HAKS

INTERIM REMEDIAL MEASURE (IRM)

AND

REMEDIAL INVESTIGATION ADDENDUM WORK PLAN (RIAWP)

NYSDEC Site #C241168

Prepared For:
77-57 Vleigh Place
Block 6630; Lot 1
Flushing, New York

Prepared By:
HAKS
40 Wall Street, 9th Floor
New York, NY 10005

Prepared On:
1 March 2016

CERTIFICATION

I Tarek Z. Khouri, P.E. certify that I am currently a NYS registered professional engineer as defined in 6 NYCRR Part 375 and that this Interim Remedial Measures (IRM) and Remedial Investigation Addendum Work Plan (RIAWP) was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

Tarek Z. Khouri, P.E.
Name

Signature

TAREK ZAKI KHOURI
086611

1 March 2016
Date

LIST OF ACRONYMS

Acronym	Definition
AWQS	Ambient Water Quality Standards
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
BGS	Below Grade Surface
BN	Base Neutral
CAMP	Community Air Monitoring Plan
C&D	Construction & Demolition
CGI	Combustible Gas Indicator
CPP	Citizen Participation Plan
DCE	Cis-1,2-dichloroethene
DB	Decibels
DUSR	Data Usability Summary Report
ESA	Environmental Site Assessment
ELAP	Environmental Laboratory Accreditation Program
FID	Flame Ionization Detector
EZ	Exclusion Zone
HASP	Health and Safety Plan
MDL	Method Detection Limit
NYC DEP	New York City Department of Environmental Protection
NYS DEC	New York State Department of Environmental Conservation
NYS DOH	New York State Department of Health
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene
PID	Photo Ionization Detector
PM	Particulate Matter
PPE	Personal protective equipment (PPE
QAO	Qualified Assurance Officer
QAPP	Quality Assurance Project Plan
QEP	Qualified Environmental Professional

QHHEA	Qualitative Human Health Exposure Assessment
QEP	Qualified Environmental Professional
REC	Recognized Environmental Condition
QA/QC	Quality Assurance/Quality Control
RIR	Remedial Investigation Report
RIWP	Remedial Investigation Work Plan
SCOs	Soil Cleanup Objectives
SCG	Standards, Criteria and Guidance
SCBA	Self-Contained Breathing Apparatus
SSO	Site Safety Officer
TAL	Full Target Analyte List
TCL	Full Target Compound List
TCE	Trichloroethene
TICs	Tentatively Identified Compounds
TOGS	Technical and Operational Guidance Series
SVOCs	Semi-Volatile Organic Compounds
USCS	Unified Soil Classification System
USGS	United States Geological Survey
VOCs	Volatile Organic Compounds

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1.0 EXECUTIVE SUMMARY

This Interim Remedial Measures and Remedial Investigation Addendum (IRM & RIAWP) has been prepared on behalf of Aldrich Management Co., LLC to document proposed interim remedial measures and additional remedial investigation s for the property located at 77-57 Vleigh Place in Flushing, New York, designated as the "Site". Aldrich Management Co., LLC filed an application to enter into the Brownfield Cleanup Program (BCP) Agreement with the New York State Department of Environmental Conservation (NYSDEC) as a Participant. A Site number C241168 was issued to this BCP project. The Site is occupied by a one-story commercial building housing thirteen (13) tenant spaces on the ground floor and 10 individual basements utilized for storage by tenants. An active dry cleaner identified as Paragon Cleaners occupies one of the tenant spaces. All proposed work presented in this document will be performed in accordance with the New York State Department of Environmental Conservation (NYSDEC) requirements as set forth in its correspondence (Immediate Action Determination) dated February 12, 2016 and via a correspondence dated February 23, 2016.

This document defines the objectives, scope and means of implementation of the IRM & RIAWP.

This IRM & RIAWP addresses several main mitigation and remediation components:

1. Design and installation of individual active ventilation systems in a total of 10 individual basements beneath the building. The ventilation system will consist of a suction pipe in each of the basement spaces connected to a radon fan exhausting air drawn from indoor onto the rooftop of the building.
2. The ventilation system will be coupled with a fresh intake system for each of the 10 individual basements beneath the building.
3. Delineate the presence of chlorinated solvents in soil and groundwater beneath the upgradient southeastern portion of the Site in order to determine the potential source of impact at the Site.
4. Investigate the dry well in the northeastern portion of the common alley.
5. Investigate the potential for soil vapor intrusion impact of chlorinated solvents at the adjacent Steppingstone Day school.

The proposed remedy described in this document will be implemented in accordance with the New York State Department of Environmental Conservation (NYSDEC) requirements under the NYS Brownfield Cleanup Program (BCP). This proposed remedy is consistent with the procedures defined in New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York dated October 2006 guidance and will also comply with all applicable Federal, State and local laws, regulations and requirements. The proposed delineation of chlorinated impact in soil and groundwater will be performed in compliance with the

NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (May 2010) and other acceptable industry standards.

The following sections provide the details and specific information pertaining to the various components of the IRM & RIAWP.

2.0 INTRODUCTION

This Interim Remedial Measures and Remedial Investigation Addendum(IRM & RIAWP) has been prepared for the property located at 77-57 Vleigh Place in Flushing, New York (Site) The Site is occupied by a one-story commercial building housing thirteen (13) tenant spaces on the ground floor and 10 individual basements utilized for storage by tenants. An active dry cleaner identified as Paragon Cleaners occupies one of the tenant spaces. Aldrich Management Co., LLC entered into a Brownfield Cleanup Agreement (BCA) with the New York State Department of Environmental Conservation (NYSDEC) in March 2015, to investigate and remediate this Site as a Participant, under BCP Site number C241168. This IRM & RIAWP provides the protocols and specifications for the proposed interim remedial measures and additional remedial investigation at the Site.

2.1 Site Description

The Site is located in the Flushing section in Queens, New York and is identified as Block 6630 and Lot 1 on the New York City Tax Map. The Site is 39,000-square feet and is bounded by Vleigh Place to the west, a 3-story multi-family building to the east, 78th Avenue to the south and 77th Road to north. Currently, the Site consists of an approximately 11,500 square foot one-story commercial building with a full basement and an open yard covered by bare soil and utilized for parking by on-Site tenants. The building houses thirteen (13) tenant spaces on the ground floor and 10 individual basements utilized for storage by tenants. A common alley with exit bilco doors into the rear open yard is located in the rear eastern portion of the basement. **Figure 1** provides a Site location Map. **Figure 2** provides a Site Plan.

2.2 Summary of Previous Work

Hydro Tech performed a Site Remedial Investigation during December 2015 in accordance with NYSDEC-approved Remedial Investigation Work Plan dated July 2015. The purpose of the activities was to fully investigate and characterize the nature and extent of contamination that has migrated or emanated from the Site to off-site locations pursuant to previous environmental assessments and investigations that characterized potential impacts associated with Paragon Cleaners, on-site and off-site. A total of sixteen (16) soil probes designated SP-1 to SP-16, nine (9) monitoring wells designated MW-1 to MW-7D including two (2) monitoring well nests identified as MW-3S, MW-3D,MW-5S and MW-5D (the label "S" signifies "shallow" and the label "D" signifies deep), one (1) groundwater probe designated GP-1, six (6) soil vapor probes designated SV-1 to SV-7 and three (3) sub-slab vapor probes designated SSB-1 to SSB-3 were installed and sampled on-site and off-site. In addition three indoor air samples were collected concurrently with sub-slab vapor samples. **Figure 2** provides the RI sampling locations.

Overall findings of the remedial investigations indicated the groundwater depth beneath the Site was determined to range between 30.08 to 34.14 feet and the groundwater flow direction was determined to be toward the southwest. Tetrachloroetheylene (PCE) occurred in a shallow soil sample (SP-3) beneath the eastern portion of the dry cleaner at a concentration of 14.6 mg/kg, which exceeds the Track 1 Unrestricted Use Soil Cleanup Objective (SCO) but below its track 2 Restricted Commercial Use SCO. Dissolved PCE was detected in all on-site and off-site groundwater samples at concentrations exceeding 6NYCRR Part 703.5 Class GA Groundwater Quality Standards (GQS) with a maximum concentration of 300 ug/L detected in the southeastern upgradient portion of the Site (MW-5D). PCE was detected in off-site monitoring wells at a maximum concentration of 31 ug/L (MW-2). VOCs associated with chlorinated compounds are present in sub-slab and soil vapor beneath the Site and also in indoor air.

PCE was the most abundant compound in on-site soil vapors and occurred at a maximum concentration of 740,000 ug/m^3 in the southeastern portion of the court yard (SV-4). PCE was also detected in the two off-site soil vapors at a maximum concentration of 130 ug/m^3 across the western vicinity of the Site (SV-6.) Trichloroethylene (TCE) ranked the second highest soil vapor compound with a maximum on-site concentration of 26,000 detected in a sub-slab vapor sample in the southern portion of the building (SSB-1). PCE and TCE were also detected in the three basement indoor air samples at maximum concentrations of 1,100 ug/m^3 and 57 ug/m^3. PCE and TCE concentrations in the basement indoor air samples exceeded their respective NYSDOH Guidance values of 30 ug/m^3 and 2 ug/m$^{3.}$

2.3 Environmental Setting

The Site is located in the central portion of Queens County, New York. The elevation of the Subject Property is approximately 77 feet above mean sea level (USGS 7 ½-Minute Jamaica, New York Quadrangle, 1969, Photo revised 1979).

Queens County is located in the western portion of Long Island, which consists of a wedge-shaped mass of unconsolidated deposits that overlie ancient basement rock. The thickness of these deposits ranges from approximately 100 feet on the Island's north shore to approximately 2,000 feet in some portions of the south shore. These deposits contain ground water that is the sole source of drinking water for the Island's over 3.1 million residents.

The major landforms of Long Island of importance to the hydrologic system are the moraines and outwash plains, which originated from glacial activity. The moraines represent the farthest extent of the glacial advances. The moraines consist of till, which is a poorly sorted mixture of sand, silt, clay, gravel and boulders. The till is poor to moderately permeable in most areas. Outwash plains are located to the south of the moraines. The outwash plains were formed by the action of glacial melt water streams, which eroded the headland material of the moraines and laid down deposits of well-sorted sands, silts and gravels. These outwash deposits have a moderate to high permeability.

The **Upper Glacial Aquifer** is the uppermost hydrogeologic unit. This aquifer encompasses the moraine and outwash deposits, in addition to some localized lacustrine, marine, and reworked materials. A relatively high horizontal hydraulic conductivity and a low vertical hydraulic conductivity characterize the outwash plain portion of this unit. Since the water table is situated in the Upper Glacial Aquifer.

The **Magothy Formation** directly underlies the Upper Glacial Aquifer in the vicinity of the site. This formation is a Cretaceous coastal-shelf deposit, which consists principally of layers of sand and gravel with some interbedded clay. This formation ranges from moderate to highly permeable. A clay layer in some parts of Long Island confines the uppermost portion of the aquifer. The Magothy is Long Island's principal aquifer for public water supply. The United States Environmental Protection Agency (USEPA) has classified the Long Island aquifer system as a sole source aquifer.

The **Raritan Formation** is the deepest unit and rests directly above the bedrock units. This formation is comprised of a sand member (**Lloyd Aquifer**) and a clay member (**Raritan Clay**). The Lloyd sand extends southward from Flushing Bay to the Atlantic Ocean. The thickness of the sand member increases to the southeast and ranges in depth from 200 to 800 feet below sea level (from northwest to southeast). The clay member acts as an aquitard confining the lower Lloyd aquifer between the clay and the underlying bedrock.

The groundwater depth beneath the Site ranges between 30.08 to 34.14 feet and the groundwater flow direction was determined to be toward the southwest. Groundwater at the site is not used as potable source.

2.4 Objective & Project Goals

The objective of the IRM & RIAWP is to initiate an immediate remedial measures for the Site in order to mitigate vapor intrusion impacts of chlorinated solvents in the tenant spaces. The scope of the IRM WP will consist of the installation of individual indoor active ventilation systems in all 10 individual basement spaces at the Site. The IRM & RIAWP also presents provisions to delineate the presence of chlorinated solvents in soil and groundwater beneath the upgradient southeastern portion of the Site in order to determine the potential source of impact at the Site and also determine any soil vapor intrusion impact of chlorinated solvents in soil vapor beneath the adjacent Steppingstone Day School. The scope of this IRM & RIAWP will be performed as per a NYSDEC requirement in a correspondence dated February 12 and 23, 2016. **Appendix A** provides the NYSDEC correspondence.

All related portions of the fieldwork associated with the IRM WP will be performed in accordance with a RAWP Health & Safety Plan and at a minimum, in accordance with acceptable industry standards. These acceptable industry standards include, but are not limited to, the ASTM Standard Guide for Phase II Environmental Site Assessments (E 1903-97), the NYSDEC CP-51/Soil Cleanup Guidance (October 2010), the NYSDEC Bureau of Spill Prevention & Response Sampling Guidelines and Protocols (March 1991), the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (May 2010) and the New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York dated October 2006 guidance.

3.0 ORGANIZATIONAL STRUCTURE AND RESPONSIBILITY

The IRM & RIAWP Contractor (Contractor), the Remedial Engineer and New York State regulatory agencies will coordinate together on the implementation of the IRM & RIAWP. The Remedial Engineer has the ultimate responsibility for implementing this IRM & RIAWP for the project and for certifying that the work has been performed in accordance with this Work Plan. NYSDEC and New York State Department of Health (NYSDOH) personnel will provide regulatory oversight of this project. All IRM & RIAWP activities will be implemented in accordance to a Health and Safety Plan (HASP), a Community Air Monitoring Plan (CAMP). **Appendix B** provides a HASP. **Appendix C** provides a Site-specific CAMP.

The Remedial Engineer will be responsible for ensuring that all on-site IRM construction operations are performed per the IRM & RIAWP. The Contractor will manage all communication with regulatory agencies.

The Contractor with oversight by the Remedial Engineer will perform the following components of the IRM:

- Site mobilization involving Site security setup, equipment mobilization, utility mark outs and marking;
- Installation of an active ventilation system at each of the tenant spaces;
- Monitoring of the ventilation systems operational integrity prior to start-up;
- Perform Remedial Investigation Addendum involving installation and sampling of soil probes, monitoring wells, sub-slab vapor probes, and indoor air samples in accordance to the scope of work described in this IRM & RIAWP;
- Investigate the potential for soil vapor intrusion impact of chlorinated solvents at the adjacent Steppingstone Day school;
- Perform Community Air Monitoring Plan (CAMP) during the performance of remedial investigation addendum; and
- Transportation and off-Site disposal of investigation derived waste in DOT approved 55-gallon drums at permitted facilities in accordance with applicable laws and regulations.

All IRM & RIAWP details specified herein will be submitted and approved by NYSDEC and NYSDOH prior to performance of the work. The indoor ventilation systems will be installed and operated under the direct oversight of a NYS-licensed Professional Engineer. The Engineer will perform a final site inspection and document the installation of the system in a Construction Completion Report (CCR). Key personnel and their assigned responsibilities for implementation of the remedial design include:

NYSDEC:
MD Hoque
New York State Department of Environmental Conservation

Division of Environmental Remediation
625 Broadway
Albany, NY 12233
Phone: (516) 402-9475
E-mail:md.hoque@gw.dec.ny.gov

NYSDOH:
Dawn Hettrick
New York State Department of Health
Empire State Plaza, Corning Tower, Room 1787
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Phone: (518) 402-7860
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Remedial Engineer:
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Contractor:
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15 Ocean Avenue, Suite B
Brooklyn, New York 11225
Phone: (718) 636-0800
E-mail: pmatli@hydrotechenvironmental.com

4.0 VENTILATION SYSTEM DESIGN, CONSTRUCTION AND OPERATION PROCEDURES

The following sections detail the ventilation system design, installation and procedures and operation protocols prior and after system start-up.

Figure 3 provides the ventilation system design and details. **Appendix D** provides specification cut sheets of ventilation fan and related components.

4.1 Site Preparation

Preliminary work that will be performed by the Contractor prior to performance of IRM activities will include the following:

Mobilization: Mobilization will be conducted as necessary for each phase of work at the Site. Mobilization includes field personnel orientation, equipment mobilization, marking and utility mark-outs. Each field team member will attend an orientation meeting to become familiar with the general operation of the Site, health and safety requirements, and field procedures.

Utility Marker Layouts, Easement Layouts: The presence of utilities and easements on the Site will be fully investigated prior to the performance of invasive work such as drilling under this plan by using, at a minimum, the One-Call System (811). All invasive activities will be performed in compliance with applicable laws and regulations to assure safety. Utility companies and other responsible authorities will be contacted to locate and mark the locations, and prior to the start of drilling or other operations will retain a copy of the Mark out Ticket. Additionally, a Ground-Penetrating Radar (GPR) survey will be conducted to ensure proper identification of sub-grade utilities or other obstructions. Overhead utilities may also be present within the anticipated work zones. Maintaining a safe distance between overhead power lines and drill rig masts will prevent electrical hazards associated with drilling in the vicinity of overhead utilities. Proper safety and protective measures pertaining to utilities and easements, and compliance with all laws and regulations will be employed during invasive and other work contemplated under this Plan. The integrity and safety of on-Site and off-Site structures will be maintained during drilling or other remedial activity performed under the IRM & RIAWP.

Equipment and Material Staging: Equipment and materials will be stored and staged on-site in a manner that complies with applicable laws and regulations. The locations of proposed equipment and material staging areas, drum storage area and the project manager will define other pertinent remedial management features during the Site preparation activities.

Decontamination: A temporary decontamination pad will be set up at the Site and will be maintained throughout ongoing IRM field activities. The decontamination pad will be used to remove waste from reusable equipment.

Demobilization: Demobilization will include:

- As necessary, restoration of temporary access areas and areas that may have been disturbed to accommodate support areas (e.g., staging areas, decontamination areas, storage areas, temporary water management areas, and access area);
- Removal of sediment from erosion control measures and disposal of materials in accordance with applicable laws and regulations;
- Equipment decontamination, and;
- Equipment will be decontaminated and demobilized at the completion of field activities. Investigation equipment and large equipment (e.g., soil excavator) will be washed at a secluded station as necessary. In addition, all investigation derived waste will be appropriately disposed.

4.2 Ventilation System Design and Installation

In order to implement immediate remedial measures to reduce exposure to chlorinated solvent vapors identified in indoor air at the Site, an active ventilation system will be installed in each of the 10 individual basement spaces present beneath the building at the Site. The active ventilation system will be coupled with an active aeration system to draw fresh air in to the 10 individual basement spaces.

The construction of these ventilation systems at the Site will be performed during normal business hours. Each ventilation system will consist of open-ended 4-inch cast iron pipe, which will exit the indoor space of each of the 10 occupied basement spaces through the rear foundation wall and into the common alley in the eastern portion of the basement as shown on the attached Figure 1-4 of the proposed design. The pipe will be connected to an inline Radonaway fan model RP-145 located in the alley. The underground piping in each system will be routed outdoor through bilco exit doors from the alley to the rear yard and then connected via a 4-inch riser to 1 foot above the rooftop, and 10 feet away from any exhaust or air intake vents. Fans must be fed independently and directly from the main electric panel. The open ended portion of cast iron pipe in indoor spaces shall be covered with rodent screen and the exhaust termination above roof top shall be covered with an elbow and a screen to prevent bird entry.

The active aeration system will consist of open-ended 6-inch cast iron pipe, which will intrude into the indoor space of each of the 10 occupied basement spaces through the rear foundation wall and into the common alley in the eastern portion of the basement. The pipe will be connected to a Tjernlund Duct Booster Fan, located in the basement or in the alley. The location to be decided during installation based on site conditions and as built drawing will be produced to reflect it. The underground piping in each system will be routed outdoor through bilco exit doors from alley to rear yard and then connected via a 6-inch riser to 7 feet above ground level, and 10 feet away from any exhaust or air intake vents. The open ended portion of cast iron pipe in indoor spaces shall be covered with rodent screen and the exhaust termination above roof top shall be covered with elbow and a screen to prevent bird entry.

The system will then be started with 100% applied suction from the fan in order to maximize the air flow drawn from indoor space. System parameters including airflow and organic vapor concentrations at the effluents will be monitored following start-up. Vapor concentrations will be measured with the PID at the effluent. System monitoring will be conducted during the first two days of operation as follows: hourly for 5 consecutive hours on the first day and once on the second day. System monitoring will then be performed 7 days, 14 days, 30 days, and 45 days following the initial 2-day startup period.

Field logs will be completed during the course of system monitoring. A field log will be completed on a daily basis that will describe all field activities including:

- Project number, name, manager, and address;
- Description of field activities;
- Date and time of performed tasks;
- Monitoring equipment;
- Apparent weather conditions (e.g. precipitation, outdoor temperature and wind direction) of the work zone; and
- Record of monitoring data on spreadsheets with all requested parameters and point of measurements.

4.3 Post- System Start-Up Air Sampling Plan

Following the start-up of the aeration/ventilation systems installed at the Site, one indoor air sample will be collected in each of the ten (10) basements tenant spaces. In addition, one (1) ambient air sample will be collected simultaneously with the indoor air samples. For the purpose of this investigation, the indoor air samples will be designated IA-1a, IA-2a, IA-3a and IA-4 to IA-10 and the outdoor air sample will be identified OA-2. The objective of this this sampling is to verify the effectiveness of the installed mitigation system at the Site by investigating the presence of potential levels of chlorinated solvents in indoor air, which were previously detected during the remedial investigation. The sampling will be conducted on day 1, day 3 and day 7, from when the system is up and running.

If the evaluation indicates that chlorinated solvents continue to be present in indoor air at the Site, then additional investigative and/or remedial activities will be considered for modification or expansion of the system following consultation with the NYSDEC.

The air sampling will be conducted in accordance with the New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York (October 2006). Indoor air samples IA-1a, IA-2a and IA-3a will be collected in the same basements, where indoor air samples IA-1, IA-2 and IA-3 were previously collected in the vicinity of former sub-slab vapor points SSB-1, SSB-2 and SSB-3. The remaining indoor air samples will be collected in the remaining basements. Outdoor air sample OA-2 will be collected at an upwind location. Indoor and ambient air sample collection will be conducted 3-5 feet above the ground to represent the breathing zone.

Table 1 - Summary of Proposed indoor Air Sampling Locations and Analyses

Indoor & Outdoor Air Samples	Location	Analysis
IA-1a	Basement in northwestern portion of Site – vicinity of former SSB-1	*VOCs and via EPA Method TO-15
IA-2a	Basement in west-central portion of Site - vicinity of former SSB-2	
IA-3a	Basement in southwestern portion of Site - vicinity of former SSB-3	
IA-4	Basement in southwestern portion of Site	
I-A-5	Basement in southwestern portion of Site	
IA-6	Basement in west-central portion of Site	
IA-7	Basement in west-central portion of Site	
IA-8	Basement in northwestern portion	
IA-9	Basement in northwestern portion	
IA-10	Basement of dry cleaner	
OA-2	Ambient Upwind	

All air samples will be collected utilizing 6 liter pre-cleaned (as certified by the laboratory), passivated and evacuated whole air Summa® Canister. Each air sampling canister will then be connected to a flow control valve set to collect the 6-L sample over a period of 6 hours at a rate of less than 0.2 liter per minute. All Summa Canisters will be labeled and sent to a laboratory certified to perform air analysis in New York State. The air samples will be analyzed for common VOCs via EPA Method TO+15

4.4 General Considerations

- A Site inspection revealed that (1) a dry well covered with a trench drain is located in the northwestern portion common alley, (2) the common alley has a concrete slab that is in poor condition and the rear foundation wall in the alley consists of concrete and stones and (3) each of the 10 individual basement spaces has a rear exit door to the common alley that is not tightly closed. Since these exit doors provide a passage of air from the ally indoor, effort should be made to properly seal any openings in their doors frames.

- All instruments and equipment to be installed per manufacturer's requirements.

- All equipment, electrical panels, and piping of considerable weight loading to be mounted and supported by adequate supports.

- The Engineer or Contractor may modify equipment locations during system installation to allow for ease of movement and access following approval.

- All piping and electrical lines should be routed along walls or overhead or installed along floor unless instructed otherwise by the engineer.

- All piping joints must be carefully cemented.

- All sheet rock and ceiling penetrations should be finished and closed with joint compounds and finished appropriately in accordance with applicable waterproofing and fire codes.

- All buildings occupants have been notified about the potential soil vapor intrusion concerns. They will also be notified (pending approval of the IRM RIAWP) of the installation of the ventilation system as a vapor interim mitigation measure and the system mode of operation. The tenants' notification letters regarding the soil vapor intrusion concerns were delivered by certified mail on February 15 and then again on February 18 (public library address was updated in the February 18 letters), along with the fact sheets. Appendix E provides copies of correspondence that was provided to all tenants present at the Site.

- A sign with a contact number will be clearly posted in the building so that current tenants can contact the Contractor for immediate assistance.

- Appropriate stickers indicating the content of pipes and contact numbers in case of emergency for immediate assistance are mounted on each ventilation system piping in a visible casing.

- The ventilation system will be operated and monitored in accordance to an Operation, Maintenance and Monitoring Plan (OM&M). The OM&M will be submitted along a PE-certified Construction Completion Report. The OM&M

will ensure the system is continuously inspected and maintained for proper operation and integrity.

- The ventilation system will be installed at the site following system design approval by the NYSDEC.

5.0 OPERATION MAINTENANCE AND MONITORING OF THE INDOOR VENTILATION SYSTEM

The proposed ventilation system is considered an immediate but interim remedial measure for the Site. The active ventilation system will be operated and maintained in accordance to Operation, Maintenance and Monitoring Plan (OM&M) as prescribed below:

- Tenants will be notified about the potential soil vapor intrusion concerns, the installation of the ventilation system in their basements as a vapor mitigation measure and the system mode of operation.
- The systems proper operation will be continuously monitored by the site ownership and also by the building occupants.
- Routine maintenance of the system will be required if any part if the system has failed or functioning improperly and/or the air flow is not maintained.

The system will be inspected and its performance certified bi-annually via a Certification Letter Report. This inspection will verify the proper functioning of system Radonaway fan, the fresh air intake fan and the evaluation of individual vapor concentrations at exist from each system utilizing a Photoionization Detector (PID).

The certification letter report will include, at a minimum:

- Date of inspections;
- Personnel conducting inspections;
- Description of the inspection activities performed;
- Any observations, conclusions, or recommendations;
- Copy of any inspection forms;
- Certification of the performance of Engineering Controls and Institutional Controls, as discussed below.
- If changes are needed to the system or controls;
- If compliance with the system operations requirements have been maintained;

6.0 REPORT OF FINDINGS & PROJECT SCHEDULE

6.1 Report of Findings

The final design of the active ventilation system including all modifications will be documented in a Construction Completion Report (CCR). The CCR will be prepared 45 days after system start up and will include post-startup system operational data (flow rate and PID reading). The CCR also include the as-built drawings of the system, plus cut sheets for system component. An OM&M Plan will also be included as an appendix in the CCR. A PE-certification letter report certifying the proper operation and maintenance will be provided on a semi-annual basis in accordance with the OM&M Plan.

6.2 Project Schedule

The proposed IRM & RIAWP activities associated with the construction of the ventilation system will be completed within two weeks following NYSDEC approval of system design.

7.0 OFF-SITE VAPOR INTRUSION IMPACT ASSESSMENT

A vapor intrusion impact assessment will be performed beneath the adjacent building occupied by Steppingstone Day School, which is located across the southwestern vicinity of the Site at 77-40 Vleigh Place. This investigation will be performed as per a NYSDEC requirement, which were communicated verbally via a conference call on February 12, 2016, a correspondence dated February 23, 2016 and it is intended to evaluate whether chlorinated solvents are impacting indoor air in this facility.

In an effort to gain access to pursue the sub-slab vapor investigation off-site, the operator of this adjacent facility will be contacted by telephone and also via written correspondence. When permission to access to the school is granted, an interior inspection of the basement floor will be performed prior to the vapor intrusion investigation in order to determine the appropriate location of at least three (3) sub-slab vapor points, and three (3) indoor air samples.

The vapor intrusion investigation will be conducted in accordance with NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York dated October 2006 guidance. An investigation work plan providing details of the scope of the sub-slab vapor investigation will be submitted to NYSDEC for approval. The findings of this investigation will be documented in an Off-Site Soil vapor Intrusion Investigation Report and will include recommendations for mitigation as per NYSDOH action guidelines, if needed.

Figure 2 provides the location of adjacent Steppingstone Day School property. **Appendix F** provides correspondence to be provided to the executive director of Steppingstone Day School.

8.0 REMEDIAL INVESTIGATION ADDENDUM

The purpose of this section is to document the details and protocols intended to be utilized in the further delineation of soil and groundwater contamination in the southeastern portion of the Site, where a maximum PCE concentration of 740,000 ug/m^3 was detected in SV-4 and a maximum PCE concentration of 300 ug/L was detected in MW-5D. To accomplish this, Hydro Tech will install and sample five soil probes and five monitoring wells utilizing direct-push technology. Select soil and groundwater samples will be analyzed via approved analytical methods, and all laboratory results will be evaluated and documented in a Remedial Investigation Report Addendum. All these activities will be implemented in accordance to a site-specific Health and Safety Plan (HASP) and a Community Air Monitoring Plan (CAMP). No waste characterization samples will be collected from the Site as part of this investigation. **Appendix B** provides a Site-specific HASP. **Appendix C** provides a Site-specific CAMP.

Prior to the performance of the fieldwork, a public utility mark-out will be requested from the New York City-Long Island One-Call Center. All work will be coordinated with representatives of the NYSDEC.

8.1 Soil Probes

Five soil probes designated SP-17 to SP-21 will be installed during the investigation in the southeastern portion of the rear yard and also off-site in the eastern upgradient vicinity of the Site at the Site. Soil probes SP-17 will be installed at the same location as SV-4. Soil probes SP-18 and SP-19 will be installed to north and east of SV-4. Soil probe SP-20 will be installed to the southeast of MW-5. . Soil probe SP-21 will be installed upgradient in the in the sidewalk in the immediate southeast-adjacent vicinity of the Site, approximately 30 feet to the southeast of SP-20. The purpose of these soil probes is to further characterize the potential source of PCE in the area concern in the vicinities of SV-4 and MW-5 in the southeastern portion of the Site and also to ensure that no off-site sources are contributing to PCE contamination beneath the Site.

Table 2 - Summary of Proposed Soil Sampling Locations and Analyses

Soil Probe (SP)	**Location**	**Soil Characterization Depth**	**Analytical Methods**
SP-17	Southeastern portion–location of SV-4	Grade to 35 feet or interface with groundwater	TCL VOCs via EPA Method 8260
SP-18	Southeastern portion–north of SV-4		
SP-19	East-central portion–east of SV-4 area		
SP-20	East-central portion–southeast of MW-5		
SP-21	Southeast-adjacent sidewalk within 30 southeast of SP-20		

All soil probes will be installed utilizing Hydro Tech's probe machine units fitted with Geoprobe® tooling and sampling equipment. The probing machine will install the soil probes utilizing direct-push (hydraulic percussion) technology. **Figure 2** provides the proposed locations of the soil probes.

Soil sampling will comply with NYSDEC DER-10 3.5.2. Soil samples will be collected in all probes at 2-foot intervals utilizing a 4-foot long Macro Core sampler fitted with dedicated acetate liners. The Macro sampler allows for the collection of discrete soil samples. Each sampler will be installed with 1½-inch diameter drill rods.

The probes will be extended to the groundwater interface, which was determined at 35 feet bgs. The soil samples will be placed in clean zip-lock storage bags and characterized in the field by a Hydro Tech geologist. The characterization will consist of field screening for evidence of organic vapors utilizing a Photoionization Detector (PID) with an 11.7eV bulb and soil classification.

Headspace analyses will be conducted on each soil sample by partially filling a zip lock bag and sealing it, thereby creating a void. This void is referred to as the sample headspace. To facilitate the detection of any hydrocarbons contained within the headspace, the container will be agitated for a period of thirty (30) seconds. The probe of the PID will then be placed within the headspace to measure the hydrocarbon concentrations present.

The soil classification will be based upon the Unified Soil Classification System (USCS). The USCS identifies common soil details such as grain size, shape, sorting and color. In addition, any visual or olfactory evidence of hydrocarbons will be identified. Soil probe logs will be generated based upon the soil characterization, along with the PID field screening. **Appendix G** provides a sample boring log.

Soil samples collected from each of the five soil probes for lab analysis will consist of the sample at the groundwater interface, and the sample that contains the greatest level of hydrocarbons above the groundwater interface (if present) based upon the field screening results.

All soil samples will be containerized in laboratory supplied soil jars and appropriately labeled.

8.2 Groundwater Monitoring Wells

A total of five (5) monitoring wells identified as MW-8 to MW-11 will be installed during the investigation. The monitoring wells are intended to further delineate the groundwater quality beneath the southeastern portion of the rear yard in the vicinity of MW-5 and SV-4. Specifically, monitoring well MW-8 will be installed at the same location as SV-4 at SP-17, MW-9 and MW-10 will be installed to the north and east of SV-4 at SP-18 and SP-19 and MW-11 will be installed to the southeast of MW-5 at SP-20.

MW-12 will be installed upgradient in the in the sidewalk in the immediate southeast-adjacent vicinity of the Site, approximately 30 feet to the southeast of MW-11.The screened interval of each monitoring well will consist of 0.010-inch slotted PVC and will be generally situated approximately 5 feet above the groundwater interface and 10 feet below. Previous **Figure 2** provides the proposed location of the monitoring wells.

Table 3 - Summary of Proposed Groundwater Monitoring Well Sampling Locations and Analyses

Monitoring Well (MW)	Location	Analysis
MW-8	Southeastern portion–location of SV-4 at SP-17	TCL VOCs via EPA Method 8260
MW-9	Southeastern portion–north of SV-4 at SP-18	
MW-10	Southeastern portion –east of SV-4 area at SP-19	
MW-11	Southeastern portion –southeast of MW-5 at SP-20	
MW-12	Southeast-adjacent sidewalk within 30 feet south of MW-12	

The monitoring wells will be installed utilizing similar technology to the soil probes (i.e. direct push). All monitoring wells will be constructed of 1-inch diameter PVC. The casing of each well will be appropriately labeled. **Appendix H** provides a sample groundwater monitoring well construction diagram.

All recently and previously installed monitoring wells, i.e. MW-1 through MW-10 will then be monitored and gauged for separate phase product during a onetime event. The monitoring will be performed utilizing a Solinst® 122 Oil/Water Interface Probe (Interface Probe). The Interface Probe can measure depths to water to 0.01 inch. The static depth to water will be measured in each well from the northern portion of the top of casing. If either LNAPL and/or DNAPL are detected during the well monitoring exercise, appropriate samples will be collected for characterization and "finger print analysis" and adequate remedial alternatives will be proposed.

Following the well monitoring, the wells will be surveyed to determine the casing elevations utilizing a David White LT8-300 Transit. A surveyor's rod will be placed on the northern portion of the top of casing and the elevation will be read with the transit. The determination of the casing elevation will allow for the calculation of the groundwater elevation beneath the site, which therefore allows for the determination of the groundwater flow direction. The groundwater elevations will then be imported into a computer-contouring program to determine the site-specific groundwater flow direction.

Groundwater samples will then be obtained from the recently installed monitoring wells, i.e. MW-8 through MW-11, utilizing a low flow pump fitted with dedicated polyethylene tubing.

The monitoring wells will be purged and sampled in accordance to the USEPA's Low Stress/Flow Groundwater Sampling Protocol (SOP #GW0001, Rev. 1996) and following the stabilization of water quality indicator parameters. Sampling of groundwater will occur following the stabilization of the following parameters within in the specified confidence limits: pH, turbidity, specific conductance, ORP/Eh, temperature, and dissolved oxygen. As per the USEPA's Low Stress/Flow Groundwater Sampling Protocol, static depth to water will also be gauged at the conclusion of sampling.

Each groundwater sample will then be placed into laboratory supplied containers and appropriately labeled.

8.3 Drywell Investigation

The drywell located in the northwestern portion of the common alley of the basement at the Site will be assessed as a potential source of contamination beneath the property. One (1) sediment sample designated DW-1 will be collected one foot beneath the bottom of the drywell. The sediment sample will be screened for organic vapors and properly characterized and containerized similar to soil samples discussed in Section 8.1.

Table 4 - Summary of Proposed Dry Well Sampling Location and Analyses

Monitoring Well (MW)	Drywell Location	Analysis
DW-1	Northwest of common alley	TCL VOCs via EPA Method 8260

8.4 Field Management of Investigation Derived Waste

Soil and Groundwater Sampling

-Soil cuttings generated during soil probe installation and sampling will be placed in one 55-gallon drum and properly disposed of.

-Fluids generated during groundwater sampling and equipment decontamination will be contained in the 55-gallons drum and properly disposed of as hazardous waste.

-Fine grade sand will be applied to direct any runoff water away from the boreholes in order to avoid any discharges of unknown surface contaminants into the subsurface soil and groundwater. The sand will be disposed of into the 55-gallon drum along the soil cuttings.

-All boreholes will be back-filled with fine grade sand and properly sealed in surface with a layer of slurry and native shallow dirt.

8.5 Laboratory Analytical Methods

As indicated in **Table 1** and **Table 2** all soil and groundwater samples will be analyzed for volatile organic compounds (VOCs) via EPA Method 8260.

8.6 Quality Assurance/Quality Control

A Hydro Tech Quality Assurance Officer (QAO) (Mark Robbins) will adopt a Quality Assurance Project Plan (QAPP) during the collection of soil, groundwater and soil vapor samples in order to ensure that proper procedures are performed and subsequently followed during sample collection and analysis. The QAPP for this investigation is provided in **Appendix I**.

9.0 REPORT OF FINDINGS

The as built drawings of the active ventilation system will be documented in a Construction Completion Report (CCR). The report will be prepared 45 days after system start up. This report will include post-startup system operational data (flow rate and PID reading).

A Remedial Investigation Report (RIR) Addendum will be prepared following the completion of the fieldwork and the laboratory analyses. This report will be certified by a QEP as per DER-10 Table 1.5 and will contain the findings and conclusions of the additional subsurface investigation and will include appropriate maps and diagrams, tabulations of all analytical data, written narratives, boring logs and well construction diagrams, well purging and sampling logs, and appendices.

The soil quality results will be compared to the 6 NYCRR Part 375 Unrestricted Residential Use, Restricted Residential Use and Commercial Use (SCOs). The groundwater quality results will be compared to the AWQS documented in NYSDEC's Technical and Operational Guidance Series (TOGS) 1.1.1. All soil samples that exceed their respective soil cleanup objectives (SCOs) and groundwater samples that exceed the Ambient Water Quality Standards (AWQS) will be highlighted in tables and shown on spider diagrams. The RIR Addendum will include the Data Usability Summary Report.

All data will also be submitted electronically to NYSDEC through the Environmental Information Management System, using the standardized electronic data deliverable (EDD) format.

9.1 Anticipated Project Schedule

A tentative schedule for the performance of the interim remedial measure and RI addendum is provided in **Appendix J**. This schedule is tentative based upon the approval of this IRM RIWP by the NYSDEC.

10.0 REFERENCES

- Standard Practice for Environmental Site Assessments: Phase II Environmental Site Assessment Process, ASTM E 1527-05, American Society for Testing and Materials, West Conshohocken, PA.
- New York State Department of Environmental Conservation Final Policy, CP-51/Soil Cleanup Guidance, October 21, 2010.
- NYSDOH. 2006. Final – Guidance for Evaluating Soil Vapor Intrusion in the State of New York. New York State Department of Health, Center for Environmental Health, Bureau of Environmental Exposure Investigation.
- USEPA. 2001. Draft – A Standard EPA Protocol for Characterizing Indoor Air Quality in Large Buildings. U.S. Environmental Protection Agency, Office of Air and Radiation, Washington, DC.
- USEPA. 1997. Engineering Forum Issue Paper: Soil Vapor Extraction Implementation Experiences, Quick Reference Fact Sheet. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response.
- USEPA. 1994. Radon Prevention in the Design and Construction of Schools and Other Large Buildings. U.S. Environmental Protection Agency, Office of Research and Development.
- USEPA. 1993. Radon Reduction Techniques for Existing Detached Houses – Technical Guidance (Third Edition) for Active Soil Depressurization Systems. U.S. Environmental Protection Agency, Office of Environmental Engineering and Technology Demonstration, Office of Research and Development
- Environmental Property Assessment, Merritt Engineering Consultants, P.C., 77-39 to 77-63 Vleigh Place, Flushing, NY, July 16, 1993.
- Phase I Environmental Site Assessment Report, Middleton, Konekosta Associates., Ltd., 77-39 to 77-63 Vleigh Place, Flushing, NY, July 22, 1999.
- Phase I Environmental Site Assessment, Environmental Affiliates, Inc., 77-39 to 77-63 Vleigh Place, Flushing, NY, August 6, 2013.
- Phase II Environmental Site Assessment (ESA), Hydro Tech Environmental, Corp., 77-39 to 77-63 Vleigh Place, Flushing, NY, October 15, 2013.
- Focused Subsurface Investigation, Hydro Tech Environmental, Corp., 77-57 Vleigh Place, Flushing, NY, February 14, 2014.
- Focused Subsurface Investigation, Hydro Tech Environmental, Corp., 77-57 Vleigh Place, Flushing, NY, August 19, 2014.
- Subsurface Investigation, Hydro Tech Environmental, Corp., 77-57 Vleigh Place, Flushing, NY, January 15, 2015.
- Subsurface Investigation, Hydro Tech Environmental, Corp., 77-57 Vleigh Place, Flushing, NY, April 6, 2015.
- Remedial Investigation Work Plan, Hydro Tech Environmental, Corp., 77-57 Vleigh Place, Flushing, NY, July 14, 2015.
- Draft Remedial Investigation Report, Hydro Tech Environmental, Corp., 77-57

Vleigh Place, Flushing, NY, January 29, 2016.

- NYSDEC Correspondence, NYSDEC Site No. C241168, February 11 and February 23, 2016.

Figures 1 and 2

Document Path: D:\GIS\Projects\S-Z\UPC\1404\mapfiles\ProjectSite_AdjacentProperties.mxd

DRAWING PREPARED FOR:

REVISION	DATE	INITIAL	COMMENTS

DRAWING INFORMATION:

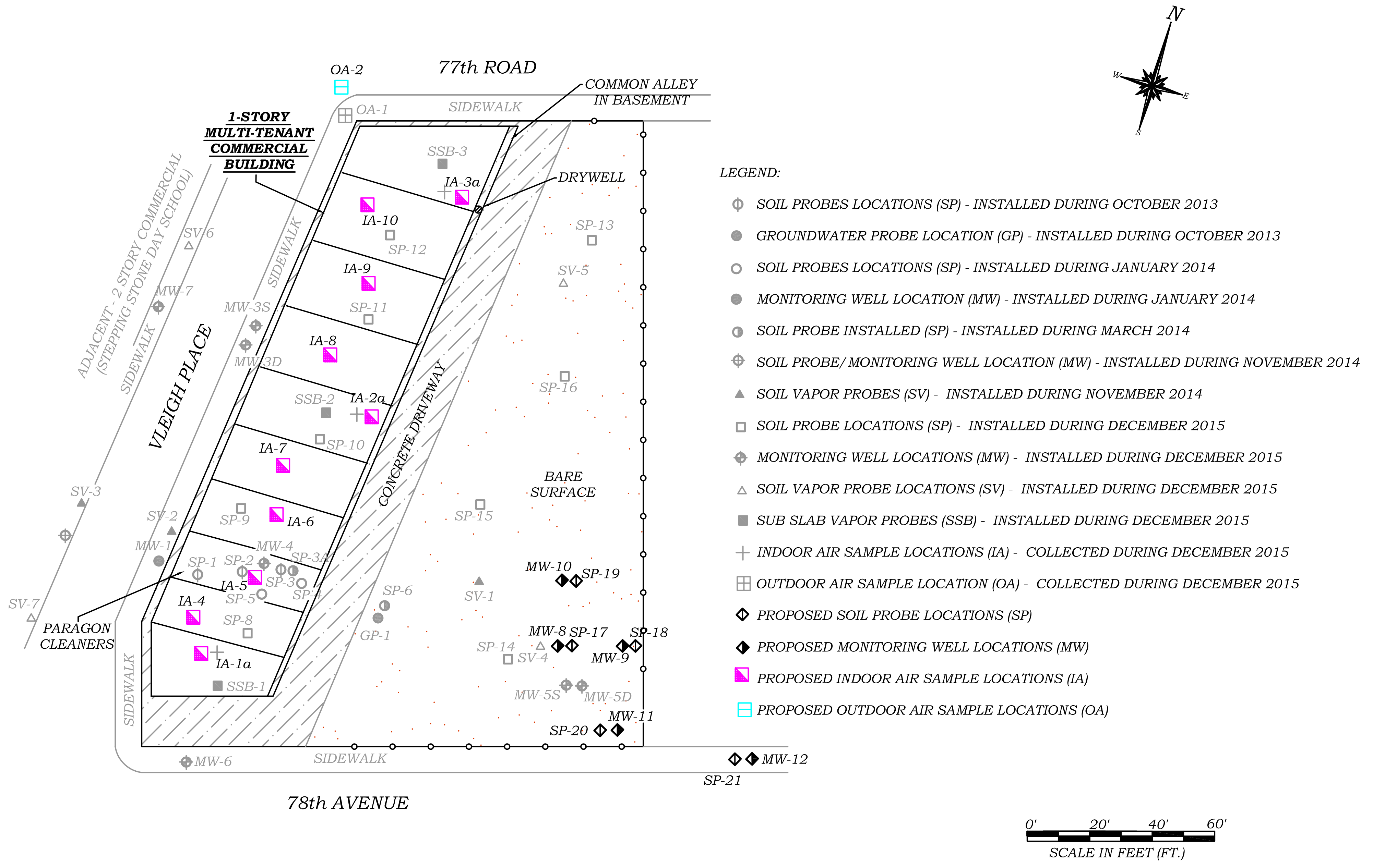
Project:	Designed by:
Date:	Drawn by:
Scale: AS SHOWN	Approved by:

PROJECT SITE AND ADJACENT PROPERTIES

77-39/63 VLEIGH PL
FLUSHING, NY

FIGURE NO:
1

SHEET:



LEGEND:

- ⏀ SOIL PROBES LOCATIONS (SP) - INSTALLED DURING OCTOBER 2013
- ● GROUNDWATER PROBE LOCATION (GP) - INSTALLED DURING OCTOBER 2013
- ○ SOIL PROBES LOCATIONS (SP) - INSTALLED DURING JANUARY 2014
- ● MONITORING WELL LOCATION (MW) - INSTALLED DURING JANUARY 2014
- ◐ SOIL PROBE INSTALLED (SP) - INSTALLED DURING MARCH 2014
- ⊕ SOIL PROBE/ MONITORING WELL LOCATION (MW) - INSTALLED DURING NOVEMBER 2014
- ▲ SOIL VAPOR PROBES (SV) - INSTALLED DURING NOVEMBER 2014
- □ SOIL PROBE LOCATIONS (SP) - INSTALLED DURING DECEMBER 2015
- ⊕ MONITORING WELL LOCATIONS (MW) - INSTALLED DURING DECEMBER 2015
- △ SOIL VAPOR PROBE LOCATIONS (SV) - INSTALLED DURING DECEMBER 2015
- ■ SUB SLAB VAPOR PROBES (SSB) - INSTALLED DURING DECEMBER 2015
- + INDOOR AIR SAMPLE LOCATIONS (IA) - COLLECTED DURING DECEMBER 2015
- ⊞ OUTDOOR AIR SAMPLE LOCATION (OA) - COLLECTED DURING DECEMBER 2015
- ◇ PROPOSED SOIL PROBE LOCATIONS (SP)
- ◆ PROPOSED MONITORING WELL LOCATIONS (MW)
- ◩ PROPOSED INDOOR AIR SAMPLE LOCATIONS (IA)
- ⊟ PROPOSED OUTDOOR AIR SAMPLE LOCATIONS (OA)

HYDRO TECH ENVIRONMENTAL CORP.

