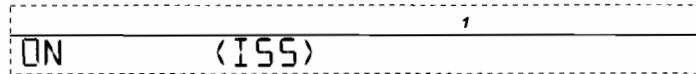
***Two are allowable only if both stations are only partially populated. For example, A network can either have both a Leaf Wetness/Temperature station and a Soil Moisture/Temperature station, or it can have one combined Leaf Wetness and Soil Moisture/Temperature station.*

Note: Listening to more than one transmitter may reduce battery life significantly.

Screen 2: Configuring Transmitter IDs — Wireless Only

(If you have a cabled station, press DONE and continue on to “Screen 4: Time & Date” on page 12.)

Setup screen 2 allows you to change the ISS transmitter ID and to add or remove optional transmitter stations. The default transmitter ID setting is “1” (ISS), which works fine for most installations.



Screen 2: Transmitter ID configuration

If you have a cabled station, or if you have a wireless station and are using the default transmitter ID setting, press DONE to move to the next screen.

Note: Typically, you can use the default transmitter ID setting of 1 unless you are installing one of the optional transmitter stations or a nearby neighbor has a Vantage Pro2 station that uses transmitter ID 1 for the ISS.

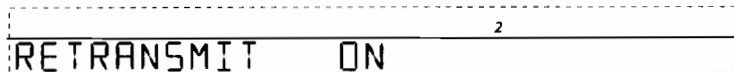
3. Press the right and left arrows to select the transmitter ID.
When you select a transmitter ID, the ID number is displayed on the screen as well as the current configuration.
4. Press the up or down arrows to toggle console reception of signals from transmitters using that ID on and off.
5. Press GRAPH to change the type of station assigned to each transmitter number. Scroll through the station types - ISS, TEMP, HUM, TEMP HUM, WIND, RAIN, LEAF, SOIL, and LEAF/SOIL - until the correct type appears.
6. Press DONE to move to the next screen.

Note: This screen contains functionality for enabling repeaters. If the word "Repeater" displays in the right corner of the screen and you are not using repeaters as part of your network, see "Clearing Repeater ID" on page 52. If you are using repeaters as part of your network see "Wireless Repeater Configuration" (Appendix C) on page 51 for configuring repeaters on the console.

Screen 3: Retransmit — Wireless Only

Press DONE and go to "Screen 4: Time & Date" on page 12 if you have a cabled station.

The console can take data it receives from the ISS and transmit it to other Vantage Pro2 consoles using the retransmit feature. By toggling the feature on, the console becomes another transmitter that requires its own unique ID to transmit the data received from the ISS.



Screen 3: Retransmit

1. Press the up or down arrow to turn the retransmit function on and off. The first available transmitter ID not used by the ISS or any optional sensor is automatically assigned. Data from the ISS is the only data that can be retransmitted by the console.
When retransmit has already been enabled, pressing the right or left arrows changes the Transmitter ID used for retransmit.

2. Use the arrows to scroll through the list of available transmitter IDs and select the ID for your console.
3. Press DONE to move to the next screen.

Note: Make a note of the ID selected for retransmit. The console that receives the data from the console you have selected to retransmit should be configured to receive the transmitter ID you selected. See "Screen 2: Configuring Transmitter IDs — Wireless Only" on page 10 for more information.

Screen 4: Time & Date

The very first time you power-up the console, the time and date are set to 12:00AM January 1st, 2005. Be sure to enter the correct date and local time.

Screen 4: Time & Date

To change the time and date:

1. Press the right and left arrows to select the hour, minute, month, day or year. The selected time or date setting blinks on and off.
2. To change a setting, press the up and down arrows to adjust the value up or down.

To choose a 12-hour or 24-hour clock, first select either the hour or minute setting, then press 2ND and immediately press UNITS. This toggles the clock setting between the two clock types.

To choose between a MM/DD or DD.MM display for the date, first select either the day or month setting, then press 2ND and immediately press UNITS. This switches the console from one date display to the other.

3. Press DONE to move to the next screen.

Screen 5: Latitude

The console uses latitude along with longitude to determine your location, allowing it to adjust the forecast and calculate the times for sunset and sunrise.

37.6	
ENTER LATITUDE...	NORTH

Screen 5: Latitude

- Latitude measures distance north or south of the equator.
- Latitude is used with longitude to identify your position on earth.

If you do not know your latitude and longitude, there are several ways to find out. Many atlases and maps include latitude and longitude lines. You can also talk to the reference department of your local library, call your local airport, or search on the Internet.

Here are some on-line resources for finding your latitude and longitude:

<http://www.geocode.com/eagle.html> (North America only)

<http://www.topozone.com/> (US only)

<http://www.calle.com/world/> (outside US)

The more accurate you are, the better; however, a reasonable estimate will work, too.

1. Press the right and left arrows to move between fields.
2. Press the up and down arrows to change the settings up or down.
3. To select between SOUTH or NORTH, press 2ND and then UNITS.
4. Press DONE to move to the next screen.

Screen 6: Longitude

The console uses longitude along with latitude to determine your location, allowing it to adjust the forecast and calculate the times for sunset and sunrise. See Screen 5: Latitude for information on determining your longitude.

122.1	
ENTER LONGITUDE...	WEST

Screen 6: Longitude

- Longitude measures distance east or west of the Prime Meridian, an imaginary line running north and south through Greenwich, England.
 - Longitude is used with latitude to identify your position on earth.
1. Press the right and left arrows to move between fields.
 2. Press the up and down arrows to change the settings up or down.

3. To select the East or West Hemisphere, press 2ND, then UNITS.
4. Press DONE to move to the next screen.

Screen 7: Time Zone

The console is pre-programmed with a combination of US time zones and the names of major cities representing time zones around the world. You can also configure your time zone using the Universal Time Coordinate (UTC) offset.

(GMT-0800) PACIFIC TIME

Screen 7: Time Zone

Note: UTC offset measures the difference between the time in any time zone and a standard time, set by convention as the time at the Royal Observatory in Greenwich, England. Hayward, California, the home of Davis Instruments, observes Pacific Standard Time. The UTC offset for Pacific Standard Time is -8:00, or eight hours behind Universal Time (UTC). When it's 7:00 pm (1900 hours) UTC, it's 19 - 8 = 1100 hours, or 11:00 am in Hayward in winter. When daylight savings time is observed, an hour is added to the offset time automatically. Use this function in correlation with Screen 8, Daylight Savings Settings.

1. Press the up and down arrows to cycle through time zones.
2. If your time zone is not shown, press 2ND then press the up and down arrows to set your UTC offset.
3. Press DONE to select the time zone or UTC offset shown on the screen and move to the next screen.

Screen 8: Daylight Savings Settings

In most of North America (except Saskatchewan, Arizona, Hawaii, and the Mexican State of Sonora); in Australia (except Western Australia, Northern Territory, and Queensland); and Europe use the AUTO Daylight Savings setting. The console is pre-programmed to use the correct starting and stopping dates for Daylight Savings Time in these areas, based on the time zone setting in screen 7.

Weather stations located outside North America, Europe, and Australia or in areas that do not observe daylight savings time should use the MANUAL setting.

DAYLIGHT SAVINGS MANUAL

Screen 8: Daylight Savings Settings

1. Press the up and down arrows to choose Auto or Manual.
2. Press DONE to move to the next screen.

Screen 9: Daylight Savings Status

Use this screen to either verify the correct automatic Daylight Savings status or to set Daylight Savings manually.

DAYLIGHT SAVINGS OFF

Screen 9: Daylight Savings Status

1. If Daylight Savings setting is MANUAL, press the up and down arrows to turn Daylight Savings Time on or off on the appropriate days of the year.
If you have an AUTO Daylight Savings setting, the console displays the appropriate setting based on the current time and date.
2. Press DONE to move to the next screen.

Screen 10: Elevation

Meteorologists standardize barometric pressure data to sea level so that surface readings are comparable, whether they're taken on a mountainside or by the ocean. To make this same standardization and ensure consistent readings, enter your elevation in this screen.

0237
ENTER ELEVATION FEET

Screen 10: Elevation

Note: If you do not know your elevation, there are several ways to find out. Many atlases and almanacs include elevation for cities and towns. You can also check with the reference department of your local library. The more accurate you are, the better, but a reasonable estimate works too.

1. Press the left and right arrows to move from one numeral in the elevation to another.
2. Press the up and down arrows to adjust a numeral up or down.
3. To switch between feet and meters, press 2ND then press UNITS.
4. If you are below sea level, like in Death Valley or Palm Springs, first enter the elevation as a positive number. Then, select the "0" immediately to the left of the leftmost non-zero digit (the second zero from the left in 0026, for example, or the first zero from the left in 0207) and press the up and down arrows to switch from a positive to negative elevation.

Note: You can only set the elevation to negative after you have entered a non-zero digit and when the zero in the position immediately to the left of the left-most non-zero digit has been selected.

5. Press DONE to move to the next screen.

Screen 11: Wind Cup Size

Vantage Pro2 stations come standard with large wind cups. Switch this setting to small only if you have separately purchased and installed small wind cups.

Note: Large wind cups are more sensitive to low wind speeds and are the best choice for most users. Small wind cups are less sensitive at low wind speeds but can measure much higher wind speeds. Install small wind cups if you wish to measure winds over 150 m.p.h. (242 km/h), (Category 5 Hurricane). Maximum speed sensitivity decreases with the age of the wind cups.

WIND CUP SIZE LARGE

Screen 11: Wind Cup Size

1. Press the up and down arrows to switch between large and small wind cups.
2. Press DONE to move to the next screen.

Screen 12: Rain Collector

The tipping bucket in the Vantage Pro2 rain collector has been calibrated at the factory to measure 0.01" of rain with each tip. The ISS comes equipped with a metric adapter that, once installed, takes 0.2 mm readings for every tip of the bucket. Determine which measurement you want your rain collector to take and configure your console and rain collector accordingly.

RAIN COLLECTOR 01 IN

Screen 12: Rain Collector Settings

To configure your console for inch measurements:

1. Press the up and down arrows to display the .01" setting.
2. Press DONE to use the selected setting and move to the next screen.

To configure your console for 0.2 mm measurements:

1. Press the up and down arrows to display the 0.2 mm setting.
2. Press DONE to use the selected setting and move to the next screen.

Note: See the *Integrated Sensor Suite Installation Manual* for instructions on installing the metric rain adapter. The 0.1mm setting does not provide correct rain measurements with either the standard measurement or the metric adapter installed in the rain bucket and should not be used. If necessary, the console can be configured to calculate the 0.01" measurements and convert these to metric measurements, rounding to the nearest 0.1 mm or can be configured to calculate the 0.2 mm measurements and convert them to the U.S. standard, rounding to the nearest .01".

To Display Rain in Metric Units on the Console

Even if you configure your console to display metric rain data in screen 12 of the Setup Mode, you have to configure your Current Weather Mode to display the same readings. To display metric rain readings in the Current Weather Mode, once you have completed or exited the Setup Mode:

1. Press RAIN.YR to display the current rain rate.

RAIN.YR

Setup Mode

Selecting Metric units for one rain variable also sets all the other rain variables to Metric units.

2. Press and release 2ND and press UNITS once.

The units used to display rain data toggle between inches and millimeters each time you repeat this key sequence.



To Display Rain in Metric Units in WeatherLink

Refer to the *WeatherLink Online Help* for instructions to set the rain collector to 0.2 mm and to select millimeters as the unit for rain.

Screen 13: Rain Season

Because rainy seasons begin and end at different times in different parts of the world, you must specify the month you wish your yearly rain data to begin.

January 1st is the default. The date the rain season begins affects yearly rain rate highs and lows.

A screenshot of a screen with a dashed border. The text on the screen reads 'RAIN SEASON BEGINS JAN 1'.

Screen 13: Rain Season

1. Press the up and down arrows to select the month for the start of the rainy season.
2. Press DONE to move to the next screen.

Note: This setting determines when the yearly rain total is reset to zero. Davis Instruments recommends a January rain season setting (the default), unless you reside in the west coast of the United States, the Mediterranean coast, experience dry winters in the Southern Hemisphere. If so, change the rain season setting to July 1st. If you are performing hydrology studies in any of these climates in the Northern Hemisphere, change the rain season setting to October 1st.

Screen 14: Serial Baud Rate

The Baud Rate screen displays only if the console detects that a WeatherLink data logger installed on the console.

The console uses a serial or USB port to communicate with a computer. If you are connecting the console directly to your computer, leave the setting at 19200, the highest rate for the port. If you're using a modem, use the highest setting your modem can handle. The console must be equipped with a WeatherLink data logger to communicate with a computer or modem.

A screenshot of a screen with a dashed border. The text on the screen reads 'SERIAL BAUD RATE' followed by '19200'.

Screen 14: Baud Rate

Note: The baud rate setting on your console must match the serial port setting in the software on your computer. If you are using WeatherLink for Vantage Pro2, refer to WeatherLink help for instructions on setting the serial port baud rate on your computer.

1. Press the up and down arrows to select the baud rate.
Your Vantage Pro2 console supports baud rates of 1200, 2400, 4800, 9600, 14400, and 19200.
2. You have completed the console setup. To exit Setup Mode, press and hold DONE until the current weather screen appears.

Clear All Command

After you have completed the above setup procedures and have exited the Setup Mode, please use the Clear All command before putting your weather station into service.

The Clear All command clears all stored high and low weather data including monthly and yearly highs and lows and clears the alarm settings. The command is recommended to properly clear and initialize the console's data logging function.

1. Press WIND on the console.
2. Press 2ND, then press and hold CLEAR for at least six seconds.
3. Release CLEAR when you see "CLEARING NOW" displayed at the bottom of the console's screen.

Current Weather Mode

In the Current Weather Mode you can display the current data readings from your station, select units of measure, and calibrate, set, or clear weather variables. You can see up to ten weather variables on the screen at the same time, as well as the time and date, the moon and forecast icons, a forecast or special message from your station, and a graph of the currently selected variable. A few variables are always visible on the console screen while most variables share their location with one or more variables. You can select any variable not currently on the screen to display it.

Selecting Weather Variables

Select a weather variable to display its data on the screen if it isn't already visible or to graph the data available for that variable.

Weather variables are selected via the console command keys:

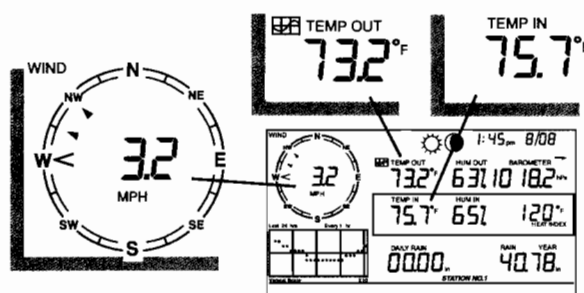
- If the variable is printed on a key, just press the key to select the variable.
- If the variable is printed on the console housing, first press and release 2ND, then quickly press the key below the variable to select it.



Note: After pressing 2ND, the 2ND icon displays on the screen for three seconds. Command key secondary functions are enabled during this time. The keys return to normal operation after the icon disappears.

Selecting Units of Measure

- Select a variable and press GRAPH to graph the variable in the Current Weather Mode screen. The console places a graph icon on the screen next to the selected variable or value you want to view to indicate the currently selected variable.
- You can also select any variable currently displayed on the LCD screen using the navigation keys. Push up (+) to move up the screen. Press down (-) to move down the screen. Push left (<) to move left and push right (>) to move right.



