GROUNDWATER
TECHNOLOGY

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APPENDIX 4

DRAFT FINAL
FIELD SAMPLING AND ANALYSIS PLAN (FSAP)
FOR THE PHASE 1 REMEDIAL INVESTIGATION
PEERLESS PHOTO PRODUCTS, INC. SITE
SHOREHAM, NEW YORK

SITE I.D. #1-52-031

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1.0 SAMPLING PROCEDURES

This Field Sampling and Analysis Plan (FSAP) describes the Phase 1 RI field activities. Subsequent FSAPs will be developed for the Phase 2 and Phase 3 RIs based on findings of the Phase 1 RI. Tasks in the Phase 1 RI require sampling of soils, water, and air to identify the presence/absence and degree of contamination in specific areas of the site. Specific sampling procedures are set forth in the FSAP. Sampling containers, preservation and holding times can be found in Table 1-2. Sample matrices, quality control samples, and associated information can be found in Table 1-3.

Individual work steps for each task will be described in this section. The following discussion will also describe sampling devices for each task as well as sample preservatives for each matrix. At the end of each task, a sampling procedure field checklist is provided. The individual tasks include sampling in the following areas:

- North Recharge Basins,
- East Soil Storage Area,
- West Soil Storage Area,
- Former Drum Storage Area,
- Northeast Corner Aerial Photography Anomaly,
- Primary Waste Water Pump Station,
- Tesla Tower Base,
- Emulsion Building Sump,
- Water Meter Room Pit,
- Three Former Fuel Oil Underground Storage Tank Locations,
- Monitoring wells,
- Off-Site locations including James Street, North Country Road, Route 25A
- Briarcliff Road Wellfield

1.1 Monitoring Well Sampling

A sampling program will be conducted to procure and analyze groundwater samples from ten shallow wells and four deep wells, three of the shallow wells (MW-1, MW-2, and MW-3) already exist. New wells will be drilled using either Hollow Stem Auger Rigs (MW-2A, MW-3A, MW-4, MW-5, MW-6 MW-7, MW-8, MW-9, and MW-10) or Tigre Tierra® (Registered trademark of Aardvark Corporation) casing driver (MW-2B and MW-3B) drilling methods. All wells will be constructed of schedule 80 PVC pipe. Following well installation, surge and pump methods will be used to develop the wells. A surge block will be used to agitate the well. This technique consists of capping the top of the well and by means of a plunger type action rapidly pulling the well water up and down. Because of the coarse nature of the aquifer, it is anticipated that three hours of surging and well pumping will be sufficient to achieve a turbidity level of 50 NTU or less. Development will continue until 50 NTU turbidity level is achieved. Refer to Table 1-A for well locations and analytical parameters.

All drill cuttings generated during the well installation will be stored on and covered with plastic sheeting and stockpiled for later treatment and/or disposal.

A single source of potable water will be established, prior to the initiation of field activities, for decontamination procedures which specify the use of clean potable water, as well as for drilling water and water used in the mixing of well construction materials (i.e., grout). This potable water source will be sampled and analyzed to ensure that no contaminants are being introduced from the outside.

1.1.1 Sampling Procedures

Analytes of interest in this investigation include Target Compound List (TCL) volatile organic compounds, TCL semi-volatile organic compounds, TCL pesticide/PCB compounds, TAL metals, and total cyanide. In addition, field measurements including pH, Eh, conductivity, temperature, and turbidity will also be collected.

Work steps to be followed are:

1.) Obtain appropriate laboratory-prepared sample containers (Table 1-2) prior to sampling.

2.) Determine the appropriate level of health and safety according to the approved Health and Safety Plan.

3.) Calibrate a pH pen, conductivity meter, turbidity meter and thermometer according to procedures outlined in Section 3.

4.) Obtain a depth to water measurement, then determine the volume of water in each well by using $V = \pi r^2 h$ where:

V = volume of water (feet^3)
π = 3.14
r = radius of well (feet)
h = height of column of water in well (feet)

Determine four well volumes in gallons by using ft^3 x 7.48 gallons/ft^3 x 4.

5.) Use a decontaminated pump to purge the low-yield wells to dryness. Purge high-yield wells of at least four to ten well volumes until pH, conductivity and temperature have stabilized and turbidity has been reduced to 50 NTUs or less. The purge pump will be leakproof and free of oil and other adulterating components. During purging, the pump intake should be maneuvered up and down the well to ensure that water stored in the casing is purged.

6.) All purged water will be pumped into drums and stored on-site. After a sufficient volume of water is collected, the water will be analyzed for waste characterization. The purged water will be disposed of properly according to the concentrations and types of compounds present (if any).

7.) Label the purge water containers with the following information: sample name, time and date of sampling, accumulation start date, generator name, address and phone number, location of purge water source and volume of water from each source.

8.) Put on disposable latex sampling gloves prior to collecting samples.

9.) If a polyethylene or teflon bladder=type positive displacement pump is used for purging, procure water from the pump after the pH, conductivity and temperature have stabilized, the turbidity is 50 NTUs or less, and after four to ten well volumes have been removed (high-yield wells) or well has been pumped dry (low-yield wells). Sampling should not be undertaken until the water level in the well has recovered from the purging process.

10.) If a stainless steel submersible centrifugal pump is used for purging, remove it after sufficient purging and procure a water sample with a lean polyethylene, steel, PVC or teflon bailer and monofilament line. Sampling should not be undertaken until the water level in the well has recovered from the purging process.

11.) Collect water samples in 40 ml glass vials (for volatiles) first. Fill the vial with sample water from the bailer to overflowing. Carefully but quickly slip the cap with the septum onto the vial with the teflon face of the septum toward the water (especially when sampling for volatile compounds). Tighten the cap securely, invert the vial and tap the cap against your hand to assure that there are no air bubbles inside. If bubbles are present, add a few more drops of sample water and reseal.

12.) Collect samples for semi-volatiles in one quart (liter) amber glass jars next. Replace the teflon-lined cap. Place the sample in an ice chest at 4° C after labeling. Collect samples for pesticides/PCBs in one quart (liter) amber glass jars. Replace the teflon-lined cap. Place the samples in an ice chest at 4° C after labeling.

13.) Collect samples for metals in one quart (liter) polyethylene jars, fill to the neck of the jar. Acidify the sample with trace grade nitric acid to a pH of 2 or less. Replace the cap.

14.) Collect samples for cyanide in 500 ml plastic containers. Preserve samples with sodium hydroxide to a pH of 12 or more. Replace the cap.

15.) Obtain duplicate and blank samples at the frequency required by Table 1-3.

16.) Label the sample containers using cloth labels and waterproof ink and seal containers with custody seals. Labels will include the following information:

  a. sample identification number,
  b. job name and identification number,
  c. well number and designation,
  d. date and time of sample collection,
  e. type of analysis requested (i.e., VOA, metals, etc.), and
  f. name of sampler.

17.) Fill out chain-of-custody form and reference the preservation technique in the remarks section.

18.) Check to make sure the vial caps are tight, then place on ice immediately.

19.) Store the collected samples together with any blank samples collected for that sampling event. The sample set and blanks must be stored together, under refrigeration, in an area known to be free of contamination.

20.) Transport the sample set, on ice, via overnight courier, maintaining custody as described in Section 2. (Text continues on Page 6.)

Table 1-A
Phase 1 RI
Groundwater Sampling Summary
Peerless Photo Products, Inc. Site
Shoreham, New York
Site ID # 1-52-031

Well Location(s)	Well Number(s)	Sample Depth Below Grade (Feet)	Analytical Parameters	Monitoring Well Rationale (To Establish)
ADMIN BLD.	MW-1	115-135	FULL SUPERFUND TCL+30/TAL	WATER QUALITY DOWNGRADIENT OF SITE
NORTH COUNTRY ROAD	MW-2	115-135	FULL SUPERFUND TCL+30/TAL	WATER QUALITY DOWNGRADIENT OF SITE
NORTH COUNTRY ROAD	MW-2A	170-180	FULL SUPERFUND TCL+30/TAL	WATER QUALITY DOWNGRADIENT OF SITE
NORTH COUNTRY ROAD	MW-3	115-135	FULL SUPERFUND TCL+30/TAL	WATER QUALITY DOWNGRADIENT OF SITE
JAMES STREET	MW-4	115-135	FULL SUPERFUND TCL+30/TAL	WATER QUALITY DOWNGRADIENT OF SITE
ROUTE 25A	MW-5	110-130	FULL SUPERFUND TCL+30/TAL	BACKGROUND UPGRADIENT WATER QUALITY
TESLA TOWER BASE	MW-6	110-130	FULL SUPERFUND TCL+30/TAL	WATER QUALITY AT BASE OF TESLA TOWER
NORTH RECHARGE BASINS	MW-9	105-125	FULL SUPERFUND TCL+30/TAL	WATER QUALITY BENEATH RECHARGE BASINS
NORTH SIDE MAIN PLANT STRUCTURE	MW-10	110-130	FULL SUPERFUND TCL+30/TAL	WATER QUALITY DOWNGRADIENT OF MAIN PLANT STRUCTURE

1.1.2 Sampling Equipment

During this task, prior to sampling, wells will be purged with either a bladder-type positive displacement pump or a stainless steel submersible pump. Purge pumps will be leakproof and free of oils and other adulterating components. If a bladder pump is used, it will be constructed of polyethylene or teflon. Samples will be procured directly with the positive displacement pump or indirectly with a teflon, steel, polyethylene, or PVC bailer. If possible, the pumps and bailers will be dedicated solely to this project.

In the event that it is not economically feasible to use dedicated equipment, decontaminated equipment will be used to collect all samples and the decontamination procedures in section 1.1.4.

1.1.3 Sample Preservatives

Samples will be preserved according to guidelines listed in Table 6-1 of the QAPP and Table 1-2. Regardless of type of contaminant suspected, all samples will be iced from time of collection to time of analysis.

1.1.4 Decontamination

Decontamination procedures will vary depending upon the sampling/purging procedures. If a positive displacement pump is used for both purging and sampling, the pump and associated piping will be decontaminated as follows:

1.) In the predetermined decontamination area fill three forty-gallon polyethylene (e.g. "Rubbermaid") containers. The first with an alconox and water solution, the second with a 10% volume/volume methanol trace grade in clean water solution, the third, a clean potable water rinse.

2.) Place the sampling pump and discharge hose in the alconox-water solution. Start the pump and cycle a minimum of five gallons through the system.

3.) Repeat step 2 in the methanol water rinse.

4.) Repeat step 2 in the clean potable water rinse.

5.) Fluids used for decontamination should be collected in 55-gallon drums (or the tank truck) and transported to the waste water treatment plant for storage in the above ground tanks.

This method is described in Keely and Boateng (1987) and has been proven as an effective method of decontamination.

If a stainless steel centrifugal submersible pump is used for purging, and a polyethylene, steel, PVC or teflon bailer or stainless steel equipment is used for sampling, all equipment will be decontaminated by the following procedure:

1.) In the predetermined decontamination area, using potable water from an established, contaminant-free source, steam clean the bed liner of the sampling truck with the truck parked to allow proper drainage.

2.) Place a piece of clean plastic in the bed of the sampling truck and place the pump, power cord, discharge hose and bailer on the plastic.

3.) Steam clean all the above sampling equipment first with an alconox water solution and followed by clean potable water.

4.) Rinse all above equipment thoroughly with distilled water.

5.) Water draining from decontamination procedures will be collected and stored in 55-gallon drums and/or tank truck and transported to the waste water treatment plan for storage in the above ground tanks.

6.) Let equipment air dry.

7.) Wrap completely in a clean aluminum foil with dull side against the equipment.

If dedicated pumps are utilized, the above procedure will not be necessary.

Internal components of the stainless centrifugal steel submersible pump need not go through rigorous decontamination procedures because this pump will be used for pumping only and not for sampling.

Regardless of sampling method, all disposable sampling equipment (e.g., latex gloves) will be collected in plastic garbage bags placed in 55-gallon drums. Full bags or drums will be placed in a designated storage area on-site.

1.1.5 Field Checklist

During shallow well and select deep well sampling, the field personnel responsibilities for sampling will review the following checklist to assure consistency and quality of sampling procedures.

Field Checklist
Monitor and Public Supply Well Sampling

Preparation

1.) Thoroughly familiar with task before proceeding?

2.) Appropriate level of health and safety determined?

3.) Lab given estimate of sample quantity and arrival time?

4.) Proper and sufficient number of sample containers?

5.) Sample preservation requirements understood and preservatives available?

6.) Have ice for preservation?

7.) Have conductivity meter, pH pen, thermometer, turbidity meter, and calibration solutions?

8.) Understand calibration procedures?

9.) Have pumps with discharge hoses, clamps, valves and fittings?

10.) Have polyethylene, steel, PVC or teflon bailer and interface probe?

11.) Have required purge water treatment (storage drums or tank trucks)?

12.) Have field books, sample labels, chain-of-custody forms, custody seals, calculator, writing instruments (including waterproof pen), sampling gloves and site map enlargements?

13.) Have decontamination equipment supplies including: Polyethylene containers, plastic five gallon buckets, alconox, methanol, distilled water, steam cleaner (fueled), water supply hoses, electric power source, clean potable water source, clean roll of plastic, garbage bags?

14.) Have tools, 100 tape, spare fittings, fuses, batteries and other parts.

15.) Procured all necessary permits?

Task

1.) Equipment (pumps, discharge hoses, bailer, interface probes) decontaminated?

    a. Decontamination area prepared?
    b. Sample truck bed steam cleaned?
    c. Clean plastic used?
    d. Equipment steam cleaned thoroughly or passed through fluid baths properly?
    e. Equipment rinsed twice with distilled water?
    f. Equipment air dried?
    g. Equipment carefully reloaded on truck to prevent contamination?

2.) Monitoring equipment calibrated when necessary?

3.) Pre-sampling information logged (location, personnel, date, weather)?

4.) Water level obtained?

5.) Pump set at correct level and plumbed with discharge treatment?

6.) Time, temperature, pH, conductivity and volume recorded?

7.) Well purged sufficiently? (4 - 10 well volumes and pH, conductivity, and temperature stabilized, turbidity less than 50 NTUs)

8.) Sample gloves put on?

9.) Samples procured, labeled, sealed, preserved and secured properly?

10.) Blanks and duplicates taken when required?

11.) Blanks labeled as regular samples?

12.) Sample information data sheet completed (if necessary)?

13.) All disposable sampling equipment collected in a plastic garbage bag?

14.) Decontamination procedures repeated when necessary?

15.) Holding times and shipment times for samples known?

16.) Sample with chain-of-custody shipped when necessary and proper icing of samples confirmed immediately prior to shipment?

17.) Confirm that lab received samples?

18.) Does sampler require any amendments to checklist? If so, report these amendments.

1.2 Soil Sampling From Test Borings

A sampling program will be conducted to procure and analyze soils obtained during split-spoon sampling of test borings. Specific sample locations can be found in Table 1-B and Figure 1-2. The Emulsion Building Sump will require careful preparation prior to drilling because of the drilling is being conducted indoors. Proper ventilation per the Health and Safety plan will be required. In addition, coring of the concrete floor will be required. Borings will be drilled using Hollow Stem Auger drilling methods. Some test borings are collocated with monitoring well locations. It should be noted that during sampling in some predetermined locations only the worst case (hottest) sample will be analyzed for full TCL+30/TAL metals constituents. The worst case sample will be determined by field and visual characterizations. In the former underground storage tank locations, samples will be collected on five foot intervals starting ten feet below grade until two consecutive samples are collected which are clean based on field and visual characterizations. Then the deeper clean sample will be submitted for laboratory analysis. Field characterizations will be assessed using a portable ionization detector (PID) or its equivalent.

All soils generated during the boring process will be stored on and covered with plastic sheeting for disposal as appropriate.

1.2.1 Sampling Procedures

Analytes of interest in this investigation include TCL volatile organic compounds, TCL semi-volatile organic compounds, TCL pesticide/PCB compounds, TAL metals and total cyanide. Selected samples will be extracted and archived at the laboratory for potential TCLP analysis. Work steps to be followed while performing this task are:

1.) Clear underground utilities as specified in the Health and Safety Plan.

2.) Determine the appropriate level of health and safety according to the approved Health and Safety Plan.

3.) Calibrate organic vapor meter according to steps outlined in Section 3 of the FSAP.

4.) Obtain decontaminated standard split-spoon (24 inches long by 4 inches inside diameter).

5.) Obtain samples by driving the split-spoon sampler through the center and ahead of the cutting teeth on the auger. These samples are to be collected from the appropriate intervals described in the Work Plan.

6.) Put on disposable latex sampling gloves prior to procuring samples.

7.) Upon retrieval of each split-spoon, open and quickly scoop the sample into the appropriate containers for the analytical parameters specified in Table 1-B.

8.) Obtain an organic vapor meter reading from this sample, remaining in the spoon.

9.) Label the sample container with cloth labels and water-proof ink and seal containers and caps with custody seals. Labels will include the following information:

- a. sample identification number
- b. boring number and designation
- c. job name and identification number
- d. date and time of sample collection
- e. type of analysis requested
- f. name of sampler

10.) Check to make sure sample is tightly sealed and place on ice immediately.

11.) Fill out chain of custody form and reference the preservation techniques in the remarks section.

12.) Obtain a trans-located duplicate sample and appropriate blank samples at the frequency outlined in Table 1-3.

13.) Blank samples should be marked as regular samples on both sample containers and on the chain-of-custody forms.

14.) Store the collected samples obtained during that sampling event. The samples must be stored together, under refrigeration in an area known to be free of contamination.

15.) Log the sample remaining in the split-spoon.

16.) Enter into bound field log book, at a minimum, the following:

- a. location where sample was obtained,
- b. sample identification number,
- c. date and time of sample collection,
- d. depths of sample collected,
- e. valuable remark concerning the drilling rates, etc.,
- f. geologic log of the samples,
- g. depth of samples, and
- h. weather conditions during operations.

17.) Mark location on enlargement of sampling site specific map.

18.) Collect the appropriate number of samples for each boring as specified in Table 1-B.

19.) Transport the iced sample set via overnight carrier maintaining chain of custody as described in Section 2.

Table 1-B
Soil Boring Summary
Phase 1 RI
Peerless Photo Products, Inc. Site
Shoreham, New York
Site ID# 1-52-031

Boring Locations	Boring Number(s)/# of Samples	Boring Depth of Screen Intervals (Feet)	Sample Depth Intervals Below Grade (Feet)	Analytical Parameters	Boring Location Rationale (To Establish)
PRIMARY WASTE WATER PUMP STATION	SB-1/5	20	0-2,4-6,8-10, 15-17,20-22	FULL SUPERFUND TCL+30/TAL METALS* (C)	VERTICAL AND LATERAL EXTENT AND CONCENTRATIONS OF CONTAMINATION
WEST SOIL STORAGE	SB-2/5	20	0-2,4-6,8-10, 15-17,20-22	FULL SUPERFUND TCL+30/TAL METALS* (C)	VERTICAL AND LATERAL EXTENT AND CONCENTRATIONS OF CONTAMINATION
FORMER DRUM STORAGE	SB-3/5	20	0-2,4-6,8-10, 15-17,20-22	FULL SUPERFUND TCL+30/TAL METALS* (C)	VERTICAL AND LATERAL EXTENT AND CONCENTRATIONS OF CONTAMINATION
EAST SOIL STORAGE	SB-4/5	20	0-2,4-6,8-10, 15-17,20-22	FULL SUPERFUND TCL+30/TAL METALS* (C)	VERTICAL AND LATERAL EXTENT AND CONCENTRATIONS OF CONTAMINATION
EMULSION BUILDING SUMP	SB-20/7	30	0-2,4-6,8-10, 15-17,20-22, 25-27,30-32	FULL SUPERFUND TCL+30/TAL METALS* (C)	VERTICAL AND LATERAL EXTENT AND CONCENTRATIONS OF CONTAMINATION
ROUTE 25-A	SB-5(MW-5)/1	110	5-7	FULL SUPERFUND TCL+30/TAL METALS	BACKGROUND SOIL QUALITY
TESLA TOWER	SB-6(MW-6)/5	110	BASED ON FIELD SCREENING AND CONCURRENCE WITH THE NYSDEC	FULL SUPERFUND TCL+30/TAL METALS (C)	VERTICAL AND LATERAL EXTENT AND CONCENTRATIONS OF CONTAMINATION
NORTH RECHARGE BASINS	SB-7/7	30	0' TO 0.25', THEN EVERY 5' STARTING AT 5' BELOW GRADE	FULL SUPERFUND TCL+30/TAL METALS' (D)	VERTICAL AND HORIZONTAL EXTENT OF CONTAMINATION
NORTH RECHARGE BASINS	SB-10/7	30	0' TO 0.25', THEN EVERY 5' STARTING AT 5' BELOW GRADE	FULL SUPERFUND TCL+30/TAL METALS' (D)	VERTICAL AND HORIZONTAL EXTENT OF CONTAMINATION
NORTH RECHARGE BASINS	SB-11/7	30	0' TO 0.25', THEN EVERY 5' STARTING AT 5' BELOW GRADE	FULL SUPERFUND TCL+30/TAL METALS' (D)	VERTICAL AND HORIZONTAL EXTENT OF CONTAMINATION
NORTH RECHARGE BASINS	SB-12/7	30	0' TO 0.25', THEN EVERY 5' STARTING AT 5' BELOW GRADE	FULL SUPERFUND TCL+30/TAL METALS' (D)	VERTICAL AND HORIZONTAL EXTENT OF CONTAMINATION

Boring Locations	Boring Number(s)/# of Samples	Boring Depth of Screen Intervals (Feet)	Sample Depth Intervals Below Grade (Feet)	Analytical Parameters	Boring Location Rationale (To Establish)
NORTH RECHARGE BASINS	SB-13/7	30	0' TO 0.25', THEN EVERY 5' STARTING AT 5' BELOW GRADE	FULL SUPERFUND TCL+30/TAL METALS[1] (D)	VERTICAL AND HORIZONTAL EXTENT OF CONTAMINATION
NORTH RECHARGE BASINS	SB-8/17	110	0' TO 0.25'; EVERY 5' FROM 5' TO 50' BELOW GRADE; EVERY 10' FROM 50' TO 110' BELOW GRADE	FULL SUPERFUND TCL+30/TAL METALS (D)	VERTICAL AND HORIZONTAL EXTENT OF CONTAMINATION
NORTH RECHARGE BASINS	SB-9(MW-9)/17	110	0' TO 0.25'; EVERY 5' FROM 5' TO 50' BELOW GRADE; EVERY 10' FROM 50' TO 110' BELOW GRADE	FULL SUPERFUND TCL+30/TAL METALS (D)	VERTICAL AND HORIZONTAL EXTENT OF CONTAMINATION
FORMER DRUM LOCATION	SB-14/1	15	A	FULL SUPERFUND TCL+30/TAL METALS (WORST CASE ONLY)	SOIL QUALITY
NORTHEAST PHOTO AREA	SB-15/1	15	A	FULL SUPERFUND TCL+30/TAL METALS (WORST CASE ONLY)	SOIL QUALITY
SCWA WELLFIELD	SB-16/1	5	5-7	FULL SUPERFUND TCL+30/TAL METALS	BACKGROUND SOIL QUALITY
WATER METER ROOM PIT	SB-21/1	8	8	FULL SUPERFUND TCL+30/TAL METALS	SOIL QUALITY
FORMER UST AREA	USTB-17/2	UNTIL CLEAN	B	TCL VOLATILES AND TCL SEMI-VOLATILES	VERTICAL EXTENT OF CONTAMINATION
FORMER UST AREA	USTB-18/2	UNTIL CLEAN	B	TCL VOLATILES AND TCL SEMI-VOLATILES	VERTICAL EXTENT OF CONTAMINATION
FORMER UST AREA	USTB-19/2	UNTIL CLEAN	B	TCL VOLATILES AND TCL SEMI-VOLATILES	VERTICAL EXTENT OF CONTAMINATION

* - Full Superfund TCL+30 and TAL analyses for one worst case soil sample per boring based on field screening. All other samples analyzed for TAL metals only.

1 - Full Superfund TCL+30 and TAL analyses for the sample at grade and one worst case sample per boring. All other samples analyzed for TAL metals only.

A - Sample will be taken from the worst-case split-spoon (of four collected: 0-2, 4-6, 8-10, 15-17) based on field and visual characterization.

B - Samples will be collected on 5 foot intervals starting 10 feet below grade until two consecutive samples are collected that are clean based on sensory and field instrument analysis. The deeper clean sample, and the worst-case sample per boring, based on field screening, will be submitted for laboratory analysis.

C - The worst case sample per soil boring, based on field screening, will be submitted for TCLP analysis for analytes present at 20 times their respective groundwater class GA standards. Addtionally, the sample with the highest TAL metals concentrations will be analyzed for TCLP metals. This sample may differ from the "worst-case" sample described above.

D - Three worst case samples from all samples collected from soil borings SB-7, SB-10, SB-12, SB-13 and SB-17 will be submitted for TCLP analysis for metals that were detected at elevated levels in total TAL metals analyses.

1.2.2 Sampling Equipment

During this task, 4 inch wide by a 24 inch long ASTM standard split-spoons will be used for sampling. The split spoons will be driven by a standard 140 pound hammer through augers.

1.2.3 Sample Preservatives

All samples will be preserved by placing on ice. No other preservation methods are necessary.

1.2.4 Decontamination

Decontamination procedures will consists of the following:

1.) Between individual samples from the same boring, scrub the split spoons with the alconox and water solution, rinse with a clean potable water solution, rinse thoroughly with distilled water and let air dry on a clean plastic sheet. A new plastic sand trap will be placed in the head of each split-spoon prior to collecting a sample.

2.) Certain locations will require more than one split-spoon of soil to provide adequate sample weight for analysis.

3.) Decontaminate augers and split-spoon rods between locations but not between borings on the same location.

4.) When augers are to be decontaminated, in a predetermined decontamination area using potable water, steam clean the bed liner of the sampling truck with the truck parked to allow proper drainage.

5.) Place a piece of clean plastic in the bed of the sampling truck and place augers, split-spoons, and sampling rods on the plastic.

6.) Steam clean all the above sampling equipment first with an alconox and water solution followed by clean potable water.

7.) Rinse all above equipment twice with distilled water.

8.) Water draining from decontamination procedures should be collected and stored in 55-gallon drums or above ground storage vessels pumped from tank trucks for later disposal or treatment.

9.) Let equipment air dry.

Regardless of sampling method, all disposable sampling equipment (e.g., latex gloves) will be collected in plastic garbage bags. Full bags will be placed in a designated storage area.

1.2.5 Field Checklist

During soil sampling, personnel responsible for sampling will review the following checklist to assure consistency and quality of sampling procedures.

Soil Sampling From Test Borings

Preparation

1.) Thoroughly familiar with task before proceeding?

2.) Appropriate level of health and safety determined?

3.) Lab given estimate of sample quantity and arrival time?

4.) Proper and sufficient number of sample containers?

5.) Sample preservation requirements understood?

6.) Have ice for preservation?

7.) Have Organic Vapor Meter?

8.) Understand calibration procedures?

9.) Have field books, sample labels, chain-of-custody forms, custody seals, calculator, writing instruments (including water proof pen), sampling gloves, photo camera, film, batteries, and site map enlargements?

10.) Have decontamination equipment supplies including: plastic five gallon buckets, alconox, distilled water, steam cleaner (fueled), water supply hoses, electric power source, clean potable water source, clean roll of plastic, garbage bags?

11.) Have tools, 100' tape, spare fittings, duct tape, fuses, batteries and other parts?

Task

1.) Equipment (split-spoon, split-spoon rods, augers drill casing, bits) decontaminated?

    a. Decontamination area prepared?
    b. Sample truck bed steam cleaned?
    c. Clean plastic used?
    d. Equipment steam cleaned thoroughly?
    e. Equipment rinsed twice with distilled water?
    f. Equipment air dried?
    g. Equipment carefully reloaded on truck to prevent contamination?

2.) Organic vapor meter calibrated when necessary?

3.) Pre-sampling information logged (location, personnel, date, weather)?

4.) Sample gloves put on?

5.) Was an OVM reading obtained?

6.) Samples preserved and secured properly?

7.) Each bottle labeled with the following information?

    a. job number,
    b. owner/client,
    c. facility location,
    d. boring number or designation,
    e. sample identification number or designation,
    f. date,
    g. time,
    h. type of laboratory analysis (i.e., VOA, TAL, metals, etc.), and
    i. name of person collecting the sample.

8.) Blanks and duplicates taken when required?

9.) Blanks labeled as regular samples?

10.) Sample information data sheet completed?

11.) All disposable sampling equipment collected in a plastic garbage bag?

12.) Decontamination procedures repeated when necessary?

13.) Holding times and shipment times for samples known?

14.) Sample with chain-of-custody shipped when necessary and proper icing of samples confirmed immediately prior to shipment?

15.) Confirm that lab received samples?

16.) Does sampler require any amendments to checklist? If so, report these amendments.

1.3 Soil Sampling From Hand Augers

A sampling program will be conducted to procure and analyze soils obtained by hand auger sampling. The specific sample location (Water Meter Room Pit), can be found in Table 1-B and Figure 1-2. All soils generated during hand augering in the Water Meter Room Pit will be left in the Water Meter Room Pit.

1.3.1 Sampling Procedures

Analytes of interest in this investigation include TCL volatile organic compounds, TCL semi-volatile organic compounds, TCL pesticide/PCB compounds, TAL metals and total cyanide. Work steps to be followed while performing this task are:

1.) Equipment (hand augers) decontaminated?
    a. Decontamination area prepared?
    b. Sample truck bed steam cleaned?
    c. Clean plastic used?
    d. Equipment steam cleaned thoroughly?
    e. Equipment rinsed twice with distilled water?
    f. Equipment air dried?
    g. Equipment carefully reloaded on truck to prevent contamination?

2.) Organic vapor meter calibrated when necessary?

3.) Pre-sampling information logged (location, personnel, date, weather)?

4.) Sample gloves put on?

5.) Was an OVM reading obtained?

6.) Samples preserved and secured properly?

7.) Each bottle labeled with the following information?
    a. Job number,
    b. owner/client,
    c. facility location,
    d. boring number or designation,
    e. sample identification number or designation,
    f. date,
    g. time,
    h. type of laboratory analysis (i.e., VOA, TAL, metals, etc.), and
    i. name of person collecting the sample.

8.) Blanks and duplicates taken when required?

9.) Blanks labeled as regular samples?

10.) Sample information data sheet completed?

11.) All disposable sampling equipment collected in a plastic garbage bag?

12.) Decontamination procedures repeated when necessary?

13.) Holding times and shipment times for samples known?

14.) Sample with chain-of-custody shipped when necessary and proper icing of samples confirmed immediately prior to shipment?

15.) Confirm that lab received samples?

1.3.2 Sampling Equipment

During this task, a stainless steel hand auger will be used for sampling.

1.3.3 Sample Preservatives

All samples will be preserved by placing on ice. No other preservation methods are necessary.

1.3.4 Decontamination

Decontamination procedures will consist of the following:

1.) Between individual samples from the same boring, scrub the hand auger with the alconox and water solution, rinse with a clean water solution, rinse thoroughly with distilled water and let air dry on a clean plastic sheet.

2.) Decontaminate hand augers between locations at the predetermined decontamination area.

3.) Steam clean the hand auger followed by an alconox and water solution followed by clean potable water.

4.) Rinse all above equipment thoroughly with distilled water.

5.) Water draining from decontamination procedures should be collected and stored in 55-gallon drums which will be transferred to above ground tanks located at the waste water treatment plant.

6.) Let equipment air dry.

Regardless of sampling method, all disposable sampling equipment (e.g., latex gloves) will be collected in plastic garbage bags. Full bags will be placed in a designated storage area.

1.4 Metal Detector Survey

A metal detector survey will be conducted around the former drum location in the northwest corner of the site. The purpose of the survey is to determine the existence or not of other drums or metal objects in this area.

Prior to conducting metal detector surveys, a planimetric survey will be conducted to establish a grid coordinate system at 100-foot intervals across the northwest corner of the site. The grid coordinate system will be sued to locate geophysical survey lines and measurement stations.

The Electromagnetic Induction (EM) survey will be performed using a Geonics EM31 terrain conductivity meter equipped with an EM31DL data logger or equivalent device. The EM survey will be completed along survey lines spaced every 20 feet. Prior to taking any readings the area will be visually inspected and any surface metal will be removed from the target area. Readings will be taken every 20 feet along each survey line. Field calibration checks of the EM instrument's sensitivity will be performed prior to the start of the survey in an area considered to represent background readings.

Both the quadrature component and in-phase component of the electromagnetic field will be recorded by the data logger at each station. The quadrature component of the electromagnetic field is linearly proportional to the apparent ground conductivity and will be used to delineate areas of past metallic waste disposal, if any. The in-phase component of the electromagnetic field is sensitive to electrically conductive materials, such as metals, and will be used to delineate areas of buried metals. All work will be performed in accordance with the manufacturer's operation manual for the EM31.

The quadrature and in-phase readings will be downloaded daily from the digital data logger to a laptop computer for further processing and contouring. Contour maps of both the quadrature and in-phase component readings will be prepared for the northwest corner of the site.

The potential exists that the high voltage LILCO power lines will adversely effect the EM31. If this occurs alternative metal detector survey equipment will be evaluated.

1.5 Visual Inspection of Main Plant Structure, Two Storage Sheds and Waste Water Treatment Plant

Prior to the initiation of on-site sampling, a thorough visual inspection of the main plant structure, two storage sheds and waste water treatment plant will be performed. The intention of this inspection is to: verify and document the presence or non-presence of residual contamination in the buildings; and to verify that pathways from spillage of contaminants in the interior of the buildings to soils beneath the buildings do not exist.

1.5.1 Visual Inspection of Structures

Work steps to be followed while performing this task include:

1.) Develop a base map based on existing site plans for plotting information gathered during visual inspection of building.

2.) Develop audit checklist for use.

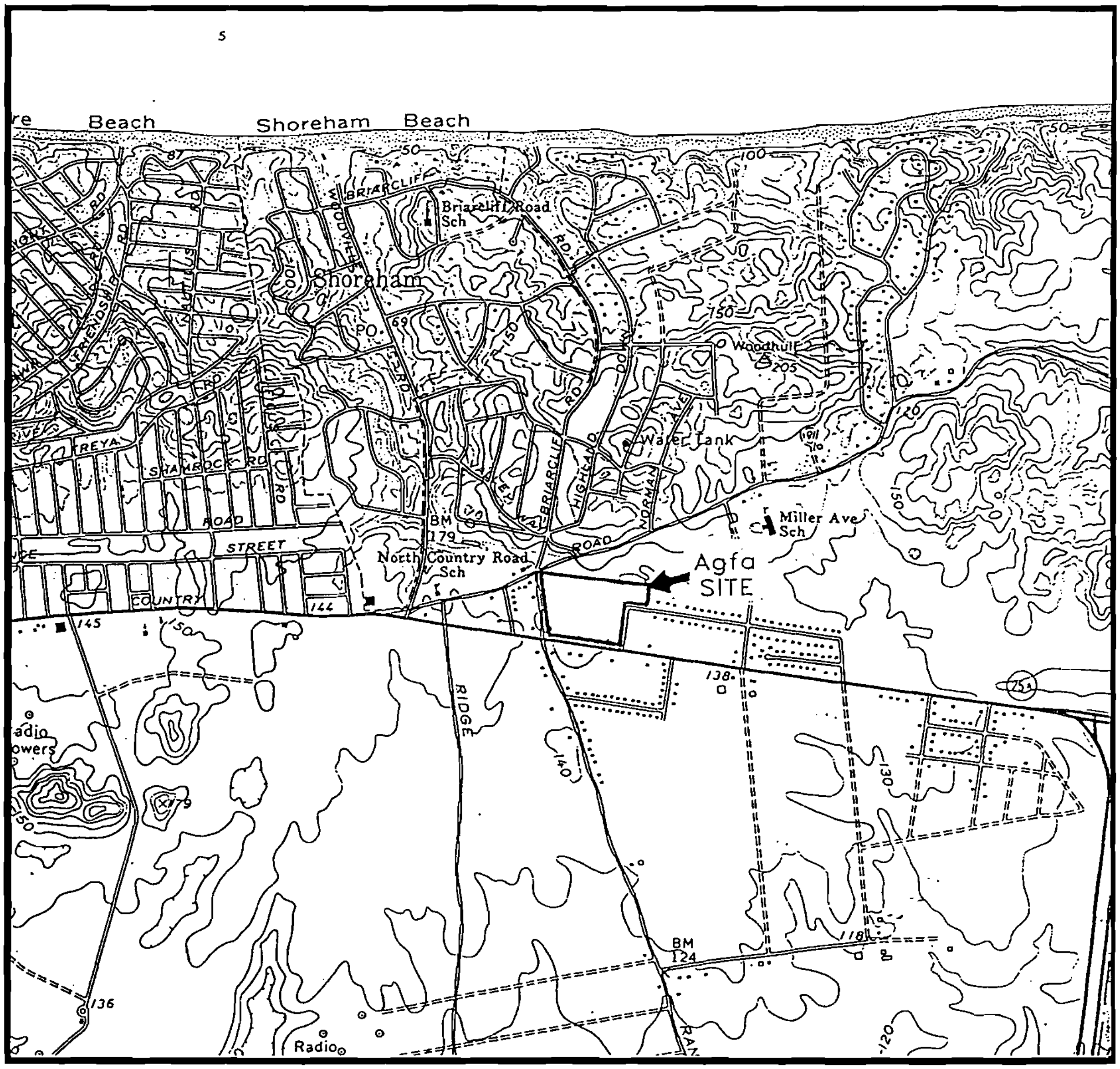
3.) Inspect existing reports and file information regarding historical use of structures.

4.) Visually inspect each room within each structure for industrial process discharges. Discharge lines and pipes for leaks or spills, and inspect condition of floors for cracks, holes, drains or stains.

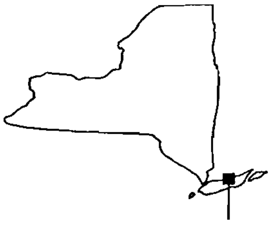
Note any abnormalities or non-conformities.

1.6 References

Keely, J.F. and K. Boateng, 1987. Monitoring well installation, purging and sampling techniques - Port 1: Conceptualizations. Groundwater, v. 25, no. 3, pp. 300-131.



SOURCE: U.S.G.S. TOPOGRAPHIC QUADRANGLE
MIDDLE ISLAND, N.Y.
7.5 MINUTE SERIES
DATE: 1967



MAP LOCATION

SCALE 1:24,000

0 2,000 4,000

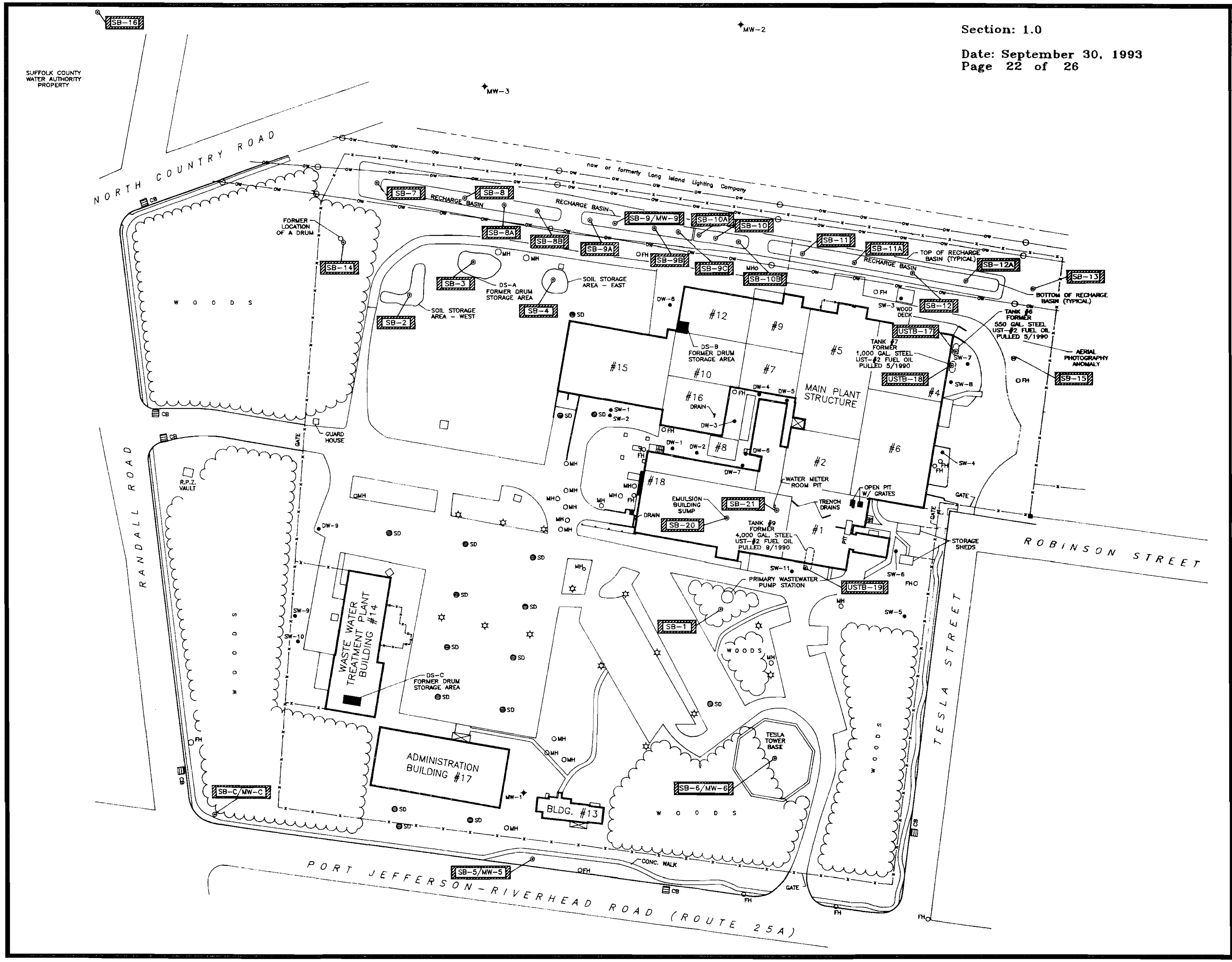
SCALE FEET

N

GROUNDWATER TECHNOLOGY

101-1 COLIN DRIVE
HOLBROOK, NEW YORK
(516) 472-4000

DESIGNED: TLD	**SITE LOCATION**	
DETAILED: TRS	NAME: Agfa Division of Miles Inc.	DRAWING DATE: 9/30/93
CHECKED: TLD	LOCATION: SITE ID# 1-52-031 RANDALL ROAD SHOREHAM, NEW YORK	FIGURE: **1-1**



NO.	DATE	BY	REVISION
1	12/92	TRS	CHANGED MW#'S. COLOR
2	1/93	TRS	ADDED INT. ROOMS
3	9/93	TLD	CHANGED LOC. OF SB-7 REMOVE MW-8

LEGEND

- ▨SB-8▨ ⊙ PROPOSED SOIL BORING
- ● INJECTION WELLS TO BE CLEANED
- ✦ MONITORING WELL
- SD ⊜ STORM DRAIN
- FH ○ FIRE HYDRANT
- ☼ LIGHT
- MH ○ MANHOLE
- • ▢ CONCRETE COVERS
- —•— CHAIN LINK FENCE
- —●— OVERHEAD WIRES
- ○ UTILITY POLE
- CB ▤ CATCH BASIN

COLOR CODE

- ▨SB-8▨ PURPLE = PHASE 1 RI
- ▨SB-8A▨ BLUE = PHASE 2 RI

NOTES: LOCATIONS OF SW-7, SW-8 AND SW-10 ARE APPROXIMATE.

SOURCE:

YOUNG & YOUNG
400 OSTRANDER AVENUE, RIVERHEAD, N.Y.
ALDEN W. YOUNG, N.Y.S. P.E.&L.S. LIC. #12845
HOWARD W. YOUNG, N.Y.S. L.S. LIC. NO. 45893
THOMAS C. WOLPERT, N.Y.S. P.E. LIC. NO. 61483

N

50 0 50 100
SCALE FEET

SIGNATURE	DATE
REVIEW ENGR:	
PROJECT ENGR:	
PROJECT MGR:	
CLIENT:	

GROUNDWATER
TECHNOLOGY

101-1 COLIN DRIVE
HOLBROOK, N.Y. 11741 (516) 472-4000

Agfa Division of Miles Inc.

PEERLESS PHOTO PRODUCTS, INC. SITE
SHOREHAM, N.Y.
SITE ID# 1-52-031

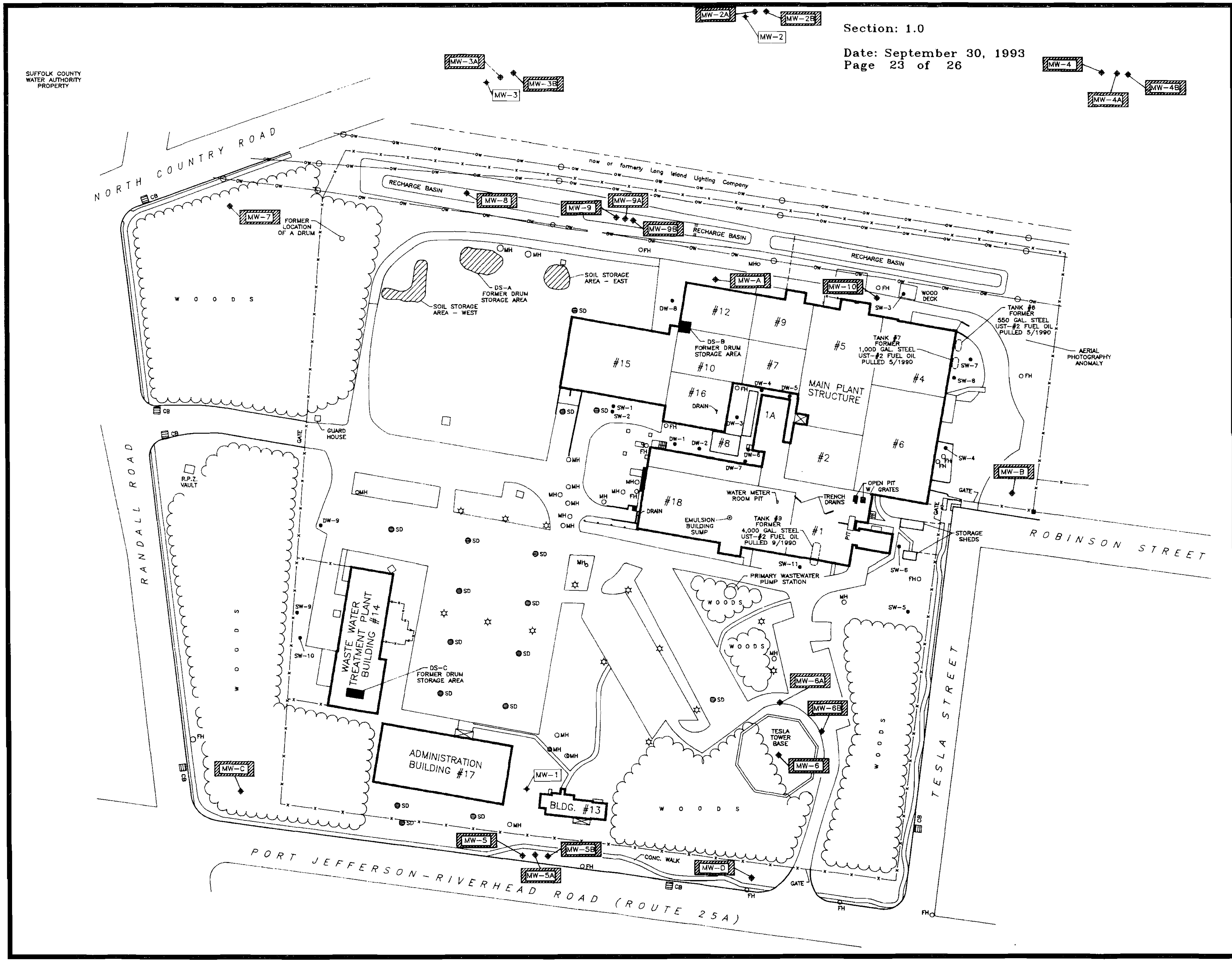
PROPOSED SOIL BORING LOCATIONS

DESIGNED BY:	DETAILED BY:	CHECKED BY:
TLD	TRS	

DRAWING DATE:	ACAD FILE:
9/13/93	5073W592

PROJECT NO.:	CONTRACT:
01113-5073	

DRAWING:	REVISION:
FIGURE 1-2	



NO.	DATE	BY	REVISION
1	12/92	TRS	CHANGED MW#'S, COLOR
2	1/93	TRS	ADDED INT. ROOMS
3	9/93	TLD	CHANGED PHASE ON MW-2B, 3A, 3B, 7, 8

LEGEND

- MW-5 PROPOSED MONITORING WELL
- ● INJECTION WELLS TO BE CLEANED
- MW-3 EXISTING MONITORING WELL
- SD STORM DRAIN
- FH ○ FIRE HYDRANT
- ✡ LIGHT
- MH ○ MANHOLE
- ▢ CONCRETE COVERS
- CHAIN LINK FENCE
- OVERHEAD WIRES
- ○ UTILITY POLE
- CB ▤ CATCH BASIN

COLOR CODE

- MW-5 PURPLE = PHASE 1 RI
- MW-5A BLUE = PHASE 2 RI
- MW-5B ORANGE = PHASE 3 RI

NOTES: LOCATIONS OF SW-7, SW-8 AND SW-10 ARE APPROXIMATE.

SOURCE:

YOUNG & YOUNG
400 OSTRANDER AVENUE, RIVERHEAD, N.Y.
ALDEN W. YOUNG, N.Y.S. P.E.&L.S. LIC. #12845
HOWARD W. YOUNG, N.Y.S. L.S. LIC. NO. 45893
THOMAS C. WOLPERT, N.Y.S. P.E. LIC. NO. 61483

N

50 0 50 100
SCALE FEET

SIGNATURE	DATE
REVIEW ENGR:	
PROJECT ENGR:	
PROJECT MGR:	
CLIENT:	

GROUNDWATER TECHNOLOGY
101-1 COLIN DRIVE
HOLBROOK, N.Y. 11741 (516) 472-4000

Agfa Division of Miles Inc.

PEERLESS PHOTO PRODUCTS, INC. SITE
SHOREHAM, N.Y.
SITE ID# 1-52-031

PROPOSED MONITORING WELL LOCATIONS

DESIGNED BY: TLD	DETAILED BY: TRS	CHECKED BY:
DRAWING DATE: 9/13/93	ACAD FILE: 5073W492	
PROJECT NO.: 01113-5073	CONTRACT:	
DRAWING: FIGURE 1-3	REVISION:	

TABLE 1-2
SAMPLING CONTAINERS, PRESERVATION AND HOLDING TIMES

Phase 1 RI
Peerless Photo Products, Inc. Site
Shoreham, New York
Site ID # 1-52-031

PARAMETER	MATRIX	CONTAINER (4)	PRESERVATION	HOLDING TIME (1)
TCL Volatiles	Aqueous	40 ml. VOA Vial w/TFE lined septum cap	4°C	7 days
TCL Volatiles	Soils	40 ml. VOA Vial w/TFE lined septum cap	4°C	7 days
TCL Semi-Volatiles	Aqueous	Amber glass w/TFE lined cap (1 liter)	4°C	5 days until extraction 40 days from extraction until analysis
TCL Semi-Volatiles	Soils	Glass wide-mouth w/TFE lined septum cap/4 oz.	4°C	5 days until extraction 40 days from extraction until analysis
TCL Pest/PCBs	Aqueous	Amber glass w/TFE lined cap (1 liter)	None	5 days until extraction 40 days from extraction until analysis
TCL Pest/PCBs	Soils	Glass wide-mouth w/TFE lined septum cap/4 oz.	None	5 days until extraction 40 days from extraction until analysis
TAL Metals (total)	Aqueous	Polyethylene 1 qt.	HNO_3 to ph < 2.0 (3)	Hg: 26 days All other metals: 6 months
TAL Metals	Soil	Polyethylene 1 qt. or 4 oz. glass wide-mouth w/TFE lined septum	4°C	Hg: 26 days All other metals: 6 months
pH	Aqueous	None	None	Performed on-site
Specific Conductance	Aqueous	None	None	Performed on-site
Dissolved Oxygen	Aqueous	None	None	Performed on-site
Eh	Aqueous	None	None	Performed on-site
Cyanide	Aqueous	1 liter wide-mouth polyethylene	NaOH to pH > 12.0 (3)	12 days

TABLE 1-2 (continued)

PARAMETER	MATRIX	CONTAINER (4)	PRESERVATION	HOLDING TIME (1)
TCLP Semi-volatiles	Soil	Glass wide-mouth w/TFE line septum Cap/8 oz.	4°C	14 days until TCLP Extraction; for Complete analysis, 7 days until extraction, 40 days from extraction until analysis.