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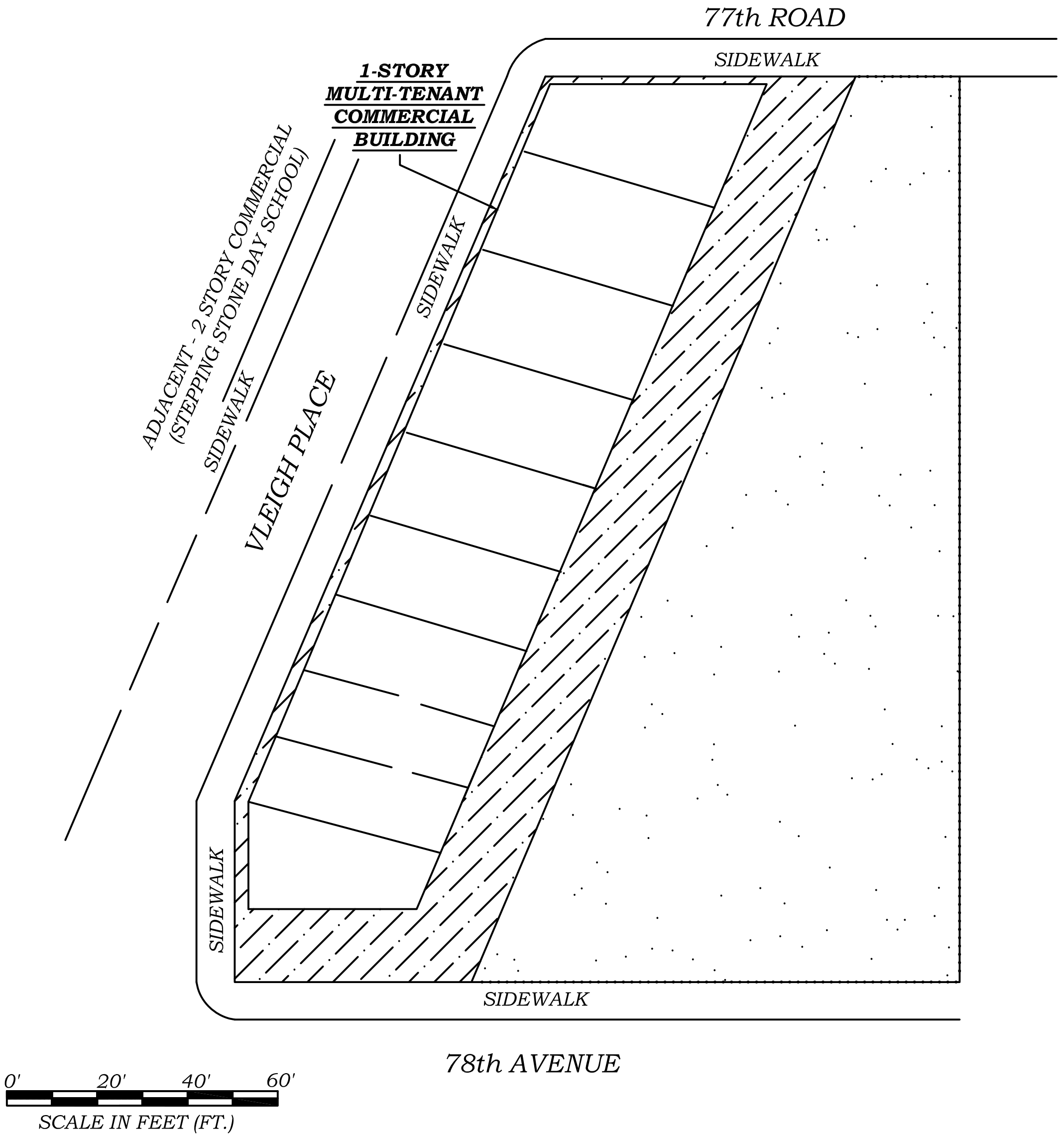
77-57 Vleigh Pl
Flushing, NY
HTE Job# 140067

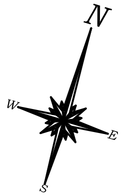
Drawn By: C.Q.
Reviewed By:
Approved By: M.R
Date: 01/22/16
Scale: AS NOTED

TITLE:

FIGURE 2: SITE PLAN / SAMPLING PLAN

Figure 3





STATE OF NEW YORK
TAREK ZAKI KHOURI
086611
LICENSED PROFESSIONAL ENGINEER

SIGNATURE	DATE

CONTRACT NO. 810

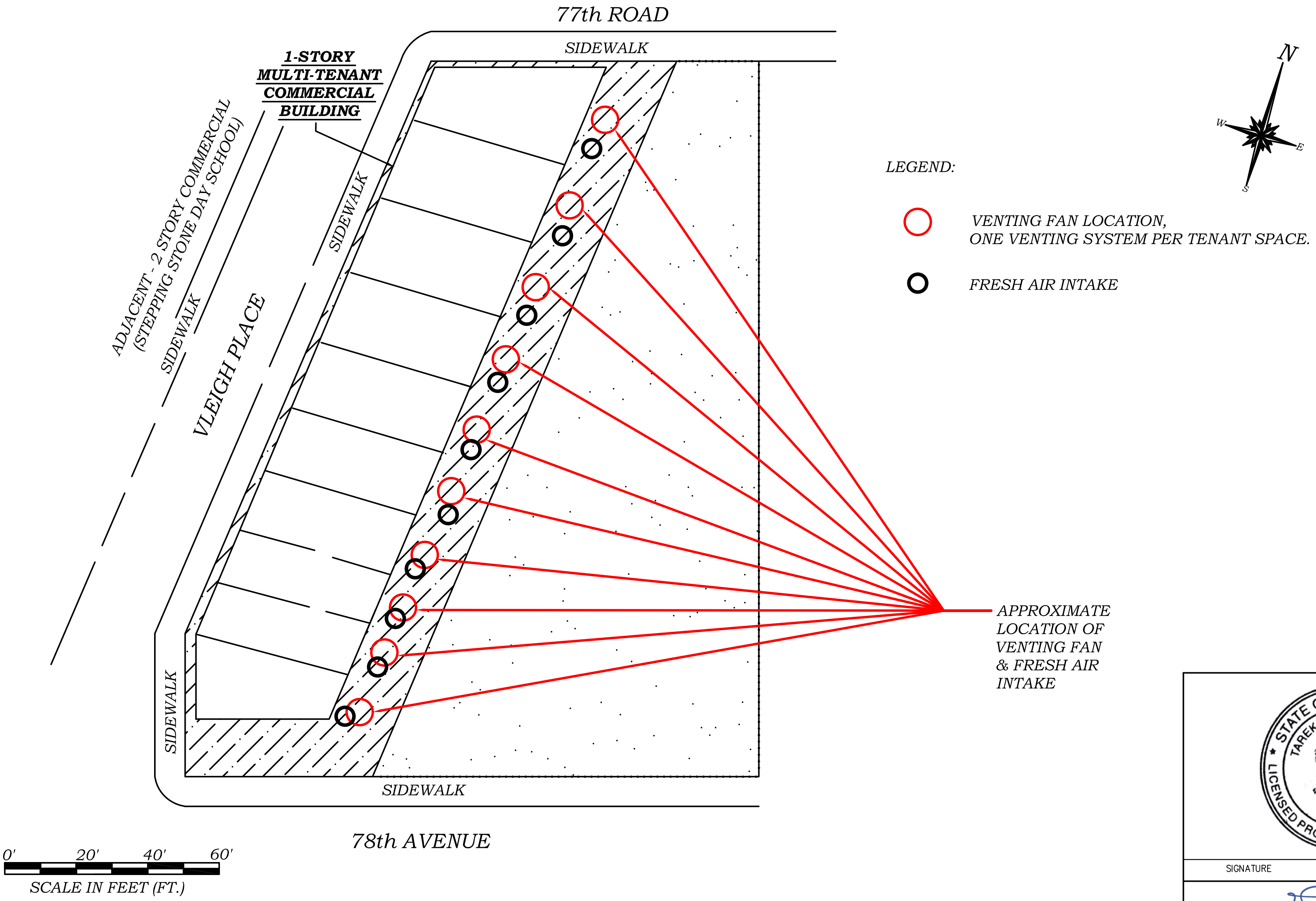
77-57 VLEIGH PLACE
FLUSHING, NY

FIGURE 1: SITE PLAN

DWG. NO.	SCALE	DATE	SHEET
VM-1	AS SHOWN	MARCH 1, 2016	1 OF 4

HAKS 40 Wall St., 11th Floor,
New York, NY 10005

PREPARED BY: HAKS
IN CHARGE ______ DRAFTER HB
DESIGNER TZK CHECKER ______



STATE OF NEW YORK LICENSED PROFESSIONAL ENGINEER
TAREK ZAKI KHOURI
086611

SIGNATURE DATE

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77-57 VLEIGH PLACE
FLUSHING, NY

FIGURE 2

DWG. NO.	**SCALE**	**DATE**	**SHEET**
VM-2	AS SHOWN	MARCH 1, 2016	2 OF 4

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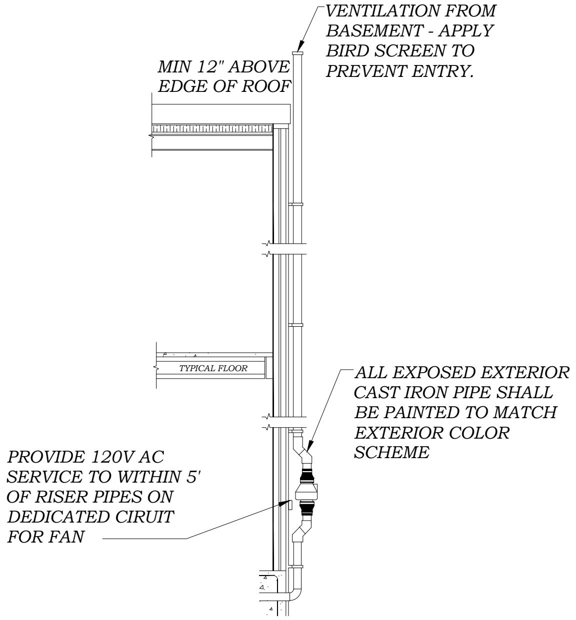
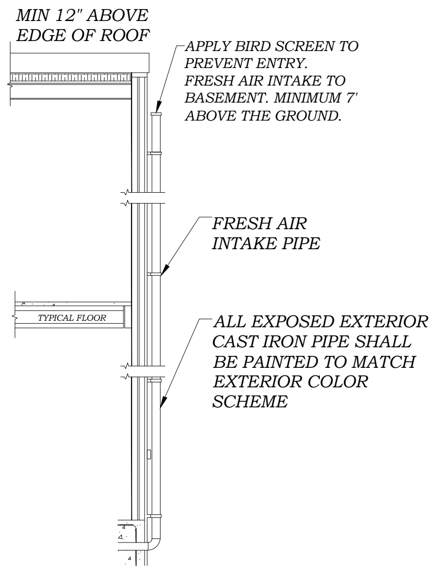
New York, NY 10005

PREPARED BY: HAKS
IN CHARGE
DESIGNER TZK
DRAFTER HB
CHECKER

OPTION 1- FAN INSTALLED AT GROUND LEVEL



TYPICAL EXTERIOR RISER PIPE INSTALLATIONNTS



TYPICAL EXTERIOR FRESH AIR INTAKE INSTALLATION

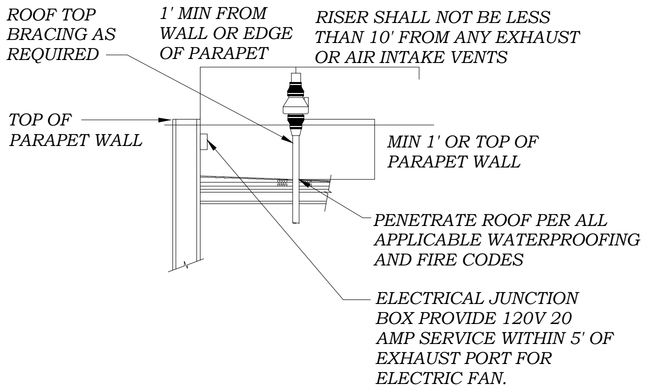
LABEL TO BE A MINIMUM 2"X4" AND READABLE AT 3 FEET FROM PIPE. SHALL BE PERMANENTLY AFFIXED TO RISER PIPE AT LEAST EVERY 5 FEET, ON EACH FLOOR AND ABOVE THE ROOF

CAUTION

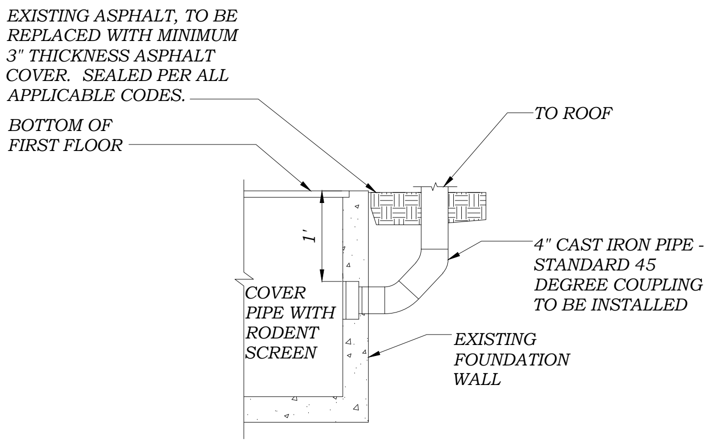
SOIL VAPOR VENTING SYSTEM
DO NOT TAMPER WITH OR DISTURB

TYPICAL LABEL DETAIL

OPTION 2- FAN INSTALLED AT ROOF LEVEL



VENT PIPE AND FAN EXHAUST



PIPE INSTALLATION THROUGH FOUNDATION BASEMENT WALL

1. FOR INSTALLATION OF FRESH AIR INTAKE PIPE, MINIMUM SEPARATION OF THREE (3)' IN ALL DIRECTIONS FROM PIPE LOCATION FOR RADON AWAY SYSTEM".

TAREK ZAKI KHOURI
086611

SIGNATURE DATE

CONTRACT NO. 810

77-57 VLEIGH PLACE
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FIGURE 3: DETAIL

DWG. NO.	SCALE	DATE	SHEET
VM-3	N.T.S.	MARCH 1, 2016	3 OF 4

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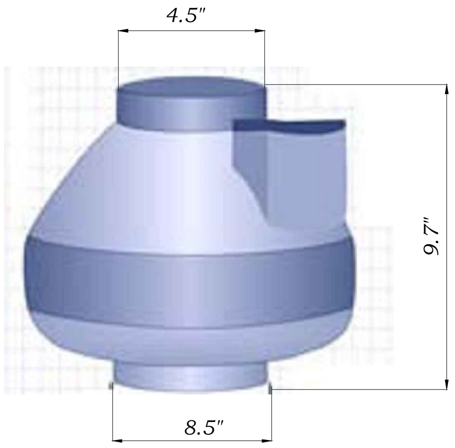
DESIGNER TZK
CHECKER

RADONAWAY FAN SIZING



FRESH AIR INTAKE FAN - 180 CFM

General Notes:

1. The work depicted on these drawings shall be performed by an experienced contractor who has working knowledge of applicable code standards and industry accepted standard good practice. Not every condition or element is or can be explicitly shown on these drawings.
2. The contractor shall confer with and seek the approval of the engineer for the final locations of all venting system components.
3. The contractor will provide an as-built drawing of the installed venting system upon completion.
4. All inspections required by the building code shall be provided by an independent inspection company or the local building department where applicable.
5. The venting system shall be in compliance with New York City Mechanical Code, Chapter 5 Section MC-512 Subslab exhaust systems.
6. Vertical piping runs shall be marked “Soil Vapor Venting System - Do Not Tamper with or Disturb”. The labels shall be easily read within three (3) feet.
7. For Option 1, the cast iron riser shall be installed vertically to the exterior of the building to the roof and shall terminate a minimum of one (1) foot above the roof line and at least ten (10) feet from HVAC RTU air intakes, doors, windows, or other openings into the occupied space of the building or adjacent buildings.
8. For Option 2, The final cast iron riser pipe termination shall be at least one (1) foot from adjacent walls including parapet walls and at least ten (10) feet from HVAC RTU air intakes, doors, windows, or other openings into the occupied space of the building or adjacent buildings.
9. For fresh air ventilation fan, the final interior location shall be located a minimum of three (3) feet in all directions from location of radon away outlet piping.
10. All piping shall be supported according to all applicable codes.
11. Provide 120V AC 20 AMP electrical service with a dedicated circuit breaker to within five (5) feet of the location of the venting fan for both installation options.

Contractor Notes

1. The Contractor shall furnish all labor, material, equipment, supplies and incidentals required for the installation of the RadonAway fan (or engineer approved equivalent) system as shown on the Drawings. The work shall include, but not limited to the following: installation in basement, coring through foundation wall for external piping run, associated piping and mechanical and electrical appurtenances in their entirety, fan installation, grouting and restoration to existing conditions and in accordance with all applicable federal, state and local requirements. Final restoration of all disturbances to existing conditions.
2. The Contractor is required to conform to all applicable New York City, state, and federal requirements.
3. The Contractor shall be responsible to comply with all local, state, and federal rules and regulations concerning emissions and disposal of solids and other materials generated by the work. Containment, handling and disposal of materials, and means and methods employed by the Contractor are the responsibility of the Contractor.
4. Compliance assurance shall be the responsibility of the Contractor. Communication between Contractor and governing authorities, regulatory agend similar entities, shall be coordinated through the Owner.
5. All permits, bonds, easements, or licenses required to perform the Work shall be obtained by the Contractor.
6. The Contractor shall coordinate with the Owner to ensure all permits are in place prior to the Contractor starting work.
7. Determination of license and permit requirements shall be the responsibility of the Contractor.
8. Copies of all executed permits and licenses shall be transmitted to the Owner upon receipt.

Submittals:

1. The Contractor shall submit the following items to the Engineer for review and approval prior to commencement of work:
a. Proposed methods of piping installation, fan installation, and all accessory installation including collection and off-site transportation and disposal of waste.
b. Proposed methods, equipment and sequence of operations.

Pipe Notes:

1. Hubless Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A 888 and CISPI Standard 301. The Charlotte Pipe and Foundry Company hubless Cast Iron Soil Pipe shall be specified, or approved equivalent. All piping to be 4” inches diameter unless otherwise noted.
2. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute ® and listed by NSF® International.
3. Hubless Couplings shall conform to CISPI Standard 310 and be certified by NSF® International.
4. Heavy Duty couplings shall conform to ASTM C 1540 and shall be used if indicated. Gaskets shall conform to ASTM C 564.
5. All pipe and fittings to be produced by a single manufacturer and are to be installed in accordance with manufacturer's recommendations and applicable code requirements. Couplings shall be installed in accordance with the manufacturer's band tightening sequence and torque recommendations.
6. Cast iron pipe to be secured to building using steel tie back securing straps at 12” vertical levels.

Venting Fan Notes:

1. Ventilation Fan to be specified as RadonAway RP 145, Part Number 23030-1, or engineer approved equivalent. A minimum of one (1) ventilation fan is to be installed per each basement location as identified in the Contract drawings.
2. Electrical connection to be provided per Radon Away Specifications.
3. Selected contractor must conform to all installation instructions as provided per the included RadonAway installation instructions.
4. Fan to be mounted to roof or roof ledger using Radonaway fan mounting bracket, SKU 25007.

Fresh Air Intake Fan Notes:

1. Ventilation Fan to be specified as Tjernlund Duct Booster Fan (180 CFM), or engineer approved equivalent. A minimum of one (1) fresh air ventilation fan is to be installed per each basement location as identified in the Contract drawings.
2. Electrical connection to be provided with 120V, 30 Watt breaker electrical connection, weather proof is placed outside.
3. Selected contractor must conform to all installation instructions as provided per the manufacturer specifications.
4. Ventilation fan will require six (6) inch ducting.

MODEL	P/N	FAN DUCT DIAMETER	WATTS	MAX. PRESSURE "WC	TYPICAL CFM vs. STATIC PRESSURE WC				
					0"	.5"	1.0"	1.5"	2.0"
RP145	23030-1	4"	41-72	2.1	166	126	82	41	3

TAREK ZAKI KHOURI
086611

SIGNATURE DATE

CONTRACT NO. 810

77-57 VLEIGH PLACE
FLUSHING, NY

FIGURE 4: NOTES

DWG. NO.	SCALE	DATE	SHEET
VM-4	N.T.S.	MARCH 1, 2016	4 OF 4

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New York, NY 10005

PREPARED BY: HAKS
IN CHARGE
DRAFTER HB
DESIGNER TZK
CHECKER

Appendices

A. NYSDEC Correspondence

Paul Matli

From: Komoroske, Michael (DEC) <michael.komoroske@dec.ny.gov>
Sent: Thursday, February 04, 2016 10:51 AM
To: Paul Matli
Cc: gduke@bsdflaw.com; Hoque, MD S (DEC); Hettrick, Dawn (HEALTH); Deming, Justin (HEALTH); Cozzy, Robert (DEC); Mintzer, Karen L (DEC); O'Connell, Jane H (DEC)
Subject: RE: BCP Site# C241168- 77-57 Vleigh Place, NY - update on RIR and RIWP
Attachments: RIR- Figure -7.pdf; vidisclosurefactsheet[1].pdf; NYSDOH TCE tenant notification fact sheet[1].pdf; NYSDOH TCE indoor and outdoor fact sheet.pdf; NYSDOH PCE tenant notification fact sheet[1].pdf; NYSDOH PCE indoor and outdoor fact sheet.pdf; Tenant Notification of Indoor Air Contamination Associated With Soil Vapor Intrusion.pdf

Paul,

The NYSDEC has completed a preliminary review of the draft RI report and have some initial comments and requests which need to be addressed.

1) The NYSDOH TCE indoor air guidance value not to exceed is 2ug/m3, not 5ug/m3. See attached NYSDOH August 2015 TCE fact sheet.

2) There are also "immediate and effective action" concentrations for both TCE and PCE. The NYSDOH September 2013 PCE Fact sheet is also attached.

3) Has the vapor data has been validated and has the DUSR been completed? If not, measures should be taken to expedite that review for the vapor samples given the TCE and PCE subslab and indoor air concentrations reported.

4) Assuming that the data has been validated and determined usable (DUSR), and based on the PCE and TCE indoor air concentrations reported in the Draft RI report (See RIR Figure 7 attached), there are tenant notification requirements that the owner or the owner's agent must comply with per ECL 27-2405. Attached is the NYSDEC "Tenant Notification of Indoor Air Contamination Associated with Soil Vapor Intrusion" information sheet, and NYSDOH tenant notification fact sheets for both PCE and TCE. The remedial party under the BCA has been designated a "participant." Additional information on tenant notification and what short term actions may be necessary may be forthcoming.

5) The approved RIWP called for a RIR and RAWP to be submitted within 60 days of RIWP approval. The RIWP was approved on August 17, 2015, although the field work did not began until late November, 2015. At this point it will not be possible to issue a decision document for this site by March 31, 2016 as we had planned. None-the-less, given the reported concentrations of PCE and TCE in the soil vapor, sub-slab and indoor air samples, an expedited submittal of a draft RAWP is requested by no later than February 26th, 2016. This should allow for a decision document to be issued by April 30th, 2016 for this site. An Interim Remedial Measure (IRM) may be prudent to address the vapor pathway. Very elevated vapor concentrations in SV-4 need to be investigated and addressed. We can hold a conference call to discuss this further.

Michael J. Komoroske, P.E.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Remediation, Remedial Bureau B
625 Broadway, 12th Floor, Albany, NY 12233-7016
P: (518) 402-9768 I F: (518) 402-9773
www.dec.ny.gov

VIA EMAIL

February 12, 2016

Aldrich Management Co, LLC
Attn: Denis Rodger
1975 Hempstead Tpke, Suite 309
East Meadow, NY 11554

DenisRodger@upcli.com

Re: 77-57 Vleigh Place- Site C241168
Immediate Action Required
February 2016 Remedial Investigation Report

The New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH) have reviewed the subject document. Formal comments will be submitted under separate cover.

On February 4, 2016, the NYSDEC provided your consultant via email with some preliminary comments and requests concerning the reported elevated concentrations of perchloroethene (PCE) and trichloroethene (TCE) in on-site soil vapor, sub-slab vapor and indoor air. The reported indoor air concentrations in the tenant spaces sampled ranged from 94 to 1,100 micrograms per cubic meter ($\mu g/m^3$) for PCE and 3.8 $\mu g/m^3$ to 57 $\mu g/m^3$ for TCE. Attached is the NYSDOH letter documenting the need for immediate actions be taken to reduce exposure to site-related contaminants in indoor air and the significant threat to public health determination for the Site.

Additional actions at the Site to address the current indoor PCE and TCE levels are necessary. We would like to schedule a conference call to discuss these actions, preferably today. Please be prepared to discuss actions to taken to date and planned to address indoor air levels of PCE and TCE.

If you have any questions concerning this matter, or would like to discuss the comments, you may contact me by telephone (518) 402-9475 or by email (md.hoque@dec.ny.gov) or the NYSDOH Project Manager, Dawn Hettrick at (518) 402-7860 or dawn.hettrick@health.ny.gov.

Sincerely,

Hoque

MD Hoque, Environmental Engineer
Remedial Bureau B, Section A
Division of Environmental Remediation

enclosure

ec:

Rachel Ataman/Paul I. MATLI - Hydro Tech Environmental Corp.
George C.D. Duke, Esq., P.G.
Tarek Khouri, HAKS
K. Mintzer – NYSDEC/OGC
R.Cozzy/M. Komoroske – NYSDEC/DER
J. Deming/ D. Hettrick - NYSDOH

NEW YORK STATE OF OPPORTUNITY. | Department of Health

ANDREW M. CUOMO
Governor

HOWARD A. ZUCKER, M.D., J.D.
Commissioner

SALLY DRESLIN, M.S., R.N.
Executive Deputy Commissioner

February 11, 2016

Mr. Robert Cozzy, Director
Remedial Bureau B
NYS Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway, 12th Floor
Albany, NY 12233

Re: Significant Threat Determination
77-57 Vleigh Place
Site #C241168
Flushing, Queens County

Dear Mr. Cozzy:

At your department's request, we have reviewed the January 29, 2016 *Remedial Investigation Report* for the referenced site. Based on that review, I understand that on-site groundwater, soil, and soil vapor are contaminated with chlorinated solvents, specifically tetrachloroethene (PCE) and trichloroethene (TCE). I also understand that elevated levels of PCE and TCE were detected in the indoor air of currently occupied tenant spaces on-site.

Based on our review of the available information, I recommend that immediate actions be taken to reduce exposure to site-related contaminants in indoor air. PCE was detected in the indoor air from 94 to 1,100 micrograms per cubic meter (mcg/m^3) and TCE was detected from 3.9 to 57 mcg/m^3. Furthermore, environmental sampling indicates that soil vapor intrusion is a potential exposure pathway for people in off-site structures and that additional investigation is warranted. Direct contact with contaminants in subsurface soil is unlikely because the site is covered with a building; however, people who dig below the surface may contact site-related contaminants in soil or groundwater. People are not drinking contaminated groundwater because the area is served by a public water supply that is not affected by this contamination.

I believe that this site represents a significant threat to public health and that immediate actions are needed to reduce exposure to site related contaminants. In addition, further investigation is warranted to characterize potential exposure pathways and to evaluate remedial alternatives. If you have any questions, or if you would like to discuss this site further, please contact me at (518) 402-7860.

Sincerely,

Justin H. Deming

Justin H. Deming, Chief
Regions 2, 4 and 8
Bureau of Environmental Exposure Investigation

ec: K. Anders / D. Hettrick / e-file
C. Westerman – NYSDOH MARO
C. D’Andrea – NYCDHOH
M. Komoroske / M. Hoque – NYSDEC Central Office
J. O'Connell – NYSDEC Region 2

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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VIA EMAIL February 23, 2016

Aldrich Management Co, LLC
Attn: Denis Rodger
1975 Hempstead Tpke, Suite 309
East Meadow, NY 11554

DenisRodger@upcli.com

Re: 77-57 Vleigh Place- Site C241168
Draft Interim Remedial Measure Work Plan – dated February 17, 2016

The New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH) have reviewed the subject document.

On February 4, 2016, the NYSDEC provided your consultant via email with some preliminary comments and requests concerning the reported elevated concentrations of perchloroethene (PCE) and trichloroethene (TCE) in on-site soil vapor, sub-slab vapor and indoor air. The reported indoor air concentrations in the tenant spaces sampled ranged from 94 to 1,100 micrograms per cubic meter (μg/m^3) for PCE and 3.8 μg/m^3 to 57 μg/m^3 for TCE. That was followed with a letter dated February 12, 2016 requesting immediate actions be taken to reduce exposure to site-related contaminants in indoor air.

The work plan referenced above is unacceptable and most be modified for the following major reasons:

1. Ventilation of the basement spaces as proposed could increase soil vapor intrusion into the structure by creating negative pressure in the basement areas. The consultant needs to either address the potential of negative pressure under their proposal or propose a different approach, like filtration of the occupied spaces with portable carbon filtration devices. This devises are readily available, portable and relatively inexpensive. They are manufactured in various sizes depending on the space requiring filtration.

2. A single sub-slab vapor point and a single indoor air sample in the Steppingstone Day School is not sufficient to access the entire building. A minimum of three

locations should be considered after consulting the floor plan of the school or doing a walkthrough of the school.

3. The work plan should be entitled “Interim Remedial Measure (IRM) and Remedial Investigation Addendum Work Plan” as opposed to “Interim Remedial Measure Remedial Action Work Plan (RAWP)” The scope of the RAWP will be determined once the full nature and extent of the contamination is determined. Additional off-site investigations may be needed to determine the full extent of the groundwater and vapor contamination. The actions proposed in the IRM work plan should not be considered a final remedy.

Due the nature of the actions needed, please submit a revised IRM work plan within one week from the receipt of this letter. Additional comments on the work plan are enclosed and must also be addressed.

If you have any questions concerning this matter, or would like to discuss the comments, you may contact me by telephone (518) 402-9475 or by email (md.hoque@dec.ny.gov) or the NYSDOH Project Manager, Dawn Hettrick at (518) 402-7860 or dawn.hettrick@health.ny.gov.

Sincerely,

MD Hoque, Environmental Engineer
Remedial Bureau B, Section A
Division of Environmental Remediation

enclosure

ec:

Rachel Ataman/Paul I. MATLI - Hydro Tech Environmental Corp.
George C.D. Duke, Esq., P.G.
Tarek Khouri, HAKS
K. Mintzer – NYSDEC/OGC
R.Cozzy/M. Komoroske – NYSDEC/DER
J. Deming/ D. Hettrick – NYSDOH

COMMENTS
Interim Remedial Measure (IRM) & Remedial Investigation Addendum Work Plan
77-57 Vleigh Place- C241168

Additional Comments are as follows:

1. Ventilation of the basement spaces as proposed could result in increased soil vapor intrusion into the structure by creating negative pressure in the basement areas. This proposal is not consistent with the methods of mitigation outlined in Section 4 of the "NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York – October 2006."The ventilation system needs to either address the potential of negative pressure under the proposal or propose a different approach such as an active sub-slab depressurization system (SSDS), adjustments to the buildings HVAC and/or sealing of cracks in basement floors and other points of potential vapor entry. In the short term filtration of the occupied spaces with portable carbon filtration devices is recommended.

2. Two weeks after installation of the mitigation units, additional indoor air samples will need to be collected to verify the effectiveness of the mitigation. Further indoor air sampling may be needed as well.

3. Section 4.3 General Consideration: There is a discussion of a dry well covered with a trench drain located in the northwestern portion of the common alley. Please locate this dry well on a figure. There should be actions added to the work plan to investigate this dry well as a potential source area. There is also a suggestion that outdoor air may be passing into the basements through the basement doors. Is there a source area outside the basement doors?

4. In cover page, the NYSDEC Site# is C241168 instead of #241126.
5. Page #7 Section: Introduction: The BCP site number should be C241168. Please correct.
6. Page #12, Section-3: Organizational Structure and Responsibility: Please substitute "Dawn Hettrick" under NYSDOH for Justin Deming. Also, please add Dawn Hettrick name and contact information to the letter intended for the Steppingstone Day School.
7. Page #20, Section 8.1: Soil Probes: In addition to the proposed new soil probe locations, one upgradient soil probe location is requested off-site to east of the property in the sidewalk to ensure that off-site sources are not releasing PCE. Also, one upgradient monitoring well is requested off-site of the property to east of the proposed MW-11 & SP-20 sampling locations at the sidewalk.
8. Page #22, paragraph #2, said "All recently and previously installed monitoring wells, i.e. MW-1 through MW-10 will then be monitored and gauged for separate phase product". Is this proposed to be a one-time event or multiple events? If multiple events, at what frequency? Please describe. If separate phase product is determined to be present, an remedial alternative to capture this product must be proposed.
9. Appendix C- CAMP, Section 1: Introduction- paragraph#2 Please say" Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or nearby residence/community".
10. Appendix H- QAPP: no comments.

B. HASP

HEALTH & SAFETY PLAN

77-57 Vleigh Place
Block 6330; Lot 1
Flushing, New York

NYSDEC BCP Site Number: C241168

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Figures

Attachments

1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been prepared as a part of the Interim Remedial Measures and Remedial Investigation Addendum Work Plan (IRM & RIAWP) for the property located at 77-57 Vleigh Place, Flushing, New York, designated as the “Site”. The Site is occupied by a one-story commercial building housing thirteen (13) tenant spaces including an active dry cleaner identified as Paragon Cleaners.

This HASP will conform to applicable regulations, safe work practices and the project’s requirements, and addresses those activities associated with the installation of individual indoor ventilation systems and the performance of a remedial investigation addendum.

The Project Manager (PM), Site Safety Officer (SSO) and field staff (when necessary) will implement the Plan during construction. Compliance with this HASP is required of all persons and third parties who perform the scope of work documented for this project. Assistance in implementing this HASP can be obtained from the SSO. The content of this HASP may change or undergo revisions based upon additional information that is made available to health and safety personnel, monitoring results, or changes in the technical scope of work.

It should be noted that this HASP does not apply to any other scopes of work that may be performed at the Site that are not specifically outlined in this report. Through preparation of this HASP, Contractor and Subcontractors (if any) do not guarantee the health or safety of any person entering this Site. Due to the nature of this Site and the activities occurring thereon, it is not possible to discover, evaluate and provide protection for all possible hazards that may be encountered. Only those portions of this HASP that specifically apply to the activities at the Site will be enacted by authorized personnel. Strict adherence to the applicable portions of these health and safety guidelines set forth herein will reduce, but not eliminate the potential for injury at this Site. The health and safety guidelines in this HASP were prepared specifically for this Site and should not be utilized for any other site without prior research and evaluation by trained health and safety specialists.

2.0 SCOPE OF WORK

This HASP has been prepared as a part of the IRM & RIAWP to be implemented during the upcoming proposed interim remedial measures at the Site. Prior environmental investigations identified range of vapors associated with chlorinated solvents in soil, groundwater, soil/sub-slab beneath the Site as well as in indoor air.

The portions of the construction activities specifically addressed in this HASP will include the following and will be performed in the following sequence:

- Installation of aeration and venting systems of indoor air in individual basements at the Site
- Installation of soil probes, monitoring wells and sub-slab vapor sampling points
- Characterization and collection of soil, sediment and groundwater samples

Prior to any fieldwork, the New York City One-Call Unit will be contacted so that all public utilities can be marked out. The proposed schedule of fieldwork will be coordinated with the New York State Department of Environmental Conservation (NYSDEC).

3.0 STAFFING

This section briefly describes the personnel involved in Site remedial activities, their contact information and their health and safety responsibilities. This section also provides directions to hospital in the case of a health emergency.

EMERGENCY NUMBERS

Emergency Numbers

Contact	Phone Number
Jamaica Hospital Medical Center	718-206-7001
EMS	911
Police	911
Fire	911
National Response Center	800-424-8802
Poison Information Center	800-562-8816
Chemtree	800-424-9555

Project Management/Health and Safety Personnel

Title	Contact	Phone Number	Cell Phone
QEP	Mark Robbins	(631) 462-5866	(631) 457-0033
PM/SSO	Paul Matli	(718) 636-0800	(631) 457-0523

Directions to Jamaica Hospital Medical Center (See attached map)

Upon leaving the Site, start going north on Vleigh Place toward 77th Road. Turn right onto 77th Road and then right onto Main Street. Take the ramp on the left to Verrazano-Narrows. Keep right at the fork, follow signs for Hillside Avenue/Jamaica Avenue and merge onto Van Wyck Boulevard. The hospital will be on the left side.

HEALTH AND SAFETY STAFF

This section briefly describes the personnel and their health and safety responsibilities for the:

PROJECT GEOLOGIST

- Has the overall responsibility for the health and safety of site personnel
- Ensures that adequate resources are provided to the field health and safety staff to carry out their responsibilities as outlined below.
- Ensures that fieldwork is scheduled with adequate personnel and equipment resources to complete the job safely.
- Ensures that adequate telephone communication between field crews and emergency response personnel is maintained.
- Ensures that field site personnel are adequately trained and qualified to work at the Site.

PROJECT MANAGER

As necessary, the Project Manager will perform the following:

- Has the overall responsibility for the health and safety of site personnel
- Ensures that adequate resources are provided to the field staff to carry out their responsibilities as outlined below.
- Ensures that fieldwork is scheduled with adequate personnel and equipment resources to complete the job in a safe manner.
- Ensures that adequate communication between field crews and emergency response personnel is maintained.
- Ensures that field site personnel are adequately trained and qualified to work at the Site.

SITE SAFETY OFFICER

As necessary, the Site Safety Officer will perform the following:

- Directs and coordinates health and safety monitoring activities.
- Ensures that field teams utilize proper personal protective equipment (PPE).
- Conducts initial on-Site, specific training prior to personnel and/or subcontractors proceeding to work.
- Conducts and documents periodic safety briefings; ensures that field team members comply with this HASP.
- Completes and maintains Accident/Incident Report Forms.
- Notifies corporate administration of all accidents/incidents.
- Determines upgrade or downgrade of PPE based on site conditions and/or downgrade of PPE based on site conditions and/or real-time monitoring results.
- Ensures that monitoring instruments are calibrated daily or as determined by manufacturer’s suggested instructions.
- Maintains health and safety field log books.
- Develops and ensures implementation of the HASP.
- Approves revised or new safety protocols for field operations.
- Coordinates revisions of this HASP with field personnel and the SSO Division Contracting Officer.
- Responsible for the development of new company safety protocols and procedures and resolution of any outstanding safety issues which may arise during the conduction of site work.
- Reviews personnel and subcontractors current and up-to-date medical examination and acceptability of health and safety training.

FIELD PERSONNEL AND SUBCONTRACTORS (IF ANY)

- Reports any unsafe or potentially hazardous conditions to the SSO
- Maintains knowledge of the information, instructions, and emergency response actions contained in this HASP.
- Comply with rules, regulations and procedures as set forth in this HASP and any revisions that are instituted.
- Prevents admittance to work sites by unauthorized personnel.

4.0 CHEMICAL & WASTE DESCRIPTION/CHARACTERIZATION

The following list of compounds is based on the results of prior Site investigations:

Chlorinated Solvents of concern in soil, groundwater and soil vapor:

- Tetrachloroethylene
- Trichloroethylene
- Cis-1,2-dichloroethene

Appendix A contains Material Safety Data Sheets

The following information references are presented in order to identify the properties, characteristics and hazards of the compounds and metals that may/will be encountered at the Site.

- Dangerous Properties of Industrial Materials - Sax
- Chemical Hazards of the Workplace - Proctor/Hughes
- Condensed Chemical Dictionary - Hawley
- Rapid Guide to Hazardous Chemical in the Workplace - Lewis 1990.
- NIOSH Guide to Chemical Hazards – 1990.
- ACGIH TLV Values and Biological Exposure Indices - 1991-1992.

5.0 HAZARD ASSESSMENT AND MITIGATION

The potential hazards associated with planned site activities include chemical, physical and biological hazards associated with the construction. This section discusses those hazards that are anticipated to be encountered during the activities listed in the scope of work.

The potential to encounter chemical hazards is dependent upon the work activity performed (invasive or non-invasive), the duration, and location of the work activity. Such hazards could include inhalation or skin contact with chemicals that could cause: dermatitis, skin burn, being overcome by vapors, or asphyxiation. In addition, the handling of contaminated materials and chemicals could result in fire and/or explosion.

The potential to encounter physical hazards during site work includes: heat stress, exposure to excessive noise, loss of limbs, being crushed, head injuries, cuts and bruises, and other physical hazards due to motor vehicle operation, heavy equipment and power tools.

CHEMICAL HAZARDS

The potential for personnel and subcontractors to come in contact with chemical hazards may occur during the following tasks:

- Installation of aboveground piping for aeration and ventilation of indoor air
- Installation and sampling of soil probes, monitoring wells and collection of sediment sample from drywell
- Removal of any contaminated materials during sampling

Exposure Pathways

Exposure to these compounds during ongoing activities may occur through inhalation of contaminated dust particles, inhalation of volatile vapor fume compounds, by way of dermal absorption, and accidental ingestion of the contaminant by either direct or indirect cross contamination activities (eating, smoking, poor hygiene). Indirectly, inhalation of contaminated dust particles can occur during adverse weather conditions (high or changing wind directions) or during operations that may generate airborne dust such as excavation.

Dust Suppression

The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities.

1. Applying water on haul roads.
2. Wetting equipment and excavation faces.
3. Spraying water on buckets during excavation and dumping.
4. Hauling materials in properly sealed or watertight containers.
5. Restricting vehicle speeds to 10mph.
6. Covering excavated areas and material after excavation activity ceases.
7. Reducing the excavation size and/or number of excavations.
8. Applying a dust suppressant, such as calcium chloride, in high vehicle traffic areas.

To evaluate the effectiveness if the dust suppression measures, air monitoring utilizing real-time dust-monitoring equipment will be performed. The requirements for air monitoring during post-remediation soil disturbance activities are presented in Section 5.0.

Additional Precautions

Dermal absorption or skin contact with chemical compounds is possible during invasive activities at the Site, including the excavation and/or capping of soils. The use of PPE in accordance with Section 9.0 and strict adherence to proper decontamination procedures should significantly reduce the risk of skin contact.

The potential for accidental ingestion of potentially hazardous chemicals is expected to be remote, when good hygiene practices are used. Unauthorized personnel, including all children, will not be allowed access to the Site.

PHYSICAL HAZARDS

A variety of physical hazards may be present during Site activities. These hazards are similar to those associated with any construction type project and include digging or boring operations and excavation activities in the vicinity of underground utility locations. These physical hazards are due to motor vehicles, and heavy equipment operation, the use of improper use of power and hand tools, misuse of pressurized cylinders, walking on objects, tripping over objects, working on surfaces which have the potential to promote falling, mishandling and improper storage of solid and hazardous materials, skin burns, crushing of fingers, toes, limbs, hit on the head by falling objects or hit one's head due to not seeing the object of concern, temporary loss of one's hearing and/or eyesight. Theses hazards are not unique and are generally familiarly to most hazardous waste site workers at construction sites. Additional task specific safety requirements will be covered during safety briefings.

6.0 SPILL PREVENTION AND CONTROL PLAN

Accidental spill and leaks of hazardous and non-hazardous materials will be properly controlled so that they do not adversely impact storm drain systems or receiving waters. A spill prevention and control plan will include the following:

Spill/Leak Prevention Measures;
-Place any material under cover (tarp) and away from storm drains or sensitive water bodies
-Properly label all containers so that the contents are easily identifiable
-Berm storage areas so that if a spill or leak occur they are easily contained

Spill Response Procedures
- Assessment of the Site and potential impacts by the SSO
- Containment of the material
- Notification of the personnel present at the Site and ensure evacuation procedure if necessary.

Spill Cleanup Procedures
-If small non-hazardous spill, use clean-up materials such as absorbents or rags and damp cloths and dispose of properly;
-If large non-hazardous spill or hazardous spill, a private hazmat team may need to be contacted to assess the situation and conduct the clean-up and proper disposal of the material.

Reporting
-Petroleum spills will be reported immediately to the NYSDEC Spill Hotline.
-If material is unknown or hazardous, contact the local Fire Department.

Training
-The SSO is responsible for providing a refreshment training to all employees working on-site about spill prevention, spill response and clean-up on a routine basis.
-The SSO will identify key spill response personnel to assist in the spill control and clean-up procedures.

7.0 TRAINING

GENERAL HEALTH AND SAFETY TRAINING

In accordance with 29 CFR 1910.120, all construction personnel involved with the portions of the scope of work described in Section 2.0 will be briefed by the Project Manager on the potential hazards and the overall requirements in meeting the specifications of this HASP.

The SSO will have the responsibility of ensuring that personnel assigned to this project comply with these requirements. Written certification of completion of any required training, if necessary, will be provided to the SSO.

MANAGER/SUPERVISOR TRAINING

In accordance with 29 CFR 1910.120, on-Site management and supervisors who will be directly responsible for, or who supervise employees engaged in hazardous waste operation shall receive training as required in this HASP and at least eight (8) additional hours of specialized training on managing such operations at the time of job assignment.

ANNUAL 8-HOUR REFRESHER TRAINING

Annual 8-hour refresher training will be required of all hazardous waste site field personnel in order to maintain their qualification for fieldwork. The following topics will be reviewed: toxicology, respiratory protection, including air purifying devices and self-contained breathing apparatus (SCBA), medical surveillance, decontamination procedures and personnel protective clothing. In addition, topics deemed necessary by the SSO may be added to the above list.

SITE SPECIFIC TRAINING

Prior to commencement of field activities, all personnel assigned to the project will be provided training that will specifically address the activities, procedures, monitoring, and equipment for the site operations. It will include Site and facility layout, hazards, and emergency services at the Site, and will highlight all provisions contained within this HASP. This training will also allow field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity.

ON-SITE SAFETY BRIEFINGS

Project personnel and visitors will be given periodic on-site health and safety briefings by the SSO, or their designee, to assist site personnel in safely conducting their work activities. The briefings will include information on new operations to be conducted, changes in work practices, or changes in the Site's environmental conditions. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety audits.

ADDITIONAL TRAINING

Additional training may be required by the SSO for participation in certain field tasks during the course of the project. Such additional training could be in the safe operation of heavy or power tool equipment or hazard communication training.

HAZWOPER TRAINING

All remedial personnel that will be in direct contact with the native soil/fill materials must complete an initial 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and, where necessary, a current 8-hour refresher course

SUBCONTRACTOR TRAINING

Subcontractor personnel working on-site may be exempted from the contents of this HASP. The SSO will determine if this exemption is allowed. In any case, the subcontractor personnel who are exposed to hazards are not exempted from the contents of this HASP.

8.0 MEDICAL SURVEILLANCE

GENERAL

No general or specific medical surveillance or other medical requirements are set forth in this HASP.

9.0 SITE CONTROL, PPE & COMMUNICATIONS

SITE CONTROL

The area where the activities of the scope of work will be performed is considered to be the Exclusion Zone (EZ). All areas where excavation and handling of contaminated materials take place are considered the EZ. This zone will be clearly delineated by cones, tape, or other means.

The SSO may establish more than one EZ where different levels of protection may be employed or where different hazards exist. Personnel are not allowed in the EZ without:

- A buddy
- Appropriate personal protective equipment (as necessary)

The remaining portions of the Site outside of the EZ will consist of a Support Zone (SZ) and a Contamination Reduction Zone (CRZ). Appropriate sanitary facilities, safety equipment, packaged/decontaminated and labeled samples will be located in SZ. Potentially contaminated personnel or materials will be allowed in the CRZ for decontamination as necessary.

PERSONAL PROTECTIVE EQUIPMENT

General

The level of protection worn by field personnel will be enforced by the SSO. Levels of protection may be upgraded or downgraded at the discretion of the SSO. The decision shall be based on real-time air monitoring, site history data, and prior site experience. Any changes in the level of protection shall be recorded in the health and safety field logbook.

PPE Specifications

For tasks requiring Level C PPE, the following equipment shall be used:
- Cotton or disposable coveralls
- Disposable outer coveralls (Poly-coated Tyvek)
- Gloves, inner (latex)
- Gloves, outer (Nitrile®)
- Boots (PVC), steel toe/shank
- Boot covers (as needed)
- Hard Hat
- Hearing protection (as needed)
- Splash suit and face shield for decontamination operations (as needed)

For tasks requiring Level D PPE, the following equipment shall be used:
- Cotton or disposable coveralls
- Gloves, inner (latex)
- Gloves, outer (Nitrile®)
- Boots (PVC) steel toe/shank
- Boot covers (as needed)
- Hard hat
- Hearing protection (as needed)
- Safety glasses

For tasks requiring Level D PPE, the following equipment shall be used:

- Cotton or disposable coveralls
- Gloves, inner (latex)
- Gloves, outer (Nitrile®)
- Boots (PVC) steel toe/shank
- Boot covers (as needed)

- Hard hat
- Hearing protection (as needed)
- Safety glasses

For tasks requiring respiratory protection, the following equipment shall be used:

Level D - No respiratory protective equipment necessary except for a dust mask
Level C - A full-face air-purifying respirator equipped with organic vapor/pesticide-HEPA cartridges
Level B - An air line respirator or a self-contained breathing apparatus (SCBA)

LEVEL OF PERSONAL PROTECTIVE EQUIPMENT REQUIRED

Activity	**Level of Protection Respiratory/PPE**
Excavations	C/D
Foundation Construction	C/D

COMMUNICATIONS

Communications is the ability to talk with others. While working in Level C Protection, personnel may find that communication become a more difficult task and process to accomplish. This is further complicated by distance and space. In order to address this problem, electronic instruments, mechanical devices or hand signals will be used as follows:

- Walkie-Talkies - Hand held radios would be utilized as much as possible by field teams for communication between downrange operations and the Command Post base station.

- Telephones - A mobile telephone will be located in the Command Post vehicle in the Support Zone for communication with emergency support services/facilities. If a telephone is demobilized, the nearest public phones will be identified.

- Air Horns - A member of the downrange field team will carry an air horn and another will be evident in the Support Zone to alert field personnel to an emergency situation.

- Hand Signals - Members of the field team using the buddy system will employ this communication method. Signals become especially important when in the vicinity of heavy moving equipment and when using Level B respiratory equipment. The signals shall become familiar to the entire field team before site operations commence and they will be reinforced and reviewed during site-specific training.

HAND SIGNALS FOR ON-SITE COMMUNICATION

Signal	**Meaning**
Hand gripping throat	Out of air, can’t breathe
Grip partners’ wrist	Leave area immediately; no debate
Hands on top of head	Need assistance
Thumbs up	OK, I’m all right; I understand
Thumbs down	No; negative, unable to understand you. I’m not all right

10.0 AIR MONITORING PLAN

GENERAL

Continuous air monitoring in the EZ during invasive tasks will accompany site operations, as indicated in this HASP or as required by the SSO. Monitoring will be performed to verify the adequacy of respiratory protection, to aid in site layout and to document work exposure. All monitoring instruments shall be operated by qualified personnel only and will be calibrated daily prior to use, or more often as necessary.

REAL-TIME MONITORING

Instrumentation

A PID (to monitor total volatile organic concentrations) will be used to measure worker breathing zone ambient on-site concentrations during on-site activities. The equipment will be calibrated daily and the results noted in the project field book. A background level will be established, at a minimum, on a daily basis, and recorded in the field book.

The following response actions will be taken based on PID readings in the breathing zone. All work will be performed in level D PPE unless breathing zone volatile organic concentrations exceed 5 ppm. Once levels of 25 ppm are measured, work will be stopped.

Volatile Organics	Photoionization Detector (PID)	>5ppm	Temporarily halt work activities & monitor until readings decrease to below 5ppm.
		>5ppm<25ppm	Halt work activities, upgrade to level C continue monitoring.
		>25ppm	Shut down work activities

During soil excavation, particulate monitoring will be performed using a real-time particulate monitor that will monitor particulate matter less than ten microns (PM10) with the following minimum performance standards:

Object to be measured: Dust. Mists, Aerosols
Size range: < 0.1 to 10 microns
Sensitivity: 0.001 mg/m3
Overall Accuracy: = 10% as compared to gravimetric analysis of stearic acid or reference dust.

Particulate levels will be monitored immediately downwind at the working site and integrated over a period not to exceed 15 minutes. The action level will be established at 150 ug/m3 over the integrated period not to exceed 15 minutes.

Action Levels

Action levels for upgrading of PPE in this HASP will apply to all site work during the duration of field activities at the Site. The action level is the presence of visible airborne dust. When airborne dust is observed, specific dust-mitigating procedures will be implemented. These dust-mitigating procedures are documented in Section 6.0.

11.0 SAFETY CONSIDERATIONS

GENERAL

In addition to the specific requirements of this HASP, common sense should be used at all times. The general safety rules and practices below will be in effect at the Site at the discretion of the Project Manager, SSO or other authorized personnel.

- The site will be suitably marked or barricaded as necessary to prevent unauthorized visitors but not hinder emergency services if needed.

- As needed, all open holes, trenches, and obstacles will be properly barricaded in accordance with local site requirements. These requirements will be determined by proximity to traffic ways, both pedestrian and vehicular, and site of the hole, trench, or obstacle. If holes are required to be left open during non-working hours, they will be adequately decked over or barricaded and sufficiently lighted.

- Before any digging or boring operations are conducted, underground utility locations will be identified. All boring, excavation, and other site work will be planned and performed with consideration for underground lines. Any excavation work will be performed in accordance with IRM Contractor’s Standard Operating Procedures for Excavations.

- Either workers or other people will enact dust-mitigating procedures when the potential for the inhalation of dust particles is present.

- The act of smoking and/or ignition sources in the vicinity of potentially flammable or contaminated material is strictly prohibited.

- Drilling, boring, and use of cranes and drilling rigs, erection of towers, movement of vehicles and equipment and other activities will be planned and performed with consideration for the location, height, and relative position of aboveground utilities and fixtures, including signs; canopies; building and other structures and construction; and natural features such as trees, boulders, bodies of water, and terrain.

- When working in areas where flammable vapors may be present, particular care shall be exercised with tools and equipment that may be sources of ignition. All tools and equipment provided must be properly bonded and/or grounded. Metal buttons and zippers are prohibited on safety clothing for areas that may contain a flammable or explosive atmosphere.

- Approved and appropriate safety equipment (as specified in this HASP), such as eye protection, hard hats, foot protection, and respirators, must be worn in areas where required. In addition, eye protection must be worn when sampling soil or water that may be contaminated.

- No smoking, eating, chewing tobacco, gum chewing, or drinking will be allowed in the contaminated areas.

- Contaminated tools and hands must be kept away from the face.

- Personnel must use personal hygiene safe guards (washing up) at the end of the shift or as soon as possible after leaving the Site.

- Each sample must be treated and handled as though it were contaminated.

- Persons with long hair and/or loose fitting clothing that could become entangled in power equipment must take adequate precautions.

- Horseplay is prohibited in the work area.

- Work while under the influence of intoxicants, narcotics, or controlled substances is prohibited.

POSTED SIGNS

Posted danger signs will be used where an immediate hazard exists. Caution signs will be posted to warn against potential hazards and to caution against unsafe practices. Traffic control methods and barricades will be used as needed. Wooden stakes and flagging tape, or equally effective material will be used to demarcate all restricted areas.

Other postings may include the OSHA poster, emergency hospital route, and telephone numbers of contact personnel.

INVASIVE OPERATIONS

The SSO will be present on-Site during all invasive work (e.g. excavations and capping). The SSO will ensure that appropriate monitoring, levels of protection, and safety procedures are followed. No personnel will enter any excavations for any reasons. All non-essential personnel will stay at least 10 feet back from the edge of the excavation and out of the swing radius of the backhoe. No drums or other potential sources will be sampled or removed during this phase without further additions to the HASP.

The proximity of water, sewer, and electrical lines will be identified prior to invasive operations. The possibility of the presence of underground conduits or vessels containing materials under pressure will also be investigated prior to invasive operations. Properly-sized containment systems will be utilized and consideration of the potential volume of liquid or waste released during operations will be discussed with members of the field team to minimize the potential for spills and provide a method for collection of waste materials. Emergency evacuation procedures and the location of safety equipment will be established prior to start up operations. The use of protective clothing, especially hard hats, boots, and gloves will be required during drilling and other heavy equipment work.

SOIL, GROUNDWATER AND LIQUID WASTE SAMPLING

During Site invasive excavation, soil sampling for waste characterization may be required for disposal purposes. No groundwater or liquid waste sampling is anticipated during site remediation.

HEAVY EQUIPMENT DECONTAMINATION

Personnel steam cleaning heavy equipment, if necessary shall use the prescribed level of protection and adhere to the buddy system. Initially this task usually employs Level C. The heavy equipment decontamination shall be restricted to authorized personnel only. Special consideration will be given to wind speed and direction. Downwind areas are to be kept free of personnel to avoid unnecessary exposure to potential airborne contamination.

ADDITIONAL SAFETY CONSIDERATIONS

No other additional safety considerations at this time.

12.0 DECONTAMINATION AND DISPOSAL PROCEDURES

CONTAMINATION PREVENTION

One of the most important aspects of decontamination is the prevention of contamination. Good contamination prevention should minimize worker exposure and help ensure valid sample results by precluding cross-contamination. Procedures for contamination avoidance include:

Personnel:
Do not walk through areas of obvious or known contamination.
Do not directly handle or touch contaminated materials.
Make sure that there are no cuts or tears on PPE.
Fasten all closures in suits; cover with tape if necessary.
Particular care should be taken to prevent any skin injuries.
Stay upwind of airborne contaminants.
Do not carry cigarettes, cosmetics, gum, etc. into contaminated areas.

Sampling and Monitoring:
When required by the SSO, cover instruments with clear plastic, leaving openings for sampling ports. Keep all decontaminated sampling materials in bags prior to emplacement of sample matrix.

Heavy Equipment:
Care should be taken to limit the amount of contamination that comes in contact with heavy equipment (tires). Dust control measures may be needed on roads inside the site boundaries.

PERSONNEL DECONTAMINATION

All personnel shall pass through an outlined decontamination procedure when exiting the hot zone at each location. A field wash for equipment and PPE shall be set up at each work location. The system will include a gross wash and rinse for all disposable clothing and boots worn in the EZ. Upon exiting the EZ, all personnel will wash their hands, arms, neck, and face before entering the Support Zone.

EQUIPMENT DECONTAMINATION

Equipment used at the Site that is potentially contaminated shall be decontaminated to prevent hazardous materials from leaving the Site. All heavy equipment will be decontaminated at the decontamination pad and inspected by the SSO and Project Manager before it leaves the Site. The decontamination area will provide for the containment of all wastewater from the decontamination process. Respirators, airline and any other personnel equipment that comes in contact with contaminated soils shall pass through a field wash.