Selecting Units of Measure

Most weather variables may be displayed in at least two different measurement units, including US and metric systems, although some variables feature more possibilities. Barometric pressure, for example, may be displayed in millibars, millimeters, inches, or hectoPascals. Note that you can set each variable's units independently, and at any time, as you like.

To change units:

1. Select the weather variable. See "Selecting Weather Variables" on page 18.
2. Press and release 2ND then press UNITS. The selected variable's units change. Repeat steps 1 and 2 until the desired units appear.



For example, to change the barometric pressure units, first select barometric pressure by pressing BAR. Next, press and release 2ND, then press UNITS. Repeating these steps cycles through the units available for barometric pressure: millibars, millimeters, inches, and hectoPascals.



Displaying Units:

Barometric Pressure Units: millibars (mb), millimeters (mm) and inches (in)

Wind Speed and Direction

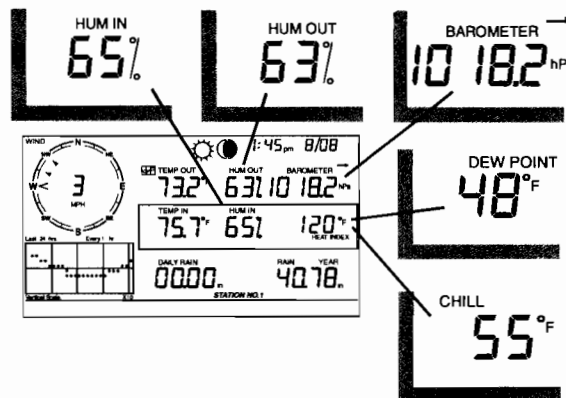
1. Press WIND to select wind speed. WIND
2. Wind speed may be displayed in miles per hour (m.p.h.), kilometers per hour (km/h), meters per second (m/s), and knots (knots). The 10 minute average wind speed will be displayed in the ticker. A solid arrow within the compass rose indicates the current wind direction. Arrow caps indicate up to six different 10-minute dominant wind directions to provide a history of the dominant wind directions for the past hour.
3. Press WIND a second time to display the wind direction in degrees instead of the wind speed.

Note: When displayed in degrees, Due North displays as 360° for consoles with firmware dated May 2005 or later. Previous releases marked Due North at 0°.

Each additional WIND key press toggles the display between wind speed and wind direction in degrees.

Outside and Inside Temperature

1. Press TEMP to select outside temperature. TEMP
Temperature may be displayed in degrees Fahrenheit (°F) or Celsius (°C). Temperatures can also be displayed in degrees or in tenths of a degree.
2. Press TEMP again to select inside temperature.
Each consecutive press of TEMP displays temperature readings for any optional temperature, temperature/humidity, soil temperature, soil moisture stations also connected to your console. The order of the optional sensors readings display depends on your station configuration. Temperatures for temperature stations display, with soil temperature and moisture stations displaying consecutively.



Humidity, Pressure, Dew Point & Wind Chill

Selecting Units of Measure

Humidity

Press HUM to select outside humidity. Pressing HUM a second time selects inside humidity. Humidity is displayed in percent relative humidity.

Each consecutive press of HUM displays humidity readings for any optional humidity, leaf wetness, and leaf temperature stations also connected to your console. The order of the optional sensors readings display depends on your station configuration. Humidity readings for humidity stations display, with leaf wetness and leaf temperature readings displaying consecutively.

Wind Chill

Press 2ND then press CHILL to select Wind Chill. Wind Chill is displayed in either Fahrenheit (°F) or Celsius (°C) in whole degrees.

The console uses the ten-minute average wind speed to calculate wind chill.

Dew Point

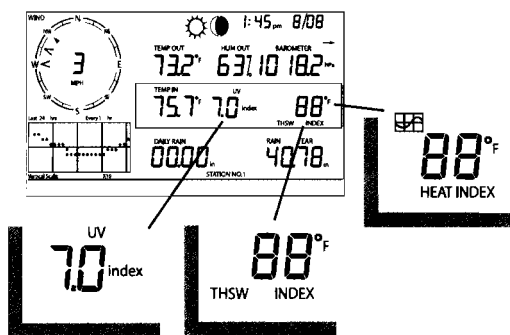
Press 2ND then press DEW to select Dew Point. Dew Point is displayed in either Fahrenheit (°F) or Celsius (°C) in whole degrees.

Barometric Pressure

Press BAR to select barometric pressure. Barometric pressure may be displayed in inches (in), millimeters (mm), millibars (mb) or hectoPascals (hPa).

Pressure Trend

The pressure trend arrow indicates the current barometric trend, measured over the last three hours. The pressure trend is updated every 15 minutes. The pressure trend requires three hours of data in order to be calculated so it won't display right away on a new station. The pressure trend is indicated on the console screen, as long as the required data is available.



UV, Heat, and THSW Index

UV (Ultraviolet Radiation)

Press 2ND and UV to display the current UV index. The current UV index is the amount of ultraviolet radiation the sensor is currently reading.

2nd UV
RAIN

Press 2ND and UV again to display the accumulated UV index for the day. The accumulated UV index is the total ultraviolet radiation that the sensor has read throughout the day. The accumulated UV index for the day is reset to zero every night.

Note: Requires a UV sensor. See "Optional Sensors" on page 2.

Heat Index

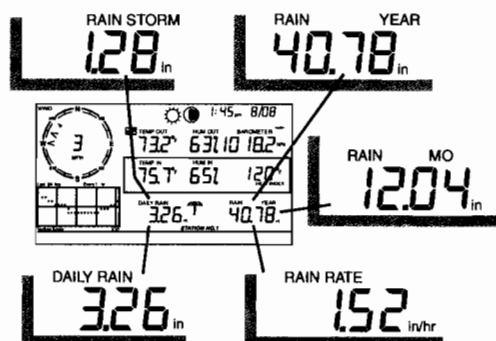
Press 2ND then press HEAT to display the Heat Index.

2nd HEAT
TEMP

THSW Index

After you have selected the Heat Index, press 2ND then press HEAT again to select the Temperature Humidity Sun Wind (THSW) Index. The THSW Index is only available on stations equipped with a solar radiation sensor.

The Heat Index and the THSW Index display in the same place on the screen and are displayed in degrees Fahrenheit (°F) or Celsius (°C).



Daily Rain, Rain Storm, Rain Year, Rain Month, & Rain Rate

Rain Rate

Press RAINYR to display the current rain rate. Rain Rate may be displayed as either inches per hour (in/hr.) or millimeters per hour (mm/hr.). Rain Rate will show zero and the umbrella icon does not appear until two tips of the rain bucket within a 15-minute period.

UV
RAIN

Month-to-date precipitation

Press RAINYR again to select the month-to-date precipitation record. Monthly rain displays the precipitation accumulated since the calendar month began. Month-to-date precipitation is displayed in inches or millimeters (mm).

Selecting Units of Measure

Year-to-date precipitation

Press RAINYR a third time to display the year-to-date precipitation record. Yearly rain displays the precipitation accumulated since the 1st of the month you've chosen as the beginning of your rain season in Setup Mode (See "Screen 13: Rain Season" on page 17). Year-to-date precipitation is displayed in inches (in) or millimeters (mm).

Daily Rain

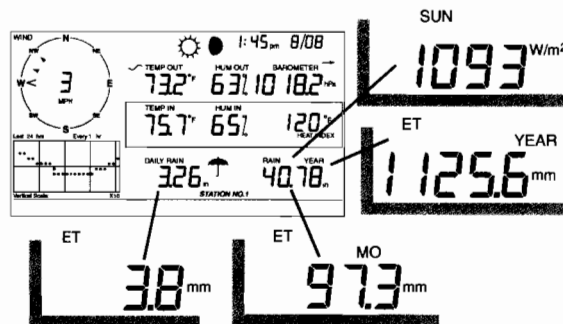
Press RAINDAY to display the rain accumulated since 12 mid-night. Any rain accumulated in the last 24 hours displays in the ticker at the bottom of the screen.

RAIN_{DAY}

Rain Storm

Rain Storm displays the rain total of the last rain event. It takes two tips of the rain bucket to begin a storm event and 24 hours without rain to end a storm event.

Press RAINDAY to toggle between the daily rain total and the Rain Storm total. Rain accumulation may be displayed as either millimeters (mm) or inches (in).



Solar Radiation, Current ET, ET Month & ET Year

Solar Radiation

Press and release 2ND then press SOLAR to display the current solar radiation reading. Solar radiation is displayed as Watts per square meter (W/m^2).

2ND SOLAR RAIN_{DAY}

Current Evapotranspiration (ET)

Press and release 2ND then press ET to display the current evapotranspiration reading.

2ND ET BAR

Monthly Evapotranspiration (ET)

Press 2ND then press ET, then repeat the key sequence to display Monthly ET.

Yearly Evapotranspiration (ET)

Press 2ND then press ET, then repeat this key sequence two more times to display the ET reading since January 1st of the current year.

Note: A solar radiation sensor is required to take readings listed above. See "Optional Sensors" on page 2.

Lamps

Press 2ND then press LAMPS to turn on the backlight for the screen display. Press 2ND then LAMPS again to turn the backlight off.



Use the backlight when the LCD is not clearly visible. When the console is battery operated, the backlight remains on as long as keys are pressed or a ticker tape message is scrolling across the screen. It automatically turns off about ten seconds from the last key press. When battery power is low, the backlight does not light.

Note: When the console receives power from the AC adapter, the backlight remains on until it is toggled off. Leaving the backlight on raises the inside temperature reading and lowers the inside humidity reading.

Displaying the Forecast

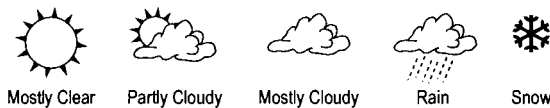
Your console generates a weather forecast based on the barometric reading & trend, wind speed & direction, rainfall, temperature, humidity, latitude & longitude, and time of year. Included in the forecast is a prediction of the sky condition (sunny, cloudy, etc.) and changes in precipitation, temperature, wind direction or wind speed.

Press FORECAST to display the forecast. The forecast ticker message at the bottom of the screen predicts the weather up to 48 hours in advance. The forecast is updated once an hour, on the hour. Predictions are made for cloud cover, temperature trends, the likelihood of precipitation, timing, severity and windy conditions.



Forecast Icons

The forecast icons show the predicted weather for the next 12 hours. If rain and/or snow is possible but not necessarily likely, the partly cloudy icon along with the rain or snow icon displays. When both the rain and snow icons display together, a chance of rain, freezing rain, sleet and/or snow is likely.



Displaying Time & Date or Sunrise & Sunset

Your console shows the sunrise and sunset time in the same place on the screen used by the current time and date.

Press 2ND and then press TIME to toggle the screen between the current time and date or the sunrise and sunset times for the current day.

Note: See "Screen 4: Time & Date" on page 12 to change the console time and date or to select a 12- or 24-hour clock.

Calibrating, Setting, and Clearing Variables

To fine-tune your station, you can calibrate most of the weather variables. For example, if your outside temperature seems consistently too high or too low, you can enter an offset to correct the deviation.

Calibrating Temperature And Humidity

You can calibrate inside & outside temperature, inside & outside humidity, as well as any extra temperature/humidity sensor readings you have transmitting to your Vantage Pro2.

1. Select a variable to be calibrated. See "Selecting Weather Variables" on page 18.
2. Press and release 2ND, then press and hold SET.

After a moment, the variable you've selected begins to blink. Keep holding SET until the Calibration Offset message displays in the ticker.



The ticker displays the current calibration offset.

3. Press the up or down arrows to add or subtract from the temperature offset value.

Inside and outside temperature are calibrated in 0.1° F or 0.1° C increments, up to a maximum offset of +12.7 (°F or °C) and a minimum offset of -12.8 (°F or °C). The variable will change value and the ticker will show the offset you've entered.

4. Press DONE to exit calibration.

Calibrate Wind Direction Reading

You can use this procedure to correct the anemometer reading. This is useful if the anemometer does not point north in your installation.

1. Check the current direction of the wind vane on the anemometer. Compare it to the wind direction reading on the console. If the wind vane is pointing south, for instance, the wind direction reading on the screen should be 180°.
 - If the wind direction reading is greater than 180°, subtract 180 from the reading and subtract the amount of the offset from the wind direction reading.
 - If the wind direction reading is less than 180°, subtract the reading from 180 and add the amount of the offset to the wind direction reading.
2. Press WIND as necessary to display the wind direction in degrees.
3. Press and release 2ND, then press and hold SET.
4. The wind direction variable will begin to blink.

5. Continue holding the key until the CAL message appears in the ticker.

Note: The ticker displays the current wind direction calibration value.

6. Press the arrows to select digits in the anemometer's current reading.
7. Press the up and down arrows to add/subtract from the anemometer reading.
8. Repeat steps 4 and 5 until you have entered the offset value from Step 1.
9. Press DONE to exit calibration.

Calibrating Barometric Pressure

Before calibrating the barometric pressure, be sure the station is set to the correct elevation. See "Screen 10: Elevation" on page 15 for more information.

1. Press BAR to select barometric pressure.
2. Press and release 2ND, then press and hold SET.
The pressure variable blinks.
3. Continue holding the key until the ticker reads "set barometer . . .".
4. Press the right and left arrows to select digits in the variable.
5. Press up and down arrows to add to or subtract from the digit's value.
6. Press DONE to exit calibration.

Setting Weather Variables

You can set values for the following weather variables:

- **Daily Rain**—Sets the daily rain total. Monthly and yearly rain totals are updated.
- **Monthly Rain**—Sets the current months total rain. Does not affect yearly rain total.
- **Yearly Rain**—Sets the current year's rain total.
- **Daily ET (Evapotranspiration)**—Sets the daily ET total. Monthly and yearly ET totals are updated.
- **Monthly ET**—Sets the current month's ET. Does not affect yearly total.
- **Yearly ET**—Sets the current year's total ET.

To set a weather variable's value:

1. Select the variable you wish to change.
2. Press and release 2ND, then press and hold SET. The variable blinks.
3. Keep holding SET until all digits are lit and only one digit is blinking.
4. Press the right or left arrows to select digits in the value.
5. Press the up and down arrows to add to or subtract from the selected digit.
6. When you are finished, press DONE to exit.

Clearing Weather Variables

The following weather variables can be cleared:

- **Barometer**—Clears any pressure offset used to calibrate the station, and the elevation entry.
- **Wind**—Clears the wind direction calibration.
- **Daily rain**—Clearing the daily rain value is reflected in the daily rain total, the last 15 minutes of rain, the last three hours of rain sent to the forecast algorithm, the umbrella icon, and the monthly and yearly rain totals. Clear the daily rain total if the station accidentally recorded rain when the ISS was installed.
- **Monthly rain**—Clears the monthly rain total. Does not affect the yearly rain total.
- **Yearly rain**—Clears the yearly rain total.
- **Daily ET**—Clears daily ET and subtracts the old daily ET total from the monthly and yearly ET totals.
- **Monthly ET**—Clears the current monthly ET total. Does not affect the yearly ET total.
- **Yearly ET**—Clears the current yearly ET total.

To clear a single weather variable:

1. Select the weather variable.

See “Selecting Weather Variables” on page 18.

2. Press and release 2ND, then press and hold CLEAR.

The variable you’ve chosen blinks. Keep holding the key until the value changes to zero or, in the case of the barometer, the raw barometer value. Clearing the barometer value also clears the elevation setting.

Clear All Command

This command clears all stored high and low weather data including monthly and yearly highs and lows and clears alarm settings all at once.