(1) Verified Time of Sample Receipt (VTSR - time from lab sample receipt until sample analysis) will be used to audit results.
(2) Percent solids will be performed using a soil sample aliquot already submitted for analysis.
(3) Nitric acid and Sodium Hydroxide will be procured from a chemical supplier, trace grade.
(4) I-Chem 300 series or equivalent grade sample containers will be used to procure samples.

Notes:

TCL = Full Superfund Target Compound List
TAL = Target Analyte List
TCLP = Toxicity Characteristic Leaching Procedures
Pest/PCBs = Pesticides and Polychlorinated Biphenyl

TABLE 1-3

NUMBER OF SAMPLES TO BE COLLECTED FOR EACH SAMPLING MEDIA AND ANALYSES TO BE PERFORMED
PHASE 1 RI PEERLESS PHOTO PRODUCTS, INC. SITE
SHOREHAM, NEW YORK
SITE I.D. # 1-52-031

Type	Source	Monitoring Well or Soil Boring No.	No. of Matrix Samples (Minimum)	No. of Wells or Borings (Minimum)	Matrix	QA/QC Required					Analysis
						(Blind)[1] Replicate	Field[2] (Minimum)	Rinse[3] (Minimum)	Trip[4] (Minimum)	MS/ MSD[5]	
Groundwater	Monitoring Wells	MW's 1, 2, 3, 2A, 4, 5, 6, 9, 10	9	9	Aqueous	1	1	1	1	1	Full Superfund TCL+30/TAL Metals
Hand Auger	Predetermined Locations	SB-21	1	1	Soil	1	1	1	NA	1	Full Superfund TCL+30/TAL Metals
Soil Boring	Predetermined Locations	SB's 5, 6, 14, 15, 16	9	5	Soil	1	4	1	NA	1	Full Superfund TCL+30/TAL Metals on all samples; TCLP analysis of select anaytes detected at > 20 times their respective class GA groundwater standards in one worst case sample per boring
Soil Boring	Predetermined Locations	SB's 8, 9	34	2	Soil	2	4	1	NA	2	Full Superfund TCL+30/TAL Metals on all samples
Soil Boring	Predetermined Locations	SB's 1, 2, 3, 4, 20	27	5	Soil	2	4	1	NA	2	Full Superfund TCL+30/TAL Metals and TCLP analysis of select analytes detected at > 20 times their respective class GA groundwater standards in one worst case sample per boring; TAL Metals only for all other samples
Soil Boring	Predetermined Locations	SB's 7, 10, 11, 12, 13	35	5	Soil	2	4	1	NA	2	TAL Metals for all samples. Additionally, Full Superfund TCL + 30 for the 0 - 0.25 foot interval and the worst case sample per boring; TCLP analysis of select TAL Metals for three worst case samples of the 35 collected
Soil Boring	Former UST Locations	USTB'S 17, 18, 19	6	3	Soil	1	2	1	NA	1	TCL Semi-Volatiles and TCL Volatiles

[1] 1 per 20 samples/matrix [2] 1 per day [3] 1 per week/sampling equipment used [4] 1 per 20 samples/day [5] 1 per 20 samples/matrix
NA = Not Applicable

2.0 SAMPLE CUSTODY

A sample is the physical evidence collected from a site or the environment. An important part of the Phase 1 RI is the control and tracking of the evidence collected.

The primary objectives of sample custody procedures are to create accurately written records that can be used to trace the possession and handling of all samples from the moment of their collection, through analysis, until their final disposition. Sample custody for samples collected during this Phase 1 RI will be maintained by the Site Manager or other field personnel collecting the samples. The field personnel are responsible for documenting each sample transfer and maintaining custody of all samples until they are shipped to the laboratory.

2.1 Field Custody Procedures

All necessary sample bottles will be shipped by the laboratory. The chain-of-custody will begin with the laboratory relinquishing sampling bottles to the Site Manager. Sample bottles needed for a specific sampling task will then be relinquished by the Site Manager to the sampling team after the Site Manager has checked the integrity of the bottles and assured that the proper bottles have been assigned to the task to be conducted.

Immediately after sample collection, each sample bottle will be sealed with an individual custody seal. The samples will then be placed into an insulated cooler for shipment to the laboratory. Field chain-of-custody records (Figure 2-2) completed at the time of sample collection will accompany the sample cooler placed inside the cooler in a zip-lock bag. The cooler is then sealed for shipment to the laboratory. The samples will be properly relinquished on the field chain-of-custody record by the sampling team. Each cooler will contain sufficient ice and/or ice packs to insure proper temperature is maintained, and will be packed in a manner to prevent damage to sample containers. The Site Manager will initial and place a custody seal (Figure 2-3) on each sample cooler. All coolers will be relinquished to an overnight courier.

2.1.1 Sample Identification

Each separate sample will be identified using the sample label shown in Figure 2-1. The sampler will complete all information, using a black waterproof pen, as follows:

A. The sample ID number will be the number assigned to the particular sampling station, including the depth of sampling, if relevant.

Example: Well/Boring I.D.: B-14
Matrix: Soil
Depth: 5' - 10'

B. The job number will be the number assigned to the particular site.

Example: 01113-5396

C. The analysis required will be indicated for each sample.

Example: TAL Metals

D. Date taken will be the date the sample was collected, using the format: MM-DD-YY.

Example: 08-15-86

E. Time will be the time the sample was collected, using military time.

Example: 1430

F. The sampler's name will be printed in the "Sampled By" section.

G. Other information relevant to the sample.

Example: Field Blank

An example sample label is presented below:

JOB NO.: 01113-5396
CLIENT: Agfa
SAMPLE I.D.: B-14
MATRIX: Soil
SAMPLING DEPTH: 5' - 17'
DATE TAKEN: 08-15-86
TIME TAKEN: 14:30
SAMPLER: Tim Douthit
OTHER:

Prior to going to the field, this sample identification procedure will be further refined (if necessary), so that a sample is accurately and easily identified.

This sample label contains the authoritative information for the sample. Inconsistencies with other documents will be settled in favor of the vial or container label unless otherwise corrected in writing from the field personnel collecting samples.

All samples analyzed by the laboratory are to be considered to be of an evidentiary nature. The possession of samples must be traceable from the time samples are collected in the field until the analysis is completed and the data are entered as evidence. The tracing of the samples is accomplished by "chain-of-custody" procedures as follows:

1.) A chain-of-custody record (Figure 2-2) will be completed for each set of samples.

2.) Samples will not leave custody of the field investigator until relinquished to another party.

Custody is defined as:

1.) In the actual physical possession of field personnel.

2.) In the field personnel's view after being in physical possession.

3.) In a locked area after being in physical possession.

4.) In a designated, locked storage area.

2.2 Laboratory Chain-of-Custody

Upon arrival at the laboratory, the Sample Custodian at the lab must maintain possession of the chain-of-custody samples and all records documenting that possession. Upon receipt of samples, the sample custodian removes the chain-of-custody from the sealed cooler and must sign the shipping report accompanying each sample and records the date and time. Samples received are verified to match those listed on the chain-of-custody, and the custody seals inspected. A copy of this record becomes part of the report file. The custodian must sign the Chain-of-Custody "Received By" laboratory space. The samples are then secured under lock and key in refrigerated storage.

After each extraction or analysis of a sample fraction, the custody record must be signed by the analyst, indicating the date and time of completion, which samples were used, and to which location they were returned.

By signing the custody record, the individual affirms that he or she was completely responsible for the sample fraction during the period of time it was not in the secure storage.

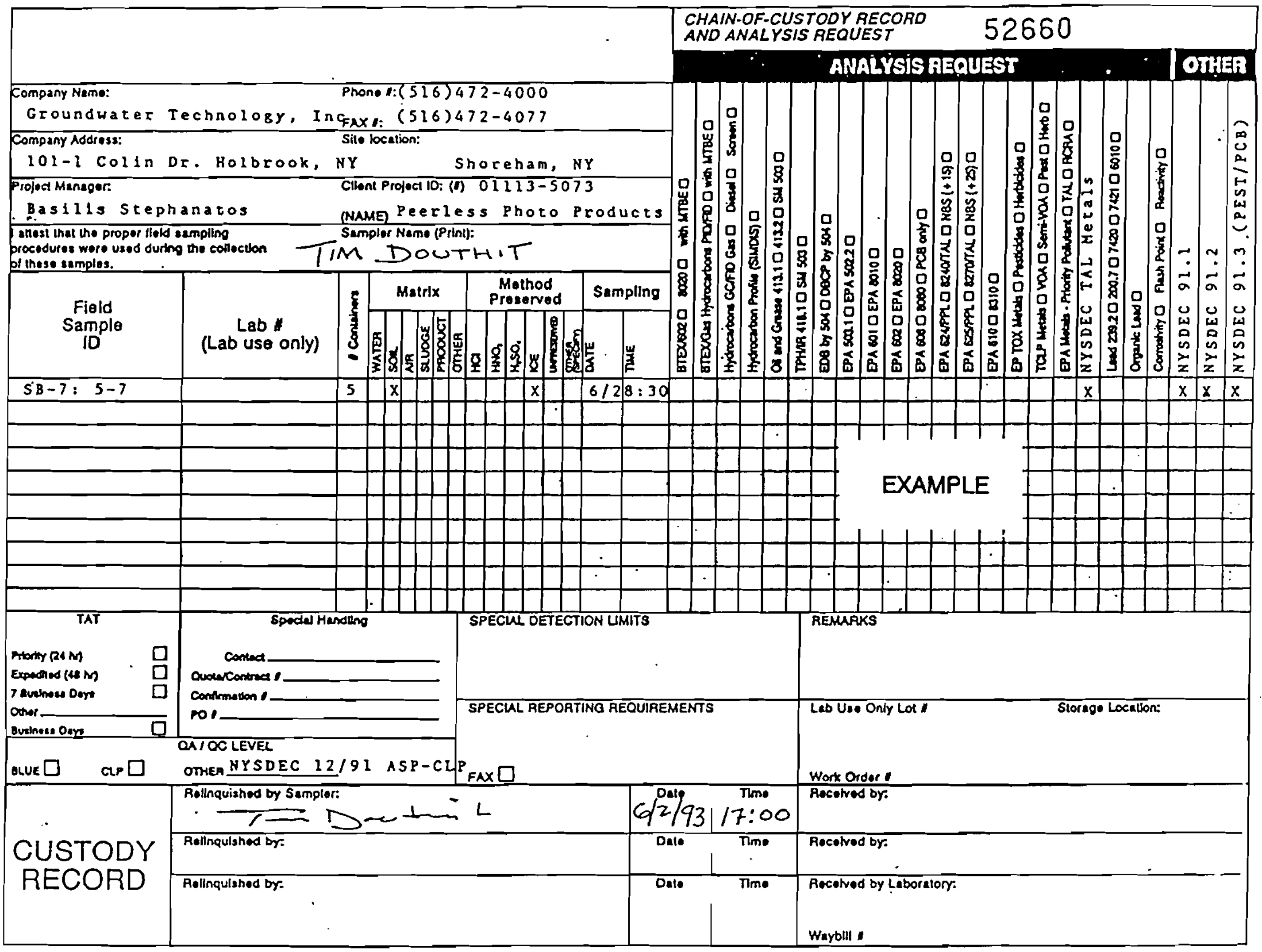
2.3 Laboratory Sample Tracking and Management

The laboratory will maintain sample information records in a LIMS (Laboratory Information Management System) computer system. The sample receipt and data entry activity (called "login") is reflected in a daily report, which is immediately entered into the master logbook. This chronological file contains all samples.

Each laboratory manager gets a report of pertinent analyses not yet completed including the daily update from the login activity. The tracking continues until the LIMS registers the completion of the report and invoice mailing.

Date:
Job ID:
Time:
ID #:
Sample:
Preservatives Added:
Type of Analysis:
Sample Type:

FIGURE 2-1
EXAMPLE SAMPLE LABEL
PEERLESS PHOTO PRODUCTS, INC. SITE
SHOREHAM, N.Y.
SITE ID# 1-52-031



CHAIN-OF-CUSTODY RECORD
AND ANALYSIS REQUEST 52660

Company Name: Groundwater Technology, Inc
Phone #: (516)472-4000
FAX #: (516)472-4077
Company Address: 101-1 Colin Dr. Holbrook, NY
Site location: Shoreham, NY
Project Manager: Basilis Stephanatos
Client Project ID: (#) 01113-5073
(NAME) Peerless Photo Products
I attest that the proper field sampling procedures were used during the collection of these samples.
Sampler Name (Print): TIM DOUTHIT

Field Sample ID	Lab # (Lab use only)	# Containers	Matrix: WATER	SOIL	AIR	SLUDGE	PRODUCT	OTHER	Method Preserved: HCl	HNO_3	H_2SO_4	ICE	UNPRESERVED	OTHER (SPECIFY)	Sampling: DATE	TIME
SB-7: 5-7		5		X								X			6/2	8:30

ANALYSIS REQUEST / OTHER

Field Sample ID	BTEX/602 ☐ 8020 ☐ with MTBE ☐	BTEX/Gas Hydrocarbons PID/FID ☐ with MTBE ☐	Hydrocarbons GC/FID Gas ☐ Diesel ☐ Screen ☐	Hydrocarbon Profile (SIMDIS) ☐	Oil and Grease 413.1 ☐ 413.2 ☐ SM 503 ☐	TPH/IR 418.1 ☐ SM 503 ☐	EDB by 504 ☐ DBCP by 504 ☐	EPA 503.1 ☐ EPA 502.2 ☐	EPA 601 ☐ EPA 8010 ☐	EPA 602 ☐ EPA 8020 ☐	EPA 608 ☐ 8080 ☐ PCB only ☐	EPA 624/PPL ☐ 8240/TAL ☐ NBS (+15) ☐	EPA 625/PPL ☐ 8270/TAL ☐ NBS (+25) ☐	EPA 610 ☐ 8310 ☐	EP TOX Metals ☐ Pesticides ☐ Herbicides ☐	TCLP Metals ☐ VOA ☐ Semi-VOA ☐ Pest ☐ Herb ☐	EPA Metals - Priority Pollutant ☐ TAL ☐ RCRA ☐	NYSDEC TAL Metals	Lead 239.2 ☐ 200.7 ☐ 7420 ☐ 7421 ☐ 6010 ☐	Organic Lead ☐	Corrosivity ☐ Flash Point ☐ Reactivity ☐	OTHER: NYSDEC 91.1	NYSDEC 91.2	NYSDEC 91.3 (PEST/PCB)
SB-7: 5-7																		X				X	X	X

EXAMPLE

TAT
Priority (24 hr) ☐
Expedited (48 hr) ☐
7 Business Days ☐
Other ____
Business Days ☐

Special Handling
Contact ____
Quote/Contract # ____
Confirmation # ____
PO # ____

QA / QC LEVEL
BLUE ☐ CLP ☐ OTHER NYSDEC 12/91 ASP-CLP

SPECIAL DETECTION LIMITS

SPECIAL REPORTING REQUIREMENTS
FAX ☐

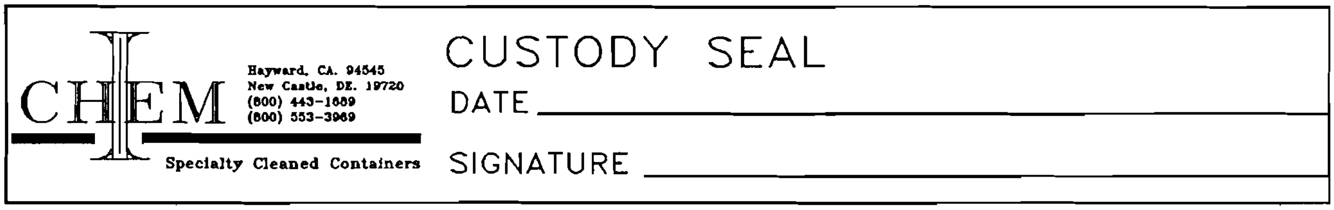
REMARKS

Lab Use Only Lot #
Storage Location:
Work Order #

CUSTODY RECORD		Date	Time	
	Relinquished by Sampler:	6/2/93	17:00	Received by:
	Relinquished by:			Received by:
	Relinquished by:			Received by Laboratory: Waybill #

FIGURE 2-2
EXAMPLE CHAIN OF CUSTODY FORM
PEERLESS PHOTO PRODUCTS, INC. SITE
SHOREHAM, N.Y.
SITE ID# 1-52-031

GROUNDWATER
TECHNOLOGY



I CHEM

Hayward, CA. 94545
New Castle, DE. 19720
(800) 443-1689
(800) 553-3969

Specialty Cleaned Containers

CUSTODY SEAL

DATE ____________________

SIGNATURE ____________________

FIGURE 7-3
EXAMPLE CUSTODY SEAL
PEERLESS PHOTO PRODUCTS, INC. SITE
SHOREHAM, N.Y.
SITE ID# 1-52-031

3.0 CALIBRATION PROCEDURES AND FREQUENCY

3.1 Laboratory Calibration

The analytical laboratory will analyze water, soil, wipe, and air samples for the project compound list by gas chromatography and mass spectroscopy, inductively coupled plasma (ICP), and furnace and flame atomic absorption (AA). The confirmation calibration frequency required by these methods is dependent on the outcome of daily calibration checks made with QC standards. Reference materials must be a minimum of 97% pure and can be obtained from companies such as Supelco Inc., (Supelco Park, Bellefonte, PA 16823), Inorganic Ventures, or Chem Service Inc. Spiked reference samples (spiked into reagent water) are introduced into the analytical system to determine recovery and to further validate calibration at a frequency dependent on the matrix spike performance.

3.2 Field Calibration

In addition to the laboratory analysis conducted during the course of this investigation, field measurements will be taken utilizing an FID or Photo Ionization Detector (PID) during soil boring, and air sampling. Specific conductance, pH, turbidity, dust level, water table elevations, and temperature will be measured in water samples and/or monitoring wells.

Field calibration procedures will, at a minimum, include the following:

All instruments will be calibrated as specified and documented as follows:

a. Each instrument/meter shall have a dedicated log book to record all calibrations, maintenance/repair work, and usage, in a standard format including the information below.

b. Entries to the instrument log books shall be made at least daily whenever the instrument is in use.

c. Calibration records shall include:
    - calibrator's name
    - standards used and source
    - date/time of calibration
    - corrective actions taken
    - instrument name/model
    - temperature/barometric pressure/humidity conditions (if known)

d. All standards used shall be checked monthly to determine stability and operating condition, and a record kept of these inspections.

e. All personnel performing instrument calibrations shall be trained in its operational calibrating procedures.

3.2.1 pH Meters

pH meters will be calibrated according to the manufacturer's instructions and two standard buffer solutions (4, 6, 7, or 10) obtained from chemical supply houses. The pH values of these buffers will be compensated slightly by temperature according to the values supplied on the manufacturer's bottle label. The temperature (measured as below) at which the sample pH was measured will then be used to compensate for the temperature on the meter.

3.2.2 Thermometers

Temperature measurement will be performed using field thermometers calibrated at 10 °C and 45 °C to an NBS certified thermometer. This correction factor will be clearly marked on each thermometer, and the corrected data recorded as the raw measurement in °C. This level of accuracy is sufficient for the temperature measurements required.

3.2.3 Conductivity Meters

Specific conductance meters will be calibrated using a 1413.0 μmho (0.01N KCl) solution prepared by a qualified laboratory according to Standard Methods for the Analysis of Water and Wastewater, 16th Edition, 1985-Method 205, 3b, page 79.

The conductivity probe cell constant will be calculated according to the formula:

$$C = (0.001413)\,(R_{KCL})\,(1 + 0.02\,(T - 25^\circ C))$$

Where: C = probe cell constant (unitless)
(R_{KCL}) = measured resistance (ohms) of standard
T = Temperature (°C)

Using the cell constant calculated above and the following formula, field specific conductance measurements will be corrected to 25°C.

$$K = \frac{1000000\ (C)}{R_m\ ((1 + 0.02\ (T - 25))}$$

Where K = specific conductance at 25oC (μ m hos/cm)

C = Calculated cell constant

R_m = filed specific conductance (μmhos/cm)

T = temperature (°C) of sample at which conductance was measured

3.2.4 Flame Ionization Detector (FID)

Startup Procedure

a. Connect the Probe/Readout Assembly to the Sidepack Assembly by attaching the sample line and electronic jack to the Sidepack.

b. Select the desired sample probe (close area sampler or telescoping probe) and connect the probe handle. Before tightening the knurled nut, check that the probe accessory is firmly seated against the flat seals in the probe handle and in the tip of the telescoping probe.

c. Move the Instr/Batt Switch to the test position. The meter needle should move to a point beyond the white line, indicating that the integral battery has more than 4 hours of operating life before recharging is necessary.

d. Move the Instr/Batt switch to the "ON" position and allow a 5 minute warm-up.

e. Turn the Pump Switch on.

f. Use the Calibrate Adjust knob to set the meter needle to the level desired for activating the audible alarm. If this alarm level is other than zero, the Calibrate Switch must be set to the appropriate range.

g. Turn the volume knob fully clockwise.

h. Using the Alarm Level Adjust knob, turn the knob until the audible alarm is activated.

i. Move the Calibrate Switch to X1 and adjust the meter reading to zero using the Calibrate Adjust (Zero knob).

j. Open the Hydrogen Tank Valve 1 or 2 turns and observe the reading on the Hydrogen Tank Pressure Indicator

k. Open the Hydrogen Supply Valve 1 or 2 turns and observe the reading on the Hydrogen Supply Pressure Indicator. The reading should be between 8 and 12 psi.

l. After approximately one minute, depress the Igniter Button until the hydrogen flame lights. The meter needle will travel upscale and begin to read "Total Organic Vapors". Caution: do not depress igniter for more than six seconds. If flame does not ignite, wait one minute and try again.

m. The instrument is ready for use. NOTE: If the ambient background organic vapors are "zeroed out" using the Calibrate Adjust knob, the meter needle may move off-scale in the negative direction when the FID is moved to a location with lower background. If the FID is to be used in the 0 to 10 ppm range, it should be "zeroed" in an area with very low background. A charcoal filter (Part No. 51--95-1) can be used to generate the clean background sample.

Operating Procedures

The following procedure describes operation of the FID in the "Survey Mode" to detect total organic vapors.

a. Set the CALIBRATE Switch to the desired range. Survey the areas of interest while observing the meter and/or listening for the audible alarm indication. For ease of operation, carry the Side Pack Assembly positioned on the side opposite the hand which holds the Probe/Readout Assembly. For broad surveys outdoors, the pickup fixture should be positioned several feet above ground level. When making quantitative readings or pinpointing, the pickup fixture should be positioned at the point of interest.

b. When organic vapors are detected, the meter pointer will move upscale and the audible alarm will sound when the setpoint is exceeded. The frequency of the alarm will increase as the detection level increases.

When a PID is used, the PID will be calibrated using a benzene standard.

3.2.5 Turbidity Meter

3.2.5.1 General Operation

The EPA recommends that cuvette used for instrument calibration or sample measurement be matched or indexed. For accurate measurements in the low range rotate the cuvettes in the well to obtain the minimum reading. Mark the cuvette and the instrument so the orientation of the cuvette will be identical each time it is placed in the instrument.

1.) To operate the Turbidity meter, switch to the "20" range and place the Reference Standard (0.1 NTU) in the optical well.

2.) With the light shield in place over the well, adjust the Reference Adjust knob to cause the meter to read the reference standard value on the scale. The unit is now ready for use in either range.

3.) To make a measurement of a sample, clean one of the cuvettes and fill to within approximately 1/2" of top with the sample. Place the top on the cuvette and carefully clean the outside surface of the cuvetted with a lint free wiper such as Kimwipes. Place the sample in the well and place the light shield over the well.

4.) If the instrument has been subjected to cold (below 10 degrees Celsius) and then bought indoors, it should be allowed to warm up before use, since condensation may form on the various lenses. This can be aided by leaving the case open and the instrument on for approximately one-half hour.

3.2.5.2 Calibration Procedures

Standard Formazin Solutions

Calibration of this instrument is based on Formazin, a material which can be made by synthesis and reproduced repeatedly within one percent. When properly mixed, it is uniform in the number, size and shape of its particles, thus making it an ideal turbidity standard. The unit of measure, and thus the calibration of this instrument is in Nephelometric Turbidity Units (NTU) based on Formazin.

Calibration samples may be obtained by diluting Formazin stock suspension using "Turbidity-free" water. Formazin stock suspension may be prepared by the user (Reference A.W.W.A. "Standard Methods", 14th Edition) or it may be purchased in kit form, HF scientific part number 50040.

The following table gives the recommended dilutions of the stock suspension. Be sure to adequately mix the stock suspension prior to removing a portion for dilution.

Pipettes Required	Formazin Standard in NTU's	Pipette amount below in ml into 200 ml flask and dilute to mark with "Turbidity-free water"
9 ml and 1 ml in 1/100	198	9.9 ml of 4000 NTU stock suspension
9 ml and 1 ml in 1/100	19.8	9.9 ml of 400 NTU Formazin dilution
1 ml in 1/100	20	0.95 ml of 400 NTU Formazin dilution

Note: 1.) When the prepared samples start to flocculate, they are unreliable and fresh ones must be made. This occurs more rapidly for the lower value diluted suspension.

2.) The value of "turbidity-free" water is approximately 0.1 NTU. This value has been added to low value dilution, i.e., 2.0 NTU include 0.1 NTU for water.

Electronic Calibration Using Freshly Prepared Formazin Solutions

The DRT Turbidity meters have been carefully calibrated by the factory. However, should the electronic P.C. board, the photo detector, or the light source be replaced or if very carefully prepared Formazin suspensions indicate a need for recalibration, this may be easily accomplished in your facility.

To carry out a complete calibration the following Formazin suspension values are required: 198 NYTU, 19.8 NTU and 2.0 NTU.

1.) Fill, cap and label a separate cuvette with a sample of each.

2.) Always mix the contents of each cuvette by inverting several times before placing in the Optical Well for a reading.

3.) Keep the outside surface of cuvettes clean.

4.) When placing any standards in the well, always use the light shield to cover the well in order to keep out ambient light.

To gain access to the trimpots, remove the accessories from the foam holder. Refer to Figure 8-1 for trimpot identification during the next few steps.

1.) Center the reference adjust control on top of the instrument.

2.) Insert the reference standard and turn the range control on the DRT-150 to the 20 range. Adjust the "Course Zero" trimpot (R2) until a reading of 0.10 NTU is obtained.

3.) Replace the reference standard with the 19.8 Formazin standard and adjust the "20 Range Adjust" trimpot (R&) to obtain a reading of 19.8 NTU ± 0.1 NTU.

4.) Replace the 19.8 NTU Formazin standard with the reference standard and adjust the reference adjust control to obtain a reading of 0.10 NTU.

5.) Repeat steps 3 and 4 until no further adjustments are required.

6.) Turn the range control on 15C to the 200 range. Insert the 198 NTU Formazin standard and adjust the "200 Range Adjust" trimpot to obtain a reading of 198 ± 1 NTU.

GROUNDWATER
TECHNOLOGY

Groundwater Technology, Inc.
101-1 Colin Drive, Holbrook, NY 11741
Tel: (516) 472-4000 Fax: (516) 472-4077

APPENDIX 5

DRAFT FINAL

HEALTH AND SAFETY PLAN (HASP) FOR THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY PEERLESS PHOTO PRODUCTS, INC. SITE SHOREHAM, NEW YORK

SITE I.D. #1-52-031
September 30, 1993

Prepared for
Agfa Division of Miles Inc.
100 Challenger Road
Ridgefield Park, New Jersey 07660-2199

Prepared by
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Project Director

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National Industry Division
Senior Project Manager

HEALTH AND SAFETY PLAN

TABLE OF CONTENTS

Section Page

LIST OF APPENDICES

1.0 EMERGENCY RESPONSE

1.1 Site Specifics

In the event of an accident or emergency situation, immediate action must be taken by the first person to recognize the event. First aid equipment is located on site inside the Groundwater Technology, Inc. vehicle. Notify (l) the Site Safety Officer, and, (2) the Project Manager and Health and Safety Officer about the situation immediately after emergency procedures are implemented.

GROUNDWATER TECHNOLOGY, INC.

	Title	Name	Telephone
1.	Regional Manager	Frank Aceto	215-388-1466
2.	Health and Safety Officer	Barry Bedaw	518-370-5631
3.	Project Manager	Basilis Stephanatos	518-370-5631
4.	Site Manager	Tim Douthit	516-472-4000
5.	Site Health & Safety Officer	Tim Douthit	516-472-4000

Client Name: Agfa Division of Miles Inc.

1.1.1 Emergency/Medical Resources

Local Police:	Dial 911
Local Fire:	Dial 911
Ambulance:	Dial 911

Hospital: John T. Mather Memorial
Telephone: 516-473-1320
Address: North Country Road, Port Jefferson, New York

National Response Center:	1-800-424-8802
US.EPA (24 hour hotline):	1-800-424-9346

1.1.2 One Call/Call Before You Dig

Groundwater Technology, Inc. Project Management representatives are responsible for contacting appropriate agencies prior to conducting on-site activities when applicable.

Gas Company: (516) 661-6000
Telephone Company: (516) 661-6000
Electric Company: (516) 661-6000
Water: (516)744-6444

1.2 Contingency/Evacuation Plan

It is possible that a site emergency could necessitate evacuating all personnel from the site. If such a situation develops, appropriate signals will be given for site evacuation. Personnel shall evacuate the site in a calm and controlled fashion and regroup a predetermined location. The route of evacuation will be dependent on wind direction, severity and type of incident, etc.

The site must not be re-entered until back-up help, monitoring equipment and/or personal protective equipment is on hand.

1.3 Usual Procedures for Injury

I. Telephone for ambulance/medical assistance if necessary. Whenever possible, notify the receiving hospital of the nature of physical injury or chemical overexposure. If no phone is available, transport the person to the nearest hospital. Refer to Appendix M for map to Hospital.

2. Send/take this HASP with the attached MSDS's to medical facility with injured person.

3. If the injury is minor, proceed to administer first aid.

4. Notify the Site Health & Safety Officer, Project Manager, and the Health and Safety Officer of all accidents, incidents and near miss situations.

5. Complete Accident/Incident/Near Miss Form found in Appendix F.

1.4 Emergency Treatment

When transporting an injured person to a hospital, bring this site HASP to assist medical personnel with diagnosis and treatment. In all cases of chemical overexposure, follow standard procedures as outlined below for poison management, first aid, and, if applicable, cardiopulmonary resuscitation. Four different routes of exposure and their respective first aid/poison management procedures are outlined below:

1.4.1 Ingestion

DO NOT INDUCE VOMITING. Transport person to nearest hospital immediately.

1.4.2 Inhalation/Confined Space:

DO NOT ENTER A CONFINED SPACE TO RESCUE SOMEONE WHO HAS BEEN OVER COME UNLESS PROPERLY EQUIPPED AND A STANDBY PERSON IS PRESENT.

1.4.3 Inhalation/Other

Move the person from the contaminated environment. Initiate CPR if necessary. Call or have someone call for medical assistance. Refer to MSDS for additional specific information. If necessary, transport the victim to the nearest hospital as soon as possible.

1.4.4 Skin Contact/Non-Caustic Contaminant (Petroleum, Gasoline, etc)

Wash off skin with a large amount of water immediately. Remove any affected clothing and rewash skin using soap, if available. Transport person to a medical facility if necessary.

1.4.5 Skin Contact/Corrosive Contaminant (Acids, Hydrogen Peroxide)

Wash off skin with a large amount of water immediately. Remove any affected clothing and rewash skin with water. Transport person to a medical facility if necessary.

1.4.6 Eyes

Hold eyelids open and rinse the eyes immediately with large amounts of water for l5 minutes. If possible, have the person remove his/her contact lenses (if worn). Never permit the eyes to be rubbed. Transport person to a medical facility as soon as possible.

2.0 INFORMATIONAL SUMMARY

2.1 Health and Safety Summary

Chemicals of Concern: Cadmium, Phenols, Lead, Silver, and UST-associated chemicals (additional chemicals associated with this site are listed in Appendix E).

Hazard Determination: Serious ________ Moderate __X__ Low________

Modified Level D is the minimum acceptable level of protection for this site.

TABLE I

ACTION LEVELS

Action levels have been developed by Groundwater Technology, Inc. health and safety professionals. Action levels are those concentrations at which an upgrade in personal protective equipment (PPE) is required. Organic vapor concentrations are to be monitored in the field by the use of an OVA meter with readings being taken in the breathing zone occupied by Groundwater Technology, Inc. field personnel to determine whether an action level has been exceeded.

NOTE: Log all monitoring results on the Vapor Monitoring Sheet in Appendix G.

Groundwater Technology, Inc. ACTION LEVEL = 5 PPM

LEVEL OF PPE

Action Level for Upgrading Personal Protection: Upgrade from Level D to Level C at 5 ppm measured within the breathing zone. This should be determined by a photoionization detector (PID) with a 11.7 lamp or a flame ionization detector (FID). Respirator cartridges will be changed once per day at a minimum. This can be accomplished at the end of the work day during respirator decontamination. If odor breakthrough is detected while wearing the respirator or if breathing becomes difficult, change cartridges immediately.

Air Monitoring Instrument	LEVEL D	LEVEL C	LEVEL B
PID/FID	<5 ppm	5 - 750 ppm	> 750 ppm
0_2	19.5 - 22%	19.5 - 22%	< 19.5%
Particulate Air Monitor	0.0 - 5.0 $\mu g/m^3$	5.1 - 15.0 $\mu g/m^3$	> 15.0 $\mu g/m^3$

NOTE: Withdraw from site and contact the project manager if:

LEL > 10%, and/or $O_2 > 22\%$

Note: Prior to work, the ambient volatile organic compound and particulate levels must be established. The stated action levels are intended to be added to the ambient background levels. If, during routine air monitoring, the FID is spiking on a routine basis, contact the District Health and Safety Specialist immediately.

TABLE II

HAZARD SUMMARY

Job Task	Level PPE	Air Monitoring Instrument	Frequency
Soil Boring/Drilling & Soil Grading	Modified Level D	PID or FID/0_2-LEL, Miniram	Start-up of work, then 30 min to continuously.
Well Installation	Modified Level D	PID or FID/0_2-LEL	Start-up of work, then 30 min to continuously.
Well Survey, Gauging	Modified Level D	PID or FID/0_2-LEL	Start-up of work at each well location.
Well Development	Modified Level D	PID or FID/0_2-LEL	Start-up of work at each well location.
Groundwater and Soil Sampling	Modified Level D	PID or FID/0_2-LEL	Start-up of work at each well location.

Note: "start up of work at each well location" means to monitor the air quality at each well on the site a few minutes after the well cover (or manhole or vault cover) has been opened. The breathing zone is the area inside a 1 foot radius around the head.

2.2 Other Site Specific Considerations

The following are site specific safety concerns that have been identified at the Agfa site. At a minimum, the following items will be reviewed during the tailgate safety meeting held each day, before site activities.

- When conducting drilling operations, engineering controls utilizing water and a fine spray nozzle must be used to minimize dusting conditions.

- Exposure to irritant and toxic plants such as poison ivy may cause allergic reactions to personnel. Native wildlife such as rodents, raccoons, and ticks present the possibility of insect bites and associated diseases such as Lyme diseases. When working in the exterior portions of the facility, long sleeve shirts shall be worn with sleeves down. Also, pant legs shall be tugged into work boots to protect the legs and ankles.

- Avoid wildlife! In case of animal bite, perform first aid. Note the behavior of the animal if possible. Report to the hospital for rabies shots. Perform a tick check after leaving the site each day.

- Use the proper equipment and lifting techniques when lifting objects. At a minimum, a pry bar should be used. The 70 pound lifting rule shall be enforced.

- All off-site work zones will be clearly marked and roped off to ensure that the public is kept at a safe distance from the drilling activities that could cause physical injury or that potentially could release contaminants into the air.

- Prior to the commencement of work activities, notification to local police, fire and potential rescue personnel will be made advising them of the drilling activities that will take place.

2.2.1 Standing Orders For Exclusion Zone

- No smoking, eating or drinking in the Exclusion Zone.
- No horse play.
- No matches or lighters in the Exclusion Zone.
- Wear appropriate level of protection as defined in the Site Safety Plan.

2.2.2 Job Safety Analysis

A Job Safety Analysis (JSA) has been prepared for the following site activities:

- Remediation Project Preparation
- Air Sampling/Monitoring
- Soil Boring
- Groundwater Sampling

The JSA's are enclosed in **Appendix N**. This information is a valuable tool for the Tool Box Safety meetings.

2.2.3 Community Air Monitoring Plan

The Community Air Monitoring Plan has been designed to protect the health and safety of surrounding community during any remedial investigation field activities associated with the site. The plan is enclosed in **Appendix I.**

3.0 INTRODUCTION

3.1 Background

Groundwater Technology, Inc. has been retained to perform environmental services at the location indicated on the cover page of this document. This HASP is prepared in accordance with OSHA 29 CFR 1910.120.

3.2 Purpose

The purpose of the HASP is to provide Groundwater Technology field personnel, subcontractors and other visitors with an understanding of the potential chemical and physical hazards that exist or may arise while the tasks of this project are being performed.

This HASP describes the procedures to be followed in order to reduce employee exposure to potential health hazards which may be present at the project site. The emergency response procedures necessary to respond to such hazards are also described within this HASP.

3.3 Objective

The primary objective is to ensure the well-being of all field personnel and the community surrounding this site. In order to accomplish this, project staff and approved subcontractors shall acknowledge and adhere to the policies and procedures established herein. Accordingly, all personnel assigned to this project shall read this HASP and sign the Agreement and Acknowledgement Statement (Appendix A) to certify that they have read, understood and agreed to abide by its provisions.

Groundwater Technology, Inc. personnel have the authority to stop work performed by our subcontractors at this site if work is not performed in accordance with the requirements of this HASP.

3.4 Amendments

Any changes in the scope of work of this project and/or site conditions must be amended in writing on the HASP Amendment Sheet (Appendix B) and approved by Health and Safety Officer.

4.0 HAZARD EVALUATION

4.1 Site Tasks

The field tasks covered by this HASP may include soil boring samples, drilling, soil grading and excavation, subsurface entry, monitoring well installation, monitoring well maintenance, monitoring well survey, groundwater well gauging, monitoring well development, vapor screening, groundwater and soil sampling, and pump test.

4.2 Job Task Hazards

4.2.1 All Field Tasks

The following hazards may be encountered.

◆ Organic Vapors:
The inhalation of volatile organic vapors during all operations can pose a potential health hazard. Hazard reduction procedures include monitoring the ambient air with a FID and use of Personal Protective Equipment. Workers should stand upwind of the source of contamination whenever possible.

◆ Flammable Vapors:
Presence of flammable vapors can pose a potential fire hazard and health hazard. Hazard reduction procedures include monitoring the ambient air with an O_2/LEL meter. If the LEL reading exceeds 10%, leave the site immediately and contact the fire department.

◆ Oxygen:
Atmospheres that contain a level of oxygen greater than 22% pose an extreme fire hazard (the usual ambient oxygen level is approximately 20.5%). This hazard can be compounded by the fact that vapors associated with this site are <u>highly</u> flammable. All personnel encountering atmospheres that contain a level of Oxygen greater than 22% must evacuate the site immediately and must notify the Fire Department. If Oxygen Level is less than 19.5%, do not enter the space.

◆ Vehicular traffic:
All employees will be required to wear a fluorescent safety vest at all times while on site. In addition, supplemental traffic safety equipment use can be exercised when warranted by specific task (ie., drilling or excavation). Supplemental equipment can be items such as cones, cone flags, barricades and/or caution tape.

4.2.2 Well Installation; Well Development; Well Gauging; Well Bailing; Soil & Groundwater Sampling:

Skin and eye contact with contaminated groundwater and/or soil may occur during these tasks. Nitrile gloves and approved safety glasses must be worn. When splash potential exists safety goggles must be worn for additional protection.

4.2.3 Sample Preservation

When hydrochloric acid is used, skin and eye contact can occur. This hazard can be reduced with the use of Nitrile gloves and the use of safety glasses, safety goggles should be worn additional if there is a potential splash hazard present.

4.2.4 Cleaning Equipment

Skin and eye contact with methanol, Alconox, or other cleaning substances can occur while cleaning equipment. This hazard can be reduced with use of nitrile gloves and the use of goggles or safety glasses.

4.2.5 Confined Space Entry

Excavation pits, storage tanks, subsurface vaults, basements and sheds are examples of confined spaces. Confined spaces can be identified as an area having any one of the following characteristics:

- limited access and egress
- unfavorable for natural ventilation, and
- not designed for continuous human occupancy.

Organic and/or combustible vapors may be trapped resulting in lack of oxygen (anoxia) and/or overexposure to vapors. When site work takes place in a confined space, the air must be monitored for:

a. oxygen level
b. flammable vapors
c. toxic vapors

The following air monitoring procedures must be followed before entering a confined space.

a. Oxygen Level: Monitor for % Oxygen with a O_2/LEL meter to ensure an oxygen level between 19.5 and 22%. Because of the high vapor density of the contaminants associated with this site there is a high probability that vapors in the enclosed spaces or vaults will replace any oxygen that is present, even if the space is open to the air. Therefore, oxygen level monitoring will be done at the top, middle and bottom of the enclosed space to determine of there is a minimum acceptable oxygen level of 19.5% prior to entry. The oxygen/LEL meter is factory set to sound an alarm at levels less than 19.5% oxygen.

   If oxygen is less than 19.5% or greater than 22%, do not enter the space.

b. Explosive Vapors: Monitor for % of Lower Explosive Limit (LEL) with a O_2/LEL meter to determine whether vapor concentrations within the confined space are within the flammable range. If LEL readings exceed 5% personnel should exercise extreme caution, use non-sparking tools and utilize ventilation engineering controls to reduce LEL levels. The oxygen/LEL meter is factory set to sound an alarm at levels greater than or equal to 20% LEL. However, Groundwater Technology, Inc.'s action level is **10%. If LEL readings exceed 10%, personnel MUST leave the site immediately and contact the project manager.**

c. Toxic Vapors: Monitor for toxic vapors with an FID (e.g., Foxboro OVA) to determine whether toxic vapors within the confined space exceed the action levels. FID readings will be taken at the top, middle and bottom of a vault, shed, or other confined space to determine vapor levels.

d. Summary: Do not enter the confined space unless:

   - the oxygen concentration is between 19.5 and 22%
   - the LEL is less than 10%
   - FID readings are less than 750 ppm
     A full face respirator must be worn if the readings exceed 5 ppm

ALL MONITORING EQUIPMENT MUST BE CALIBRATED AND MAINTAINED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS

4.2.6 Occupational Noise

Requirements set forth in the OSHA Hearing Conservation Regulation (OSHA 1910.95) shall be adhered to during work on-site. Hearing protection shall be provided to the employee where sound pressure levels exceed 85 dB. Hearing protection shall be worn where sound pressure levels in areas and/or on equipment exceeds 90 dB. Typical Groundwater Technology, Inc. drilling operations have been monitored with a sound level meter and indicate that hearing protection is required for all personnel while engaged in this action.

4.2.7 Heat Stress

Since climatic changes cannot be avoided, work schedules will be adjusted to provide time intervals for intake of juices, juice products and water in an area free from contamination and in quantity appropriate for fluid replacement.

Heat stress may occur even in moderate temperature areas and may present any or all of the following:

A. Heat Rash: result of continuous exposure to heat, humid air, and chafing clothes. Heat rash is uncomfortable and decreases the ability to tolerate heat.

B. Heat Cramps: result of the inadequate replacement of body electrolytes lost through perspiration. Signs include severe spasms and pain in the extremities and abdomen.

C. Heat Exhaustion: result of increase stress on the vital organs of the body in the effort to meet the body's cooling demands. Signs include shallow breathing; pale, cool, moist skin; profuse sweating; dizziness.

D. Heat Stroke: result of overworked cooling system. Heat stroke is the most serious form of heat stress. Body surfaces must be cooled and medical help must be obtained immediately to prevent severe injury and/or death. Signs include red, hot, dry skin; absence of perspiration; nausea; dizziness and confusion; strong, rapid pulse; coma; and death.

HEAT STRESS PREVENTION

A. Replace body fluids (water and electrolytes) lost through perspiration. Solutions may include a 0.1% salt and water solution or commercial mixes such as Gatorade or Squench. Employees must be encouraged to drink more than the amount required to satisfy thirst.

B. Cooling devices to aid the natural body ventilation. Cooling occurs through evaporation of perspiration and limited body contact with heat-absorbing protective clothing. Utilize fans and air conditioners to assist in evaporation. Long, cotton underwear is suggested to absorb perspiration and limit any contact with heat-absorbing protective clothing (i.e., coated tyvek suits).

C. Provide hose-down mobile shower facilities to cool protective clothing and reduce body temperature.

D. Conduct non-emergency response activities in the early morning or evening during very hot weather.

E. Provide shelter against heat and direct sunlight to protect personnel, take breaks in shaded areas.

F. Rotate workers utilizing protective clothing during hot weather.

G. Establish a work regime that will provide adequate rest periods, with personnel working in shifts.

* HEAT STRESS MONITORING *

Heat stress may occur even in moderate temperatures and may present heat rash, heat cramps, heat exhaustion, and/or heat stroke.

Monitoring procedures should be implemented to prevent heat stress arising from any of the following: environmental conditions, use of personal protective equipment, intensity of workload. Such procedures may include the following.

For temperature above 70F, the following regime shall be followed for workers wearing permeable coveralls:

Adjusted Temperature	**Normal Ensemble**	**Impermeable Ensemble**
90 F or above	After @ 45 min work	After @ 15 min work
87.5-90 F	After @ 60 min work	After @ 30 min work
82.5-87.5 F	After @ 90 min work	After @ 60 min work
77.5-82.5 F	After @ 120 min work	After @ 90 min work
72.5-77.5 F	After @ 150 min work	After @ 120 min work

Workers wearing semipermeable or impermeable encapsulating protective clothing should be monitored for heart rate and temperature when the temperature in the work area is above 70 degrees Fahrenheit. To monitor the worker, measure:

a. Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third.

b. Oral temperature. Use a clinical thermometer or similar device to measure the oral temperature at the end of the work period (before drinking). If oral temperature exceeds 99.6F shorten the next work cycle by one-third.

Do not permit a worker to wear a semipermeable or impermeable garment if the core body temperature exceed 100.6F.

Workers shall not be required to continue working if they feel any of the symptoms of heat stress. Rest periods should be a minimum of 15 minutes. Length of rest period should be extended as appropriate or as recommended by the Site Health & Safety Officer or alternate.

4.2.8 Exposure: Cold Stress

Work schedules will be adjusted to provide sufficient rest periods in a heated area for warming up during operations conducted in cold weather. Also thermal protective clothing such as wind and/or moisture resistant outerwear is recommended to be worn.

If work is performed continuously in the cold at or below -7°C (20°F), including wind chill factor, heated warming shelters (tents, cabins, company vehicles, rest rooms, etc.) shall be made available nearby and the worker should be encouraged to use these shelters at regular intervals, the frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria, are indications for immediate return to the shelter. When entering the heated shelter the outerlayer of clothing shall be removed and the remainder of the clothing loosened to permit sweat evaporation. A change of dry work clothing shall be provided as necessary to prevent workers from returning to their work with wet clothing.

Dehydration, or the loss of body fluids, occurs in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of a diuretic and circulatory effect. (Adapted from TLV's and Biological Exposure Indices 1988-1989; ACGIH).

5.0 PERSONAL PROTECTIVE EQUIPMENT

Modified Level D is the minimum acceptable level of PPE for this site.

Modified Level D includes:

- hard hat
- safety glasses
- steel toe and shank boots
- fluorescent vest
- nitrile "N-Dex" inner gloves
- coveralls/work uniform
- outer nitrile gloves
- latex outer boots - chemical resistant
- splash goggles
- polyethylene coated Tyvek suit
- hearing protection (as appropriate)

Level C includes:

- buddy system required at all times
- full face respirator with NIOSH approved OV/AG/HEPA combination cartridges (MSA GMC-H)
- Saranex coated Tyvek suit
- inner nitrile "N-Dex" gloves
- outer nitrile (NBR) gloves
- steel toe and shank boots
- outer boots - chemical resistant
- hard hat
- hearing protection (as appropriate)

NOTE: Respirator cartridges will be changed once per day at a minimum. This can be accomplished at the end of the work day during respirator decontamination. If odor breakthrough is detected while wearing the respirator or if breathing becomes difficult, change cartridges immediately.

Level B includes:

- Regional Health and Safety representatives must be on site upon start up of any project requiring level B protection, this should be understood to include subcontractors conducting level B activity.
- buddy system required at all times

- supplied air respirator or SCBA
- Saranex coated Tyvek suit
- inner nitrile "N-Dex" gloves
- outer nitrile (NBR) gloves
- steel toe and shank boots
- chemical resistant boot covers
- hard hat
- hearing protection (as appropriate)

Contact with contaminated surfaces, or surfaces suspected of being contaminated should be avoided. This includes walking through, kneeling on or placing equipment in puddles, mud, discolored surfaces, or on drums and other containers. Eating, smoking, drinking and/or the application of cosmetics in the immediate work area is prohibited.

When utilizing protective garments such as Tyvek suit, gloves and booties, all seams between protective items will be sealed with duct tape.

6.0 DECONTAMINATION PROCEDURES

All operations conducted at this site have the potential to contaminate monitoring equipment and personal protection equipment. To prevent the transfer of any contamination to vehicles, administrative areas and personnel, the following procedures must be followed.

Whenever possible, monitoring equipment should be decontaminated with a solution of Alconox and thoroughly rinsed with water prior to leaving the site. This must be done outside a 5-foot radius of any work area.

<u>Personal Decontamination</u>

LEVEL D
- segregated equipment drop
- wash/rinse outer boot, then remove (as appropriate)
- wash/rinse chemical resistant outer glove, then remove (as appropriate)
- remove hard hat, goggles/safety glasses/faceshield
- remove and throw out inner disposable gloves in designated receptacles (as appropriate)

LEVEL C
- segregated equipment drop
- wash/rinse outer boots
- wash/rinse chemical resistant outer gloves, then remove
- remove chemical resistant suit (remove by rolling down the suit)
- remove outer boots and place to dry
- remove first pair(s) of disposable gloves
- remove respirator/hard hat, dispose of cartridges and wash respirator
- remove last pair of disposable gloves

LEVEL B
- segregated equipment drop
- wash/rinse outer boots
- wash/rinse chemical resistant outer gloves, then remove
- cross hotline (into decon area) and change air tanks, then redress <u>or</u>

- cross hotline (into clean area)
- remove boots and gloves
- remove SCBA, if worn over chemical resistant suit
- if SCBA is worn under the suit, remove the chemical resistant suit, then the SCBA
- remove hard hat

All water used in decontamination procedures should be stored in portable storage tanks, until sufficient amounts are stockpiled to facilitate disposal treatment.

All decontamination solutions shall be disposed at the work station where it was generated.

Disposable sampling and personal protective equipment will be placed in plastic bags and temporarily stored in designated drums. These drums shall be disposed of according to regulatory guidelines, if necessary.

7.0 HEALTH AND SAFETY REQUIREMENTS

7.1 Medical Monitoring Program

A baseline physical examination must be conducted on all employees before they are permitted to engage in sampling, cleanup and remedial action work. A complete medical survey should be completed on each employee upon start of employment. Yearly re-examinations should be performed to update information on employee health status. Additional re-evaluation will be considered in the event of a chemical over-exposure. These medical surveillance requirements shall comply with OSHA regulations as defined in 29 CFR 1910.120.

7.2 Training

All personnel working at this site should have received a minimum of 40 hours of initial hazardous waste activity instruction, and a minimum of three days of field experience under the direct supervision of a trained, experienced person. Personnel assigned to the site will also receive 8 hours refresher training per year. On-site managers and supervisors directly responsible for employees engaged in hazardous waste operations have received an additional 8 hours of supervisory training. These training requirements comply with the OSHA Hazardous Waste Operations and Emergency Response regulation, 29 CFR 1910.120.