DECONTAMINATION DURING MEDICAL EMERGENCIES

If emergency life-saving first aid and/or medical treatment are required, normal decontamination procedures may need to be abbreviated or omitted. The Site SSO or designee will accompany contaminated victims to the medical facility to provide advice on matters involving decontamination, when necessary. The outer garments can be removed if they do not cause delays, interfere with treatment, or aggravate the problem. Respiratory equipment must always be removed. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed, a plastic barrier between the individual and clean surfaces should be used to help prevent contaminating the inside of ambulances and /or medical personnel. Outer garments are then removed at the medical facility.

No attempt will be made to wash or rinse the victim, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material that could also cause severe injury or loss of life to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed. Note that heat stroke requires prompt treatment to prevent irreversible damage or death. Protective clothing must be promptly removed. Less serious forms of heat stress also require prompt attention and removal of protective clothing immediately. Decontamination should be omitted or minimized and treatment begun immediately unless the victim is obviously contaminated.

DISPOSAL PROCEDURES

A segregating system of non-hazardous waste and hazardous waste will be developed by the SSO and Project Manager. All discarded material, waste materials, or other objects shall be handled in such a way as to preclude the potential for spreading contamination, creating sanitary hazards, or causing litter to be left on site. All potentially contaminated materials, e.g. clothing, gloves, etc., will be bagged or drummed as necessary, labeled and segregated for disposal. All non-contaminated materials shall be collected and bagged for appropriate disposal as normal domestic waste.

13.0 EMERGENCY PLAN

The potential for the development of an emergency situation is low considering the low concentrations of hazardous substances at the work site. Nevertheless, an emergency situation could occur. All personnel, prior to the start of work, will know the emergency plan outlined in this section. The emergency plan will be available for use at all times during site work.

Various individual site characteristics will determine preliminary actions taken to assure that this emergency plan is successfully implemented in the event of a site emergency. Careful consideration must be given to the proximity of neighborhood housing or places of employment, and to the relative possibility of site fire, explosion or release of vapors or gases that could affect the surrounding community.

The Project Manager shall make contact with local fire, police, and other emergency units prior to beginning work on site. In these contacts, the Project Manager will inform the emergency units about the nature and duration of work expected to the Site and the type of contaminants and the possible health or safety effects of emergencies involving these contaminants. At this time, the Project Manager and the emergency response units shall make the necessary arrangements to be prepared for any emergencies that could occur.

The Project Manager shall implement the contingency plan whenever conditions at the Site warrant such action. The Project Manager will be responsible for coordination of the evacuation emergency treatment, and transportation of site personnel as necessary, and notification of emergency response units and the appropriate management staff.

EVACUATION

In the event of an emergency situation, such as fire, explosion, or significant release of toxic gases, an air horn or other appropriate device will be sounded for approximately 10 second intervals indicating the initiation of evacuation procedures. All personnel will evacuate and assemble near the entrance to the site. The location shall be upwind of the Site where possible.

For efficient and safe site evacuation and assessment of the emergency situation, the Project Manager will have authority to initiate action if outside services are required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency signal has been given. The SSO or designated SSO must ensure that access for emergency equipment is provided and that all combustion apparatuses have been shut down once the alarm has been sounded. Once the safety of all personnel is established, the Fire Department and other emergency response groups as necessary will be notified by telephone of the emergency.

POTENTIAL OR ACTUAL FIRE OR EXPLOSION

Immediately evacuate the Site (air horn will sound for 10-second intervals), notify the local fire and police departments, and other appropriate emergency response groups if an actual fire or explosion has taken place.

PERSONNEL INJURY

Emergency first aid shall be applied on site as deemed necessary. If necessary, the individual shall be decontaminated and transported to the nearest medical facility.

The ambulance/rescue squad shall be contacted for transport as necessary in an emergency. However, since some situations may require transport of an injured party by other means, the hospital route is identified below. A map to this facility provided with this HASP in Section 2.2.3.

ACCIDENT/INCIDENT REPORTING

As soon as first aid and/or emergency response needs have been met, the employer of the injured party must be immediately notified of any incident. Written confirmation of verbal reports is to be submitted within 24 hours. A standard report form entitled "Accident Data Report" is to be used for this purpose.

For reporting purposes, the term accident refers to fatalities, lost time injuries, spill, or exposure to hazardous materials (toxic materials, explosive or flammable materials).

Any information released from the health care provider, which is not deemed confidential patient information, is to be attached to the appropriate form. Any medical information that is released by patient consent is to be filed in the individuals' medical records and treated as confidential.

OVERT PERSONNEL EXPOSURE

SKIN CONTACT:	Use copious amounts of soap and water. Wash/rinse affected area thoroughly, and then provide appropriate medical attention. Eyes should be rinsed for 15 minutes upon chemical contamination.
INHALATION:	Move personnel to fresh air and if necessary, decontaminate and transport to hospital.

INGESTION: Decontamination and transport to emergency medical facility.

PUNCTURE WOUND
OR LACERATION: Decontaminate and transport to emergency medical facility.

ADVERSE WEATHER CONDITIONS

In the event of adverse weather conditions, the SSO or designee will determine if work can continue without sacrificing the health and safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

* Potential for heat stress and heat-related injuries
* Potential for cold stress and cold-related injuries
* Treacherous weather-related conditions
* Limited visibility
* Potential for electrical storms

Site activities will be limited to daylight hours and acceptable weather conditions. Inclement working conditions include heavy rain, fog, high winds, and lighting. Observe daily weather reports and evacuate if necessary in case of inclement weather conditions.

EMERGENCY RESPONSE EQUIPMENT LIST

Some or all of the following will either be available on-Site or be able to be brought to the Site within a 2-hour period:

* 55 Gallon Drums
* 85 Gallon Drums
* Absorbent Pads
* Absorbent Booms
* Speedy-Dry
* Plastic Sheeting
* Hay Bales
* Pneumatic Nibbler
* Back Hoe
* Pressure Washer
* Air Compressor
* Wilden Pumps
* Equipment Storage Trailer
* Submersible Pumps
* Miscellaneous Hand Tools
* Portable Lighting

LARGE EQUIPMENT

If necessary, the following large equipment will be brought to the Site within 2-hours:

* Large Vacuum Truck
* Super Sucker
* Dump Trucks
* Drill Rig
* Utility Vehicle

14.0 LOGS, REPORTS AND RECORD KEEPING

Medical and Training Records

The Site Superintendent keeps medical and training records. All subcontractors must provide verification of training and medical qualifications to the Site Superintendent. The Site Superintendent will keep a log of personnel meeting appropriate training and medical qualifications for site work. The log will be kept in the project file. Medical records will be maintained in accordance with 29 CFR 1910.20.

Onsite Log

A log of personnel onsite each day will be kept by the Site Superintendent. Originals will be kept in the project file.

Exposure Records

Any monitoring results, laboratory reports, calculations and air sampling data sheets are part of an employee exposure record. These records will be kept in accordance with 29 CFR 1910.20. The originals will be sent to the Contractor records coordinator. For subcontractor employees, the original will be sent to the subcontractor employer and a copy kept in the project file.

Accident/Incident Reports

An accident/incident report must be completed for all accidents and incidents. The originals will be sent to the appropriate Contractor records coordinator for maintenance by Contractor. Copies will be distributed as stated. A copy of the forms will be kept in the project file.

OSHA Form 200

An OSHA Form 200 (Log of Occupational Injuries and Illnesses) will be kept at the Site. All recordable injuries or illnesses will be recorded on this form. At the end of the project, the original will be sent to the Contractor corporate records administrator for maintenance. Subcontractor employers must also meet the requirements of maintaining an OSHA 200 form. The Contractor accident/incident report meets the requirements of the OSHA Form 101 (Supplemental Record) and must be maintained with the OSHA Form 200 for all recordable injuries or illnesses.

Health and Safety Field Log Book

The SSO or designee will maintain the logbook in accordance with standard Contractor procedures. Daily site conditions, activities, personnel, calibration records, monitoring results and significant events will be recorded. The original logbooks will become part of the exposure records file.

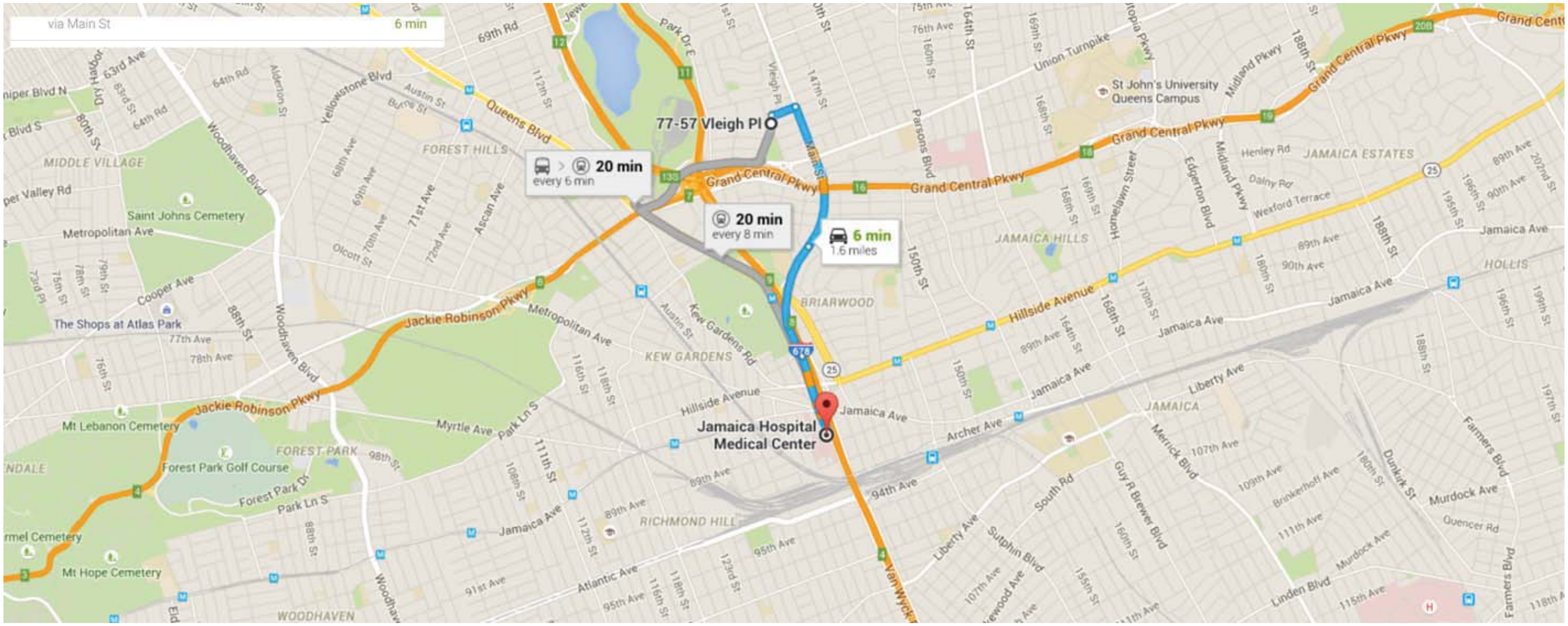
15.0 SANITATION

Since sanitary sewer connection has not been established, provisions shall be made for access to sanitary systems by using nearby public facilities consistent with provisions of governing local ordinance codes. This will include the use of outside firms providing and maintaining “Porta Potties” or similar devices.

If a commercial/industrial laundry is used to clean or launder clothing that is potentially contaminated, they shall be informed of the potential harmful effects of exposure to hazardous substances related to the affected clothing.

Personnel and subcontractors sites shall follow decontamination procedures described in the HASP. This will generally include, when necessary, site-specific training in shower usage and cleanup, personal hygiene requirements and the donning of protective equipment/clothing.

FIGURE 1
DIRECTIONS TO HOSPITAL



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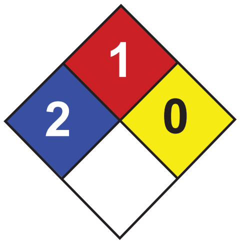
ATTACHMENT A
HEALTH AND SAFETY FACT SHEETS

ScienceLab.com
Chemicals & Laboratory Equipment



Health	2
Fire	1
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Trichloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Trichloroethylene

Catalog Codes: SLT3310, SLT2590

CAS#: 79-01-6

RTECS: KX4560000

TSCA: TSCA 8(b) inventory: Trichloroethylene

CI#: Not available.

Synonym:

Chemical Formula: C2HCl3

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Trichloroethylene	79-01-6	100

Toxicological Data on Ingredients: Trichloroethylene: ORAL (LD50): Acute: 5650 mg/kg [Rat]. 2402 mg/kg [Mouse]. DERMAL (LD50): Acute: 20001 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified A5 (Not suspected for human.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to kidneys, the nervous system, liver, heart, upper respiratory tract. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 420°C (788°F)

Flash Points: Not available.

Flammable Limits: LOWER: 8% UPPER: 10.5%

Products of Combustion: These products are carbon oxides (CO, CO2), halogenated compounds.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/

spray. Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Carcinogenic, teratogenic or mutagenic materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 50 STEL: 200 (ppm) from ACGIH (TLV) TWA: 269 STEL: 1070 (mg/m3) from ACGIH Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 131.39 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 86.7°C (188.1°F)

Melting Point: -87.1°C (-124.8°F)

Critical Temperature: Not available.

Specific Gravity: 1.4649 (Water = 1)

Vapor Pressure: 58 mm of Hg (@ 20°C)

Vapor Density: 4.53 (Air = 1)

Volatility: Not available.

Odor Threshold: 20 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, acetone.

Solubility:
Easily soluble in methanol, diethyl ether, acetone. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity:
Extremely corrosive in presence of aluminum. Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): 2402 mg/kg [Mouse]. Acute dermal toxicity (LD50): 20001 mg/kg [Rabbit].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified A5 (Not suspected for human.) by ACGIH. The substance is toxic to kidneys, the nervous system, liver, heart, upper respiratory tract.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Passes through the placental barrier in human. Detected in maternal milk in human.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. Ho□ever, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Trichloroethylene : UN1710 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Trichloroethylene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Trichloroethylene Pennsylvania RTK: Trichloroethylene Florida: Trichloroethylene Minnesota: Trichloroethylene Massachusetts RTK: Trichloroethylene New Jersey: Trichloroethylene TSCA 8(b) inventory: Trichloroethylene CERCLA: Hazardous substances.: Trichloroethylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1□: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2□: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R36/38- Irritating to eyes and skin. R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

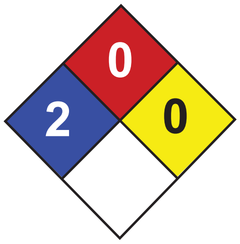
Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:54 PM

Last Updated: 11/01/2010 12:00 PM



Health	2
Fire	0
Reactivity	0
Personal Protection	G

Material Safety Data Sheet

Tetrachloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Tetrachloroethylene

Catalog Codes: SLT3220

CAS#: 127-18-4

RTECS: KX3850000

TSCA: TSCA 8(b) inventory: Tetrachloroethylene

CI#: Not available.

Synonym: Perchloroethylene; 1,1,2,2-Tetrachloroethylene; Carbon bichloride; Carbon dichloride; Ankilostin; Didakene; Dilatin PT; Ethene, tetrachloro-; Ethylene tetrachloride; Perawin; Perchlor; Perclene; Perclene D; Percosolvel; Tetrachloroethene; Tetraleno; Tetralex; Tetravec; Tetroguer; Tetropil

Chemical Name: Ethylene, tetrachloro-

Chemical Formula: C2-Cl4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Tetrachloroethylene	127-18-4	100

Toxicological Data on Ingredients: Tetrachloroethylene: ORAL (LD50): Acute: 2629 mg/kg [Rat]. DERMAL (LD): Acute: >3228 mg/kg [Rabbit]. MIST(LC50): Acute: 34200 mg/m 8 hours [Rat]. VAPOR (LC50): Acute: 5200 ppm 4 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (anticipated carcinogen) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, peripheral nervous system, respiratory tract, skin, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with skin. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, metals, acids, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 25 (ppm) from OSHA (PEL) [United States] TWA: 25 STEL: 100 (ppm) from ACGIH (TLV) [United States] TWA: 170 (mg/m3) from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Ethereal.

Taste: Not available.

Molecular Weight: 165.83 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 121.3°C (250.3°F)

Melting Point: -22.3°C (-8.1°F)

Critical Temperature: 347.1°C (656.8°F)

Specific Gravity: 1.6227 (Water = 1)

Vapor Pressure: 1.7 kPa (@ 20°C)

Vapor Density: 5.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 5 - 50 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.4

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Miscible with alcohol, ether, chloroform, benzene, hexane. It dissolves in most of the fixed and volatile oils. Solubility in water: 0.015 g/100 ml @ 25 deg. C It slowly decomposes in water to yield Trichloroacetic and Hydrochloric acids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Oxidized by strong oxidizing agents. Incompatible with sodium hydroxide, finely divided or powdered metals such as zinc, aluminum, magnesium, potassium, chemically active metals such as lithium, beryllium , barium. Protect from light.

Special Remarks on Corrosivity: Slowly corrodes aluminum, iron, and zinc.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2629 mg/kg [Rat]. Acute dermal toxicity (LD50): >3228 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5200 4 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (Some evidence.) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. May cause damage to the following organs: kidneys, liver, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Publishe Lethal Dose/Conc: LDL [Rabbit] - Route: Oral; Dose: 5000 mg/kg LDL [Dog] - Route: Oral; Dose: 4000 mg/kg LDL [Cat] - Route: Oral; Dose: 4000 mg/kg

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects(teratogenic). May affect genetic material (mutagenic). May cause cancer.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation with possible dermal blistering or burns. Symtoms may include redness, itching, pain, and possible dermal blistering or burns. It may be absorbed through the skin with possible systemic effects. A single prolonged skin exposure is not likely to result in the material being absorbed in harmful amounts. Eyes: Contact causes transient eye irritation, lacrimation. Vapors cause eye/conjunctival irritation. Symptoms may include redness and pain. Inhalation: The main route to occupational exposure is by inhalation since it is readily absorbed through the lungs. It causes respiratory tract irritation, . It can affect behavior/central nervous system (CNS depressant and anesthesia ranging from slight inebriation to death, vertigo, somnolence, anxiety, headache, excitement, hallucinations, muscle incoordination, dizziness, lightheadness, disorentiation, seizures, enotional instability, stupor, coma). It may cause pulmonary edema Ingestion: It can cause nausea, vomiting, anorexia, diarrhea, bloody stool. It may affect the liver, urinary system (proteinuria, hematuria, renal failure, renal tubular disorder), heart (arrhythmias). It may affect behavior/central nervous system with symptoms similar to that of inhalation. Chronic Potential Health Effects: Skin: Prolonged or repeated skin contact may result in excessive drying of the skin, and irritation. Ingestion/Inhalation: Chronic exposure can affect the liver(hepatitis,fatty liver degeneration), kidneys, spleen, and heart (irregular heartbeat/arrhythmias, cardiomyopathy, abnormal EEG), brain, behavior/ central nervous system/peripheral nervous system (impaired memory, numbness of extremeties, peripheral neuropathy and other

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 18.4 mg/l 96 hours [Fish (Fathead Minnow)]. 18 mg/l 48 hours [Daphnia (daphnia)]. 5 mg/l 96 hours [Fish (Rainbow Trout)]. 13 mg/l 96 hours [Fish (Bluegill sunfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Tetrachloroethylene UNNA: 1897 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Tetrachloroethylene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Tetrachloroethylene Connecticut hazardous material survey.: Tetrachloroethylene Illinois toxic substances disclosure to employee act: Tetrachloroethylene Illinois chemical safety act: Tetrachloroethylene New York release reporting list: Tetrachloroethylene Rhode Island RTK hazardous substances: Tetrachloroethylene Pennsylvania RTK: Tetrachloroethylene Minnesota: Tetrachloroethylene Michigan critical material: Tetrachloroethylene Massachusetts RTK: Tetrachloroethylene Massachusetts spill list: Tetrachloroethylene New Jersey: Tetrachloroethylene New Jersey spill list: Tetrachloroethylene Louisiana spill reporting: Tetrachloroethylene California Director's List of Hazardous Substances: Tetrachloroethylene TSCA 8(b) inventory: Tetrachloroethylene TSCA 8(d) H and S data reporting: Tetrachloroethylene: Effective date: 6/1/87; Sunset date: 6/1/97 SARA 313 toxic chemical notification and release reporting: Tetrachloroethylene CERCLA: Hazardous substances.: Tetrachloroethylene: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects. R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. S23- Do not breathe gas/fumes/vapour/spray S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S37- Wear suitable gloves. S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: g

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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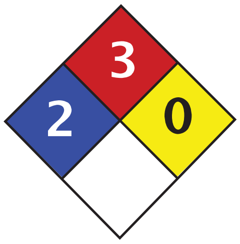

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
p-Xylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: p-Xylene

Catalog Codes: SLX1120

CAS#: 106-42-3

RTECS: □E2625000

TSCA: TSCA 8(b) inventory: p-Xylene

CI#: Not applicable.

Synonym: p-Methyltoluene

Chemical Name: 1,4-Dimethylbenzene

Chemical Formula: C6H4(CH3)2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
□p-□Xylene	106-42-3	100

Toxicological Data on Ingredients: p-Xylene: ORAL (LD50): Acute: 5000 mg/kg [Rat.]. DERMAL (LD50): Acute: 12400 mg/kg [Rabbit.]. VAPOR (LC50): Acute: 4550 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to blood, kidneys, the nervous system, liver.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 527°C (980.6°F)

Flash Points: CLOSED CUP: 25°C (77°F). OPEN CUP: 28.9°C (84°F) (Cleveland).

Flammable Limits: LOWER: 1.1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Toxic flammable liquid, insoluble or very slightly soluble in water.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as oxidizing agents.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 150 (ppm) from ACGIH (TLV)
TWA: 434 STEL: 651 (mg/m3) from ACGIHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Liquid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 138°C (280.4°F)

Melting Point: 12°C (53.6°F)

Critical Temperature: Not available.

Specific Gravity: 0.86 (Water □ 1)

Vapor Pressure: 9 mm of Hg (□ 20□C)

Vapor Density: 3.7 (Air □ 1)

Volatility: Not available.

Odor Threshold: 0.62 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether.

Solubility:
Easily soluble in methanol, diethyl ether.
Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 5000 mg/kg [Rat.].
Acute dermal toxicity (LD50): 12400 mg/kg [Rabbit.].
Acute toxicity of the vapor (LC50): 4550 ppm 4 hour(s) [Rat].

Chronic Effects on Humans: The substance is toxic to blood, kidneys, the nervous system, liver.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:

0347 Animal: embryotoxic, foetotoxic, passes through the placental barrier.
0900 Detected in maternal milk in human.
Narcotic effect; may cause nervous system disturbances.

Special Remarks on other Toxic Effects on Humans: Material is irritating to mucous membranes and upper respiratory tract.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Xylene : UN1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: p-Xylene
Florida: p-Xylene
Massachusetts RTK: p-Xylene
New Jersey: p-Xylene
TSCA 8(b) inventory: p-Xylene
SARA 313 toxic chemical notification and release reporting: p-Xylene
CERCLA: Hazardous substances.: p-Xylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS □-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-2□: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R10- Flammable.
R38- Irritating to skin.
R41- Risk of serious damage to eyes.
R48/20- Harmful: danger of serious

damage to health by prolonged
exposure through inhalation.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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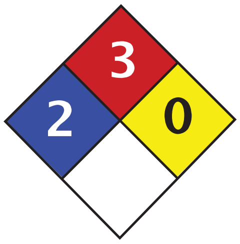

Health	2
Fire	3
Reactivity	0
Personal Protection	J

Material Safety Data Sheet
m-Xylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: m-Xylene

Catalog Codes: SLX1066

CAS#: 108-38-3

RTECS: □E2275000

TSCA: TSCA 8(b) inventory: m-Xylene

CI#: Not applicable.

Synonym: m-Methyltoluene

Chemical Name: 1,3-Dimethylbenzene

Chemical Formula: C6H4(CH3)2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
□m-□Xylene	108-38-3	100

Toxicological Data on Ingredients: m-Xylene: ORAL (LD50): Acute: 5000 mg/kg [Rat.]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit.].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to blood, kidneys, the nervous system, liver.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 527°C (980.6°F)

Flash Points: CLOSED CUP: 25°C (77°F). OPEN CUP: 28.9°C (84°F) (Cleveland).

Flammable Limits: LOWER: 1.1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid, insoluble in water.

Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as oxidizing agents.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection: Splash goggles. Lab coat. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 150 (ppm) from ACGIH (TLV)
TWA: 434 STEL: 651 (mg/m3) from ACGIHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Liquid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 139.3°C (282.7°F)

Melting Point: -47.87°C (-54.2°F)

Critical Temperature: Not available.

Specific Gravity: 0.86 (Water = 1)

Vapor Pressure: 6 mm of Hg (@ 20°C)

Vapor Density: 3.7 (Air □ 1)

Volatility: Not available.

Odor Threshold: 0.62 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether.

Solubility:
Easily soluble in methanol, diethyl ether.
Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact.

Toxicity to Animals:
Acute oral toxicity (LD50): 5000 mg/kg [Rat.].
Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit.].

Chronic Effects on Humans: The substance is toxic to blood, kidneys, the nervous system, liver.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
0347 Animal: embryotoxic, foetotoxic, passes through the placental barrier.
0900 Detected in maternal milk in human.
Narcotic effect; may cause nervous system disturbances.

Special Remarks on other Toxic Effects on Humans: Material is irritating to mucous membranes and upper respiratory tract.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Xylene : UN1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: m-Xylene
Massachusetts RTK: m-Xylene
TSCA 8(b) inventory: m-Xylene
SARA 313 toxic chemical notification and release reporting: m-Xylene
CERCLA: Hazardous substances.: m-Xylene

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS □-2: Flammable liquid with a flash point lower than 37.8□C (100□F).
CLASS D-2□: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R10- Flammable.
R38- Irritating to skin.
R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: □

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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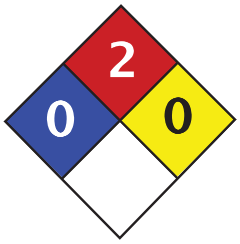

Health	0
Fire	2
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Mesitylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Mesitylene

Catalog Codes: SLM2410

CAS#: 108-67-8

RTECS: OX6825000

TSCA: TSCA 8(b) inventory: Mesitylene

CI#: Not available.

Synonym: 1,3,5-Trimethylbenzene

Chemical Formula: C9H12

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Mesitylene	108-67-8	100

Toxicological Data on Ingredients: Mesitylene: VAPOR (LC50): Acute: 4881.9 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of eye contact (irritant), of ingestion, of inhalation (lung irritant). Slightly hazardous in case of skin contact (irritant, permeator), .

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes,

keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 559°C (1038.2°F)

Flash Points: CLOSED CUP: 43°C (109.4°F).

Flammable Limits: Not available.

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Be careful that the product is not present at a

concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. Avoid contact with eyes Wear suitable protective clothing If ingested, seek medical advice immediately and show the container or the label.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. Keep container dry. Keep in a cool place.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 25 CEIL: 35 (ppm)
TWA: 125 CEIL: 170 (mg/m3)
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Aromatic.

Taste: Not available.

Molecular Weight: 120.2 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: 164.7°C (328.5°F)

Melting Point: -44.8°C (-48.6°F)

Critical Temperature: Not available.

Specific Gravity: 0.8637 (Water = 1)

Vapor Pressure: 1.86 mm of Hg (@ 20°C)

Vapor Density: 4.14 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.23 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute toxicity of the vapor (LC50): 4881.9 ppm 4 hour(s) [Rat].

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation (lung irritant).
Slightly hazardous in case of skin contact (irritant, permeator), .

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : 1,3,5-Trimethylbenzene : UN2325 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Florida: Mesitylene
New Jersey: Mesitylene
TSCA 8(b) inventory: Mesitylene

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-3: Combustible liquid with a flash point between 37.8°C (100°F) and 93.3°C (200°F).

DSCL (EEC):
R10- Flammable.
R36/37- Irritating to eyes and respiratory system.

HMIS (U.S.A.):

Health Hazard: 0

Fire Hazard: 2

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 0

Flammability: 2

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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International Chemical Safety Cards

BENZO(B)FLUORANTHENE

ICSC: 0720

[illegible]

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	[illegible]	[illegible]	[illegible]
EXPLOSION			
EXPOSURE		[illegible]	[illegible]
• **INHALATION**		[illegible]	[illegible]
• **SKIN**	[illegible]	[illegible]	[illegible]
• **EYES**		[illegible]	[illegible]
• **INGESTION**		[illegible]	[illegible]

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
[illegible]	[illegible]	[illegible]

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0720 [illegible]

International Chemical Safety Cards

BENZO(B)FLUORANTHENE

ICSC: 0720

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** [illegible] **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** [illegible] **OCCUPATIONAL EXPOSURE LIMITS (OELs):** [illegible] **ROUTES OF EXPOSURE:** [illegible] **INHALATION RISK:** [illegible] **EFFECTS OF SHORT-TERM EXPOSURE:** **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** [illegible]
PHYSICAL PROPERTIES	[illegible]
ENVIRONMENTAL DATA	[illegible]

NOTES

[illegible]

ADDITIONAL INFORMATION

ICSC: 0720 **BENZO(B)FLUORANTHENE**

[illegible]

IMPORTANT LEGAL NOTICE:	[illegible]

International Chemical Safety Cards

BENZO(K)FLUORANTHENE

ICSC: 0721

[illegible]
[illegible]
[illegible]
$\square_{20}H_{12}$
Molecular mass: 252.3

CAS # 207-08-9
RTECS # DF6350000
ICSC # 0721

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.	NO open flames.	Water spray, powder.
EXPLOSION			
EXPOSURE		PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID ALL CONTACT!	IN ALL CASES CONSULT A DOCTOR!
• **INHALATION**		Local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
• **SKIN**	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention. Wear protective gloves when administering first aid.
• **EYES**		Safety goggles or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work.	Wear protective gloves when inducing vomiting. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into containers. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment.	Provision to contain effluent from fire extinguishing. Separated from strong oxidants. Tightly closed.	

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0721

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International Chemical Safety Cards

BENZO(K)FLUORANTHENE

ICSC: 0721

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** YELLOW CRYSTALS. **PHYSICAL DANGERS:** **CHEMICAL DANGERS:** Upon heating, toxic fumes are formed. Reacts with strong oxidants. **OCCUPATIONAL EXPOSURE LIMITS (OELs):** TLV not established.	**ROUTES OF EXPOSURE:** The substance can be absorbed into the body by inhalation of its aerosol and through the skin. **INHALATION RISK:** Evaporation at 20°C is negligible□a harmful concentration of airborne particles can, however, be reached quickly. **EFFECTS OF SHORT-TERM EXPOSURE:** **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** This substance is possibly carcinogenic to humans.
PHYSICAL PROPERTIES	Boiling point: □80°C Melting point: 215.7°C	Solubility in water: none Octanol/water partition coefficient as log Pow: 6.8□
ENVIRONMENTAL DATA	This substance may be hazardous to the environment□special attention should be given to the total environment. In the food chain important to humans, bioaccumulation takes place, specifically in oils and fats.	

NOTES

Data are insufficiently available on the effect of this substance on human health, therefore utmost care must be taken. Do NOT take working clothes home.

ADDITIONAL INFORMATION

ICSC: 0721 **BENZO(K)FLUORANTHENE**

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International Chemical Safety Cards

BENZ(a)ANTHRACENE

ICSC: 0385

BENZ(a)ANTHRACENE
1,2-Benzoanthracene
Benzo(a)anthracene
2,3-Benzphenanthrene
Naphthanthracene
$C_{18}H_{12}$
Molecular mass: 228.3

CAS # 56-55-3
RTECS # CV9275000
ICSC # 0385
EC # 601-033-00-9

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Combustible.		Water spray, powder. In case of fire in the surroundings: all extinguishing agents allowed.
EXPLOSION	Finely dispersed particles form explosive mixtures in air.	Prevent deposition of dust□ closed system, dust explosion-proof electrical equipment and lighting.	
EXPOSURE		AVOID ALL CONTACT!	
• **INHALATION**		Local exhaust or breathing protection.	Fresh air, rest.
• **SKIN**		Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
• **EYES**		Safety goggles, face shield, or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
• **INGESTION**		Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Sweep spilled substance into sealable containers□if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place (extra personal protection: complete protective clothing including self-contained breathing apparatus).	Well closed.	T symbol R: □5 S: 53-□5

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0385

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International Chemical Safety Cards

BENZ(a)ANTHRACENE

ICSC: 0385

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS TO YELLOW-BROWN FLUORESCENT FLAKES OR POWDER.

PHYSICAL DANGERS:
Dust explosion possible if in powder or granular form, mixed with air.

CHEMICAL DANGERS:

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV not established.

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

INHALATION RISK:
Evaporation at 20□C is negligible□a harmful concentration of airborne particles can, however, be reached quickly.

EFFECTS OF SHORT-TERM EXPOSURE:

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:
This substance is probably carcinogenic to humans.

PHYSICAL PROPERTIES

Sublimation point: □35□C
Melting point: 162□C
Relative density (water □1): 1.27□
Solubility in water: none
Vapour pressure, Pa at 20□C: 292
Octanol/water partition coefficient as log Pow: 5.61

ENVIRONMENTAL DATA

In the food chain important to humans, bioaccumulation takes place, specifically in seafood.

NOTES

This substance is one of many polycyclic aromatic hydrocarbons - standards are usually established for them as mixtures, e.g., coal tar pitch volatiles. However, it may be encountered as a laboratory chemical in its pure form. Insufficient data are available on the effect of this substance on human health, therefore utmost care must be taken. Do NOT take working clothes home. Tetraphene is a common name.

ADDITIONAL INFORMATION

ICSC: 0385 **BENZ(a)ANTHRACENE**

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Material Safety Data Sheet

Benzo[a]pyrene, 98%

ACC# 37175

Section 1 - Chemical Product and Company Identification

MSDS Name: Benzo[a]pyrene, 98%
Catalog Numbers: AC105600000, AC105600010, AC105601000, AC377200000, AC377200010, AC377201000 AC377201000
Synonyms: 3,4-Benzopyrene; 3,4-Benzpyrene; Benzo[def]chrysene.
Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
50-32-8	Benzo[a]pyrene	>96	200-028-5

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: yellow to brown powder.
Danger! May cause harm to the unborn child. May impair fertility. May cause eye, skin, and respiratory tract irritation. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. Cancer hazard. May cause allergic skin reaction. May cause heritable genetic damage.
Target Organs: Reproductive system, skin.

Potential Health Effects

Eye: May cause eye irritation.
Skin: May cause skin irritation. May be harmful if absorbed through the skin. May cause an allergic reaction in certain individuals.
Ingestion: May cause irritation of the digestive tract. The toxicological properties of this substance have not been fully investigated. May be harmful if swallowed.
Inhalation: May cause respiratory tract irritation. The toxicological properties of this substance have not been fully investigated. May be harmful if inhaled.
Chronic: May cause cancer in humans. May cause reproductive and fetal effects. Laboratory experiments have resulted in mutagenic effects.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.
Ingestion: Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.
Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: Use water spray, dry chemical, carbon dioxide, or appropriate foam.
Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 2; Flammability: 0; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Clean up spills immediately, observing precautions in the Protective Equipment section. Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Use with adequate ventilation. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.
Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs

Benzo[a]pyrene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (as benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Benzo[a]pyrene: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.

Section 9 - Physical and Chemical Properties

Physical State: Powder
Appearance: yellow to brown
Odor: faint aromatic odor
pH: Not available.
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 495 deg C @ 760 mm Hg
Freezing/Melting Point:175 - 179 deg C
Decomposition Temperature: Not available.
Solubility: 1.60x10-3 mg/l @25°C
Specific Gravity/Density: Not available.
Molecular Formula:C20H12
Molecular Weight:252.31

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Dust generation.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 50-32-8: DJ3675000
LD50/LC50:

Not available.

Carcinogenicity:
CAS# 50-32-8:

- **ACGIH:** A2 - Suspected Human Carcinogen
- **California:** carcinogen, initial date 7/1/87
- **NTP:** Suspect carcinogen
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

Epidemiology: No information found
Teratogenicity: No information found
Reproductive Effects: Adverse reproductive effects have occurred in experimental animals.
Mutagenicity: Mutagenic effects have occurred in humans.Mutagenic effects have occurred in experimental animals.
Neurotoxicity: No information found
Other Studies:

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series:
CAS# 50-32-8: waste number U022.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	NOT REGULATED FOR DOMESTIC TRANSPORT	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOL (Benzo{a} pyrene)
Hazard Class:		9
UN Number:		UN3077
Packing Group:		III

Section 15 - Regulatory Information

US FEDERAL

TSCA

CAS# 50-32-8 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 50-32-8: 1 lb final RQ; 0.454 kg final RQ

SARA Section 302 Extremely Hazardous Substances

None of the chemicals in this product have a TPQ.

SARA Codes

CAS # 50-32-8: immediate, delayed.

Section 313

This material contains Benzo[a]pyrene (CAS# 50-32-8, >96%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 50-32-8 is listed as a Priority Pollutant under the Clean Water Act.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 50-32-8 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Prop 65

The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act:

WARNING: This product contains Benzo[a]pyrene, a chemical known to the state of California to cause cancer.
California No Significant Risk Level: CAS# 50-32-8: 0.06 æg/day NSRL

European / International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

T N

Risk Phrases:

R 43 May cause sensitization by skin contact.
R 45 May cause cancer.
R 46 May cause heritable genetic damage.
R 60 May impair fertility.
R 61 May cause harm to the unborn child.
R 50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Safety Phrases:

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

S 53 Avoid exposure - obtain special instructions before use.
S 60 This material and its container must be disposed of as hazardous waste.
S 61 Avoid release to the environment. Refer to special instructions /safety data sheets.

WGK (Water Danger/Protection)
CAS# 50-32-8: No information available.
Canada - DSL/NDSL
CAS# 50-32-8 is listed on Canada's DSL List.
Canada - WHMIS
This product has a WHMIS classification of D2A.
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.
Canadian Ingredient Disclosure List
CAS# 50-32-8 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 9/02/1997
Revision #7 Date: 6/30/2006

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

Material Safety Data Sheet

Chrysene, 98%

ACC# 95251

Section 1 - Chemical Product and Company Identification

MSDS Name: Chrysene, 98%
Catalog Numbers: AC224140000, AC224140010, AC224140050, AC224145000
Synonyms: 1,2-Benzophenanthrene; Benzo(a)phenanthrene; 1,2,5,6-Dibenzonaphthalene.
Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
218-01-9	Chrysene	98	205-923-4

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: very light beige solid.
Caution! May cause eye and skin irritation. May cause respiratory tract irritation. May cause cancer in humans.
Target Organs: Liver, skin.

Potential Health Effects

Eye: May cause eye irritation.
Skin: May cause skin irritation.
Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea.
Inhalation: May cause respiratory tract irritation.
Chronic: May cause cancer according to animal studies.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Get medical aid. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.
Ingestion: Do not induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
Inhalation: Get medical aid immediately. Remove from exposure and move to fresh air

immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. This material in sufficient quantity and reduced particle size is capable of creating a dust explosion.
Extinguishing Media: Use water spray, dry chemical, carbon dioxide, or chemical foam.
Flash Point: Not applicable.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: ; Flammability: 1; Instability:

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Vacuum or sweep up material and place into a suitable disposal container. Clean up spills immediately, observing precautions in the Protective Equipment section. Wear a self contained breathing apparatus and appropriate personal protection. (See Exposure Controls, Personal Protection section). Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Wash hands before eating. Avoid contact with eyes, skin, and clothing. Use only with adequate ventilation. Avoid breathing dust.
Storage: Store in a tightly closed container. Store in a cool, dry area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use process enclosure, local exhaust ventilation, or other engineering controls to control airborne levels.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Chrysene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (as benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Chrysene: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: very light beige
Odor: Not available.
pH: Not available.
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 448 deg C @ 760 mm Hg
Freezing/Melting Point:250-255 deg C
Decomposition Temperature: Not available.
Solubility: insoluble
Specific Gravity/Density: Not available.
Molecular Formula:$C_{18}H_{12}$
Molecular Weight:228.29

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Dust generation.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 218-01-9: GC0700000
LD50/LC50:
Not available.

Carcinogenicity:
CAS# 218-01-9:

- **ACGIH:** A3 - Confirmed animal carcinogen with unknown relevance to humans

- **California:** carcinogen, initial date 1/1/90
- **NTP:** Known carcinogen (listed as Coal tar pitches).
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

Epidemiology: No information found
Teratogenicity: No information found
Reproductive Effects: No information found
Mutagenicity: Chrysene was mutagenic to S. Typhimurium in the presence of an exogenous metabolic system.
Neurotoxicity: No information found
Other Studies:

Section 12 - Ecological Information

Ecotoxicity: Water flea LC50 = 1.9 mg/L; 2 Hr.; Unspecified Fish toxicity : LC50 (96hr) Neauthes arenacedentata >1ppm.(Rossi,S.S. et al Marine Pollut. Bull. 1978) Invertebrate toxicity : lethal treshold concentration (24hr) Daphnia Magna 0,7æg/l.(* Newsted,J.L. et al Environ. Toxicol. Chem. 1987) Bioaccumulation : 24hr Daphnia Magna log bioconcentration factor 3.7845 (*)
Environmental: Degradation studies : biodegradated by white rot fungus (Proc.Annu.Meet.Am.Wood-Preserv.Assoc.1989) May be utilised by axenic cultures of microorganisms e.g. Pseudomonas pancimobilis EPA505, which may have novel degradative systems(Mueller,J.G. et al ppl.Environ.Microbiol.1990; Mueller, J.G. et al Environ.Sci.Technol.1991).
Physical: Not found.
Other: No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series:
CAS# 218-01-9: waste number U050.

Section 14 - Transport Information

	US DOT	**Canada TDG**
Shipping Name:	Not regulated as a hazardous material	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 218-01-9 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
CERCLA Hazardous Substances and corresponding RQs
CAS# 218-01-9: 100 lb final RQ; 45.4 kg final RQ
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
Section 313
This material contains Chrysene (CAS# 218-01-9, 98%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:
This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 218-01-9 is listed as a Priority Pollutant under the Clean Water Act.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
CAS# 218-01-9 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Prop 65
The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act:
WARNING: This product contains Chrysene, a chemical known to the state of California to cause cancer.
California No Significant Risk Level: CAS# 218-01-9: 0.35 æg/day NSRL (oral)

European / International Regulations

European Labeling in Accordance with EC Directives
Hazard Symbols:
T
Risk Phrases:
R 45 May cause cancer.
R 50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Safety Phrases:
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 53 Avoid exposure - obtain special instructions before use.
S 60 This material and its container must be disposed of as hazardous waste.

S 61 Avoid release to the environment. Refer to special instructions /safety data sheets.

WGK (Water Danger/Protection)

CAS# 218-01-9: No information available.

Canada - DSL/NDSL

CAS# 218-01-9 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of D2A.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 218-01-9 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 6/30/1999
Revision #4 Date: 10/03/2005

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

Material Safety Data Sheet

Fluoranthene, 98%

ACC# 80991

Section 1 - Chemical Product and Company Identification

MSDS Name: Fluoranthene, 98%
Catalog Numbers: AC119170000, AC119170250, AC119171000, AC119175000
Synonyms: 1,2-(1,8-Naphthalenediyl)benzene; 1,2-(1,8-Naphthylene)benzene; 1,2-Benzacenaphthene; Benzene, 1,2-(1,8-naphthylene)-; Benzo(j,k)fluorene; Benzo(jk)fluoranthene; Benzo(jk)fluorene
Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
206-44-0	Fluoranthene	98	205-912-4

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: yellow needles.
Caution! Harmful. Causes eye and skin irritation and possible burns. May be harmful if absorbed through the skin. May be harmful if swallowed. May cause heart and liver injury.
Target Organs: Heart, liver, lungs.

Potential Health Effects

Eye: Causes eye irritation and possible burns.
Skin: May be harmful if absorbed through the skin. Causes severe skin irritation and possible burns.
Ingestion: May be harmful if swallowed. May cause rapid heartbeat and cardiac arrythmias. May cause liver injury, pulmonary edema, and respiratory arrest. May cause gastrointestinal disturbances such as nausea.
Inhalation: May cause effects similar to those described for ingestion. May produce cardiac failure and pulmonary edema.
Chronic: Prolonged or repeated skin contact may cause defatting and dermatitis.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the

upper and lower eyelids. Get medical aid immediately. Do NOT allow victim to rub eyes or keep eyes closed. Extensive irrigation with water is required (at least 30 minutes).
Skin: Get medical aid immediately. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Remove contaminated clothing and shoes.
Ingestion: Never give anything by mouth to an unconscious person. Get medical aid immediately. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.

Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: In case of fire, use water, dry chemical, chemical foam, or alcohol-resistant foam.
Flash Point: Not applicable.
Autoignition Temperature: Not applicable.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 2; Flammability: 0; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well-ventilated area. Do not get in eyes, on skin, or on clothing. Do not ingest or inhale. Use only in a chemical fume hood. Do not breathe dust.
Storage: Keep containers tightly closed. Store in a cool, dry area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Fluoranthene	none listed	none listed	none listed

OSHA Vacated PELs: Fluoranthene: No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin: Wear appropriate protective gloves and clothing to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.

Section 9 - Physical and Chemical Properties

Physical State: Needles
Appearance: yellow
Odor: None reported.
pH: Not available.
Vapor Pressure: 0.01 mm Hg @ 20 deg C
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 384 deg C @ 760.00mmHg
Freezing/Melting Point:107.00 - 110.00 deg C
Decomposition Temperature: Not available.
Solubility: insoluble
Specific Gravity/Density:1.252 g/cm3
Molecular Formula:$C_{16}H_{10}$
Molecular Weight:202.25

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Incompatible materials, strong oxidants.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide, acrid smoke and fumes.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 206-44-0: LL4025000
LD50/LC50:
CAS# 206-44-0:
Oral, rat: LD50 = 2 gm/kg;

Skin, rabbit: LD50 = 3180 mg/kg;

.

Carcinogenicity:
CAS# 206-44-0: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology: IARC Group 3: Limited or insufficient evidence for carcinogenicity in both animals and humans.Experimental tumorigenic data has been reported.
Teratogenicity: No information found
Reproductive Effects: No information found
Mutagenicity: Mutation in microorganisms: Salmonella typhimurium = 5ug/plate.Mutation in mammalian somatic cells: Human Lymphocyte = 2 umol/L.
Neurotoxicity: No information found
Other Studies:

Section 12 - Ecological Information

Ecotoxicity: Fish: Bluegill/Sunfish: 3980 um/L; 96 H; (not specified) No data available.
Environmental: Remains in the upper few cm of soil, but can be transported to groundwater. Biodegrades from soil in a few years. Will not volatilize from soil or water. Rapidly absorbed to sediment and particulates and will readily bioconcentrate. Unadsorbed substance in water will degrade by photolysis in a days to weeks. Stable in sediment for decades or more. In the atmostphere, photodegrades with half life of 4 - 5 days, but may transport long distances without settling or raining out.
Physical: No information available.
Other: No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series:
CAS# 206-44-0: waste number U120.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	Not regulated as a hazardous material	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA

CAS# 206-44-0 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 206-44-0: 100 lb final RQ; 45.4 kg final RQ

SARA Section 302 Extremely Hazardous Substances

None of the chemicals in this product have a TPQ.

SARA Codes

CAS # 206-44-0: immediate.

Section 313

This material contains Fluoranthene (CAS# 206-44-0, 98%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 206-44-0 is listed as a Priority Pollutant under the Clean Water Act. CAS# 206-44-0 is listed as a Toxic Pollutant under the Clean Water Act.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 206-44-0 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Massachusetts.

California Prop 65

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

XN

Risk Phrases:

R 21/22 Harmful in contact with skin and if swallowed.

Safety Phrases:

S 22 Do not breathe dust.
S 24/25 Avoid contact with skin and eyes.

WGK (Water Danger/Protection)

CAS# 206-44-0: No information available.

Canada - DSL/NDSL

CAS# 206-44-0 is listed on Canada's NDSL List.

Canada - WHMIS

This product has a WHMIS classification of D2B.
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

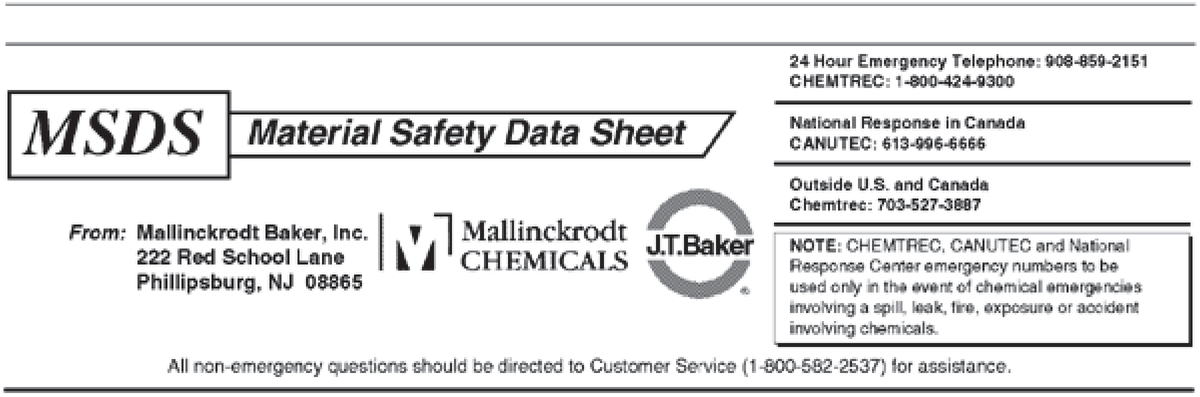
CAS# 206-44-0 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 9/02/1997
Revision #5 Date: 10/03/2005

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

MSDS Number: **L2347** □ □ □ □*Effective Date:* ***08/10/04*** ** * * * * Supercedes:* ***11/02/01***



MSDS *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

LEAD METAL

1. Product Identification

Synonyms: Granular lead, pigment metal□C.I. 77575
CAS No.: 7□39-92-1
Molecular Weight: 207.19
Chemical Formula: Pb
Product Codes:
□T. Baker: 2256, 2266
Mallinckrodt: 5668

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Lead	7439-92-1	95 - 100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! MAY BE FATAL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. NEUROTOXIN. AFFECTS THE GUM TISSUE, CENTRAL NERVOUS SYSTEM, KIDNEYS, BLOOD AND REPRODUCTIVE SYSTEM. POSSIBLE CANCER HAZARD. MAY CAUSE CANCER BASED ON ANIMAL DATA. Risk of cancer depends on duration and level of exposure.

J.T. Baker SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Life)
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:

Lead can be absorbed through the respiratory system. Local irritation of bronchia and lungs can occur and, in cases of acute exposure, symptoms such as metallic taste, chest and abdominal pain, and increased lead blood levels may follow. See also Ingestion.

Ingestion:

POISON! The symptoms of lead poisoning include abdominal pain and spasms, nausea, vomiting, headache. Acute poisoning can lead to muscle weakness, "lead line" on the gums, metallic taste, definite loss of appetite, insomnia, dizziness, high lead levels in blood and urine with shock, coma and death in extreme cases.

Skin Contact:

Lead and lead compounds may be absorbed through the skin on prolonged exposure; the symptoms of lead poisoning described for ingestion exposure may occur. Contact over short periods may cause local irritation, redness and pain.

Eye Contact:

Absorption can occur through eye tissues but the more common hazards are local irritation or abrasion.

Chronic Exposure:

Lead is a cumulative poison and exposure even to small amounts can raise the body's content to toxic levels. The symptoms of chronic exposure are like those of ingestion poisoning; restlessness, irritability, visual disturbances, hypertension and gray facial color may also be noted.

Aggravation of Pre-existing Conditions:

Persons with pre-existing kidney, nerve or circulatory disorders or with skin or eye problems may be more susceptible to the effects of this substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.
Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

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5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. Powder/dust is flammable when heated or exposed to flame.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Do not allow water runoff to enter sewers or waterways.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Can produce toxic lead fumes at elevated temperatures and also react with oxidizing materials.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

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7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Areas in which exposure to lead metal or lead compounds may occur should be identified by signs or appropriate means, and access to the area should be limited to authorized persons. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For lead, metal and inorganic dusts and fumes, as Pb:
-OSHA Permissible Exposure Limit (PEL): 0.05 mg/m3 (TWA)
For lead, elemental and inorganic compounds, as Pb:
-ACGIH Threshold Limit Value (TLV): 0.05 mg/m3 (TWA), A3 animal carcinogen
ACGIH Biological Exposure Indices (BEI): 30 ug/100ml, notation B (see actual Indices for more information).
For lead, inorganic:
-NIOSH Recommended Exposure Limit (REL): 0.1 mg/m3 (TWA)

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a half-face high efficiency particulate respirator (NIOSH type N100 filter) may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece high efficiency particulate respirator (NIOSH type N100 filter) may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

Other Control Measures:
Eating, drinking, and smoking should not be permitted in areas where solids or liquids containing lead compounds are handled, processed, or stored. See OSHA substance-specific standard for more information on personal protective equipment, engineering and work practice controls, medical surveillance, record keeping, and reporting requirements. (29 CFR 1910.1025).