1. Press WIND on the console.
2. Press 2ND then press and hold CLEAR for at least six seconds.
3. Release CLEAR when “CLEARING NOW” displays at the bottom of the console’s screen.

Highs and Lows Mode

The Vantage Pro2 records highs and lows for many weather conditions over three different periods: days, months, and years. Except for Yearly Rainfall, all high and low registers are cleared automatically at the end of each period.

For example, daily highs are cleared at midnight, monthly highs are cleared at month-end midnight, yearly highs are cleared at year-end midnight. You may

enter the month that you would like the Yearly Rainfall accumulation to clear. The Yearly Rainfall clears on the first day of the month you chosen. The Yearly High Rain rate clears using the same setting.

The following table lists the high and low modes for all the weather variables:

Weather Variable	High	Low	Day, Time & Date	Month	Year	Additional Information
Outside Temperature	Yes	Yes	Yes	Yes	Yes	
Inside Temperature	Yes	Yes	Yes	Yes	Yes*	
Outside Humidity	Yes	Yes	Yes	Yes	Yes*	
Inside Humidity	Yes	Yes	Yes	Yes	Yes*	
Barometer	Yes	Yes	Yes	Yes	Yes*	
Heat Index	Yes		Yes	Yes	Yes*	
Temp/Hum/Wind/Sun (THSW) Index	Yes		Yes	Yes	Yes*	requires solar radiation sensor
Wind Chill		Yes	Yes	Yes	Yes*	
Wind Speed	Yes		Yes	Yes	Yes	Includes direction
Rainfall Rate	Yes		Yes	Yes	Yes	
Daily Rain			Total	Total	Total	
UV Index	Yes		Yes	Yes**	Yes*	requires UV sensor
Solar Radiation	Yes		Yes	Yes**	Yes*	requires solar radiation sensor
Dew Point	Yes	Yes	Yes	Yes	Yes*	
Evapotranspiration			Total	Total	Total	requires solar radiation sensor
Soil Moisture	Yes	Yes	Yes	Yes**	Yes*	requires soil moisture sensor
Leaf Wetness	Yes	Yes	Yes	No	Yes*	requires leaf wetness sensor

* Only stores the yearly high for the current year.

** Only stores monthly high for the current month.

Weather Data Highs and Lows

Viewing Highs and Lows

1. Press HI/LOW to enter the Highs and Lows mode.

The DAY and HIGHS icons light up and the station displays the highs for all visible fields.

2. Press the up and down arrows to scroll between Day Highs, Day Lows, Month Highs, Month Lows, Year Highs and Year Lows.

The HIGH or LOW icon, as well the DAY, MONTH or YEAR icon lights to display which High/Low screen you've selected.

3. Press the left and right arrows to scroll back and forth through the last 24 values.

Pressing the left arrow displays the previous day's highs. Each time you press the left arrow, the date moves back another day. The 24 dots in the

graph field also represent each of the last 24 days, months, or years; the right-most dot is the present. As you move backward and forward the flashing dot changes to show what value you're looking at.

4. Use the console keys to select a different weather variable.

The console's time displays time of the selected variable's high or low.

5. Press DONE to exit the Highs and Lows mode. The console screen switches to the Current Weather mode.

Alarm Mode

The Vantage Pro2 features more than 30 alarms that can be programmed to sound whenever a reading exceeds or drops below a set value. With the exception of barometric pressure and time, all alarms sound when a reading reaches the alarm threshold. For example, if the high outside temperature alarm is set at 65° F, the alarm sounds when the temperature rises to 65.0° F.

When an alarm condition exists, the audible alarm sounds, the alarm icon blinks repeatedly, and an alarm description appears in the ticker at the bottom of the screen. The alarm sounds for a maximum of two minutes if the console is battery-powered, but the icon continues to blink and the message stays in the ticker until you clear the alarm or the condition clears. If you're using the AC adapter, the alarm will continue sounding as long as the condition exists.

The alarm will sound again for each new alarm. If more than one alarm is active, the description for each active alarm cycles onto the screen every four seconds. A "+" symbol appears at the end of the alarm text if more than one alarm is tripped.

Low alarms work the same way. For example, if the wind chill threshold is set for 30°F, the alarm condition begins when the wind chill drops to 30° and will continue until the wind chill rises above 30°.

Four Special Alarms

ET (Evapotranspiration)

ET is updated only once an hour, on the hour. If during a given hour the ET Value exceeds the alarm threshold, the ET alarm sounds at the end of that hour. This is true for daily, monthly, and yearly ET alarms. You must have the optional Solar Radiation Sensor to use this alarm. See "Evapotranspiration (ET)" on page 46. for a description of this variable.

Barometric Pressure

The Vantage Pro2 allows you to set two barometric pressure alarms: a "rise" alarm and a "fall" alarm. You may select any rate of change per three hours between 0.00 and 0.25 inches (6.35 mm) Hg, (8.5 mb, hPa); the alarm will

sound if the rate of change (in either direction) exceeds the threshold you set. This alarm is updated every 15 minutes.

Time

The time alarm is a standard “alarm clock” alarm. It sounds for one minute at the set time. Make sure you choose AM or PM, if you’re in 12-hour mode.

UV Dose

The UV dose alarm sounds when the accumulated UV dose has exceeded the dose you set. The UV dose alarm does not arm unless the initial UV dose for the day has been reset. Once the UV dose alarm value is set, clear the accumulated UV dose. See “Clearing Weather Variables” on page 27.

Setting Alarms

1. Press ALARM to enter the Alarm Mode to view or set the high alarm thresholds. The screen displays the current high alarm thresholds. The ALARM and HIGHS icons also appear.
2. Press the right and left arrows to select one of the variables displayed on the screen or use the console keys to select any weather variable. Also, press HI/LOW to display the toggle between the high and low alarm threshold settings.
3. Press 2ND then press ALARM to activate the currently selected weather variable.
4. Press the right and left arrows to select digits in the threshold value.
5. Press the up and down arrows to change the digit’s value up and down.
6. Press DONE to finish changing the alarm setting.
7. Repeat steps 3 through 6 to change additional alarm settings.
8. Press DONE to exit Alarm Mode.

Setting the Time Alarm

1. Press ALARM to enter alarm mode.
The ALARM and HIGHS icons appear.
2. Press 2ND, then press TIME, then press 2ND again, and then press ALARM.
The time field begins blinking.
3. Press the left and right arrows to select hours, minutes, or AM/PM.
4. Press up and down arrows to change the digit’s value up and down.
5. Press DONE to exit Alarm Mode.

Clearing Alarm Settings

1. Press ALARM to enter alarm mode.
The ALARM and HIGHS icons appear.

Graph Mode

2. Select the alarm setting you wish to clear.
3. Press 2ND, then press and hold CLEAR until the setting changes to all dashes.

You have cleared the alarm setting.

4. Press DONE to exit Alarm Mode.

Silencing Alarms

1. Press DONE to silence an alarm when it sounds.

Vantage Pro2 Station Alarms

Variable	Alarms
Barometric Pressure Trend	Storm Warning - uses trend value rising rate Storm Clearing - uses trend value falling rate
Evapotranspiration	ET Alarm - uses total ET for the day
Humidity, Inside	High and Low
Humidity, Outside	High and Low
Dew Point	High and Low
Leaf Wetness	High and Low
Rain	Flash Flood Alarm - uses current 15 minute rainfall total 24 Hour Rain Alarm - uses current 24 hour rainfall total
Storm	Storm Alarm - uses current storm rainfall total
Rain Rate	High
Soil Moisture	High and Low
Solar Radiation	High
Inside Temperature	High and Low
Outside Temperature	High and Low
Extra Temperature	High and Low
Heat Index Temperature	High
THSW Index Temperature	High
Wind Chill Temperature	Low
UV Radiation Index	High
UV Radiation MED	High - uses the current total if variable has been reset
Wind Speed	High
Time & Date	Yes - the alarm sounds for 1 minute.

Graph Mode

The Vantage Pro2 console includes a powerful Graph Mode that allows you to view over 100 graphs of different kinds right on the screen, all without connecting to a personal computer.

Viewing Graphs

Although the graphs available may vary for each weather variable, you display the graphs in the same way.

1. Select a variable to graph.

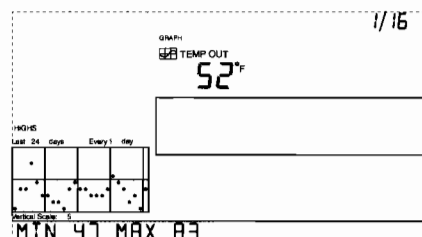
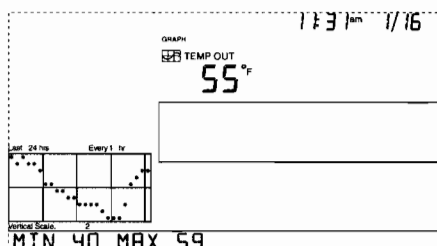
Only the date, graph, graph icon, and selected variable are visible. The rest of the screen is blank.

2. Press GRAPH to enter Graph Mode.

Values for the each of the last 24 hours are displayed in the graph, each hour represented by a dot. The dot at right end of the graph is the value for the current hour. You'll notice that the dot is blinking.

3. Press the left arrow and the second dot from the right starts to blink.
The screen displays the new dot's value. The time display shows what hour of the last 24 is being viewed.
4. Press the left and right arrows to view the variable's values for each of the last 24 hours. The console also displays the maximum and minimum temperatures recorded in the last 24 hours.
5. Press the up and down arrows to shift the graph's time span.

If you press the down arrow, the graph shifts from the last 24 hours to the last 24 days. Now each dot represents the high recorded on the day shown in the date field. To see the lows recorded in the last 24 days, press HI/LOW. Press the left and right arrows to move between days.



By pressing the down arrow again, the graph shifts to show the highs of the last 24 months. As before, use the right and left arrows to move between months. Press HI/LOW to shift between the highs and lows.

By pressing the down arrow again, the graph shifts one more time to show the highs of the last 24 years. Press HI/LOW to shift between highs and lows.

The console beeps when you've reached the first or last possible value or time span for the graph. Since the console only graphs data collected by the station, the graphs can only show data collected since the station was first installed.

Graph Mode

View graphs of all other variables the same way.

1. Select the variable you want to view.
2. Press GRAPH.
3. Use the left and right arrows to select different variables.
4. Press the up arrow to shorten the time range.
5. Press the down arrow to lengthen the time range.
6. Press HI/LOW to shift between highs and lows.
7. Press DONE to exit.

Vantage Pro2 Console Graphs

Weather Variable	Available Graphs*							
	Current	1 Min	10 Min	15 Min	Hourly	Daily	Monthly	Yearly
Barometric Pressure	C			C	C	H, L	H, L	
Evapotranspiration (ET)**	T				T	T	T	T
Humidity, Inside	C				C	H, L	H, L	
Humidity, Outside	C				C	H, L	H, L	
Dew Point	C				C	H, L	H, L	
Leaf Wetness***	C				C	H, L		
Rain	T			T	T	T	T	T
Storm****								
Rain Rate	H	H			H	H	H	H
Soil Moisture	C				C	H, L		
Solar Radiation**	A				A	H		
Inside Temperature	C				C	H, L	H, L	
Outside Temperature	C				C	H, L	H, L	H, L
Heat Index Temperature	C				C	H	H	
Temp/Hum/Sun/Wind (THSW) Index**	C				C	H	H	
Wind Chill Temperature	L				L	L	L	
UV Radiation Index*****	A				A	H	C	
UV Radiation MED (Minimal Erythral Dose)*****	T				T	T		
Wind Speed	A		A		A, H	H	H	H
Direction of High Wind Speed	Y					Y	Y	Y
Dominant Wind Direction	A				A	A	A	

* A = Average, H = Highs, L = Lows, T = Totals, Y = Yes, C = Current reading at the end of each period

** Requires solar radiation sensor, *****Requires UV sensor

*** Requires Wireless Leaf & Soil Moisture Temperature station

**** Graphs the last 24 storm events and doesn't follow the same graph conventions as other variables.

Chapter 4

Troubleshooting and Maintenance

Vantage Pro2 Troubleshooting Guide

While your Vantage Pro2 weather station is designed to provide years of trouble-free operation, occasional problems may arise. If you are having a problem with your station, please consult this troubleshooting guide before calling Davis technical support. You may be able to quickly solve the problem yourself. Please see "Contacting Davis Technical Support" on page 53.

Note: Refer to the ISS Installation Manual for additional troubleshooting information.

TABLE 4-1: TROUBLESHOOTING GUIDE

	Problem	Solution
Display	Display is blank	Unit is not receiving power. Check the power adapter connections and/or replace batteries.
	Display shows dashes in place of weather data	- ISS not plugged in (cabled station). See ISS manual. - Sensors not transmitting (wireless station). See ISS (or other transmitter) manual. - Console not receiving (wireless station) - See "Troubleshooting Reception Problems" on page 35. - A reading has exceeded the limits indicated in the specifications table. - Calibration numbers may be causing readings to exceed display limits. Check calibration number and adjust if necessary.
	Console is sluggish or does not work at low temperatures	The console and display may not work below 32° F (0° C). Use an External Temperature sensor in low-temperature locations or install the console indoors.
	Display "locks up"	Reset the console by removing AC and battery power then restoring power. If this occurs frequently in an AC-powered console, plug the AC power-adaptor into a surge suppressor.
Humidity	Inside humidity seems too high or too low	Make sure the console is not near a humidifier or de-humidifier. Check calibration number and adjust if necessary. If inside humidity is low, and inside temperature is too high, see "inside temp" below. Also make sure the console backlight is not on.
Wind Speed	Wind speed reading seems too high or too low.	For low readings, remove wind cups and check for friction sources. Check the anemometer location. Is it sheltered from the wind? See ISS manual for additional wind speed troubleshooting information.
	Wind speed reads 0 either all the time or intermittently	The problem may be with the anemometer. Test anemometer by spinning wind cups. Check fields one-b and two-b on diagnostic screen and call technical support.
Dew	Dew Point reading seems too high or too low	Check calibration numbers for temperature. Dew point depends on temperature and outside humidity. Make sure they're working.

TABLE 4-1: TROUBLESHOOTING GUIDE

	Problem	Solution
Temperature	Outside temperature sensor reading seems too high	Check calibration number and adjust if necessary. ISS or temp sensor may need to be relocated. See ISS or other transmitter manual.
	Inside temperature sensor reading seems too high	Move the console out of direct sunlight. Make sure that the console or sensor is not in contact with an exterior wall that heats up in sunlight or when outside temperature rises. Make sure the console or sensor is not near a heater or other internal heat source (lamps, appliances, etc.). Also make sure the console backlight is not on. Check calibration number and adjust if necessary.
	Outside temperature seems too low	Check calibration number and adjust if necessary. Sprinklers may be hitting the ISS radiation shield. Relocate. See ISS manual.
	Inside temperature sensor reading seems too low	Make sure the console or other temperature sensor is not in contact with an exterior wall that cools down when outside temperature drops. Make sure the console or other temperature sensor is not near an air conditioning vent. Check calibration number and adjust if necessary.
Wind Direction	Wind direction reading is dashed out	- Wireless model - check reception. See Reception Problems below. - Cabled model - cable may be faulty. If these steps do not reveal the problem, the anemometer may be faulty. Call technical support for return authorization.
	Wind direction always says north	Usually an ISS problem, especially if outside temperature is dashed out as well. See the ISS manual for troubleshooting information
Chill	Wind chill reading seems too high or too low	Check calibration numbers for temperature. Wind chill depends on temperature and wind speed. Make sure they're working.
Heat	Heat Index reading seems too high or too low	Check calibration numbers for temperature. The heat index depends on temperature and outside humidity. Make sure the sensors are working.
Rain	No rain readings	Make sure cable-tie is removed from rain collector. See the ISS manual.
UV/Solar	Readings are too high	Can be caused by high thin cirrus clouds.
Time	Incorrect times for sunrise and sunset	Check your latitude, longitude, time zone, and daylight savings time settings. Sunrise and sunset times are calculated from the console using all of these settings.