7.3 Work Zone Areas

Work and support areas shall be established based on ambient air data and proposed work sites. They shall be established in order to contain contamination within the smallest areas possible and shall ensure that each employee has the proper personal protective equipment for the area or zone in which work is to be performed.

7.4 First Aid Equipment

Vehicles used for site work will be equipped with a first aid kit and safety equipment including:

- fluorescent vests,
- cones (and flags as needed),
- hazard tape (barricades as needed),
- mounted fire extinguisher (10 pound A/B/C type),
- working flashlight,
- water, suitable for drinking,
- portable eye wash,
- first aid kit with appropriate bandage material,
- full body harness with lifeline (for confined space entry)

7.5 Drilling Procedures

A Digsafe authorization number must be obtained prior to drilling.

During the drilling operation, two persons (one designated as "driller" and the other as "helper") must be present at all times. The helper (whether Groundwater Technology, Inc. personnel or subcontractors) must be instructed as to the location of the emergency shut-off switch. Every attempt must be made to keep unauthorized personnel from entering the work area. If this is not possible, the operation should be shut down until the area is cleared. The area where the operation is taking place shall be cordoned off with a barricade. The Site Health and Safety Officer has the authority and the responsibility to shut down the drilling operations whenever a hazardous situation is deemed present.

The mast of the drilling rig must maintain a minimum clearance of 20 feet from any overhead electrical cables. All drilling operations will cease immediately during hazardous weather conditions such as high winds, heavy rain, lightening and heavy snow.

7.6 Fire Prevention

During equipment operation, periodic vapor concentration measurements should be taken with an explosimeter or combustimeter. If at any time the vapor concentrations exceed 20% of LEL, then the Site Health & Safety Officer or designated field worker should immediately shut down all operations.

Only approved safety cans will be used to transport and store flammable liquids.

All gasoline and diesel-driven engines requiring refueling must be shut down and allowed to cool before filling.

Smoking is not allowed during any operations within the work area in which petroleum products or solvents in free-floating, dissolved or vapor forms, or other flammable liquids may be present.

No open flame or spark is allowed in any area containing petroleum products, or other flammable liquids.

8.0 PROJECT PERSONNEL

Groundwater Technology, Inc. will oversee and act accordingly during all phases of the project. The following management structure will be instituted for the purpose of successfully and safely completing this project.

8.1 Project Manager

The Project Manager will be responsible for implementing the project and obtaining any necessary personnel or resources for the completion of the project. Specific duties will include:

- coordinating the activities of all subcontractors, to include informing them of the required personal protective equipment and insuring their signature acknowledging this HASP (see Appendix A),
- selecting a Site Health & Safety Officer and field personnel for the work to be undertaken on site,
- ensuring that the tasks assigned are being completed as planned and on schedule,
- providing authority and resources to ensure that the Site Health & Safety Officer is able to implement and manage safety procedures,
- preparing reports and recommendations about the project to clients and affected Groundwater Technology, Inc. personnel,
- ensuring that all persons allowed to enter the site (i.e. USEPA, contractors, state officials, visitors) are made aware of the potential hazards associated with the substances known or suspected to be on site, and are knowledgeable as to the on-site copy of the specific HASP,
- ensuring that the Site Health & Safety Officer is aware of all of the provisions of this HASP and is instructing all personnel on site about the safety practices and emergency procedures defined in the plan, and
- ensuring that the Site Health & Safety Officer is making an effort to monitor site safety, and has designated a Field Team Leader to assist with the responsibility when necessary.

8.2 Health and Safety Manager

The Health and Safety Manager shall be responsible for the overall coordination and oversight of the site safety plan. Specific duties will include:

- approving the selection of the types of personal protective equipment (PPE) to be used on site for specific tasks,
- monitoring the compliance activities and the documentation processes undertaken by the Site Health & Safety Officer
- evaluating weather and chemical hazard information and making recommendations to the Project Manager about any modifications to work plans or personal protection levels in order to maintain personnel safety,
- coordinate upgrading or downgrading PPE with Site Health & Safety Officer, due to changes in exposure levels, monitoring results, weather, or other site conditions,
- approving all field personnel working on site, taking into consideration their level of safety training, their physical capacity, and their eligibility to wear the protective equipment necessary for their assigned tasks (i.e. Respirator Fit Testing Results, etc.), and,
- overseeing the air monitoring procedures as they are carried out by site personnel for compliance with all company health and safety policies.

8.3 Site Health & Safety Officer

The Site Health & Safety Officer shall be responsible for the implementation of the HASP on site. Specific duties will include:

- monitoring the compliance of field personnel for the routine and proper use of the PPE that has been designated for each task,
- routinely inspecting PPE and clothing to ensure that it is in good condition and is being stored and maintained properly,
- stopping work on the site or changing work assignments or procedures if any operation threatens the health and safety of workers or the public,
- monitoring personnel who enter and exit the site and all controlled access points,
- reporting any signs of fatigue, work-related stress, or chemical exposures to the Project Manager and/or Health and Safety Officer,

- dismissing field personnel from the site if their actions or negligence endangers themselves, co-workers, or the public, and reporting the same to the Project Manager and/or Health and Safety Officer,
- reporting any accidents or violations of the Site Safety Plan to the Project Manager and/or Health and Safety Officer, and documenting the same for the project in the project records,
- knowing emergency procedures, evacuation routes and the telephone numbers of the ambulance, local hospital, poison control center, fire and police departments,
- ensuring that all project-related personnel have signed the personnel agreement and acknowledgments form contained in this HASP,
- coordinate upgrading and downgrading PPE with the Health and Safety Officer, as necessary, due to changes in exposure levels, monitoring results, weather, and other site conditions, and
- perform air monitoring with approved instruments in accordance with requirements stated in this HASP (see monitoring procedures on page 20 for specific information).

8.4 Other Field Personnel

All field personnel shall be responsible for acting in compliance with all safety procedures outlined in the HASP. Any hazardous work situations or procedures should be reported to the Site Health & Safety Officer so that corrective steps can be taken.

8.5 Medical/Technical Advisors

Katy Perkoski, R.N., C.O.H.N. GROUNDWATER TECHNOLOGY, INC., Norwood, MA	(800) 635-0053
Jack Geissert, C.I.H. GROUNDWATER TECHNOLOGY, INC., Norwood, MA	(800) 635-0053
David T. Crowley, C.S.P., C.E.T, C.H.M.M. GROUNDWATER TECHNOLOGY, INC., Norwood, MA	(617) 769-7602

The specific duties of the Medical/Technical Advisors include:

- providing technical input into the design of the HASP,
- advising worker exposure potential along with appropriate hazard reduction methods, and
- recommending a suitable medical monitoring program for the site workers.

Chemicals of Concern

- Aluminum
- Arsenic
- Barium
- Benzene
- Cadmium
- Calcium
- Chromium
- Cobalt
- Copper
- Ethyl Benzene
- Iron
- Lead
- Magnesium
- Manganese
- Mercury
- Nickel
- Nitrate
- Phenols
- Potassium
- Selenium
- Silver
- Toluene
- 1,1,1-Trichloroethane
- Vanadium
- Vinyl Chloride
- Zinc

APPENDIX A

Agreement and Acknowledgment Statement

APPENDIX A-2: AGREEMENT AND ACKNOWLEDGEMENT SHEET

Groundwater Technology personnel have the authority to stop field activities at this site if any activity is not performed in accordance with the requirements of the Site Safety Plan. All Groundwater Technology project personnel, subcontractor personnel and visitors are required to sign the Agreement and Acknowledgement Sheet **prior** to conducting field activities at this site.

APPENDIX A-2
GROUNDWATER TECHNOLOGY, INC.
AGREEMENT AND ACKNOWLEDGEMENT SHEET

1. **I have read and fully understand the SSP and my responsibilities.**
2. **I agree to abide by the provisions of the SSP.**

Name	**Signature**
Company	**Date**
Name	**Signature**
Company	**Date**
Name	**Signature**
Company	**Date**
Name	**Signature**
Company	**Date**
Name	**Signature**
Company	**Date**
Name	**Signature**
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Name	**Signature**
Company	**Date**
Name	**Signature**
Company	**Date**
Name	**Signature**
Company	**Date**

APPENDIX A-3: VISITOR/TRAINEE GUIDELINES

Groundwater Technology, Inc. is committed to providing a safe environment on all work sites for visitors, trainees, employees and/or passersby. In order to accomplish this, the following guidelines must be followed.

1. VISITORS

Any person not actively participating in the work at the site is regarded as a "visitor" and must follow Groundwater Technology's visitor/trainee guidelines. Visitors must be accompanied by a representative while on site.

Sites must be marked with signs, placards, and/or barricades to designate hazardous boundaries. Visitors will not be allowed on any site that is not adequately marked.

2. TRAINEES

Trainees are employees of Groundwater Technology who have not yet completed Groundwater Technology's required safety training program. New hires and in-house company transfers will be considered trainees until safety training requirements are met.

Trainees will be informed of restrictions by their supervisor and must abide by them before visiting active sites.

Trainees will be permitted to visit Groundwater Technology sites as observers as long as the following conditions are met:

- Trainees are supervised at all times while observing on site.
- Trainees do not perform work functions of any type while on site.
- Trainees do not handle any equipment, tools and/or supplies while on site.
- Trainees do not enter any hazardous or hot zone or confined space areas while on site.

Supervisors will be responsible for informing trainees of the above conditions and for ensuring that the conditions are met. Supervisors will also ensure that trainees will not be asked to violate the conditions listed above.

A Trainee/Observer Agreement Form must be signed by both the trainee and the supervisor and placed on file in the Regional Human Resources department.

Infractions of the above agreement will be viewed as extremely serious and will be subject to discipline up to and including termination for either the trainee and/or supervisor.

TRAINEE/OBSERVER AGREEMENT FORM

Groundwater Technology is committed to providing a safe working environment for all employees. In addition, Groundwater Technology will comply with OSHA requirements for employee safety training prior to working on any hazardous site.

The following section is to be filled out by trainee.

Agreement between:

______________________________ __________________ and Groundwater Technology.
Name (print/type) SS#

Because we have your safety in mind, you will be considered a trainee until all training criteria are met. This means you must complete all training requirements prior to performing work activities on site. As a requirement of the training program, you will be asked to visit Groundwater Technology sites as an observer. You must be supervised on all of these site visits.

As an on-site observer trainee, your signature below indicates your agreement to these restrictions.

You may not:

1. Perform work functions of any type.
2. Handle any equipment/tools and/or supplies of any type.
3. Enter any hazardous or hot zone areas.

I agree to adhere to the above conditions in all instances while on site as a trainee/observer.

______________________________ ________________
Signature Date

- -

This section is to be filled out by supervisor.

As supervisor to the above trainee, I agree to the above restrictions and agree not to request him/her to perform activities contrary to those restrictions.

______________________________ ________________
Signature Date

APPENDIX B

Site Safety Plan Amendment Sheet

GROUNDWATER
TECHNOLOGY

APPENDIX A-1: AMENDMENT SHEET

Project Name: ____________________

Project Number: ____________________

Project Manager: ____________________

Location: ____________________

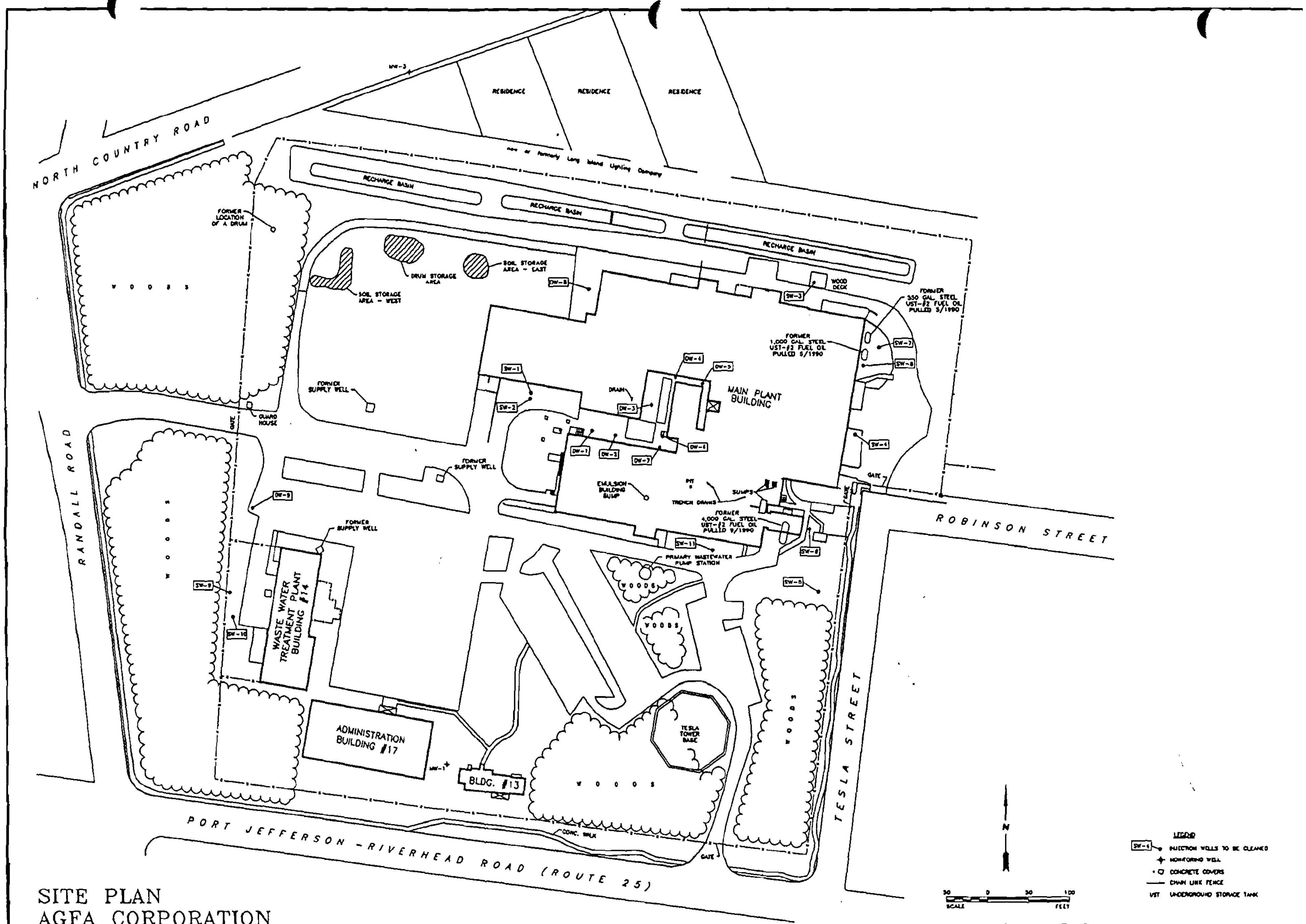
Changes in field activities or hazards:

Approved by: ____________________ ____________________

Regional Health and Safety Representative **Date**

APPENDIX C

Site Map



SITE PLAN
AGFA CORPORATION
SHOREHAM, N.Y.

GROUNDWATER
TECHNOLOGY

APPENDIX D

Definitions

APPENDIX B-1: MSDS DEFINITIONS

(TLV-TWA)	***Threshold Limit Value - Time Weighted Average.*** The time-weighted average concentration for a normal 8-hour work day and a 40-hour work week, to which nearly all workers may be repeatedly exposed without adverse effect.
(PEL)	Time-weighted average concentrations similar to (and in many cases derived from) the Threshold Limit Values.
(REL)	***Recommended Exposure Limit*** as defined by NIOSH similar to the Threshold Limit Values.
(IDLH)	***Immediately dangerous to life or health*** - Any atmospheric condition that poses an immediate threat to life, or which is likely to result in acute or immediate severe health effects. Oxygen deficiency is IDLH.
(LEL)	***Lower Explosive Limit*** - The minimum concentration of vapor in air below which propagation of a flame will not occur in the presence of an ignition source.
(UEL)	***Upper Explosive Limit*** - The maximum concentration of vapor in air above which propagation of a flame will not occur in the presence of an ignition source.
Flash Point (F.P.)	The lowest temperature at which the vapor of a combustible liquid can be made to ignite momentarily in air.
Vapor Pressure (V.P.)	The pressure characteristic at any given temperature of a vapor in equilibrium with its liquid or solid form, often expressed in millimeters of mercury (mm Hg).
Odor Threshold	A property displayed by a particular compound. Low detection indicates a physiological sensation due to molecular contact with the olfactory nervous system (based on 50% of the population).
Ionization Potential (I.P.)	The amount of ionization characteristic a particular chemical compound displays.

APPENDIX E
MSDS

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 100
Aluminum Metal/Powder

Issued: 12/81 Revision: B, 4/90

Section 1. Material Identification

Aluminum Metal/Powder Description: The primary sources of aluminum are the ores cryolite and bauxite. Produced by electrolysis of bauxite in a bath of molten cryolite, or made synthetically from fluorspar. As pure metal or as alloys, aluminum is used for aircraft, building and construction materials, die-cast auto parts, highway products, permanent magnets, photoengraving plates, corrosion-resistant chemical equipment, machinery and accessory equipment, and electrical conductors; tubes for ointments, toothpaste, and shaving cream; containers and flexible packaging; in dental alloys, manufacturing printing inks; testing for gold, arsenic, and mercury; the jewelry industry; as reducers for determining nitrates and nitrites; for precipitating copper and coagulating colloidal solutions of arsenic or antimony; and in the manufacture of aluminum powder for aluminum paints, explosives, fireworks, flashlights in photography, and for absorbing occluded gases in the manufacture of steel.

Other Designations: CAS No. 7429-90-5; Al; alumina fibre; aluminum flake; aluminum dehydrated; metana aluminum paste.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

R 1
I 2
S 2
K 1

NFPA
1
0 1
-

HMIS
H 0
F 1
R 1
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Aluminum metal/powder, ca 100%*

OSHA PELs	ACGIH TLVs, 1989-90	NIOSH REL, 1987
8-hr TWA: 5 mg/m^3 (respirable fraction, pyro powders, welding fumes)	TLV-TWA: 5 mg/m^3 (pyro powders, welding fumes)	None established
8-hr TWA: 15 mg/m^3 (total dust)	TLV-TWA: 10 mg/m^3 (metal dust)	Toxicity Data†
		None reported

* Since commercially "pure" Al may contain up to 1% iron (Fe), silicon (Si), and copper (Cu), exposure may also be to a mixture of these and other materials.
† Monitor NIOSH, *RTECS* (BD0330000), for future toxicity data.

Section 3. Physical Data

Boiling Point: 4221 °F/2327 °C
Melting Point: 1220 °F/660 °C
Vapor Pressure: 1 mm Hg at 2343 °F/1284 °C
Molecular Weight: 26.98 g/mol
Specific Gravity (H_2O = 1 at 39 °F/4 °C): 2.70
Water Solubility: Insoluble in hot and cold water

Appearance and Odor: Silvery-white, metallic solid, foil, particulate. No odor.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: 1202 °F/650 °C (cloud); 1440 °F/760 °C (dust layer)*	LEL: >0.04 oz/ft^3	UEL: None reported

Extinguishing Media: If possible, isolate and permit large fires to burn out while controlling smaller fires with sand, talc, or sodium chloride. Use nonsparking tools to ring small fires. *Do not use water, carbon tetrachloride (CCl_4), or halon!* A mixture of aluminum powder and water slowly forms hydrogen that can be hazardous if confined.

Unusual Fire or Explosion Hazards: Bulk aluminum is not combustible, but powdered aluminum can be a severe fire and explosion hazard when exposed to heat and ignition sources or by chemical reaction with powerful oxidizers. Aluminum forms explosive mixtures in air. When bulk dust is damp, it may heat spontaneously. Particles size, coating, and dispersion in air determine reactivity. The hazard increases with fineness.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Evacuate all unnecessary personnel upwind and isolate hazard area. Prevent dust clouds and eliminate drafts. Cool exposed containers with water, but be careful not to get water inside container. Be aware of runoff from fire control methods. Runoff to sewers may cause fire, explosion hazard, or pollution. Do not release to sewers or waterways.

* One hundred percent of dust goes through a 44-μm sieve. A 0.05-J spark can ignite an Al dust cloud.

Section 5. Reactivity Data

Stability/Polymerization: Stable at room temperature in closed containers under normal storage and handling conditions, aluminum corrodes rapidly in contact with other metals since it is strongly electropositive. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Aluminum is incompatible with perchlorate/nitrate/water mixtures, powdered silver chloride, ammonium peroxodisulfate + water, peroxides, halocarbons, halogens, acids, hydrogen chloride gas, molten silicon steels, phosphorus, sulfur, selenium, interhalogens, oxidants, perchlorate salts, and chlorates. Potentially explosive reaction with carbon tetrachloride during ball milling operations with chloroform amidinium nitrate, and sodium acetylide. Violent or explosive 'thermite' reaction when heated with metal oxides, oxosalts (nitrates, sulfates), or sulfides; hot copper oxide worked with an iron or steel tool; or with antimony, arsenic, and anitmony trichloride vapor. An explosive reaction (above 1472 °F/600 °C) of Al with iron powder + water releases explosive hydrogen gas; interaction with sodium hydroxide also releases explosive hydrogen gas; and a violent exothermic reaction occurs above (1112 °F/600 °C) with sodium diuranate. Al reacts with diborane to form a pyrophoric product. Bulk Al may undergo dangerous interactions with alcohols. Reaction with arseneic trioxide + sodium arsenate + sodium hydroxide produces the toxic arsine gas.

Hazardous Products of Decomposition: Inhalation of metallic oxide smoke (Al_2O_3) at 15 mg/m^3 or greater can cause "metal fume fever."

Section 6. Health Hazard Data

Carcinogenicity: Neither the NTP, IARC, nor OSHA lists aluminum as a carcinogen.
Summary of Risks: Its powder and dust are the most dangerous forms. Most hazardous exposures to aluminum occur in refining and smelting processes. Aluminum dust is a respiratory and eye irritant. Lung fibrosis is reported in aluminum welders and polishers, aluminum smelting (potroom) workers, and in workers involved in manufacturing alumina abrasives or explosives from stamped aluminum powders. A single case [illegible] reported of fibrosis occuring with encephalopathy (alterations of the brain's structure) after 13.5 years of working with fine powder. Death [illegible]lted from bronchopneumonia following progressive encephalopathy. Particles of aluminum deposited in the eye may cause necrosis (localized tissue death) of the cornea. Repeated aluminum contact with skin has been associated with skin telangiectases (bleeding into the tissues and mucous surfaces because of the abnormal fragility and dilatation of the capillary vessels and arterioles), delayed hypersensitivity, and granulomas. Acroanesthesia (numbness of the fingers) is reported in cotton mill operations where there is long contact with wet Al during bobbin winding. Mortality analysis of Al production workers showed malignant tumors of the nervous system, cancer of the pancreas, bronchus, and lung, and leukemia, especially in potroom workers.
Medical Conditions Aggravated by Long -Term Exposure: Symptoms of long-term overexposure are weakness, cough, and shortness of breath with generalized interstitial fibrosis and emphysema.
Target Organs: Respiratory tract, eyes, skin.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: Signs and symptoms of inhalation of aluminum powder or dust are dyspnea, cough, lethargy, anorexia, and an increased respiration rate.
Chronic Effects: Chronic inhalation of aluminum dust is associated with pulmonary fibrosis, asthma, emphysema, dyspnea, cough, and chronic obstructive lung disease.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water. For cuts, abrasive irritation or thermal burns, get medical attention.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Since aluminum is poorly absorbed through the gastrointestinal tract, vomiting is seldom necessary. However, if large amounts of aluminum are ingested, contact a physician.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Chronic exposure may lead to fibrosis with large bleb formation and risk of spontaneous pnuemothorax.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice an aluminum powder spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel upwind and remove all heat and ignition sources. Cleanup personnel must use protection against airborne dust and threat of fire. Promptly clean spill using conductive, nonsparking scoops and soft brushes with natural bristles. Use approved, grounded vacuum cleaners only in final cleanup. Place powder in closed, pressure-vented, dry, metal containers. Mix dry sand with scrap and tightly seal. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
S[illegible]A Extremely Hazardous Substance (40 CFR 355): Not listed
L[illegible]d as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Use tight-weave, nonstatic generating, protective clothing (no metallic fasteners, cuffs, or pockets) and nonsparking safety shoes when working with Al powder. Special protective clothing is needed to work with hot or molten aluminum.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PELs and ACGIH TLVs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Launder contaminated clothing before wearing. Remove this material from your shoes and equipment.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in sealed containers in a dry, low fire risk area away from all heat and ignition sources, oxidizing agents, combustibles, acids, alkalis, halogens, carbon disulfide, halogenated hydrocarbons, and all other incompatible materials (Sec. 5). Protect containers from physical damage; exclude moisture and humid air.
Engineering Controls: Avoid generation of airborne dust. Use good housekeeping to prevent dust accumulation. Electrically ground and bond all equipment used with aluminum metal powder. Give preemployment and periodic medical examinations, with particular emphasis on the skin, eyes, and lungs.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Aluminum metallic, powder
DOT Hazard Class: Flammable solid
ID No.: UN1396
DOT Label: Flammable solid
D[illegible]ackaging Requirements: 173.232
DOT Packaging Exceptions: 173.232

MSDS Collection References: 2, 4-11, 14-20, 26, 37, 38, 41, 73, 84, 85, 87, 89, 100, 103, 109, 124, 126, 127, 133

Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD

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Material Safety Data Sheets Collection:

Sheet No. 296

Arsenic and Compounds

Issued: 4/90

Section 1. Material Identification 31

Arsenic Description: Obtained from flue dust of copper and lead smelters as white arsenic (arsenic trioxide). Reduction with charcoal and sublimation in an N_2 current yields pure arsenic. Metallic arsenic is used for hardening copper, lead, and alloys; as a doping agent in germanium and silicon solid-state products, special solders, and medicine; and to make gallium arsenide for dipoles and other electronic devices. Arsenic compounds are used in manufacturing certain types of glass; in textile printing, tanning, taxidermy, pharmaceuticals, insecticides and fungicides, pigment production, and antifouling paints; and to control sludge formation in lubricating oils. Arsenic trioxide is the source for 97% of all arsenic products.

Other Designations: CAS No. 7440-38-2; arsen; arsenic black; As; gray arsenic; metallic arsenic.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R	1
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S	2
K	0

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HMIS

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R	2
PPG*	

* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Arsenic and soluble compounds, as As

OSHA PEL
8-hr TWA: 0.5 mg/m³,* 0.01 mg/m³†

ACGIH TLV, 1989-90
TLV-TWA: 0.2 mg/m³

NIOSH REL, 1987
Ceiling: 0.002 mg/m³

Toxicity Data‡
Man, oral, TD_{Lo}: 76 mg/kg administered intermittently over a 12-year period affects the liver (tumors) and blood (hemorrhage)
Man, oral: 7857 mg/kg administered over 55 years produces gastrointestinal (in the structure or function of the esophagus), blood (hemorrhage), and skin and appendage (dermatitis) changes
Rat, oral, TC_{Lo}: 605 µg/kg administered to a 35-week pregnant rat affects fertility (pre- and post-implantation mortality)

* Organic compounds.
† Inorganic compounds.
‡ See NIOSH, *RTECS* (CG0525000), for additional mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: sublimes at 1134 °F/612 °C
Melting Point: 1497 °F/814 °C
Vapor Pressure: 1 mm at 702 °F/372 °C (sublimes)

Atomic Weight: 74.92
Density: 5.724 at 57 °F/14 °C
Water Solubility: Insoluble†

Appearance and Odor: A brittle, crystalline, silvery to black metalloid. Odorless.

* This data pertains to arsenic only.
† Arsenic is soluble in nitric acid (HNO_3).

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use dry chemical, CO_2, water spray, or foam to fight fires.

Unusual Fire or Explosion Hazards: Flammable and slightly explosive in the form of dust when exposed to heat or flame.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Arsenic is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Arsenic can react vigorously on contact with powerful oxidizers such as bromates, peroxides, chlorates, iodates, lithium, silver nitrate, potassium nitrate, potassium permanganate, and chromium (VI) oxide. This material is also incompatible with halogens, bromine azide, palladium, dirubidium acetylide, zinc, and platinum.

Hazardous Products of Decomposition: Thermal oxidative decomposition of arsenic and its compounds produces irritating or poisonous gases.

Section 6. Health Hazard Data

Carcinogenicity: The IARC, NTP, and OSHA list arsenic as a human carcinogen (Group 1). This evaluation applies to arsenic and arsenic compounds as a whole, and not necessarily to all individual chemicals within the group. Studies report that both the trivalent and pentavalent compounds are strongly implicated as causes of skin, lung, and lymphatic cancers. Experimental studies have shown that arsenic has tumorigenic and teratogenic effects in laboratory animals.
Summary of Risks: Arsenic compounds are irritants of the skin, mucous membranes, and eyes. The moist mucous membranes are most sensitive ritation. Prolonged contact results in local hyperemia (blood congestion) and later vesicular or pustular eruption. Epidermal carcinoma is a orted risk of exposure. Peripheral neuropathy (degenerative state of the nervous system) is common after acute or chronic arsenic poisoning. Symptoms include decreased sensation to touch, pinprick, and temperature; loss of vibration sense; and profound muscle weakness and wasting. Other complications of acute and chronic arsenic poisoning are encephalopathy (alterations of brain structure) and toxic delirium.
Medical Conditions Aggravated by Long-Term Exposure: Damage to the liver, nervous, and hematopoietic (responsible for the formation of blood or blood cells in the body) system may be permanent. Pulmonary and lymphatic cancer may also occur.
Target Organs: Liver, kidneys, skin, lungs, lymphatic system.
Primary Entry Routes: Inhalation, ingestion of dust and fumes, via skin absorption.
Acute Effects: Acute industrial intoxication is more likely to arise from inhalation of arsine. However, with corrosive arsenical vapors, conjunctivitis, eyelid edema, and even corneal erosion may result. Inhalation may result in nasal irritation with perforation of the septum, cough, chest pain, hoarseness, pharyngitis, and inflammation of the mouth. If ingested, metallic or garlic taste, intense thirst, nausea, vomiting, abdominal pain, diarrhea, and cardiovascular arrhythmias (heartbeat irregularities) may occur. Symptoms generally occur within 30 minutes, but may be delayed for several hours if ingested with food. Acute poisoning may result in acute hemolysis (breakdown of red blood cells).
Chronic Effects: Chronic symptoms include weight loss, hair loss, nausea, and diarrhea alternating with constipation, palmar and plantar hyperkeratoses (thickening of the corneous layer of skin on palms and soles of feet), and skin eruptions, and peripheral neuritis (inflammation of the nerves). Leukemia, bone marrow depression, or aplastic anemia (dysfunctioning of blood-forming organs) may occur after chronic exposure.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have a *conscious* person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: If emesis is unsuccessful after two doses of Ipecac, consider gastric lavage. Monitor urine arsenic level. Alkalinization of urine may help prevent disposition of red cell breakdown products in renal tubular cells. If acute exposure is significant, maintain high urine output and monitor volume status, preferably with central venous pressure line. Abdominal X-rays should be done routinely for all ingestions. Chelation therapy with BAL, followed by n-penicillamine is recommended, but specific dosing guidelines are not clearly established.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spill, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against dust inhalation and contact with skin and eyes. Use nonsparking tools. With a clean shovel, scoop material into a clean, dry container and cover. Absorb liquid material with sand or noncombustible inert material and place in disposal containers. Do not release to sewers, drains, or waterways. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations*
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance† (40 CFR 302.4), Reportable Quantity
)): 1 lb (0.454 kg) [† per Clean Water Act, Sec. 307(a); per Clean Air Act, Sec. 112]
A Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations‡
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

* Designations for arsenic only.
‡ Listed as arsenic organic compounds (as As).

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PELs, ACGIH TLVs, and NIOSH REL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed, properly labeled, containers in a cool, well-ventilated area away from all incompatible materials (Sec. 5) and heat and ignition sources. Protect containers from physical damage.

Engineering Controls: Avoid inhalation or ingestion of dust and fumes, and skin or eye contact. Practice good personal hygiene and housekeeping procedures. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program with training, maintenance, inspection, and evaluation. All engineering systems should be of maximum explosion-proof design and electrically grounded and bonded. Provide preplacement and annual physical examination with emphasis on the skin, respiratory system, and blood.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Arsenic, solid
DOT Hazard Class: Poison B
ID No.: UN1558
DOT Label: Poison
Packaging Requirements: 173.366
DOT Packaging Exceptions: 173.364

IMO Shipping Name: Arsenic, metallic
IMO Hazard Class: 6.1
IMO Label: Poison
IMDG Packaging Group: II
ID No.: UN1558

MSDS Collection References: 7, 26, 38, 53, 73, 85, 87, 88, 89, 100, 103, 109, 123, 124, 126, 127, 130, 136, 138
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD

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Material Safety Data Sheets Collection:

Sheet No. 297
Barium and Compounds

Issued: 4/90

Section 1. Material Identification

Barium and Compounds Description: Produced by reducing barium oxide with aluminum or silicon in a vacuum at high temperature. The minerals barite ($BaSO_4$) and witherite ($BaCO_3$) are the primary sources of barium. Used as lubricant for anode rotors in X-ray tubes; a deoxidizer for copper; an extender in paints; a loader for paper, soap, rubber, and linoleum; a carrier for radium; a fire extinguisher for uranium or plutonium fires; a rodenticide; a stabilizer and mold lubricant in the rubber and plastics industries; a flux for magnesium alloys; getter alloys in vacuum tubes; and in spark-plug alloys and Frary's metal. Important barium compounds include carbonate (ceramics, rodenticide), sulfate (pigment and filler), hydroxide (water treatment, ceramics), nitrate (pyrotechnics), chloride (chemicals), chromate (pigments), oxide (lubricants), and peroxide (bleach).

Other Designations: CAS No. 7440-39-3; Ba.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R 2
I 3
S 2
K 4

Genium

HMIS
H 2
F 2
R 4
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Barium, ca 100%

OSHA PEL
8-hr TWA: 0.5 mg/m³ (Barium, soluble compounds, as Ba)

ACGIH TLV, 1989-90
TLV-TWA: 0.5 mg/m³ (Barium, soluble compounds, as Ba)

NIOSH REL, 1987
None established

Toxicity Data*
None listed

* Monitor *RTECS* (CQ8370000), for additional future data.

Section 3. Physical Data*

Boiling Point: 2984 °F/1640 °C
Melting Point: 1337 °F/725 °C
Vapor Pressure: 10 mm Hg at 1920 °F/1049 °C
Molecular Weight: 137.33 g/mol
Specific Gravity (H_2O = 1 at 39 °F/4 °C): 3.51 at 68 °F/20 °C
Water Solubility: Insoluble

Appearance and Odor: A silver white metal that is slightly lustrous and somewhat malleable.

Comment: Barium has a distinctive property of absorbing gases.

* Physcial data are for barium only.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: *Do not* use water or foam. For small fires, use dry chemical, soda ash, lime, or sand. For large fires, withdraw from area and let fire burn.

Unusual Fire or Explosion Hazards: In the powder form, barium is flammable at room temperature. It is also explosive in the form of dust when exposed to heat, flame, or by chemical reaction. The chlorate, peroxide, and nitrate compounds are reactive and may present fire hazards in storage and use.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and fully encapsulating suit. Barium may ignite itself if exposed to air. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Barium is stable at room temperature under special storage and handling conditions (Sec. 9). If the free metal is exposed to air, an explosion hazard exists because hydrogen is liberated. Barium compounds are more stable than elemental barium. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Barium reacts violently with water, carbon tetrachloride, trichloroethylene, fluorotrichloromethane, and tetrachloroethylene. This material is incompatible with acids, trichloroethylene and water, trichlorotrifluoroethane, 1,1,2-trichloro trifluoro ethane, and flurotrichloroethane. Barium is extremely reactive and reacts readily with halogens and ammonia. Barium compounds are not as reactive as elemental barium. See MSDSs 40, 119, 132, 173, 181, and 251 for specific chemical incompatibilities.

Conditions to Avoid: Avoid heating barium in hydrogen to about 392 °F/200 °C since it reacts violently and forms barium hydride (BaH_2). An explosion hazard exists if the free metal is exposed to moist air or cold water because hydrogen is liberated.

Section 6. Health Hazard Data

Carcinogenicity: Although the NTP, IARC, and OSHA do not list barium as a carcinogen, the IARC lists barium chromate (VI) as a carcinogen.

Summary of Risks: Barium presents mainly an explosion hazard. However, soluble compounds of barium by the oral route are highly toxic and the fatal dose of the chloride has been stated to be 0.8 to 0.9 g. Death may occur from a few hours to a few days. The soluble barium compounds exert a profound effect on skeletal, arterial, intestinal, bronchial, and particularly cardiac muscle. Effects on the hematopoietic system (responsible the formation of blood or blood cells in the living body) and the cerebral cortex are also noted. Poisoning may also occur if the dust of soluble compounds is inhaled. Certain compounds of barium are irritants of the skin, eyes, and mucous membranes. Barium oxide and barium hydroxide, strongly alkaline in aqueous solution, cause severe skin irritation and burns of the eye. Inhalation of insoluble barium produces a benign pneumoconiosis (baritosis). The half-life of barium in bone has been estimated at 50 days.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Target Organs: Skin, eyes, mucous membranes, lung, heart.

Primary Entry Routes: Inhalation of dust or fume, ingestion, skin or eye contact.

Acute Effects: Systemic absorption from ingestion causes gastroenteritis (inflammation of the stomach lining and the intestines), slow pulse rate (heart may stop while contracting), muscle spasm, and hypokalemia (potassium deficiency in the blood). Inhalation causes coughing, bronchial irritation, and pneumoconiosis. Contact with soluble salts causes dermatitis, irritation of the eyes and mucous membranes, and burns. During radiological examination, intraperitoneal (in the abdomen) or intrathoracic (in the chest) barium sulfate contamination resulting from a complication rupture may cause a significant inflammatory response.

Chronic Effects: Although baritosis (caused by inhaling barium sulfate) produces nodular opacities on chest X-rays, there is no evidence of clinical illness or bodily dysfunction.

FIRST AID

Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.

Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have a *conscious* person drink 1 to 2 glasses of water, then induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Physician's Note: Consider using calcium gluconate for muscular spasms. Consider gastic lavage followed by saline catharsis if soluble barium compounds are ingested. Institute cardiac monitoring for all significant ingestions of soluble barium salts.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spill. Immediately shut off all heat and ignition sources and evacuate hazard area. Cleanup personnel should protect against dust inhalation and contact with skin, eyes, and mucous membranes. For small dry spills, use a clean shovel to place material into a clean, dry container with a cover. For a large dry spill, cover with a plastic sheet to minimize spreading. For liquid spills, cover with sand or other noncombustible material and place in disposal containers. Follow applicable OSHA regulations (29 CFR 1910.120).

posal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

A Designations*
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations *
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)

*Designations for barium only.

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.

Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below OSHA PEL and ACGIH TLV (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store under inert gas, petroleum, or oxygen-free liquid in a cool, dry, well-ventilated area away from all incompatibles (Sec. 5).

Engineering Controls: Barium metal itself presents mainly an explosion hazard. All engineering systems should be of maximum explosion-proof design and electrically grounded and bonded. Use nonsparking tools. Proper storage is essential. Avoid dust inhalation and skin, eye, and mucous membrane contact. All processes should be enclosed and/or exhaust ventilation installed to keep the dust concentrations below the recommended levels. Practice good personal hygiene and housekeeping procedures. Preemployment and periodic medical examinations should be given to workers exposed to barite dust. Prevent exposing individuals with respiratory disorders.

Transportation Data (49 CFR 172.102)

IMO Shipping Name: Barium alloys, pyrophoric
IMO Hazard Class: 4.2
O Label: Spontaneously combustible
G Packaging Group: II
ID No.: UN1854

MSDS Collection References: 7, 26, 38, 73, 85, 87, 89, 100, 103, 109, 123, 124, 126, 127, 133, 136, 138, 139

Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD

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Material Safety Data Sheets Collection:
Sheet No. 316
Benzene

Issued: 11/78 **Revision: E, 8/90**

Section 1. Material Identification 32

Benzene (C_6H_6) Description: Derived by fractional distillation of coal tar, hydrodealkylation of toluene or pyrolysis of gasoline, catalytic reforming of petroleum, and transalkylation of toluene by disproportionation reaction. Used as a fuel; a chemical reagent; a solvent for a large number of materials such as paints, plastics, rubber, inks, oils, and fats; in manufacturing phenol, ethylbenzene (for styrene monomer), nitrobenzene (for aniline), dodecylbenzene (for detergents), cyclohexane (for nylon), chlorobenzene, diphenyl, benzene hexachloride, maleic anhydride, benzene-sulfonic acid, artificial leather, linoleum, oil cloth, varnishes, and lacquers; for printing and lithography; in dry cleaning; in adhesives and coatings; for extraction and rectification; as a degreasing agent; in the tire industry; and in shoe factories. Benzene has been banned as an ingredient in products intended for household use and is no longer used in pesticides.
Other Designations: CAS No. 0071-43-2, benzol, carbon oil, coal naphtha, cyclohexatriene, mineral naphtha, nitration benzene, phene, phenyl hydride, pyrobenzol.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R	1
I	4
S	2*
K	4

*Skin absorption

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PPG†
† Sec. 8

Cautions: Benzene is a confirmed *human carcinogen* by the IARC. *Chronic low-level exposure may cause cancer (leukemia) and bone marrow damage, with injury to blood-forming tissue.* It is also a dangerous fire hazard when exposed to heat or flame.

Section 2. Ingredients and Occupational Exposure Limits

Benzene, ca 100%*

1989 OSHA PELs
(29 CFR 1910.1000, Table Z-1-A)
8-hr TWA: 1 ppm, 3 mg/m³
15-min STEL: 5 ppm, 15 mg/m³

(29 CFR 1910.1000, Table Z-2)
8-hr TWA: 10 ppm
Acceptable Ceiling Concentration: 25 ppm
Acceptable Maximum Peak: 50 ppm (10 min)†

1989-90 ACGIH
TLV-TWA: 10 ppm, 32 mg/m³

1988 NIOSH RELs
TWA: 0.1 ppm, 0.3 mg/m³
Ceiling: 1 ppm, 3 mg/m³

1985-86 Toxicity Data‡
Man, oral, LD_{Lo}: 50 mg/kg; no toxic effect noted
Man, inhalation, TC_{Lo}: 150 ppm inhaled intermittently over 1 yr in a number of discrete, separate doses affects the blood (other changes) and nutritional and gross metabolism (body temperature increase)
Rabbit, eye: 2 mg administered over 24 hr produces severe irritation

* OSHA 29 CFR 1910.1000, Subpart Z, states that the final benzene standard in 29 CFR 1910.1028 applies to all occupational exposures to benzene except in some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table Z-2 apply.
† Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift.
‡ See NIOSH, *RTECS* (CY1400000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 176 °F (80 °C)
Melting Point: 42 °F (5.5 °C)
Vapor Pressure: 100 mm Hg at 79 °F (26.1 °C)
Vapor Density (Air = 1): 2.7
Evaporation Rate (Ether = 1): 2.8
Molecular Weight: 78.11
Specific Gravity (15 °C/4 °C): 0.8787
Water Solubility: Slightly (0.180 g/100 g of H_2O at 25 °C)
% Volatile by Volume: 100
Viscosity: 0.6468 mPa at 20 °C

Appearance and Odor: A colorless liquid with a characteristic sweet, aromatic odor. The odor recognition threshold (100% of panel) is approximately 5 ppm (unfatigued) in air. Odor *is not* an adequate warning of hazard.

Section 4. Fire and Explosion Data

Flash Point: 12 °F (-11.1 °C), CC	**Autoignition Temperature:** 928 °F (498 °C)	**LEL:** 1.3% v/v	**UEL:** 7.1% v/v

Extinguishing Media: Use dry chemical, foam, or carbon dioxide to extinguish benzene fires. Water may be ineffective as an extinguishing agent since it can scatter and spread the fire. Use water spray to cool fire-exposed containers, flush spills away from exposures, disperse benzene vapor, and protect personnel attempting to stop an unignited benzene leak.
Unusual Fire or Explosion Hazards: Benzene is a Class 1B flammable liquid. A concentration exceeding 3250 ppm is considered a potential fire explosion hazard. Benzene vapor is heavier than air and can collect in low lying areas or travel to an ignition source and flash back. Explosive and flammable benzene vapor-air mixtures can easily form at room temperature. Eliminate all ignition sources where benzene is used, handled, or stored.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Structural firefighter's protective clothing provides limited protection. Stay out of low areas. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Runoff to sewer can create pollution, fire, and explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Benzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Benzene explodes on contact with diborane, permanganic acid, bromine pentafluoride, peroxodisulfuric acid, and peroxomonosulfuric acid. It ignites on contact with dioxygen difluoride, dioxygenyl tetrafluoroborate, iodine heptafluoride, and sodium peroxide + water. Benzene forms sensitive, explosive mixture with iodine pentafluoride, ozone, liquid oxygen, silver perchlorate, nitryl perchlorate, nitric acid, and arsenic pentafluoride + potassium methoxide (explodes above 30 °C). A vigorous or incandescent reaction occurs with bromine trifluoride, uranium hexafluoride, and hydrogen + Raney nickel [above 410 °F (210 °C)]. Benzene is incompatible with oxidizing materials.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of benzene can produce toxic gases and vapors such as carbon monoxide.

Section 6. Health Hazard Data

Carcinogenicity: The ACGIH, OSHA, and IARC list benzene as, respectively, a supected human carcinogen, a cancer hazard, and, based on sufficient human and animal evidence, a human carcinogen (Group 1).
Summary of Risks: Prolonged skin contact or excessive inhalation of benzene vapor may cause headache, weakness, appetite loss, and fatigue. The most important health hazards are cancer (leukemia) and bone marrow damage with injury to blood-forming tissue from chronic low-level exposure. Higher level exposures may irritate the respiratory tract and cause central nervous system (CNS) depression.
edical Conditions Aggravated by Long-Term Exposure: Exposure may worsen ailments of the heart, lungs, liver, kidneys, blood, and CNS.
arget Organs: Blood, central nervous system, bone marrow, eyes, upper respiratory tract, and skin.
Primary Entry Routes: Inhalation, skin contact.
Acute Effects: Symptoms of acute overexposure include irritation of the eyes, nose, and respiratory tract, breathlessness, euphoria, nausea, drowsiness, headache, dizziness, and intoxication. Severe exposure may lead to convulsions and unconsciousness. Skin contact may cause a drying rash (dermatitis).
Chronic Effects: Long-term chronic exposure may result in many blood disorders ranging from aplastic anemia (an inability to form blood cells) to leukemia.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Immediately rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air. Emergency personnel should protect against inhalation exposure. Provide CPR to support breathing or circulation as necessary. Keep awake and transport to a medical facility.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* since aspiration may be fatal. Call a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Evaluate chronic exposure with a CBC, peripheral smear, and reticulocyte count for signs of myelotoxicity. Follow up any early indicators of leukemia with a bone marrow biopsy. Urinary phenol conjugates may be used for biological monitoring of recent exposure. Acute management is primarily supportive for CNS depression.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a benzene spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel, eliminate all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation, eye contact, and skin absorption. Absorb as much benzene as possible with an inert, noncombustible material. For large spills, dike far ahead of spill and contain liquid. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of confined spaces such as sewers, watersheds, and waterways because of explosion danger. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U019
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 307 (a), 311 (b)(4), 112; and per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
ted as SARA Toxic Chemical (40 CFR 372.65)
HA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations at least below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and incompatible materials. *Caution! Benzene vapor may form explosive mixtures in air.* To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. When opening or closing benzene containers, use nonsparking tools. Keep fire extinguishers readily available.
Engineering Controls: Because OSHA specifically regulates benzene (29 CFR 1910.1028), educate workers about its potential hazards and dangers. Minimize all possible exposures to carcinogens. If possible, substitute less toxic solvents for benzene; use this material with extreme caution and only if absolutely essential. Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Designate regulated areas of benzene use (see legend in the box below) and label benzene containers with "DANGER, CONTAINS BENZENE, CANCER HAZARD."
Other Precautions: Provide preplacement and periodic medical examinations with emphasis on a history of blood disease or previous exposure.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Benzene (*benzol*)
DOT Hazard Class: Flammable liquid
ID No.: UN1114
T Label: Flammable liquid
T Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Benzene
IMO Hazard Class: 3.2
ID No.: UN1114
IMO Label: Flammable liquid
IMDG Packaging Group: II

DANGER
BENZENE
CANCER HAZARD
FLAMMABLE–NO SMOKING
AUTHORIZED PERSONNEL ONLY
RESPIRATOR REQUIRED

MSDS Collection References: 1, 2, 12, 26, 73, 84-94, 100, 101, 103, 109, 124, 126, 127, 132, 134, 136, 138, 139, 143
Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: MJ Upfal, MD, MPH; Edited by: JR Stuart, MS

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Material Safety Data Sheets Collection:
Sheet No. 317
Toluene
Issued: 8/79 Revision: E, 9/92

Section 1. Material Identification

39

Toluene ($C_6H_5CH_3$) Description: Derived from petroleum i.e., dehydrogenation of cycloparaffin fractions followed by the aromatization of saturated aromatic hydrocarbons or by fractional distillation of coal-tar light oil and purified by rectification. Used widely as a solvent (replacing benzene in many cases) for oils, resins, adhesives, natural rubber, coal tar, asphalt, pitch, acetyl celluloses, cellulose paints and varnishes; a diluent for photogravure inks, raw material for organic synthesis (benzoyl & benzilidene chlorides, saccharine, TNT, toluene diisocyanate, and many dyestuffs), in aviation and high octane automobile gasoline, as a nonclinical thermometer liquid and suspension solution for navigational instruments.

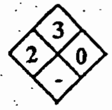
Other Designations: CAS No. 108-88-3, Methacide, methylbenzene, methylbenzol, phenylmethane, toluql, Tolu-sol.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

Cautions: Toluene is an eye, skin, and respiratory tract irritant becoming narcotic at high centrations. Liver and kidney damage has occurred. Pregnant women chronically exposed to toluene have shown teratogenic effects. Toluene is highly flammable.

R 1
I 3
S 2*
K 3
* Skin absorption

NFPA



HMIS
H 2- Chronic effects
F 3
R 0
PPE-Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Toluene, < 100%; may contain a small amount of benzene (~ 1%), xylene, and nonaromatic hydrocarbons.

1991 OSHA PELs
8-hr TWA: 100 ppm (375 mg/m^3)
15-min STEL: 150 ppm (560 mg/m^3)

1990 IDLH Level
2000 ppm

1990 NIOSH RELs
TWA: 100 ppm (375 mg/m^3)
STEL: 150 ppm (560 mg/m^3)

1992-93 ACGIH TLV (Skin)
TWA: 50 ppm (188 mg/m^3)

1990 DFG (Germany) MAK*
TWA: 100 ppm (380 mg/m^3)
Half-life: 2 hr to end of shift
Category II: Substances with systemic effects
Peak Exposure Limit: 500 ppm, 30 min average value, 2/shift

1985-86 Toxicity Data†
Man, inhalation, TC_{Lo}: 100 ppm caused hallucinations, and changes in motor activity and changes in psychophysiological tests.
Human, oral, LD_{Lo}: 50 mg/kg; toxic effects not yet reviewed
Human, eye: 300 ppm caused irritation.
Rat, oral, LD_{50}: 5000 mg/kg
Rat, liver: 30 μmol/L caused DNA damage.

* Available information suggests damage to the developing fetus is probable.
†See NIOSH, *RTECS* (XS5250000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 232 °F (110.6 °C)
Melting Point: -139 °F (-95 °C)
Molecular Weight: 92.15
Density: 0.866 at 68 °F (20/4 °C)
Surface Tension: 29 dyne/cm at 68 °F (20 °C)
Viscosity: 0.59 cP at 68 °F (20 °C)
Refraction Index: 1.4967 at 20 °C/D
Water Solubility: Very slightly soluble, 0.6 mg/L at 68 °F (20 °C)
Other Solubilities: Soluble in acetone, alcohol, ether, benzene, chloroform, glacial acetic acid, petroleum ether, and carbon disulfide.
Vapor Pressure: 22 mm Hg at 68 °F (20 °C); 36.7 mm Hg at 86 °F (30 °C)
Saturated Vapor Density (Air = 0.075 lb/ft^3 or 1.2 kg/m^3): 0.0797 lb/ft^3 or 1.2755 kg/m^3
Odor Threshold (range of all referenced values): 0.021 to 69 ppm

Appearance and Odor: Colorless liquid with a sickly sweet odor.