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9. Physical and Chemical Properties

Appearance:
Small, white to blue-gray metallic shot or granules.
Odor:
Odorless.
Solubility:
Insoluble in water.
Density:
11.34
pH:
No information found.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
1740C (3164F)
Melting Point:
327.□C (622F)
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
1.77 @ 1000C (1832F)
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Does not decompose but toxic lead or lead oxide fumes may form at elevated temperatures.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Ammonium nitrate, chlorine trifluoride, hydrogen peroxide, sodium azide, zirconium, disodium acetylide, sodium acetylide and oxidants.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Toxicological Data:
Investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
Lead and other smelter emissions are human reproductive hazards. (Chemical Council on

Environmental Quality, Chemical Hazards to Human Reproduction (1981).

Carcinogenicity:

EPA / IRIS classification: Group B2 - Probable human carcinogen, sufficient animal evidence.

--------\Cancer Lists\--

Ingredient	NTP Carcinogen Known	NTP Carcinogen Anticipated	IARC Category
Lead (7439-92-1)	No	No	2B

12. Ecological Information

Environmental Fate:

When released into the soil, this material is not expected to leach into groundwater. This material may bioaccumulate to some extent.

Environmental Toxicity:

No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

Ingredient	TSCA	EC	Japan	Australia
Lead (7439-92-1)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---------------------------------

--Canada--

Ingredient	Korea	DSL	NDSL	Phil.
Lead (7439-92-1)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------------

	-SARA 302-		------SARA 313------	
Ingredient	RQ	TPQ	List	Chemical Catg.
Lead (7439-92-1)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------------

		-RCRA-	-TSCA-
Ingredient	CERCLA	261.33	8(d)
Lead (7439-92-1)	10	No	No

Chemical Weapons Convention: No   TSCA 12(b): No   CDTA: No
SARA 311/312: Acute: Yes   Chronic: Yes Fire: No Pressure: No
Reactivity: No   (Pure / Solid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER AND BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.

Australian Hazchem Code: None allocated.
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **3** Flammability: **1** Reactivity: **0**
Label Hazard Warning:
POISON! DANGER! MAY BE FATAL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. NEUROTOXIN. AFFECTS THE GUM TISSUE, CENTRAL NERVOUS SYSTEM, KIDNEYS, BLOOD AND REPRODUCTIVE SYSTEM. POSSIBLE CANCER HAZARD. MAY CAUSE CANCER BASED ON ANIMAL DATA. Risk of cancer depends on duration and level of exposure.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe dust.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not

breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention.

Product Use:
Laboratory Reagent.

Revision Information:
No Changes.

Disclaimer:

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Number: **M1599** □ □ □ □*Effective Date:* ***12/19/05*** * * * * * *Supercedes:* ***08/10/04***

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

MSDS ***Material Safety Data Sheet***

From: **Mallinckrodt Baker, Inc.**
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

MERCURY

1. Product Identification

Synonyms: Quicksilver□hydrargyrum□Liquid silver
CAS No.: 7439-97-6
Molecular Weight: 200.□9
Chemical Formula: Hg
Product Codes:
J.T. Baker: 2□64□2□67□2□69
Mallinckrodt: 1278□1280□1288

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Mercury	7439-97-6	90 - 100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! CORROSIVE. CAUSES BURNS TO SKIN, EYES, AND RESPIRATORY TRACT. MAY BE FATAL IF SWALLOWED OR INHALED. HARMFUL IF ABSORBED THROUGH SKIN. AFFECTS THE KIDNEYS AND CENTRAL NERVOUS SYSTEM. MAY CAUSE ALLERGIC SKIN REACTION.

SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 4 - Extreme (Life)
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 3 - Severe (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Mercury vapor is highly toxic via this route. Causes severe respiratory tract damage. Symptoms include sore throat, coughing, pain, tightness in chest, breathing difficulties, shortness of breath, headache, muscle weakness, anorexia, gastrointestinal disturbance, ringing in the ear, liver changes, fever, bronchitis and pneumonitis. Can be absorbed through inhalation with symptoms similar to ingestion.

Ingestion:
May cause burning of the mouth and pharynx, abdominal pain, vomiting, corrosive ulceration, bloody diarrhea. May be followed by a rapid and weak pulse, shallow breathing, paleness, exhaustion, tremors and collapse. Delayed death may occur from renal failure. Gastrointenstinal uptake of mercury is less than □□ but its ability to penetrate tissues presents some hazard. Initial symptoms may be thirst, possible abdominal discomfort.

Skin Contact:
Causes irritaton and burns to skin. Symptoms include redness and pain. May cause skin allergy and sensitization. Can be absorbed through the skin with symptoms to parallel ingestion.

Eye Contact:
Causes irritation and burns to eyes. Symptoms include redness, pain, blurred vision; may cause serious and permanent eye damage.

Chronic Exposure:
Chronic exposure through any route can produce central nervous system damage. May cause muscle tremors, personality and behavior changes, memory loss, metallic taste, loosening of the teeth, digestive disorders, skin rashes, brain damage and kidney damage. Can cause skin allergies and accumulate in the body. Repeated skin contact can cause the skin to turn gray in color. A suspected reproductive hazard; may damage the developing fetus and decrease fertility in males and females.

Aggravation of Pre-existing Conditions:
Persons with nervous disorders, or impaired kidney or respiratory function, or a history of allergies or a known sensitization to mercury may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

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5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Do not allow water runoff to enter sewers or waterways.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Undergoes hazardous reactions in the presence of heat and sparks or ignition. Smoke may contain toxic mercury or mercuric oxide. Smoke may contain toxic mercury or mercuric oxide.

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6. Accidental Release Measures

Ventilate area of leak or spill. Clean-up personnel require protective clothing and respiratory protection from vapor.

Spills: Pick up and place in a suitable container for reclamation or disposal in a method that does not generate misting. Sprinkle area with sulfur or calcium polysulfide to suppress mercury. Do not flush to sewer. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker CINNASORB® and RESISORB® are recommended for spills of this product.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Do not use or store on porous work surfaces (wood, unsealed concrete, etc.). Follow strict hygiene practices. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
- OSHA Acceptable Ceiling Concentration:
mercury and mercury compounds: 0.1 mg/m3 (TWA) skin
- ACGIH Threshold Limit Value (TLV):
inorganic and metallic mercury (as Hg): 0.025 mg/m3 (TWA) skin, A4 Not classifiable as a human carcinogen.
- ACGIH Biological Exposure Indices:
total inorganic mercury in urine (preshift): 35 µg/g creatinine,
total inorganic mercury in blood (end of shift): 15 µg/l.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a half-face respirator with a mercury vapor or chlorine gas cartridge may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece respirator with a mercury vapor or chlorine gas cartridge may be worn up to 50 times the exposure limit, or the maximum use concentraiton specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Silver-white, heavy, mobile liquid metal.
Odor:
Odorless.
Solubility:
Insoluble in water.
Density:
13.□□
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
3□6.7□ □67□□
Melting Point:
-38.87□ □-38□□
Vapor Density (Air=1):
7.0
Vapor Pressure (mm Hg):
0.0018 □ 2□□ □77□□
Evaporation Rate (BuAc=1):
4

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10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
At high temperatures, vaporizes to form extremely toxic fumes.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Acetylenes, ammonia, ethylene oxide, chlorine dioxide, azides, metal oxides, methyl silane, lithium, rubidium, oxygen, strong oxidants, metal carbonyls.
Conditions to Avoid:
Heat, flames, ignition sources, metal surfaces and incompatibles.

---

11. Toxicological Information

Toxicological Data:
Investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
All forms of mercury can cross the placenta to the fetus, but most of what is known has

been learned from experimental animals. See Chronic Health Hazards.
Carcinogenicity:
EPA / □□□□ classification: Group D1 - Not classifiable as a human carcinogen.

```
--------\Cancer Lists\------------------------------------------------------
                                                ---NTP Carcinogen---
Ingredient                                      Known    Anticipated    IARC Category
------------------------------------            -----    -----------    -------------
Mercury (7439-97-6)                              No          No              3
```

12. Ecological Information

Environmental Fate:
This material has an experimentally-determined bioconcentration factor □□□□□of greater than 100. This material is expected to significantly bioaccumulate.
Environmental Toxicity:
This material is expected to be toxic to aquatic life. The LC50/96-hour values for fish are less than 1 mg/l.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a □□□A approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: □□□ME□□□□□
Hazard Class: 8
UN/NA: □□2809
Packing Group: □□□
Information reported for product/size: 1L□

International (Water, I.M.O.)

Proper Shipping Name: ME□□□□□
Hazard Class: 8
UN/NA: □□2809
Packing Group: □□□
Information reported for product/size: 1L□

International (Air, I.C.A.O.)

Proper Shipping Name: ME□□□□□
Hazard Class: 8
UN/NA: □□2809
Packing □ro□p: □□□
Information reported for product/size: 1L□

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15. Regulatory Information

```
--------\Chemical Inventory Status - Part 1\---------------------------------
Ingredient                                       TSCA  EC   Japan  Australia
-----------------------------------------------  ----  ---  -----  ---------
Mercury (7439-97-6)                               Yes  Yes   No       Yes

--------\Chemical Inventory Status - Part 2\---------------------------------
                                                        --Canada--
Ingredient                                       Korea  DSL   NDSL  Phil.
-----------------------------------------------  -----  ---   ----  -----
Mercury (7439-97-6)                               Yes   Yes   No     Yes

--------\Federal, State & International Regulations - Part 1\----------------
                                           -SARA 302-    ------SARA 313------
Ingredient                                 RQ    TPQ     List  Chemical Catg.
-----------------------------------------  ---   -----   ----  --------------
Mercury (7439-97-6)                        No    No      Yes         No

--------\Federal, State & International Regulations - Part 2\----------------
                                                      -RCRA-    -TSCA-
Ingredient                                 CERCLA     261.33     8(d)
-----------------------------------------  ------     ------    ------
Mercury (7439-97-6)                        1          U151       No
```

```
Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: No  Pressure: No
Reactivity: No          (Pure / Liquid)
```

WARNING:
T□□□P□□D□□T □□□TA□□□A □□EM□AL□□□□□□ □ T□ T□E □TATE □□ □AL□□□□□A T□ □A□□E □□□T□ DE□E□T□ □□ □T□E□ □EP□□D□□T□□E □A□M.

Australian Hazchem Code: 2□
Poison Schedule: □7
WHMIS:
This M□D□has been prepared according to the ha□ard criteria of the □ontrolled Prod□cts □eg□lations □□P□□and the M□D□contains all of the information re□□ired b□the □P□.

---

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0**

Label Hazard Warning:

DANGER! CORROSIVE. CAUSES BURNS TO SKIN, EYES AND RESPIRATORY TRACT. MAY BE FATAL IF SWALLOWED OR INHALED. HARMFUL IF ABSORBED THROUGH SKIN. AFFECTS THE KIDNEYS AND CENTRAL NERVOUS SYSTEM. MAY CAUSE ALLERGIC SKIN REACTION.

Label Precautions:

Do not get in eyes, on skin, or on clothing.
Do not breathe vapor.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.

Label First Aid:

If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 1□ minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 3.

Disclaimer:

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Prepared by: Environmental Health & Safety
Phone Number: (314) 6□4-1600 (U.S.A.)

Material Safety Data Sheet

Phenanthrene, 90%

ACC# 59921

Section 1 - Chemical Product and Company Identification

MSDS Name: Phenanthrene, 90%
Catalog Numbers: AC130100000, AC130100010, AC130102500
Synonyms:
Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
85-01-8	Phenanthrene	90.0	201-581-5

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: brown solid.
Caution! Powdered material may form explosive dust-air mixtures. May cause allergic skin reaction. May cause eye and skin irritation. May cause respiratory tract irritation. Cancer suspect agent.
Target Organs: None.

Potential Health Effects

Eye: May cause eye irritation.
Skin: May cause skin irritation. May cause photosensitive skin reactions in certain individuals.
Ingestion: May cause irritation of the digestive tract.
Inhalation: Inhalation of dust may cause respiratory tract irritation.
Chronic: No information found.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.
Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.

Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Dusts at sufficient concentrations can form explosive mixtures with air. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: Use water spray or dry chemical.
Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 1; Flammability: 1; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Clean up spills immediately, observing precautions in the Protective Equipment section. Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions. Provide ventilation. Do not let this chemical enter the environment.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.
Storage: Keep container closed when not in use. Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Phenanthrene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (as benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Phenanthrene: No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: brown
Odor: none reported
pH: Not available.
Vapor Pressure: 1 mm Hg @116c
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 340 deg C
Freezing/Melting Point:101 deg C
Decomposition Temperature: Not available.
Solubility: insoluble
Specific Gravity/Density:1.0630g/cm3
Molecular Formula:C14H10
Molecular Weight:178.23

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Incompatible materials, dust generation, strong oxidants.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 85-01-8: SF7175000
LD50/LC50:
CAS# 85-01-8:
    Oral, mouse: LD50 = 700 mg/kg;
    Oral, rat: LD50 = 1.8 gm/kg;
.

Carcinogenicity:
CAS# 85-01-8:

- **ACGIH:** A1 - Confirmed Human Carcinogen (as benzene soluble aerosol) (listed as 'Coal tar pitches').
- **California:** Not listed.
- **NTP:** Known carcinogen (listed as Coal tar pitches).
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

Epidemiology: No data available.
Teratogenicity: No data available.
Reproductive Effects: No data available.
Mutagenicity: No data available.
Neurotoxicity: No data available.
Other Studies:

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	Not regulated as a hazardous material	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 85-01-8 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 85-01-8: 5000 lb final RQ; 2270 kg final RQ

SARA Section 302 Extremely Hazardous Substances

None of the chemicals in this product have a TPQ.

SARA Codes

CAS # 85-01-8: immediate.

Section 313

This material contains Phenanthrene (CAS# 85-01-8, 90.0%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 85-01-8 is listed as a Priority Pollutant under the Clean Water Act.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 85-01-8 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, (listed as Coal tar pitches), Massachusetts.

California Prop 65

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

T

Risk Phrases:

R 45 May cause cancer.

Safety Phrases:

S 24/25 Avoid contact with skin and eyes.

WGK (Water Danger/Protection)

CAS# 85-01-8: No information available.

Canada - DSL/NDSL

CAS# 85-01-8 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of D2B.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 85-01-8 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 7/14/1998
Revision #3 Date: 10/03/2005

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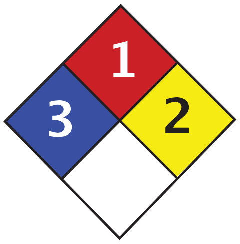

Health	3
Fire	1
Reactivity	2
Personal Protection	E

Material Safety Data Sheet
Arsenic MSDS

Section 1: Chemical Product and Company Identification

Product Name: Arsenic

Catalog Codes: SLA1006

CAS#: 7440-38-2

RTECS: CG0525000

TSCA: TSCA 8(b) inventory: Arsenic

CI#: Not applicable.

Synonym:

Chemical Name: Arsenic

Chemical Formula: As

Contact Information:

Sciencelab.com, Inc.
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Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Arsenic	7440-38-2	100

Toxicological Data on Ingredients: Arsenic: ORAL (LD50): Acute: 763 mg/kg [Rat]. 145 mg/kg [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to kidneys, lungs, the nervous system, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Flammable in presence of open flames and sparks, of heat, of oxidizing materials.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards:
Material in powder form, capable of creating a dust explosion. When heated to decomposition it emits highly toxic fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Be careful that the product is not

present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, acids, moisture.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.01 from ACGIH (TLV) [United States] [1995]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Lustrous solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 74.92 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: Not available.

Melting Point: Sublimation temperature: 615°C (1139°F)

Critical Temperature: Not available.

Specific Gravity: 5.72 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents, acids, moisture.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 145 mg/kg [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH.
Causes damage to the following organs: kidneys, lungs, the nervous system, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of ingestion, of inhalation.
Slightly hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Arsenic UNNA: UN1558 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Arsenic
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Arsenic
Pennsylvania RTK: Arsenic
Massachusetts RTK: Arsenic
TSCA 8(b) inventory: Arsenic

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R22- Harmful if swallowed.
R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 1

Reactivity: 2

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 1

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Liste des produits purs tératogènes, mutagènes, cancérogènes. Répertoire toxicologique de la Commission de la Santé et de la Sécurité du Travail du Québec.
-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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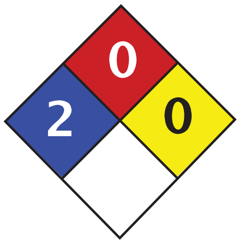

Health	2
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet

Nickel metal MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nickel metal

Catalog Codes: SLN2296, SLN1342, SLN1954

CAS#: 7440-02-0

RTECS: □R5950000

TSCA: TSCA 8(b) inventory: Nickel metal

CI#: Not applicable.

Synonym: Nickel Metal shot□Nickel metal foil.

Chemical Name: Nickel

Chemical Formula: Ni

Contact Information:

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Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

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1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Nickel metal	7440-02-0	100

Toxicological Data on Ingredients: Nickel metal LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant, sensitizer), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer), of ingestion, of inhalation (lung sensitizer).
CARCINOGENIC EFFECTS: Classified 2□ (Possible for human.) by IARC. Classified 2 (Some evidence.) by NTP.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to skin.
The substance may be toxic to kidneys, lungs, liver, upper respiratory tract.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Material in powder form, capable of creating a dust explosion. This material is flammable in powder form only.

Special Remarks on Explosion Hazards:
Material in powder form, capable of creating a dust explosion.
Mixtures containing Potassium Perchlorate with Nickel & Titanium powders & infusorial earth can explode.
Adding 2 or 3 drops of approximately 90% peroxyformic acid to powdered nickel will result in explosion.
Powdered nickel reacts explosively upon contact with fused ammonium nitrate at temperatures below 200 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Keep away from incompatibles such as oxidizing agents, combustible materials, metals, acids.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 (mg/m3) from ACGIH (TLV) [United States] Inhalation Respirable.
TWA: 0.5 (mg/m3) [United Kingdom (UK)]
TWA: 1 (mg/m3) from OSHA (PEL) [United States] InhalationConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid. Lustrous solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 58.71 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: 2730°C (4946°F)

Melting Point: 1455°C (2651°F)

Critical Temperature: Not available.

Specific Gravity: Density: 8.908 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Insoluble in cold water, hot water.
Insoluble in Ammonia.
Soluble in dilute Nitric Acid.
Slightly soluble in Hydrochloric Acid, Sulfuric Acid.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, combustible materials, metals, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with strong acids, selenium, sulfur, wood and other combustibles, nickel nitrate, aluminum, aluminum trichloride, ethylene, p-dioxan, hydrogen, methanol, non-metals, oxidants, sulfur compounds, aniline, hydrogen sulfide, flammable solvents, hydrazine, and metal powders (especially zinc, aluminum, and magnesium), ammonium nitrate, nitryl fluoride, bromine pentafluoride, potassium perchlorate + titanium powder + indusorial earth.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. Classified 2 (Some evidence.) by NTP.
Causes damage to the following organs: skin.
May cause damage to the following organs: kidneys, lungs, liver, upper respiratory tract.

Other Toxic Effects on Humans:

Hazardous in case of inhalation.
Slightly hazardous in case of skin contact (irritant, sensitizer), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose/Conc:
LDL [Rat] - Route: Oral; Dose: 5000 mg/kg
LDL [Guinea Pig] - Route: Oral; Dose: 5000 mg/kg

Special Remarks on Chronic Effects on Humans: May cause cancer based on animal test data

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Nickel dust and fume can irritate skin.
Eyes: Nickel dust and fume can irritate eyes.
Inhalation: Inhalation of dust or fume may cause respiratory tract irritation with non-productive cough, hoarseness, sore throat, headache, vertigo, weakness, chest pain, followed by delayed effects, including tachypnea, dyspnea, and ARDS. Death due to ARDS has been reported following inhalation of high concentrations of respirable metallic nickel dust. Later effects may include pulmonary edema and fibrosis.
Ingestion: Metallic nickel is generally considered not to be acutely toxic if ingested. Ingestion may cause nausea, vomiting, abdominal , and diarrhea. Nickel may damage the kidneys(proteinuria), and may affect liver function. It may also affect behavior (somnolence), and cardiovascular system (increased cornary artery resistance, decreased myocardial contractility, myocardial damage, regional or general arteriolar or venus dilation).
Chronic Potential Health Effects:
Skin: May cause skin allergy. Nickel and nickel compounds are among the most common sensitizers inducing allergic contact dermatitis.
Inhalation: Chronic inhalation nickel dust or fume can cause chronic hypertrophic rhinitis, sinusitis, nasal polyps, perforation of the nasal septum, chronic pulmonary irritation, fibrosis, pulmonary edema, pulmonary eosinophilia, Pneumoconiosis, allergies (asthma-like allergy), and cancer of the nasal sinus cavities, lungs, and possibly other organs. Future exposures can cause asthma attacks with shortness of breath, wheezing, cough, and/or chest tightness. Chronic inhalation of nickel dust or fume may also affect the liver (impaired liver function tests), and blood (changes in red blood cell count).
Ingestion: Prolonged or repeated ingestion of nickel can be a source chronic urticaria and other signs of allergy. Chronic ingestion of NIckel may also affect respiration and cause pneumoconiosis or fibrosis.
Note: In the general population, sensitization occurs from exposure to nickel-containing coins, jewelry, watches,

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Nickel metal
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Nickel metal
Connecticut hazardous material survey.: Nickel metal
Illinois toxic substances disclosure to employee act: Nickel metal
Illinois chemical safety act: Nickel metal
New York release reporting list: Nickel metal
Rhode Island RTK hazardous substances: Nickel metal
Pennsylvania RTK: Nickel metal
Michigan critical material: Nickel metal
Massachusetts RTK: Nickel metal
Massachusetts spill list: Nickel metal
New Jersey: Nickel metal
New Jersey spill list: Nickel metal
Louisiana spill reporting: Nickel metal
California Director's List of Hazardous Substances: Nickel metal
TSCA 8(b) inventory: Nickel metal

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects.
R43- May cause sensitization by skin contact.
S22- Do not breathe dust.
S36- Wear suitable protective clothing.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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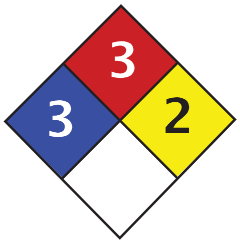

Health	3
Fire	3
Reactivity	2
Personal Protection	J

Material Safety Data Sheet
Calcium MSDS

Section 1: Chemical Product and Company Identification

Product Name: Calcium

Catalog Codes: SLC2782

CAS#: 7440-70-2

RTECS: EV8040000

TSCA: TSCA 8(b) inventory: Calcium

CI#: Not available.

Synonym:

Chemical Formula: Ca

Contact Information:

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Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Calcium	7440-70-2	100

Toxicological Data on Ingredients: Calcium LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Corrosive to eyes and skin. The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or death.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to lungs, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands : Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Corrosive solid. Flammable solid that, in contact with water, emits flammable gases.
Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Cover with dry earth, sand or other non-combustible material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal.

Section 7: Handling and Storage

Precautions:
Keep under inert atmosphere. Keep container dry. Do not breathe dust. Never add water to this product Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes Keep away from incompatibles such as acids, moisture.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. Keep container dry. Keep in a cool place.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor and dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 40.08 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: 1484°C (2703.2°F)

Melting Point: 839°C (1542.2°F)

Critical Temperature: Not available.

Specific Gravity: 1.54 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Not available.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances:
Highly reactive with acids.
Reactive with moisture.
The product reacts violently with water to emit flammable but non toxic gases.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: The substance is toxic to lungs, mucous membranes.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 4.3: Material that emits flammable gases on contact with water.

Identification: : Calcium : UN1401 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RT□: Calcium
Massachusetts RT□: Calcium
TSCA 8(b) inventory: Calcium

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS □-6: Reactive and very flammable material.
CLASS E: Corrosive solid.

DSCL (EEC): R36/38- Irritating to eyes and skin.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 3

Reactivity: 2

Personal Protection: □

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 3

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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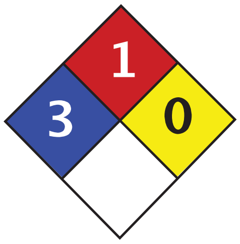

Health	3
Fire	1
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Cadmium MSDS

Section 1: Chemical Product and Company Identification

Product Name: Cadmium

Catalog Codes: SLC3484, SLC5272, SLC2482

CAS#: 7440-43-9

RTECS: EU9800000

TSCA: TSCA 8(b) inventory: Cadmium

CI#: Not applicable.

Synonym:

Chemical Name: Cadmium

Chemical Formula: Cd

Contact Information:

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14025 Smith Rd.
Houston, Texas 77396

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1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Cadmium	7440-43-9	100

Toxicological Data on Ingredients: Cadmium: ORAL (LD50): Acute: 2330 mg/kg [Rat.]. 890 mg/kg [Mouse]. DUST (LC50): Acute: 50 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, sensitizer), of eye contact (irritant). Severe over-exposure can result in death.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A2 (Suspected for human.) by ACGIH, 2 (Reasonably anticipated.) by NTP.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to kidneys, lungs, liver.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact: No known effect on eye contact, rinse with water for a few minutes.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested—the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 570°C (1058°F)

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances:
Non-flammable in presence of open flames and sparks, of heat, of oxidizing materials, of reducing materials, of combustible materials, of moisture.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards:
Material in powder form, capable of creating a dust explosion. When heated to decomposition it emits toxic fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Keep container tightly closed. Keep in a cool, well-ventilated place. Highly toxic or infectious materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.01 (ppm)
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Lustrous solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 112.4 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: 765°C (1409°F)

Melting Point: 320.9°C (609.6°F)

Critical Temperature: Not available.

Specific Gravity: 8.64 (water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water, methanol, diethyl ether, n-octanol.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not considered to be corrosive for metals and glass.

Special Remarks on Reactivity: Reacts violently with potassium.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 890 mg/kg [Mouse].
Acute toxicity of the dust (LC50): 229.9 mg/m3 4 hour(s) [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A2 (Suspected for human.) by ACGIH, 2 (Reasonably anticipated.) by NTP.
The substance is toxic to kidneys, lungs, liver.

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation.
Slightly hazardous in case of skin contact (irritant, sensitizer).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: An allergen. 0047 Animal: embryotoxic, passes through the placental barrier.

Special Remarks on other Toxic Effects on Humans: May cause allergic reactions, exzema and/or dehydration of the skin.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification:

Identification:

Special Provisions for Transport:

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Cadmium
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Cadmium
Pennsylvania RTK: Cadmium
Massachusetts RTK: Cadmium
TSCA 8(b) inventory: Cadmium
SARA 313 toxic chemical notification and release reporting: Cadmium
CERCLA: Hazardous substances.: Cadmium

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R26- Very toxic by inhalation.
R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 1

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Liste des produits purs tératogènes, mutagènes, cancérogènes. Répertoire toxicologique de la Commission de la Santé et de la Sécurité du Travail du Québec.
-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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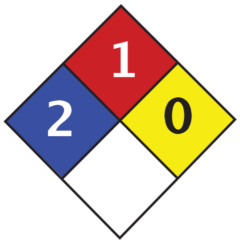

Health	2
Fire	1
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Copper MSDS

Section 1: Chemical Product and Company Identification

Product Name: Copper

Catalog Codes: SLC4939, SLC2152, SLC3943, SLC1150, SLC2941, SLC4729, SLC1936, SLC3727, SLC5515

CAS#: 7440-50-8

RTECS: GL5325000

TSCA: TSCA 8(b) inventory: Copper

CI#: Not available.

Synonym:

Chemical Name: Not available.

Chemical Formula: Cu

Contact Information:

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International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Copper	7440-50-8	100

Toxicological Data on Ingredients: Copper LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of ingestion. Hazardous in case of eye contact (irritant), of inhalation. Slightly hazardous in case of skin contact (irritant).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to lungs, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not breathe dust. Avoid contact with eyes Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If you feel unwell, seek medical attention and show the label when possible.

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Keep container tightly closed. Keep in a cool, well-ventilated place. Combustible materials should be stored away from extreme heat and away from strong oxidizing agents.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 (mg/m3) from ACGIH [1990]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 63.54 g/mole

Color: Not available.

pH (1% soln/water): Not applicable.

Boiling Point: 2595°C (4703°F)

Melting Point: 1083°C (1981.4°F)

Critical Temperature: Not available.

Specific Gravity: 8.94 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: The substance is toxic to lungs, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of ingestion.
Hazardous in case of inhalation.
Slightly hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Human: passes through the placenta, excreted in maternal milk.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Copper
Massachusetts RTK: Copper
TSCA 8(b) inventory: Copper
CERCLA: Hazardous substances.: Copper

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC): R36- Irritating to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an
approved/certified respirator or
equivalent. Wear appropriate respirator

When ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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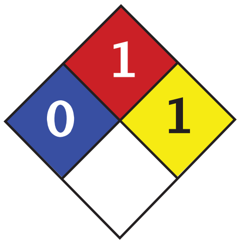

Health	1
Fire	3
Reactivity	2
Personal Protection	E

Material Safety Data Sheet
Magnesium MSDS

Section 1: Chemical Product and Company Identification

Product Name: Magnesium

Catalog Codes: SLM4408, SLM2263, SLM3637

CAS#: 7439-95-4

RTECS: OM2100000

TSCA: TSCA 8(b) inventory: Magnesium

CI#: Not applicable.

Synonym: Magnesium ribbons, turnings or sticks

Chemical Name: Magnesium

Chemical Formula: Mg

Contact Information:

Sciencelab.com, Inc.
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Houston, Texas 77396

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1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Magnesium	7439-95-4	100

Toxicological Data on Ingredients: Magnesium LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at

least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat.
Flammable in presence of acids, of moisture.
Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.
Explosive in presence of acids, of moisture.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Magnesium turnings, chips or granules, ribbons, are flammable. They can be easily ignited. They may reignite after fire is extinguished. Produces flammable gases on contact with water and acid. May ignite on contact with water or moist air.
Magnesium fires do not flare up violently unless moisture is present.

Special Remarks on Explosion Hazards: Reacts with acids and water to form hydrogen gas with is highly flammable and explosive

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Flammable solid.
Stop leak if without risk. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not breathe dust. Keep away from incompatibles such as oxidizing agents, acids, moisture.

Storage:
Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Moisture sensitive. Dangerous when wet.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 24.31 g/mole

Color: Silver-white

pH (1% soln/water): Not applicable.

Boiling Point: 1100°C (2012°F)

Melting Point: 651°C (1203.8°F)

Critical Temperature: Not available.

Specific Gravity: 1.74 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Very slightly soluble in hot water.
Insoluble in cold water.
Insoluble in chromium trioxides, and mineral acids, alkalies.
Slightly soluble with decomposition in hot water.
Soluble in concentrated hydrogen fluoride, and ammonium salts.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, incompatible materials, water or moisture, moist air.

Incompatibility with various substances: Reactive with oxidizing agents, acids, moisture.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Violent chemical reaction with oxidizing agents.
Reacts with water to create hydrogen gas and heat. Must be kept dry.
Reacts with acids to form hydrogen gas which is highly flammable and explosive.
Magnesium forms hazardous or explosive mixtures with aluminum and potassium perchlorate; ammonium nitrate; barium nitrate, barium dioxide and zinc; beryllium oxide; boron phosphodiiodide; bromobenzyl trifluoride; cadmium cyanide; cadmium oxide; calcium carbide; carbonates; carbon tetrachloride; chlorine; chlorine trifluoride; chloroform; cobalt cyanide; copper cyanide; copper sulfate(anhydrous), ammonium nitrate, potassium chlorate and water; cupric oxide; cupric sulfate; fluorine; gold cyanide; hydrogen and calcium carbonate; hydrogen iodide; hydrogen peroxide; iodine; lead cyanide; mercuric oxide; mercury cyanide; methyl chloride; molybdenum trioxide; nickel cyanide; nitric acid; nitrogen dioxide; oxygen (liquid); performic acid; phosphates; potassium chlorate; potassium perchlorate; silver nitrate; silver oxide; sodium perchlorate; sodium peroxide; sodium peroxide and carbon dioxide; stannic oxide; sulfates; trichloroethylene; zinc cyanide; zinc oxide.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: May cause skin irritation by mechanical action. May get mechanical injury or embedding of chips/particles in skin. The particles that are embedded in the wounds may retard healing.
Eyes: May cause eye irritation by mechanical action. Mechanical injury may occur. Particles or chips may embed in eye and retard healing.
Inhalation: Low hazard for ususal industrial handling. It may cause respiratory tract irritation. However, it is unlikely due to physical form. When Magnesium metal is heated during welding or smelting process, Metal Fume Fever may result from inhalation of magnesium fumes. Metal Fume Fever is a flu-like condition consisting of fever, chills, sweating, aches, pains, cough, weakness, headache, nausea, vomiting, and breathing difficulty. Other symptoms may include metallic taste, increased white blood cell count. There is no permanent ill-effect.
Ingestion: Low hazard for usual industrial handling. There are no known reports of serious industrial poisonings with Magnesium. Ingeston of large amounts of chips, turnings or ribbons may cause gastrointestinal tract irritation with nausea, vomiting, and diarrhea. Acute ingestion may also result in Hypermagnesia.
Hypermagnesia may cause hypotension, bradycardia, CNS depression, respiratory depression, and impairment of neuromuscular transmission (hyporeflexia, paralysis).

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 4.1: Flammable solid.

Identification: : Magnesium UNNA: 1869 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Magnesium
Rhode Island RTK hazardous substances: Magnesium
Pennsylvania RTK: Magnesium

Massachusetts RTK: Magnesium
Massachusetts spill list: Magnesium
New Jersey: Magnesium
TSCA 8(b) inventory: Magnesium

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-4: Flammable solid.
CLASS B-6: Reactive and very flammable material.

DSCL (EEC):
R11- Highly flammable.
R15- Contact with water liberates extremely flammable gases.
S7/8- Keep container tightly closed and dry.
S43- In case of fire, use dry chemical. Never use water.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 3

Reactivity: 2

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 0

Flammability: 1

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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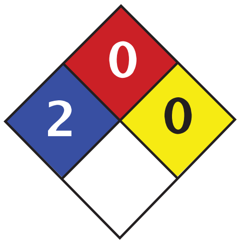

Health	2
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet

Nickel metal MSDS

Section 1: Chemical Product and Company Identification

Product Name: Nickel metal

Catalog Codes: SLN2296, SLN1342, SLN1954

CAS#: 7440-02-0

RTECS: □R5950000

TSCA: TSCA 8(b) inventory: Nickel metal

CI#: Not applicable.

Synonym: Nickel Metal shot□Nickel metal foil.

Chemical Name: Nickel

Chemical Formula: Ni

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

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1-800-424-9300

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For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Nickel metal	7440-02-0	100

Toxicological Data on Ingredients: Nickel metal LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant, sensitizer), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer), of ingestion, of inhalation (lung sensitizer).
CARCINOGENIC EFFECTS: Classified 2□ (Possible for human.) by IARC. Classified 2 (Some evidence.) by NTP.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to skin.
The substance may be toxic to kidneys, lungs, liver, upper respiratory tract.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Material in powder form, capable of creating a dust explosion. This material is flammable in powder form only.

Special Remarks on Explosion Hazards:
Material in powder form, capable of creating a dust explosion.
Mixtures containing Potassium Perchlorate with Nickel & Titanium powders & infusorial earth can explode.
Adding 2 or 3 drops of approximately 90% peroxyformic acid to powdered nickel will result in explosion.
Powdered nickel reacts explosively upon contact with fused ammonium nitrate at temperatures below 200 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Keep away from incompatibles such as oxidizing agents, combustible materials, metals, acids.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 (mg/m3) from ACGIH (TLV) [United States] Inhalation Respirable.
TWA: 0.5 (mg/m3) [United Kingdom (UK)]
TWA: 1 (mg/m3) from OSHA (PEL) [United States] InhalationConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid. Lustrous solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 58.71 g/mole

Color: Silvery.

pH (1% soln/water): Not applicable.

Boiling Point: 2730°C (4946°F)

Melting Point: 1455°C (2651°F)

Critical Temperature: Not available.

Specific Gravity: Density: 8.908 (Water □ 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Insoluble in cold water, hot water.
Insoluble in Ammonia.
Soluble in dilute Nitric Acid.
Slightly soluble in Hydrochloric Acid, Sulfuric Acid.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, combustible materials, metals, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with strong acids, selenium, sulfur, wood and other combustibles, nickel nitrate, aluminum, aluminum trichloride, ethylene, p-dioxan, hydrogen, methanol, non-metals, oxidants, sulfur compounds, aniline, hydrogen sulfide, flammable solvents, hydrazine, and metal powders (especially zinc, aluminum, and magnesium), ammonium nitrate, nitryl fluoride, bromine pentafluoride, potassium perchlorate □ titanium powder □ indusorial earth.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 2□ (Possible for human.) by IARC. Classified 2 (Some evidence.) by NTP.
Causes damage to the following organs: skin.
May cause damage to the following organs: kidneys, lungs, liver, upper respiratory tract.

Other Toxic Effects on Humans:

Hazardous in case of inhalation.
Slightly hazardous in case of skin contact (irritant, sensitizer), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose/Conc:
LDL [Rat] - Route: Oral; Dose: 5000 mg/kg
LDL [Guinea Pig] - Route: Oral; Dose: 5000 mg/kg

Special Remarks on Chronic Effects on Humans: May cause cancer based on animal test data

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Nickel dust and fume can irritate skin.
Eyes: Nickel dust and fume can irritate eyes.
Inhalation: Inhalation of dust or fume may cause respiratory tract irritation with non-productive cough, hoarseness, sore throat, headache, vertigo, weakness, chest pain, followed by delayed effects, including tachypnea, dyspnea, and ARDS. Death due to ARDS has been reported following inhalation of high concentrations of respirable metallic nickel dust. Later effects may include pulmonary edema and fibrosis.
Ingestion: Metallic nickel is generally considered not to be acutely toxic if ingested. Ingestion may cause nausea, vomiting, abdominal , and diarrhea. Nickel may damage the kidneys(proteinuria), and may affect liver function. It may also affect behavior (somnolence), and cardiovascular system (increased cornary artery resistance, decreased myocardial contractility, myocardial damage, regional or general arteriolar or venus dilation).
Chronic Potential Health Effects:
Skin: May cause skin allergy. Nickel and nickel compounds are among the most common sensitizers inducing allergic contact dermatitis.
Inhalation: Chronic inhalation nickel dust or fume can cause chronic hypertrophic rhinitis, sinusitis, nasal polyps, perforation of the nasal septum, chronic pulmonary irritation, fibrosis, pulmonary edema, pulmonary eosinophilia, Pneumoconiosis, allergies (asthma-like allergy), and cancer of the nasal sinus cavities, lungs, and possibly other organs. Future exposures can cause asthma attacks with shortness of breath, wheezing, cough, and/or chest tightness. Chronic inhalation of nickel dust or fume may also affect the liver (impaired liver function tests), and blood (changes in red blood cell count).
Ingestion: Prolonged or repeated ingestion of nickel can be a source chronic urticaria and other signs of allergy. Chronic ingestion of NIckel may also affect respiration and cause pneumoconiosis or fibrosis.
Note: In the general population, sensitization occurs from exposure to nickel-containing coins, jewelry, watches,

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Nickel metal
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Nickel metal
Connecticut hazardous material survey.: Nickel metal
Illinois toxic substances disclosure to employee act: Nickel metal
Illinois chemical safety act: Nickel metal
New York release reporting list: Nickel metal
Rhode Island RTK hazardous substances: Nickel metal
Pennsylvania RTK: Nickel metal
Michigan critical material: Nickel metal
Massachusetts RTK: Nickel metal
Massachusetts spill list: Nickel metal
New Jersey: Nickel metal
New Jersey spill list: Nickel metal
Louisiana spill reporting: Nickel metal
California Director's List of Hazardous Substances: Nickel metal
TSCA 8(b) inventory: Nickel metal

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects.
R43- May cause sensitization by skin contact.
S22- Do not breathe dust.
S36- Wear suitable protective clothing.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:42 PM

Last Updated: 11/06/2008 12:00 PM

Health	1
Fire	1
Reactivity	1
Personal Protection	E

Material Safety Data Sheet
Zinc Metal MSDS

Section 1: Chemical Product and Company Identification

Product Name: Zinc Metal

Catalog Codes: SL□1054, SL□1159, SL□1267, SL□1099, SL□1204

CAS#: 7440-66-6

RTECS: □G8600000

TSCA: TSCA 8(b) inventory: Zinc Metal

CI#: Not applicable.

Synonym: Zinc Metal Sheets□Zinc Metal Shot□Zinc Metal Strips

Chemical Name: Zinc Metal

Chemical Formula: Zn

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Zinc Metal	7440-66-6	100

Toxicological Data on Ingredients: Zinc Metal LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 480°C (896°F)

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances:
Slightly flammable to flammable in presence of open flames and sparks, of heat, of oxidizing materials, of acids, of alkalis, of moisture.
Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Zinc + NaOH causes ignition.
Oxidation of zinc by potassium proceeds with incandescence.
Residues from zinc dust /acetic acid reduction operations may ignite after long delay if discarded into waste bins with paper.
Incandescent reaction when Zinc and Arsenic or Tellurium, or Selenium are combined.
When hydrazine mononitrate is heated in contact with zinc, a flamming decomposition occurs at temperatures a little above its melting point.
Contact with acids and alkali hydroxides (sodium hydroxide, postasium hydroxide, calcium hydroxide, etc.) results in evolution of hydrogen with sufficient heat of reaction to ignite the hydrogen gas.
Zinc foil ignites if traces of moisture are present.
It is water reactive and produces flammable gases on contact with water. It may ignite on contact with water or

moist air.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Flammable solid that, in contact with water, emits flammable gases.
Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Cover with dry earth, sand or other non-combustible material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not breathe dust. Keep away from incompatibles such as oxidizing agents, acids, alkalis, moisture.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Keep from any possible contact with water. Do not allow water to get into container because of violent reaction.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Lustrous solid. Metal solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 65.39 g/mole

Color: Bluish-grey

pH (1% soln/water): Not applicable.

Boiling Point: 907°C (1664.6°F)

Melting Point: 419°C (786.2°F)

Critical Temperature: Not available.

Specific Gravity: Not available.

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water, methanol, diethyl ether, n-octanol, acetone.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, incompatible materials, moisture

Incompatibility with various substances:
Reactive with oxidizing agents, acids, alkalis.
Slightly reactive to reactive with moisture.
The product may react violently with water to emit flammable but non toxic gases.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with acids, halogenated hydrocarbons, NH4NO3, barium oxide, Ba(NO3)2, Cadmium, CS2, chlorates, Cl2, CrO3, F2, Hydroxylamine, Pb(N3)2, MnCl2, HNO3, performic acid, KClO3, KNO3, N2O2, Selenium, NaClO3, Na2O2, Sulfur, Te, water, (NH4)2S, As2O3, CS2, CaCl2, chlorinated rubber, catalytic metals, halocarbons, o-nitroanisole, nitrobenzene, nonmetals, oxidants, paint primer base, pentacarbonoyliron, transition metal halides, seleninyl bromide, HCl, H2SO4, (Mg + Ba(NO3)2 + BaO2), (ethyl acetoacetate + tribromoneopentyl alcohol.
Contact with Alkali Hydroxides(Sodium Hydroxide, Potassium Hydroxide, Calcium Hydroxide, etc) results in evolution of hydrogen.
Ammonium nitrate + zinc + water causes a violent reaction with evolution of steam and zinc oxide.
May react with water.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:

LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: May cause skin irritation. Dermal exposure to zinc may produce leg pains, fatigue, anorexia and weight loss.
Eyes: May cause eye irritation.
Ingestion: May be harmul if swallowed. May cause digestive tract irritation with tightness in throat, nausea, vomiting, diarrhea, loss of appetite, malaise, abdominal pain. fever, and chills. May affect behavior/central nervous system and autonomic nervous system with ataxia, lethargy, staggering gait, mild derrangement in cerebellar function, lightheadness, dizzness, irritability, muscular stiffness, and pain. May also affect blood.
Inhalation: Inhalation of zinc dust or fumes may cause respiratory tract and mucous membrane irritation with cough and chest pain. It can also cause "metal fume fever", a flu-like condition characterized appearance of chills, headached fever, maliase, fatigue, sweating, extreme thirst, aches in the legs and chest, and difficulty in breathing. A sweet taste may also be be present in metal fume fever, as well as a dry throat, aches, nausea, and vomiting, and pale grey cyanosis.
The toxicological properties of this substance have not been fully investisgated.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: Not available.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:

New York release reporting list: Zinc Metal
Rhode Island RTK hazardous substances: Zinc Metal
Pennsylvania RTK: Zinc Metal
Florida: Zinc Metal
Michigan critical material: Zinc Metal
Massachusetts RTK: Zinc Metal
New Jersey: Zinc Metal
California Director's List of Hazardous Substances: Zinc Metal
TSCA 8(b) inventory: Zinc Metal
TSCA 12(b) one time export: Zinc Metal
SARA 313 toxic chemical notification and release reporting: Zinc Metal
CERCLA: Hazardous substances.: Zinc Metal: 1000 lbs. (453.6 kg)

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not Available

DSCL (EEC):
R15- Contact with water liberates
extremely flammable gases.
R17- Spontaneously flammable in air.
S7/8- Keep container tightly closed and dry.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 1

Reactivity: 1

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 0

Flammability: 1

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an
approved/certified respirator or
equivalent.
Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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ATSDR Department of Health and Human Services
Agency for Toxic Substances & Disease Registry

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ToxFAQs™: Chemical Agent Briefing Sheets (CABS)

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Lead

January 2006

PDF Version

- What is lead?
- What are the forms of lead?
- What are the common uses of lead?
- What are the routes of exposure for lead?
- Who are the populations most at risk and how are they usually exposed?
- What are the possible toxic effects of lead?
- How can I reduce the risk of exposure to lead?
- What are the safety guidelines for lead exposure?
- What are the most important or common mediating factors?
- Is there a test to see if my child or I have been exposed to lead?
- Future Research Needs
- For more information

What is lead?

Lead is a heavy, bluish-gray metal that has a low melting point. It occurs naturally in the Earth's crust, but it is not a particularly abundant element. It is rarely found naturally as a metal, but rather in its divalent (2+) oxidative state in ore deposits widely distributed throughout the world. The most important lead containing ores are galena (PbS), anglesite ($PbSO_4$), and cerussite ($PbCO_3$). Natural lead is a mixture of four stable isotopes: ^{208}Pb (51%–53%), ^{206}Pb (23.5%–27%), ^{207}Pb (20.5%–23%), and ^{204}Pb (1.35%–1.5%).

What are the forms of lead?

- Metallic lead
- Inorganic lead and lead compounds (or lead salts)
- Organic lead (containing carbon)

What are the common uses of lead?

The largest use for lead is in storage batteries in cars and other vehicles. Lead may be used as a "pure" metal, alloyed with other metals, or as chemical compounds.

Lead used by industry comes from mined ores ("primary") or from recycled scrap metal or batteries ("secondary"). However, most lead today is obtained from recovery of recycled scrap, mostly lead-acid batteries.

Human activities, such as lead mining and smelting operations and manufacturing and use of lead products (*e.g.*, leaded gasoline, lead-based paint), have resulted in the contamination of many industrial and residential areas with lead.

Form	Uses
Metallic lead **Lead and lead compounds (or lead salts), such as** - **lead acetate** - **lead chloride** - **lead nitrate** - **lead oxide** - **lead phosphate** - **lead acetate**	Certain uses of lead, such as leaded gasoline, lead-based paints for domestic use, lead-based solder in food cans and water pipes, lead sinkers, and ammunition, have been reduced or banned to minimize lead's harmful effects on people and animals. - **Cosmetics and hair dye** - Some hair dyes and some non-Western cosmetics, such as kohl and surma, contain lead. - **Fishing equipment** - Most fishing weights and sinkers are made from lead. - **Folk remedies** - Many non-Western folk remedies used to treat diarrhea or other ailments may contain substantial amounts of lead. Examples of these include alarcon, ghasard, alkohl, greta, azarcon,

- **lead sulfate** - **lead sulfide**	liga, bali goli, pay-loo-ah, coral, and rueda. - **Glazing** - Applied to some ceramicware can contain lead. - **Lead based paint** - Although the sale of residential lead-based paint was banned in the United States in 1978, it remains a major source of lead exposure for young children residing in older houses. - **Lead batteries** - Production of lead-acid batteries is the major use of lead. - **Lead-based solder** - Has been banned for use in water distribution systems, but many buildings and homes contain lead pipes or lead-based solder. Lead-based solder also is used for electrical circuitry applications. - **Lead-shot** and **ammunition** - It is the second highest production use of lead. - Other uses of lead include the production of lead alloys, soldering materials, shielding for x-ray machines, and manufacturing of corrosion- and acid-resistant materials used in the building industry.
Organic - **tetraethyl lead** - **tetramethyl lead**	The use of lead in gasoline was phased out in the 1980s, and has been banned since January 1, 1996. The use of lead in gasoline has contributed to its dispersion throughout the environment. During the combustion of gasoline containing these alkyllead compounds, significant amounts of inorganic lead can be released to the surrounding areas. **Current Uses** - Gasoline for off-road vehicles, farm equipment, and airplanes **Past Uses** - Gasoline additives (to increase octane rating)

What are the routes of exposure for lead?

People are most likely to be exposed to lead by consuming contaminated food and drinking water. Exposure can also occur by inadvertently ingesting contaminated soil, dust, or lead-based paint.

Form	Routes of Exposure
Metallic lead **Lead and lead compounds (or lead salts), such as** - **lead acetate** - **lead chloride** - **lead nitrate** - **lead oxide** - **lead phosphate** - **lead subacetate** - **lead sulfate** - **lead sulfide**	- Ingestion is the primary source of exposure to the general population. - Lead paint is a major source of environmental exposure for children who ingest flaking paint, paint chips, and weathered powdered paint (mostly from deteriorated housing units in urban areas). Lead paint can also contribute to soil/dust lead which can be inadvertently ingested via hand-to-mouth activity of young children. - Lead can leach into drinking water from lead-based solder used in water pipes. - Lead can leach into foods or liquids stored in ceramic containers made with lead glazing. - Engaging in hobbies such as casting ammunition, making fishing weights, and stained glass can result in exposure to lead. - Exposure by inhalation can result during activities such as soldering with lead solder or sanding or sandblasting lead-based paint.
Organic - **tetraethyl lead** - **tetramethyl lead**	- Inhalation - Dermal studies in animals have shown that organic lead is well absorbed through the skin

Who are the populations most at risk and how are they usually exposed?

People living near hazardous waste sites, lead smelters or refineries, battery recycling or crushing centers, or other industrial lead sources may be exposed to lead and chemicals that contain lead. Workers in occupations that have sources of lead exposure (*e.g.*, plumbers, miners, mechanics, and lead smelter or refinery workers).

Certain hobbies, folk remedies, home activities, and car repairs (*e.g.*, radiator repair) can contribute to lead exposure. Smoking cigarettes or breathing second-hand smoke increases exposure because tobacco smoke contains small amounts of lead.

Pregnant women, the developing fetuses, and young children are particularly vulnerable to the effects of lead. Young children are more likely to play in dirt and to place their hands and other objects in their mouths, thereby increasing the opportunity for exposure via ingestion of lead-contaminated soil and dust.

What are the possible toxic effects of lead?

The most sensitive targets for lead toxicity are the developing nervous system, the hematological and cardiovascular systems, and the kidney. However, because of lead's many modes of action in biological systems, lead could potentially affect any system or organs in the body. The effects are the same whether it is breathed or swallowed.

Blood Lead Concentrations Corresponding to Adverse Health Effects

Life Stage	Effect	Blood lead (μg/dL)
Children	Depressed ALAD□ activity	□5
	Neurodevelopmental effects	□10
	Sexual maturation	□10
	Depressed vitamin D	□15
	Elevated EP□□	□15
	Depressed NCV□□□	□30
	Depressed hemoglobin	□40
	Colic	□60
Adults	Depressed GFR□□□□	□10
	Elevated blood pressure	□10
	Elevated EP (females)	□20
	Enzymuria/proteinuria	□30
	Peripheral neuropathy	□40
	Neurobehavioral effects	□40
	Altered thyroid hormone	□40
	Reduced fertility	□40
	Depressed hemoglobin	□50
Elderly adults	Depressed ALAD□	□5
	Neurobehavioral effects	□4

□aminolevulinic acid dehydratase (ALAD)

□□erythrocyte porphyrin (EP)

□□□nerve conduction velocity (NCV)

□□□□glomerular filtration rate (GFR)

Source: ATSDR Toxicological Profile for Lead (Draft for Public Comment), 2005.

How can I reduce the risk of exposure to lead?

- Do not allow children to chew or mouth surfaces that may have been painted with lead-based paint (homes built before 1978).
- If you have a water lead problem, the U.S. Environmental Protection Agency (EPA) recommends that you flush your cold water pipes if they have not been used in over 6 hours by running water until it is cold (5 seconds to 2 minutes) before drinking or cooking with it.
- Avoid some types of paints and pigments that contain lead and are used as make-up or hair coloring□keep these kinds of products away from children.
- Hire a professional contractor, who is required to follow certain health safety requirements for remediation or renovation involving lead-based paint, (www.epa.gov/lead/pubs/leadinfo.htm□remodeling).
- Wash children's hands and faces often to remove lead dusts and soil, and regularly clean the house of dust and tracked in soil.