Troubleshooting Reception Problems

While we have tested the Wireless Vantage Pro2 radio extensively, each site and each installation presents its own issues and challenges. Obstructions, particularly metallic ones, often cut down your station's reception distance. Be sure to test reception between the console and ISS, in the locations you intend to install them, before permanently mounting your ISS or other transmitter(s).

The console's reception status displays at the lower right corner of the screen.

- An "X" flashes for every data packet received by the console.
- An "R" displays when the console is trying to re-establish a lost connection. The console tries for 10 minutes to re-establish a connection before going into L Mode. When no data packets have been received for 10 minutes, the console dashes-out any missing sensor readings.
- An "L" displays when the signal is lost. The console stays in this mode for 15 minutes until returned to "R" mode. Enter and exit Setup Mode to force the console into "R" mode, making the console manually exit "L" mode.

Check Console Reception

Enter Setup mode by pressing and holding DONE, then pressing the down arrow at the same time. Wait a few minutes while the console lists all the stations transmitting within range (See "Screen 1: Active Transmitters" on page 10 for more information). If the console does not detect your transmitter, check the following:

- Adjust the console and ISS antennas so that they are in line of sight with each other.
- Reduce the distance between the ISS and the console.
- If the console is directly beneath the ISS, the antennas should be horizontal.
- Try distancing your console from your ISS, at least 10 feet apart.

Refer to the *ISS Installation Manual* or other station manual for instructions on how to check the station for potential transmission problems.

Console Diagnostic Mode

In addition to logging weather data, the console continuously monitors the station's radio reception. You may find this information very helpful, especially when you are choosing locations for your console and ISS.

The Console Diagnostics Mode consists of two screens, the Statistical Diagnostic Screen and the Reception Diagnostic Screen. The Statistical Diagnostic screen applies for both cabled and wireless weather stations. The Reception Diagnostic screen applies only to wireless weather stations and is not accessible to a cabled weather station.

Note: Radio transmission data used by the diagnostic screens clears each day at midnight.

Diagnostic Screen Commands

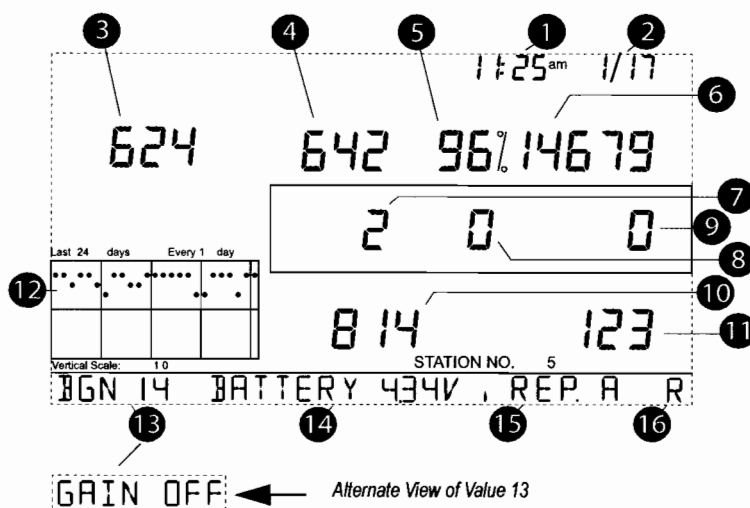
- Press and hold TEMP, then press HUM to display the Statistical Diagnostic screen.
 - Press DONE to exit the diagnostic screen.
 - Press the right arrow to display signal statistics for the next installed transmitter ID.
-

Console Diagnostic Mode

- Press 2ND and then press CHILL to toggle between the Statistical and Reception Diagnostic screens.
- A degree (°) sign displays in right corner of value 1 of the Reception Diagnostic screen (screen 2) to differentiate which screen is currently displayed.

Screen 1: Statistical Diagnostic Screen

The Statistical Diagnostic displays information about how data is being received from the weather station to the console. The information that is displayed in this screen includes:



Screen 1: Statistical Diagnostics Screen

Note: All values with a * mark the value as being for Davis Instruments Internal use. All values with a † mark values that are the same on both the Statistical and Reception Diagnostic screens.

1. Time of day or number of times the anemometer reed switch was seen closed*. The reed switch closes once each revolution of the anemometer wind cups. Press WIND to toggle between these two values.
2. Date or the number of times the anemometer reed switch was seen open*. Press WIND to toggle between these two values.

Note: The time and date displays can be toggled in both statistical and reception diagnostic screens.

3. Number of packets containing CRC errors received. The system runs a CRC check on data packets. Any data packets that don't pass this check are considered to contain errors and are discarded. These are considered bad packets.

4. The total number of bad data packets including missed packets and CRC errors. Missed packets are describes as when a data packet is expected, but is not recognized as a data packet by the console.
5. Percentage of good packets received.
6. Total number of good packets received.
7. Number of times the console resynchronized with the transmitter. The console will attempt to resynchronize with the station after 20 consecutive bad packets.
8. Maximum number of bad packets in a row without resynchronization.
9. Current streak of consecutive bad packets. The counter increments when the console is synchronized but the packet is bad. This value is reset to zero when a good packet is received.
10. Longest streak of consecutive good packets received.
11. Current streak of consecutive good packets received.
12. Graph of the daily percentage of good data packets received over the last 24 days.
13. Background noise level. This refers to the undesirable signal level the console hears while it is in the process of acquiring a signal from a station. The range displayed is from 5 to 60. When the noise level is high, try to move the console closer to the station to get a stronger signal. Small background noise level does not always guarantee good reception. The signal strength between the station and the console needs to be stronger than the background noise level in order for the console to receive clearly. If there are reception problems while a small background noise level is still being displayed, make sure the console is within reasonable range of the station.

If the console currently has acquired all the station signals it is set to receive, the background noise level displayed is the last noise level measurement taken before acquisition finished.

Note: Receiver Gain Status is an alternate view that is displayed for consoles with firmware versions of May 2005 or earlier. For consoles in which background noise level displays, the receiver gain is automatically adjusted to obtain the best sensitivity and does not need to be controlled manually.

Alternate View: Receiver Gain Status. Some versions of the console display receiver gain status and not background noise level. The Receiver Gain setting provides control over the receiver sensitivity. Press HI/LOW to toggle Gain on and off. If you're having trouble with reception, try changing the Gain. Note that Gain can adversely affect performance depending upon conditions. If you are having reception problems, you should try both settings. Gain should generally not be turned on when signal strength is above 30. See Value 4 on page 40 for more information on signal strength.

14. Current console battery voltage. Ignore this value if using the AC Adapter only to power the console.
15. Repeater ID currently communicating with the console. If a repeater or group of repeaters is used to relay station information to the console, the Repeater ID displayed is the repeater that the console is set to receive. If the console is not listening to repeaters, this section remains blank. Please see Application Note 25 available on the Davis Instruments Support web page for more information on using repeaters.

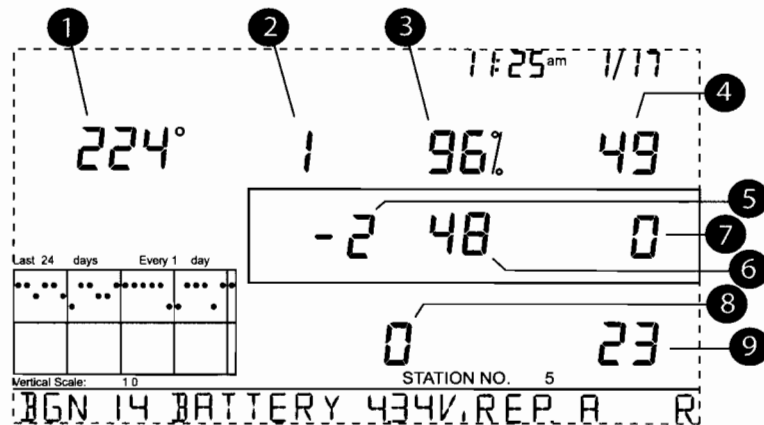
Note: The Repeater ID does not display in the ticker banner in firmware versions earlier than May 2005. If you want your console to support repeater communication, upgrade your console to the most recent console firmware version.

16. The console's reception status. See "Troubleshooting Reception Problems" on page 35 for information on the status types.

Screen 2: Reception Diagnostic Screen

The Reception Diagnostic screen displays information pertinent to the console's wireless reception. To view this screen from the Statistical Diagnostic screen, press 2ND and then press CHILL. The degree sign displaying in the upper left corner next to value 1 verifies that the Reception Diagnostic screen is currently displayed.

The information that is displayed in this screen includes:



Screen 2: Reception Diagnostics Screen

1. 8-bit timer value of next reception.*
2. Radio frequency error of the last packet received successfully. In normal operation, this value is +1, -1, or 0. This value affects the value of #5 on the next page.
3. Percentage of good data packets.†

4. Signal strength of the last packet received. The values displayed in this field should generally be between 20 and 60. If a packet is not received successfully, the signal strength field is dashed out (--).
5. Current frequency correction factor. Shows the Automatic Frequency Control setting.
6. Frequency index of the next packet to be received.*
7. Current number of consecutive bad packets.‡
8. The number of times that the Phase Lock Loop did not lock.*
9. Current streak of consecutive good packets received.‡

Console Firmware Versions

In some cases, the problem may be that your console firmware doesn't support what you are trying to do. Use this command to determine the firmware revision level in your console. You can find more information on Vantage Pro2 console firmware versions and changes in the Weather Software Support section of our website. - for information.

Press and hold DONE then press the up arrow at the same time to display the console firmware version in the ticker at the bottom of the screen.

Console Maintenance

Changing Batteries

Use this procedure to change console batteries without losing any stored weather data or console configuration settings.

1. Plug in the AC adapter or, if the AC adapter is not present, enter Setup Mode by pressing DONE and then the down arrow.
Entering Setup Mode makes sure the station isn't writing any data to memory when power is removed.
2. Remove the battery cover located on the back of the console by pressing down on the two latches at the top of the cover.
3. Place the console face down on a flat, firm surface.
4. Insert a fingertip between the two exposed batteries then press the middle battery down toward the notch (toward the "hidden" battery). This will relieve tension on the first battery and allow you to remove it.
5. Remove the old batteries and install the new batteries.
6. Replace the battery cover and remove the AC power adapter, if used.

One Year Limited Warranty

For details on our warranty policy, please refer to the *Maintenance, Service, and Repair Information* brochure included with your station.

Appendix A

Weather Data

Refer to this appendix to learn more about the weather variables that are measured, displayed, and logged by your Vantage Pro2 Station. Some weather variables require optional sensors. See “Optional Sensors” starting on page 2.

Wind

The anemometer measures wind speed and direction, and is part of the Integrated Sensor Suite (ISS). The console calculates a 10-minute average wind speed and 10-minute dominant wind direction. The 10-minute average wind speed is displayed in the console ticker whenever wind has been selected on the console. The last six 10-minute dominant wind directions are included in the compass rose wind display.

Temperature

The ISS houses the outside temperature sensor in a vented and shielded enclosure that minimizes the solar radiation induced temperature error. The console houses the inside temperature sensor. Additional temperature sensors are available for wireless stations and can measure up to eight locations.

Apparent Temperatures

Vantage Pro2 calculates three apparent temperature readings: Wind Chill, Heat Index, and the Temperature/Humidity/Sun/Wind (THSW) Index. Apparent temperatures use additional weather data to calculate what a human body perceives the temperature to be in those conditions.

Wind chill

Wind chill takes into account how the speed of the wind affects our perception of the air temperature. Our bodies warm the surrounding air molecules by transferring heat from the skin. If there's no air movement, this insulating layer of warm air molecules stays next to the body and offers some protection from cooler air molecules. However, wind sweeps that warm air surrounding the body away. The faster the wind blows, the faster heat is carried away and the colder you feel. Wind has a warming effect at higher temperatures.

Note: The Wind chill is not calculated above 92° F (33° C) for console with firmware version May 2005 or later, or 78° F (26° C) for earlier firmware versions.

Heat Index

The Heat Index uses temperature and the relative humidity to determine how hot the air actually “feels.” When humidity is low, the apparent temperature will be lower than the air temperature, since perspiration evaporates rapidly to cool the body. However, when humidity is high (*i.e.*, the air is more saturated with water vapor) the apparent temperature “feels” higher than the actual air temperature, because perspiration evaporates more slowly.

Note: In console firmware versions May 2005 or later, Heat Index is equal to the air temperature at or below 0° F (-18° C). For console firmware versions earlier than May 2005, Heat Index is equal to the air temperature at or below 57° F (14° C), because the heat index is less significant at lower temperatures. Heat Index values about 135° F (57° C) are approximate.

Temperature/Humidity/Sun/Wind (THSW) Index

The THSW Index uses humidity and temperature like for the Heat Index, but also includes the heating effects of sunshine and the cooling effects of wind (like wind chill) to calculate an apparent temperature of what it “feels” like out in the sun. The THSW Index requires a solar radiation sensor.

Humidity

Humidity itself simply refers to the amount of water vapor in the air. However, the total amount of water vapor that the air can contain varies with air temperature and pressure. Relative humidity takes into account these factors and offers a humidity reading which reflects the amount of water vapor in the air as a percentage of the amount the air is capable of holding. Relative humidity, therefore, is not actually a measure of the amount of water vapor in the air, but a ratio of the air’s water vapor content to its capacity. When we use the term humidity in the manual and on the screen, we mean relative humidity.

It is important to realize that relative humidity changes with temperature, pressure, and water vapor content. A parcel of air with a capacity for 10 g of water vapor which contains 4 g of water vapor, the relative humidity would be 40%. Adding 2 g more water vapor (for a total of 6 g) would change the humidity to 60%. If that same parcel of air is then warmed so that it has a capacity for 20 g of water vapor, the relative humidity drops to 30% even though water vapor content does not change.

Relative humidity is an important factor in determining the amount of evaporation from plants and wet surfaces since warm air with low humidity has a large capacity to absorb extra water vapor.

Dew Point

Dew point is the temperature to which air must be cooled for saturation (100% relative humidity) to occur, providing there is no change in water vapor content. The dew point is an important measurement used to predict the formation of dew, frost, and fog. If dew point and temperature are close together in the late afternoon when the air begins to turn colder, fog is likely during the night. Dew point is also a good indicator of the air’s actual water vapor content, unlike relative humidity, which takes the air’s temperature into account. High dew point indicates high water vapor content; low dew point indicates low water vapor content. In addition a high dew point indicates a better chance of rain, severe thunderstorms, and tornados.

You can also use dew point to predict the minimum overnight temperature. Provided no new fronts are expected overnight and the afternoon relative

humidity is greater than or equal to 50%, the afternoon's dew point gives you an idea of what minimum temperature to expect overnight, since the air can never get colder than the dew point.