Section 4. Fire and Explosion Data

Flash Point: 40 °F (4.4 °C) CC	**Autoignition Temperature:** 896 °F (480 °C)	**LEL:** 1.27% v/v	**UEL:** 7.0% v/v

Extinguishing Media: Toluene is a Class 1B flammable liquid. To fight fire, use dry chemical carbon dioxide, or 'alcohol-resistant' foam. Water spray may be ineffective as toluene floats on water and may actually spread fire. **Unusual Fire or Explosion Hazards:** Concentrated vapors are heavier than air and may travel to an ignition source and flash back. Container may explode in heat of fire. Toluenes' burning rate = 5.7 mm/min and its flame speed = 37 cm/sec. Vapor poses an explosion hazard indoors, outdoors, and in sewers. May accumulate static electricity. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing provides only limited protection. Apply cooling water to sides of tanks until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from fire and let burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire because a BLEVE (boiling liquid expanding vapor explosion) may be imminent. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Toluene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization can't occur. **Chemical Incompatibilities:** Strong oxidizers, concentrated nitric acid, nitric acid + sulfuric acid, dinitrogen tetroxide, silver perchlorate, bromine trifluoride, tetranitromethane, and 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione. **Conditions to Avoid:** Contact with heat, ignition sources, or incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of toluene can produce carbon dioxide, and acrid, irritating smoke.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list toluene as a carcinogen. **Summary of Risks:** Toluene is irritating to the eyes, nose, and respiratory tract. Inhalation of high concentrations produces a narcotic effect sometimes leading to coma as well as liver and kidney damage. 93% of inhaled toluene is retained in the body of which 80% is metabolized to benzoic acid, then to hippuric acid and excreted in urine. The remainder is metabolized to *o*-cresol and excreted or exhaled unchanged. Toluene metabolism is inhibited by alcohol ingestion and is synergistic with benzene, asphalt fumes, or chlorinated hydrocarbons (i.e. perchloroethylene). Toluene is readily absorbed through the skin at 14 to 23 mg/cm^2/hr. Toluene is absorbed quicker during exercise than at rest and appears to be retained longer in obese versus thin victims, presumably due to its lipid solubility. There is inconsistent data on toluene's ability to damage bone marrow; chronic poisoning has resulted in anemia and leucopenia with biopsy showing bone marrow hypo-plasia. These reports are few and some authorities argue that the effects may have been due to benzene contaminants. Chronic inhalation during pregnancy has been associated with teratogenic effects on the fetus including microcephaly, CNS dysfunction, attentional deficits, developmental delay + language impairment, growth retardation, and physical defects including a small midface, short palpebral fissures with deep-set eyes, low-set ears, flat nasal bridge with a small nose, micrognathia, and blunt fingertips. There is some evidence that toluene causes an autoimmune illness in which the body produces antibodies that cause inflammation of its own kidney.

Continue on next page

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Alcoholism and CNS, kidney, skin, or liver disease. **Target Organs:** CNS, liver, kidney, skin. **Primary Entry Routes:** Inhalation, skin contact/absorption. **Acute Effects:** Vapor inhalation causes respiratory tract irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, watering eyes, nervousness, insomnia, parasthesis, and vertigo progressing to narcotic coma. Death may result from cardiac arrest due to ventricular fibrillation with catecholamines loss. Liquid splashed in the eye causes conjunctival irritation, transient corneal damage and possible burns. Prolonged skin contact leads to drying and fissured dermatitis. Ingestion causes GI tract irritation and symptoms associated with inhalation. **Chronic Effects:** Symptoms include mucous membrane irritation, headache, vertigo, nausea, appetite loss and [illegible]ol intolerance. Repeated heavy exposure may result in encephalopathies (cerebellar ataxia and cognitive dysfunction), liver enlargement, and kidney dystrophy (wasting away). Symptoms usually appear at workdays end, worsen at weeks end and decrease or disappear over the weekend.

FIRST AID Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult an ophthalmologist immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting because of danger of aspiration into the lungs. Gastric lavage may be indicated if large amounts are swallowed; potential toxicity needs to be weighed against aspiration risk when deciding for or against gastric lavage. **Note to Physicians:** Monitor cardiac function. If indicated, use epinephrine and other catecholamines carefully, because of the possibility of a lowered myocardial threshold to the arrhythmogenic effects of such substances. Obtain CBC, electrolytes, and urinalysis. Monitor arterial blood gases. If toluene has > 0.02% (200 ppm) benzene, evaluate for potential benzene toxicity. BEI: hippuric acid in urine, sample at shift end (2.5 g/g creatinine); Toluene in venous blood, sample at shift end (1.0 mg/L).

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel protect against inhalation and skin/eye contact. Use water spray to cool and disperse vapors but it may not prevent ignition in closed spaces. Cellosolve, hycar absorbent materials, and fluorocarbon water can also be used for vapor suppression/containment. Take up small spill with earth, sand, vermiculite, or other absorbent, noncombustible material. Dike far ahead of large spills for later reclamation or disposal. For water spills, (10 ppm or greater) apply activated carbon at 10X the spilled amount and remove trapped material with suction hoses or use mechanical dredges/lifts to remove immobilized masses of pollutants and precipitates. Toluene can undergo fluidized bed incineration at 842 to 1796 °F (450 to 980 °C), rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C), or liquid injection incineration at 1202 to 2912 °F (650 to 1600 °C). Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Blue gill, LC_{50} = 17 mg/L/24 hr; shrimp (*Crangonfracis coron*), LC_{50} = 4.3 ppm/96 hr; fathead minnow (*Pimephales promelas*), LC_{50} = 36.2 mg/L/96 hr. **Environmental Degradation:** If released to land, toluene evaporates and undergoes microbial degradation. In water, toluene volatilizes and biodegrades with a half-life of days to several weeks. In air, toluene degrades by reaction with photochemically produced hydroxyl radicals. **Disposal:** Treat contaminated water by gravity separation of solids, followed by skimming of surface. Pass through dual media filtration and carbon absorption units (carbon ratio 1 kg to 10 kg soluble material). Return waste water from backwash to gravity separator. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U220
SARA Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg)
[* per RCRA, Sec. 3001; CWA, Sec. 311 (b)(4); CWA, Sec. 307 (a)]
[illegible]d as a SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses with shatter-resistant glass and side-shields or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 100 ppm, use any chemical cartridge respirator with appropriate organic vapor cartridges, any supplied-air respirator (SAR), or SCBA. For < 200 ppm, use any SAR operated in continuous-flow mode, any SAR or SCBA with a full facepiece, or any air-purifying respirator with a full facepiece having a chin-style, front or back mounted organic vapor canister. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl alcohol with a breakthrough time of > 8 hr, Teflon and Viton are recommended as suitable materials for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove toluene from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from ignition sources and incompatibles. Outside or detached storage is preferred. If stored inside, use a standard flammable liquids warehouse, room, or cabinet. To prevent static sparks, electrically ground and bond all equipment used with toluene. Do not use open lights in toluene areas. Install Class 1, Group D electrical equipment. Check that toluene is free of or contains < 1% benzene before use. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Adopt controls for confined spaces (29 CFR 1910.146) if entering areas of unknown toluene levels (holes, wells, storage tanks). Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, liver, kidney, and skin. Include hemocytometric and thrombocyte count in cases where benzene is a contaminant of toluene. Monitor air at regular intervals to ensure effective ventilation.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Toluene	**Packaging Authorizations**	**Quantity Limitations**	**Vessel Stowage Requirements**
DOT Hazard Class: 3	a) Exceptions: 150	a) Passenger Aircraft or Railcar: 5L	Vessel Stowage: B
ID No.: UN1294	b) Non-bulk Packaging: 202	b) Cargo Aircraft Only: 60L	Other:
[illegible] **Packing Group:** II	c) Bulk Packaging: 242		
DOT Label: Flammable Liquid			
Special Provisions (172.102): T1			

MSDS Collection References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 140, 148, 153, 159, 163, 164, 167, 169, 171, 174, 175, 176, 180.
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, CIH, MPH; **Medical Review:** AC Darlington, MD, MPH

Material Safety Data Sheet

from Genium's Reference Collection

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GENIUM PUBLISHING CORP.

No. 23
CADMIUM
(Revision C)
Issued: September 1977
Revised: November 1988

SECTION 1. MATERIAL IDENTIFICATION 27

Material Name: CADMIUM

Description (Origin/Uses): Used in electroplating other metals; in dentistry; in alloys; in nickel-cadmium batteries; and in reactor control rods.

Other Designations: Cd; CAS No. 7440-43-9

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

1
3 0
-
Genium

HMIS	
H 3	R 1
F 1	I 4
R 0	S 1
PPG*	K 4 (Dust)
*See sect. 8	

SECTION 2. INGREDIENTS AND HAZARDS, EXPOSURE LIMITS

Cadmium, CAS No. 7440-43-9, ca 100%

OSHA PEL
8-Hr TWA: 0.1 mg/m³ (Cd Fume)
Ceiling: 0.3 mg/m³ (Cd Fume)
8-Hr TWA: 0.2 mg/m³ (Cd Dust)
Ceiling: 0.6 mg/m³ (Cd Dust)

ACGIH NIC,* 1988-89
TLV-TWA: 0.01 mg/m³ (Cadmium and Compounds, as Cd)
ACGIH A2, Suspected Human Carcinogen

ACGIH TLVs, 1988-89
TLV-TWA: 0.05 mg/m³ (Cadmium Dusts and Salts, as Cd)
TLV-Ceiling: 0.05 mg/m³ (Cadmium Oxide Fume, as Cd)
TLV-TWA: 0.05 mg/m³ (Cadmium Oxide Production)

Toxicity Data**
Human, Inhalation, LC_{Lo}: 39 mg/m³ (20 Minutes)

*Notice of Intended Changes, Genium reference 116, p. 39.
**See NIOSH, *RTECS* (EU9800000), for additional data referring to reproductive, tumorigenic, and mutagenic effects.

SECTION 3. PHYSICAL DATA

Boiling Point: 1413°F (767°C)
Melting Point: 610°F (321°C)
Vapor Pressure: 0.095 Torr at 610°F (321°C)
Molecular Weight: 112 Grams/Mole
Solubility in Water (%): Insoluble
Specific Gravity (H_2O = 1): 8.642

Appearance and Odor: A soft, blue white, malleable, lustrous metal that can be cut easily with a knife; odorless.

Comments: Cadmium has a significant vapor pressure of 0.000021 torr (corresponding to 0.12 mg/m³) at 315°F (157°C). Heating this metal without using correct engineering controls and/or personal protective equipment can result in overexposure.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method*	Autoignition Temperature*	LEL*	UEL*

Extinguishing Media: *Cadmium metal burns readily in air if it is heated. As with most metals, the reactivity/dust-cloud-explosion hazard increases as the cadmium metal becomes more finely divided. In fact, finely divided, powdered cadmium metal can be pyrophoric (it burns spontaneously in air without any source of ignition). Carbon dioxide, dry chemical, or sand are recommended extinguishing agents for cadmium fires. **Unusual Fire or Explosion Hazards:** Cadmium dust can explode during a fire. Massive cadmium metal does not present this potential explosion hazard; however, certain work operations such as grinding, welding, or cutting, can produce dust made of finely divided cadmium particles. **Warning:** Do not create a dust cloud of cadmium particles, especially during cutting, grinding, or welding operations. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Cadmium is stable in closed containers during routine operations. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Cadmium reacts dangerously with ammonium nitrate, hydrazoic acid, tellurium, and zinc (Genium ref. 84). **Conditions to Avoid:** Avoid all exposure to sources of ignition and to incompatible chemicals. **Hazardous Products of Decomposition:** When heated, which is likely during fires and work operations such as welding and machining, cadmium metal can decompose into cadmium metal fume and cadmium oxide fume.

SECTION 6, HEALTH HAZARD INFORMATION

Carcinogenicity: The ACGIH classifies cadmium and its compounds as suspected human carcinogens (group A2); the IARC lists them as probable human carcinogens (group 2B); and the NTP classifies them as anticipated human carcinogens (group b). **Summary of Risks:** Heating cadmium metal produces intensely irritating cadmium metal fume. The acute effects of its excessive inhalation, which include severe tracheobronchitis, pneumonitis, and pulmonary edema, are life threatening and are usually delayed for several hours; their mortality rate is about 20%. Nonfatal pneumonitis has resulted from exposure to 0.5 to 2.5 mg/m³; a fatality has been reported for five hours' exposure at 9 mg/m³ and for 1 hour's exposure at 40 to 50 mg/m³. There is no warning discomfort or immediate irritation from exposure to cadmium fume. Acute gastroenteritis and symptoms of metal fume fever are associated with even lower acute exposure. Symptoms of acute overexposure include excessive salivation, a dry, burning throat; headache; aching muscles; coughing; chest tightness and pain; nausea; chills, and fever chills; and fever. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** Skin, eyes, respiratory system, kidneys, and blood. **Primary Entry:** Inhalation, skin contact. **Acute Effects:** See Summary of Risks, above. **Chronic Effects:** Long-term, chronic inhalation of cadmium dust, salts, or fume causes chronic cadmium poisoning characterized by a distinctive, nonhypertrophic emphysema with or without renal tubular injury, accompanied by the urinary excretion of a protein with a molecular weight

SECTION 6. HEALTH HAZARD INFORMATION, cont.

of 20,000 to 30,000. This protein is itself a sign of early but reversible chronic poisoning. (Possible chromosomal aberrations and decreased birth weight among babies of women exposed to cadmium have been noted.) Danger: Continued overexposure from inhalation causes irreversible renal tubular damage. Cancer, anemia, eosinophilia, anosmia, chronic rhinitis, yellowed teeth, and bone changes have been reported. Bone pain in the ribs, backbone, and femur is common; disorders of calcium metabolism develop; and kidney stones and pulmonary fibrosis have been described. **FIRST AID:** Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. **Skin.** Rinse the affected area with flooding amounts of water, then wash it with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. **Ingestion.** If a physician is not readily available, give the exposed person 2 to 3 glasses of water to drink and induce vomiting. A physician may administer a gastric lavage followed by saline catharsis. Comments: A comprehensive medical program is advised for those who work with cadmium or its compounds. This should include chest X rays and forced-vital-capacity tests. Get medical help (in plant, paramedic, community) for all exposures. Seek prompt medical assistance for further treatment, observation, and support after first aid. **Note to Physician:** Chelation therapy may be useful in treatment; calcium disodium edetate and pencillamine are recommended. Dimercaprol (BAL) is not recommended because of reported renal toxicity of the cadmium-BAL complex.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately, and provide adequate ventilation. Cleanup procedures must not create dusty conditions. Pick up the spilled material using vacuuming, mopping, or wet-sweeping techniques. Cleanup personnel need protection against inhalation of dust and fume (see sect. 8). Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations. Concentrated solutions of cadmium waste can be precipitated with lime and collected by filtration. Effluent should be treated as needed to reduce the concentration of the cadmium to a level that is within regulatory compliance limits.

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste, No. D006 (40 CFR 261.24 [Characteristic of EP toxicity])
CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg), per the Clean Water Act (CWA), § 307 (a).

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of a cadmium solution is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). Respirator: Use a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. Warning: Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. Other: Wear impervious gloves, boots, aprons, and gauntlets, to prevent prolonged or repeated skin contact with this material. Ventilation: Install and operate general and local maximum explosion-proof ventilation systems powerful enough to maintain airborne levels of cadmium below the OSHA PEL cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommnedations. Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. Contaminated Equipment: Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from your shoes and equipment. Do not wear work clothes home. Comments: Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale cadmium fume. Do not expose individuals with lung, liver, kidney, and blood ailments to cadmium until such exposure is approved by a physician.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store cadmium in closed containers in a cool, dry, well-ventilated area away from sources of ignition and strong oxidizers. Protect containers from physical damage. Avoid storage situations where corrosion can occur. Keep powdered cadmium in closed containers; prevent the airborne dispersion of powdered cadmium. Engineering Controls: Make sure all engineering systems (production, transportation) are of maximum explosion-proof design. Ground and bond all containers, pipelines, etc., used in shipping, transferring, reacting, producing, and sampling operations to prevent static sparks. **Other Precautions:** The toxic effects of cadmium are influenced by the presence or absence of other elements such as zinc and selenium. If these materials are present in the workplace, careful evaluation of any exposure to cadmium is required to understand any contributing factors.

Hazardous Materials Table (49 CFR 172.101): Not Listed
Optional Hazardous Materials Table (49 CFR 172.102)

ID No. UN2570

IMO Shipping Name: Cadmium Compounds
IMO Hazard Class: 6.1
IMO Labels: Poison or Saint Andrew's Cross (X)*

*Harmful—Stow away from Foodstuffs (IMO Label, Materials of Class 6.1 Packaging Group III).

References: 1, 26, 38, 84-94, 100, 116, 117, 120, 122.

Prepared by PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: W Silverman, MD

Material Safety Data Sheet

From Genium's Reference Collection
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GENIUM PUBLISHING CORP.

No. 221

CALCIUM METAL

Issued: November 1987

SECTION 1. MATERIAL IDENTIFICATION 24

Material Name: CALCIUM METAL

Description (Origin/Uses): Produced by electrolysis of calcium chloride. Used in alloys of aluminum, copper, and lead.

Other Designations: Calcicat; Calcium; Ca; NIOSH *RTECS* No. EV8040000; CAS No. 7440-70-2

Manufacturer/Supplier: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyer's Guide* (Genium ref. 73) for a list of suppliers.

HMIS			
H	1		
F	1	R	2
R	2	I	NA
PPG*		S	3
*See sect. 8		K	0

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Calcium Metal, CAS No. 7440-70-2	100	Element Calcium: No Exposure Limits Established
Calcium plus water yields calcium hydroxide, Ca$(OH)_2$, having the CAS No. 1305-62-0 and the NIOSH *RTECS* No. EW2800000 with the following data: ACGIH TLV, 1987-88 TLV-TWA: 5 mg/m^3		Artificial Isotopes: ^{45}Ca and ^{47}Ca pose a radiation hazard; they emit gamma radiation.

SECTION 3. PHYSICAL DATA

Boiling Point: 2703°F (1484°C)
Water Solubility: Reacts Violently with Water*
Specific Gravity (H_2O = 1): 1.5
Melting Point: 1542°F (839°C)
Molecular Weight: 40.08 Grams/Mole
pH: Water Solution Alkaline (pH >7)

*Soluble in water forming the hydroxide; soluble in acids forming salts.

Appearance and Odor: Silver-white, crystalline, lustrous metal; tarnishes to blue-gray-white on exposure to air. Odorless.

Comments: Calcium metal is soluble in alcohol, ammonia, and dilute acids.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
Flammable Solid	Not Applicable	Not Applicable	Not Applicable	Not Applicable

Extinguishing Media: Do *not* use water, foam, or halogenated hydrocarbons such as Halon® or carbon tetrachloride to extinguish fires involving calcium metal. Carbon dioxide and dry chemical are ineffective. Use only graphite powder, soda ash, powdered sodium chloride, or an appropriate metal-fire-extinguishing dry powder such as Met-L-X®. For large fires, withdraw from the area and let the fire burn (see Genium ref. 85). **Unusual Fire/Explosion Hazards:** Calcium metal is a flammable solid. It is extremely dangerous when wet; keep it dry. This material forms calcium hydroxide and hydrogen gas (explosion hazard) when wet. It may form toxic fumes of calcium oxide. This substance can also develop explosive pressures in closed containers. It reacts with wet extinguishing agents (water, alcohol, halogens, and possibly carbon dioxide). Its contact with alkali hydroxides or carbonates may result in detonation. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Fire fighters should move containers from the fire area if this can be done without risk. Do not use water or foam! Use dry powders only. Fire fighters should wear full protective gear. This kind of fire may produce irritating or poisonous gases. **Comments:** Finely divided calcium metal particles may ignite spontaneously in air or oxygen at room temperature. Fires may reignite after they have been extinguished. Runoff of waste material into a sewer or drain may create an additional fire or explosion hazard.

SECTION 5. REACTIVITY DATA

Calcium metal is not stable. Hazardous polymerization is not known to occur.

Chemical Incompatibilities: Hazardous reactions involving this material occur with air, moist air, water, acids, strong oxidizing agents, alcohols, and halogens. Contact with alkali hydroxides or carbonates may cause detonation.

Conditions to Avoid: This material may ignite spontaneously if exposed to air or kept in the presence of moisture. Store in airtight containers or under oil (see sect. 9). Calcium metal can develop explosive pressures in containers; keep them dry at all times.

Hazardous Products of Decomposition: Toxic calcium oxide fumes, which can react with water to produce heat, calcium hydroxide (corrosive), and flammable hydrogen gas (explosion hazard).

Comments: Calcium metal reacts with water considerably less than sodium metal does.

SECTION 6. HEALTH HAZARD INFORMATION

Calcium metal is not listed as a carcinogen by the NTP, IARC, or OSHA.

Summary of Risks: This material is harmful or fatal if swallowed; inhaled as a mist (calcium hydroxide), dust, or fume; or absorbed through the skin or mucous membranes. Solid calcium metal will cause skin and eye burns because it reacts with moisture to form corrosive calcium hydroxide. Fumes from burning calcium metal (calcium oxide) are highly irritating to skin, eyes, and mucous membranes, including the upper respiratory tract. **Medical Conditions Aggravated by Long-Term Exposure:** None reported.

Target Organs: Eyes, skin, mucous membranes (upper respiratory tract). **Primary Entry:** Inhalation, ingestion, skin and eye contact. **Acute Effects:** Corrosive and irritating to body tissue. May cause skin burns and corneal damage. Inhalation of dust or fume may cause respiratory irritation, cough, difficulty in breathing (dyspnea), and chemical pneumonitis. **Chronic Effects:** Prolonged inhalation of dust or fume may cause severe mucous membrane irritation, chemical pneumonitis.

FIRST AID: **Eye Contact.** Flush eyes, including under the eyelids, promptly and gently with plenty of running water for 15 minutes. If burns are present seek medical help immediately. **Skin Contact.** Remove calcium metal-contaminated material immediately with a dry cloth. Wash with large amounts of water until all of the chemical is removed. In case of chemical burn, treat as indicated. **Inhalation.** Remove victim to fresh air; restore and/or support his breathing as needed. Keep him warm and at rest. **Ingestion.** If swallowed, and victim is conscious, give him large amounts of water to dilute the alkali. Do not induce vomiting. A gastric lavage can be used by trained staff. Never give anything by mouth to someone who is unconscious.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Do not touch spilled calcium metal. Wear protective apparel. Do not smoke or place flame or ignition sources near a spill area. Do not allow water to touch spilled material or to get inside containers. Use a cover (plastic sheet) to prevent water or rain from dissolving spilled material or to prevent its spreading. Isolate hazard area and keep nonessential personnel away from spill or leak site. Shovel small dry spills into a dry container and cover it tightly. Move containers away from spill to a safe area. Take up small spills with sand or an absorbent material and contain it as described above. Dike the flow of large calcium metal and water spills with soil, sandbags, or concrete. Keep the waste from entering drains or open sewers. Wear fully protective gear.

Waste Disposal: You may dilute residual spilled material with water jets. Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations
Air Contaminant (20 CFR 1910.1000 Subpart Z): Not Listed
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste, No. D003 (Reactivity)
CERCLA Hazardous Substance: Not Listed

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Follow the eye- and face-protection guidelines of 29 CFR 1910.133. Wear chemical splash-proof and dust-resistant safety goggles and/or a faceshield (8" minimum) with approved safety glasses to prevent eye and face contact with calcium metal.

Gloves: Wear appropriate, heavy-duty, chemical-resistant gloves. **Respirator:** Where uncomfortable or nuisance levels of calcium metal dust exist, a dust/mist respirator can be used. Where high levels of calcium metal dust or fume or calcium hydroxide, calcium oxide, or hydrogen may exist (as in a fire situation or spill), use only an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode.

Special Considerations: Wear protective clothing; a rubber apron may be appropriate for the particular work situation.

Ventilation: Work with this material only under a chemical fume hood with localized ventilation or where general dilution ventilation is adequate.

Safety Stations: Make eyewash stations, washing facilities, and safety showers available in areas of use and handling because calcium metal is corrosive to eyes and body tissue.

Contaminated Equipment: Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Particles may cling to contact lens surfaces, causing corneal injury.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage Segregation: Store calcium metal away from sources of heat, ignition (sparks and open flame), water, combustible material, acids, halogens, alcohols, and other liquid chemicals. Store it away from oxidizers.

Special Handling/Storage: Protect containers against physical damage. Store this material in airtight containers under an inert atmosphere such as nitrogen or argon or under liquid hydrocarbons (naphtha, kerosene, or coal oil). *Never store it under halogenated hydrocarbons* such as Freon®. Avoid high temperatures. An isolated, well-ventilated, fire-resistant building is recommended for large-quantity storage. Do not store material near automatic water sprinklers or where water or steam is present. Provide enough heat in the storage area to keep material sufficiently dry. **Comments:** Calcium metal is air sensitive. Keep it in tightly closed containers at all times when not in use. Remove only the amount of calcium metal from its storage container that is immediately necessary. Use a metal container with a tightly fitting lid or well-stoppered glass bottles for storage and transport. Scrupulously avoid water contamination of storage tanks, reactor vessels, testing areas, etc.

Transportation Data (49 CFR 172.101-2)
DOT Hazard Class: Flammable Solid **DOT Shipping Name:** Calcium Metal **DOT ID No.** UN1401
DOT Label: Flammable Solid; Dangerous When Wet **IMO Label:** Dangerous When Wet **IMO Class:** 4.3
Additional DOT Requirements: Keep Cold and Dry. Segregation is the same as for flammable solids labeled Dangerous When Wet.

References: 1-11, 12, 18, 24, 37, 39, 44, 73, 82, 84, 87-94. OW/PJI

Approvals
Indust. Hygiene/Safety
Medical Review

Material Safety Data Sheet

From Genium's Reference Collection

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GENIUM PUBLISHING CORP.

No. 82

COBALT METAL/POWDER
(Revision A)
Issued: March 1981
Revised: April 1988

SECTION 1. MATERIAL IDENTIFICATION

25

Material Name: COBALT METAL/POWDER

Description (Origin/Uses): Used in alloys and in nuclear weapons.

Other Designations: Co; NIOSH *RTECS* No. GF8750000; CAS No. 7440-48-4

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

Comments: The hazards of working with cobalt metal/powder are associated with cutting, grinding, welding, etc., that produce dust, fumes, powders, and gases.

Not Found

HMIS			
H	1		
F	1	R	1
R	1	I	4
PPG*		S	1
*See sect. 8		K	-

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Cobalt Metal/Powder, CAS No. 7440-48-4	Ca 100	IDLH* Level: 20 mg/m^3 OSHA PEL 8-Hr TWA: 0.1 mg/m^3 ACGIH TLVs, 1987-88 TLV-TWA: 0.05 mg/m^3 TLV-STEL: 0.1 mg/m^3 Toxicity Data** Rat, Oral, LD_{Lo}: 1500 mg/kg

All the exposure limits above are defined for cobalt metal, dust, and fume as Co.
*Immediately dangerous to life and health.
**See NIOSH, *RTECS*, for additional data with references to tumorigenic effects.

SECTION 3. PHYSICAL DATA

Boiling Point: Ca 5792°F (3200°C)
Melting Point: 2719°F (1493°C)
Specific Gravity (H_2O = 1): 8.92

Water Solubility (%): Insoluble
Molecular Weight: 59 Grams/Mole

Appearance and Odor: A gray, hard, magnetic, ductile, and somewhat malleable metal or black powder; odorless.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
*	*		*	*

Extinguishing Media: *Do not use water. Recommended extinguishing agents include dry sand, dry dolomite, dry graphite powder, or sodium chloride. Solid cobalt does not burn; however, its dust can burn and it may form explosive mixtures with air.
Unusual Fire or Explosion Hazards: Cobalt dust particles suspended in the air can explode. If a cobalt dust cloud does form, immediately eliminate all possible sources of ignition such as sparks, open flame, etc., and take appropriate precautions (e.g., spray the affected area with a water mist or fog). Pyrophoric cobalt, which appears as a black powder, burns brilliantly when exposed to air. Working with this material can produce heat and sparks, which can ignite flammable materials and vapors in the workplace.
Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Cobalt metal/powder is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.

Chemical Incompatibilities: Pyrophoric cobalt decomposes cold acetylene and becomes incandescent. Fused ammonium nitrate can sometimes react explosively with powdered cobalt.

Conditions to Avoid: Prevent contact with incompatible chemicals. Powdered cobalt is more reactive than the solid metal; do not allow the powder to accumulate or form a potentially explosive dust cloud.

Hazardous Products of Decomposition: Only powdered cobalt can burn; various oxides of cobalt may be produced during fires.

SECTION 6. HEALTH HAZARD INFORMATION

Cobalt metal/powder is not listed as a carcinogen by the NTP, IARC, or OSHA.

Summary of Risks: Inhalation of cobalt dust can cause pulmonary symptoms such as wheezing, irritation of the upper respiratory tract (URT), and hypersensitivity reactions (asthma). Skin contact with powdered cobalt may cause dermatitis, especially in the creases of the elbows, knees, ankles, and neck. Contact with eyes may cause conjunctivitis. Ingestion may produce a hot sensation along with vomiting, diarrhea, and nausea. **Medical Conditions Aggravated by Long-Term Exposure:** Disorders of the skin and the URT may be worsened by exposure to cobalt; administer preplacement and periodic medical exams emphasizing these functions.

Target Organs: Respiratory system, skin, bladder, kidneys, and eyes. **Primary Entry:** Skin contact, inhalation.

Acute Effects: Contact dermatitis and breathing difficulties. **Chronic Effects:** Allergic asthma, restricted pulmonary functions, and interstitial fibrosis may be caused by long-term occupational exposure to cobalt or its compounds.

FIRST AID

Eyes: Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes.

Skin: Immediately wash the affected area with soap and water.

Inhalation: Remove the exposed person to fresh air; restore and/or support his or her breathing as needed.

Ingestion: Never give anything by mouth to someone who is unconscious or convulsing. If cobalt salts are ingested, give 1 to 2 glasses of water and induce vomiting.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate all nonessential personnel, remove all sources of heat and ignition, and provide adequate ventilation. Cleanup personnel need protection against contact with and inhalation of dust (see sect. 8). Prevent skin contact. Scoop up spilled cobalt into suitable containers for disposal. Carefully sweep or vacuum up small spills or residues without creating dust.

Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Consider recycling. Follow Federal, state, and local regulations.

OSHA Designations

Air Contaminant (29 CFR 1910.1000 Subpart Z, for cobalt metal, dust, and fume)

EPA Designations (40 CFR 302.4)

RCRA Hazardous Waste: Not Listed

CERCLA Hazardous Substance: Not Listed

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Follow the eye- and face-protection guidelines in 29 CFR 1910.133. **Respirator:** Wear a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. For emergency or nonroutine use (e.g., cleaning reactor vessels or storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres.

Other: Wear impervious gloves; boots; aprons; and clean, impervious body-covering clothing to prevent any possibility of skin contact. Barrier creams may be useful to limit the effects of skin contact. **Ventilation:** Install and operate general and local ventilation systems powerful enough to maintain airborne levels of cobalt metal, dust, or fume below the OSHA PEL standard cited in section 2.

Safety Stations: Make eyewash stations, washing facilities, and safety showers available in use and handling areas.

Contaminated Equipment: Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Particles can adhere to contact lenses and cause corneal damage. Do *not* wear contact lenses in any work area.

Comments: Practice good personal hygiene; always wash thoroughly after using this material. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale dust or create dusty working conditions.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store cobalt metal/powder in a cool, dry, well-ventilated area in closed containers away from oxidizing agents, incompatible chemicals (see sect. 5), and sources of heat or ignition.

Special Handling/Storage: Practice good housekeeping techniques that minimize accumulation of dust; cleaning procedures should not create dusty conditions.

Transportation Data (49 CFR 172.101-2): Not Listed

References: 1, 2, 12, 73, 84-94, 100, 103

Prepared by PJ Igoe, BS

Industrial Hygiene Review: DJ Wilson, CIH

Medical Review: MJ Hardies, MD

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Material Safety Data Sheets Collection:

Sheet No. 83
Chromium Metal/Powder

Issued: 3/81 **Revision: A, 11/89**

Section 1. Material Identification

30

Chromium Metal/Powder Description: Obtained from chrome ore, chromite ($FeCr_2O_4$), by electrolysis of chromium solutions, by direct reduction (ferrochrome), and by reducing the oxide with finely divided carbon or aluminum. Used for chromeplating other metals; for greatly increasing metal resistance and durability; in manufacturing chrome-steel or chrome-nickel-steel alloys (stainless steel); as a constituent of inorganic pigments; as protective coating for automotive and equipment accessories; and in nuclear and high-temperature research.

Other Designations: Chrome; Cr; CAS No. 7440-47-3.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide* (Genium ref. 73) for a suppliers list.

R 1
I 4
S 1
K 1

Genium

HMIS
H 2
F 1
R 1
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Chromium metal/powder, ca 100%

OSHA PEL	ACGIH TLV, 1988-89*	NIOSH REL, 1987†	Toxicity Data‡
8-hr TWA: 1 mg/m³	TLV-TWA: 0.5 mg/m³	8-hr TWA (for chromium metal and insoluble salts): 1 mg Cr/m³	Rat, implant, TD_{Lo}: 1200 µg/kg body weight administered intermittently over six weeks

* This TLV is applicable to Cr^{+2} and Cr^{+3} compounds. For water soluble and water-insoluble Cr^{+6}, the 8-hr TWA is 0.05 mg Cr^{+6}/m^3. Certain water-insoluble Cr^{+6} compounds (zinc chromate, calcium chromate, lead chromate, barium chromate, strontium chromate, and sintered chromium trioxide) are designated as A1a (human carcinogen).

† The NIOSH REL (10-hr TWA) for carcinogen Cr^{+6} compounds is 1 µg/m³; for noncarcinogenic Cr^{+6} compounds (including chromic acid), the RELs (10-hr TWAs) are 25 µg/m³ and 50 µg/m³ (15-min ceiling). The noncarcinogenic compounds include mono- and dichromates of hydrogen, cesium, sodium, lithium, potassium, rubidium, ammonia, and Cr^{+6} (chromic acid anhydride). Any and all Cr^{+6} materials excluded from the noncarcinogenic group above are carcinogenic Cr^{+6} compounds.

‡ See NIOSH, *RTECS* (GB4200000), for additional data with references to tumorigenic effects.

Section 3. Physical Data

Boiling Point: 4788 °F (2642 °C)
Melting Point: 3452 °F (1900 °C)
Vapor Pressure: 1 mm Hg at 2941 °F (1616 °C)
Vapor Density (Air = 1): 1.79
Atomic Weight: 51.996 g/mol
Specific Gravity (H_2O = 1 at 39 °F (4 °C)): 7.2 at 68 °F (20 °C)
Water Solubility: Insoluble

Appearance and Odor: Steel-gray, lustrous metal; no odor.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** Cloud, 1076 °F (580 °C); dust layer, 752 °F (400 °C)	**LEL:** Dust cloud explosion, 0.230 oz/ft³	**UEL:** None reported

Extinguishing Media: Use dry chemical or sand.

Unusual Fire or Explosion Hazards: Particle size and dispersion in air determine reactivity. Chromium powder explodes spontaneously in air, while chromium dust suspended in CO_2 is ignitable and explosive when heated.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

*One hundred percent of dust goes through a 74-µm sieve. A 140-mJ spark can ignite a dust cloud.

Section 5. Reactivity Data

Stability/Polymerization: Chromium is stable when properly handled and stored. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Chromium reacts readily with dilute, not nitric, acids to form chromous salts. It is soluble in acids (not nitric) and strong alkalis. Its powder is incompatible with strong oxidizing agents, including high O_2 concentration. Evaporation of mercury (Hg) from Cr amalgam leaves pyrophoric chromium. Finely divided Cr attains incandescence with nitrogen oxide, potassium chlorate, and sulfur dioxide. Molten lithium at 18 °C severely attacks Cr. Fused ammonium nitrate below 200 °C reacts explosively and may ignite or react violently with bromine pentafluoride.

Hazardous Products of Decomposition: Thermal oxidative decomposition of Cr can produce toxic chromium oxide fumes.

Section 6. Health Hazard Data

Carcinogenicity: The NTP and OSHA list chromium as a human carcinogen.

Summary of Risks: When ingested chromium is a human poison, with gastrointestinal (GI) effects. Chromium 3 (Cr^{+3}) compounds show little or no toxicity. Less soluble chromium 6 (Cr^{+6}) compounds are suspected carcinogens and severe irritants of the larynx, nasopharynx, lungs, and skin (Sec. 2). Chromic acid or chromate salts cause irritation of the skin and respiratory passage. Ingestion leads to severe irritation of the gastrointes- al tract, renal damage, and circulatory shock. Chromium metal (when heated to high temperatures) and insoluble salts are said to be involved in histological fibrosis of the lungs, which may progress to clinically evident pneumoconiosis. Exposure to chromate dust and powder can cause skin (dermatitis) and eye irritation (conjunctivitis).

Medical Conditions Aggravated by Long-Term Exposure: An incresed incidence of bronchogenic carcinoma occurs in workers exposed to chromate dust.

Target Organs: Respiratory system.

Primary Entry: Inhalation, percutaneous absorption, and ingestion.

Acute Effects: Acute exposures to dust may cause headache, coughing, shortness of breath, pneumoconiosis, fever, weight loss, nasal irritation, inflammation of the conjunctiva, and dermatitis.

Chronic Effects: Asthmatic bronchitis.

FIRST AID

Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.

Skin: Brush off chromium dust. After rinsing affected area with flooding amounts of water, wash it with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that conscious person slowly drink 1 to 2 glasses of water to dilute. Do not induce vomoting. A physician should evaluate all ingestion cases.

After first aid, get appropriate in-plant, paramedic, or community medical attention and support.

Physician's Note: Acute toxicity causes a two-phase insult: 1) multisystem shock due to gastrointestinal corrosivity and 2) hepatic, renal, hematopoetic insult. Treatment should use ascorbic acid as a neutralizer with gastric lavage. If the ingestion is substantial, exchange transfusions and/or consider hemodialysis. Treat allergic dermatitis with local cortisone or 10% ascorbic acid to reduce Cr^{+6} to Cr^{+3}. Ten percent EDTA in a lanolin base applied every 24 hr helps heal skin ulcers.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of large spills. Cleanup personnel should wear protective clothing and approved respirators. Remove heat and ignition sources. Provide adequate ventilation. Keep airborne dust at a minimum. Remove spills quickly and place in appropriate containers for disposal or reuse.

Disposal: Reclaim salvageable metal. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

HA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)

EPA Designations

RCRA Hazardous Waste (40 CFR 261.33): Not listed

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a)]

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

Listed as a SARA Toxic Chemical (40 CFR 372.65)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Wear a NIOSH-approved respirator if necessary. Wear an SCBA with a full facepiece when the particle concentration's upper limit is 50 mg/m^3.

Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.

Other: Wear impervious rubber gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA standard (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by eliminating it at its source (Genium ref. 103).

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Launder contaminated clothing before wearing. Remove this material from your shoes and equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store material in cool, dry, well-ventilated area separate from acids and oxidizing agents. Seal and protect containers from physical damage. Keep away from heat or ignition sources.

Engineering Controls: Avoid dust inhalation. Practice good housekeeping (vacuuming and wet sweeping) to minimize airborne particulates and to prevent dust accumulation. Use nonsparking tools and ground electrical equipment and machinery.

nsportation Data (49 CFR 172.101, .102): Not listed

MSDS Collection References: 1, 2, 26, 38, 80, 87, 88, 89, 100, 109, 124, 126

Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD

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Material Safety Data Sheets Collection:
Sheet No. 162
Copper

Issued: 12/85 **Revision: A, 8/90**

Section 1. Material Identification 32

Copper (Cu) Description: Widely distributed in nature in elemental state, arsenites, sulfides, chlorides, and carbonates. Prepared by crushing, grinding, and concentrating copper ores by flotation and leaching or by smelting copper ore concentrates to yield a blister (96 to 98%) copper which is electrolytically refined to yield 99.9+% copper. Copper is the most widely used structural metal, next to iron and aluminum. Used in electric wiring; switches, heating, plumbing, roofing, and building construction; alloys (brass, bronze, Monel metal, beryllium-copper); coins; chemical and pharmaceutical machinery; electroplated protective coatings and undercoats for nickel, chromium, zinc, etc., cooking utensils; insecticides; antifouling paints; and as a catalyst. Copper whiskers are used in thermal and electrical composites. Copper flakes are used as insulation for liquid fuels.

Other Designations: CAS No. 7440-50-8, bronze powder, copper slag-airborne, copper slag-milled.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[(73)] for a suppliers list.

R 0
I 4
S 1
K 0

Genium

HMIS
H 2
F 0
R 0
PPG*
* Sec. 8

Cautions: *Copper may be toxic through contact, inhalation, and ingestion.* It may cause skin and eye irritation and metal fume fever. Copper is not considered a fire hazard, but fine particles may burn in air.

Section 2. Ingredients and Occupational Exposure Limits

Copper, ca 100%

1989 OSHA PELs	**1989-90 ACGIH TLVs**	**1988 NIOSH REL**	**1985-86 Toxicity Data‡**
8-hr TWA: 1 mg/m^3*	TLV-TWA: 1 mg/m^3*	None established	Human, oral, TD_{Lo}: 120 µg/kg affects the gastrointestinal tract (nausea or vomiting)
8-hr TWA: 0.1 mg/m^3†	TLV-TWA: 0.2 mg/m^3†		Rat, oral, TD_{Lo}: 1210 µg/kg (35 weeks prior to mating) affects fertility (pre- and post-implantation mortality)

* Copper dusts and mists, as Cu.
† Copper fume.
‡ See NIOSH, *RTECS* (GL5325000), for additional reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 4703 °F (2595 °C)
Melting Point: 1981 °F (1083 °C)
Vapor Pressure: 1 mm Hg at 2962 °F (1628 °C)
Molecular Weight: 63.546
Density/Specific Gravity: 8.94
Water Solubility: Insoluble

Appearance and Odor: Solid, various shapes, odorless, red/brown-colored metal or powder. Copper is ductile, tough, and easily worked. It is very resistant to corrosion, but readily attacked by alkalies.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use extinguishing media appropriate to the surrounding fire since copper does not burn. Finely divided copper burns in air, and in extreme cases ignites spontaneously.

Unusual Fire or Explosion Hazards: Liquid copper explodes on contact with water. High concentrations of fine copper particles in the air may present an explosion hazard.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and a fully encapsulating suit.

Section 5. Reactivity Data

Stability/Polymerization: Copper is stable at room temperature in closed containers under normal storage and handling conditions. However, on long standing, a white, highly explosive peroxide deposit may form. Copper's vapors are uninhibited and may form polymers in vents and flame arresters.

Chemical Incompatibilities: Copper reacts violently with ammonium nitrate, bromates, iodates, chlorates, ethylene oxide, hydrazoic acid, potassium oxide, dimethyl sulfoxide + trichloroacetic acid, hydrogen peroxide, sodium peroxide, sodium azide, sulfuric acid, hydrogen sulfide + air, and lead azide. A potentially explosive reaction occurs with actylenic compounds. Copper ignites on contact with chlorine, fluorine [above 250 °F (121 °C)], chlorine trifluoride, and hydrazinium nitrate [above 158 °F (70 °C)]. It is also incompatible with 1-bromo-2-propyne; an incandescent reaction occurs with potassium dioxide.

Conditions to Avoid: Avoid prolonged exposure to air and moisture. On exposure to moist air, copper slowly converts to the carbonate.

Hazardous Products of Decomposition: Thermal oxidative decomposition of copper can produce metallic oxides (copper fumes).

Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list copper as a carcinogen. Experimental studies show tumorigenic and teratogenic effects in laboratory animals.
Summary of Risks: Copper is a necessary human nutrient, excessive intake levels of which the kidneys normally eliminate. In individuals with kidney disease or, rarely, Wilson's disease (abnormal retention and storage of copper in the body that damages the liver, kidneys, brain, blood, bones, and endocrine glands), copper levels may accumulate. Significant industrial exposure to copper occurs mainly through inhalation of fumes [illegible]ing welding, smelting, or refining operations; or through exposure to copper dusts and mists during mining, extracting, refining, or manufacturing processes. Copper particles may irritate, discolor, and damage eyes. Exposure to copper salts in many applications is potentially toxic. Copper dusts, fumes, and salts may irritate the upper respiratory tract. Long-term exposure may irritate the skin and discolor the skin or hair.
Medical Conditions Aggravated by Long-Term Exposure: Individuals with impaired pulmonary or renal function should avoid exposure.
Target Organs: Respiratory system, skin, eyes, liver, kidneys.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: Inhalation of copper fumes may give rise to metal fume fever (after an incubation period of about 5 hr), an allergic reaction with flu-like symptoms—high temperature, metallic taste, nausea, coughing, general weakness, muscle aches, and exhaustion. These symptoms usually disappear within 24 hr. Direct contact with copper causes skin and (less often) eye irritation, and itching of the linings of the nose, mouth, and respiratory tract. Exposure to copper dust may cause a greenish-black skin discoloration. Copper ingestion causes nausea, vomiting, abdominal pain, and diarrhea. Ingestion of large doses may cause stomach and intestine ulceration, jaundice, and kidney and liver damage.
Chronic Effects: Continued exposure to copper may cause mild dermatitis and degeneration of the mucous membranes. Repeated or prolonged exposure to copper dusts and mists can discolor skin and hair and irritate the skin. Repeated inhalation can cause chronic respiratory disease. Individuals with Wilson's disease (1 in 200,000 individuals) are more susceptible to chronic copper poisoning. If undetected and untreated, this progressive condition is eventually fatal.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing with artificial respiration.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of water, then induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: A blood count shows leucocytosis if an individual has metal fume fever. Consider chellation with penicillamine or BAL (British Anti-Lewisite or dimercaprol) for chronic intoxication.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, remove all heat and ignition sources, and provide adequate ventilation. Avoid creating dusty conditions. Cleanup personnel should protect against vapor inhalation and skin and eye contact. Cleanup methods such as vacuuming (with the appropriate filter) or wet mopping minimizes dust dispersion. Absorb liquid containing copper with vermiculite, dry sand, or other inert materials. Place in appropriate containers for disposal. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
[illegible]RA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 5000 lb (2270 kg) [* per Clean Water Act, 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Some recommendations follow. For copper dust and mists greater than 50 mg/m^3, wear a high-efficiency particulate respirator, a supplied-air respirator, or an SCBA, all with a full facepiece. For copper dust and mists greater than 2000 mg/m^3, wear a supplied-air respirator equipped either with a full facepiece operated in pressure-demand or positive-pressure mode or with a hood in continuous-flow mode. For copper fumes over 100 mg/m^3, wear either a powered air-purifying respirator with a high-efficiency filter, or a supplied-air respirator equipped either with a full facepiece operated in pressure-demand or positive-pressure mode or with a hood in continuous-flow mode. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Eye and face protection is required when grinding, welding, cutting, or remelting. Protect skin from molten metal and radiant heat when melting scrap. Machine turnings may also present a laceration hazard. When handling oil-contaminated copper, wear rubber gloves to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below OSHA PELs and ACGIH TLVs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store copper in tightly closed containers in a cool, dry, well-ventilated area. Avoid exposure to air and moisture.
Engineering Controls: Avoid dust and fume inhalation and direct contact with skin and eyes. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Maintain exposures below the PEL/TLV. Monitor copper dust and mist levels in the air.
[illegible]r Precautions: Provide placement and periodic examinations that emphasize the skin, eyes, and respiratory system. Prevent exposing [illegible]viduals with chronic respiratory disease or Wilson's disease.
Transportation Data (49 CFR 172.101, .102): Not listed.

MSDS Collection References: 26, 38, 73, 84, 88, 89, 100, 101, 103, 109, 124, 126, 127, 132, 133, 134, 136, 138, 139, 143, 144
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Material Safety Data Sheets Collection:

Sheet No. 385
Ethylbenzene

Issued: 8/78 Revision: B, 9/92

Section 1. Material Identification

Ethylbenzene ($C_6H_5C_2H_5$) Description: Derived by heating benzene and ethylene in presence of aluminum chloride with subsequent distillation, by fractionation directly from the mixed xylene stream in petroleum refining, or dehydrogenation of naphthenes. Used as a solvent, an antiknock agent in gasoline; and as an intermediate in production of synthetic rubber, styrene, cellulose acetate, diethylbenzene, acetophenone, ethyl anthraquinone, propyl oxide, and α-methylbenzol alcohol.

Other Designations: CAS No. 100-41-4, ethylbenzol, EB, phenylethane, NCI-C56393.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

Cautions: Ethylbenzene is a skin and mucous membrane irritant considered the most irritating of the benzene series. Inhalation causes acute and chronic central nervous system (CNS) effects. It is highly flammable and forms explosive mixtures with air.

R 1
I 3
S 2*
K 4
* Skin absorption

NFPA
3
2 0
-

HMIS
H 2†
F 3
R 0
PPE - Sec. 8
† Chronic effects

Section 2. Ingredients and Occupational Exposure Limits

Ethylbenzene, ca >99.0%. Impurities include ~ 0.1% *meta & para* xylene, ~ 0.1% cumene, and ~ 0.1% toluene.

1991 OSHA PELs
8-hr TWA: 100 ppm (435 mg/m^3)
15-min STEL: 125 ppm (545 mg/m^3)
Action Level: 50 ppm (217 mg/m^3)

1990 IDLH Level
2000 ppm

1990 NIOSH REL
TWA: 100 ppm (435 mg/m^3)
STEL: 125 ppm (545 mg/m^3)

1992-93 ACGIH TLVs
TWA: 100 ppm (434 mg/m^3)
STEL: 125 ppm (545 mg/m^3)

1990 DFG (Germany) MAK
TWA: 100 ppm (440 mg/m^3)
Category 1: local irritants
Peak Exposure Limit: 200 ppm, 5 min momentary value, max of 8/shift
Danger of cutaneous absorption

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 100 ppm/8 hr caused eye effects, sleep, and respiratory changes.
Human, lymphocyte: 1 mmol/L induced sister chromatid exchange.
Rat, oral, LD_{50}: 3500 mg/kg; toxic effects not yet reviewed
Rat (female), inhalation, TC_{Lo}: 1000 ppm/7 hr/day, 5 days/wk, for 3 wk prior to mating and daily for 19 days of gestation produced pups with high incidence of extra ribs.[179]

* See NIOSH, *RTECS* (DA0700000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 277 °F (136 °C)
Melting Point: -139 °F (-95 °C)
Surface Tension: 31.5 dyne/cm
Ionization Potential: 8.76 eV
Viscosity: 0.64 cP at 77 °F (25 °C)
Refraction Index: 1.4959 at 68 °F (20 °C)
Relative Evaporation Rate (ether = 1): 0.0106
Bulk Density: 7.21 lb/Gal at 77 °F (25 °C)
Critical Temperature: 651 °F (343.9 °C)
Critical Pressure: 35.6 atm
Molecular Weight: 106.16
Density: 0.863 at 77 °F (25 °C)
Water Solubility: Slightly, 14 mg/100 mL at 59 °F (15 °C)
Other Solubilities: Miscible in alcohol, ether; soluble in carbon tetrachloride, benzene, sulfur dioxide, and many organic solvents; insoluble in ammonia
Odor Threshold: 2.3 ppm
Vapor Pressure: 7.1 mm Hg at 68 °F (20 °C); 10 mmHg at 78.62 °F (25.9 °C); 100 mm Hg 165.38 °F (74.1 °C)
Saturated Vapor Density (Air = 0.075 lb/ft^3 or 1.2 kg/m^3): 0.0768 lb/ft^3 or 1.2298 kg/m^3

Appearance and Odor: Colorless, flammable liquid with a pungent odor.