What are the safety guidelines for lead exposure?

Air

- National Institute for Occupational Safety and Health (NIOSH)

  Recommended exposure limit (REL) time-weighted average (TWA) - 0.05 mg/m^3
  Immediately dangerous to life or health (IDLH) - 100 mg/m^3

- Occupational Safety and Health Administration (OSHA)

  Air - workplace 50 μg/m^3
  Action level - 40 μg/100 g of whole blood

- The American Conference of Governmental Industrial Hygienists (ACGIH)

Threshold limit values (TLV)/(TWA) - 0.05 mg/m^3
TLV/TWA guideline for lead arsenate - 150 μg/m^3
TLV/TWA guideline for other forms of lead - 50 μg lead/m^3

- U.S. Environmental Protection Agency (EPA)

  National Primary and Secondary Ambient Air Quality Standards - 1.5 μg/m^3

- World Health Organization (WHO)

  Air Quality guidelines -- 0.5 μg/m^3

Water

- EPA

  Maximum contaminant level (MCL) - action level 0.015 mg/L
  Action level for public supplies - 15 μg/L

- WHO

  Drinking Water Quality Guidelines - 0.01 mg/L

Blood

- Centers for Disease Control and Prevention (CDC)

  Level of concern for children - 10 μg/dL

- OSHA

  Cause for written notification and medical exam - 40 μg/dL
  Cause for medical removal from exposure - 50 μg/dL

- ACGIH

  Advisory biological exposure index - 30 μg/dL

Food

- Food and Drug Administration (FDA)

  Bottled drinking water - 0.005 mg/L

Other

- ACGIH

  Biological exposure indices (lead in blood) - 30 μg/100 mL

- Consumer Product Safety Commission

  Paint - 600 ppm

- FDA

  Ceramic ware (μg/mL leaching solution) - 0.5-3.0 μg/mL

μg/m^3: micrograms per cubic meter
μg/dL: micrograms per deciliter
μg/L: micrograms per liter
g: gram
mg/L: milligrams per liter
mL: milliliter
ppm: parts per million

What are the most important or common mediating factors?

Factors that determine the severity of the health effects from lead exposure include

- Dose
- Age of the person exposed
  - the developing nervous system is the most sensitive system to the effects of lead
  - the efficiency of lead absorption from the gastrointestinal tract is greater in children than in adults
- Life stages of women (childbirth, lactating, menopause)
- Occupational exposures
- Duration of exposure
- Health and lifestyle of the person exposed
- Nutritional status of the person exposed
  - a diet adequate in calcium and iron may decrease lead absorption

The toxic effects of lead exposure may be worse in individuals with inherited genetic diseases or gene polymorphisms such as thalassemia, individuals with glucose-6-phosphate dehydrogenase (G6PD) deficiency, and carriers of certain gene polymorphic forms (*e.g.*, ALAD and vitamin D receptor). Research continues about this topic.

Is there a test to see if my child or I have been exposed to lead?

Blood

- The screening test of choice is blood lead levels.
- Blood tests are commonly used to screen children for lead poisoning.
- Analysis of lead in whole blood is the most common and accurate method of assessing lead exposure.
- Exposure to lead also can be evaluated by measuring erythrocyte protoporphyrin (EP) in blood samples. EP is a part of red blood cells known to increase when the amount of lead in the blood is high. However, the EP level is not sensitive enough to identify children with elevated blood lead levels below about 25 micrograms per deciliter (μg/dL).

Bone and Teeth

- X-ray fluorescence techniques have been used to determine lead concentration in bones and teeth. It is not widely available and is used mostly in research.
- Lead partitions to bone over a lifetime of exposure; therefore, bone lead measurements may be a better indicator of cumulative exposure than blood lead.

Urine

- Measurements of urinary lead levels have been used to assess lead exposure.
- The measurement of lead excreted in urine following chelation with calcium disodium EDTA (EDTA provocation) has been used to detect elevated body burden of lead in adults and children.

Hair and Nails

- These are not reliable for testing due to errors external contamination. They are relatively poor predictors of blood lead, particularly at low concentrations.

Future Research Needs

To close current gaps in the scientific database on the health effects of lead, a long-term research program is needed that might include the following:

- Further short-term studies or studies in vitro designed to clarify mechanisms of action for the various toxicities might be useful.
- Studies identifying exposures during different developmental periods can help identify critical periods of vulnerability for immunocompetence, development of sex organs, or neurobehavioral parameters.
- Chronic-duration exposure studies in animals would expand information on the toxicity of lead. Special studies that examine biochemical and morphological effects of lead may provide new information on mechanisms of action of lead, particularly for the effects of greatest concern such as neurobehavioral changes in children.
- Development of new and more sensitive tests of specific neuropsychological functions.
- Further investigation of links between lead and amyotrophic lateral sclerosis, essential tremor, schizophrenia, and Parkinson's disease.
- Epidemiological studies designed in a manner that permits more rigorous assessments of effect modification.
- Studies about the long-term consequences of lead-related neurobehavioral deficits detected in infants and children and the manifestation of chronic neurobehavioral problems in adolescence and adulthood.
- Further characterization of bone lead concentration as a biomarker of exposure for various effect end points (*e.g.*, blood pressure and renal effects).
- Studies of the potential prevalence of elevated bone lead stores in women of reproductive age and the associated risk that this poses to fetal development by mobilization of maternal bone stores during pregnancy.
- Further clarification of the role of some genetic polymorphisms.
- Evaluation of cohorts from prospective studies into adulthood for potential late-appearing effects including cancer.

For more information

- Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for Lead

  http://www.atsdr.cdc.gov/toxprofiles/tp13.html

- ATSDR ToxFAQs™ for Lead

  http://www.atsdr.cdc.gov/tfacts13.html

- ATSDR Case Studies in Environmental Medicine Lead Toxicity

  http://www.atsdr.cdc.gov/csem/lead/

- ATSDR Interaction Profile for Chemical Mixtures for Arsenic, Cadmium, Chromium, and Lead

  http://www.atsdr.cdc.gov/interactionprofiles/ip04.html

- ATSDR Interaction Profile for Chemical Mixtures for Lead, Manganese, Zinc, and Copper

  http://www.atsdr.cdc.gov/interactionprofiles/ip06.html

- ATSDR Interaction Profile for Chemical Mixtures for Chlorpyrifos, Lead, Mercury, and Methylmercury

  http://www.atsdr.cdc.gov/interactionprofiles/ip11.html

- Centers for Disease Control and Prevention Lead Web Page

  http://www.cdc.gov/lead/

- U.S. Environmental Protection Agency Lead Web Page

  http://www.epa.gov/lead/

- U.S. Department of Labor, Occupational Safety & Health Administration

  http://www.osha.gov/SLTC/lead/

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Environmental Medicine
1600 Clifton Road NE, Mailstop F-32
Atlanta, GA 30333
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Email: CDCINFO@cdc.gov

This page was updated on 01/04/2008

Mercury

Mercury is a naturally occurring metal found in air, water, and soil. It exists in several forms, including elemental (or metallic) mercury, inorganic mercury compounds, and organic mercury compounds:

- **Elemental mercury** is liquid at room temperature and is used in thermometers, fluorescent light bulbs, some electrical switches, and some industrial processes.
- **Inorganic mercury** compounds are formed when mercury combines with other elements to form salts, which are usually powders or crystals. Inorganic mercury compounds are found naturally in the environment. Some forms of inorganic mercury have been used in antiseptic creams, ointments, and preservatives.
- **Organic mercury** compounds are formed when mercury combines with carbon. Microscopic organisms can produce organic mercury compounds (methylmercury) in contaminated water and soil, which can accumulate in the food chain. Other special types of organomercurials have been used as medical preservatives and medicines.

How People Are Exposed to Mercury

- Eating fish or shellfish that is contaminated with methylmercury, which is the main source of general human exposures to mercury;
- Breathing air contaminated with elemental mercury vapors (e.g., in workplaces such as dental offices and industries that use mercury or in locations where a mercury spill or release has occurred);
- Having dental fillings that contain mercury; and
- Practicing cultural or religious rituals that use mercury.

How Mercury Affects People’s Health

- Short-term exposure to extremely high levels of elemental mercury vapors can result in lung damage, nausea, diarrhea, increases in blood pressure or heart rate, skin rashes, eye irritation, and injury to the nervous system.
- Prolonged exposure to lower levels of elemental mercury can permanently damage the brain and kidneys.
- The developing brain of a fetus can be injured if the mother is exposed to methylmercury.

Levels of Mercury in U.S. Population

Scientists tested levels of mercury in the blood of 16,780 participants who took part in CDC's national study known as the National Health and Nutrition Examination Survey (NHANES). These findings are based on total blood mercury levels in the U.S. general population for persons aged 1 year and older who participated in NHANES during 2003-2006, as well as trends in the total mercury of children aged 1–5 and females aged 16–49 during 1999–2006.

- In the total population during 2003–2006, the total blood mercury levels for non–Hispanic blacks and non–Hispanic whites were higher than those for Mexican Americans.
- Across the age groups in the total population during 2003-2006, total blood mercury levels increased with age, peaked at the fifth or sixth decade, depending on race/ethnicity, and then declined.
- In the most recent survey period of 2005–2006, the 95th percentile levels for total blood mercury in children aged 1-5 years and females aged 16-49 years were 1.43 µg/L and 4.48 µg/L, respectively. The 95th percentile means that 95 percent of the U.S. population's exposure is below this estimated level. Conversely, only 5 percent of the population will have values at this level or higher.
- Over the four survey periods from 1999-2006, blood mercury levels increased slightly for non–Hispanic white children and decreased slightly for non–Hispanic black and Mexican American children. Female children had slightly higher blood mercury levels than male children.

For More Information

- Agency for Toxic Substances and Disease Registry
  Detailed information about mercury and public health is available at http://www.atsdr.cdc.gov/alerts/970626.html and http://www.atsdr.cdc.gov/cabs/mercury/index.html
- CDC Emergency Preparedness and Response
  Case definitions of mercury, toxicology FAQs, and toxicological profile at http://emergency.cdc.gov/agent/mercury/

May 2009

The Centers for Disease Control and Prevention (CDC) protects people's health and safety by preventing and controlling diseases and injuries; enhances health decisions by providing credible information on critical health issues; and promotes healthy living through strong partnerships with local, national, and international organizations.

ATSDR Department of Health and Human Services
Agency for Toxic Substances & Disease Registry

ATSDR Home › ToxFAQs™ Arsenic

ToxFAQs™

ToxFAQs™
for
Arsenic
(*Arsénico*)
August 2007

PDF Version, 92 KB

CAS#: 7440-38-2

This fact sheet answers the most frequently asked health questions (FAQs) about arsenic. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

Highlights

Exposure to higher than average levels of arsenic occur mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. At high levels, inorganic arsenic can cause death. Exposure to lower levels for a long time can cause a discoloration of the skin and the appearance of small corns or warts. Arsenic has been found in at least 1,149 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is arsenic?

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Inorganic arsenic compounds are mainly used to preserve wood. Copper chromated arsenate (CCA) is used to make "pressure-treated" lumber. CCA is no longer used in the U.S. for residential uses; it is still used in industrial applications. Organic arsenic compounds are used as pesticides, primarily on cotton fields and orchards.

What happens to arsenic when it enters the environment?

- Arsenic occurs naturally in soil and minerals and may enter the air, water, and land from wind-blown dust and may get into water from runoff and leaching.
- Arsenic cannot be destroyed in the environment. It can only change its form.
- Rain and snow remove arsenic dust particles from the air.
- Many common arsenic compounds can dissolve in water. Most of the arsenic in water will ultimately end up in soil or sediment.
- Fish and shellfish can accumulate arsenic; most of this arsenic is in an organic form called arsenobetaine that is much less harmful.

How might I be exposed to arsenic?

- Ingesting small amounts present in your food and water or breathing air containing arsenic.
- Breathing sawdust or burning smoke from wood treated with arsenic.
- Living in areas with unusually high natural levels of arsenic in rock.
- Working in a job that involves arsenic production or use, such as copper or lead smelting, wood treating, or pesticide application.

How can arsenic affect my health?

Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs.

Ingesting very high levels of arsenic can result in death. Exposure to lower levels can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of “pins and needles” in hands and feet.

Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the appearance of small “corns” or “warts” on the palms, soles, and torso.

Skin contact with inorganic arsenic may cause redness and swelling.

Almost nothing is known regarding health effects of organic arsenic compounds in humans. Studies in animals show that some simple organic arsenic compounds are less toxic than inorganic forms. Ingestion of methyl and dimethyl compounds can cause diarrhea and damage to the kidneys.

How likely is arsenic to cause cancer?

Several studies have shown that ingestion of inorganic arsenic can increase the risk of skin cancer and cancer in the liver, bladder, and lungs. Inhalation of inorganic arsenic can cause increased risk of lung cancer. The Department of Health and Human Services (DHHS) and the EPA have determined that inorganic arsenic is a known human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic arsenic is carcinogenic to humans.

How does arsenic affect children?

There is some evidence that long-term exposure to arsenic in children may result in lower IQ scores. There is also some evidence that exposure to arsenic in the womb and early childhood may increase mortality in young adults.

There is some evidence that inhaled or ingested arsenic can injure pregnant women or their unborn babies, although the studies are not definitive. Studies in animals show that large doses of arsenic that cause illness in pregnant females, can also cause low birth weight, fetal malformations, and even fetal death. Arsenic can cross the placenta and has been found in fetal tissues. Arsenic is found at low levels in breast milk.

How can families reduce their risk for exposure to arsenic?

- If you use arsenic-treated wood in home projects, you should wear dust masks, gloves, and protective clothing to decrease exposure to sawdust.
- If you live in an area with high levels of arsenic in water or soil, you should use cleaner sources of water and limit contact with soil.
- If you work in a job that may expose you to arsenic, be aware that you may carry arsenic home on your clothing, skin, hair, or tools. Be sure to shower and change clothes before going home.

Is there a medical test to show whether I've been exposed to arsenic?

There are tests available to measure arsenic in your blood, urine, hair, and fingernails. The urine test is the most reliable test for arsenic exposure within the last few days. Tests on hair and fingernails can measure exposure to high levels of arsenic over the past 6-12 months. These tests can determine if you have been exposed to above-average levels of arsenic. They cannot predict whether the arsenic levels in your body will affect your health.

Has the federal government made recommendations to protect human health?

The EPA has set limits on the amount of arsenic that industrial sources can release to the environment and has restricted or cancelled many of the uses of arsenic in pesticides. EPA has set a limit of 0.01 parts per million (ppm) for arsenic in drinking water.

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit (PEL) of 10 micrograms of arsenic per cubic meter of workplace air (10 $\mu g/m^3$) for 8 hour shifts and 40 hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Arsenic *(Update)*. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Environmental Medicine
1600 Clifton Road NE, Mailstop F-62
Atlanta, GA 30333
Phone: 1-800-CDC-INFO • 888-232-6348 (TTY)
FAX: 770-488-4178
Email: cdcinfo@cdc.gov

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

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U.S. Environmental Protection Agency

Pesticides: Topical & Chemical Fact Sheets

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Health & Safety
Specific Chemicals
Regulatory Actions

Assessing Health Risks from Pesticides

January 1999
735-F-99-002

The Federal Government, in cooperation with the States, carefully regulates pesticides to ensure that they do not pose unreasonable risks to human health or the environment. As part of that effort, the Environmental Protection Agency (EPA) requires extensive test data from pesticide producers that demonstrate pesticide products can be used without posing harm to human health and the environment. EPA scientists and analysts carefully review these data to determine whether to register (license) a pesticide product or a use and whether specific restrictions are necessary. This fact sheet is a brief overview of EPA's process for assessing potential risks to human health when evaluating pesticide products.

Background

There are more than 865 active ingredients registered as pesticides, which are formulated into thousands of pesticide products that are available in the marketplace. About 350 pesticides are used on the foods we eat, and to protect our homes and pets.

EPA plays a critical role in evaluating these chemicals prior to registration, and in reevaluating older pesticides already on the market, to ensure that they can be used with a reasonable certainty of no harm. The process EPA uses for evaluating the health impacts of a pesticide is called risk assessment.

EPA uses the National Research Council's four-step process for human health risk assessment:

Step One: Hazard Identification
Step Two: Dose-Response Assessment
Step Three: Exposure Assessment
Step Four: Risk Characterization

Step One: Hazard Identification (Toxicology)

The first step in the risk assessment process is to identify potential health effects that may occur from different types of pesticide exposure. EPA considers the full spectrum of a pesticide's potential health effects.

Generally, for human health risk assessments, many toxicity studies are conducted on animals by pesticide companies in independent laboratories and evaluated for acceptability by EPA scientists. EPA evaluates pesticides for a wide range of adverse effects, from eye and skin irritation to cancer and birth defects in laboratory animals. EPA may also consult the public literature or other sources of supporting information on any aspect of the chemical.

Step Two: Dose-Response Assessment

Paracelsus, the Swiss physician and alchemist, the "father" of modern toxicology (1493-1541) said,

> "The dose makes the poison."

In other words, **the amount of a substance a person is exposed to** is as important as **how toxic the chemical might be**. For example, small doses of aspirin can be beneficial to people, but at very high doses, this common medicine can be deadly. In some individuals, even at very low doses, aspirin may be deadly.

Dose-response assessment involves considering the dose levels at which adverse effects were observed in test animals, and using these dose levels to calculate an equal dose in humans.

Step Three: Exposure Assessment

People can be exposed to pesticides in three ways:

1. Inhaling pesticides (inhalation exposure),
2. Absorbing pesticides through the skin (dermal exposure), and
3. Getting pesticides in their mouth or digestive tract (oral exposure).

Depending on the situation, pesticides could enter the body by any one or all of these routes. Typical sources of pesticide exposure include:

- **Food**
  Most of the foods we eat have been grown with the use of pesticides. Therefore, pesticide residues may be present inside or on the surfaces of these foods.

- **Home and Personal Use Pesticides**
  You might use pesticides in and around your home to control insects, weeds, mold, mildew, bacteria, lawn and garden pests and to protect your pets from pests such as fleas. Pesticides may also be used as insect repellants which are directly applied to the skin or clothing.

- **Pesticides in Drinking Water**
  Some pesticides that are applied to farmland or other land structures can make their way in small amounts to the ground water or surface water systems that feed drinking water supplies.

- **Worker Exposure to Pesticides**
  Pesticide applicators, vegetable and fruit pickers and others who work around pesticides can be exposed due to the nature of their jobs. To address the unique risks workers face from occupational exposure, EPA evaluates occupational exposure through a separate program. All pesticides registered by EPA have been shown to be safe when used properly.

Step Four: Risk Characterization

Risk characterization is the final step in assessing human health risks from pesticides. It is the process of combining the hazard, dose-response and exposure assessments to describe the overall risk from a pesticide. It explains the assumptions used in assessing exposure as well as the uncertainties that are built into the dose-response assessment. The strength of the overall database is considered, and broad conclusions are made. EPA's role is to evaluate both toxicity and exposure and to determine the risk associated with use of the pesticide.

Simply put,

RISK = TOXICITY x EXPOSURE.

This means that the risk to human health from pesticide exposure depends on both the toxicity of the pesticide and the likelihood of people coming into contact with it. At least *some* exposure and *some* toxicity are required to result in a risk. For example, if the pesticide is very poisonous, but no people are exposed, there is no risk. Likewise, if there is ample exposure but the chemical is non-toxic, there is no risk. However, usually when pesticides are used, there is some toxicity and exposure, which results in a potential risk.

EPA recognizes that effects vary between animals of different species and from person to person. To account for this variability, *uncertainty factors* are built into the risk assessment. These uncertainty factors create an additional margin of safety for protecting people who may be exposed to the pesticides. FQPA requires EPA to use an extra 10-fold safety factor, if necessary, to protect infants and children from effects of the pesticide.

Types of Toxicity Tests EPA Requires for Human Health Risk Assessments

EPA evaluates studies conducted over different periods of time and that measure specific types of effects. These tests are evaluated to screen for potential health effects in infants, children and adults.

Acute Testing: Short-term exposure; a single exposure (dose).

- Oral, dermal (skin), and inhalation exposure
- Eye irritation
- Skin irritation
- Skin sensitization
- Neurotoxicity

Sub-chronic Testing: Intermediate exposure; repeated exposure over a longer period of time (i.e., 30-90 days).

- Oral, dermal (skin), and inhalation
- Neurotoxicity (nerve system damage)

Chronic Toxicity Testing: Long-term exposure; repeated exposure lasting for most of the test animal's life span. Intended to determine the effects of a pesticide after prolonged and repeated exposures.

- Chronic effects (non-cancer)
- Carcinogenicity (cancer)

Developmental and Reproductive Testing: Identify effects in the fetus of an exposed pregnant female (birth defects) and how pesticide exposure affects the ability of a test animal to successfully reproduce.

Mutagenicity Testing: Assess a pesticide's potential to affect the cell's genetic components.

Hormone Disruption: Measure effects for their potential to disrupt the endocrine system. The endocrine system consists of a set of glands and the hormones they produce that help guide the development, growth, reproduction, and behavior of animals including humans.

Risk Management

Once EPA completes the risk assessment process for a pesticide, we use this information to determine if (when used according to label directions), there is a reasonable certainty that the pesticide will not harm a person's health.

Using the conclusions of a risk assessment, EPA can then make a more informed decision regarding whether to approve a pesticide chemical or use, as proposed, or whether additional protective measures are necessary to limit occupational or non-occupational exposure to a pesticide. For example, EPA may prohibit a pesticide from being used on certain crops because consuming too much food treated with the pesticide may result in an unacceptable risk to consumers. Another example of protective measures is requiring workers to wear personal protective equipment (PPE) such as a respirator or chemical resistant gloves, or not allowing workers to enter treated crop fields until a specific period of time has passed.

If, after considering all appropriate risk reduction measures, the pesticide still does not meet EPA's safety standard, the Agency will not allow the proposed chemical or use. Regardless of the specific measures enforced, EPA's primary goal is to ensure that legal uses of the pesticide are protective of human health, especially the health of children, and the environment.

Human Health Risk Assessment and the Law

Federal law requires detailed evaluation of pesticides to protect human health and the environment. In 1996, Congress made significant changes to strengthen pesticide laws through the Food Quality Protection Act (FQPA). Many of these changes are key elements of the current risk assessment process. FQPA required that EPA consider:

- **A New Safety Standard**: FQPA strengthened the safety standard that pesticides must meet before being approved for use. EPA must ensure with a reasonable certainty that no harm will result from the legal uses of the pesticide.
- **Exposure from All Sources**: In evaluating a pesticide, EPA must estimate the combined risk from that pesticide from all non-occupational sources, such as:
  - Food Sources
  - Drinking Water Sources
  - Residential Sources
- **Cumulative Risk**: EPA is required to evaluate pesticides in light of similar toxic effects that different pesticides may share, or "a common mechanism of toxicity." At this time, EPA is developing a methodology for this type of assessment.
- **Special Sensitivity of Children to Pesticides**: EPA must ascertain whether there is an increased susceptibility from exposure to the pesticide to infants and children. EPA must build an additional 10-fold safety factor into risk assessments to ensure the protection of infants and children, unless it is determined that a lesser margin of safety will be safe for infants and children.

For More Information

If you would like more information about EPA's pesticide programs, contact the Communication Service Branch at (703) 305-5017 or visit the Pesticides Web site.

For more information on specific pesticides, or to inquire about the symptoms of pesticide poisoning, call the National Pesticide Information Center (NPIC), a toll-free hotline information at: 1-800-858-7378, or visit their Web site EXIT Disclaimer .

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Last updated on Tuesday, May 2nd, 2006
URL: http://www.epa.gov/pesticides/factsheets/riskassess.htm

ATSDR
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February 2001

ToxFAQs™
for
Polychlorinated Biphenyls (PCBs)

(Bifenilos Policlorados (BPCs))

This fact sheet answers the most frequently asked health questions about polychlorinated biphenyls (PCBs). For more information, you may call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Polychlorinated biphenyls (PCBs) are a mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment. Health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals. PCBs have been found in at least 500 of the 1,598 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polychlorinated biphenyls (PCBs)?

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors,

Contact Information

RELATED RESOURCES

ToxFAQ™ 35k

ToxFAQ™ en Español 32k

Public Health Statement 125k

Public Health Statement en Español 321k

Toxicological Profile 13.6MB

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ATSDR RESOURCES

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ToxFAQs™ en Español

Public Health Statements

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MMGs

MHMIs

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Priority List of Hazardous Substances

Division of Toxicology

and old microscope and hydraulic oils.

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What happens to polychlorinated biphenyls (PCBs) when they enter the environment?

- PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.
- PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.
- PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.
- PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

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How might I be exposed to polychlorinated biphenyls (PCBs)?

- Using old fluorescent lighting fixtures and electrical devices and appliances, such as television sets and refrigerators, that were made 30 or more years ago. These items may leak small amounts of PCBs into the air when they get hot during operation, and could be a source of skin exposure.
- Eating contaminated food. The main dietary sources of PCBs are fish (especially sportfish caught in contaminated lakes or rivers), meat, and dairy products.
- Breathing air near hazardous waste sites and drinking contaminated well water.
- In the workplace during repair and maintenance of PCB transformers; accidents, fires or spills involving transformers, fluorescent lights, and other old electrical devices; and disposal of PCB materials.

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How can polychlorinated biphenyls (PCBs) affect my health?

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

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How likely are polychlorinated biphenyls (PCBs) to cause cancer?

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. The EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans.

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How do polychlorinated biphenyls (PCBs) affect children?

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

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How can families reduce the risk of exposure to polychlorinated biphenyls (PCBs)?

- You and your children may be exposed to PCBs by eating fish or wildlife caught from contaminated locations. Certain states, Native American tribes, and U.S. territories have issued advisories to warn people about PCB-contaminated fish and fish-eating wildlife. You can reduce your family's exposure to PCBs by obeying these advisories.
- Children should be told not play with old appliances, electrical equipment, or transformers, since they may contain PCBs.
- Children should be discouraged from playing in the dirt near hazardous waste sites and in areas where there was a transformer fire. Children should also be discouraged from eating dirt and putting dirty hands, toys or other objects in their mouths, and should wash hands frequently.
- If you are exposed to PCBs in the workplace it is possible to carry them home on your clothes, body, or tools. If this is the case, you should shower and change clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

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Is there a medical test to show whether I've been exposed to polychlorinated biphenyls (PCBs)?

Tests exist to measure levels of PCBs in your blood, body fat, and breast milk, but these are not routinely conducted. Most people normally have low levels of PCBs in their body because nearly everyone has been environmentally exposed to PCBs. The tests can show if your PCB levels are elevated, which would indicate past exposure to above-normal levels of PCBs, but cannot determine when or how long you were exposed or whether you will develop health effects.

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Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.0005 milligrams of PCBs per liter of drinking water (0.0005 mg/L). Discharges, spills or accidental releases of 1 pound or more of PCBs into the environment must be reported to the EPA. The Food and Drug Administration (FDA) requires that infant foods, eggs, milk and other dairy products, fish and shellfish, poultry and red meat contain no more than 0.2-3 parts of PCBs per million parts (0.2-3 ppm) of food. Many states have established fish and wildlife consumption advisories for PCBs.

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References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for polychlorinated biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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Where can I get more information?

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop F-32
Atlanta, GA 30333
Phone: 1-888-42-ATSDR (1-888-422-8737)
FAX: (770)-488-4178
Email: ATSDRIC@cdc.gov

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Department of Health and Human Services
ATSDR Agency for Toxic Substances & Disease Registry

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2007 CERCLA Priority List of Hazardous Substances

2007 RANK	SUBSTANCE NAME	TOTAL POINTS	2005 RANK	CAS #
1	ARSENIC	1672.58	1	007440-38-2
2	LEAD	1534.07	2	007439-92-1
3	MERCURY	1504.69	3	007439-97-6
4	VINYL CHLORIDE	1387.75	4	000075-01-4
5	POLYCHLORINATED BIPHENYLS	1365.78	5	001336-36-3
6	BENZENE	1355.96	6	000071-43-2
7	CADMIUM	1324.22	8	007440-43-9
8	POLYCYCLIC AROMATIC HYDROCARBONS	1316.98	7	130498-29-2
9	BENZO(A)PYRENE	1312.45	9	000050-32-8
10	BENZO(B)FLUORANTHENE	1266.55	10	000205-99-2
11	CHLOROFORM	1223.03	11	000067-66-3
12	DDT, P,P'-	1193.36	12	000050-29-3
13	AROCLOR 1254	1182.63	13	011097-69-1
14	AROCLOR 1260	1177.77	14	011096-82-5
15	DIBENZO(A,H)ANTHRACENE	1165.88	15	000053-70-3
16	TRICHLOROETHYLENE	1154.73	16	000079-01-6
17	DIELDRIN	1150.91	17	000060-57-1
18	CHROMIUM, HEXAVALENT	1149.98	18	018540-29-9
19	PHOSPHORUS, WHITE	1144.77	19	007723-14-0
20	CHLORDANE	1133.21	21	000057-74-9
21	DDE, P,P'-	1132.49	20	000072-55-9
22	HEXACHLOROBUTADIENE	1129.63	22	000087-68-3
23	COAL TAR CREOSOTE	1124.32	23	008001-58-9
24	ALDRIN	1117.22	25	000309-00-2
25	DDD, P,P'-	1114.83	24	000072-54-8
26	BENZIDINE	1114.24	26	000092-87-5
27	AROCLOR 1248	1112.20	27	012672-29-6
28	CYANIDE	1099.48	28	000057-12-5
29	AROCLOR 1242	1093.14	29	053469-21-9
30	AROCLOR	1091.52	62	012767-79-2
31	TOXAPHENE	1086.65	30	008001-35-2
32	HEXACHLOROCYCLOHEXANE, GAMMA-	1081.63	32	000058-89-9
33	TETRACHLOROETHYLENE	1080.43	31	000127-18-4
34	HEPTACHLOR	1072.67	33	000076-44-8
35	1,2-DIBROMOETHANE	1064.06	34	000106-93-4
36	HEXACHLOROCYCLOHEXANE, BETA-	1060.22	37	000319-85-7
37	ACROLEIN	1059.07	36	000107-02-8
38	DISULFOTON	1058.85	35	000298-04-4
39	BENZO(A)ANTHRACENE	1057.96	38	000056-55-3
40	3,3'-DICHLOROBENZIDINE	1051.61	39	000091-94-1

41	ENDRIN	1048.57	41	000072-20-8
42	BERYLLIUM	1046.12	40	007440-41-7
43	HEXACHLOROCYCLOHEXANE, DELTA-	1038.27	42	000319-86-8
44	1,2-DIBROMO-3-CHLOROPROPANE	1035.55	43	000096-12-8
45	PENTACHLOROPHENOL	1028.01	45	000087-86-5
46	HEPTACHLOR EPOXIDE	1027.12	44	001024-57-3
47	CARBON TETRACHLORIDE	1023.32	46	000056-23-5
48	AROCLOR 1221	1018.41	47	011104-28-2
49	COBALT	1015.57	50	007440-48-4
50	DDT, O,P'-	1014.71	49	000789-02-6
51	AROCLOR 1016	1014.33	48	012674-11-2
52	DI-N-BUTYL PHTHALATE	1007.49	52	000084-74-2
53	NICKEL	1005.40	55	007440-02-0
54	ENDOSULFAN	1004.65	54	000115-29-7
55	ENDOSULFAN SULFATE	1003.56	53	001031-07-8
56	DIAZINON	1002.08	57	000333-41-5
57	ENDOSULFAN, ALPHA	1001.30	58	000959-98-8
58	XYLENES, TOTAL	996.07	59	001330-20-7
59	CIS-CHLORDANE	995.08	51	005103-71-9
60	DIBROMOCHLOROPROPANE	994.87	60	067708-83-2
61	METHOXYCHLOR	994.47	61	000072-43-5
62	BENZO(K)FLUORANTHENE	981.26	63	000207-08-9
63	ENDRIN KETONE	978.99	64	053494-70-5
64	TRANS-CHLORDANE	973.99	56	005103-74-2
65	CHROMIUM(VI) OXIDE	969.58	66	001333-82-0
66	METHANE	959.78	67	000074-82-8
67	ENDOSULFAN, BETA	959.19	65	033213-65-9
68	AROCLOR 1232	955.64	68	011141-16-5
69	ENDRIN ALDEHYDE	954.86	69	007421-93-4
70	BENZOFLUORANTHENE	951.48	70	056832-73-6
71	TOLUENE	947.50	71	000108-88-3
72	2-HEXANONE	942.02	72	000591-78-6
73	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	938.11	73	001746-01-6
74	ZINC	932.89	74	007440-66-6
75	DIMETHYLARSINIC ACID	922.06	75	000075-60-5
76	DI(2-ETHYLHEXYL)PHTHALATE	919.02	76	000117-81-7
77	CHROMIUM	908.52	77	007440-47-3
78	NAPHTHALENE	896.67	78	000091-20-3
79	1,1-DICHLOROETHENE	891.19	79	000075-35-4
80	METHYLENE CHLORIDE	888.96	81	000075-09-2
81	AROCLOR 1240	888.11	80	071328-89-7
82	2,4,6-TRINITROTOLUENE	883.59	82	000118-96-7
83	BROMODICHLOROETHANE	870.00	83	000683-53-4
84	HYDRAZINE	864.41	85	000302-01-2
85	1,2-DICHLOROETHANE	863.99	84	000107-06-2
86	2,4,6-TRICHLOROPHENOL	863.71	86	000088-06-2
87	2,4-DINITROPHENOL	860.45	87	000051-28-5
88	BIS(2-CHLOROETHYL) ETHER	859.88	88	000111-44-4
89	THIOCYANATE	849.21	89	000302-04-5
90	ASBESTOS	841.54	90	001332-21-4
91	CHLORINE	840.37	92	007782-50-5
92	CYCLOTRIMETHYLENETRINITRAMINE (RDX)	840.28	91	000121-82-4
93	HEXACHLOROBENZENE	838.34	93	000118-74-1

94	2,4-DINITROTOLUENE	837.88	96	000121-14-2
95	RADIUM-226	835.93	94	013982-63-3
96	ETHION	834.03	97	000563-12-2
97	1,1,1-TRICHLOROETHANE	833.81	95	000071-55-6
98	URANIUM	833.41	98	007440-61-1
99	ETHYLBENZENE	832.13	99	000100-41-4
100	RADIUM	828.07	100	007440-14-4
101	THORIUM	825.17	101	007440-29-1
102	4,6-DINITRO-O-CRESOL	822.78	102	000534-52-1
103	1,3,5-TRINITROBENZENE	820.17	103	000099-35-4
104	CHLOROBENZENE	819.69	105	000108-90-7
105	RADON	817.89	104	010043-92-2
106	RADIUM-228	816.76	106	015262-20-1
107	THORIUM-230	814.72	107	014269-63-7
107	URANIUM-235	814.72	107	015117-96-1
109	BARIUM	813.46	109	007440-39-3
110	FLUORANTHENE	812.40	113	000206-44-0
111	URANIUM-234	812.11	110	013966-29-5
112	N-NITROSODI-N-PROPYLAMINE	811.05	111	000621-64-7
113	THORIUM-228	810.36	112	014274-82-9
114	RADON-222	809.78	114	014859-67-7
115	HEXACHLOROCYCLOHEXANE, ALPHA-	809.56	116	000319-84-6
116	1,2,3-TRICHLOROBENZENE	808.41	143	000087-61-6
117	MANGANESE	807.90	115	007439-96-5
118	COAL TARS	807.07	117	008007-45-2
119	CHRYSOTILE ASBESTOS	806.68	119	012001-29-5
119	STRONTIUM-90	806.68	119	010098-97-2
121	PLUTONIUM-239	806.67	118	015117-48-3
122	POLONIUM-210	806.39	122	013981-52-7
123	METHYLMERCURY	806.39	121	022967-92-6
124	PLUTONIUM-238	806.01	123	013981-16-3
125	LEAD-210	805.90	124	014255-04-0
126	PLUTONIUM	805.23	125	007440-07-5
127	CHLORPYRIFOS	804.93	125	002921-88-2
128	COPPER	804.86	133	007440-50-8
129	AMERICIUM-241	804.55	128	086954-36-1
130	RADON-220	804.54	127	022481-48-7
131	AMOSITE ASBESTOS	804.07	129	012172-73-5
132	IODINE-131	803.48	130	010043-66-0
133	HYDROGEN CYANIDE	803.08	132	000074-90-8
134	TRIBUTYLTIN	802.61	131	000688-73-3
135	GUTHION	802.32	134	000086-50-0
136	NEPTUNIUM-237	802.13	135	013994-20-2
137	CHRYSENE	802.10	139	000218-01-9
138	CHLORDECONE	801.64	136	000143-50-0
138	IODINE-129	801.64	136	015046-84-1
138	PLUTONIUM-240	801.64	136	014119-33-6
141	S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	797.88	140	000078-48-8
142	BROMINE	789.15	142	007726-95-6
143	POLYBROMINATED BIPHENYLS	789.11	141	067774-32-7
144	DICOFOL	787.56	144	000115-32-2
145	PARATHION	784.14	145	000056-38-2
146	1,1,2,2-TETRACHLOROETHANE	782.15	146	000079-34-5

147	SELENIUM	778.98	147	007782-49-2	
	148	HEXACHLOROCYCLOHEXANE, TECHNICAL GRADE	774.91	148	000608-73-1
149	TRICHLOROFLUOROETHANE	770.74	149	027154-33-2	
150	TRIFLURALIN	770.12	150	001582-09-8	
151	DDD, O,P'-	768.73	151	000053-19-0	
152	4,4'-METHYLENEBIS(2-CHLOROANILINE)	766.66	152	000101-14-4	
153	HEXACHLORODIBENZO-P-DIOXIN	760.42	153	034465-46-8	
154	HEPTACHLORODIBENZO-P-DIOXIN	754.47	154	037871-00-4	
155	PENTACHLOROBENZENE	753.58	155	000608-93-5	
156	1,3-BUTADIENE	747.31	201	000106-99-0	
157	AMMONIA	745.55	156	007664-41-7	
158	2-METHYLNAPHTHALENE	743.24	157	000091-57-6	
159	1,4-DICHLOROBENZENE	737.32	159	000106-46-7	
160	1,1-DICHLOROETHANE	736.23	158	000075-34-3	
161	ACENAPHTHENE	731.25	160	000083-32-9	
162	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	726.14	161	039001-02-0	
163	1,1,2-TRICHLOROETHANE	724.96	162	000079-00-5	
164	TRICHLOROETHANE	723.32	163	025323-89-1	
165	HEXACHLOROCYCLOPENTADIENE	719.01	164	000077-47-4	
166	HEPTACHLORODIBENZOFURAN	718.58	165	038998-75-3	
167	1,2-DIPHENYLHYDRAZINE	713.90	166	000122-66-7	
168	2,3,4,7,8-PENTACHLORODIBENZOFURAN	710.71	167	057117-31-4	
169	TETRACHLOROBIPHENYL	709.21	168	026914-33-0	
170	CRESOL, PARA-	707.83	169	000106-44-5	
171	OXYCHLORDANE	706.32	170	027304-13-8	
172	1,2-DICHLOROBENZENE	704.91	171	000095-50-1	
173	1,2-DICHLOROETHENE, TRANS-	704.04	178	000156-60-5	
174	INDENO(1,2,3-CD)PYRENE	703.30	180	000193-39-5	
175	GAMMA-CHLORDENE	702.59	172	056641-38-4	
176	CARBON DISULFIDE	702.55	174	000075-15-0	
177	TETRACHLOROPHENOL	702.54	173	025167-83-3	
178	AMERICIUM	701.62	175	007440-35-9	
178	URANIUM-233	701.62	175	013968-55-3	
180	PALLADIUM	700.66	177	007440-05-3	
181	HEXACHLORODIBENZOFURAN	700.56	179	055684-94-1	
182	PHENOL	696.96	183	000108-95-2	
183	CHLOROETHANE	693.90	182	000075-00-3	
184	ACETONE	693.31	181	000067-64-1	
185	P-XYLENE	690.20	185	000106-42-3	
186	DIBENZOFURAN	689.19	187	000132-64-9	
187	ALUMINUM	688.13	186	007429-90-5	
188	2,4-DIMETHYLPHENOL	685.76	189	000105-67-9	
189	CARBON MONOXIDE	684.49	188	000630-08-0	
190	TETRACHLOROETHANE	677.97	190	025322-20-7	
191	HYDROGEN SULFIDE	676.51	193	007783-06-4	
192	PENTACHLORODIBENZOFURAN	673.21	192	030402-15-4	
193	CHLOROMETHANE	670.19	191	000074-87-3	
194	BIS(2-METHOXYETHYL) PHTHALATE	666.08	194	034006-76-3	
195	BUTYL BENZYL PHTHALATE	659.38	195	000085-68-7	
196	CRESOL, ORTHO-	658.66	196	000095-48-7	
197	HEXACHLOROETHANE	653.10	199	000067-72-1	
198	VANADIUM	651.70	198	007440-62-2	

199	N-NITROSODIMETHYLAMINE	650.71	200	000062-75-9
200	1,2,4-TRICHLOROBENZENE	647.30	203	000120-82-1
201	BROMOFORM	643.53	202	000075-25-2
202	TETRACHLORODIBENZO-P-DIOXIN	635.74	204	041903-57-5
203	1,3-DICHLOROBENZENE	631.41	205	000541-73-1
204	PENTACHLORODIBENZO-P-DIOXIN	625.12	207	036088-22-9
205	N-NITROSODIPHENYLAMINE	624.79	208	000086-30-6
206	1,2-DICHLOROETHYLENE	622.49	206	000540-59-0
207	2,3,7,8-TETRACHLORODIBENZOFURAN	622.15	210	051207-31-9
208	2-BUTANONE	620.01	209	000078-93-3
209	2,4-DICHLOROPHENOL	616.45	212	000120-83-2
210	1,4-DIOXANE	616.29	215	000123-91-1
211	FLUORINE	613.28	214	007782-41-4
212	NITRITE	612.64	216	014797-65-0
213	CESIUM-137	612.50	217	010045-97-3
214	SILVER	612.19	213	007440-22-4
215	CHROMIUM TRIOXIDE	610.85	218	007738-94-5
216	NITRATE	610.66	219	014797-55-8
217	POTASSIUM-40	608.91	220	013966-00-2
218	DINITROTOLUENE	607.65	221	025321-14-6
219	ANTIMONY	605.37	222	007440-36-0
220	COAL TAR PITCH	605.33	224	065996-93-2
221	THORIUM-227	605.32	223	015623-47-9
222	2,4,5-TRICHLOROPHENOL	604.83	225	000095-95-4
223	ARSENIC ACID	604.45	226	007778-39-4
224	ARSENIC TRIOXIDE	604.36	227	001327-53-3
225	PHORATE	603.10	228	000298-02-2
226	BENZOPYRENE	603.00	230	073467-76-2
227	CRESOLS	602.74	229	001319-77-3
228	CHLORDANE, TECHNICAL	602.62	231	012789-03-6
229	DIMETHOATE	602.61	232	000060-51-5
230	ACTINIUM-227	602.57	233	014952-40-0
230	STROBANE	602.57	233	008001-50-1
232	4-AMINOBIPHENYL	602.51	235	000092-67-1
232	PYRETHRUM	602.51	235	008003-34-7
234	ARSINE	602.42	237	007784-42-1
235	NALED	602.32	238	000300-76-5
236	DIBENZOFURANS, CHLORINATED	602.13	239	042934-53-2
236	ETHOPROP	602.13	239	013194-48-4
238	ALPHA-CHLORDENE	601.94	241	056534-02-2
238	CARBOPHENOTHION	601.94	241	000786-19-6
240	DICHLORVOS	601.64	243	000062-73-7
241	CALCIUM ARSENATE	601.45	244	007778-44-1
241	MERCURIC CHLORIDE	601.45	244	007487-94-7
241	SODIUM ARSENITE	601.45	244	007784-46-5
244	FORMALDEHYDE	599.64	247	000050-00-0
245	2-CHLOROPHENOL	599.62	248	000095-57-8
246	PHENANTHRENE	597.68	249	000085-01-8
247	HYDROGEN FLUORIDE	588.03	250	007664-39-3
248	2,4-D ACID	584.47	251	000094-75-7
249	DIBROMOCHLOROMETHANE	580.59	252	000124-48-1
250	DIURON	579.16	253	000330-54-1
251	BUTYLATE	578.43	254	002008-41-5

252	DIMETHYL FORMAMIDE	578.23	255	000068-12-2
253	PYRENE	577.95	256	000129-00-0
254	DICHLOROBENZENE	577.70	211	025321-22-6
255	ETHYL ETHER	572.47	257	000060-29-7
256	DICHLOROETHANE	570.46	258	001300-21-6
257	4-NITROPHENOL	567.79	259	000100-02-7
258	1,3-DICHLOROPROPENE, CIS-	561.82	184	010061-01-5
259	PHOSPHINE	559.74	260	007803-51-2
260	TRICHLOROBENZENE	557.96	261	012002-48-1
261	2,6-DINITROTOLUENE	555.20	262	000606-20-2
262	FLUORIDE ION	549.64	263	016984-48-8
263	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	547.90	264	035822-46-9
264	METHYL PARATHION	545.83	265	000298-00-0
265	PENTAERYTHRITOL TETRANITRATE	545.59	266	000078-11-5
266	1,3-DICHLOROPROPENE, TRANS-	543.37	267	010061-02-6
267	BIS(2-ETHYLHEXYL)ADIPATE	540.20	268	000103-23-1
268	CARBAZOLE	534.52	269	000086-74-8
269	METHYL ISOBUTYL KETONE	533.24	271	000108-10-1
270	1,2-DICHLOROETHENE, CIS-	533.15	270	000156-59-2
271	STYRENE	532.70	272	000100-42-5
272	CARBARYL	530.98	273	000063-25-2
273	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	529.45	274	067562-39-4
274	ACRYLONITRILE	528.28	275	000107-13-1
275	1-METHYLNAPHTHALENE	526.51	NEW	

Substances were assigned the same rank when two (or more) substances received equivalent total point scores.

CAS #= Chemical Abstracts Service Registry Number

This page was updated on 01/10/2008

C. CAMP

COMMUNITY AIR MONITORING PLAN (CAMP)

77-57 Vleigh Place
Block 6330; Lot 1
Flushing, New York

NYSDEC BCP Site Number: C241168

1- Introduction

The Community Air Monitoring Plan (CAMP) has been prepared to monitor the air quality during the intrusive activities proposed as a part of the Remedial Investigation (RI) Addendum activities at the property located at 77-57 Vleigh Place in Flushing, New York. Levels of VOCs and dust in the air will be monitored continuously and periodically utilizing a Photo Ionization Detector (PID) and Real-Time Particulate Dust Tracker, respectively. For this investigation, the PID will be calibrated at the beginning of each day to the compound isobutylene, which is published by the manufacturer. The PID has a minimum detection limit of 0.1 parts per million (ppm). The Dust Tracker provides real-time measurement based on 90° light scattering. The Dust Tracker has a minimum detection limit of 0.001 mg/m^3.

Continuous real-time air monitoring for VOCs and particulate levels at the perimeter of the exclusion zone or work area will be performed for all ground intrusive activities. Ground intrusive activities include, but are not limited to the installation of soil borings, monitoring wells, sub-slab vapor probes and collection of sediment samples from drainage systems. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or nearby residence/community.

Periodic monitoring for VOCs will be performed during non-intrusive activities such as the collection of soil samples, the collection of groundwater samples from monitoring wells. For instance, periodic monitoring during sample collection will consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well bailing/purging, and taking a reading prior to leaving a sample location. Depending upon the proximity of potentially exposed individuals, continuous monitoring may be performed during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence. Exceedances of action levels observed during performance of the Community Air Monitoring Plan (CAMP) will be reported to the NYSDEC and recorded in a field daily log. A summary of daily logs/reports will be provided in the Remedial Investigation Report (RIR).

2- VOCs Monitoring, Response Levels And Actions

VOCs will be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis during invasive work. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work will be performed using a PID, which will be calibrated at least daily for to the compound isobutylene. The PID will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.

If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200-feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20-feet - is below 5 ppm over background for the 15-minute average.

Activities will be shut down if the organic vapor level at the perimeter of the work area is above 25 ppm.

All 15-minute readings must be recorded in a daily field log. Instantaneous readings, if any, used for decision purposes will also be recorded.

3- PM Monitoring, Response Levels And Actions

Particulate concentrations will be monitored continuously at the downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring will be performed using a Dust Tracker real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10 particulate levels are not 150 mcg/m^3 or greater above the upwind level and provided that no visible dust is migrating from the work area.

If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are 150 mcg/m^3 or greater above the upwind level, work will be stopped and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration. All readings will be recorded in a daily field log.

D. Specification Cut Sheets of Ventilation Fan and Related Components Log

RadonAway®
The world's leading radon fan manufacturer

RP Series

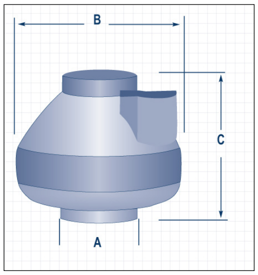
Radon Mitigation Fan

All RadonAway® fans are specifically designed for radon mitigation. RP Series Fans provide superb performance, run ultra-quiet and are attractive. They are ideal for most sub-slab radon mitigation systems.

Features

- Energy efficient
- Ultra-quiet operation
- Meets all electrical code requirements
- Water-hardened motorized impeller
- Seams sealed to inhibit radon leakage (RP140 & RP145 double snap sealed)
- ETL Listed - for indoor or outdoor use
- Thermally protected motor
- Rated for commercial and residential use

MODEL	P/N	FAN DUCT DIAMETER	WATTS	MAX. PRESSURE"WC	TYPICAL CFM vs. STATIC PRESSURE WC				
					0"	.5"	1.0"	1.5"	2.0"
RP140	23029-1	4"	15-21	0.8	135	70	-	-	-
RP145	23030-1	4"	41-72	2.1	166	126	82	41	3
RP260	23032-1	6"	50-75	1.6	272	176	89	13	-
RP265	23033-1	6"	91-129	2.3	334	247	176	116	52
RP380	28208	8"	95-152	2.3	497	353	220	130	38



Model	A	B	C
RP140	4.5"	9.7"	8.5"
RP145	4.5"	9.7"	8.5"
RP260	6"	11.75"	8.6"
RP265	6"	11.75"	8.6"
RP380	8"	13.41"	10.53"

CERTIFIED Made In USA

Made in USA with US and imported parts

c ETL us Intertek

ETL Listed

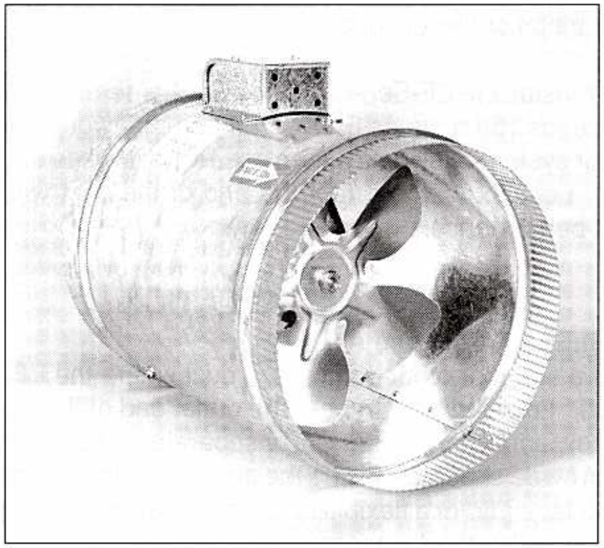
WARRANTY 5 YEARS PERIOD

All RadonAway inline radon fans are covered by our 5-year, hassle-free warranty

For Further Information Contact

TJERNLUND PRODUCTS, INC.
1601 Ninth Street • White Bear Lake, MN 55110-6794
PHONE (651) 426-2993 • (800) 255-4208 • FAX (651) 426-9547
Visit our web site • www.tjernlund.com

INSTALLATION INSTRUCTIONS FOR MODELS EF-6, EF-8, EF-10, EF-12, EF-14 DUCT BOOSTER® FANS



MOTOR SPECIFICATIONS & PERFORMANCE DATA

SELECTION TABLE

MODEL	MOTOR SPECIFICATIONS	FREE AIR CFM	DUCT LENGTH IN FEET		
			25 FEET CFM	50 FEET CFM	75 FEET CFM
EF-6	120V 30 Watt .40A	180	150	100	90
EF-8	120V 56 Watt 1.1A	325	300	250	200
EF-10	120V 1/100 HP .46A	475	400	325	275
EF-12	120V 1/35 HP 1.25A	875	800	700	600
EF-14	120V 1/25 HP 1.70A	1200	1100	1000	900

1. Table is based on straight metal duct. 90 degree elbows are equivalent to 10 feet of straight duct. 45 degree elbows are equivalent to 5 feet of straight duct. Performance is based on 70° F. standard air.
2. The number after the EF-matches the round duct diameter. Example: The EF-6 connects to 6" round duct.
3. For complete dimension and performance specifications consult factory.

GENERAL INFORMATION

The EF-Series DUCT BOOSTER Fans are designed to increase the flow of heated air in warm air heating systems or cooled air in central air conditioning systems. They may also be installed in the duct work of a gravity warm air furnace.