Rain

Vantage Pro2 incorporates a tipping-bucket rain collector in the ISS that measures 0.01" for each tip of the bucket. A metric adapter can be installed to measure 0.2 mm for each tip of the bucket. Your station logs rain data in the same units it is measured in and converts the logged totals into the selected display units (inches or millimeters) at the time it is displayed. Converting at display time reduces possible compounded rounding errors over time.

Four separate variables track rain totals: "rain storm," "daily rain," "monthly rain," and "yearly rain." Rain rate calculations are based on the interval of time between each bucket tip, which is each 0.01" rainfall increment or .2 mm.

Barometric Pressure

The weight of the air that makes up our atmosphere exerts a pressure on the surface of the earth. This pressure is known as atmospheric pressure. Generally, the more air above an area, the higher the atmospheric pressure, this means that atmospheric pressure changes with altitude. For example, atmospheric pressure is greater at sea level than on a mountaintop. To compensate for this difference and facilitate comparison between locations with different altitudes, atmospheric pressure is generally adjusted to the equivalent sea level pressure. This adjusted pressure is known as barometric pressure. In reality, the Vantage Pro2 measures atmospheric pressure. When you enter your location's altitude in Setup Mode, the Vantage Pro2 stores the necessary offset value to consistently translate atmospheric pressure into barometric pressure.

Barometric pressure also changes with local weather conditions, making barometric pressure an extremely important and useful weather forecasting tool. High pressure zones are generally associated with fair weather while low pressure zones are generally associated with poor weather. For forecasting purposes, however, the absolute barometric pressure value is generally less important than the change in barometric pressure. In general, rising pressure indicates improving weather conditions while falling pressure indicates deteriorating weather conditions.

Solar Radiation

What we call "current solar radiation" is technically known as Global Solar Radiation, a measure of the intensity of the sun's radiation reaching a horizontal surface. This irradiance includes both the direct component from the sun and the reflected component from the rest of the sky. The solar radiation reading gives a measure of the amount of solar radiation hitting the solar radiation sensor at any given time, expressed in Watts/sq. meter (W/m^2). Solar radiation requires the solar radiation sensor.

UV (Ultra Violet) Radiation

Energy from the sun reaches the earth as visible, infrared, and ultraviolet (UV) rays. Exposure to UV rays can cause numerous health problems, such as sunburn, skin cancer, skin aging, cataracts, and can suppress the immune system. The Vantage Pro2 helps analyze the changing levels of UV radiation and can advise of situations where exposure is particularly unacceptable. UV radiation requires the UV radiation sensor. The Vantage Pro2 displays UV readings in two scales: MEDs and UV Index.

Note: Your station's UV readings do not take into account UV reflected off snow, sand, or water, which can significantly increase your exposure. Nor do your UV readings take into account the dangers of prolonged UV exposure. The readings do not suggest that any amount of exposure is safe or healthful. Do not use the Vantage Pro2 to determine the amount of UV radiation to which you expose yourself. Scientific evidence suggests that UV exposure should be avoided and that even low UV doses can be harmful.

UV MEDs

MED (Minimum Erythral Dose) is defined as the amount of sunlight exposure necessary to induce a barely perceptible redness of the skin within 24 hours after sun exposure. In other words, exposure to 1 MED will result in a reddening of the skin. Because different skin types burn at different rates, 1 MED for persons with very dark skin is different from 1 MED for persons with very light skin.

Both the U.S. Environmental Protection Agency (EPA) and Environment Canada have developed skin type categories correlating characteristics of skin with rates of sunburn.

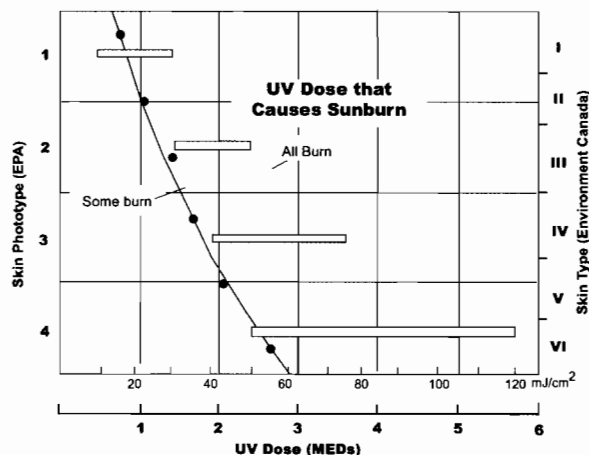
TABLE A-1: EPA SKIN PHOTOTYPES

Skin Phototype	Skin color	Tanning & Sunburn history
1 - Never tans, always burns	Pale or milky white; alabaster	Develops red sunburn; painful swelling, skin peels
2 - Sometimes tans, usually burns	Very light brown; sometimes freckles	Usually burns, pinkish or red coloring appears; can gradually develop light brown tan
3 - Usually tans, sometimes burns	Light tan; brown, or olive; distinctly pigmented	Rarely burns; shows moderately rapid tanning response
4 - Always tans; rarely burns	Brown, dark brown, or black	Rarely burns; shows very rapid tanning response

Table A-2: ENVIRONMENT CANADA SKIN TYPES AND REACTION TO THE SUN^a

Skin Type	Skin Color	History of Tanning & Sunburning
I	White	Always burns easily, never tans
II	White	Always burns easily, tans minimally
III	Light Brown	Burns moderately, tans gradually
IV	Moderate Brown	Burns minimally, tans well
V	Dark Brown	Burns rarely, tans profusely
VI	Black	Never burns, deep pigmentation

a. Developed by T. B. Fitzpatrick of the Harvard Medical School. More about the Fitzpatrick Skin Types is available in: Fitzpatrick TB. Editorial: the validity and practicality of sun-reactive skin types I through VI. Arch Dermatol 1988; 124:869-871



UV Dose and Sunburn - Use this plot to estimate the MED dose leading to sunburn. A person with Type II (Environment Canada) skin type might choose 0.75 MED as the maximum for the day; in contrast, a person with Type V (Environment Canada) Skin Type might consider 2.5 MEDs a reasonable dose for the day. NOTE: the Vantage Pro2 assumes a Fitzpatrick (Environment Canada) Skin Type of II.

UV Index

Vantage Pro2 can also display UV Index, an intensity measurement first defined by Environment Canada and since been adopted by the World Meteorological Organization. UV Index assigns a number between 0 and 16 to the current UV intensity. The US EPA categorizes the Index values as shown in table A-3. The lower the number, the lower the danger of sunburn. The Index value published by the U.S. National Weather Service is a forecast of the next day's noontime UV intensity. The index values displayed by the Vantage Pro2 are real-time measurements.

TABLE A-3: UV INDEX

Index Values	Exposure Category
0 - 2	Low
3 - 4	Moderate
5 - 6	High
7 - 9	Very High
10+	Extreme

Evapotranspiration (ET)

Evapotranspiration (ET) is a measurement of the amount of water vapor returned to the air in a given area. It combines the amount of water vapor returned through evaporation (from wet surfaces) with the amount of water vapor returned through transpiration (exhaling of moisture through plant stomata) to arrive at a total. Effectively, ET is the opposite of rainfall, and it is expressed in the same units of measure (inches, millimeters).

The Vantage Pro2 uses air temperature, relative humidity, average wind speed, and solar radiation data to estimate ET, which is calculated once an hour on the hour. ET requires the optional solar radiation sensor.

Leaf Wetness

Leaf wetness (see “Optional Sensors” on page 2) provides an indication of whether the surface of foliage in the area is wet or dry by indicating how wet the surface of the sensor is. The leaf wetness reading ranges from 0 (dry) to 15. Leaf wetness requires an optional Leaf & Soil Moisture/Temperature Station and is only available for Wireless Vantage Pro2 Stations.

Soil Moisture

Soil Moisture, as the name suggests, is a measure of the moisture content of the soil. Soil moisture is measured on a scale of 0 to 200 centibars, and can help choose times to water crops. The soil moisture sensor measures the vacuum created in the soil by the lack of moisture. A high soil moisture reading indicates dryer soil; a lower soil moisture reading means wetter soil. Soil Moisture requires an optional Leaf & Soil Moisture/Temperature Station or Soil Moisture Station and is only available for Wireless Vantage Pro2 Stations.

Time

A built-in clock and calendar track the time and date. The console automatically adjusts for daylight savings time in most of North America, Europe and Australia (and allows manual adjustment elsewhere) and for leap years.

Appendix B

Specifications

See complete specifications for your Vantage Pro2 Station at our website:
www.davisnet.com.

Console Specifications

Console Operating Temperature	+14° to +140°F (-10° to +60°C)
Display Temperature	+32° to +140°F (0° to +60°C)
Non-operating Temperature	-5° to +158°F (-20° to +70°C)
Console Current Draw	Wireless: 0.9 mA average, 30 mA peak, (add 80 mA for display lamps, add 0.125 mA for each transmitter station received by console) at 4 to 6 VDC Cabled: 10 mA (average), 15 mA (peak) (+80 mA for illuminated display) at 4 to 6 VDC
Power Adapter	5 VDC, 200 mA
Battery Backup	3 C-cells
Battery Life (no AC power)	Wireless: up to 9 months; (Cabled: 1 month (approximately))
Connectors	Modular RJ-11
Housing Material	UV-resistant ABS plastic
Console Display Type	LCD Transflective
Display Backlight	LEDs
Dimensions:	
Console (with antenna)	10.375" x 6.125" x 1.5" (264 mm x 156 mm x 38 mm)
Console (no antenna)	9.625" x 6.125" x 1.5" (244 mm x 156 mm x 38 mm)
Display	5.94" x 3.375" (151 mm x 86 mm)
Weight (with batteries)	1.88 lbs. (.85 kg)

Wireless Communication Specifications

Transmit/Receive Frequency	US Models: 902 - 928 MHz Overseas Models: 868.0 - 868.6 MHz
ID Codes Available	8
Output Power	902 - 928 MHz FHSS: FCC-certified low power, less than 8 mW, no license required 868.0 - 868.6 MHz: CE-certified, less than 8 mW, no license required
Range	
Line of Sight	up to 1000 feet (120 m)
Through Walls	200 to 400 feet (75 to 150 m)

Console Data Display Specifications

Historical Data	Includes the past 24 values listed unless otherwise noted; all can be cleared and all totals reset.
Daily Data	Includes the earliest time of occurrence of highs and lows; period begins/ends at 12:00 am.
Monthly Data	Period begins/ends at 12:00 am on the first of every month.
Yearly Data	Period begins/ends at 12:00 am on January 1 st unless otherwise noted.
Current Data	Current data appears in the right most column in the console graph and represents the latest value within the last period of the graph; totals can be set or reset.
Graph Time Interval	1 min., 10 min., 15 min., 1 hour, 1 day, 1 month, 1 year (user-selectable, availability depends upon variable selected).
Graph Time Span	24 Intervals + Current Interval (see Graph Intervals to determine time span).
Graph Variable Span (Vertical Scale)	Automatic (varies depending upon data range); maximum and minimum value in range appear in ticker.
Alarm Indication	Alarms sound for 2 minutes (time alarm is 2 minute) if operating on battery power. Alarm message displays in ticker as long as threshold is met or exceeded. Alarms can be silenced, but not cleared, by pressing DONE.
Update Interval	Varies with sensor - see individual sensor specs. Also varies with transmitter ID code - 1 = shortest, 8 = longest.
Forecast:	
Variables Used	Barometric reading & trend, wind speed & direction, rainfall, temperature, humidity, latitude & longitude, time of year.
Update Interval	1 hour
Display Format	Icons on top center of display; detailed message in ticker at bottom.
Variables Predicted	Sky condition, precipitation, temperature changes, wind direction and speed changes.

Weather Data Specifications

Weather Data Specifications

Note: These specifications include optional sensors that may not be installed in your Vantage Pro2 Station.

Weather Data Specifications

Variable	Required Sensors	Resolution	Range	Nominal Accuracy (+/-)
Barometric Pressure*	Included in Console	0.01" Hg; 0.1 mm; 0.1 hPa; 0.1 mb	26" to 32" Hg; 660 to 810 mm; 880 to 1080 hPa; 880 to 1080 mb	0.03" Hg; 0.8 mm Hg; 1.0 hPa; 1.0 mb
Barometric Trend (3 hour)		Change Rates Rapidly: $\geq 0.06"$ H; 1.5 mm Hg; 2 hPa; 2 mb Slowly: $\geq 0.02"$ H; 0.5 mm Hg; 0.7 hPa; 0.7 mb	5 Arrow Positions: Rising Rapidly Rising Slowly Steady Falling Slowly Falling Rapidly	
Evapotranspiration (ET)	ISS or Temp/Hum Station & Solar Radiation sensor	0.01"; 0.25 mm	Daily to 99.99"; 999.9 mm Monthly & Yearly to 199.99"; 1999.9mm	greater of 5% or 0.01"; 0.25 mm
Inside Humidity	Included in Console	1%	10 to 90%	5% RH
Outside Humidity	ISS or Temp/Hum Station	1%	0 to 100%	3% RH; 4% above 90%
Extra Humidity	ISS or Temp/Hum Station	1%	0 to 100%	3% RH; 4% above 90%
Dew Point (overall)	ISS or Temp/Hum Station	1°F; 1°C	-105° to +130°F; -76° to +54°C	3°F; 1.5°C
Leaf Wetness	Leaf & Soil Station	1	0 to 15	0.5
Soil Moisture	Leaf & Soil Station or Soil Moisture Station	1 cb	0 to 200 cb	
Daily & Storm Rainfall	Rain Collector	0.01"; 0.25mm	to 99.99"; 999.9 mm	greater of 4% or 1 tip,
Monthly & Yearly Rainfall		0.01"; 0.25mm (1mm at totals over 2000 mm)	to 199.99"; 19,999 mm	greater of 4% or 1 tip
Rain Rate		0.01"; 0.25 mm	to 100"/hr.; 1999.9 mm/hr.	greater of 5% or 0.04"/hr.; 1 mm/hr.

*Barometric pressure readings are standardized to sea level. Elevation Range: -1500' to +15,300'; -460 to +4670 m. Note: The console screen limits display of lower elevation to -999' when using feet as elevation unit.

**This is the reduced value after standardizing to sea level.

Weather Data Specifications

Weather Data Specifications

Variable	Required Sensors	Resolution	Range	Nominal Accuracy (+/-)
Solar Radiation	Solar sensor	1 W/m ²	0 to 1800 W/m ²	5% of full scale
Inside Temperature	Included in Console	0.1°F; 0.1°C	+32° to +140°F; 0 to +60°C	1°F; 0.5°C
Outside Temperature ***	ISS, Temp Station or Temp Hum Station	0.1°F; 0.1°C	-40° to +150°F; -40° to +65°C	1°F; 0.5°C
Extra Temperature	ISS, Temp Station, Temp Hum Station, Leaf Soil Station or Soil Station	1°F; 1°C	-40° to +150°F; -40° to +65°C	1°F (0.5°C)
Heat Index	ISS or Temp/Hum Station	1°F; 1°C	-40° to +135°F; -40° to +57° C	3°F (1.5°C)
Temp-Hum-Sun-Wind index (THSW)	ISS & Solar Radiation	1°F; 1°C	-90° to +135°F; -68° to +64° C	4°F (2°C)
Time	Included in Console	1 min	24 hours	8 sec/Mon.
Date		1 day	month/day	8 sec/Mon.
UV Index	UV Radiation	0.1 Index	0 to 16	5% of full scale
UV Dose		0.1 MED < 20, 1 MED > 20	0 to 199 MEDs	5%
Wind Direction	Anemometer	1°	0 to 360°	7°
Compass Rose		22.5°	16 compass pts	0.3 compass pt
Wind Speed (large cups)		1 mph; 1 kt; 0.5 m/s; 1 km/h	2 to 150 mph; 2 to 130 kts 3 to 241 km/h, 1 to 68 m/s	greater of 2 mph/kts; 1 m/s; 3 km/h or 5%
Wind Speed (small cups)		1 mph; 1 kt; 0.5 m/s; 1 km/h	3 to 175 mph; 3 to 150 kts 1.5 to 79 m/s 5 to 282 km/h	greater of 3mph; 3 kts; 1 m/s; 5km/h or 5%
Wind Chill	ISS	1°F; 1°C	-120° to +130°F -84° to +54°C	2°F; 1°C

***Outside temperature accuracy is based on the temperature sensor itself and not on the sensor and the passive shielding together. The solar radiation induced error for standard ration shield: +4°F (2°C) at solar noon; for fan aspirated radiation shield: +0.6°F (0.3°C) at solar noon (insolation = 1040 W/m², avg. wind speed ≤ 2 mph (1 m/s), reference: RM Young Model 43408 Fan-Aspirated Radiation Shield).