Section 4. Fire and Explosion Data

Flash Point: 64 °F (18 °C) CC	**Autoignition Temperature:** 810 °F (432 °C)	**LEL:** 1.0% v/v	**UEL:** 6.7% v/v

Extinguishing Media: Class 1B Flammable liquid. For small fires, use dry chemical, carbon dioxide, or 'alcohol-resistant' foam. For large fires, use fog or 'alcohol-resistant' foam. Use water only if other agents are unavailable; EB floats on water and may travel to an ignition source and spread fire. **Unusual Fire or Explosion Hazards:** Burning rate = 5.8 mm/min. Vapors may travel to an ignition source and flash back. Container may explode in heat of fire. EB poses a vapor explosion hazard indoors, outdoors, and in sewers. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Cool container sides with water until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Withdraw immediately if you hear rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Ethylbenzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Reacts vigorously with oxidizers.
Conditions to Avoid: Exposure to heat and oxidizers.
Hazardous Products of Decomposition: Thermal oxidative decomposition of EB can produce acrid smoke and irritating fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list EB as a carcinogen. **Summary of Risks:** Occupational exposure to EB alone is rare since it is usually present together with other solvents. EB is irritating to the eyes, skin, and respiratory tract. Vapor inhalation produces varying degrees of CNS effects depending on concentration. The liquid is absorbed through the skin but vapors are not. 56 to 64% of inhaled ethylbenzene is retained and metabolized. Urinary metabolites following exposure to 23 to 85 ppm for 8 hr are mandelic acid (64%), phenylglyoxylic acid (25%), and methylphenylcarbinol/1-phenyl ethanol (5%). Concurrent exposure to xylene and ethylbenzene causes slower excretion of EB metabolites. Based on the rat LD_{50}, one manufacturer gives 3 to 4 oz. as the lethal dose for a 100 lb person.

Continue on next page

Section 6. Health Hazard Data

Medical Conditions Aggravated by Long-Term Exposure: Skin and CNS diseases and impaired pulmonary function (especially obstructive airway disease). **Target Organs:** Eyes, respiratory system, skin, CNS, blood. **Primary Entry Routes:** Inhalation, skin and eye contact. **Acute Effects:** Vapor inhalation of 200 ppm caused transient eye irritation; 1000 ppm caused eye irritation with profuse watering (tolerance developed rapidly); 2000 ppm caused severe and immediate eye irritation and watering, nasal irritation, chest constriction, and vertigo; 5000 ppm was [illegible]lerable and caused eye and nose irritation. Inhalation of high concentrations may cause narcosis, cramps, and death due to respiratory paralysis. [illegible]n exposed to pure ethylbenzene for 10 to 15 min absorbed 22 to 33 mg/cm^2/hr. Immersion of hand in solutions of 112 & 156 mg/L for 1 hr absorbed 118 & 215.7 μg/cm^2/hr, respectively. **Chronic Effects:** Repeated skin contact may cause dryness, scaling, and fissuring. Workers chronically exposed to > 100 ppm complained of fatigue, sleepiness, headache, and mild irritation of the eyes and respiratory tract. Repeated vapor inhalation may result in blood disorders, particularly leukopenia (abnormally low level of white blood cells) and lymphocytosis.

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting! Aspiration of even a small amount of EB in vomitus can cause severe damage since its low viscosity and surface tension will cause it to spread over a large area of the lung tissue.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: BEI = mandelic acid in urine (1.5 g/g of creatinine), sample at end of shift at workweeks end. Since this test is not specific, test for EB in expired air for confirmation.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate and ventilate area, deny entry and stay upwind. Shut off all ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container. Dike far ahead of large spill for later reclamation or disposal. Report any release >1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** If released to soil, EB partially evaporates into the atmosphere, with a half-life of hrs to wks, and some leaches into groundwater, especially in soil with low organic carbon content. Biodegradation occurs with a half-life of 2 days. Some EB may absorb to sediment or bioconcentrate in fish. Evidence points to slow biodegradation in groundwater. In air, it reacts with photochemically produced hydroxyl radicals with a half-life of hrs to 2 days. Additional amounts may be removed by rain. **Ecotoxicity Values:** Shrimp (*Mysidopsis bahia*), LC_{50} = 87.6 mg/L/96 hr; sheepshead minnow (*Cyprinodon variegatus*) LC_{50} = 275 mg/L/96 hr; fathead minnow (*Pimephales promelas*) LC_{50} = 42.3 mg/L/96 hr in hard water & 48.5 mg/L/96 hr in softwater. **Disposal:** A candidate for rotary kiln incineration at 1508 to 2912°F (820 to 1600°C), liquid injection incineration at 1202 to 2912°F (650 to 1600°C), and fluidized bed incineration at 842 to 1796°F (450 to 980°C). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.21): No. D001

Listed as a SARA Toxic Chemical (40 CFR 372.65)

[illegible]A Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed

[illegible]d as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [* per CWA, Sec. 311 (b)(4) & CWA, Sec. 307 (a)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 1000 ppm, use a powered air-purifying respirator with an appropriate organic vapor cartridge, a supplied-air respirator (SAR), SCBA, or chemical cartridge respirator with appropriate organic vapor cartridge. For < 2000 ppm, use a SAR or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of Viton or polyvinylchloride to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a cool, dry, well-ventilated area away from ignition sources and oxidizers. Outside or detached storage is preferred. If inside, store in a standard flammable liquids cabinet. Containers should have flame-arrester or pressure-vacuum venting. To prevent static sparks, electrically ground and bond all equipment used with ethylbenzene. Install Class 1, Group D electrical equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain levels as low as possible. Purge and ventilate reaction vessels before workers are allowed to enter for maintenance or cleanup. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the CNS, skin, blood, and respiratory system.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Ethylbenzene
DOT Hazard Class: 3
ID No.: UN1175
[illegible] **Packing Group:** II
D[illegible] **Label:** Flammable liquid
Special Provisions (172.102): T1

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60 L

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: —

MSDS Collection References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 153, 159, 162, 163, 164, 167, 168, 171, 176, 179

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** W Silverman, MD

Material Safety Data Sheet

From Genium's Reference Collection

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GENIUM PUBLISHING CORP.

No. 216

MAGNESIUM METAL
(Ribbons/Turnings)

Issued: August 1987

SECTION 1. MATERIAL IDENTIFICATION

23

MATERIAL NAME: MAGNESIUM METAL (RIBBONS/TURNINGS)

DESCRIPTION (Origin/Uses): Prepared by electrolysis of a mixture of magnesia and mercuric oxide. Used in alloys of light metals, in pyrotechnics, flashbulbs and flares; as a Grignard reagent; for recovery of titanium.

OTHER DESIGNATIONS: Mg; NIOSH *RTECS* #OM2100000; CAS #7439-95-4

TRADE NAMES/VENDORS: MAGNESIUM METAL, Reade Manufacturing Co.

MANUFACTURER/SUPPLIER: Available from several suppliers, including:
Reade Manufacturing Co., Ridgeway Blvd., Lakehurst, NJ 08733; Telephone: (201) 657-6451

COMMENTS: Combustible magnesium metal in the form of fine powder, thin sheets, and turnings is easily ignited and burns with intense heat. Powders form explosive mixtures in air that can be ignited by a spark.

HMIS
H 1
F 3
R 3
PPE*
* See sect. 8

R 1
I 1
S 1
K 4

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Magnesium Metal, CAS #7439-95-4, NIOSH *RTECS* #OM2100000	100	Hazard and Toxicity Data TLV: 10 mg/m^3 as Magnesium Oxide* TLV: Magnesium Metal: None Established Toxic Dose for Magnesium Oxide Human, Inhalation, TC_{Lo}: 400 mg/m^3 (Toxic Effects: Unspecified in Source) Hamster, Intratracheal, TD_{Lo}: 480 mg/kg (30 Weeks, Intermittent Toxic Effects: Equivocal Tumorigenic Agent)
Magnesium Oxide (Fumes), CAS #1309-48-4; NIOSH *RTECS* #OM3850000		
* Current 1987-88 ACGIH TLV		
Comments: Primarily hazardous as a combustible metal.		

SECTION 3. PHYSICAL DATA

Boiling Point ... 2025°F (1107°C)
Vapor Pressure ... 1 Torr at 1150°F (621°C)
Water Solubility ... Insoluble
Vapor Density ... Negligible
Evaporation Rate ... Negligible

Specific Gravity ... 1.740
Melting Point ... 1300°F (649°C)
Percent Volatile by Volume ... Not Found
Molecular Weight ... 24.31 Grams/Mole
pH ... Water Solution Alkaline (pH >7)

Appearance and odor: Silvery white metal. Odorless.

Comments: Solvent solubility: mineral acids, concentrated hydrofluoric acid ammonium salts.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
Combustible	Not Found	Not Found	Not Found	Not Found

EXTINGUISHING MEDIA: Use G-1® graphite powder, Met-L-X® powder, powdered talc, dry graphite, powdered sodium chloride, soda ash, or other suitable powders. WARNING: Do not use foam, carbon tetrachloride, carbon dioxide, or water to extinguish magnesium fires, because dangerous reactions will occur (see sect. 5). UNUSUAL FIRE/EXPLOSION HAZARDS: Magnesium may react with moisture or acids to evolve hydrogen gas (H_2), which is a highly dangerous fire or explosion hazard. It will react violently with oxidizing materials. SPECIAL FIRE-FIGHTING PROCEDURES: During machining, magnesium fires may result from use of dull cutting tools or making light (thin) cuts at high speed. Magnesium turnings and borings should be collected frequently during working hours. Store them in clean, dry, metal-covered containers labeled "Magnesium Only." Fire fighters should protect their eyes and skin from flying particles. In order to prevent eye injury, do not look directly at magnesium fires. Wear protective breathing apparatus. In the case of massive magnesium fires, protect nearby facilities and let the fire burn.

SECTION 5. REACTIVITY DATA

Magnesium is stable.. Hazardous polymerization cannot occur.

CHEMICAL INCOMPATIBILITIES: This material will react violently with chlorinated solvents, methanol, hydrogen peroxide, oxidizing agents, sulfur compounds, animal and vegetable oils, water, metal oxides, metal cyanides, metal oxide salts, oxygen, and tellurium compounds. CONDITIONS TO AVOID: Magnesium may ignite itself if it is exposed to air or in the presence of moisture. It may reignite itself after the fire is extinguished. Its violent reaction with water will generate hydrogen. Prohibit open flames or electrical or gas cutting or welding equipment where magnesium dust is produced or handled. Special precautions are needed to prevent ignition while dressing grinding wheels. Use nonsparking tools in dusty situations. PRODUCTS OF HAZARDOUS DECOMPOSITION: Magnesium oxide. COMMENTS: Fire fighters should not breathe fumes from magnesium fires. Smoking must be prohibited in all areas where magnesium is found.

SECTION 6. HEALTH HAZARD INFORMATION

Magnesium is not listed as a carcinogen by the NTP, IARC, or OSHA.

SUMMARY OF RISKS: Magnesium metal does not have well-characterized toxicity. Magnesium particles imbedded in the skin can produce sores that resist healing and an accumulation of gas under the skin and gaseous blebs (small blisters). Inhalation of magnesium fumes may cause metal fume fever. Magnesium oxide (MgO) fumes can irritate the nose and throat. Magnesium oxide has a TLV of 10 mg/m^3, while the TLV for magnesium metal is unavailable. TARGET ORGANS: Upper respiratory tract and lungs, skin, eyes, and central nervous system. PRIMARY ENTRY: Inhalation or oral ingestion of magnesium salts. ACUTE EFFECTS: Magnesium fumes in oxide form can irritate the eyes, nose and throat and cause metal fume fever with febrile conditions, cough, a feeling of pressure on the chest, and leukocytosis (an increase in the number of leukocytes circulating in the blood). Spills of molten magnesium can cause skin burns. CHRONIC EFFECTS: None reported.

MEDICAL CONDITIONS AGGRAVATED BY LONG-TERM EXPOSURE: Intoxication may be caused by oral administration of magnesium salts to someone with kidney disease.

FIRST AID: EYE CONTACT: Immediately flush eyes, including under the eyelids, gently but thoroughly for at least 15 minutes. Get medical help.* SKIN CONTACT: Wash thoroughly after handling magnesium. Get medical help.*

INHALATION: Remove victim to fresh air; restore and/or support his breathing as needed. Avoid prolonged or repeated exposure to magnesium. If victim is not breathing, give him artificial respiration. Get medical help.* INGESTION: Rinse victim's mouth with water; give him 2 or 3 glasses of water to drink. Do not induce vomiting. Never give anything by mouth to someone who is unconscious or convulsing. Magnesium metal has a low oral toxicity. Get medical help.*

* GET MEDICAL ASSISTANCE = IN PLANT, PARAMEDIC, COMMUNITY. Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Remove any sources of ignition from a magnesium spill. Do not use water in cleanup or get spilled material wet. Use nonsparking tools. Place waste in clean, dry, metal containers and remove them to clean, dry storage.

WASTE DISPOSAL: Magnesium scrap is usually reclaimed for economic value. Small amounts may be disposed of in landfills. Follow Federal, state, and local regulations.

EPA Hazardous Waste Number (40 CFR 261.21, Ignitability): D001

Both magnesium metal and magnesium oxide are reported in the 1980 EPA TSCA Inventory.

Aquatic Toxicity Rating: TLm96: Over 1000 ppm for magnesium oxide.

Magnesium is not designated as a hazardous substance by the EPA (40 CFR 116.4).

EPA Reportable Quantity (40 CFR 117.3): Not Listed

SECTION 8. SPECIAL PROTECTION INFORMATION

GOGGLES: Wear dust-resistant goggles or face shields to prevent eye contact with magnesium. GLOVES: Wear impervious gloves to prevent prolonged contact with skin. RESPIRATOR: Where high dust levels prevail, use a NIOSH-approved dust mask. VENTILATION: Where dusty conditions prevail, provide dry, explosion-proof ventilation. Eliminate all possible sources of ignition/explosion.

SAFETY STATIONS: Eyewash stations, washing facilities, and safety showers should be available in areas of use and handling.

CONTAMINATED EQUIPMENT: Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Particles may cling to contact lens surfaces and cause corneal injury.

COMMENTS: Practice good personal hygiene. Keep materials off your clothes and equipment. Avoid transferring materials from hands to mouth while eating, drinking, or smoking.

In all cases prevent contact with fire sources or possible chemical mixing, because this metal is highly reactive (see sect. 5).

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Store magnesium in tightly closed containers in a cool, dry, well-ventilated area away from fire sources or combustibles. Protect containers from physical damage. SPECIAL HANDLING/STORAGE: Use nonsparking tools when working with or near this material. Store massive amounts of magnesium bars in the open, as is done with aluminum or steel. ENGINEERING CONTROLS: Install ventilation systems that maintain airborne levels of magnesium oxide below 10 mg/m^3. Ground and bond all metal containers. Eliminate all possible sources of ignition.

OTHER PRECAUTIONS: Avoid inhaling dust or letting it come in contact with your eyes. Practice good personal hygiene when handling this material. Prohibit all use of tobacco near magnesium. COMMENTS: Do not take this material out of your work area or to your home on your clothing or equipment.

TRANSPORTATION DATA (per 49 CFR 172.101-2):

DOT Shipping Name: Magnesium Metal DOT Hazard Classification: Flammable Solid DOT ID No. UN1869

DOT Required Label: Flammable Solid; Dangerous When Wet Additional DOT Requirements: Segregation, the same as for flammable solids labeled Dangerous When Wet.

References: 1-12, 18, 24, 37, 39, 44, 82, 84, 87-102. OW

Approvals

Indust. Hygiene/Safety

Medical Review

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Material Safety Data Sheets Collection:

Sheet No. 148
Manganese Metal/Powder

Issued: 9/85 Revision: A, 11/89

Section 1. Material Identification 30

Manganese Metal/Powder Description: A metallic element associated with iron ores such as pyrolusite, manganite, psilomelane, and rhodochrosite found mainly in open-hearth slags. Manganese is obtained from the reduction of the oxide with aluminum or carbon. Pure manganese is obtained electrically from chloride or sulfate solution. Used in ferroalloys (steel manufacture); for wagon buffers, rock crushers, railway points and crossings; as a purifying and scavenging agent in metal production; in the manufacture of aluminum by Toth process, dry-cell batteries, glass, welding rods, inks, rubber and wood preservatives, paints, and ceramics; high-purity salt for various chemical uses.
Other Designations: Manganese; colloidal manganese; magnacat; Mn; CAS No. 7439-96-5.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide* (Genium ref. 73) for a suppliers list.

R 1
I 3
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Genium
2
3 1
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HMIS
H 3
F 2
R 1
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Manganese, ca 100%

OSHA PEL
Ceiling limit: 5 mg/m^3 (manganese compounds, as Mn)

ACGIH TLVs, 1988-89
TLV-TWA: 5 mg/m^3 (dust and compounds)
TLV-TWA: 1 mg/m^3 (fume)
STEL: 3 mg/m^3 (fume)

NIOSH REL, 1987
Ceiling limit: 5 mg/m^3 (manganese and compounds, as Mn)
Toxicity Data*
Human, inhalation, TC_{Lo}: 2300 µg/m^3

* See NIOSH, *RTECS* (OO9275000), for additional data with references to mutagenic and tumorigenic effects.

Section 3. Physical Data

Boiling Point: 3803 °F (2095 °C)*
Melting Point: 2300 °F (1260 °C)
Vapor Pressure: 1 mm Hg at 2358 °F (1292 °C)
Atomic Weight: 54.94
Specific Gravity (H_2O = 1 at 39 °F (4 °C)): 7.20
Water Solubility: Impure Mn decomposes slowly

Appearance and Odor: Reddish-grey or silvery powder or metal. No odor.

* Other sources (Genium refs. 7, 89, and 126) give 3807 °F (2097 °C), 3564 °F (1962 °C), and 3452 °F (1900 °C) boiling points, respectively.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** *	**LEL:** *	**UEL:** None reported

Extinguishing Media: Use dry chemical extinguishing agent designed for metal fires.
Unusual Fire or Explosion Hazards: Manganese dust or powder is flammable and moderately explosive when exposed to flame or heated in carbon dioxide. Mixtures of manganese dust and aluminum dust may explode in air. Ammonium nitrate and manganese may explode when heated. Flammable hydrogen gas is generated under certain conditions (Sec. 5).
Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

* Manganese metal/powder can present a dust explosion hazard under favoring conditions of particle size and airborne dust dispersion. The minimum explosive concentration of Mn is 0.125 oz/ft^3, with a minimum ignition temperature of 842 °F (450 °C). Oxygen concentrations of less than 15% prevent ignition.

Section 5. Reactivity Data

Stability/Polymerization: Manganese is stable at room temperature in closed containers. Hazardous polymerization cannot occur.
Chemical Incompatibilities: The powdered metal ignites on contact with hydrogen peroxide, bromine pentafluoride, fluorine, chlorine and heat, and sulfur dioxide and heat. It reacts violently with oxidants and nitrogen dioxide (NO_2), and incandescently with nitric acid, phosphorus, and nitryl fluoride. Manganese reacts slowly with water at 21 °F (100 °C), forming hydrogen gas (flammable). Contact with acids (including dilute acids) readily dissolves Mn, with the evolution of hydrogen. Hot, concentrated potassium and sodium hydroxides also dissolve Mn, forming hydrogen and manganese hydroxide.
Hazardous Products of Decomposition: Thermal oxidative decomposition of manganese can produce manganese oxides.

Section 6. Health Hazard Data

Carcinogenicity: Neither the NTP, IARC, nor OSHA lists manganese as a carcinogen.

Summary of Risks: Although an essential element for man, manganese is also toxic to humans in several ways. Acute or chronic manganese poisoning can result from excessive inhalation or ingestion. The immune system reacts to acute exposures with "metal fume fever," characterized by: fever, chills, nausea, weakness, body aches, frontal headache, occasional blurred vision, low back pain, muscle cramping, shallow respiration, throat dryness and irritation, a dry cough, a sweet or metallic taste, and chest tightness occurring over several hours. Progressive and permanent injury can result from chronic, untreated Mn poisoning. Its most notable effects are the neurological disorders caused by its ability to inhibit the chemical transmission of electrical impulses in the central nervous system. The lungs may become inflammed (manganese pneumonititis), as reported in workers exposed to manganese ores and compounds. Sufficient evidence proves that in several species, manganese is embryolethal at toxic doses. Impotence is a common symptom in grossly contaminated men.

Medical Conditions Aggravated by Long-Term Exposure: Degenerative brain changes, muscle weakness, change in motor activity.

Target Organs: Central nervous system (CNS), respiratory system, kidneys, blood.

Primary Entry: Inhalation, ingestion.

Acute Effects: High-concentration exposures may cause metal fume fever, with its onset occurring over several hours. Inhalation of large concentrations may cause managanese pneumonitis. This material is a skin and eye irritant leading to dermatitis, conjunctivitis, and corneal damage.

Chronic Effects: Exposure to manganese fume over 6 months to 2 years may harm the central nervous system, with symptoms progressing from headache, restless sleep or sleepiness, personality changes, irritability and inappropriate laughing or crying to visual hallucinations, double vision, uncontrolled impulse behavior, euphoria, and to abnormal reaction to painful stimuli, excess salivation, trembling in the extremities and head, impaired walking, and other signs similar to Parkinson's disease.

FIRST AID

Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.

Skin: After rinsing affected area with flooding amounts of water, wash it with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that conscious person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear.

After first aid, get appropriate in-plant, paramedic, or community medical attention and support.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Remove heat and ignition sources. Ventilate spill area. Cleanup personnel should wear appropriate respiratory protective equipment. Carefully scoop spilled material, avoiding dust generation, into a suitable salvage container.

Disposal: Return scrap material to supplier or processor for recovery. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)

EPA Designations

RCRA Hazardous Waste (40 CFR 261.33): Not listed

CERCLA Hazardous Substance (40 CFR 302.4): Not listed

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

Listed as a SARA Toxic Chemical (40 CFR 372.65)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Wear a NIOSH-approved respirator where airborne concentrations exceed the ceiling limit. Fume or high-efficiency particulate filter respirators are acceptable for concentrations up to 50 mg/m^3 (250 mg/m^3 with full facepiece). Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.

Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below OSHA, ACGIH, and NIOSH standards. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by eliminating it at its source (Genium ref. 103). Consider the dust explosion potential of finely divided Mn powder when designing exhaust ventilation systems and other process equipment to contain heavily dust-laden air.

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Launder contaminated clothing before wearing. Remove this material from your shoes and equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed containers in a cool, dry, well-ventilated area away from ignition sources, acids, alkali, and other incompatible materials. Protect containers from physical damage.

Engineering Controls: Use with adequate ventilation. Avoid breathing dust and fumes. Maintain good housekeeping practices to prevent dust accumulation. Use cleanup procedures that minimize dust generation. Practice good personal hygiene. Examine exposed personnel at regular intervals with emphasis on the respiratory and central nervous systems.

Transportation Data (49 CFR 172.101, .102): Not listed

MSDS Collection References: 2, 4, 7, 8, 9, 12, 14, 20, 25, 27, 38, 44, 47, 55, 58, 81, 89, 90, 100, 124, 126

Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** Warren Silverman, MD FS

Material Safety Data Sheet

From Genium's Reference Collection
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GENIUM PUBLISHING CORP.

No. 26

MERCURY
(Revision C)
Issued: September 1981
Revised: August 1988

SECTION 1. MATERIAL IDENTIFICATION 26

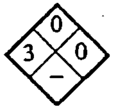
Material Name: MERCURY

Description (Origin/Uses): Used in barometers, thermometers, hydrometers, and pyrometers; in mercury arc lamps producing ultraviolet rays; in switches and fluorescent lamps; as a catalyst in oxidations of organic compounds; in alloys; in explosives; and for extracting gold and silver from ore.

Other Designations: Colloidal Mercury; Metallic Mercury; Quicksilver; Hg; Hydrargyrum; CAS No. 7439-97-6

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

Comments: Inorganic and organic mercury compounds are highly toxic, as is pure mercury.



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H 3
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PPG*
*See sect. 8

R 1
I 4
S 1
K 0

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Mercury, CAS No. 7439-97-6 *Mercury can be absorbed through intact skin, which contributes to overall exposure. **See NIOSH, *RTECS* (OV4550000), for additional data with references to reproductive, mutagenic, and tumorigenic effects.	Ca 100	OSHA PEL Ceiling: 1 mg per 10 m^3 ACGIH TLV (Skin*), 1987-88 TLV-TWA: 0.05 mg/m^3 as Hg (Mercury Vapor) Toxicity Data** Rabbit, Inhalation, LC_{Lo}: 29 mg/m^3 (30 Hrs)

SECTION 3. PHYSICAL DATA

Boiling Point: 673°F (357°C)
Specific Gravity (H_2O = 1): 13.546 at 68°F (20°C)
Vapor Pressure: 0.0018 Torr at 77°F (25°C)

Water Solubility (%): Insoluble
Molecular Weight: 201 Grams/Mole
Melting Point: -37.93°F (-38.85°C)

Appearance and Odor: A silver, heavy liquid; odorless. Danger: Mercury vapor has no warning properties.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
*	*	% by Volume	*	*

Extinguishing Media: *Mercury does not burn. Use extinguishing agents that will put out the surrounding fire.

Unusual Fire or Explosion Hazards: When exposed to the high temperatures that occur during a fire, mercury can vaporize to form extremely toxic fumes.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Mercury is stable in closed containers at room temperature under normal storage and handling conditions. It cannot undergo hazardous polymerization.

Chemical Incompatibilities: Hazardous reactions involving mercury and acetylene, ammonia, boron phosphodiiodide, chlorine, chlorine dioxide, methyl azide, sodium carbide, nitric acid, oleum, and sulfuric acid are reported (Genium ref. 84).

Conditions to Avoid: Do not expose mercury to incompatible chemicals.

Hazardous Products of Decomposition: Extremely toxic mercury metal fumes are likely to be produced during fires.

SECTION 6. HEALTH HAZARD INFORMATION

Mercury is not listed as a carcinogen by the NTP, IARC, or OSHA.

Summary of Risks: Mercury is very toxic due to its liquid and fat solubility, lack of charge, and membrane permeability. It is a slowly cumulative poison that concentrates in the brain, kidneys, and liver. It is very hazardous when spilled or heated. Mercury and its vapor are rapidly absorbed by the membranes lining the respiratory tract, the gastrointestinal (GI) tract, and the skin. Mercury is a teratogen (causes physical defects in embryos). **Medical Conditions Aggravated by Long-Term Exposure:** Preexisting problems of the target organs can be worsened. Provide preplacement and periodic medical exams emphasizing the target organs. **Target Organs:** Skin, eyes, respiratory system, central nervous system (CNS), kidneys. **Primary Entry:** Skin absorption/contact, inhalation. **Acute Effects:** Erosion of the respiratory/GI tracts, nausea, vomiting, bloody diarrhea, shock, headache, metallic taste. Inhalation of high concentrations for short periods can cause pneumonitis, chest pain, dyspnea, coughing, stomatitis, gingivitis, and salivation. **Chronic Effects:** Tremors, emotional problems, loss of concentration, depression, drowsiness, fatigue, insomnia, loss of memory, kidney problems, eye lesions, vision disturbances, sore mouth and throat, problems with the sense of taste or smell, nosebleeds, nasal inflammation, loss of weight or appetite, poor hand-eye coordination, awkwardness, and unsteadiness, as well as dermatitis. **FIRST AID: Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. **Skin.** Immediately wash the affected area with soap and water because of the increased exposure from skin absorption. **Inhalation.** Remove exposed person to fresh air; restore and/or support his or her breathing as needed. Have medical personnel administer oxygen to treat the chemical pneumonitis that may develop. **Ingestion.** Never give anything by mouth to someone who is unconscious or convulsing. Note to physician: If indicated by degree of ingestion, saline cathartics and charcoal should be used. Chelation therapy with d-penicillamine may also be indicated.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. Treatment of chronic mercury poisoning requires expert medical care. At the first signs, immediately remove the exposed person from further exposure and have him or her examined and treated by a physician trained in occupational mercury poisoning.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, restrict access to the spill area to necessary personnel, and provide adequate ventilation. Clean up spills promptly. Specialized equipment and/or techniques may be required to safely deal with large mercury spills; if large quantities of mercury are used in the workplace, detailed, prior spill-management planning is recommended. Collect spilled mercury by using a suction pump and an aspirator bottle with a long capillary tube. For finely divided mercury in inaccessible cracks, corners, etc., treatment with calcium polysulfide and excess sulfur is recommended to convert the mercury globules into mercury sulfide. Vacuum cleaners may be used if they are equipped with specially designed mercury-absorbent exhaust filters. Collect the mercury into tightly sealed containers for later disposal or reclamation. Cleanup personnel must use the recommended personal protective equipment (see sect. 8).

Waste Disposal: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Do not pour mercury down a drain. Mercury is very harmful to the environment. Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations	**EPA Designations (40 CFR 302.4)**
Air Contaminant (29 CFR 19010.1000 Subpart Z)	RCRA Hazardous Waste No. U151
	CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg)*

*Per the Clean Water Act, § 407 (a); Clean Air Act, § 112; and Resource Conservation and Recovery Act, § 3001.

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of mercury may occur, wear a full face shield or splash guard. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., to prevent any contact with mercury and the skin.

Ventilation: Install and operate general and local ventilation systems powerful enough to continuously maintain airborne levels of mercury below the OSHA PEL standard cited in section 2.

Safety Stations: Make emergency eyewash stations, washing facilities, and safety/quick-drench showers available in work areas.

Contaminated Equipment: Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean mercury from shoes and equipment. Separate work and street clothes; store work clothes in special lockers and always shower before changing to street clothes.

Comments: Practice good personal hygiene; always wash thoroughly after using this material. Keep it off of your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store mercury in a cool, dry, well-ventilated area in tightly closed unbreakable polyethylene containers. Protect these containers from physical damage.

Special Handling/Storage: Construct storage areas to have smooth, hard, nonporous floors with no cracks or spaces so that spilled mercury globules do not form in inaccessible areas.

Comments: Mercury evaporates slowly, but if it is spilled it can form many tiny globules that evaporate much faster than a single pool of it will. In an unventilated area, significant concentration of mercury vapor can develop from this enhanced evaporation effect. This poisonous vapor is particularly hazardous if breathed over a long period of time, so spills or releases of mercury require very meticulous cleaning procedures.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Mercury, Metal **DOT Label:** None **IMO Class:** 8

DOT Hazard Class: ORM-B **DOT ID No.** NA2809 **IMO Label:** Corrosive

References: 1, 2, 8, 26, 38, 84-94, 100.

Prepared by PJ Igoe, BS

Industrial Hygiene Review: DJ Wilson, CIH

Medical Review: MJ Hardies, MD

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Material Safety Data Sheets Collection:

Sheet No. 355
Phenol

Issued: 9/80 **Revision: C, 11/90**

Section 1. Material Identification 33

Phenol (C_6H_5OH) Description: One of many aromatic compounds in coal tar. Made by alkylating benzene with propylene then oxidizing the resulting cumene to produce phenol and acetone. Used as a feedstock in manufacturing various phenolic resins, caprolactum, bis-phenol-A, and other chemicals and drugs; a disinfectant; a fuel-oil sludge inhibitor; a reagent in chemical analysis; in producing or manufacturing a large variety of aromatic compounds including fertilizers, illuminating gas, coke, explosives, lampblack, paints, paint removers, asbestos goods, wood preservatives, textiles, perfumes, bakelite, rubber, and other plastics; in medical and industrial organic compounds and dyes; and in germicidal paints and slimicides. Phenol has been identified in cigarette smoke and automobile exhaust.

Other Designations: CAS No. 0108-95-2, carbolic acid, hydroxybenzene, monohydroxy benzene, oxybenzene, phenic acid, phenyl alcohol, phenyl hydroxide.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

Cautions: Phenol has a marked corrosive effect on any tissue. Eye contact may cause severe damage and *blindness*. Its primary entry route is through *skin absorption*. Systemic absorption may cause *liver and kidney damage, convulsions (seizures), or death.*

R 1
I 4
S 3*
K 2
* Skin absorption

NFPA

HMIS
H 3
F 2
R 0
PPG†
† Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Phenol, ca 100%

1989 OSHA PEL (Skin)	1990-91 ACGIH TLV (Skin)	1988 NIOSH REL	1985-86 Toxicity Data*
8-hr TWA: 5 ppm, 19 mg/m³	TWA: 5 ppm, 19 mg/m³	TWA: 5 ppm, 19 mg/m³ Ceiling: 15.6 ppm, 60 mg/m³	Mammal, inhalation, LC_{50}: 74 mg/m³ Rat, oral, LD_{50}: 317 mg/kg; toxic effects include behavorial changes (convulsions or effect on seizure threshold) Rabbit, eye, TC_{Lo}: 5 mg produces severe irritation

1987 IDLH Level
250 ppm

* See NIOSH, *RTECS* (SJ3325000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 359.15 °F (181.75 °C) at 760 mm Hg
Melting Point: 109.4 °F (43 °C)
Vapor Pressure: 0.3513 mm Hg at 77 °F (25 °C)
Vapor Density (Air = 1): 3.24
pH: 6 (aqueous solution)
Molecular Weight: 94.11
Specific Gravity (20 °C/4 °C): 1.0576
Water Solubility: 1 g dissolves in about 15 ml H_2O
Viscosity: 12.7 centipoise at 64.9 °F (18.3 °C)

Appearance and Odor: White crystalline solid with a characteristic sharp medicinal sweet, tangy odor detectable above 0.05 ppm. Phenol turns pink or red if it contains impurities or is exposed to heat or light.

Section 4. Fire and Explosion Data

Flash Point: 175 °F (79 °C), CC	**Autoignition Temperature:** 1319 °F (715 °C)	**LEL:** 1.7% v/v	**UEL:** 8.6% v/v

Extinguishing Media: Use water spray, carbon dioxide, dry chemical, or alcohol-type foam to extinguish fires involving phenol. Do not use a solid stream of water since the stream scatters and spreads fire. Use water spray to cool fire-exposed tanks/containers.

Unusual Fire or Explosion Hazards: Phenol presents a moderate fire hazard when exposed to heat, flame, or oxidizers. When heated, it emits toxic fumes and vapors that form explosive mixtures with air. Air mixtures containing 3 to 10% phenol are explosive. Solid phenol burns with difficulty, giving off heavy smoke.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective clothing. Be aware of runoff from fire control methods. Water containing phenol can cause severe chemical burns. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Phenol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: In general, phenol is incompatible with strong oxidizing agents and halogens. It coagulates colodion and proteins. A potentially explosive reaction occurs with formaldehyde, peroxydisulfuric acid, peroxymonosulfuric acid, sodium nitrite + heat, and aluminum chloride + nitromethane (at 110 °C/100 bar). A violent reaction occurs with butadiene, sodium nitrite + trifluoroacetic acid, and aluminum chloride + nitrobenzene at 248 °F (120 °C). Combining phenol with mineral oxidizing acids results in fire; with acetaldehyde results in violent condensation; with isocyanates results in heat generation and violent polymerization, with calcium hypochlorite results in an exothermic reaction producing toxic fumes which may ignite; and with nitrides results in heat and flammable gas generation. Hot phenol is corrosive to many metals, including aluminum, lead, magnesium, and zinc. Reaction with these materials causes phenol to discolor.

Conditions to Avoid: Avoid heating phenol above 122 °F (90 °C).

Hazardous Products of Decomposition: Thermal oxidative decomposition of phenol can produce oxides of carbon and water.

Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list phenol as a carcinogen. Although no specific evidence of human cancer exists, its carcinogenicity to mice emphasizes the need for precaution when handling this material. Phenol also causes human mutations (genetic changes).

Summary of Risks: Phenol is a general protoplasmic poison that is corrosive to any living tissue it contacts. Toxicity most likely results from dermal (skin) contact or ingestion. Skin absorption occurs readily with a rapid onset of symptoms or death (within 30 min to several hours). Contact with eyes may cause severe damage and blindness. Ingestion of 1 g may be fatal. Although phenol is irritating to the respiratory tract, due to its low volatility and good warning properties, inhalation is typically less of a concern. Chronic toxic effects are uncommon, but may include digestive disturbances, neurological disorders, skin rash (dermatitis), and liver and kidney damage.

Medical Conditions Aggravated by Long-Term Exposure: Individuals with chronic respiratory disorders, pre-existing skin disorders, convulsive disorders, or kidney or liver abnormalities may be at increased risk from phenol exposure.

Target Organs: Liver, kidneys, nervous system, and skin.

Primary Entry Routes: Skin absorption, eye contact, ingestion, and inhalation.

Acute Effects: Skin contact results in white, wrinkled discoloration, followed by a severe burn or systemic poisoning if removed improperly.

Continue on next page.

Section 6. Health Hazard Data, *continued*

Phenol ingestion can cause gangrene and corrosion of lips, mouth, throat, esophagus, and stomach if not properly decontaminated (see First Aid). Although not immediately painful, skin contact can cause serious burns and systemic toxicity. In addition to skin burns and respiratory tract irritation, systemic absorption may cause pallor, anorexia (appetite loss), nausea, vomiting, diarrhea, weakness, muscle aches, darkened urine, headache, tinnitus (ringing in ears), sweating, convulsions, cyanosis (bluish coloration of lips and/or fingertips), shock, unconsciousness, r ratory failure, and death. After ingestion, major percutaneous (skin), or inhalation exposures, collapse and death can be rapid. Ingestion can e severe tissue corrosion or gangrene affecting lips, mouth, throat, esophagus, and stomach. Eye contact can cause severe corrosive damage to the eye (conjunctival edema, corneal opacification, and hypesthesia) and possible blindness.

Chronic Effects: Chronic phenol poisoning is rarely reported. Symptoms include vomiting, difficulty swallowing, diarrhea, appetite loss, headache, fainting, dizziness, darkened urine, and mental disturbances. Chronic exposure can cause death from liver and kidney damage. Repeated skin contact with phenol or phenol-bearing products can result in dermatitis with dark pigmentation (ochronosis) of skin and whites of eyes (sclerae).

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician immediately.

Skin: Speedy action is critical. Flood exposed area with water and quickly remove contaminated clothing. *As soon as possible*, repeatedly spray or swab with the decontaminating agent polyethyleneglycol-300 (PEG). Immerse extremities in PEG. Rescue personnel should protect themselves from skin contact with phenol. Do not use greases, powders, or ointments to treat phenol burns. *Never* delay phenol removal if PEG is not readily available. Use soap and water instead.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: *Speed is essential in the treatment of oral poisoning*. Immediately consult a physician and poison center. Never give anything by mouth to an unconscious or convulsing person. Administer to that *conscious* person 15 to 30 cc castor oil or another vegetable oil, and be prepared to induce vomiting upon a physician's advice. Vegetable oils slow phenol absorption and reduce local damage.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat ingestion with gastric lavage using 40% aqueous Bacto-Peptone, milk, or water until phenolic odor is eliminated. Then give 15 to 50 cc castor or vegetable oil. Debride necrotic skin. Monitor vital signs, fluid status, electrolytes, BUN, renal and hepatic function, and electrocardiogram. Manage sedation, seizures, renal failure, and fluid electrolyte imbalances symptomatically as indicated.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and skin and eye contact with a self-contained breathing apparatus and full personal protective clothing and equipment. Absorb small spills with some noncombustible inert material and place in a closed metal container for disposal. Dike large spills and allow material to cool and solidify. Using nonsparking tools, shovel solid into steel containers for disposal. Thoroughly flush spill area with water, use caustic soda solution for neutralization, and collect flushings and wash water for disposal. Do not allow phenol to enter sewers, watersheds, or waterways. Follow applicable OSHA regulations (29 CFR 1910.120). Notify proper authorities including the National Response Center (800-424-8802).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33)

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Reportable Quantity (RQ), 1000 lb (454 kg) [* per Clean Water Act, Sec. 311(b)(4), Sec. 307(a), and per RCRA, Sec. 3001]

I l as a SARA Extremely Hazardous Substance (40 CFR 355): RQ, 1000 lb; Threshold Planning Quantity (TPQ), 500/10,000 lb

d as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Where potential exists for exposures near or over 19 mg/m³, use a MSHA/NIOSH-approved full facepiece respirator with an organic vapor cartridge/canister and dust/mist prefilter. Increased protection is obtained from full facepiece powered-air purifying respirators. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. ACGIH recommends neoprene or butyl rubber as good-to-excellent protective materials.

Ventilation: Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL and ACGIH TLV (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed containers in a cool, dry, well-ventilated area away from heated surfaces, open flame, and ignition sources. Outside or detached storage is preferred. Protect containers from physical damage.

Engineering Controls: Enclose all operations, eliminating all possible phenol exposure routes. Educate workers about phenol's hazards and potential dangers. Use only with appropriate personal protective gear and adequate ventilation. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Provide local exhaust ventilation at the site of chemical release. Practice good personal hygiene and housekeeping procedures.

Medical Surveillance: Provide preplacement or periodic medical examinations that emphasize central nervous system (CNS), hepatic, renal, and skin. Tests should include BUN, creatinine, LFTs, and urinalysis. Phenol can be detected in urine in free or conjugated forms. The ACGIH biological exposure index (BEI) is 250 mg total phenol/g creatinine or 15 mg/hr.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Phenol
DOT Hazard Class: Poison B
ID No.: UN1671
D Label: Poison
D Packaging Exceptions: 173.364
DOT Packaging Requirements: 173.369

IMO Shipping Name: Phenol
IMO Hazard Class: 6.1
ID No.: UN1671
IMO Label: Poison
IMDG Packaging Group: II

MSDS Collection References: 1, 2-12, 15, 19, 23, 24, 26, 31, 34, 37, 38, 59, 73, 79, 84, 85, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138-140, 143, 146, 148, 149

Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

Material Safety Data Sheet

From Genium's Reference Collection
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GENIUM PUBLISHING CORP.

No. 136

SELENIUM

Issued: April 1988

SECTION 1. MATERIAL IDENTIFICATION

25

Material Name: SELENIUM

Description (Origin/Uses): Used to manufacture other selenium compounds; also used in photography and xerography and as a catalyst and pigment.

Other Designations: Elemental Selenium; Selenium Base; Selenium Dust; Selenium Metal; Selenium Metal Powder; Se; NIOSH *RTECS* No. VS7700000; CAS No. 7782-49-2

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

Comments: See Genium Industrial MSDS 152 (Selenium Dioxide).

Not Found

HMIS			
H	3		
F	0	R	1
R	1	I	4
PPG*		S	2
*See sect. 8		K	0

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Selenium, CAS No. 7782-49-2	ca 100	IDLH* Level: 100 mg/m^3 **OSHA PEL**** 8-Hr TWA: 0.2 mg/m^3 **ACGIH TLV,** 1987-88** TLV-TWA: 0.2 mg/m^3 **Toxicity Data***** Rat, Oral, LD_{50}: 6700 mg/kg Rat, Inhalation, LD_{Lo}: 33 mg/kg (8 Hrs)

*Immediately dangerous to life and health

**This exposure limit is defined for selenium compounds as Se.

***See NIOSH, *RTECS*, for additional data with references to reproductive, mutagenic, and tumorigenic effects.

SECTION 3. PHYSICAL DATA

Boiling Point: ca 1263°F (684°C)

Water Solubility: Insoluble

Melting Point: ca 644°F (340°C)

Specific Gravity (H_2O = 1): Both amorphous and crystalline forms have specific gravities between 4 and 5.

Molecular Weight: 79 Grams/Mole

Appearance and Odor: A dark red to bluish black amorphous solid or dark red, grey, or black crystals appearing in two distinct forms, or allotropes, because of differences in crystalline structures; odorless.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
*	*	% by Volume	*	*

Extinguishing Media: *Selenium does not burn. Use agents such as dry chemical, "alcohol" foam, or carbon dioxide that will extinguish the surrounding fire.

Unusual Fire or Explosion Hazards: None.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Selenium is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.

Chemical Incompatibilities: This material reacts dangerously with carbides, fluorine, oxygen, potassium, and many more materials (see Genium ref. 84).

Conditions to Avoid: Avoid direct contact with incompatible chemicals to prevent dangerous and violent reactions. Avoid the unintended contact of water with selenium in storage areas or reactor vessels.

Hazardous Products of Decomposition: When heated to decomposition, selenium readily emits toxic oxides of selenium (SeO_x). Selenium itself is a highly toxic and dangerous material.

SECTION 6. HEALTH HAZARD INFORMATION

Selenium is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: Direct exposure to selenium or inhalation of its dust causes severe irritation of the skin, eyes, and the upper respiratory tract (URT). **Caution:** Some symptoms of exposure to selenium (e.g., chemical pneumonia) may be delayed for several hours. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** URT, skin, eyes.
Primary Entry: Inhalation, skin contact. **Acute Effects:** Skin and eye burns, contact dermatitis, intense irritation of the URT, and headache. Cases with flulike symptoms resembling metal-fume fever within 24 hours of exposure have been reported.
Chronic Effects: Odor of garlic on breath; fatigue; irritability; URT irritation; pallor; gastrointestinal distress; metallic taste; and an allergic eye reaction with red, sometimes puffy, eyelids.
FIRST AID: Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water.
Skin. Immediately wash the affected area with plenty of running water. Any worker who develops a rash or contact dermatitis must get medical attention and prevent any further contact with selenium metal or its compounds (e.g., selenium dioxide; see Genium Industrial MSDS 152). **Inhalation.** Remove exposed person to fresh air; restore and/or support his or her breathing as needed. Prompt administration of oxygen gas (O_2) by trained medical personnel may aid recovery. **Ingestion.** Give exposed person several glasses of water to dilute material. Do not induce vomiting. Never give anything by mouth to someone who is unconscious or convulsing.

Treat each exposure to selenium as an emergency! GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. If chelation therapy to remove the metallic selenium is indicated, calcium disodium edetate ($CaNa_2$-EDTA) is the chelating agent of choice; do *not* use dimercaprol. Burns may require treatment with 10% sodium thiosulfate cream.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate all nonessential personnel, provide adequate ventilation, and do not add any water to the spill or leak area. Cleanup personnel need protection against contact with and inhalation of dust (see sect. 8). Scoop up spilled selenium into suitable containers for disposal. Carefully sweep or vacuum up small spills or residues without creating dust.
Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations for disposal. Follow Federal, state, and local regulations.
OSHA Designations
Air Contaminant (29 CFR 1910.1000 Subpart Z)
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste: Listed without a Number
CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Follow the eye- and face-protection guidelines in 29 CFR 1910.133. **Respirator:** Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. For emergency or nonroutine use (e.g., cleaning reactor vessels or storage tanks) wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves; boots; aprons; and clean, impervious, body-covering clothing to prevent any possibility of skin contact.
Ventilation: Install and operate general and local maximum explosion-proof ventilation systems powerful enough to maintain airborne levels of selenium below the OSHA PEL standard cited in section 2. **Safety Stations:** Make eyewash stations, washing facilities, and safety showers available in areas of use and handling. Make the 10% sodium thiosulfate solution or cream and the $CaNa_2$-EDTA chelating agent formula (sect. 6) readily available to a trained safety specialist. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Particles can adhere to contact lenses and cause corneal damage. Do *not* wear contact lenses in any work area.
Comments: Practice good personal hygiene; always wash thoroughly after using this material. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store selenium in a cool, dry, well-ventilated area in tightly closed containers away from oxidizing agents, organic materials, water, metals, and incompatible chemicals (see sect. 5). **Special Handling/Storage:** Prevent moisture or water contamination in any storage facility. Consider installing an automatic monitoring system to detect selenium contamination; storage under an inert gas (e.g., a nitrogen blanket) may be warranted depending on the work environment. **Engineering Controls:** Use selenium in closed engineering systems because of its significant health and physical hazards (see sects. 4, 5, and 6). All engineering systems (production, transportation, etc.) should be of maximum explosion-proof design (i.e., they must be nonsparking, electrically grounded and bonded, etc.). **Comments:** Perform all work with selenium with a sustained, conscientious effort to prevent accidental contact with water. Do not create a dusty working environment. Develop a sustained, conscientious program of working guidelines prior to any accidental exposure.
Transportation Data (49 CFR 172.101-2)
DOT Shipping Name: Selenium Metal Powder **DOT Label:** Poison **IMO Label:** St. Andrew's Cross (X)*
DOT Class: Poison B **DOT ID No.** UN2658 **IMO Class:** 6.1
*Harmful-Stow away from Foodstuffs (IMO Label, Materials of Class 6.1 Packaging Group III)
References: 1, 2, 12, 73, 84-94, 100, 103.

Prepared by PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: MJ Hardies, MD

Material Safety Data Sheet

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GENIUM PUBLISHING CORP.

No. 181
SILVER
Issued: April 1986

SECTION 1. MATERIAL IDENTIFICATION 20

MATERIAL NAME: SILVER
DESCRIPTION: Elemental metal.
OTHER DESIGNATIONS: Ag, Argentum, CAS #7440-22-4.

MANUFACTURER/SUPPLIER: Available from many suppliers.

COMMENTS: Photography products account for 30% of industrial consumption. Additional uses include electrical conductors, coins, silverware, and jewelry.

HMIS
H:1
F:0
R:0
PPE*
*See sect. 8

Not Found

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Silver, Ag	99+	TWA 0.1 mg/m^3* TWA 0.01 mg/m^3** Rat, Implant, TD: 2570 mg/kg

* Current (1985-86) ACGIH TLV for silver dust and fume.

** Current (1985-86) ACGIH TLV for soluble silver compounds and OSHA exposure limit.

SECTION 3. PHYSICAL DATA

Boiling Point ... 3833.6°F (2112°C)
Vapor Pressure ... Not Found
Water Solubility ... Insoluble
Vapor Density (Air = 1) ... Not Found
Evaporation Rate ... Not Found

Specific Gravity (H_2O = 1) ... 10.5
Melting Point ... 1763.4°F (961.9°C)
Percent Volatile by Volume ... Not Found
Molecular Weight ... 107.87

Appearance and odor: Ductile and malleable lustrous white metal.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
Not Found	Not Found	Not Found	Not Applicable	Not Applicable

NFPA Classification: Noncombustible.

EXTINGUISHING MEDIA: Use proper extinguisher for surrounding fire.

UNUSUAL FIRE/EXPLOSION HAZARDS: None.

SPECIAL FIRE-FIGHTING PROCEDURES: None.

SECTION 5. REACTIVITY DATA

Silver is stable. Hazardous polymerization cannot occur.

CHEMICAL INCOMPATIBILITIES: Acetylene and silver form an insoluble, explosive acetylide. If silver is treated with nitric acid in the presence of ethyl alcohol, silver fulminate may be formed, which can be detonated. Ethylenimine forms explosive compounds with silver. Finely divided silver and hydrogen peroxide solutions may explode. This material is incompatible with oxalic and tartaric acid. Ammonia plus silver may form explosive compounds. Bromoazide explodes on contact with silver foil.

SECTION 6. HEALTH HAZARD INFORMATION | TLV

Silver is not considered a carcinogen by the NTP, IARC, or OSHA.
SUMMARY OF RISKS: Silver has no known physiological function in man and will accumulate in most tissues. Chronic accumulation (threshold in excess of 1 gram) in the body can result in argyria, a permanent condition associated with widespread bluish pigmentation of the skin and conjunctiva. TARGET ORGANS: Generally, where contact occurs. PRIMARY ENTRY: Inhalation, long-term handling (causes particles to become embedded in skin), or absorption through sweat glands. ACUTE EFFECTS are associated with soluble silver compounds that may be caustic, causing local irritations or destruction of tissue, depending upon strength of solution. CHRONIC EFFECTS: Argyria may be a local or general effect, depending upon previous exposure. FIRST AID: EYE CONTACT: Flush with water for 15 minutes. Get medical attention.* SKIN CONTACT: Wash skin with soap and water. Argyria from long-term exposure is permanent and cannot be washed away. INHALATION: Remove victim to fresh air. INGESTION: Dilute with water. Get medical attention.*

* GET MEDICAL ASSISTANCE = In plant, paramedic, community. Get medical help for further treatment, observation, and support after first aid, if indicated.

COMMENTS: The original 0.01 mg/m^3 TLV was established to prevent a lifetime body accumulation exceeding 1 gram, where argyria would become evident. Evaluation of 25 years of data has shown 0.01 mg/m^3 to be too conservative; therefore, the ACGIH raised the TLV to 0.1 mg/m^3.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Notify safety personnel; prevent entry into sewers or surface waters. Wear respirator where a dusting hazard is anticipated.

WASTE DISPOSAL: Reclaim or sell waste to a commercial reclaimer.

SECTION 8. SPECIAL PROTECTION INFORMATION

GOGGLES are not required unless metal is in the molten state.
GLOVES: Repeated handling may discolor the skin because of skin rubbing against the metal. Cotton gloves will prevent this cosmetic effect.
RESPIRATOR is required where metal dust or fumes are generated with inadequate exhaust ventilation. Air samples should be collected to quantify the exposure levels.
VENTILATION is required where air exposures exceed the TLV-TWA'S.
OTHER: Reclamation of silver from photographic or X-ray film may involve cyanide compounds. Proper precautions must be taken when working with cyanide compounds. See Genium MSDS #13, Potassium Cyanide, for further information.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Silver is usually stored in locked cabinets or safes to prevent theft.