The EF-6 through EF-10 fans are usually used in branch ducts, not the main supply or "trunk line" duct. Models EF-12 & EF-14 can be mounted in branch ducts & the main supply or "trunk line". All models can be easily mounted in sheet metal or flexible duct.

DO NOT install the EF-Series fans where the temperature of air within the duct exceeds 150 degrees F. This temperature would rarely be found on a forced air system but would exist close to the furnace on a gravity warm air system. Locating the fan near the end of the duct will provide the most efficient performance.

INSTALLATION

FLEXIBLE DUCT (Figure A)
Choose a seam or other point in the duct where the EF-Series fan will be mounted. Locating the fan near the outlet end of the duct will provide the most effeicient performance. Cut or separate the flexible duct and install the fan. Fan blade should be facing the direction of the air flow. Seal both sides with duct tape and/or a flexible duct clamp. Support with plumber's strap or other suitable method if necessary.

SHEET METAL DUCT (Figure B)
Choose a joint on the existing duct where the EF-Series fan will be mounted. Locating the fan near the outlet end of the duct will provide the most efficient performance. Separate the existing duct sections at the joint. Cut a piece of duct on the female side of the existing duct 1 inch shorter than the shroud length of the EF-Series model being installed. **NOTE:** DO NOT CUT OFF A PIECE OF EXISTING DUCT WHICH HAS THE CRIMPED END. Insert fan in duct with fan blade facing the direction of air flow. Seal joints with duct tape. If extra support is necessary, use screws provided. Support with plumber's strap or other suitable method if necessary.

FIGURE A

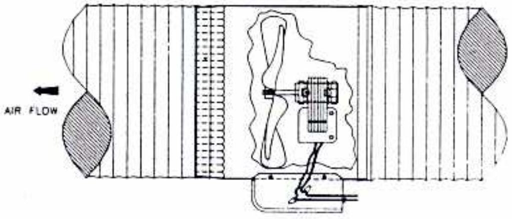
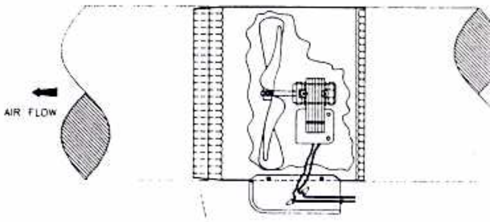


FIGURE B



OPERATION

The EF-Series fans can be operated and controlled in several manners:

1. Manually with an ON/OFF switch or the Tjernlund Products, Inc. Variable Speed Controller Model SC-1, sold separately. NOTE: EF-12 and EF-14 will require the SC-1 pot to be adjusted for higher RPM.
2. By using the optional Tjernlund Products, Inc., Model PS1503 DUCT AIRSTAT , sold separately. The DUCT AIRSTAT will automatically control the operation of the EF-Series fan in **both** heating and cooling systems. When the air handler begins to supply warm or cool air the DUCT AIRSTAT senses positive pressure and starts the EF-Series fan. The DUCT AIRSTAT can be mounted on the plenum, trunk or branch lines, (See Figure C).
3. The EF-Series fans can be wired in parallel with a gas or oil-fired central furnace blower motor. WARNING: THE FURNACE BLOWER MOTOR MUST BE 120 VAC, 1 PHASE, 60 CYCLES. BLOWER MOTOR MUST NOT BE A VARIABLE SPEED TAP OR SOLID STATE SPEED CONTROL TYPE, (See Figure D).

The basic furnace wiring and components should not be disturbed except for wiring connections of the EF-Series fan and the furnace blower motor at the junction box in the furnace.

The wiring of the furnace to the EF-Series fan must be 14 AWG wire and the furnace should be protected by overcurrent protection (fuses or circuit breakers) rated 15 amps or less.

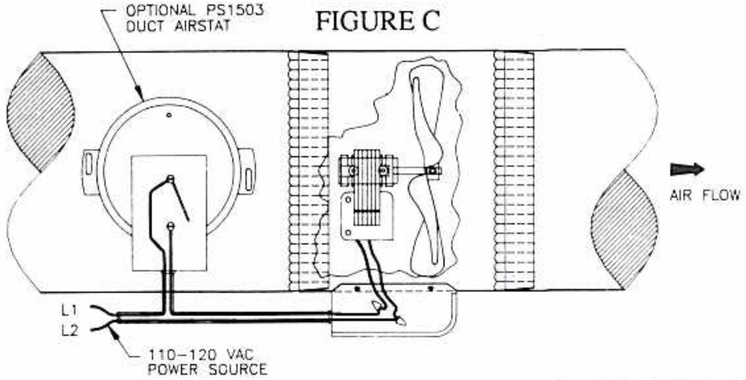
WIRING

IMPORTANT

1. For electrical supply connections use wires suitable for at least 75° C when used on a heated duct system.
2. When installed on a warm air system without filters, flexible conduit or equivalent with sufficient slack in the conduit should be used to facilitate cleaning of blades. Refer to "Maintenance".
3. Electrical conduit must be routed away from warm air system ducts. Use adequate supports if necessary.
4. The motor wires and the power source wires are connected black to black and white to white. The green wire is used for grounding purposes only.

TJERNLUND PRODUCTS, INC. DUCT AIRSTAT

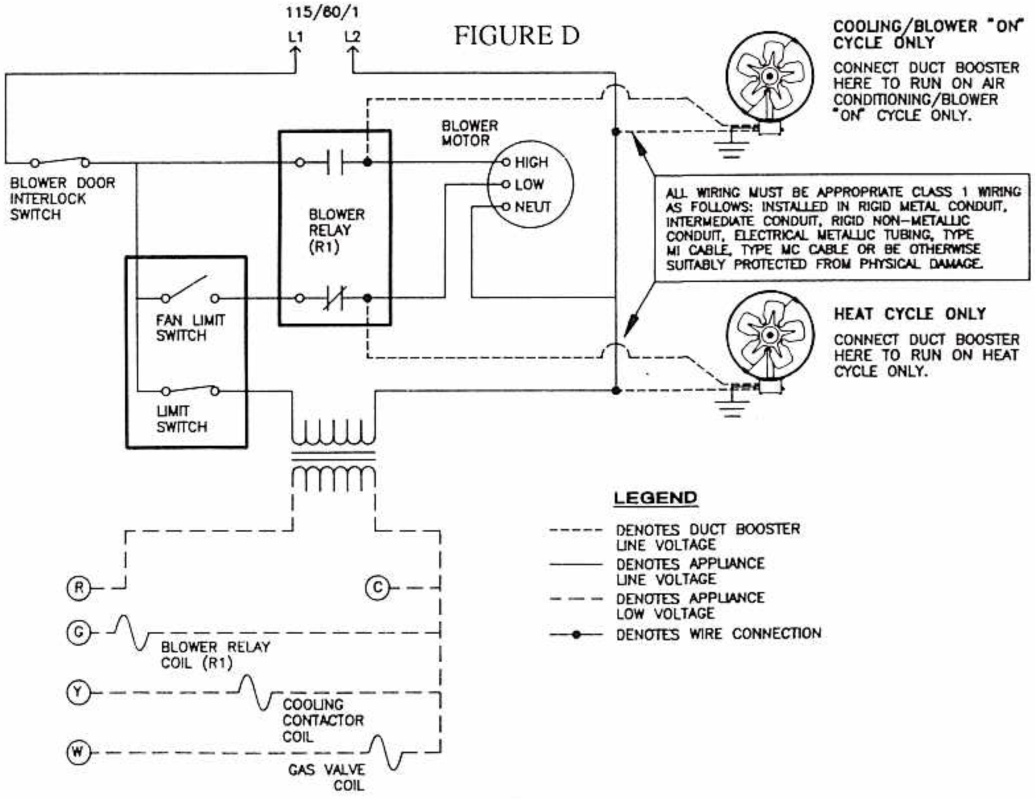
FIGURE C



NOTE: DO NOT install the PS1503 on the air flow side of the EF-Series fan. This will keep the fan running constantly.

WIRING EF-SERIES FANS IN PARALLEL WITH HEAT CYCLE OR COOLING/BLOWER "ON" CYCLE

FIGURE D



CONNECT DUCT BOOSTER HERE TO RUN ON AIR CONDITIONING/BLOWER "ON" CYCLE ONLY.

ALL WIRING MUST BE APPROPRIATE CLASS 1 WIRING AS FOLLOWS: INSTALLED IN RIGID METAL CONDUIT, INTERMEDIATE CONDUIT, RIGID NON-METALLIC CONDUIT, ELECTRICAL METALLIC TUBING, TYPE MI CABLE, TYPE MC CABLE OR BE OTHERWISE SUITABLY PROTECTED FROM PHYSICAL DAMAGE.

CONNECT DUCT BOOSTER HERE TO RUN ON HEAT CYCLE ONLY.

CAUTION: FURNACE PHYSICAL WIRING ARRANGEMENTS MAY DIFFER FROM DIAGRAM. TO AVOID FIRE OR SHOCK HAZARD ALL INSTALLATIONS INVOLVING CONNECTION TO EXISTING FURNACE WIRING MUST BE MADE WITHIN FURNACE JUNCTION BOX.

CAUTION: THE DUCT BOOSTER CANNOT BE WIRED INTO, BOTH THE LOW (HEATING) AND HIGH (AIR CONDITIONING/FAN "ON") CONTACTS OF THE BLOWER RELAY. DOING SO WILL SHORT OUT THE BLOWER.

CAUTION: THE FAN/LIMIT SWITCH, FAN CENTER RELAY AND ASSOCIATED WIRING MUST BE RATED FOR THE ADDITIONAL POWER CONSUMPTION OF THE DUCT BOOSTER.

NOTE: IF OPERATION IS NECESSARY DURING ALL BLOWER CONDITIONS, USE A TJERNLUND PRODUCTS, INC. MODEL PS1503 DUCT AIRSTAT.

MAINTENANCE

If installed on a forced warm air or cooling system where filters are properly installed and maintained, no cleaning of the EF-Series fan or motor should be required.

If installed on a gravity warm air heating system without filters, the EF-Series fan should be removed from the duct and cleaned before each heating season.

The EF-Series fans have high temperature lubrication and require no oiling.

LIMITED PARTS WARRANTY

Tjernlund products, Inc. warrants the components of the EF-Series fans for one year from date of original installation. This warranty covers defects in material and workmanship. This warranty does not cover normal maintenance, transportation or installation charges for replacement parts or any other service calls or repairs. This warrranty **DOES NOT** cover the complete EF-Series fan if it is operative, except for the defective part.

WARRANTY CLAIM PROCEDURE

Tjernlund Products, Inc. will issue credit or provide a free part to replace one that becomes defective during the one year warranty period. Tjernlund will automatically extend the warranty to 18 months from the date code found on the product nameplate. If the part is over 18 months old, proof of date of installation in the form of a distributor sales/installation receipt is necessary to prove the unit has been in service for under one year. All receipts should include the date code of the complete unit to ensure that the date code of the defective component corresponds with the complete unit. This will help preclude possible credit refusal.

Please direct any installer who wants to make a warranty claim to follow these instructions:

1. Determine the defective part. If unable to determine the defective part, call your Tjernlund distributor or Tjernlund Products, Inc. at 1-800-255-4208 for troubleshooting assistance.

2. After the faulty component is determined, return it to your Tjernlund Products, Inc. distributor for replacement. Please include the date code of the EF-Series fan with the defective component. The date code is listed on the fan nameplate. If the date code is over 18 months you will need to provide a copy of the original installation or sales receipt to your distributor.

COVERED PARTS

Motors
Fan Blades

WHAT IS NOT COVERED

Product installed contrary to our installation instructions.
Product that has been altered, neglected or misused.
Product that has been wired incorrectly.
Any freight charges related to the return of the defective part.
Any labor charges related to evaluating and replacing defective part.

TJERNLUND LIMITED ONE YEAR WARRANTY

Tjernlund Products Inc. warrants to the original purchaser of this product that the product will be free from defects due to faulty material or workmanship for a period of one (1) year from the date of original purchase or delivery to the original purchaser, whichever is earlier. Remedies under this warranty are limited to repairing or replacing, at our option, any product which shall, with the above-stated warranty period, be returned to Tjernlund Products, Inc. at the address listed below, postage prepaid. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF, AND TJERNLUND PRODUCTS, INC. EXPRESSLY DISCLAIMS LIABILITY FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING FROM THE USE OF THIS PRODUCT. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS WARRANTIES, AND NO AGENT IS AUTHORIZED TO ASSUME FOR US ANY LIABILITY ADDITIONAL TO THOSE SET FORTH IN THIS LIMITED WARRANTY. IMPLIED WARRANTIES ARE LIMITED TO THE STATED DURATION OF THIS LIMITED WARRANTY. Some states do not allow limitation on how long an implied warranty lasts, so that limitation may not apply to you. In addition some states do not allow the exclusion of limitation of incidental or consequential damages, so that above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state.

Send all inquiries to Tjernlund Products, Inc., 1601 9th St., White Bear Lake, MN 55110-6794
(651) 426-2993.

EF-SERIES REPLACEMENT PARTS LIST

MODEL	MOTOR#	FANBLADE#
EF-6	950-0416	950-0417
EF-8	950-0428	950-0418
EF-10	950-0425	950-0419
EF-12	950-0424	950-0420
EF-14	950-0423	950-0421

E. Tenants notification letters

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Naim's International health Food Market, Inc.
141-04 77th Road,
Flushing, NY 11367
Attn: Joseph Gavrielov

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

As you are aware, the property at 77-57 Vleigh Place, Queens, New York (the “Site”) is currently undergoing an investigation of the environmental condition of the property as part of its participation in the New York State Brownfield Cleanup Program (the “BCP”). The BCP is administered by the New York State Department of Environmental Conservation (“DEC”) in consultation with other necessary agencies, including the New York State Department of Health (“DOH”).

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We are currently working with the DEC and DOH to remedy the situation and all information pertaining to this work will be publicly available at the above-referenced Public Library. In addition, the DOH has provided Fact Sheets pertaining to the chemicals of concern at the Site, which are attached for your convenience. If you have any additional questions, please feel free to contact the DOH representative, Ms. Dawn Hettrick dawn.hettrick@health.ny.gov.

Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7003 2260 0007 2739 3379

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Swan Delight II Inc.
77-41 Vleigh Place
Flushing, NY 11367
Attn: David

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

As you are aware, the property at 77-57 Vleigh Place, Queens, New York (the "Site") is currently undergoing an investigation of the environmental condition of the property as part of its participation in the New York State Brownfield Cleanup Program (the "BCP"). The BCP is administered by the New York State Department of Environmental Conservation ("DEC") in consultation with other necessary agencies, including the New York State Department of Health ("DOH").

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7003 2260 0007 2739 3386

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Liron David Beauty Salon
77-41A Vleigh Place
Flushing, NY 11367
Attn: Liron Davidov

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

As you are aware, the property at 77-57 Vleigh Place, Queens, New York (the "Site") is currently undergoing an investigation of the environmental condition of the property as part of its participation in the New York State Brownfield Cleanup Program (the "BCP"). The BCP is administered by the New York State Department of Environmental Conservation ("DEC") in consultation with other necessary agencies, including the New York State Department of Health ("DOH").

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7003 2260 0007 2739 3393

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Ralph Alouidor & Associates P.C.
77-43 Vleigh Place
Flushing, NY 11367
Attn: Ralph Alouidor

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

As you are aware, the property at 77-57 Vleigh Place, Queens, New York (the “Site”) is currently undergoing an investigation of the environmental condition of the property as part of its participation in the New York State Brownfield Cleanup Program (the “BCP”). The BCP is administered by the New York State Department of Environmental Conservation (“DEC”) in consultation with other necessary agencies, including the New York State Department of Health (“DOH”).

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7003 2260 0007 2739 3409

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Amsterdam Appraisal Services Inc.
77-45 Vleigh Place
Flushing, NY 11367
Attn: Oleg Borukhov

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7003 2260 0007 2739 3416

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Professional Cleaning Co.
77-45R (rear) Vleigh Place
Flushing, NY 11367
Attn: James Steffens

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4296

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Avraham Bakery, Inc.
77-47 Vleigh Place
Flushing, NY 11367
Attn: Aleksey Murdakayev

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4302

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Kosher Pizzamania Corp.
77-49 Vleigh Place
Flushing, NY 11367
Attn: Daniel Musoev

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4319

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

D & G Bakery Inc.
77-51 Vleigh Place
Flushing, NY 11367
Attn: Gavriel Murdakhayev

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4326

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Jay Ambe Convenience Store, Inc.
77-53 Vleigh Place
Flushing, NY 11367
Attn: Kinjal/ Jagdish Patel

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4333

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Paragon Cleaners Corp.
77-57/59 Vleigh Place
Flushing, NY 11367
Attn: Kyung R. Hong

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

As you are aware, the property at 77-57 Vleigh Place, Queens, New York (the “Site”) is currently undergoing an investigation of the environmental condition of the property as part of its participation in the New York State Brownfield Cleanup Program (the “BCP”). The BCP is administered by the New York State Department of Environmental Conservation (“DEC”) in consultation with other necessary agencies, including the New York State Department of Health (“DOH”).

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4340

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Yellowtail Catering Inc.
77-61 Vleigh Place
Flushing, NY 11367
Attn: Gavriel Menashrov

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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We are currently working with the DEC and DOH to remedy the situation and all information pertaining to this work will be publicly available at the above-referenced Public Library. In addition, the DOH has provided Fact Sheets pertaining to the chemicals of concern at the Site, which are attached for your convenience. If you have any additional questions, please feel free to contact the DOH representative, Ms. Dawn Hettrick dawn.hettrick@health.ny.gov.

Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4357

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Tolmas Place Inc.
77-63 Vleigh Place
Flushing, NY 11367
Attn: Brenda Mamonov

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

As you are aware, the property at 77-57 Vleigh Place, Queens, New York (the “Site”) is currently undergoing an investigation of the environmental condition of the property as part of its participation in the New York State Brownfield Cleanup Program (the “BCP”). The BCP is administered by the New York State Department of Environmental Conservation (“DEC”) in consultation with other necessary agencies, including the New York State Department of Health (“DOH”).

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4364

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

As you are aware, the property at 77-57 Vleigh Place, Queens, New York (the “Site”) is currently undergoing an investigation of the environmental condition of the property as part of its participation in the New York State Brownfield Cleanup Program (the “BCP”). The BCP is administered by the New York State Department of Environmental Conservation (“DEC”) in consultation with other necessary agencies, including the New York State Department of Health (“DOH”).

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Professional Cleaning Co.
60-17b 194th Street
Fresh Meadow, NY 11365
Attn: James Steffens

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

As you are aware, the property at 77-57 Vleigh Place, Queens, New York (the “Site”) is currently undergoing an investigation of the environmental condition of the property as part of its participation in the New York State Brownfield Cleanup Program (the “BCP”). The BCP is administered by the New York State Department of Environmental Conservation (“DEC”) in consultation with other necessary agencies, including the New York State Department of Health (“DOH”).

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 15, 2016

Yellowtail Catering Inc.
7840 164th St., Ste. 1b
Fresh Meadow, NY 11365
Attn: Gavriel Menashrov

Re: Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

As you are aware, the property at 77-57 Vleigh Place, Queens, New York (the “Site”) is currently undergoing an investigation of the environmental condition of the property as part of its participation in the New York State Brownfield Cleanup Program (the “BCP”). The BCP is administered by the New York State Department of Environmental Conservation (“DEC”) in consultation with other necessary agencies, including the New York State Department of Health (“DOH”).

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 18, 2016

Naim's International health Food Market, Inc.
141-04 77th Road,
Flushing, NY 11367
Attn: Joseph Gavrielov

Re: REVISED LETTER
Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

As you are aware, the property at 77-57 Vleigh Place, Queens, New York (the "Site") is currently undergoing an investigation of the environmental condition of the property as part of its participation in the New York State Brownfield Cleanup Program (the "BCP"). The BCP is administered by the New York State Department of Environmental Conservation ("DEC") in consultation with other necessary agencies, including the New York State Department of Health ("DOH").

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All of these test results, as well as a detailed summary of the investigations conducted to date, and any future proposals to address and remediate the Site pursuant to the BCP program, are available for public review at the Public Library located at: 71-34 Main St., Flushing, NY 11367, Attn: Susan Wetjen.

We are currently working with the DEC and DOH to remedy the situation and all information pertaining to this work will be publicly available at the above-referenced Public Library. In addition, the DOH has provided Fact Sheets pertaining to the chemicals of concern at the Site, which are attached for your convenience. If you have any additional questions, please feel free to contact the DOH representative, Ms. Dawn Hettrick dawn.hettrick@health.ny.gov.

Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4395

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 18, 2016

Swan Delight II Inc.
77-41 Vleigh Place
Flushing, NY 11367
Attn: David

Re: REVISED LETTER
Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

As you are aware, the property at 77-57 Vleigh Place, Queens, New York (the “Site”) is currently undergoing an investigation of the environmental condition of the property as part of its participation in the New York State Brownfield Cleanup Program (the “BCP”). The BCP is administered by the New York State Department of Environmental Conservation (“DEC”) in consultation with other necessary agencies, including the New York State Department of Health (“DOH”).

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4401

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 18, 2016

Liron David Beauty Salon
77-41A Vleigh Place
Flushing, NY 11367
Attn: Liron Davidov

Re: REVISED LETTER
Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

As you are aware, the property at 77-57 Vleigh Place, Queens, New York (the “Site”) is currently undergoing an investigation of the environmental condition of the property as part of its participation in the New York State Brownfield Cleanup Program (the “BCP”). The BCP is administered by the New York State Department of Environmental Conservation (“DEC”) in consultation with other necessary agencies, including the New York State Department of Health (“DOH”).

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4418

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 18, 2016

Ralph Alouidor & Associates P.C.
77-43 Vleigh Place
Flushing, NY 11367
Attn: Ralph Alouidor

Re: REVISED LETTER
Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4425

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 18, 2016

Amsterdam Appraisal Services Inc.
77-45 Vleigh Place
Flushing, NY 11367
Attn: Oleg Borukhov

Re: REVISED LETTER
Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4432

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 18, 2016

Professional Cleaning Co.
77-45R (rear) Vleigh Place
Flushing, NY 11367
Attn: James Steffens

Re: REVISED LETTER
Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7012 3460 0002 6053 6847

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 18, 2016

Avraham Bakery, Inc.
77-47 Vleigh Place
Flushing, NY 11367
Attn: Aleksey Murdakayev

Re: REVISED LETTER
Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7012 3460 0002 6053 6854

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 18, 2016

Kosher Pizzamania Corp.
77-49 Vleigh Place
Flushing, NY 11367
Attn: Daniel Musoev

Re: REVISED LETTER
Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7012 3460 0002 6053 6861

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 18, 2016

D & G Bakery Inc.
77-51 Vleigh Place
Flushing, NY 11367
Attn: Gavriel Murdakhayev

Re: REVISED LETTER
Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7012 3460 0002 6053 6878

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 18, 2016

Jay Ambe Convenience Store, Inc.
77-53 Vleigh Place
Flushing, NY 11367
Attn: Kinjal/ Jagdish Patel

Re: REVISED LETTER
Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7012 3460 0002 6053 6885

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 18, 2016

Paragon Cleaners Corp.
77-57/59 Vleigh Place
Flushing, NY 11367
Attn: Kyung R. Hong

Re: REVISED LETTER
Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7012 3460 0002 6053 6892

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 18, 2016

Yellowtail Catering Inc.
77-61 Vleigh Place
Flushing, NY 11367
Attn: Gavriel Menashrov

Re: REVISED LETTER
Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

Dear Tenant:

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7012 3460 0002 6053 6908

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 18, 2016

Tolmas Place Inc.
77-63 Vleigh Place
Flushing, NY 11367
Attn: Brenda Mamonov

Re: REVISED LETTER
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77-57 Vleigh Place, Queens, New York

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February 18, 2016

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February 18, 2016

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Certified Mail / Return Receipt Requested

Aldrich Management Co., LLC
1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
FAX: 516-223-6215

February 18, 2016

Professional Cleaning Co.
60-17b 194th Street
Fresh Meadow, NY 11365
Attn: James Steffens

Re: REVISED LETTER
Brownfield Cleanup Investigation - Indoor Air Test Results
77-57 Vleigh Place, Queens, New York

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4371

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1975 HEMPSTEAD TPKE, 309
EAST MEADOW, NY 11554
TEL: 516-223-6200
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February 18, 2016

Yellowtail Catering Inc.
7840 164th St., Ste. 1b
Fresh Meadow, NY 11365
Attn: Gavriel Menashrov

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Sincerely,

Aldrich Management Co., LLC
Certified Mail / Return Receipt Requested 7011 2970 0002 3872 4388

TETRACHLOROETHENE (PERC) IN INDOOR AND OUTDOOR AIR

SEPTEMBER 2013 FACT SHEET

This fact sheet answers questions about a chemical called tetrachloroethene (PERC), which is widely used to dry-clean clothes. It provides information on health effects seen in humans exposed to PERC in air. It also provides information about the New York State Department of Health's new guideline of 30 micrograms of PERC per cubic meter of air (30 mcg/m^3) or 0.03 milligrams of PERC per cubic meter of air (0.03 mg/m^3). The fact sheet focuses on the health risks from air exposures because most of the PERC released into the environment goes into air.

Prepared by

Bureau of Toxic Substance Assessment
New York State Department of Health

1. WHAT IS TETRACHLOROETHENE (PERC)?

Tetrachloroethene is a manufactured chemical that is widely used in the dry-cleaning of fabrics, including clothes. It is also used for degreasing metal parts and in manufacturing other chemicals. Tetrachloroethene is found in consumer products, including some paint and spot removers, water repellents, brake and wood cleaners, glues, and suede protectors. Other names for tetrachloroethene include PERC, tetrachloroethylene, perchloroethylene, and PCE. PERC is a commonly used name and will be used in the rest of the fact sheet.

PERC is a nonflammable, colorless liquid at room temperature. It readily evaporates into air and has an ether-like odor. Because most people stop noticing the odor of PERC in air after a short time, odor is not a reliable warning signal of PERC exposure.

2. HOW CAN I BE EXPOSED TO PERC?

People may be exposed to PERC in air, water, and food. Exposure can also occur when PERC or material containing PERC (for example, soil) gets on the skin. For most people, almost all exposure is from PERC in air.

PERC gets into outdoor and indoor air by evaporation from industrial or dry-cleaning operations and from areas where chemical wastes are stored or disposed. People living in homes located near these operations may be exposed to higher levels of PERC than the general population not living near such operations. Groundwater near these areas may become contaminated if PERC is improperly dumped or leaks into the ground. People may be exposed if they drink the contaminated water. They also may be exposed if PERC evaporates from contaminated drinking water into indoor air during cooking and washing. PERC may evaporate from contaminated groundwater and soil into the indoor air of buildings above the contaminated area. PERC also may evaporate from dry-cleaned clothes into indoor air or may get into indoor air after PERC-containing products, such as spot removers, are used. Indoor air PERC levels may get high if PERC-containing products are used in poorly ventilated areas.

3. HOW DOES PERC ENTER AND LEAVE MY BODY?

When people inhale air containing PERC, the PERC is taken into the body through the lungs and passed into the blood, which carries it to all parts of the body. A large fraction of this PERC is exhaled, unchanged, through the lungs into the air. Some of this PERC is stored in the body (for example, in fat, the liver, and the brain) and some is broken down in the liver to other compounds and eliminated in urine. PERC can also be found in breastmilk. Once exposure stops, most of the PERC and its breakdown products leave the body in several days. However, it may take several weeks for all of the PERC and its breakdown products to leave the body.

4. WHAT KINDS OF HEALTH EFFECTS CAN BE CAUSED BY EXPOSURE TO PERC IN AIR?

In humans, PERC may affect the central nervous system, the liver, kidneys, blood, immune system, and perhaps the reproductive system. The available data are insufficient to draw conclusions regarding effects of PERC exposure on development in infants and children.

For all health effects, the potential for an increased health risk depends on several factors, including the amount of exposure, the frequency of exposures, and the duration of the exposures. It also depends on the characteristics of the exposed person, such as age, sex, diet, family traits, lifestyle, genetic background, the presence of other chemicals in their body (e.g., alcohol, prescription drugs), and general state of health. Although difficult to quantify, these differences can affect how people will respond to a given exposure. This is known as sensitivity. Differences in sensitivity should be kept in mind when reading the following information on the human health effects of PERC.

Short-Term Exposure - Studies with volunteers show that exposure of eight hours or less to 700,000 micrograms per cubic meter of air (mcg/m^3) cause central nervous system symptoms such as dizziness, headache, sleepiness, lightheadedness, and poor balance. Exposure to 350,000 mcg/m^3 for four hours affected the nerves of the visual system and reduced scores on certain behavioral tests (which, for example, measure the speed and accuracy of a person's response to something they see on a computer screen). These effects were mild and disappeared soon after exposure ended.

Long-Term Exposure - Numerous studies of dry-cleaning workers indicate that long-term exposure (7 to 20 years, for example) to workplace air levels (41,000 mcg/m^3 to 120,000 mcg/m^3) caused reduced scores on neurobehavioral or color vision tests, increased levels of biochemical indicators of liver or kidney damage, reduced red blood cells, and blood and immune system effects [increased white blood cells and blood levels of a certain type of antibody (immunoglobulin E)]. The effects were mild and required special tests to be detected. It is not known how long these effects last.

The New York State Department of Health (NYSDOH, 2010) measured visual function [visual contrast sensitivity (VCS); color vision][1] in adults and children living in the apartments located in buildings with or without a dry-cleaner using PERC and also measured PERC indoor air levels. PERC levels were higher in the indoor air of apartments in buildings with dry-cleaners. Elevated indoor air PERC levels were associated with a slightly increased risk for children to have decreased VCS scores. The effect of PERC on VCS scores was most noticeable in a small group of children living in buildings with co-located dry cleaners using PERC. In those apartments, indoor air PERC levels ranged from 127 to 710 mcg/m^3, with a 50th percentile[2] (also known as the median) level of 340 mcg/m^3. For affected children (7 years mean duration of residency), the decrease was very small and occurred for only one eye in one of five tests. Mean VCS test scores were still within a normal range. Therefore, the risk for decreased VCS scores among affected children is considered to be small. Elevated indoor air PERC levels were not associated with effects on adult VCS scores, or with color vision of either children or adults. The observed associations between elevated indoor air PERC levels and children's VCS suggests that indoor air PERC levels in the range detected may have subtle effects on the brain.

A few epidemiological studies showed positive associations between workplace PERC exposure and reproductive effects (increased risk of spontaneous abortion, sperm disorders, and reduced fertility or delayed conception). Data on workplace air levels were not reported or were limited; however, workplace air levels during the times these studies were conducted were considerably higher than those typically found in indoor or outdoor air. These data suggest, but do not prove, that the reproductive effects were caused by PERC and not by some other factor or factors.

Lastly, epidemiological studies provide a pattern of evidence for a positive association between PERC exposure in the workplace and several types of cancer, specifically bladder cancer, non-Hodgkin lymphoma, and multiple myeloma. These associations were observed in studies with high quality assessments of the likelihood of PERC only exposures. However, data on PERC workplace air levels were not reported, but measurements from other studies indicate that workplace air levels during the times the workers were exposed were considerably higher than those typically found in indoor or outdoor air. Moreover, it is unlikely that the associations were dependent, totally or in part, on factors other than PERC exposures, such as common lifestyle factors as smoking or drinking alcohol. Data from more limited studies suggest that other types of cancer (esophageal, kidney, lung, liver, cervical, and breast cancer) are associated with PERC exposure. In laboratory studies, PERC caused cancer in rats and mice when they ingested or inhaled high doses almost daily for a lifetime. Based on human and animal data, the United States Environmental Protection Agency (USEPA) classifies PERC as “likely to be carcinogenic in humans by all routes of exposure.”

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[1] VCS is a measure of a person's ability to distinguish the contrast between a viewed object and its background. It is easier to detect images of high contrast (e.g., a black cat on snow) than low contrast (e.g., a white cat on snow).

[2] Half the results are less than or equal to this value and half are above this value.

5. WHAT ARE BACKGROUND LEVELS FOR PERC IN OUTDOOR AND INDOOR AIR IN AREAS THAT ARE NOT NEAR A KNOWN ENVIRONMENTAL SOURCE OF PERC?

Various studies provide data on background levels of PERC in outdoor and indoor air. The New York State Department of Environmental Conservation collects data on outdoor air levels of air toxics under the Toxics Monitoring System (also known as Volatile Organics Network). The monitoring sites were selected to provide air quality data from the state's urban, industrial, residential, and rural areas. Based on 5882 samples collected across the state during 1999 to 2008, the 50th percentile (median) and 95th percentile[3] PERC levels were 0.41 mcg/m^3 and 4.8 mcg/m^3, respectively. NYSDOH (2005) conducted a study between 1997 and 2005 on the occurrence of volatile organic chemicals, including PERC, in the indoor and outdoor air of about 100 homes across the state (excluding New York City). Two outdoor samples were collected just outside each home for a total of 200 samples. The 50th percentile and 95th percentile PERC levels were less than 0.25 mcg/m^3 and 1.6 mcg/m^3, respectively. Finally, the 50th percentile and 95% percentile PERC levels in 587 outdoor air samples collected in 1999 - 2011 during the investigation of NYS remedial sites not known to have nor suspected to have sources of PERC were 0.52 mcg/m^3 and 2.6 mcg/m^3, respectively (NYSDOH, 2013b). Collectively, these three data sets, particularly given the low 95% percentile level in the large dataset from the Toxics Monitoring System, indicate that fewer than 5% of the background PERC levels in outdoor air are above 10 mcg/m^3.

The NYSDOH, the USEPA, and others have collected and analyzed information on PERC levels in indoor air. The table below contains the results from air samples collected inside of buildings that were not near known sources of PERC and other chemicals (for example, a home not known to be near a chemical spill, a hazardous waste site, a dry-cleaner, or a factory). The five studies that reported 90th percentile PERC air levels indicate that fewer than 10% of the background PERC levels in indoor air are above 10 mcg/m^3. In addition, the results for six of the eight studies that reported 95th percentiles and contained most of the samples indicate that fewer than 5% of the background PERC levels in indoor air are above 10 mcg/m^3. The other two studies (NYSDOH, 2009, 2013b; USEPA, 2001, 2013) indicate that fewer than 5% of the background indoor air levels are above 20 mcg/m^3.

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[3] 95% of the results are less than or equal to this value.

Background Indoor Air Levels in US Buildings (1990-2013).

Study Description (and Sampling Years)	No. of Samples	Air Level Percentiles (mcg/m^3)			Reference
		50th (median)	90th[A]	95th	
Residential Buildings					
13 studies on residential properties (number NR[B]) in North America (1990-2005)	2312[C]	ND[D] - 2.2 (range)[E]	ND[D] - 7 (range)[E]	4.1 - 9.5 (range)[E]	USEPA (2011); also see Dawson & McAlary (2009)
screening study of households (284) in urban or non-urban areas of MN (1997)	284	1.4	NR[B]	4.9	Adgate et al. (2004)
subset of the screened households (101) in MN (1997)	101	1.3	NR[B]	5.2	
single family homes (about 100) heated with fuel oil from across NYS (excluding NYC) (1997-2003)	400	0.34	2.9	3.9	NYSDOH (2005, 2013a)[F]
households (about 100 each) in Elizabeth, NJ, Houston, TX, and Los Angeles, CA (1999-2001)	554	0.56	NR[B]	6.0	Weisel et al. (2005)
apartments (61) in NYC building **without** a co-located dry-cleaner (2001-2003)	61	2.2	8.5	19.09	NYSDOH (2009, 2013b)
Office Buildings					
public & commercial office buildings (70) in US (1994-1996)	209	1.5	9.3	18	USEPA (2001, 2013)
Mixed-Use Buildings					
buildings (number NR[B]) near NYS remedial sites not known nor suspected to have sources of PERC (1999-2011)	1625	0.72	2.8	6.6	NYSDOH (2013b)

[A] 90% of the results are less than or equal to this value.

[B] NR: not reported.

[C] Total number of samples, but number of samples associated with each percentile range is less than 2312, but was not reported.

[D] ND: not detected.

[E] The range from 13, 8, and 5 studies that reported the 50th, 90th, and 95th percentiles, respectively.

[F] One of the 13 studies included in USEPA (2011) and Dawson & McAlary (2009).

6. WHAT IS THE NEW YORK STATE DEPARTMENT OF HEALTH'S NEW GUIDELINE FOR PERC IN AIR?

After consideration of the potential health effects of PERC, background levels of PERC in air, and analytical techniques (the ability and reliability of methods to measure PERC in air), NYSDOH recommends that the average air level not exceed 30 mcg/m^3. This determination considered continuous, lifetime exposure and sensitive people. Three other ways of expressing the new guideline are 0.03 milligrams per cubic meter of air (0.03 mg/m^3), 4.4 parts per billion (ppb) or 0.0044 parts per million (ppm). This replaces the old guideline of 100 mcg/m^3.

An air guideline of 30 mcg/m^3 is below the PERC air levels known to cause noncancer effects, including developmental and reproductive effects, in humans and animals, and should be protective against those effects. It is lower than the USEPA's (2012) reference concentration (RfC)[4] for PERC of 40 mcg/m^3. The estimated excess cancer risk associated with lifetime, continuous exposure to 30 mcg/m^3 is about one-in-one-hundred thousand.

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[4] The reference concentration is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Decisions about whether to take actions to further reduce exposure are generally made on a case-by-case basis at this level of risk.

However, NYSDOH recommends that reasonable and practical actions should be taken to reduce PERC exposure whenever air levels are above background. The purpose of the guideline is to help guide decisions about the urgency of the actions to reduce PERC exposure. The urgency to initiate these actions and to determine, in a timely manner, whether they have reduced exposure, increases with indoor air levels, particularly when air levels are above the guideline.

Indoor air levels substantially above the guideline indicate a significant PERC source and may require more immediate remedial action. NYSDOH has concerns about lengthy exposure (months to years) to air levels higher than 300 mcg/m^3 because the results of a recent NYSDOH study suggested that indoor air PERC levels in apartments (median value of 340 mcg/m^3) may have subtle effects on the nervous system (vision function) of children (NYSDOH, 2010 at http://www.health.ny.gov/environmental/investigations/perc/info_sheet.htm). Thus, NYSDOH recommends taking immediate and effective action to reduce exposure when an air level is equal to or above 300 mcg/m^3. In all cases, the specific corrective actions to be taken depend on a case-by-case evaluation of the situation. The goal of the recommended actions is to reduce PERC levels in indoor air to as close to background as practical.

7. WHY DID NEW YORK STATE DEPARTMENT OF HEALTH REDUCE THE GUIDELINE FOR PERC IN AIR FROM 100 MCG/M^3 TO 30 MCG/M^3?

The guideline of 100 mcg/m^3 was issued in 1997 and was based on the toxicological data available at the time. Since then, many new toxicity studies have been published and the USEPA has completed a comprehensive, state-of-the-science, peer-reviewed risk assessment of PERC. Based on the risk assessment, the USEPA recommended values for evaluating the potential for noncancer and cancer effects from exposure to PERC in air [a RfC (40 mcg/m^3) and an air level (4 mcg/m^3) associated with an estimated excess cancer risk of one-in-one million, assuming continuous, lifetime exposure]. NYSDOH staff reviewed the USEPA risk assessment and determined that the recommended values are scientifically robust and should replace the values derived in 1997. The USEPA publication of its RfC (40 mcg/m^3) necessitated a re-evaluation of the health-protectiveness of the old NYSDOH guideline (100 mcg/m^3) because it has been the past practice of NYSDOH to set guidelines at air levels that are equal to or less than a RfC. Consequently, the guideline was reduced to 30 mcg/m^3 after consideration of new toxicity data (e.g., NYSDOH, 2010) and the USEPA risk assessment.

8. SHOULD I BE CONCERNED ABOUT HEALTH EFFECTS IF I AM EXPOSED TO AN AIR LEVEL SLIGHTLY ABOVE THE GUIDELINE?

The guideline is not a bright line between PERC levels that cause health effects and those that do not. The differences between exposure at the guideline and exposure levels known to cause effects in humans and animals are large. Thus, exposure to levels above but near the guideline will not cause health effects in most, if not all, people. In addition, the guideline is based on the assumption that people are continuously exposed to PERC in air all day, every day for as long as a lifetime. Continuous exposure is rarely true for most people, who, if exposed, are more likely to be exposed for a part of the day and part of their lifetime.

9. IS THERE A TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO PERC?

PERC levels can be measured in the breath for weeks following a high exposure to PERC because it is stored in body fat and is slowly released into the bloodstream and then exhaled in the breath. PERC can be measured in blood. Also, breakdown products of PERC can be detected in the blood and urine for several days after exposure to PERC. Because exposure to other chemicals can produce the same breakdown products in the urine and blood as PERC, the tests for breakdown products cannot determine if you have been exposed only to PERC. Although the tests can show if PERC levels in the body are elevated compared to background levels, they cannot conclusively determine when and for how long a person was exposed, what the source of that exposure was, or whether or not the person will develop adverse health effects.

10. WHEN SHOULD MY CHILDREN OR I SEE A PHYSICIAN?

If you believe you or your children have symptoms that you think are caused by PERC exposure, you and your children should see a physician. You should tell the physician about the symptoms and about when, how, and for how long you think you and/or your children were exposed to PERC.

11. WHERE CAN I GET MORE INFORMATION?

If you have any questions about the information in this fact sheet, would like to know more about PERC, or are concerned that you may be exposed to elevated levels of PERC, please call the New York State Department of Health at 518-402-7800 or 1-800-458-1158, send an e-mail to btsa@health.state.ny.us, or write to us at the following address.

New York State Department of Health
Bureau of Toxic Substance Assessment
Corning Tower, Room 1743
Empire State Plaza,
Albany, NY 12237

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New York State Department of Health
Tenant Notification Fact Sheet for Tetrachloroethene (Perc)

This fact sheet is provided to fulfill New York State Department of Health (NYS DOH) requirements for preparation of generic fact sheets under Article 27 (Title 24, Section 27-2405) of the Environmental Conservation Law.

Tetrachloroethene (Perc)

Tetrachloroethene (also known as perchloroethylene or Perc) is a man-made volatile organic chemical that is widely used in the dry-cleaning of fabrics, including clothes, and in manufacturing other chemicals. It was also used for degreasing metal parts and in consumer products, including some paint and spot removers, water repellents, brake and wood cleaners, glues, and suede protectors.

Sources of Perc in Indoor Air

Household products containing Perc could be a possible source for Perc in indoor air. Perc also may evaporate from dry-cleaned clothes or dry-cleaning operations into indoor air. Another source could be evaporation from contaminated well water that is used for household purposes. Perc may also enter homes through soil vapor intrusion, which occurs when the chemical evaporates from groundwater, enters soil vapor (air spaces between soil particles), and migrates through building foundations into the building's indoor air. Perc has also been found at low concentrations in outdoor air.

Levels Typically Found in Air

The NYS DOH reviewed and compiled information from studies in New York State as well as from homes and office buildings across the United States on typical levels of Perc in indoor and outdoor air. Levels of Perc in the indoor air of homes and office settings and in outdoor air are expected to be below 10 micrograms per cubic meter (mcg/m^3).

Health Risks Associated with Exposure

An association exists between exposure of people in the workplace to high levels of Perc in air and certain forms of cancer. Perc causes cancer in laboratory animals exposed to high levels over their lifetimes. Overall, the studies of humans and in animals do not prove that Perc causes cancer in people, but are highly suggestive that there may be an increased risk for cancer in people who are exposed to Perc (particularly at high concentrations) over long periods of time

People exposed to high levels of Perc in air had nervous system effects and slight changes to their liver and kidneys. Some studies show a slightly increased risk for some types of reproductive effects among workers (including dry-cleaning workers) exposed to Perc and other chemicals. The reproductive effects associated with exposure included increased risks for spontaneous abortion, menstrual and sperm disorders, and reduced fertility. The data suggest, but do not prove, that the effects were caused by Perc and not by some other factor or factors. Exposure to high levels of Perc has caused liver and kidney damage in laboratory animals and effects on the nervous system. Taken together, the human and animal studies indicate that human exposure to high levels of Perc causes effects on the nervous system, and suggest that human exposure to high levels of Perc may increase the risk for liver and kidney toxicity.

NYS DOH Air Guideline

The NYS DOH guideline for Perc in air is 30 mcg/m^3. This level is lower than the levels that have caused health effects in animals and humans. The guideline is based on the assumption that people are continuously exposed to Perc in air all day, every day for as long as a lifetime. This is rarely true for most people who, if exposed, are likely to be exposed for only part of the day and part of their lifetime. In setting this level, the NYS DOH also considered the possibility that certain members of the population (infants, children, the elderly, and those with pre-existing health conditions) may be especially sensitive to the effects of Perc.

The purpose of the guideline is to help guide decisions about the nature of the efforts to reduce Perc exposure. Reasonable and practical actions should be taken to reduce Perc exposure when indoor air levels are above those typically found in indoor air, even when they are below the guideline of 30 mcg/m^3. The urgency to take actions increases as indoor air levels increase, especially when air levels are above the guideline. The NYS DOH recommends taking immediate action to reduce exposure when an air level is ten times or more higher than the guideline (that is, when the air level is 300 mcg/m^3 or higher).

Ways to Limit Exposure to Perc in Indoor Air

In all cases, the specific actions to limit exposure to Perc in indoor air depend on a case-by-case evaluation of the situation. Removing household sources of Perc and maintaining adequate ventilation will usually help reduce indoor air levels of the chemical. A sub-slab depressurization system can reduce the amount of Perc entering indoor air by soil vapor intrusion. Use of an activated carbon filter on the water supply can reduce the amount of the chemical in contaminated well water that could evaporate into indoor air.

Reportable Detection Level

The reportable detection level for a chemical can vary depending on the analytical method used, the laboratory performing the analysis, and several other factors. Most laboratories that use the analytical methods recommended by the NYS DOH for measuring Perc in air (and approved by the National Environmental Laboratory Accreditation Conference or New York State's Environmental Laboratory Approval Program) can routinely detect the chemical at concentrations below 1 mcg/m^3.

Additional Information

Additional information on Perc, ways to reduce exposure, indoor air contamination resulting from soil vapor intrusion, indoor and outdoor air levels and the Environmental Conservation Law can be found on the NYS DOH website at www.health.state.ny.us/environmental/indoors/air/contaminants.

If you have further questions about Perc and the information in this fact sheet, please call the NYS DOH at 1-518-402-7800 or 1-800-458-1158 (extension 2-7800), e-mail to **ceheduc@health.state.ny.us**, or write to the following address:

New York State Department of Health
Center for Environmental Health
Outreach and Education Group
Empire State Plaza-Corning Tower, Room 1642
Albany, New York 12237

New York State Department of Health
December, 2013

TRICHLOROETHENE (TCE) IN INDOOR AND OUTDOOR AIR

AUGUST 2015 FACT SHEET

This fact sheet answers questions about a chemical called trichloroethene (TCE), which is widely used to remove grease from manufactured products. It provides information on health effects seen in humans exposed to TCE in air. It also provides information about the New York State Department of Health's guideline of 2 micrograms of TCE per cubic meter of air (2 mcg/m^3) or 0.002 milligrams of TCE per cubic meter of air (0.002 mg/m^3). The fact sheet focuses on the health risks from air exposures because the primary route of exposure for most people in New York State is via indoor air.

Prepared by

Bureau of Toxic Substance Assessment
New York State Department of Health

1. WHAT IS TRICHLOROETHENE?[1]

Trichloroethene is a human-made clear, colorless liquid that has a somewhat sweet odor similar to ether or chloroform, but it is volatile, meaning it readily evaporates at room temperature into air. It is used as a solvent to remove grease from metal during the manufacture of variety of products, including building/furniture materials, fixtures, fabricated metal, and electric/electronic equipment. Trichloroethene also is used as a paint stripper, adhesive solvent, as an ingredient in paints and varnishes, and in the manufacture of other chemicals. Other names for trichloroethene include TCE and trichloroethylene. TCE will be used in the rest of this fact sheet.

2. HOW CAN PEOPLE BE EXPOSED TO TCE?

People may be exposed to TCE in air, water, and food. Exposure can also occur when TCE or material containing TCE (for example, soil) gets on the skin. For most people, almost all TCE exposure is from indoor air.

TCE gets into air when it is released from industrial facilities and when it evaporates from areas where chemical wastes are stored or disposed. People living in homes located near TCE sources may be exposed to higher levels of TCE than most other people. Groundwater near these areas may become contaminated if TCE is improperly dumped or leaks into the ground. People may be exposed if they drink the contaminated water or if TCE evaporates from contaminated drinking water into indoor air during cooking, showering, and bathing. They may also be exposed if TCE evaporates from the groundwater, enters soil vapor (air spaces between soil particles), and migrates through the foundation and into the indoor air of an overlying building. This process is called soil vapor intrusion. TCE also may get into indoor air when TCE-containing products (for example, glues, adhesives, paint removers, spot removers, and metal cleaners) are used. Indoor air TCE concentrations may increase if people use TCE-containing products in poorly ventilated areas.

3. HOW CAN TCE ENTER AND LEAVE THE BODY?

If people inhale air containing TCE, some of the TCE is exhaled unchanged from the lungs and back into the air. Much of the TCE is taken into the body through the lungs and is passed into the blood, which carries it to other parts of the body. The liver changes most of the TCE in the blood into other compounds,

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[1] For a “plain language” version of this fact sheet, see the fact sheet “Important Information on Trichloroethene (TCE) in Indoor and Outdoor Air” available at http://www.health.ny.gov/environmental/chemicals/trichloroethene/.

called breakdown products, most of which are excreted in the urine within a week or so. However, some of the TCE and its breakdown products can be stored in the fat or the liver, and it may take several weeks after exposure stops before almost all of them leave the body.

4. WHAT ARE THE CONCENTRATIONS OF TCE IN INDOOR AND OUTDOOR AIR?

Background Concentrations in Air

Indoor Air

Background indoor air concentrations of chemicals such as TCE are the concentrations measured in buildings in the absence of a local, external environmental source of the chemical. In the absence of such a source, the presence of the chemical in the air of the building is due to its release from products in the building. We used several sources of information on background concentrations of TCE in indoor air collected across the US and in NY and other states (Adgate et al., 2004; Dawson and McAlary, 2009; NYSDOH, 2005, 2014; USEPA, 2001, 2011b, 2015a; Weisel et al., 2005). Overall, the results indicate background concentrations are almost always 1 micrograms per cubic meter of air (1 mcg/m^3) or less when a local, external TCE source is not present.

Outdoor Air

Background outdoor air concentrations of TCE are the concentrations measured in the absence of a known local point-source of TCE. Various NYS studies provide data on TCE outdoor air background concentrations (NYSDEC, 2000, 2002; NYSDOH, 2005, 2014). Collectively, the results indicate background concentrations are almost always 1 mcg/m^3 or less when a local, point-source of TCE source is not present.

Workplace Air Concentrations

TCE air concentrations in workplaces where TCE is manufactured or used are substantially higher than background concentrations. Bakke et al. (2007) reported that the average TCE workplace air concentration across all U.S. industries and over four decades (1950s to 1980s) was 210,000 mcg/m^3. Hein et al. (2010) reviewed the literature (1940 to 2001) and reported the average workplace air concentrations in various industries and occupations ranged from 1.1 mcg/m^3 to 5.9 million mcg/m), with a median of 38,000 mcg/m^3. ATSDR (1997, 2013) reported that the majority of published data on workplace air concentrations showed average concentrations ranging from less than 270,000 mcg/m^3 to 540,000 mcg/m^3.

5. WHAT KINDS OF HEALTH EFFECTS CAN BE CAUSED BY EXPOSURE TO TCE IN AIR?

Information on the health effects of TCE largely comes from studies where people were exposed to air levels much higher than the background levels commonly found in indoor or outdoor air (for example, 90,000 to 807,000 mcg/m^3). In humans, TCE can cause effects on the central nervous system (CNS), liver, kidneys, reproductive and immune systems, and may affect fetal development during pregnancy. Studies in animals show similar kinds of effects. In this fact sheet, we focus on those health effects of greatest concern, largely because they are considered the most sensitive or most serious human health responses to TCE exposures (i.e., CNS effects, developmental and reproductive effects, and cancer).

For all of the different kinds of health effects, the potential for a person to actually experience a health effect depends on several factors, including the amount of exposure, the frequency of exposure, and the duration of the exposure. It also depends on the characteristics of the exposed person, such as age, sex, diet, family traits, lifestyle, genetic background, the presence of other chemicals in their body (for example, alcohol, prescription drugs), and general state of health. Although difficult to quantify, these differences can affect how people will respond to a given exposure. This is known as sensitivity. Differences in sensitivity should be kept in mind when reading the following information on the human health effects of TCE.

Short-Term Exposure

TCE was once used as an anesthetic during surgery. The primary effects of short-term exposure to TCE in air are on the CNS. Exposure to 590,000 mcg/m^3 for eight hours or less reduced performance on neurobehavioral tests of perception, reaction time, memory, and learning. Symptoms of CNS effects, including headaches, lightheadedness, sleepiness, and fatigue, were common in volunteers exposed to 1,100,000 mcg/m^3 for 7 hours/day for 5 days. Also reported were eye, nose, and throat irritation.

A few studies have reported an increased risk for harmful effects on human development, including fetal heart defects, in the offspring of women who lived in areas with elevated concentrations of TCE in indoor air or drinking water. Due to the limitations of the studies, including poor or no quantitative exposure estimates, we do not know if the observed effects on fetal development in humans were caused by TCE or some other factor. Some, but not all, studies in rats, indicate that TCE exposure can cause heart defects in rat pups exposed *in utero* when the mother was exposed during pregnancy.