Appendix C

Wireless Repeater Configuration

A Vantage Pro2 Wireless Repeater (#7626, #7627) or Long-Range Wireless Repeater (#7653, #7654) increase transmission distances or improve transmission quality between a station and a console. A repeater receives information transmitted from a Vantage Pro2 station and retransmits it to a console.

Depending on transmission distance, one repeater or several repeaters can be used to collect and retransmit weather data.

All consoles communicating with repeaters must be set up with the correct Transmitter ID and Repeater ID before the console can correctly receive station information.

Note: Not all consoles have the capability for repeater support. If your console has firmware dated earlier than May 2005, it does not have the capability to receive Vantage Pro2 wireless repeaters. To check your console's firmware, press the DONE and up arrow (+) keys. The firmware revision date displays in the ticker tape section of the console. If the console firmware version is older than May 2005, a Vantage Pro2 Updater can be used to update the console. Contact Technical Support about acquiring an Updater for your console. See "Contacting Davis Technical Support" on page 53 for more information.

To set Repeater ID on the console:

1. Press DONE and the down arrow (-) to enter Setup Mode.
2. If Setup Mode has previously been completed, press DONE to display Screen 2: Configuring Transmitter IDs.
3. See "Screen 2: Configuring Transmitter IDs — Wireless Only" on page 10 for more information on configuring Transmitter IDs.

Note: The way the Repeater ID information is accessed depends on the firmware version available on the console. If the firmware is dated May 2005, the Repeater ID is accessed by pressing WIND. If the firmware is dated October 2005, the Repeater ID is accessed by pressing 2ND and WIND. Follow the instructions below based on your console's firmware.

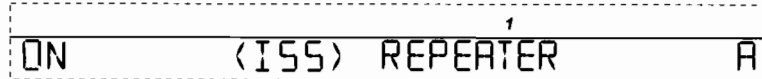
4. For consoles with May 2005 firmware, press WIND to turn the repeater function on and to select a Repeater ID. Pressing WIND sets the console to receive the signal from a repeater instead of directly from a station. The first Repeater ID displayed is repeater A.

For consoles with November 2005 firmware or later, press 2ND and then press WIND to enter Repeater Setup Mode and to select a Repeater ID. Pressing 2ND and WIND sets the console to receive the signal from a repeater instead of directly from a station. Once the console is in the repeater setup mode, subsequent pressing of WIND continue to cycle through the all the repeater IDs.

5. Press WIND repeatedly to cycle through all eight repeater IDs possible or to clear the repeater ID in the right hand corner. When no repeater ID is

shown, the console is configured to listen directly to a station and not to a repeater.

In the example below, the console is set up to receive an ISS station on transmitter ID 1 from repeater A.

A screenshot of a console display within a dashed rectangular border. The display shows the text 'ON (ISS) REPEATER 1 A'. The '1' is positioned above the word 'REPEATER'. The 'A' is at the far right of the line.

6. For each station using a repeater, select the station and turn on the repeater function and select the correct repeater ID.
7. Press DONE to continue to the other screens in the Setup Mode, or press and hold DONE to return to the Current Weather Mode.

Note: In console with the October 2005 version of firmware, the only way to exit Repeater Setup mode is to press DONE to continue to the next setup screen.

Verifying Setup

To verify that you have successfully set up your console to receive a repeater in the console's Current Weather Mode:

1. View the transmitter information displaying at the bottom of the console screen.

If the transmitter ID being repeated is displayed and an "X" flashes in the bottom right corner of the ticker tape, the transmitter is being repeated and received by the console successfully.

The repeater's information also displays at the bottom of the console's diagnostics screens.

Clearing Repeater ID

If a repeater ID is being displayed in Screen 2 and you are not using a repeater with the selected station, you must turn off the repeater function to receive station information successfully.

In Setup Screen 2:

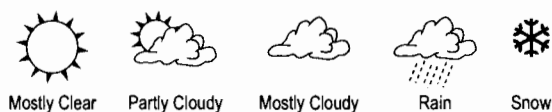
For consoles with May 2005 firmware, press WIND repeatedly so that the console cycles through the list of repeater IDs (Repeaters A-H) until the section where the repeater ID was displayed is blank. Press DONE to continue to the next screen or press and hold DONE to return to the Current Weather Mode.

For consoles with October 2005 firmware, press 2ND and then press WIND repeatedly so that the console cycles through the list of repeater IDs (Repeaters A-H) until the section where the repeater ID was displayed is blank. Press DONE to continue to the next screen or press and hold DONE to return to the Current Weather Mode.

Vantage Pro2 Console Icons

Console icons indicate weather conditions and special functions.

Forecast



Indicates the weather forecast for the next 12 hours.

Moon Phase



Shows the current moon phase. Sequence shown for Northern Hemisphere. Reverse sequence for the Southern Hemisphere.

Alarm Bell

Flashes when an alarm is triggered. Also indicates when the console is in Alarm Mode.



Graph

Appears next to the currently selected weather variable. Also indicates the graphed variable on most screens.



Second Function

Appears when you press 2ND key. Indicates that console key secondary functions are enabled.



Rain

Appears when the console is currently detecting rain.



Barometric Pressure Trend

Arrows show direction of pressure change for last three hours.



Contacting Davis Technical Support

If you have any questions, or encounter problems installing or operating your Vantage Pro 2 weather station, please contact Davis Technical Support. We'll be glad to help.

(510) 732-7814 — Monday - Friday, 7:00 a.m. - 5:30 p.m. Pacific Time. We are unable to accept collect calls.

(510) 670-0589 — Technical Support Fax.

support@davisnet.com — E-mail to Technical Support.

info@davisnet.com — General e-mail.

www.davisnet.com — Davis Instruments web site.

See the Weather Support section for copies of user manuals, product specifications, application notes, and information on software updates. Watch for FAQs and other updates.

Appendix F
Action Level Documentation

[Home](#) › [MRLs](#)

Minimal Risk Levels (MRLs) for Hazardous Substances

Minimal Risk Levels (MRLs) for Hazardous Substances

 [Print MRL List, 43 KB](#)

- › [Narrative](#)
- › [MRL List](#)

Narrative

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [42 U.S.C. 9604 et seq.], as amended by the Superfund Amendments and Reauthorization Act (SARA) [Pub. L. 99 499], requires that the Agency for Toxic Substances and Disease Registry (ATSDR) develop jointly with the U.S. Environmental Protection Agency (EPA), in order of priority, a list of hazardous substances most commonly found at facilities on the CERCLA National Priorities List (NPL) (42 U.S.C. 9604(i)(2)); prepare toxicological profiles for each substance included on the priority list of hazardous substances, and to ascertain significant human exposure levels (SHELs) for hazardous substances in the environment, and the associated acute, subacute, and chronic health effects (42 U.S.C. 9604(i)(3)); and assure the initiation of a research program to fill identified data needs associated with the substances (42 U.S.C. 9604(i)(5)).

The ATSDR Minimal Risk Levels (MRLs) were developed as an initial response to the mandate. Following discussions with scientists within the Department of Health and Human Services (HHS) and the EPA, ATSDR chose to adopt a practice similar to that of the EPA's Reference Dose (RfD) and Reference Concentration (RfC) for deriving substance specific health guidance levels for non neoplastic endpoints. An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure. These substance specific estimates, which are intended to serve as screening levels, are used by ATSDR health assessors and other responders to identify contaminants and potential health effects that may be of concern at hazardous waste sites. **It is important to note that MRLs are not intended to define clean up or action levels for ATSDR or other Agencies.**

The toxicological profiles include an examination, summary, and interpretation of available toxicological information and epidemiologic evaluations of a hazardous substance. During the development of toxicological profiles, MRLs are derived when ATSDR determines that reliable and sufficient data exist to identify the target organ(s) of effect or the most sensitive health effect(s) for a specific duration for a given route of exposure to the substance. MRLs are based on noncancer health effects only and are not based on a consideration of cancer effects. Inhalation MRLs are exposure concentrations expressed in units of parts per million (ppm) for gases and volatiles, or milligrams per cubic meter (mg/m³) for particles. Oral MRLs are expressed as daily human doses in units of milligrams per kilogram per day (mg/kg/day). Radiation MRLs are expressed as external exposures in units of millisieverts.

ATSDR uses the no observed adverse effect level/uncertainty factor (NOAEL/UF) approach to derive MRLs for hazardous substances. They are set below levels that, based on current information, might cause adverse health effects in the people most sensitive to such substance-induced effects. MRLs are derived for acute (1-14 days), intermediate (>14-364 days), and chronic (365 days and longer) exposure durations, and for the oral and inhalation routes of exposure. Currently MRLs for the dermal route of exposure are not derived because ATSDR has not yet identified a method suitable for this route of exposure. MRLs are generally based on the most sensitive substance-induced end point considered to be of relevance to humans. ATSDR does not use serious health effects (such as irreparable damage to the liver or kidneys, or birth defects) as a basis for establishing MRLs. Exposure to a level above the MRL does not mean that adverse health effects will occur.

MRLs are intended to serve as a screening tool to help public health professionals decide where to look more closely. They may also be viewed as a mechanism to identify those hazardous waste sites that are not expected to cause adverse health effects. Most MRLs contain some degree of uncertainty because of the lack of precise toxicological information on the people who might be most sensitive (e.g., infants, elderly, and nutritionally or immunologically compromised) to effects of hazardous substances. ATSDR uses a conservative (i.e., protective) approach to address these uncertainties consistent with the public health principle of prevention. Although human data are preferred, MRLs often must be based on animal studies because relevant human studies are lacking. In the absence of evidence to the contrary, ATSDR assumes that humans are more sensitive than animals to the effects of hazardous substances that certain persons may be particularly sensitive. Thus the resulting MRL may be as much as a hundredfold below levels shown to be nontoxic in laboratory animals.

When adequate information is available, physiologically based pharmacokinetic (PBPK) modeling and benchmark dose (BMD) modeling have also been used as an adjunct to the NOAEL/UF approach in deriving MRLs.

Proposed MRLs undergo a rigorous review process. They are reviewed by the Health Effects/MRL Workgroup within the Division of

Toxicology and Environmental Medicine; an expert panel of external peer reviewers; the agency wide MRL Workgroup, with participation from other federal agencies, including EPA; and are submitted for public comment through the toxicological profile public comment period. Each MRL is subject to change as new information becomes available concomitant with updating the toxicological profile of the substance. MRLs in the most recent toxicological profiles supersede previously published levels. To date, 130 inhalation MRLs, 219 oral MRLs and 8 external radiation MRLs have been derived. A listing of the current published MRLs by route and duration of exposure is provided as follows.

ATSDR Contact Person for MRLs:

Dr. Selene Chou
 Division of Toxicology and Environmental Medicine
 Agency for Toxic Substances and Disease Registry
 1600 Clifton Road, Mailstop F32
 Atlanta, Georgia 30333
 Telephone: 770-488-3357
 E-Mail: SChou@cdc.gov

MRL List

ATSDR Minimal Risk Levels (MRLs) December 2006								
Name	Route	Duration	MRL	Factors	Endpoint	Draft/Final	Cover Date	CAS Number
ACENAPHTHENE	Oral	Int.	0.6 mg/kg/day	300	Hepatic	Final	08/95	000083-32-9
ACETONE	Inh.	Acute	26 ppm	9	Neurol.	Final	05/94	000067-64-1
		Int.	13 ppm	100	Neurol.			
		Chr.	13 ppm	100	Neurol.			
	Oral	Int.	2 mg/kg/day	100	Hemato.			
ACROLEIN	Inh.	Acute	0.003 ppm	100	Resp.	Draft	09/05	000107-02-8
		Int.	0.00004 ppm	300	Resp.			
	Oral	Int.	0.008 mg/kg/day	100	Gastro.			
ACRYLONITRILE	Inh.	Acute	0.1 ppm	10	Neurol.	Final	12/90	000107-13-1
	Oral	Acute	0.1 mg/kg/day	100	Develop.			
		Int.	0.01 mg/kg/day	1000	Repro.			
		Chr.	0.04 mg/kg/day	100	Hemato.			
ALDRIN	Oral	Acute	0.002 mg/kg/day	1000	Develop.	Final	09/02	000309-00-2
		Chr.	0.00003 mg/kg/day	1000	Hepatic			
ALUMINUM	Oral	Int.	1.0 mg/kg/day	30	Neurol.	Draft	09/06	007429-90-5
		Chr.	1.0 mg/kg/day	90	Neurol.			
AMERICIUM	Rad.	Acute	4 mSv/yr	3	Develop.	Final	10/04	007440-35-9
		Chr.	1 mSv/yr	3	Other			
								007664-

AMMONIA	Inh.	Acute	1.7 ppm	30	Resp.	Final	10/04	41-7
		Chr.	0.1 ppm	30	Resp.			
ANTHRACENE	Oral	Int.	10 mg/kg/day	100	Hepatic	Final	08/95	000120-12-7
ARSENIC	Oral	Acute*	0.005 mg/kg/day	10	Gastro.	Draft	09/05	007440-38-2
*provisional		Chr.	0.0003 mg/kg/day	3	Dermal			
ATRAZINE	Oral	Acute	0.01 mg/kg/day	100	Body Wt.	Final	09/03	001912-24-9
		Int.	0.003 mg/kg/day	300	Repro.			
BARIUM, SOLUBLE SALTS	Oral	Int.	0.7 mg/kg/day	100	Renal	Draft	09/05	007440-39-3
		Chr.	0.6 mg/kg/day	100	Renal			
BENZENE	Inh.	Acute	0.009 ppm	300	Immuno.	Draft	09/05	000071-43-2
		Int.	0.006 ppm	300	Immuno.			
		Chr.	0.003 ppm	10	Immuno.			
BERYLLIUM	Oral	Chr.	0.002 mg/kg/day	300	Gastro.	Final	09/02	007440-41-7
BIS(CHLOROMETHYL) ETHER	Inh.	Int.	0.0003 ppm	100	Resp.	Final	12/89	000542-88-1
BIS(2 CHLOROETHYL) ETHER	Inh.	Int.	0.02 ppm	1000	Body Wt.	Final	12/89	000111-44-4
BORON	Oral	Int.	0.01 mg/kg/day	1000	Develop.	Final	07/92	007440-42-8
BROMODICHLOROMETHANE	Oral	Acute	0.04 mg/kg/day	1000	Hepatic	Final	12/89	000075-27-4
		Chr.	0.02 mg/kg/day	1000	Renal			
BROMOFORM	Oral	Acute	0.7 mg/kg/day	100	Hepatic	Final	09/05	000075-25-2
		Int.	0.2 mg/kg/day	300	Hepatic			
		Chr.	0.02 mg/kg/day	3000	Hepatic			
BROMOMETHANE	Inh.	Acute	0.05 ppm	100	Neurol.	Final	09/92	000074-83-9
		Int.	0.05 ppm	100	Neurol.			
		Chr.	0.005 ppm	100	Neurol.			
	Oral	Int.	0.003 mg/kg/day	100	Gastro.			
CADMIUM	Oral	Chr.	0.0002 mg/kg/day	10	Renal	Final	07/99	007440-43-9
CARBON DISULFIDE	Inh.	Chr.	0.3 ppm	30	Neurol.	Final	08/96	000075-15-0
	Oral	Acute	0.01 mg/kg/day	300	Hepatic			