ENGINEERING CONTROLS: Exhaust ventilation where TLV-TWA is exceeded.

EPA Hazardous Substance Designation: 40 CFR 260

Data Source(s) Code: 2, 4, 6, 14, 59, 82, 84, NFC 1983. DW

Approvals

Indust. Hygiene/Safety

Medical Review

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Material Safety Data Sheets Collection:
Sheet No. 311
Methyl Chloroform

Issued: 11/75 Revision: F, 3/92

Section 1. Material Identification

Methyl Chloroform ($C_2H_3Cl_3$) Description: Derived by catalytic addition of hydrogen chloride to 1,1-dichloroethylene or by re-fluxing chlorine monoxide with carbon tetrachloride and chloroethane. Available in technical and solvent grades which differ only in the amount of stabilizer added to prevent metal parts corrosion. Used as a solvent for oils, waxes, tars, cleaning precision instruments, and pesticides; as a component of inks and drain cleaners; in degreasing metals, and textile processing. In recent years, methyl chloroform (TCE) has found widespread use as a substitute for carbon tetrachloride.

R	I	S	K
1	2	2*	1

Genium

HMIS
H 2
F 1
R 1
PPG*
* Sec. 8

Other Designations: CAS No. 71-55-6, α-trichloroethane; Inhibisol; 1,1,1-trichloroethane; Strobane; TCE.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: TCE is a skin, eye, and respiratory tract irritant and can become narcotic with an anesthetic effect at high concentrations.

* Data on skin absorption via methyl chloroform is conflicting.(133) Some studies show definite absorption where others don't.

Section 2. Ingredients and Occupational Exposure Limits

Methyl chloroform, ca 92 to 97%*

1990 OSHA PELs
8-hr TWA: 350 ppm (1900 mg/m^3)
15-min STEL: 450 ppm (2450 mg/m^3)

1990 IDLH Level
1000 ppm

1990 NIOSH REL
15-min Ceiling: 350 ppm (1900 mg/m^3)

1991-92 ACGIH TLVs
TWA: 350 ppm (1910 mg/m^3)
STEL: 450 ppm (2460 mg/m^3)

1990 DFG (Germany) MAKs
TWA: 200 ppm (1080 mg/m^3)
Half-life: 2 hr to shift length
Peak Exposure Limit: 1000 ppm/30 min (average value)/2 per shift

1985-86 Toxicity Data†
Human, oral, TD_{Lo}: 670 mg/kg produced diarrhea, nausea, and vomiting
Human, inhalation, LC_{Lo}: 27 g/m^3/10 min; toxic effects not yet reviewed
Man, eye: 450 ppm/8 hr produced irritation
Rat, inhalation, TC_{Lo}: 2100 ppm/24 hr for 14 days prior to mating and from 1 to 20 days of pregnancy produced specific developmental abnormalities of the musculoskelatal system

* Methyl chloroform usually contains inhibitors (3 to 8%) to prevent corrosion of aluminum and some other metals. Typical inhibitors are nitromethane, butylene oxide, secondary butyl alcohols, ketones, and glycol diesters.
† See NIOSH, *RTECS* (KJ2975000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 165 °F (75 °C)
Freezing Point: -22 °F (-30 °C)
Vapor Pressure: 100 mm Hg at 68 °F (20 °C)
Vapor Density (air = 1): 4.55
Corrosivity: Readily corrodes aluminum and its alloys
Refraction Index: 1.43765 at 69.8 °F (21 °C)
Viscosity: 0.858 cP at 68 °F (20 °C)
Molecular Weight: 133.42
Density: 1.3376 at 68/39.8 °F (20/4 °C)
Water Solubility: Insoluble
Other Solubilities: Soluble in acetone, alcohol, ether, benzene, carbon tetrachloride, and carbon disulfide
% in Saturated Air: 16.7% at 77 °F (25 °C)
Relative Evaporation Rate (butyl acetate = 1): 12.8

Appearance and Odor: Colorless liquid with a sweetish, chloroform-like odor. The odor threshold is 44 ppm.

Section 4. Fire and Explosion Data

Flash Point: None (in conventional CC tests)	**Autoignition Temperature:** 932 °F (500 °C)	**LEL:** 7% v/v	**UEL:** 16% v/v

Extinguishing Media: *Noncombustible liquid* whose *vapor* burns in the presence of excess oxygen or a strong ignition source. For small fires, use dry chemical or carbon dioxide (CO_2). For large fires use fog or regular foam. If these materials are unavailable, a water spray may be used but be aware that water reacts slowly with methyl chloroform to release hydrochloric acid.
Unusual Fire or Explosion Hazards: Vapors are heavier than air and may travel to a strong ignition source and flash back. Air/vapor mixtures may explode when heated. Container may explode in heat of fire. Exposure to open flames or arc welding can produce hydrogen chloride and phosgene.
Special Fire-fighting Procedures: TCE's burning rate is 2.9 mm/min. Since fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides limited protection. Wear clothing specifically recommended by the manufacturer for use in fires involving methyl chloroform. Apply cooling water to container sides until after fire is extinguished. Stay away from ends of tanks. Isolate area for 1/2 mile if fire involves tank, truck, or rail car. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: TCE is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization can occur in contact with aluminum trichloride.
Chemical Incompatibilities: TCE is incompatible with sodium hydroxide, nitrogen tetroxide, oxygen (liquid or gas), strong oxidizers, and chemically active metals like aluminum, zinc, and magnesium powders; reacts violently with caustics to form dichloroacetylene; reacts slowly with water to form hydrochloric acid; forms shock sensitive mixtures with potassium; and polymerizes in contact with aluminum trichloride.
Conditions to Avoid: Exposure to moisture, strong ignition sources, and arc-welding units, and contact with incompatibles.
Hazardous Products of Decomposition: Thermal oxidative decomposition (temperatures >500 °F, contact with hot metals, or under UV rays) of methyl chloroform can produce carbon dioxide (CO_2) and toxic dichloroacetylene, hydrogen chloride, and phosgene gases.

Section 6. Health Hazard Data

Carcinogenicity: The IARC (Class 3, inadequate evidence),(164) NTP,(142) and OSHA(164) do not list methyl chloroform as a carcinogen.
Summary of Risks: Methyl chloroform is considered one of the least toxic of the liquid chlorinated hydrocarbons. It is irritating to eyes, skin, and respiratory tract. Although low in systemic toxicity, TCE is an anesthetic capable of causing death at high concentrations (>15,000 ppm), generally in poorly ventilated, enclosed areas. Quick and complete recovery is observed after prompt removal of unconscious persons from area of exposure. Like many other solvents, TCE sensitizes the heart to epinephrine (blood pressure-raising hormone) and may induce cardiac arrhythmias and arrest.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Skin, eyes, central nervous (CNS) and cardiovascular (CVS) systems.

Continue on next page

Section 6. Health Hazard Data, *continued*

Primary Entry Routes: Inhalation, skin contact.

Acute Effects: TCE defats the skin causing irritation, redness, dryness, and scaling. Contact with eyes produces irritation and mild conjunctivitis. Vapor inhalation can cause headache, dizziness, equilibrium disturbances, and in high concentrations may lead to CNS depression, unconsciousness, and coma. During a 60-min exposure period these effects are observed: 100 ppm is the observed odor threshold, at 500 ppm there is obvious odor and decreased reaction time, 1000 ppm causes slight equilibrium loss, at 5000 ppm there is definite incoordination, and 20,000 ppm produces surgical [illegible]gth anesthesia with possible death. Mild liver and kidney dysfunction may occur after CNS depression recovery. Although unlikely, if ingestion [illegible]rs, symptoms include nausea, vomiting, diarrhea, and possible esophageal burns. The acute lethal human dose is ~500 to 5000 mg/kg.

Chronic Effects: None reported.

FIRST AID

Eyes: Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. *Do not* allow victim to rub or keep eyes tightly shut. Consult a physician immediately.

Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center, and unless they advise otherwise, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. When deciding whether to induce vomiting, carefully consider amount ingested, time since ingestion, and availability of medical help. If large amounts are recently ingested (absorption into the body is not yet likely to have occurred), and medical help or transportation to a medical facility is not readily available, induce vomiting. Otherwise, vomiting is not recommended since aspiration of vomitus can produce chemical pneumonitis.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Do not use adrenaline or sympathomimetic amines in treatment because of the increased cardiac sensitivity involved.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate area, deny entry, and stay upwind. Shut off all ignition sources. If possible without risk, shut off leak. Cleanup personnel should wear fully encapsulating vapor-protective clothing. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material. Using nonsparking tools, place in suitable containers for disposal or reclamation. For large spills, dike far ahead of liquid spill for later disposal or reclamation. Report any release in excess of 1000 lb. Follow applicable OSHA regulations (29 CFR 1910.120).

Environmental Transport: In water, methyl chloroform's half-life is hours to weeks depending on wind and mixing conditions. It is very persistent in groundwater. On land it volatilizes due to its high vapor pressure and leaches extensively. When released to the atmosphere, methyl chloroform can be transported long distances and returned to earth via rain. It is slowly degraded by reaction with hydroxyl radicals and has a half-life of 6 months to 25 years. The Natural Resources Defenses Council reported recently that TCE depletes ozone.

Ecotoxicity Values: *Pimephales promelas* (fathead minnow), LC_{50}: 52.8 mg/L/96 hr; *Poecilia reticulata* (guppy), LC_{50}: 133 ppm/7 day.

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U226
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Reportable Quantity (RQ), 1000 lb (454 kg) [* per RCRA, Sec. 3001, CWA, Sec. 307(a), and CAA, Sec. 112]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

[illegible]tion 8. Special Protection Data

Goggles: Wear splash-proof, protective chemical safety goggles or faceshields, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy.

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent repeated or prolonged skin contact. Viton and butyl rubber [with breakthrough times (BTs) of >8 hr and 4 to 7.9 hr, respectively] are recommended materials for protective gear. *Do not use* neoprene, polyvinyl chloride (PVC), natural rubber, or polyethylene because these materials have a BT of <1 hr.

Ventilation: Provide general and local exhaust (in some cases, explosion-proof) ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into work area by controlling it at its source.(103)

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean personal protective equipment.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in cool, dry, well-ventilated (use pressure-vacuum ventilation) area away from ignition sources, arc-welding operations, and incompatibles (Sec. 5). Regularly monitor inhibitor levels. *Do not* store in aluminum containers or use pressure-spraying equipment when methyl chloroform is involved.

Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. To prevent static sparks, electrically ground and bond all equipment used in methyl chloroform manufacturing, use, storage, transfer, and shipping.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers that emphasize CNS, CVS, liver and skin.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: 1,1,1-Trichloroethane
DOT Hazard Class: ORM-A
ID No.: UN2831
D[illegible] Label: None
[illegible] Packaging Exceptions: 173.505
DOT Packaging Requirements: 173.605

IMO Shipping Name: 1,1,1-Trichloroethane
IMO Hazard Class: 6.1
ID No.: UN2831
IMO Label: St. Andrews Cross
IMDG Packaging Group: III

***MSDS Collection* References:** 26, 38, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 148, 153, 159, 162, 163, 164

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** AC Darlington, MPH, MD; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 124
Vanadium Metal/Powder

Issued: 10/83 Revision: A, 11/90

Section 1. Material Identification

Vanadium Metal/Powder (V) Description: Occurs ubiquitously in the earth's crust. Its principle ores are patronite, roscoelite, carnolite, and vanadinite. There are more than 65 different vanadium-containing ores. Also found in crude petroleum, in flue-gas deposits from oil-fired furnaces, or in slags from ferrovanadium production. Vanadium production includes roasting ores and electrolytic refining using a molten salt electrolyte containing vanadium chloride. Used to manufacture rust-resistant vanadium steel, alloy steels, vanadium compounds; as a target material for x-rays; and as a catalyst for sulfuric acid and synthetic rubber.

Other Designations: CAS No. 7440-62-2

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[(73)] for a suppliers list.

Cautions: Vanadium is a primary irritant of the mucous membranes of the respiratory tract and the conjunctiva (eye).

R 0
I 4
S 1
K 0

Genium

HMIS
H 2
F 0
R 0
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Vanadium, ca 100%

1989 OSHA PEL **Vanadium, as V_2O_5, Respirable Dust and Fume** 8-hr TWA: 0.05 mg/m³	1990-91 ACGIH TLV **Vanadium, as V_2O_5, Respirable Dust and Fume** TWA: 0.05 mg/m³	1985-86 Toxicity Data* Human, inhalation, TD_{Lo}: 4 µg/kg; affected the lungs, thorax, or respiration (sputum, cough); and sense organs and special senses (changes in circulation)
1987 IDLH Level **Vanadium Pentoxide Dust or Fume (as V)** 70 mg/m³	1988 NIOSH REL **Vanadium, as V_2O_5, Respirable Dust and Fume** 15-min Ceiling: 0.05 mg/m³	

* Monitor NIOSH, *RTECS* (YW1630000), for future toxicity data.

Section 3. Physical Data

Boiling Point: 6116 °F (3380 °C)
Melting Point: 3434 + 10 °F (1890 + 10 °C)
Vapor Pressure: 1.5 mm Hg at 4172 °F (2300 °C)
Atomic Weight: 50.92
Specific Gravity: 5.96
Water Solubility: Insoluble in hot or cold water

Appearance and Odor: Light gray powder or white, lustrous bulk solid; no odor.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:*** layer 914 °F (490 °C), cloud 932 °F (500 °C)	**LEL:** 0.22 oz/ft³*	**UEL:** None reported

Extinguishing Media: Use dry chemical powder or CO_2 to extinguish a metal fire.
Unusual Fire or Explosion Hazards: Very hot vanadium can burn in air. When dispersed in air as dust, it can be exploded by an ignition source.* However, it has a low explosibility index (0.1) and low ignition sensitivity (0.3) on a scale of 10.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective gear. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

* Vanadium metal dust whose particle size is 100% below 75 µm. Reported minimum ignition energy is 60 mJ for dust cloud.

Section 5. Reactivity Data

Stability/Polymerization: Vanadium is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Massive metal is relatively inert to O_2, N_2, H_2, and H_2O at ambient conditions, but vanadium reacts when heated, and still more readily if powdered. When heated in air, vanadium oxidizes to brownish-black trioxide, blue-black tetroxide or yellow-red pentoxide, depending on temperature.
Chemical Incompatibilities: Vanadium is incompatible with bromine trifluoride, chlorine, nitryl fluoride, lithium, and oxidants. Some samples of vanadium prepared by magnesium reduction of vanadium dichloride or vanadium trichloride are pyrophoric (ignite spontaneously).
Conditions to Avoid: Avoid creating airborne dusty conditions.
Hazardous Products of Decomposition: Thermal oxidative decomposition of vanadium can produce toxic fumes of vanadium oxides (VO_x).

Section 6. Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list vanadium metal powder as a carcinogen.
Summary of Risks: Elemental vanadium is considered relatively nontoxic and the risks noted in mining operations are usually limited. However, toxic vanadium compounds form easily with the addtion of heat, and may be present in many occupational settings. Vanadium compounds are very irritating to mucous membranes including the respiratory tract. Although no specific lesions are noted, inflammation of all portions of the a[illegible]ys, as well as pulmonary edema, pneumonia, and emphysema are described. The presence of vanadium compounds in areas where residue from the burning of fuel oil may accumulate presents particular problems with unrecognized risk.
Medical Conditions Aggravated by Long-Term Exposure: No permanent effects are reported, but respiratory symptoms may persist for years.
Target Organs: Respiratory system, skin, and eyes.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: *Skin*: eczema-like reaction with intense itching. Sensitization or generalized hives may occur. Green discoloration of the hands and groin area is noted. *Eyes*: severe irritation with burning and tearing may occur. *Airway*: nasal congestion, throat irritation, dry mouth, green discoloration of the tongue, metallic taste, coughing, bronchitis, pneumonia, chest pain, and pulmonary edema are noted. *Cardiovascular*: constriction of blood supply to the lungs, spleen, kidneys, and intestines. *CNS*: headaches, decreased constriction mentation in severe exposures. *GI*: diarrhea, black stools, cramping.
Chronic Effects: The lung effects may last up to two weeks following exposure. Skin and tongue discoloration may develop gradually.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Notes to Physician: Include diagnostic tests such as vanadium in urine (normal <1 µg/g creatine), patch (eczema), and pulmonary function (FEV_1 and FVC).

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and provide adequate ventilation. Cleanup personnel should protect against dust inhalation and skin or eye contact. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
L[illegible] as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For concentrations less than or equal to 70 mg/m^3, use a powered air-purifying respirator with full facepiece and high-efficiency particulate filter. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks) or concentrations >70 mg/m^3, wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact.
Ventilation: Provide general and local ventilation systems to maintain airborne concentrations just below the exposure limits (Sec. 2). Exhaust ventilation systems discharging to outside air must conform with applicable local, state, and federal air pollution regulations. Ventilation systems need to be cleaned and their effectiveness tested with airflow measurements taken at least every 3 months. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed containers in a cool, dry, well-ventilated area. Protect containers from damage. Use good housekeeping practices to prevent accumulation of dust and follow cleaning techniques that minimize airborne particulate.
Engineering Controls: Avoid dust, vapor, or fume inhalation when generated. Prevent contact with eyes and skin. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures.
Other Precautions: Provide preplacement and periodical medical examinations that emphasize the eyes, skin, and lungs. For biological monitoring of exposed workers use urinary vanadium excretion. Include pulmonary function tests in periodical medical examinations.
Transportation Data (49 CFR 172.101, .102): Not listed

MSDS Collection References: 2-10, 12, 14, 20, 26, 40, 41, 73, 84, 88, 89, 100, 101, 103, 109, 124, 126, 127, 132, 133, 136, 138, 139, 140, 143, 146
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Material Safety Data Sheets Collection:
Sheet No. 382
Vinyl Chloride
Issued: 7/78 Revision: C, 9/92

Section 1. Material Identification 39

Vinyl Chloride (C_2H_3Cl) Description: Derived from ethylene dichloride and alcoholic potassium, by reaction of acetylene and hydrogen chloride (as gas or liquids), or by oxychlorination where ethylene reacts with hydrochloric acid and oxygen. Inhibitors such as butyl catechol, hydroquinone, or phenol are added to prevent polymerization. Used in the plastics industry for the production of polyvinyl chloride resins, in organic synthesis and formerly as a refrigerant, extraction solvent, and propellant (banned in 1974 because of its carcinogenic activity).

Other Designations: CAS No. 75-01-4, chloroethylene, chloroethene, ethylene monochloride, Trovidur, VC, VCM.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

Cautions: Vinyl chloride is a confirmed human carcinogen. Vapor inhalation leads to central nervous system (CNS) depression. The liquid can cause frostbite. It is a flammable gas at room temperature and polymerizes on exposure to air or sunlight. Avoid exposure to VC through engineering controls and wearing PPE

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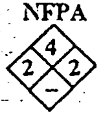
NFPA



HMIS
H 3*
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PPE - Sec. 8
* Chronic effects

Section 2. Ingredients and Occupational Exposure Limits

Vinyl Chloride, ca 98 to 99%. Impurities include water, acetaldehyde, hydrogen chloride, hydrogen peroxide, methyl chloride, butane, 1,3-butadiene, chlorophene, diacetylene, vinyl acetylene, and propine.

1991 OSHA PELs
8-hr TWA: 1 ppm
Ceiling: 5 ppm; OSHA-X

1990 NIOSH REL
NIOSH-X

1992-93 ACGIH TLV
TWA: 5 ppm (13 mg/m^3)
TLV-A1

1990 DFG (Germany) TRK*
Existing Installations: 3 ppm
MAK-A1

1985-86 Toxicity Data†
Man, inhalation, TC_{Lo}: Intermittent exposure to 200 ppm for 14 yr caused liver tumors.
Man, inhalation, TC_{Lo}: 30 mg/m^3/5 yr caused spermatogenesis.
Human, inhalation, TC: Continuous exposure to 300 mg/m^3 for an undetermined number of weeks caused blood tumors.
Rat, oral, LD_{50}: 500 mg/kg; toxic effects not yet reviewed

* TRK (technical exposure limit) is used in place of MAK when a material is a carcinogen. Unlike an MAK below which no adverse effects are expected, the TRK is a limit set below which adverse effects may still occur. This is based on the theory that 1 molecule of a carcinogenic substance may still produce a tumor. The TRK is set to allow for an acceptable risk (for example, 1 tumor in 1 million persons may be an acceptable risk).
† See NIOSH, *RTECS* (KU9625000), for additional mutation, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 7 °F (-13.9 °C)
Freezing Point: -245 °F (-159.7 °C)
Molecular Weight: 62.5
Specific Gravity: 0.9106 at 68 °F (20 °C)
Ionization Potential: 9.99 eV
Refraction Index: 1.370 at 20 °C/D
Surface Tension: 23.1 dyne/cm at -4 °F (-20 °C)
Odor Threshold: 2000 to 5000 ppm*
Vapor Density (Air = 1): 2.155
Water Solubility: Slightly soluble, 0.1% at 77 °F (25 °C)
Other Solubilities: alcohol, benzene, carbon tetrachloride, ether, hydrocarbon and oils.
Vapor Pressure: 2530 mm Hg at 68 °F (20 °C), 400 mm Hg at -18.4 °F (-28 °C)
Critical Temperature: 304.7 °F (151.5 °C)
Critical Pressure: 56.8 atm
Viscosity: 0.01072 cP at 68 °F (20 °C), *gas*; 0.28 cP at -4 °F (-20 °C), *liquid*
Appearance and Odor: A gas at room temperature. Usually found as a compressed/cooled liquid. The colorless liquid forms a vapor with a pleasant ethereal odor.

*The actual vapor concentration that can be detected by humans has not been adequately determined and varies from one individual to another, from impurities, and probably from exposure duration. The odor threshold is not an accurate warning of exposure.

Section 4. Fire and Explosion Data

Flash Point: -108.4 °F (-78 °C) OC	**Autoignition Temperature:** 882 °F (472 °C)	**LEL:** 3.6% v/v	**UEL:** 33% v/v

Extinguishing Media: For small fires, use dry chemical or carbon dioxide. For large fires, use water spray, fog, or regular foam. **Unusual Fire or Explosion Hazards:** Large fires can be practically inextinguishable. Vapors may travel to an ignition source and flash back. VC may polymerize in cylinders or tank cars and explode in heat of fire. Vapors pose an explosion hazard indoors, outdoors, and in sewers. VC decomposes in fire to hydrogen chloride, carbon monoxide, carbon dioxide, and phosgene. Burning rate = 4.3 mm/min. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Stop gas leak if possible. Let tank, tank car, or tank truck burn unless leak can be stopped. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if this is impossible, withdraw from area and let fire burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. *Do not* release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Long term exposure to air may result in formation of peroxides which initiates explosive polymerization of the chloride. VC can polymerize on exposure to light or in presence of a catalyst. **Chemical Incompatibilities:** VC can explode on contact with oxide of nitrogen, may liberate hydrogen chloride on exposure to strong alkalies, and is incompatible with copper, oxidizers, aluminum, and peroxides. In the presence of moisture, VC attacks iron and steel. **Conditions to Avoid:** Exposure to sunlight, air, heat, and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of vinyl chloride can produce carbon oxides, and chloride gas.

Section 6. Health Hazard Data

Carcinogenicity: Vinyl chloride is listed as a carcinogen by the IARC (Class 1, *sufficient human evidence*),[164] NTP (Class 1, *sufficient human evidence*),[169] NIOSH (Class X, *carcinogen defined without further categorization*),[163] ACGIH (TLV-A1, *confirmed human carcinogen*),[163] DFG (MAK A1, *capable of inducing malignant tumors in humans*),[163] and OSHA (Class X, *carcinogen defined without further categorization*).[164] Liver tumors (angiosarcomas) are confirmed from VC exposure. Other tumors of the CNS, respiratory system, blood, and lymphatic system have occurred from exposure to the polyvinyl chloride manufacture process but VC itself may not be the causative agent. **Summary of Risks:** Vapor inhalation causes varying degrees of CNS depression with noticeable anesthetic effects at levels of 1% (10,000 ppm). Studies have shown loss of libido and sperm in men exposed to VC and in Russian studies, 77% of exposed women experienced ovarian dysfunction, benign uterine growths, and prolapsed genital organs. However, no teratogenic effects have been seen in offspring of exposed workers.

Continue on next page

Section 6. Health Hazard Data, *continued*

It appears that metabolism is necessary before many of VC's toxic effects occur. Some vinyl chloride is exhaled unchanged but most is metabolized to chloroacetaldehyde. Skin absorption may occur if liquid is confined on skin but absorbed amount would be small. It is possible that the phenol inhibitor may be absorbed as well. The compressed liquid can cause frostbite. Vapors are severely irritating to the eyes. Chronic exposure can cause cancer and a triad of syndromes known as *vinyl chloride disease*. **Medical Conditions Aggravated by Long-Term Exposure:** Liver, cardiac, pulmonary, and c[illegible]ective tissue disorders. **Target Organs:** Liver, CNS, respiratory and lymphatic systems, bone, and connective tissue of the skin. **Primary Entry [illegible]es:** Inhalation, skin/eye contact. **Acute Effects:** CNS effects include fatigue, headache, vertigo, ataxia, euphoria, visual disturbances, dulling of auditory cues, numbness and tingling in the extremities, narcosis, unconsciousness, and death due to respiratory failure. Respiratory problems include dyspnea, asthma, and pneumonoconiosis. **Chronic Effects:** Repeated exposure has lead to liver cancer; confirmed because of the otherwise rarity of its type (angiosarcoma). Tumors in other organs have occurred in the polyvinyl chloride industry but agents other than VC may be responsible; authorities are still debating this issue. A triad of other effects are associated with VC exposure. Acro-osteolysis is associated with hand cleaning of polymerization vessels and characterized by dissolution of bone in the hands, especially when associated with resorption. Raynaud's Phenomenon is a vascular disorder marked by recurrent spasm of the capillaries and especially those of the fingers and toes on exposure to cold. This is usually accompanied by pain and in severe cases may progress to local gangrene. Sclerodermatous skin changes (affecting the dorsal hands and distal forearms) are seen and described as a slowly progressive disease marked by deposition of fibrous connective tissue in the skin. The skin becomes thickened and raised nodules appear. Arthralgias (pain in one or more joints) and blood changes with decreased platelet number and capillary abnormalities may also occur.

FIRST AID **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. For frostbite, immerse affected area in 107.6 °F (42 °C) water until completely rewarmed. *Do not* use dry heat. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Unlikely! VC is a gas above 7 °F (-14°C). **Note to Physicians:** Endotracheal intubation may be required if significant CNS or respiratory depression occur. Diagnostic test: thiodiglycolic acid in urine (normally < 2 mg/g creatinine).

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. If possible without risk, stop gas flow. Shut off ignition sources. Report any release > 1 lb. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** VC reacts with hydroxyl radicals in the trophosphere with a half-life of 1.2 days. The half-life = a few hr in photochemical smog. Reaction products in the air include chloroacetaldehyde, hydrogen chloride, chloroethylene, epoxide, formaldehyde, formyl chloride, formic acid, and carbon monoxide. In soil, VC rapidly volatilizes. What does not evaporate will be highly mobile and may leach into groundwater. In water, VC is not expected to hydrolyze, bioconcentrate, or absorb to sediment. It will rapidly volatilize with an estimated half-life of 0.805 hr for evaporation from a river 1 meter deep with a current of 3 meter/sec and a wind velocity of 3 meter/sec. In waters containing photosensitizers such as humic acid, photodegradation will be rapid. **Soil Absorption/Mobility:** From an estimated solubility of 2,700 ppm, a Koc of 56 is established for VC which indicates high soil mobility and potential to leach into groundwater. **Disposal:** Dilute any waste compressed liquid to a 1% solution and remove phenol inhibitor as sodium. Pour onto vermiculite, sodium bicarbonate, or a sand & soda ash mixture (90/10). Add slaked lime if fluoride is present. Mix in paper boxes, place in incinerator, cover with scrap wood and paper, and ignite with excelsior train. Another method is to dissolve waste in a flammable solvent and spray in incinerator firebox equipped with an afterburner and alkali scrubber. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U043

S[illegible] Extremely Hazardous Substance (40 CFR 355), TPQ: Not listed

L[illegible] as a SARA Toxic Chemical (40 CFR 372.65)

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1 lb (0.454 kg) [* per CWA, Sec. 307 (a); CAA, Sec. 112, & RCRA, Sec. 3001]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. According to NIOSH(148), for any detectable concentration use a SCBA or supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode. See 29 CFR 1910.1017 for detailed OSHA respirator recommendations. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of Viton or chlorinated polyethylene to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL's (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate work clothes from street clothes, launder before reuse and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a cool, dry, well-ventilated area in clearly labeled containers. Outside or detached storage is preferred. Large amounts should be stored in steel containers under pressure. Keep separate from incompatibles (Sec. 5). Venting, under pressure should be safety relief. At atm, venting should be pressure vacuum. Regularly monitor inhibitor levels. To avoid static sparks, electrically ground and bond all equipment used with VC. Avoid open flames, spark formation and electric discharges around VC. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Install Class 1, Group D electrical equipment. **Administrative Controls:** Inform VC exposed personnel of hazards associated with its use. Preplacement and periodic medical exams of workers exposed above the action level is mandatory under OSHA 29 CFR (1910.1017). Monitor for liver cancer, scleroderma, pneumonitis, clotting abnormalities, and acro-osteolysis.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Vinyl Chloride
DOT Hazard Class: 2.1
ID N[illegible]: UN1086
D[illegible]acking Group: —
DO[illegible] Label: Flammable Gas
Special Provisions (172.102): B44

Packaging Authorizations
a) Exceptions: 173.306
b) Non-bulk Packaging: 173.304
c) Bulk Packaging: 173.314 & 173.315

Quantity Limitations
a) Passenger Aircraft or Railcar: Forbidden
b) Cargo Aircraft Only: 150 kg

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: 40

***MSDS Collection* References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 140, 148, 149, 153, 159, 162, 163, 164, 167, 168, 171, 174, 175

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** AC Darlington, MPH, MD

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Material Safety Data Sheets Collection:

Sheet No. 73
Zinc Metal/Powder

Issued: 7/80 Revision: A, 11/89

Section 1. Material Identification

30

Zinc Metal/Powder Description: A metallic element extracted from ores which are first roasted to form zinc oxide and then: 1) the zinc oxide is leached from the roasted material with sulfuric acid to form a zinc sulfate solution which is electrolyzed in cells to deposit zinc on cathodes and 2) the zinc oxide is reduced with carbon in retorts (distilling vessels) to yield distilled and condensed zinc. Used as ingredient in alloys such as brass, bronze, and die-casting alloys; galvanizing sheet iron; for electrical apparatus, especially castings, building materials, dry cell batteries, automotive equipment, household utensils, railroad car linings; as a fungicide; in nutrition (essential growth element); as reagent in analytical chemistry; in bleaching bone glue, manufacturing sodium hydrosulfite, and insulin zinc salts.

Other Designations: Blue powder; spelter; granular zinc; jasad; merrillite; pasco; Zn; CAS No. 7440-66-6.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide* (Genium ref. 73) for a suppliers list.

R 1
I 1
S 1
K 1

NFPA
1
0 1
-

HMIS
H 0
F 1
R 1
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Zinc metal/powder, ca 99%

OSHA PEL	ACGIH TLV, 1989-90	NIOSH REL, 1987	Toxicity Data†
None established*	None established*	None established*	Human, inhalation, TC_{Lo}: 124 mg/m³/50 min, pulmonary system effects

* The current OSHA standard and ACGIH (1989-1990) TWA for zinc oxide (ZnO) fumes is 5 mg/m³. The ACGIH TWA for zinc oxide dust is 10 mg/m³, providing that total contains no asbestos and is <1% crystalline silica. NIOSH has recommended a 10-hr TWA of 5 mg/m³ and a ceiling level of 15 mg/m³ (15-min sample) for zinc oxide fume. The TLV-TWA level was set to prevent metal fume fever.

† See NIOSH, *RTECS* (ZG8600000), for additional data with references to irritative effects.

Section 3. Physical Data

Boiling Point: 907 °F (1663 °C)
Melting Point: 419 °F (787 °C)
Vapor Pressure: 1 mm Hg at 909 °F (487 °C)
Brinell Hardness: 31
Atomic Weight: 65.37 g/mol
Specific Gravity (H_2O = 1 at 39 °F (4 °C)): 7.13 at 77 °F (25 °C)
Water Solubility: Insoluble
Index of Explosibility, Zn Powder (<0.1 weak, >10 severe): 0.1

Appearance and Odor: Bluish-white lustrous metal, also finely divided forms.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: Cloud, 1256 °F (680 °C);* dust layer, 860 °F (460°C);* powder, 650 mJ*	LEL: Dust cloud explosion, 0.5 oz/ft³	UEL: None reported

Extinguishing Media: Use special dry chemical or clean dry sand. *Never* use CO_2. Using a direct stream of water may scatter the fire or disperse dust, creating a potentially explosive mixture if exposed to heat or ignition sources. A water spray may be used to cool fire-exposed containers and disperse vapors.

Unusual Fire or Explosion Hazards: Flammable hydrogen gas is liberated by reaction with alkali hydroxides (sodium, potassium, and calcium hydroxides), acids, or even water (when material is in dust form) and is an explosion hazard in a confined space. In a fire, zinc may melt, vaporize, and burn to form ZnO fumes (Sec. 2).

Special Fire-fighting Procedures: For major fires, or if large quantities of this material are involved, fire fighters should wear appropriate protective clothing and respiratory protection. Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

* Zinc dust refers to the product of zinc vapor condensation, and zinc powder to the product of molten zinc atomization (*Zinc Dust and Zinc Powder: Their Production, Properties, and Applications*, B.C. Hafford, W.E. Pepper, and T.B. Lloyd, 1982). Dust 100% thru 74-μm sieve; a 0.96-J spark can ignite a cloud. The ignition temperature in CO_2 is 896 °F (480 °C). The reaction temperature in a nitrogen atmosphere is 1112 °F (600 °C).

Section 5. Reactivity Data

Stability/Polymerization: Zinc is stable in dry air at room temperature. Moist zinc dust can react exothermically and ignite spontaneously in air. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Zinc dust is an explosion hazard when reacted with acids, chlorates, oxidizing agents (sulfur and oxygen), halogenated hydrocarbons, hydrazine mononitrate, hydroxylamine, ammonium nitrate, barium dioxide, barium nitrate, cadmium, performic acid, manganese chloride, nitric acid, ethyl acetoacetate and tribromoneopentyl alcohol, tellurium, carbon disulfide, lead azide, magnesium and barium nitrate and barium dioxide, selenium, sodium peroxide, potassium nitrate, and water. In humans, a toxic effect results from inhaling 124 mg/m³ of zinc metal/powder for 50 min.

Hazardous Products of Decomposition: Thermal oxidative decomposition of zinc can produce highly toxic fumes. Above 999 °F (537 °C) vaporized zinc burns in air with a blue-green flame to produce zinc oxide fumes.

Section 6. Health Hazard Data

Carcinogenicity: Neither the NTP, IARC, nor OSHA lists zinc as a carcinogen.

Summary of Risks: Zinc is relatively nontoxic, but when combined with other materials such as oxygen or mineral acids, the resulting compounds can have toxic effects. It is not readily absorbed through the skin, gastrointestinal (GI tract), or lungs. Although most inorganic zinc compounds are potential causes of gastroenteric irritation, a high-level dose is relatively nontoxic when ingested. Zinc is considered essential to life. gestion of soluble salts may cause nausea and vomiting, sluggishness, and light-headedness. Inhalation of zinc fumes normally generated by c and extreme heat may cause *metal fume fever*, which is accompanied by throat dryness and irritation, coughing, weakness, dyspnea, and generalized aching that generally passes within 24 hr. These symptoms usually begin 3 to 10 hr after exposure and resolve within 24 to 48 hr. Inhalation of zinc dust may cause mild irritation to the upper respiratory tract. Prolonged skin contact with zinc may cause a mild, drying dermatitis.

Medical Conditions Aggravated by Long-Term Exposure: Since metallic zinc particulates can be considered a niusance dust, repeated inhalation of zinc dust could lead to respiratory complications.

Target Organs: Respiratory system.

Primary Entry: Inhalation, ingestion.

Acute Effects: Metal fume fever is an acute, self-limiting condition, without recognized complications, aftereffects, or chronic forms. Symptoms appear several hours after exposure. Removal from exposure normally alleviates symptoms with no residual or chronic effects. A degree of tolerance may result from continued exposure, but is quickly lost after a day or two of nonexposure.

Chronic Effects: Zinc and zinc powder have little history of causing chronic effects.

FIRST AID

Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.

Skin: After rinsing affected area with flooding amounts of water, wash it with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that conscious person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear. **Physician's Note:** Calcium disodium edetate ($CaNa_2$-EDTA) has been used medically to increase the rate of zinc removal from the body; however, this usually results from chronic fume exposure or exposure to zinc salts, not to zinc metal powders.

After first aid, get appropriate in-plant, paramedic, or community medical attention and support.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of powder spills. Eliminate all heat and ignition sources. Cleanup personnel should protect against dust inhalation and eye contact. Use nonsparking tools for cleanup. Sweep or otherwise place the spilled material in an appropriate, pressure-vented, dry-metal container (with lid) for later disposal. Container should be pressure vented. Avoid creating airborne dust conditions.

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

OSHA Designations

Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

EPA Designations

RA Hazardous Waste (40 CFR 261.33): Not listed

ed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 307(a)]

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

Zinc (fume or dust) is listed as SARA Toxic Chemical (40 CFR 372.65)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: For zinc oxide dust or fume concentrations up to 50 mg/m^3 and 250 mg/m^3, use, respectively, a fume (high-efficiency particulate) respirator or an air-supplied or self-contained respirator with a full facepiece. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.

Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below established TLVs-TWAs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by eliminating it at its source (Genium ref. 103).

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Launder contaminated clothing before wearing. Remove this material from your shoes and equipment. Wash thoroughly before changing to street clothes.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in covered metal containers in a dry, well-ventilated, low fire risk area. Protect containers from physical damage. Never store with acids, halogenated hydrocarbons, or strong alkalis.

Engineering Controls: Avoid breathing dust or fumes. Use good housekeeping and cleaning techniques to minimize airborne particulates and to prevent dust accumulation. Provide suitable training in personal hygiene and in the cause and effect of metal fume fever. Prevent exposure of workers with respiratory problems or gastrointestinal disorders.

Transportation Data (49 CFR 172.102)

IMO Shipping Name: Zinc, powder or dust, nonpyrophoric	**IMO Shipping Name:** Zinc, powder or dust, pyrophoric
I Hazard Class: 4.3	**IMO Hazard Class:** 4.2
Label: Dangerous when wet	**IMO Label:** Spontaneously combustible
IMDG Packaging Group: II	**IMDG Packaging Group:** II

***MSDS Collection* References:** 2, 4-11, 24, 31, 39-41, 80, 81, 84, 85, 91, 109

Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** Warren Silverman, MD

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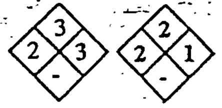
Material Safety Data Sheets Collection:

Sheet No. 758
Iron

Issued: 7/91

Section 1. Material Identification

Genium



Powder Solid

R	1	HMIS	
I	2	H	2
S	1	F	2
K	1	R	1
		PPG*	

* Sec. 8

Iron (Fe) Description: Occurs naturally as the second most abundant metal (~5%) in the earth's crust. Its commercial form usually contains some carbon, phosphorus, silica, sulfur, and manganese. It has four naturally occurring isotopes: 54, 56, 57 and 58, and six artificial ones: 52, 53, 55, 59, 60, and 61. Iron is purified by smelting ore with limestone and coke in blast furnaces (purity 91 to 92 %), or by continuous direct reduction of iron ore with limestone heated to 1699 °F (926 °C), melted at 3499 °F (1926 °C), and then reduced to iron at 2998 °F (1648 °C) with powdered coal (purity 99%). The powder form is obtained by treating ore or scrap metal with hydrochloric acid to give ferrous chloride solution, then filtrating, vacuum crystallizing, dehydrating, and reducing it at 1472 °F (800 °C) to metallic iron (briquettes or powder); or by thermal decomposition of iron carbonyl. Solid iron is used to alloy with carbon, manganese, chromium, nickel, and other elements to form steel. Its radioisotopes (^{55}Fe and ^{59}Fe) are used in biological tracer studies. The powder form is used in metallurgy products, magnets, high-frequency cores, and auto parts; and as a catalyst in ammonia synthesis.
Other Designations: CAS No. 7439-89-6, Ancor En 80/150,® Armco iron,® carbonyl iron, Loha,® Suy B-2.®
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Iron is moderately toxic by ingestion and inhalation of iron dusts and powder. The powder form is pyrophoric (ignites spontaneously upon exposure to air and other substances).

Section 2. Ingredients and Occupational Exposure Limits

Iron, ca 91 to 99%

1990 OSHA PEL	1990-91 ACGIH TLV	1990 NIOSH REL	1985-86 Toxicity Data†
8-hr TWA: 10 mg/m³*	TWA: 5 mg/m³*	5 mg/m³*	Rabbit, intraperitoneal, LD_{Lo}: 20 mg/kg; no toxic effect noted

*As iron oxide fumes.
† See NIOSH, *RTECS* (NO4565500), for additional toxicity data.

Section 3. Physical Data

Boiling Point: 4982 °F (2750 °C)
Melting Point: 2795 °F (1535 °C)
Vapor Pressure: 1 mm Hg at 3248 °F (1787 °C)
Electrical Resistivity: 9.71 µΩ/cm at 68 °F (20 °C)
Molecular Weight: 55.847
Density/Specific Gravity: 7.86 at 68 °F (20 °C)
Water Solubility: Insoluble

Appearance and Odor: Pure, solid iron is a silvery-white or gray, soft, ductile, malleable (can be rolled, hammered, or bent), slightly magnetic (becoming more so as it is alloyed; for example, steel) metal. It is available as ingots, wire, sheets, or powder. The powder form is black-gray.

Section 4. Fire and Explosion Data

Flash Point: None reported*	**Autoignition Temperature:** None reported*	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: For small fire, use water spray, carbon dioxide (CO_2), or regular foam. For large fires, use water spray or regular foam. Apply cooling water spray to fires-exposed container sides until fire is well out. If possible with no risk, remove containers from area.
Unusual Fire or Explosion Hazards: Since finely divided iron powder is pyrophoric and ignites upon exposure to air at normal temperatures, fires and dust explosions can occur in ducts or separators used to remove the dust during grinding and polishing operations.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Fight fire from as far a distance as possible. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

*Although no flash point or autoignition temperature is reported, remember that the powder form is pyrophoric and can ignite spontaneously in air at room temperatures.

Section 5. Reactivity Data

Stability/Polymerization: Iron is stable in dry air, but readily oxidizes in moist air to form rust. Highly divided powder forms are very unstable and can ignite spontaneously in air.
Chemical Incompatibilities: Solid or powdered iron ignites or explodes on contact with acetaldehyde, ammonium peroxodisulfate, chloroformamidinium, chloric acid, ammonium nitrate, halogens, dinitrogen tetraoxide, nitryl fluoride, polystyrene, sodium acetylide, potassium dichromate, peroxyformic acid, and nitryl fluoride. Hot iron wire burns in chlorine gas and iron with water forms rust.
Conditions to Avoid: Avoid generation of iron dusts and contact with the materials listed above.
Hazardous Products of Decomposition: Thermal oxidative decomposition of iron can produce toxic iron oxide fumes.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC, NTP, and OSHA do not list iron as a carcinogen although the mining of one particular ore, hematite, may be associated with an increased risk of lung cancer in miners. No other iron ores are identified specifically as a carcinogen.

Summary of Risks: Occupational exposures usually result from dust or fume inhalation during mining, ore preparation, production, and refining of the metal and its alloys. Acute and chronic toxicity can occur. Although rare, occupational toxicity by ingestion has occurred. Its effects are the same as those by ingestion of large amounts of iron tablets.

Medical Conditions Aggravated by Long-Term Exposure: Chronic respiratory diseases.

Target Organs: Eyes, respiratory tract, liver, and pancreas.

Primary Entry Routes: Eyes, inhalation, and ingestion.

Acute Effects: Inhalation may be irritating to the respiratory tract. Eye contact may cause conjunctivitis (inflammation of the eye's lining), and deposition of iron particles can leave a "rust ring" or brownish stain on the cornea. Iron's acute toxicity results primarily from accidental or suicidal ingestions (e.g., overdose of iron-containing vitamin pills). Initially, the patient may have vomiting, abdominal pain, bloody diarrhea, hematemesis (vomiting blood), lethargy, and shock. After several hours, the patient may improve, but should be observed carefully, as toxicity may progress to development of profound shock, severe acidosis (increased acidity in blood), cyanosis (bluish skin discoloration), and fever. Two to four days after exposure, liver damage may occur. Within several weeks after exposure, in several rare cases, gastrointestinal fibrosis (scarring) has occurred with obstruction of the digestive tract. Iron overdose may be fatal.

Chronic Effects: Chronic inhalation can produce mottling (spotting) of lungs (siderosis). This condition is often without symptoms and has been referred to as "benign radiopaque pneumoconiosis." Ingestion of greater than 50 to 100 mg of iron per day may result in pathological iron deposition in body tissues. Symptoms include fibrosis (scarring) of the pancreas, diabetes mellitus, and liver cirrhosis. Repeated iron ingestion can produce cardiac toxicity.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. Consult poison control center.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Management of iron poisoning by ingestion is complex and beyond this MSDS's scope. Consult a medical toxicologist.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel. Isolate hazard area, deny entry, and stay upwind. Shut off all ignition sources–no flares, smoking, or flames in hazard area. Avoid dust generation by cleaning small spills with a damp mop. Since finely divided iron powder is explosive, take special care during cleanup. For large spills, flush material with a stream of water and dike for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
[illegible]RA Extremely Hazardous Substance (40 CFR 355): Not listed
[illegible]RA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

Listed (as iron oxide fumes) as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator.

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent any skin contact.

Ventilation: Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Avoid physical damage to containers. Store in a cool, dry, well-ventilated area away from flammable gases or liquids, oxidizing materials, or organic peroxides (Sec. 5).

Engineering Controls: Avoid dust inhalation. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Regularly service the ducting at grinding and polishing machines and finishing belts to maintain efficiency of exhaust ventilation and prevent explosion. Remote control operations of machinery is advisable when at all possible.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Iron mass or sponge, *not properly oxidized*
DOT Hazard Class: Flammable solid
ID No.: NA1383
DOT Label: Flammable solid
DOT Packaging Exceptions: None
D[illegible] Packaging Requirements: 173.174

MSDS Collection References: 26, 73, 103, 124, 126, 127, 132, 136, 138, 139, 143, 146, 148, 149, 159

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 713
Lead (Inorganic)

Issued: 8/90

Section 1. Material Identification

32

Lead (Inorganic) (Pb) Description: Exists widely throughout the world in a number of ores. Its main commercial source is galena (lead sulphide). Lead mineral is separated from crude ores by blast-furnace smelting, drossing, or electrolytic refining. Lead is used mostly in manufacturing storage batteries. Other uses are in manufacturing tetraethyllead and both organic and inorganic lead compounds in ceramics, plastics, and electronic devices; in producing ammunition, solder, cable covering, sheet lead, and other metal products (brass, pipes, caulking); in metallurgy; in weights and as ballast; as a chemical intermediate for lead alkyls and pigments; as a constuction material for the tank linings, piping, and equipment used to handle the corrosive gases and liquids used in sulfuric acid manufacturing, petroleum refining, halogenation, sulfonation, extraction, and condensation; and for x-ray and atomic radiation protection.

Other Designations: CAS No. 7439-92-1, lead oxide; lead salts, inorganic; metallic lead; plumbum.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

R	0
I	4
S	-
K	0

Genium

HMIS
H 3
F 1
R 0
PPG*
* Sec. 8

Cautions: *Inorganic lead is a potent systemic poison.* Organic lead (for example, tetraethyl lead) has severe, but different, health effects. Occupational lead poisoning is due to inhalation of dust and fumes. Major affected organ systems are the nervous, blood, and reproductive systems, and kidneys. Health impairment or disease may result from a severe acute short- or long-term exposure.

Section 2. Ingredients and Occupational Exposure Limits

Lead (inorganic) fumes and dusts, as Pb, ca 100%

1989 OSHA PELs (Lead, Inorganic compounds)
8-hr TWA: 50 µg/m³
Action Level TWA*: 30 µg/m³

29 CFR 1910.1025 Lead Standard
Blood Lead Level: 40 µg/100 g

1989-90 ACGIH TLV (Lead, Inorganic, fumes and dusts)
TLV-TWA: 150 µg/m³

1988 NIOSH REL
10-hr TWA: <100 µg/m³

1985-86 Toxicity Data†
Human, inhalation, TC_{Lo}: 10 µg/m³ affects gastrointestinal tract and liver
Human, oral, TD_{Lo}: 450 mg/kg ingested over 6 yr affects peripheral and central nervous systems
Rat, oral, TD_{Lo}: 790 mg/kg affects multigeneration reproduction

* Action level applies to employee exposure without regard to respirator use.
† See NIOSH, *RTECS* (OF7525000), for additional mutative, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 3164 °F (1740 °C)
Melting Point: 621.3 °F (327.4 °C)
Vapor Pressure: 1.77 mm Hg at 1832 °F (1000 °C)
Viscosity: 3.2 cp at 621.3 °F (327.4 °C)
Molecular Weight: 207.20
Specific Gravity (20 °C/4 °C): 11.34
Water Solubility: Relatively insoluble in hot or cold water*

Appearance and Odor: Bluish-white, silvery, gray, very soft metal.

* Lead dissolves more easily at a low pH.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or foam to extinguish fire.
Unusual Fire or Explosion Hazards: Flammable and moderately explosive in the form of dust when exposed to heat or flame.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Lead is stable at room temperature in closed containers under normal storage and handling conditions. It tarnishes on exposure to air. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Mixtures of hydrogen peroxide + trioxane explode on contact with lead. Lead is incompatible with sodium azide, zirconium, disodium acetylide, and oxidants. A violent reaction on ignition may occur with concentrated hydrogen peroxide, chlorine trifluoride, sodium acetylide (with powdered lead), ammonium nitrate (below 200 °C with powdered lead). Lead is attacked by pure water and weak organic acids in the presence of oxygen. Lead is resistant to tap water, hydrofluoric acid, brine, and solvents.
Conditions to Avoid: Rubber gloves containing lead may ignite in nitric acid.
Hazardous Products of Decomposition: Thermal oxidative decomposition of lead can produce highly toxic fumes of lead.

Section 6. Health Hazard Data

Carcinogenicity: Although the NTP and OSHA do not list lead as a carcinogen, the IARC lists it as probably carcinogenic to humans, but having (usually) no human evidence. However, the literature reports instances of lead-induced neoplasms, both benign and malignant, of the kidney and other organs in laboratory rodents. Excessive exposure to lead has resulted in neurologic disorders in infants. Experimental studies show lead has reproductive and teratogenic effects in laboratory animals. Human male and female reproductive effects are also documented.
Summary of Risks: Lead is a potent, systemic poison that affect a variety of organ systems, including the nervous system, kidneys, reproductive system, blood formation, and gastrointestinal (GI) system. The most important way lead enters the body is through inhalation, but it can also be ingested when lead dust or unwashed hands contaminate food, drink, or cigarettes. Much of ingested lead passes through feces without absorption into the body. Adults may absorb only 5 to 15% of ingested lead; children may absorb a much larger fraction. Once in the body, lead enters the bloodstream and circulates to various organs. Lead concentrates and remains in bone for many years. The amount of lead the body stores increases as exposure continues, with possibly cumulative effects. Depending on the dose entering the body, lead can be deadly within several days or affect health after many years. Very high doses can cause brain damage (encephalopathy).
Medical Conditions Aggravated by Exposure: Lead may aggravate nervous system disorders (e.g., epilepsy, neuropathies), kidney diseases, high blood pressure (hypertension), infertility, and anemia. Lead-induced anemia and its effect on blood presssure can aggravate cardiovascular disease.