Long-Term Exposure

Long-term exposure to high concentrations of TCE in workplace air has caused a variety of effects on the CNS, including effects on nerve function, behavior, vision, hearing, muscle control, memory, ability to think, and other symptoms, such as headache and dizziness.

Some human studies have reported associations between TCE exposure and effects on the reproductive system. For women, reported effects include more difficulty getting pregnant and menstrual cycle disturbances. For men, reported effects have included changes in sperm quality/quantity, hormonal function, and reproductive behavior. These studies suggest, but do not prove, that the reproductive effects were caused by TCE and not by some other factor or factors.

Lastly, epidemiological studies provide convincing evidence of a cause-effect relationship between TCE exposure and cancer. The strongest evidence comes from several well-designed studies that found increased risks of kidney cancer among workers exposed to TCE during the degreasing of metal parts, with more limited evidence for non-Hodgkin's lymphoma (NHL) and liver cancer. In laboratory studies, TCE caused cancer at several sites (kidneys, liver, and lymphoid tissues) in rats and mice when they ingested or inhaled high doses almost daily for a lifetime. Based on human and animal data, the United States Environmental Protection Agency (USEPA) classifies TCE as "carcinogenic to humans by all routes of exposure."

6. WHAT IS THE NEW YORK STATE DEPARTMENT OF HEALTH (NYSDOH) GUIDELINE FOR TCE IN AIR?

After considering the potential health effects of TCE, the background concentrations of TCE in air, and the ability and reliability of the analytical techniques used to measure TCE in air, NYSDOH recommends that the TCE concentration in air not exceed 2 mcg/m^3. This determination also considers continuous exposure for months or as long as a lifetime and sensitive populations (for example, children, pregnant women). Three other ways of expressing this guideline are 0.002 milligrams per cubic meter of air (0.002 mg/m^3), 0.4 parts per billion (ppb) or 0.0004 parts per million (ppm). This replaces the previous guideline of 5 mcg/m^3 (NYSDOH, 2006).

7. WHY WAS THE TCE AIR GUIDELINE REDUCED FROM 5 MCG/M^3 TO 2 MCG/M^3?

NYSDOH reduced its air guideline because of new information on the toxicity of TCE. In 2011, the USEPA (2011a, 2015b) recommended a reference concentration (RfC), of 2 mcg/m^3 and an air unit risk of

4.8×10^{-6} per mcg/m^3. An RfC is the level of a chemical in air that is unlikely to cause harmful noncancer health effects in people, even after a lifetime of continuous exposure. An air unit risk is a measure of the potency of a chemical to cause cancer. The air unit risk for TCE means that 4.8 excess cancers are estimated to develop per 1,000,000 people continuously exposed to TCE in air for a lifetime at a concentration of 1 mcg/m^3. Another way to express this value is to say that an air concentration of 0.21 mcg/m^3 is associated with an estimated excess cancer risk of 1×10^{-6} (also expressed as one-in-one million), assuming continuous, lifetime exposure.

The NYSDOH replaced its old RfC and unit risk with USEPA's RfC and unit risk after determining that the USEPA values were (1) based on toxicity information not available when NYSDOH derived its RfC and unit risk and issued the guideline of 5 mcg/m^3; (2) scientifically strong; and (3) adequately protective of the public health. The new RfC is lower than the old NYSDOH guideline, which raised concerns because it has been the past practice of NYSDOH to set a guideline for a chemical at an air concentration that is equal to or less than its RfC. Lowering the guideline also would lower the estimated excess cancer risk associated with lifetime, continuous exposure to the guideline. Consequently, the guideline was reduced to 2 mcg/m^3.

8. HOW IS THE GUIDELINE USED?

The guideline is used to help guide decisions regarding the urgency of efforts to reduce TCE exposure. At TCE air levels above the guideline, the higher the level, the greater the urgency to take action to reduce exposure. But as with any chemical in indoor air, the NYSDOH always recommends taking action to reduce exposure when the air concentration of a chemical is above background, even if it is below the guideline.

Indoor air concentrations substantially above the guideline clearly indicate a significant TCE source and the need for action to reduce exposure. In particular, NYSDOH has concerns about exposure during pregnancy, particularly during the first trimester, to air concentrations higher than 20 mcg/m^3 because the major steps of heart development occur during this period and TCE may be a risk factor for fetal heart defects in humans. Thus, NYSDOH recommends taking immediate and effective action to reduce exposure when an air concentration is equal to, or above 20 mcg/m^3. In all cases, the specific recommended action depends on a case-by-case evaluation of the situation.

9. SHOULD I BE CONCERNED ABOUT HEALTH EFFECTS IF I AM EXPOSED TO TCE LEVELS SLIGHTLY ABOVE THE GUIDELINE?

The guideline is not a bright line between TCE concentrations that cause health effects and those that do not. The guideline was set at an air concentration that is lower than air concentrations known to cause, or suspected of causing, effects in humans and animals. Thus, exposure to concentrations above, but near the guideline, is not expected to cause health effects in people. In addition, the guideline is based on the assumption that people are continuously exposed to TCE in air all day, every day for months or as long as a lifetime. Continuous exposure is rarely true for most people, who, if exposed, are more likely to be exposed for a part of the day, part of a week, or part of their lifetime.

10. WHEN SHOULD I OR MY CHILDREN SEE A PHYSICIAN?

If you believe you, your children, or others you know have signs or symptoms that you think are caused by TCE exposure, see a physician. Tell the physician about the signs/symptoms and about when, how and for how long you think you and/or your children were exposed to TCE.

11. IS THERE A MEDICAL TEST THAT CAN TELL ME IF I HAVE BEEN EXPOSED TO TCE?

TCE can be measured in people's breath and blood soon after they are exposed, and levels generally reflect recent exposures (for example, within the past week or so). TCE breakdown products can be measured in the urine and blood for up to several weeks after exposure to TCE stops. However, the tests for breakdown products cannot determine if you have been exposed only to TCE because exposure to other chemicals can produce the same breakdown products in the urine and blood as TCE. These tests are not routinely done by most clinical laboratories.

Finding a measurable amount of any of these chemicals in breath, blood, or urine does not mean that the levels have or will cause adverse health effects. The results can be used to compare to levels in people without a known source of TCE exposure (i.e., the general population) or to levels found in workers exposed to much greater amounts of TCE. Your physician should discuss these test results with you.

12. WHERE CAN I GET MORE INFORMATION?

If you have any questions about the information in this fact sheet, would like to know more about TCE, or are concerned that you may be exposed to elevated levels of TCE, please call the New York State Department of Health at 1-518-402-7800 or 1-800-458-1158, send an e-mail to btsa@health.ny.gov, or write to us at the following address.

New York State Department of Health
Bureau of Toxic Substance Assessment
Corning Tower, Room 1743
Empire State Plaza,
Albany, NY 12237

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New York State Department of Health
Tenant Notification Fact Sheet for Trichloroethene (TCE)

This fact sheet is provided to fulfill New York State Department of Health (NYSDOH) requirements for preparation of generic fact sheets under Article 27 (Title 24, Section 27-2405) of the Environmental Conservation Law.

Trichloroethene (TCE)

Trichloroethene (also known as trichloroethylene or TCE) is a human-made chemical. It is volatile, meaning it readily evaporates at room temperature into the air, where you can sometimes smell it. It is used as a solvent to remove grease from metal, a paint stripper, an adhesive solvent, an ingredient in paints and varnishes, and in the manufacture of other chemicals and products (for example, furniture and electric/electronic equipment).

Exposure to TCE

People may be exposed to TCE in air, water, and food, or when TCE or material containing TCE (for example, soil) gets on the skin. For most people, almost all TCE exposure is from indoor air.

Sources of TCE in Air

TCE may get into indoor air when TCE-containing products (for example, glues, adhesives, paint removers, spot removers, and metal cleaners) are used. Another source could be evaporation from contaminated well water that is used for household purposes. TCE may enter homes through soil vapor intrusion, which occurs when TCE evaporates from contaminated groundwater, enters soil vapor (air spaces between soil particles), and migrates through cracks or other openings in the foundation and into the building. TCE gets into outdoor air when it is released from industrial facilities and when it evaporates from areas where chemical wastes are stored or disposed.

Levels Typically Found in Air

The background indoor air levels of TCE in homes and office buildings not near known environmental sources of TCE are almost always 1 microgram per cubic meter of air (1 mcg/m^3) or less. Background outdoor air levels also are almost always 1 mcg/m^3 or less.

Health Risks Associated with Exposure to TCE

Most people, if exposed to TCE, are exposed to air levels much lower than those known to cause health effects in humans (for example, workplace air levels 90,000 to 800,000 mcg/m^3). TCE exposure can cause effects on the central nervous system, liver, kidneys, and immune system of humans. TCE exposure is associated with reproductive effects in men and women, and may affect fetal development during pregnancy. However, the studies suggest, but do not prove, that the reproductive and developmental effects were caused by TCE, and not by some other factor. The United States Environmental Protection Agency (USEPA) classifies TCE as a chemical that causes cancer in humans by all routes of exposure. Whether a person experiences a health effect depends on how much of the chemical he or she is exposed to, how often the exposure occurs, and how long the exposures last. Individual characteristics such as age, health, lifestyle, and genetics also play a role.

NYSDOH Air Guideline

NYSDOH recommends that TCE levels in air not exceed 2 mcg/m^3. This replaces the previous guideline of 5 mcg/m^3. The guideline was set at an air level that is lower than levels known to cause, or suspected of causing, health effects in humans, including sensitive populations (for example, children, pregnant women) and animals. The guideline is based on the assumption that people are continuously exposed to TCE in air all day, every day for months or as long as a lifetime. Continuous exposure is rarely true for most people, who, if exposed, are more likely to be exposed for a part of the day, part of a week, or part of their lifetime.

The guideline is used to help guide decisions regarding the urgency of efforts to reduce TCE exposure. At TCE air levels above the guideline, the higher the level, the greater the urgency to take action to reduce exposure. But as with any chemical in indoor air, the NYSDOH always recommends taking action to reduce exposure when the air concentration of a chemical is above background, even if it is below the guideline.

Indoor air concentrations substantially above the guideline clearly indicate a significant TCE source and the need for action to reduce exposure. In particular, NYSDOH has concerns about exposure during pregnancy, particularly during the first trimester, to air concentrations higher than 20 mcg/m^3 because the major steps of heart development occur during this period and TCE may be a risk factor for fetal heart defects in humans. Thus, NYSDOH recommends taking immediate and effective action to reduce exposure when an air concentration is equal to, or above 20 mcg/m^3.

Ways to Limit Exposure to TCE in Indoor Air

In all cases, the specific recommended actions to limit exposure to TCE in indoor air depend on a case-by-case evaluation of the situation. Removing household sources of TCE and maintaining adequate ventilation will usually help reduce indoor air levels of the chemical. A sub-slab depressurization system can reduce the amount of TCE entering indoor air by soil vapor intrusion. Use of an activated carbon filter on the water supply can reduce the amount of the chemical in contaminated well water that evaporates into indoor air.

Concerns about Exposure to TCE

Most people, if exposed to TCE, are exposed to air levels much lower than those known to cause health effects in humans. However, if you are concerned that you, your children, or others have been exposed to TCE, discuss your symptoms/signs with your health care provider. There are special tests to measure TCE and related chemicals in your blood, breath, or urine, and your health care provider can compare the results to those of people without known exposure to TCE or to workers with high exposure to TCE.

Reportable Detection Level

The reportable detection level for a chemical can vary depending on the analytical method used, the laboratory performing the analysis, and several other factors. Most laboratories that use the analytical methods recommended by the NYSDOH for measuring TCE in air (and approved by the National Environmental Laboratory Accreditation Conference or New York State's Environmental Laboratory Approval Program) can routinely detect the chemical at levels below 1 mcg/m^3.

Additional Information

Additional information on TCE, ways to reduce exposure, indoor air contamination resulting from soil vapor intrusion, indoor and outdoor air levels and the Environmental Conservation Law can be found on the NYSDOH website at www.health.state.ny.us/environmental/indoors/air/contaminants/.

If you have further questions about TCE and the information in this fact sheet, please call the NYSDOH at 1-518-402-7800 or 1-800-458-1158, e-mail to ceheduc@health.state.ny.us, or write to the following address:

New York State Department of Health
Center for Environmental Health
Outreach and Education Group
Empire State Plaza-Corning Tower, Room 1642
Albany, New York 12237

Updated August 2015

F. Correspondence to Steppingstone Day School

Hydro Tech Environmental, Corp.

Main Office
77 Arkay Drive, Suite G
Hauppauge, New York 11788
T (631) 462-5866 • F (631) 462-5877

NYC Office
15 Ocean Avenue, 2nd Floor
Brooklyn, New York 11225
T (718) 636-0800 • F (718) 636-0900

WWW.HYDROTECHENVIRONMENTAL.COM

March 1, 2016

Ms. Susanne Martin
Steppingstone Day School
77-40 Vleigh Place
Flushing, NY 11367

Re: Soil Vapor Intrusion Investigation
77-57 Vleigh Place, Queens, NY

Dear Ms. Martin:

This letter is intended to advise you that the New York State Department of Environmental Conservation (NYSDEC) is requesting the owner of the commercial facility identified as 77-57 Vleigh Place, which is located across the northern vicinity of your above referenced property, to conduct a soil vapor intrusion evaluation at the children sensitive receptor community at Steppingstone Day School to delineate the extend of soil vapor impact associated with the release of chlorinated solvents at the adjacent property.

Therefore, we would like to seek your approval to facilitate access to install one sub-slab vapor probe beneath the slab of the basement at Stepping Day School. The bore hole will be less than 2 inches in diameter. At the termination of the collection of a sub-slab vapor sample, the bore hole will be sealed with concrete. The NYSDEC would also require the collection of an indoor air sample at the school property concurrent with the sub-slab vapor investigation.

We appreciate to hear back from you within 10 days about whether you have any concerns to conduct this upcoming investigation at your property. Please feel free to contact me at (718) 636-0800 or pmatli@hydrotechenvironmental.com.

Very Truly Yours,
Hydro Tech Environmental Corp.

Paul I. Matli, Ph.D.
Senior Project Manager

Encl.
Hydro Tech File 150127, w/ Enc.

Cc:
M. Hoque – NYSDEC
T. Khoury – HAKS
D. Rodger – Aldrich Management Co., LLC

G. Sample Boring Log

Hydro Tech Environmental, Corp.

Main Office
2171 Jericho Turnpike, Suite 240
Commack, New York 11725
T (631) 462-5866 · F (631) 462-5877

NYC Office
15 Ocean Avenue, 2nd Floor
Brooklyn, New York 11225
T (718) 636-0800 · F (718) 636-0900

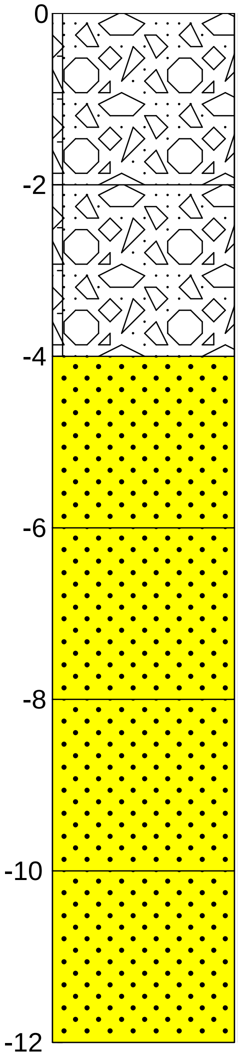
www.hydrotechenvironmental.com

Soil Probe Log

Job No: xxxxxx
Date: xx/xx/xxxx
Page: 1 of 1
Location: ABCD, EF, GH
Sampling Interval: 2 feet
Boring No.: SP-x
Sampling Method: Grab
Drilling Method: Direct Push
Driller:
Total Depth: 12 feet
Depth to Water:

USCS SYMBOLS

GW - Well Graded Gravel
GP - Poorly Graded Gravel
GM - Silty Gravel
GC - Clayey Gravel
SW - Well Graded Sand
SP - Poorly Graded Sand
SM - Silty Sand
SC - Clayey Sand
ML - Inorganic Silt / Sandy Silt
CL - Inorganic Clays/Sandy Clay
OL - Inorganic Silts/Organic Silty Clay
MH- Elastic Silts
CH - Inorganic Clay, High Plastic
OH - Organic Silt / Clay
PT - Peat/High Organics



Depth Below Grade and Lithology	PID Reading (ppm)	USCS	Soil Description
0	0.0	SP	concrete/dark brown, med grained sandy loam with brick and pebble sized clasts
-2	0.0	SP	dark brown, med grained sandy loam with brick and pebble sized clasts
-4	0.0	SP	brown, med grained sand
-6	0.0	SP	brown, med grained sand
-8	0.0	SP	brown, med grained sand
-10	0.0	SP	brown, med grained sand
-12			

H. Groundwater Monitoring Well Construction Diagram

HYDRO TECH ENVIRONMENTAL CORP.

MAIN OFFICE:
2171 JERICHO TURNPIKE, SUITE 345
COMMACK, NEW YORK 11725

NYC OFFICE:
1111 FULTON STREET, SECOND FLOOR
BROOKLYN, NEW YORK 11238

PHONE: (631) 462-5866 FAX: (631) 462-5877

WELL CONSTRUCTION LOG

Job No:

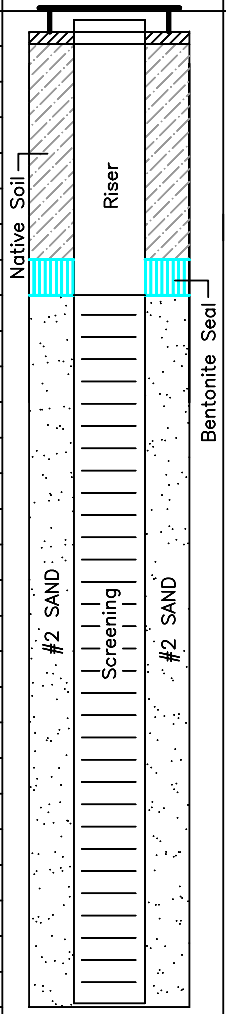
Date:

Page: 1 OF 1

Location:

Well Number:	MW-1	Screen Size:	0.010"
Drilling Method:	DIRECT PUSH	Screen Interval:	20.00'
Total Depth:	28'	Diameter:	1"
Depth to Water:	14.71"	Riser Length:	8'
Manhole Size:	5"	Sand Size:	#2

Depth Below Grade (ft.)	Sample Interval (ft.)	Well Construction	Description
2			
4			
6			
8			
10			
12			
14			
16			
18			
20			
22			
24			
26			
28			
30			
32			
34			
36			



5" Manhole Cover

0' – 7.00' – Native Soil

7' – 8.00' – Bentonite Seal

8' – 28.00' – #2 Sand

0' – 8.00' – Riser

8' – 28.00' – Screen

I. QAPP

QUALITY ASSURANCE PROJECT PLAN

77-57 Vleigh Place
Block 6630; Lot 1
Flushing, New York

NYSDEC BCP Site Number: C241168

Table of Content

Tables

Attachments

1.0 Introduction

This Quality Assurance Project Plan (QAPP) has been prepared for the samples to be collected in accordance with the additional Remedial Investigation Work documented in the Interim Remedial Measures and Remedial Investigation Addendum Work Plan (IRM & RIAWP) for the property located at 77-57 Vleigh Place in Flushing, NY. The intent of the QAPP is to ensure that (1) proper equipment handling and maintenance is followed, (2) cross-contamination between sampling locations does not occur, (3) standard number of quality control replicate environmental samples are obtained, (4) proper procedures for samples custody are performed and (5) data review, validation and verification requirements are complete.

All related portions of the fieldwork will be performed, at a minimum, in accordance with acceptable industry standards. These acceptable industry standards include, but are not limited to, the ASTM Standard Guide for Phase II Environmental Site Assessments (E 1903-97) and the New York State Department of Environmental Conservation (NYSDEC) Bureau of Spill Prevention & Response Sampling Guidelines and Protocols, March 1991 and NYSDEC DER-10, Technical Guidance for Site Investigation and Remediation, May 2010, 6 NYCRR Subpart 360 and New York State Department of Health (NYSDOH) Guidance for evaluating Soil Vapor Intrusion in the State of NY (October 2006) and other acceptable industry standards.

2.0 Project Objective and Scope of Work

The objective of the investigation as set forth in the IRM & RIAWP is to delineate the presence of chlorinated solvents in soil and groundwater beneath the upgradient southeastern portion of the Site in order to determine the potential source of impact at the Site. This investigation will be performed in accordance to the New York State Department of Environmental Conservation (NYSDEC) requirements under the NYS Brownfield Cleanup Program (BCP) and in compliance with the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (May 2010).

To meet the above objectives a total of five (5) soil probes and five (5) monitoring wells will be installed and sampled during this investigation. In addition, ten (10) indoor air samples and one (1) outdoor air sample will also be collected. Soil probes and monitoring well installation, construction, and development shall conform to NYCRR Part 360.

3.0 Sampling Procedures, Decontamination Methods and Data Quality Usability Objectives

3.1 Soil Sampling

Soil samples will be collected from soil probes SP-17 through SP-21. All soil samples will be obtained at 2-foot intervals utilizing a 1½-inch diameter 4-foot long Macro Core sampler fitted with dedicated acetate liners. The location of the soil probes is provided in Figure 2 of the IRM & RIAWP.

At minimum one (1) soil sample will be selected from each of the soil probes for lab analysis and will consist of the sample at the groundwater interface. A second sample may be collected from a soil probe above the groundwater interface if it exhibits a considerable level of hydrocarbons based upon the field screening results.

Each soil sample will be placed directly into pre-cleaned containers provided by the laboratory samples. Sample containers will be labeled and placed in a cooler filled with ice and maintained at 4 degrees Celsius. Each sample will be transmitted under proper chain of custody procedures to a NYSDOH ELAP-certified laboratory for analysis. **Table 1** provides the sample containers, volumes, test methods, preservation techniques, reporting limits and holding times for soil samples.

3.2 Groundwater Sampling

Groundwater samples will be obtained from the five new wells MW-8, MW-9, MW-10, MW-11 and MW-12 utilizing a low flow pump fitted with dedicated polyethylene tubing. Initially, each monitoring well will be purged prior to sampling. Purging and sampling of the monitoring wells will be conducted according to USEPA's Low Stress/Flow

Groundwater Sampling Protocol (SOP #GW0001, Rev. 1996) utilizing a portable water quality meter YSI-6820, which utilizes an in-line flow cell for water quality indicator measurements (the USEPA low flow sampling protocol and monitoring well purge/sampling form is provided in Attachment A). Groundwater will be purged at a low flow rate of less than 500 milliliter per minute (mL/min) until water quality indicator parameters including pH, temperature, specific conductivity, oxidation reduction potential, dissolved oxygen and turbidity are stabilized. The sampling of each well will be performed once groundwater purging is completed. Attachment B provides a sample Groundwater Sampling/Purge Log. The location of the monitoring wells is provided in Figure 2 of the IRM RAIWP.

Each groundwater sample will be placed directly into pre-cleaned containers provided by the laboratory. Sample containers will be labeled and placed in a cooler filled with ice and maintained at 4 degrees Celsius. Sample containers will be labeled and placed in a cooler filled with ice and maintained at 4 degrees Celsius. Each sample will be transmitted under proper chain of custody procedures to a NYSDOH ELAP-certified laboratory for analysis. **Table 2** provides the sample containers, volumes, test methods, preservation techniques, reporting limits and holding times for the groundwater samples.

3.3 Indoor/Outdoor Air Sampling

The ten indoor air samples designed IA-1a, IA-2a, IA-3a and IA-4 to IA-10 and the outdoor air sample designed OA-2 will be collected utilizing 6 liter pre-cleaned, passivated, evacuated whole air Summa® Canister over a period of 6 hours at a rate of less than 0.2 liter per minute.

The air samples will be transmitted under proper chain of custody procedures to a NYSDOH ELAP-certified laboratory for analysis. **Table 3** provides the sample containers, volumes, test methods, reporting limits and holding times for the vapor/air samples.

3.4 Sediment Sampling

A drywell sediment sample designed DW-1 will be collected from the drywell located beneath the northeastern portion of the common alley of the basement at the Site. The sediment sample will be obtained 1 foot below the bottom of the drywell.

The drywell sediment sample will be placed directly into pre-cleaned containers provided by the laboratory. Sample containers will be labeled and placed in a cooler filled with ice and maintained at 4 degrees Celsius. This sample will be transmitted under proper chain of custody procedures to a NYSDOH ELAP-certified laboratory for analysis. **Table 4** provides the sample containers, volumes, test methods, preservation techniques, reporting limits and holding times for the sediment sample.

3.5 Decontamination Methods/ Quality Assurance And Quality Usability Objectives

A Hydro Tech Quality Assurance (QA) officer (Paul I. Matli.) will adopt this QAPP during the collection of soil and groundwater samples in order to ensure that (1) proper equipment handling and maintenance is followed, (2) cross-contamination between sampling locations does not occur, (3) standard number of quality control replicate environmental samples are obtained, (4) proper procedures for samples custody are performed and (5) data review, validation and verification requirements are complete. Attachment C provides resumes of key personnel involved with this project.

During the field sampling, Hydro Tech QA officer will be responsible for monitoring the decontamination procedure of every piece of sampling equipment prior to each use by field personnel. The following procedure will be implemented during the decontamination process:

- Wipe clean and wash with Alconox®
- Potable water rinse
- Methanol rinse
- Deionized water rinse
- Air dry

All decontamination procedures will be performed in an area segregated from any sampling areas. Any rinsate from the decontamination area will be contained and placed in 55-gallons drums and properly disposed of. The following Quality Assurance (QA) and Quality Control (QC) samples will also be collected and analyzed.

- One trip blank per trip will be analyzed via EPA Method 8260
- One field blank (rinsate blank) for soil will be analyzed via EPA Method 8260.
- One field blank (rinsate blank) for groundwater will be analyzed via EPA Method 8260.

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) samples will also be collected and analyzed.

- One MS soil sample and one MSD soil sample will be analyzed via EPA Method 8260.
- One MS sediment sample and one MSD sediment sample will be analyzed via EPA Method 8260
- One MS groundwater sample and one MSD groundwater sample will be analyzed via EPA Method 8260

The soil, groundwater and drywell sediment samples will be managed and analysis with the following protocol:

- Samples will be labeled and logged in a monitor notebook upon collection.
- In the field, samples will be the responsibility of, and will stay with, the Hydro Tech QA officer.
- Once samples have been collected they are returned to Hydro Tech office and logged in for temporary (i.e. < 48 hrs) storage.
- Samples will be refrigerated to maintain a temperature at a maximum 4 degrees Celsius.
- Hydro Tech QA officer will be then responsible for arranging transport of samples to State-certified (ELAP) laboratory for analysis under a proper Chain of Custody. Attachment D provides a sample chain of custody form.
- Laboratory personnel will record the date and time of samples arrival at the lab and ensure that all holding times for each matrix and analysis will be met.
- After samples are analyzed, laboratory information is added to the label.
- The Sample Chain of Custody Form will be used to record all transport and storage information.
- Samples analytical data report will undergo QA/QC performed by a laboratory officer, who checks each data sheet for precision, missing or illegible information, errors in calculation and values outside of the expected range. Attachment E provides a conventional lab QA/QC procedures associated with soil/sediment, groundwater and air methods and analyses.
- As necessary, data uploads will be conducted utilizing EQUIS.
- ASP Protocol, Category B deliverables.

Upon completion of the sampling and analysis, an independent QA Officer will generate a data usability analysis. The analysis shall consist of (1) an assessment to determine if the data quality objectives were met; (2) evaluation of field duplicate results to indicate the samples are representative; (3) comparison of the results of all field blanks, trip blanks and methods blanks with full data sets to provide information concerning contaminants that may have been introduced during sampling, shipping or analyzing; (4) evaluation of matrix effects to assess the performance of the analytical method with respect to sample matrix, and determine whether the data have been biased high or low due to matrix effects. The data usability analysis shall be included in the QA summary of the Field Investigation Report. **Tables 1** to **Table 4** provide the sampling and analytical Method Requirements for soil, groundwater drywell sediment and air samples.

Table 1: Sampling & Analytical Method Requirements – Soil Samples

Soil Matrix (1)	Parameters	Minimum Sample Volume	Sample Container	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
Sample ID							
SP-17 to SP-21 & Matrix Spike /Matrix Spike Duplicate	TCL VOCs	120 ml + 2 OZ	2 oz. clear wide-mouth glass with Teflon lined septum + 40 ml methanol vial with Teflon lined cap + 40 ml DI water vial with Teflon lined cap + 40 ml unpreserved vial with Teflon lined cap	Cool to 4 °C(2)	EPA Method 8260	Compound Specific (0.001-0.05 mg/Kg)	14 days
Field Blank	TCL VOCs	120 ml	40 ml VOC vial with Teflon lined cap	1:1 HCL to pH<2 Cool to 4 °C	EPA Method 8260	Compound Specific (0.2-10 µg/L)	14 days
Trip Blank	TCL VOCs	80 ml	40 ml VOC vial with Teflon lined cap	1:1 HCL to pH<2 Cool to 4 °C	EPA Method 8260	Compound Compound Specific (0.2-10 µg/L)	14 days

((1)….Analytical Services Protocols (ASP) Deliverables Package Category B.

(2)…If samples are not delivered to the lab with 48 hours after collection, the 40 ml DI Water vials should be preserved in a frozen condition following sampling

Table 2: Sampling & Analytical Method Requirements – Groundwater Samples

Groundwater Matrix (1)	Parameters	Minimum Sample Volume	Sample Container	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
Sample ID							
MW-8 to MW-12 & Matrix Spike /Matrix Spike Duplicate & & Field Blank	TCL VOCs	120 ml	40 ml VOC vial with Teflon lined cap	1:1 HCL to pH<2 Cool to 4 °C	EPA Method 8260	Compound Specific (0.2-10 µg/L)	14 days
Trip Blank	TCL VOCs	80 ml	40 ml VOC vial with Teflon lined cap	1:1 HCL to pH<2 Cool to 4 °C	EPA Method 8260	Compound Specific (0.5-20 µg/L)	14 days

((1)….Analytical Services Protocols (ASP) Deliverables Package Category B.

Table 3: Sampling & Analytical Method Requirements – Air Samples

Vapor/Air Matrix	Parameters	No. of Samples	Minimum Sample Volume	Sample Container	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
Sample ID								
Indoor Air (IA-1a, IA-2a, IA-3a and IA-4 to IA -10)	VOCs	3	6 L	Summa® Canister	NA	TO + 15	Compound Specific (1-20 µg/m^3)	30 days
Outdoor Air (OA-2)	VOCs	1	6 L	Summa® Canister	NA	TO + 15	Compound Specific (1-20 µg/m^3)	30 days

Table 4: Sampling & Analytical Method Requirements – Drywell Sediment Sample

Soil Matrix (1)	Parameters	Minimum Sample Volume	Sample Container	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
Sample ID							
DW-1 & Matrix Spike /Matrix Spike Duplicate	TCL VOCs	120 ml + 2 OZ	2 oz. clear wide-mouth glass with Teflon lined septum + 40 ml methanol vial with Teflon lined cap + 40 ml DI water vial with Teflon lined cap + 40 ml unpreserved vial with Teflon lined cap	Cool to 4 °C(2)	EPA Method 8260	Compound Specific (0.001-0.05 mg/Kg)	14 days

((1)….Analytical Services Protocols (ASP) Deliverables Package Category B.

(2)…If sample is not delivered to the lab with 48 hours after collection, the 40 ml DI Water vials should be preserved in a frozen condition following sampling

ATTACHMENT A
USEPA LOW FLOW SAMPLING PROTOCOL

United States
Environmental Protection
Agency

Office of
Research and
Development

Office of Solid Waste
and Emergency
Response

EPA/540/S-95/504
April 1996

Ground Water Issue

LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES

by Robert W. Puls[1] and Michael J. Barcelona[2]

Background

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange information related to ground-water remediation at Superfund sites. One of the major concerns of the Forum is the sampling of ground water to support site assessment and remedial performance monitoring objectives. This paper is intended to provide background information on the development of low-flow sampling procedures and its application under a variety of hydrogeologic settings. It is hoped that the paper will support the production of standard operating procedures for use by EPA Regional personnel and other environmental professionals engaged in ground-water sampling.

For further information contact: Robert Puls, 405-436-8543, Subsurface Remediation and Protection Division, NRMRL, Ada, Oklahoma.

I. Introduction

The methods and objectives of ground-water sampling to assess water quality have evolved over time. Initially the emphasis was on the assessment of water quality of aquifers as sources of drinking water. Large water-bearing units were identified and sampled in keeping with that objective. These were highly productive aquifers that supplied drinking water via private wells or through public water supply systems. Gradually, with the increasing awareness of subsurface pollution of these water resources, the understanding of complex hydrogeochemical processes which govern the fate and transport of contaminants in the subsurface increased. This increase in understanding was also due to advances in a number of scientific disciplines and improvements in tools used for site characterization and ground-water sampling. Ground-water quality investigations where pollution was detected initially borrowed ideas, methods, and materials for site characterization from the water supply field and water analysis from public health practices. This included the materials and manner in which monitoring wells were installed and the way in which water was brought to the surface, treated, preserved and analyzed. The prevailing conceptual ideas included convenient generalizations of ground-water resources in terms of large and relatively homogeneous hydrologic *units*. With time it became apparent that conventional water supply generalizations of *homogeneity* did not adequately represent field data regarding pollution of these subsurface resources. The important role of *heterogeneity* became increasingly clear not only in geologic terms, but also in terms of complex physical,

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[1]National Risk Management Research Laboratory, U.S. EPA
[2]University of Michigan

Superfund Technology Support Center for Ground Water

National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
Robert S. Kerr Environmental Research Center
Ada, Oklahoma

Technology Innovation Office
Office of Solid Waste and Emergency
Response, US EPA, Washington, DC

Walter W. Kovalick, Jr., Ph.D.
Director

chemical and biological subsurface processes. With greater appreciation of the role of heterogeneity, it became evident that subsurface pollution was ubiquitous and encompassed the unsaturated zone to the deep subsurface and included unconsolidated sediments, fractured rock, and *aquitards* or low-yielding or impermeable formations. Small-scale processes and heterogeneities were shown to be important in identifying contaminant distributions and in controlling water and contaminant flow paths.

It is beyond the scope of this paper to summarize all the advances in the field of ground-water quality investigations and remediation, but two particular issues have bearing on ground-water sampling today: aquifer heterogeneity and colloidal transport. Aquifer heterogeneities affect contaminant flow paths and include variations in geology, geochemistry, hydrology and microbiology. As methods and the tools available for subsurface investigations have become increasingly sophisticated and understanding of the subsurface environment has advanced, there is an awareness that in most cases a primary concern for site investigations is characterization of contaminant flow paths rather than entire aquifers. In fact, in many cases, plume thickness can be less than well screen lengths (e.g., 3-6 m) typically installed at hazardous waste sites to detect and monitor plume movement over time. Small-scale differences have increasingly been shown to be important and there is a general trend toward smaller diameter wells and shorter screens.

The hydrogeochemical significance of colloidal-size particles in subsurface systems has been realized during the past several years (Gschwend and Reynolds, 1987; McCarthy and Zachara, 1989; Puls, 1990; Ryan and Gschwend, 1990). This realization resulted from both field and laboratory studies that showed faster contaminant migration over greater distances and at higher concentrations than flow and transport model predictions would suggest (Buddemeier and Hunt, 1988; Enfield and Bengtsson, 1988; Penrose et al., 1990). Such models typically account for interaction between the mobile aqueous and immobile solid phases, but do not allow for a mobile, reactive solid phase. It is recognition of this third *phase* as a possible means of contaminant transport that has brought increasing attention to the manner in which samples are collected and processed for analysis (Puls et al., 1990; McCarthy and Degueldre, 1993; Backhus et al., 1993; U. S. EPA, 1995). If such a phase is present in sufficient mass, possesses high sorption reactivity, large surface area, and remains stable in suspension, it can serve as an important mechanism to facilitate contaminant transport in many types of subsurface systems.

Colloids are particles that are sufficiently small so that the surface free energy of the particle dominates the bulk free energy. Typically, in ground water, this includes particles with diameters between 1 and 1000 nm. The most commonly observed mobile particles include: secondary clay minerals; hydrous iron, aluminum, and manganese oxides; dissolved and particulate organic materials, and viruses and bacteria. These reactive particles have been shown to be mobile under a variety of conditions in both field studies and laboratory column experiments, and as such need to be included in monitoring programs where identification of the *total* mobile contaminant loading (dissolved + naturally suspended particles) at a site is an objective. To that end, sampling methodologies must be used which do not artificially bias *naturally* suspended particle concentrations.

Currently the most common ground-water purging and sampling methodology is to purge a well using bailers or high speed pumps to remove 3 to 5 casing volumes followed by sample collection. This method can cause adverse impacts on sample quality through collection of samples with high levels of turbidity. This results in the inclusion of otherwise immobile artifactual particles which produce an overestimation of certain analytes of interest (e.g., metals or hydrophobic organic compounds). Numerous documented problems associated with filtration (Danielsson, 1982; Laxen and Chandler, 1982; Horowitz et al., 1992) make this an undesirable method of rectifying the turbidity problem, and include the removal of potentially mobile (contaminant-associated) particles during filtration, thus artificially biasing contaminant concentrations low. Sampling-induced turbidity problems can often be mitigated by using low-flow purging and sampling techniques.

Current subsurface conceptual models have undergone considerable refinement due to the recent development and increased use of field screening tools. So-called hydraulic *push* technologies (e.g., cone penetrometer, Geoprobe®, QED HydroPunch®) enable relatively fast screening site characterization which can then be used to design and install a monitoring well network. Indeed, alternatives to conventional monitoring wells are now being considered for some hydrogeologic settings. The ultimate design of any monitoring system should however be based upon adequate site characterization and be consistent with established monitoring objectives.

If the sampling program objectives include accurate assessment of the magnitude and extent of subsurface contamination over time and/or accurate assessment of subsequent remedial performance, then some information regarding plume delineation in three-dimensional space is necessary prior to monitoring well network design and installation. This can be accomplished with a variety of different tools and equipment ranging from hand-operated augers to screening tools mentioned above and large drilling rigs. Detailed information on ground-water flow velocity, direction, and horizontal and vertical variability are essential baseline data requirements. Detailed soil and geologic data are required prior to and during the installation of sampling points. This includes historical as well as detailed soil and geologic logs which accumulate during the site investigation. The use of borehole geophysical techniques is also recommended. With this information (together with other site characterization data) and a clear understanding of sampling objectives, then appropriate location, screen length, well diameter, slot size, etc. for the monitoring well network can be decided. This is especially critical for new in situ remedial approaches or natural attenuation assessments at hazardous waste sites.

In general, the overall goal of any ground-water sampling program is to collect water samples with no alteration in water chemistry; analytical data thus obtained may be used for a variety of specific monitoring programs depending on the regulatory requirements. The sampling methodology described in this paper assumes that the monitoring goal is to sample monitoring wells for the presence of contaminants and it is applicable whether mobile colloids are a concern or not and whether the analytes of concern are metals (and metalloids) or organic compounds.

II. Monitoring Objectives and Design Considerations

The following issues are important to consider prior to the design and implementation of any ground-water monitoring program, including those which anticipate using low-flow purging and sampling procedures.

A. Data Quality Objectives (DQOs)

Monitoring objectives include four main types: detection, assessment, corrective-action evaluation and resource evaluation, along with *hybrid* variations such as site-assessments for property transfers and water availability investigations. Monitoring objectives may change as contamination or water quality problems are discovered. However, there are a number of common components of monitoring programs which should be recognized as important regardless of initial objectives. These components include:

1) Development of a conceptual model that incorporates elements of the regional geology to the local geologic framework. The conceptual model development also includes initial site characterization efforts to identify hydrostratigraphic units and likely flow-paths using a minimum number of borings and well completions;

2) Cost-effective and well documented collection of high quality data utilizing simple, accurate, and reproducible techniques; and

3) Refinement of the conceptual model based on supplementary data collection and analysis.

These fundamental components serve many types of monitoring programs and provide a basis for future efforts that evolve in complexity and level of spatial detail as purposes and objectives expand. High quality, reproducible data collection is a common goal regardless of program objectives.

High quality data collection implies data of sufficient accuracy, precision, and completeness (i.e., ratio of valid analytical results to the minimum sample number called for by the program design) to meet the program objectives. Accuracy depends on the correct choice of monitoring tools and procedures to minimize sample and subsurface disturbance from collection to analysis. Precision depends on the repeatability of sampling and analytical protocols. It can be assured or improved by replication of sample analyses including blanks, field/lab standards and reference standards.

B. Sample Representativeness

An important goal of any monitoring program is collection of data that is truly representative of conditions at the site. The term *representativeness* applies to chemical and hydrogeologic data collected via wells, borings, piezometers, geophysical and soil gas measurements, lysimeters, and temporary sampling points. It involves a recognition of the statistical variability of individual subsurface physical properties, and contaminant or major ion concentration levels, while explaining extreme values. Subsurface temporal and spatial variability are facts. Good professional practice seeks to maximize representativeness by using proven accurate and reproducible techniques to define limits on the distribution of measurements collected at a site. However, measures of representativeness are dynamic and are controlled by evolving site characterization and monitoring objectives. An evolutionary site characterization model, as shown in Figure 1, provides a systematic approach to the goal of consistent data collection.

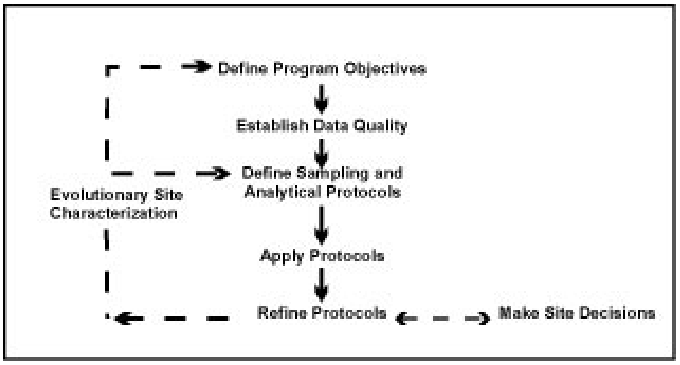

Figure 1. Evolutionary Site Characterization Model

The model emphasizes a recognition of the causes of the variability (e.g., use of inappropriate technology such as using bailers to purge wells; imprecise or operator-dependent methods) and the need to control avoidable errors.

1) Questions of Scale

A sampling plan designed to collect representative samples must take into account the potential scale of changes in site conditions through space and time as well as the chemical associations and behavior of the parameters that are targeted for investigation. In subsurface systems, physical (i.e., aquifer) and chemical properties over time or space are not statistically independent. In fact, samples taken in close proximity (i.e., within distances of a few meters) or within short time periods (i.e., more frequently than monthly) are highly auto-correlated. This means that designs employing high-sampling frequency (e.g., monthly) or dense spatial monitoring designs run the risk of redundant data collection and misleading inferences regarding trends in values that aren't statistically valid. In practice, contaminant detection and assessment monitoring programs rarely suffer these *over-sampling* concerns. In corrective-action evaluation programs, it is also possible that too little data may be collected over space or time. In these cases, false interpretation of the spatial extent of contamination or underestimation of temporal concentration variability may result.

2) Target Parameters

Parameter selection in monitoring program design is most often dictated by the regulatory status of the site. However, background water quality constituents, purging indicator parameters, and contaminants, all represent targets for data collection programs. The tools and procedures used in these programs should be equally rigorous and applicable to all categories of data, since all may be needed to determine or support regulatory action.

C. Sampling Point Design and Construction

Detailed site characterization is central to all decision-making purposes and the basis for this characterization resides in identification of the geologic framework and major hydro-stratigraphic units. Fundamental data for sample point location include: subsurface lithology, head-differences and background geochemical conditions. Each sampling point has a proper use or uses which should be documented at a level which is appropriate for the program's data quality objectives. Individual sampling points may not always be able to fulfill multiple monitoring objectives (e.g., detection, assessment, corrective action).

1) Compatibility with Monitoring Program and Data Quality Objectives

Specifics of sampling point location and design will be dictated by the complexity of subsurface lithology and variability in contaminant and/or geochemical conditions. It should be noted that, regardless of the ground-water sampling approach, few sampling points (e.g., wells, drive-points, screened augers) have zones of influence in excess of a few feet. Therefore, the spatial frequency of sampling points should be carefully selected and designed.

2) Flexibility of Sampling Point Design

In most cases *well-point* diameters in excess of 1 7/8 inches will permit the use of most types of submersible pumping devices for low-flow (minimal drawdown) sampling. It is suggested that *short* (e.g., less than 1.6 m) screens be incorporated into the monitoring design where possible so that comparable results from one device to another might be expected. *Short*, of course, is relative to the degree of vertical water quality variability expected at a site.

3) Equilibration of Sampling Point

Time should be allowed for equilibration of the well or sampling point with the formation after installation. Placement of well or sampling points in the subsurface produces some disturbance of ambient conditions. Drilling techniques (e.g., auger, rotary, etc.) are generally considered to cause more disturbance than *direct-push* technologies. In either case, there may be a period (i.e., days to months) during which water quality near the point may be distinctly different from that in the formation. Proper development of the sampling point and adjacent formation to remove fines created during emplacement will shorten this water quality *recovery* period.

III. Definition of Low-Flow Purging and Sampling

It is generally accepted that water in the well casing is non-representative of the formation water and needs to be purged prior to collection of ground-water samples. However, the water in the screened interval may indeed be representative of the formation, depending upon well construction and site hydrogeology. Wells are purged to some extent for the following reasons: the presence of the air interface at the top of the water column resulting in an oxygen concentration gradient with depth, loss of volatiles up the water column, leaching from or sorption to the casing or filter pack, chemical changes due to clay seals or backfill, and surface infiltration.

Low-flow purging, whether using portable or dedicated systems, should be done using pump-intake located in the middle or slightly above the middle of the screened interval. Placement of the pump too close to the bottom of the well will cause increased entrainment of solids which have collected in the well over time. These particles are present as a result of well development, prior purging and sampling events, and natural colloidal transport and deposition. Therefore, placement of the pump in the middle or toward the top of the screened interval is suggested. Placement of the pump at the top of the water column for sampling is only recommended in unconfined aquifers, screened across the water table, where this is the desired sampling point. Low-flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval.

A. Low-Flow Purging and Sampling

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives. Typically, flow rates on the order of 0.1 - 0.5 L/min are used, however this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min. The effectiveness of using low-flow purging is intimately linked with proper screen location, screen length, and well construction and development techniques. The reestablishment of natural flow paths in both the vertical and horizontal directions is important for correct interpretation of the data. For high resolution sampling needs, screens less than 1 m should be used. Most of the need for purging has been found to be due to passing the sampling device through the overlying casing water which causes mixing of these stagnant waters and the dynamic waters within the screened interval. Additionally, there is disturbance to suspended sediment collected in the bottom of the casing and the displacement of water out into the formation immediately adjacent to the well screen. These disturbances and impacts can be avoided using dedicated sampling equipment, which precludes the need to insert the sampling device prior to purging and sampling.

Isolation of the screened interval water from the overlying stagnant casing water may be accomplished using low-flow minimal drawdown techniques. If the pump intake is located within the screened interval, most of the water pumped will be drawn in directly from the formation with little mixing of casing water or disturbance to the sampling zone. However, if the wells are not constructed and developed properly, zones other than those intended may be sampled. At some sites where geologic heterogeneities are sufficiently different within the screened interval, higher conductivity zones may be preferentially sampled. This is another reason to use shorter screened intervals, especially where high spatial resolution is a sampling objective.

B. Water Quality Indicator Parameters

It is recommended that water quality indicator parameters be used to determine purging needs prior to sample collection in each well. Stabilization of parameters such as pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature and turbidity should be used to determine when formation water is accessed during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. Temperature and pH, while commonly used as purging indicators, are actually quite insensitive in distinguishing between formation water and stagnant casing water; nevertheless, these are important parameters for data interpretation purposes and should also be measured. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. Instruments are available which utilize in-line flow cells to continuously measure the above parameters.

It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter, particularly with respect to drawdown, flow rate and sampling device. Generally, the time or purge volume required for parameter stabilization is independent of well depth or well volumes. Dependent variables are well diameter, sampling device, hydrogeochemistry, pump flow rate, and whether the devices are used in a portable or dedicated manner. If the sampling device is already in place (i.e., dedicated sampling systems), then the time and purge volume needed for stabilization is much shorter. Other advantages of dedicated equipment include less purge water for waste disposal, much less decontamination of equipment, less time spent in preparation of sampling as well as time in the field, and more consistency in the sampling approach which probably will translate into less variability in sampling results. The use of dedicated equipment is strongly recommended at wells which will undergo routine sampling over time.

If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. It should also be noted that turbidity is a very conservative parameter in terms of stabilization. Turbidity is always the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. It should be noted that natural turbidity levels in ground water may exceed 10 nephelometric turbidity units (NTU).

C. Advantages and Disadvantages of Low-Flow (Minimum Drawdown) Purging

In general, the advantages of low-flow purging include:

- samples which are representative of the *mobile* load of contaminants present (dissolved and colloid-associated);
- minimal disturbance of the sampling point thereby minimizing sampling artifacts;
- less operator variability, greater operator control;

- reduced stress on the formation (minimal drawdown);
- less mixing of stagnant casing water with formation water;
- reduced need for filtration and, therefore, less time required for sampling;
- smaller purging volume which decreases waste disposal costs and sampling time;
- better sample consistency; reduced artificial sample variability.

Some disadvantages of low-flow purging are:

- higher initial capital costs,
- greater set-up time in the field,
- need to transport additional equipment to and from the site,
- increased training needs,
- resistance to change on the part of sampling practitioners,
- concern that new data will indicate a *change in conditions* and trigger an *action*.

IV. Low-Flow (Minimal Drawdown) Sampling Protocols

The following ground-water sampling procedure has evolved over many years of experience in ground-water sampling for organic and inorganic compound determinations and as such summarizes the authors' (and others) experiences to date (Barcelona et al., 1984, 1994; Barcelona and Helfrich, 1986; Puls and Barcelona, 1989; Puls et. al. 1990, 1992; Puls and Powell, 1992; Puls and Paul, 1995). High-quality chemical data collection is essential in ground-water monitoring and site characterization. The primary limitations to the collection of *representative* ground-water samples include: mixing of the stagnant casing and *fresh* screen waters during insertion of the sampling device or ground-water level measurement device; disturbance and resuspension of settled solids at the bottom of the well when using high pumping rates or raising and lowering a pump or bailer; introduction of atmospheric gases or degassing from the water during sample handling and transfer, or inappropriate use of vacuum sampling device, etc.

A. Sampling Recommendations

Water samples should not be taken immediately following well development. Sufficient time should be allowed for the ground-water flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and methods of installation but often exceeds one week.

Well purging is nearly always necessary to obtain samples of water flowing through the geologic formations in the screened interval. Rather than using a general but arbitrary guideline of purging three casing volumes prior to sampling, it is recommended that an in-line water quality measurement device (e.g., flow-through cell) be used to establish the stabilization time for several parameters (e.g. , pH, specific conductance, redox, dissolved oxygen, turbidity) on a well-specific basis. Data on pumping rate, drawdown, and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.

The following are recommendations to be considered before, during and after sampling:

- use low-flow rates (<0.5 L/min), during both purging and sampling to maintain minimal drawdown in the well;
- maximize tubing wall thickness, minimize tubing length;
- place the sampling device intake at the desired sampling point;
- minimize disturbances of the stagnant water column above the screened interval during water level measurement and sampling device insertion;
- make proper adjustments to stabilize the flow rate as soon as possible;
- monitor water quality indicators during purging;
- collect unfiltered samples to estimate contaminant loading and transport potential in the subsurface system.

B. Equipment Calibration

Prior to sampling, all sampling device and monitoring equipment should be calibrated according to manufacturer’s recommendations and the site Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). Calibration of pH should be performed with at least two buffers which bracket the expected range. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

C. Water Level Measurement and Monitoring

It is recommended that a device be used which will least disturb the water surface in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity equilibration. Measure well depth after sampling is completed. The water level measurement should be taken from a permanent reference point which is surveyed relative to ground elevation.

D. Pump Type

The use of low-flow (e.g., 0.1-0.5 L/min) pumps is suggested for purging and sampling all types of analytes. All pumps have some limitation and these should be investigated with respect to application at a particular site. Bailers are inappropriate devices for low-flow sampling.

1) General Considerations

There are no unusual requirements for ground-water sampling devices when using low-flow, minimal drawdown techniques. The major concern is that the device give consistent results and minimal disturbance of the sample across a range of *low* flow rates (i.e., < 0.5 L/min). Clearly, pumping rates that cause minimal to no drawdown in one well could easily cause *significant* drawdown in another well finished in a less transmissive formation. In this sense, the pump should not cause undue pressure or temperature changes or physical disturbance on the water sample over a reasonable sampling range. Consistency in operation is critical to meet accuracy and precision goals.