CARBON TETRACHLORIDE	Inh.	Int.	0.03 ppm	30	Hepatic	Final	09/05	000056-23-5
		Chr.	0.03 ppm	30	Hepatic			
	Oral	Acute	0.02 mg/kg/day	300	Hepatic			
		Int.	0.007 mg/kg/day	100	Hepatic			
CESIUM	Rad.	Acute	4 mSv	3	Develop.	Final	10/04	007440-46-2
		Chr.	1 mSv/yr	3	Other			
CHLORDANE	Inh.	Int.	0.0002 mg/m3	100	Hepatic	Final	05/94	000057-74-9
		Chr.	0.00002 mg/m3	1000	Hepatic			
	Oral	Acute	0.001 mg/kg/day	1000	Develop.			
		Int.	0.0006 mg/kg/day	100	Hepatic			
		Chr.	0.0006 mg/kg/day	100	Hepatic			
CHLORDEcone	Oral	Acute	0.01 mg/kg/day	100	Neurol.	Final	08/95	000143-50-0
		Int.	0.0005 mg/kg/day	100	Renal			
		Chr.	0.0005 mg/kg/day	100	Renal			
CHLORFENVINPHOS	Oral	Acute	0.002 mg/kg/day	1000	Neurol.	Final	09/97	000470-90-6
		Int.	0.002 mg/kg/day	1000	Immuno.			
		Chr.	0.0007 mg/kg/day	1000	Neurol.			
CHLORINE DIOXIDE	Inh.	Int.	0.001 ppm	300	Resp.	Final	10/04	010049-04-4
CHLORITE	Oral	Int.	0.1 mg/kg/day	30	Neurol.	Final	10/04	007758-19-2
CHLOROBENZENE	Oral	Int.	0.4 mg/kg/day	100	Hepatic	Final	12/90	000108-90-7
CHLORODIBROMOMETHANE	Oral	Acute	0.1 mg/kg/day	300	Hepatic	Final	09/05	000124-48-1
		Chr.	0.09 mg/kg/day	300	Hepatic			
CHLOROETHANE	Inh.	Acute	15 ppm	100	Develop.	Final	12/98	000075-00-3
CHLOROFORM	Inh.	Acute	0.1 ppm	30	Hepatic	Final	09/97	000067-66-3
		Int.	0.05 ppm	300	Hepatic			
		Chr.	0.02 ppm	100	Hepatic			
	Oral	Acute	0.3 mg/kg/day	100	Hepatic			
		Int.	0.1 mg/kg/day	100	Hepatic			
		Chr.	0.01 mg/kg/day	1000	Hepatic			

CHLOROMETHANE	Inh.	Acute	0.5 ppm	100	Neurol.	Final	12/98	000074-87-3
		Int.	0.2 ppm	300	Hepatic			
		Chr.	0.05 ppm	1000	Neurol.			
CHLORPYRIFOS	Oral	Acute	0.003 mg/kg/day	10	Neurol.	Final	09/97	002921-88-2
		Int.	0.003 mg/kg/day	10	Neurol.			
		Chr.	0.001 mg/kg/day	100	Neurol.			
CHROMIUM(VI), AEROSOL MISTS	Inh.	Int.	0.000005 mg/m3	100	Resp.	Final	09/00	007738-94-5
CHROMIUM(VI), PARTICULATES	Inh.	Int.	0.001 mg/m3	30	Resp.	Final	09/00	018540-29-9
COBALT	Inh.	Chr.	0.0001 mg/m3	10	Resp.	Final	10/04	007440-48-4
	Oral	Int.	0.01 mg/kg/day	100	Hemato.			
	Rad.	Acute	4 mSv	3	Develop.			
		Chr.	1 mSv/yr	3	Other			
COPPER	Oral	Acute	0.01 mg/kg/day	3	Gastro.	Final	10/04	007440-50-8
		Int.	0.01 mg/kg/day	3	Gastro.			
CRESOLS	Oral	Int.	0.1 mg/kg/day	100	Resp.	Draft	09/06	001319-77-3
CYANIDE, SODIUM	Oral	Int.	0.05 mg/kg/day	100	Repro.	Final	07/06	000143-33-9
CYCLOTETRAMETHYLENE TETRANITRAMINE (HMX)	Oral	Acute	0.1 mg/kg/day	1000	Neurol.	Final	09/97	002691-41-0
		Int.	0.05 mg/kg/day	1000	Hepatic			
CYCLOTRIMETHYLENETRINITRAMINE (RDX)	Oral	Acute	0.06 mg/kg/day	100	Neurol.	Final	06/95	000121-82-4
		Int.	0.03 mg/kg/day	300	Repro.			
CYHALOTHRIN	Oral	Acute	0.01 mg/kg/day	100	Gastro.	Final	09/03	068085-85-8
		Int.	0.01 mg/kg/day	100	Gastro.			
CYPERMETHRIN	Oral	Acute	0.02 mg/kg/day	100	Neurol.	Final	09/03	052315-07-8
DDT, P,P'-	Oral	Acute	0.0005 mg/kg/day	1000	Develop.	Final	09/02	000050-29-3
		Int.	0.0005 mg/kg/day	100	Hepatic			
DI(2-ETHYLHEXYL)PHTHALATE	Oral	Int.	0.1 mg/kg/day	100	Repro.	Final	09/02	000117-81-7
		Chr.	0.06 mg/kg/day	100	Repro.			

DI-N-BUTYL PHTHALATE	Oral	Acute	0.5 mg/kg/day	100	Develop.	Final	09/01	000084- 74-2
DI-N-OCTYL PHTHALATE	Oral	Acute	3 mg/kg/day	300	Hepatic	Final	09/97	000117- 84-0
		Int.	0.4 mg/kg/day	100	Hepatic			
DIAZINON	Inh.	Int.	0.01 mg/m3	30	Neurol.	Draft	09/06	000333- 41-5
	Oral	Acute	0.006 mg/kg/day	100	Neurol.			
		Int.	0.002 mg/kg/day	100	Neurol.			
		Chr.	0.0007 mg/kg/day	100	Neurol.			
DICHLOROBENZENE, 1,2-	Oral	Acute	0.7 mg/kg/day	100	Hepatic	Final	07/06	000095- 50-1
		Int.	0.6 mg/kg/day	100	Hepatic			
		Chr.	0.3 mg/kg/day	100	Renal			
DICHLOROBENZENE, 1,3-	Oral	Acute	0.4 mg/kg/day	100	Hepatic	Final	07/06	000541- 73-1
		Int.	0.02 mg/kg/day	100	Endocr.			
DICHLOROBENZENE, 1,4-	Inh.	Acute	2 ppm	10	Ocular	Final	07/06	000106- 46-7
		Int.	0.2 ppm	100	Hepatic			
		Chr.	0.01 ppm	30	Resp.			
	Oral	Int.	0.07 mg/kg/day	100	Hepatic			
		Chr.	0.07 mg/kg/day	100	Hepatic			
DICHLORVOS	Inh.	Acute	0.002 ppm	100	Neurol.	Final	09/97	000062- 73-7
		Int.	0.0003 ppm	100	Neurol.			
		Chr.	0.00006 ppm	100	Neurol.			
	Oral	Acute	0.004 mg/kg/day	1000	Neurol.			
		Int.	0.003 mg/kg/day	10	Neurol.			
		Chr.	0.0005 mg/kg/day	100	Neurol.			
DIELDRIN	Oral	Int.	0.0001 mg/kg/day	100	Neurol.	Final	09/02	000060- 57-1
		Chr.	0.00005 mg/kg/day	100	Hepatic			
DIETHYL PHTHALATE	Oral	Acute	7 mg/kg/day	300	Repro.	Final	06/95	000084- 66-2
		Int.	6 mg/kg/day	300	Hepatic			
DIISOPROPYL METHYLPHOSPHONATE (DIMP)	Oral	Int.	0.8 mg/kg/day	100	Hemato.	Final	10/98	001445- 75-6
		Chr.	0.6	100	Hemato.			

			mg/kg/day					
DISULFOTON	Inh.	Acute	0.006 mg/m3	30	Neurol.	Final	08/95	000298-04-4
		Int.	0.0002 mg/m3	30	Neurol.			
	Oral	Acute	0.001 mg/kg/day	100	Neurol.			
		Int.	0.00009 mg/kg/day	100	Develop.			
		Chr.	0.00006 mg/kg/day	1000	Neurol.			
ENDOSULFAN	Oral	Int.	0.005 mg/kg/day	100	Immuno.	Final	09/00	000115-29-7
		Chr.	0.002 mg/kg/day	100	Hepatic			
ENDRIN	Oral	Int.	0.002 mg/kg/day	100	Neurol.	Final	08/96	000072-20-8
		Chr.	0.0003 mg/kg/day	100	Neurol.			
ETHION	Oral	Acute	0.002 mg/kg/day	30	Neurol.	Final	09/00	000563-12-2
		Int.	0.002 mg/kg/day	30	Neurol.			
		Chr.	0.0004 mg/kg/day	150	Neurol.			
ETHYLBENZENE	Inh.	Int.	1.0 ppm	100	Develop.	Final	07/99	000100-41-4
ETHYLENE GLYCOL	Inh.	Acute	0.5 ppm	100	Renal	Final	09/97	000107-21-1
	Oral	Acute	2.0 mg/kg/day	100	Develop.			
		Chr.	2.0 mg/kg/day	100	Renal			
ETHYLENE OXIDE	Inh.	Int.	0.09 ppm	100	Renal	Final	12/90	000075-21-8
FLUORANTHENE	Oral	Int.	0.4 mg/kg/day	300	Hepatic	Final	08/95	000206-44-0
FLUORENE	Oral	Int.	0.4 mg/kg/day	300	Hepatic	Final	08/95	000086-73-7
FLUORIDE, SODIUM	Oral	Chr.	0.05 mg/kg/day	3	Musculo.	Final	09/03	007681-49-4
FLUORINE	Inh.	Acute	0.01 ppm	10	Resp.	Final	09/03	007782-41-4
FORMALDEHYDE	Inh.	Acute	0.04 ppm	9	Resp.	Final	07/99	000050-00-0
		Int.	0.03 ppm	30	Resp.			
		Chr.	0.008 ppm	30	Resp.			
	Oral	Int.	0.3 mg/kg/day	100	Gastro.			
		Chr.	0.2 mg/kg/day	100	Gastro.			
			0.02					068476-

FUEL OIL NO.2	Inh.	Acute	mg/m3	1000	Neurol.	Final	06/95	30-2
GUTHION	Inh.	Acute	0.02 mg/m3	30	Neurol.	Draft	09/06	000086-50-0
		Int.	0.01 mg/m3	30	Neurol.			
		Chr.	0.01 mg/m3	30	Neurol.			
	Oral	Acute	0.01 mg/kg/day	100	Neurol.			
		Int.	0.003 mg/kg/day	100	Neurol.			
		Chr.	0.003 mg/kg/day	100	Neurol.			
HEPTACHLOR	Oral	Int.	0.0001 mg/kg/day	300	Immuno.	Draft	09/05	000076-44-8
HEXACHLOROBENZENE	Oral	Acute	0.008 mg/kg/day	300	Develop.	Final	09/02	000118-74-1
		Int.	0.0001 mg/kg/day	90	Repro.			
		Chr.	0.00005 mg/kg/day	300	Develop.			
HEXACHLOROBUTADIENE	Oral	Int.	0.0002 mg/kg/day	1000	Renal	Final	05/94	000087-68-3
HEXACHLOROCYCLOHEXANE, ALPHA-	Oral	Chr.	0.008 mg/kg/day	100	Hepatic	Final	09/05	000319-84-6
HEXACHLOROCYCLOHEXANE, BETA-	Oral	Acute	0.05 mg/kg/day	100	Neurol.	Final	09/05	000319-85-7
		Int.	0.0006 mg/kg/day	300	Hepatic			
HEXACHLOROCYCLOHEXANE, GAMMA-	Oral	Acute	0.003 mg/kg/day	300	Develop.	Final	09/05	000058-89-9
		Int.	0.00001 mg/kg/day	1000	Immuno.			
HEXACHLOROCYCLOPENTADIENE	Inh.	Int.	0.01 ppm	30	Resp.	Final	07/99	000077-47-4
		Chr.	0.0002 ppm	90	Resp.			
	Oral	Int.	0.1 mg/kg/day	100	Renal			
HEXACHLOROETHANE	Inh.	Acute	6 ppm	30	Neurol.	Final	09/97	000067-72-1
		Int.	6 ppm	30	Neurol.			
	Oral	Acute	1 mg/kg/day	100	Hepatic			
		Int.	0.01 mg/kg/day	100	Hepatic			
HEXAMETHYLENE DIISOCYANATE	Inh.	Int.	0.00003 ppm	30	Resp.	Final	10/98	000822-06-0
		Chr.	0.00001 ppm	90	Resp.			
HEXANE, N-	Inh.	Chr.	0.6 ppm	100	Neurol.	Final	07/99	000110-54-3
								000302-

HYDRAZINE	Inh.	Int.	0.004 ppm	300	Hepatic	Final	09/97	01-2
HYDROGEN FLUORIDE	Inh.	Acute	0.02 ppm	30	Resp.	Final	09/03	007664-39-3
HYDROGEN SULFIDE	Inh.	Acute	0.07 ppm	27	Resp.	Final	07/06	007783-06-4
		Int.	0.02 ppm	30	Resp.			
IODIDE	Oral	Acute	0.01 mg/kg/day	1	Endocr.	Final	10/04	007553-56-2
		Chr.	0.01 mg/kg/day	1	Endocr.			
IONIZING RADIATION, N.O.S.	Rad.	Acute	4 mSv	3	Neurol.	Final	09/99	HZ1800-45-T
		Chr.	1 mSv/yr	3	Other			
ISOPHORONE	Oral	Int.	3 mg/kg/day	100	Other	Final	12/89	000078-59-1
		Chr.	0.2 mg/kg/day	1000	Hepatic			
JP-4	Inh.	Int.	9 mg/m3	300	Hepatic	Final	06/95	050815-00-4
JP-5/JP-8	Inh.	Int.	3 mg/m3	300	Hepatic	Final	10/98	HZ0600-26-T
JP-7	Inh.	Chr.	0.3 mg/m3	300	Hepatic	Final	06/95	HZ0600-22-T
KEROSENE	Inh.	Int.	0.01 mg/m3	1000	Hepatic	Final	06/95	008008-20-6
MALATHION	Inh.	Acute	0.2 mg/m3	100	Neurol.	Final	09/03	000121-75-5
		Int.	0.02 mg/m3	1000	Resp.			
	Oral	Int.	0.02 mg/kg/day	10	Neurol.			
		Chr.	0.02 mg/kg/day	100	Neurol.			
MANGANESE	Inh.	Chr.	0.00004 mg/m3	500	Neurol.	Final	09/00	007439-96-5
MERCURIC CHLORIDE	Oral	Acute	0.007 mg/kg/day	100	Renal	Final	03/99	007487-94-7
		Int.	0.002 mg/kg/day	100	Renal			
MERCURY	Inh.	Chr.	0.0002 mg/m3	30	Neurol.	Final	03/99	007439-97-6
METHOXYCHLOR	Oral	Int.	0.005 mg/kg/day	1000	Repro.	Draft	09/00	000072-43-5
METHYL PARATHION	Oral	Int.	0.0007 mg/kg/day	300	Neurol.	Final	09/01	000298-00-0
		Chr.	0.0003 mg/kg/day	100	Hemato.			
METHYL-T-BUTYL ETHER	Inh.	Acute	2 ppm	100	Neurol.	Final	08/96	001634-