Continue on next page

Section 6. Health Hazard Data, *continued*

Target Organs: Blood, central and peripheral nervous systems, kidneys, and gastrointestinal (GI) tract.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: An acute, short-term dose of lead could cause acute encephalopathy with seizures, coma, and death. However, short-term exposures of this magnitude are rare. Reversible kidney damage can occur from acute exposure, as well as anemia.
onic Effects: Symptoms of chronic long-term overexposure include appetite loss, nausea, metallic taste in the mouth, lead line on gingival [illegible]) tissue, constipation, anxiety, anemia, pallor of the face and the eye grounds, excessive tiredness, weakness, insomnia, headache, nervous irritability, fine tremors, numbness, muscle and joint pain, and colic accompanied by severe abdominal pain. Paralysis of wrist and, less often, ankle extensor muscles may occur after years of increased lead absorption. Kidney disease may also result from chronic overexposure, but few, if any, symptoms appear until severe kidney damage has occurred. Reproductive damage is characterized by decreased sex drive, impotence, and sterility in men; and decreased fertility, abnormal menstrual cycles, and miscarriages in women. Unborn children may suffer neurologic damage or developmental problems due to excessive lead exposure in pregnant women. Lead poisoning's severest result is encephalopathy manifested by severe headache, convulsions, coma, delirium, and possibly death.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Consult a physician if any health complaints develop.
Inhalation: Remove exposed person to fresh air and support breathing as needed. Consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If large amounts of lead were ingested, induce vomiting with Ipecac syrup. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: For diagnosis, obtain blood pressure, blood lead level (PbB), zinc protoporphyrin (ZPP), complete blood count for microcytic anemia and basophilic stippling, urinalysis, and blood urea nitrogen (BUN) of creatinine. Examine peripheral motor neuropathy, pallor, and gingival lead line. Use Ca-EDTA to treat poison, but *never* chelate prophylactically. Consult an occupational physician or toxicologist.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel immediately. Cleanup personnel should protect against inhalation of dusts or fume and contact with skin or eyes. Avoid creating dusty conditions. Water sprays may be used in large quantities to prevent the formation of dust. Cleanup methods such as vacuuming (with an appropriate filter) or wet mopping minimizes dust dispersion. Scoop the spilled material into closed containers for disposal or reclamation. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33, Appendix II—EP Toxicity Test Procedures)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

ion 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Protective clothing made of man-made fibers and lacking turn-ups, pleats, or pockets retain less dust from lead.
Ventilation: Provide general and local ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially washing hands before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all incompatible materials, direct sunlight, and heat and ignition sources.
Engineering Controls: Educate worker about lead's hazards. Follow and inform employees of the lead standard (29 CFR 1910.1025). Avoid inhalation of lead dust and fumes and ingestion of lead. Use only with appropriate personal protective gear and adequate ventilation. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Avoid creating dusty conditions. Segregate and launder contaminated clothing. Take precautions to protect laundry personnel. Practice good personal hygiene and housekeeping procedures. For a variety of reasons, the lead concentration in workroom air may not correlate with the blood lead levels in individuals.
Other Precautions: Provide preplacement and periodic medical examinations which emphasize blood, nervous system, gastrointestinal tract, and kidneys, including a complete blood count and urinalysis. Receive a complete history including previous surgeries and hospitalization, allergies, smoking history, alcohol consumption, proprietary drug intake, and occupational and nonoccupational lead exposure. Maintain records for medical surveillance, airborne exposure monitoring, employee complaints, and physician's written opinions for at least 40 years or duration of employment plus 20 years. Measurement of blood lead level (PbB) and zinc protoporphyrin (ZPP) are useful indicators of your body's lead absorption level. Maintain worker PbBs at or below 40 µg/100 g of whole blood. To minimize adverse reproductive health effects to parents and developing fetus, maintain the PbBs of workers intending to have children below 30 µg/100 g. Elevated PbBs increase your risk of disease, and the longer you have elevated PbBs, the greater your chance of substantial permanent damage.

Transportation Data (49 CFR 172.102)
IMO Shipping Name: Lead compounds, soluble, n.o.s.
I Hazard Class: 6.1
I: UN2291
IMO Label: St. Andrews Cross (X, Stow away from foodstuffs)
IMDG Packaging Group: III

MSDS Collection **References:** 26, 38, 73, 84, 85, 88, 89, 90, 100, 101, 103, 109, 124, 126, 132, 133, 134, 136, 138, 139, 142, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:
Sheet No. 723
Nickel Metal
Issued: 8/90

Section 1. Material Identification

32

Nickel (Ni) Description: Found in ores in combination with sulphur, oxygen, antimony, arsenic, and/or silica. The Orford (sodium sulfide and electrolysis) and the Mond (nickel carbonyl) processes are used to refine nickel. Used in electroplating, casting operations for machine parts, manufacturing acid-resisting and magnetic alloys and tapes, synthesizing acrylic esters; in surgical and dental prostheses, coinage, catalytic gastrification of coal, paint pigments, Ni-Cd batteries, ceramics and glass; and as a catalyst in hydrogenation of fats and oils.

Other Designations: CAS No. 7440-02-0, Raney alloy, Raney nickel.*

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

Cautions: Nickel is an eye, skin, and respiratory tract irritant. *Chronic inhalation of nickel dust or fumes may cause cancer of the lungs and nasal passages. Nickel powder (Raney nickel) is a dangerous fire hazard.*

R 0
I 3
S 2
K 1

NFPA
4
2 0

catalyst
HMIS
H 2
F 4
R 0
PPG†

Genium
1
2 0
-

metal
HMIS
H 2
F 1
R 0
PPG†
† Sec. 8

* Raney nickel is prepared by leaching (with 25% caustic soda solution) aluminum from an alloy of 50% aluminum and 50% nickel. It is used as a catalyst for hydrogenation. Raney nickel, a silvery gray metal powder, is a dangerous fire risk and ignites spontaneously in air (Sec. 4). Nickel catalysts cause many industrial accidents.

Section 2. Ingredients and Occupational Exposure Limits

Nickel, ca 100%

1989 OSHA PEL	1989-90 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data*
8-hr TWA: 1 mg/m³	TLV-TWA: 1 mg/m³	0.015 mg/m³	Dog, intravenous, LD_{Lo}: 10 mg/kg Guinea pig, oral, LD_{Lo}: 5 mg/kg Rat, implant, TD_{Lo}: 250 mg/kg

* See NIOSH, *RTECS* (QR5950000), for additional mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 4946 °F (2730 °C)
Melting Point: 2651 °F (1455 °C)
Vapor Pressure: 1 mm at 3290 °F (1810 °C)
Atomic Weight: 58.71
Density: 8.90 at 25 °C
Water Solubility: Insoluble

Appearance and Odor: A silvery-white, hard, malleable and ductile metal.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Smother with suitable dry powder or use large amounts of water.

Unusual Fire or Explosion Hazards: Nickel is combustible as dust or powder. Raney nickel ignites spontaneously in air. Nickel carbonyl (*MSDS Collection*, No. 226), a highly toxic substance, may form under fire conditions.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since nickel dust or powder is toxic if inhaled, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Nickel is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Nickel can react violently with fluorine, ammonium nitrate, hydrogen + dioxane, performic acid, selenium, sulfur, ammonia, hydrazine, phosphorus, and titanium + potassium chlorate. Nickel is also incompatible with oxidants. Raney nickel catalysts may initiate hazardous reactions with sulfur compounds, *p*-dioxane, hydrogen, hydrogen + oxygen, ethylene + aluminum chloride, magnesium silicate, methanol, and organic solvents + heat.

Conditions to Avoid: Avoid incompatibilities.

Hazardous Products of Decomposition: Thermal oxidative decomposition of nickel can produce highly toxic nickel carbonyl.

Section 6. Health Hazard Data

Carcinogenicity: The IARC and NTP classify nickel as, respectively, a human carcinogen (Group 1) and an anticipated human carcinogen.
Summary of Risks: Nickel dust or fume is a respiratory irritant that with chronic exposure may cause nasal or lung cancer in humans. The average latency period for the induction of these cancers appears to be about 25 yr (within a 4- to 51-yr range). Experimental studies show nickel also has neoplastigenic, tumorigenic, and teratogenic effects in laboratory animals. Hypersensitivity to nickel is common and can cause conjunctivitis, allergic contact dermatitis, and asthma. The allergic contact dermatitis ("nickel-itch," a pink papular erythema with pustulation and ulcera[illegible]) usually clears within one week, but sensitization is permanent.
Medical Conditions Aggravated by Long-Term Exposure: Chronic pulmonary, upper respiratory tract, and skin disorders. Carcinoma of the paranasal sinuses, larynx, and lung may also develop.
Target Organs: Nasal cavities, lungs, skin.
Primary Entry Routes: Inhalation, dermal contact, and ingestion.
Acute Effects: Exposure to nickel fumes can cause upper respiratory tract irritation (with nonproductive cough, rapid breathing, dyspnea, chest tightness), metal fume fever (chills, fever, flu-like symptoms), asthma, inflammation of the lungs (noninfectious pneumonia), eye (conjunctiva) irritation, nausea, vomiting, and abdominal pain. Dermal contact causes "nickel itch." Ingesting large doses causes nausea, vomiting, and diarrhea.
Chronic Effects: Prolonged or repeated contact can cause nickel sensitization. Symptoms of sensitization include nickel dermatitis with eczematous skin and lichenification (hardened and leathery skin). Chronic inhalation exposure can cause chronic pulmonary irritation, chronic thickening of the mucous membranes of the nose, nasal sinusitis, anosmia (loss or impairment of the sense of smell), and perforation of the nasal septum. Chronic exposure to dust and fumes may cause carcinoma of paranasal sinuses, larynx, and lung.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Since oral toxicity for elemental nickel is low, inducing vomiting is seldom necessary. In cases of severe vomiting or diarrhea, treat for fluid replacement.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Chronic exposure to nickel dust may cause *eosinophilic pneumonitis* (Loeffler's syndrome) which responds well to systemic cortico-steroids. There are cases of host rejection of nickel-containing prostheses after development of nickel sensitivity.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personal should protect against vapor inhalation and dermal contact. Avoid dust generation. Using nonsparking tools, carefully scoop spilled material into appropriate containers for reclamation or disposal. After completing material pickup, wash spill site. Do not release to sewers or waterways. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
[illegible]d as a SARA Toxic Chemical (40 CFR 372.65)
[illegible]A Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL, ACGIH TLV, and NIOSH REL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from incompatible materials (Sec. 2). Protect against physical damage. Store Raney nickel under inert gas or water in tightly closed containers away from heat or ignition sources, acids, caustics, and oxidizing materials.

Engineering Controls: Minimize all possible exposures to potential carcinogens. Avoid vapor inhalation and dermal contact. Use only with appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures.

Other Precautions: Provide preplacement and periodic medical examinations that emphasize the skin, nasal cavities, and lungs, including a 14" x 17" chest roentgenogram and urine nickel determinations.

Transportation Data (49 CFR 172.102)
IMO Shipping Name: Nickel catalyst, wetted with not less than 40% water or other suitable liquid, by weight, finely divided, activated, or spent
IMO Hazard Class: 4.2
ID No.: UN1378
I[illegible]Label: Spontaneously combustible
IMDG Packaging Group: II

***MSDS Collection* References:** 26, 38, 73, 84, 85, 88, 89, 90, 100, 101, 103, 109, 124, 126, 132, 133, 134, 136, 138, 139, 140, 142, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD; **Edited by:** JR Stuart, MS

APPENDIX F

Accident Investigation Form

APPENDIX A-4: ACCIDENT/INCIDENT (NEAR MISS) REPORT FORM

Employee's Name:______________________________ D.O.B.______________
Address:_____________________________________ D.O.H.__________
____ SS#__________
Job Title:______________________ Supervisor's Name:______________
Office Location:____
Location at Time of Incident:_______________________________
Date/Time of Incident:____________________________________
Project Name:____
Project Number:__________________ Project Mgr.______________

= =

Describe clearly how the accident occurred:___________________________
____
____

Was incident: Physical____________________ Chemical__________
Parts of body affected___________________ Exposure: Dermal________
right _____ left _____ Inhalation________
Ingestion__________
Witnesses: 1)_______________________________ 2)______________
Conditions/acts contributing to this Incident___________________________
____
____

= =

Managers must complete this section:

Explain specifically the corrective action you have taken to prevent a recurrence:__________
____
____

Did injured go to doctor:__________________ Where:______________
____ When:________________
Did Injured go to hospital:_________________ Where:______________
____ When:________________

= =

Signatures:

Employee	Reporting Manager	Health & Safety Representative
Date	Date	Date

Accidents must be reported immediately; this form must be completed, signed and returned to the Health and Safety Representative within *24 hours*. The Health and Safety Representative will forward a copy to Corporate Health and Safety.

Revised 5/92

APPENDIX G

Vapor Monitoring Sheet

APPENDIX B-3
GROUNDWATER TECHNOLOGY, INC.
VAPOR MONITORING FORM

Project Name:

Project Number:

Contaminants:

Date	Time	Ionization Detector Reading		Explosimeter Reading		Radiation Monitor Reading	Location	Purpose	Initials
		FID	PID	%LEL	$\%O_2$	mR/hr			

APPENDIX B-3
GROUNDWATER TECHNOLOGY, INC.
VAPOR MONITORING FORM

Project Name:

Project Number:

Contaminants:

Date	Time	Ionization Detector Reading		Explosimeter Reading		Radiation Monitor Reading	Location	Purpose	Initials
		FID	PID	%LEL	%O_2	mR/hr			

APPENDIX B-3
GROUNDWATER TECHNOLOGY, INC.
VAPOR MONITORING FORM

Project Name:

Project Number:

Contaminants:

Date	Time	Ionization Detector Reading		Explosimeter Reading		Radiation Monitor Reading	Location	Purpose	Initials
		FID	PID	%LEL	$\%O_2$	mR/hr			

APPENDIX B-3
GROUNDWATER TECHNOLOGY, INC.
VAPOR MONITORING FORM

Project Name:

Project Number:

Contaminants:

Date	Time	Ionization Detector Reading		Explosimeter Reading		Radiation Monitor Reading	Location	Purpose	Initials
		FID	PID	%LEL	%O_2	mR/hr			

APPENDIX H

Confined Space Entry Procedures

CONFINED SPACE ENTRY PERMIT

Client: ____________________
Address: ____________________
Job #: ____________________
Job location: ____________________
Dig safe #: ____________________
☐ Fire permit: ____________________
Description of work: ____________________

Permit is valid from: ____________________ AM PM
Day Date Time

To: ____________________ AM PM
Day Date Time

Hazards

☐ Toxic: ____________
☐ Corr: ____________
☐ Flamm: ____________
☐ Confined space
☐ Tank testing
☐ Drilling
☐ Extreme cold
☐ High heat area
☐ Live electrical circuits
☐ Drains/sumps
☐ Asbestos
☐ Soil excavation
☐ Sand blasting
☐ Hotsy/hydro wash
☐ Tightness joints under pressure
☐ Underground/overhead utilities
☐ Tank excavation
☐ Welding & cutting
☐ Welding under pressure
☐ Welding on vessel or enclosed space
☐ Trenching
☐ Lightning

Personal Safety

☐ Air line resp.
☐ Escape bottle
☐ SCBA
☐ Air purifying respirator
☐ Fully encapsulated suit
☐ Flame retardant suit
☐ Acid suit w/hood
☐ Face shield
☐ Protective coveralls
☐ Rain gear
☐ Hard hat
☐ Rubber gloves
☐ Rubber boots
☐ Standby person
☐ First aid supplies
☐ Safety shower/eye wash
☐ Air blower
☐ Goggles
☐ Ear protection
☐ Skin cream
☐ Non-sparking tools
☐ Escape ladder
☐ Evacuation plan
☐ Properly shored trench
☐ Properly sloped excavation
☐ Communications
☐ Harness/lifeline
☐ Acid proof lifeline
☐ Emergency tel. #'s
Hospital ____________
Police ____________

Fire Safety

☐ Alarm box in area
☐ Fire hose laid out
☐ Local fire dept. tel. # ____________
☐ Water hose running
☐ Area kept wet
☐ Equip. grounded & bonded
☐ Non-sparking tools
☐ Explosion proof equipment
☐ Eliminate ignition sources
☐ Fire blanket
☐ CO^2 extinguisher
☐ Dry powder extinguisher
☐ Smoking area designated

Isolate Equipment

☐ Stop transfers
☐ Disconnect & blank
☐ Tag & lockout
☐ Post work signs
☐ Exclusion area
☐

Electrical Safety

☐ Lockout circuits
☐ Non metal ladders
☐ Ground fault interrupters
☐ Pull fuses
☐ Equipment grounded
☐

Personnel in Space/Area	Time In	Time Out	Time In	Time Out

Type of meter: ____________
Date last calibrated: ____________

Air Monitoring Location	Time	% L.E.L.	$\%O^2$	Remarks	Tester

TABLE 3-4
SITE SPECIFIC CONFINED SPACES

Location	Permit Required (Y or N)	Buddy Required (Y or N)	Specific Entry Procedures

APPENDIX I

Community Air Monitoring Plan

Community Air Monitoring Plan

Real time air monitoring for volatile compounds and particulate levels at the perimeter of the exclusion zone shall be conducted in accordance with the New York State Department of Environmental Conservation (NYSDEC). The following procedures shall be adhered to.

A. Air Monitoring Instruments

Flame Ionization Detector (FID)
Frequency : Two hour intervals
Locations : Downwind from perimeter of exclusion zone

Real Time Aerosol Monitor (MINIRAM)
Frequency : Continuous monitoring
Location : Downwind from exclusion zone

B. Action Levels

Volatile organic compounds
>5ppm above background : Halt operations and monitor until readings are acceptable

Particulate (measured downwind)
>150 $\mu g/m^3$ (over 15 minutes) : Measure upwind levels

If downwind level >100 $\mu g/m^3$ of the upwind levels : Halt operations and correct.

Vapor Emission Response Plan

If the ambient air concentrations of organic vapors exceeds 5 ppm above background at the perimeter of the Exclusion Zone, drilling/excavation activities will be halted and monitoring continued. If the organic vapor level decreases below 5 ppm above background, drilling/excavation activities can resume but more frequent intervals of monitoring, as directed by the District Health and Safety Specialist, must be conducted. If the organic vapor levels are greater than 5 ppm over background but less than 25 ppm over background at the perimeter of the exclusion zone, drilling/excavation activities can resume provided:

- the organic vapor level 200 feet downwind of the Exclusion Zone or half the distance to the nearest residential or commercial structure, whichever is less, is below 5 ppm over background; and
- more frequent intervals of monitoring, as directed by the Safety Officer, are conducted.

If the organic vapor level is above 25 ppm at the perimeter of the Exclusion Zone activities must be shutdown. When work shutdown occurs, downwind air monitoring as directed by the Safety Officer will be implemented to ensure that vapor emission does not impact the nearest residential or commercial structure at levels exceeding those specified in the Major Vapor Emission section.

Major Vapor Emission

If any organic vapor levels greater than 5 ppm over background are identified 200 feet downwind from the Site or half the distance to the nearest residential or commercial property, whichever is less, all work activities must be halted.

If, following the cessation of the work activities, or as the result of an emergency, organic vapor levels persist above 5 ppm above background 200 feet downwind or half the distance to the nearest residential or commercial property from the Exclusion Zone, then the air quality must be monitored within 20 feet of the perimeter of the nearest residential or commercial structure (20 foot zone).

If either of the following criteria are exceeded in the 20 Foot Zone, then the Major Vapor Emission Response Plan shall automatically be implemented:

- Organic vapor levels approaching 5 ppm above background for a period of more than 30 minutes.
- Organic vapor levels greater than 10 ppm above background for any time period.

Major Vapor Emission Response Plan

Upon activation, the following activities will be undertaken:

1. The local police authorities will immediately be contacted by the Safety Officer by dialing 911 and advised of the situation.
2. Frequent air monitoring will be conducted at 30 minute intervals within the 20 Foot Zone. If two successive readings below action levels are measured, air monitoring may be halted or modified by the Safety Officer.
3. All Emergency contacts will go into effect as appropriate.

APPENDIX J

Excavation And Trenching

EXCAVATION/TRENCHING

Purpose

The intent of these requirements is to help reduce the risk of injury to all person's working in or around trenching and excavation operations. These requirements are in accordance with OSHA Subpart P 29 CFR 1926.65 - .653.

Definitions

According to the OSHA construction safety and health standards, 29 CFR 1926, the following is defined:

Trench:	A narrow excavation in which the depth is greater than the width, although the width is not greater than 15 feet.
Excavation:	Any mechanically made cavity or depression in the earth's surface. This can include excavations for anything from cellars to highways.

General Requirements

OSHA requires that, in all excavations, employees exposed to danger from moving ground shall be protected by a shoring system, sloping of the ground, or some other equivalent means.

In addition, OSHA requires that all trenches <u>over 5 feet deep</u> in either hard and compact or soft and unstable soil be sloped, shored, sheeted, braces or otherwise supported and that trenches <u>less than 5 feet in depth</u> also be effectively protected when hazardous ground movement may be expected.

One method of ensuring the safety and health or workers in a trench or excavation is to slope the sides of the cut to the "angle of repose," the greatest angle above the horizontal plane at which a material will lie without sliding. The angle of repose varies with different kinds of soil, and must be determined on each individual project. When an excavation has water conditions, silty material or loose boulders, or when it is being dug in areas where erosion, deep frost, or slide planes are apparent, the angle of repose must be flattened.

Specific Requirements

a. Prior to excavation, all utility companies should be contacted and underground utilities located to reduce accidental damage to gas, sewer, electric, telephone lines, etc. In areas where available, the utility "DIG-SAFE" hot line, located in front of the local telephone book, should be contacted.

b. To reduce the risk of collapse, all trenches more than 5 feet deep, and those less than 5 feet deep in unstable soil, should be provided with adequate shoring or the trench should be sloped back to the angle of repose.

c. To reduce the risk of injury from materials falling into excavations, all excavated soils or other materials should be stored 2 feet or more from the edge of the excavation.

d. To reduce the risk of trips/falls, trenches more than 4 feet deep should have ladders or steps located so as to require no more than 25 feet of lateral base and extend a minimum of 36 inches above the landing and secured against movement.

e. To reduce the risk of collapse from adverse weather conditions, diversion ditches, dikes, or other suitable means should be used to prevent surface water from entering an excavation or trench.

f. To help prevent unauthorized traffic and personnel from entering trenching and excavation sites, cones with 6 foot flags, barricades and flagging tape should be used to cordon off the immediate area.

APPENDIX C-2
EXCAVATION/TRENCHING SAFETY PROCEDURES

Egress: **Excavation areas four feet or more deep**

- Ladders must be spaced no more than 25 feet apart so that a person in the trench is always within 25 feet of a ladder for egress.

Shoring: **Excavation areas five feet or more deep**

- Excavations must be sloped or shored if personnel will be entering the excavation.
- Soil classification may be done only by a competent person using both a visual and manual test.

WARNING:

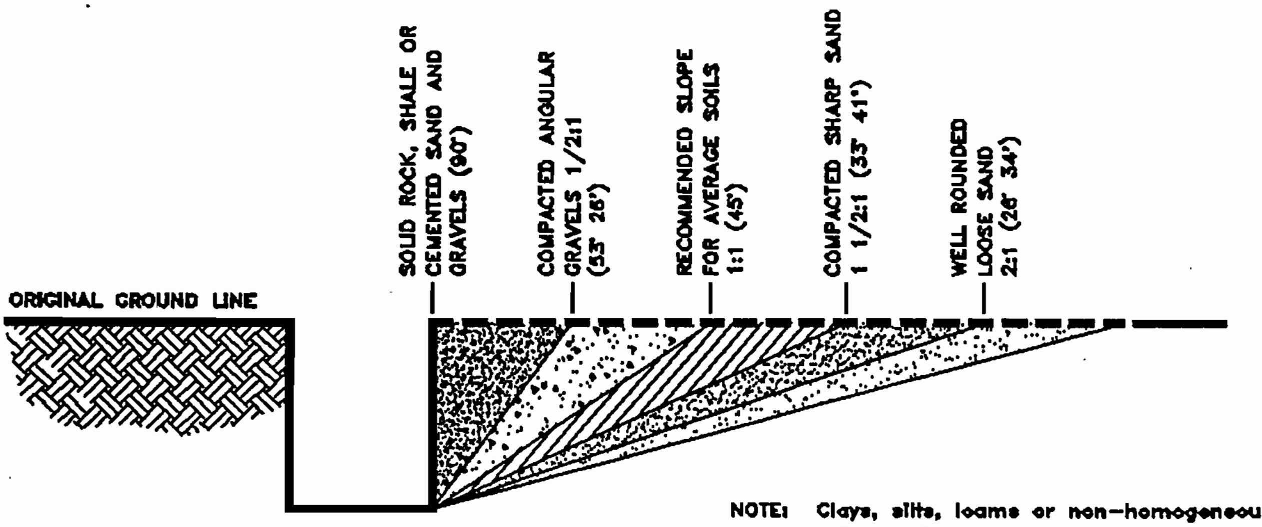
One soil classification may not be enough. Outside disturbances during excavation may change even the best classification.

Inspect the soil after any condition change.

Storage: **All excavations**

- Spoils and heavy equipment must be stored a minimum of two feet from the edge of the excavation.
- Store spoils on the downhill side.

APPROXIMATE ANGLE OF REPOSE
FOR SLOPING OF SIDES OF EXCAVATIONS



NOTE: Clays, silts, loams or non-homogeneous soils require shoring and bracing. The presence of groundwater requires special treatment.

APPENDIX K

OSHA Inspection Steps

IMMEDIATE OSHA INSPECTION STEPS

- Identify the Inspector.

  (a) Ask to see credentials.

  (b) Write down the relevant information, including the inspector's name, agency affiliation, address, telephone number and the statutory authority under which the inspection is being conducted.

  (c) If inspection occurs at a project site, indicate that documentation of medical monitoring and for 40 hour training certification is needed should the inspector want to venture into the actual work area.

- Notify the Regional Health and Safety and the Project Manager immediately.

- Take notes on:

  (a) What is said
  (b) What is seen
  (c) Who spoke to whom
  (d) Any sample of copies taken
  (e) Any corrective actions done in the inspector's presence
  (f) Any activity, including where, when, who, and what
  (g) Any other occurrence, even if minor

- When in doubt on any question, **do not bluff an answer.** Ask the inspector to put the question in writing. Never lie or fabricate an answer.

- If inspection occurs on site, carefully review the Site Safety Plan with the Inspector if asked to do so.

- If inspection occurs at an office, have accident reports, OSHA 200 logs ready at all times for inspection. Always make sure the OSHA poster is visible.

- Determine the scope of the inspection: Ask the OSHA inspector what areas of the company activity are of interest and the reason for the inspection. Discover what has triggered the inspection. If complaints initiated the inspection, find out specifically what they were.

APPENDIX L

OSHA Poster

GROUNDWATER TECHNOLOGY

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Provisions of the Act include the following:

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

Employers in States operating OSHA approved State Plans should obtain and post the State's equivalent poster.

Under provisions of Title 29, Code of Federal Regulations, Part 1903.2(a)(1) employers must post this notice (or facsimile) in a conspicuous place where notices to employees are customarily posted.

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:

Atlanta, GA	(404) 347-3573
Boston, MA	(617) 565-7164
Chicago, IL	(312) 353-2220
Dallas, TX	(214) 767-4731
Denver, CO	(303) 844-3061
Kansas City, MO	(816) 426-5861
New York, NY	(212) 337-2378
Philadelphia, PA	(215) 596-1201
San Francisco, CA	(415) 744-6670
Seattle, WA	(206) 553-5930

Lynn Martin

Lynn Martin, Secretary of Labor

Washington, DC
1992 (Reprinted)
OSHA 2203

U.S. Department of Labor

Occupational Safety and Health Administration

To report suspected fire hazards, imminent danger safety and health hazards in the workplace, or other job safety and health emergencies, such as toxic waste in the workplace, call OSHA's 24-hour hotline: 1-800-321-OSHA.

☎

This information will be made available to sensory impaired individuals upon request. Voice phone: (202) 219-8615; TDD message referral phone: 1-800-326-2577

*U.S.GPO:1992—334-220

APPENDIX M

Maps

Note: A detailed fold-out map to John T. Mather Hospital will be provided with the field edition of the HASP.

APPENDIX N

Job Safety Analysis

GROUNDWATER
TECHNOLOGY

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Remediation Project Preparation

Person Doing JSA Barry Bedaw **Date** 6-16-93

Job Steps	Job Hazards	Safeguards and Precautions
Site Clearing/Grading	① Back Strain from clearing vegetation	Frequent rest breaks. Use slow, even movements and proper lifting techniques
	② Eye injury from foreign objects	wear eye protection
	③ Irritation from dust	Dust suppression techniques, e.g. wetting the soil.
	④ Driving vehicles, placing site trailers	A site surveillance should be performed

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Remediation Project Preparation

Person Doing JSA Barry Bedaw **Date** 6-16-93

Job Steps	Job Hazards	Safeguards and Precautions
	and collecting debris	on foot to choose
	on uneven surfaces	a clear driving
	creates a possibility	path
	of a rollover	
	⑤ Crushing or pinching	Stay clearing of
	hazard due to	trailer hitches and
	trailer placement	wear ~~thick~~ leather work
		gloves
	⑥ Hand injuries	wear leather work
	from using hand tools	gloves,

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Remediation Project Preparation

Person Doing JSA Barry Bedaw **Date** 6-16-93

Job Steps	Job Hazards	Safeguards and Precautions
	and collecting debris	on foot to choose
	on uneven surfaces	a clear driving
	creates a possibility	path
	of a rollover	
	⑤ Crushing or pinching	stay clearing of
	hazard due to	trailer hitches and
	trailer placement	wear leather ~~thick~~ work
		gloves
	⑥ Hand injuries	wear leather work
	from using hand tools	gloves,

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Remediation Project Preparation

Person Doing JSA Barry Bedaw Date 6-16-93

Job Steps	Job Hazards	Safeguards and Precautions
Site Walk	① Exposure to irritant	Wear long sleeved
	and toxic plants such	clothing to protect
	as poison ivy and	against insect bites.
	sticker bushes may	Use repellents
	cause allergic	
	reactions to employees	
	② Surfaces covered	Be alert and observe
	with heavy vegetation	terrain while walking
	and undergrowth	to minimize slips
	create tripping hazards	and falls. Steel-toed

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Remediation Project Preparation

Person Doing JSA Barry Bedan Date 6-16-93

Job Steps	Job Hazards	Safeguards and Precautions
		boots provide additional
		support and stability
	③ Back strain due	Use proper lifting
	to carrying	techniques.
	instruments	
	④ Native wildlife	Avoid wildlife when
	such as rodents,	possible. Cover exposed
	ticks and snakes	body parts. Tuck
	present possibility	pants into boots
	of diseases such	Conduct tick checks
	as Lyme disease	

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Remediation Project Preparation

Person Doing JSA Barry Bedaw Date 6-16-93

Job Steps	Job Hazards	Safeguards and Precautions
	Heat stress/cold	Implement heat stress
	stress exposures.	management techniques
		such as shifting
		work hours, fluid
		intake and monitoring
		employees
	On-site chemical	Avoid contact with
	hazards depending	unknown objects.
	on contamination	such as drums
	located on-site	stained soils etc.

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Air sampling / Monitoring

Person Doing JSA Barry Bedaw **Date** 6-15-93

Job Steps	Job Hazards	Safeguards and Precautions
Collecting air	Electrical hazards	Grounded plugs
samples	as a result of	should be used when
	power sources to	power source is
	run sampling pumps	needed to reduce the
		hazards of electrical
		shock. Test outlets
		with an indicator
	Placing sampling	Be alert to terrain
	pumps in elevated	changes.
	areas where slips	

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Air Sampling / Monitoring

Person Doing JSA Barry Bedaw **Date** 6-15-93

Job Steps	Job Hazards	Safeguards and Precautions
	/trips and fall hazards	
	exist.	
	Electrical hazards	Extension cords must
	from damaged	be protected and
	extension cords	visualy marked.
	Air sampling matrix	Proper protective
	solutions may be	clothing such as
	acidic or basic,	gloves and goggles
	causing a corrosive	should be worn

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Air Sampling / Monitoring

Person Doing JSA Barry Bedar **Date** 6-15-93

Job Steps	Job Hazards	Safeguards and Precautions
	hazard, and broken	when handling corrosive
	glass collection	substances, 15 minute
	tubes can cut hands	eyewash and first
		aid should be
		available.
	Hazards associated	Perform continuous
	with ambient	monitoring in variable
	enviroment being	atmospheres. Have
	sampled	available proper
		respiratory protection

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Soil Boring

Person Doing JSA Barry Bedaw Date 6-15-93

Job Steps	Job Hazards	Safeguards and Precautions
Soil Boring	Noise levels exceeding the OSHA PEL of 90 dBA	Ear muffs and ear plugs effectively reduce noise levels
	Fumes from the drill rig	Review the contaminants suspected to be on-site and perform air monitoring. Shut down drill rig or divert exhaust fumes

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Soil Boring

Person Doing JSA Barry Bedaw Date 6-15-93

Job Steps	Job Hazards	Safeguards and Precautions
	Overhead utility	Raise and lower boom
	wires	prior to moving.
		Maintain proper safe
		distance, 10' or 20'.
	Underground pipelines	Have a dig-safe
	and utility lines	search conducted.
	can be ruptured	hand dig around
	or damaged during	suspect utilities.
	active drilling	
	operations	

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Soil Boring

Person Doing JSA Barry Bedaw Date 6-15-93

Job Steps	Job Hazards	Safeguards and Precautions
	Free or falling parts from the cat head may cause head injury	Wear head protection and inspect daily the wires, cables and ropes
	Moving parts such as augers on the rig may catch clothing.	Secure loose clothing and do not wear reflective vests
	High pressure hydraulic lines and air lines	All high pressure lines should be checked

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Soil Boring

Person Doing JSA Barry Bedaw Date 6-15-93

Job Steps	Job Hazards	Safeguards and Precautions
	used on drill rigs	prior to and during
	are hazardous	use.
	when they are in	
	ill repair or	
	incorrectly assembled.	

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Groundwater Sampling

Person Doing JSA Barry Redaw Date 6-15-93

Job Steps	Job Hazards	Safeguards and Precautions
Collection of	Exposure to vapors	Monitor well head with
groundwater	of volatile organics	an HNU or OVA. Monitor
samples	when the well head	the breathing zone also.
	is initially opened	
	Back strain due	Use proper lifting
	to lifting bailers	techniques and frequent
	or pumps from	rest breaks for items
	down-well depths.	weighing less than
		70 lbs. Utilize
		mechanical lifting

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Groundwater Sampling

Person Doing JSA Barry Bedau Date 6-15-93

Job Steps	Job Hazards	Safeguards and Precautions
		devices when possible
	Slipping on wet,	Slipping can be
	muddy surfaces	prevented by placing
	created by spilled	all purged water
	water	in drums for removal
	Electrical hazards	GFCI should be
	associated with use	used.
	of electrical equipment	
	around water or wet	
	surfaces	

GROUNDWATER TECHNOLOGY, INC.

JOB SAFETY ANALYSIS WORKSHEET

Operation/Location Groundwater Sampling

Person Doing JSA Barry Bedan Date 6-15-93

Job Steps	Job Hazards	Safeguards and Precautions
	Possible water splashing	wear eye protection
	in eyes during	to prevent splashing
	sampling	
	Repetative injuries	Use pumps or
	due to excessive	alternate arms
	bailer during "milk	while bailing.
	runs"	

APPENDIX O

Electrical Safety

GROUNDWATER
TECHNOLOGY

ELECTRICAL SAFETY

General

Electrical equipment in the field poses a significant safety hazard. This is especially true in environments that may contain flammable vapors. For this reason, all electrical equipment and power cables in and around wells or structures that are suspected of containing chemical contamination, must be intrinsically safe. Some environments will require explosion-proof equipment instead of intrinsically safe equipment.

Explosion-proof equipment shall be used according to the requirements of the National Fire Protection Association (NFPA) National Standard Electrical Code. The Code should be referred to before each installation is attempted because each one will need to be evaluated on an individual basis to determine if explosion-proof equipment needs to be installed. The Code specifies minimum safe distances for each chemical contaminant, listed with each Class, Division and Group. If receptacle outlets or other electrical hook-ups are installed within the confines of this minimum safe distance, then explosion-proof equipment is mandatory. All installations must be inspected by a licensed electrical inspector before power is supplied to any equipment.

If the electrical installation is provided by the client, please advise the client of these requirements. If the client does not install the GFCI breakers or receptacle outlets in accordance with the requirements of this policy, we will be forced to hire someone and charge the client for the retrofit.

All power must be turned off at the main switch and the appropriate lock-outs and tag-outs shall be put in place before any repair work is done on the installation or system.

Electrical Extension Cords

All electrical cords used on any site shall be the three-pronged grounded variety. The integrity of the cord and exterior covering shall be inspected and maintained at all times. Any cord which has cuts or frayed areas in the outer covering shall be discarded and replaced. The use of three-to-two prong adapters shall be prohibited at all times irregardless of reason. Disabling the grounding prong by cutting it off or removing it from the male receptacle end shall be prohibited at all times.

Ground Fault Circuit Interrupters

The GFCI is a fast-acting circuit breaker which senses small imbalances in the circuit caused by current leakage to ground, and within a fraction of a second, shuts off the electrical power. The GFCI will not protect the employee from line-to-line contact hazards (such as a person holding two "hot" wires, or a hot and neutral wire, in each hand. The GFCI will provide protection from the most common form of electrical shock hazard - the ground fault. It also provides protection against fires, overheating, and the destruction of insulation on wires subject to power-to-ground conditions.

GFCI's can be used successfully to reduce electrical hazards on construction sites. Tripping (interruption of current flow) is sometimes caused by wet connectors and tools. The exposure of connectors and tools to excessive moisture shall be limited by using watertight or sealable connectors. Providing more GFCI's, or shorter circuits can prevent tripping caused by the cumulative leakage from several tools, or by leakage from extremely long circuits or cable runs.

APPENDIX C-1
SITE-SPECIFIC LOCKOUT/TAGOUT PROCEDURES

Equipment	Operation	Lockout Method/Location

APPENDIX P

Contingency Plan

CONTINGENCY PLANS

I. CONTINGENCY PLAN FOR EVACUATION

Although very unlikely, it is possible that a site emergency could necessitate evacuating all personnel from the site. If such a situation develops, the Site Safety Officer, or designated representative will notify the Project Supervisor, or vice versa, of the event and appropriate signal will be given for site evacuation. The above officers shall ensure that the evacuation is carried out in a calm, controlled fashion.

All personnel shall exit the site and shall congregate in an area designated by the Project Supervisor and/or Site Safety Officer. The route of evacuation will be dependent on wind direction, severity and type of incident, etc.

The Project supervisor and/or Site Safety Officer shall ensure that all personnel are accounted for. If someone is missing the Site Safety Officer will alert emergency personnel. This may be done by contacting the local Police Department. Advise them of the situation and request and expedient response by Emergency Services personnel.

Contact the Project Manager, Health & Safety Manager and/or District Manager as soon as possible after attending to the evacuation.

II. CONTINGENCY PLAN FOR MEDICAL EMERGENCY

The following procedures should be instituted immediately in the event of a medical emergency involving illness or injury to one of Groundwater Technology's employees while on-site.

The site should be shut-down and immediately secured. The area in which the injury or illness occurred should be considered off-limited until the cause of the illness or injury is known.

In the event of a non-trauma related illness or injury, instantaneous real-time air monitoring with flame or photoionization detectors should be acquired to ascertain if the illness or injury was caused by potential exposure to hazardous materials. Monitoring should be done both upwind and downwind of the incident site.

Assess the victim's condition for the nature of injury or illness. Pay close attention to the level of consciousness and any cardiac or respiratory involvement.

If the victim appears to be critically injured (i.e. unconsciousness, cardiac or respiratory abnormalities, stroke, seizures, etc.), support the victim's vital functions. Administer CPR if needed. Notify Police, Fire Department and EMS Units immediately.

The victim should be decontaminated as soon as possible after removal from the contaminated environment. This should be done in non-contaminated area well away from the source of the problem.

If the victim appears to be critically injured, they should be transported to the nearest Emergency Room by an EMS Unit staffed with qualified personnel.

If the victim's condition appear to be non-critical, and is anything more severe than minor cuts or bruises, they should be transported to the nearest hospital. Under no circumstances should the victim be transported to the hospital in anything other than an EMS Unit staffed by qualified personnel.

If the victim has sustained extremely minor injuries or a minor illness, it will be up to the discretion of the Site Safety Officer whether or not the victim should be treated on-site, and, may continue to work. If the Site Safety Officer determines that the victim may not continue to work, the victim should be decontaminated, relieved of duty for the day and returned to the office, if during normal working hours. An occupational physician from the current medical surveillance contractor, or the victim's family physician should be contacted.

Contact the Project Manager, Health & Safety Manager or District Manager as soon as possible after attending the needs of the victim. The Incident should be documented both in the project file and on the Groundwater Technology Accident/Incident/Near-Miss.

III. CONTINGENCY PLAN FOR CONTAMINATION EMERGENCY

The following procedures should be instituted immediately in the event of contamination to one of the Groundwater Technology's employees by Hazardous Materials.

If Emergency Rescue is needed to remove the victim from the contaminated area, notify, Police, Fire Department and EMS Units immediately. Advise them of the situation and request an expedient response by Emergency Services Personnel.

Absolutely no Emergency Rescue is to be attempted without having a trained back-up present.

If the victim is able to move under their own power, escort them to a non-contaminated area as soon as possible.

The site should be shut-down immediately secured. The area in which the contamination occurred should be considered off-limits until the arrival of trained personnel who are properly equipped with the appropriate personal protective equipment and monitoring instrumentation.

Assess the victim's condition for the nature of injury or contamination. The victim should be considered symptomatic if they exhibit any evidence of abnormal symptoms. Pay close attention to the level of consciousness and any cardiac or respiratory involvement. Use special care to insure that you do not become contaminated as well. If any abnormal symptoms are present, notify Police, Fire Department and EMS units immediately.

Attempted to identify the exact type of material involved. Use extreme caution if the danger of being contaminated exists.

The victim should be decontaminated as soon as possible after removal from the contaminated environment. This should be done in non-contaminated area well away from the source of the problem. Extreme care should be used to avoid cross-contamination. The victim should be washed by water spray or safety shower. Contaminated protective clothing should be removed after washing.

The victim should not be transported until decontamination is performed to the degree that medical personnel will not be subjected to cross-contamination.

If the victim appears to be critically injured (i.e. unconsciousness, cardiac or respiratory abnormalities, seizures, etc.), support the victim's vital functions. Administer CPR if needed.

If the victim appears to be symptomatic, they should be transported to the nearest Emergency Room by an EMS unit staffed with qualified personnel.

If the victim appears to be asymptomatic, the victim should be decontaminated, relieved of duty for the day and returned to the office, if during normal working hours. An occupational physician from the current medical surveillance contractor should be contacted.

Contact the Project Manager, Health & Safety Manger and/or District Manager as soon as possible after attending to the needs of the victim. The incidents should be documented both in the project file and on the Groundwater Technology Accident/Incident/Near-Miss Report Form.

IV. CONTINGENCY PLAN FOR FIRE EMERGENCY

The following procedures should be instituted <u>immediately</u> in the event of a fire on-site.

The site should be shut-down and immediately secured. The area in which the fire occurred should be considered off-limits until the cause can be determined. All non-essential site personnel should be evacuated from the site to a safe, secure area. Notify the Fire Department <u>immediately.</u>

This may be done by contacting the local Fire Department. Advise them of the situation and the identify of any hazardous material involved.

The four classes of fire along with their constituents are as follows:

Class A:	Wood, cloth, paper, rubber, many plastics, ordinary combustible materials.
Class B:	Flammable liquids, gases and greases.
Class C:	Energized electrical equipment.
Class D:	Combustible metals such as magnesium, titanium, sodium, potassium.

Small fires on-site may be actively attached for control and extinguishment. Extreme care should be taken while in this operation.

The designated Site Fire Safety Officer, or his representative, will be responsible for all fire fighting activities on the site.

All approaches to the fire should be done from the upwind side if possible. Distance from the employee to the fire should be close enough to ensure proper attach of the extinguishing material, but far enough away to ensure that the employee is safe. The proper extinguisher should be utilized for the Class(s) of fire present on the site.

If possible, the fuel source should be cut off or separated from the fire. Care must be taken when performing operations involving the shut-off values and manifolds, if present.

Examples of proper extinguishing agents are as follows:

Class A -	Water Water with 1% AFFF Foam (Wet Water) Water with 6% AFFF or Fluoroprotein Foam ABC Dry Chemical Halon 1211
Class B -	ABC Dry Chemical Purple K Halon 1211 Carbon Dioxide Water with 6% AFFF Foam
Class C -	ABC Dry Chemical Halon 1211 Carbon Dioxide
Class D -	Metal-X Dry Powder

No attempt should be made against large fires. These should be handled by the Fire Department.

Contact the Project Manager, Health & Safety Manager and/or District Manager as soon as possible. The incident should be documented both in the project file and on the Groundwater Technology Accident/Incident/Near-Miss Report Form.

V. CONTINGENCY PLAN FOR SPILL OR AIR RELEASE

The following procedures should ne instituted IMMEDIATELY in the event of a spill or air release of a hazardous material on-site.

The site should be shut-down and immediately secured. The area in which the spill or release occurred should be considered off-limits until the cause can be determined and site safety can be evaluated. All non-essential site personnel should be evacuated from the site to a safe, secure area.

The spilled or released product should be immediately identified and appropriate measures, such as dikes or birms, should be instituted to halt and contain the flow. If the spill extends into waterways, the National Response Center should be notified immediately. Spill booms should be put in place in an attempt to prevent downstream contamination.

Real-time air monitoring with ionization and combustible has indicators should be started. Monitoring should be done both upwind and downwind of the spill site or release point. An evaluation of upgrades in personnel protective equipment should be made based upon the results of the air monitoring.

If the material is unknown, Level B protection is mandatory. Samples of the material should be acquired to facilitate identification of the material.

If the results of the monitoring show that the levels of contaminants exceed IDLH values, the site should be immediately evacuated and the appropriate Federal, State, County and local regulatory authorities and emergency response personnel should be notified.

Notify the Police and Fire Departments IMMEDIATELY if contaminants are found to have migrated off-site into populated areas, a large spill or flammable products is involved, or, the material is considered acutely toxic or exceeding published IDLH values.

The procedures as listed above should be instituted if there is a discovery of an acutely toxic material in must larger quantities than expected. In this case, all employees on the site should be cleared to a safe area and briefed.

The spill or release should be reported to the appropriate Federal, State, County and local regulatory authorities per the reporting standards of those regulatory agencies.

Contact the Project Manager, Safety Director, and/or District Manager as soon as possible. The incident should be documented both in the project file and on the Groundwater Technology Accident/Incident/Near-Miss Report Form.

GROUNDWATER
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APPENDIX 6

DRAFT FINAL

CITIZEN PARTICIPATION PLAN (CPP) FOR THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY PEERLESS PHOTO PRODUCTS, INC. SITE SHOREHAM, NEW YORK

SITE I.D. #1-52-031

September 30, 1993

Prepared for:
Agfa Division of Miles Inc.
100 Challenger Road
Ridgefield Park, New Jersey 07660-2199

Prepared by:
Groundwater Technology, Inc.
101-1 Colin Drive
Holbrook, New York 11741

Groundwater Technology, Inc.
Written/Submitted by

Mark L. Wert
Project Citizen
Participation Specialist

Groundwater Technology, Inc.
Reviewed/Approved by

Paul Maus
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National Industry Division
Senior Project Manager

CITIZEN PARTICIPATION PLAN
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1.0 INTRODUCTION

This **Citizen Participation Plan (CPP)**[1] describes a program of public involvement activities that will be conducted by Agfa Division of Miles Inc. (Agfa) in conjunction with the New York State Department of Environmental Conservation (NYSDEC) during the **Remedial Investigation** and **Feasibility Study (RI/FS)** at the Peerless Photo Products Inactive Hazardous Waste Site in Shoreham, New York. The program of public involvement activities in this CPP has been prepared in accordance with **6NYCRR Part 375.7**. The purpose of this CPP is to: 1)ensure that the public is provided with accurate, timely, and understandable information; and 2)establish avenues through which the public can voice concerns, ask questions, and provide information regarding the site and the remedial program.

Agfa and NYSDEC are committed to a citizen participation program as a part of their responsibilities for the inactive hazardous waste site remedial program at this site. Citizen participation will promote public understanding of the responsibilities, planning activities, and remedial activities associated with the site. It will provide an opportunity for both Agfa and NYSDEC to learn from the public information that will enable them to develop a comprehensive remedial program that is protective of both public health and the environment.

This CPP should be regarded as a working document. Its program of community relations activities is flexible and may be changed over the course of the RI/FS to accommodate community interests as well as new information generated by the technical studies.

Questions regarding the site may be directed to the site contact person below:

Site Public Contact

Paul Maus
Project Director
Groundwater Technology, Inc.
101-1 Colin Drive
Holbrook, New York 11741
516-472-4000

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[1] Words in bold print are defined in the glossary in Section VIII.

2.0 SITE BACKGROUND

Based on the results of previous environmental investigations (**Phase I and Phase II**) NYSDEC has determined that the Peerless Photo Products Site is an Inactive Hazardous Waste Disposal Site, Class 2 (No. 1-52-031). This classification requires the performance of a RI/FS to determine the nature and extent of contamination, assess its potential impact on humans and the environment, and devise methods for site cleanup as necessary.

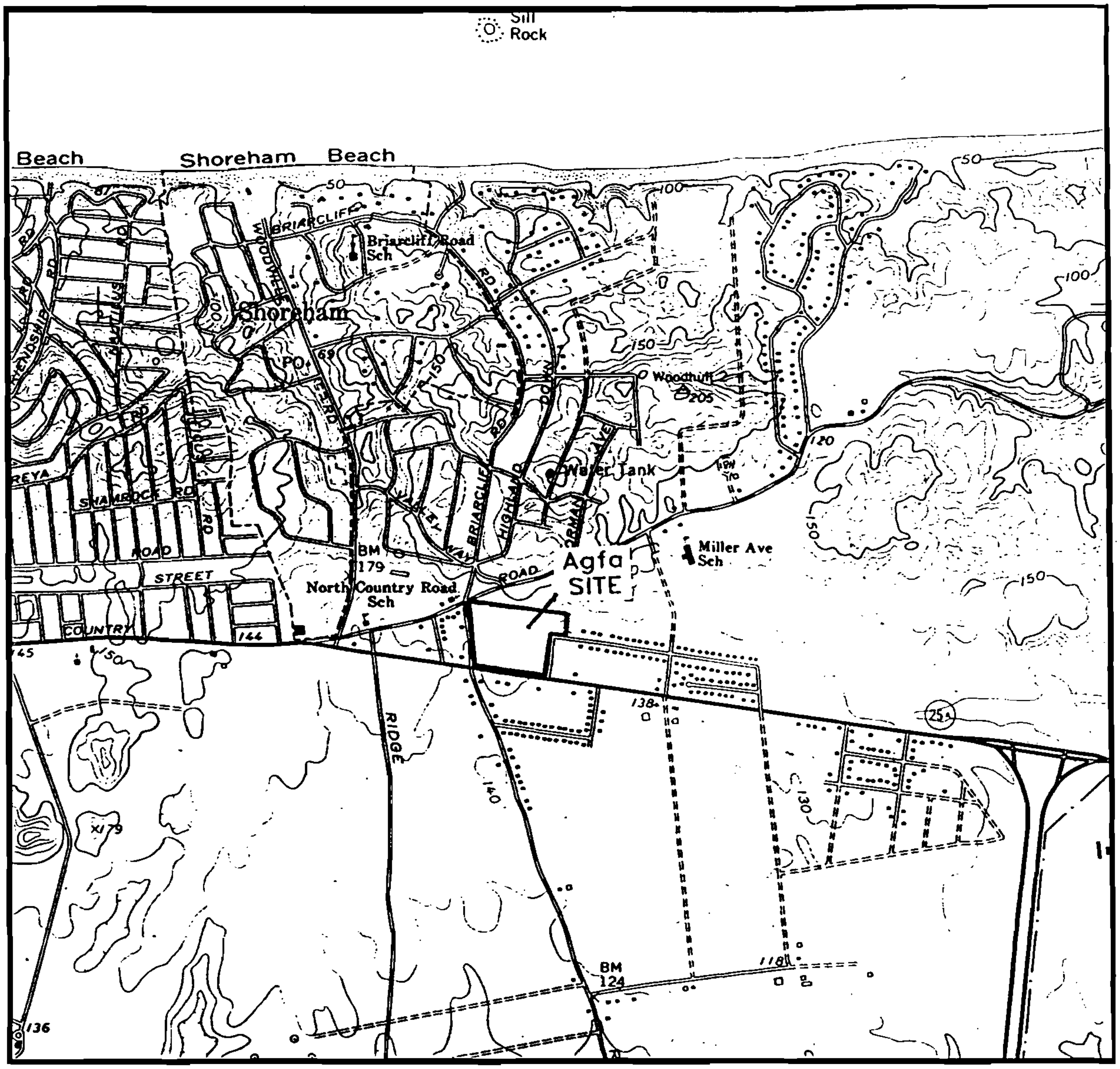
The RI/FS will be performed by Agfa under a NYSDEC **Order on Consent** (W10428-89-07). Agfa has contracted with Groundwater Technology, Inc., a large nationwide environmental consulting firm, to carry out the RI/FS. NYSDEC has approval authority over all of the work conducted during the RI/FS.