2) Advantages and Disadvantages of Sampling Devices

A variety of sampling devices are available for low-flow (minimal drawdown) purging and sampling and include peristaltic pumps, bladder pumps, electrical submersible pumps, and gas-driven pumps. Devices which lend themselves to both dedication and consistent operation at definable low-flow rates are preferred. It is desirable that the pump be easily adjustable and operate reliably at these lower flow rates. The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. Gas-driven pumps should be of a type that does not allow the gas to be in direct contact with the sampled fluid.

Clearly, bailers and other *grab* type samplers are ill-suited for low-flow sampling since they will cause repeated disturbance and mixing of *stagnant* water in the casing and the *dynamic* water in the screened interval. Similarly, the use of inertial lift foot-valve type samplers may cause too much disturbance at the point of sampling. Use of these devices also tends to introduce uncontrolled and unacceptable operator variability.

Summaries of advantages and disadvantages of various sampling devices are listed in Herzog et al. (1991), U. S. EPA (1992), Parker (1994) and Thurnblad (1994).

E. Pump Installation

Dedicated sampling devices (left in the well) capable of pumping and sampling are preferred over <u>any</u> other type of device. Any portable sampling device should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g., 1-1.5 m below the top of a 3 m screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which will have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. There also appears to be a direct correlation between size of portable sampling devices relative to the well bore and resulting purge volumes and times. The key is to minimize disturbance of water and solids in the well casing.

F. Filtration

Decisions to filter samples should be dictated by sampling objectives rather than as a *fix* for poor sampling practices, and field-filtering of certain constituents should not be the default. Consideration should be given as to what the application of field-filtration is trying to accomplish. For assessment of truly dissolved (as opposed to operationally *dissolved* [i.e., samples filtered with 0.45 µm filters]) concentrations of major ions and trace metals, 0.1 µm filters are recommended although 0.45 µm filters are normally used for most regulatory programs. Alkalinity samples must also be filtered if significant particulate calcium carbonate is suspected, since this material is likely to impact alkalinity titration results (although filtration itself may alter the CO_2 composition of the sample and, therefore, affect the results).

Although filtration may be appropriate, filtration of a sample may cause a number of unintended changes to occur (e.g. oxidation, aeration) possibly leading to filtration-induced artifacts during sample analysis and uncertainty in the results. Some of these unintended changes may be unavoidable but the factors leading to them must be recognized. Deleterious effects can be minimized by consistent application of certain filtration guidelines. Guidelines should address selection of filter type, media, pore size, etc. in order to identify and minimize potential sources of uncertainty when filtering samples.

In-line filtration is recommended because it provides better consistency through less sample handling, and minimizes sample exposure to the atmosphere. In-line filters are available in both disposable (barrel filters) and non-disposable (in-line filter holder, flat membrane filters) formats and various filter pore sizes (0.1-5.0 µm). Disposable filter cartridges have the advantage of greater sediment handling capacity when compared to traditional membrane filters. Filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of 1 L of ground water following purging and prior to sampling. Once filtration has begun, a filter cake may develop as particles larger than the pore size accumulate on the filter membrane. The result is that the effective pore diameter of the membrane is reduced and particles smaller than the stated pore size are excluded from the filtrate. Possible corrective measures include prefiltering (with larger pore size filters), minimizing particle loads to begin with, and reducing sample volume.

G. Monitoring of Water Level and Water Quality Indicator Parameters

Check water level periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 m) during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience. In-line water quality indicator parameters should be continuously monitored during purging. The water quality indicator parameters monitored can include pH, redox potential, conductivity, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well. Measurements should be taken every three to five minutes if the above suggested rates are used. Stabilization is achieved after all parameters have stabilized for three successive readings. In lieu of measuring all five parameters, a minimum subset would include pH, conductivity, and turbidity or DO. Three successive readings should be within ± 0.1 for pH, ± 3% for conductivity, ± 10 mv for redox potential, and ± 10% for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable values during purging. Dissolved oxygen and turbidity usually require the longest time for stabilization. The above stabilization guidelines are provided for rough estimates based on experience.

H. Sampling, Sample Containers, Preservation and Decontamination

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well, if this is known. Generally, volatile (e.g., solvents and fuel constituents) and gas sensitive (e.g., Fe^{2+}, CH_4, H_2S/HS^-, alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as discussed above. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

The appropriate sample container will be prepared in advance of actual sample collection for the analytes of interest and include sample preservative where necessary. Water samples should be collected directly into this container from the pump tubing.

Immediately after a sample bottle has been filled, it must be preserved as specified in the site (QAPP). Sample preservation requirements are based on the analyses being performed (use site QAPP, FSP, RCRA guidance document [U. S. EPA, 1992] or EPA SW-846 [U. S. EPA, 1982]). It may be advisable to add preservatives to sample bottles in a controlled setting prior to entering the field in order to reduce the chances of improperly preserving sample bottles or introducing field contaminants into a sample bottle while adding the preservatives.

The preservatives should be transferred from the chemical bottle to the sample container using a disposable polyethylene pipet and the disposable pipet should be used only once and then discarded.

After a sample container has been filled with ground water, a Teflon™ (or tin)-lined cap is screwed on tightly to prevent the container from leaking. A sample label is filled out as specified in the FSP. The samples should be stored inverted at 4°C.

Specific decontamination protocols for sampling devices are dependent to some extent on the type of device used and the type of contaminants encountered. Refer to the site QAPP and FSP for specific requirements.

I. Blanks

The following blanks should be collected:

(1) field blank: one field blank should be collected from each source water (distilled/deionized water) used for sampling equipment decontamination or for assisting well development procedures.

(2) equipment blank: one equipment blank should be taken prior to the commencement of field work, from each set of sampling equipment to be used for that day. Refer to site QAPP or FSP for specific requirements.

(3) trip blank: a trip blank is required to accompany each volatile sample shipment. These blanks are prepared in the laboratory by filling a 40-mL volatile organic analysis (VOA) bottle with distilled/deionized water.

V. Low-Permeability Formations and Fractured Rock

The overall sampling program goals or sampling objectives will drive how the sampling points are located, installed, and choice of sampling device. Likewise, site-specific hydrogeologic factors will affect these decisions. Sites with very low permeability formations or fractures causing discrete flow channels may require a unique monitoring approach. Unlike water supply wells, wells installed for ground-water quality assessment and restoration programs are often installed in low water-yielding settings (e.g., clays, silts). Alternative types of sampling points and sampling methods are often needed in these types of environments, because low-permeability settings may require extremely low-flow purging (<0.1 L/min) and may be technology-limited. Where devices are not readily available to pump at such low flow rates, the primary consideration is to avoid dewatering of the well screen. This may require repeated recovery of the water during purging while leaving the pump in place within the well screen.

Use of low-flow techniques may be impractical in these settings, depending upon the water recharge rates. The sampler and the end-user of data collected from such wells need to understand the limitations of the data collected; i.e., a strong potential for underestimation of actual contaminant concentrations for volatile organics, potential false negatives for filtered metals and potential false positives for unfiltered metals. It is suggested that comparisons be made between samples recovered using low-flow purging techniques and samples recovered using passive sampling techniques (i.e., two sets of samples). Passive sample collection would essentially entail acquisition of the sample with no or very little purging using a dedicated sampling system installed within the screened interval or a passive sample collection device.

A. Low-Permeability Formations (<0.1 L/min recharge)

1. Low-Flow Purging and Sampling with Pumps

a. "portable or non-dedicated mode" - Lower the pump (one capable of pumping at <0.1 L/min) to mid-screen or slightly above and set in place for minimum of 48 hours (to lessen purge volume requirements). After 48 hours, use procedures listed in Part IV above regarding monitoring water quality parameters for stabilization, etc., but do not dewater the screen. If excessive drawdown and slow recovery is a problem, then alternate approaches such as those listed below may be better.

b. "dedicated mode" - Set the pump as above at least a week prior to sampling; that is, operate in a dedicated pump mode. With this approach significant reductions in purge volume should be realized. Water quality parameters should stabilize quite rapidly due to less disturbance of the sampling zone.

2. Passive Sample Collection

Passive sampling collection requires insertion of the device into the screened interval for a sufficient time period to allow flow and sample equilibration before extraction for analysis. Conceptually, the extraction of water from low yielding formations seems more akin to the collection of water from the unsaturated zone and passive sampling techniques may be more appropriate in terms of obtaining "representative" samples. Satisfying usual sample volume requirements is typically a problem with this approach and some latitude will be needed on the part of regulatory entities to achieve sampling objectives.

B. Fractured Rock

In fractured rock formations, a low-flow to zero purging approach using pumps in conjunction with packers to isolate the sampling zone in the borehole is suggested. Passive multi-layer sampling devices may also provide the most "representative" samples. It is imperative in these settings to identify flow paths or water-producing fractures prior to sampling using tools such as borehole flowmeters and/or other geophysical tools.

After identification of water-bearing fractures, install packer(s) and pump assembly for sample collection using low-flow sampling in "dedicated mode" or use a passive sampling device which can isolate the identified water-bearing fractures.

VI. Documentation

The usual practices for documenting the sampling event should be used for low-flow purging and sampling techniques. This should include, at a minimum: information on the conduct of purging operations (flow-rate, drawdown, water-quality parameter values, volumes extracted and times for measurements), field instrument calibration data, water sampling forms and chain of custody forms. See Figures 2 and 3 and "Ground Water Sampling Workshop -- A Workshop Summary" (U. S. EPA, 1995) for example forms and other documentation suggestions and information. This information coupled with laboratory analytical data and validation data are needed to judge the "useability" of the sampling data.

VII. Notice

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U. S. EPA. 1982. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA SW-846. Office of Solid Waste and Emergency Response, Washington, D.C.

Figure 2. **Ground Water Sampling Log**

Project ________________ **Site** ________________ **Well No.** ______________ **Date** ___________________________
Well Depth _____________ **Screen Length** ___________ **Well Diameter** __________ **Casing Type** _____________
Sampling Device ________________ **Tubing type** ______________________ **Water Level** ___________________
Measuring Point ____________________ **Other Infor** ____
____
Sampling Personnel ____

Time	pH	Temp	Cond.	Dis.O_2	Turb.	[ ]Conc			Notes

Type of Samples Collected

____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi\ r^3$

Figure 3. **Ground Water Sampling Log** (with automatic data logging for most water quality parameters)

Project ________________ **Site** ________________ **Well No.** ______________ **Date** __________________________

Well Depth _____________ **Screen Length** ___________ **Well Diameter** __________ **Casing Type** ____________

Sampling Device ________________ **Tubing type** ______________________ **Water Level** __________________

Measuring Point ____________________ **Other Infor** ____

____

Sampling Personnel ____

Time	Pump Rate	Turbidity	Alkalinity	[ ] Conc	Notes

Type of Samples Collected

____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $\mathrm{Vol}_{cyl} = \pi r^2 h$, $\mathrm{Vol}_{sphere} = 4/3\pi\ r^3$

ATTACHMENT B
GROUNDWATER SAMPLING/PURGE LOG

Hydro Tech Environmental, Corp.

Project 5th Street **Well No.** MW-1 **Date** 3/7/2011
Well Depth 22' **Screen Length** 15 feet **Well Diameter** 1" **Casing Type**
Sampling Device YSI-pump **Tubing type** PVC **Water Level** 12.22 feet
Measuring Point 1 **Riser aboveground** manhole Cover

Sampling Personnel Paul

Time	pH	Temp (ºF)	Cond. (S/Cm)	Dis.O2 (mg/L)	Turb.(NTU)	ORP (mV)	Notes
1:20 AM	6.75	52.70	0.707	8.26	101.90	110	
1:25 AM	6.88	54.97	0.687	8.60	340.10	114	
1:30 AM	6.75	54.73	0.730	8.25	560.10	115	
1:35 PM	6.74	54.91	0.721	8.26	301.10	119	
							4 liters bailed

ATTACHMENT C
RESUMES OF KEY PERSONNEL INVOLVED IN THIS PROJECT

Mark E. Robbins, C.P.G., C.E.I.

Vice President, Senior Geologist

Mr. Robbins has over nine (9) years experience in geology and hydrogeology, involving such activities as Phase I Environmental Site Assessments, Phase II Environmental Site Assessments, Subsurface Investigations, Remedial Actions, data acquisition, evaluation and contouring, and geotechnical investigations. Mr. Robbins has performed over 400 Phase I Assessments involving residential through heavy industrial properties and over 200 Subsurface Investigations throughout the United States. Mr. Robbins has also designed and implemented over 20 remediation systems for both public and private sectors.

Representative Occupational Experience

- *Environmental Site Assessments*
  Conducted Phase I and II Environmental Site Assessments, analysis of site investigation reports, identifying contamination locations and sources. Soil, soil-vapor and water sampling, analyzing laboratory results for QA/QC, magnetometer and Ground-Penetrating Radar surveys for locating buried drums and underground storage tanks (USTs), estimating UST and other subsurface leaks, monitoring well logging, Project Management, liability assessments and estimating costs to attain compliance.

- *Remedial Investigation and Feasibility Studies*
  Oversight/planning of site investigations; data analysis, including statistical analysis and geostatistical contouring utilizing SURFER; performance of feasibility studies, including technology evaluations, alternatives development and evaluation and cost estimations.

- *Due- Diligence Programs*
  Designed and implemented due-diligence programs (ranging from Phase I Assessment to Comprehensive Hydrogeologic Investigations) to assess environmental liabilities for numerous land development clientele.

- *Delineation of Chlorinated Organic Plumes*
  Supervised the delineation of a dissolved chlorinated organic plume from underground tank loss. Developed a remedial action program in accordance with New York State regulatory guidelines to abate soil and groundwater contamination.

- *Remedial Action*
  Prepared numerous Remedial Action Plans. Designed and implemented hydrocarbon and chlorinated solvent remediation systems for soil and groundwater.

- *Pump Test Aquifer Analysis*
  Conducted several pump tests and pump test analysis and field coordination in relation to dewatering permit requirements for Keyspan Energy and the private sector.

Employment

2001 - Present Vice President, Senior Geologist
Hydro Tech Environmental Corp., Commack, New York

2000 – 2001	Assistant Director, Professional Services Fenley & Nicol Environmental, Inc., Deer Park, New York
1999 – 2000	Senior Geologist Fenley & Nicol Environmental, Inc. Deer Park, New York
1995 – 1999	Operations Director Advanced Cleanup Technologies, Inc., Farmingdale, New York
1992 – 1995	Project Geologist Advanced Cleanup Technologies, Inc., Roslyn Heights, New York

Education

B.S. Geology, State University of New York at Oneonta, 1991

Affiliations and Certifications

- American Institute of Professional Geologists
- American Association of Petroleum Geologists
- Long Island Geologist Organization
- Geological Society of America
- American Standards in Testing Materials – E50 Committee Member
- Environmental Assessment Association
- OSHA 40-Hour & 8-Hour, Supervisor

Registrations and Certifications

- Certified Professional Geologist (C.P.G. # 10527)
- Certified Environmental Inspector (C.E.I. # 73383)
- GPR Operator's Course, Geophysical Survey Systems, Inc., 1993.

Publications/Presentations

- *A Case Study of the Impact of MTBE on the Investigation and Remediation of a Fuel Oil Release,* National Groundwater Focus Conference MTBE in Groundwater: Assessment, Remediation Technologies & Public Policy, Baltimore, MD June 4-5, 2001.
- *Is MTBE in Fuel Oil? Why MTBE Plays a Major Concern on Long Island,* Long Island Business News, February 2001.

Paul I. Matli (Ph.D.)

EXPERIENCES

Senior Project Manager
Hydro Tech Environmental Corp. - USA
Apr. 2005 - Nov. 2005 & July 2006 - Present
Completed Environmental Assessment Statements, Phase I Environmental Site Assessments, Phase II Investigations Work Plans, environmental monitoring programs of groundwater and indoor air quality, field sampling of soil, water, air, soil gas, mold and solid wastes, data evaluation through Quality Assurance and Quality Control programs and reports writing. Prepared and engineered Phase III Remedial Action Work Plans for regulated developments, superfund sites and hazardous waste facilities by implementing in-situ bio-chemical remedial technologies, ex-situ disposal of impacted media and on-site mitigation methods of soil vapor intrusion. Supervised and coordinated the closure and removal of petroleum storage tanks. Fulfilled the task of Health and Safety Officer and the duties of a Geologist at a New York State Brownfield Cleanup Program site and multiple New York City Brownfield Cleanup Program sites.

Vocational Lecturer of the Course “Ecology and Environment”
Saint Joseph University – Lebanon
Nov. 2003 - Feb. 2004
Introduced undergraduate students in the School of Agriculture Engineering and the Nursing School to advanced knowledge in the fields of ecology, environment, ecosystem management, earth science and multivariate statistical analytical methods.

Agriculture Engineer in the Italian Rural Development Project in the Upper Bekaa Valley, Baalbek-Hermel Region
Lebanese Agricultural Research Institute - Lebanon
May 2003 - Jan. 2004
Contributed to boosting agricultural production in rural communities in a semi-arid region by identifying deficient production and marketing elements in their farming system and promoting sustainbale agriculture by introducing drought tolerant crops and the construction and management of engineered water reservoirs.

Teaching Assistant
Tokyo University of Agriculture and Technology - Japan
Apr.1999-Sept. 2002
Played a key role in the completion of research thesis of graduate research students by instructing and assisting them in their experimental designs and the application of statistical analytical methods.

Environmental Manager of Ammiq Private Wetlands in the Bekaa Valley - Lebanon
Oct.1997 - Sept. 1998
Successfully managed the exploitation of natural resources of privately owned wetlands by local stakeholders and implemented the United Nations strategies to suppress hunting of endangered bird species and waterfawls in coordination with government and international non-government organizations.

EDUCATION

Ph.D. in Environmental Sciences (a)
Tokyo University of Agriculture and Technology- Japan
Apr. 1999 - Sept. 2002
Research Theme: Conducted field research of crop physiological responses to micro-climatic conditions and developed empirical and multivariate statistical models predicting the impact of future global warming on crop production.

M.Sc. in Environmental Sciences (b)
International Center for Advanced Mediterranean Agronomic Studies - Greece
Sept. 1995 - Sept. 1997
Research Theme: Performed field surveys and laboratory analytical studies of the physico-chemical properties of forest and plant species in promoting wildland fires and developed empirical statistical models predicting their inputs into forest fire behavior prediction systems.

D.S.P.G.S. in Management and Conservation of Mediterranean Ecosystems
International Center for Advanced Mediterranean Agronomic Studies - Greece
Nov. 1994 - Aug. 1995
Top second among 15% of students successfully passing a one-year postgraduate program of intensive multidisciplinary courses for the major of management and conservation of natural renewable resources with a GPA of 4.0.

Diploma of Agricultural Engineer (c)
University of Saint Joseph - Lebanon
Sept. 1989 - July 1994
Successfully passed a five-year engineering program in agronomy and ranked first in the 1994 class graduation with a GPA of 3.69.
Research Theme: Collected and established a socio-economic database of the impact of trout fish farms on the bio-chemical property and microbial quality of fresh watercourses.

PEER-REVIEWED PUBLICATIONS

Matli P.I., Aoki M., Ozawa Y., Hideshima Y., Nakayama H., and Maruya S. 2002. Characterization of canopy photosynthetic CO_2 flux and leaf stomatal conductance responses of potato crop to changing field meteorological conditions in Hokkaido (in English). Journal of Agricultural Meteorology, **58**(3)115-122.

Dimitrakopoulos A.P., and **Matli P.** 2001. Bulk density and physical properties of *Sarcopoterium spinosum* (L.) Spach as fuel characteristics (in English). Journal of Mediterranean Ecology, **2**:75-82.

Elzein G., **Matli P.**, and Darwish S. 1997. The Study of physico-chemical and biological parameters of fresh water in fisheries in the Bekaa Valley (in French). Lebanese Scientific Bulletin, **10**(1):3-20.

Matli P. 1998. Measures and strategies to prevent and manage forest fires in Lebanon (in Arabic). Al Nahar Newspaper; Nahar El Shabab, Sept. 22, pp.2-3.

Matli P. 1997. A preliminary planning of managerial strategies for the conservation and management of Ammiq private wetlands (in English). Technical report submitted to the owners committee of Ammiq Estates-Lebanon, 10p.

EXTRACURRICULAR TRAININGS AND SKILLS

40 Hours OSHA training Course in Health & Safety Methods in Handling Hazardous Materials, USA, Feb. 2010.

10 Hours OSHA Training Course in Construction Safety & Health, Feb. 2013.

Turbo Training in pursuing environmental remedial activities at hazardous sites in compliance with the New York City Mayor’s Office of Environmental Remediation, Feb. 2015.

(a), (b), (c) Accredited US Educational Equivalence, *Globe Language Services, Inc*.

DONALD C. ANNÉ
SENIOR CHEMIST

EDUCATION:	M.S., Chemical Oceanography, Florida Institute of Technology, 1981 B.A., Earth Sciences, Millersville University of Pennsylvania, 1975
SPECIAL TRAINING:	Certified 40-Hour OSHA Health and Safety Certified 8-Hour OSHA Supervisory Course Ground Water Geochemistry (NWWA) Ground Water Pollution and Hydrology (Princeton Associates) Quality Assurance Programs for Environmental Monitoring Data (Stat-A-Matrix)
PROFESSIONAL AFFILIATIONS:	American Chemical Society (AFS), 1979-Present

EXPERIENCE SUMMARY:

Mr. Anné has more than 27 years of environmental chemistry experience specializing in data validation, environmental sampling, analytical methodologies, petroleum fingerprinting, laboratory audits, field sampling audits, and preparing Quality Assurance Project Plans and Quality Assurance Manuals. Mr. Anné's experience includes analytical laboratory work with gas chromatography, atomic absorption, infrared spectrometry and wet chemistry methods.

PROJECT EXPERIENCE:

Quality Assurance/Quality Control of Chemical Data

Mr. Anné has more than 20 years experience as a data validator and quality assurance officer. Mr. Anné has validated data for most EPA Regions and under several independent state programs, including the NYSDEC. He has performed laboratory and field audits as well as written Quality Assurance Project Plans. Mr. Anné has written, reviewed, and initiated laboratory Quality Assurance Manuals for laboratories to maintain their regulatory compliance. Typical project experience includes:

- Senior Chemist responsible for data validation. Reviewed chemical data for several projects under the New Jersey ISRA regulations. The clients included industry and utilities.

- Supervising Environmental Scientist responsible for data validation. Reviewed chemical laboratory data for adherence to QA/QC protocols for several key projects, including National Priorities List sites and RCRA Corrective Actions located in EPA Regions I, II, III, IV, V, and IX. Validated analytical data, outlined problems and actions to be taken, and qualified all affected data. Consulted with project managers on data usability, and recommended corrective actions to support project goals. Responded to comments made by regulators regarding data quality.

- Supervising Environmental Scientist recognized by the New York State Department of Environmental Conservation (NYSDEC) to perform third party data validation. Attended NYSDEC workshop on data validation as part of the requirements set forth by NYSDEC. Performed data validation in support of NYSDEC STARS and ASP programs as well as data in support of the NYSDEC Part 360 Regulations for landfills. Validated data for an Albany area municipal landfill.

- Supervising Environmental Scientist responsible for developing and preparing Quality Assurance Project Plans (QAPPs) for several state and federal Superfund sites and federal RCRA corrective action sites. Negotiated with regulators for the acceptance of the QAPPs. The sites were located throughout the eastern United States.

- Environmental Chemist responsible for developing a laboratory QA/QC program which fulfilled requirements of the EPA and agencies from the States of Texas and Louisiana. Implemented and managed the program throughout DOE's SPR Environmental laboratories. Received verbal commendations from EPA and the Texas Water commission on the QA/QC Program.

Environmental Chemistry

Mr. Anné is experienced in sampling soil, water, air, and wastes in accordance with federal and state guidelines. He has performed field sampling audits and prepared sampling plans for numerous projects in accordance with applicable programmatic requirements. Mr. Anné is familiar with the geochemical aspects of fate and transport of contaminants. Mr. Anné's typical project experience includes:

- Data manager for the Pennwalt Corporation's RCRA Corrective Action RFI Phase I program. The project included quantifying and characterizing soil contamination and hydrogeologic flow systems of 12 SWMUs at a flourochemicals plant in Thorofare, New Jersey. Validated and prepared QA/QC reports for data generated during the project. Qualified all data in preparation of the final report. Work was performed under the direction of NJDEP.

- Project Chemist in charge of field sampling activities, including coordinating and scheduling all subcontracted laboratory work for more than 25 sites in Connecticut. Trained field teams in sampling techniques for soil, groundwater, and surface water; chain of custody requirements; sampling QA/QC protocols; and analytical requirements. Work was performed under the scrutiny of ConnDEP.

- Field Team Leader for a major hazardous waste drum excavation project. Supervised all field activities including site safety; excavation; removal, sampling, and over packing of drums; staging and sampling of contaminated soil; and preparation of samples. Coordinated excavation and laboratory subcontractors. Work was performed under the scrutiny of ConnDEP.

- Created an environmental monitoring program for the Bryan Mound site of DOE's Strategic Petroleum Reserve for testing ground water and surface water. Developed sampling protocols, frequency of sampling, and lists of target analytes. This program was designed to provide baseline data for pre-spill conditions in the event of a release. The site was under scrutiny by EPA Region V and the Texas Water commission.

- Project Chemist responsible for developing analytical QA/QC program that included sampling and chemical analyses of surface water, groundwater, soil, and sediment matrices as part of a Remedial Investigation/Feasibility Study (RI/FS). The RI/FS involved more than 25 sites throughout the State of Connecticut. Work was under the guidance of ConnDEP.

Analytical Chemistry

Mr. Anné has experience working in both fixed-base and mobile laboratories. His experience includes the use of gas chromatography, atomic absorption spectrometers, infrared spectrometers, and numerous wet chemistry and preparation equipment methods. He has served in the laboratory as an analyst, laboratory advisor, and QA officer. He has interfaced with regulators in the area of analytical chemistry and has experience in petroleum fingerprinting techniques and methods. Typical projects include:

- Performed bench scale experiments for St. Lawrence Zinc in order to obtain the optimum level of Phlotec necessary to treat discharged water to resolve an N.O.V. for the SPDES outfall. The optimum level of Phlotec would precipitate enough dissolved zinc for the water to meet the discharge requirement. Also performed routine analyses of samples after implementing the treatment, to insure that the proper concentration was being used.

- Environmental Chemist in charge of project to design updates for the DOE's laboratories at its SPR facilities. Evaluated IR and FT-IR instrumentation and personal computers to link with existing and future instrumentation. Wrote procedures for the acceptance of an alternative oil & grease method for NPDES permit monitoring by EPA Region V. Coordinated all site activities necessary for implementing upgrades.

- Environmental Chemist in charge of replacing obsolete total organic carbon (TOC) analyzers for the SPR laboratories. Evaluated state-of-the-art TOC analyzers and recommended replacement TOC analyzer. Negotiated with supplier and wrote technical specification for the bid process required by DOE. Supervised installation and set-up of all new TOC analyzers.

- Analytical Chemist for Berkley Products Company responsible for product development. Analyzed competitor's products and formulated new coatings with equal or better quality. Responsible for solvent operations which included managing the waste solvent recovery operations, solvent formulation, and manufacturing QA/QC. Worked with sales and manufacturing staff to address and resolve client complaints. Received two cash bonuses for suggestions on the manufacture of products which saved the company money.

- Analytical Chemist for the mobile laboratory responsible for sample preparation in support of several projects for a range of clients located in three EPA regions and in conjunction with several state agencies. Extracted, concentrated, and prepared water and soil samples for analyses by GC/FIND, GC/ECD, GC/PID, and GC/MS. Samples were prepared for PCB, pesticide, polynuclear aromatic hydrocarbon, and petroleum hydrocarbon analyses.

EMPLOYMENT: 2005- present, Alpha Geoscience
1998-2005, Alpha Environmental Consultants, Inc.
1990-1998, McLaren/Hart
1986-1990, Fred C. Hart Associates
1985-1986, Boeing Petroleum Services
1982-1985, Petroleum Operations and Support Services
1981-1982, Dravo Utility Constructors
1979-1981, Florida Institute of Technology
1975-1979, Berkley Products Company

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ATTACHMENT D
SAMPLE CHAIN OF CUSTODY FORM

YORK
ANALYTICAL LABORATORIES, INC.
120 RESEARCH DR. STRATFORD, CT 06615
(203) 325-1371 FAX (203) 357-0166

Field Chain-of-Custody Record

Page____ of ____

NOTE: York's Std. Terms & Conditions are listed on the back side of this document.
This document serves as your written authorization to York to proceed with the analyses requested and your signature binds you to York's Std. Terms & Conditions unless superseded by written contract.

York Project No.________________

Client Information

Company: ____________
Address: ____________
____
Phone No. ____________
Contact Person: ____________
E-Mail Address: ____________

Report To:

Company: ____________
Address: ____________
____
Phone No. ____________
Attention: ____________
E-Mail Address: ____________

Invoice To:

Company: ____________
Address: ____________
____
Phone No. ____________
Attention: ____________
E-Mail Address: ____________

Client Project ID

Purchase Order No.

Turn-Around Time

24 hr ________
48 hr ________
72 hr ________
5 Day ________
Standard______

Report Type/Deliverbles

Summary Results Only______QA/QC Summary______
RCP Package______ASP B Pkg ________
ASP A Pkg______Excel format________
EDD ________OTHER______________

Print Clearly and Legibly. All Information must be complete. Samples will NOT be logged in and the turn-around time clock will not begin until any questions by York are resolved.

____
Samples Collected/Authorized By (Signature)

____
Name (printed)

Matrix Codes
S - soil
Other - specify(oil, etc.)
WW - wastewater
GW - groundwater
DW - drinking water
Air-A - ambient air
Air-SV - soil vapor

Volatiles		Semi-Vols.	Pest/PCB/Herb	Metals	Misc. Org.	Full Lists	Miscellaneous Parameters		
8260 full	TICs	8270 or 625	8082PCB	RCRA8	TPH GRO	Pri.Poll.	Corrosivity	Nitrate	Color
624	Site Spec.	STARS	8081Pest	PP13	TPH DRO	TCL Organics	Reactivity	Nitrite	Phenols
STARS	SPLP or TCLP	BN Only	8151Herb	TAL	CT ETPH	TAL Met/CN-	Ignitability	TKN	Cyanide-T
BTEX	Benzene	Acids Only	CT RCP	CT15	NY 310-13	Full TCLP	Flash Point	Tot. Nitrogen	Cyanide-A
MTBE	Nassau Co.	PAH	App. IX	Total	TPH 418.1	Full App. IX	Sieve Anal.	Ammonia-N	BOD5
TCL list	Suffolk Co.	TAGM	Site Spec.	Dissolved	Air TO14A	Part 360-Routine	Heterotrophs	Chloride	CBOD5
TAGM	Ketones	CT RCP	SPLP or TCLP	SPLP or TCLP	Air TO15	Part 360-Baseline	TOX	Phosphate	BOD28
CT RCP	Oxygenates	TCL list	TCLP Pest	**Indiv. Metals**	Air STARS	Part 360-Expanded No Dioxins/Furans	BTU/lb.	Tot. Phos.	COD
Arom.	TCLP list	TICs	TCLP Herb	Hg, Pb, As, Cd	Air VPH	Part 360-Expanded Full List	Aquatic Tox.	Oil&Grease	TSS
Halog.	524.2	App. IX	Chlordane	Cr, Ni, Be, Fe,	Air TICs	NYCDEP Sewer	TOC	F.O.G.	Total Solids
App.IX	502.2	SPLP or TCLP	608 Pest	Se, Tl, Sb, Cu,	Methane	NYSDEC Sewer	Asbestos	pH	TDS
8021B list	5035	TCLP BNA	608 PCB	Na, Mn, Ag, etc.	Helium	TAGM	Silica	MBAS	TPH - IR

Special Instructions
Field Filtered ☐
Lab to Filter ☐

Sample Identification	Date Sampled	Sample Matrix	Choose Analyses Needed from the Menu Above and Enter Below							Container Description(s)

Preservation **Check those Applicable**	**4°C____ Frozen_____** **HCl MeOH**	**4°C____**	**4°C____**	**HNO_3____** **4°C____**	**4°C____** **H_2SO_4____**	**4°C____** **Other____**	**4°C____ H_2SO_4____ NaOH____** **ZnAc___ Ascorbic___ Other____**

Comments

Samples Relinquished By ____________ Date/Time ____________
Samples Received By ____________ Date/Time ____________
Samples Relinquished By ____________ Date/Time ____________
Samples Received in **LAB** by ____________ Date/Time ____________

Temperature on Receipt

______°C

ATTACHMENT E
CONVENTIONAL LABORATORY QA/QC

FORM I

PREVENTIVE MAINTENANCE – LABORATORY EQUIPMENT

Instrument	Activity	Frequency
Gas Chromatographs	Clean injector for capillary column Replace injector septum Check carrier gas connections/filters Check filter flow controller Inspect / replace capillary columns Replace detector due to excessive signal Replace Injection port liner	Weekly Daily As Required As Required As Required As Required Daily
Mass Spectrometers (MS)	Inspect/replace mass analyzer assembly Clean quadruple mass analyzer Replace electron multiplier Inspect/change oil for vacuum pumps Inspect turbomolecular or Diffusion pump Clean vacuum system filter (if equipped) Clean ion source/Retune	As Required Annually As Rrequired Annually Every 3 months Weekly As Required
Mercury Cold Vapor Analyzer	Replace tubing Replace Purge bottle Replace Cell	Monthly Monthly As-needed
Ion Chromatographs (anions)	Replace or flush guard column Replace Analytical Column Perform annual PM servicing of parts	Every 6 months Every 6 months Every 12 months
ICP (Inductively Coupled Plasma), and ICP/MS	Check tubing, waste and gas flow Replace tubing/Empty waste container Change coolant water Check air filters/Change air filters Clean/replace torch Check and clean filters Clean nebulizer chamber area/Replace	Daily Daily Daily Every 2/6 months As needed Every 6 months As needed

FORM J

CALIBRATION AND CORRECTIVE ACTION – LABORATORY INSTRUMENTATION

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
GC/MS-Volatiles Including Air	BFB Tuning	Every 12 hours, if necessary	Per Method 8260 and EPA TO-15 for AIR	Perform instrument maintenance, retune instrument	1a, 1b
	Initial Calibration (minimum of 5 standards)	Startup, CCC failure, LCS failure, major maintenance	Low STD @ 0.5 ppb for water, 5.0 ppb for soil ≤15% Average RSD or “r”≥0.99 CCC ≤30% and RSD or “r”≥0.99 Contains all target analytes, min. $R_f \geq 0.05$ If regression used curve must not be forced through origin	Recalibrate as required by method (1) if any of CCC %RSDs or if any one of CCC “r” <0.990 or (2) if >20% of remaining analytes have %RSD >30 or “r” < 0.990.	
	Initial Calib. Verification	After initial calibration	All compounds 80-120%; 20% of compounds can be outside of range; no compounds <65>135%.	Recalibrate	
	Continuing Calibration Check (CCC)	Every 12 hours prior to analysis of samples	Concentration level near midpoint of curve Contain all target analytes Percent difference must be ≤20% for CCC and ≤30% for other compounds.	Recalibrate as required by method (1) If %D of any CCC>20% (2) If %D of >10% of other analytes >30%	
	Method Blanks	Every 20 samples prior to running samples and after calibration STDs	Matrix and preservative specific Target analytes should be <RL except common contaminants laboratory contaminants. If not, note in narrative.	Locate the source of contamination, correct problem, reanalyze method blank	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
GC/MS-Volatiles	Laboratory Control Samples (LCS)	Every 20 field samples	Prepared using a std source different than initial calibration Concentration level near midpoint of curve Contain representative target analytes Matrix specific Laboratory determined recoveries must be between 70-130% for all compounds-narrative for outliers Can also be used as Cont. Cal. Verification. Up to 10% outside of range acceptable as long as within 40-160%.	Recalculate the percent recoveries, reanalyze the LCS, locate source of problem, reanalyze associated sample	1a
	Surrogates	Minimum of three at retention times across the GC run	Response must be 70-130% of the initial calibration response.Retention times must be +/- 30 seconds of initial calibration retention time	If surrogate outside lab control limits, rerun except when: (1) obvious interference documented by re-run (2) No targets detected	
	Internal Stds	3 must be used	Response must be > ½ the corres. Area in the CCC or 2x that area.		

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
GC/MS- Semi-Volatiles	DFTPP Tune	Every 12 hours	Per SW-846 Method 8270C	Perform instrument maintenance, retune instrument	2a, 2b, 2c, 2d
	Initial Calibration (minimum of 5 standards)	Startup, CCC failure, LCS failure, major maintenance	Low STD @ 5.0 ug/ml SCAN; 0.05 ug/ml SIM 1) Minimum of 5 standards. 2)Full Scan % RSD ≤ 15 or "r" ≥ 0.990 for all compounds except CCC's, which must be ≤ 30% RSD or "r" ≥ 0.990.; SIM % RSD ≤30 or "r" ≥ 0.990. 3) Must contain all target analytes 4) If SIM is used, laboratory must monitor at least two ions/analyte for all targets, surrogates, and IS's. 5) Minimum RF for all compounds > 0.05.	Recalibrate as required by method. (1) If any CCC RSD>20% or "r"<0.99 (2) If >20% of remaining analytes have a RSD>30% or "r"<0.99	
	Initial Calib. Verification	After Initial Calib.	1) Compounds must recover within 80-120% 2) Laboratories are allowed to have 20% of compounds out, as long as all compounds within recover 65-135%	Recalibrate system	
	Continuing Calibration Check (CCC)	Every 12 hours prior to analysis of samples	1)Contain all target analytes 2)Percent difference must be ≤20% for CCC and ≤30% for other compounds.	Recalibrate system	
	Method Blanks	Every 20 samples prior to running samples and after calibration STDs	Matrix specific Target analytes should be <RL except common phthalates, which cab be ≤ 3x RL	Locate the source of contamination, correct problem, reextract and reanalyze method blank	
	Lab Control Sample (LCS) and MS/MSD	One per Extraction batch of ≤ 20 samples Per matrix	1) Every 20 samples or each batch, whichever is more frequent. 2) Concentration level must be near or at the mid-point of the initial calibration. 3) Must contain all target analytes 4) Matrix and preservative specific 5) Laboratory determined percent recovery limits must be between 40-140% for base-neutrals and 30-130% for acid compounds. RPD ≤ 20 for waters and ≤30 for soils	Re-extract LCS and samples if >20% compounds outside acceptance criteria For Site Specific MS/MSD note outliers in narrative.	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
GC/ECD Pesticides	Endrin/DDT Breakdown	At beginning of each 12 hour clock	≤ 15% breakdown for each	Perform corrective action on injection port	3a, 2b, 2c, 2d
	Initial Calibration	Startup, CCC failure, LCS failure, major maintenance	1) Minimum of 5 stds for single response pesticides. 2) Low std at RL 3) % RSD must be ≤20% or if linear regression used "r" ≥ 0.990 4) For multi-response pesticides analysis of single std at mid-point of calibration range. 5) If curves are used, curve must NOT be forced through origin. Section 7.5 6) Curves must be verified with independent ICV prior to sample analysis.	Recalibrate after corrective action on injection port or column	
	Continuing Calibration Verification	Prior to samples, every 12-hours or 20 samples, whichever is more frequent, and at the end of the analytical sequence.	Percent difference or drift ≤15%. Verify all analytes fall in retention time windows.	1) Perform instrument maintenance, reanalyze CCAL and/or recalibrate. 2) Reanalyze associated samples if beginning or closing CCAL exhibited low response and associated pesticides not detected in samples. 3) Reanalyze associated samples if beginning or closing CCAL high and associated pesticides were detected in samples.	
	Method Blank	1) Extracted every 20 samples or every batch, whichever is greater. 2) Matrix specific	All target analytes < RL	Locate source of contamination and correct problem. Reanalyze method blank. Re-extract samples if method blank contamination found.	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
GC/ECD Pesticides	Laboratory Control Sample (LCS)	1) Extracted every 20 samples or every batch, whichever is greater. 2) Matrix specific 3) Standard source different from initial calibration source. 4) Concentration level must be near or at the mid-point of the initial calibration. 5) Must contain all single response pesticides.	Laboratory determined percent recovery limits must be between 40-140% except for difficult analytes, which must be between 30-140% recovery.	Reanalyze the LCS If MS/MSD in same batch compare to determine if problem isolated to LCS Re-extract LCS and samples if >10% compounds outside acceptance criteria and no MS/MSD with acceptable criteria Locate & correct problem, reanalyze associated samples	3a, 2b, 2c, 2d
	Site Specific Matrix Spike/Matrix Spike Duplicate	1) Every 20 samples per matrix* 2) Spike concentration in lower part of calibration curve. 3) Must contain all single response pesticides.	Laboratory determined percent recovery limits must be between 30-150% RPD’s ≤ 30% for single response pesticides.	If compounds out compare to LCS; if LCS recoveries in note in narrative.	
	Surrogates	Minimum of two compounds across retention times of GC run. Recommended compounds Tetrachloro-m-xylene and decachlorobiphenyl.	Recovery limits lab generated and within 30-150% for both compounds on both columns.	1)Note exceedances in narrative. 2) If re-extraction or reanalysis confirms matrix interference or if re-extraction outside holding times report all results. 3) If re-extraction or reanalysis results in criteria and in holding time, report only compliant data.	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
GC/ECD PCBs	Initial Calibration	Startup, CCC failure, LCS failure, major maintenance	1) Minimum of 5 stds (Note 1) 2) Low std at or below reporting limit 3) % RSD must be ≤20% or if linear regression used "r" ≥ 0.990 4) 5-point cal for PCB-1016/1260. Single point for other Aroclors at mid-point within 12-hrs of sample analysis. If congeners are determined, must use 5-point for each congener. 5) If curves are used, curve must NOT be forced through origin. 6) Curves must be verified with independent ICV prior to sample analysis.	Recalibrate after corrective action on injection port or column	4a, 2b, 2c, 2d
	Continuing Calibration Verification	1) Prior to samples, every 12-hours or 20 samples, whichever is more frequent, and at the end of the analytical sequence. 2) Concentration near mid-point of curve using AR-1016/1260. Congeners; CCAL must include all congeners	Percent difference or drift ≤15%. Verify all analytes fall in retention time windows.	1) Perform instrument maintenance, reanalyze CCAL and/or recalibrate. 2) Reanalyze associated samples if beginning or closing CCAL exhibited low response and associated pesticides not detected in samples. 3) Reanalyze associated samples if beginning or closing CCAL high and associated pesticides were detected in samples.	
	Method Blank	1) Extracted every 20 samples or every batch, whichever is greater. 2) Matrix specific	All target PCBs < RL	Locate source of contamination and correct problem. Reanalyze method blank. Re-extract samples if method blank contamination found.	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
GC/ECD PCBs	Laboratory Control Sample (LCS)	1) Extracted every 20 samples or every batch, whichever is greater. 2) Matrix specific 3) Standard source different from initial calibration source. 4) Concentration level must be near or at the mid-point of the initial calibration. 5) Must contain all single response pesticides.	Laboratory determined percent recovery limits must be between 40-140%	1) Report non-conformances in case narrative. 2) If re-extraction performed within holding time, report only compliant data. If re-extraction performed outside holding time report all data.	4a, 2b, 2c, 2d
	Site Specific Matrix Spike/Matrix Spike Duplicate	1) Every 20 samples per matrix* 2) Spike concentration in middle of calibration curve. 3) Must contain PCB 1016/1260	Laboratory determined percent recovery limits must be between 40-140% RPD’s ≤ 50% for PCB.	If compounds out compare to LCS; if LCS recoveries in note in narrative.	
	Surrogates	Minimum of two compounds across retention times of GC run. Recommended compounds Tetrachloro-m-xylene and decachlorobiphenyl.	Recovery limits lab generated and within 30-150% for both compounds on both columns.	1)Note exceedances in narrative. 2) If re-extraction or reanalysis confirms matrix interference or if re-extraction outside holding times report all results. 3) If re-extraction or reanalysis results in criteria and in holding time, report only compliant data.	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
ICP or ICP/MS Metals	Initial Calibration	1) Daily following instrument profiling and prior to sample analysis. 2) Minimum of calibration blank plus one standard.	Per instrument manufacturer's specification	Recalibrate system	5a,5c
	Initial Calibration Verification (ICV)	1) Daily immediately after calibration and prior to sample analysis. 2) 2nd source standard	ICV ±10% of true value. Must use at least two replicates with RPD <5%	Re-calibrate/Re-analyze ICV as required by method.	
	Initial Calibration Blank (ICB)	1) Daily immediately after ICV. 2) Matrix matched with standards and samples.	< Reporting Limit	Re-calibrate/Re-analyze ICB as required by method.	
	Low Level Calibration Check Standard	1) Daily prior to sample analysis 2) Std concentration ≤ RL for all analytes	Recovery ±30% of true value except for antimony, arsenic, cobalt, and thallium which have a ± 50% limit	Recalibrate/Explain in Narrative	
	Continuing Calibration Verification (CCV)	1) Every 10 samples and at end of analytical sequence. 2) Can be same source or second source.	Recovery ±10% of true value, Must use at least two replicates with RPD <5%	Recalibrate and rerun all samples run after non-compliant CCV	
	Continuing Calibration Blank (CCB)	1) Every 10 samples immediately after CCV. 2)) Matrix matched with standards and samples.	< Reporting limit	Recalibrate/Re-analyze all samples since last compliant CCV	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
ICP or ICP/MS Metals	Interference Check Standards (ICSA & ICSAB)	1) Daily prior to sample analysis and at the end of the analytical sequence. 2) ICSA and ICSAB containing known amounts of analytes and/or interferents per method.	Recoveries for all analytes ±20% of true value or 2x the RL, whichever is greater. If analyte not present, its true value is zero.	May require adjustment of interelement,, correction factors, background correction and/or linear ranges	5a,5c
	Method Blanks	1) Digested every 20 or every batch, whichever is greater. If no digestion, ICB = blank 2) Matrix specific and matrix matched	Target analytes must be <RL	Locate source of contamination and correct problem. Reanalyze method blank. Reprepare samples unless all analyte concentration >10x method blank level	
	Laboratory Control Sample (LCS)	1) Every 20 samples or each batch, whichever is more frequent. If samples not digested, ICV = LCS 2) Matrix specific (solid, aqueous, etc)	LCS recoveries ±20% for aqueous media and within vendor control (95% confidence limits) for solids.	Redigest and reanalyze all samples.	
	Site Specific Matrix Spike	Every 20 samples or batch per matrix	Percent recovery limits must be between 75-125%.	If recoveries >30% and LCS in limits note in narrative If MS recoveries <30%, reprepare and reanalyze samples	
	Site Specific Matrix Duplicate	Every 20 samples or batch per matrix*	For aqueous samples, if concentration >5x the RL, RPD <20%. If concentration <5x RL, difference ±RL. 3) For solids if conc >5x RL, RPD <35%. If conc. < 5x RL, difference ± 2x RL	If LCS in criteria, narrate outliers	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
Cold Vapor Mercury	Initial Calibration	1) Daily prior to sample analysis. 2) Minimum of calibration blank plus five calibration standards.	Linear curve with “r” ≥ 0.995. Can use second order fit if “r “ ≥ 0.995.	Re-optimize instrument and recalibrate as necessary.	6a
	Initial Calibration Verification (ICV)	1) Daily immediately after calibration and prior to sample analysis. 2) 2nd source std	ICV ±10% of true value.	Re-calibrate/Re-analyze ICV as required by method.	
	Initial Calibration Blank (ICB)	1) Daily immediately after ICV. 2) Matrix matched with standards and samples.	ICB must be < RL	Recalibrate/Narrate	
	Continuing Calibration Verification (CCV)	1) Every 10 samples and at end of analytical sequence. 2) Can be same source or second source.	± 20% of true value	Recalibrate/Re-analyze all samples since last compliant CCV	
	Continuing Calibration Blank (CCB)	1) Every 10 samples immediately after CCV. 2)) Matrix matched with standards and samples.	CCB must be < RL	Recalibrate/Re-analyze all samples since last compliant CCV, Narrate outliers	
	Method Blanks	1) Digested every 20 or every batch, whichever is greater. 2) Matrix specific and matrix matched	Mercury < RL	Report non-conformances in case narrative. Reprepare samples unless all analyte concentration >10x method blank level	

Instrument/Analysis	**Activity**	**Frequency**	**Acceptance Criteria**	**Corrective Action**	**SOP Ref. ***
Cold Vapor Mercury	Laboratory Control Sample (LCS)	1) Every 20 samples or each batch, whichever is more frequent 2) Standard source can be initial calibration source. 3) Matrix specific (solid, aqueous, etc).	1) Every 20 samples or each batch, whichever is more frequent 2) Standard source can be initial calibration source. 3) Matrix specific (solid, aqueous, etc).	Redigest and reanalyze all samples	6a
	Site Specific Matrix Spike	Every 20 samples or batch per matrix	Percent recovery limits must be between 75-125%.	If recoveries >30% and LCS in limits note in narrative If MS recoveries <30%, reprepare and reanalyze samples	
	Site Specific Matrix Duplicate	Every 20 samples or batch per matrix	1) For aqueous samples RPD ± 20% if conc. >5x the RL. If conc. < 5x RL, the limit is ± RL 2) For solids RPD ±35% if conc >5x the RL. If conc. < 5x the RL, limit is ± the RL.	If LCS in criteria, narrate outliers.	

Instrument/Analysis	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. *
Ion Chromatograph Anions (Nitrite/Nitrate)	Initial Calibration	1) As needed when operation dictates 2) Minimum of five calibration standards.	Linear curve with "r" ≥ 0.990 and RSD < 15	Re-optimize instrument and recalibrate as necessary.	7a
	Initial Calibration Verification (ICV)	1) Daily immediately after calibration and prior to sample analysis. 2) 2nd source std	ICV ±10% of true value.	Re-calibrate/Re-analyze ICV as required by method.	
	Initial Calibration Blank (ICB)	1) Daily immediately after ICV.	ICB must be < RL	Recalibrate/Narrate	
	Continuing Calibration Verification (CCV)	1) Every 10 samples and at end of analytical sequence. 2) Can be same source or second source.	± 10% of true value	Recalibrate/Re-analyze all samples since last compliant CCV	
	Continuing Calibration Blank (CCB)	1) Every 10 samples immediately after CCV.	CCB must be < RL	Recalibrate/Re-analyze all samples since last compliant CCV, Narrate outliers	
	Lab Control Sample(LCS)	One per 20 samples	Must revocer within mfg. limits	Rerun, if still out, recalibrate.	
	Matrix Spikes	One per 20 samples	Recovery 90-110%	Narrate outliers	
	Matrix Duplicates	One per 20 samples	RPD < 15% for results > 10x RL	Narrate outliers	

Standard Operating Procedure Cross Reference

Analysis/Method	YORK SOP Number-AQUEOUS/Air	YORK SOP Number-SOILS	Table Reference
Volatile Organics 8260	GCMSVOC011700 Rev 1.9 091107	GCMSVOC011700 Rev 1.9 091107	1a
Volatile Organics by EPA TO-15	GCMSAIR111692 Rev.6.0 111709	NA	1b
Semi-Volatile Organics 8270 Scan and SIM	GCMSSVOC011700 Rev 1.9 091107	GCMSSVOC011700 Rev 1.9 091107	2a
Extraction for SVOCs/Pest/PCB- 3545A		EXTSVOCSASE083106 Rev 1.3 102406	2b
Extraction for SVOCs/Pest/PCB- 3550C		EXTSVOCS052600 Rev 1.7 010307	2c
Extraction for SVOCs/Pest/PCB- 3510C	EXTAQSVOC052600 Rev 1.9 022608		2d
Pesticides 8081	GCPEST011700 Rev 1.2 091107	GCPEST011700 Rev 1.2 091107	3a
PCBs 8082	GCPCB011700 Rev 1.3 091107	GCPCB011700 Rev 1.3 091107	4a
Metals 6010B	ICP031195 Rev 1.3 091107	ICP031195 Rev 1.3 091107	5a
Metals 6020B	ICPMS6020 080106 Rev 1.2 11/25/08	ICPMS6020 080106 Rev 1.2 11/25/08	5b
Digestion of Samples for Metals -3010A and 3050B	MetalsPrep030695 Rev 1.2 091207	MetalsPrep030695 Rev 1.2 091207	5c
Mercury 7470A, 7471B	Hg120998 Rev 1.3 091107	Hg120998 Rev 1.3 091107	6a
Anions 300.0/9056	IC011400 Rtev 1.6 101107	IC011400 Rtev 1.6 101107	7a

J. IRM & RIAWP Project Schedule

IRM RIAWP Project Schedule

Time Intervals	**Weeks**													**6 Months Intervals**
Task Schedule following Approval of IRM RIAWP	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**12**	
Site preparation and obtain utility markout	▨													
Procure system components & materials	▨													
Provide penetrations in rear foundation walls of basements and rear alley	▨													
Installation of system conduits, pipings and electic connection		▨												
Sytem check up for operational integrity			▨	▨										
Obtain utility markout				▨										
Perform RIA Addendum					▨	▨	▨	▨						
DUSR										▨	▨	▨		
Drum Disposal											▨			
Submission of RIR Addendum												▨	▨	
System Monitoring (Air flow and PID at effluent)			5 hrs on day 1 & once on day 2	once on day 14		once on day 30			once on day 45					
Indoor/Outdoor Air Sampling			once on day 1, day 3 & day 7											
CCR Reporting of system installation and Start-up										▨	▨	▨		
Semi-Annual Inspection and Certification of system Operation and Maintenance														▨