								04-4
		Int.	0.7 ppm	100	Neurol.			
		Chr.	0.7 ppm	100	Renal			
	Oral	Acute	0.4 mg/kg/day	100	Neurol.			
		Int.	0.3 mg/kg/day	300	Hepatic			
METHYLENE CHLORIDE	Inh.	Acute	0.6 ppm	100	Neurol.	Final	09/00	000075-09-2
		Int.	0.3 ppm	90	Hepatic			
		Chr.	0.3 ppm	30	Hepatic			
	Oral	Acute	0.2 mg/kg/day	100	Neurol.			
		Chr.	0.06 mg/kg/day	100	Hepatic			
METHYLMERCURY	Oral	Chr.	0.0003 mg/kg/day	4	Develop.	Final	03/99	022967-92-6
MIREX	Oral	Chr.	0.0008 mg/kg/day	100	Hepatic	Final	08/95	002385-85-5
N-NITROSODI-N-PROPYLAMINE	Oral	Acute	0.095 mg/kg/day	100	Hepatic	Final	12/89	000621-64-7
NAPHTHALENE	Inh.	Chr.	0.0007 ppm	300	Resp.	Final	09/05	000091-20-3
	Oral	Acute	0.6 mg/kg/day	90	Neurol.			
		Int.	0.6 mg/kg/day	90	Neurol.			
NICKEL	Inh.	Int.	0.0002 mg/m3	30	Resp.	Final	09/05	007440-02-0
		Chr.	0.00009 mg/m3	30	Resp.			
PENTACHLOROPHENOL	Oral	Acute	0.005 mg/kg/day	1000	Develop.	Final	09/01	000087-86-5
		Int.	0.001 mg/kg/day	1000	Repro.			
		Chr.	0.001 mg/kg/day	1000	Endocr.			
PERCHLORATES	Oral	Chr.	0.0007 mg/kg/day	10	Endocr.	Draft	09/05	007778-74-7
PERMETHRIN	Oral	Acute	0.3 mg/kg/day	100	Neurol.	Final	09/03	052645-53-1
		Int.	0.2 mg/kg/day	100	Neurol.			
PHENOL	Inh.	Acute	0.02 ppm	30	Resp.	Draft	09/06	000108-95-2
	Oral	Acute	0.6 mg/kg/day	100	Body Wt.			
PHOSPHORUS, WHITE	Inh.	Acute	0.02 mg/m3	30	Resp.	Final	09/97	007723-14-0
	Oral	Int.	0.0002 mg/kg/day	100	Repro.			

POLYBROMINATED BIPHENYLS (PBBs)	Oral	Acute	0.01 mg/kg/day	100	Endocr.	Final	10/04	036355-01-8
POLYBROMINATED DIPHENYL ETHERS (PBDEs), LOWER BROMINATED	Inh	Int.	0.006 mg/m3	90	Endocr.	Final	10/04	032534-81-9
	Oral	Acute	0.03 mg/kg/day	30	Endocr.			032536-52-0
		Int.	0.007 mg/kg/day	300	Hepatic			
PBDE, DECABROMINATED	Oral	Int.	10 mg/kg/day	100	Develop.	Final	10/04	001163-19-5
POLYCHLORINATED BIPHENYLS (PCBs) (Aroclor 1254)	Oral	Int.	0.03 ug/kg/day	300	Neurol.	Final	11/00	011097-69-1
		Chr.	0.02 ug/kg/day	300	Immuno.			
PROPYLENE GLYCOL DINITRATE	Inh.	Acute	0.003 ppm	10	Neurol.	Final	06/95	006423-43-4
		Int.	0.00004 ppm	1000	Hemato.			
		Chr.	0.00004 ppm	1000	Hemato.			
PROPYLENE GLYCOL	Inh.	Int.	0.009 ppm	1000	Resp.	Final	09/97	000057-55-6
REFRACTORY CERAMIC FIBERS	Inh.	Chr.	0.03 fibers/cc	30	Resp.	Final	10/04	HZ0900-26-T
SELENIUM	Oral	Chr.	0.005 mg/kg/day	3	Dermal	Final	09/03	007782-49-2
STRONTIUM	Oral	Int.	2 mg/kg/day	30	Musculo.	Final	10/04	007440-24-6
STYRENE	Inh.	Chr.	0.06 ppm	100	Neurol.	Final	09/92	000100-42-5
	Oral	Int.	0.2 mg/kg/day	1000	Hepatic			
SULFUR DIOXIDE	Inh.	Acute	0.01 ppm	9	Resp.	Final	12/98	007446-09-5
SULFUR MUSTARD	Inh.	Acute	0.0007 mg/m3	30	Ocular	Final	09/03	000505-60-2
		Int.	0.00002 mg/m3	30	Ocular			
	Oral	Acute	0.5 ug/kg/day	1000	Develop.			
		Int.	0.07 ug/kg/day	300	Gastro.			
TETRACHLOROETHYLENE	Inh.	Acute	0.2 ppm	10	Neurol.	Final	09/97	000127-18-4
		Chr.	0.04 ppm	100	Neurol.			
	Oral	Acute	0.05 mg/kg/day	100	Develop.			
TIN, INORGANIC	Oral	Int.	0.3 mg/kg/day	100	Hemato.	Final	09/05	007440-31-5
TIN, DIBUTYL-	Oral	Int.	0.005 mg/kg/day	1000	Immunol.	Final	09/05	000683-18-1

TIN, TRIBUTYL-	Oral	Int.	0.0003 mg/kg/day	100	Immunol.	Final	09/05	000056-36-9
		Chr.	0.0003 mg/kg/day	100	Immunol.			
TITANIUM TETRACHLORIDE	Inh.	Int.	0.01 mg/m3	90	Resp.	Final	09/97	007550-45-0
		Chr.	0.0001 mg/m3	90	Resp.			
TOLUENE	Inh.	Acute	1 ppm	10	Neurol.	Final	09/00	000108-88-3
		Chr.	0.08 ppm	100	Neurol.			
	Oral	Acute	0.8 mg/kg/day	300	Neurol.			
		Int.	0.02 mg/kg/day	300	Neurol.			
TOXAPHENE	Oral	Acute	0.005 mg/kg/day	1000	Hepatic	Final	08/96	008001-35-2
		Int.	0.001 mg/kg/day	300	Hepatic			
TRICHLOROETHYLENE	Inh.	Acute	2 ppm	30	Neurol.	Final	09/97	000079-01-6
		Int.	0.1 ppm	300	Neurol.			
	Oral	Acute	0.2 mg/kg/day	300	Develop.			
URANIUM, HIGHLY SOLUBLE SALTS	Inh.	Int.	0.0004 mg/m3	90	Renal	Final	09/99	HZ1800-90-T
		Chr.	0.0003 mg/m3	30	Renal			
	Oral	Int.	0.002 mg/kg/day	30	Renal			
URANIUM, INSOLUBLE COMPOUNDS	Inh.	Int.	0.008 mg/m3	30	Renal	Final	09/99	HZ1800-92-T
VANADIUM	Inh.	Acute	0.0002 mg/m3	100	Resp.	Final	07/92	007440-62-2
	Oral	Int.	0.003 mg/kg/day	100	Renal			
VINYL ACETATE	Inh.	Int.	0.01 ppm	100	Resp.	Final	07/92	000108-05-4
VINYL CHLORIDE	Inh.	Acute	0.5 ppm	30	Develop.	Final	07/06	000075-01-4
		Int.	0.03 ppm	30	Hepatic			
	Oral	Chr.	0.003 mg/kg/day	30	Hepatic			
XYLENES, MIXED	Inh.	Acute	2 ppm	30	Neurol.	Draft	09/05	001330-20-7
		Int.	0.6 ppm	90	Neurol.			
		Chr.	0.05 ppm	300	Neurol.			
	Oral	Acute	1 mg/kg/day	100	Neurol.			
		Int.	1 mg/kg/day	300	Neurol.			
		Chr.	0.6 mg/kg/day	300	Neurol.			

ZINC	Oral	Int.	0.3 mg/kg/day	3	Hemato.	Final	09/05	007440-66-6
		Chr.	0.3 mg/kg/day	3	Hemato.			
1-METHYLNAPHTHALENE	Oral	Chr.	0.07 mg/kg/day	1000	Resp.	Final	09/05	000090-12-0
2-METHYLNAPHTHALENE	Oral	Chr.	0.04 mg/kg/day	100	Resp.	Final	09/05	000091-57-6
1,1-DICHLOROETHENE	Inh.	Int.	0.02 ppm	100	Hepatic	Final	05/94	000075-35-4
	Oral	Chr.	0.009 mg/kg/day	1000	Hepatic			
1,1-DIMETHYLHYDRAZINE	Inh.	Int.	0.0002 ppm	300	Hepatic	Final	09/97	000057-14-7
1,1,1-TRICHLOROETHANE	Inh.	Acute	2 ppm	100	Neurol.	Final	07/06	000071-55-6
		Int.	0.7 ppm	100	Neurol.			
	Oral	Int.	20 mg/kg/day	100	Body Wt.			
1,1,2-TRICHLOROETHANE	Oral	Acute	0.3 mg/kg/day	100	Neurol.	Final	12/89	000079-00-5
		Int.	0.04 mg/kg/day	100	Hepatic			
1,1,2,2-TETRACHLOROETHANE	Oral	Int.	0.5 mg/kg/day	100	Hepatic	Draft	09/06	000079-34-5
1,2-DIBROMO-3-CHLOROPROPANE	Inh.	Int.	0.0002 ppm	100	Repro.	Final	09/92	000096-12-8
	Oral	Int.	0.002 mg/kg/day	1000	Repro.			
1,2-DICHLOROETHANE	Inh.	Chr.	0.6 ppm	90	Hepatic	Final	09/01	000107-06-2
	Oral	Int.	0.2 mg/kg/day	300	Renal			
1,2-DICHLOROETHENE, CIS-	Oral	Acute	1 mg/kg/day	100	Hemato.	Final	08/96	000156-59-2
		Int.	0.3 mg/kg/day	100	Hemato.			
1,2-DICHLOROETHENE, TRANS-	Inh.	Acute	0.2 ppm	1000	Hepatic	Final	08/96	000156-60-5
		Int.	0.2 ppm	1000	Hepatic			
	Oral	Int.	0.2 mg/kg/day	100	Hepatic			
1,2-DICHLOROPROPANE	Inh.	Acute	0.05 ppm	1000	Resp.	Final	12/89	000078-87-5
		Int.	0.007 ppm	1000	Resp.			
	Oral	Acute	0.1 mg/kg/day	1000	Neurol.			
		Int.	0.07 mg/kg/day	1000	Hemato.			
		Chr.	0.09 mg/kg/day	1000	Hepatic			
			0.0008					000540-

1,2-DIMETHYLHYDRAZINE	Oral	Int.	mg/kg/day	1000	Hepatic	Final	09/97	73-8
1,2,3-TRICHLOROPROPANE	Inh.	Acute	0.0003 ppm	100	Resp.	Final	09/92	000096-18-4
	Oral	Int.	0.06 mg/kg/day	100	Hepatic			
1,3-DICHLOROPROPENE	Inh.	Int.	0.008 ppm	30	Resp.	Draft	09/06	000542-75-6
		Chr.	0.007 ppm	30	Resp.			
	Oral	Int.	0.04 mg/kg/day	100	Gastro.			
		Chr.	0.03 mg/kg/day	100	Gastro.			
1,3-DINITROBENZENE	Oral	Acute	0.008 mg/kg/day	100	Repro.	Final	06/95	000099-65-0
		Int.	0.0005 mg/kg/day	1000	Hemato.			
1,4-DIOXANE	Inh.	Acute	2 ppm	30	Ocular	Final	07/06	000123-91-1
		Int.	1 ppm	30	Hepatic			
		Chr.	1 ppm	30	Hepatic			
	Oral	Acute	4 mg/kg/day	100	Resp.			
		Int.	0.6 mg/kg/day	100	Hepatic			
		Chr.	0.1 mg/kg/day	100	Hepatic			
2-BUTOXYETHANOL	Inh.	Acute	6 ppm	9	Hemato.	Final	10/98	000111-76-2
		Int.	3 ppm	9	Hemato.			
		Chr.	0.2 ppm	3	Hemato.			
	Oral	Acute	0.4 mg/kg/day	90	Hemato.			
		Int.	0.07 mg/kg/day	1000	Hepatic			
2,3-DICHLOROPROPENE	Inh.	Acute	0.002 ppm	90	Resp.	Draft	09/06	000078-88-6
2,3,4,7,8-PENTACHLORODIBENZOFURAN	Oral	Acute	0.001 ug/kg/day	3000	Immuno.	Final	05/94	057117-31-4
		Int.	0.00003 ug/kg/day	3000	Hepatic			
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	Oral	Acute	0.0002 ug/kg/day	21	Immuno.	Final	12/98	001746-01-6
		Int.	0.00002 ug/kg/day	30	Lymphor.			
		Chr.	0.000001 ug/kg/day	90	Develop.			
2,4-DICHLOROPHENOL	Oral	Int.	0.003 mg/kg/day	100	Immuno.	Final	07/99	000120-83-2
2,4-DINITROPHENOL	Oral	Acute	0.01 mg/kg/day	100	Body Wt.	Final	08/95	000051-28-5
2,4-DINITROTOLUENE	Oral	Acute	0.05 mg/kg/day	100	Neurol.	Final	12/98	000121-14-2
		Chr.	0.002 mg/kg/day	100	Hemato.			

2,4,6-TRINITROTOLUENE	Oral	Int.	0.0005 mg/kg/day	1000	Hepatic	Final	06/95	000118- 96-7
2,6-DINITROTOLUENE	Oral	Int.	0.004 mg/kg/day	1000	Hemato.	Final	12/98	000606- 20-2
4-CHLOROPHENOL	Oral	Acute	0.01 mg/kg/day	100	Hepatic	Final	07/99	000106- 48-9
4,4'-METHYLENEBIS(2-CHLOROANILINE)	Oral	Chr.	0.003 mg/kg/day	3000	Hepatic	Final	05/94	000101- 14-4
4,4'-METHYLENEDIANILINE	Oral	Acute	0.2 mg/kg/day	300	Hepatic	Final	10/98	000101- 77-9
		Int.	0.08 mg/kg/day	100	Hepatic			
4,6-DINITRO-O-CRESOL	Oral	Acute	0.004 mg/kg/day	100	Neurol.	Final	08/95	000534- 52-1
		Int.	0.004 mg/kg/day	100	Neurol.			

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