2.1 Site Location and Description

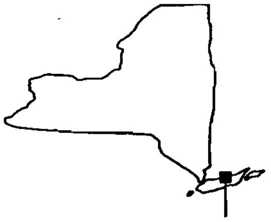
The site is located in Shoreham in the town of Brookhaven, Suffolk County, New York (see Figure 2-1 for the Site Location Map). The site is bordered to the south by Route 25A (also known as the Port Jefferson-Riverhead Road), to the west by Randall Road, to the north by residences and the Long Island Lighting Company (LILCO) right-of-way, and to the east by residences.

The site is located in a predominantly residential area. Retail establishments are located to the east and west along Route 25A. Immediately to the north, the site is bordered and overlapped by a LILCO right-of-way and transmission lines. To the south of the site across Route 25A a mixed use residence and dog kennel has been operated. The Suffolk County Water Authority's (SCWA's), formerly Shorewood Water Supply Company, Briarcliff Road public supply well field, is located 600 feet to the northwest of the site. To date there has been no impact on the Briarcliff Road supply well field from the site. This assessment is based on several years of water quality data collected at the public supply well.

At present there are seven structures on the 16.2 acre site, including the main plant structure on the northeast corner of the site, Building #13 on the south side of the site, the administration (Building #17) and wastewater treatment (Building #14) buildings located on the southwest corner of the site, a gatehouse at the entrance on the west side of the site, and two small storage sheds on the southwest corner of the main plant structure. Parking lots are located adjacent to the administration building and



SOURCE: U.S.G.S. TOPOGRAPHIC QUADRANGLE
MIDDLE ISLAND, N.Y.
7.5 MINUTE SERIES
DATE: 1967



SCALE 1:24,000

0 2,000 4,000

SCALE FEET

N

GROUNDWATER TECHNOLOGY

101-1 COLIN DRIVE
HOLBROOK, NEW YORK
(516) 472-4000

DESIGNED:	TLD
DETAILED:	TRS
CHECKED:	TLD

SITE LOCATION

NAME: Agfa Division of Miles Inc.

DRAWING DATE: 1/21/93

LOCATION: SITE ID# 1-52-031
RANDALL ROAD
SHOREHAM, NEW YORK

FIGURE: 2-1

roadways lead to the various buildings. The former wastewater treatment plant recharge basins are located along the northern side of the site beneath LILCO's power lines. Figure 2-2 shows significant site features.

The site is completely encircled by a six foot high chain linked fence and is guarded twenty-four hours per day, 365 days a year. The perimeter of the fence area is inspected daily. Periodically LILCO inspects the fence for continuity, as grounding of the fence is critical because of its proximity to the LILCO power lines along the north side of the site.

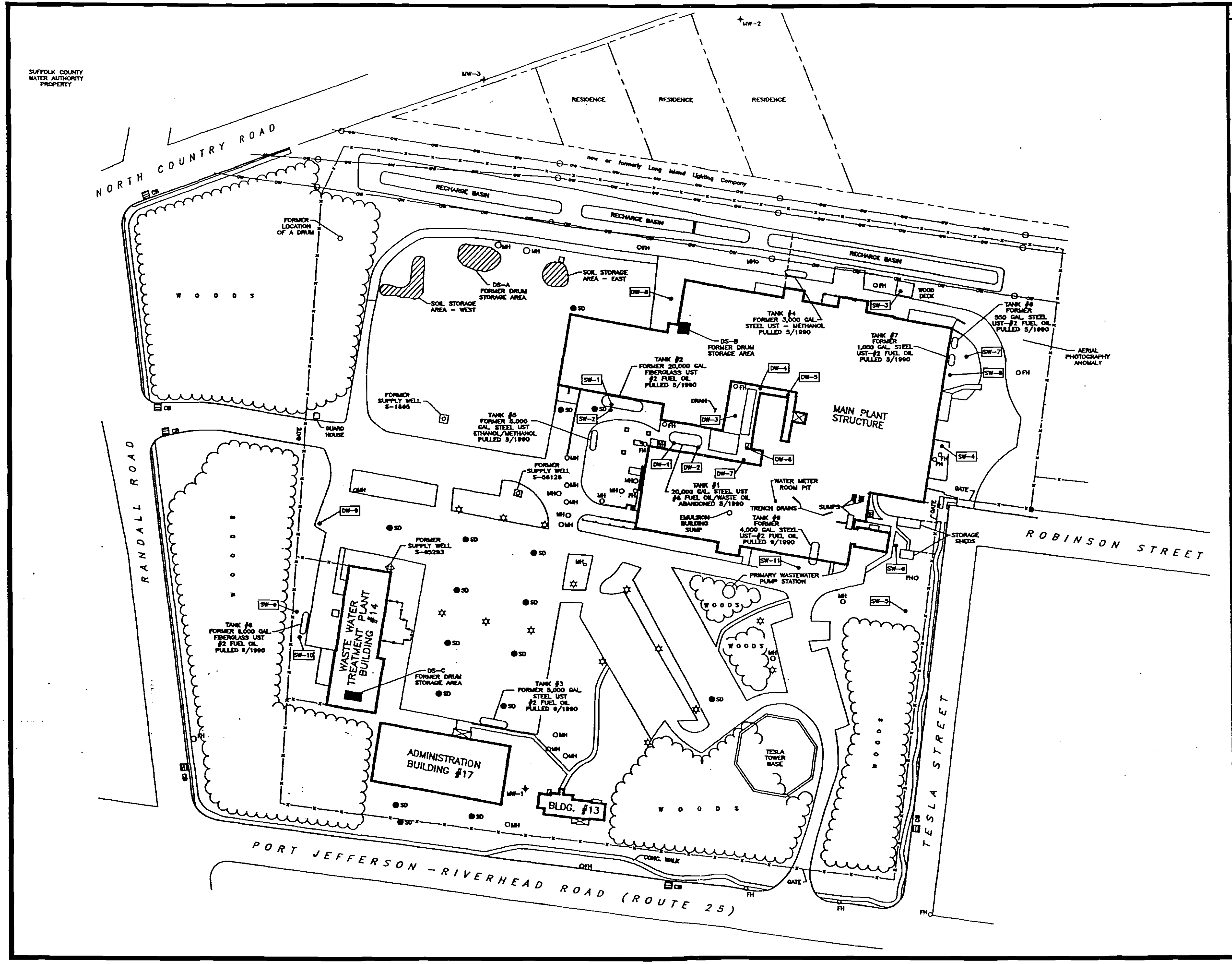
2.2 Site History

In 1901, Nikola Tesla purchased the site from James D. Warden who was the manager and director of Suffolk County Land Company. Mr. Tesla's purchase of the site was financed by J. Pierpont Morgan. This early account of the site history is based on the book entitled "Tesla: Man Out of Time", written by Margaret Cheney 1981, Prentice-Hall, Inc.

The site was first developed after it was purchased by Mr. Tesla. Mr. Tesla constructed a building in 1903 which served as a residence and a laboratory. This building is part of Building #1 located in the main plant structure. In addition, he constructed a radio tower which was demolished between 1917 and 1918. The foundation of the former radio tower, herein referred to as Tesla Tower Base, is located in the southeast corner of the site.

The Tesla tower was demolished reportedly because of the fear that German submarines and surface raiders would use the facility. According to one report, demolition consisted of collapsing the structure into the hole formed by the octagonal shaped masonry foundation walls which had supported the structure. However, another report indicates that the tower was hauled off site for scrap in 1920. The top of the foundation walls are still evident and extend approximately two feet above grade. Prior to Peerless Photo Products, Inc's. purchase of the property, the hole formed by the foundation walls was used for disposal of unknown materials. Review of file data and interviews with former employees indicate that disposal may have stopped as early as 1960 or as late as 1973. At present, the area within the foundation walls is level and vegetated with grass and large trees.

Peerless Photo Products, Inc. operated at the site from 1939 until 1969. Primary operations included production of photographic emulsions used in the manufacture of photographic film and emulsion coating of photographic paper. From 1939 until 1979, Peerless Photo Products, Inc. disposed of



NO.	DATE	BY	REVISION

LEGEND

SW-4 / DW-4 ● INJECTION WELL
✦ MONITORING WELL
• ☐ CONCRETE COVERS
—•—•— CHAIN LINK FENCE
UST UNDERGROUND STORAGE TANK
◙ FORMER SUPPLY WELL
SD ● STORM DRAIN
FH ○ FIRE HYDRANT
✡ LIGHT
MH ○ MANHOLE
—•—•— OVERHEAD WIRES
○ UTILITY POLE
CB ⊟ CATCH BASIN

NOTES: LOCATIONS OF SW-7, SW-8 AND SW-10 ARE APPROXIMATE.

SOURCE:
YOUNG & YOUNG
400 OSTRANDER AVENUE, RIVERHEAD, N.Y.
ALDEN W. YOUNG, N.Y.S. P.E.&L.S. LIC. #12845
HOWARD W. YOUNG, N.Y.S. L.S. LIC. NO. 45893
THOMAS C. WOLPERT, N.Y.S. P.E. LIC. NO. 61483

LOCATION OF FORMER UNDERGROUND
STORAGE TANKS
ERM - NORTHEAST
SITE PLAN - PEERLESS PHOTO PRODUCTS
FIGURE 3-2

N

50 0 50 100
SCALE FEET

SIGNATURE	DATE
REVIEW ENGR:	
PROJECT ENGR:	
PROJECT MGR:	
CLIENT:	

GROUNDWATER TECHNOLOGY
101-1 COLIN DRIVE
HOLBROOK, N.Y. 11741 (516) 472-4000

Agfa Division of Miles Inc.

PEERLESS PHOTO PRODUCTS, INC. SITE
SHOREHAM, N.Y.
SITE ID# 1-52-031

BASE MAP

DESIGNED BY: SEE SOURCE	DETAILED BY: TRS	CHECKED BY:

DRAWING DATE: 1/21/93	ACAD FILE: 50732-2
PROJECT NO.: 01113-5073	CONTRACT:
DRAWING: **FIGURE 2-2**	REVISION:

untreated process water into an 800 foot long, 25 foot wide recharge basin along the north side of the property and referred to herein as the "North Recharge Basin". The North Recharge Basin was formerly a depression in which was located a Long Island Railroad track.

In 1979 the wastewater treatment plant was installed and a New York State Pollution Discharge Elimination System (SPDES) permit was obtained from NYSDEC to discharge treated effluent into the North Recharge Basin. Between 1979 and 1988, Peerless Photo Products, Inc. treated and discharged 15,000 to 20,000 gallons per day of treated process water and 200,000 gallons per day of non-contact cooling water into the North Recharge Basin.

Between 1979 and 1985, analyses of the effluent indicated violations of SPDES permit limitations for these constituents. Process modifications after 1985 resulted in less frequent and minor excursions. On July 31, 1987, the wastewater treatment plant was closed and discharges to the North Recharge Basins from the waste water treatment plant ceased. From 1987 to December 31, 1991, only non contact cooling water was discharged into the basins at a maximum rate of 5,000 gallons per day. At present the North Recharge Basin only receives storm water run off from roof and parking lot areas.

In 1979 as part of the wastewater treatment plant construction, soil from the bottom of the North Recharge Basin was excavated to a depth of four feet, and was stored for approximately one year on the northwest side of the site. In 1980 this soil was disposed of in a secure landfill operated by CECOS in Niagara Falls, New York. In 1981, Peerless Photo Products, Inc. was subject to a Consent Order to upgrade the wastewater treatment plant. As part of this improvement, an additional 250 cubic yards of soil were again excavated from the North Recharge Basin and stockpiled for approximately one year on a plastic liner on the northwest side of the site near where the previous soil pile (1979) had been. The SCDHS analyzed soil samples from this stockpile and determined that the soil was non-hazardous and Peerless Photo Products, Inc. subsequently disposed of the soil in the town of Brookhaven Landfill. The locations of two soil storage areas are shown in Figure 2-2 and are referred to as the "East and West Soil Storage areas".

In the aerial photograph from 1962, east of the main plant structure approximately 12 objects, somewhat neatly arranged, are discernable. The area is referred to as the Northeast area.

Several construction-related spills occurred in 1981 during the upgrading of the wastewater treatment plant. In July 1981 a spill of an unknown quantity of sludge containing silver and cadmium occurred on the south side of the wastewater treatment plant. This sludge was scraped off and stockpiled again on the northwest side of the site in the same area that the soil from the North Recharge Basin was stored. This sludge was determined to contain elevated concentrations of metals by the Suffolk County Department of Health Services (SCDHS) and was disposed of in a permitted landfill in Pennsylvania.

On July 23, 1981 the influent line to the wastewater treatment plant ruptured during construction to upgrade the wastewater treatment plant. The rupture occurred under what is now the north end of the treatment plant (Building #14) and resulted in a spill of 3,000 gallons of the influent to the plant. The water flowed onto the parking lot surface and into a nearby storm drain (storm drain DW-9, Figure 2-2). Approximately 330 gallons of the spill was recovered from storm drain DW-9 and returned to the wastewater treatment plant. The remainder of the spill was absorbed by surface soils and/or evaporated. Soils below and adjacent to the rupture in the influent pipe were excavated, analyzed and removed to an appropriate solid waste disposal facility. This work was supervised by the SCDHS.

In June 1981, a 5 gallon spill of "rusty" water from an empty drum (iron content - 13 ppm) occurred adjacent to the truck loading ramp next to Building #14 (Figure 2-2). Soils excavated from the site were analyzed and hauled away for proper disposal under SCDHS supervision.

In June 1981, an inspection of the site by SCDHS revealed that there were three separate areas being used for storage of 55 gallon drums without provisions for spill control. These locations are designated as DS-A through DS-C (Figure 2-2). Only site DS-A is currently accessible. Buildings have been erected in areas DS-B and DS-C. Drum storage facilities were installed at the site as requested by the SCDHS.

In February 1984, a 1,000 gallon spill of influent occurred at the primary wastewater pump station (Figure 2-2). Soil samples were collected and analyzed under the supervision of the SCDHS.

Until 1987, process water and cooling water for plant operations were drawn from two on-site supply wells, S-65293 and S-56126 (Figure 2-2), which were screened in the water table aquifer, and from the Briarcliff well field which also supplied water for the surrounding community.

Sanitary waste disposal was provided on site by 14 sanitary leaching pools. The locations of the sanitary septic pools, designated by the letters SW, are shown on Figure 2-2. Sanitary pools SW-9 and SW-10 connected to buildings # 13 and # 17, respectively, were used for disposal of sanitary waste. Sanitary pools SW-9 and SW-10 were connected to a bathroom and a former laboratory sink within the Waste Water Treatment Plant. One of these pools was sampled by the SCDHS and found to contain toluene. The historical use of cesspools SW-1 through SW-8 and SW-11, surrounding the main plant structure, potentially received process waste waters. The historic usage of the cesspools is not well documented, although it is speculated they primarily received septic waste.

Storm water runoff at the site is controlled by twenty five storm water drywells located throughout the site, these drywells discharge directly into the underlying soils. Most of the drywells are located in the parking lot. Several of these storm drains, DW-1 through DW-8, are located in close proximity to the main plant structure and have piping connected to the interior of the main plant structure.

2.3 Previous Studies and Investigations

There have been several investigations and data gathering events at the site. The three major investigations include: a **Phase I Preliminary Investigation** conducted on behalf of NYSDEC by Woodward-Clyde Consultants, Inc. in 1983, a **Phase II Investigation** conducted by ERM-Northeast on behalf of Agfa between 1986 and 1988 and an underground storage tank removal program conducted by Groundwater Technology on behalf of Agfa in 1990. In addition, various miscellaneous investigations and data gathering events have occurred including an investigation of **groundwater** conducted for Agfa by Malcolm Pirnie, Inc. in 1980, a survey of all significant features including areas of potential environmental concern in 1992, and a survey of all sanitary pools and storm water drywells in 1992. The following is a brief description of each of these investigations and data gathering events.

2.3.1 NYSDEC Phase I Preliminary Investigation

A Phase I Preliminary Investigation of the site was conducted in August 1983 by Woodward-Clyde Consultants, Inc. for the NYSDEC. The Phase I Preliminary Investigation included the collection and review of data, preparation and documentation of a draft **Hazard Ranking System (HRS)**, development of a site-specific site Work Plan for Phase II Investigation, development of a Phase II Site Investigation cost estimate, identification of known responsible parties, and preparation of a summary report. Based upon the available data, the HRS score was calculated as 37.57, which is above the 28.5 threshold level for inclusion on the **National Priority List (NPL)**. However, because there is no record of hazardous wastes ever having been disposed at the site, the site was not included on the NPL. Therefore, the NYSDEC designated the site a New York State Inactive Hazardous Waste Site and assigned the site identification number 1-52-031.

2.3.2 Phase II Investigation

A Phase II Investigation was conducted by ERM-Northeast on behalf of Agfa. The purpose of the Phase II Investigation was to address data requirements identified by the NYSDEC during their Phase I Preliminary Investigation. The investigation included reviewing of files, sampling of 31 soil borings, installation and sampling of three monitoring wells and collection of water samples from two on-site production wells and the Briarcliff Road well field supply wells. In summary, the data yielded the following conclusions:

- Soil in four areas of the site contained cadmium, chromium, lead, silver and mercury in concentrations above the average concentrations typical of soils in the eastern United States. These four areas included the Northern Recharge Basin, West Soil Storage area, Emulsions Building Sump and Tesla tower base.
- Groundwater at the site occurs approximately 120 feet below grade under water table conditions. The water table drawdown caused by the production wells is not known.
- Groundwater flow on site is to the north-northeast, but flow may shift directions downgradient of the site. Sufficient data does not exist to permit establishing **downgradient** groundwater flow direction.
- Water samples from the Briarcliff Road Well field have not exceeded NYSDOH drinking water guidelines since installation.
- The groundwater quality data indicates a possible off site **upgradient** source of groundwater contamination.

2.3.3 Underground Storage Tank Program

An underground storage tank (UST) testing, removal and abandonment program was completed by Groundwater Technology at the site in 1990 under the direction of the NYSDEC and SCDHS. The program included the removal of eight USTs and abandoning one UST in place. The one UST was abandoned in place due to the close proximity to the main plant structure and the risk of foundation damage should this tank was removed.

Endpoint samples were collected from the bottom of the tank excavations in accordance with the draft Quality Assurance Project Plan (QAPP) subsequently provided to the NYSDEC as part of the first draft submission of this Work Plan, dated December 16, 1991. The endpoint samples were collected after the tanks were removed, except for the two 20,000 gallon UST which were sampled through holes cut in the bottoms of the USTs.

The samples were analyzed by York Laboratories of Monroe, Connecticut. All samples were analyzed according to the parameters agreed upon by the NYSDEC utilizing CLP procedures.

The analytical results revealed concentrations of tentatively identified semi-volatile compounds and total petroleum hydrocarbons (TPH) in endpoint samples from UST locations 6, 7, and 9. The NYSDEC's Oil Spill Unit in a letter dated October 16, 1992 has requested the collection of soil samples beneath the former UST locations 6, 7, and 9. In the October 16, 1992 letter the NYSDEC also stated that no additional investigatory or remedial work is required at the UST locations 1, 2, 3, 4, 5, and 8.

2.3.4 Miscellaneous Studies

In December 1980, Malcolm Pirnie, Inc. conducted an investigation of the groundwater quality at and downgradient of the site. The findings of this investigation were presented in the report entitled "Groundwater Evaluation, Peerless Photo Products, Inc. Shoreham, New York", dated December 1980. Water samples were collected from Agfa and Briarcliff Road well field supply wells and analyzed for ammonia nitrogen, nitrate nitrogen, MBAS, chloride, sulfate, iron, manganese, copper, zinc, sodium, pH, specific conductance, cadmium, coliform, trichloroethylene, tetrachloroethylene, chloroform, trichloroethane, trichloro-trifluoroethane, bromodichloromethane, bromoform, carbontetrachloride, chlorodibromomethane and total trihalomethanes. The results indicate water quality did not exceed applicable drinking water standards, with the exception of iron and pH, which are indicative of background groundwater quality. The high iron values were attributed to corrosion of the well casing, or the sampling line. The modeling study conducted by Malcolm Pirnie suggested that there should be a one hundred-fold reduction in solute concentration between the North Recharge Basin and the Briarcliff Road wells. It was concluded that there would be no drinking water standards violated with this dilution factor.

Site inspections conducted by Agfa, NYSDEC and SCDHS in 1992 identified areas of potential environmental concern. In general, the areas identified included sanitary septic pools, storm water drywells, sumps in the main plant building, the water meter room pit, former drum location in the northwest corner of the property, and an aerial photography anomaly in the northeast corner of the property. Based on these inspections, a NYS-licensed professional land surveyor mapped the locations of all storm drains, sanitary pools, sumps, and pit within the main plant structure and prepared an accurate survey of the site which has been used as a basis for the figures presented in this Work Plan.

In addition, all available engineering drawings of the structures have been reviewed to identify piping and areas of potential environmental concern. The engineering drawings did not yield any useful information.

In 1992, all storm drains and sanitary pools were identified, opened, visually inspected for presence of liquids, depth, diameter, construction and interconnecting piping. Based on this inspection, a Work Plan for removing materials from selected sanitary pools and drywells, sampling, and subsequent closure was prepared for submittal to the SCDHS and NYSDEC. The Work Plan entitled "Work Plan For Closure of Class V Injection Wells", dated February, 1993, will be submitted to the SCDHS and NYSDEC for their approval immediately following the submittal of the RI/FS Work Plan.

2.4 Community Interest

Public involvement in the site does not appear to historically have been high. One possible reason for this is that the site does not appear to affect the nearby public water supply. Some increase in the level of public interest is expected as the RI/FS progresses.

3.0 PROJECT DESCRIPTION

3.1 RI/FS Objectives

The purpose of this RI/FS is to determine existing on-site soil contamination, to investigate possible off-site impacts of contamination and to evaluate the need for appropriate on and off-site remedial responses. Major project objectives include:

- Confirmation of the existence and determination of the extent of on-site sources of contamination with specific attention to the north recharge basin, west soil storage area, east soil storage area, drum storage, storm drain, two cesspools adjacent to the main building, and the Tesla tower base.
- Upgradient groundwater quality to determine the impact of potential upgradient sources not associated with the site.
- Groundwater quality associated with potential source areas, i.e., North recharge basins, Tesla tower base.
- Downgradient groundwater quality.
- Groundwater flow patterns on-site and downgradient with respect to the public supply wells.
- Identification of all the **applicable or relevant and appropriate requirements (ARARs)** with respect to the site contaminants, location, and potential remedial activities.
- Performance of a public health risk assessment to address the potential impact resulting from on-site soils and groundwater contamination.
- Determination of the extent of remediation required.
- Selection of an appropriate remedy.

3.2 Key Decision Points in the RI/FS Process

The ultimate goal of the remedial process is to protect human health and the environment. The RI/FS process contributes to this goal by determining the type and extent of contamination at the site, evaluating its potential threat to human health and the environment, and then, if necessary, developing methods to control or treat the contamination. The RI/FS process ends with a decision by NYSDEC, called a Record of Decision (ROD), which selects a remedial program for the site.

The RI/FS work will generate the information necessary for NYSDEC to complete a ROD. A Risk Assessment, which will be conducted as part of the RI, will determine whether the site poses any significant threat to human health or the environment. The FS will then evaluate alternatives for control or treatment of the contamination and propose a cleanup plan for the site. The cleanup alternatives for the site will be evaluated based on the following nine criteria: 1)overall protection of human health and the environment; 2)compliance with applicable or relevant and appropriate requirements (ARARs); 3)long-term effectiveness and permanence; 4)reduction of toxicity, mobility, or volume of contaminants; 5)short-term effectiveness; 6)implementability; 7)cost; 8)State acceptance; and 9)community acceptance. NYSDEC will then make the final decision and document that decision in the ROD.

3.3 RI/FS Program for the Site

The principal components of the RI/FS for the Peerless Photo Products site are the following:

RI **Soil Sampling** - Soil borings will be made at 21 locations both on and off the site. Depths of the borings will range from 0 to 110 feet. Soil samples from these borings and from the monitoring wells described below will be analyzed for a variety of metals, volatile organic compounds (VOCs), pesticides, PCBs, and base/neutral and acid extractable semi-volatile organic compounds (BNAs or SVOCs).

Groundwater Sampling - Six monitoring wells will be installed at locations both on and off of the site. Most of the wells will be installed in clusters of three with each well drawing groundwater from a different depth. One round of groundwater samples will be taken from both the new and existing wells. The samples will be analyzed for metals, VOCs, and BNAs.

Risk Assessment - The risk assessment will include the following phases: 1)a review of soil and groundwater sampling data and the selection of **chemicals of concern**; 2)a hazard assessment for the chemicals of concern to determine whether they could pose a health risk based on known biological and chemical information; 3)an evaluation of the existing and potential pathways by which humans could come in contact with the chemicals if no cleanup action is taken at the site; 4)identification of human populations and plants or animals which may contact the chemicals with a special emphasis on sensitive populations such as children or the elderly and on endangered plant and animal species; 5)calculation of the concentrations of chemicals that may exist at the points of contact; 6)estimation of the amount of each chemical of concern that a human might receive from the site; and 7)a quantitative estimate of the human health risk and an estimate of the environmental risk posed by the site.

FS **Development of Cleanup Objectives** - Based on the data in the RI, cleanup objectives for the site will be set for each contaminant in each environmental media (i.e. soil or groundwater) to levels low enough to protect human health and the environment.

Development of Remedial Action Alternatives - A variety of cleanup methods will be identified as potential alternatives for achieving the site cleanup objectives. The cost of using these methods to clean up the site will be estimated.

Treatability Investigations - Studies will be undertaken as necessary to determine whether specific treatment alternatives would be effective on the contaminants at this site.

Evaluation of Alternatives and the Recommendation of a Cleanup Method - All of the alternatives will be compared to the nine criteria previously mentioned in this section. The one alternative which achieves the protection of human health and the environment, meets all ARARs, and achieves the best balance among the other seven criteria will be recommended to NYSDEC as the cleanup remedy for the site.

In addition, the RI/FS process will also attempt to identify all of the **Potentially Responsible Parties (PRPs)** that may have contributed to the contamination at the site.

3.4 Project Schedule

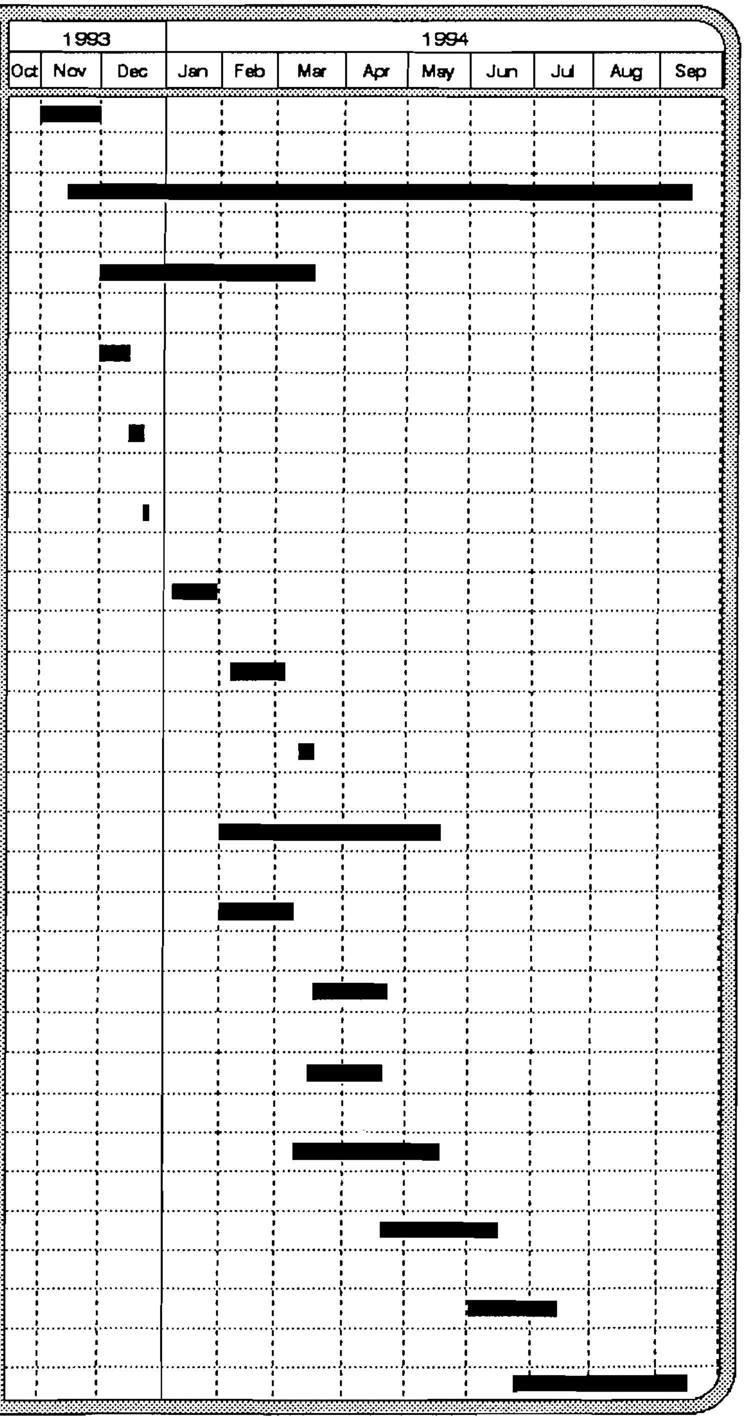
A diagram of the project schedule is provided on the following page.

Table 3-1

DRAFT FINAL PHASE 1 RI/FS PROJECT SCHEDULE

Peerless Photo Products (Site ID #: 1-52-031)
Shoreham, New York

Task Name	Duratn (Days)
TASK 1: PROJECT PLANNING	20
TASK 2: COMMUNITY RELATIONS	212
TASK 3: FIELD INVESTIGATION	73
Mobilization	10
Building Inspection	5
Metal Detector Survey	2
Soil Boring Program	15
Monitoring Well Installation	18
Groundwater Sampling	5
TASK 4: ANALYSIS/VALIDATION	75
Laboratory Analysis(CLP)-Soil	25
Laboratory Analysis(CLP)-Water	25
Laboratory Analysis(TCLP)-Soil	25
Laboratory Data Validation	50
TASK 5: DATA EVALUATION	40
TASK 6: RISK ASSESSMENT	30
TASK 7: DRAFT RI REPORT	60



Note 1: FS Tasks will be completed pending NYS DEC approval of RI Report
Note 2: Date/durations are approximate
Note 3: Assumes that off-site property access has been granted
te 4: Dates will be finalized following 1st public meeting
Prep D: 09/24/93

4.0 INTERESTED/AFFECTED MEMBERS OF THE PUBLIC (CONTACT LIST)

The following is an initial list of contacts for the site. This list will be updated throughout the RI/FS process to ensure that it includes all interested persons.

Town of Brookhaven Officials

Town Hall
3233 Rt.112
Medford, NY 11763

Rosemary Weisner
Public Information Officer
516-451-6260

John Lamura
Supervisor
516-451-6666

Carol Swick, Commissioner
Department of Planning, Environment, and Development
516-451-6200

John Pavacic, Environmental Planner
Division of Environmental Protection
516-451-6455

John Girandola
Division of Planning
516-451-6400

Richard Friscia, Acting Commissioner
Department of Public Safety
516-451-6291

Robert Reutzel, Commissioner
Department of Community Development
516-451-6600

County Officials

Robert Gaffney
Suffolk County Executive
H. Lee Dennison Building
Hauppauge, N.Y. 11788
516-853-4000

Michael Caracciolo
County Legislator
P.O. Box 1030
Aquebogue, N. Y. 11931

State Officials

Joseph Sawicki Jr.
State Assembly Person, District 1
107 Roanoke Ave.
Riverhead, N.Y. 11901

National Officials

U.S. Congressman
George Hochbrueckner
3771 Nesconset Highway, Suite 213
Centereach, NY 11720

Kenneth P. LaValle
325 Middle Country Road
Selden, N.Y. 11784

Local Newspapers

North Shore Record
208 Rt. 112
Port Jefferson Station, NY 11776
Attn: Catherine Schmoller

Suffolk Times
P.O. Box 1500
Mattituck, NY 11952
Attn: Jeff Miller

News Review
P.O. Box 1500
Mattituck, NY 11952
Attn: Sue Miller

The Village Times
185 Rt. 25A
Setauket, NY 11733
Attn: Leah S. Dunaief

Suffolk Life
P.O. Box 167
Riverhead, NY 11901-0102

Yankee Trader
1 Glemere Lane
Coram, NY 11727
Attn: Caroline Thorenz

Citizens Groups

Affiliated Brookhaven Civic Organizations
P.O. Box 190
Stony Point, NY 11790

Sarah Meyland, Executive Director
Citizens Campaign for the Environment
518 Broadway
Massapequa, NY 11758

John R. Testut
Shoreridge Hills, Inc.
Box 456
Shoreham, NY 11786

Long Island Citizen's Advisory Committee on Hazardous Waste (LICAC)

Water Supply Company

Michael LoGrande, Chairman
Suffolk County Water Authority
4060 Sunrise Highway
Oakdale, NY 11769
Phone: 516-589-5200

School Districts

Shoreham Wading River School District
Attn: Edward Weiss
Rt. 25A
Shoreham, NY 11786

Miller Avenue School
Attn: Jack Schwartz
Miller Avenue
Shoreham, NY 11786

Local Residents

[The site contact list includes residents in the area of the site and any other persons who contact NYSDEC regarding environmental matters at the site. These names are not given in the published version of this document so as to protect the privacy of those on the list. Persons who sign-in at public meetings or otherwise request that their name placed on the list will be included in the future.]

5.0 NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) CONTACTS

NYSDEC Project Manager

Girish V. Desai
Environmental Engineer
New York State Department of Environmental Conservation
SUNY Building 40
Stony Brook, NY 11790-2356
Phone: 516-444-0240 ext. 386

NYSDEC Citizen Participation Specialist

Joshua Epstein
Citizen Participation Specialist
New York State Department of Environmental Conservation
Building 40 - SUNY,
Stony Brook, NY 11790-2356
Phone: 516-444-0230

NYSDEC Enforcement

David S. Rubinton
Division of Environmental Enforcement
202 Mamroneck Avenue, 3rd Floor
White Plains, NY 10601
Phone: 914-761-3575

NYSDEC Inactive Hazardous Waste Program Information Number: 800-342-9296

New York State Department of Health

Don Miles
New York State Department of Health,
Bureau of Environmental Exposure Investigation,
2 University Place, Albany, NY 12203
Phone: 518-458-6305

CPP
Date: September 30, 1993

Nina Knapp,
New York State Department of Health,
Bureau of Toxic Substance Assessment,
Room 240, 2 University Place,
Albany, NY 12203
Phone: 1-800-458-1158 or 518-458-6405

6.0 DOCUMENT REPOSITORIES

The following locations will serve as repositories for documents related to remedial activities at the site. Documents in the repositories are available for public review and copying. There may be a charge for copies made at the document repositories. To ensure that the interested public is aware of project documents that are available for their review, fact sheets mailed to the site contact list will include a description of significant documents that have been placed in the repositories.

Local Library
Shoreham-Wading River Public Library
Rt.25A
Shoreham, NY 11786
516-929-4488

Contact:Reference Desk
Elaine Brecka, Director (contact for public meetings)

Hours: 10 a.m. - 9 p.m. Monday - Friday
10 a.m. - 5 p.m. Saturday
1 p.m. - 5 p.m. Sunday

Meeting Rooms/Capacities: 125, 110, and approx. 25 persons

NYSDEC Office
SUNY Stony Brook
Bldg. 40
Stony Brook, N.Y. 11790

Hours: 8:30 a.m. - 4:45 p.m. Monday - Friday

Documents that will be included in the repositories as they become available include:

Phase I & II Reports
Order On Consent
Final RI/FS Work Plan
Community Participation Plan
Quality Assurance/Quality Control Plans
Site Health & Safety Plan
RI Report (including Risk Assessment)
FS Report
Responsiveness Summary
ROD
All fact sheets, public notices, newsletters, etc.

At this time, the placement of one copy of each document in each repository is expected to be adequate to meet the public's needs.

7.0 SPECIFIC CITIZEN PARTICIPATION ACTIVITIES FOR EACH MAJOR ELEMENT OF THE RI/FS

This section describes the citizen participation activities that will be carried out at each RI/FS technical milestone. These activities satisfy the requirements of 6NYCRR Part 375.7. All citizen participation materials will be approved by NYSDEC prior to their release to the public.

7.1 Activities to be Performed Following RI/FS Work Plan Approval

Designate Site Public Contact: The public contact person for the site will be the Groundwater Technology, Inc. project director, Paul Maus.

Establish Local Document Repository: A local repository will be established at the location described in Section VI. The final RI/FS Work Plan, Order on Consent, Citizen Participation Plan, Phase I Report, and Phase II Report will be placed in the repository at this time. Other site related documents, including all citizen participation documents, will be placed in the repository as they become available over the course of the project.

Fact Sheet Announcing Start of RI/FS Work: The fact sheet will: 1)briefly describe the site, its history, and the findings of previous environmental studies; 2)discuss the objectives of the RI/FS; 3)provide an overview of the RI/FS program; 4)discuss health and safety concerns related to site conditions and investigation activities such as drilling and equipment decontamination; 5)announce the local document repository location and hours; 6)identify the NYSDEC contact person/s; and 7)announce the date, time, and location of the public meeting. This fact sheet will also solicit additional names of interested residents for the site contact list, as will the other fact sheets described in this CPP. The fact sheet will be mailed to the site contact list, which includes local media, at least 2 weeks in advance of the public meeting.

Public Meeting: A public meeting will be held to: 1)describe the site, its history, and the findings of previous environmental studies; 2)discuss the objectives of the RI/FS; 3)provide an overview of the RI/FS program and describe RI/FS activities that will take place in the neighborhoods outside of the Agfa property; 4)discuss health and safety concerns related to site conditions and investigation activities such as drilling and equipment decontamination; 5)announce the local document repository location and hours; 6)give the community an opportunity to meet the NYSDEC contact person/s; 7)present the qualifications of Agfa's consultant, Groundwater Technology, Inc., and explain NYSDEC's oversight role; and 8)respond to questions raised by the public. If significant public concerns are raised and a written response is warranted, a brief meeting/responsiveness summary will be written and placed in the site document repositories. The meeting will be held in the Shoreham-Wading River Public Library, which is located on Rt.25A approximately 1 mile east of the site.

7.2 Following RI Report Completion

Placement of RI Report in Local Document Repository.

Fact Sheet: A fact sheet will be prepared to: 1)briefly describe the site; 2)discuss the objectives of the RI/FS; 3)summarize work completed in the RI; 4)summarize the findings of the RI; 5)provide a schedule for the remainder of RI/FS program; 6)identify the location of the local document repository and its hours; 5)identify the NYSDEC contact person/s; and 7)request that any members of the public who believe that a public meeting is needed at this time contact NYSDEC. A public meeting or availability session may be held at this stage if public interest warrants such an activity. The fact sheet will be mailed to the site contact list, which includes local media.

7.3 Following Final Draft RI/FS Report Completion

Placement of Final Draft RI/FS Report (stamped "DRAFT") in Local Document Repository.

Public Notice: A legal notice announcing the availability of the Final Draft RI/FS Report will be published in a local newspaper of general circulation prior to the public meeting and comment period described below. This notice will: 1)provide a brief analysis of the proposed cleanup method/s; 2)summarize NYSDEC's reasons for selecting the proposed program over the other alternatives considered; 3)describe the construction and operational requirements of the proposed program; 4)announce the public meeting and comment period; and 5)identify the name and address of the person to whom the public should address comments.

Fact Sheet: A fact sheet will be prepared that will: 1)briefly describe the site; 2)provide an overview of work completed in the RI/FS; 3)summarize the findings of the RI/FS; 4)provide a brief analysis of the proposed remedial program; 5)summarize NYSDEC's reasons for selecting the proposed program over the other alternatives considered; 6)announce date, time, and place of the public meeting; 7)announce the 30-day public comment period for written comments; 8)request comments from the public pertinent to the finalization of the RI/FS; 9)identify the location of the local document repository and its hours; and 10)identify the NYSDEC contact person/s. The fact sheet will be mailed to the site contact list, which includes local media, at least two weeks prior to the public meeting and the start of the public comment period described below.

__Public Comment Period:__ A 30-day public comment period will be held during which written comments will be accepted by NYSDEC.

__Public Meeting:__ A public meeting will be held to: 1)discuss the Final Draft RI/FS Report; 2)discuss briefly the remedial alternatives considered; 3)describe in detail the recommended alternative and how this alternative achieves the site cleanup objectives; 4)present a schedule for future work; 5)explain the process for public comment and NYSDEC's decision; and 6)receive public comments. A transcript of the meeting will be prepared and placed in the site document repositories. The meeting will be held in the Shoreham-Wading River Public Library.

7.4 Following Selection of a Remedy (ROD)

__Public Notice/Responsiveness Summary:__ A legal notice will be published in a local newspaper of general circulation. This notice will: 1)provide a brief analysis of the remedial program selected for implementation; 2)discuss any significant changes from the proposed remedial program; and 3)provide a response to significant public comments, criticisms, and new data. If the remedial program selected differs significantly from the proposed remedial program, this notice will also provide an explanation of the significant differences and the reasons such changes were made. This notice will be mailed to the site contact list. If a large number of significant public comments are received during the public comment period, the version of this document that is mailed to the contact list may be expanded to provide more detailed responses to the public's concerns.

8.0 GLOSSARY OF KEY TERMS

NOTE: The first eight definitions represent major elements of the remedial process. They are presented in the order in which they occur, rather than in alphabetical order, to provide a context to aid in their definition.

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Site Placed on Registry of Inactive Hazardous Waste Sites - Each inactive site known or suspected or containing hazardous waste must be included in the Registry. Therefore, all sites which state or county environmental or public health agencies identify as known or suspected to have received hazardous waste should be listed in the Registry as they are identified. Whenever possible, the NYSDEC carries out an initial evaluation at the site before listing.

Phase I Site Investigation - Preliminary characterizations of hazardous substances present at a site; estimates pathways by which pollutants might be migrating away from the original site of disposal; identifies population or resources which might be affected by pollutants from a site; observes how the disposal area was used or operated; and gathers information regarding who might be responsible for wastes at a site. Involves a search of records from all agencies known to be involved with a site, interviews with site owners, employees and local residents to gather pertinent information about a site. Information gathered is summarized in a Phase I report. After a Phase I investigation, DEC may choose to initiate an emergency response; to nominate the site for National Priorities List; or, where additional information is needed to determine site significance, to conduct further (Phase II) investigation.

Phase II Site Investigation - Ordered by DEC when additional information is still needed after completion of Phase I to properly classify the site. A Phase II investigation is not sufficiently detailed to determine the full extend of the contamination, to evaluate remedial alternatives, or to prepare a conceptual design for construction. Information gathered is summarized in a Phase II report and is used to arrive at a final hazard ranking score and to classify the site.

Remedial Investigation (RI) - A process to determine the nature and extent of contamination by collecting data and analyzing the site. It included sampling and monitoring, as necessary, and includes the gathering of sufficient information to determine the necessity for, and proposed extent of, a remedial program for the site.

Feasibility Study (FS) - A process for developing, evaluating and selecting remedial actions, using data gathered during the remedial investigation to: define the objectives of the remedial program for the site and broadly develop remedial action alternatives; perform an initial screening of these alternatives; and perform a detailed analysis of a limited number of alternatives which remain after the initial screening stage.

Remedial Design - Once a remedial action has been selected, technical drawings and specifications for remedial construction at a site are developed, as specified in the final RI/FS report. Design documents are used to bid and construct the chosen remedial actions. Remedial design is prepared by consulting engineers with experience in inactive hazardous waste disposal site remedial actions.

Construction - Construction may be as straightforward as excavation of contaminated soil with disposal at a permitted hazardous waste facility. On the other hand, it may involve drum sampling and identification, complete encapsulation, leachate collection, storage and treatment, groundwater management, or other technologies. Construction costs may vary from several thousand dollars to many millions of dollars, depending on the size of the site, the soil, groundwater and other conditions, and the nature of the wastes.

Monitoring/Maintenance - Denotes post-closure activities to insure continued effectiveness of the remedial actions. Typical monitoring/maintenance activities include quarterly inspection by an engineering technician; measurement of level of water in monitoring wells; or collection of ground water and surface water samples and analysis for factors showing the condition of water, presence of toxic substances, or other indicators of possible pollution from the site. Monitoring/maintenance may be required indefinitely at many sites.

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6NYCRR Part 375.7 - State regulations establishing citizen participation requirements for inactive hazardous waste disposal sites.

Applicable, Relevant, and Appropriate Requirements (ARARs) - Applicable requirements are those standards, criteria, or limitations created under federal or state environmental law that specifically address a contaminant, remedial action, location, or other circumstance at an inactive hazardous waste site. Relevant and appropriate requirements are those standards, criteria, or limitations created under federal or state environmental law that, while not "applicable" to a specific substance or situation at a site, address problems or situations sufficiently similar to those encountered at the site that they are well suited for use at a particular site.

Availability Session - Scheduled gathering of the NYSDEC staff and the public in a setting less formal than a public meeting. Encourages "one-to-one" discussions in which the public meets with NYSDEC staff on an individual or small group basis to discuss particular questions or concerns.

Citizen Participation - A process to inform and involve the interested/affected public in the decision-making process during identification, assessment and remediation of inactive hazardous waste sites. This process helps to assure that the best decisions are made from environmental, human health, economic, social and political perspectives.

Citizen Participation Plan - A document that describes the site-specific citizen participation activities that will take place to complement the "technical" (remedial) activities. It also provides site background and rationale for the selected citizen participation program for the site. A plan may be updated or altered as public interest or the technical aspects of the program change.

Citizen Participation Specialist - A NYSDEC staff member within the Office of Public Affairs who provides guidance, evaluation and assistance to help the Project Manager carry out his/her site-specific Citizen Participation program.

Contact List - Names, addresses and/or telephone numbers of individuals, groups, organizations and media interested and/or affected by a particular hazardous waste site. Interest in the site, stage of remediation and other factors guide how comprehensive the list becomes. Used to assist the NYSDEC and to inform and involve the interested/affected public.

Delisting - Removal of a site from the state Registry based on study which shows the site does not contain hazardous wastes.

Document Repository - Typically a regional DEC office and/or public building, such as a library, near a particular site, at which documents related to remedial and citizen participation activities at the site are available for public review. Provides access to documents at times and a location convenient to the public.

Downgradient - A term used to describe an area of relatively lower groundwater elevation. Groundwater flows from upgradient to downgradient areas.

Fact Sheet - A written discussion of a site's remedial process, or some part of it, prepared by the NYSDEC for the public in easily understandable language. May be prepared for the "general" public or a particular segment. Uses may include, for example: discussion of an element of the remedial program, opportunities for public involvement, availability of a report or other information, or announcement of a public meeting. May be mailed to all or part of the interested public, distributed at meetings and availability sessions or sent on an "as requested" basis.

Groundwater - Water found beneath the earth's surface that fills pores between materials such as sand, soil, and gravel and also may fill cracks in bedrock. Groundwater is the source of drinking water on Long Island.

Hazard Ranking System - The United States Environmental Protection Agency uses a hazard ranking system (HRS) to assign numerical scores to each inactive hazardous waste site. The scores express the relative risk or danger from the site.

National Priorities List (NPL) - The U.S Environmental Protection Agency's list of the top priority hazardous waste sites that are eligible to receive federal funds for investigation and cleanup under the Federal Superfund program. EPA is required to update the NPL list at least once a year.

Order on Consent - A legal and enforceable negotiated agreement between the NYSDEC and responsible parties where responsible parties agree to undertake investigation and cleanup or pay for the costs of investigation and cleanup work at a site. The order includes a description of the remedial actions to be undertaken at the site and a schedule for implementation.

Potentially Responsible Parties - Individuals, companies (e.g. site owners, operators, transporters or generators of hazardous waste) potentially responsible for or contributing to the contamination problems at a hazardous waste site.

Potentially Responsible Party Lead Site - An inactive hazardous waste site at which those potentially legally liable for the site have accepted responsibility for investigating problems at the site, and for developing and implementing the site's remedial program. The Peerless Photo Products, Inc. site is a PRP lead site. PRP's include: those who owned the site during the time wastes were placed, current owners, past and present operators of the site, and those who generated the wastes placed at the site. Remedial programs developed and implemented by PRP's generally result form an enforcement action taken by the State and the costs of the remedial program are generally borne by the PRP.

Project Manager - A NYSDEC staff member within the Division of Hazardous Waste Remediation (usually an engineer, geologist or hydrogeologist) responsible for the day-to-day administration of activities, and ultimate disposition of, one or more hazardous waste sites. The Project Manager works with the Office of Public Affairs as well as fiscal and legal staff to accomplish site-related goals and objectives.

Public Meeting - A scheduled gathering of the NYSDEC staff and the public to give and receive information, ask questions and discuss concerns. May take one of the following forms: large-group meeting called by the NYSDEC; participation by the NYSDEC at a meeting sponsored by another organization such as a town board or Department of Health; working group or workshop; tour of the hazardous waste site.

Public Notice - A written or verbal informational technique for telling people about an important part of a site's remedial program coming up soon (example: announcement that the report for the RI/FS is publicly available; a public meeting has been scheduled). The public notice may be formal and meet legal requirements (for example: what it must say, such as announcing beginning of a public comment period; where, when and how it is published).

Publish - For purposes of 6NYCRR Part 375.7, at a minimum requires publication of a legal notice in a local newspaper of general circulation. Another kind of public notice may be more informal and may not be legally required (examples: paid newspaper advertisement; telephone calls to key citizen leaders; targeted mailings).

Responsiveness Summary - A formal or informal written or verbal summary and response by the NYSDEC to public questions and comments. Prepared during or after important elements in a site's remedial program. The responsiveness summary may list and respond to each question, or summarize and respond to questions in categories.

Site Classification - The NYSDEC assigns sites to classifications established by state law, as follows:

- Classification 1 - A site causing or presenting an imminent danger of causing irreversible or irreparable damage to the public health of environment--immediate action required.
- Classification 2 - A site posing a significant threat to the public health or environment--action required. The Peerless Photo Products, Inc. site is a Class 2 site.
- Classification 2a - A temporary classification for a site known or suspected to contain hazardous waste. Most likely the site will require a Phase I and Phase II investigation to obtain more

information. Based on the results, the site then would be reclassified or removed from the state Registry if found not to contain hazardous waste.

o Classification 3 - A site which has hazardous waste confirmed, but not a significant threat to the public health or environment--action may be deferred.

o Classification 4 - A site which has been properly closed--requires continued management.

o Classification 5 - A site which has been properly closed, with no evidence of present or potential adverse impact--no further action required.

Standards, Criteria or Guidelines (SCGs) - See ARARs

State-Lead Site - An inactive hazardous waste sit at which the NYSDEC has responsibility for investigating problems at the site and for developing and implementing the site's remedial program. The NYSDEC uses money available from the State Superfund and the Environmental Quality Bond Act of 1986 to pay for these activities. The NYSDEC has direct control and responsibility for the remedial program.

Upgradient - A term used to describe an area of relatively higher groundwater elevation. Groundwater flows from upgradient to downgradient areas.